INLAND WATERWAYS AUTHORITY OF INDIA

Ministry of Shipping, Government of India

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT, ENVIRONMENTAL MANAGEMENT PLAN AND RESETTLEMENT ACTION PLAN FOR "CAPACITY AUGMENTATION OF NATIONAL WATERWAY.1" BETWEEN HALDIA AND ALLAHABAD

(JAL MARG VIKAS PROJECT)

(DRAFT)

CUMULATIVE IMPACT ASSESSMENT REPORT

FOR

NATIONAL WATERWAYS-1

MAY, 2016

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Table of Contents

List of Tables

List of Figures

List of Annexure

EXECUTIVE SUMMARY

Inland Waterways Authority of India (IWAI) is a statutory body under Ministry of Shipping, Govt. of India. IWAI is primarily responsible for development, maintenance and regulation of Inland Water Transport (IWT) in the country specifically on National waterways. In this context, the Ganga-Bhagirathi-Hooghly river system from Allahabad to Haldia has been declared as National Waterway-I (NW-I). It is a natural waterway of about 1620 km in length and passes through the states of Uttar Pradesh, Bihar, Jharkhand and West Bengal. One of the limitations on viable Inland waterway transport on NW-1 is a weak navigation infrastructure. Therefore, IWAI has proposed the Capacity Augmentation of navigational infrastructure of NW-I between Allahabad to Haldia with technical and financial assistance from The World Bank.

In this regard, IWAI has commissioned Social & Environmental Impact Assessment (SEIA) studies to map and understand potential environmental and social impacts associated with navigation improvement of NW-I and to prepare plan for effective mitigation and management of the Impact associated with the project. This report is prepared for Cumulative Impact Assessment (CIA) study which is the part of the SEIA study.

NW-1 is being fed by various tributaries at different locations. Major tributaries to NW-1 between Haldia to Allahabad are Tons, Gomti, Ghagra, Son, Gandak, Punpun and Kosi. The following interventions have been proposed and planned under the Jal Marg Vikas Project.

- Maintenance dredging to provide LAD in waterway/channel and the terminal facility
- Improved Navigation Infrastructure & Navigation Aids
  - Construction of 10 Ro-Ro jetties & ferry passenger jetties. Locations of these jetties are yet to be identified.
  - Construction of 6 terminals: Site identification and planning for 3 terminals sites at Sahibganj, Varanasi and Haldia is completed. 2 more potential sites for development of terminals are identified at Ghazipur and Kalughat. These two sites are still under consideration for finalization and planning of design at initial stage only. One more terminal site along NW-1 is being identified.
  - Construction of one Navigation Lock at Farakka, West Bengal.
  - Provision for tow barges, inland vessels, survey vessels including rescue boats and survey equipment. Development of low draught cargos.
  - Development of navigation aids along NW-1 for facilitation of day & night time navigation.
- Development of efficient River Information System with all hardware & software.
- Provision for bank protection / slope protection and river training works for critical locations.

The project also envisages the creation and improvement of integration opportunities with other surface transport modes such as roads and railways, so as to improve the overall efficiency of the logistics chain by linking the waterways through various well equipped terminals and jetties.

The main objectives of this study are:

- Assess the potential impacts and risks of a proposed and other developments over time on a chosen Critical Environmental Resources (CER)

- Verify that the proposed development's cumulative social and environmental impacts and risks will not exceed a threshold that could compromise the sustainability or viability of selected CERs;
- Confirm that the proposed development's value and feasibility are not limited by cumulative social and environmental effects;
- Support the development of governance structures for making decisions and managing cumulative impacts at the appropriate geographic scale (e.g., airshed, river catchment, town, regional landscape);
- Ensure that the CERs of affected communities about the cumulative impacts of a proposed development are identified, documented, and addressed; and
- Manage potential reputation risks

Approach & Methodology for CIA study is given below.

Step 1: Identify CERs, and determine spatial and temporal Boundaries for CIA
Step 2: Identify other activities and developments affecting CERs
Step 3: Establish information on baseline status of CERs
Step 4: Assess cumulative impacts on CERs
Step 5: Assess significance of predicted cumulative impacts
Step 6: Management of cumulative impacts – design and implementation

Draft Cumulative Impact Assessment Report has been structured in seven chapters containing 1. Introduction and Background, 2. Project Description, 3. Delineation of CIA boundaries and CERs, 4. Stakeholders consultations, Other Development Proposals and finalization of CERs, 5. Cumulative Baseline Study, 6 Cumulative Impact Assessment and 7 Mitigation measure and management Plan.

Chapter 2 describes existing infrastructure & current traffic, components and salient features. At first, project description has been summarized. This is followed by summary of existing project components, proposed components, applicable legislation and World Bank Operational Policies. NW-1 project offers potential opportunity for diversification of cargo movement from road & rail to waterways. In order to achieve this diversification, the existing infrastructure needs to be augmented with proposed project interventions. These proposed interventions consisting of both development & operation of navigation route require availability of water (depth) & its maintenance supported by new infrastructure. Further, these activities will trigger indirect & induced development in the influence area. Therefore, NW-1 development along with these existing, direct, indirect & induced developments will have cumulative impact in the influence area.

Chapter 3 describes spatial and temporal boundaries in order to assess the impacts of direct, indirect and induced activities due to proposed project. Process of delineation of boundary largely depends upon the type of development & its potential to exhibit direct & indirect impacts on the surrounding environment. The chapter describes the CIA boundary, the rationale & basis of its delineation, CERs within the delineated boundaries, and hot spots identified.

In this study all the natural as well as manmade features have been taken into account and plotted spatially to delineate the boundary of the CIA. The natural and manmade features mapped are Forests; National parks; Wild Life Sanctuaries; Tiger Reserves; Birds Areas; Archaeological sites; Water bodies; Wetlands; Roads; Railways; Urban Agglomerations; Industrial Areas; Thermal Power Plants and Critically Polluted Areas (CEPI)

To conduct the detailed study of the project, 10 kms buffer boundary has been considered. The basis for delineating these buffer boundaries are based on the EIA/SIA (NW-

1/terminals/ maintenance dredging) basin level CER reports as the influence area EIA report, IFC guidelines and stakeholders consultations and the expert's consultation/judgment.

10 kms buffer has been considered so that the extent of area of influence of the project may not go upto 10 kms as per the expert's and stakeholder's consultations. Therefore, the farthest distance covered in the CIA boundary is 10 kms.

CERs have been classified in terms of Physical features comprising Urban Agglomerations / Centers and Land Resources, Ecological Profile comprising Bio Diversity(Wildlife Sanctuaries/ National Parks / Tiger Reserves / Bird Areas / Wetlands) and Agriculture, Physical Environmental Profile (e.g., water and nutrient cycles, microclimate), Water, Air and noise and Socio Economic (e.g., health, economics), or Infrastructure, Industry, Power Plants and Cultural aspects comprising Archaeological/ Heritage Sites.

Assessment of Status of Identified CERs including the site visits, study of the project alignment through topographic maps & Google maps, review of existing studies and literature was carried out to assess the status of identified CERs within the CIA boundary of NW-1. On the basis of the identified CERs, spatial analysis, literature review and study of the EIA & SIA Reports of the NW1 1, hotspots have been identified. Identified hotspots and CERs in NW-1 have also been mapped.

The CERs are the ultimate recipient of impacts because they tend to be at the ends of ecological pathways considering water related proposed activities both in terms of availability & quality in NW-1. These CERs may be directly or indirectly affected by a specific development or by the cumulative effects of several developments.

Chapter 4 provides details of the public consultation and participation activities undertaken during the CIA/ESIA studies for the Project "Jal Marg Vikas". From CIA perspective, an effort was made by conducting consultations particularly in reference to confirmation of hotspots mentioned in Chapter 3 as well as to identify new hotspots, if any. The approach involved a mix of conventional as well as participatory/ rapid rural appraisal (PRA/RRA), focus group discussions (FGD) and one-to-one discussions with wide range of stakeholders encompassing government, non government organisations, local communities, research and development organisations, academia, media. Two stage consultations have been carried out in line with World Bank Guidelines for conducting the public consultation. First level consultation was carried out prior and during impact assessment studies and second level consultation was carried out after completion of impact assessment studies. Finally, this chapter concludes with identification of hotspots based on preliminary assessment, baseline data and inputs from stakeholder consultations. The inputs of stakeholder consultations have been used in finalisation of hotspots.

During the formal and informal consultations for 'Jal Marg Vikas Project', it is found that there is mix view of people about the project. Some people take it as positive development as the proposed project will benefit the economy of country. Whereas affected people, i.e. fishermen and land holders who will loose land are concerned about the restriction of fishing activity, reduction in fish yield, loss of land and livelihood and receipt of adequate compensation and alternate livelihood. Locals and experts are also concerned about the water pollution and impact on the aquatic fauna which may result due to the project. All the concerns were taken in consideration during assessment of impacts and the mitigation measures are proposed for all the concerns to minimize/mitigate the impact. Mitigation measures proposed are well addressed in management plan along with their period of implementation.

Chapter 5 provides details of baseline study which has been conducted to assess the existing condition or status of the identified CERs in the study area. Baseline study has been carried out on the basis of secondary information collected from EIA/SIA study of NW-1, data from pollution control boards, IMD, Agricultural departments and other Governmental Organization. Baseline study has provided the details of condition of identified CERs along the NW-1 and of the district through which NW-1 traverse. This data has helped to identify the significance of the impact on the VECs condition and has provided the basis of carrying out the impact assessment study. Baseline study indicates NW1 has flat terrain with vast catchment being drained by main river along with tributaries. Geological influence area has alluvial soil and falls in Zone III & IV. Land use is largely agricultural land followed by water body, settlements with only 3.59 %vegetation. Turtle sanctuary Vikramshila Gangetic Dolphin sanctuary & Hilsa sanctuary are major CERs with Vikramshila Gangetic Dolphin sanctuary & Udhwa bird sanctuary are protected areas. This area has diverse terrestrial & aquatic biodiversity with spawning & breeding grounds adjoining NW1. Flow analysis indicates that NW 1 has flow constraints in certain stretches considering CAD requirements.

Overall soil type / quality along the NW-1 area is of moderately fertile and not expected to be detrimental to the growth of agricultural and forest crops. It can be concluded that soils fall within medium fertility levels in the entire stretch of NW-1and forms the basis of agriculture resources / cropping pattern. Assessment of land resources indicates land use change particularly diversion of agriculture land for urbanization industries & infrastructure development. Though it is an ongoing phenomenon, any new infrastructure development intervention is expected to accelerate it. No portion of NW-1 and intervention areas falls under any reserved forest or normal forests area. Ecologically the area has important CERs.
Udhwa bird sanctuary and 5 other important bird areas are also located within 10 km radius of NW-1 stretch. However, project interventions like maintenance dredging with alleviate the flow constraints for smooth operation of the barges, water availability analysis also indicates the river water is good for propagation of wild life and fisheries.

Observations on River Bed-Dredge Material Quality indicate that the concentration level of heavy metal was found low and within acceptable limit as per standard (Criteria for Off-Shore Dumping of Dredged Material, USA) except cadmium which is slightly above the USA standard that may be due to industrial effluent discharge in this section. Pesticide concentration in all samples was found below the USA criteria. The pesticides presence is on expected line as these are predominantly used for various agriculture applications. The source of these pesticide parathion and endosulphan might be from applications of insecticides and pesticides for agriculture in the study area which has significant agriculture land use. Air quality in terms of $PM_{10,}$ $PM_{2.5}$ NOx SO_2 has been found high in major urban centers.

The population of major cities/ town located along the Ganga River in NW-1 section was recorded as 12875343 comprising 6782150 male and 6093193 females. Scheduled Caste population consisting of 544284 males and 483706 females respectively in major city/towns along the study area and accounts for 7.9% of the total population. The 'Scheduled Tribe' population consist of 27576 males and 25244 females respectively and accounts for 0.41% of the total population (12875343). About 75.4% of the population is literate and 23.6% is illiterate in cities/town located along the NW-1 is illiterate. Male population is more literate than female. In cities and town along NW-1 area the main and marginal workers[1] are 14% and 29% respectively while the remaining 57% of total

1A person who has worked for more than 183 days in a year is called the main worker. Marginal workers are those who have worked any time in the year preceding the census but have not worked for major part, which is not more than 183 days, of the year

population constitutes non-workers. The main occupation is agriculture, labour class and trading activities. Agriculture is the main source of the livelihood generation for the people residing along the NW-1 area. Many towns in the area are primarily industrial. Ganga provides the necessary infrastructure for the factories to perform. Commercial fisheries in the Ganga River System are an important source of livelihood for the people residing along the Ganga River. Pilgrimage and the associated tourism brings along a major source of revenue for religious towns and their people. There is substantial decline in major carps fish catch in Allahabad to Farakka stretch over past few years. At Buxar hilsa was the main fishery and with the commissioning of Farakka barrage the fishery declined sharply between 1972-80. Fishery improved during 1981-86 due to improvement in landings of other species. Patna centre also showed drastic decline in major carp landings and as compared to sixties it was almost half during 1986-93. Decline at Bhagalpur was not as severe as at other centres. It is reported that almost every village along the both sides of the river are having some fishermen who earn their livelihood by fishing in the Ganga river. Generally, one member of the family is engaged in fishing in lower stretch of NW-1(Allahabad to Haldia), sometimes two, the average comes to be 1.5. However, in upper stretch (Allahabad to Farakka) the average person engaged in fishing is 1.2 that is mainly due to low fish catch in this stretch. Fishing Income: The monthly average income of the fisherman ranged from Rs.4000 to 7000 per month in Allahabad to Patna stretch. In lower zone (Farakka to Haldia) the average income of fisherman is slightly high and ranging between 7000 to Rs. 10,000 per month because of higher catch and high value fish (mainly hilsa) in the catch.

All the towns and cities along the NW-1 are well connected with national highways, state highways, district roads, railways. Cities like Varanasi, Patna, and Kolkata are also connected with airways. Eleven thermal power plants are located in close proximity of river Ganga between Haldia and Allahabad and 10 more are reportedly are proposed to be set up in close proximity of the river. There are 30 class I cities and 8 class II towns along the mainstream of river Ganga at NW-1 segment. These cities are discharging 2173.8 MLD wastewater out of which only 959.6 MLD has the treatment capacity.

The above mentioned baseline data provides basis for identification, classification & quantification of impacts.

Chapter 6 provides Cumulative Impact Assessment of NW-1 from Haldia to Allahabad carried out for 10 km area in both sides along the entire stretch. For the purpose of CIA, CERs has been identified to assess their existing conditions so that probable impact & significance of the impacts on these CERs can be evaluated.

For purpose of CIA study an influence zone is identified where cumulative impact due to NW-1 and other developments within this zone will be identified. Through preliminary desktop study, baseline study and stakeholder consultations the existing developments in influence area, baseline scenario of the influence area, pollution load in environmental area, planned and anticipated developments in influence area are identified. It is found that some zones are experiencing/will experience more of the above mentioned developments as compared to other zones. Such zones are demarcated on the basis of quantum and nature of developments the zone is experiencing or will experience in future. These zones are termed as hotspots as the impacts due to existing/planned development will be maximum/more in these zones as compared to other zones.

Type and nature of the cumulative impact has been evaluated on all CERs in each finalized hotspot Table 1.

Finalized Hotspots Selected for CIA Study

S. No.	Hotspots Stretch/Location	Criteria For Selection of Hotspots	CERs
1.	Haldia	• Declared as critically polluted area but at present moratorium is lifted by MoEF&CC • Declared notified zone by CGWB • Operation of terminal would require dredging of 1,57,60,596 cum. • Existing floating terminal and proposed new terminal at Haldia • Shifting of ammonia pipeline of TATA chemicals and existing road to Mitsubishi Plant • Haldia Port & Shipping Activities • Haldia Dock Complex & Industrial Area • Celebration of Ganga Sagar Mela at Sagar • Urban areas: Haldia Town • Expected increased industrial development in existing industrial area and enhanced traffic movement • Indragachi TPP at Sangrampur & Haldia Energy Ltd. TPP	• Ground Water Quality • River Water Quality • Traffic • GHG emissions (micro climate) • Air Quality • Religious Values • Aquatic ecology • Existing infrastructure • New infrastructure development • Fishing Activities • Quality of Life • Water Resources • Drainage • Traffic • Noise • Soil Quality
2.	Kolkata-Mahesthala	• Existing BISN jetty, GR-1 & GR-2 and Botanical Garden Jetty • Archaeological sites within 300 m: Temple of Gour Chandra and Krishnachandra at Chatra-Gaur Chandra Ghat (0 m, W) , St John Church • High PM_{10} concentration in Howrah • Urban areas: Mahesthala, Kolkata & Howrah	• Archaeological sites • Air Quality • Water resources • River Water Quality • Ground Water Quality • Traffic • Aquatic ecology • Quality of Life
3.	Katwa to Hoogly Ghat	• Floating Terminal Katwa, Floating Terminal Swarupganj, Floating Terminal Shantipur, Floating Terminal Tribeni, BISN jetty • New proposed terminal at Tribeni • Hilsha Sanctuary (fishing restriction for larvae of Hilsha) • TPP at Bandel & Balagarh • Urban Areas: Katwa, Swaroopganj, Nabadwip, Kalna, Balagarh, Kanchrapara, Hoogly • Increased traffic volume due to newly proposed terminal	• Traffic • GHG emissions (micro climate) • Air Quality • Aquatic Ecology • Terrestrial ecology • Existing infrastructure • Fishing Activities & Livelihood (Agriculture Land Acquisition) • New infrastructure development • Water resources • River Water Quality • Ground Water Quality

S. No.	Hotspots Stretch/Location	Criteria For Selection of Hotspots	CERs
			• Drainage • Noise • Terrestrial ecology • Soil Quality • Quality of Life • Land Use
4.	Farakka to Murshidabad	• Floating Terminal at Hazardwari, Existing RCC Jetty Pakur, U/s & D/s jetty, feeder canal, RCC jetty and old lock at Farakka • Proposed New lock at Farakka • Archaeological Sites: Hazardwari Palace • Hilsha Sanctuary (fishing restriction for larvae of Hilsha) • IBA: Farakka and surrounding areas • Farakka feeder canal is prone to erosion • Sagardighi TPP, Farakka STPS • Urban Areas: Farakka, Murshidabad, Azimganj, Baranagar, Balia, Raghunathganj • Bagmari siphon	• Bank/Soil erosion • GHG emissions (micro climate) • Air Quality • Water resources • River Water Quality • Ground Water Quality • Existing Infrastructure • New Infrastructure Development • Fishing Activities • Traffic • Noise • Drainage • Aquatic ecology • Terrestrial Ecology • Soil Quality • Quality of Life • Land Use • Archaeological Sites
5.	Mangalghat (Rajmahal)	• Existing floating terminal • Archaeological sites within 300 m: Jama Maszid & Singhi Dalan • Chatt Pooja celebration Oct-Nov • Udhawa Lake Bird Sanctuary at app 6 km • Mining activities	• Traffic • Air Quality • Archaeological sites • Religious Values • River Water Quality • Aquatic ecology
6.	Sahibganj	• Existing Samdhaghat terminal and proposed Sahibganj terminal • Chatt Pooja celebration Oct-Nov • Construction of approach road to connect the terminal to NH-80 • Construction of railway siding to provide linkage with existing IR track • Existing Fishing Activities • Acquisition of Land, R& R and shifting of community temple • Cutting of app. 500 trees	• Land Use • Livelihood (agriculture land acquisition) & Fishing Activities • Socio-economy • Air Quality • GHG emissions (micro climate) • Aquatic ecology • Terrestrial Ecology • Existing Infrastructure • Religious Values • New infrastructure development • Water resources • River Water Quality • Ground Water Quality

S. No.	Hotspots Stretch/Location	Criteria For Selection of Hotspots	CERs
			• Bank/Soil erosion • Traffic • Noise • Drainage • Quality of Life • Land Use
7.	Pirpanti-kahalgaon-Bhagalpur	• Chatt Pooja celebration Oct-Nov • Existing Bateshwarsthan Floating Terminal, Bhagalpur Terminal • Vikramshila Gangetic Dolphin Sanctuary • IBA: Kurseala River Course and Diyara Flood Plains • Bhagalpur TPP, Kahalgaon STPS, Pripanti TPP, Pripanti Power CESC • Presence of arsenic in ground water • Urban Area: Bhagalpur, Kahalgaon	• Air Quality • GHG emissions (micro climate) • Religious Values • Aquatic Ecology • Avifauna • Water resources • River Water Quality • Ground Water Quality • Traffic • Soil Quality • Quality of Life
8.	Munger	• Existing Floating Terminal at Munger • Chatt Pooja celebration Oct-Nov • Presence of arsenic in ground water • Urban Area: Munger	• Ground Water Quality • Religious Values • Traffic • Aquatic ecology
9.	Semaria-Begusarai-Barh	• Existing Floating Terminal at Semaria • Chatt Pooja celebration Oct-Nov • Urban Area: Semaria, Doraiganj, Begusarai, Barh • Barauni TPP, Barh TPP & Lakhisarai TPP • IBA: Mokama Taal	• Air Quality • GHG emissions (micro climate) • Aquatic ecology • Terrestrial flora • Religious value • Water resources • River Water Quality • Ground Water Quality • Avifauna • Soil Quality • Quality of Life
10.	Patna	• Low & High Level Jetty (Gaighat) • Proposed Terminal at Kalughat • Chatt Pooja celebration Oct-Nov • IBA: Danapur Cantonment Area • High PM_{10} concentration in Patna • Urban Area: Patna • Development of River Front at Patna	• Avifauna • Air Quality • River Water Quality • Religious Value • Traffic • Noise • Water resources • Drainage • Aquatic ecology • Terrestrial Ecology

S. No.	Hotspots Stretch/Location	Criteria For Selection of Hotspots	CERs
			• Bank/soil erosion • Quality of Life • Land Use
11.	Buxar	• Existing floating terminal at Buxar • Buxar TPP (under construction) • Chatt Pooja celebration Oct-Nov • Urban Area: Buxar	• Religious Values • Traffic • Air Quality • Water resources • River Water Quality • Ground Water Quality • Aquatic ecology • Soil Quality • Quality of Life
12.	Ghazipur	• Proposed Terminal • Urban Area: Ghazipur	• Land Use • Livelihood (agriculture land acquisition) • Air Quality • GHG emissions (micro climate) • Aquatic ecology • Terrestrial Ecology • Existing Infrastructure • River Bed Sediments Quality • New infrastructure development • Water resources • River Water Quality • Ground Water Quality • Bank/Soil erosion • Drainage • Traffic • Noise • Quality of Life
13.	Varanasi	• Rajghat floating terminal • Proposed Varanasi Terminal • Archaeological Sites: Kardmeshwar Mahadeva Mandir, Ramnagar, fort, archaeological excavation site, Varanasi • Festival: Ganga Mahotsav at Varanasi (Oct-Nov) & Dhrupad Mela at Tulsi Ghat of Varanasi (Feb to March) • Kashi Turtle Sanctuary • DFCCIL Connectivity at Varanasi Terminal • Slightly high cadmium concentration in river bed sediments but below toxicity	• Land use • Livelihood (agriculture land acquisition) & Fishing Activities • Aquatic ecology • Existing Infrastructure • New infrastructure development • Archaeological sites • Air Quality • GHG emissions (micro climate) • River Bed Sediments Quality • Bank/Soil erosion • Noise level • Religious Value

S. No.	Hotspots Stretch/Location	Criteria For Selection of Hotspots	CERs
		level of fishes • High PM_{10} levels in Varanasi • High noise level in Turtle sanctuary area	• Vibrations • Water resources • River Water Quality • Drainage • Traffic • Noise • Quality of Life
14.	Allahabad	• Festival: Kumbh Mela • Slightly high cadmium concentration in river bed sediments but below toxicity level of fishes	• Religious Value • River Bed Sediments Quality • River Water Quality • Aquatic ecology • Quality of Life

Attempt has been made to quantify the anticipated impact by assigning score to each impact and the development in scale of 1-5.

Cumulative impact assessment is carried out for the 14 hotspots identified in Table.1 & the criteria for selection of them as hotspot above to assess the magnitude and significance of cumulative impact. It has been identified that nature of impact varied from low to moderately high. For example, Varanasi, Patna and Howrah, air quality of the area is already impacted due to high PM_{10} concentration. Varanasi turtle sanctuary and Dolphin sanctuary are the eco-sensitive zones in NW-1 which are being impacted due to existing development and will be impacted due to development of NW-1 and other upcoming and planned development in the area. Other areas like Barh, Danapur, Bhagalpur etc are sensitive due to presence of important bird area. Varanasi will be the common station of upcoming EDFC and NW-1 and exchange of material will take place between these two points. Depending on the sensitivity of the area and nature of existing & upcoming developments in the area, certain zones are declared as hotspots. Total 14 zones are identified as hotspots. Rating is provided to impact of each identified activity on CERs and it is found that impact on these hotspots due to existing, planned and upcoming development varies from low to moderate. As per the impact assessment it is also found that the identified impacts can be mitigated by implementing the mitigation measures and management plan.

Chapter 7 provides mitigation measures and management plan. The chapter provides review of the mitigation measures proposed in EIA/SIA Study of the Jal Marg Vikas Project, Mitigation Measures & Management Plan for Jal Marg Vikas Project & strengthening measures identified to minimize cumulative impacts, Environment Management Plan, Environment Monitoring Plan, Organizational framework, Environmental Health & Safety Policy and EHS Management System, Mechanism for Feedback and Adjustments and Grievance Redress Mechanism.

Mitigation measures as proposed in EIA/SIA studies have been reviewed in detail. It has been found that mitigation measures proposed are adequate and address all major and minor issues which may have an impact on environment and society. Impacts are adequately addressed for the construction and operation of proposed civil interventions, barge operation and maintenance dredging and accordingly mitigation measures are proposed and management plans are prepared. After carrying out the CIA study and assessment of the baseline condition of the areas through which proposed NW-1 traverses

and nature of developments which this area will experience after & due to development of Jal Marg Vikas Marg, it is learned that some of the proposed measures requires strengthening.

IWAI can take up the mitigation measures and remediation measures for controlling the impact on CERs in influence area, however an extended role of IWAI is suggested in this plan so as to manage the cumulative impacts in the influence area. IWAI has an operational and effective institutional framework which will implement the environment management plan as suggested for Jal Marg Vikas Project during all the stages. It is recommended through this plan that IWAI should additionally take up the task of interaction with the ULBs, DAs, PCBs, Industrial Departments, EDFC, Road Development Authorities, NHAI and other concerned department six monthly so as to know their developmental plans, to assess effect of their plans on NW-1 and sharing the suggestive environment management and impact mitigation plan for respective development prepared in this document. This practise can regulate the cumulative impacts to some extent and may help in mitigation of the impacts.

Chapter 1. : INTRODUCTION & BACKGROUND

1.1. Introduction

From the beginning of history, human sensitivity has revealed an urge for mobility leading to a measure of Society's progress. The history of this mobility or transport is the history of civilization. For any country to develop with right momentum modern and efficient. Transport as a basic infrastructure is a must. It has been seen throughout the history of any nation that a proper, extensive and efficient Road Transport has played a major role. Where roads are considered as veins and arteries of a nation, passenger and goods transported are likened to blood in circulation, water transport is the cheapest and the oldest form of transport for heavy goods and bulk cargoes.

Inland Waterways Authority of India (IWAI) is a statutory body under Ministry of Shipping, Govt. of India. IWAI is primarily responsible for development, maintenance and regulation of Inland Water Transport (IWT) in the country specifically on National waterways. In this context, the Ganga-Bhagirathi-Hooghly river system from Allahabad to Haldia has been declared as National Waterway-I (NW-I). It is a natural waterway of about 1620 km in length and passes through the states of Uttar Pradesh, Bihar, Jharkhand and West Bengal. One of the limitations on viable Inland waterway transport on NW-1 is a weak navigation infrastructure. Therefore, IWAI has initiated the project of “Capacity Augmentation of National Waterway-1” between Haldia and Allahabad named as “Jal Marg Vikas Project”. However, considering the available LAD and cargo demand scenario, IWAI is focusing on the stretch between Haldia to Varanasi at present.

In this regard, IWAI has commissioned Social & Environmental Impact Assessment (SEIA) studies to map and understand potential environmental and social impacts associated with navigation improvement of NW-I and to prepare plan for effective mitigation and management of the Impact associated with the project. This report is prepared for Cumulative Impact Assessment (CIA) study which is the part of the SEIA study.

1.2. Objectives

The main objectives of this study are as follows:

- Assess the potential impacts and risks of a proposed and other developments over time on a chosen CERs;
- Verify that the proposed development’s cumulative social and environmental impacts and risks will not exceed a threshold that could compromise the sustainability or viability of selected CERs;
- Confirm that the proposed development’s value and feasibility are not limited by cumulative social and environmental effects;
- Support the development of governance structures for making decisions and managing cumulative impacts at the appropriate geographic scale (e.g., airshed, river catchment, town, regional landscape);
- Ensure that the CERs of affected communities about the cumulative impacts of a proposed development are identified, documented, and addressed; and
- Manage potential reputation risks

1.3. Study Area, Project Description

The NW-1 stretch starts from Haldia (Sagar) to Allahabad (1620 km) on Ganga - Bhagirathi - Hooghly river system. The Hooghly river portion of the waterway from Haldia to Nabadwip is under tidal influence. From Nabadwip to Jangipur the NW1 stretch is formed by Bhagirathi river. Bhagirathi river flow is regulated through barges at Farakka and Jangipur. From Farakka upstream the navigable route depends upon the main Ganga river flow. The Feeder Canal and the navigation lock at Farakka become the link between the Bhagirathi and main Ganga upstream of Farakka Barrage. NW-1 is passing through four states namely UP, Bihar, Jharkhand and West Bengal. Location map, alignment map of NW-1 is shown in **Figure 1.1.**

Proposed Project-Jal Marg Vikas aims at improvement of navigation in entire stretch of 1620 km. of NW-1 (Haldia to Allahabad). NW-1 is the Ganga - Bhagirathi - Hooghly river system. NW-1 is being fed by various tributaries at different locations. Major tributaries to NW-1 between Haldia to Allahabad are Tons, Gomti, Ghagra, Son, Gandak, Punpun and Kosi. The following interventions have been proposed and planned under the Jal Marg Vikas Project.

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- Improved Navigation Infrastructure & Navigation Aids
  - Construction of 10 Ro-Ro jetties & ferry passenger jetties. Locations of these jetties are yet to be identified.
  - Construction of 6 terminals: Site identification and planning for 3 terminals sites at Sahibganj, Varanasi and Haldia is completed. 2 more potential sites for development of terminals are identified at Ghazipur and Kalughat. These two sites are still under consideration for finalization and planning of design at initial stage only. One more terminal site along NW-1 is being identified.
  - Construction of one Navigation Lock at Farakka, West Bengal.
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  - Development of navigation aids along NW-1 for facilitation of day & night time navigation.
- Development of efficient River Information System with all hardware & software.
- Provision for bank protection / slope protection and river training works for critical locations.

The project also envisages the creation and improvement of integration opportunities with other surface transport modes such as roads and railways, so as to improve the overall efficiency of the logistics chain by linking the waterways through various well equipped terminals and jetties.

Cargo being transported in NW-1 includes cement, fly ash, iron ore, iron ore fines, coal, steel shed, tyres, iron fines, iron ingots, Galvanized steel plain sheets, stone chips, furnace oil, high Speed diesel, lube oil, boulders, pulses, aluminium block, sand, chips, ship block, log, pulses, Manganese ore, Petroleum, Coke, Cooking coal, Rock Phosphate, Timber, Peas, Slag oil, and Non-cooking coal. Traffic projections for the planned infrastructure site are given at **Table 1.1.** The terminals cargo handling capacity are being designed considering these traffic projections.

Table 1.1 : Traffic Forecast for Planned Navigational Infrastructural Facilities

S. No.	Infrastructural Facility	Projected Cargo-2015 (MTPA)	Projected Cargo-2030 (MTPA)	Projected Cargo-2045 (MTPA)
1	Sahibganj Terminal	2.24	4.39	9.00
2	Varanasi Terminal	0.54	1.22	1.22

S. No.	Infrastructural Facility	Projected Cargo-2015 (MTPA)	Projected Cargo-2030 (MTPA)	Projected Cargo-2045 (MTPA)
	(with current land)			
3	Haldia Terminal	4.07 MTPA (1.57 other cargo & 2.5 MTPA coal transhipment)		

Source: HOWE Engineering Projects (India) Pvt.Ltd. (Design Consultant)

There are various challenges for Jal Marg Vikas Project development which includes typical characteristics alluvial river Ganga his braiding, meandering large water fluctuations between summer and monsoon months and annual silt loads of 1600 million tonnes. The maintenance dredging requirements, planned infrastructures facilities, and other facilities are planned keeping these challenges and transportation requirements in consideration. The salient features of the Jal Marg Vikas Project with the details of planned and proposed developments are given at **Table 1.2.**

Table 1.2 : Salient Features of Jal Marg Vikas Project

<table>
<tr><th>Salient Features</th><th>Capacity/Quantity/Nos.</th></tr>
<tr><td>Facilities Planned</td><td>• 3 terminal sites (Sahibganj, Varanasi & Haldia)
• 1 new Navigation lock- Farakka
• River bank protection works at planned terminal sites and along Feeder canal</td></tr>
<tr><td>Facilities under Planning Stage</td><td>• 3 additional terminal sites
• 10 ro-ro jetties
• Barge repair and maintenance facility
• River training works
• River bank protection works at the proposed civil intervention sites</td></tr>
<tr><td>Designed capacity of Terminals</td><td><table><tr><td>Infrastructural Facility</td><td>Projected Cargo-2015 (MTPA)</td><td>Projected Cargo-2030 (MTPA)</td><td>Projected Cargo-2045 (MTPA)</td></tr><tr><td>Sahibganj Terminal</td><td>2.24</td><td>4.39</td><td>9.00</td></tr><tr><td>Varanasi Terminal (with current land)</td><td>0.54</td><td>1.22</td><td>1.22</td></tr><tr><td>Haldia Terminal</td><td colspan="3">4.07 MTPA (1.57 other cargo & 2.5 MTPA coal transhipment)</td></tr></table></td></tr>
<tr><td>Navigation Channel</td><td>Width-64 m
LAD-3 m from Haldia to Barh, 2.5 m from Barh to Buxar and 2.2 m from Buxar to Varanasi at present</td></tr>
<tr><td>Design Vessel Specifications</td><td>Vessels of maximum length 110 m, beam 11.4 m, draught 2.5 m-2.8 m and air draught of 9 m will ply in the waterway</td></tr>
<tr><td>Size of Vessels</td><td>1500-2000 dWT</td></tr>
<tr><td>River Slope</td><td>Haldia to Farakka-1 in 11000
Farakka downstream-1 in 18000
Farakka to Allahabad-1 in 17,000</td></tr>
<tr><td>Maintenance Dredging</td><td>Navigation Channel-15,765,596 cum/year*</td></tr>
<tr><td>Type of Dredgers</td><td>CSD, Agitation dredgers/plough dredgers and back hoe dredgers</td></tr>
<tr><td>Dredge disposal</td><td>Preferably off-shore, onshore only if sediments are found to be contaminated</td></tr>
</table>

* quantities are tentative and subject to change with revision in planning

Figure 1.1 : Location and Alignment of the Project

1.4. Approach & Methodology

Stepwise approach & methodology (A&M) is given below.

Step 1: Identify CERs, and determine spatial and temporal Boundaries for CIA
Step 2: Identify other activities and developments affecting CERs
Step 3: Establish information on baseline status of CERs
Step 4: Assess cumulative impacts on CERs
Step 5: Assess significance of predicted cumulative impacts
Step 6: Management of cumulative impacts – design and implementation

The above step wise approach has been converted into activities and tasks as mentioned below & schematically shown in **Figure 1.2.**

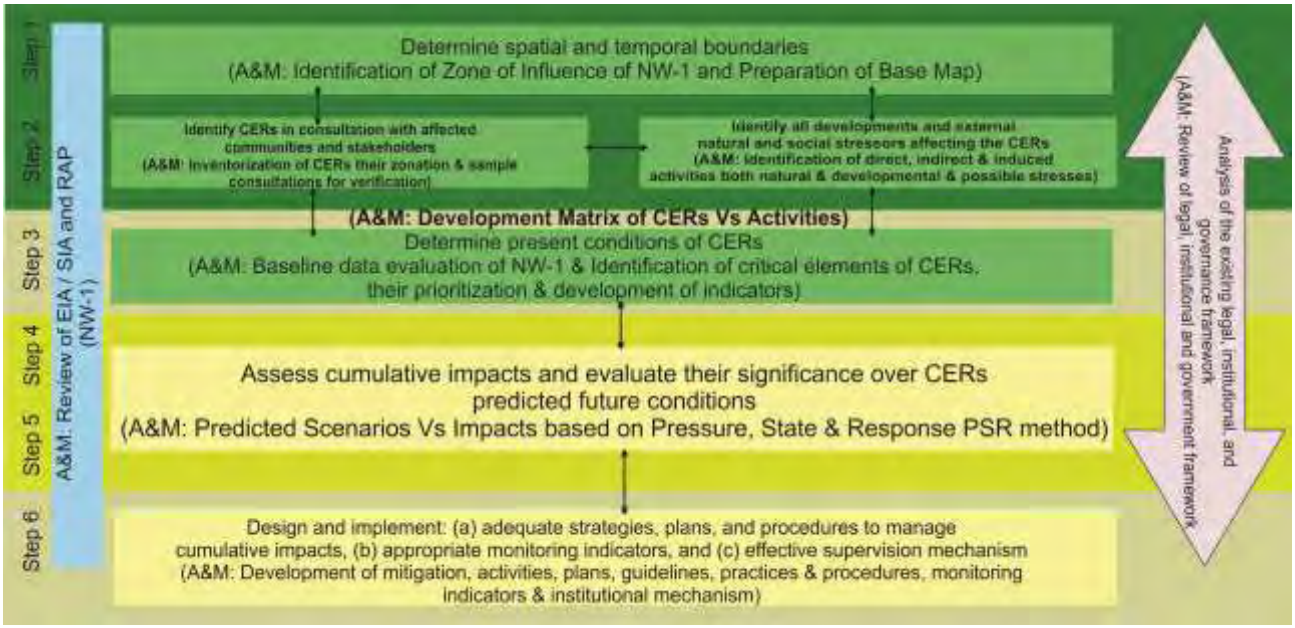

Figure 1.2 : Schematic Representation of Proposed Approach & Methodology (A&M)

Activity 1: Scoping Phase I – CERs, Spatial and Temporal Boundaries

1. Identify the CERs to include in the CIA.
2. Identify the spatial boundaries of the CIA.
3. Identify the temporal extent of the CIA.

A&M: (1) Determine spatial and temporal boundaries (Identification of Zone of Influence of NW-1 and Preparation of Base Map) Identify CERs in consultation with affected communities and stakeholders (2) Inventorization of CERs their zonation & sample consultations for verification.

Activity 2: Other Activities and Environmental Drivers

1. Identify other existing and reasonably predictable projects and human activities that do/would affect the CERs to be included in the CIA;
2. Identify natural environmental drivers that also impact the condition of CERs identified in Step 1.

A&M: Identify all developments and external natural and social stressors affecting the CERs Identification of direct, indirect & induced activities both natural & developmental & possible

stresses.

Activity 3: Establish Information on Baseline Status of CERs

1. Collect available information on the impacts of the other activities and natural drivers on the condition of the CER;
2. Collect available information on CER trends;
3. Collect any available information on regional thresholds for CERs (e.g. air pollution).

A&M: (1) Identify all developments and external natural and social stressors affecting the CERs Identification of direct, indirect & induced activities both natural & developmental & possible stresses (2) Development Matrix of CERs Vs Activities.

Activity 4: Assess Cumulative Impact on CERs

1. Establish indicators for expression of CER condition. This may already be reflected in the information collected on CER baseline status (in Step 3 above). If not, then indicators may need to be established that can be estimated from the baseline information;
2. Estimate the "future baseline" for condition of the CERs—i.e., the condition of CERs as affected by the other projects, human activities, and natural drivers; and Estimate the project impact on CERS condition. This estimation is done with the effects of planned project mitigation included; and
3. Estimate the cumulative impact on CERs—the total impact on the CERs when the impacts of the development are combined with the future baseline.

A&M: Baseline data evaluation of NW-1 & Identification of critical elements of CERs, their prioritization & development of indicators.

Activity 5: Assess Significance of Anticipated Cumulative Impacts

1. Assess the significance of the foreseen cumulative impacts on the CERs;

Activity 6: Management of Cumulative Impacts: Design and Implementation

1. Identify, when necessary, additional project mitigation (beyond that identified in the project ESIA) to reduce an estimated unacceptable cumulative impact on a CER to an acceptable level. This should represent effective application of the mitigation hierarchy in environmental and social management of the specific project contributions to the expected cumulative impacts;
2. If necessary, identify the potential, or need for, additional mitigation of other existing or reasonably predictable future projects;
3. Identify the potential for other regional strategies that could maintain CERs at acceptable conditions; and
4. Undertake best efforts to engage, enhance, and contribute to a multi-stakeholder collaborative approach for the implementation of management actions that are beyond the capacity of the project proponent.

A&M: (1) Assess cumulative impacts and evaluate their significance over CERs predicted future conditions (Predicted Scenarios Vs Impacts based on Pressure, State & Response PSR method). Design and implement: (a) adequate strategies, plans, and procedures to manage cumulative impacts, (b) appropriate monitoring indicators, and (c) effective supervision mechanism (2) Development of mitigation, activities, plans, guidelines, practices & procedures, monitoring indicators & institutional mechanism)

Activity 7: Stakeholder Engagement

1. Identify the stakeholders getting affected during the construction phase and operational phase of the project and other developmental proposals along the alignment.
2. Consultation with stakeholders including public, line departments, infrastructure, service providers and experts.
3. Incorporate input from other people knowledgeable of the study area to inform conclusions about future land use and developments in the study area.
4. Identify and finalise the Hotspots / Pressure Points based on Consultations.

1.5. Format of the Report

Draft Cumulative Impact Assessment Report has been compiled in seven chapters. The table of contents of each chapter is given below.

Chapter 1 Introduction and Background: This chapter describes Introduction; Objective of the Study as per ToR; Study Area; Approach and Methodology and format of the report.

Chapter 2 Project Description: This chapter describes project description; components of NW-1 in an integrated manner; and applicable legislations and World Bank policies.

Chapter 3 Delineation of CIA boundaries and CERs. This chapter describes delineation of CIA boundary; CERs and Social components; Assessment of status of identified CERs; Preliminary Identification of Hotspots.

Chapter 4 Stakeholders consultations, Other Development Proposals and finalization of CERs: This chapter describes Basis and Strategy of Stakeholder's Selection; Methodology and the Tools Used; Proceedings of Stakeholder Consultations; Public Consultations; Summary of Output of the Stakeholders Consultations; and Identification of Hotspots based on Consultations.

Chapter 5: Cumulative Baseline Study: This chapter describes cumulative baseline including EIA's of NW-1 in an integrated manner.

Chapter 6: Cumulative Impact Assessment: This chapter describes Finalization of Hotspots/CERs for Cumulative Impact Assessment; Impact identification due to Proposed project; Interaction of CERs and proposed development; Assessment of Cumulative Impacts; Recommendation of Basin level CERs Study.

Chapter 7: Mitigation measure and management Plan: This chapter describes review of the Mitigation Measures Proposed in standalone EIA/EMP/SIA Studies; Mitigation Measures for Proposed / Planned & Anticipated Developments within Study Area; Environment Management Plan; Environment Monitoring Plan; and Organizational Framework. Further, sections describe Segment wise maintenance and augmentation of River Flow; Segment wise strategies of the targeted quality of water; Segment wise avoidance and/or minimization of pollution load; segment wise avoidance and/or minimization of social issues.

Chapter 2. : DESCRIPTION OF THE PROJECT

2.1. Introduction

This chapter presents the details of the project, its existing infrastructure & current traffic, components and salient features. At first, project description has been summarized. This is followed by summary of existing project components, proposed components, applicable legislation and World Bank Operational Policies. Finally, inferences have been drawn considering the scope & boundaries of CIA.

2.2. Project Description of NW-1

NW-1 which is natural waterway, extends from Haldia (Sagar) to Allahabad and spans 1620 kms crossing the states of Bihar, Jharkhand, Uttar Pradesh & West Bengal. NW-1 falls in The Ganga - Bhagirathi - Hooghly river system between Haldia & Allahabad. It links the ports of Haldia and Kolkata to Bhagalpur, Patna, Ghazipur, Varanasi and Allahabad, their industrial hinterlands, and several industries located along the Ganga basin. Alignment of NW-1 is depicted in Figure 2.1 below.

Figure 2.1 : Alignment of NW-1

NW-1 is being fed by various tributaries at different locations. Major tributaries to NW-1 between Haldia to Allahabad are Tons, Gomti, Ghagra, Son, Gandak, Punpun and Kosi. Jal Marg Vikas project is aimed at augmentation of navigation in the waterway by maintaining the LAD in the

waterway throughout the year for navigation, development of the navigational infrastructure and navigation aids, river training works at critical location, equipment of the necessary barges/dredgers/boats for navigation purpose and development of efficient River information system.

2.3. Components of the Existing Infrastructure & Current Cargo Movement

Navigation infrastructure existing at NW-1 which facilitates the cargo transportation are given below. This includes, Low & High level jetties at Patna; GR jetty in Kolkata; Fixed Jetty at Farakka & Pakur and floating terminals at Haldia, BISN & Botanical Garden in Kolkata, Tribeni, Shantipur, Swaroopganj, Katwa, Hazardwari, d/s Farakka, u/s Farakka, Manglahaat (Rajmahal), Samdaghat (sahebganj), Bateshwarsthan, Bhagalpur, Munger, Semaria, Buxar, Ghazipur, Ramnagar (Varanasi) and Allahabad. Details of the location, Chainage, capacity, area, facilities of these above mentioned existing facilities in NW-1 are given below in **Table 2.1**. Map showing location of the existing developments in NW-1 is given in **Figure 2.2** below.

Table 2.1 : Details of Existing Infrastructure in NW-1

A. Floating Terminals										
Sl. No.	**Name of terminal with chainage (In km)**	**Land area (in Sq. m)**	**Size of berth, water front (In metre)**	**No. of Pontoon Barge & Gangway**	**Cargo Handling equipment**	**Storage area**	**Link approach road**	**Security (in each shift)**	**Water/ Lighting facility**	**Remarks**
1	Allahabad (Ch. 1535)	8.759 Hectare Land	35 m berth & 300 WF	01 Pontoon Barge 01 Pontoon Gangway	Nil	To be stored on Pontoon and open space of IWAI's land 5000 Sq. m	Pucca Rasta (Concreted road)500 m and metalled road 2 kmconnected with NH 76	01 no. armed 01 no. unarmed	Drinking Water facility available	Generator could be provided for lighting if required
2	Ramnagar (Varanasi) (Ch. 1315)	5.586 Hectare Land	35 m berth & 300 WF	01 Pontoon Barge 01 Pontoon Gangway	Nil	To be stored on Pontoon and open space of IWAI's land 2000 Sq. m	Land acquisition in process for approach road of about 700m connecting with NH 07	01 no. armed 01 no. unarmed	-	Being developed under Jal Marg Vikas Project
3	Ghazipur (Ch. 1177 Km) / Rajghat (Varanasi)	-	35 m berth	01 Pontoon Barge 01 Pontoon Gangway	Nil	To be stored on Pontoon. Private land could be made available if required	Kachcha Rasta(Earthen Road) 100m and Pucca road 100 m connected with NH 19	-	Drinking Water facility available	Generator could be provided for lighting if required
4	Buxar (Ch. 1124 Km)	-	35 m berth	01 Pontoon Barge 01 Pontoon Gangway	Nil	To be stored on Pontoon. Private land could be made available if required	KachchaRasta100 m and Pucca road 400 m connected with NH 84	-	Drinking Water facility available and Street Lights available as provided by Local Administration	
4	Semaria (Ch. 850 Km)	-	35 m berth	01 Pontoon Barge 01 Pontoon Gangway	Crane on Pontoon available	To be stored on Pontoon. Private land could be made	Kachcha Rasta 200m and Pucca road 300 m connected with NH	-	Drinking Water facility available	

A. Floating Terminals										
Sl. No.	**Name of terminal with chainage (In km)**	**Land area (in Sq. m)**	**Size of berth, water front (In metre)**	**No. of Pontoon Barge & Gangway**	**Cargo Handling equipment**	**Storage area**	**Link approach road**	**Security (in each shift)**	**Water/ Lighting facility**	**Remarks**
						available if required	31			
5	Munger (Ch.793Km.)	3.40 Acre Land	35 m berth	01 Pontoon Barge 01 Pontoon Gangway	Nil	To be stored on Pontoon and open space of IWAI's land 1000 Sq. m	Pucca Rasta 100 m and metalled road 5 km connected with NH 80	01 no. armed 01 no. unarmed	Drinking Water facility available and Street Lights available provided by Local Administration	Generator could be provided for lighting whenever required
6	Bhagalpur (Ch715Km.)	3.86 Acre Land	35 m berth	01 Pontoon Barge 01 Pontoon Gangway	Nil	To be stored on Pontoon and open space of IWAI's land 1000 Sq. m	Pucca Rasta 300 m and metalled road 2 km connected with NH 80	01 no. armed 02 nos unarmed	Drinking Water Sodium Vapour Lamps (Full Illumination)	DGPS Station is operational and being utilized since 2010.
7	Bateshwarsthan (Ch. 683Km.)	-	35 m berth	01 Pontoon Barge 01 Pontoon Gangway	Nil	To be stored on Pontoon.	Kachcha Rasta 200m and Pucca road 5km connected with NH 80	-	Drinking Water facility available	Generator could be provided for lighting whenever required
8	Samdaghat (Sahebganj) (Ch.617Km.)	-	35 m berth	01 Pontoon Barge 01 Pontoon Gangway	Crane on pontoon	To be stored on Pontoon. Private land could be made available if required	Kachcha Rasta300m and Pucca road 1km connected with NH 80	-	Drinking Water facility available	Generator could be provided for lighting whenever required
9	Manglahat (Rajmahal) (Ch. 588Km.)	-	35 m berth	01 Pontoon Barge 01 Pontoon Gangway	Nil	To be stored on Pontoon. Private land could be made available if required	Kachcha Rasta 100m and connected with NH 80	-	Drinking Water facility available	Generator could be provided for lighting whenever required

A. Floating Terminals										
Sl. No.	**Name of terminal with chainage (In km)**	**Land area (in Sq. m)**	**Size of berth, water front (In metre)**	**No. of Pontoon Barge & Gangway**	**Cargo Handling equipment**	**Storage area**	**Link approach road**	**Security (in each shift)**	**Water/ Lighting facility**	**Remarks**
10	U/s Farakka (Ch. 545.0)	4800	35 m berth	01 Pontoon 01 Bamboo Gangway	NIL	To be stored on Pontoon & land of FBP	100 m	01 nos. armed 03 no. unarmed	Drinking Water Sodium Vapour Lamps	Land belongs to FBP being used by IWAI.
11	D/s Farakka (Ch. 542.0)	-	35 m berth	01 Pontoon 01 Bamboo Gangway	NIL	To be stored on Pontoon.	Along the road	NIL	Street Lights provided by Local Administration	Land not available pontoon placed on water front
12	Hazardwari (Ch. 439.0)	-	35 m berth	01 Pontoon 01 Bamboo Gangway	NIL	To be stored on Pontoon.	100 m	NIL	Street Lights provided by Local Administration	Land not available pontoon placed on water front
13	Katwa (Ch. 334.50)	-	35 m berth	01 Pontoon 01 Bamboo Gangway	NIL	To be stored on Pontoon.	1.5 km	NIL	NIL	Land not available pontoon placed on water front
14	Swaroopganj (Ch. 280)	2337	35 m berth	01 Pontoon 01 Bamboo Gangway	NIL	One Godown of size 4.5 x 5 m and Open space 290 m^2	500 m	01 nos. armed 03 no. unarmed	Drinking Water Sodium Vapour Lamps	Land taken from KoPT on lease basis
15	Shantipur (Ch. 241.0)	8000	35 m berth & 100 WF	01 Pontoon 06 Modular Pontoons Gangway	NIL	To be stored on Pontoon and open space of IWAI's land 2000 Sq. m	3 km	03 nos. unarmed	NIL	Land belongs to State Govt. of W.B. being used by IWAI.
16	Tribeni (Ch. 196.0)	-	35 m berth	01 Pontoon 01 Bamboo Gangway	NIL	To be stored on Pontoon	Along the road	01 nos. armed 02 no. unarmed	NIL	Land not available pontoon placed on water front
17	BISN Jetty & G.R.	30409.64	70 m berth & 100 WF	03 Pontoons 01 Steel Gangway	NIL	Open Space area 6000 m^2	1 km	01 nos. armed 03 no.	Sodium Vapour Lamps (Full Illumination)	Land taken from KoPT on lease basis

A. Floating Terminals										
Sl. No.	**Name of terminal with chainage (In km)**	**Land area (in Sq. m)**	**Size of berth, water front (In metre)**	**No. of Pontoon Barge & Gangway**	**Cargo Handling equipment**	**Storage area**	**Link approach road**	**Security (in each shift)**	**Water/ Lighting facility**	**Remarks**
	Jetty-1 (Ch. 135.0)							unarmed		
18	Botanical Garden Jetty (Ch. 134.5)	996	35 m berth & 50 m WF	01 Pontoon 01 Steel Gangway	NIL	To be stored on Pontoon	150 m	03 nos. unarmed	Sodium Vapour Lamps (Full Illumination)	Land belongs to KoPT being used by IWAI.
19	Haldia (Ch. 35.0)	10930	70 m berth & 200 m WF	04 Pontoons 01 Gangway	NIL	One Godown of size 12 x 30 m and Open space 1630 m^2	3.5 km via HDC	01 nos. armed 03 no. unarmed	Drinking Water Sodium Vapour Lamps	Land taken from Haldia Dock Complex (HDC) on lease basis.
B. Fixed RCC Jetties										
1	G.R.Jetty-2 (Ch. 134.5)	14,557	70 m berth	-	-	One Transit shed of size 25 x 46 m and Open space 4000 m^2	500 m.	01 nos. armed 03 no. unarmed	Drinking Water Sodium Vapour Lamps (Full Illumination)	Land taken from KoPT on long term lease basis. RCC Jetty completed and being operational since Nov., 2013.
2	Farakka RCC Jetty (Ch. 542 km)	-	115 m berth	-	-	-	Along the road	-	Drinking Water Sodium Vapour Lamps	Owned by FBP this can be used by the common users.
3	Pakur RCC Jetty (Ch. 522 km)	-	60 m berth	-	-	-	1 km	-	-	Owned by FBP this can be used by the common users.
4	Patna (Gaighat) (Ch.	2.93 Acre	46.0 m berth 100 m WF	Nil	Shore Crane-2 with capacity of	45m x 14m Transit shed and open space of IWAI's	Pucca Rasta 500 m and metalled road 2 km connected with NH 30	01 no. armed 03 no.unarme	Drinking Water Sodium Vapour Lamps (Full Illumination)	Permanent High level Jetty and DGPS Station is operational and being utilised

A. Floating Terminals										
Sl. No.	**Name of terminal with chainage (In km)**	**Land area (in Sq. m)**	**Size of berth, water front (In metre)**	**No. of Pontoon Barge & Gangway**	**Cargo Handling equipment**	**Storage area**	**Link approach road**	**Security (in each shift)**	**Water/ Lighting facility**	**Remarks**
	955Km.)				01 - 20 tonnes subject to radius	land 1000 Sq. m		d		since 2012.

(Source: Howe Engineering -Detailed Feasibility Report)

Figure 2.2 : Existing Navigation Infrastructure Facilities in NW-1

2.3.2. Existing and Anticipated Cargo Movement at NW-1

The above infrastructure supported a cargo movement of 27,16,436 MT (15,11,961,380 TKM/1.512 BTKM) during 2012-2013 (IWAI). Cargo transported include cement, fly ash, iron ore, iron ore fines, coal, steel shed, tyres, iron fines, iron ingots, Galvanized steel plain sheets, stone chips, furnace oil, high Speed diesel, lube oil, boulders, pulses, aluminium block, sand, chips, ship block, log, pulses, Manganese ore, Petroleum, Coke, Cooking coal, Rock Phosphate, Timber, Peas, Slag oil, and Non-cooking coal. Cargo traffic and the commodities transported in NW-1 vary in different stretches. Cargo volume by rail & road mode along NW-1 stretch for year 2014 is given at **Table 2.2**.

Table 2.2 : Current Traffic Along NW-1 Stretch (2014)

Commodities	By Road (in tonne)	By Rail (in tonne)	Total Cargo (in tonne)
Coal	45258500	18723758	68222258
Construction Material	30171490	14429354	44760679
Consumer Goods	191811	0	191811
Container	2033280	0	2033280
Fertilizer	156900	1377741	1534641
Food and Food Stuff	1404369	484233	1888602
Gas and Petroleum	8400	217026	475976
Minerals and Chemicals	43950	575750	1953161
Project Cargo	186560	18250	228622
Vehicles	37100	100000	137100
Total Cargo (in tonnes)	79492360	35926112	121426130

Source: HPC&HOWE ENGINEERING PROJECTS (INDIA) PVT. LTD. (DESIGN CONSULTANT)

Table 2.2 indicates that the current potential along NW-1 vis a vis other modes is very high which can be shared by NW-1.

Further, an Indo-Bangladesh Protocol on Inland Water Transit & Trade also exists between India and Bangladesh apart from intra country water transport. Under Indo-Bangladesh Protocol, inland vessels of one country can transit through the specified routes of the other country. The existing protocol routes are: Kolkata – Pandu-Kolkata, Kolkata-Karimganj–Kolkata, Rajshahi-Dhulian-Rajshahi, and Pandu-Karimganj-Pandu. For Inter-country trade, four ports of call have been designated in each country, namely; India –Haldia (West Bengal), Kolkata (West Bengal), Pandu (Assam), Karimganj (Assam) and Silghat (Assam) and Bangladesh-Narayanganj, Khulna, Mongla, Sirajganj and Ashuganj.

2.4. Traffic Projections & Components of Planned Project

Projection study for 30 years has been undertaken by survey and marketing consultant HPC for growth of traffic under three scenarios, i.e. base scenario (in absence of Jal Marg Vikas Project), Medium Augmentation scenario (Jal Marg Vikas project with 3 m LAD upto Farakka, 2.5 m until Patna and 2 m upto Varanasi) and Full augmentation scenario (LAD of 3 m upto Patna and 2.5 m upto Varanasi). For HPC has considered scenario for medium augmentation. Since traffic will be generated for different stretches, the traffic projections is made for three different stretches, i.e. Haldia-Varanasi, Haldia-Patna & Patna-Varanasi. The traffic projection for these stretches as per medium augmentation scenario is given below in **Table 2.3, 2.4 & 2.5**.

Table 2.3 : Traffic Forecast for Stretch-1 (Haldia-Varanasi)*

Cargo Type	Commodity	Forecast Medium Augmentation Case (tons)				
		Forecast MAC 2015 (t)	Forecast MAC 2020 (t)	Forecast MAC 2025 (t)	Forecast MAC 2035 (t)	Forecast MAC 2045 (t)
Dry Bulk	Stone chips	99,336	1,01,52,467	1,27,98,104	1,70,90,680	1,98,68,049
Dry Bulk	Coal	32,82,875	74,05,156	84,57,510	1,04,26,875	1,16,59,733
Dry Bulk	Iron ore	0	85,444	1,12,020	1,52,328	1,61,924
Dry Bulk	Limestone	0	3,889	4,932	6,925	8,050
Dry Bulk	Sand	0	1,38,070	1,74,090	2,32,932	2,70,785
Bagged	Food & Foodstuff	0	15,61,662	18,88,883	23,85,956	25,19,450
Bagged	Cement	0	8,27,552	12,13,633	20,34,856	25,62,950
Bagged	Fertilizer	0	60,061	66,117	75,037	80,216
Bagged	Plastic granules	0	9,383	12,270	18,713	24,250
Bagged	Textile	0	1,25,941	1,80,823	3,11,868	3,99,577
Neo-bulk	Logs & woods	63,151	86,976	1,08,042	1,45,196	1,82,878
Neo-bulk	Paper	0	3,745	5,282	8,320	10,480
Neo-bulk	Petroleum	2,62,460	5,15,815	6,61,925	9,25,784	10,70,067
Neo-bulk	Project cargo	0	3,79,560	4,43,000	5,67,556	7,14,850
Neo-bulk	Statues	0	1,07,208	1,21,296	1,37,339	1,37,339
Neo-bulk	Steel products	0	8,86,183	10,89,119	14,69,146	18,50,424
Ro-Ro	Vehicles	0	47,863	65,484	1,09,045	1,45,370
Container	General cargo	0	18,72,123	27,83,131	48,68,543	63,44,978
Total		37,07,822	2,42,69,096	3,01,85,663	4,09,67,100	4,80,11,367

Source: HPC & HOWE ENGINEERING PROJECTS (INDIA) PVT. LTD. (DESIGN CONSULTANT)

Table 2.4 : Traffic Forecast for Stretch-2 (Patna-Varanasi)*

Cargo Type	Commodity	Forecast Medium Augmentation Case (tons)				
		Forecast MAC 2015 (t)	Forecast MAC 2020 (t)	Forecast MAC 2025 (t)	Forecast MAC 2035 (t)	Forecast MAC 2045 (t)
Dry bulk	Coal	0	2,51,993	2,46,256	2,68,992	2,71,067
Dry bulk	Sand stone	0	5,185	6,576	9,233	10,733
Dry bulk	Limestone	0	3,889	4,932	6,925	8,050
Bagged	Food & Foodstuff	0	3,32,723	4,35,396	5,94,442	6,28,316
Bagged	Textile	0	61,229	73,563	1,01,778	1,30,401
Bagged	Plastic granules	0	9,383	12,270	18,713	24,250
Bagged	Cement	0	8,13,646	11,93,886	20,03,696	25,23,702
Neo-Bulk	Paper	0	3,745	5,282	8,320	10,480
Neo-Bulk	Project cargo	0	2,02,152	2,24,605	2,77,894	3,50,014
Neo-bulk	Steel products	0	4,81,730	5,77,518	7,69,196	9,68,820
Neo-bulk	Statues	0	1,07,208	1,21,296	1,37,339	1,37,339
Ro-Ro	Vehicles	0	47,863	65,484	1,09,045	1,45,370

Cargo Type	Commodity	Forecast Medium Augmentation Case (tons)				
		Forecast MAC 2015 (t)	Forecast MAC 2020 (t)	Forecast MAC 2025 (t)	Forecast MAC 2035 (t)	Forecast MAC 2045 (t)
Container	General cargo	0	17,43,011	25,91,191	45,32,781	59,07,393
Total		0	38,11,763	53,12,000	85,69,361	1,08,44,869

Source: HPC & HOWE ENGINEERING PROJECTS (INDIA) PVT. LTD. (DESIGN CONSULTANT

Table 2.5 : Traffic Forecast for Stretch-3 (Haldia-Patna)*

Cargo Type	Commodity	Forecast Medium Augmentation Case (tons)				
		Forecast MAC 2015 (t)	Forecast MAC 2020 (t)	Forecast MAC 2025 (t)	Forecast MAC 2035 (t)	Forecast MAC 2045 (t)
Dry bulk	Stone chips	0	23,98,814	30,23,922	40,38,168	46,94,401
Dry bulk	Coal	32,82,875	69,39,211	79,69,586	98,53,827	1,10,56,473
Dry bulk	Iron ore	0	9,71,959	12,25,242	16,36,197	19,02,091
Dry bulk	Limestone	0	3,23,986	4,08,414	5,45,399	6,34,030
Dry bulk	Sand	0	68,652	84,513	1,12,091	1,41,182
Bagged	Food & Foodstuff	1,62,487	63,63,580	79,20,893	1,04,42,930	1,19,90,623
Bagged	Fertilizers	0	17,94,026	26,47,350	45,96,517	59,75,527
Bagged	Plastic granules	0	23,258	32,621	50,627	58,517
Bagged	Textile	0	2,22,364	3,02,610	4,71,792	5,99,523
Neo-Bulk	Logs and wood	0	6,47,972	8,16,828	10,90,798	12,68,061
Neo-bulk	Petroleum	2,62,460	14,63,318	18,43,599	24,76,593	28,74,916
Neo-Bulk	Project cargo	0	2,64,189	3,15,652	4,24,786	5,19,963
Neo-bulk	Steel products	0	9,39,231	11,52,032	15,42,578	19,02,495
Ro-Ro	Vehicles	0	25,886	30,543	41,522	53,199
Container	General cargo	0	2,17,457	2,95,933	4,65,037	5,85,405
Total		37,07,822	2,26,63,903	2,80,69,739	3,77,88,862	4,42,56,407

Source: HPC& HOWE ENGINEERING PROJECTS (INDIA) PVT. LTD. (DESIGN CONSULTANT

Though above traffic projection indicates sufficient traffic cargo potential till 2045, however design consultant has considered different traffic forecasted the traffic again for the presently designed infrastructure facility. These terminals are designed on the basis of the traffic expected to be shifted at these sites from rail/road to IWT mode. Traffic projections for the planned infrastructure site are given below in **Table 2.6.**

Table 2.6 : Traffic Forecast for Planned Navigational Infrastructural Facilities*

Sr. No.	Infrastructural Facility	Projected Cargo-2015 (MTPA)	Projected Cargo-2030 (MTPA)	Projected Cargo-2045 (MTPA)
1	Sahibganj Terminal	2.24	4.39	9.00
2	Varanasi Terminal (with current land)	0.54	1.22	1.22

3	Haldia Terminal	4.07 MTPA (1.57 other cargo & 2.5 MTPA coal transhipment)

Source: HOWE ENGINEERING PROJECTS (INDIA) PVT. LTD. (DESIGN CONSULTANT
** Quantities are tentative and subject to change with revision in planning*

2.4.2. Components of the Planned Project

Entire stretch measures 1620 kms and traverses through 4 states namely Jharkhand, Uttar Pradesh, Bihar and West Bengal. Developments planned under the Jal Marg Vikas project to support traffic forecasts includes.

- Maintenance dredging to maintain the LAD in waterway/channel and the terminal facility
- Improved Navigation Infrastructure & Navigation Aids
  - Construction of 10 Nos. of Ro-Ro jetties & ferry passenger jetties. Location for these jetties is not yet identified.
  - Construction of 6 Nos. of terminals. Site identification and planning for 3 terminals sites at Sahibganj, Varanasi and Haldia is completed. 2 more potential sites for development of terminals are identified at Ghazipur and Kalughat. These two sites are still under consideration for finalization and planning is at initial stage only. One more terminal site is to be identified along NW-1.
  - Construction of Navigation Locks
  - Provision for tow barges, inland vessels, survey vessels including rescue boats and survey equipment. Development of low draught cargos
  - Development of navigation aids along NW-1 for facilitation of day & night time navigation
- Development of efficient River Information System with all hardware & software
- Provision for bank protection / slope protection and river training works for critical locations

2.4.3. Depth & Width of Navigation Channel & Size of Vessel / Ships

It is planned to maintain depth of 3 m from Haldia to Barh, 2.5 m from Barh to Buxar and 2.2 m from Buxar to Varanasi at present * [2]. Further, it is planned to maintain the channel width of 64 m and side slopes of 1:10 from section Haldia to Varanasi[3]. As per IWAI planning, Vessels of maximum length 110 m, beam 11.4 m, draught 2.5 m-2.8 m and air draught of 9 m will play in the waterway (***Detailed Feasibility Study for Jal Marg Vikas Project and Detailed Engineering for its Ancillary Works and Processes between Haldia to Allahabad by HOWE Engineering Projects (India) Pvt. Ltd)***. However, the vessel size will vary in different stretched as per the available LAD and type and quantity of cargo to be transported. Vessels of size 1500-2000 DWT is expected to ply in the waterway. However, size of the ships to ply in waterway will depend on the estimated cargo generation capacity and available LAD at particular intervention. Study for cargo estimation is under process and size of the vessels will be finalized accordingly.

2.4.4. Challenges for Project Development

Some of the major challenges include nature of the river, its morphology & related phenomena along NW-1. River Ganga (NW-1) is alluvial river with typical characteristic of braiding, meandering and large water level fluctuation between summer and monsoon months. Wide variations in water level are observed ranging from 2.5 m at Farakka to 16.5 m at Allahabad. Current velocity varies between 0.2m/s during lean season to 4.0 m/s during flood season in the

[2] *Source of Data: (Detailed Feasibility Study for Jal Marg Vikas Project and Detailed Engineering for its Ancillary Works and Processes between Haldia to Allahabad by HAWE Engineering Projects (India) Pvt. Ltd). * quantities are tentative and subject to change with revision in planning*
[3] *Source of Data: (Detailed Feasibility Study for Jal Marg Vikas Project and Detailed Engineering for its Ancillary Works and Processes between Haldia to Allahabad by HAWE Engineering Projects (India) Pvt. Ltd).*

stretch between Allahabad to Farakka. Current velocity is 1.2 m/s in Feeder Canal & 1.7 m/s (max.) in Bhagirathi river stretch.

Ganga carries annual silt load of 1600 million tons. Fine silt leads to rapid shoal formation. It becomes difficult to maintain even 2 m depth during low water season throughout the stretch. The stretch between Haldia and Tribeni (196 km) is tidal and the Least Available Depth (LAD) of more than 3.0 m is maintained naturally therein. IWAI has to erect bandals and carry out dredging to maintain the LAD in upper stretches of Tribeni. Due to unavailability of adequate depth/width and navigational infrastructure facilities, navigation of the large cargos throughout the year is not possible. Major challenges for navigation in NW-1 are listed below.

1. Highly braiding and meandering river
2. Large water level fluctuation
3. Unavailability of LAD for navigation throughout NW-1 and unreliable water depths
4. Existence of sharp bends
5. High silt load & shoal/bar/island formation leading to splitting of main channel
6. Growing of bars reducing the available depth
7. Lateral migration of the river
8. Existence of power line pylons at various locations
9. Existence of pontoon bridges. About 7 pontoon bridges are present between Buxar and Allahabad which are in use. Pontoon bridges are significant threat to navigation
10. Existence of siphon in the Farakka feeder canal for irrigation purpose which generates eddy currents, reduces water level by 0.1-0.2 m in immediate vicinity of the structure and reduction in buoyancy of vessel due to presence of air bubbles in water column above this siphon leading to increase in vessel draught
11. Existence of critical bridges (bridges with Horizontal Clearance (HC) & Vertical Clearance (VC) less than 70 m & 9 m respectively). Details of the critical bridges are given below in **Table 2.7** below.
12. Inadequate navigation infrastructure and aids like inadequate fairway width, channel marking, navigation lights, signals, RIS etc., lack of modern vessel based navigation aids, absence of effective waterway reporting & tracking system etc.

Table 2.7 : Details of Critical Bridges on NW-1

S. No.	Location	Chainage	Horizontal Clearance (HC)-m	Vertical Clearance (VC)-m
1	Pakur Bridge	525	49.07	12.15
2	Rajendra Setu- Semaria	853	40.00	10.00
3	Malaviya-Varanasi	1308	101.50	6.56
4	Mirzapur	1398	30.50	2.52
5	Swami Vivekananda Setu	--	--	8.8
6	Bridge at Digha	--	20	--
7	Rajendra/Mokama Bridge, Hathida	--	--	10.6
8	Buxar Road Bridge	--	--	10.91
9	Ghazipur Road Bridge	--	--	11.82

Source: IWAI & HAWE ENGINEERING PROJECTS (INDIA) PVT. LTD. (DESIGN CONSULTANT)

Project Jal Marg Vikas is aimed at minimizing these challenges to ensure the navigation in the entire stretch during most of the time in year. Implementation of project will focus on maintaining the LAD for navigation in the desired stretches, improving existing navigation infrastructure, developing new infrastructure, improved navigation aids and navigation cargos.

2.5. Physical Intervention

The components of the projects, during phase 1 mentioned in 2.3 which are required to be achieved have been described in the following sections. These include:

1. Planned Infrastructure
- Terminal sites at Haldia, Sahibganj & Varanasi
- New Lock at Farakka

2. Infrastructure Facilities at Initial Planning Stage
- Terminals at Ghazipur and Tribeni

3. Facilities yet to be planned
- One similar terminal site
- 10 Nos. Ro-Ro Jetty and Passenger Ferry Jetties
- Development of low draught cargo
- River Training Works at Critical Locations like bends
- Bank/slope & scour protection works
- Equipment of tow barges, inland vessels, survey vessels including rescue boats and survey equipment
- Maintenance dredging for maintenance of waterways and proposed civil interventions/ navigation infrastructure.

Currently planned infrastructure and infrastructure facilities at initial planning stage have been considered as part 1 of phase 1. Map showing the location of already planned and the sites under initial planning stage on NW-1 under Jal Marg Vikas Project are given below in Figure 2.3. However, facilities yet to be planned have been considered as part 2 of the phase 1.

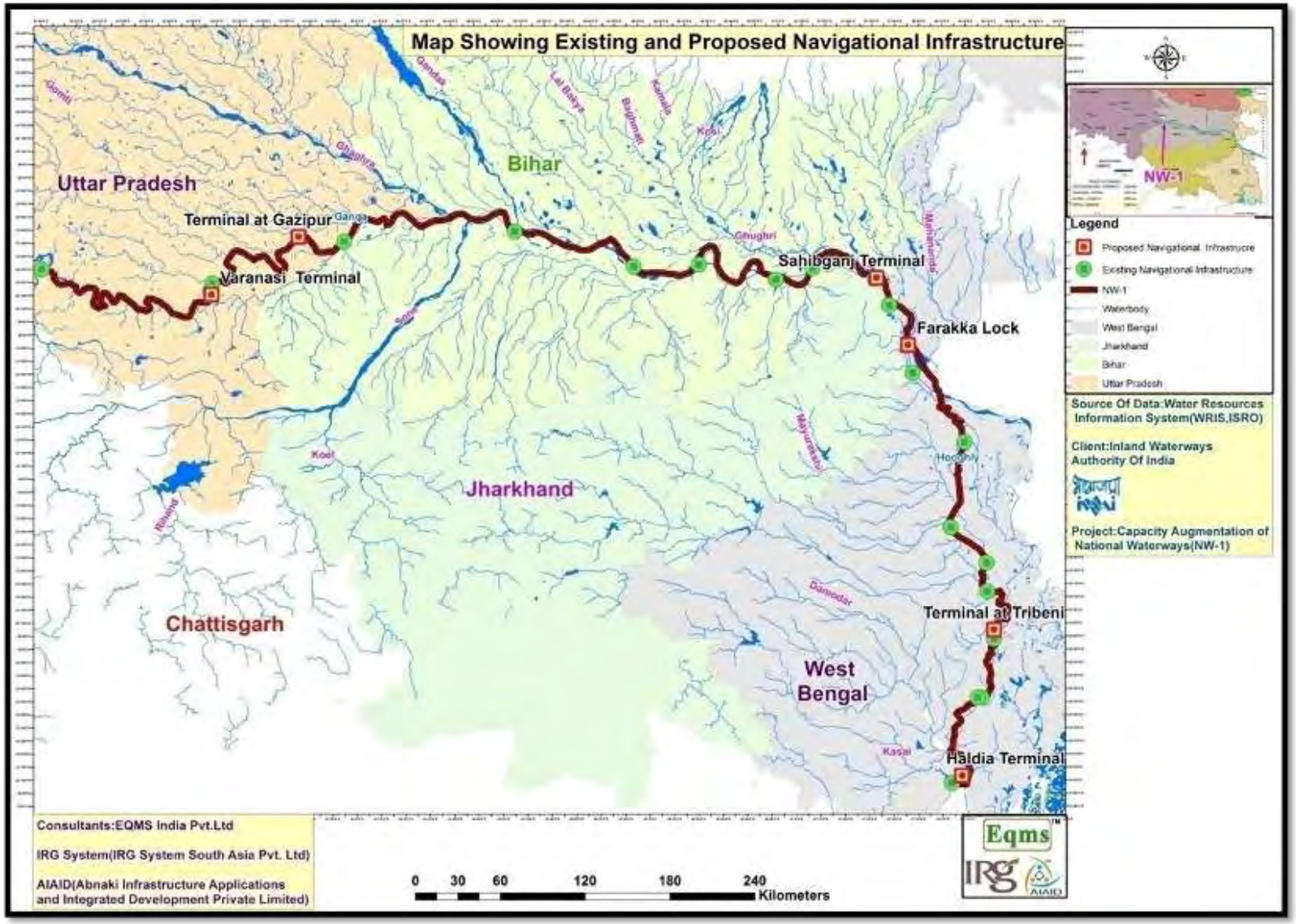

Figure 2.3 : Planned Navigation Infrastructure Facilities in NW-1 Under Jal Marg Vikas project

2.5.2. Terminal at Haldia

Haldia inland water terminal at River Hooghly (NW-1) is proposed to be located at River Hooghly at Industrial Zone of Haldia dock Complex near Durgachak (J.L.No-135, Barmurchak-138 & Jagatchak J.L.No-140), Haldia, District Purbi Medinipur, West Bengal. River Hooghly flows in South direction of the terminal site. Map showing location of Terminal at Haldia is given in **Figure 2.4**. Salient features of the project are given below in **Table 2.8.**

Figure 2.4 : Location Map of Haldia Terminal

Table 2.8 : Salient Features of the Haldia Terminal

Sr. No.	Salient Feature	Capacity/Quantity/Nos.
1.	Location	Haldia Industrial Complex area, Haldia, District Purbi Medinipur, West Bengal.
2.	Geographical Coordinates	22°03'38.34"N & 88°08'29.49"E
3.	Capacity of Cargo Handling	4.07 million MTPA 1.57 MTPA for Stone aggregates, fertilizers, Fly ash and edible oil & POL and 2.5 MTPA for coal transhipment
4.	Connectivity	Site connected to NH-41 through 7 m wide road along western boundary of site. Nearest railway station is Durgachak Railway

<table>
<tr><th>Sr. No.</th><th>Salient Feature</th><th>Capacity/Quantity/Nos.</th></tr>
<tr><td></td><td></td><td>Station at 600 m in NE direction. Railway connectivity is not proposed.</td></tr>
<tr><td>5.</td><td>Topography of terminal site</td><td>Site is almost flat in topography and elevation ranges of 4-9 m amsl. Site requires levelling and filling (3.3 lakh cum) to achieve finished level of 7 m</td></tr>
<tr><td>6.</td><td>Facilities Proposed for Haldia Terminal (Phase 1A & 1 B)</td><td>• Storage sheds (future storage area will be developed in phase 1B)
• 8 Nos. of Silos in phase 1A & 8 nos. of silos in phase 1B for flyash storage and pipeline conveyor system
• Unloading & Loading Areas
• Internal Roads
• Berths (5 Nos.) (berth for coal transhipment in phase 1 B)
• Water area & approach channel
• Administration Building
• Workers Amenity Building
• Fuel bunker
• Security office
• Weigh bridge building
• Lighting Towers
• Railway siding (future development)
• Other associated facilities like sewerage system, STP, dump pond, drainage system, RWH pond, fire-fighting facilities, communication system, water supply, ESS & power supply.</td></tr>
<tr><td>7.</td><td>Facilities to be shifted</td><td>Existing underground ammonia pipeline of Tata chemicals further towards the bank (above ground) and Existing Road to Mitsubishi Plant in South to Eastern Boundary of the site</td></tr>
<tr><td>8.</td><td>Shore Protection Works</td><td>The existing river bank protection works is adequate</td></tr>
<tr><td>9.</td><td>LAD (Least Available Draft)</td><td>3 m for barge vessels (4 nos. berths) and 8 m for large vessel (coal transhipment berth)</td></tr>
<tr><td>10.</td><td>Extension of Off-shore structure in River</td><td>
<table>
<tr><th>Offshore structure</th><th>Extension of off-shore structure (berth + approach trestle) inside the river</th><th>Length of approach trestle inside river</th><th>Length of Berth</th><th>Width of Berth</th></tr>
<tr><td>2 Nos of berths for barges</td><td>200</td><td>170</td><td>30</td><td>105</td></tr>
<tr><td>1 Nos of berths for barges</td><td>200</td><td>170</td><td>30</td><td>120</td></tr>
<tr><td>1 No of berth for barges/Berth No. 4</td><td>200</td><td>150</td><td>50</td><td>120</td></tr>
<tr><td>1 No of berth for coal transhipment</td><td>313.5</td><td>85 + 50 m (length of berth no.</td><td>28.5</td><td>150</td></tr>
</table>
</td></tr>
</table>

Sr. No.	Salient Feature	Capacity/Quantity/Nos.
		attached to Berth No. 4 | | 4) | | * length of 4 nos. approach trestle at terminal site is 145 m
11.	HFL of the River	4.46 m amsl
12.	Finished level of site	7 m
13.	Top level of berth & approach trestle	14 m
14.	Dredging During Construction Phase	7 lakh cum
15.	Material Transportation System	Trucks, Pay loaders, Barge loaders, mobile harbour cranes & granty cranes. Fly ash will be transported by trucks and loaded to the silos pneumatically by pumps and then it will be loaded to barge by pipe conveyor system. 16 Nos. silos of 1200 Tonne capacity will be provided for ash storage
16.	Maintenance Dredging during operation phase	8.5 lakh cum/year
17.	Water Requirement-construction phase	90 KLD
18.	Water Requirement-operation phase	70 KLD 20 KLD-Raw water requirement and 50 KLD potable water requirement
19.	Power Requirement	Connected load-5500 KW Demand Load-2400 KW
20.	Storm Water System	Open Storm water drains of total length 6 km Stock yard, parking area & roads –dump pond Buildings- Rain water storage sump
21.	STP Capacity-Operation Phase	30 KLD
22.	Dust Suppression Methods	Fly Ash-Dust extraction system on top of silos Aggregate & fertilizers stockyards- Swivelling plain water sprinklers for abatement of aggregate dust generation along the length of the stockpile.

Source: Site visit & HOWE Engineering Projects (India) Pvt. Ltd. (Design Consultant) India

2.5.3. Terminal at Sahibganj

Sahibganj terminal will be developed along River Ganga, Village Samdha Nala & Rampura, Tehsil & District Sahibganj, Jharkhand. Map showing location of Terminal at Sahibganj is given in **Figure 2.5**. Salient features of project are given below in **Table 2.9**.

Figure 2.5 : Location Map of Sahibganj Terminal Site

Table 2.9 : Salient Features of the Sahibganj Terminal

S. No.	Salient Feature	Capacity/Quantity/Nos.
1.	Location	River Ganga, Village Samdha Nala & Rampura, Tehsil & District Sahibganj, Jharkhand
2.	Geographical coordinates	25°15'0.73"N & 25°15'0.73"N
3.	Cargo Handling Capacity	Phase I-2.24 million MTPA Phase II-4.39 million MTPA Phase III-9.00 million MTPA
4.	Nature of Cargo to be handled	Coal, stone chips, food grains, cement, fertilizers & sugar
5.	Connectivity	Approach road to be constructed by PWD to connect to NH-80 and Railway connectivity to be developed to link the existing railway line Nearest Railway Station: Sakrigali Railway Station (1.1 km, S) & Sahibganj Railway Station (6 kms, W) Nearest Airport: Patna Airport (270 km, NW) Ferry Service: Sahibganj ghat to Manihari Ghat
6.	Topography of terminal site	Undulating with level variation of 30 m-56 m

S. No.	Salient Feature	Capacity/Quantity/Nos.
7.	On-shore Facilities Proposed for Phase I	• Stockyard for coal (6 stock piles-1.12 ha), for stone chips (8 stock piles-0.875 ha) & 1 covered shed (0.416 ha) • Unloading & Loading Areas • Internal Roads (12 m wide & 3.6 km length) • Administration Building • Workers Amenity Building • Lighting Towers • Other associated facilities like sewerage system, STP, drainage system, fire-fighting facilities, communication system, water supply & power supply (ESS) • Boundary wall of 2.4 m high • Green belt- 15-20 m (2.9 ha) To be developed by PWD/Railways: • Approach Road (1 km connecting to NH-80 crossing LC-54) • Railway Connectivity (through Sagrakali Railway Station) with provision of ROB over LC-54 for approach road to be developed
8.	Off-shore Facilities Proposed for Phase I	• Jetty (1 No.) & Berth (2 Nos.) • Water area & approach channel (45 m wide channel) • Turning Circle (2 Nos. at starting & end of channel) • Shore protection (1.5 kms along River Bank, 800 m in Phase I & 700 m in phase II)
9.	Extension of Off-shore structure (jetty & Berths) in River	75 m (50 m-approach trestle & 25 m jetty) length & 270 m width.
10.	Shore Protection Works	Retaining wall and stone pitching (30-50 kgs) along the length of bank (1.5 km total, 800 m in phase I & 700 m in phase II) and 40 m apron inside the River.
11.	LAD	1-2.5 m near shoreline 7-11 m at distance of 50 m
12.	Water level fluctuation of River near Terminal Site	10 m
13.	HFL of Site	30.91 m amsl
14.	Finished Level of Site	37 m amsl
15.	Top level of Berth & Jetty	33.5 m
16.	Earthwork Phase I	Cut: 14.25 lakh cum Fill: 2.15 lakh cum Muck for disposal: 12.1 lakh cum
17.	Dredging During Construction Phase	1.5 lakh cum

S. No.	Salient Feature	Capacity/Quantity/Nos.
18.	Material Transportation System	In Phase-1 of terminal, it is proposed to provide hopper at the coal and stone chips stockyard and the cargo shall be carried through conveyor system to the berth where it shall be discharged to the vessels through barge loader
19.	Maintenance Dredging during operation phase	30,000 cum in lean season
20.	River Water Requirement for dust suppression and horticulture	Phase 1: 162 KLD Phase II: 210 KLD Phase III: 350 KLD
21.	Municipal supply water for domestic purpose (staff & vessels)	Phase 1: 46.5 KLD Phase II: 65 KLD Phase III: 90 KLD
22.	Power Requirement	Phase 1: 588 KW Phase II: 2535 KW Phase III: 1897 KW
23.	Storm Water System	Storm water drain of length 3.05 km Stock yard, parking area & roads –dump pond Buildings- Rain water storage sump
24.	Sewage Generation & STP	Phase 1: 30 KLD Phase II: 36 KLD Phase III: 40 KLD STP: 40 KLD capacity
25.	Dust Suppression Methods	**Barge Loaders-** Plain water fine spray with medium pressure standard hydraulic system using raw water **Coal Stock Yard-** Swivelling plain water sprinklers for abatement of coal dust generation along the length of the stockpile.
26.	Vehicle Parking Area	1 ha
27.	Solid Waste Generation & management	Solid waste to be generated from terminal facility will include majorly the food waste and the garden waste. This waste can be disposed off through the local agency in the area responsible for waste handling. Dustbins shall be provided at the site for collection of the waste. Used oils from DG sets/transformers/pumps etc may also generate at the site. Used/Waste oil will be stored in HDPE containers at the site in isolated location and will be sold to authorized vendors

Source: Site visit & HOWE Engineering Projects (India) Pvt. Ltd. (Design Consultant) India

2.5.4. Terminal at Varanasi (Ramnagar)

A multimodal terminal is proposed to be developed at Ramnagar, on river Ganga in Varanasi district in Uttar Pradesh. Map showing location of Terminal at Varanasi is given in **Figure 2.6**. Salient features of the development of phase 1A of the Varanasi terminal are listed in **Table 2.10** below.

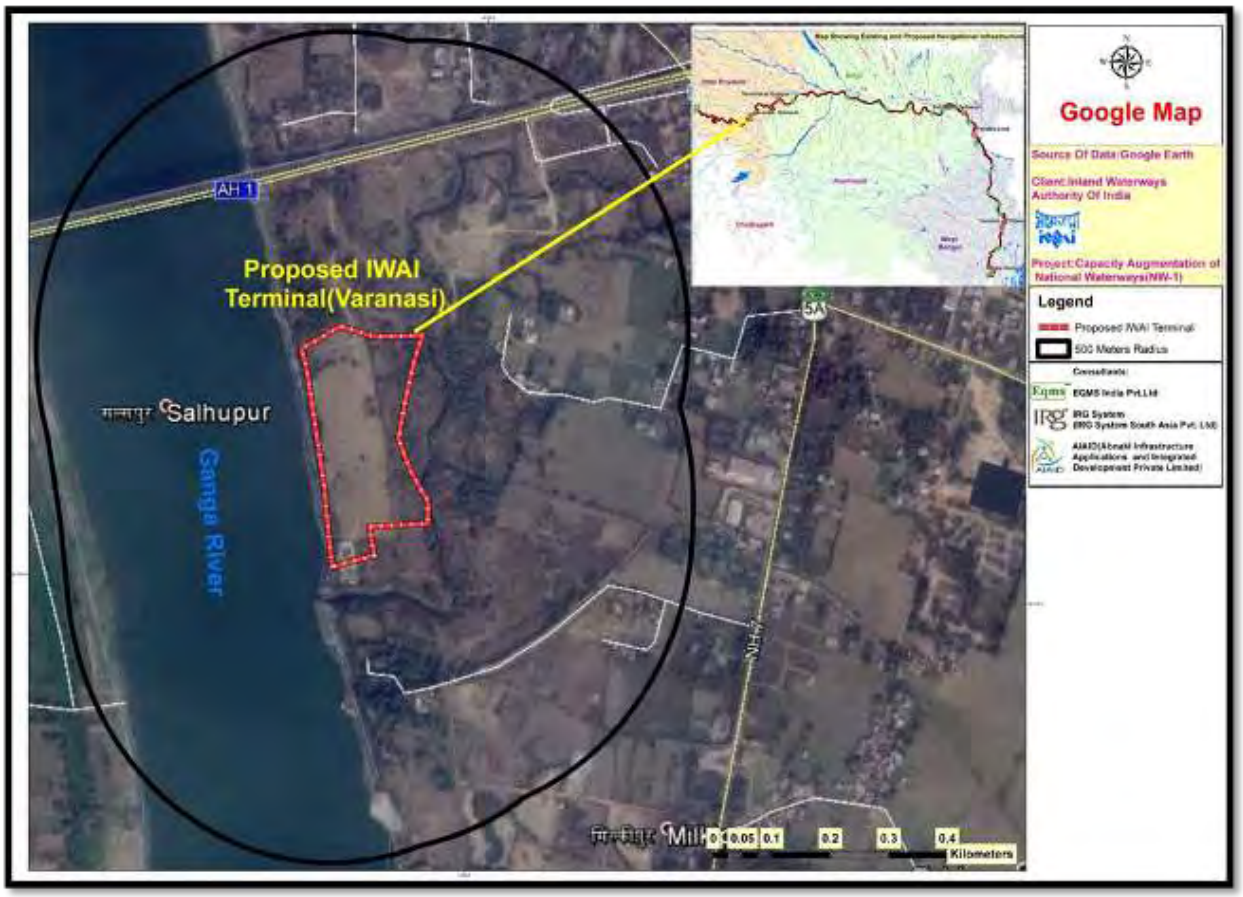

Figure 2.6 : Location of Varanasi Terminal Site

Table 2.10 : Salient Features of Varanasi Terminal

Sr. No.	Salient Feature	Capacity/Quantity/Nos.
1.	Location	River Ganga, Ramnagar, Varanasi, U.P.
2.	Project site Geographical Coordinates	25°15'7.90"N & 83° 1'55.45"E
3.	Project Area	5.685 ha
4.	Type of Land	Private Agricultural Land (12 small khejur trees and 8 babool shrubs) but no agricultural activity is being undertaken
5.	Site Surroundings	River Ganga (abuts site, West) Gurha Nallah (Abuts, East & South)
6.	Accessibility &	No pucca public road to access site. Site accessible through katcha village

<table>
<tr><th>Sr. No.</th><th>Salient Feature</th><th>Capacity/Quantity/Nos.</th></tr>
<tr><td></td><td>Connectivity</td><td>road and it connects site to NH-7. Approach road of 700 m is planned to connect the site with NH-7 for which additional area of 0.592 ha will be acquired.
Nearest Railway Station – Jeonathpur (4.0 km, SE)
Nearest Airport - Lal Bahadur Shastri Airport (30 km, NW)</td></tr>
<tr><td>7.</td><td>Facilities Proposed</td><td>• 2 Nos. berths (100 m length & 36 m width each) so as 2 vessels of 80 m each can be berthed at one time. Berth will be laong the River bed
• 2 mobile cranes for loading & unloading
• Open area at site for storage of transportation material (Edible oil tank storage area)
• Passenger jetty (floating pontoons-20 m X 10 m) & gangway (1.2 m wide)
• Stone pitching upstream & downstream river bank (35 m length downstream & 117 m length upstream)
• Area for DGPS
• 12 m wide internal roads-365 m & 22 m wide internal road-650 m
• Approach road to NH-7
• ESS (400 sq m) building & power back-up
• Soak pit & septic tanks-wastewater management system
• Workers amenity building (30 sqm)
• Water supply system
• Storm water drainage system
• Earthing & lighting protection system for all conducting materials
• Lighting system
• Green area</td></tr>
<tr><td>8.</td><td>Cargo to be handled</td><td>Coal (imported & domestic), cement, fertilizers, wheat & crude edible oil</td></tr>
<tr><td>9.</td><td>Plying vessel</td><td><table><tr><th>Multimodal jetty</th><th>DWT</th><th>LOA (m)</th><th>Beam (m)</th><th>Loaded Draft (m)</th></tr><tr><td>Maximum Ship Size</td><td>2000</td><td>80</td><td>11</td><td>3.5</td></tr><tr><td>Minimum Ship Size</td><td>200</td><td>18</td><td>5</td><td>1.0</td></tr></table></td></tr>
<tr><td>10.</td><td>LAD at jetty</td><td>+3.5 m</td></tr>
<tr><td>11.</td><td>Eco-sensitivity</td><td>Kashi Turtle Sanctuary at 2.3 km in North direction (downstream)
No national park, reserved/protected forest, reserves, zoological parks, migratory bird route, protected wetland under Ramsar convention etc are present within the 10 km radius area</td></tr>
<tr><td>12.</td><td>Water Supply System</td><td>Municipal Corporation, Varanasi</td></tr>
<tr><td>13.</td><td>Power Requirement</td><td>State grid (Purvanchal Vidyut Vitran Nigam Ltd).</td></tr>
</table>

Source: Site visit & HOWE Engineering Projects (India) Pvt. Ltd. (Design Consultant) India

2.5.5. Lock at Farakka

A new lock is proposed to be developed in Farakka on the Feeder Canal of Farakka Barrage adjacent to the existing lock at Farakka in Murshidabad district of West Bengal. New lock will be further West to the existing lock and will share its right bank with the left bank of the existing lock. Site is located in village Goraipada, Gram panchayat Bewa, Farakka in Murshidabad district of West Bengal. The Ganga River is flowing about 1.2 km East of the

proposed lock gate site. Map showing location of Lock at Farakka is given in **Figure 2.7**. The salient features of the existing lock site are given in **Table 2.11.**

Figure 2.7 : Location Map of Farakka Lock

Table 2.11 : Salient Features of New Lock

S. No.	Parameters	Value
1	Location	Feeder Canal, village Goraipada, Grampanchayat Bewa, Farakka in Murshidabad district of West Bengal.
2	Geographical Coordinates	24°48'32.38"N to 24°49'02.23"N & 87°54' 05.63"E to 87°54' 17.18"E.
3	Land Required	14.86 ha
4	Topography	RL+13 to RL+29m
5	Finished Level of Site	28.44 m
6	High Water Level U/S High Water Level D/S	RL + 26.30 m RL +24.38 m
7	Length of Lock	179 m
8	Width of Lock	25.148 m
9	Av. Depth of Lock	13.10 m
10	Capacity of Lock to handle no. of vessels of size 85 m (length) X 12 m (width)	four vessels of size 85 m (length) X 12 m, (width) so as two vessels are moored lengthwise and two sidewise like existing lock

S. No.	Parameters	Value
11	Seismic Risk Design Consideration	Site lies in Zone III and design is calculated as per IS: 1893:2002
12	Length of extension of U/S Approach Channel (m)	190
13	Length of extension of D/S Approach Channel (m)	310
14	Dredging required in upstream and downstream of approach channel to achieve water depth of 3 m	0.05 + 0.08 = 0.13
15	Counter Fort Retaining wall • Top wall level • Bottom wall level • Slope	 28.44 m 12.8-14.8 m 1V:370 H
16	Slope of Excavation along River Bank	1.5 H :1 V
17	Inlet & Outlet water Structures	4 Nos. feeder culverts (2 U/s & 2 D/s) of length 60 m each.
18	Base Slab Thickness	1.2 m
19	Main Units other than the lock	• Mitre Gates- 2 sets (two leaves per set) • Radial Valve Gates- 4 sets (2 for U/S and 2 for D/S) • Mooring Bits (Floating)- 8 sets (4 sets per bank) • Caisson Gates/Stoplogs- 2 Nos (Used for U/S or D/S) • Bulkhead Gates- 4 sets (2 sets for U/S or D/S) • Control Rooms for remote control-1 each for U/S or D/S
20	Length of FBP Inspection Road to be realigned (m)	675
21	Length of Boundary Wall to be constructed (m)	1180
22	Scour Protection • River Bank Slopes U/s & D/s of approach channel • Guide wall	 2 layers of back pitching with PCC blocks of size 1 X 1 X 0.6 m and 6 m wide launching apron consisting of two layers of concrete blocks of size 1.5 X 1.5 X 0.9 m Tied to existing lock and cut-offs to a depth of 5 m
23	Flood Protection	Filling site to 28.44 m + RL, i.e. above HFL, strengthening of existing levees and banks to prevent erosion & flooding
24	Other facilities	Water supply system, soak pit & septic tanks, storm water drainage system, green belt (1 ha & 900 trees) and office building
25	Water Requirement	Construction Phase-16.5 KLD Operation Phase-6.5 KLD for domestic, 7.3 KLD for dust suppression & 2.7 KLD for horticulture
26	Power Requirement	557 KW

S. No.	Parameters	Value
	Green Area	10000 m^2 (1000 m X 10 m). 900 trees to be planted

Source: HOWE Engineering Projects (India) Pvt. Ltd. (Design Consultant) India

2.5.6. Terminal at Tribeni (Tentative Location)

It is planned to develop terminal at Tribeni. Currently, Planning is at initial stage and site selection & finalization is under progress at present. Two locations have been considered for development of terminal. First site is located on left bank of River Hoogly upstream of Road Bridge on SH-6 at Tribeni, west Bengal. Site is well connected with road & railways. Kalyani Samanta is nearest railway station. App. 40 ha of agricultural land is identified for development of terminal at this site. Some brick kilns also exist at the site. One more site is considered for development of the terminal. Site is located on the right bank of the River downstream of the road bridge at SH-6. This site is located near the thickly populated area. Out of both the options alternative 1, i.e. site located upstream if SH-6 is considered for development of terminal. Google map showing the site considered for development of terminal at Tribeni is given in **Figure 2.8**.

Figure 2.8 : Proposed Terminal Site at Tribeni

2.5.7. Terminal at Ghazipur (Tentative Location)

It is planned to develop terminal at Ghazipur, U.P. Currently, planning is at initial stage for this terminal & site identification and alternative site analysis are under progress. Two sites have been identified at present for development of project. Out of the two sites, preferable site is located at Village Chaukiya, Ghazipur. This site is located on left bank of River Ganga (main channel) and downstream of NH-97. The site is agricultural land with no development or facilities or settlements on it. Area of the site identified is app. 22 ha. Site is well connected with road & railway. Depth of the channel is more than 2.5 m close to the shoreline. However, approach road will require to be constructed for connecting the terminal site to NH-19. Google map showing the site considered for development of terminal at Ghazipur is given in **Figure 2.9**.

Figure 2.9 : Proposed Terminal Site at Ghazipur

Table 2.12 : Implementation Time for Key Proposed Interventions

Sr. No.	Intervention Type	Construction/Implementation Time
1	Terminal	30 months
2	Lock	30 months
3	Maintenance Dredging	During Low flow time (6-8 months in year)

2.6. Applicable Legislation and World Bank Operational Policies

There are four World Bank operational policies applicable to NW-1. These are listed at **Table 2.13.** Required mitigation measures have been incorporated in project design/Environmental management plans.

Table 2.13 : Salient World Bank Safeguard Policies

Name	Key Requirement	Applicability	Remarks
OP 4.01 Environmental Assessment	Ensures sustainability and environmental feasibility of the project. Projects are classified into A, B & C category depending on the nature and extent of the impact.	Triggers	Project classified as Category A considering nature of activities and impacts
OP 4.04 Natural habitats	Ensures conservation of natural habitats and discourages disturbance of nay natural habitat due to project development by recommending adoption of alternative method/route/approach or	Triggered	Triggered for Sahibganj & Varanasi Terminal Projects. No other project is in close vicinity of such endangered or protected environment

Name	Key Requirement	Applicability	Remarks
	adopting management measures		
OP 4.36 Forests	Ensures that project activities donot disturbs/interfere with the forest, forest dwellers activities, fauna and flora of the forest. Prevents and discourages deforestation and impacts on rights of forest dependent people.	Triggers	No diversion of forest land is involved however large number of tree cutting is involved. Permission will be required for felling these trees from forest department.
OP 4.12 Involuntary Resettlement	Ensures minimal involuntary resettlement by considering feasible alternatives project design, assisting displaced people to improve their former living standard.	Triggers	Applicable for facilities which involves land acquisition like Sahibganj terminal, Varanasi terminal etc.
OP 4.10 Indigenous people	Ensures protection of the dignity, right and cultural uniqueness of indigenous people and ensures they receive social and economic benefits	Triggers	No indigenous group of people will be affected directly by project, however ST population is residing within 10 km radius area of the Sahibganj terminal.
OP 4.11 Physical Cultural Resources	Ensures preservation of property of cultural and religious importance, heritage and property of natural importance and enhancement of cultural properties	Triggers	Applicable for Sahibganj terminal project as it involves shifting of one of the community temple which exists at the site. It may be applicable for other sites for civil interventions which are under planning and identification
OP 7.5 Projects on International Waterways	Projects on international waterways may affect the relations between the World Bank and its borrowers, and between riparian states. Therefore, the Bank attaches great importance to the riparian making appropriate agreements or arrangements for the entire waterway, or parts thereof, and stands ready to assist in this regard. A borrower must notify other riparian of planned projects that could affect water quality or quantity, sufficiently far in advance to allow them to review the plans and raise any concerns or objections	Triggered	NW-1 traverse through Farakka canal to Hoogly River and does not affect or change the water treaty between India and Bangladesh in any way. However due to movement of vessels in River Ganga in Farakka area which is part of international riparian treaty between India & Bangladesh, this policy is considered triggered with a view to give advance intimation of NW-1 plans of this area to Bangladesh

World Bank's operational policy 4.01 (OP 4.01) categorize the project into Category A, B & C on the basis of nature and extent of the impacts anticipated from the project. Scope of Environmental assessment studies depends on the category in which the project falls and is defined below.

Category A - Projects with significant environmental impacts and requiring a full Environmental Assessment (EA),
Category B - Projects with moderate environmental impacts and requiring a lesser level of environmental assessment,
Category C - Projects which require no environmental analysis.

India has well defined environmental and social legislation framework. Applicability of these regulations depends on nature of project and activities. The summary of various Laws and Regulation applicable to NW-1 project is summarized at **Table 2.14**.

The Government of India (GOI) has detailed legislative framework imposing various restrictions for developments of inland & water areas. The attempt has been made to summarize the legislations which will determine the No Go/restriction areas for project foot prints.

The key legislations are
1. Wildlife Protection Act
2. Forest Conservation Act
3. Environmental Protection Act
4. Ancient Monuments and Archaeological Sites and Remains Act

Various national parks & sanctuaries are notified under above acts which impose ban of any activities without following a defined clearance process going up to Supreme Court level. Such areas have been considered as no go areas wherever applicable in the basin and project intervention areas. Other areas identified like reserve forest, Hilsa sanctuaries are also notified but with much lesser degree of restrictions.

Table 2.14 : Key Environmental Legislation at a Glance

Name	Key Requirement	Likely Applicability	Controlling Authorities
Acts/Rules			
Environment Protection Act-1986 and Rules there under including EIA Notification 14th Sep 2006 and amendment till date	To protect and improve overall environment	Considered Not Applicable (EIA Notification 2006 does not classify terminals/jetties/ floating terminals on river or dredging in the river as a project requiring environmental clearance. The applicability of this legislation should be re-assessed periodically from the concerned authority during NW-1 project development and implementation stages to ensure conformity with changes in the regulations if any).	MoEFCC/SEIAA

Name	Key Requirement	Likely Applicability	Controlling Authorities
Acts/Rules			
		Borrowing of earth for road construction as may be required, will require prior environment clearance under mining category.	
The Forest (Conservation) Act, 1980 and amendments The Forest (conversion) Rules 1981 and amendments	To protect forest by restricting conversion of forested areas into non- forested areas and deforestation	Applicable if forest land is diverted or tree cutting is involved.	Forest Department, MoEFCC
Wild Life Protection Act, 1972	To protect wildlife through notifying National Parks and Sanctuaries and buffer areas around these zones	Applicable, project passes through the sanctuary area or its eco sensitive zone.	Sate Wild Life Departments and MoEFCC
Air (Prevention and Control of Pollution) Act, 1981	To control air pollution Pollutants from the construction and operation activities	Applicable for construction activities like setting up hot mix plants, batching plants	SPCB
Water Prevention and Control of Pollution) Act, 1974	To control water pollution Pollutants from the construction and operation activities	Applicable for construction activities for setting up construction camps involving discharges of liquid waste	SPCB
Noise Pollution (Regulation and Control Act) 2000 and amendment till date	The standards for noise for day and night have been promulgated by the MoEFCC for various land uses.	Applicable for all construction and operation phase activities	SPCB/MoEFCC
Hazardous Wastes (Management Handling and Trans-boundary) Rules, 2008 .	The rules prescribe the details of management of hazardous industrial solid wastes from its generation to final disposal (cradle to grave) and fixes responsibilities on the generator, the	Applicable for managing hazardous waste that can be generated during construction & operation phase	SPCB

Name	Key Requirement	Likely Applicability	Controlling Authorities
Acts/Rules			
	transporter and the disposal agent.		
Ancient Monuments and Archaeological Sites and Remains Act, 1958	Conservation of cultural and historical remains found in India	Applicable for river stretches located within 300 m of such monument	Archaeological Dept.
Explosive Act 1984	Safe transportation, storage and use of explosive material	Applicable only if large quantity of fuel is stored.	Chief Controller of Explosives
Central Motor Vehicle Act 1988 Central Motor Vehicle Rules, 1989 and amendments till date	To check vehicular air and noise pollution.	Applicable, for construction vehicles	Motor Vehicle Department
Prevention of Collision on national Waterways Regulations, 2002	Regard to precautions required by the ordinary practice of Seamen and limitation of the vessel	Applicable for development of the terminal for all the vessel plying in National Waterway	IWAI
National Waterways, Safety of Navigation and Shipping Regulations, 2002	ensuring safety of navigation and shipping on the national waterways	Applicable for development of the terminal for all the vessel plying in National Waterway	IWAI
The National Waterway-1 Act, 1982	Provision for regulation and development of that river for purpose of shipping and navigation on the NW-1 and for the matters connected therewith or incidental thereto	Applicable for development of the terminal for all the vessel plying in National Waterway	IWAI
New Inland Vessel Act, 2015 & Rules Under IV Act	Economical and safe transportation through inland waters	Applicable for development of all the vessel plying in National Waterway	IWAI

2.6.2. International Conventions, Protocols and Agreements

International Maritime Organization Conventions: India is member state of the International Maritime Organization (IMO). Therefore, all activities relating to shipment through the port shall have to be done strictly in compliance with the standards set by the IMO, particularly the conventions, protocols and agreements. IMO Conventions/ Protocols related to environment & pollution are given in **Table 2.15** for reference purposes and inputs for design requirement.

The World Bank Operation Policies are also applicable to the project but are not summarized here as these would be followed while developing the mitigation measures in the EIA reports.

Table 2.15 : International Maritime Conventions, Protocols and Agreements

Sr. No.	Issues	International Maritime Conventions, Protocols and Agreements	Remarks
1.	Maritime safety	SOLAS Convention, 1974	The SOLAS Convention in its successive forms is generally regarded as the most important of all international treaties concerning the safety of merchant ships. The 1974 version includes the tacit acceptance procedure - which provides that an amendment shall enter into force on a specified date unless, before that date, objections to the amendment are received from an agreed number of Parties. The Convention came into force on May 25, 1980
2.	Measurement of ships	Load Lines Convention,1966	It has long been recognized that limitations on the draught to which a ship may be loaded make a significant contribution to her safety. These limits are given in the form of freeboards, which constitute, besides external weather tight and watertight integrity, the main objective of the Convention.
3.	Preventing collisions at sea	Convention on International Regulations for Preventing Collisions at Sea (COLREG), 1972	The 1972 Convention was designed to update and replace the Collision Regulations of 1960 which were adopted at the same time as the 1960 SOLAS Convention. One of the most important innovations in the 1972 COLREGs was the recognition given to traffic separation schemes - Rule 10 gives guidance in determining safe speed, the risk of collision and the conduct of vessels operating in or near traffic separation schemes.
4.	Prevention of Pollution from Ships	International Convention for the Prevention of Pollution from Ships (MARPOL), 1973, as modified by the Protocol of 1978 relating thereto and by the Protocol of 1997(MARPOL)	The MARPOL Convention is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. It is a combination of two treaties adopted in 1973 and 1978 respectively and also includes the Protocol of 1997 (Annex VI). It has been updated by amendments through the years.
		Convention on Facilitation of International Maritime Traffic (FACILITATION), London, 1965	The Convention's main objectives are to prevent unnecessary delays in maritime traffic, to aid cooperation between Governments, and to secure the highest practicable degree of uniformity in formalities and other procedures. In particular, the Convention reduces the number of declarations which can be required by public authorities.
5.	Safety of maritime navigation	Convention for The Suppression of Unlawful Acts of Violence Against the Safety of Maritime Navigation (SUA	The main purpose of the convention is to ensure that appropriate action is taken against persons committing unlawful acts against ships. These include: • the seizure of ships by force; • acts of violence against persons on board ships; and

Sr. No.	Issues	International Maritime Conventions, Protocols and Agreements	Remarks
		convention), 1988	• the placing of devices on board a ship which are likely to destroy or damage it. The convention obliges Contracting Governments either to extradite or prosecute alleged offenders.
6.	Environmental Safety	Convention Relating to Intervention on the High Seas, 1969	Contracting States are empowered to act against ships of other countries which have been involved in an accident or have been damaged on the high seas if there is a grave risk of oil pollution occurring as a result.
7.	Standards of Training, Certification and Watch keeping for Seafarers	International Convention on Standards of Training, Certification and Watch keeping for Seafarers (STCW) as amended, including the 1995 and 2010 Manila Amendments	The main purpose of the convention is to ensure the safety of seagoing personnel. Convention in explained in two codes A & B. Code A is mandatory while Code B is recommendation. It intends to help parties implement the convention.
8.	Safe containers	International Convention for Safe Containers (CSC) 72/77	The 1972 Convention for Safe Containers has two goals. • to maintain a high level of safety of human life in the transport and handling of containers by providing generally acceptable test procedures and related strength requirements • to facilitate the international transport of containers by providing uniform international safety regulations, equally applicable to all modes of surface transport to avoid proliferation of divergent national safety regulations The requirements of the Convention apply to the great majority of freight containers used internationally, except those designed especially for carriage by air. As it was not intended that all containers or reusable packing boxes should be affected, the scope of the Convention is limited to containers of a prescribed minimum size having corner fittings - devices which permit handling, securing or stacking.
9.	Safety of Fishing vessel	The Torremolinos International Convention for the Safety of Fishing Vessels (SFV),1977,	The Protocol applies to fishing vessels of 24 metres in length and over including those vessels also processing their catch. The general trend in modern designed fishing vessels, if they are to be economically profitable, must include improvements in machinery and fishing gear, improvements in safety features as

Sr. No.	Issues	International Maritime Conventions, Protocols and Agreements	Remarks
		superseded by the The 1993 Torremolinos Protocol; Cape Town Agreement of 2012 on the Implementation of the Provisions of the 1993 Protocol relating to the Torremolinos International Convention for the Safety of Fishing Vessels	a whole and better working conditions for fishermen. The safety provisions include automatically controlled machinery spaces, improved life-saving appliances, immersion suits and thermal protective aids, satellite communication systems and other components of the global maritime distress and safety system.
10.	Standards of Training, Certification and Watch keeping for Fishing Vessel Personnel	International Convention on Standards of Training, Certification and Watch keeping for Fishing Vessel Personnel (STCW-F), 1995	General Provisions & certifications of Safety of Skippers, Officers, Engineer Officers and Radio Operators.
11.	Space Requirements for Special Trade Passenger Ships, 1973	Special Trade Passenger Ships Agreement (STP), 1971 and Protocol on Space Requirements for Special Trade Passenger Ships, 1973	Following the International Conference on Special Trade Passenger Ships, 1971, IMO, in cooperation with other Organizations, particularly the World Health Organization (WHO), developed technical rules covering the safety aspects of carrying passengers on board in special trade passenger ships (ships carrying large nos. of unberthed passengers such as in pilgrim area)
12.	Prevention of Marine Pollution by Dumping of Wastes and Other Matter	Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (LC), 1972 (and the 1996 London Protocol)	London Convention, one of the first international conventions for the protection of the marine environment from human activities, came into force on 30 August 1975. Since 1977, it has been administered by IMO. It contributes to the international control and prevention of marine pollution by prohibiting the dumping of certain hazardous materials. In addition, a special permit is required prior to dumping of a number of other identified materials and a general permit for other wastes or matter.
13.	Oil Pollution Preparedness, Response and Co operation	International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC), 1990	As per convention, Ships are required to carry a shipboard oil pollution emergency plan. Operators of offshore units under the jurisdiction of Parties are also required to have oil pollution emergency plans or similar arrangements which must be coordinated with national systems for responding promptly and effectively to oil pollution incidents. Ships are required to report incidents of pollution to coastal authorities and the

Sr. No.	Issues	International Maritime Conventions, Protocols and Agreements	Remarks
			convention details the actions that are then to be taken. The Convention calls for the establishment of stockpiles of oil spill combating equipment, the holding of oil spill combating exercises and the development of detailed plans for dealing with pollution incidents. Parties to the convention are required to provide assistance to others in the event of a pollution emergency and provision is made for the reimbursement of any assistance provided.
14.	Preparedness, Response and Co-operation to pollution Incidents by Hazardous and Noxious Substances	Protocol on Preparedness, Response and Co-operation to pollution Incidents by Hazardous and Noxious Substances, 2000 (OPRC-HNS Protocol)	Convention aims to establish national systems for preparedness and response and to provide a global framework for international co-operation in combating major incidents or threats of marine pollution. Parties to the OPRC-HNS Protocol are required to establish measures for dealing with pollution incidents, either nationally or in co-operation with other countries. Ships are required to carry a shipboard pollution emergency plan to deal specifically with incidents involving hazardous and noxious substances. The OPRC-HNS Protocol ensures that ships carrying hazardous and noxious substances are covered by preparedness and response regimes similar to those already in existence for oil incidents.
15.	Control of Harmful Anti-fouling Systems	International Convention on the Control of Harmful Anti-fouling Systems on Ships (AFS), 2001	Under the terms of the AFS Convention, Parties to the Convention are required to prohibit and/or restrict the use of harmful anti-fouling systems on ships flying their flag, as well as ships not entitled to fly their flag but which operate under their authority and all ships that enter a port, shipyard or offshore terminal of a Party. Anti-fouling paints are used to coat the bottoms of ships to prevent sealife such as algae and molluscs attaching themselves to the hull – thereby slowing down the ship and increasing fuel consumption. n the early days of sailing ships, lime and later arsenic were used to coat ships' hulls, until the modern chemicals industry developed effective anti-fouling paints using metallic compounds. These compounds slowly "leach" into the sea water, killing barnacles and other marine life that have attached to the ship. But studies have shown that these compounds persist in the water, killing sea-life, harming the environment and possibly entering the food chain. One of the most effective anti-fouling paints, developed in the 1960s, contains the organotin tributyltin (TBT), which has been proven to cause deformations in oysters and sex changes in whelks.
16.	Safe and Environmentally	The Hong Kong International Convention	Convention aimed at ensuring that ships, when being recycled after reaching the end of their operational lives, do not pose any unnecessary risk to human health

Sr. No.	Issues	International Maritime Conventions, Protocols and Agreements	Remarks
	Sound Recycling of Ships	for the Safe and Environmentally Sound Recycling of Ships, 2009	and safety or to the environment. It intends to address all the issues around ship recycling, including the fact that ships sold for scrapping may contain environmentally hazardous substances such as asbestos, heavy metals, hydrocarbons, ozone depleting substances and others. It will address concerns about working and environmental conditions in many of the world's ship recycling facilities. Regulations in the new Convention cover: the design, construction, operation and preparation of ships so as to facilitate safe and environmentally sound recycling, without compromising the safety and operational efficiency of ships; the operation of ship recycling facilities in a safe and environmentally sound manner; and the establishment of an appropriate enforcement mechanism for ship recycling, incorporating certification and reporting requirements. Ships to be sent for recycling will be required to carry an inventory of hazardous materials, which will be specific to each ship.
17.	Control and Management of Ships' Ballast Water and Sediments	International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004	Convention aims to prevent the spread of harmful aquatic organisms from one region to another, by establishing standards and procedures for the management and control of ships' ballast water and sediment. Under the Convention, all ships in international traffic are required to manage their ballast water and sediments to a certain standard, according to a ship-specific ballast water management plan. All ships will also have to carry a ballast water record book and an international ballast water management certificate. The ballast water management standards will be phased in over a period of time. As an intermediate solution, ships should exchange ballast water mid-ocean. However, eventually most ships will need to install an on-board ballast water treatment system
18.	Salvage Convention, 1989	International Convention on Salvage (SALVAGE), 1989	As per convention, "special compensation" to be paid to salvors who have failed to earn a reward in the normal way (i.e. by salving the ship and cargo). The compensation consists of the salvor's expenses, plus up to 30% of these expenses if, thanks to the efforts of the salvor, environmental damage has been minimized or prevented. The salvor's expenses are defined as "out-of-pocket expenses reasonably incurred by the salvor in the salvage operation and a fair rate for equipment and personnel actually and reasonably used".
19.	The United Provinces Fisheries Act, 1948	The Fisheries Act provides for the	Definition of fish is a broad one under the Act and includes a wide gamut of aquatic biodiversity including “turtles, dolphins, aquatic plants, fisheries, whale

Sr. No.	Issues	International Maritime Conventions, Protocols and Agreements	Remarks
		prohibition and licensing of fishing in selected waters.	and fish in all states in its life history". For the purposes of regulating fishing, the rules made under this Act provides for selected waters where there is prohibition for fishing. However, this excludes 'private waters' 4and 'religious waters'5. The authority constituted under this Act has been vested with power of arrest without warrant, compound certain offences as well as prohibit the sale of fish in such area as may be specified.

[4] *Private waters are exclusive property of any person or religious body or institution where such persons or institution has exclusive right of fishery.*
[5] *Religious water means water belonging to a religious body or institutions and which have never been fished before on account of any restrictions on religious grounds.*

2.7. Other Convention and Policies

International Maritime Dangerous Goods Code (IMDG-code): The IMDG code relates to methods of safe transport of dangerous cargoes and related activities. It sets out procedures for documentation, storage, segregation, packing, marking and labelling of dangerous goods.

2.8. Conclusion

NW-1 project offers potential opportunity for diversification of cargo movement from road & rail to waterways. In order to achieve this diversification, the existing infrastructure needs to be augmented with proposed project interventions. These proposed interventions consisting of both development & operation of navigation route require availability of water (depth) & its maintenance supported by new infrastructure. Further, these activities will trigger indirect & induced development in the influence area. Therefore, NW-1 development along with these existing, direct, indirect & induced developments will have cumulative impact in the influence area.

Chapter 3. : DELINEATION OF CIA BOUNDARY AND CERs

3.1. Introduction

Proposed NW1 is expected to enhance the economic development of the country by increasing the freight transportation substantially. The NW-1 will provide the accessibility to the areas through which it traverses and the nearby areas and this activity will lead to development and growth of these areas. This necessitates that study area size should be based on the extent of the area where accessibility improvements could occur and may require some judgments about the extent of the influence of the project. Therefore, Cumulative Impact Assessment (CIA) requires fixation of spatial and temporal boundaries in order to assess the impacts of direct, indirect and induced activities due to proposed project. Process of delineation of boundary largely depends upon the type of development & its potential to exhibit direct & indirect impacts on the surrounding environment. The following sections describe the CIA boundary, the rationale & basis of its delineation, CERs within the delineated boundaries, and hot spots identified.

3.2. Delineation of the CIA Boundary

Important factors which need to be considered for proposed assessment of indirect and cumulative impacts and impact interactions is the setting of the geographical or 'spatial' boundary and the temporal or 'time frame' boundary. Indirect and direct impacts as well as impact interactions may well extend beyond the geographical site boundaries of the project. Therefore, preferred methodology for detailed analysis is a combination of collaborative judgment and GIS based allocation mode as described in chapter 1. Hence, mapping the geographical and time boundaries provides areas of potential overlap and therefore where indirect and cumulative impacts as well as impact interactions may occur.

The boundary delineation exercise identifies the potential impacts considered to be significant and which require further assessment. In this study all the natural as well as manmade features have been taken into account and plotted spatially to delineate the boundary of the CIA. The natural and manmade features mapped are as follows:

- Forests;
- National parks;
- Wild Life Sanctuaries;
- Tiger Reserves;
- Birds Areas;
- Archaeological sites;
- Water bodies;
- Wetlands;
- Roads;
- Railways;
- Urban Agglomerations;
- Industrial Areas;
- Thermal Power Plants
- Critically Polluted Areas, based on Comprehensive Environmental Pollution Index (CEPI)

To conduct the detailed study of the project, 10km buffer (Influenced area) boundary has been considered. The basis for delineating these buffer boundaries are based on the EIA /

SIA (NW-1 / terminals / maintenance dredging) basin level CER reports as the influence area EIA report, IFC guidelines and stakeholders consultations and the expert's consultation/ judgment.

10 kms buffer – It is being considered that the extent of area of influence of the project may not go upto 10 kms as per the expert's and stakeholder's consultations. Therefore, the farthest distance covered in the CIA boundary is 10 kms.

3.3. Critical Environmental Resources (CERs)

CERs are environmental attributes that are considered to be important in assessing risks. While CERs may be directly or indirectly affected by a specific development, they often are also affected by the cumulative effects of several developments. CERs are the ultimate recipient of impacts because they tend to be at the ends of ecological pathways. CERs in general refer to sensitive or valued receptors of impact whose desired future condition determines the assessment end points to be used in the CIA process.

3.3.1. Approaches for Identification of CERs

To identify the CERs for CIA study, it is possible to largely obtain cumulative opinions of various stakeholders which are directly & indirectly impacted due to proposed development, and extensive review of the existing environmental and social impact assessment studies of the proposed project. Approach followed to identify CERs for purpose of CIA study is shown in Figure 3.1.

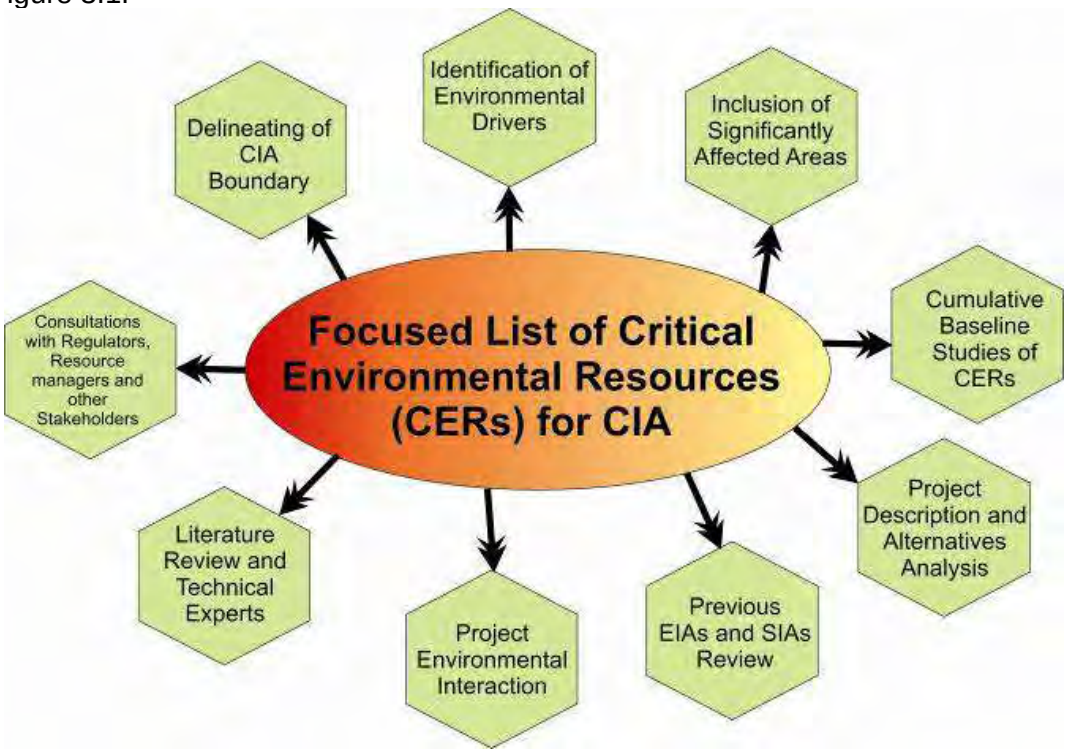

Figure 3.1 : Approach for CERs Identification

Source: Derived from IFC Guideline

3.3.2. Classification of CERs

Further, overlay mapping and GIS have been used for identifying the spatial distribution of CERs. Based on the above approach, mapping method as per IFC guidelines for Cumulative Impact Assessment and Management, CERs have been classified as given below.

• Physical features,

- Urban Agglomerations / Centers
- Land Resources

• Ecological Profile,

- Bio Diversity (Wildlife Sanctuaries/ National Parks / Tiger Reserves / Bird Areas / Wetlands)
- Agriculture

• Physical Environmental Profile (e.g., water and nutrient cycles, microclimate),

- Water
- Air
- Noise

• Socio Economic (e.g., health, economics), or

- Infrastructure
- Industry
- Power Plants

• Cultural aspects

- Archaeological / Heritage Sites

3.3.3. Identification of Indicators to Assess Conditions of CERs

To analyze the conditions and impact on identified CERs various indicators have been identified & analyzed. These indicators will help to identify the extent of impact on the identified CERs and assist in defining “Cause & Effect” relationship.

3.4. Assessment of Status of Identified CERs

An extensive study including the site visits, study of the project alignment through topographic maps & Google maps, review of existing studies and literature was carried out to assess the status of identified CERs within the CIA boundary of NW - 1. Details are given in Table 3.2 for NW-1.

Table 3.1 : Indicators of CERs

Sr. No.	Critical Environmental Resources		Indicators	References / Basis
1.	**Physical Features / Habitats**	**Urban Centers / Agglomerations**	Population	PCA U.P., Bihar, Jharkhand and West Bengal.
			Literacy	PCA U.P., Bihar, Jharkhand and West Bengal
		Land Resources	Soil Erosion	Experts / Stakeholders Secondary consultation / Literature Review / EIA (NW-1)
			Soil Quality	Experts / Stakeholders Secondary consultation / Literature Review / EIA (NW-1)
			Land Use Change	EIA / SIA (NW1 – 1)
2.	**Ecological Profile**	**Bio Diversity**	Impact on flora & fauna	EIA / SIA (NW1 - 1), IWAI
		Agriculture	Agricultural production	Experts / Stakeholders Secondary consultation / Literature Review / EIA (NW-1)
3.	**Physical Environmental Profile**	**Air**	Air Quality Index	Experts / Stakeholders Secondary consultation / Literature Review / EIA (NW-1)
		Noise	Noise Levels	Experts / Stakeholders Secondary consultation / Literature Review / EIA (NW-1)
		Surface Water / Ground Water	Water quality	Experts / Stakeholders Secondary consultation / Literature Review / EIA

Sr. No.	Critical Environmental Resources		Indicators	References / Basis
				(NW-1)
			Water Resources	Experts / Stakeholders Secondary consultation / Literature Review / EIA (NW-1)
		Micro Climate change	GHG	Experts / Stakeholders Secondary consultation / Literature Review / EIA (NW-1)
4.	**Socio Economic**	**Infrastructure**	Roads	Experts / Stakeholders Secondary consultation / Literature Review / EIA (NW-1)
			Traffic Congestion (Main Routes)	Experts / Stakeholders Secondary consultation / Literature Review / EIA (NW-1)
			Traffic Congestion (Feeder Routes)	Experts / Stakeholders Secondary consultation / Literature Review / EIA (NW-1)
			Rails	IWAI
			Quality of Life	Experts / Stakeholders Secondary consultation / Literature Review / EIA (NW-1)
		Industry	Number of Industries	UPSIDC, BSIDC, Jk DIC, WBIIDA
		Power Plants	Power production (Number)	CEAI, CERC, BEE (Websites)
5.	**Cultural Aspects**	**Archaeological Sites / Heritage Sites**	Impact on Archeological Monuments	Experts / Stakeholders Secondary consultation / Literature Review / EIA (NW-1)

Table 3.2 : Details of CERs and their Status within the CIA boundary (NW1)

Sr. No.	CERs in NW1		Upto 10 kms	Remarks
1	**Physical Features**	Urban Agglomerations / Centers	Varanasi, Kadipur, Ramnagar, Ghazipur, Saidpur, Buxar, Mokama, Barahiya, Munger, Bhagalpur , Sultanganj, Sahibganj Township, Rajmahal, Farakka Township, Baharampur, Katwa, Shantipur, Kalyani, Gayespur, Bhatpara, Halisahar, Mahestala, South Dum Dum, Bidhan Nagar, Budge Budge, Haldia, Nandigram, Mirzapur, Chunar, Dhanapur, Zamania, Gahmar, Chausa, Doriganj, Dighwara, Sitakund, Salapur, Narainpur, Barari, Palashgachhi, Jangipur, Jiaganj, Shaktipur, Dainhat, Patuli, Kalna, Guptipara, Bansberia, Chunchura, Naihati, Chandan Nagar, Ichhapur, Barrakpore, Serampore, Titagarh, Panihati, Bally, Phalta.	Landuse is varying constantly throughout the stretch.
		Land Resources (landuse)	Agricultural, habitation, Encroachment, Industrial	
2	**Ecological Profile**	Agriculture (yield)	Good to moderate	Agricultural yield may decrease, as a result of change in landuse.
		Bio Diversity (Wildlife Sanctuaries/ National Parks / Tiger Reserves / Bird Areas / Wetlands)	Kachhua Sanctuary, Vikramshila GDS, Udhwa Lake	
3	**Physical Environmental Profile (**Micro Climate)	Air Quality	Moderate / Critical	
		Noise Pollution	Critical	
		Vibrations	No impact	
		Water Quality	Moderate / Critical	
4	**Social Economic**	Infrastructure (Education, Health, Connectivity)	Improved social and physical infrastructure	The list of existing and proposed power plants along the districts through which NW1 crosses has been provided in Chapter – 3.
		Industrial Corridor (Proposed / Planned)		

Sr. No.	CERs in NW1		Upto 10 kms	Remarks
		Power Plants (Existing & Proposed)	Exist	
5	**Cultural Aspects**	Archaeological Sites		Area important due to archaeological perspective

3.5. Preliminary Identification of Hotspots

On the basis of the identified CERs, spatial analysis, literature review and study of the EIA & SIA Reports of the NW1 1, hotspots have been identified. This list will be further enhanced after addition of input from stakeholder consultation and baseline study of the CERs. From the primary desktop study, it is obvious that these areas are significantly going to be impacted and this has helped focusing on these areas while carrying out stakeholder consultation. Base map of identified hotspots and CERs in NW-1 are given in Table 3.3 and are also given in Figure 3.2 to 3.22.

Table 3.3 : Identified Major Hotspots

Sr. No.	Locations	CERs identified to be impacted majorly	Reasons for declaring Hotspot
1.	Allahabad	• Religious Value • River Bed Sediments	• Festival: Kumbh Mela
2.	Varanasi	• Land acquisition • Livelihood & Fishing Activities • Aquatic ecology • Terrestrial flora • Existing Infrastructure • Archaeological sites • Air Quality • River Bed Sediments • Noise level • Religious Value	• Rajghat floating terminal • Proposed Varanasi Terminal • Kashi Turtle Sanctuary • DFCCIL Connectivity at Varanasi Terminal
3.	Ghazipur	• Land acquisition • Livelihood • Aquatic ecology • Terrestrial flora • Existing Infrastructure • River Bed Sediments	• Proposed Terminal • Urban Area: Ghazipur
4.	Buxar	• Religious Values	• Existing floating terminal at Buxar • Urban Area: Buxar
5.	Patna	• Avifauna • Air Quality • Religious Value	• Low & High Level Jetty • Urban Area: Patna • Development of River Front
6.	Semaria	• Land acquisition • Livelihood • Aquatic ecology • Terrestrial flora • Existing Infrastructure • Religious value	• Existing Floating Terminal at Semaria • Proposed Terminal at Kalughat • Urban Area: Semaria, Doraiganj
7.	Munger	• Ground Water • Religious Values	• Existing Floating Terminal at Munger • Urban Area: Munger
8.	Bhagalpur	• Aquatic Ecology	• Existing Bhagalpur Terminal

		• Avifauna • Air Quality • Ground Water • Religious Values • Fishing Activities	• Vikramshila Gangetic Dolphin Sanctuary • Urban Area: Bhagalpur
9.	Khalgaon	• Aquatic Ecology • Avifauna • Air Quality • Religious Values	• Existing Bateshwarsthan Floating Terminal • Urban Area: Kahalgaon
10.	Sahibganj	• Land Use • Livelihood & Fishing Activities • Socio-economy • Aquatic ecology • Terrestrial flora • Existing Infrastructure • Religious Values	• Existing Samdhaghat terminal and proposed Sahibganj terminal • Construction of approach road to connect the terminal to NH-80 • Construction of railway siding to provide linkage with existing IR track • Existing Fishing Activities • Acquisition of Land, R& R and shifting of community temple • Cutting of app. 500 trees
11.	Rajmahal	• Archaeological sites • Religious Values	• Mining activities
12.	Mangalghat		• Existing floating terminal
13.	Lalbagh in Farakka to Murshidabad*	• Bank erosion • Air Quality • Existing Infrastructure • Fishing Activities	• Floating Terminal, Hazardwari, Existing RCC Jetty Pakur, U/s & D/s jetty, feeder canal, RCC jetty and old lock at Farakka • New lock Farakka • Urban Areas: Farakka, Murshidabad, Azimganj, Baranagar, Balia, Raghunathganj • Bagmari siphon
14.	Katwa to HooglyGhat	• Traffic • Air Quality • Aquatic Ecology • Existing infrastructure • Fishing Activities	• Floating Terminal Katwa, Floating Terminal Swarupganj, Floating Terminal Shantipur, Floating Terminal Tribeni • New proposed terminal at Tribeni • Urban Areas: Katwa, Swaroopganj, Nabadwip, Kalna, Balagarh, Kanchrapara, Hoogly • Increased traffic volume due to newly proposed terminal
15.	Maheshthala		• Existing BISN jetty, GR-1 & GR-2 and Botanical Garden Jetty • Urban areas: Mahesthala
16.	Haldia	• Ground water • Traffic • Air Quality • Religious Values • Aquatic ecology • Existing infrastructure • Fishing Activities	• Declared as critically polluted area but at present moratorium is lifted by MoEFCC • Declared notified zone by CGWB • Presence of Industrial Zone of Haldia Dock Complex • Operation of terminal would require dredging of 0.1-0.2 million cum • Existing floating terminal and proposed new terminal at Haldia

			• Shifting of ammonia pipeline of TATA chemicals and existing road to Mitsubishi Plant • Haldia Port & Shipping Activities • Haldia Dock Complex & Industrial Area • Urban areas: Haldia Town • Expected increased industrial development in existing industrial area and enhanced traffic movement

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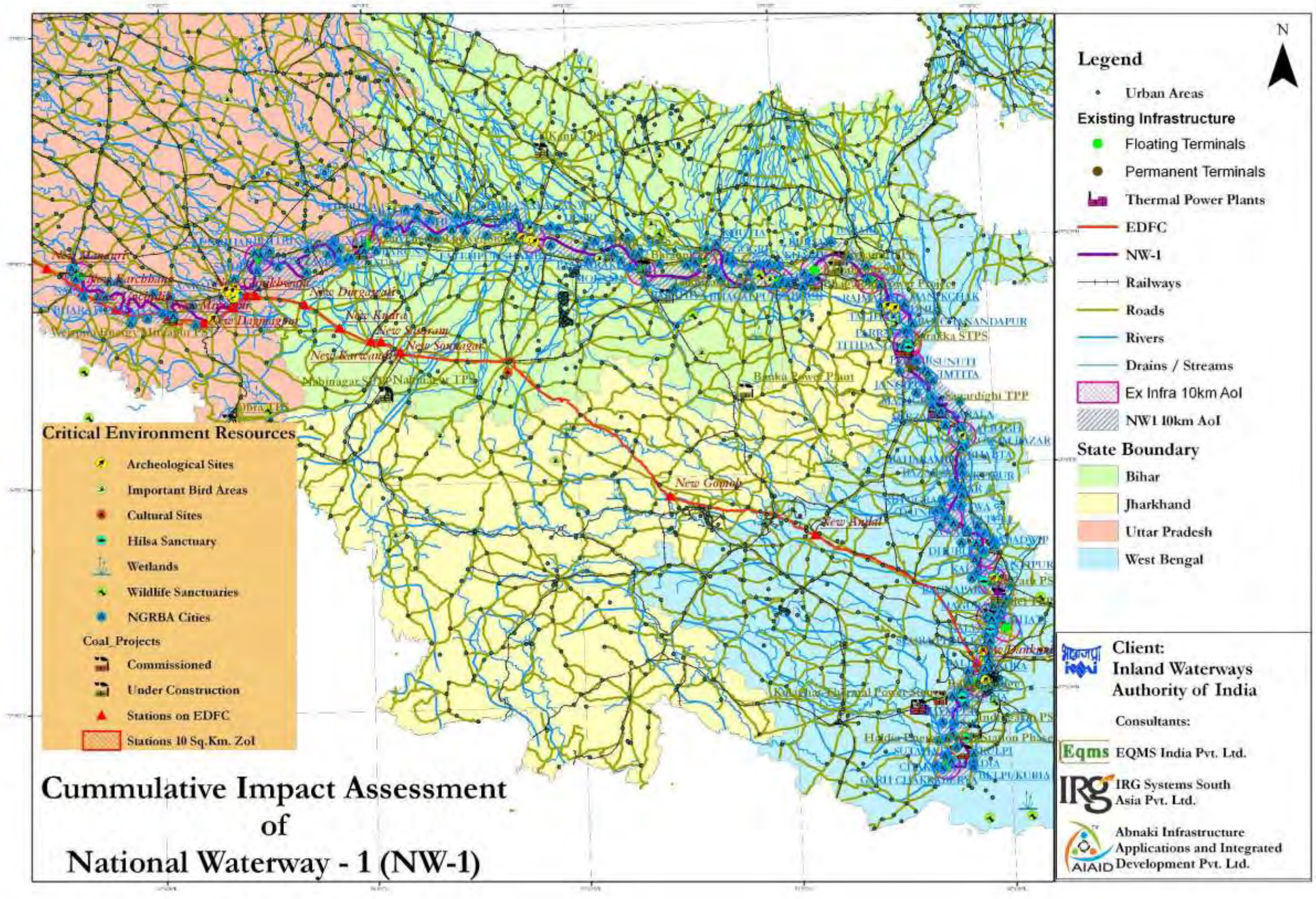


Figure 3.2 : Base Map of CERs in UP

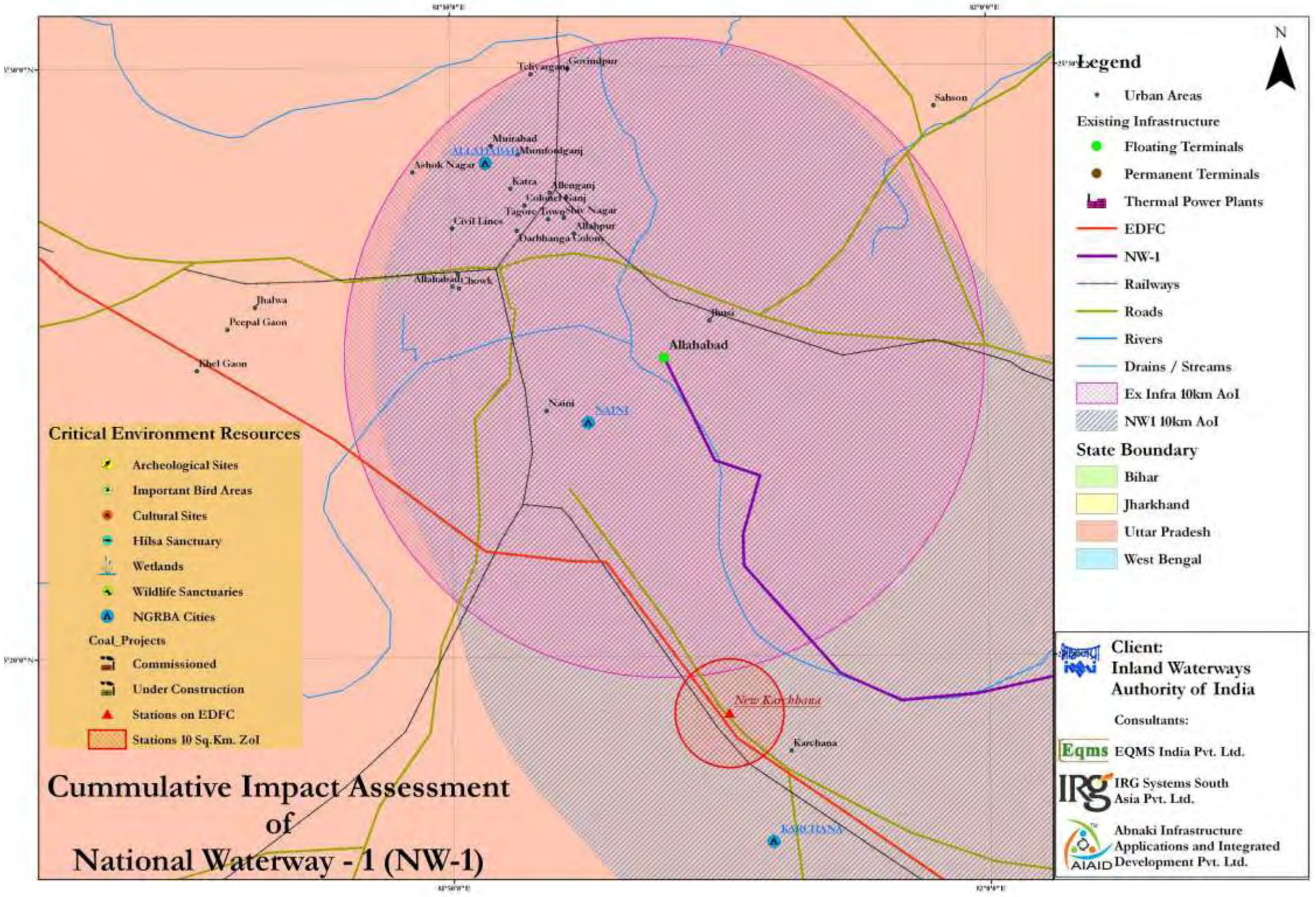


Figure 3.3 : CERs in Allahabad

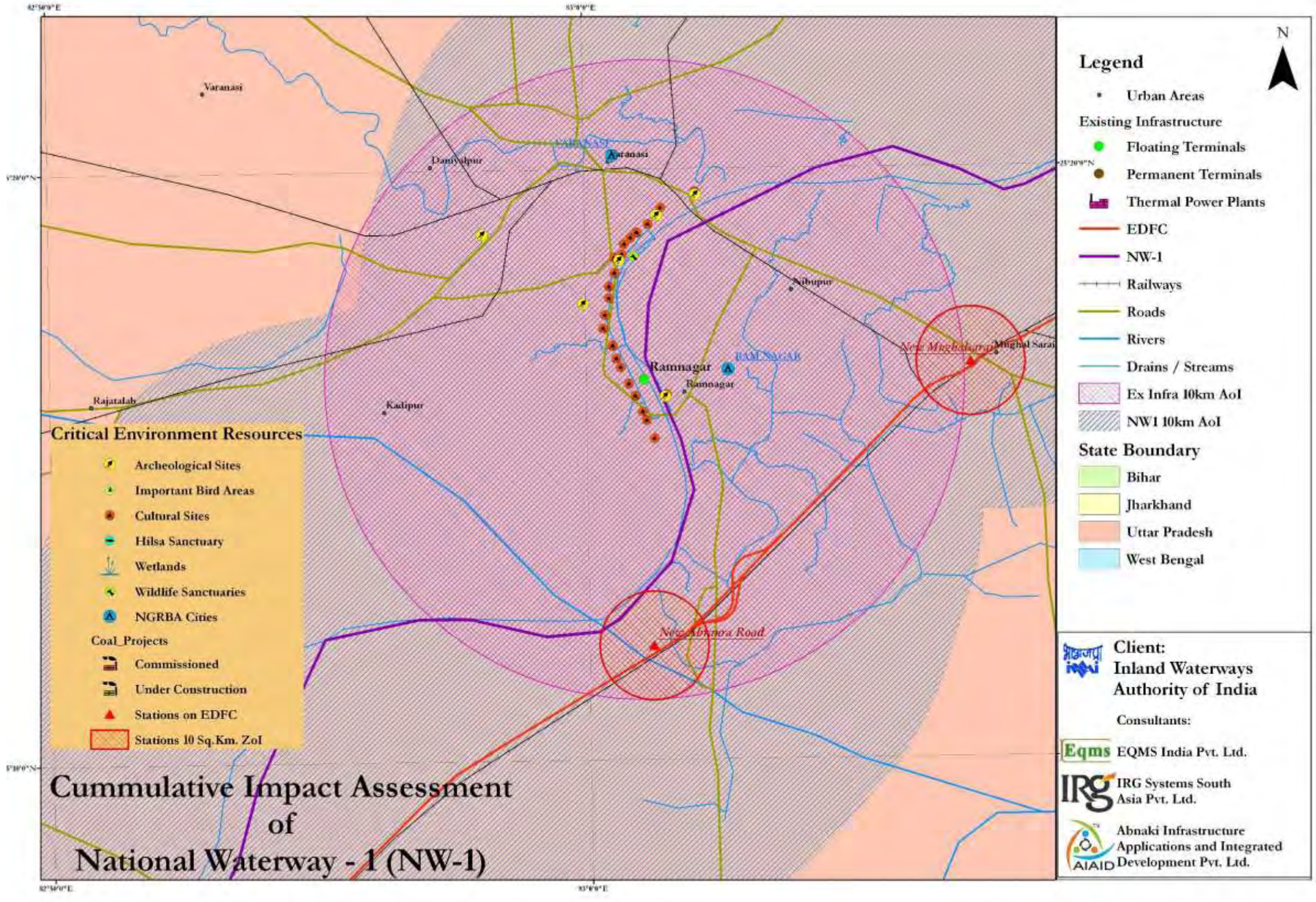


Figure 3.4 : CERs in Varanasi

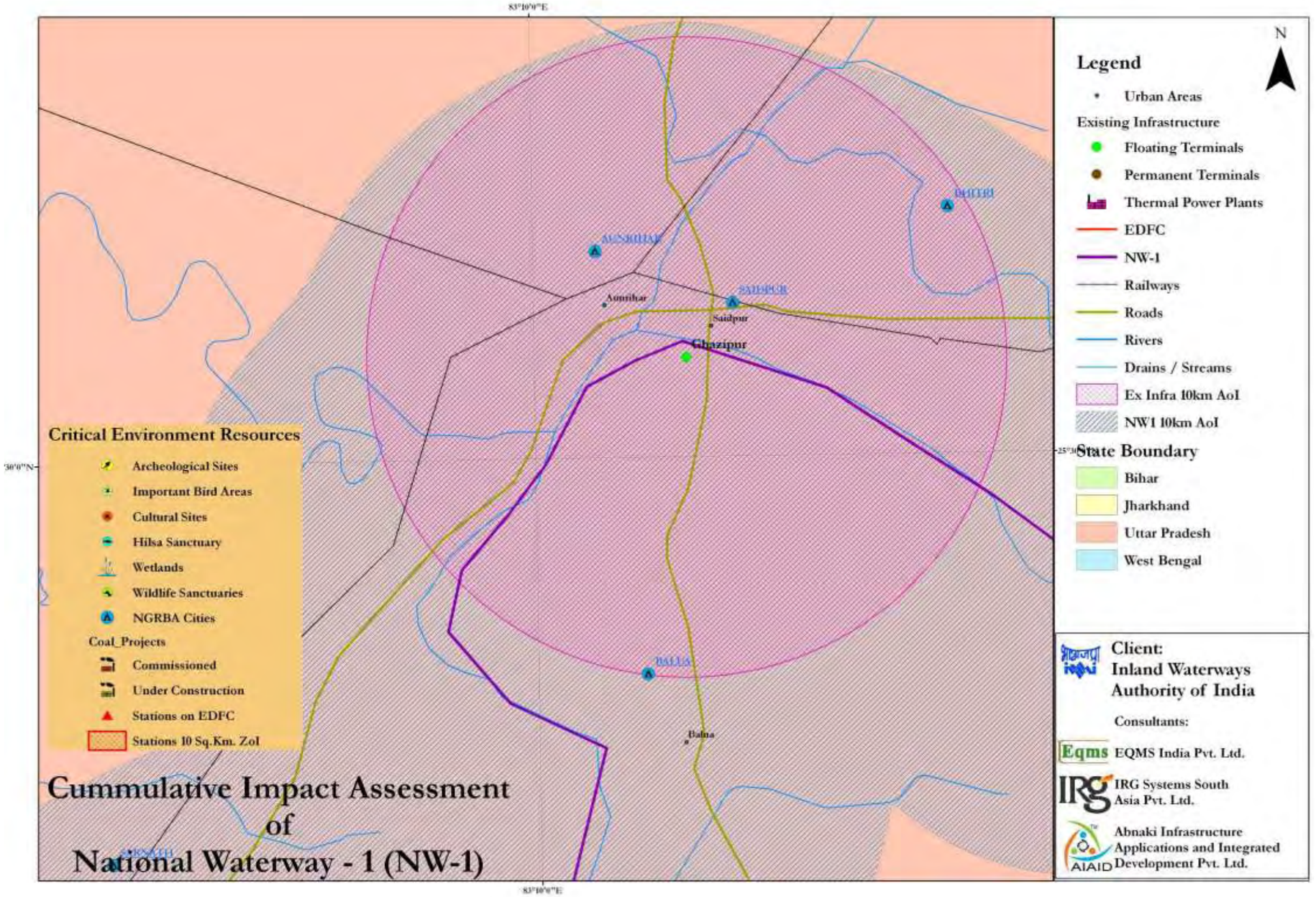


Figure 3.5 : CERs in Ghazipur

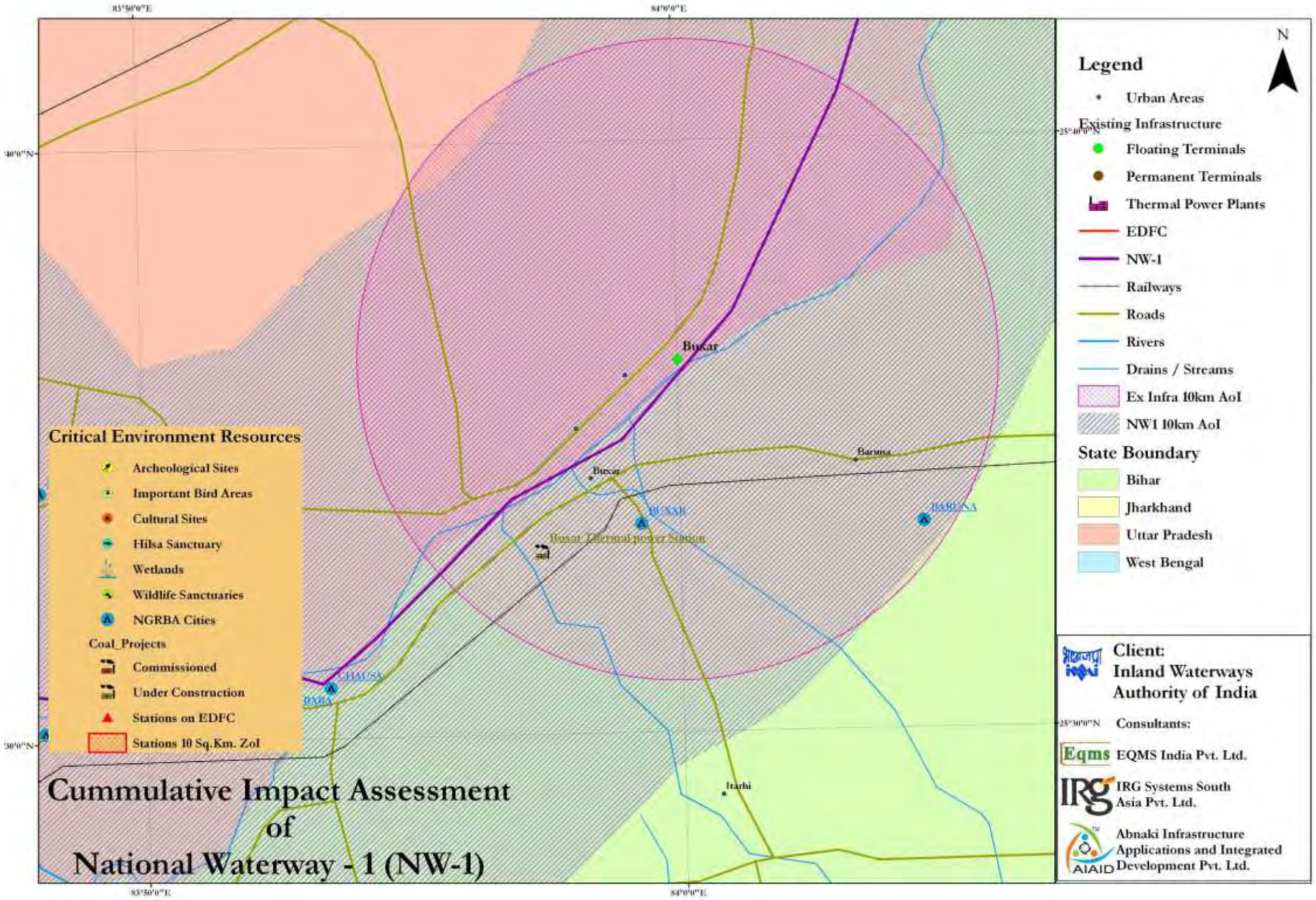


Figure 3.6 : CERs in Buxar

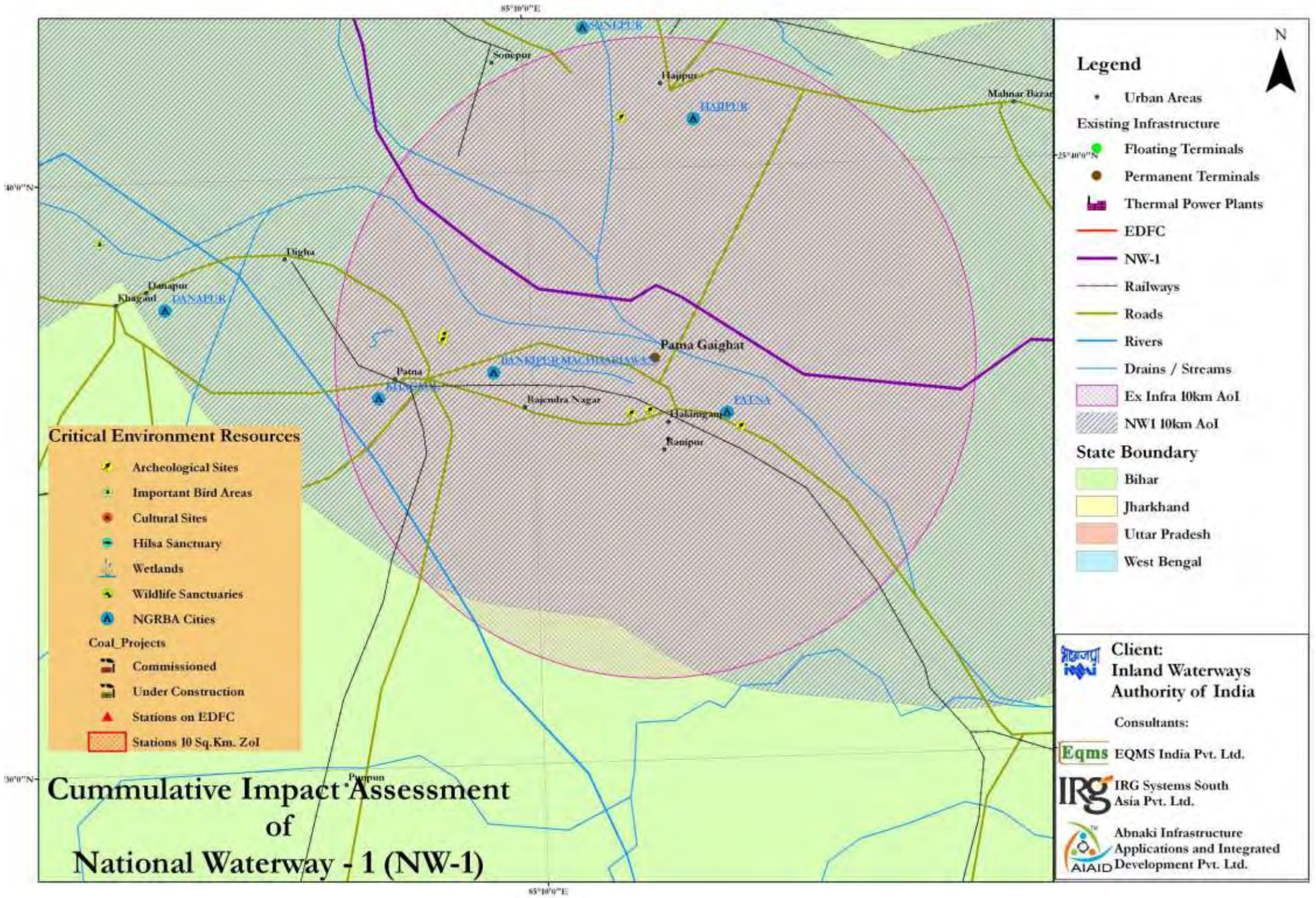


Figure 3.7 : CERs in Patna Gaighat

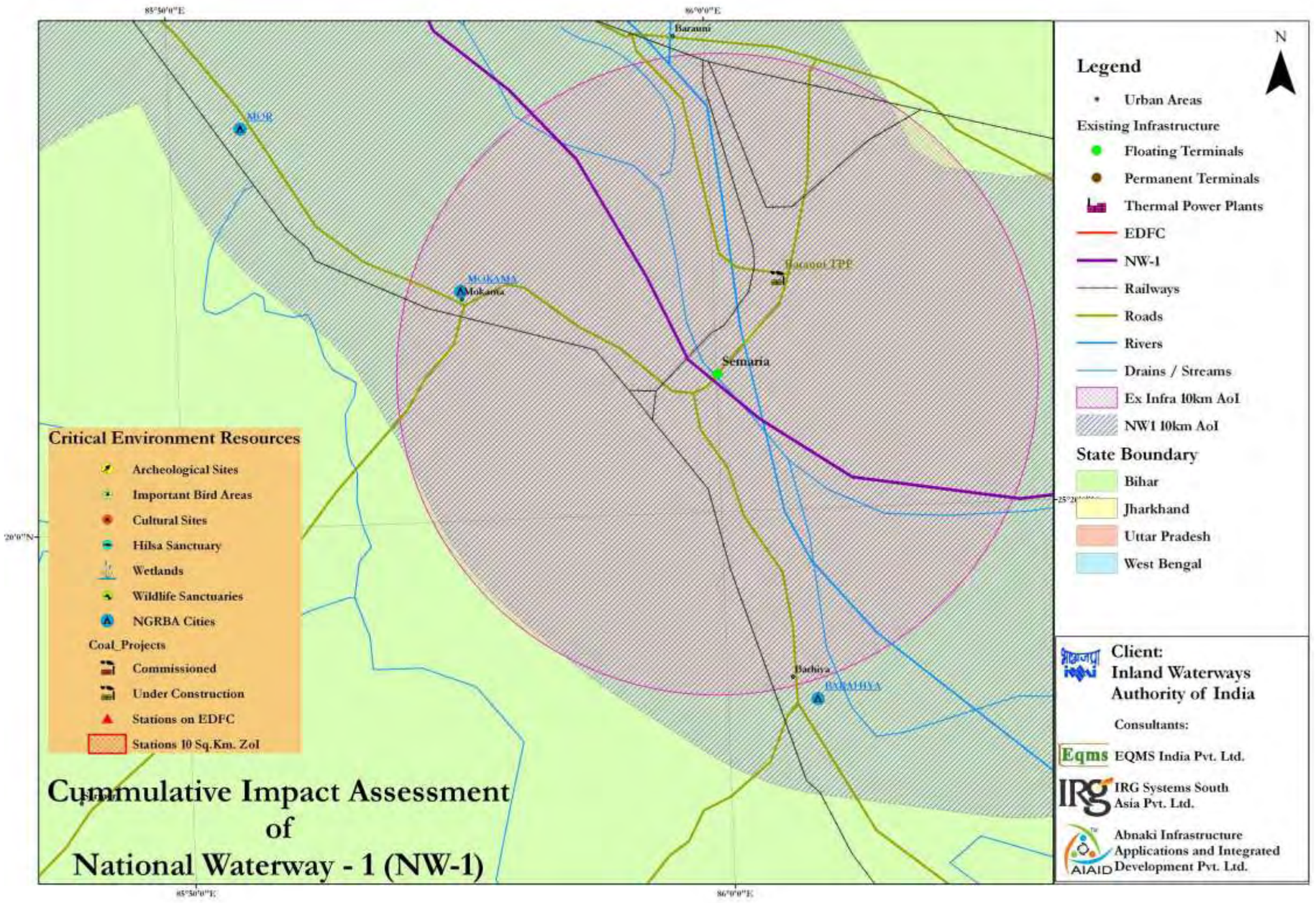


Figure 3.8 : CERs in Semaria

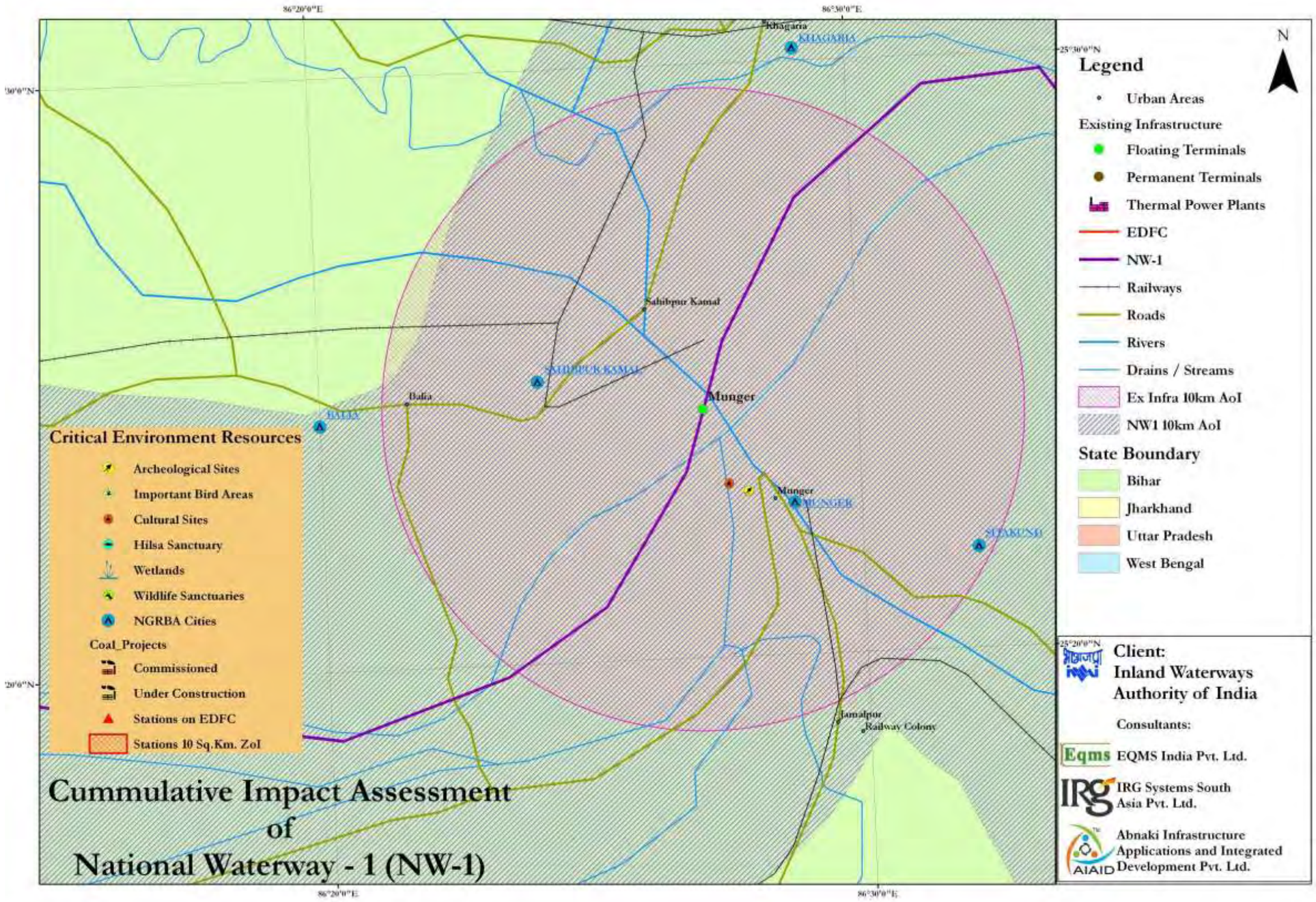


Figure 3.9 : CERs in Munger

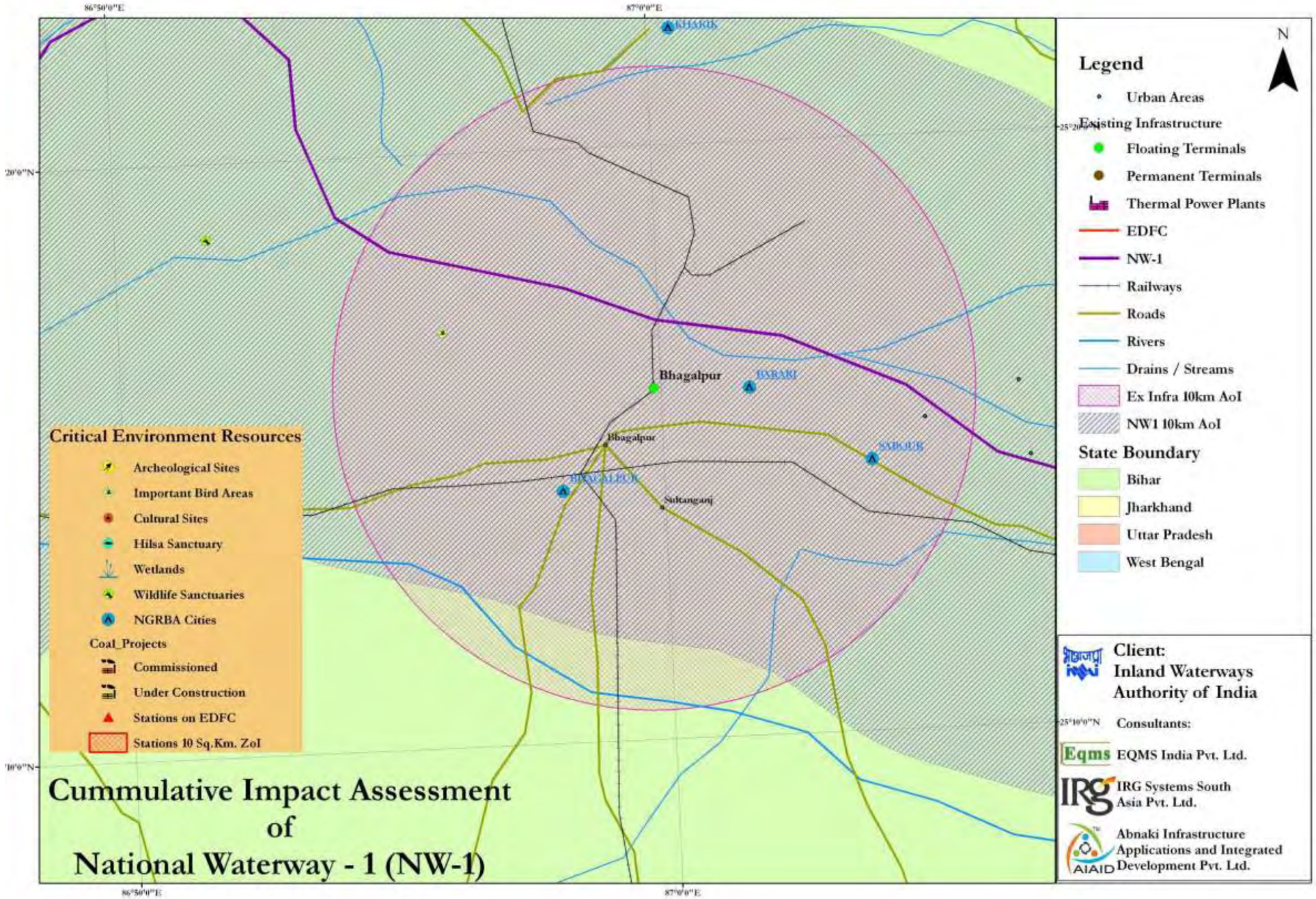


Figure 3.10 : CERs in Bhagalpur

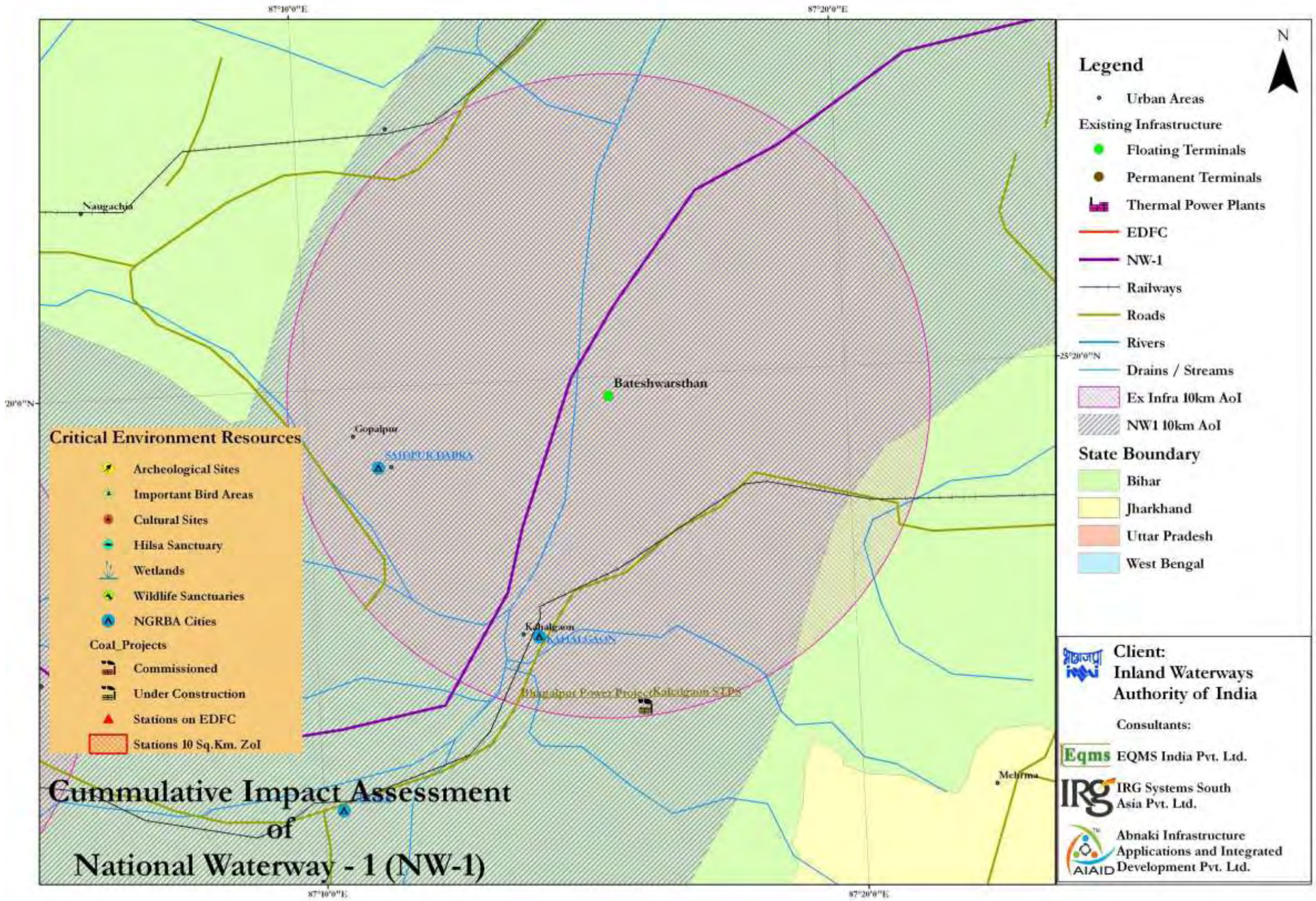


Figure 3.11 : CERs in Bateshwarsthan

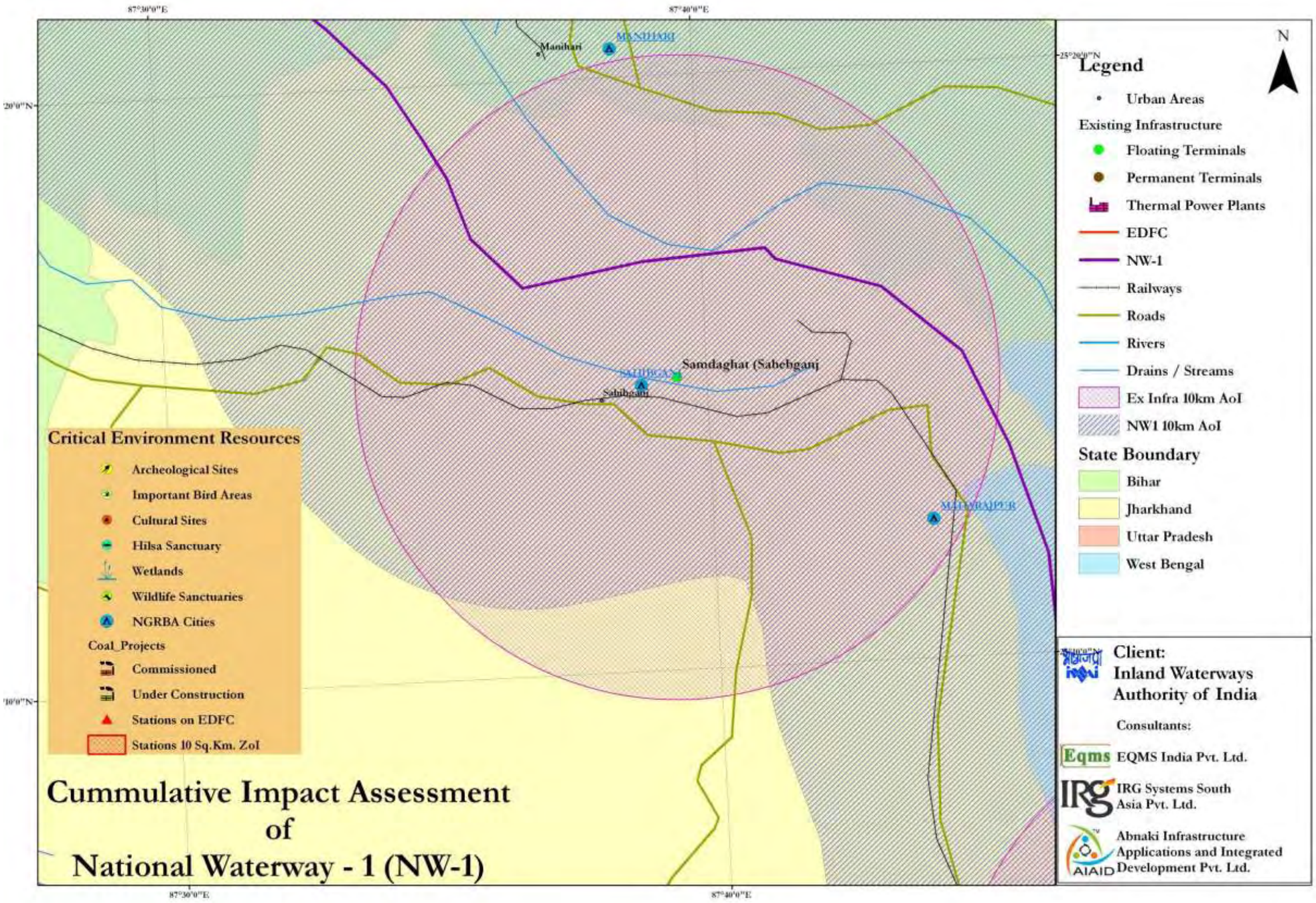


Figure 3.12 : CERs in Samdhaghat (Sahebganj)

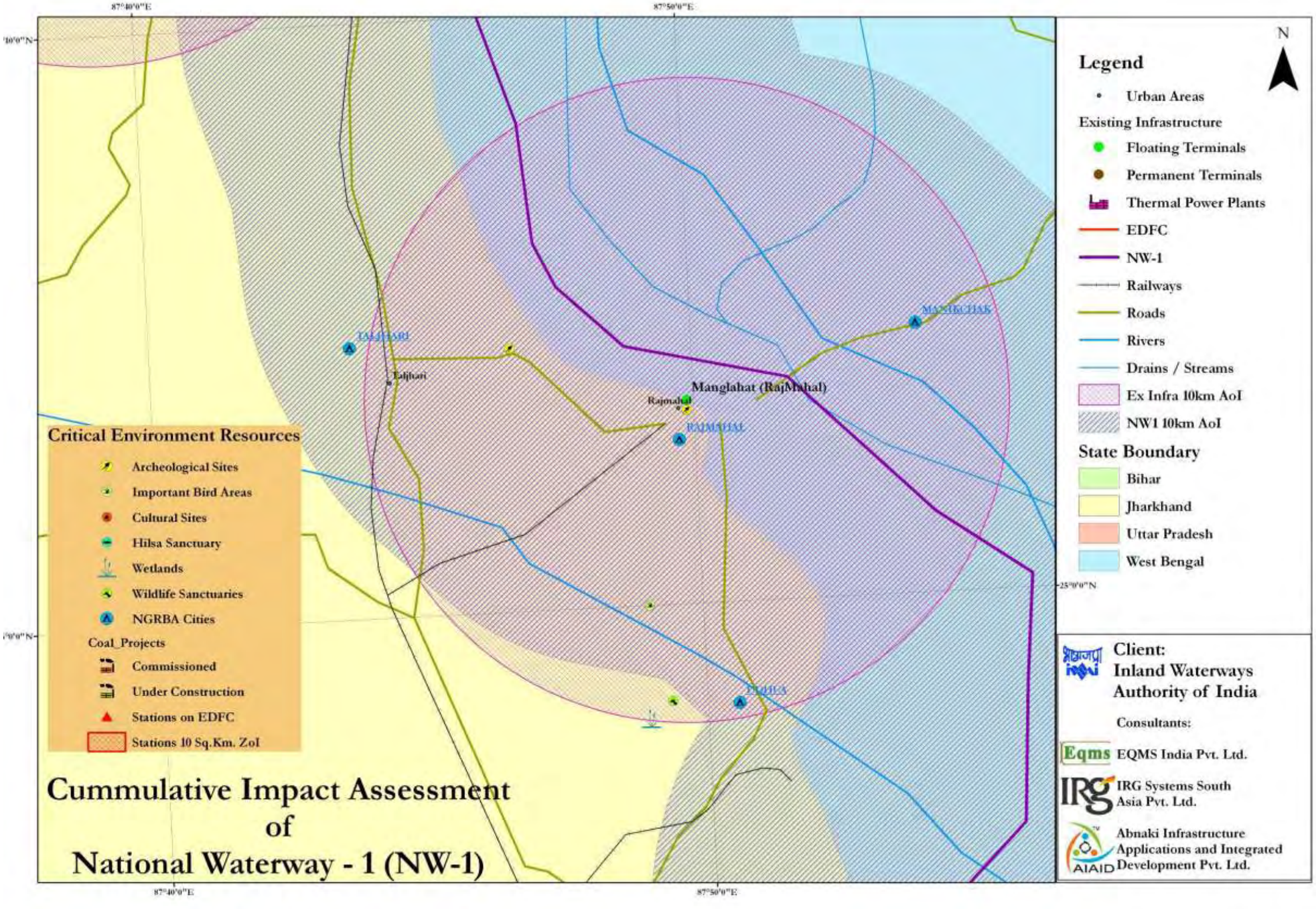


Figure 3.13 : CERs in Manglahat (Rajmahal)

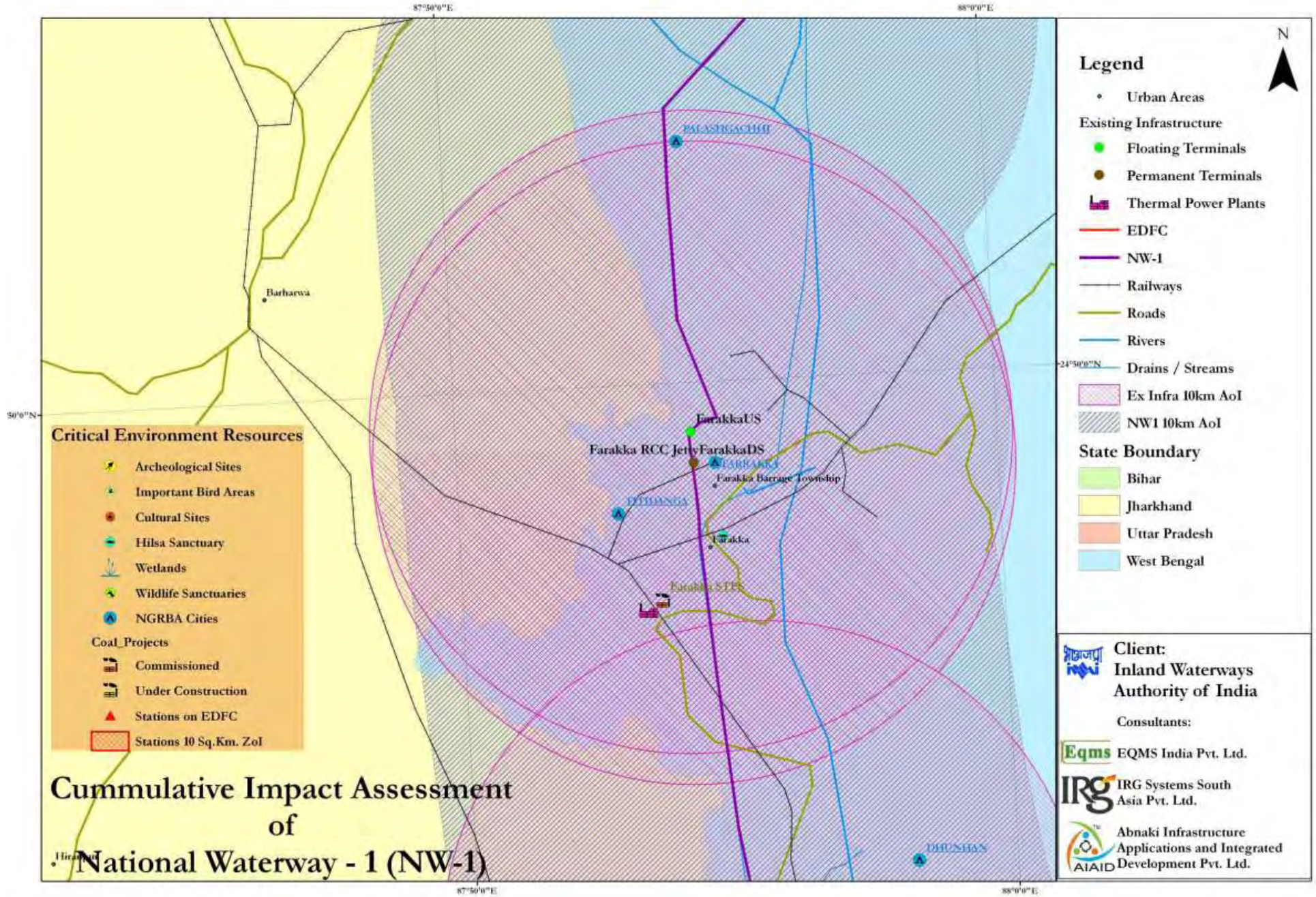


Figure 3.14 : CERs in Farakka

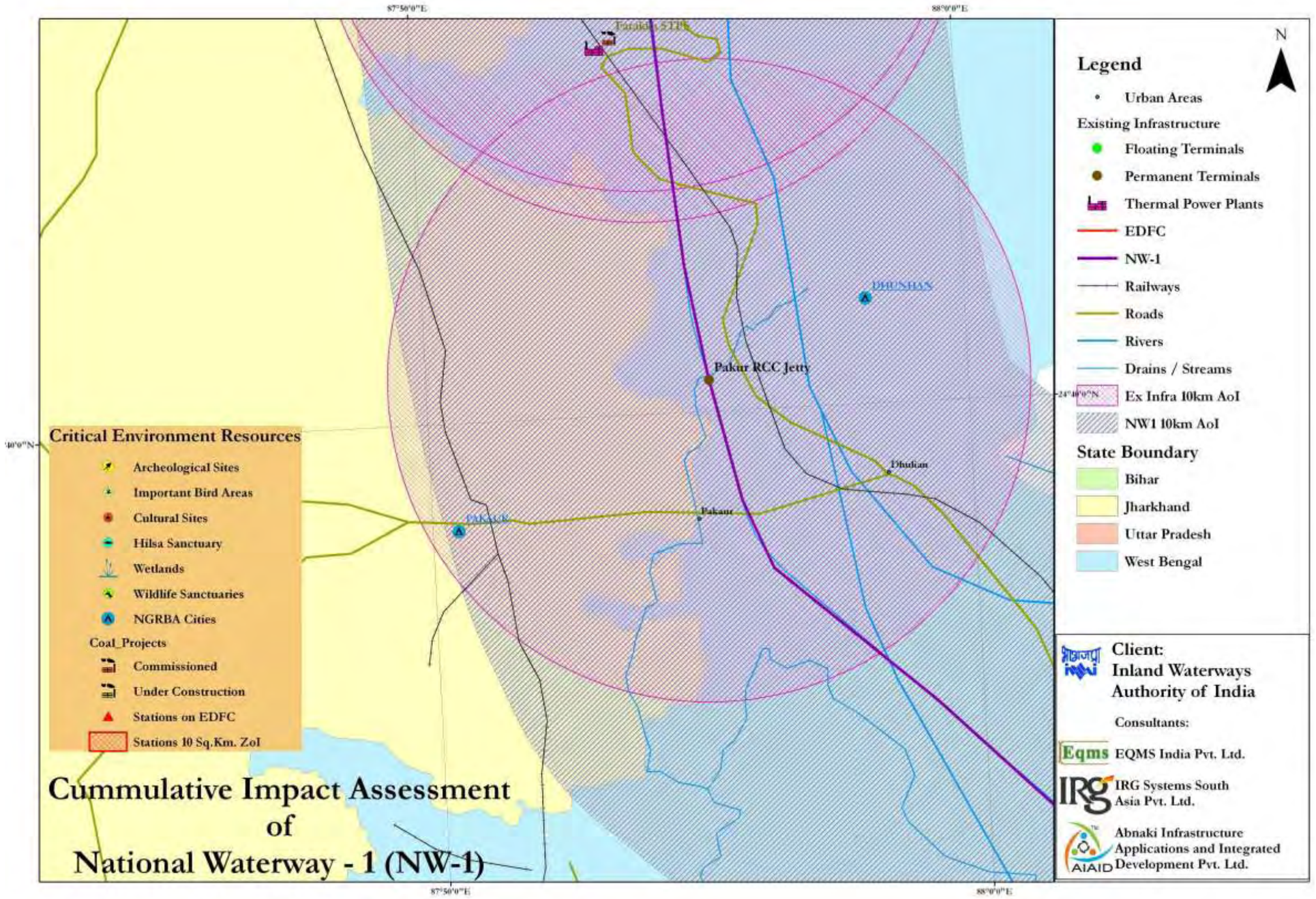


Figure 3.15 : CERs in Pakur

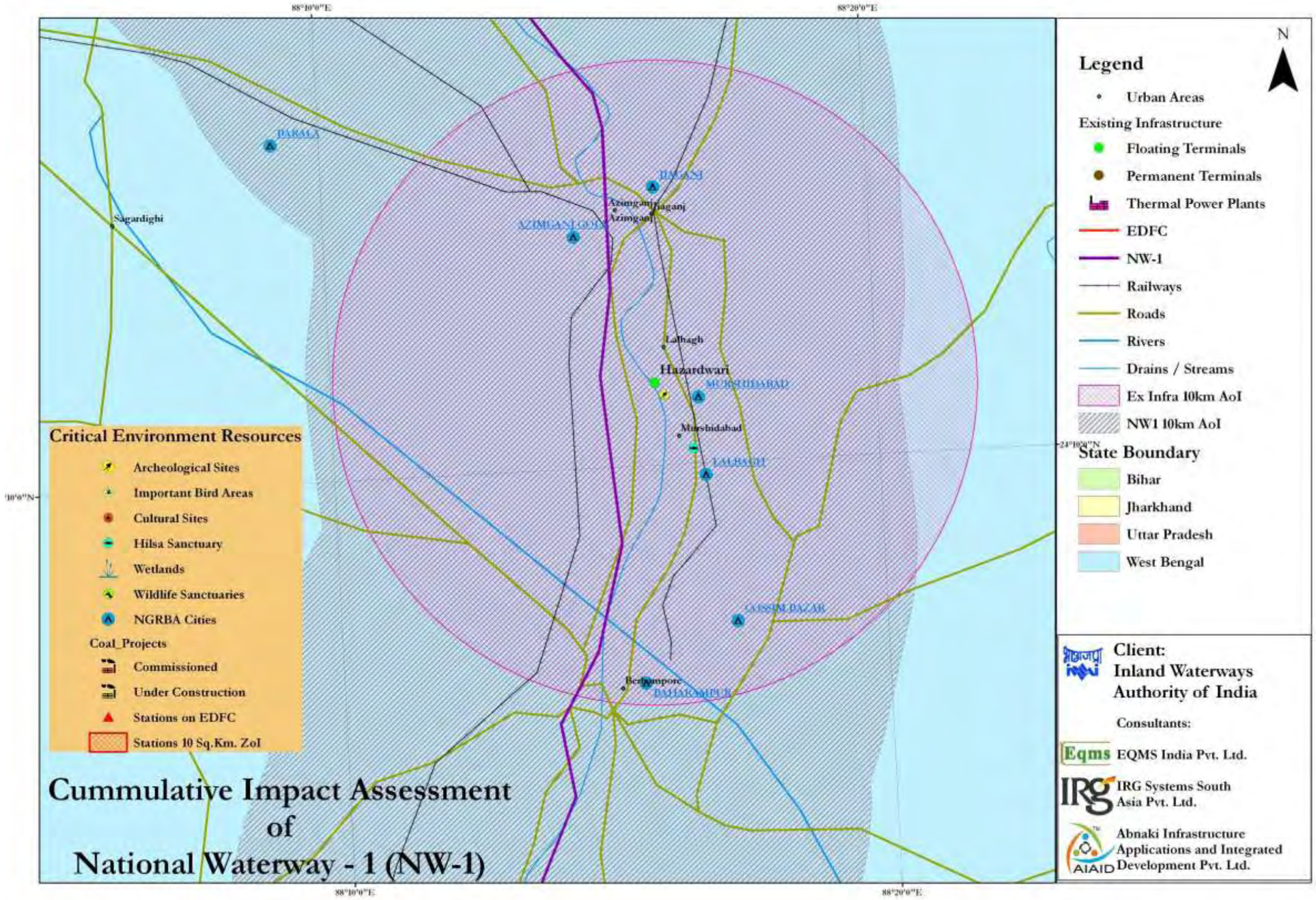


Figure 3.16 : CERs in Hazardwari

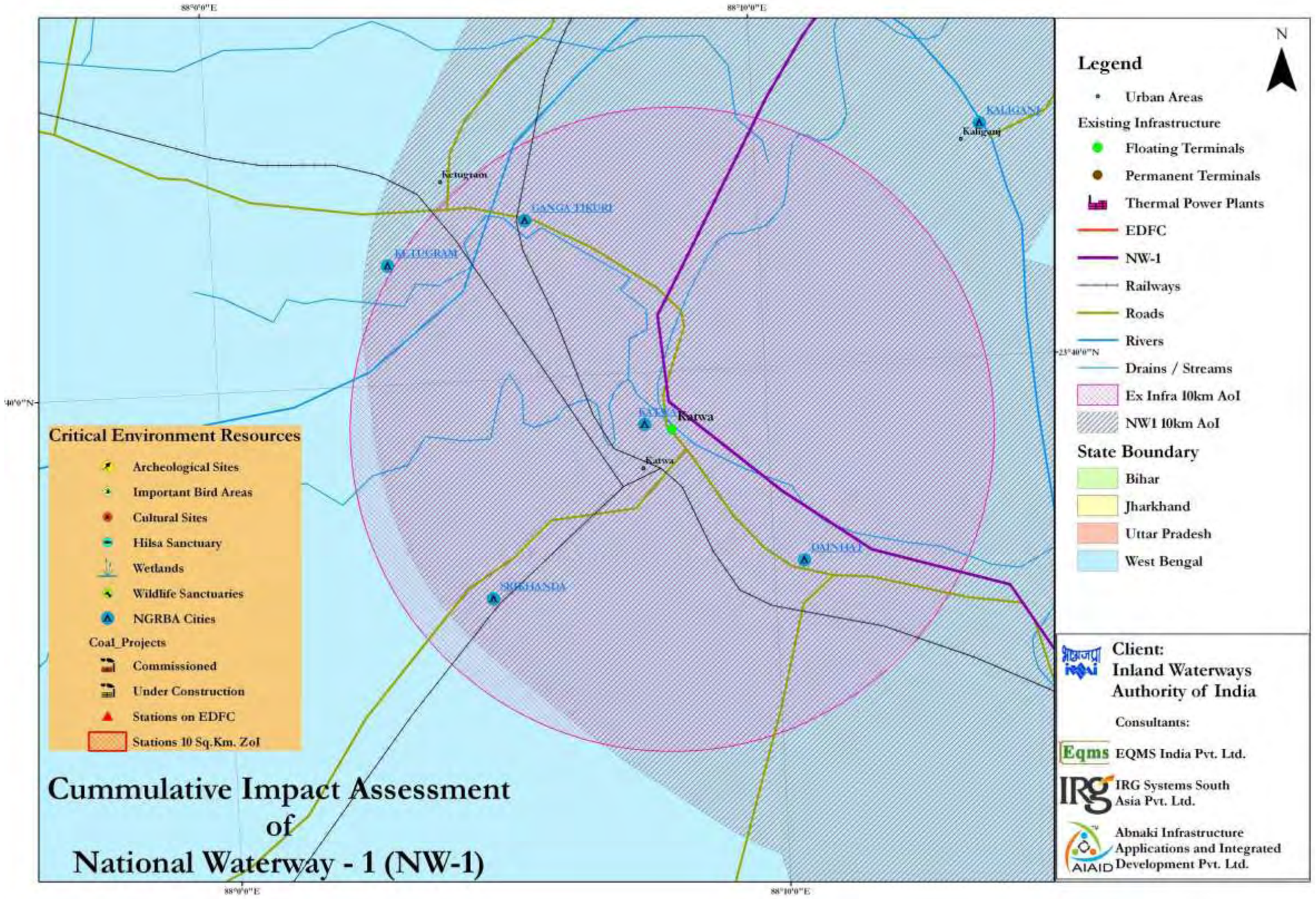


Figure 3.17 : CERs in Katwa

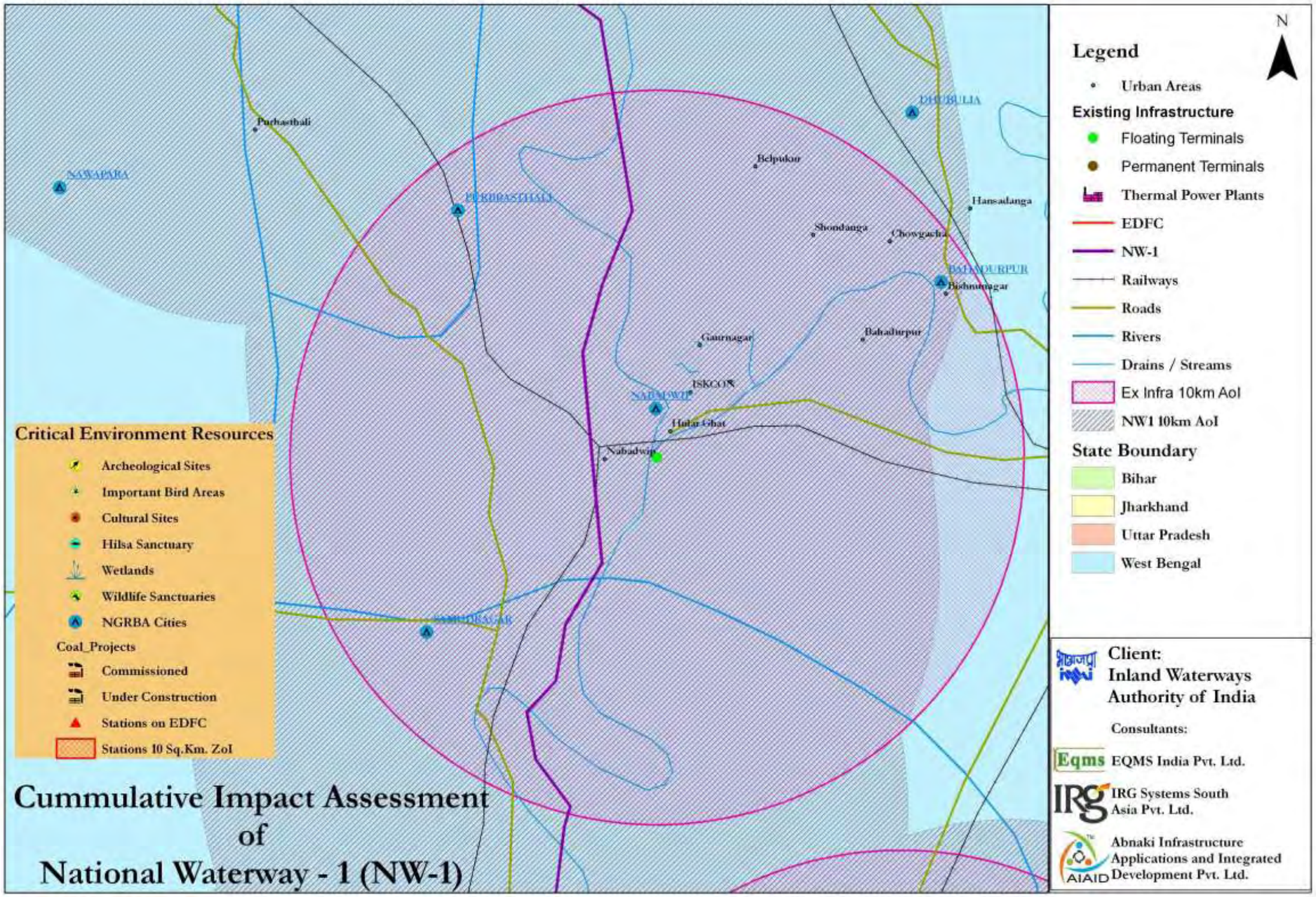


Figure 3.18 : CERs in Swaroopganj

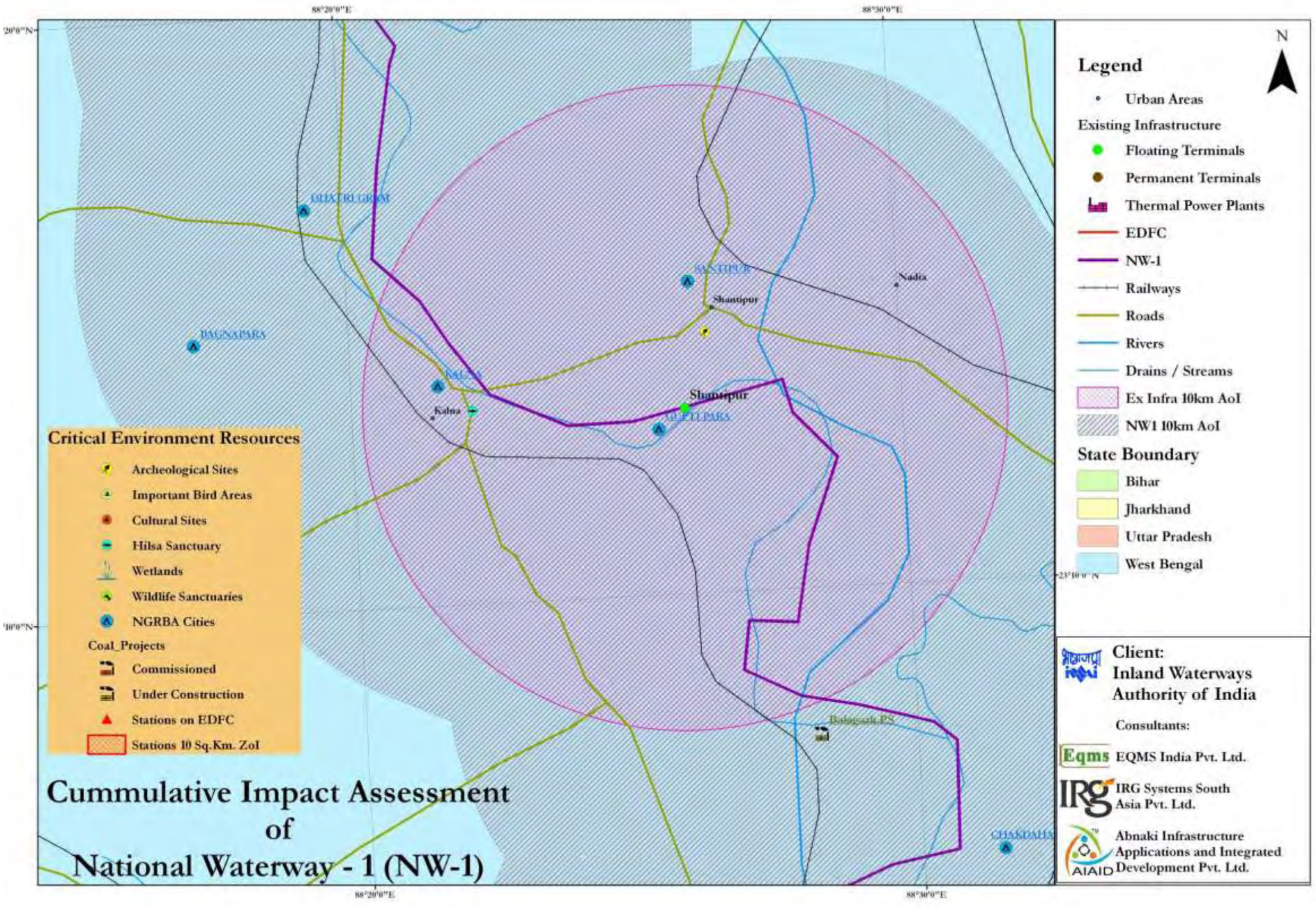


Figure 3.19 : CERs in Shantipur

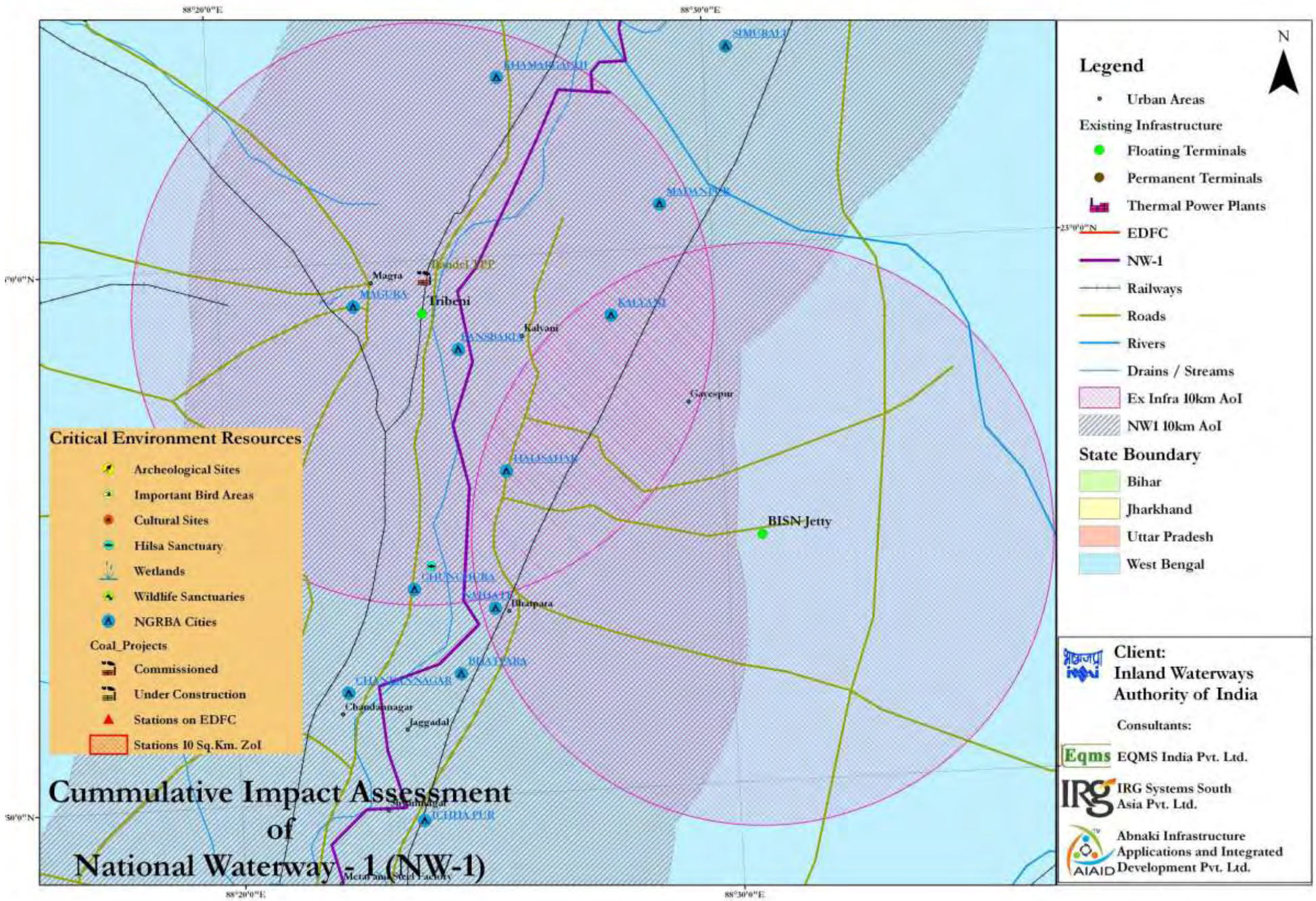


Figure 3.20 : CERs in Tribeni

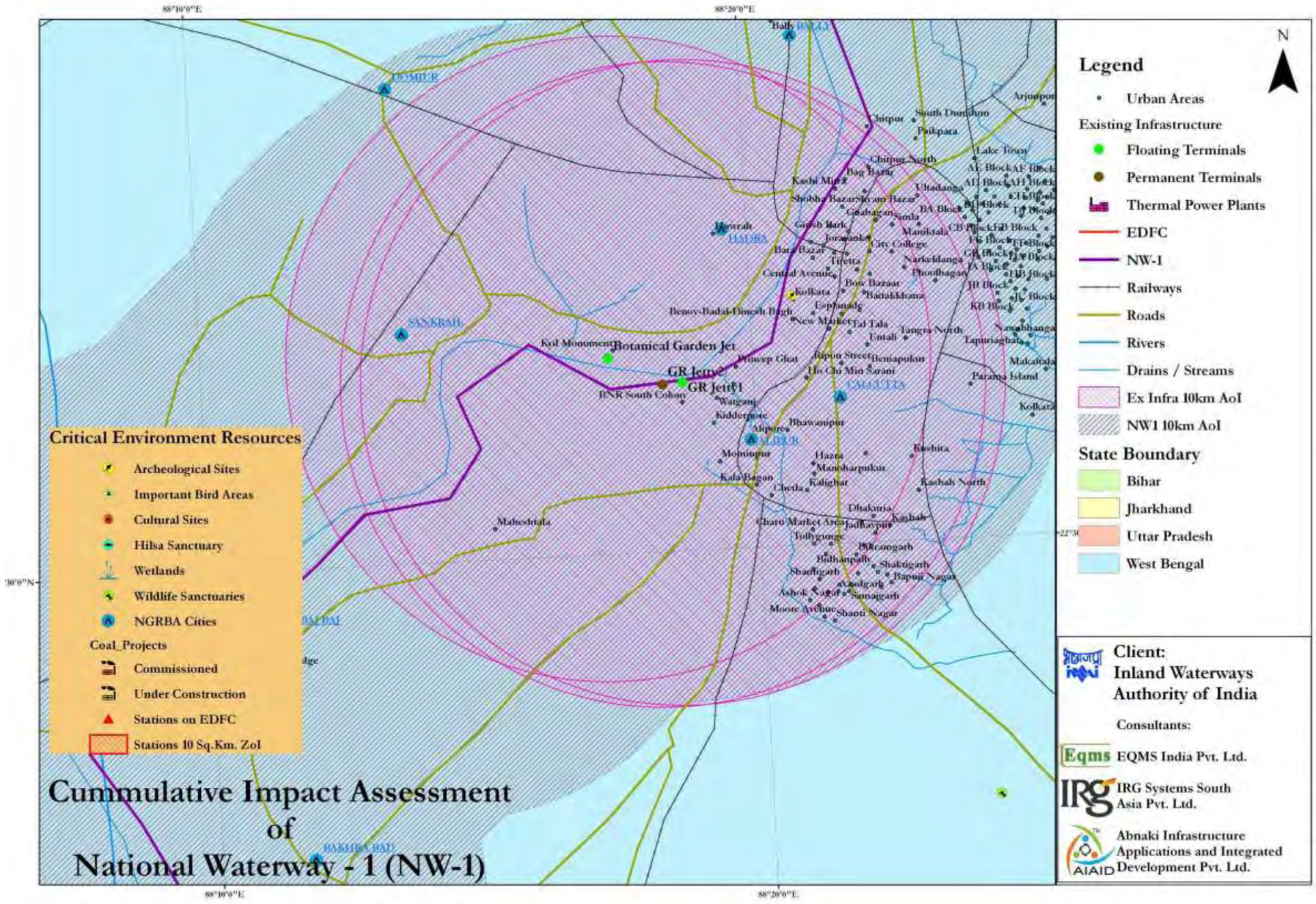


Figure 3.21 : CERs in Botanical Garden / Garden Reach Jetty

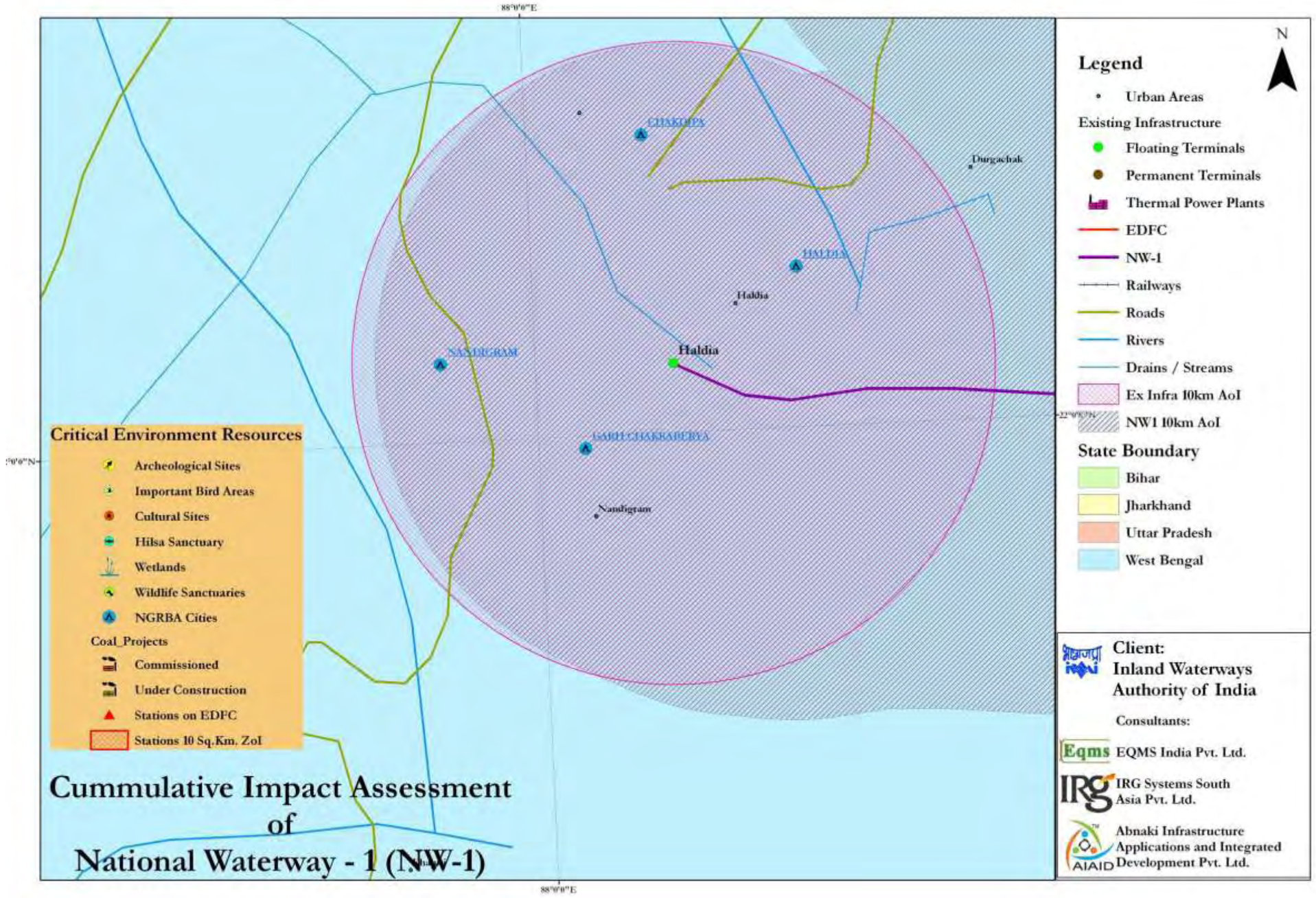


Figure 3.22 : CERs in Haldia

3.6. Conclusion

Delineation of CIA boundaries has been carried out along with identification of CERs, their current status and hotspots in the NW1 study area. These CERs are the ultimate recipient of impacts because they tend to be at the ends of ecological pathways considering water related proposed activities both in terms of availability & quality in NW-1. These CERs may be directly or indirectly affected by a specific development or by the cumulative effects of several developments. Therefore, it is essential to carry out the stakeholders consultations (a kind of collaborative judgement) considering other proposed developmental work within the CIA influence area. This will give insight into type and extent of impacts and after finalization of hotspots, further baseline assessments of the CERs can be done.

Chapter 4. : PUBLIC CONSULTATIONS AND DISCLOSURE

4.1. Introduction

Public consultation is one of the key components of the environmental assessment. The CIA/ESIA team conducted public consultations in project site area and study area. From CIA perspective, an effort was made by conducting consultations particularly in reference to confirmation of hotspots mentioned in Chapter 3 as well as to identify new hotspots, if any. The approach involved a mix of conventional as well as participatory/ rapid rural appraisal (PRA/RRA), focus group discussions (FGD) and one-to-one discussions with wide range of stakeholders encompassing government, non government organisations, local communities, research and development organisations, academia, media. Two stage consultations have been carried out in line with World Bank Guidelines for conducting the public consultation. First level consultation was carried out prior and during impact assessment studies and second level consultation was carried out after completion of impact assessment studies. Finally, this chapter concludes with identification of hotspots based on preliminary assessment, baseline data and inputs from stakeholder consultations.

This chapter provides details of the public consultation and participation activities undertaken during the CIA/ESIA studies for the Project “Jal Marg Vikas” extending from Allahabad to Haldia. During public consultation, emphasis was placed on a fully-inclusive, open and transparent public participation process in the transfer of information regarding the project and likely impacts from the project on each environment and social components. A number of stakeholders are involved in this project ranging from the local communities, local bodies, State & Central Level Government agencies and Non-Government Organizations.

4.2. Methods of Public Consultation

4.2.1. First Stage Consultations

Both the informal and formal consultations were conducted during and prior to the CIA/ESIA study to obtain the views of people about the project and to ensure their involvement. Issues pertaining to both environment and social environment were discussed in depth during the consultations.

4.2.2. Informal Consultation

Informal consultations were carried out between June, 2015 to April, 2016, prior and during the CIA/ESIA study of the different components of the Jal Marg Vikas project. Since the project comprises of various components like terminals, jetties etc., informal consultations were undertaken in reference to these proposed components at the respective locations. One to one and focused consultations were conducted on informal interview basis. No questionnaires/ brochures were supplied to the participants.

The discussions were primarily focused on receiving maximum inputs from the participants regarding their acceptability and environmental concerns arising out of the project. Consultations were initiated with the short description of the upcoming project components under Jal Marg Vikas Project. The objectives, proposed developments and the possible impacts of the project components and the connectivity links of the study area with the project were also explained. The survey team recorded their perceptions, demands and recommendations, about the project.

Informal consultations were carried out for different planned components at different time periods. The details of the same are given in **Table 4.1**.

Table 4.1 : Detail of Developmental Activity and Period of Public Consultation

Sr. No.	Details of Developmental Activity	Period
1.	Haldia Terminal	Sep, 2015
2.	Farakka Lock	June, 2015
3.	Sahibganj Terminal	July-Nov, 2015
4.	Varanasi Terminal	Oct-Nov, 2015
5.	Movement of Barges in Buxar & Patna Area	Feb, 2016
6.	Proposed development in NW-1, Bihar & Jharkhand	April, 2016

Visits were made to the villages and offices of the local bodies, Government officials, Universities and NGOs to meet the stakeholders and obtain their views. Local people included the farmers, fishermen, boatmen, land owners, cultivators and students. Interaction with females was also done during the informal focused group discussions. During the consultations, it was found that people are generally aware about the IWAI planning for development of planned components, i.e. terminals and lock. Again a brief was provided to people prior consultation. People were then asked about their views, issues and expectation from the project. Focus on both environmental and social issues was given during the consultations.

4.2.3. Formal Consultations

Formal consultations were carried out for the interventions sites where acquisition of land involved has associated R & R issues and indirect impact. Two large scale consultations have been carried out for the project, one for Farakka Lock on 9th October, 2015 at Bewa Panchayat, Farakka and second for Sahibganj Terminal on 16th October, 2015 at Ashram, Samda Nala village, Sahibganj. Invitation letter were given through e-mail and through in person meeting to Local bodies, Government officials & NGOs for attending the public consultation, minimum a day before the formal public consultation meeting. Locals were given invitation by personally visiting the village. List of the stakeholders invited for the consultation meeting at Farakka Lock and Sahibganj Terminal are attached as Annexure 4.1. Copy of one invitation letter sent to stakeholder is attached as Annexure 4.2 as sample and for the reference.

4.2.4. Second Stage Consultations

Second stage public consultation was carried out after the completion of impact assessment studies by IWAI on 22nd February, 2016 at Maurya Hotel in Patna. Second stage public consultation was carried out with the experts, NGOs, Government Officials, prominent personalities of the public, and other interested parties for discussion of identified impacts and proposed mitigation measures to get their opinions and suggestion for enhancing the acceptability of the project by the public and improvement in mitigation and management plan. Consultations with officials of Bihar Pollution Control Board and Jharkhand Pollution Control Board were held to elicit views on proposed development in NW-1 and suggestions w.r.t likely impacts and mitigation.

4.3. Objectives of Public Consultation

The public consultations were conducted with the following objectives:

- To spread awareness and generate understanding about the project among stakeholders, and to collect their opinion, suggestions for planning and designing of the project
- To assess positive as well as adverse socio economic and environmental impacts in the area through participatory methods such as walk through and focus group discussions.
- To identify the need and concern of the public
- To assess cultural patterns and behaviour of local communities towards the project
- To understand the environmental and social issues associated with the project through discussions
- To understand suggestions and opinions of the community, Government officials and NGOs on mitigation measures to counter and check the adverse and negative impact that threaten the socio economic environment in the area.
- To understand the satisfaction level of people with proposed mitigation and management measures proposed for the project

4.4. Outcome of Informal Stakeholder Consultation

People and are supportive of the project in general. Extract of the informal public consultation meetings held are attached as **Annexure 4.3**. Main concerns raised during the consultation and redressal of the concerns is given at **Table 4.2**. Photographs of informal public consultation are given in **Annexure 4.5.**

Table 4.2 : Main Outcome of Informal Consultation and Redressal of Concerns

Sr. No.	Outcomes/Concerns	Redressal
1	Development of project may lead to fish kill and in turn will affect the fishing businesses. They expect some allowances from the Government in lieu of their affected income.	Mitigation measures and management plan includes the measures for reduction of impacts of intervention construction &operation, maintenance dredging and barge movement on fish yield. Some of the measures are: Regulated/slow speed shipping Management of pollution by ships/vessels Intimation of dredging/piling plan to fishers prior carrying out any activity Enhancement of fishing in the area by boosting and funding fish nurseries and provision of better fishing aids and funding training of fishermen by CIFRI or organizing training program for fishermen through CIFRI Provision of sirens and strong search lights in vessels/barges so as fishermen would know the approach of ship/barge from minimum distance of 500 m
2	Nearby roads to the terminal facilities should be strengthened and widened, as there may be substantial increase in traffic	Being taken care and approach road will be constructed at Sahibganj terminal and Varanasi terminal.

Sr. No.	Outcomes/Concerns	Redressal
	movement in the roads connecting the terminal site after development of terminal.	
3	Turtle will get impacted due to regular movement of ships and vessels in river.	Only 1-2 vessels per hour are expected to move in the sanctuary area. Speed of vessels will be maintained to 5 kmph/2.7 knots in turtle sanctuary area. Such speed barges generate noise in order of 11-140 dB. Threshold noise level of turtles for change in behavioural response is 150 dB which is above the noise expected to be generated by moving barges and the impact on turtles behaviour responses is insignificant. Other measures are also being proposed in the EMP to minimize impact of barge movement on turtle.
4	Oil spillage from ships during accident may impact the aquatic flora, fauna and water quality	Safety measures to be taken by vessels are given in the EMP. This will minimize the chances of accidents and will facilitate the quick clean-up operations in case of spillage
5	Concerns regarding the water quality issues which may be there due to construction of terminal facility and operation of cargos, spillage in case of accidents, discharge of waste and sewage, oil leakage and other related activities	Environment management plan has incorporated the measures for barges and terminal facilities to be taken up to minimize the water pollution
6	Adequate compensation should be provided for the land which will be acquired	SIA has been carried out for Sahibganj terminal site and RAP/LA/compensation plan has been prepared as per the R & R Act, 2013 and R & R policy for the project
7	Demand for livelihood by the people who will loose their land	Engagement of NGO can be taken up to find them alternative livelihood
8	At Sahibganj, locals expressed that they were keen on being relocated near the River Ganga iteself	It was informed that a relocation site has been identified by the District Officials near the current habitation in the diyara land
9	Large no. of tree cutting involved at Sahibganj site which may impact the climate.	Compensatory plantation and additional plantation is proposed to be undertaken. At all the terminal/jetty site green belt will be developed to the extent possible. This will help in minimizing the impact and will lead to reduced impact of CO2.
10	Impact of barge movement on dolphins	Regulated speed of barge movement in dolphin sanctuary area. Provision of propeller guards to prevent entangling of dolphins. Other measures are also proposed in management plan to reduce the impact on dolphins
11	Plying vessels at present get stuck in lean season and this enhances the impact	LAD is proposed to be maintained in stretch between Haldia to Varanasi during entire lean period

Sr. No.	Outcomes/Concerns	Redressal
12	Dredging may have significant impact on breeding and spawning season	Dredging is proposed to be regulated during this season
	Erosion occurs along the bank of feeder canal and that is creating problem. Ship movement has further enhanced erosion	River training works of 39 km are proposed to be undertaken on banks of feeder canal
13	As part of social development the local immersion Ghat at Durgachak (near project site) should be expanded by the project sponsors to overcome the current congestion especially during the local festival.	Proposal is made to undertake expansion of ghat and budgetary provisions are also kept.
14	The access road of Haldia terminal needs to be carpeted as present road is not in good condition.	Shall be carried out as part of project development
15	Provision for appropriate parking facilities inside the proposed terminal for better management of container carrying vehicles.	Provision of parking area is made at each terminal site
16	Sanjana Chemicals near Haldia terminal site suggested that no water logging should take place at terminal site and nearby areas after development of terminal and firefighting measures should be provided at the site	Adequate storm water drainage is provided at the site to drain the storm water and fire-fighting facility is also proposed at the site.

4.5. Formal Public Consultation Meetings

Formal public consultation was conducted for Terminal at Sahibganj & Lock at Farakka. Formal consultation at Sahibganj was conducted on 16th October, 2015 in Ashram, Samda Nala village, Sahibganj. Formal consultation at Haldia was conducted on 9th October, 2015 at Bewa Panchayat, Farakka. Request for support and participation in public consultation meeting was sent to stakeholder, Gram Panchayat, other locals such as fishermen and Local Administrations. Some of the stakeholders were invited by giving invitations personally. Villagers were invited through Gram Sarpanch and also by giving door to door invitations.

4.5.1. Formal Consultation in Sahibganj

Meeting was started with brief introduction about the project by Mr. Ravi Kant, Director IWAI, Patna. At the community meetings information on the socio-economic studies, environment impact studies and other engineering related to the proposed terminal of IWAI were discussed. He requested stakeholders to cooperate and provide information to these teams for facilitating their studies. The stakeholders and community members were then given an opportunity to raise their concerns regarding the proposed project. About 700 people participated in the PCM. Meeting was attended by Government officials, PAF's, World Bank Officials, IWAI Official, ESIA/CIA team and General public. The summary of the key concerns/views and observations of the different stakeholders are presented in Table 4.3. Photographs of the formal public consultation meeting are given in Annexure 4.5. Attendance sheet for the PCM is attached as Annexure 4.4.

Table 4.3 : Summary of Formal Public Consultation Meeting at Sahibganj

Sr. No.	Person Name/organization, Phone, Address	Outcome (concerns and suggestions) / Views
1	**Person/ Organization:** Shri K.K. Tiwari **Designation:** Divisional Forest Officer ,Sahibganj **E mail:** sbgforest@gmail.com **Phone**: 09431306331 **Address:** Divisional Forest Office, Sahibganj, Jharkhand	Shri K.K. Tiwari told that the area behind the terminal site is protected forest. He told that forest department has plans to carry out afforestation and grasses/shrubs in 5 km area of the Ganga River and along the Railway lines in Udhwa Region for benefit of livelihoods of local communities. Also forest department has plan to develop wetland. His concerns about the project development are: 1. Dolphins will be impacted due to the movement of cargo so mitigation measures should be taken to minimize the accidents 2. Water pollution may result due to disposal of sewage from terminal and from vessels and disposal of solid and other waste in River Water. Thus mitigation measures and management plan should be prepared to prevent water pollution. 3. Surveys should be carried out to identify the breeding and spawning grounds of fishes and project activities should not be undertaken in those regions 4. Construction activities should not be carried out during spawning and breeding seasons 5. Piling and construction within water should be carried out during low flow period 6. Measures should be taken to minimize the impact of the project on aquatic organism
21	**Person/ Organization Consulted:** Shri Jayant Ranjan **Designation:** District Fisheries officer **Phone**: 09835031630 **Email**:jayant.ranjan21@gmail.com **Address:** Department of Fisheries, Sahibganj	Shri Jayant Ranjan raised the following concerns: 1. About 5000 fishermen depend on River for their livelihood 2. Major fish species in the area are Indian Major carps, singhi, shrimps, Mystus sp. catfishes, tengra etc. These are commercially important species. Project development may affect the production of fishes in the River and will affect the livelihood of people 3. Breeding and spawning grounds of the fishes should be identified and care should be taken that no development should be carried out in

Sr. No.	Person Name/organization, Phone, Address	Outcome (concerns and suggestions) / Views
		these regions 4. Dolphins are very sensitive and care should be taken that minimum disturbance should be caused to dolphins 5. Mechanism should be developed for river clean up during accidents, oil spills, spillage etc. 6. Dredged material should be disposed in safe places and dumping should not be carried out on banks as these are habitat to various important species. 7. Fish catch may reduce due to increase in water pollution due to project development 8. Project may increase the export of frozen fishes and also there is potential for growth of commercial fisheries
4.	**Person/ Organization:**Mrs Munni Gaud **Phone**: 07808789116, 7070603324	Mrs. Munni Gaud raised the following concerns: 1. Appropriate compensation should be given to the land owners 2. Alternate employment options should be provided to people who are losing their complete land 3. Developments should be carried out in the nearby areas also for development of villages 4. Fishing activity should not be restricted after development of terminals 5. Farmers practising river terrace agriculture should not be stopped
5.	**Person/ Organization:** Mrs Usha Khalkoo **Phone**: 9801018326,9801352024 **Address:** Gram Panchyat Head, Hathigarhi	Mrs. Usha Khalkoo raised the following concerns: 1. Villagers are opposing the project as they are losing their land and they do not have any alternate employment option and are completely dependent on agriculture for their livelihood 2. Compensation should be given to villagers as per prevailing market rate, then they may get interested in selling their land 3. Alternate livelihood options should be provided to affected people 4. Pollution should not increase at the site and nearby areas due to project development
6.	**Person/ Organization:**Mr	Mr. Niranjan Kumar informed the survey of

Sr. No.	Person Name/organization, Phone, Address	Outcome (concerns and suggestions) / Views
	Niranjan Kumar **Designation:** Additional Deputy Collector + Land Acquisition officer, Sahib ganj **Phone**: 09431306331 **Location/ Address: District Collectorate Office** Sahibganj, Jharkhand	land is under process and some more time is required to finalize the award list and land details.
7.	**Person/ Organisation:** Mr Vishal Chandra **Address:** Jharkhand RajyaVidutVitran Nigam Ltd Sahibganj Jharkhand	Mr Vishal Chandra raised the following points: 1. He was in favour of project and said that the project is good for betterment of the area 2. This project will increase the development opportunities in the area 3. Shifting of LT line may be required from village which will be a challenging task 4. IWAI should be responsible to compensate for shift of the utilities
8.	**Person/ Organization:**Mr Sushil Kumar Executive Engineer PWD **Address:** Public works Department Sahibganj, Jharkhand	Mr Sushil Kumar said that project is good for development of the area and raised the following points: 1. Land acquisition will be the major hurdle for project development as one of the PWD project of road is also on hold due to difficulties in land acquisition 2. No paved public road connects the site to the highway or other road. Also it is expected that traffic will increase in the area, thus to prevent dust generation and traffic congestion, it is required to construct minimum 4 lane road to connect site to NH-80. 3. ROB should also be constructed above the railway line to allow smooth flow of traffic 4. Green belt should be maintained along the approach road to suppress the dust generation 5. Assessment of increase in traffic should also be carried out on existing roads so as expansion can be planned when required
9.	**Person/ Organization :** Dr. Bhagwant Marandi **Designation:** Chief Medical Officer **Address:** CMO,Health Department, Sahinganj, Sahibganj, Jharkhand	Dr. Bhagwant said that in his point of view, project will lead to overall development of the area. Healthcare facilities will also increase in the area after development of project.

Sr. No.	Person Name/organization, Phone, Address	Outcome (concerns and suggestions) / Views
10	**Person/ Organization :** Mr Safaij Reiz, **Address:** Ganga pump Canal Nahar Pariyojna (Irrigation Department, Sahibganj, Jharkhand	He supported the project and said that project is beneficial for overall development of area and improvement of living standards of people.
11.	**Person/ Organization :** Mr Faiku Ram **Address:** District Mining Officer , Sahibganj, Jharkhand	He supported the project and said that project is beneficial for overall development of area and improvement of living standards of people. He is ready to extend his support to IWAI, if required
12	**Person/ Organization :** Mr Vinay Kumar Mishra and (5 staff members) **Address:** District Land Acquisition Officer Sahibganj, Sahibganj, Jharkhand	He said that land acquisition is under process and they are trying to identify land near the village for relocation and resettlement of displaced families and facilities
13.	**Person/ Organization :** Mr Prasant Kumar Additional Director, IWAI and (6staff members) **Address:** IWAI, Bhagalpur, Jharkhand	He gave confirmation to villagers that no additional land will be acquired for terminal construction. Land will be acquired as per law of land. He explained about the project to villagers and clarified the queries of people during meeting.
14.	**Person/ Organization:** Villagers of Samda Nala and Rampur village (Direct and Indirect Affected Persons)	Villagers were highly concerned and raised following points 1. They said that land should be acquired as per prevailing market rates 2. Alternate employment options should be provided to people who are losing their land 3. Land should be provided to affected people within or near village for relocation and resettlement 4. Fishing should not be restricted in the River due to project development 5. Employment opportunity should be provided preferably to local people
15.	**Other Participant** Mrs. Abha Singal Joshi, Consultant World Bank Mrs. Mridula Singh, World Bank Mr Pranay Kumar +2 persons from social team of IWAI Consultant Mr Krishna + 2 persons from Environment team of IWAI Consultant Media: Dainik Jagaran, Hindustan	

4.5.2. Formal Consultation in Farakka

The consultation was kicked off by Mr. Madhusudan Hanumappa (Social Expert), part of EQMS-AIAID-IRGSSA JV by welcoming all the dignitaries and participants. In his address, he emphasized on the proposed project i.e. “Capacity Augmentation of Navigational Infrastructure on NW-1 between Allahabad to Farakka”. He also explained the objective of

the ESIA/CIA for managing environmental and social issues for sustainable development. At the community meetings information on the socio-economic studies, environment impact studies and other engineering aspects related to the proposed lock gate of IWAI were discussed. He requested stakeholders to cooperate and provide information to these teams for facilitating their studies. The stakeholders and community members were then given an opportunity to raise their concerns regarding the proposed project. The summary of the key concerns/views and observations of the different stakeholders are presented in Table 4.4. Photographs of the formal public consultation meeting are given in Annexure 4.5.

Table 4.4 : Summary of formal Stakeholder Consultation

Sr. No.	Person Name/organization, Phone, Address	Outcome (concerns and suggestions) / Views
1.	Kesang Dhendup Bhutia BDO & Block Executive Officer Farakka Block Development Office, Farakka, Murshidabad	• BDO, Farakka, welcomed the project development and assured his and local administration cooperation for the project implementation. • Also mentioned that without addressing environmental and social concern/impact in a structured manner no project can be completed on time successfully. • Any kind of toxic pollution by the vessel like oil spillage and chemicals in the river water, transport emissions, needs to be considered. • The project implementing agency should be careful about river erosion during the vessels movement. River bank erosion has a permanent effect upon the socio-economic conditions and demographic dislocation. • As Farakka BDO, he appealed to the authority that they should provide jobs to the local unemployed youth based on their skill and should give business opportunities to the local people. • The access road needs to widened and upgraded to ensure smooth traffic movement because it has an important link with NH-34. A traffic management plan needs to be in place. • He suggested that the project should employ local people in the proposed location on a priority basis provided they have the required skills. • The health safety and protection of labour and other community members should be considered on project site as well as nearest locality of the villages during the operation phase. • Also suggested for adequate mitigation measures in ESIA/CIA to address to erosion issue because due to river bank erosion Farakka block is one of the worse affected area and many people have lost their homes/properties since 1975 when Farakka barrage was commissioned. • The public consultation meeting should be held at different places for awareness of the people and Grievance Redressal Committees should be active with timely conflict resolution. • The Interviewee was optimistic that implementation of

Sr. No.	Person Name/organization, Phone, Address	Outcome (concerns and suggestions) / Views
		this project would change the current socio-economic scenario of the local communities.
2.	Mr. Arnab Chakraborty Journalist (Malda & Murshidabad Division) Uttarbanga Samgbad Farakka, Murshidabad	• He suggested that the project should employ local people in the proposed location on a priority basis provided they have the required skills. • The health safety and protection of labour and other community members should be considered on project site as well as nearest locality of the villages during the operation phase. • Also suggested for adequate mitigation measures in ESIA/CIA to address to erosion issue because due to river bank erosion Farakka block is one of the worse affected area and many people have lost their homes/properties since 1975 when Farakka barrage was commissioned. • The public consultation meeting should be held at different places for awareness of the people and Grievance Redressal Committees should be active with timely conflict resolution. • The Interviewee was optimistic that implementation of this project would change the current socio-economic scenario of the local communities.
3.	Mr.Jahid Hussain Director, Mahadevnagar Rural Welfare Society, Farakka,Murshidabad	• The authority can support them through livelihood restoration programmes. • Also suggested for safety and protection from the construction site near the locality of the villages and • The consensus described as during the construction period authority should consider the vulnerable health issues like HIV/AIDS because Murshidabad is one of the vulnerable health related district in West Bengal.
4.	Mr. Rana Dutta,IFS DFO Divisional Forest Office,Nadia&Murshidabad Range Institutional Stakeholders consultation through KII (key informant interview)	• There is no forest conservation around the Farakkaarea. • The continuous turbulence and waves from plying vessel movement can cause river bank erosion. This is problem that is difficult to resolve in entire downstream • As a DFO gave the assurances that DFO range will give all help for smooth operation of the project activities.
5.	Community members of local Villages at PCM	• The villagers also informed that there is no forest area. Further, they did not anticipate any adverse impacts on their livelihood due to construction works. • They further opined that there would be positive impacts on the sources of livelihood due to increased economic opportunities which will provide good earning sources to the local families due to the project implementation. It was also informed that there is no

Sr. No.	Person Name/organization, Phone, Address	Outcome (concerns and suggestions) / Views
		Schedule Tribe (ST) population in the project area. • Representatives from Beoa Panchayat extended their support during the construction and operational phase of the proposed project. -They also suggested that public consultation meetings should be held at different places for awareness of the people and Grievance Redressal Committee should be active with timely conflict resolution.

4.6. Second Stage Consultation

Second stage consultation for the project was held at Patna on 22.02.2016 at Patna with IWAI team, environmental and design consultants and experts of various fields. Identified impacts were discussed during the consultation and discussion was held on adequacy of the mitigation and management measures proposed. Suggestions were given and concerns were raised by the experts during the consultations. Suggestions and concerns are given in the Table 4.5. Photographs of the consultation are given in Annexure 4.5.

Table 4.5 : Summary of the Second Stage Consultation

S. No.	Person Consulted	Concerns Raised
1	Mohd. Najeeb Ahsan, Sr. Social Management. Specialist, National Mission for Clean Ganga	Alignment of Jal Marg Vikas Project's Environmental Management Plans and afforestation plans with the DPR's of Namami Gange would be appropriate. Facilities of Ferry and Ro-Ro crossings should be examined in detail under the JMV Project. Provision of Water Ambulance for transportation of patients in congested cities. Disaster Management and Emergency Response System should be developed under the project. Plan for treatment of waste water and re-use should be developed. As traffic on NW-1 would increase in future; proper planning for deployment of river patrolling and security is required. Last mile connectivity should be examined properly.
2	Dr. S. Samanta, Principal Scientist, CIFRI	Documenting the impacts along the river and understanding the various relationships with the river is important. IWAI is also a stakeholder in river. As other stakeholders need water in river for different uses as irrigation, drinking etc., IWAI also require water for navigation. The role of the project on overall water management in the river must be clarified.
3	Shri Vishva Ranjan, Urban Planning & Urban Development Specialist, Patna	Environment friendly waste disposal mechanism is required for vessels. Need of a Charter for ensuring waste is not directly discharged in the river and third party monitoring to

S. No.	Person Consulted	Concerns Raised
		ensure the same. Waste management has been included in the draft revised Indian Vessels Act.
4	Shri K. Praveen Rao, Chief Conservator of Forests-Kanpur, Department of Forest, U.P	Reconstitution of Project Oversight Committees with representation of appropriate Forest Officers. Afforestation along the banks of Ganga should be done under the project.
5	Professor R.K Sinha, Head, Zoology Dept., Patna University	Vessel traffic management system should be developed under the Project. Dolphins are National aquatic animals and are blind. Noise generated due to vessel movement should be controlled to avoid adverse impact on dolphins. Propellers on the vessels should be caged for safety of the dolphins
6	Shri Rakesh Tiwary, Astt. Professor, A.N. Sinha Institute of Social Studies	Proper planning should be done to maintain sufficient depth by conserving wet lands and constructing reservoirs (rain water harvesting) and releasing them in the river during lean season in the system. Long term modelling of rivers should be ensured to meet the water depth requirement Cumulative impact on the society due to the project should be studied in details and proper mitigation measures should be adopted
7	Office of Member Secretary, Bihar Pollution Control Board Beltron Bhawan, Shastri Nagar Jawahar Lal Nehru Marg Patna (Bihar) - 800 023 Phone - 2281250; 2281776; 2283782	-Impacts on air, water and noise are anticipated due to various components by proposed development in NW-1. It is essential to formulate environment and social safeguards in CIA/ESIA particularly to address pollution and quality of life aspects. -Required clearances and NOCs should be taken from concerned regulatory authorities and ensure compliances.
8	Office of Member Secretary, Jharkhand Pollution Control Board H.E.C., Dhurwa, Ranchi-834004 (Jharkhand) **Tel.** : 2400894/851/852/902/979/138.	-Impacts on air, water and noise are anticipated due to various components by proposed development in NW-1. It is essential to formulate environment and social safeguards in CIA/ESIA particularly to address pollution and quality of life aspects. -Required clearances and NOCs should be taken from concerned regulatory authorities and ensure compliances. Due to proposed location of terminal at Sahibgunj, it is important to consider impacts on aquatic biodiversity and address them in EMP.

4.7. Finalisation of Hotpots

Hotspots have been identified based on consultative process by engaging with various stakeholders. These hotspots are given in **Table 4.6.**

Table 4.6 : Hotspots based on Stakeholder Consultations

S. No.	Hotspots Strech/Location	Criteria For Selection of Hotspots	CERs
1.	Haldia	• Celebration of Ganga Sagar Mela at Sagar • Urban areas: Haldia Town	• Religious Values
2.	Farakka to Murshidabad	• Farakka feeder canal is prone to erosion • Urban Areas: Farakka, Murshidabad, Azimganj, Baranagar, Balia, Raghunathganj	• Bank/Soil erosion
3.	Rajmahal	• Chatt Pooja celebration Oct-Nov • Mining activities	• Religious Values • Air Quality
4.	Sahibganj	• Chatt Pooja celebration Oct-Nov • Acquisition of Land, R& R and shifting of community temple • Cutting of app. 500 trees	• Land Use • Livelihood & Fishing Activities • Socio-economic • Air Quality • Terrestrial flora • Religious Values • New infrastructure development
5.	Pirpanti	• Chatt Pooja celebration Oct-Nov	• Religious Values
6.	Kahalgaon	• Chatt Pooja celebration Oct-Nov • Urban Area: Kahalgaon	• Religious Values
7.	Bhagalpur	• Chatt Pooja celebration Oct-Nov • Urban Area: Bhagalpur	• Religious Values
8.	Munger	• Chatt Pooja celebration Oct-Nov •	• Religious Values
9.	Semaria	• Chatt Pooja celebration Oct-Nov • Urban Area: Semaria, Doraiganj	• Religious Values
10.	Begusarai	• Chatt Pooja celebration Oct-Nov • Urban Area: Begusarai	• Religious Values
11.	Barh	• Chatt Pooja celebration Oct-Nov • Urban Area: Barh	• Religious Values
12.	Patna	• Chatt Pooja celebration Oct-Nov • Urban Area: Patna • Development of River Front	• Religious Values • Water Quality • Land Use • Soil Erosion
13.	Buxar	• Chatt Pooja celebration Oct-Nov	• Religious Values

S. No.	Hotspots Strech/Location	Criteria For Selection of Hotspots	CERs
		• Urban Area: Buxar	
14.	Varanasi	• Festival: Ganga Mahotsav at Varanasi (Oct-Nov) & Dhrupad Mela at Tulsi Ghat of Varanasi (Feb to March)	• Religious Values
15.	Allahabad	• Festival: Kumbh Mela	• Religious Values

4.8. Conclusion

Stakeholder's view and perception was assessed through informal and formal public consultation meetings. Two stage consultations have been carried out for the project. This ensures involvement of public, NGO, experts in the project's pre-planning stage itself and addressal of their problems and expectation from the projects. The inputs of stakeholder consultations have been used in finalisation of hotspots.

During the formal and informal consultations for 'Jal Marg Vikas Project', it is found that there is mix view of people about the project. Some people take it as positive development as the proposed project will benefit the economy of country. Whereas affected people, i.e. fishermen and land holders who will loose land are concerned about the restriction of fishing activity, reduction in fish yield, loss of land and livelihood and receipt of adequate compensation and alternate livelihood. Locals and experts are also concerned about the water pollution and impact on the aquatic fauna which may result due to the project. All the concerns were taken in consideration during assessment of impacts and the mitigation measures are proposed for all the concerns to minimize/mitigate the impact. Mitigation measures proposed are well addressed in management plan along with their period of implementation.

Chapter 5. : BASELINE ENVIRONMENTAL PROFILE OF THE CUMULATIVE IMPACT INFLUENCE AREA

5.1. Introduction

Baseline study is an essential component of cumulative impact assessment of any project. Baseline study aims at collecting & collating the data on the CERs and their indicators. This data provides the basis on which an impact assessment can be carried out. It not only helps to determine the existing scenario of the study area in terms of environment and social conditions but also helps in identification of external environment and social drivers which may have an impact on the identified CERs due to future developments within the area. This will further assist in identifying & redefining hotspots. Baseline study also provides an insight into both existing & future condition of the area within the boundary for which CIA study has to be carried out.

5.2. Influence Area

Baseline study area coverage includes NW-1 & area within 10 km on either side of NW-1 to study the sites declared by ASI as heritage & cultural sites; to study eco-sensitive areas like national park, wild life sanctuaries, bird migratory routes etc. and major development area / critical zone having potential to be impacted by NW-1 which may further impact the surrounding environment. Map showing the study area for baseline study of the NW-1 is given below in **Figure 5.1**. List of the districts through which NW-1 passes is given in **Table 5.1** below.

Table 5.1 : State and Districts through which the NW-1 corridor is traversing

Sr. No.	Name of Districts	State
1.	Allahabad	Uttar Pradesh
2.	Ravidas Nagar	
3.	Mirzapur	
4.	Varanasi	
5.	Chandauli	
6.	Ghazipur	
7.	Balia	
8.	Buxar	Bihar
9.	Bhojpur	
10.	Saran	
11.	Patna	
12.	VAishali	
13.	Samastipur	
14.	Begusarai	
15.	Munger	
16.	Khagaria	
17.	Bhagalpur	
18.	Kathihar	
19.	Sahibganj	Jharkhand
20.	Pakur	
21.	Malda	West Bengal
22.	Murshidabad	

Sr. No.	Name of Districts	State
23.	Vardhman	
24.	Nadia	
25.	Hugli	
26.	North – 24 Pargnas	
27.	South – 24 Pargnas	
28.	Kolkata	
29.	Howrah	
30.	Mednipur	

It may be noted that since the study area boundaries extends up to 10 Kms for major development area / critical zone, the baseline data collection & collation gives a range observed near vicinity of alignment up to observations at district level.

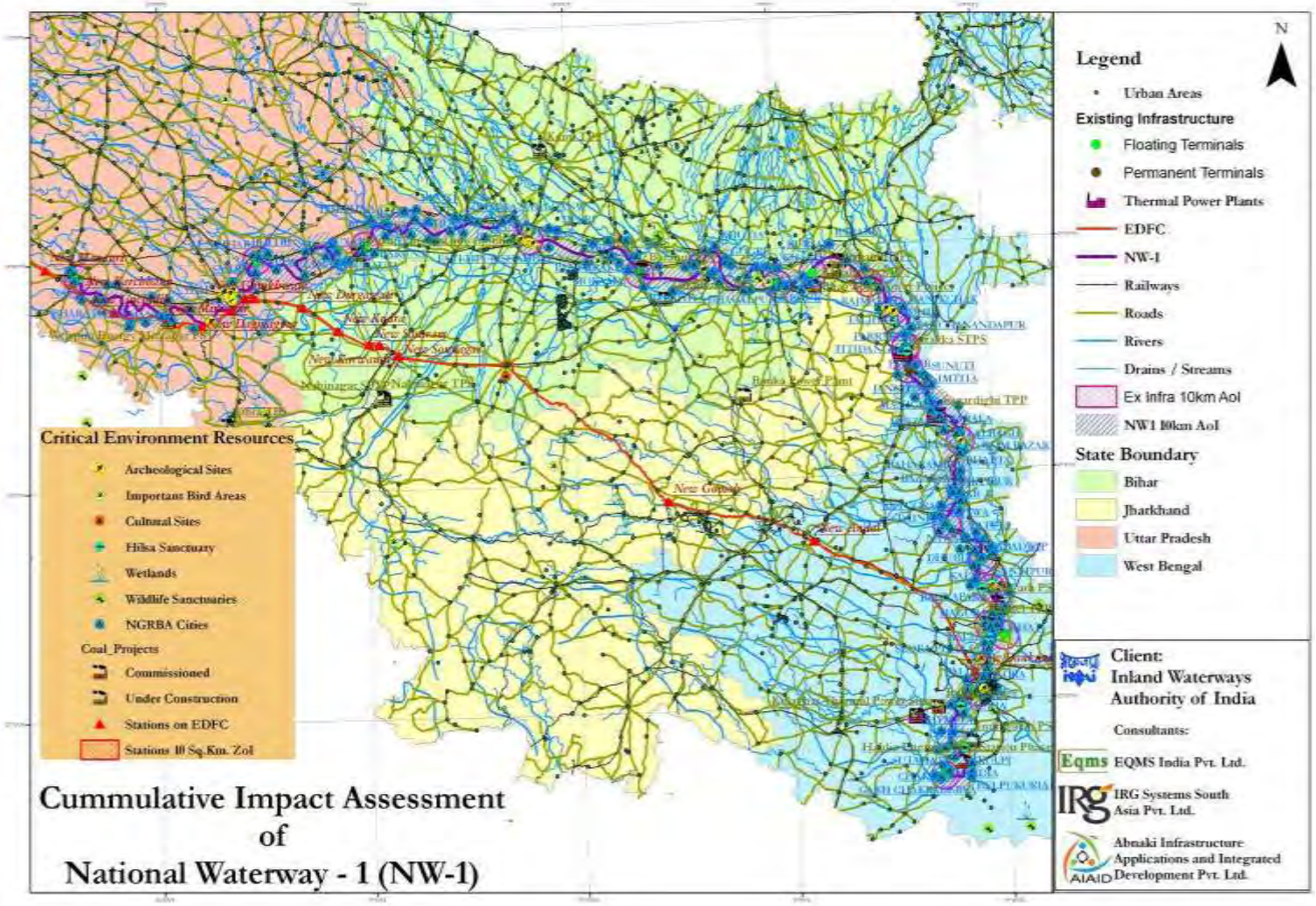


Figure 5.1 : Map Showing Baseline Study Area for NW-1

5.3. Baseline Data

Baseline data has been collected from Secondary & primary sources like existing studies, reports, and consultation with Government Departments etc. Detail of sources of the baseline study for the CIA study is listed in the **Table 5.2** below:

Table 5.2 : Sources of Data for Baseline Study for the CIA Study

Source Organization	Report/Source Name	Type of Data
CPCB & MOEF	CPCB Gazette notification dated 18.11.2009 on AAQ, Noise Notification, and BDU criteria	AAQ Standards BDU Criteria Standards Noise Standards
	Water Quality Assessment River Ganga 2013	Water Quality of NW-1 stretch
MOEF & CC	Endangered Species Brochure, 2009	Endangered Species
Indian Meteorological department	Climatological Normal 1961-1990	Met Data
	First order seismic micro zonation IMD	Seismicity and seismic map and Cyclone Hazard Prone Map
MOEF & CC	Jharkhand Wetland Atlas, Prepared by Space Applications Centre (ISRO), Ahmedabad and Institute of Environmental Studies & Wetland Management (IESWM), Kolkata)	Wetland information
MOEF & CC	Information on Wetlands	Wetland information
Central Ground Water Board	Ground Water Boucher of Project Districts	Geology, Ground water related information
Botanical Survey of India	Red Data Book of Indian Plants	RET species
Zoological Survey of India	Red data book on Indian Animal	RET species
IUCN (International Union for Conservation of Nature) 1980	Gland, Switzerland: International Union for Conservation of Nature. IUCN (International Union for Conservation of Nature) 1980.World Conservation Strategy: Regional strategies for international river basins and seas.	RET species
IWC (International Whaling Commission) 2000	Report of the standing sub-committee on small cetaceans. Journal of Cetacean Research and Management 1 (Supplement),	Cetacean fauna
Mohan, R. S. L. and Kunhi, K. V. M. 1996.	Fish oil as alternative to river dolphin, *Platanista gangetica* (Lebeck) oil for fishing catfish *Clupisoma garua* in the River Gangetic, India.Journal of the Bombay Natural History Society 93, 86-88.	Oil impact on Aquatic fauna
Gland, Switzerland: IUCN. Perrin, W.F. 1999.	Selected examples of small cetaceans at risk. Pp. 296-310 in: Conservation and Management of Marine Mammals (eds. J.R. Twiss, Jr. and R.R. Reeves) Smithsonian Institution Press,	Aquatic fauna

Source Organization	Report/Source Name	Type of Data
	Washington, DC.	
NGBRA (Indian Institutes of Technology)	GRB EMP: Ganga River Basin Environment Management Plan	Flora & Fauna
NGBRA (IIT Consortium)	Main Plan Document by Consortium of 7 Indian Institute of Technology's (IITs)	Ganga basin
NGBRA (Indian Institutes of Technology)	Status of Higher aquatic vertebrates in Ganga river (Ganga River Basin Management Plan) By Consortium of India's IIT Institutes	Higher aquatic vertebrates
NGBRA	Hilsa an assessment of in lower ganga basin (Ganga River Basin Management Plan) By Consortium of India's IIT Institutes	Fish
NGBRA (Indian Institutes of Technology)	Status of fish and fisheries in Ganga river (Ganga River Basin Management Plan) By Consortium of India's IIT Institutes	Fish
NGBRA	River Ganga at a Glance: Identification of Issues and Priority Actions for Restoration	Waterways quality
NGBRA (IIT Consortium)	Main Plan Document by Consortium of 7 Indian Institute of Technology's (IITs)	Ganga basin
Publication of BHU university	Flora of BHU	Flora
Kashi Turtle Sanctuary	Management Plan of Kashi turtle sanctuary	Turtle
Kalpavriksha	India's Notified Ecologically Sensitive Areas (ESAs)	Sensitive ecosystem
Chaudhary, S. K., Smith, B.D., Dye, S., Dye, S. And Prakash, S. 2006.	Conservation and Biomonitoring in the Vikramshila Gangetic Dolphin Sanctuary, Bihar, India. Oryx, 40 (2), 189-197	Dolphin
Quaritich. Braulik, G. 2000.	Entrapment of Indus dolphins (*Platanista minor*) in irrigation canals: incidence, implications and solutions. International Whaling Commission, Scientific Committee Document SC/52/SM9, Cambridge, UK.	Dolphin
Harison, R. J. 1972.	Reproduction and reproductive organs in *Platanista indi* and *Platanista gangetica*. Invest Cetacea.	Dolphin
Hua, Y., Zhao, Q., & Zhang G. 1989.The habitat and behavior of *Lipotes vexillifer*. In W. F. Perrin, R. L. Jr. Brownell, K. Zhou & J. Liu (Eds.)	Biology and conservation of the river dolphins Occasional Paper of the IUCN Species Survival Commission (No.3., pp. 92-98).	Conservation Dolphin

Source Organization	Report/Source Name	Type of Data
Kannan, K. Sinha, R.K., Tanabe, S., Ichihashi, H. and Tatsukawa, R. 1993	Heavy metals and organochlorine residues in Gangetic Dolphin from India. Marine Pollution Bulletin Vol. 26 No. 3 pp 159-162 Pergamon press U.K.	Heavy metal impact on Dolphin
Kannan, K., Tanabe, S., and Tatsukawa, R. And Sinha R.K. 1994.	Biodegradation capacity and residue pattern of organochlorines in Gangetic Dolphins from India. Toxicological and Environmental Chemistry.	Dolphin toxicology
Kasuya, T. 1972.	Some information on the growth of the Gangetic Dolphin with a comment on the Indus dolphin. The Scientific Reports of the Whales Research Institute	Morphology of dolphin
Mohan, R. S. L. and Kunhi, K. V. M. 1996.	Fish oil as alternative to river dolphin, *Platanista gangetica* (Lebeck) oil for fishing catfish *Clupisoma garua* in the River Gangetic, India. Journal of the Bombay Natural History Society 93, 86-88.	Oil impact on Aquatic fauna
KK Vass, S K Mandal, S Samanta, V R Suresh and P K Katiha, (CIFRI)	The Environment and Fishery status of River Ganges	Fish
Srivastava, P. And M.P. Singh, M.P. (2013)	Phenology and Biodiversity of Riparian Plant Species of Ganga River Bank at Bharwari (Kaushambi), U.P., India. Indian J.Sci.Res. 4(1)	Flora
Sahibganj Forest Division	Forest Working Plan of Sahibganj Forest Division	Flora and Fauna
Kalpavriksha	India's Notified Ecologically Sensitive Areas (ESAs)	Sensitive ecosystem
R.J. Rao Conservation Biology Lab School of Studies in Zoology Jiwaji University, Gwalior	The Diversity, Ecology and Conservation Management of Freshwater turtles in Ganges River System	Ecology & Turtles
Agriculture Department	Agriculture plans	Cropping pattern
Census of India, Govt. Of India	Census of India 2011	Census data
Census of India, Govt. Of India	District Statistics Hand Book & Village Profile of the Project Districts	Basic Amenities
Kelkar, N., Krishnamurthy J., Choudhary, S., and Sutaria, D. 2010.	Coexistence of fisheries with River Dolphin Conservation. Conservation Biology, Vol. 24 (4): 1130-1140.	Dolphin conservation
WWF-Nepal. 2006	Conservation and Management of river dolphins in Asia. Proceedings of the regional meeting on conservation and management of river dolphins. 26-27 May, Kathmandu, Nepal.	Dolphin

Source Organization	Report/Source Name	Type of Data
Forest Division	Forest Working Plan of Kashi Forest Division, Farakka Division	Flora and Fauna
Guideline, Standard and recommendations as published by Environmental Committee of PIANC	• Initial Assessment of Environmental Effect of Navigation and Infrastructure Project (WG 143-2014) • Sustainable waterway within the context of Navigation and Flood Management (WG 107-2009) • Climate Change and Navigation (TG3-2008) • Dredging Management Practices for the Environment (WG 100-2009) • Dredging Material as a Resources (WG 104-2009) • Environmental Impact Assessments of Dredging and Disposal Operation (WG 10-2006) • Biological Assessment Guidance for Dredged Material (WG 8-2006) • Ecological and Engineering Guidelines for Wetland Restoration in relation to the Development, Operation and Maintenance of Navigational Infrastructure (WG 7-2003) • Management of Aquatic Disposal of dredged material (WG 1-1998) • Dredged Material Management Guide 1997. • Guidelines for sustainable Inland Waterways and Navigation WG 6-2003 • Environmental guidelines for aquatic, near shore and upland confined disposal facilities for contaminated dredged material WG 5-2002 • Dredging the environmental facts-where to find what you need to know? PIANC-IADC-WODA brochure-2001 • Environmental management framework for ports and related industries WG 4-1999 • Dredging: the fact WODA brochure-PIANC-IADC-CEDA-IAPH1999	

5.4. Cumulative Environmental Baseline

Cumulative Environmental Baseline has been described below in terms of identified CERs, Physical features, Ecological Profile, Physical Environment Profile, Socio-economic & Archaeological / Heritage sites.

5.4.1. Physical Features

Physical features have been described in terms of land environment consisting of topography, geology, land use, soil type, soil quality and agriculture resources.

5.4.1.1 Topography

The whole NW-1 (Allahabad to Haldia) falls within a relatively flat terrain. Physiographically, it constitutes a part of the Indo-Gangetic plain, which is largely flat, featureless and is formed of recent alluvial deposits of the river Ganga and its tributaries. River erosions, change in course of rivers and human activities of recent times have played an important role in shaping the relief of the river terrain. Based on the contour of the NW-1, the Digital Elevation Model has been prepared for 10 km area around the NW-1. The Nearest

Neighbour method has been used to interpolate the elevation data to develop the elevation model. The elevation within this stretch ranges between 321 m to 1 m. Highest elevation was observed at Sahibganj area (Jharkhand), because of presence of hillocks in this area. This map depicts clearly that the elevation of waterways declines from western to eastern part towards Haldia. Digital Elevation Model of study area is shown in Figure 5.2.

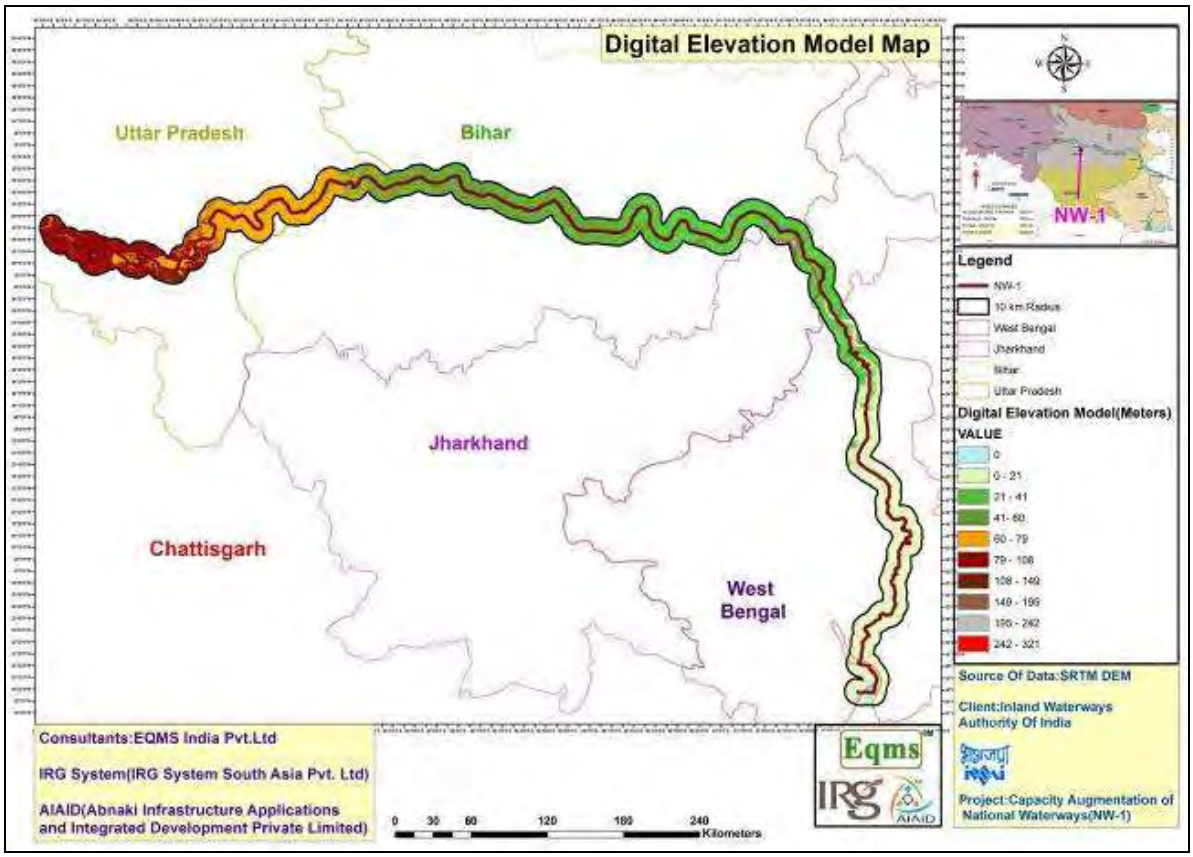


Figure 5.2 : DEM of NW-1

5.4.1.2 Drainage Pattern (Ganga River)

The Ganga River (about 2525 km long) is fed by runoff from a vast catchment area bounded by the snow peaks of the Himalaya on one side in the north and the peninsular highlands and the Vindhya Range on the other side in the south. The basin encompasses an area of more than a million square kilometres (1,186,000 Sq. km) spread over four countries: India, Nepal, Bangladesh and China. With 861,404 Sq.km within India itself, the Ganga basin is the largest river basin in India and covers approximately 25 per cent of India‘s total geographical area. The catchment area, length, total utilizable water of Ganga river basins within India and the states that they cover is given in Table 5.3. State wise distribution of drainage area of Ganga River is given in Table 5.4.

Table 5.3 : Ganga river Basin Catchment Area

Sl. No.	Length (km.)	Catchment Area (Sq. km.)	Total utilizable water
1	2525	861404 (1186000)	420.99

Source: Status paper on river Ganga, NRCD, MoEF, 2009

Table 5.4 : Distribution of the Drainage Area of Ganga River in India

Sl. No.	State	Total Geographical Area (Sq. Km)	Drainage area as Percent of Total Geographical Area
1	Uttar Pradesh & Uttarakhand	294364	34.2
2	Madhya Pradesh	198962	23.1
3	Bihar & Jharkhand	143961	16.7
4	Rajasthan	112490	13.1
5	West Bengal	71485	8.3
6	Haryana	34341	4.0
7	Himachal Pradesh	4317	0.5
8	Delhi	1484	0.2
	Ganga Basin (Total)	861404	100.0

Source: Status paper on river Ganga, NRCD, MoEF, 2009

5.4.1.3 Drainage pattern NW-1

Many tributaries of Ganga namely, the Tons, Son, Gomati, Ghaghara, Gandak, Burhi Gandak and Kosi meets NW-1 after Allahabad. Drainage pattern of the NW-1 is controlled by these rivers. By the time Ganga reach the head of its delta at Farakka (after Rajmahal) in the state of Jharkhand, its water flow and volumes increases substantially due the contribution from these tributaries. Its water quality and sediment load also fluctuate depending on the composition of the contributing stream. Beyond Farakka, the Ganga River bifurcates into the Padma and the original channel of the Ganga, known as the Bhagirathi. Therefore, the Bhagirathi is treated as the main Ganga for all purposes in West Bengal.

The Padma carries the majority of Ganga's flow, eventually turns south-eastwards into Bangladesh, while the Bhagirathi (Ganga) winds southwards down the deltaic plain of West Bengal and ultimately empties into the Bay of Bengal under the name of Hugli. Nearly halfway between Farakka and Sagar Island, the hydraulic character of the Bhagirathi (Ganga) changes upon its entry into the tidal zone of the Gangetic delta. The speed and direction of water in the estuarine streams and creeks are in continual flux due to the ebb and flow of the tides. Drainage Map of NW-1 is shown in Figure 5.3. Line diagram of the NW-1and its major tributaries is shown in Figure 5.4.

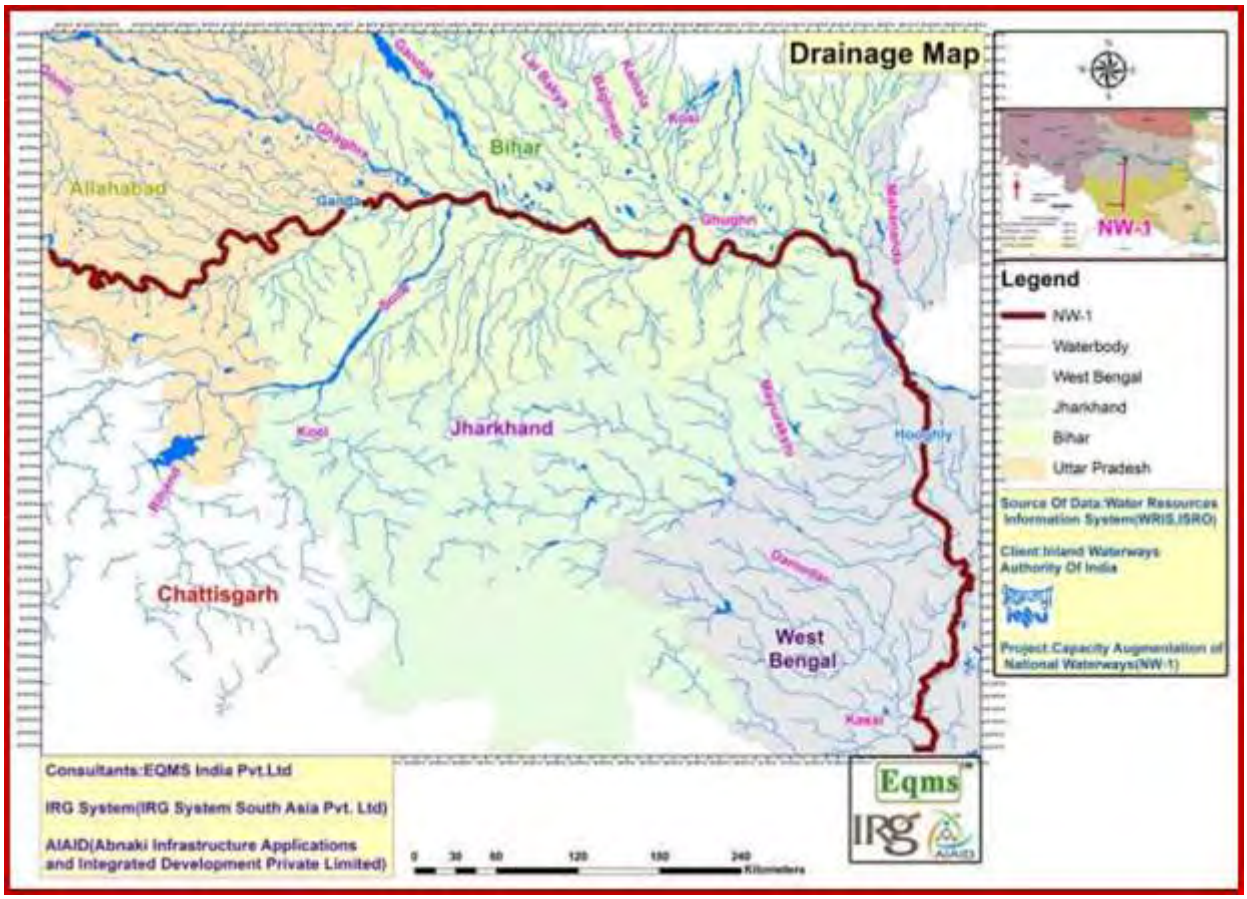
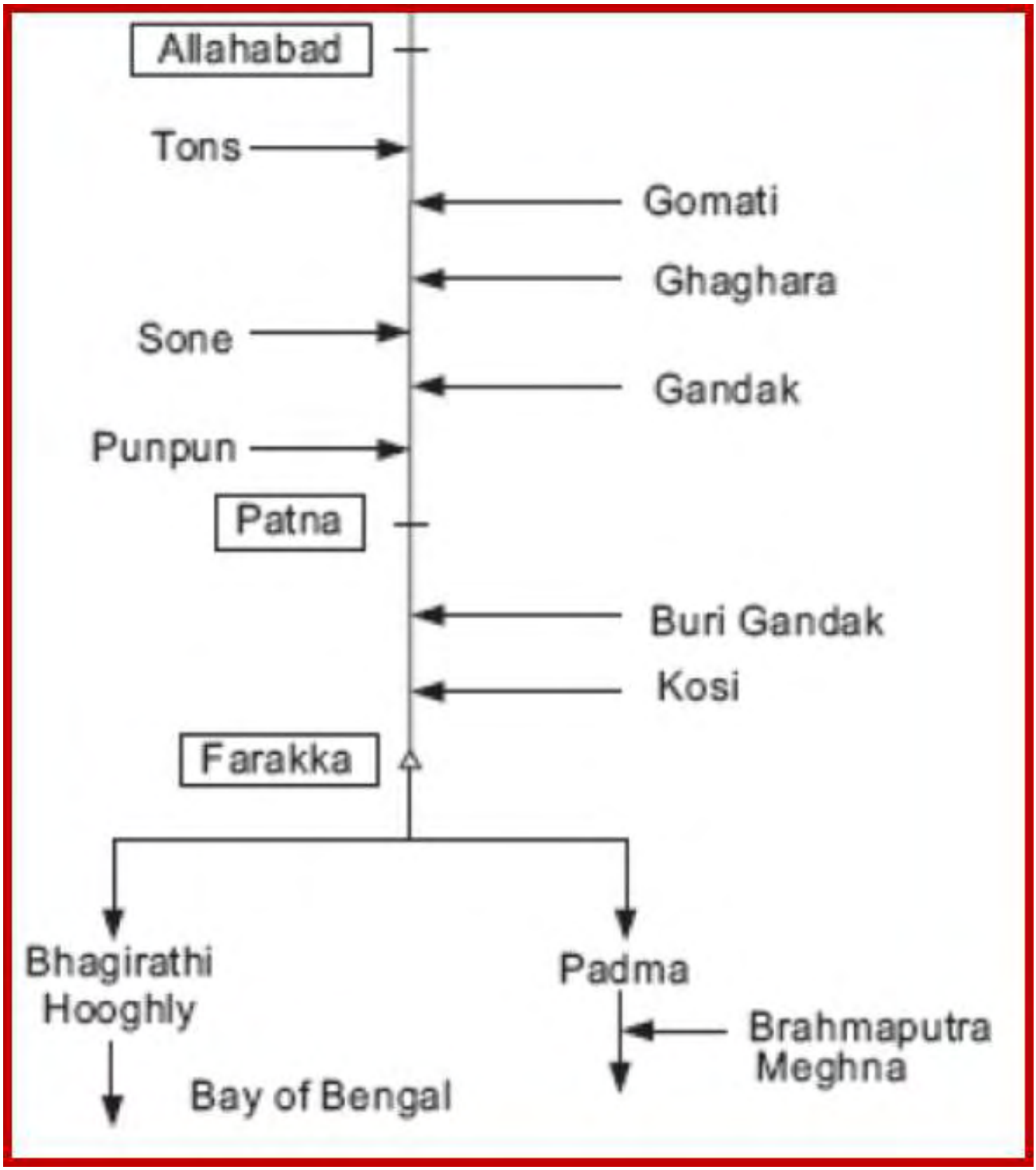


Figure 5.3 : Drainage Map of 2 Km radius of NW-1



Source: NMGC report

Figure 5.4 : Line Diagram of Ganga and its tributaries

5.4.1.4 Geology

Ganga river basin is part of the tectonically active foreland basin of the Himalayan mountain range formed by collision of the Indian tectonic plate with the Eurasian plate more than fifty million years ago. Thus, most of the area of NW-1 consists of alluvial plains formed during the Tertiary and Quaternary periods by flood deposits of Himalayan Rivers. The Ganga River network not only conveys water, but also transfers enormous amounts of eroded

Himalayan sediments to the sea. The alluvial deposits on the plain area constitute large and highly productive multi-aquifer systems in the area, which are a major storehouse of ground water. The soils of the area are also largely alluvial. Geological map of NW-1 is provided in Figure 5.5.

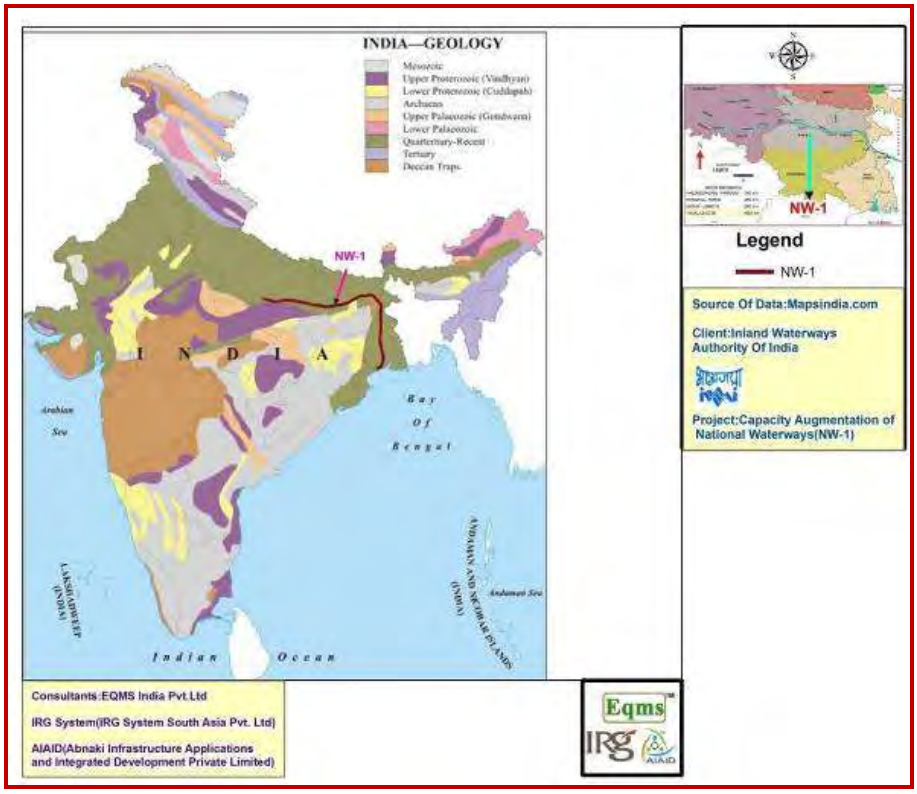


Figure 5.5 : Geological Map of India

5.4.1.5 Seismicity

As per seismic classification of India most of the NW-1stretch falls under zone-III which mean moderate seismic risk. Some stretch in Bihar state falls under zone IV which means high seismic risk. The seismic zoning map of India is shown at Figure 5.6.

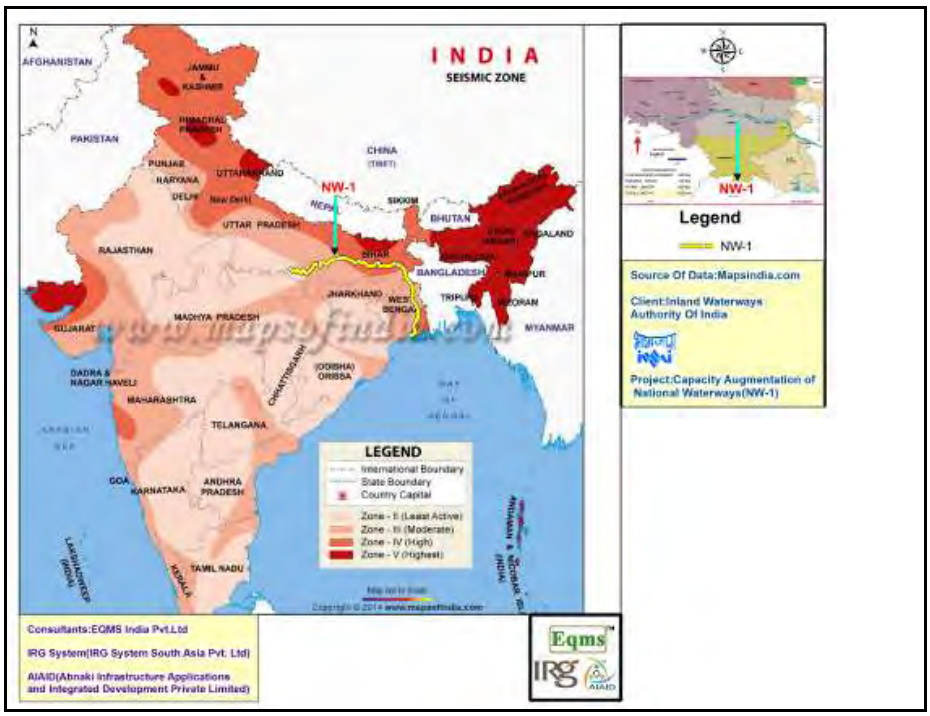


Figure 5.6 : Seismic of Zones Map of India

(Source: As per IS: 1893 Part I 2002)

5.4.1.6 Land use Pattern

NW-1 passes through states of Uttar Pradesh, Bihar, Jharkhand and West Bengal which are extensively cultivated, constituting about 10 per cent of the total area of the India. About 11 per cent of total land of NW-1 states are fallow land and 52% percent as net sown area. The cropping intensity is highest in west Bengal with 184.1 per cent followed by Jharkhand, Uttar Pradesh and Bihar. The overview of land use pattern of the sates traversed by NW-1 is given in Table 5.5.

Table 5.5 : Overview of Land use in the States traversed by NW-1

Land use	West Bengal	Jharkhand	Bihar	Uttar Pradesh	Total NW-1 States	India
Geographical Area	88750	79720	94160	240930	503560	3287260
Reporting Area for Land Utilization Statistics	86840	79700	93600	241700	501840	3056740
Forest	11740	22390	6220	16580	56930	696260
Land not Available for Cultivation	17830	13190	20830	32680	84530	432180
Total Fallow land	3310	23410	6860	19480	53060	251480
Net Area Sown	52960	15360	56650	164170	289140	1408610
Total Cropped Area	97520	23910	79100	249270	449800	1958350
Cropping Intensity (%)	184.1	155.7	139.6	151.8	157.8	139

(Source: Directorate of Economics and Statistics, Department of Agriculture 2008; indiastat.com

5.4.1.7 Land use pattern along NW-1

The land use analysis of study area (10 km area around NW-1) was carried out using remote sensing data. Systematic interpretation was carried out using a set of digitized images with color coding for delineating the land use classes. By integrating the areas demarcated under different land use/land cover as different colors are assigned to different land use/land cover types of satellite imagery6 .

The land use classes in 10 km area of the NW-1 are agricultural land, settlement, water body, forest, barren land and vegetation. It is majorly dominated by agricultural land about 78.9 % of the land is under cultivation. NW-1 also passes through many urban areas. About 7.18% land is under settlement. As per the land use data analysis about 7.21% of the land is under water bodies, about 3.59% land is under vegetation, 2.82% land is under dry river bed and rest of the land falls under other uses (refer Table 5.6).

Table 5.6 : Land use of the Study Area

Sl. No.	Class	Area(KM^2)	Percent (%)
1	Agricultural Land	19767.57	78.90
2	Water body	1805.8	7.21
3	Vegetation	899.94	3.59
4	Settlement	1799.93	7.18
5	Dry River Bed	705.76	2.82
6	Open Land(Non Agri. Land)	76.01	0.30
Total		25055.01	100.00

Source: Satellite Image Analysis

The land use map of different sections of the NW-1 is shown in Figure 5.7 to 5.9.

6: The satellite Imagery of Indian Remote Sensing Satellite (IRS- ID, sensor P6, LISS III) of 24 m resolution was used. The Swath of the imagery is 141 Km x 141 Km. Band used are 4, 3, 2 and 5. LANDSAT imagery of 30 m resolution and 185 x 185 km swath is also used for the comparative and overall analysis of the area. LISS III imagery and LANDSAT 4-5 TM imagery were used for the complete coverage of the study area

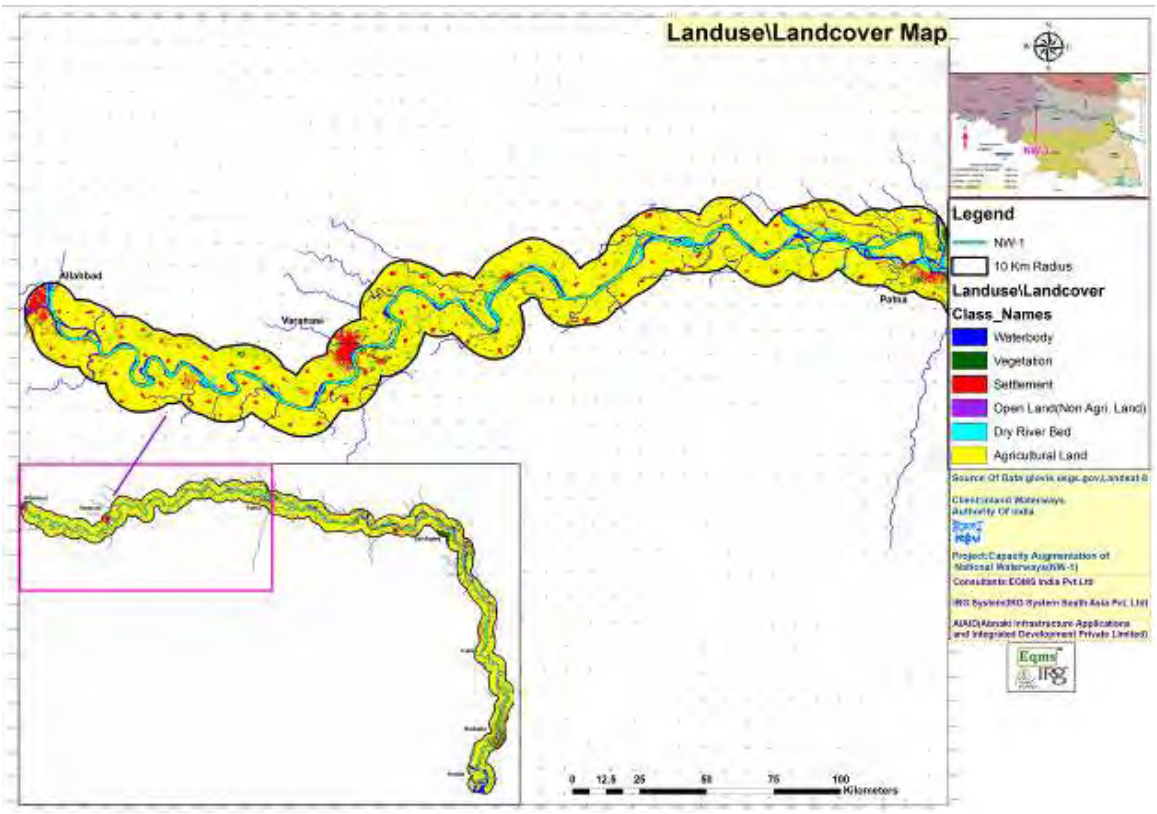


Figure 5.7 : Land use Map (Allahabad to Patna)

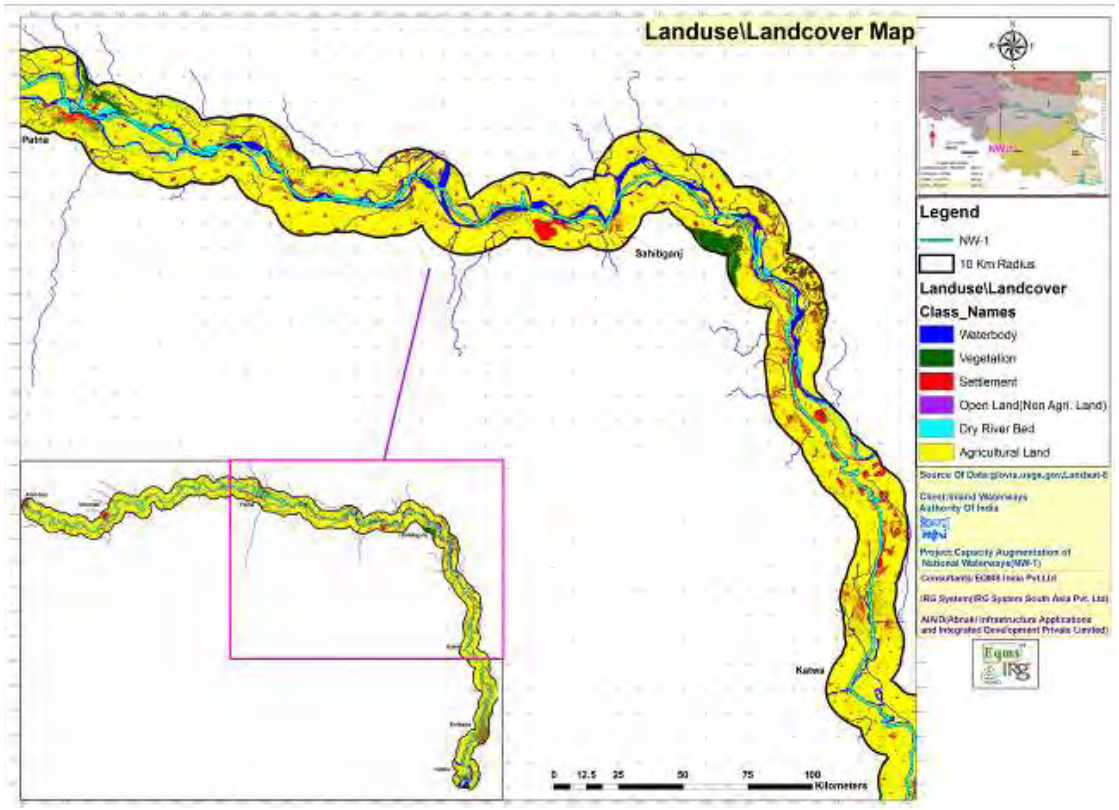


Figure 5.8 : Land use Map (Patna to Katwa)

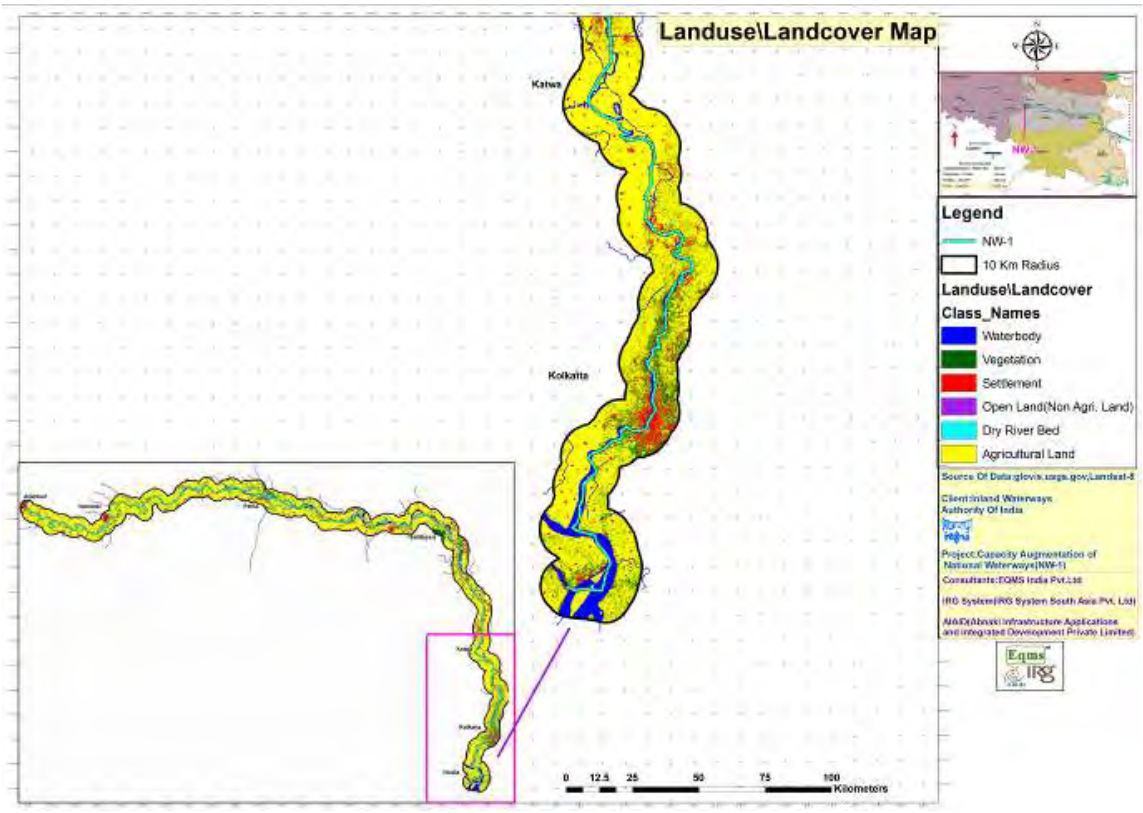


Figure 5.9 : Land use Map (Katwa to Haldia)

5.4.1.8 Soil Type / Quality

The soil along the NW-1 is alluvial type. As per 'USDA' Triangular Classification System, overall soils of all the sampling locations along NW-1 can be described as Sandy Clay and Clay Loam type. Bulk Density of soils along NW-1 was found in the range of 1.25 to 1.48-gm/cc. Porosity of soils was observed between 44.2 to 52.8%. Water Holding Capacity (WHC) of the soils varied between 28.9-33.8%.

Chemical analysis of the soils are generally neutral to slightly alkaline nature with pH ranging from 6.62-7.86 at all locations along with NW-1". Electrical Conductivity (EC) was found varying between 135.4-360.5-µmhos/cm and found with acceptable range. Available nitrogen content in the surface soils along NW-1 stretch ranges between 226.4& 345.5-kg/ha thereby, indicates that soils are low to medium for available nitrogen content. Phosphorous take part in important functions like photosynthesis, nitrogen fixation, crop maturation, root development, strengthening straw in cereal crops etc. Available phosphorus content ranged between 16.2-32.4-kg/ha thereby indicating that soils are low in phosphorus in Jharkhand zone, medium in Uttar Pradesh and is on higher side in the soils of West Bengal. Potassium is an activator of various enzymes responsible for plant processes like energy metabolism, starch synthesis, nitrate reduction and sugar degradation. It is also important in grain formation and tuber development and encourages crop resistance for certain fungal and bacterial diseases. Available potassium content in these soils at sampling locations ranged between 116.5-267.9-kg/ha thereby indicating that the all sampled soils were medium category of available potassium. Cation Exchange Capacity (CEC) was found in the range of 9.6 to 22.5-meq/100-gm at all locations along with NW-1. Range of copper, zinc, Chromium, Lead and other micronutrients were observed in normal range. Overall soil type / quality along the NW-1 area is of moderately fertile and not expected to be detrimental to the growth of agricultural and forest crops. It can be

concluded that soils fall within medium fertility levels in the entire stretch of NW-1 and forms the basis of agriculture resources / cropping pattern.

5.4.1.9 Cropping Pattern

The Ganga River with its fertile soil is having a great influence to the agriculture based economies of adjoining district along the NW-1. The Ganges and its tributaries provide a constant source of irrigation water catering to the agricultural needs of an extensive area along the NW-1. The major crops cultivated in that area include rice, lentils, sugarcane, potatoes, oil seeds and wheat. Along the banks of the river, the existence of swamps and lakes also provide a rich fertile soil for crops like legumes, chillies, sesame, mustard, sugarcane, and jute.

5.4.1.10 Major Habitation along the NW-1

The major habitation located along NW-1 are Allahabad, Sirsa, Mirzapur, Chunar, Varanasi, Zamania, Ghazipur, Gahmar, Buxar, Ballia, Chapra, Patna, Barh, Bihat, Munger, Bhagalpur, Kahalgaon, Sahibganj, Farakka, Berhampore, Katwa, Kalna, Kolkata and Haldia.

Assessment of land resources indicates land use change particularly diversion of agriculture land for urbanization industries & infrastructure development. Though it is an ongoing phenomena, any new infrastructure development intervention is expected to accelerate it.

5.5. Ecological Profile Ecological Profile

5.5.1. Biological Environment (NW-1)

This Section provides detail of terrestrial and aquatic environment along NW-1, and influence area around NW-1. Ecological profile of the area has been described in terms of biogeographic zone followed by terrestrial & aquatic flora & fauna and the critical environmental resources.

5.5.1.1 Ecological Profile - Biogeographic Zone

Biogeographic zone indicates area of animal and plant distribution having similar or shared characteristics throughout. NW-1 falls largely under Gangetic Plain Biogeographic zone (7) 7 and small section under Coast Biogeographic Zone (8). Biogeographically, the NW-1 falls in Gangetic plain Biogeographic zone which is divided in two biotic provinces namely Upper Gangetic plain (7A) and Lower Gangetic plain (7B)8.

Gangetic Plain Zone (7A and 7B) consists of plains of UP, Bihar, West Bengal which is most fertile having alluvial soil. It is mostly under crop having very little forest cover. The trees belonging to these forests are teak, sal, shisham, mahua, khair etc.

7: Biogeographic classification is India is the division of India according to biogeographic characterstics. It is based on distribution of species (biology), organism and in ecosystem in geographic space. There are ten biogeographic zones in India namely 1. Trans Himalayan Zone, 2. Himalayan Zone, 3. Desert Zone, 4, Semiarid zone, 5. Western ghat zone, 6. Deccan Plateau Zone 7. Gangetic Pl ain Zone, 8. North East Zone, 9. Coastal Zone 10. Island present near the shore line zone.

8: Biogeographic classification of India was done by Rodgers and Panwar (1988), describing 10 biogeographic zones in India, further divided into 25 biogeographic provinces. The maps were further revised by Rodgers, Panwar and Mathur (2002), using GIS techniques into 10 zones and 26 provinces. The classification was done using various factors such as altitude, moisture, topography, and rainfall.

Zone 8 (B) consists of Coastal belts of east coasts, higher rainfall, and exposure to cyclones near sea coast, rich in flora and fauna exactly replicating the peninsular type of vegetation near estuary areas.

Biodiversity of study area & NW-1 uniquely synthesizes two different eco-regions of India situated along climatic gradients, namely, the Gangetic plains and the Deltaic regions in line with its Biographic classification. The unique biodiversity in the study area has been summarized in terms of Forest types and Critical Environmental Resources. The river's biodiversity comprises periphytons, phytoplanktons and macrophytes which are consumers in the trophic level of energy pyramid and thus the real commercial products at tertiary level of food chain.

5.5.1.2 Forest type

Data on forest and tree cover in states9 traversed by NW-1 indicates that forest and tree cover is highest in Jharkhand (32.74% of total geographical area) followed by West Bengal (21.35%), Bihar (10.04%) and Uttar Pradesh (8.82%) as given in Table 5.7. Reserved forest map in the state traversed by NW-1 is provided in Figure 5.10. No portion of NW-1 and intervention areas falls under any reserved forest or normal forests area.

Table 5.7 : State-wise Forest and Tree Cover in study area and State Traversed by NW-1

State	Geographical Area (Sq. km)	Forest and Tree Cover					% of Geographical Area of the State	Biogeographic Zone and chainage of NW-1
		Very Dense Forest (Sq. km)	Moderately Dense Forest Cover (Sq. km)	Open Forest (Sq. km)	Tree Cover (Sq. km)	Total (Sq. km)		
West Bengal	88,752	2971	4146	9688	2144	18949	21.35	7B (NW-1 indicative chainage 583)
Jharkhand	79,714	2587	9667	11,219	2629	26,102	32.74	7B (NW-1 indicative chainage 583-1547)
Bihar	94,163	247	3380	3664	2164	9455	10.04	7B NW-1 chainage indicative 583-1547
Uttar Pradesh	240,928	1623	4550	8176	6895	21,244	8.82	7A NW-1 Indicative chainage 583-1547
(Total)	503,557	7,428	21,743	32,747	13,832	75,750		

9State of Forest Report, 2013

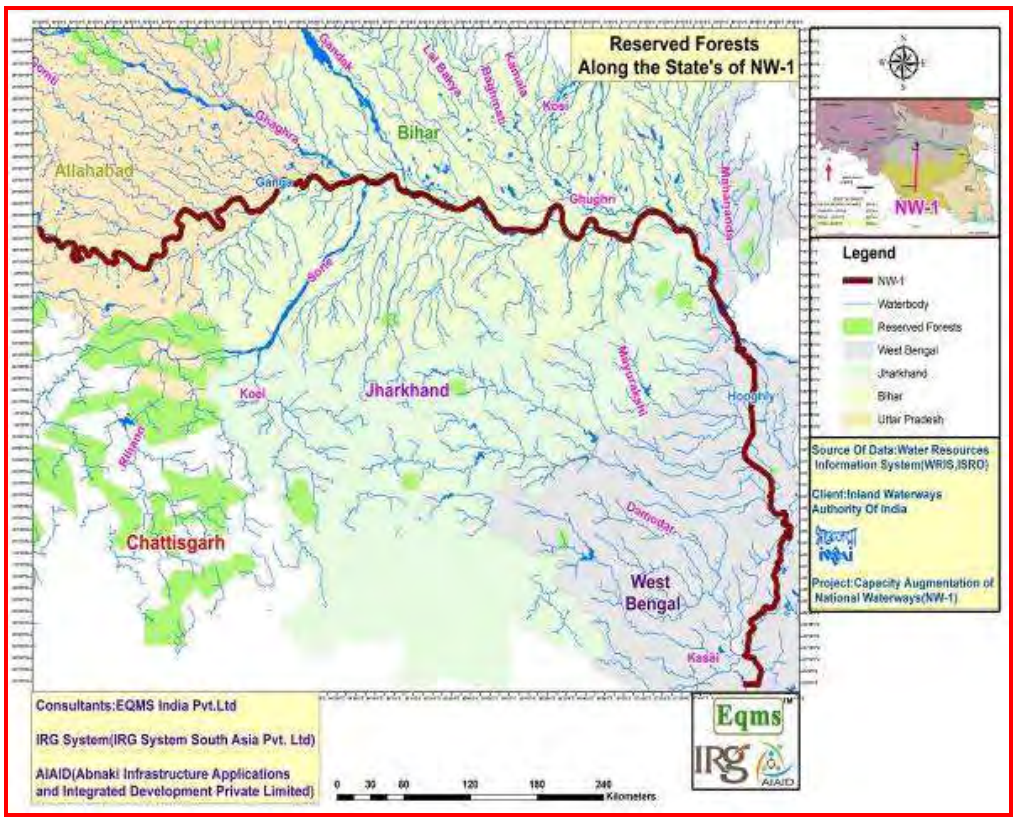


Figure 5.10 : Reserve Forest Map of States Traversed by NW-1

The forest cover directly and indirectly impacts the quality as well as quantity of waters of the rivers in the whole Indo-gangetic plain, besides the sedimentation patterns through soil erosion levels.

Therefore, within 10 km of influence area, forest cover (if any) need to be conservec.

5.5.1.3 Critical Environmental Resources in Project Area (NW-1)

The critical Environmental Resources (CERs) namely Biosphere Reserves, Wildlife Sanctuaries, National Parks, wetlands, Tiger Reserves, Important bird areas, and Breeding and nesting grounds for aquatic species (Schedule-I species) are identified and mapped for entire NW-1 stretch due their importance for providing suitable habitats for wildlife, humans, and their role in sustaining ecological functions. There are 2 wildlife Sanctuaries, and four Hilsa Fish sanctuaries are located within river boundary of NW-1 stretch. Udhwa bird sanctuary and 5 other important bird areas are also located within 10 km radius of NW-1 stretch. Details of CER's along NW-1 are described below.

5.5.1.4 Wildlife Sanctuaries within NW-1

There are two notified wildlife sanctuaries namely Kashi Turtle Sanctuary and Vikramshila, Dolphin Sanctuary under Wildlife Protection Act, 1972 (amended as on date) and 4 Hilsa Sanctuaries located within the NW-1. Hilsa Sanctuaries have been notified under West Bengal inland Fisheries Rules, 1985 to propagate Hilsa Fish production. Salient features of the wildlife sanctuaries (refer Table 5.8) along with flora and fauna details is described in following sections.

Table 5.8 : Salient features of Wild life Sanctuaries present within NW-1

Sr. No.	State	Wildlife Sanctuary	Protection status	Applicability of Wild life act for NW-1 operations	Applicability of Forest act for NW-1 operations	Regulated buffer Zone (Km radius)
1	UP	Turtle sanctuary, Varanasi	Protected under Wildlife Protection Act, 1972 (amended as on date)	Yes	No	10
2	Bihar	Vikramshila Gangetic Dolphin, Sultanganj to Kahalgaon pahad	Protected under Wildlife Protection Act, 1972 (amended as on date)	Yes	No	10
3	West Bengal	Hilsa Sanctuary	West Bengal inland Fisheries Rules, 1985 to facilitate spawning of Hilsa,	No	No	10

Note: ESZ have not been notified for above sanctuaries hence default area of 10 km from the boundary of sanctuary is considered as the Eco-sensitive zone (ESZ)

Description of each wildlife sanctuary is given in **Annexure 5.1.**

5.5.1.5 Important Bird Area within 10 km area of the NW-1

Seven Important Bird Areas (IBAs)[10] have been identified along NW-1 stretch because they support important congregations of water birds (**Table 5.9**). None of these areas are protected area except Vikramshila Gangetic Dolphin Sanctuary and Udhwa Lake Bird Sanctuary areas.

Table 5.9 : Important Bird Area within 10 km area of the NW-1

Sr. No.	Name of State	Important Bird Area in Ganga Basin	Coordinates	Protection status	Migration period for Birds	Distance from NW-1 (km)
1	Bihar	Danapur cantonment area	25°39'N 85°02'E	Officially Not protected	Winter	2 km S
2		Kurseala River Course and Diyara Flood Plains	25°27'N 87°15'E	Officially Not protected	Winter	2 km E along NW-1

10 These IBAs have been identified by Bird Life International under its BirdLife Important Bird and Biodiversity Area (IBA) Programme

Sr. No.	Name of State	Important Bird Area in Ganga Basin	Coordinates	Protection status	Migration period for Birds	Distance from NW-1 (km)
3		Mokama Taal (Barah) Wetlands	25°28'N 85°42'E	Officially Not protected	Winter	Close to NW-1
4		Vikramshila Gangetic Dolphin Sanctuary	25°17'N 86°56'E	Protected as Wildlife Sanctuary under Wildlife Protection Act, 1972 (as amended till date).	Winter	Within NW-1
5	Jharkhand	Udhwa Lake Bird Sanctuary	25°0'N 87°49'E	Protected as Wildlife Sanctuary under Wildlife Protection Act, 1972 (as amended till date).	Winter	9 km W
6	West Bengal	Farakka Barrage and adjoining area	24°48' to 14.05"N, 87°55' to 44.28"E	Officially Not protected	Winter	Surrounding NW-1

Description of important bird areas is given in **Annexure 5.1**.

5.5.2. Terrestrial biodiversity along NW-1 stretch of River Ganga

Terrestrial Biodiversity describing riparian flora of the Ganga for NW-1 has been reported state wise into two main stretches of Allahabad to Farakka stretch and Berhampur to Haldia stretch.

In Uttar Pradesh, the Allahabad belt up to Gazipur is relatively sparsely occupied with variety of trees which are equally well present up to Farakka belt. However, the density of flora is relatively thin in U.P. & Bihar areas as compared to Jharkhand and West Bengal region. The Allahabad to Balia region comprises about 41 varieties of macrophytes in which some species like Ruellia prostrata, Amaranthus spinosus, Calotropis procera and Polygonum plebeium are present along the bank of river. Tree cover is formed by the Sal (Shorea robusta), Teak (Tectona grandis), Sheesham (Dalbergia sissoo), Mango (Mangifera indica), Neem (Tamarindus indica), Banyan (Ficus sp.), Peepal (Ficus religiosa), Jamun (Syzygium cumini), Mahua (Madhuca longifolia) and Semal (Bombax ceiba).

The riparian flora in Bihar, region is comprises of 7 shrubs species, 41 herbs species, 6 grasses and sedges species, besides these a number of tree species along the banks of river is reported. The tree species in the stretch is mainly composed of Shorea robusta, Diospyros melanoxylon, Boswellia serrata, Dalbergia sissoo, Tamarindus indica Terminalia tomentosa, Terminalia bellirica, Terminalia arjuna, Pterocarpus marsupium, and Madhuca indica. 23 families comprising of 48 species in Diara land of Ganga and its tributaries are reported. The important species of this land are Justicia peploides, Rauwolfia serpentina, Eclipta prostrata, Leucas aspera, Desmodium gangeticum, Lippia javanica and Scoparia dulcis.

From Munger to Farakka about 212 macrophytes have been reported along the river Ganga. From Bally to Bandel about 32 species of macrophytes have been reported which includes 7 species of Asteraceae, 4 species of Euphorbiaceae, 2 of Amaranthaceae and 3 of Cyperaceae, 2 of Polygonaceae and 1 of Poaceae. Tree species is mainly comprises of Semal (Bombax ceiba), Mango (Mangifera indica), Peepal (Ficus religiosa), Neem (Tamarindus indica), Jackfruit (Artocarpus heterophyllus) and Pakur (Ficus lacor). Other Macrophytes comprises Adhatoda zeylanica, Barleria prionitis, B. cristata, Dipteracanthus

prostratus, Hygrophila auriculata, Achyranthes aspera, Alternanthera pungens, A. sessilis, Amaranthus spp, Chenopodium album, Centella asiatica, Rauvolfia serpentina, Calotropis procera, Leptadenia reticulata, Asparagus spp., Oroxylum indicum, Cannabis sativa, Cyperus rotundus, Hydrilla verticillata, Marsilea minuta.

Farakka to Haldia: The climatic condition of this region is humid, subtropical, and tropical. Humidity is less near Farakka as compared to Haldia. Farakka to Nawadip the riparian flora is similar as in Bihar stretch as it is freshwater flora zone. After Nawadip the salinity increase in river water due to estuarine affect the change in riparian flora is noticed. The tree species is mainly comprised of Semal (Bombax ceiba), Mango (Mangifera indica), Peepal (Ficus religiosa), Neem (Tamarindus indica), Jackfruit (Artocarpus heterophyllus) and Pakur (Ficus lacor). Other macrophytes (aquatic and semi aquatic) is Alternanthera philoxeoroides, Amaranthus spinosus, Blumea lacera, Eclipta alba, Grangea maderaspatana, Tridax procumbens,Vernonia cinerea, Xanthium strumarium, Nasturtium indicum, Chenopodium indicum, Juncellus sp., Cyperus sp., Sida rhombifolia, Chrozophora plicata, Croton bonpandianum, Boerhavia repens, Polygonum sp and Chrozophora plicata.

5.5.2.1 Aquatic Biodiversity in NW-1

The Allahabad to Farakka segment of River Ganga (LG-A) comprises a fresh water zone of 701 km. The floral and faunal diversity comprises phytoplankton, zooplankton, zoo-benthos including macro-invertebrates, fish and higher vertebrates. Phytoplankton is represented by total of 270 taxa (91 sp. of Chlorophyceae, 81 sp. of Bacillariophyceae, 78 sp. of Cyanophyceae, 8 sp. of Euglenophyceae, 3 sp. of Chrysophyceae, 3 sp. of Xanthophyceae, 2 sp. of Dinophyceae, 2 sp. of Rhodophyceae, 1 sp. of Cryptophyceae, 1 sp. of Synurophyceae). Zooplankton comprises of Protozoans (8 sp.), Rotifers (26 sp.) and Crustaceans (5 sp. of Copepods and 13 sp. of Cladocerans). In this stretch all groups are represented though are low in specific composition. The stretch supports the zoobenthos i.e. Insects (43%), Annelids (21%) and Molluscs (36%). Nematodes are also reported in the stretch. Fish in the stretch is represented by total of 121 species belonging to 35 families. Thirty five commercially important fishes are included in the taxa along with six invasive species. Beside the preponderance of fish species in this zone, an aquatic mammal, Gangetic dolphin is also present in the Bihar stretch. Fresh water turtle were also reported in Kashi turtle sanctuary area.

286 km of stretch of Lower Ganga downstream of Farakka up to Haldia consist of Phytoplankton, Zooplankton, Macrobenthos, Nekton, Macrofauna and Angiosperms. Phytoplankton distribution in this stretch is represented by 641 algal species (Cyanophyceae 280 taxa; Chlorophyceae 206 taxa; Bacillariophyceae 115 taxa; Rhodophyceae 17 taxa; Dinophyceae 14 taxa; Xanthophyceae 4 taxa; Euglenophyceae 3 taxa; Phaeophyceae 2 taxa) under 169 genera. The dominant algal species in lower Ganga is Cyanophyceae followed by Chlorophyceae. The zooplankton communities in lower Ganga basin are represented by members of Cnidaria (25 taxa), Rotifera (102 taxa), Copepod (26 taxa), Cladocerans (53 taxa) and larval forms of Decapods and Cyclopods.. Macrobenthos and Macro-invertebrates constitute Annelida (90 taxa), Arthropoda (Total 476 taxa;240 species of Crustaceans, 33 species of Arachnids, 201 species of insects and 2 species of Merostomata), Mollusca (Total 68 taxa) and Echinodermata (17 taxa). The Ichthyo-fauna is represented by 175 species, out of which 103 species, under 69 genera and 37 families are strictly estuarine in nature. The higher aquatic vertebrates observed in this stretch during study period are represented by turtles and dolphins.

The higher aquatic vertebrates present in NW-1 stretch (Allahabad to Haldia area are only Gangetic dolphin (Platanista gangetica gangetica) and turtle species. However the

population dynamics vary for this beautiful mammalian species at different location. List of flora and fauna observed in NW-1 Strech (Allahabad to Haldia) is given in Annexure-?

5.5.2.2 Phytoplanktons & Zooplanktons Observed in Sanctuary Area along NW-1

Primary observations and existing literature cites that the Ganga river system has a rich diversity of both types of planktons i.e. phyto-plankton and the Zooplankton, though the diversity varies on account of local anthropogenic impacts from station to station. The diversity of planktons is slightly high in Hilsa Sanctuary than Kashi Turtle sanctuary and Vikramshila dolphin sanctuary area. The list of phytoplankton and zooplanktons, observed in Kashi Turtle sanctuary, Vikramshila Dolphin Sanctuary and Hilsa Sanctuary area along NW-1 is given in **Table 5.10** and **Table 5.11**.

Table 5.10 : Phytoplankton observed at Sanctuary Area along NW-1

Sr. No.	Taxa	Kashi Turtle Sanctuary Area	Dolphin Sanctuary Area	Hilsa Sanctuary area
Phytoplankton				
Bacillariophyceae				
1	Amphora sp.	+	+	+
2	Amphipleura	+	+	+
3	Achnanthes sp.	-	+	+
4	Asterionella sp.	+	+	+
5	Bacillaria sp.	-	+	+
6	Biddulphia sp.	+	+	+
7	Brebissonia sp.	-	+	+
8	Caloneis sp.	+	+	+
9	Ceratoneis sp.	-	+	+
10	Coconeis sp.	-	-	+
11	Chaetoceros sp.	+	+	+
12	Cosinodiscus sp.	-	+	+
13	Cyclotella sp.	+	-	+
14	Cymatopleura sp.	-	+	+
15	Cymbella sp.	+	+	+
16	Denticula sp.	+	+	+
17	Diatoma sp.	+	+	+
18	Diatomella sp.	-	+	+
19	Epithelmia sp.	-	+	+
20	Fragilaria sp.	+	+	+
21	Frustulia sp.	+	-	+
22	Gomphoneis sp.	-	+	+
23	Gyrosigma sp.	+	+	+
24	Hantzchia sp.	-	+	+
25	Melosira sp.	+	+	+
26	Meridian sp.	-	+	+
27	Navicula sp.	+	+	+
28	Nedium sp.	-	+	+
29	Opephora sp.	-	-	-
30	Pinnularia sp.	+	-	+
31	Pleurosigma sp.	+	+	+

Sr. No.	Taxa	Kashi Turtle Sanctuary Area	Dolphin Sanctuary Area	Hilsa Sanctuary area
32	Rhicosphenia sp.	-	+	+
33	Stephanodiscus sp.	-	+	+
34	Surirella sp.	-	+	+
35	Tabellariasp	-	+	+
36	Tetracylus sp.	+	-	+
Chlorophyceae				
37	Actinastrum sp.	+	+	+
38	Chlamydomonas sp.	-	+	+
39	Chlorella sp	+	+	+
40	Chlorococium sp.	-	+	+
41	Cladophora sp.	+	+	+
42	Closterium sp.	+	+	+
43	Coelastrum sp.	+	+	+
44	Conococcus sp.	+	-	+
45	Cosmarium sp.	_	+	+
46	Desmidium sp.	-	+	+
47	Eudorina sp.	+	+	+
48	Gonatozygon sp.	-	+	+
49	Gonium sp	+	+	+
50	Hormidiumsp	+	+	+
51	Hydrodictyon sp.	-	+	+
52	Microspora sp	+	+	+
53	Oedogonium sp.	+	+	+
54	Pandorina sp.	+	+	+
55	Pediastrum sp.	+	+	+
56	Spirogyra sp.	+	+	+
57	Tetraspora sp.	-	-	+
58	Ulothrix sp.	+	+	+
59	Zygnema sp	-	+	+
60	Debaryasp	-	+	+
61	Mesotaeniumsp	-	+	+
62	Stigecloniumsp	-	+	+
63	Tetradesmussp	-	-	+
64	Rhizocloniumsp	-	+	+
Cyanophyceae				
65	Spirulina sp	+	+	+
66	Rivularia sp.	+	+	+
67	Schizothrix sp.	+	+	+
68	Phormidium sp.	+	+	+
69	Oscillatoria sp.	-	+	+
70	Anabaena sp.	+	-	+
71	Calothrix sp.	+	+	+
Xanthophyceae				
72	Bumillaria sp.	+	+	+
73	Chlorobotrys sp.	+	+	+
74	Tribonema sp.	-	-	+
75	T. bombycinum	-	+	+
76	Voucheria sp.	-	-	+

Sr. No.	Taxa	Kashi Turtle Sanctuary Area	Dolphin Sanctuary Area	Hilsa Sanctuary area
Euglenophyceae				
77	Astasis sp.	+	+	+
78	Euglena sp.	+	+	+
79	Peronia sp.	+	+	+
80	Phacus sp.	+	+	+
Rhodophyceae				
81	Bostrychia radicans	-	-	+
82	Catenella impudica	-	+	+
83	Ceramium elegans	-	-	+

Table 5.11 : Zooplanktons observed at Sanctuary Area along NW-1

Sr. No.	Zooplankton Group/Species	Kashi Turtle Sanctuary Area	Dolphin Sanctuary Area	Hilsa Sanctuary area
Protozoa				
1	Arcella sp.	+	+	+
2	Chilodonella sp.	+	+	+
3	Difflugiia sp.	+	+	+
4	Globigerina sp.	+	+	+
5	Holophrya sp.	+	+	+
6	Noctiluca sp.	+	+	+
7	Paramecium sp.	-	+	+
8	Spathidium sp.	+	+	+
9	Sphenoderia sp	+	+	-
10	Tintinnopsis sp.	+	-	+
11	Vorticella sp	-	+	+
12	Rotifera			
13	Anura sp.	+	+	+
14	Asplanchna sp.	+	+	+
15	Brachionus sp.	+	+	+
16	Filinia sp.	+	+	+
17	Horaella sp.	+	+	+
18	Keratella sp.	+	+	+
19	Lecane sp.	-	+	+
20	Notholca sp.	+	+	-
21	Rotaria sp.	+	+	+
22	Testudinella sp	-	+	+
Copepoda				
23	Cyclops sp.	+	+	+
24	Diaptomus	+	+	+
25	Nauplii	-	+	+
Cladocera				
26	Bosmina sp	+	+	+
27	Ceriodaphnia sp.	+	-	+
28	Cydorus sp.	+	+	-
29	Daphnia sp.	-	+	+

Sr. No.	Zooplankton Group/Species	Kashi Turtle Sanctuary Area	Dolphin Sanctuary Area	Hilsa Sanctuary area
30	Diphanosoma sp.	-	+	+
31	Moina sp	-	+	+
32	Simocephalus sp	+	+	+

Phytoplankton group reported from the above sampled locations are Bacillariophyceae, Chlorophyceae, Cyanophyceae, Xanthophyceae and Euglenophyceae members. Dominance of Bacillariophyceae members is followed by Chlorophyceae and Cyanophyceae was observed in studied sampling locations. However the diversity of the phytoplankton group is high in Hilsa sanctuary area followed by Dolphin Sanctuary and Kashi Turtle sanctuary area. Among the zooplankton group, Brachionous sp.(Rotifera) had highest percentage composition and the lowest percentage composition was of Asplanchana sp.

5.5.2.3 Breeding and Spawning

Fish Breeding and Spawning: Generally, fish breeding and spawning is most frequent in monsoon season (July to September). A field study was conducted during mid-June 2015 to September 2015. It was found that spawning grounds of fishes are generally located in shallow parts of river meandering sites, where water current is slow and depth is around 5-10 cm. The genera of cat fish families like Mystus, Wallago and Clarias make a nest type breeding niche, which is looked after by male and where after a little time courtship female lays its spawn followed by the release of milt leading to fertilization. .As per the situation, a small exploratory assessment was done to know the availability of fish spawn/ larvae along the study stretch using spawn collection nets during study period. The cone shaped spawn collection nets were fixed against the water flow along the right and left edges of the NW-1 at each selected sampling site, for a duration of half an hour. The mass of spawn/larvae collected varied from site to site and were a mixture of different species of fishes distributed in the particular sites and the study indicated that fishes were breeding throughout the river stretch and the larvae and the spawns were abundant near river meandering points and shallow zones. The map showing likely breeding and spawning grounds at different stretch along the NW-1 is given in **Figure 5.11** to **Figure 5.14**.

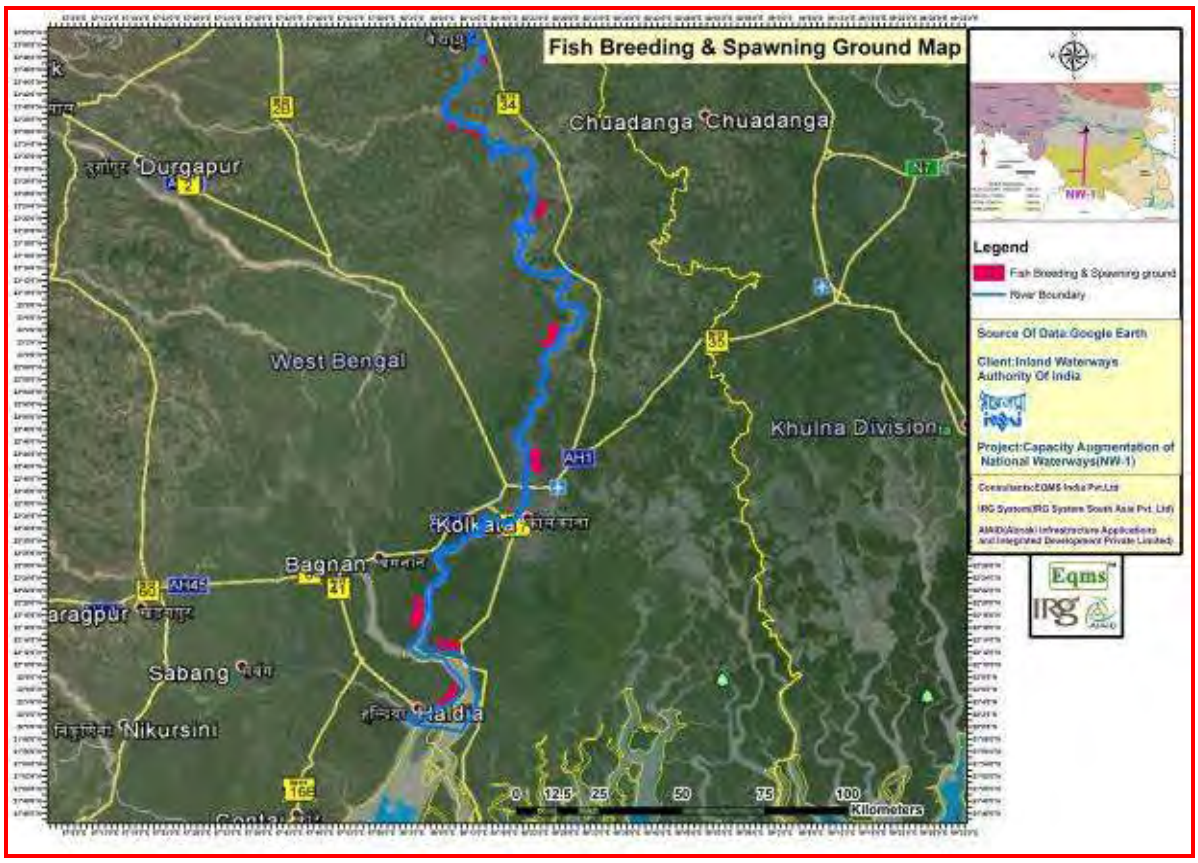


Figure 5.11 : Fish Breeding and Spawning Grounds along NW-1 (Haldia to Baidyapur Stretch)

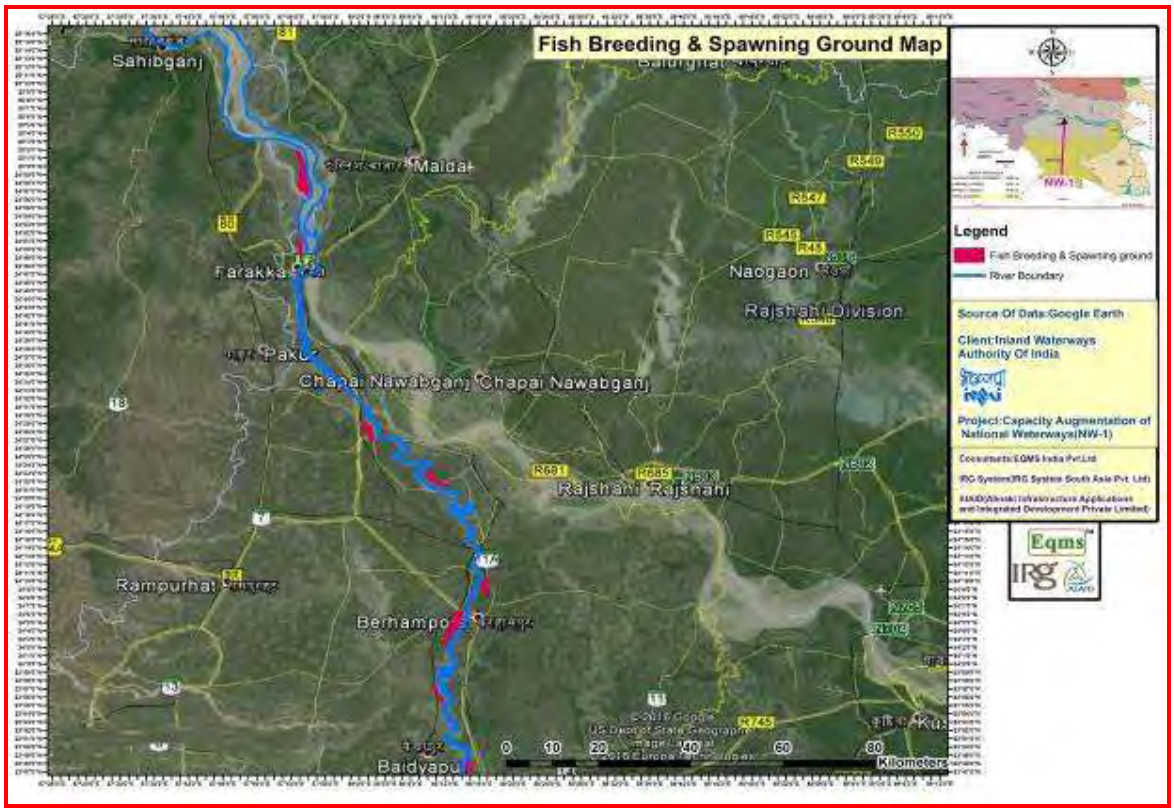


Figure 5.12 : Fish Breeding and Spawning Grounds along NW-1 (Baidyapur to Sahibganj Stretch)

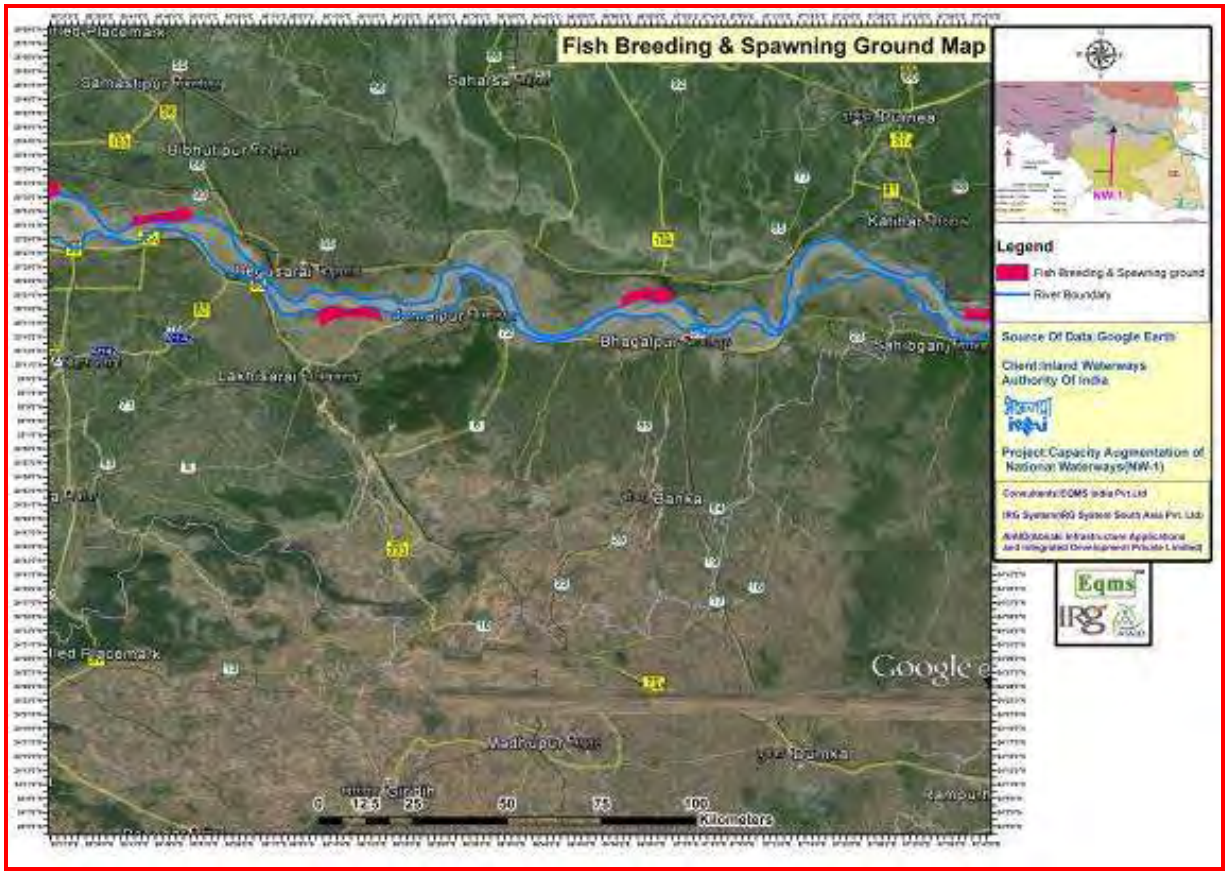


Figure 5.13 : Fish Breeding and Spawning Grounds along NW-1 (Sahibganj to Patna Stretch)

Figure 5.14 : Fish Breeding and Spawning Grounds along NW-1 (Patna to Allahabad Stretch)

Hilsha Fish Breeding: The Bengal Hilsa (Tenualosa ilisha) occurs in marine environment but migrates to fresh water for breeding and is anadromous in nature. It tolerates variations in salinity and travels over 1200 km in inland water for breeding upto Farakka. The Hilsa fish is heterosexual. Breeding starts with start of monsoon in July and peaks in September-December. Hilsa is primarily restricted to the estuarine zone only and its migration has been stopped in fresh water zone beyond Farakka.

Dolphin Breeding (reproduction): Calving of Gangetic Dolphin generally occurs in December to January and March to May, though it can occur any time of the year. Newborn calves have been observed mainly in April and May[11].

Turtle Breeding: Turtle nesting season vary depending on the species. It's hatching period normally confined between May to October. The nesting and hatching season of fresh water turtle vary from May to October. The Nesting and hatching season of fresh water turtle in NW-1 is given at **Table 5.12**.

Table 5.12 : Nesting and hatching season of turtle species

S1. No.	Species	Nesting season	Hatching season

11Dolphin reproduction starts with the copulation of group of dolphins.Dolphin mothers usually go to shallow waters to deliver the calves. Usually a single calf is born, which is nursed for around 18 months with milk from the mother.Calves live close to their mothers for around 6 years.

S1. No.	Species	Nesting season	Hatching season
1	*Batagur dhongoka*	December-February-April	May
2	*Batagur kachuga*	December-February-April	May
3	*Pangshura smithii*	October-December	May
4	*Pangshura tentoria*	September-February	May
5	*Pangshura tecta*	October-December	May
6	*Lissemys punctata*	July-October	July
7	*Chitra indica*	September	October
8	*Nilssonia gangeticus*	August-October	June/July

Reference: Status of Higher Aquatic Vertebrates in the Ganga River GRB EMP: Ganga River Basin Environment Management Plan by consortium of 7 Indian Institute of Technology.

5.6. Environmental Profile

Environmental profile has been described in terms of water environment, air environment, meteorology, noise environment and other climatic / meteorological parameters.

5.6.1. Water Environment

Water environment has been described in terms of river mobility, flow availability, water levels, sediment load, tributaries flow & their sediment load and least available depth for navigation. Each of these items are described below. Further, summary of surface and ground water quality has also been describe below.

5.6.1.1 River Mobility

River Ganga is significantly mobile and changes flow pattern from one season to another. In the upper reaches, from Allahabad to Doriaganj, the river is meandering or sinuous with minor secondary branches and several chutes. The river shows a clear change of planform typology at area around Patna to Munger. The change is from a meandering to an ana branching typology, with multiple channels. Change in planform is due to confluence of various tributaries namely Ghagra & Gandak in left bank and Son & Punpun in the right bank. The river typology changes again, downstream of Munger where the channel shows a sinuous channel with a certain degree of braiding. Bars are common in this area. Between Kahalgaon and Manihari the main channel clearly splits in two, with a certain degree of braiding in each channel. The contribution of the Kosi River takes place near Kahalgaon. From Manihari to Farakka there is one main sinuous channel and several sinuous secondary channels. Downstream stretches of Farakka to Farakka lock and Farakka lock to Jangipur lock is an artificial canal. Reaches downstream of Jangipur Lock show a meandering channel with different degrees of sinuosity, from tortuous to irregular meanders. From Jangipur Lock to Tribeni the presence of oxbow Lakes is common, and cut-offs meanders[12]. Detailed morphology of the river in different reaches is given in **Annexure 5.2**.

5.6.1.2 Available Flow in NW-1

The Ganga River is characterised by high flows during the monsoon season, approximately from July until October, and low flows during the rest of the year. Annual minimum discharges provided by IWAI at Allahabad, Mirzapur and Varanasi during the last 3 years are given below in **Table 5.13 & Figure 5.15.**

[12] *Source of Data: (Detailed Feasibility Study for Jal Marg Vikas Project and Detailed Engineering for its Ancillary Works and Processes between Haldia to Allahabad by HOWE Engineering Projects (India) Pvt. Ltd).*

Table 5.13 : Annual minimum discharges obtained from statistical analysis

Parameter	Discharge (cusec)		
	Allahabad	Mirzapur	Varanasi
Minimum recorded flow (m3/s)	96	122	117
1 in 2-year minimum flow (50% annual probability)	188	167	185
1 in 10-year minimum flow (10% annual probability)	117	128	130
1 in 100-year minimum flow (1% annual probability)	90	119	110

Source: IWAI

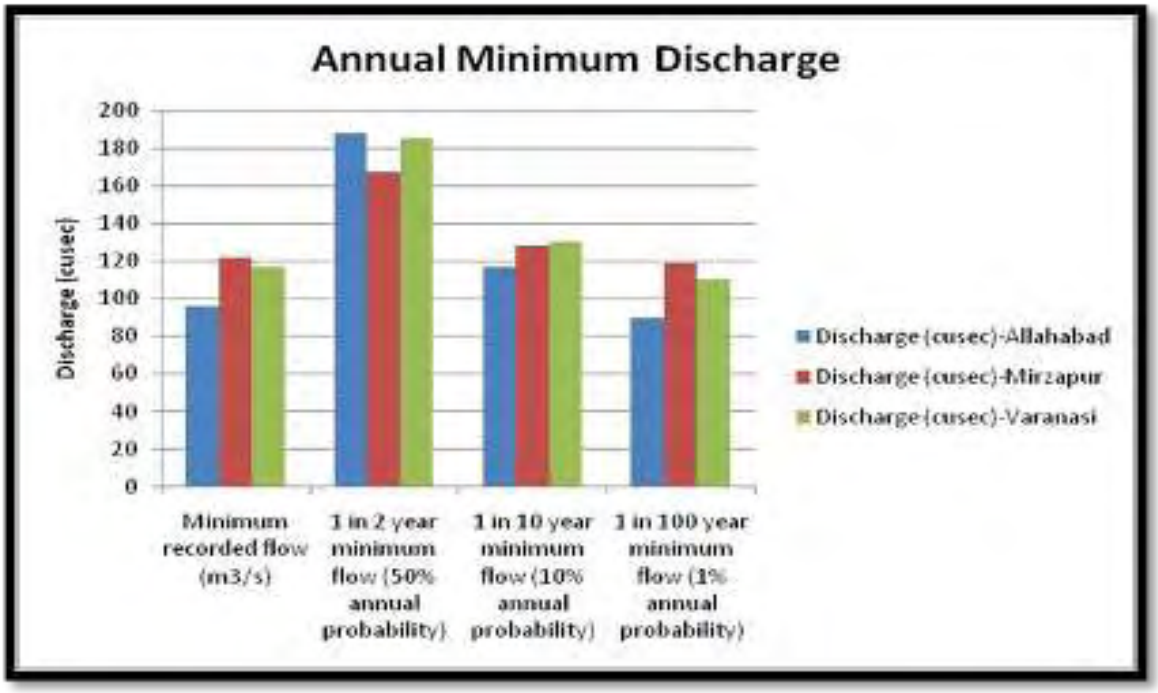


Figure 5.15 : Annual minimum discharges obtained from statistical analysis

Source: IWAI

As per data available with IWAI, lowest flow recorded at Buxar was 225 cusec and lowest available flow at Patna was 689 cusec. These flows are considerably lower than the average dry season flows. The design discharge for the feeder channel at Farakka is around 1,100 m^3/s.

As per the data available in the report “Status on River Ganga: State of the Environment and Water Quality” by the National River Conservation Directorate (2009), discharges with a probability of exceeding 50%, 10% and 90% of times at 6 stations namely Allahabad, Mirzapur, Varanasi, Buxar, Patna and Azamabad during low flow season are given in **Table 5.14 & Figure 5.16** below.

Table 5.14 : Annual Minimum Discharges at Different Locations in NW-1

Flow regime	Discharge (cusec)					
	Allahabad	Mirzapur	Varanasi	Buxar	Patna	Azamabad

Q50 (flow with 50% probability of exceeding) during low season	300	300	300	450	1050	1400
Q90 (flow with 90% probability of exceeding) during low season	175	175	175	250	600	1050
Q10 (flow with 10% probability of exceeding) during low season	450	450	450	600	1600	2000
Average in October-November	2000	2000	2400	3100	5500	9500
Average in December-February	500	500	500	750	1300	2200
Average in March-May	400	400	400	500	1000	1500

Source: National River Conservation Directorate

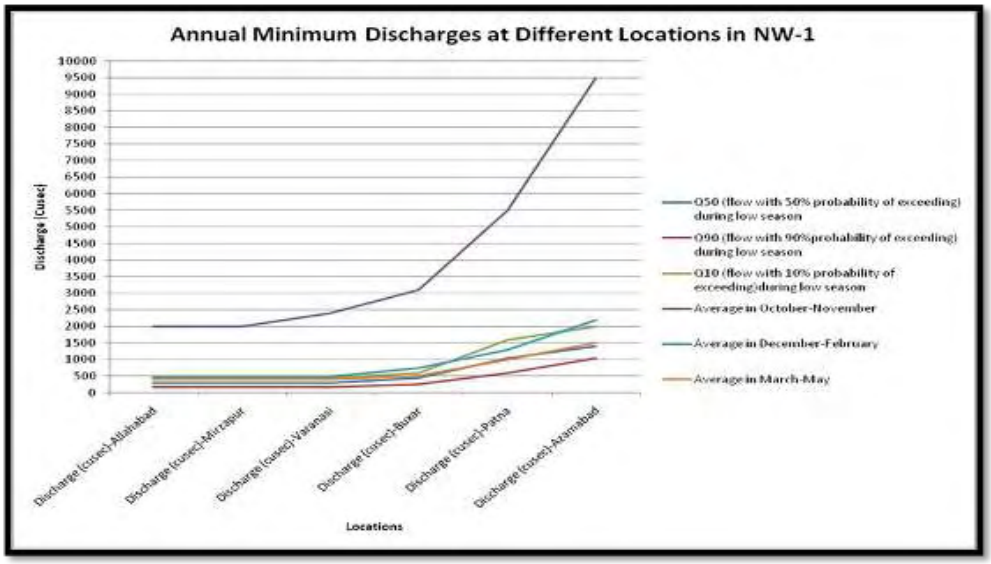


Figure 5.16 : Annual Minimum Discharges at Different Locations in NW-1

Source: National River Conservation Directorate

5.6.1.3 Water Level of NW-1

NW-1 experiences high water level variations, i.e. of order of 10 m during high season. In general, water levels are at their highest in August-September and sharply decrease in October-November. In general, they continue to decrease during the whole low flow season, from December to May, and start to rise again in June-July. The variability of water levels during the dry season is lower than during the high season, with variations of the order of 2-3m. The period of the year in which the minimum water level can occur varies with location along the river. In the upstream reaches from Allahabad to Ghazipur the minimum water levels occur from April to July. Downstream of the three major tributaries, Ghagra, Son and Gandak that join the river near Patna, the minimum water levels can occur between February and June as a result of the influence of snow melt. Minimum & Maximum surface water levels at 7 gauging stations between Allahabad and Farakka for 3 annual probability of occurrence is given in **Table 5.15 & 5.16 & Figures 5.17 & 5.18** below.

Table 5.15 : Minimum Water Levels for a Range of Annual Probabilities

Location	Minimum Water Level (m)

	50%	10%	1%
Allahabad	71.45	70.72	70.38
Mirzapur	63.10	62.58	62.37
Varanasi	58.59	57.91	57.27
Ghazipur	52.45	51.69	51.27
Patna	40.88	40.27	39.56
Hathida	33.28	32.59	32.18
Kahalgaon	23.64	22.96	22.57

Source: HOWE ENGINEERING PROJECTS (INDIA) PVT. LTD. (DESIGN CONSULTANT)

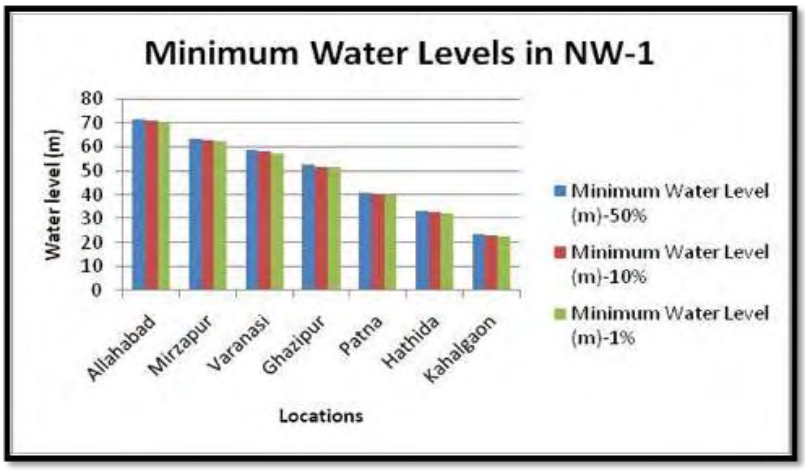


Figure 5.17 : Minimum Water Levels for a Range of Annual Probabilities

Table 5.16 : Maximum Water Levels for a Range of Annual Probabilities

Location	Maximum Water Level (m)		
	50%	10%	1%
Allahabad	82.36	85.67	87.22
Mirzapur	75.65	78.77	79.89
Varanasi	70.0	72.48	73.37
Ghazipur	62.88	64.78	65.18
Patna	49.36	50.44	50.91
Hathida	41.78	42.85	43.01
Kahalgaon	30.99	32.70	32.90

Source: HOWE ENGINEERING PROJECTS (INDIA) PVT. LTD. (DESIGN CONSULTANT)

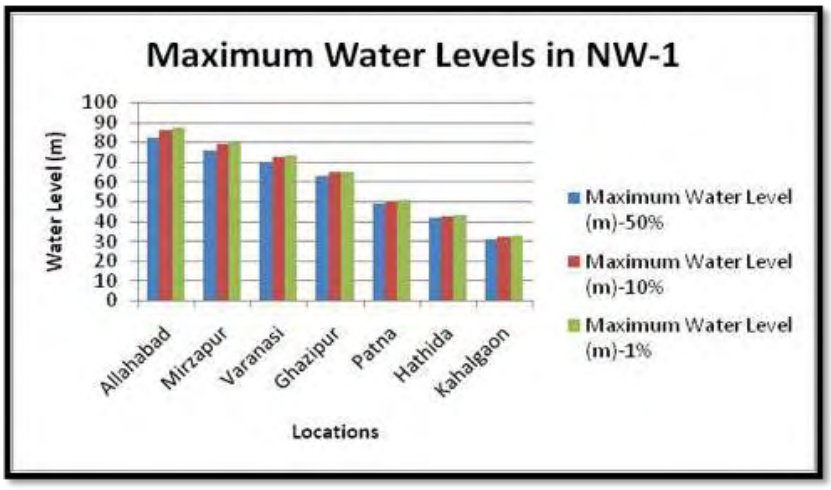


Figure 5.18 : Maximum Water Levels for a Range of Annual Probabilities

5.6.1.4 Tidal Variation in NW-1

Tides affect the Hugli River as far as Nabadweep, at chainage 280km. According to the Admiralty Tide Tables (Indian Ocean 2015), there is an average spring tidal range of 4 to 4.8m at Haldia. The average spring tidal range on the NW-1 route reaches a peak at Diamond Harbour, of around 4.9m before diminishing with distance landward, such that it has reduced to about 4m in Kolkata, to 1.5 to 2.0m at Tribeni (IWAI 2012 NW-1 River Pilot), and effectively to zero at Nabadweep.

The tides are predominantly semi-diurnal, with two high waters, and two low waters occurring during any 24-hour period. The tidal conditions are largely governed by the (predictable) tidal cycles, but the river freshwater discharge influences the local conditions in the tidal stretch of the river significantly. In the tidal section of the waterway, in general terms, the water will continue to flow down-river on the ebb (falling tide). However, the flow direction is reversed to flow up-river on the flood (rising tide).

5.6.1.5 Sediment Load in NW-1

NW-1 comprises of the River Ganga and the tributaries system between Haldia and Allahabad. Rivers originating from the Himalaya region (Ganga, Ghaghara and Gandak) are characterized by a predominance of fine and very fine sand. The rivers draining from the Indian craton region (Tons, Son and Yamuna) bring much coarser sediments with higher contents of coarse and medium sand. Sediments are classified into suspended and bed load depending on the size of the particles. Sediments of diameter smaller than 125µm are transported in suspension and can be deposited during the low flow period. Sediment size decreases from Allahabad to Farakka. Sediment load at different locations and tributaries of NW-1is given below in **Table 5.17**.

Table 5.17 : Sediment Load at Different Locations and Tributaries of NW-1

Locations	Sediment Load (MT/Year)		
	From CWC (available online)	From Abbas and Subramanian (1984)	From Jain and Sinha (2003)
Ganges at			
Allahabad	-	228	-
Farakka	-	729	729
Kolkata	-	328	-
Gomati	-	6	6
Ghaghara	-	125	125
Son	22	50	-
Gandak	33	24	82
Kosi	73	-	193

Source: HOWE Engineering Projects (India) Pvt. Ltd. (Design Consultant)

5.6.2. Tributaries

Ganga River originates in the Gangotri Glacier at about 4,000 m above sea level in the Indian state of Uttarakand. Its major tributaries include the Himalayan rivers of the Yamuna, Mahakali, Karnali, Gandak, Kosi and Mahananda rivers flowing south from the Himalaya. These northern Himalayan tributaries rise primarily in Nepal and India, with some portions of the Kosi rising in China. From the south, the tributaries of the Yamuna and the Tons and Son Rivers flow north from the Deccan Plateau into the main stem of the Ganga. The Deccan Plateau in the south of the Basin is generally at low elevation with hills up to 1,200

m. Other important tributaries are Gomati, Ghaghara and Gandak from the North and Punpun from the south. **Figure 5.19** shows the main tributaries along the River Ganga between Allahabad and Farakka.

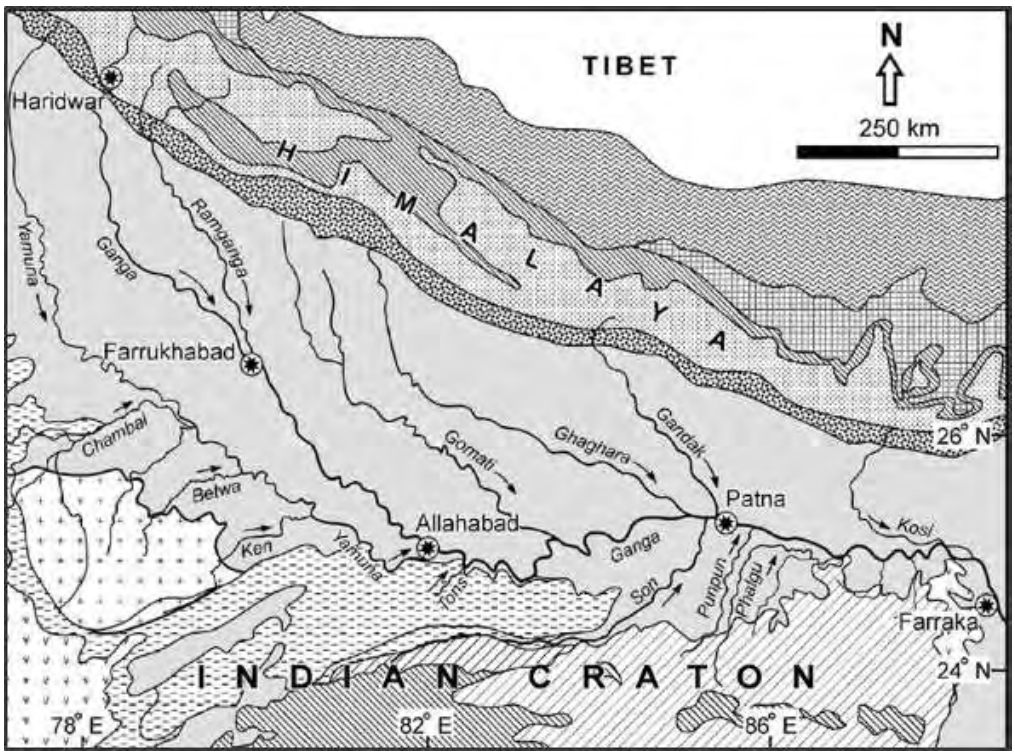


Figure 5.19 : River Ganga and its tributaries in the region between Allahabad and Farraka. Extracted from Singh et al (2007)

Catchment areas and annual water yield for some of the main tributaries in the Allahabad – Farakka reach are provided in **Table 5.18**.

Table 5.18 : Information about main tributaries between Allahabad and Farakka

Tributaries	Catchment area[1](Km2)	Mean Annual Flow[2](BCM)
Tons	17,000	10.6
Gomati	30,000	113.5**
Ghaghara	85,000	
Son	71,000	44.1
Gandak	57,000	59
Punpun	8,500*	-
Kosi	72,000	81.8

*Source: [1]Catchment areas from the River basin Atlas of India except Punpun * from Singh and Pandey (2014); [2]From the report "Status on River Ganga: State of the Environment and Water Quality" from the National River Conservation Directorate (2009); ** value for the system Gomati-Ghaghara*

Tributaries also contribute sediment to the River Ganga. Singh et al (2007) reports that floods occur almost simultaneously in the River Ganga and its tributaries due to the concurrent monsoon conditions over the alluvial plain for a long period and the simultaneous heavy rainfall over the Himalaya. Tributaries may increase sediment concentration in the main river because of their sediment load or decrease it because of the

dilution due to the increase in water discharge. Percentages of sediment in different tributaries of Ganga is given in **Table 5.19**.

Table 5.19 : Percentages of Sediment in Different Tributaries

River	Very coarse sand (2000-1000µm)	Coarse sand (1000-500µm)	Medium sand (500-1000µm)	Fine sand (250-125µm)	Very fine sand (125-63µm)	Silt & clay (<63µm)
Yamuna	-	2.5	22.5	22.5	45	7.5
Ganga	-	-	1.5	63.5	27.5	7.5
Ghaghara	-	-	2.5	59.5	28	10
Gandak	-	-	1	54	40	5
Gomti	-	-	1	11	58	30
Tons	-	-	25	70	4	1
Son	2	8	50	37	2	1

5.6.2.2 Least Available Depth for Navigation in NW-1

It is essential that minimum depth of the water is maintained in the river all the time of navigation. As per the surveys carried out by IWAI, depths available in NW-1 naturally are given below.

- Haldia to Tribeni (196 km)- LAD of 3m- throughout the year
- Tribeni to Farakka (364 km)- LAD of 2.5 m – 320 days
- Farakka to Ghazipur (690 km)- LAD of 2 m- 200 days
- Ghazipur to Allahabad (370 km)-LAD of 1.5 m-170 days

IWAI is currently maintaining LAD for managing the navigation in NW-1 through dredging and bandalling. Depths maintained by IWAI in different stretches currently is given below.

- Haldia (Sagar) - Farakka (560 km)-2.8-3.0 m
- Farakka - Barh (400 km)-2.1-2.5 m
- Barh - Ghazipur (290 km)-1.6-2 m
- Ghazipur – Chunar/Allahabad (124 km)-1.2-1.5m
- Chunar-Allahabad (246 km)-No maintenance

5.6.2.3 Ganga River Water Quality in NW-1 Stretch

Water can be classified in five classes of best designated use (BDU) depending upon its chemical properties. CPCB's BDU Criteria Standard in India is given in **Table 5.20**. Ganga river quality data monitored by CPCB at different locations along NW-1 are shown in **Table 5.21** and shown in **Figure 5.20** and **Figure 5.21**.

DO & pH – meets the water quality criteria for bathing at most of the monitoring locations. DO vary from 4.8-12.8 mg/l and found within water quality criteria of river. BOD ranges from 1.1-8.2 mg/l. The maximum value of BOD was recorded at Diamond harbour. Faecal Coliform values ranged from 230-650000 MPN/100ml. The total coliform values ranged from 490 at Mirzpur to 85,0000 at Howrah. It is mostly above 5000 MPN/100ml/coliform limit for category 'C' -designated best use requirement.

Table 5.20 : CPCB Best Designated Use Standard (source: CPCB)

Designed Best Use	Class of Water	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	Total Coliforms Organism MPN/100ml shall be 50 or less pH between 6.5 and 8.5 Dissolved Oxygen 6mg/l or more Biochemical Oxygen Demand 5 days 20°C 2mg/l or less
Outdoor bathing (Organized)	B	Total Coliforms Organism MPN/100ml shall be 500 or less pH between 6.5 and 8.5 Dissolved Oxygen 5mg/l or more Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	Total Coliforms Organism MPN/100ml shall be 5000 or less pH between 6 to 9 Dissolved Oxygen 4mg/l or more Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Propagation of Wild life and Fisheries	D	pH between 6.5 to 8.5 Dissolved Oxygen 4mg/l or more Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	pH between 6.0 to 8.5 Electrical Conductivity at 25°C micro mhos/cm Max.2250 Sodium absorption Ratio Max. 26 and Boron Max. 2mg/l

Table 5.21 : River Water Quality at Different cities along NW-1

Locations	State	Temperature °c		DO (mg/l)		Ph		Conductivity (µmhos/cm)		BOD (mg/l)		Fecal coliform (mpn/100ml)		Total coliform (mpn/100ml)	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Water Quality Criteria (C Category for Drinking water source after conventional treatment and disinfection)				> 4 mg/l		6.5-8.5		-		< 3 mg/l		< 2500 mpn/100ml		< 5000 mpn/100ml	
At Allahabad (Rasoolabad)	UP	21.0	29.0	6.0	9.8	7.4	8.4	278	488	2.8	6.0	3000	3500	7000	9000
Ganga d/s, Mirzapur	UP	18.0	33.0	5.1	10.3	7.3	8.2	207	555	2.9	4.5	230	7000	490	17000
At Varanasi u/s (Assighat)	UP	18.0	27.0	7.5	7.8	7.5	7.8	224	266	3.7	4.2	8000	8000	13000	13000
Ganga at Trighat (Ghazipur)	UP	19.5	28.5	7.0	7.4	7.9	8.2	232	270	4.1	4.4	13000	13000	17000	21000
Ganga at Buxar, Bihar	Bihar	16.0	31.0	7.8	9.0	7.6	8.5	287	402	2.7	2.8	1100	9000	2800	16000
Ganga at Khurji, Patna u/s	Bihar	17.0	32.0	8.0	8.9	7.9	8.6	262	416	2.6	2.8	1300	5000	2400	16000
At confl. Sone Doriganj, Chapra	Bihar	16.0	25.0	7.9	9.3	7.1	8.1	214	380	2.7	2.8	1100	3000	2200	5000
At Patna d/s (ganga bridge)	Bihar	18.0	32.0	7.9	8.7	8.0	8.6	292	495	2.7	3.0	3000	9000	9000	24000
Ganga at Fatuha	Bihar	18.0	31.0	8.0	8.8	8.1	8.7	282	420	2.7	2.9	1400	5000	3000	16000
Ganga at Mokama (u/s)	Bihar	20.0	30.0	7.1	8.7	7.8	8.2	339	389	2.6	2.8	1100	5000	2200	16000
Ganga at Munger	Bihar	20.0	28.0	6.2	8.6	7.7	8.1	298	366	2.6	2.9	800	5000	2200	9000
Ganga at sultanganj, Bhagalpur	Bihar	20.0	27.0	6.4	8.7	7.6	8.1	354	384	2.7	2.8	1300	3000	2200	5000
Ganga at Bhagalpur	Bihar	20.0	27.0	6.2	8.6	7.7	8.1	355	395	2.6	2.9	1300	9000	2200	90000
Ganga at Kahalgaon	Bihar	19.0	30.0	6.4	8.7	7.7	8.2	286	372	2.7	2.9	1100	9000	2800	24000
Ganga at Baharampore	WB	14.5	32.0	6.9	11.2	7.2	8.4	209	360	1.0	3.9	17000	240000	26000	300000
Tribeni burning ghat	WB	20.0	32.0	4.8	13.4	7.0	8.5	185	354	0.8	2.9	700	11000	900	14000
Ganga at Howrah-Shivpur	WB	19.0	32.0	4.8	12.8	7.5	8.2	194	370	2.4	8.2	33000	650000	34000	850000
Ganga at diamond harbor	WB	18.0	32.0	5.4	8.5	7.5	8.5	261	10240	1.1	5.1	8000	80000	11000	110000

Source: (NMCG / CPCB Ganga Water Quality Assessment -2011)

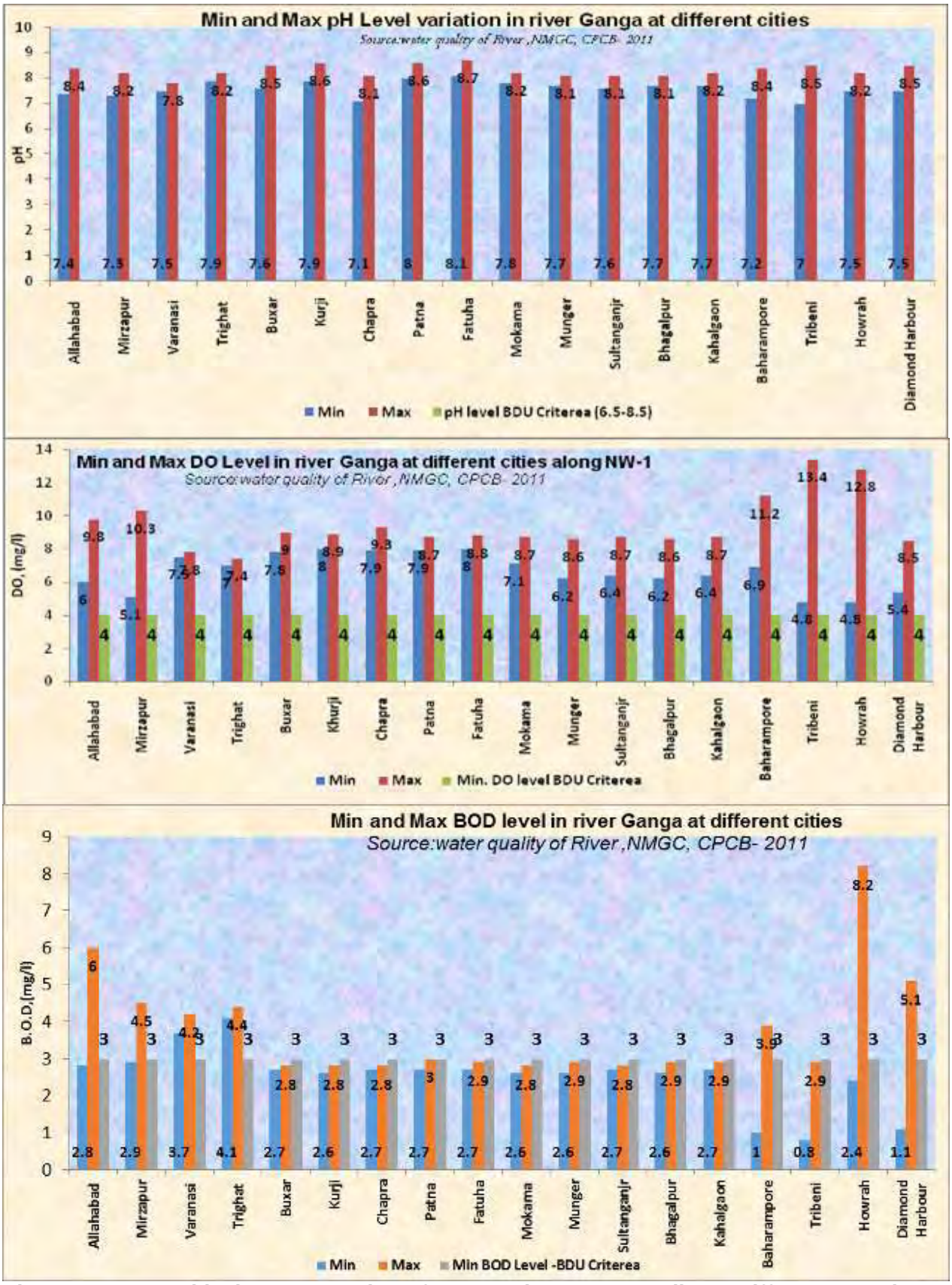


Figure 5.20 : Graphical representation of Ganga River water quality at Different Locations

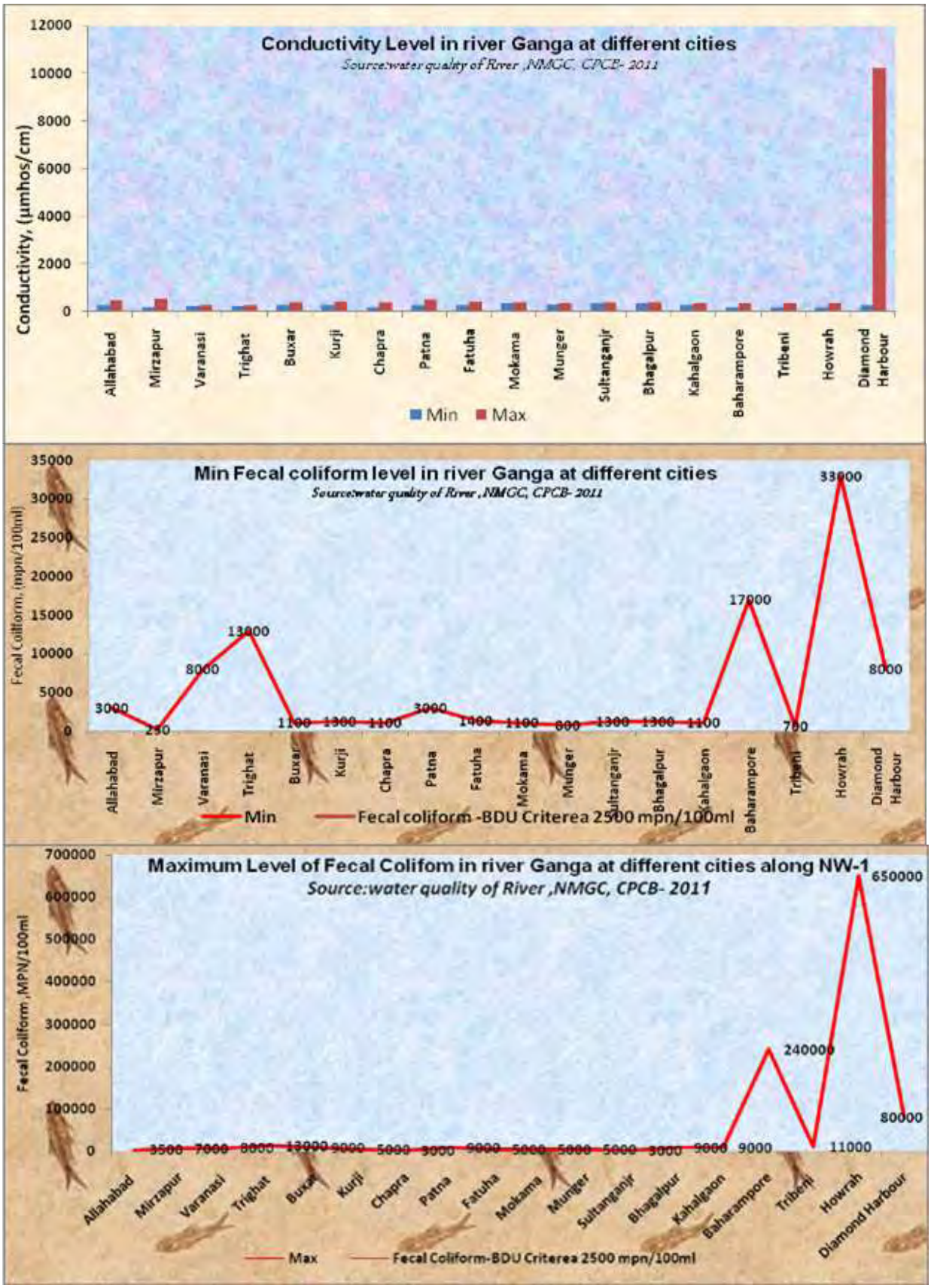


Figure 5.21 : Graphical representation of Ganga Water Quality at Different Cities along NW-1

Primary data analysis and observation on surface water quality at project intervention areas & sensitive location areas indicate that water quality meets with BDU Class D Criteria of CPCB barring few parameters PH, DO which meets A class criteria **(Annexure 5.3)**. Metallic and pesticide level is within prescribed limit of Drinking water standard. The primary data results are similar to secondary data analysed. **The analysis concludes that the river water is good for propagation of Wild life and fisheries.**

5.6.2.4 River Water Quality at Maintenance dredging locations & Observations

To analyse the effct of dredging activity on water quality water samples in upstream and downstream of the river at different distance from the operating dredger were taken during study period. During site visit dredging was in operation only in Farakka navigational lock channel. The details of sampling locations and analysis results are presented in **(Annexure 5.4)**.

5.6.2.5 Observation on Surface Water Quality during Maintenance Dredging operation

The river water quality observations reflect that the parameters like turbidity and total suspended solid increases in downstream of the dredging location up to 700 m, which gradually gets normalised at a distance of 1000 m from the dredging location. In upstream side of the river there were no major changes observed in these parameter. However the metals like iron, copper, cadmium and lead were also detected in traces in water sample close to the dredging location in downstream. No variation was observed in other water quality parameter.

5.6.2.6 River Sediment Analysis

The river bed sediment quality, has been mapped by collecting & testing about 110 river bed sediment samples (average 3 samples per location upto the depth of 3m) spread across the NW-1 and analysed for various parameters/contaminants. (**Refer Figure 5.22**). The summery of the test resultsof river bed sediment sample at different stretches of the NW-1 is given in **Annexure 5.5**.

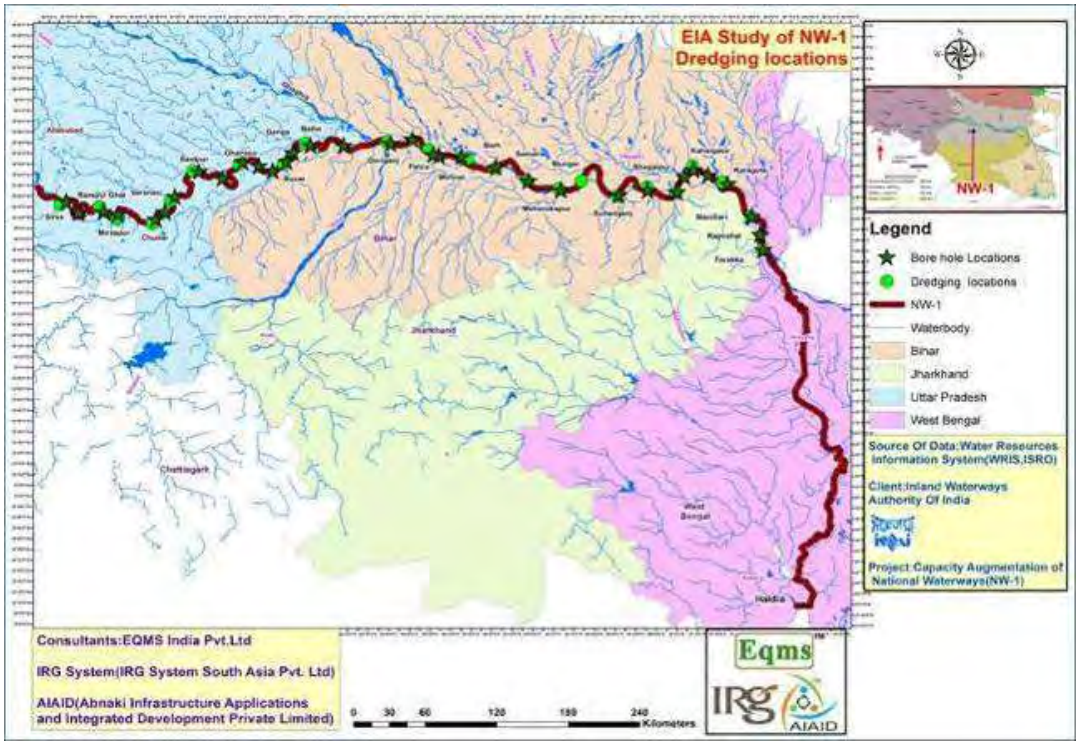


Figure 5.22 : Dredging and Bore hole locations along NW-1

Observations on River Bed-Dredge Material Quality indicate that the concentration level of heavy metal was found low and within acceptable limit as per standard (Criteria for Off-Shore Dumping of Dredged Material, USA) except cadmium which is slightly above the USA standard that may be due to industrial effluent discharge in this section. Pesticide concentration in all samples were found below the USA criteria. The pesticides presence is on expected line as these are predominantly used for various agriculture applications. The source of these pesticide parathion and endosulphan might be from applications of insecticides and pesticides for agriculture in the study area which has significant agriculture land use.

5.6.2.7 Ground Water

Observation on Ground Water Consumtion and Quality

The Physico-chemical chatersteristics of the ground water samples were assessed with respect to prescribed drinking water standard IS:105000. Few parameters namely TDS, total hardness and chloride values are marginally above the desirable limits at Haldia and Sahibganj, Howrah and Kolkata but all were within the permissible limits as per prescribed Standard (IS: 10500) except Fe which exceeds the prescribed limits at certain locations. Other heavy metal were either present in traces or below prescribed standards. The arsenic content in ground water either present in traces or below prescribed standards. The arsenic content in ground water sample of Bhagalpur and Munger werer found present byt lower than the permissible limit. Ground water consumption pattern and quality is described in **Annexure 5.5.**

The ground water usage pattern in the states traversed by NW-1. The extent of ground water utilization for irrigation is highest in Uttar Pradesh (45.36 BMC per year), followed by West Bengal (10.84 BMC per year), Bihar (9.39 BMC per year) and Jharkhand (0.7 BMC per year).

5.7. Air Environment

The ambient air quality has been monitored at all proposed terminal/ lock, RO-RO jetty, floating terminal locations along NW-1. Additional baseline monitoring was carried out around proposed terminals/lock site areas. The locations of the monitoring stations were selected based on frequency of wind directions, presence of sensitive receptor (habitation, eco sensitive receptor) located within the buffer zone of 2KM. Three monitoring station was setup (One station close to the terminal/lock site, one location in downwind direction and other location was near to the existing air pollution source (if any) such as industrial area, crushers or mining areas. Ambient air quality monitoring was carried out between 16th September to 28th February 2016 with the frequency of weekly two samples of 24 hours average each (8 hrs. averaging for CO) at each monitoring location around designated terminal/lock location (5 terminals and one lock[13]) and 10 nos. of existing Ro-Ro jetty/ floating terminal of NW1 to get representative data along NW-1 spread over longer period and stretch. Air sampling location map is projected in **Figure 5.23**.

5.7.1. Ambient Air Quality along Nw-1 (at Proposed or Planned Facilities)

The AAQ data of NW-1 are summarised in **Table 5.22** to **Table 5.25**. Graphical representations of the AAQ data are given at **Figure 5.24** and **Figure 5.25**.

13These terminals and lock are located at close to start point at Haldia and end point near Varansi. Intermittent locations Farakka, Sahibganj, Tribeni, Chazipur are also located far apart from each other locations.

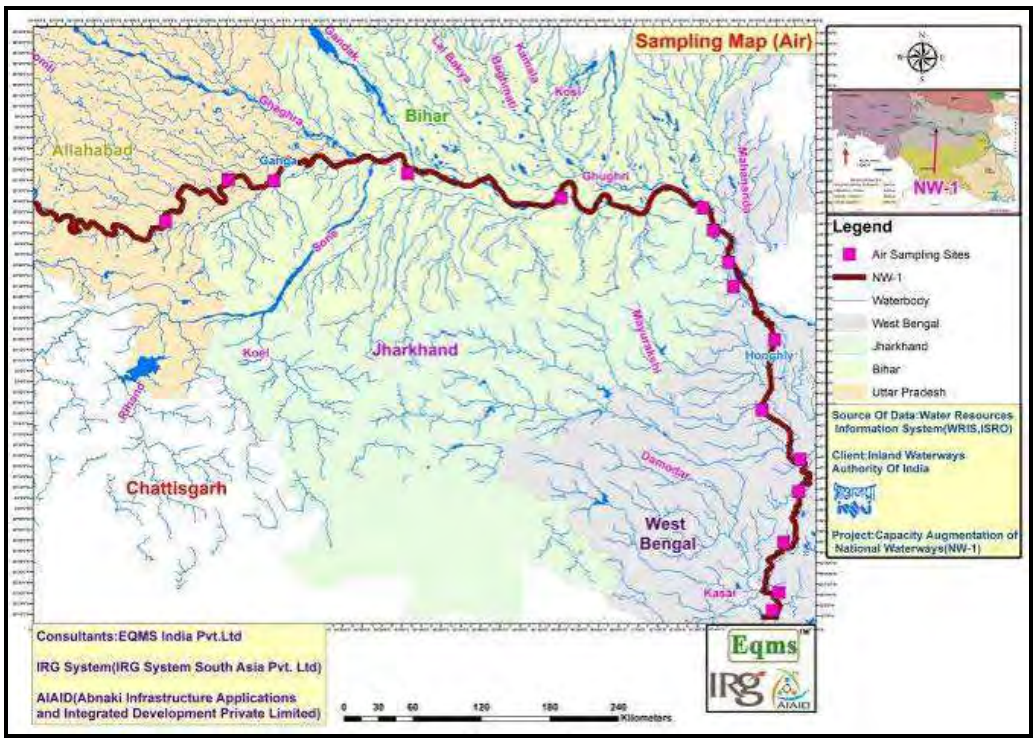


Figure 5.23 : AAQ Monitoring Location Map

Table 5.22 : Ambient Air Quality results for PM2.5 and PM10 (24-hour average) along NW-1 (at Proposed Terminal Locations)

Terminal Location	PM2.5, µg/m3		PM10 (µg/m3)	
	Min	Max	Min	Max
Haldia Terminal, West Bengal	19	37	58	97
Farakka Lock, West Bengal	18	36	44	74
Tribeni Terminal, West Bengal	22	38	55	84
Sahibganj Terminal, Jharkhand	14	34	40	82
Ghazipur Terminal, Uttar Pradesh	17	28	44	64
Varanasi terminal, Uttar Pradesh	20	58	54	145

Source: Data Sampling & Analysis by JV and NABL accredited Lab

Table 5.23 : Ambient Air Quality Monitoring Results for SOx, NOx (24-h avg.) along NW-1 (at Proposed Terminal Locations)

Terminal Location	SO2, µg/m3		NO2, µg/m3		CO(mg/m3) 8 hrs avg.	
	Min	Max	Min	Max	Min	Max
Haldia Terminal, West Bengal	7.9	15.0	22.5	48.0	0.5	1.2
Farakka Lock, West Bengal	4.5	8.9	9.0	13.6	<0.1	<0.1
Tribeni Terminal, West Bengal	6.1	10.2	9.2	17.2	0.18	0.22
Sahibganj Terminal, Jharkhand	4.4	7.8	9.0	13.4	<0.1	<0.1
Ghazipur Terminal, Uttar Pradesh	5.0	8.2	9.0	14.2	<0.1	<0.1
Varanasi terminal, Uttar Pradesh	13.4	35.6	17.4	46.8	0.25	0.69

Source: Data Sampling & Analysis by JV and NABL accredited Lab

Table 5.24 : Ambient Air Quality results for PM2.5 and PM10 (24-hour average) along NW-1 (at RO-RO Jetty/ Floating Terminals)

RO-RO Jetty/ Floating Terminal Location	PM2.5, µg/m3		PM10 (µg/m3)	
	Min	Max	Min	Max

RO-RO Jetty/ Floating Terminal Location	PM2.5, µg/m3		PM10 (µg/m3)	
	Min	Max	Min	Max
Diamond Harbour	24	47	53	89
Howrah	31	56	68	125
Shantipur	21	34	43	70
Katwa	18	30	39	64
Hazardwari	19	32	41	67
Pakur	19	32	40	68
Magalhat	16	29	39	62
Buxar	21	36	46	78
Munger	18	32	43	71
Patna	29	56	72	138

Source: Data Sampling & Analysis by JV and NABL accredited Lab

Table 5.25 : Ambient Air Quality Monitoring Resultsfor SOx, NOx and CO (24-h avg.) along NW-1(at RO-RO Jetty/ Floating Terminals)

Terminal Location	SO2, µg/m3		NO2, µg/m3		CO(mg/m3) 8 hrs avg.	
	Min	Max	Min	Max	Min	Max
Diamond Harbour	5.2	12.3	9.4	18.6	0.2	0.4
Howrah	6.8	17.6	13.6	32.4	0.3	0.9
Shantipur	4.8	7.4	9.0	11.2	<0.1	<0.1
Katwa	5.2	8.7	9.2	14.3	<0.1	<0.1
Hazardwari	4.7	7.8	9.1	13.2	<0.1	<0.1
Pakur	5.1	8.6	9.0	14.3	<0.1	<0.1
Magalhal	4.4	6.7	9.0	11.2	<0.1	<0.1
Buxar	5.2	9.4	9.3	13.2	<0.1	<0.1
Munger	5.0	8.3	9.1	15.5	<0.1	<0.1
Patna	6.3	14.6	13.2	22.3	0.20	0.45

Source: Data Sampling & Analysis by JV and NABL accredited Lab

5.7.1.2 Observation on Ambient Air Quality

Particulate Matter (PM10): Particulate Matter PM10 level at proposed and planned terminal and existing jetty locations along NW-1 varies from 39 to 145µg/m^3. **PM_{10} values in all locations are within the specified limit of 100 µg/m^3 as per NAAQS except at Varanasi, Patna and Howrah.** The higher concentration of PM10 i.e.145 µg/m^3 is observed at Ramnagar area of Varanasi followed by Patna and Howrah. The higher dust levels are because of industrial activities, heavy vehicular pollution and domestic burning in these large urban agglomerations.

Particulate Matter ($PM_{2.5}$): PM levels were found ranging from 16 to 58µg/m^3. All value of $PM_{2.5}$ are within the specified limit of 60 µg/m_3 as per NAAQS but **high values with respect to $PM_{2.5}$ were recorded in Varanasi, Patna and Howrah locations.** The higher fine respirable dust levels are because of various industrial and domestic combustions (coal and biomass burning) and heavy construction activities in these areas.

Sulphur Dioxide (SO_2): SO_2 levels were universally found low with respect toparticulate matter. Background level of SO_2 ranged from 4.4 to 35.6 µg/m^3. **The highest levels of SO_2 were found at Varanasi, Howrah and Patna location that may be due to heavy vehicular movement and industrial activities in these locations.**

Oxides of Nitrogen (NOx): **High NOx was observed in those locations that lie in city area like Varanasi, Patna, Howrah and Haldia.** The NOx levels were found ranges between 9.0 to 48µg/m^3. The observed NOx level was found within the national Ambient Air Quality Standard. Again, the highest levels of NOx were found at Haldia followed by Varanasi, Patna, Howrah, Tribeni and Diamond Harbour location. Predominant sources contributing to high level of NOx in the study area are industrial pollution arising out from industries and vehicle/motorboats operating in the area.

Carbon Mono-oxides (CO): CO was detected in few locations i.e. Haldia, Howrah, Patna and Varanasi. CO was not detected either in all enrooted cities or around other facilities of NH-1. The 8hrs CO level was found ranging between 0.18 to 1.2 mg/m^3, which is found within the national Ambient Air Quality Standard. The highest levels of CO were found at Haldia location.

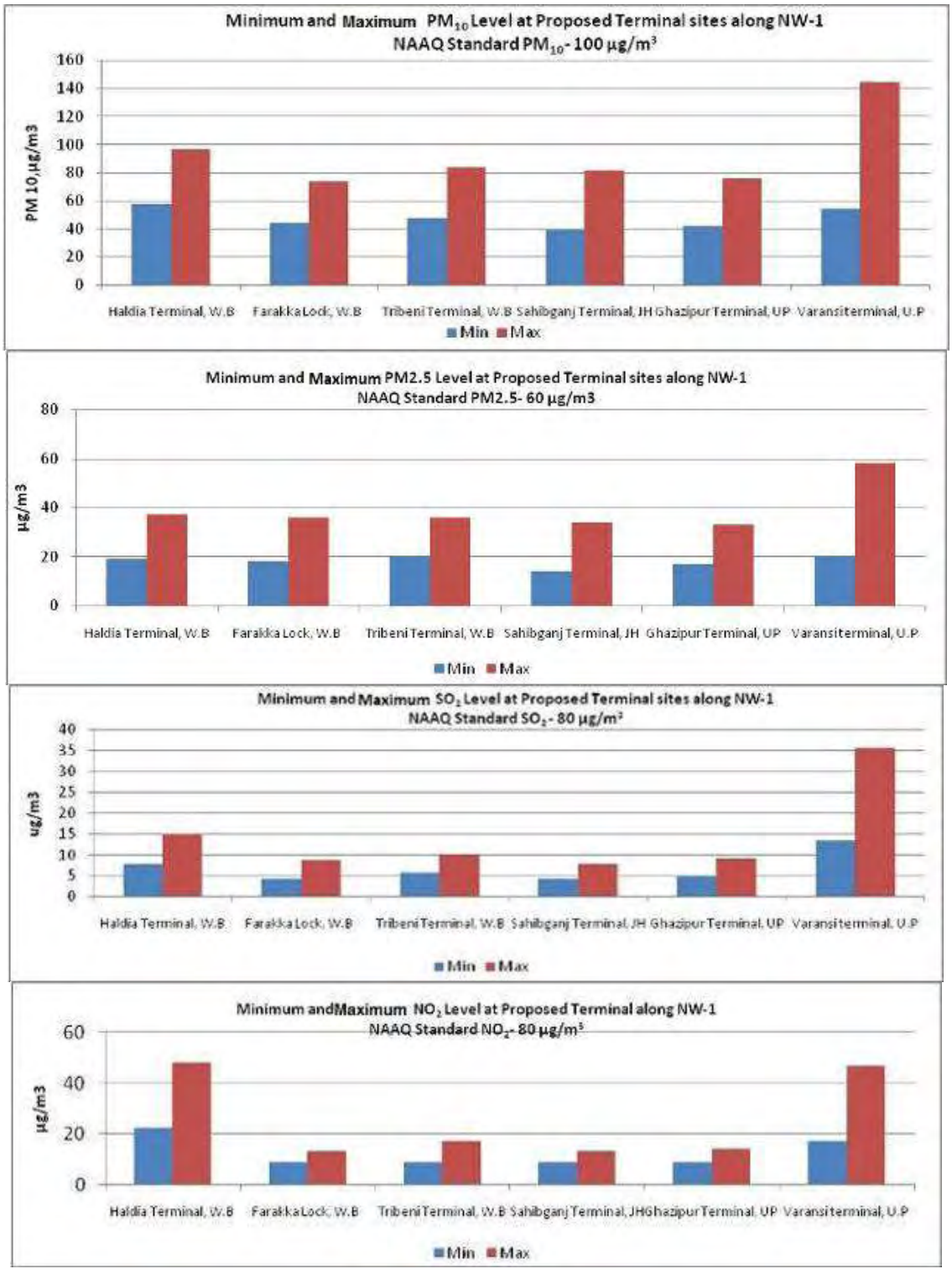
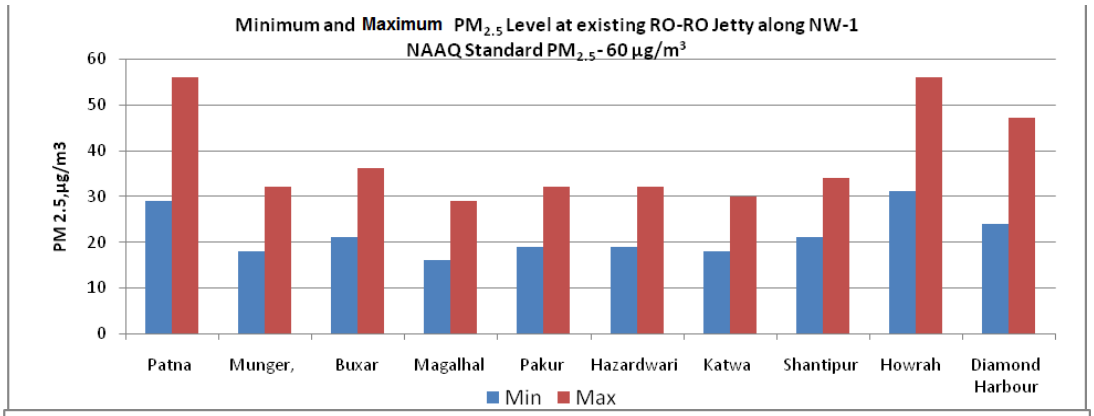
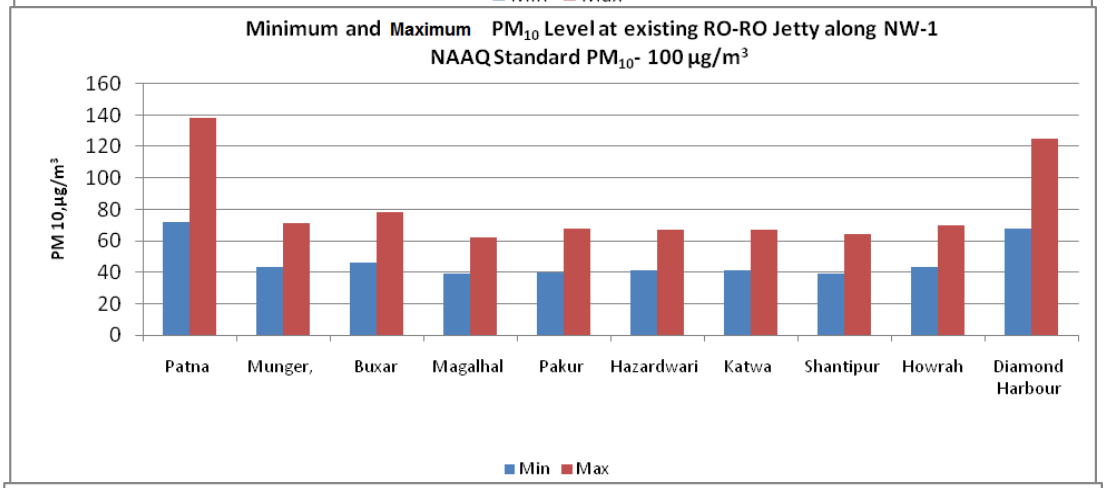
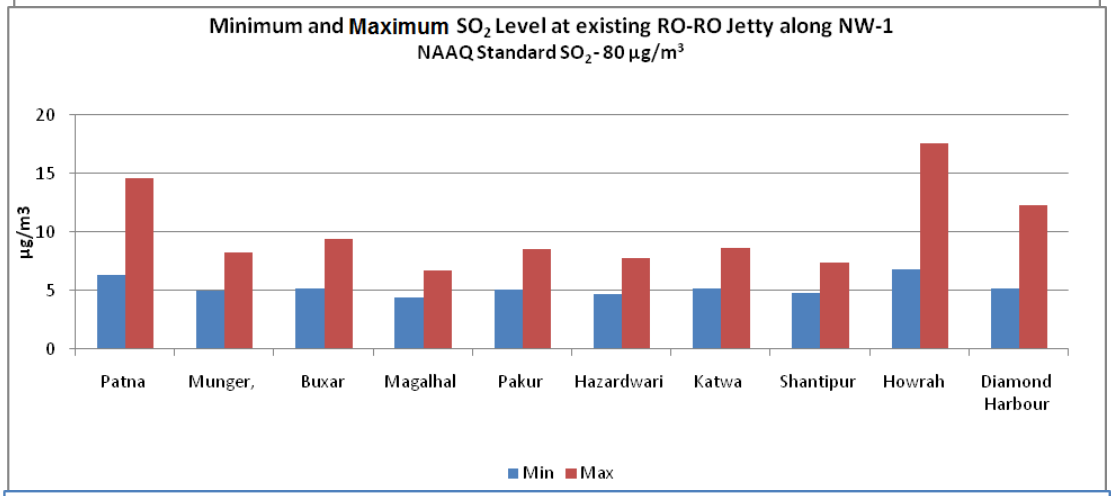


Figure 5.24 : Graphical Representation of AAQ monitoring results around Proposed Terminal and Lock Locations







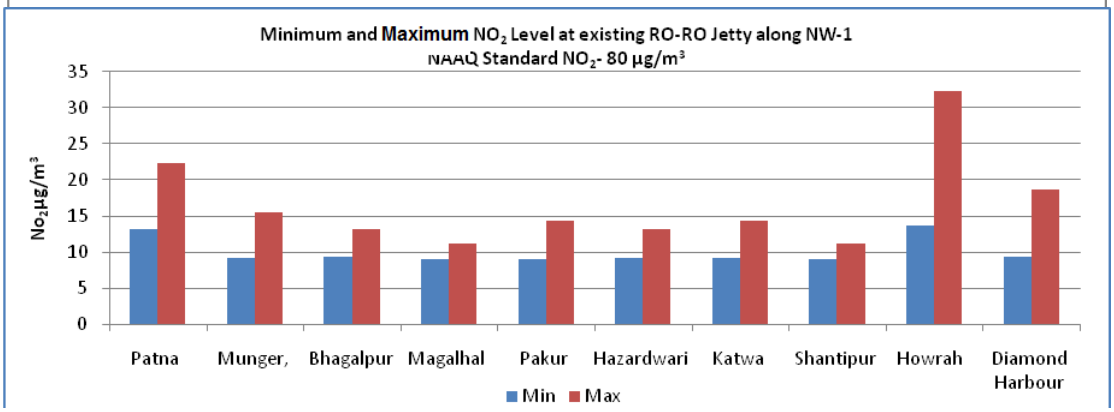


Figure 5.25 : Graphical Representation of AAQ Monitoring Results at RO-RO and Floating Jetty Locations

5.8. Meteorology & Other Climatic Parameter

The main climatic factors of concern are temperature, sunlight and precipitation. In India, has four temperature zones namely tropical, sub-tropical, temperate and alpine. Among these, the tropical zone (Humid, sub-tropical and Tropical wet and dry)is most predominant in the entire NW-1 stretch.

The meteorological parameters also play a vital role in transport and dispersion of pollutants in the atmosphere. Historical meteorological data were obtained from climatological tables pertaining to different IMD stations all along the NW-1. The met data of the nearest representative IMD stations all along the NW-1(period 1961-1990) is summarized in **Table 5.26** and **Table 5.27**.

Table 5.26 : Meteorological Data (Period 1961-1990)

Month	Kolkata, IMD					Malda, IMD					Bhagalpur, IMD					Patna, IMD					Varanasi, IMD				
	Temp (OC) daily		Relative Humidity, %		Rain Fall	Temp (OC) daily		Relative Humidity %		Rain fall	Temp (OC) daily		Relative Humidity, %		Rain Fall	Temp (OC) daily		Relative Humidity, %		Rain fall	Temp (OC) daily		Relative Humidity, %		Rain fall
	Max	Min	Max	Max	mm	Max	Min	Max	Min	mm	Max	Min	Max	Min	Mm	Max	Min	Max	Min	mm	Max	Min	Max	Min	mm
Jan	26.4	13.8	71	55	15.0	25.1	11.8	67	56	10.1	24.6	11.9	78	65	11.9	23.3	9.1	78	59	13.2	23.2	9.2	77	53	17.7
Feb	29.4	17.0	65	48	24.4	28.0	13.9	61	47	10.1	27.4	14.1	69	56	11.2	26.0	11.3	69	48	13.1	26.4	11.6	67	42	17.1
Mar	33.8	21.8	66	47	32.9	33.3	18.0	53	40	12.0	33.6	19.3	57	43	9.3	32.3	16.2	53	33	11.7	32.8	16.4	51	29	9.3
April	35.7	25.0	69	59	57.0	36.9	22.1	57	43	36.9	37.5	23.8	58	41	26.0	37.1	22.0	48	27	10.1	38.5	22.1	42	25	5.4
May	35.6	26.1	71	65	120.7	36.0	24.0	65	54	120.3	37.5	24.8	68	51	63.6	38.0	24.9	59	37	40.0	40.4	25.5	49	29	13.2
June	34.0	26.5	78	75	291.2	34.5	25.6	72	66	189.4	36.0	26.4	77	68	188.7	36.5	26.6	70	55	123	38.5	27.2	62	47	91.3
July	32.4	26.1	82	81	375.7	32.6	25.7	76	74	332.8	33.1	26.2	84	79	293.5	32.9	26.0	83	75	360	33.7	25.8	81	72	309.3
Aug	32.1	26.0	83	82	348.4	32.7	25.9	77	73	248.8	32.9	26.3	84	79	235.9	32.5	26.0	83	76	269	32.9	25.4	84	76	286.5
Sept	32.4	25.8	80	81	291.4	32.8	25.5	75	73	229.7	33.1	25.9	82	78	204.0	32.3	25.2	82	76	213	32.9	24.4	81	72	203.5
Oct	32.2	23.8	73	72	137.7	31.8	22.9	72	68	107.6	32.4	23.1	77	71	97.4	31.6	21.4	76	69	93	32.8	20.5	72	59	27.3
Nov	30.1	19.1	66	64	22.2	29.5	17.7	66	61	11.4	30.0	17.8	72	65	4.2	28.9	14.9	73	64	8.1	29.5	14.3	68	54	13.8
Dec	26.9	14.3	70	61	11.9	26.3	13.1	67	60	6.2	25.8	12.9	77	67	5.4	24.5	9.8	77	62	5.5	24.7	9.9	75	55	5.9

(Source-IMD)

Table 5.27 : Meteorological Data (Period 1961-1990)

Month	Kolkata, IMD			Malda, IMD			Bhagalpur, IMD			Patna, IMD			Varanasi, IMD		
	Wind speed	Pre-dominant wind direction	Pressure	Wind speed	Pre-dominant wind direction	Pressure	Wind speed	Pre-dominant wind direction	Pressure	Wind speed	Pre-dominant wind direction	Pressure	Wind speed	Pre-dominant wind direction	Pressure
	Kmph	From	Hpa	Kmph	From	Hpa	Kmph	From	hpa	Kmph	From	hpa	Kmph	From	Hpa
Jan	3.0	NW, N	1014.8	2.7	N,NW	1013.7	3.0	SW,W	1012.3	2.6	W,SW	1006	3.4	W, NW	NA
Feb	4.0	NW, N	1014.2	3.0	W,NW	1011.3	4.0	SW,W	1009.8	3.3	W,SW	1007	4.3	W, NW	NA
Mar	5.6	S, SW	1011.2	3.4	W,NW	1008.3	5.6	SW,W	1006.6	4.2	W,SW	1004	5.0	W, NW	NA
April	8.2	S, SW	1007.6	4.4	E,SE	1004.4	8.2	E,W	1002.7	6.2	E,W	1000	5.4	W, NW	NA
May	8.7	S, SW	1004.1	4.7	E,SE	1001.6	8.7	NE,E	999.4	7.9	E, NE	996	5.7	W,NW	NA
June	7.2	S, SE	999.6	4.6	E,SE	997.9	7.2	E,SE	995.3	7.3	E, NE	992	5.7	W, NW	NA
July	6.4	S, SE	1000.0	4.0	E,SE	997.7	6.4	E,SE	995.7	6.2	E, NE	992	5.8	W, E	NA

Aug	5.7	S, SE	1001.0	4.2	E,SE	998.6	5.7	E,SE	996.7	5.6	E, NE	994	5.0	W, E	NA
Sept	5.1	S, SE	1005.1	3.8	E,SE	1002.7	5.1	E,SE	1000.9	5.1	E, NE	998	4.8	W, E	NA
Oct	3.7	NW, S	1010.4	2.5	N,NE	1007.2	3.7	E,W	1006.5	2.7	E	1004	3.0	W, NW	NA
Nov	3.1	NW, N	1014.2	2.4	N,NW	1011.6	3.1	SW,W	1010.6	1.9	W,SW	1008	2.3	W, NW	NA
Dec	2.9	NW, N	1016.6	2.6	N,NW	1013.7	2.9	SW,W	1012.7	1.9	W,SW	1010	3.0	W, NW	NA

(Source-IMD)

5.8.2. Wind Speed and Direction

The wind speed in the area was mostly between 1.9 km/hour at Patna IMD and maximum of 8.7 km/hour at Kolkata IMD for all the months of a year. The predominant wind direction is from North and Northwest direction in winters and South and Southeast direction during rest of the season.

5.8.3. Rainfall

The annual total rainfall in all IMD stations (representing respective city/towns) ranges between 1000.3mm at Varanasi and 1728.5 mm at Kolkata. Over 80% of the total annual rainfall at all locations is received during the monsoon period between June to September.

5.8.4. Relative Humidity

The air is generally dry in the region except during monsoon. March and April are the driest months with relative humidity ranging between 25-84%. Lowest humidity was observed in Varanasi (as per IMD records) which slightly increased with decreasing altitude. The maximum humidity was observed during rainy season as reflected in data base of all IMD stations along NW1.

5.8.5. Temperature

December and January constitutes winter months with daily mean minimum temperature of around 9.1^0C at Patna (IMD Station) and daily mean maximum temperature of around 26.9^0C at Kolkata. April and May are the hottest months with daily mean maximum temperature varying around 40.4^0C at Varanasi and daily mean minimum temperature around 24^0C at Malda (IMD records).

5.8.6. Barometric Pressures

The station level barometric pressure at all IMD sites ranged between 997 to 1016.8 h Pa. The station level pressure is highest in winter months and low in during rainy season.

5.8.7. Day Time Length

At Allahabad, the longest day of the year (falling in June) is of 13 hours 35 minutes of daylight. The shortest day (falling in December) is only of 10 hours 24 minutes long. Similarly, at Haldia (which is farther towards South, and closer to the equator), the longest day of the year is of 13 hours 29 minutes, and the shortest day is of 10 hours 47 minutes.

5.8.8. Visibility

Visibility is of key concern for safe navigation all along NW1. A review of climate date for a few key locations along the NW-1 route suggests that there are occasions with reduced visibility (characterised by the average number of days affected by fog). The time period over which fog is likely to affect the NW-1 route extends from October to March inclusive. There is a subtle difference in the period of the year when fog is more likely to affect navigation on different locations particularly the locations falling nearer the coast (Haldia and Kolkata) are having a larger window over which fog could occur (October to March).

Berhampur is having the narrowest window (January to March). The greatest probability of fog occurring at locations along the NW-1 route is during January, the potentialinland locations (Patna and Varanasi) to be affected by fog on more than 50% of days during December and January. Visibility may also be reduced significantly during periods of heavy rain. During such conditions, the performance of vessel-mounted navigation aids, such as radar, may also be affected.
Site specific Met Data at proposed terminals

Secondary one-month data was collated for terminal and Lock locations at Haldia, Farakka lock, Sahibganj and Varanasi. The analysis reflected that predominant wind direction all along NW-1 is from NW, WNW, E, S and SE direction. The prevalence of calm period ranges between 26 to 31%. Site specific met data and wind roses are given at **Table 5.28** and **Figure 5.26**.

Table 5.28 : Meteorological Data

IMD	Temperature (deg C)		Relative Humidity, %		Wind speed Range m/s		Predominant wind Direction	Calm Period
	Max	Min	Max	Min	Min	Max	(from)	%
Haldia Site	38.5	25.6	94	34	0.5	8.8	S, SE	26.06
Farakka site	38.6	22.5	81	56	0.5	5.7	ESE, E	24.3
Sahibganj	39.0	22.0	97	30	0.5	8.8	ESE, E	30.2
Varanasi	35.4	23.4	78	57	0.5	6.5	WNW, NW	31.2

(Source-World Weather on line.com)

5.8.9. History of Cyclones

As per Cyclone Hazard Prone Map of India some stretch of NW-1 close to Haldia in West Bengal (nearer to sea) falls high Cyclone prone area. Cyclone hazard prone areas of NW-1 are shown at **Figure 5.26**.

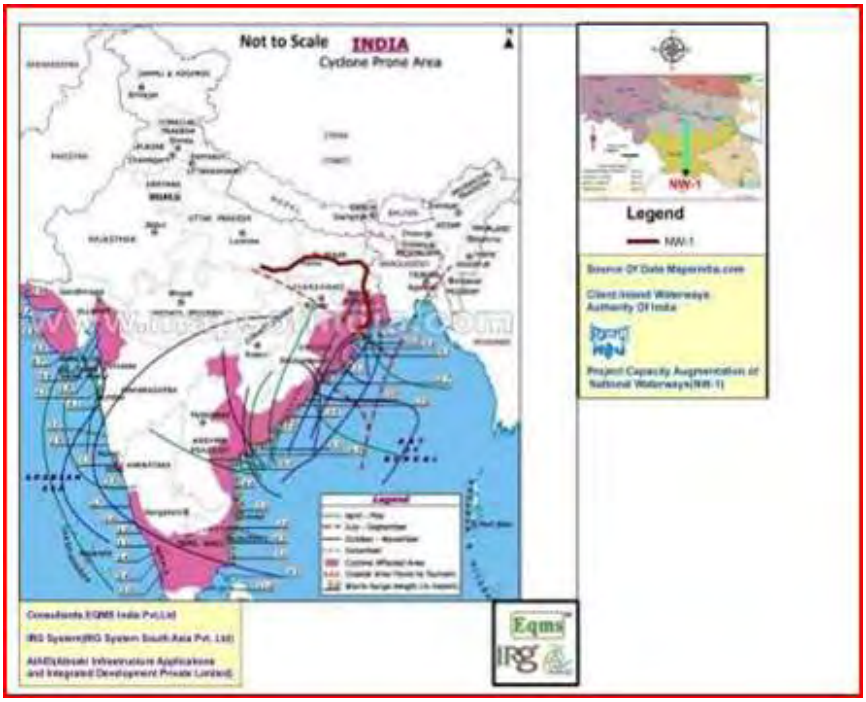


Figure 5.26 : Cyclone Prone Area Map of India showing NW-1

5.8.10. Tidal Surges

Tidal surges are also important for navigation ease. There are no tidal surges observed in NW-1 area from Allahabad to Farakka. Nearly halfway between Farakka and Sagar Island, Hoogly (Ganga) enters into the tidal zone of the Gangetic delta. The tide runs rapidly on the Hoogly, and tidal effect upto Kolkata (about 175 Km).

5.9. Socio-Economic Environment

The socio-economic profile of districts/cities/towns of these states falling along NW-1 are analysed to understand overall socio-economic environment around NW-1 project areas.

5.9.1. Demography

Demography is one of the important indicators of environmental health of an area. It includes population, number of households, literacy, population density, etc. Demographic profile of the area was analysed based on 2011 census data.

5.9.1.1 Population Distribution in Major Cities along NW-1

There are many cities, towns and villages located along the NW-1. As per the Census Record of India 2011, **the population of major cities/ town located along the Ganga River in NW-1 section was recorded as 12875343 comprising 6782150 male and 6093193 females.** Total number of 'Households' was also recorded as 2562165 and 0-6-year age population was also recorded as 1308682. City/town wise Population distribution in study area (NW-1 section) is shown in **Table 5.29** and **Figure 5.27**.

Table 5.29 : Population of Major City & Towns along with NW-1

Sl. No.	Name of Town/City	No of Household	Total Population	Male	Female	Population 0-6-year age
1	Allahabad	205529	1168385	630577	537808	120620
2	Sirasa	1867	12686	6637	6049	1826
3	Gyanpur	2906	19058	10029	9029	2662
4	Mirzapur-cum-Vindhyachal	38185	234871	125601	109270	30340
5	Chunar	5951	37185	19647	17538	4926
6	Varanasi	190835	1198491	635140	563351	135677
7	Saidpur	3505	24338	12716	11622	3578
8	Zamania	4863	33243	17322	15921	5226
9	Gahmar	4365	25994	13367	12627	3650
10	Ballia	15772	104424	55459	48965	11623
11	Ghazipur	19556	121020	63513	57507	15139
12	Buxar	16710	102861	54277	48584	14165
13	Chhapra	31501	202352	106501	95851	29100
14	Fathua	8225	50961	26953	24008	8499
15	Hajipur	24033	147688	78047	69641	20899
16	Patna	294631	1684297	893445	790852	203047
17	Barauni	12964	71660	37858	33802	12723
18	Sonepur	6383	37776	19995	17781	5273
19	Bakhtiarpur	7295	47897	25168	22729	8653
20	Kahagaria	9123	49406	26594	22812	7273
21	Begusarai	48620	261384	138519	122865	41560
22	Barh	9310	61470	32823	28647	9627
23	Bihat	12958	67952	35965	31987	10694
24	Munger	38921	213303	113291	100012	30484
25	Sultanganj	9410	52892	28240	24652	8741
26	Bhagalpur	69984	400146	212813	187333	54818
27	Sahibganj	17076	88214	46449	41765	12262
28	Farakka Barrage Township	4786	20126	10430	9696	1882
29	Pakaur	9333	45840	23653	22187	6352
30	Berhampore	43075	195223	100247	94976	13881
31	Katwa	19382	81615	41350	40265	6799
32	Santipur	36506	151777	77011	74766	13573
33	Hugli-Chinsurah	45005	179931	90217	89714	12604
34	Haora	244135	1077075	561220	515855	91315
35	Kolkata	1024928	4496694	2356766	2139928	339323
36	Diamond Harbour	10048	41802	21050	20752	3688
37	Tamluk	14489	65306	33260	32046	6180
38	Haldia	44065	200827	104841	95986	21945
Total		2562165	12875343	6782150	6093193	1308682

Source: Primary Census of India 2011

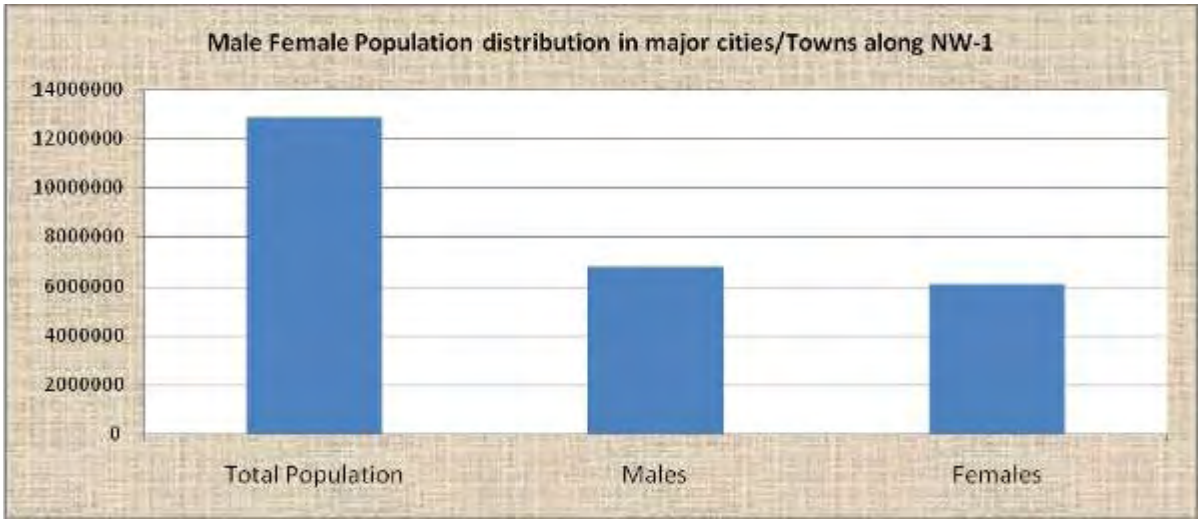


Figure 5.27 : Graphical Presentation of Male-Female wise Population

5.9.1.2 Scheduled Caste and Schedule Tribe Population in Major cities/Town along NW-1

The Scheduled Caste (SC) and Scheduled Tribe (ST) communities are considered as socially weak who are supported by Government through various welfare schemes. **Scheduled Caste population consisting of 544284 males and 483706 females respectively in major city/towns along the study area and accounts for 7.9% of the total population. The 'Scheduled Tribe' population consist of 27576 males and 25244 females respectively and accounts for 0.41% of the total population (12875343).** It implies that 91.6% of total population belong to the general category and other backward classes. SC & ST population profile is given at **Table 5.30** and **Figure 5.28**.

Table 5.30 : Caste wise (SC & ST) Population breakup in cities/towns along NW-1

Sr. No.	Name	SC Population	SC Male	SC Female	ST Population	ST Male	ST Female
1	Allahabad	148794	80023	68771	2694	1494	1200
2	Sirasa	1799	965	834	21	14	7
3	Gyanpur	911	486	425	0	0	0
4	Mirzapur-cum-Vindhyachal	26700	14495	12205	391	204	187
5	Chunar	5657	3053	2604	119	68	51
6	Varanasi	82190	44058	38132	6595	3558	3037
7	Saidpur	6194	3256	2938	28	13	15
8	Zamania	3359	1758	1601	220	118	102
9	Gahmar	3295	1774	1521	327	168	159
10	Ballia	8703	4637	4066	3942	2088	1854
11	Ghazipur	9548	4965	4583	881	464	417
12	Buxar	8619	4612	4007	1800	961	839
13	Chhapra	16629	8739	7890	566	291	275
14	Fathua	7991	4198	3793	29	12	17
15	Hajipur	24908	13132	11776	97	57	40
16	Patna	151924	80521	71403	5139	2527	2612

Sr. No.	Name	SC Population	SC Male	SC Female	ST Population	ST Male	ST Female
17	Barauni	5540	2898	2642	195	103	92
18	Sonepur	5158	2721	2437	138	81	57
19	Bakhtiarpur	7122	3676	3446	50	21	29
20	Kahagaria	3782	2029	1753	89	44	45
21	Begusarai	31227	16668	14559	279	138	141
22	Barh	8578	4575	4003	37	22	15
23	Bihat	8540	4556	3984	274	150	124
24	Munger	14562	7632	6930	406	215	191
25	Sultanganj	4839	2552	2287	19	11	8
26	Bhagalpur	32681	17453	15228	1061	493	568
27	Sahibganj	11105	5848	5257	5306	2688	2618
28	Farakka Barrage Township	6604	3423	3181	274	138	136
29	Pakaur	3224	1625	1599	2557	1258	1299
30	Berhampore	19349	9952	9397	1104	625	479
31	Katwa	12189	6146	6043	209	101	108
32	Santipur	33493	17174	16319	2371	1194	1177
33	Hugli-Chinsurah	26157	13353	12804	1306	658	648
34	Haora	35025	18289	16736	3339	1735	1604
35	Kolkata	241932	128053	113879	10684	5729	4955
36	Diamond Harbour	5221	2677	2544	72	34	38
37	Tamluk	4441	2312	2129	201	101	100
38	Haldia	36946	19342	17604	1560	838	722
Total		1027990	544284	483706	52820	27576	25244

Source: Primary Census of India 2011

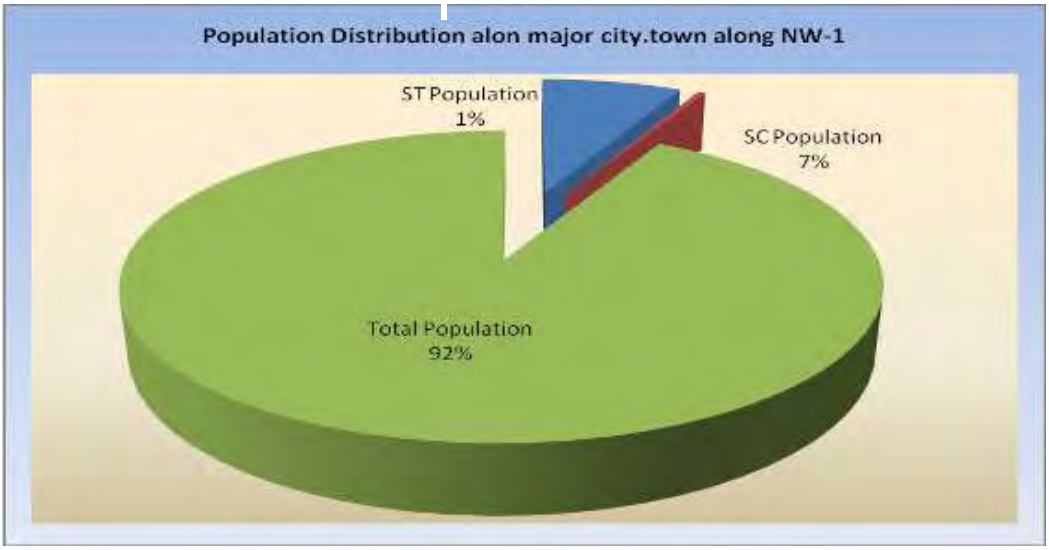


Figure 5.28 : Graphical representation of SC, ST and General Population

5.9.2. Literacy Level in Major cities/towns along NW-1

Literacy level is quantifiable indicator to assess the development status of an area or region. The statistic of literate and illiterate male and female population is presented in **Table 5.31** and **Figure 5.29**. **About 75.4% of the population is literate and 23.6% is illiterate in**

cities/town located along the NW-1 is illiterate. Male population is more literate than female.

Table 5.31 : Literate and Illiterate Population breakup in cities/towns along NW-1

Sl. No.	Name	Population literate	Male Literate	Male Literate	Population Illiterate	Male Illiterate	Female Illiterate
1	Allahabad	887136	499842	387294	281249	130735	150514
2	Sirasa	8715	5004	3711	3971	1633	2338
3	Gyanpur	13004	7362	5642	6054	2667	3387
4	Mirzapur-cum-Vindhyachal	156408	89938	66470	78463	35663	42800
5	Chunar	24674	14442	10232	12511	5205	7306
6	Varanasi	842497	469653	372844	355994	165487	190507
7	Saidpur	15898	9138	6760	8440	3578	4862
8	Zamania	21462	12473	8989	11781	4849	6932
9	Gahmar	17108	9897	7211	8886	3470	5416
10	Ballia	77331	43298	34033	27093	12161	14932
11	Ghazipur	88656	49359	39297	32364	14154	18210
12	Buxar	74344	41701	32643	28517	12576	15941
13	Chhapra	135951	76783	59168	66401	29718	36683
14	Fathua	29803	17248	12555	21158	9705	11453
15	Hajipur	97372	55206	42166	50316	22841	27475
16	Patna	1234991	685885	549106	449306	207560	241746
17	Barauni	40529	23456	17073	31131	14402	16729
18	Sonepur	25893	14909	10984	11883	5086	6797
19	Bakhtiarpur	27477	16117	11360	20420	9051	11369
20	Kahagaria	35124	19853	15271	14282	6741	7541
21	Begusarai	167178	95014	72164	94206	43505	50701
22	Barh	39168	22578	16590	22302	10245	12057
23	Bihat	44350	25534	18816	23602	10431	13171
24	Munger	146507	82590	63917	66796	30701	36095
25	Sultanganj	31327	18466	12861	21565	9774	11791
26	Bhagalpur	273695	153821	119874	126451	58992	67459
27	Sahibganj	60164	34053	26111	28050	12396	15654
28	Farakka Barrage Township	14394	7907	6487	5732	2523	3209
29	Pakaur	30641	16640	14001	15199	7013	8186
30	Berhampore	163312	85970	77342	31911	14277	17634
31	Katwa	65187	34159	31028	16428	7191	9237
32	Santipur	111806	59588	52218	39971	17423	22548
33	Hugli-Chinsurah	152333	78617	73716	27598	11600	15998
34	Haora	874491	468026	406465	202584	93194	109390
35	Kolkata	3588137	1926915	1661222	908557	429851	478706
36	Diamond Harbour	32753	17193	15560	9049	3857	5192
37	Tamluk	53318	28282	25036	11988	4978	7010
38	Haldia	158380	87334	71046	42447	17507	24940
Total		9703134	5316917	4386217	3172209	1465233	1706976

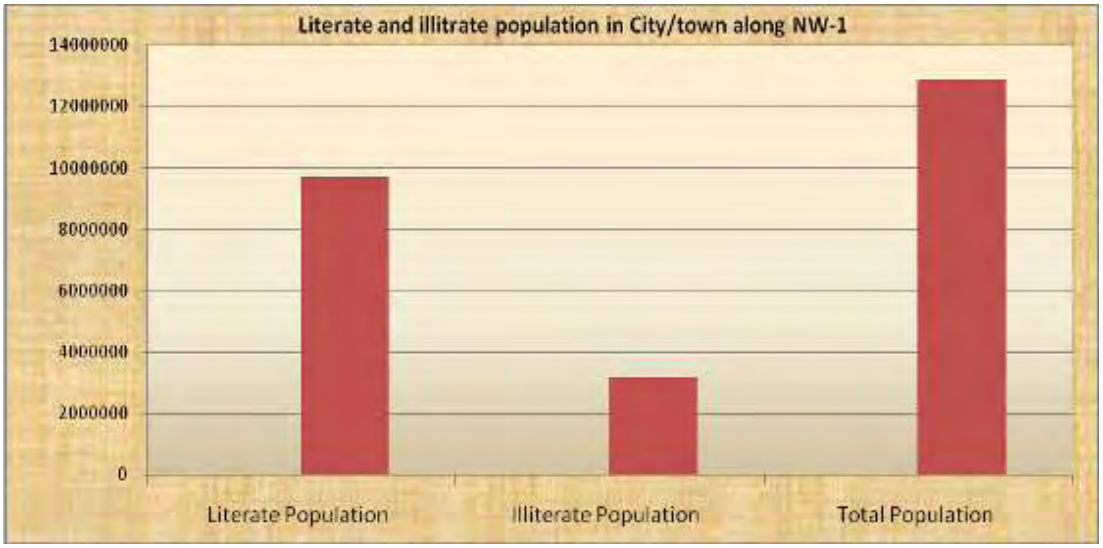


Figure 5.29 : Graphical representation of literate and Illiterate Population

5.9.3. Workers Scenario and Livelihood Pattern of the community along NW-1

In cities and town along NW-1 area the main and marginal workers[14] are 14% and 29% respectively while the remaining 57% of total population constitutes non-workers. The main occupation is agriculture, labour class and trading activities. The workers' scenario is given in the cities and town along "NW-1" is presented in the **Table 5.32** and **Figure 5.30**. The occupation based bifurcation of population in study area is provided in **Figure 5.31**.

Table 5.32 : Working and Non-Working Population breakup in cities/towns along NW-1

Sr. No.	Name	Total Workers	Main worker	Marginal Workers	Non workers
1	Allahabad (M Corp. + OG)	390202	281443	108759	778183
2	Sirasa	4365	2959	1406	8321
3	Gyanpur	5105	4255	850	13953
4	Mirzapur-cum-Vindhyachal (NPP)	77247	56326	20921	157624
5	Chunar (NPP)	11901	7986	3915	25284
6	Varanasi (M Corp.)	402122	339305	62817	796369
7	Saidpur (NP)	7015	5368	1647	17323
8	Zamania (NPP)	8459	6527	1932	24784
9	Gahmar	7058	4399	2659	18936
10	Ballia (NPP)	35256	23069	12187	69168
11	Ghazipur (NPP + OG)	33464	26881	6583	87556
12	Buxar (Nagar Parishad)	26652	23493	3159	76209

14A person who has worked for more than 183 days in a year is called the main worker. Marginal workers are those who have worked any time in the year preceding the census but have not worked for major part, which is not more than 183 days, of the year

Sr. No.	Name	Total Workers	Main worker	Marginal Workers	Non workers
13	Chhapra	53479	40896	12583	148873
14	Fathua	13540	11832	1708	37421
15	Hajipur	39836	33596	6240	107852
16	Patna (M Corp. + OG)	509839	426086	83753	1174458
17	Barauni	18923	16144	2779	52737
18	Sonepur	9197	7329	1868	28579
19	Bakhtiarpur	12978	8896	4082	34919
20	Kahagaria	12925	10808	2117	36481
21	Begusarai	75740	54680	21060	185644
22	Barh (Nagar Parishad)	17152	14417	2735	44318
23	Bihat (Nagar Parishad)	18862	13707	5155	49090
24	Munger (M Corp.)	57185	43389	13796	156118
25	Sultanganj(Town)	15403	10520	4883	37489
26	Bhagalpur (M Corp.)	119346	95077	24269	280800
27	Sahibganj (Nagar Parishad)	25443	20498	4945	62771
28	Farakka Barrage Township (CT)	7174	6153	1021	12952
29	Pakaur (NP)	14906	13171	1735	30934
30	Berhampore (M)	73145	68515	4630	122078
31	Katwa (M)	28718	25283	3435	52897
32	Santipur (M)	72023	63783	8240	79754
33	Hugli-Chinsurah (M + OG)	68994	61730	7264	110937
34	Haora (M Corp)	397048	358922	38126	680027
35	Kolkata (M Corp.)	1795740	1576419	219321	2700954
36	Diamond Harbour (M)	14808	13178	1630	26994
37	Tamluk (M)	22929	19230	3699	42377
38	Haldia (M)	61216	50792	10424	139611
Total		4565395	3847062	718333	8510775

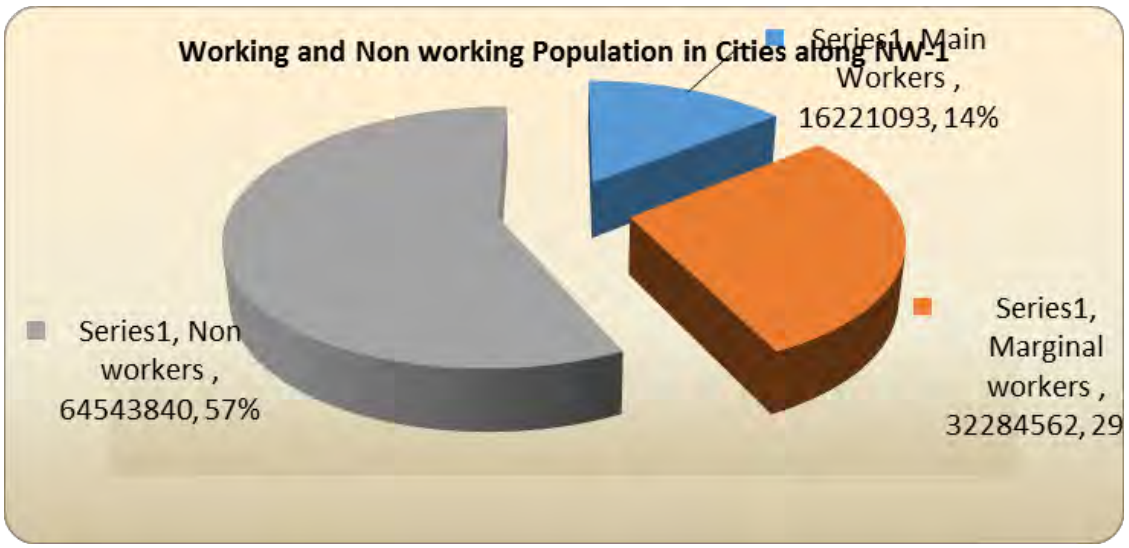


Figure 5.30 : Graphical representation of Working and Non-working Population

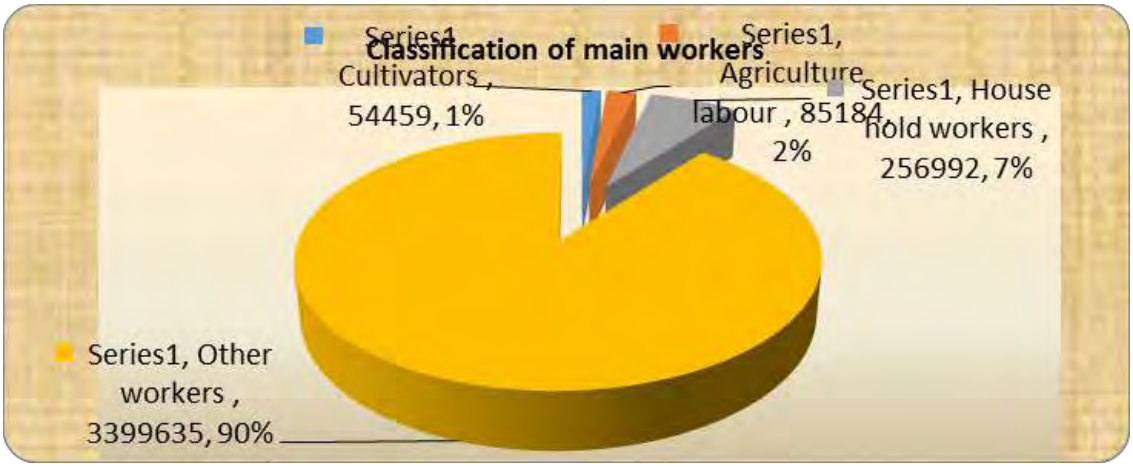


Figure 5.31 : Classification of Main Working Population in cities/town along NW-1

5.9.4. Livelihood Pattern of the community Depending on the river

Ganga along the NW-1 state is intrinsically linked to the economy of the area. It provides the necessary silt in much of the land around it, increasing its fertility. Paddy is the greatest crop of the region. **Agriculture is the main source of the livelihood generation for the people residing along the NW-1 area. Many towns in the area are primarily industrial. Ganga provides the necessary infrastructure for the factories to perform. Commercial fisheries in the Ganga River System are an important source of livelihood for the people residing along the Ganga River.** The Ganga in Allahabad and Varanasi is also considered to be the most auspicious. Thousands of devotee Hindus come to the Ghats to pray for their ancestors. **Pilgrimage and the associated tourism brings along a major source of revenue for religious towns and their people.**

5.9.4.1 Fishing and Livelihood Generation along NW-1

Ganga is the most important river and source of livelihood for countless fishers inhabiting on its bank. The fishery in the potamon zone of the river is mainly represented by the species belonging to Cyprinidae and Siluridae families. **There is substantial decline in major carps fish catch in Allahabad to Farakka stretch over past few years.** In recent period, the fishery showed some improvement due to emergence of exotic species, specifically C. carpio and O. niloticus. **At Buxer hilsa was the main fishery and with the commissioning of Farakka barrage the fishery declined sharply between 1972-80. Fishery improved during 1981-86 due to improvement in landings of other species. Patna centre also showed drastic decline in major carp landings and as compared to sixties it was almost half during 1986-93. Decline at Bhagalpur was not as severe as at other centres.** Gupta and Tyagi (1991) have discussed the fishery of Ganga with an analytical approach and showed that the fishery is harvested at a level higher than the optimum fishing level and efforts should be made to reduce the fishing pressure to obtain a sustainable fishery from the system.

Fishermen Population and Fishing pattern: It is very important to know the total number of fishers involved in capture fisheries in the NW-1 stretch. **It is reported that almost every village along the both sides of the river are having some fishermen who earn their livelihood by fishing in the Ganga river.** There is no census data available regarding

fishers specifically involved in capture fisheries in the whole NW-1 stretch. **Generally, one member of the family is engaged in fishing in lower stretch of NW-1(Farakka to Haldia), sometimes two, the average comes to be 1.5. However, in upper stretch (Allahabad to Farakka) the average person engaged in fishing is 1.2 that is mainly due to low fish catch in this stretch.** The fishermen do fishing for 5-12 hours daily, depending upon the season. Fishing activities is very less during monsoon season. Fishing is the main occupation to 90% of the fishermen, which contribute to more than 80% of their household income. Other major occupation includes fish vending, ferry service, tourism, driving and daily labour. Most of the fishermen do not have agricultural land and small amount of income comes from labour wage, service, and petty business. In the season of less catch the youth generally engage themselves in labour works or rickshaw van pulling to earn their livelihood.

Fishing Income: The monthly average income of the fisherman ranged from Rs.4000 to 7000 per month in Allahabad to Patna stretch. However, in Varanasi stretch the most of the fisherman is engaged in boating and ferry services now and earning more than fishing. **In lower zone (Farakka to Haldia) the average income of fisherman is slightly high and ranging between 7000 to Rs. 10,000 per month because of higher catch and high value fish (mainly hilsa) in the catch.**

Fishing Crafts: For fishing purpose mainly small or medium sized boats was used. As compared to sixties, the availability of boats per fishermen showed an increase, this may be due to change in fishing pattern. As in past mainly dragnets were used for fishing involving only two boats and more than 10 fishers in a fishing unit. With the passage of time dragnets have lost their place and fishers have switched over to gill nets involving maximum 2-3 persons and a boat. Single piece tin made fishing craft dingi are mostly found in Farakka and surrounding stretch and whereas the wooden boats/ big crafts are mostly found in the lower zone near Haldia.

Nets & Gears: Dragnets, dip net, gill nets, traps, bag nets are commonly used by the fisherman along the NW-1 stretch. Gill nets availability was highest in Patna, Munger and Bhagalpur stretch of NW-1 and lower in Allahabad and Mirzapur stretch of NW-1. Availability of dragnets was low in almost Allahabad to Farakka stretches. Large dragnets were not present at all. Use of hook and lines were mainly in the Allahabad and Mirzapur stretches of NW-1 whereas traps were more in district Ballia and Bihar stretches. Small scoop nets were available in the entire stretch but large size was available only in lower stretches down to Farakka. Dip nets were observed in Allahabad and Mirzapur districts.
Various forms of gill nets and bag nets are found to be operated by the fishers. Among them gill nets are most prevalent throughout the NW-1 stretch. Around 80% of the fishers were using the gear. The gill nets have different local names like Current jal, Nagin jal, Kajli jal, Phasa jal, Bhola jal, Vacha jal, Ghero jal, Dhoali jal, Gule jal, Pungus jal, etc. A number of variations in material and mesh size in gill nets are observed depending upon the targeted fishes. However, drift gill nets are the major nets used to catch hilsa, the main migratory fish of Bhagirathi- Hooghly river system. All different types of gill nets have their distinct seasonality in operation depending upon the availability of the target species.

Fishing sites and Jal/net operation in river: Most of the gears, bigger nets are operated inside the river for quite long time. Few bigger nets like Khelpa jal / Bachari jal and hooks can operate from river bank. Gears, bigger nets are more frequently used by the fisherman

near Farakka and downstream of Farakka to Haldia. However, the use of Gears and bigger nets is not so common in upper reach from Rajmahal to Allahabad.

5.9.5. Infrastructure Facilities along NW-1

The cities and towns along NW-1 has most of required infrastructure facilities. Infrastructural facilities namely Industries/industrial areas, transmission line, national highways, other roads, railways, settlement, cultural sites and archaeological site located within 500 either side of NW-1 is mapped using satellite imageries and limited physical verifications. These are presented in **Annexure 5.6**.

5.9.5.1 Transport Network (Road/Rail/Water and Airways)

All the towns and cities along the NW-1 are well connected with national highways, state highways, district roads, railways. Cities like Varanasi, Patna, and Kolkata are also connected with airways. Some of cities located along the NW-1 are connected with localised ferry services as well.

5.9.5.2 Thermal Power plants along NW-1

Eleven thermal power plants are located in close proximity of river Ganga between Haldia and Allahabad and 10 more are reportedly are proposed to be set up in close proximity of the river. These terminal power plants have boosted the prospect of the waterway like never before for transportation of imported coal to these power stations. Transportation of coal to NTPC power plant at Farakka is already operational through NW-1.

5.9.5.3 Current Pollution Load from Point Sources and its flow at Different Segment of NW-1

There are 30 class I cities and 8 class II towns along the mainstream of river Ganga at NW-1 segment. These cities are discharging 2173.8 MLD wastewater out of which only 959.6 MLD has the treatment Capacity. The City sewage discharge is major source of pollution to river Ganga which is another cause of declining fish catch in the river. Status of wastewater generation and treatment capacity in these cities is summarized in **Table 5.33** and detailed at **Table 5.34**.

Table 5.33 : Wastewater Generation and Treatment Capacity

Category	Wastewater Generation, MLD	Treatment Capacity, MLD
Class-I (30)	2110.4	957.6
Class-II (8)	63.4	2
Total	2173.8	959.6

Source: CPCB report Status of Water Supply, Wastewater Generation and Treatment in Class-I Cities Class-II Towns of India

Table 5.34 : Sewage Generation of class Cities-I in River Ganga

State	City/Town	Sewage Generation (MLD)	Treatment Capacity (MLD)
Uttar Pradesh	Allahabad	208	89

State	City/Town	Sewage Generation (MLD)	Treatment Capacity (MLD)
	Mirzapur	27.5	14
	Varanasi	187.1	141
	Sub-Total	422.6	244
Bihar	Patna	249.2	109
	Munger	34	13.5
	Bhagalpur	61.6	11
	Katihar	31.7	31.7
	Sub-Total	376.5	165.2
West Bengal	Kolkata	618.4	172
	Haldia	24.5	24.5
	Santipur	18.7	18.7
	Nabadwip	15.5	10
	Basirhat	15.3	--
	Bangaon	13.8	--
	South dumdum	53	52.9
	Rajpur sonarpur	33.6	45.4
	Kamarhati	48.8	40
	North Dumdum	29.7	--
	Naihati	20.5	--
	Ulberia	27.3	--
	Kanchrapara	17	--
	Halisahar	16.8	--
	North Barrackpur	19.2	16.7
	Rishra	13.5	15.3
	Ashoknagar Kalyangarh	17.3	15
	Haora	136.2	63.9
	Bhatpara	59.7	28.5
	Maheshtala	52.5	3.9
	Serampore	26.7	18.9
	Chandannagar	16.1	22.7
	Habra	17.2	--
	Sub-Total	1311.3	548.4
	Total	2110.4	957.6

Source: CPCB report Status of Water Supply, Wastewater Generation and Treatment in Class-I Cities Class-II Towns of India

Waste water generation from cities and towns along NW-1 in Uttar Pradesh segment generated 422.6 MLD i.e. 26. % of total wastewater generation. Waste water generation from cities and towns along NW-1 in Bihar segment is 376.5 MLD i.e. 14 % of total wastewater generation. The major city is Patna which generates 249.2 MLD of total waste water generated from this stretch. The cities/towns located along NW-1segment of West Bengal generate about 1311 MLD i.e. about 50 %. Out of the total waste water generation in NW-1 segment. Kolkata alone contributes47% and Howrah generates 10% of the total waste water generation of west Bengal stretch.

5.9.6. Cultural Activities and Religiously Important Places along NW-1 and Important Festivals

Ganga River is worshipped in India and holds an important place as it is considered sacred and holy river in Hindu religion. Hindu people believe that holy dip in river Ganga washes

their sins. This dip is considered more important at religious places at Allahabad and Varanasi located along NW-1. Hindus also believe that bathing in the river on certain special occasions and periods causes the forgiveness of sins and helps attain salvation. People also travel from distant places to immerse the ashes of their kin in the waters of the Ganga. This immersion also is believed to send the ashes to heaven. Various festivals are organised on the bank of rivers at different places and different period. These festivals attract very large crowds and may have bearing even on movement of barges in NW-1 during festival periods. The list of culturally and religiously important places with its festivals along the NW-1 is given at **Table 5.35**.

Table 5.35 : Culturally and Religiously Important Places with Fair and Festivals

Sl. No.	City	Place	Fairs & Festivals
1	Allahabad	Sangam	**Kumbh Mela:** The confluence of the 3 rivers Ganga, Jamuna and the sacred and mythological river Saraswati at Sangam is considered to be quite auspicious for the Hindus. It is said that when Lord Vishnu carried a pot or Kumbha of Nectar or Amrita, a fight broke out among the gods. In the milieu, four nectar drops fell on the earth at the four place which are known as the Tirthas and include Nasik, Haridwar, Prayad and Ujjain. These places are therefore considered as place where the mortal humans can pass on to a celestial world form the human world. In each of these locations, there is a kumbha mela held but on the 12th year, the mela is organized in Allahabad as it is considered the most sacred of the Tirthas. The Greatest Kumbha Mela is held in Allahabad which is also known as Maha Kumbha Mela and is the biggest fair related to religious practices. **Magh Mela:** Apart from the Maha Kumbh and another kumbh mela by the name of Ardh Kumbh, there is the Magh Mela. Maha kumbh is held every 12th year in the city of Allahabad which is a sacred city in the state of Uttar Pradesh. As because the Magh Mela falls during the period of Magh months of Jan and Feb, so the name has been given. During this period, the devotees take a holy bath at the confluence of the 3 rivers believing that the waters will wash away their sins.
2	Varanasi	Ghats	There are more than 100 ghats along the Ganga river at Varanasi (steps leading to the water of the Ganges). The banks of the Holy River at Varanasi are the most preferred cremation grounds.
		Ghats	**Panch Koshi Parikrama:** This parikrama starts and finishes at Manikarnika Ghat and has the great importance in ancient Parikrama of India. The devotee will pass through the five great places that's why it has named so behind this. The five places of which the devotees have to round up and complete his Panch Koshi Parikrama are Kardmeshwar, Shivpur, Rameshwar, Bhimchandi and Kapildhara. **Ganga Mahotsav:** This festival is being celebrated in the months of October and November which is the tourism festival of Varanasi that is being celebrated from Prabodhani Ekadashi to Kartik Purnima (November month) ending by a dance presentation at Ganga Mahotsav. The rich cultural heritage of Varanasi is being reflected by this festival. Besides various cultural programs and the boat racing the martial arts are also presented. This festival also corresponds with another traditional festival of Dev Deepavali in which all the

Sl. No.	City	Place	Fairs & Festivals
			ghats of Varanasi are enlightened by thousands of Diyas. **Dhrupad Mela:** This mela is basically a music festival that is organized on the Tusli Ghat for five days (Feb or March month) in which the renowned artists of the area give there performances. This mela is especially famous among the foreign tourists.
3.	Bihar & Jharkhand	Ghats	**Chatth Puja:** Chhath is an ancient Hindu festival dedicated to the worship of the Lord Sun in November month and is mainly celebrated in Bihar and Jharkhand on the banks of Ganga.

5.9.7. Tourism

The river is of great cultural and religious significance for the whole Indian peoples. All of this makes the Ganges a must for all tourists who wish to encounter all of India's diverse beauty in terms of both culture and nature. There are many cities along the banks of NW-1 specially Allahabad, Varanasi and Kolkata which are important from tourism prospective and attract thousands of religious and non religious tourists every year. Varanasi, a pilgrim place for Hindus and Buddhist alone attracts over one million pilgrims every year followed by Allahabad.

5.9.8. Existing Waste Management Facilities along NW-1

The municipal and bio-medical waste management facility is available at select cities only along the entire stretch of NW-1. Common Hazardous waste facility is available only at Haldia in NW-1 area. The status of these facilities in select cities along the NW-1 is described below:

Allahabad (Uttar Pradesh): Currently, the local body of Allahabad Municipal Corporation collects and dispose its the municipal solid waste through Allahabad Waste Processing Company Pvt. Ltd (AWPCPL at Solid Waste Disposal Site (SWDS) located near Kareli which is about 4 km away from the Allahabad railway station and functions on composting technology. The compost that is produced from this plant will be supplied to local agricultural farms.

Municipal solid waste treatment facilities in Varanasi (Uttar Pradesh): Varanasi Municipal Corporation (VMC) currently collects municipal waste and dispose off to unorganized dumping site located 20 Km away from the city in Karsada. Construction of a treatment plant and organized landfill site is planned under JNNURM.

Bio-medical waste treatment facilities in Varanasi (Uttar Pradesh): Varanasi Nagar Nigam has established Common Bio Medical Waste Treatment Facility (CBWTF) at 310-MohanSarai, National Highway and is well managed.

Solid waste disposal Facilities in Patna (Bihar): Solid waste management is an overall responsibility of the Municipal Corporation as per Bihar Municipal act 2007 and MSW (management & Handling) rules 2000. Patna Municipal Corporation (PMC) is responsible for development municipal waste land fill sites butit has yet to develop an organized land fill site. At present municipal waste is dumped to identify unorganized dumping sites. Bihar Urban infrastructure development Corporation Ltd. (BUIDCO) has also initiated the process

of an integrated Solid Waste Management process plant at Patna on PPP mode with power generation capacity of 8 MW electricity.

Solid waste Disposal in Bhagalpur (Bihar): No organized or bio medical waste disposal facility is available in this city.

Solid waste disposal facilities in Kolkata (West Bengal): About 95% of total waste generated in Kolkata Municipal Corporation (KMC) area is disposed at Dhapa landfill site and the rest at Garden Reach dumping ground. 700 TPD compost plant is set up by M/S. Eastern Organic Fertilizer Ltd. with technical back up of Excel Industry, Mumbai. Plant was set up and commissioned in the year 2000 and operated at 200 – 250 TPD capacity till 2003. Since 2003 Eastern Organic Fertilizer has stopped operating the plant because they are unable to sell the compost with reasonable profit margin and failed to meet their commitments towards KMC.

Haldia (West Bengal): The first Common Storage, Treatment and Disposal Facility (CSTDF) for hazardous waste under the Public Private Partnership (PPP) have been developed at Haldia. It is a joint venture project of Haldia Development Authority (HDA) and M/s Ramky Enviro Engineers Limited. In April 2003, the HDA and M/s Ramky Enviro Engineers Limited formed a joined venture company under the name and style as M/s West Bengal Waste Management Limited to develop and operate the integrated waste management complex for taking care of the industrial hazardous wastes of West Bengal. Apart from these, the facility will also deal with the biomedical waste as well as municipal solid wastes for the adjacent municipal areas.

5.9.9. Water Borne Diseases

Waterborne diseases increase where standards of water, sanitation and personal hygiene are low. Contaminated drinking-water is a frequent cause of diseases such as cholera, typhoid, viral hepatitis A and dysentery, malaria, dengue. The extent and effect of water born diseases in the states traversed by NW-1 are given at **Table 5.36** to **Table 5.39**.

Table 5.36 : Epidemiological status of Malaria in 2010 and 2011 in the States Traversed by NW-1

States	Year	Population	Cases	Deaths
West Bengal	2010	84908	134795	47
	2011	98922	66368	19
Jharkhand	2010	32187	199842	16
	2011	32928	160653	17
Bihar	2010	103230	1908	1
	2011	103483	2643	0
Uttar Pradesh	2010	188015	64606	0
	2011	194373	56968	0

Sources: National Vector Borne Disease Control Programme

Table 5.37 : State-Wise Dengue Cases and Deaths in the States Traversed by NW-1

Sl.No.	State	2008	2009	2010	2011

		Case	Death	Case	Death	Case	Death	Case	Death
1	West Bengal	1038	7	399	0	805	1	510	0
2	Jharkhand	0	0	0	0	27	0	36	0
3	Bihar	1	0	1	0	510	0	21	0
4	Uttar Pradesh	51	2	168	2	960	8	155	5

Sources: National Vector Borne Disease Control Programme

Table 5.38 : Kala-azar cases and deaths in the States Traversed by NW-1

State	2007		2008		2009		2010		2011	
	Case	Death	Case	Death	Case	Death	Case	Death	Case	Death
West Bengal	1817	9	1256	3	756	0	1482	4	1962	0
Jharkhand	4803	20	3690	5	2875	12	4305	5	5960	3
Bihar	37819	172	28489	142	20519	80	23084	95	25222	76
UP	69	1	26	0	17	1	14	0	11	1

Sources: National Vector Borne Disease Control Programme

Table 5.39 : AES/JE (Viral) Cases and Deaths (2006 – 2011) in the States Traversed by NW-1

Sl. No.	Affected States/UTs	2006		2007		2008		2009		2010		2011	
		Case	Death	Case	Death	Case	Death	Case	Death	Case	Death	Case	Death
1	Uttar Pradesh	2320	528	3024	645	3012	537	3073	556	3540	494	3490	579
2	Bihar	21	3	336	164	203	45	325	95	50	7	821	197
3	Jharkhand	0	0	0	0	0	0	0	0	18	2	303	19
4	West Bengal	0	0	16	2	58	0	0	0	70	0	714	58
	Total (India)	2871	663	4110	995	3855	684	4521	774	5167	679	8247	1169

Sources: National Vector Borne Disease Control Programme
(Japanese Encephalitis (JE), Acute Encephalitis Syndrome (AES)

5.9.10. ArcheologicallyProtected structures (within 300 m of NW-1)

The archeologically protected structures/monument[15] located within 300 m of NW-1 is listed at **Table 5.40**.

Table 5.40 : Archeologically Protected area around 300 m of NW-1

Sl. No.	Name	Latitude& Longitude	Place	Distance from NW-1 km	Direction from NW-1
1	Kardmeshwar Mahadeva Mandir	25°19'13.13"N 83° 1'20.91"E	Varanasi, UP	0.24	W
2	Ramnagar, fort,	25°16'9.17"N 83° 1'28.17"E	Varanasi, UP	0.04	East
3	Archaeological excavation site, Varanasi	25°19'33.72"N 83° 2'4.47"E	Varanasi, UP	0.13	North

15As per Indian regulation no construction activity can take place within 300 m of archeologically protected monuments/ structures/site without written permission from archeological department.

Sl. No.	Name	Latitude& Longitude	Place	Distance from NW-1 km	Direction from NW-1
4	Manmahal and observatory	25°18'27.83"N 83° 0'38.55"E	Varanasi, UP	0.04	West
5	Sindhi Dalan	25° 3'15.32"N 87°49'51.17"E	Rajmahal, Jharkhand	0.3	West
6	Jami masjid	25° 4'25.73"N 87°46'39.01"E	Mangalhat, Jharkhand	0.14	West
7	St. John's Church	22°34'11.38"N 88°20'45.27"E	Council house street, Kolkata, WB	0.3	East
8	Temple of Gour Chandra and Krishnachandra at Chatra (Gaur Chandra Ghat)	22°45'48.96"N 88°20'13.76"E	Hooghly, WB	0	West
9	Hazardwari Palace	24°11'10.27"N 88°16'5.73"E	Murshidabad, WB	0.03	East

1

5.10. External Environment & Social Drivers

External environment & social drivers include the natural disasters like earthquake, cyclones, fires, forest fires, valconic eruptions, immigration, emigration etc. Some of the drivers which will affect the NW-1 development project or which will affect the surrounding areas are given below:

Earthquakes: As described in earlier section, area falls within seismic zone III & IV as per BIS classification. This zone has experienced various earthquakes in past and have recorded high causality & loss of property. Occurrence of earthquake has potential to disturb & disrupt infrastructure, transportation, industrial operations, connectivity, communication etc, if occurs with severe intensity

Flood: Area falls under ganga River water System. Ganga is Perenneial river. Ganga River has experienced and recorded several devastating floods. Similarly floods also have potential to disrupt all infrastructural, communication, industrial, electricity operations in the area:

Immigration & Emigration: Whenever there are some developments in part of the state or country, there is possibility of movement of population to the activity zone in search of employment. Thus the areas proposed and identified as major development area may experience high immigration. Thus for these areas, infrastructural development is essentially to be taken in phasec manner as per requirement. Young/Work force population from rural areas may migrate into these regions.

5.11. Identification of Hotspots on Basis of Baseline Study

From the above study, areas has been identified which are sensitive or the areas where status of CERs is critical. These areas are considered as hotspots which will experience maximum stress in future, i.e. post development of NW-1 and other identified developments. These identified Hotspots as per baseline study is given in **Table 5.41 below**.

Table 5.41 : Identified Hotspots on Basis of Baseline Study

S. No.	Hotspots Strech/Location	Criteria For Selection of Hotspots	CERs
1.	Haldia	• Declared as critically polluted area but at present moratorium is lifted by MoEFCC • Declared notified zone by CGWB • Haldia Port & Shipping Activities • Haldia Dock Complex & Industrial Area • Haldia Energy Ltd. TPP • Urban areas: Haldia Town • Indragachi TPP at Sangrampur	• Ground Water Quality • River Water Quality • Traffic • GHG emissions (micro climate) • Air Quality • Aquatic ecology • Existing infrastructure • New infrastructure development • Fishing Activities • Quality of Life • Water Resources
2.	Kolkata	• Archaeological sites within 300 m: Temple of Gour Chandra and Krishnachandra at Chatra-Gaur Chandra Ghat (0 m, W) , St John Church • High PM_{10} concentration in Howrah • Urban areas: Kolkata & Howrah	• Archaeological sites • Air Quality • River Water Quality • Water resources • Surface Water Quality • Ground Water Quality
3.	Katwa to Hoogly Ghat	• Hisha Sanctuary (fishing restriction for larvae of Hilsha) • TPP at Bandel & Balagarh • Urban Areas: Katwa, Swaroopganj, Nabadwip, Kalna, Balagarh, Kanchrapara, Hoogly	• Traffic • GHG emissions (micro climate) • Air Quality • Aquatic Ecology • Existing infrastructure • Fishing Activities • New infrastructure development • River Water Quality
4.	Lalbagh in Farakka to Murshidabad*	• Floating Terminal, Hazardwari, Existing RCC Jetty Pakur, U/s & D/s jetty, feeder canal, RCC jetty and old lock at Farakka • New lock Farakka • Archaeological Site: Hazardwari Palace • Hilsha Sanctuary (fishing restriction for larvae of Hilsha) • IBA: Farakka and surrounding areas • Farakka feeder canal is prone to erosion • Sagardighi TPP, Farakka STPS • Urban Areas: Farakka, Murshidabad, Azimganj, Baranagar, Balia, Raghunathganj	• Bank/Soil erosion • GHG emissions (micro climate) • Air Quality • River Water Quality • Existing Infrastructure • Fishing Activities • Archaeological Site

S. No.	Hotspots Strech/Location	Criteria For Selection of Hotspots	CERs
		• Bagmari siphon	
5.	Sahibganj	• Existing Samdhaghat terminal and proposed Sahibganj terminal • Existing Fishing Activities • Land Acquisition • Cutting of app. 500 trees • Archaeological sites within 300 m: Jama Maszid & Singhi Dalan • Udhawa Lake Bird Sanctuary at app 6 km • Mining activities	• Land Use • Livelihood & Fishing Activities • Socio-economy • Air Quality • GHG emissions (micro climate) • Aquatic ecology • Terrestrial flora • Existing Infrastructure • Religious Values • New infrastructure development • River Water Quality • Bank/Soil erosion • Archaeological sites • River Water Quality
6.	Pirpanti	• Pripanti TPP, Pripanti Power CESC	• Air Quality • GHG emissions (micro climate)
7.	Kahalgaon	• Vikramshila Gangetic Dolphin Sanctuary • IBA: Kurseala River Course and Diyara Flood Plains • Kahalgaon STPS • Urban Area: Kahalgaon	• Aquatic Ecology • Avifauna • GHG emissions (micro climate)
8.	Bhagalpur	• Vikramshila Gangetic Dolphin Sanctuary • Bhagalpur TPP • Presence of arsenic in ground water • Urban Area: Bhagalpur	• Aquatic Ecology • Avifauna • Air Quality • GHG emissions (micro climate) • Ground Water • River Water Quality • Fishing Activities
9.	Munger	• Presence of arsenic in ground water • Urban Area: Munger	• Ground Water • Traffic • Air Quality
10.	Begusarai	• Barauni TPP & Lakhisarai TPP • Urban Area: Begusarai	• Air Quality • GHG emissions (micro climate)
11.	Barh	• IBA: Mokama Taal • Barh TPP • Urban Area: Barh	• Avifauna • Air Quality • GHG emissions (micro climate) • Ground Water
12.	Patna	• IBA: Danapur Cantonment Area • High PM_{10} concentration in Patna • Urban Area: Patna • Development of River Front	• Avifauna • Air Quality • River Water Qualit

S. No.	Hotspots Strech/Location	Criteria For Selection of Hotspots	CERs
13.	Varanasi	• Archaeological Sites: Kardmeshwar Mahadeva Mandir, Ramnagar, fort, archaeological excavation site, Varanasi • Kashi Turtle Sanctuary • Slightly high cadmium concentration in river bed sediments but below toxicity level of fishes • High PM_{10} levels in Varanasi • High noise level in Turtle sanctuary area	• Archaeological site • Aquatic ecology • Ground water quality • Air quality • Noise levels
14.	Allahabad	• Slightly high cadmium concentration in river bed sediments but below toxicity level of fishes	• River Bed Sediments Quality • River Water Quality

These zones have been already marked in Maps shown in either chapter 3 or chapter 4.

5.12. Conclusion

Baseline study has been conducted to assess the existing condition or status of the identified CERs in the study area. Baseline study has been carried out on the basis of secondary information collected from EIA/SIA study of NW-1, data from pollution control boards, IMD, Agricultural departments and other Governmental Organization. Baseline study has provided the details of condition of identified CERs along the NW-1 and of the district through which NW-1 traverse. This data has helped to identify the significance of the impact on the VECs condition and has provided the basis of carrying out the impact assessment study. Baseline study indicates NW1 has flat terrain with vast catchment being drained by main river along with tributaries. Geologivcal influence area has alluvial soil and falls in Zone III & IV. Land use is largely agricultural land followed by water body, stllements with only 3.59 %vegetation. Turtle sanctuary Vikramshila Gangetic Dolphin sanctuary & Hilsa sanctuary are major CERs with Vikramshila Gangetic Dolphin sanctuary & Udhwa bird sanctuary are protected areas. This area has diverse terrestrial & aquatic biodiversity with spawning & breeding grounds adjoining NW1. Flow analysis indicates that NW 1 has flow constraints in certain stretches considering CAD requirements.

Overall soil type / quality along the NW-1 area is of moderately fertile and not expected to be detrimental to the growth of agricultural and forest crops. It can be concluded that soils fall within medium fertility levels in the entire stretch of NW-1and forms the basis of agriculture resources / cropping pattern. Assessment of land resources indicates land use change particularly diversion of agriculture land for urbanization industries & infrastructure development. Though it is an ongoing phenomenon, any new infrastructure development intervention is expected to accelerate it. No portion of NW-1 and intervention areas falls under any reserved forest or normal forests area. Ecologically the area has important CERs.

Udhwa bird sanctuary and 5 other important bird areas are also located within 10 km radius of NW-1 stretch. However, project interventions like maintenance dredging with alleviate

the flow constraints for smooth operation of the barges, water availability analysis also indicates the river water is good for propogation of wild life and fesheries.

Observations on River Bed-Dredge Material Quality indicate that the concentration level of heavy metal was found low and within acceptable limit as per standard (Criteria for Off-Shore Dumping of Dredged Material, USA) except cadmium which is slightly above the USA standard that may be due to industrial effluent discharge in this section. Pesticide concentration in all samples were found below the USA criteria. The pesticides presence is on expected line as these are predominantly used for various agriculture applications. The source of these pesticide parathion and endosulphan might be from applications of insecticides and pesticides for agriculture in the study area which has significant agriculture land use. Air quality in terms of $PM_{10,}$ $PM_{2.5}$ NOx SO_2 has been found high in major urban centers.

The population of major cities/ town located along the Ganga River in NW-1 section was recorded as 12875343 comprising 6782150 male and 6093193 females. Scheduled Caste population consisting of 544284 males and 483706 females respectively in major city/towns along the study area and accounts for 7.9% of the total population. The 'Scheduled Tribe' population consist of 27576 males and 25244 females respectively and accounts for 0.41% of the total population (12875343). About 75.4% of the population is literate and 23.6% is illiterate in cities/town located along the NW-1 is illiterate. Male population is more literate than female. In cities and town along NW-1 area the main and marginal workers[16] are 14% and 29% respectively while the remaining 57% of total population constitutes non-workers. The main occupation is agriculture, labour class and trading activities. Agriculture is the main source of the livelihood generation for the people residing along the NW-1 area. Many towns in the area are primarily industrial. Ganga provides the necessary infrastructure for the factories to perform. Commercial fisheries in the Ganga River System are an important source of livelihood for the people residing along the Ganga River. Pilgrimage and the associated tourism brings along a major source of revenue for religious towns and their people. There is substantial decline in major carps fish catch in Allahabad to Farakka stretch over past few years. At Buxer hilsa was the main fishery and with the commissioning of Farakka barrage the fishery declined sharply between 1972-80. Fishery improved during 1981-86 due to improvement in landings of other species. Patna centre also showed drastic decline in major carp landings and as compared to sixties it was almost half during 1986-93. Decline at Bhagalpur was not as severe as at other centres. It is reported that almost every village along the both sides of the river are having some fishermen who earn their livelihood by fishing in the Ganga river. Generally, one member of the family is engaged in fishing in lower stretch of NW-1(Farakka to Haldia), sometimes two, the average comes to be 1.5. However, in upper stretch (Allahabad to Farakka) the average person engaged in fishing is 1.2 that is mainly due to low fish catch in this stretch. Fishing Income: The monthly average income of the fisherman ranged from Rs.4000 to 7000 per month in Allahabad to Patna stretch. In lower zone (Farakka to Haldia) the average income of fisherman is slightly high and ranging between 7000 to Rs. 10,000 per month because of higher catch and high value fish (mainly hilsa) in the catch.

All the towns and cities along the NW-1 are well connected with national highways, state highways, district roads, railways. Cities like Varanasi, Patna, and Kolkata are also

16A person who has worked for more than 183 days in a year is called the main worker. Marginal workers are those who have worked any time in the year preceding the census but have not worked for major part, which is not more than 183 days, of the year

connected with airways. Eleven thermal power plants are located in close proximity of river Ganga between Haldia and Allahabad and 10 more are reportedly are proposed to be set up in close proximity of the river. There are 30 class I cities and 8 class II towns along the mainstream of river Ganga at NW-1 segment. These cities are discharging 2173.8 MLD wastewater out of which only 959.6 MLD has the treatment capacity.

The above mentioned baseline features provides basis for identification, classification & quantification of impacts.

Chapter 6. : CUMULATIVE IMPACT ASSESSMENT

6.1. Introduction

Cumulative impacts are those that result from the successive, incremental, and/or combined effects of an action, project, or activity (collectively referred to in this document as "developments") when added to other existing, planned, and/or reasonably anticipated future ones. For practical reasons, the identification and management of cumulative impacts are limited to those effects generally recognized as important on the basis of scientific concerns and/or concerns of affected communities. Multiple and successive environmental and social impacts from existing developments, combined with the potential incremental impacts resulting from proposed and/or anticipated future developments, may result in significant cumulative impacts that would not be expected in the case of a stand-alone development.

Cumulative impacts are contextual and encompass a broad spectrum of impacts at different spatial and temporal scales. In this case, cumulative impacts occur because a series of projects of the same type and correlated to each other are being developed; for example, when several development projects are planned or constructed along the NW-1 or within the same stretch, when multiple roads projects and railway projects are developed in close proximity, or when a number of logistic hubs, industrial areas are constructed or planned within the same flyway or region.

Cumulative Impact Assessment study for NW-1 from Haldia to Allahabad has been carried out for 10 km area in both sides along the entire stretch. For the purpose of CIA, CERs has been identified to assess their existing conditions in previous chapter so as the probable impact & significance of the impacts on these CERs can be evaluated. Below sections provides details of anticipated cumulative impacts due to NW-1 development, existing/past developments and proposed/planned developments.

6.2. Finalization of Hotspots

For purpose of CIA study an influence zone is identified where cumulative impact due to NW-1 and other developments within this zone will be identified. Through preliminary desktop study, baseline study and stakeholder consultations the existing developments in influence area, baseline scenario of the influence area, pollution load in environmental area, planned and anticipated developments in influence area are identified. It is found that some zones are experiencing/will experience more of the above mentioned developments as compared to other zones. Such zones are demarcated on the basis of quantam and nature of developments the zone is experiencing or will experience in future. These zones are termed as hotspots as the impacts due to existing/planned development will be maximum/more in these zones as compared to other zones. **Table 6.1** represents the hotspots demarcated on the basis of preliminary selection, baseline study and stakeholder consultations along with criteria for selection of hotspots and CERs to be impacted in each zone. These hotspots are also marked on the maps and are given in **Figures 6.1-6.13.** Cumulative impacts due to the identified developments will be assessed specifically in these hotspots.

Table 6.1 : Finalized Hotspots Selected for CIA Study

S. No.	Hotspots Stretch/Location	Criteria For Selection of Hotspots	CERs
1.	Haldia	• Declared as critically polluted area but at present moratorium is lifted by MoEF&CC • Declared notified zone by CGWB • Operation of terminal would require dredging of 1,57,60,596 cum • Existing floating terminal and proposed new terminal at Haldia • Shifting of ammonia pipeline of TATA chemicals and existing road to Mitsubishi Plant • Haldia Port & Shipping Activities • Haldia Dock Complex & Industrial Area • Celebration of Ganga Sagar Mela at Sagar • Urban areas: Haldia Town • Expected increased industrial development in existing industrial area and enhanced traffic movement • Indragachi TPP at Sangrampur & Haldia Energy Ltd. TPP	• Ground Water Quality • River Water Quality • Traffic • GHG emissions (micro climate) • Air Quality • Religious Values • Aquatic ecology • Existing infrastructure • New infrastructure development • Fishing Activities • Quality of Life • Water Resources • Drainage • Traffic • Noise • Soil Quality
2.	Kolkata-Mahesthala	• Existing BISN jetty, GR-1 & GR-2 and Botanical Garden Jetty • Archaeological sites within 300 m: Temple of Gour Chandra and Krishnachandra at Chatra-Gaur Chandra Ghat (0 m, W) , St John Church • High PM_{10} concentration in Howrah • Urban areas: Mahesthala, Kolkata & Howrah	• Archaeological sites • Air Quality • Water resources • River Water Quality • Ground Water Quality • Traffic • Aquatic ecology • Quality of Life
3.	Katwa to Hoogly Ghat	• Floating Terminal Katwa, Floating Terminal Swarupganj, Floating Terminal Shantipur, Floating Terminal Tribeni, BISN jetty • New proposed terminal at Tribeni • Hisha Sanctuary (fishing restriction for larvae of Hilsha) • TPP at Bandel & Balagarh • Urban Areas: Katwa, Swaroopganj, Nabadwip, Kalna, Balagarh, Kanchrapara, Hoogly • Increased traffic volume due to newly proposed terminal	• Traffic • GHG emissions (micro climate) • Air Quality • Aquatic Ecology • Terrestrial ecology • Existing infrastructure • Fishing Activities & Livelihood (Agriculture Land Acquisition) • New infrastructure development • Water resources • River Water Quality • Ground Water Quality • Drainage • Noise • Terrestrial ecology

S. No.	Hotspots Stretch/Location	Criteria For Selection of Hotspots	CERs
			• Soil Quality • Quality of Life • Land Use
4.	Farakka to Murshidabad	• Floating Terminal at Hazardwari, Existing RCC Jetty Pakur, U/s & D/s jetty, feeder canal, RCC jetty and old lock at Farakka • Proposed New lock at Farakka • Archaeological Sites: Hazardwari Palace • Hilsha Sanctuary (fishing restriction for larvae of Hilsha) • IBA: Farakka and surrounding areas • Farakka feeder canal is prone to erosion • Sagardighi TPP, Farakka STPS • Urban Areas: Farakka, Murshidabad, Azimganj, Baranagar, Balia, Raghunathganj • Bagmari siphon	• Bank/Soil erosion • GHG emissions (micro climate) • Air Quality • Water resources • River Water Quality • Ground Water Quality • Existing Infrastructure • New Infrastructure Development • Fishing Activities • Traffic • Noise • Drainage • Aquatic ecology • Terrestrial Ecology • Soil Quality • Quality of Life • Land Use • Archaeological Sites
5.	Mangalghat (Rajmahal)	• Existing floating terminal • Archaeological sites within 300 m: Jama Maszid & Singhi Dalan • Chatt Pooja celebration Oct-Nov • Udhawa Lake Bird Sanctuary at app 6 km • Mining activities	• Traffic • Air Quality • Archaeological sites • Religious Values • River Water Quality • Aquatic ecology
6.	Sahibganj	• Existing Samdhaghat terminal and proposed Sahibganj terminal • Chatt Pooja celebration Oct-Nov • Construction of approach road to connect the terminal to NH-80 • Construction of railway siding to provide linkage with existing IR track • Existing Fishing Activities • Acquisition of Land, R& R and shifting of community temple • Cutting of app. 500 trees	• Land Use • Livelihood (agriculture land acquisition) & Fishing Activities • Socio-economy • Air Quality • GHG emissions (micro climate) • Aquatic ecology • Terrestrial Ecology • Existing Infrastructure • Religious Values • New infrastructure development • Water resources • River Water Quality • Ground Water Quality • Bank/Soil erosion • Traffic • Noise • Drainage

S. No.	Hotspots Stretch/Location	Criteria For Selection of Hotspots	CERs
			• Quality of Life • Land Use
7.	Pirpanti-kahalgaon-Bhagalpur	• Chatt Pooja celebration Oct-Nov • Existing Bateshwarsthan Floating Terminal, Bhagalpur Terminal • Vikramshila Gangetic Dolphin Sanctuary • IBA: Kurseala River Course and Diyara Flood Plains • Bhagalpur TPP, Kahalgaon STPS, Pripanti TPP, Pripanti Power CESC • Presence of arsenic in ground water • Urban Area: Bhagalpur, Kahalgaon	• Air Quality • GHG emissions (micro climate) • Religious Values • Aquatic Ecology • Avifauna • Water resources • River Water Quality • Ground Water Quality • Traffic • Soil Quality • Quality of Life
8.	Munger	• Existing Floating Terminal at Munger • Chatt Pooja celebration Oct-Nov • Presence of arsenic in ground water • Urban Area: Munger	• Ground Water Quality • Religious Values • Traffic • Aquatic ecology
9.	Semaria-Begusarai-Barh	• Existing Floating Terminal at Semaria • Chatt Pooja celebration Oct-Nov • Urban Area: Semaria, Doraiganj, Begusarai, Barh • Barauni TPP, Barh TPP & Lakhisarai TPP • IBA: Mokama Taal	• Air Quality • GHG emissions (micro climate) • Aquatic ecology • Terrestrial flora • Religious value • Water resources • River Water Quality • Ground Water Quality • Avifauna • Soil Quality • Quality of Life
10.	Patna	• Low & High Level Jetty (Gaighat) • Proposed Terminal at Kalughat • Chatt Pooja celebration Oct-Nov • IBA: Danapur Cantonment Area • High PM_{10} concentration in Patna • Urban Area: Patna • Development of River Front at Patna	• Avifauna • Air Quality • River Water Quality • Religious Value • Traffic • Noise • Water resources • Drainage • Aquatic ecology • Terrestrial Ecology • Bank/soil erosion • Quality of Life • Land Use
11.	Buxar	• Existing floating terminal at Buxar	• Religious Values

S. No.	Hotspots Stretch/Location	Criteria For Selection of Hotspots	CERs
		• Buxar TPP (under construction) • Chatt Pooja celebration Oct-Nov • Urban Area: Buxar	• Traffic • Air Quality • Water resources • River Water Quality • Ground Water Quality • Aquatic ecology • Soil Quality • Quality of Life
12.	Ghazipur	• Proposed Terminal • Urban Area: Ghazipur	• Land Use • Livelihood (agriculture land acquisition) • Air Quality • GHG emissions (micro climate) • Aquatic ecology • Terrestrial Ecology • Existing Infrastructure • River Bed Sediments Quality • New infrastructure development • Water resources • River Water Quality • Ground Water Quality • Bank/Soil erosion • Drainage • Traffic • Noise • Quality of Life
13.	Varanasi	• Rajghat floating terminal • Proposed Varanasi Terminal • Archaeological Sites: Kardmeshwar Mahadeva Mandir, Ramnagar, fort, archaeological excavation site, Varanasi • Festival: Ganga Mahotsav at Varanasi (Oct-Nov) & Dhrupad Mela at Tulsi Ghat of Varanasi (Feb to March) • Kashi Turtle Sanctuary • DFCCIL Connectivity at Varanasi Terminal • Slightly high cadmium concentration in river bed sediments but below toxicity level of fishes • High PM_{10} levels in Varanasi • High noise level in Turtle sanctuary area	• Land use • Livelihood (agriculture land acquisition) & Fishing Activities • Aquatic ecology • Existing Infrastructure • New infrastructure development • Archaeological sites • Air Quality • GHG emissions (micro climate) • River Bed Sediments Quality • Bank/Soil erosion • Noise level • Religious Value • Vibrations • Water resources • River Water Quality • Drainage • Traffic

S. No.	Hotspots Stretch/Location	Criteria For Selection of Hotspots	CERs
			• Noise • Quality of Life
14.	Allahabad	• Festival: Kumbh Mela • Slightly high cadmium concentration in river bed sediments but below toxicity level of fishes	• Religious Value • River Bed Sediments Quality • River Water Quality • Aquatic ecology • Quality of Life

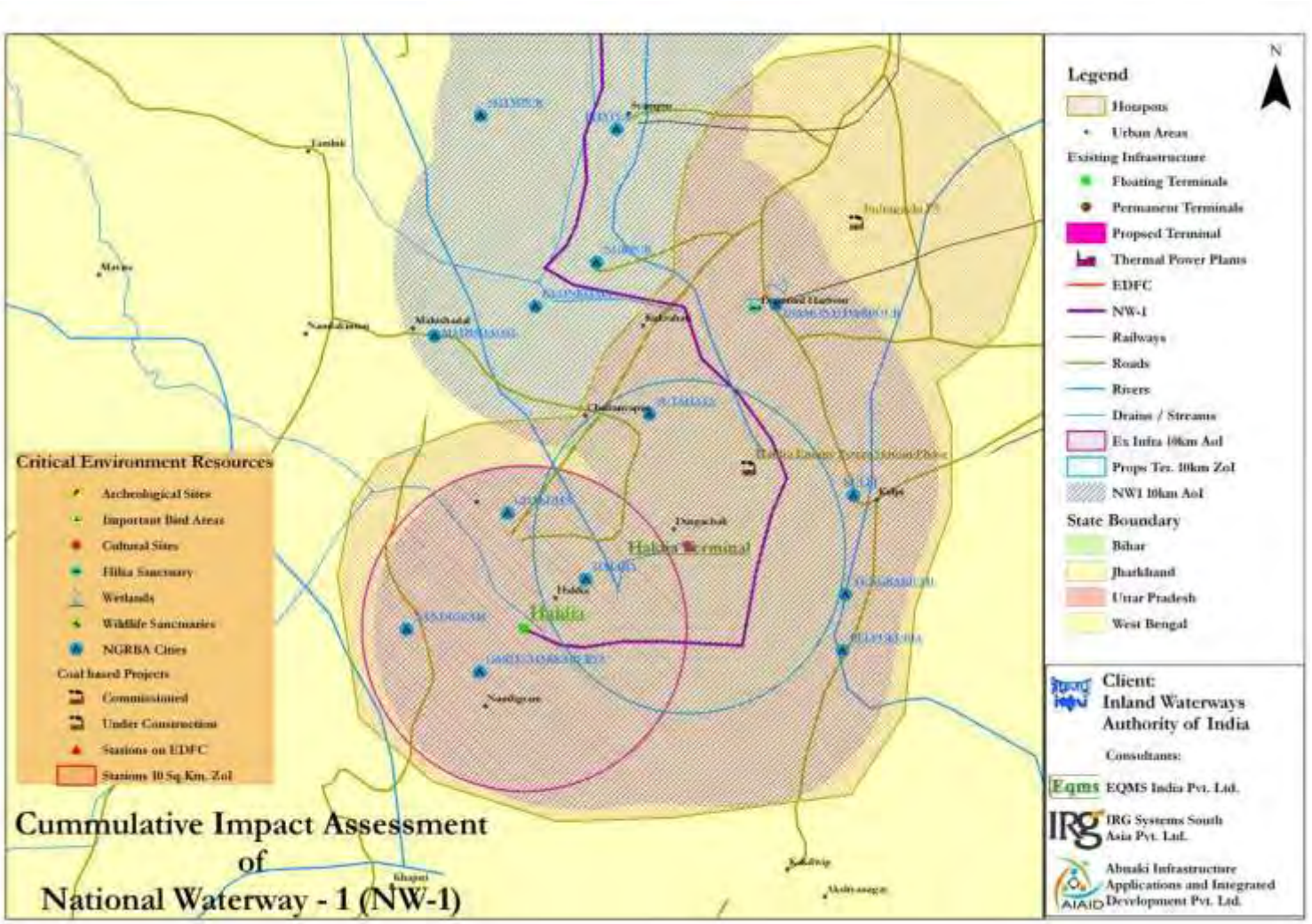


Figure 6.1 : Map depicting Hotspot Haldia

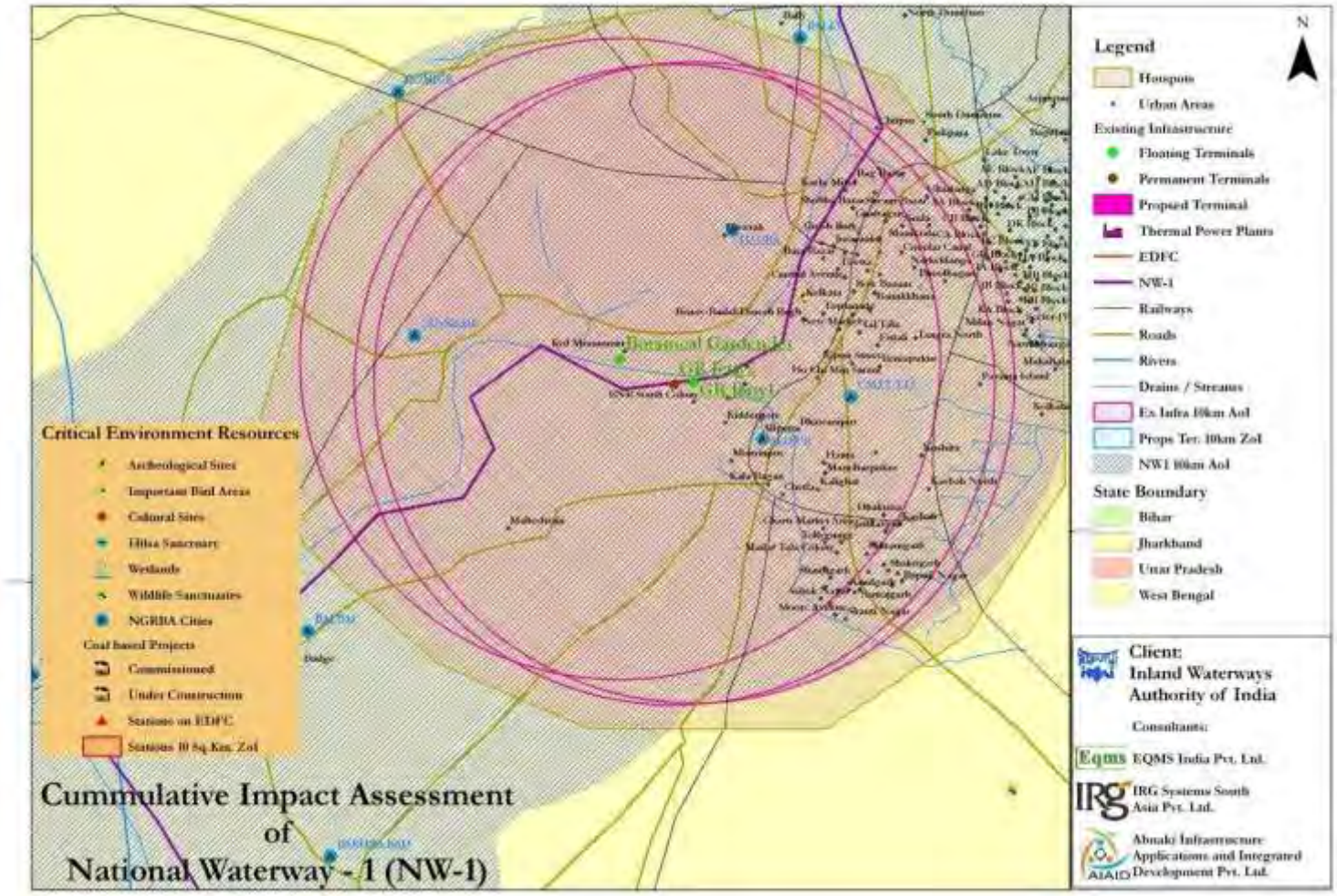


Figure 6.2 : Map depicting Hotspot Kolkata- Mahesthala

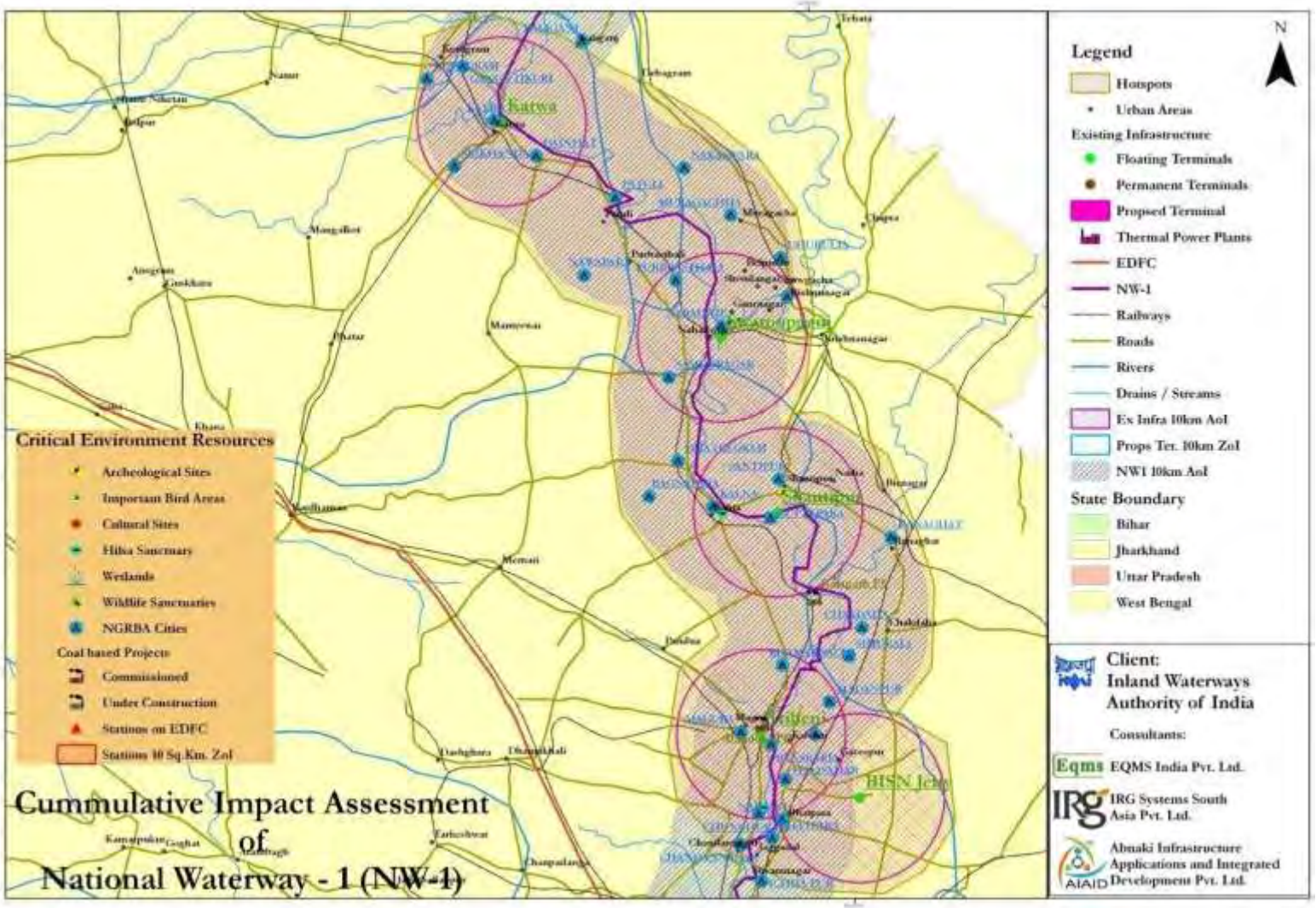


Figure 6.3 : Map depicting Hotspot Katwa to Hoogly Ghat

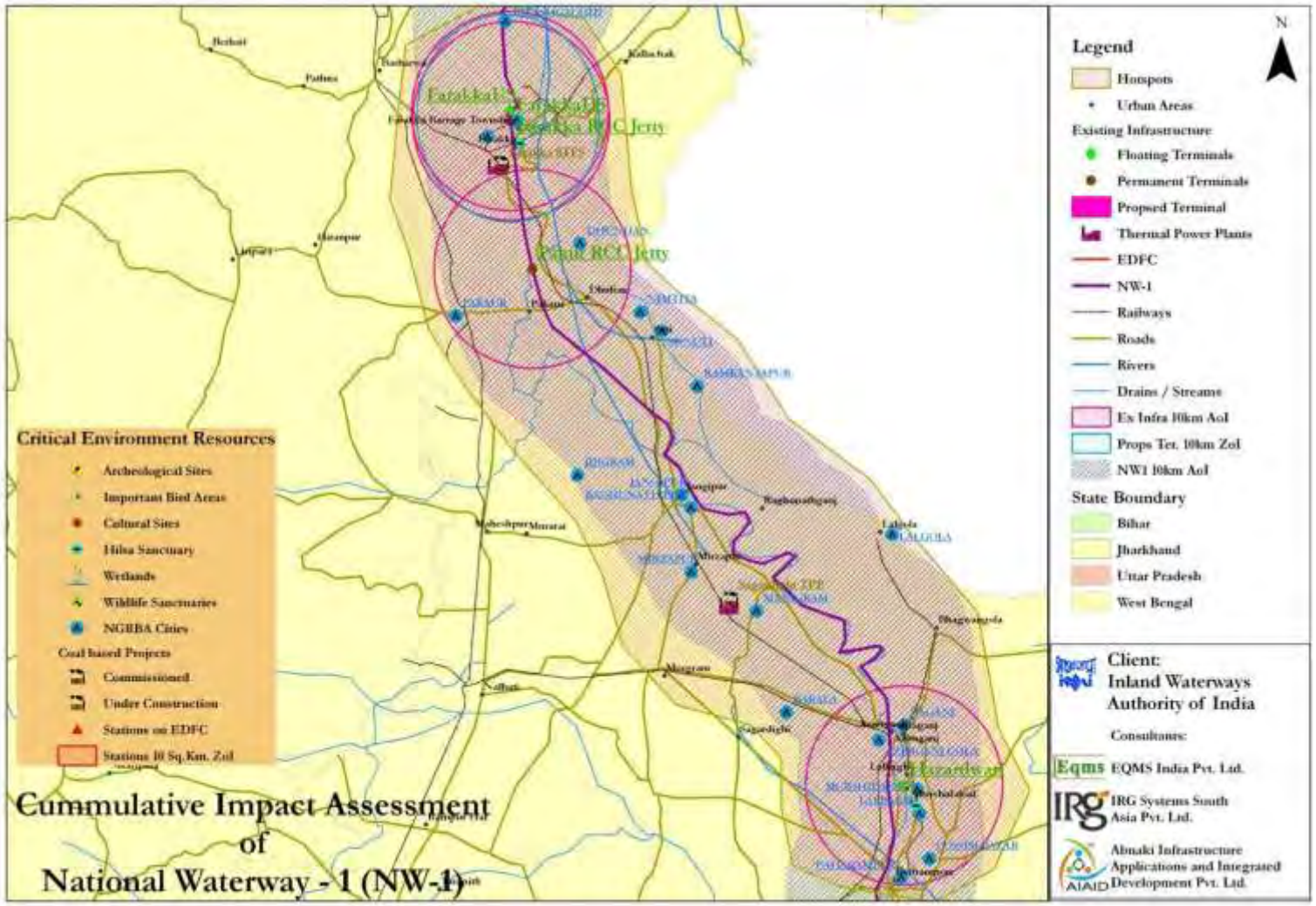


Figure 6.4 : Map depicting Hotspot Farakka to Murshidabad

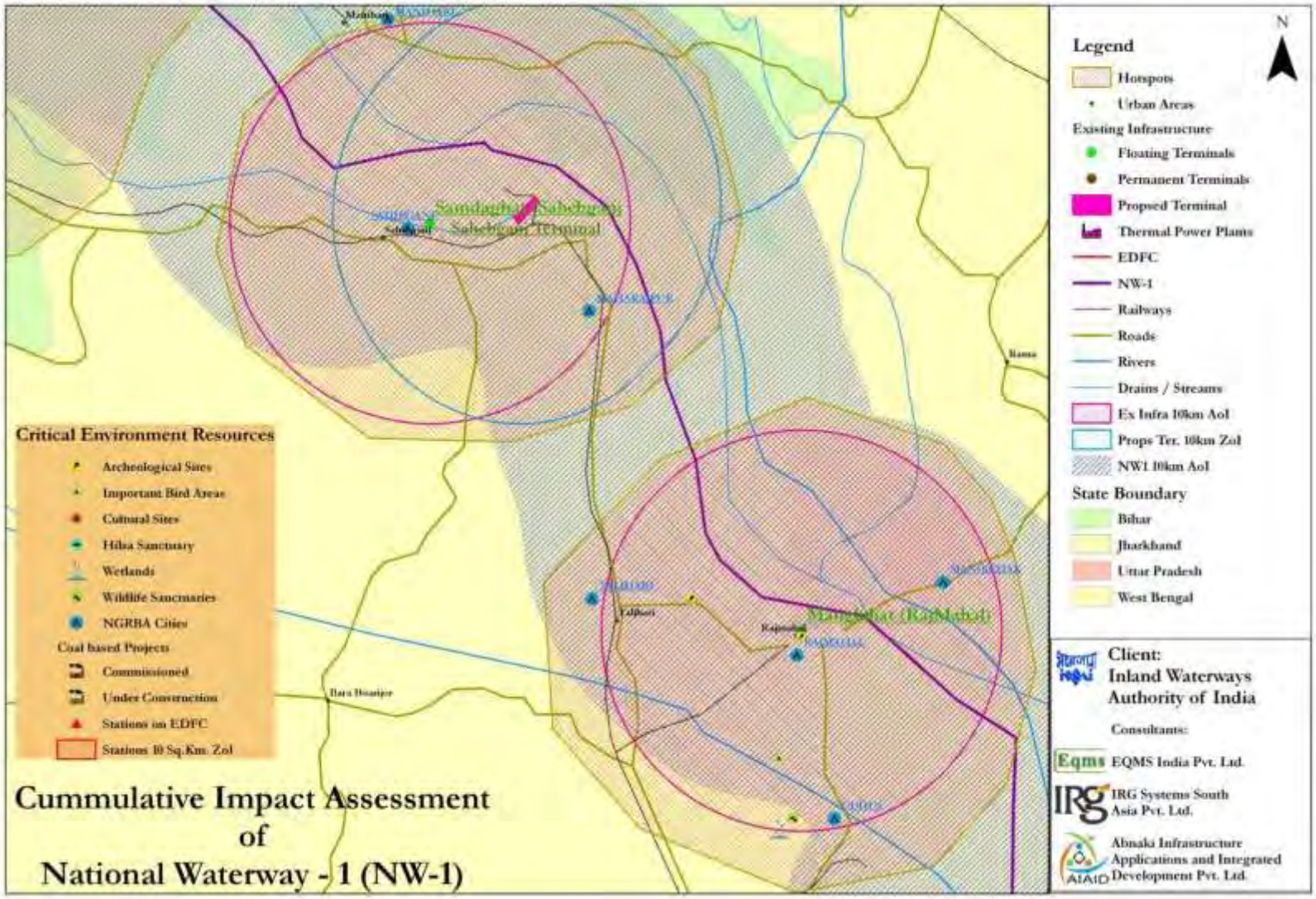


Figure 6.5 : Map depicting Hotspot Mangalghat (Rajmahal) & Sahibganj

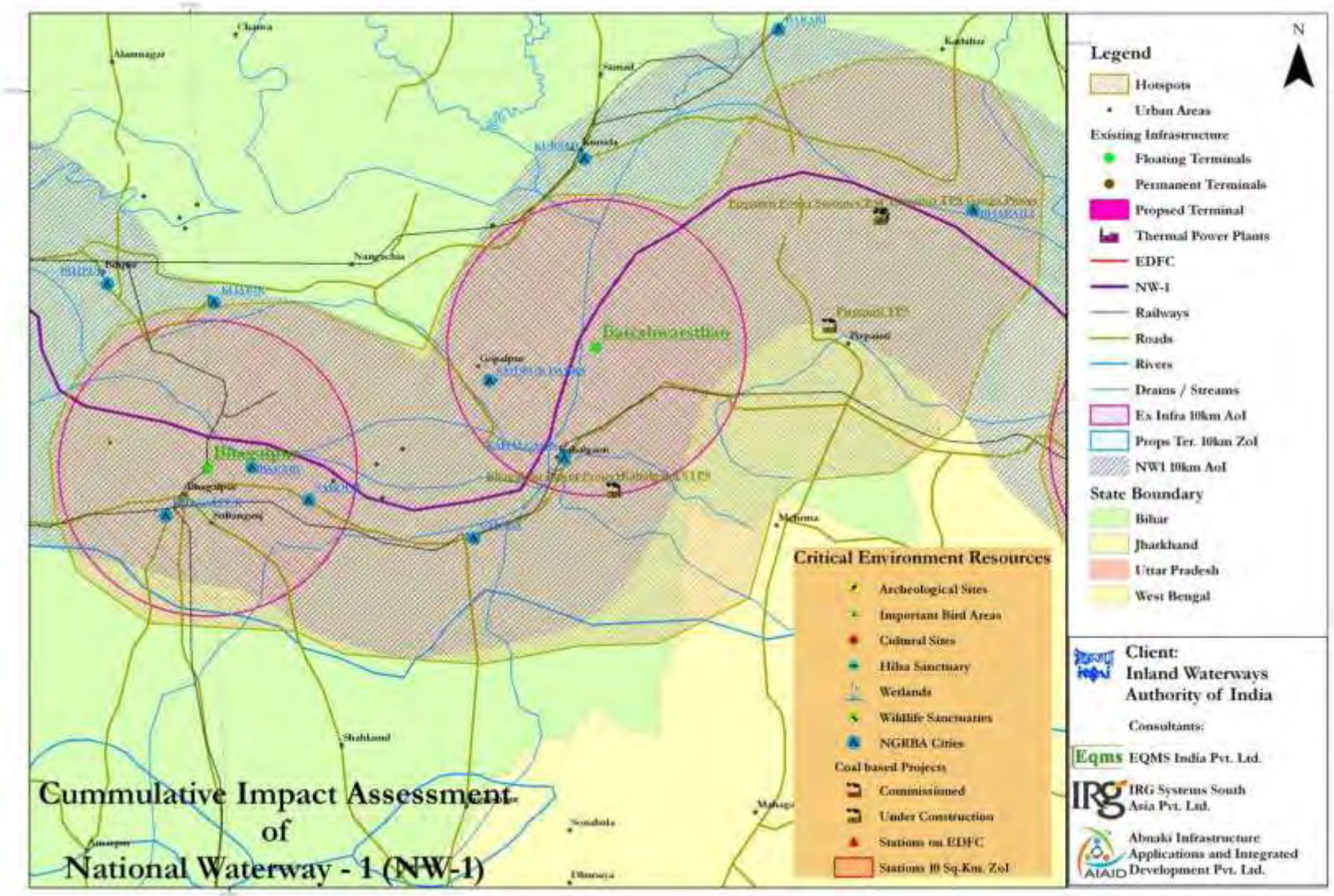


Figure 6.6 : Map depicting Hotspot Pirpanti-kahalgaon-Bhagalpur

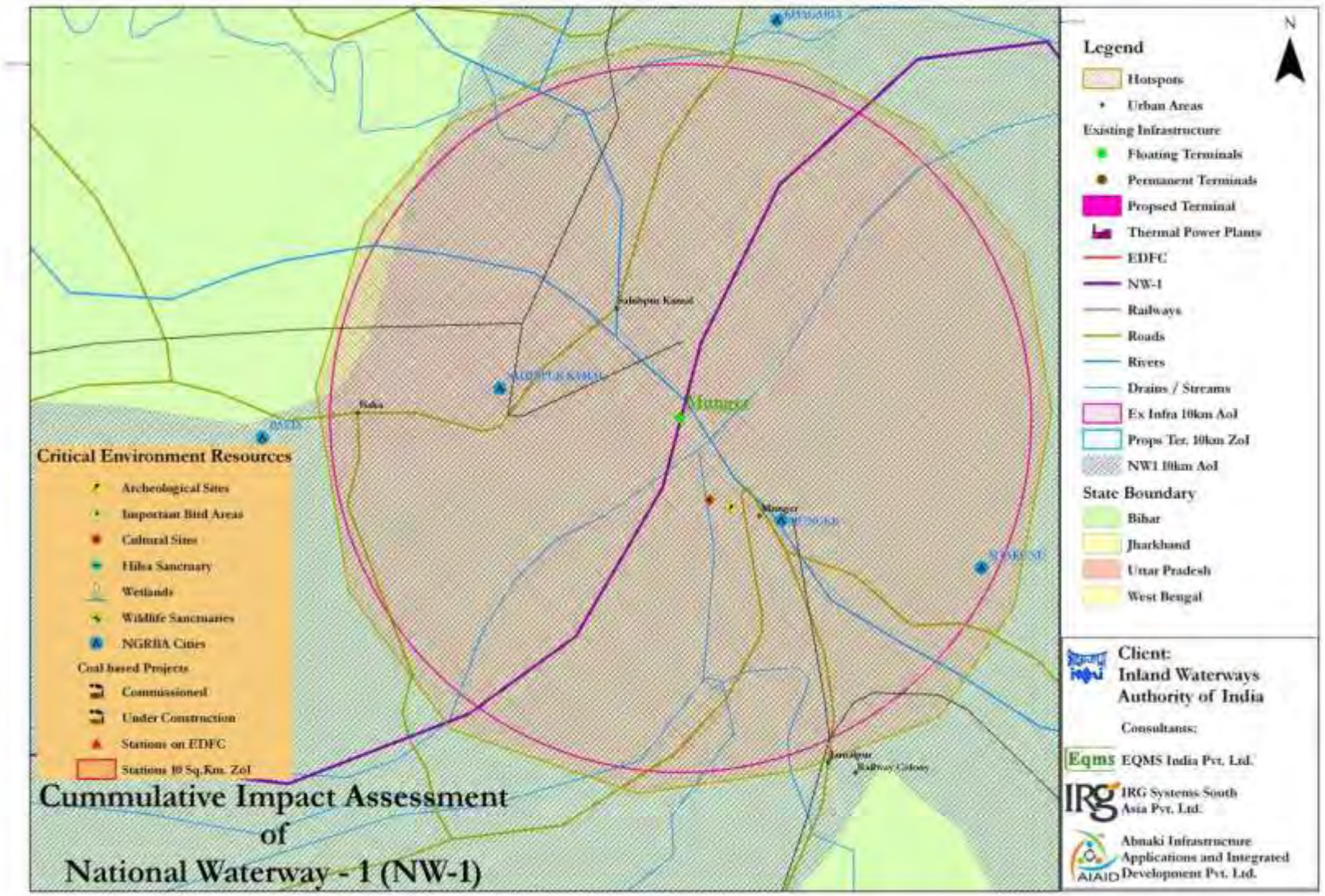


Figure 6.7 : Map depicting Hotspot Munger

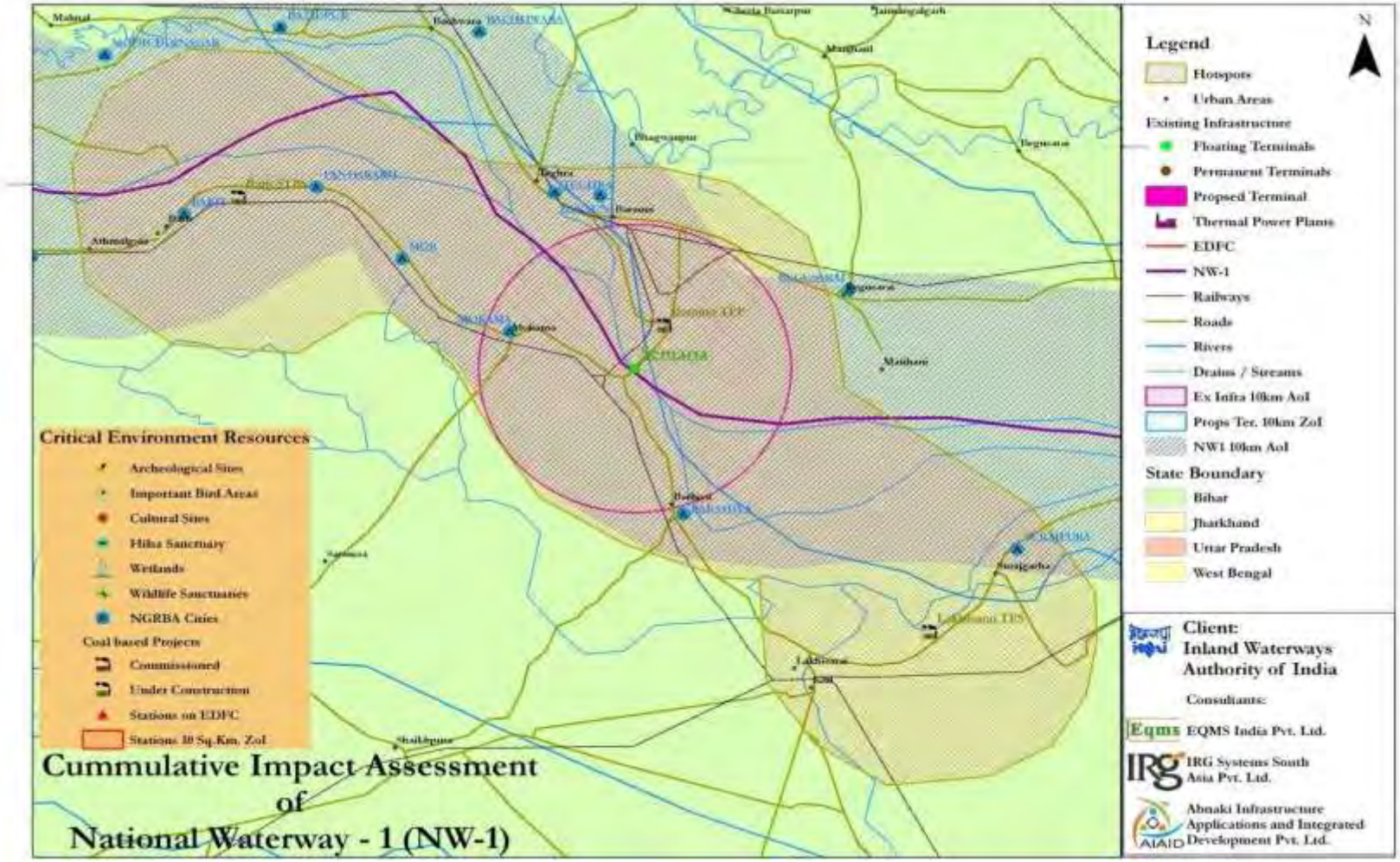


Figure 6.8 : Map depicting Hotspot Semaria-Begusarai-Barh

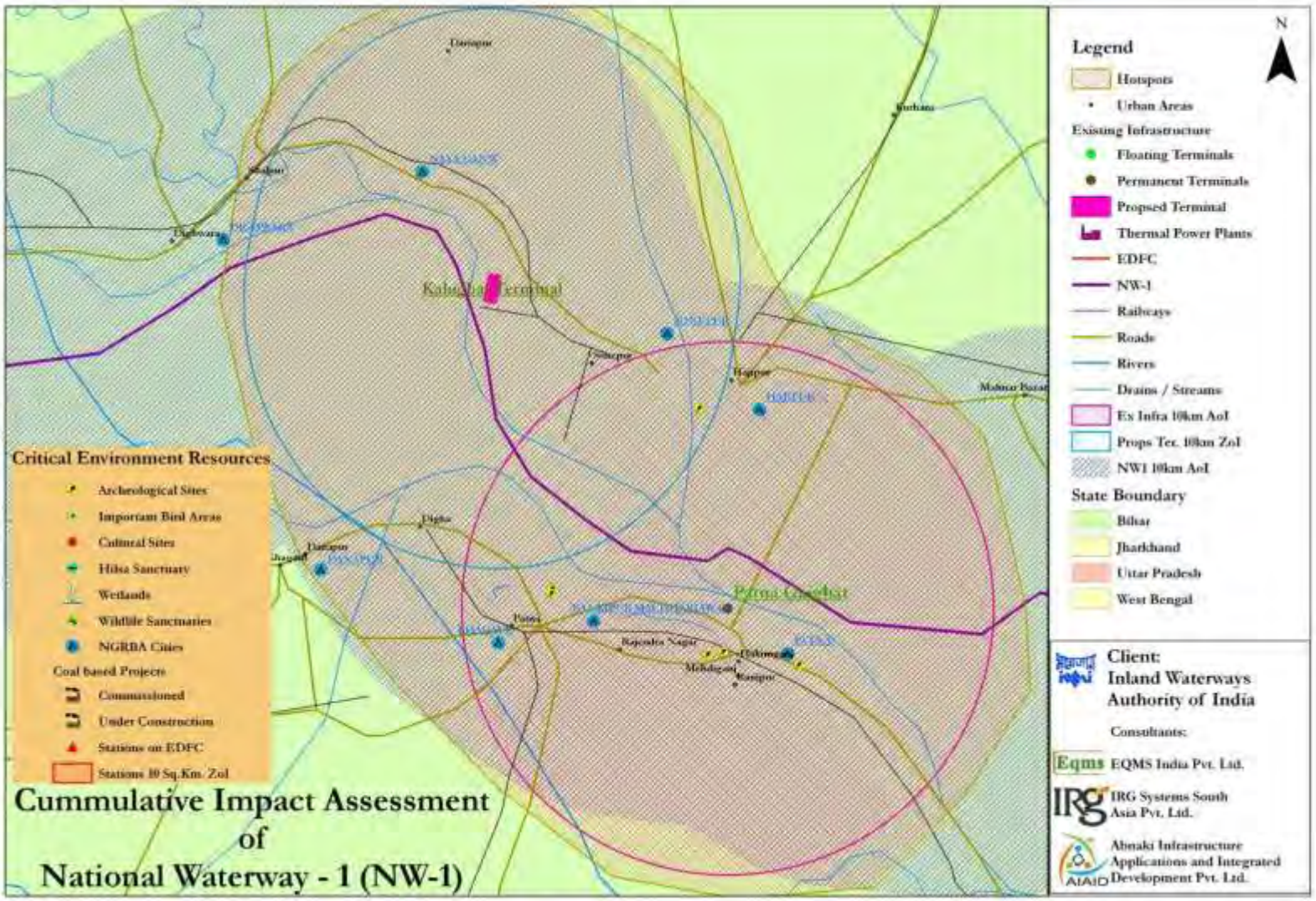


Figure 6.9 : Map depicting Hotspot Patna

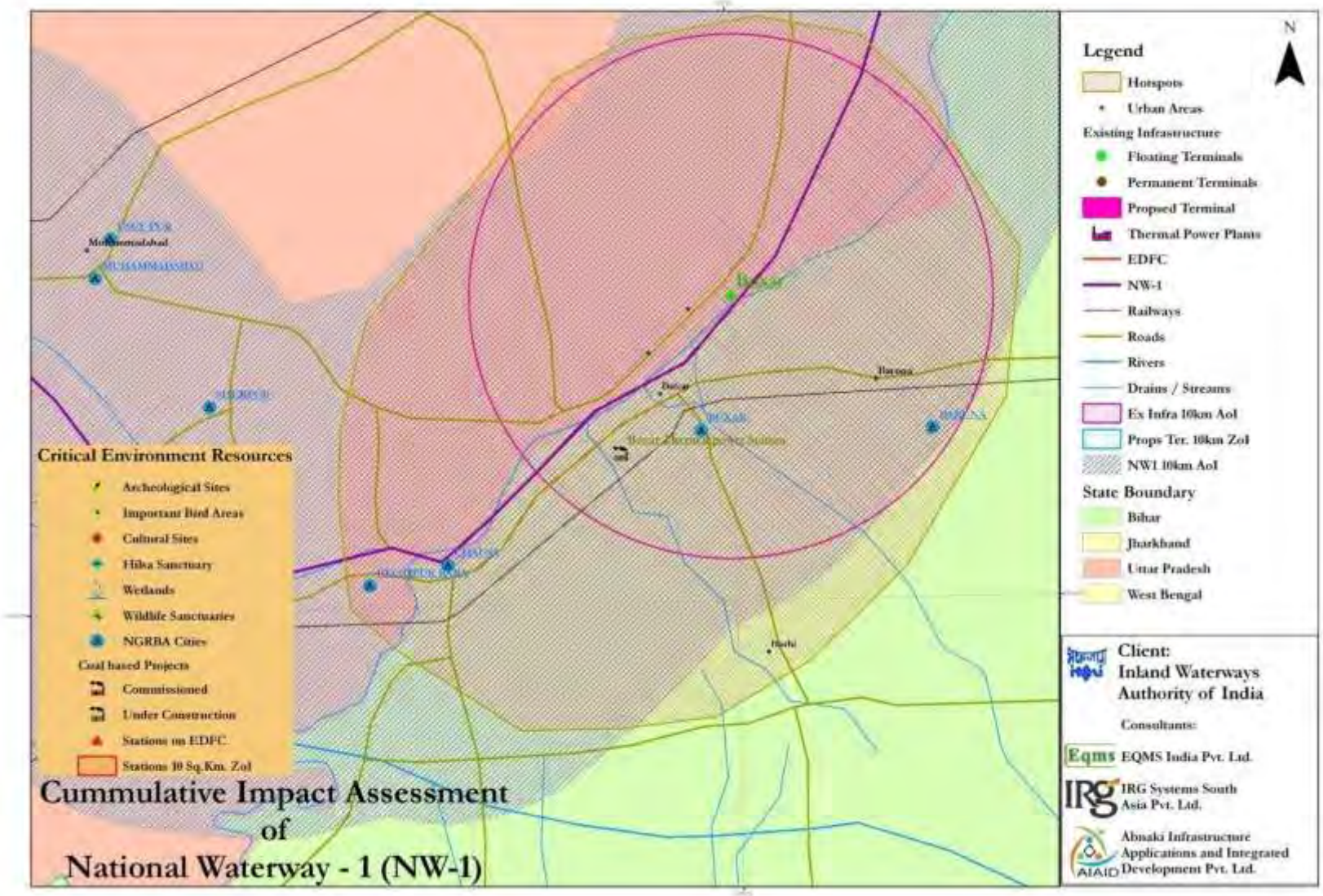


Figure 6.10 : Map depicting Hotspot Buxar

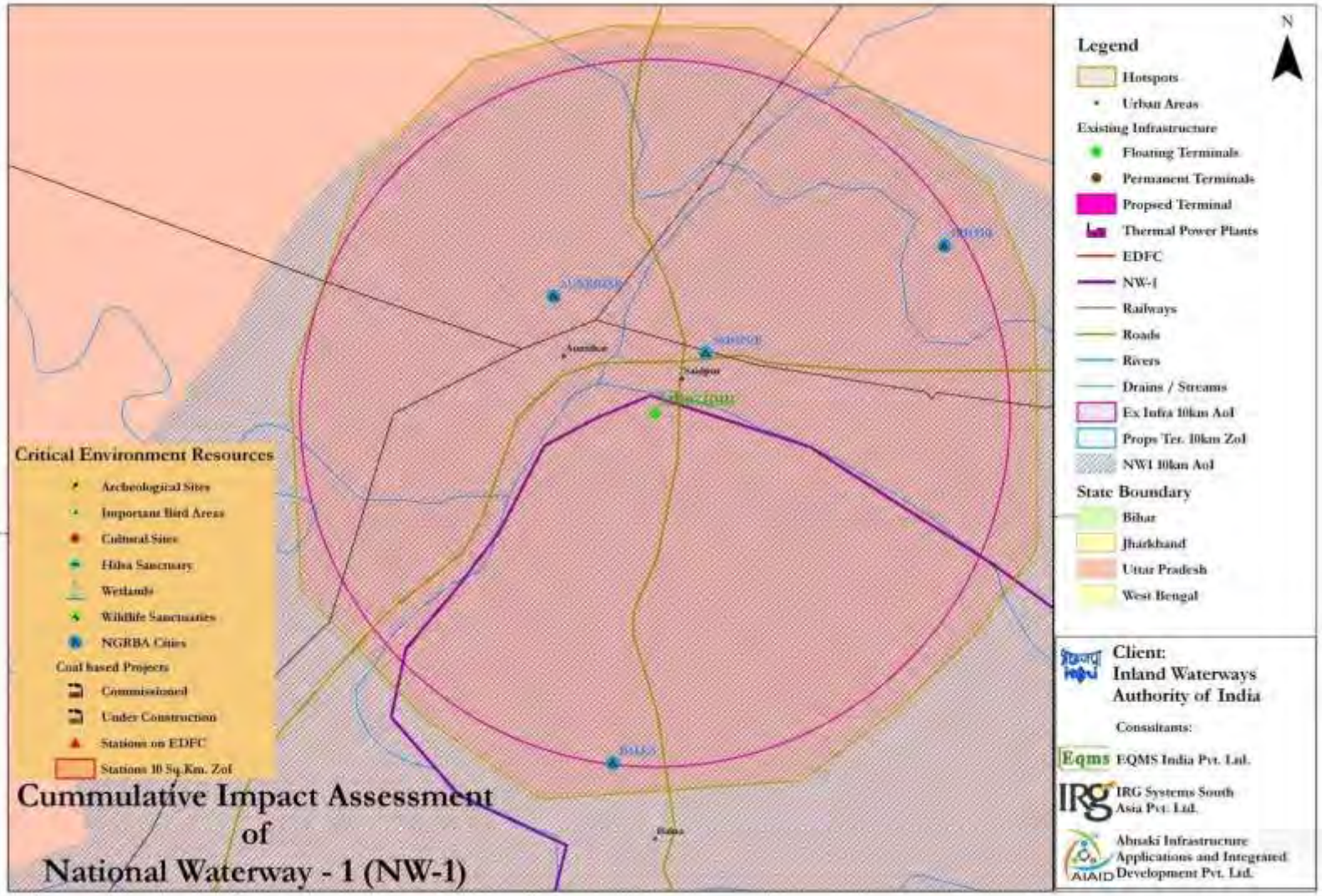


Figure 6.11 : Map depicting Hotspot Ghazipur

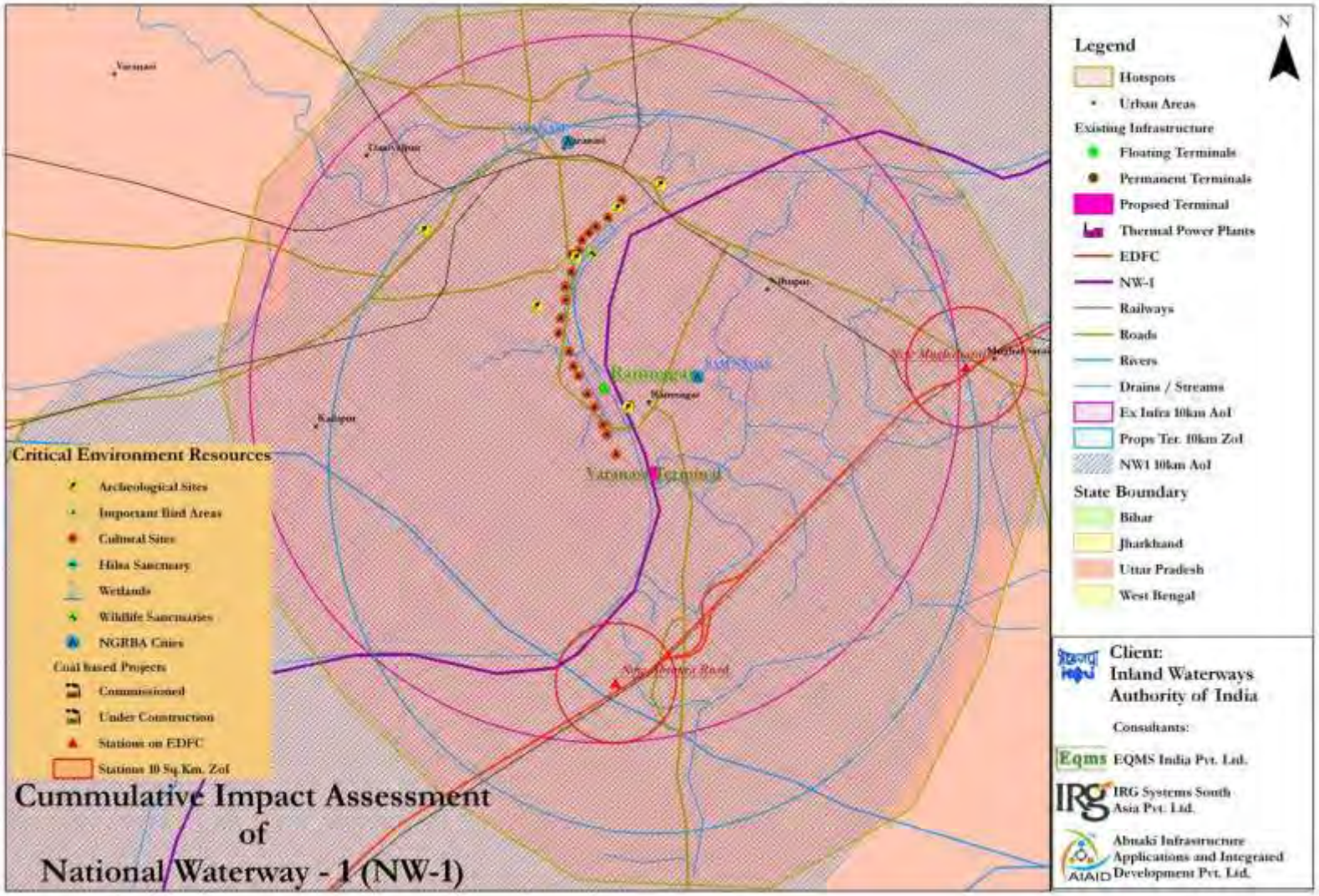


Figure 6.12 : Map depicting Hotspot Varanasi

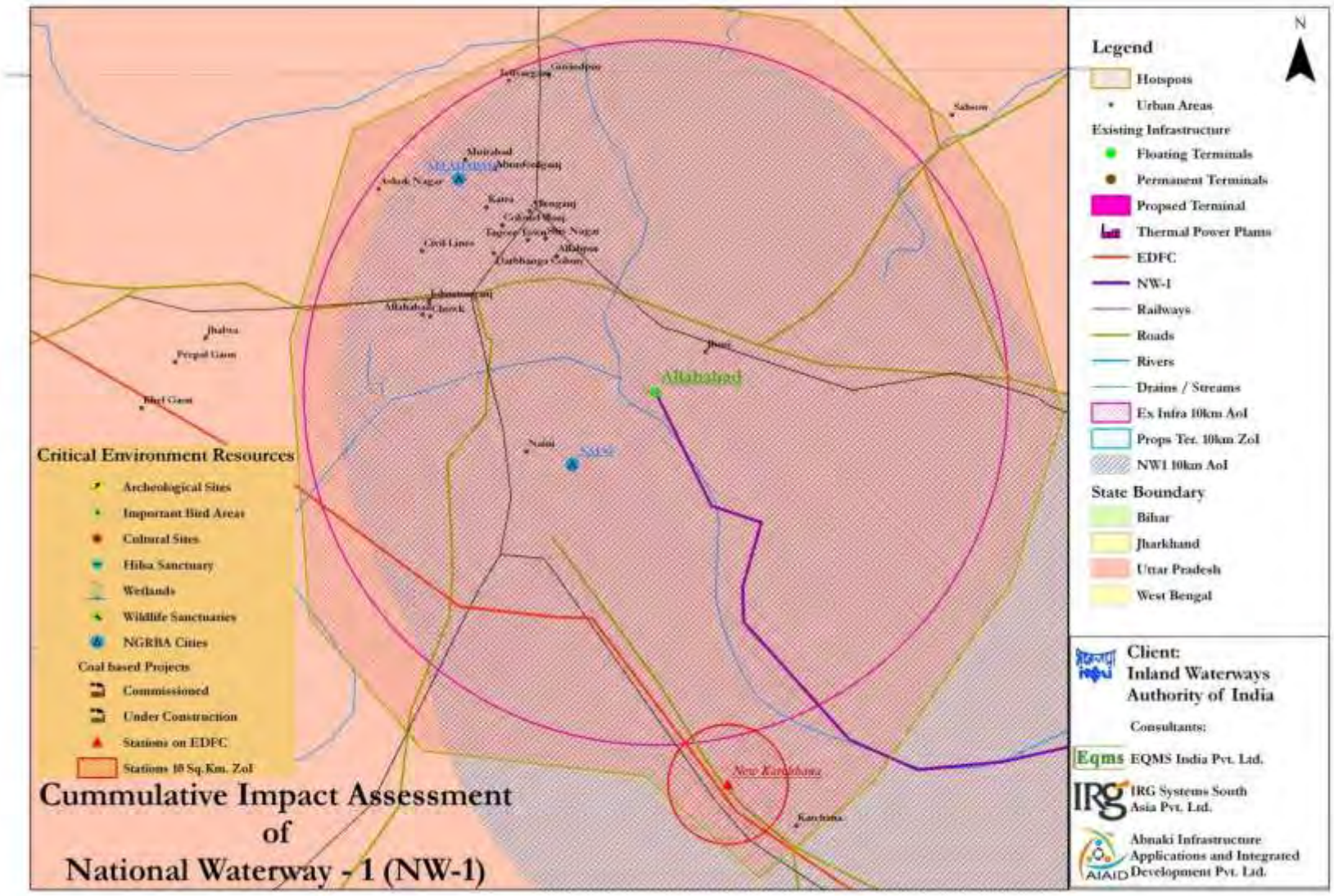


Figure 6.13 : Map depicting Hotspot Allahabad

6.3. Impact identification

Planned Jal Marg Vikas Project is augmentation of navigation capacity of NW-1 through construction of new navigation infrastructure, maintaining LAD through dredging & bandalling, river training works, bank protection works and improvement of existing and development of new navigational aids. NW-1 traverses through major cities which are highly populated. Various festivals and religious rituals are associated with the River Ganga. Developments like TPPs & industrial areas also exist along the NW-1. Total 5 bird areas and 3 eco-sensitive zones, i.e. Kashi turtle sanctuary, dolphin sanctuary & Udhawa sanctuary exists within 10 km of the NW-1. As per the EIA/SIA studies carried out for the project, it is found that the project has potential to impact various CERs in its different stages.

As per the baseline study and stakeholder consultation carried out, it is found that there are already significant developments in the influence area of NW-1 and several other developments are planned. Those developments are and may be development of Eastern Dedicated freight Corridor (within influence area near Varanasi MMT), Industrial areas, TPPs, Roads, Indian Railways line/ROB/RUB, Expansion and development of and within urban areas and irrigation schemes/dams. All of these developments also have potential to impact CERs at different stages. The impacts due to proposed Jal Marg Vikas project and these mentioned developments is given in **Table 6.2** below. Also an attempt is made to assess the nature of the impact of each development on the CERs which will be impacted and is given in **Table 6.3.**

Table 6.2 : Impact identification

S. No.	Existing/Planned and Proposed Development	Activities	Impacts	CERs Impacted
1.	Planned Development-NW-1	Civil Intervention Development	**Design & Construction Phase:** • Acquisition of land • Loss of livelihood • Impact on Fishing Activities • Tree Cutting • Impact on aquatic ecology due to piling & dredging during • Shifting of CPRs & utilities • Increased traffic and GHG near terminals & jetties • Unpleasant view during construction phase • Soil contamination due to spillage of oil **Operation Phase:** • Impact on aquatic	• Land Use • Livelihood (R & R) • Religious Value • Terrestrial Flora • Aquatic Ecology • Traffic near terminal/jetty • Noise • Air Quality • Micro climate • Soil Quality (top soil loss) • River Water Quality • Archaeological sites • Bank/soil erosion • Existing Infrastructure

S. No.	Existing/Planned and Proposed Development	Activities	Impacts	CERs Impacted
			ecology due to berthing & mooring of vessels during operation phase • Impact on Fishing Activities • Increased Traffic & GHG near terminals & jetties • Bank erosion near interventions • Surface water contamination • Change in drainage pattern	• New Infrastructure Development • Religious value • Archaeological sites • River Bed Sediments
		Maintenance Dredging	• Impact on Fishing Activities • Avifauna near important bird areas • Aquatic ecology (major impact in VGDS & turtle sanctuary) due to high underwater noise generation, dredging and dredge disposal • Water quality due to release of sediments • Increased noise level	
		Barge Movement	• Impact on Fishing Activities • Aquatic ecology (major impact in VGDS & turtle sanctuary) due to high underwater noise generation and collision with ships • River banks & bank structure	
2.	EDFC	Freight movement through railway	• Acquisition of land, R & R • Change in land use • Tree cutting any impact to eco-sensitive zone • Emissions due to material loading/unloading • Increased GHGs near stations • Change in drainage pattern	• Land use • Terrestrial Ecology • Noise • Vibration • Livelihood (R & R) • Air Quality • Drainage • Soil Quality

S. No.	Existing/Planned and Proposed Development	Activities	Impacts	CERs Impacted
			• High noise and vibration • Shifting of Utilities	• Soil Erosion • Existing Infrastructure • New Infrastructure & Industrial Development • Aquatic Ecology • Archaeological sites • Traffic near stations
3.	Roads	Vehicular Movement	• Acquisition of land, R & R • Change in land use • Tree cutting any impact to eco-sensitive zone • Emissions due to material loading/unloading • Increased GHGs • Change in drainage pattern • Reduction in Traffic jams and air/noise emissions due to traffic jams/congestion • Enhanced connectivity • Shifting of Utilities	• Land use • Terrestrial Ecology • Noise • Livelihood (R & R) • Air Quality • Drainage • Soil Quality • Soil Erosion • Existing Infrastructure • New Infrastructure & Industrial Development • Aquatic Ecology • Archaeological sites
4.	Existing and Planned Industrial Areas & TPPs	Industrial operations	• Traffic movement, Material transportation & increased GHG emissions • Increased air emissions • Increased water consumption and degradation of water quality • Soil quality contamination • Pressure on existing infrastructure	• Air Quality • Land Use • Terrestrial Ecology • Water resources • Ground & Surface Water Quality • Noise • Soil Quality
5.	Infrastructure Development and Urbanization	Increased population growth	• Increased water consumption and sewage generation	• Air Quality • Soil Quality • Land Use

S. No.	Existing/Planned and Proposed Development	Activities	Impacts	CERs Impacted
			• Increased air emission • Increased pressure on existing infrastructure • Increased waste generation (municipal, e-waste, bio-medical waste) • Change in land use	• Water resources • Ground & Surface Water Quality • Noise • Traffic
6.	Irrigation Scheme	Withdrawal of water from river	• Impact on water flow • Impact on surface & ground water quality due to contamination of pesticides/fertilizers • Water logging in area	• Water Resources • River water Quality • Ground Water Quality • Soil Quality • Drainage

Table 6.3 : Type of Impact of Proposed/Planned/Anticipated Developments on CERs within Influence Area

CERs	Impact Due to development in Influence Area						
	NW-1	EDFC & Other Railways	Road Developments	Industrial development /TPP	Infrastructure development	Urbanization	Irrigation Schemes/Dams/Agriculture
Micro Climate	+ve	-ve	-ve	-ve	-ve	-ve	Nil
Air Quality	+ve	+ ve	+ve	-ve	-ve	-ve	Nil
Water Resources	Nil	Nil	Nil	-ve	-ve	-ve	-ve
Ground Water Quality	-ve	Nil	Nil	-ve	-ve	-ve	-ve
Surface Water Quality	-ve	-ve	-ve	-ve	-ve	-ve	-ve
Natural Drainage Pattern	-ve	-ve	-ve	-ve	-ve	-ve	-ve
Noise Levels	-ve (UW)	-ve	+ve	-ve	-ve	-ve	Nil
Vibrations	Nil	-ve	Nil	Nil	Nil	Nil	-ve
Terrestrial Ecology	-ve	-ve	-ve	-ve	-ve	-ve	-ve

CERs	Impact Due to development in Influence Area						
	NW-1	EDFC & Other Railways	Road Developments	Industrial development /TPP	Infrastructure development	Urbanization	Irrigation Schemes/Dams/Agriculture
Aquatic Ecology	-ve	-ve	-ve	-ve	-ve	-ve	-ve
Avifauna	-ve	-ve	-ve	-ve	-ve	-ve	Nil
Soil Quality	-ve	-ve	-ve	-ve	-ve	-ve	-ve
River Bed Sediments Quality	-ve	Nil	Nil	-ve	-ve	-ve	-ve
Soil Erosion	-ve	-ve	-ve	Nil	Nil	+ve	-ve
Quality of Life	+ ve	+ ve	+ ve	+ ve	+ ve	+ ve	+ ve
Existing Infrastructure	+ ve	+ ve	+ ve	-ve	-ve	-ve	Nil
New Infrastructure Development	+ ve	+ ve	+ ve	+ ve	+ ve	+ ve	+ ve
Livelihood -Fishing Activity & loss of Agriculture land	-ve	-ve	-ve	-ve	-ve	-ve	+ve
Religious Values	-ve	-ve	-ve	-ve	-ve	-ve	-ve
Traffic	-ve (NT) & +ve (OA)	-ve (NS) & +ve (OA)	+ve	-ve	-ve	-ve	Nil
Land Use	-ve	-ve	-ve	-ve	-ve	-ve	-ve
Archaeological sites	-ve	-ve	-ve	-ve	-ve	-ve	-ve

UW: Underwater, NT: Near Terminals, NS: Near Stations, OA: Overall

6.4. Interaction of the CERs and Developments (NW-1 & other developments in Influence Area)

In above sections, areas experiencing cumulative impacts, i.e hotspots are identified. Also assessment is made to identify the impact of the identified existing/planned developments in

these hotspots. Attempt was also made to assess the nature of these impacts on the CERs to be impacted as identified in table 6.1 & 6.2.

Further a tabular representation is made showing assessment of impacts due to developments individually and cumulatively on each of the identified CERs. The table shows how these developments will interact with each of the CERs individually and cumulative impact due of each development is given in the last column. An attempt is also made to quantify the impact to the extent possible. Interaction Matrix of Individual & Cumulative Impacts of Development on CERs is given below in **Table 6.4.**

Table 6.4 : Interaction Matrix of Developments and Identified CERs

Developments/CERs (Hotspots)	Small Scale Impacts						Large Scale Impacts
	NW-1	EDFC	Development of Industries & Industrial Area/zones/parks/TPPs	Urbanization	Road Development	Irrigation Schemes/Dams	Cumulative Impact
Micro-Climate (Haldia, Katwa to Hoogly Ghat, Farakka to Murshidabad, Sahibganj, Pirpanti-kahalgaon-Bhagalpur, Semaria-Begusarai-Barh, Ghazipur, Varanasi)	Will reduce GHG emissions due to shift of freight from road/rail to IWT thus positive impacts. GHG emissions may be high near terminals and jetties. GHG emission calculations for transportation of freight planned through IWT mode for phase I of NW-1 is given in **Annexure 6.1.**	Will reduce GHG emissions due to shift of freight from road to Rail thus positive impacts. GHG emissions may be high near stations. GHG emission calculations for transportation of freight planned through Rail for phase I of NW-1 is given in **Annexure 6.1**	Will increase GHG emissions will impact negatively. List of TPPs along the nW-1 are given as **Annexure 6.2**	Will increase GHG emissions will impact negatively	Will reduce GHG emissions due to reduction in traffic jams and congestion and ultimately thus positive impacts. GHG emission calculations for transportation of freight planned through Road for phase I of NW-1 is given in **Annexure 6.1**	No significant impact	GHG emission will increase due to increase in developments in business as usual but GHG emission will cut down due to shift of freight from Road/Rail to IWT. Assessment of reduction of GHG emissions due to development of Jal Marg Vikas Project is given in **Annexure 6.1**
Air Quality (Haldia, Katwa to Hoogly Ghat, Farakka to Murshidabad, Sahibganj, Pirpanti-	Air quality will improve due to shift of freight from road/rail to IWT thus positive impacts. Air emissions may	Will reduce Air emissions due to shift of freight from road to Rail thus positive impacts. Air emissions may be high near	Air Quality will deteriorate significantly but can be controlled with adequate APCEs	Air Quality will deteriorate but can be controlled with imposing restrictions and development of green belts and avenue	Air quality will improve due to reduction in traffic jams and congestion and ultimately thus positive impacts. Air emission	No significant impact	Air Quality will deteriorate due to increased traffic, urbanization and industrial development in business as usual but the Air

Developments/CERs (Hotspots)	Small Scale Impacts						Large Scale Impacts
	NW-1	EDFC	Development of Industries & Industrial Area/zones/parks/TPPs	Urbanization	Road Development	Irrigation Schemes/Dams	Cumulative Impact
kahalgaon-Bhagalpur, Semaria-Begusarai-Barh, Patna, Buxar, Ghazipur, Varanasi)	be high near terminals and jetties. Air emission calculations for transportation of freight planned through IWT mode for phase I of NW-1 is given in **Annexure 6.3.**	stations. Air emission calculations for transportation of freight planned through Rail mode for phase I of NW-1 is given in **Annexure 6.3.**		plantation	calculations for transportation of freight planned through Road mode for phase I of NW-1 is given in **Annexure 6.3.**		emission will cut down due to shift of freight from Road/Rail to IWT. Assessment of reduction of Air emissions due to development of Jal Marg Vikas Project is given in **Annexure 6.1**
Water Resources/Flow (Haldia, Kolkata-Mahesthala, Katwa to Hoogly Ghat, Farakka to Murshidabad, Mangalghat (Rajmahal), Sahibganj, Pirpanti-kahalgaon-Bhagalpur, Semaria-Begusarai-Barh, Patna, Buxar, Ghazipur, Varanasi)	No impact on water resources/flow as no consumption of water is involved. Nor any water storage and diversion structure is proposed on NW-1 which can impact the water resources/flow.	No impact on water resources. Water is required only during construction phase which is short term. No significant impact on water resources. Water flow may be impacted due to construction of bridge piers	Depletion of water resources due to extraction of water for industrial consumption but can be controlled by using water efficient modern technologies	Depletion of water resources due to increased water consumption & change in life style but can be controlled by spreading awareness and making it mandatory to use only water efficient fixtures. Water requirement of the Districts through which NW-1 traverses is given in **Annexure 6.4**	No impact on water resources. Water is required only during construction phase which is short term. No significant impact on water resources. Water flow may be impacted due to construction of bridge piers	Water will required to be withdrawn from NW-1 or the tributaries of NW-1 along which the irrigation scheme will be developed. Dams and this scheme will affect the water flow available in these rivers and tributaries. List of the dams and irrigation schemes within the Ganga Basin is attached as **Annexure 6.5 & 6.6.** However	Water Resources will deplete due to continued urbanization, industrial development and infrastructure development. NW-1 will not have significant impact on water resources and flow. But coming up of new dams and irrigation schemes may impact the availability of flow in NW-1 significantly.

Developments/CERs (Hotspots)	Small Scale Impacts						Large Scale Impacts
	NW-1	EDFC	Development of Industries & Industrial Area/zones/parks/TPPs	Urbanization	Road Development	Irrigation Schemes/Dams	Cumulative Impact
						impacts of these existing schemes and dams are considered while carrying out design study. Any new scheme or dam will impact the availability of flow in NW-1	
Ground Water Quality (Haldia, Kolkata-Mahesthala, Katwa to Hoogly Ghat, Farakka to Murshidabad, Mangalghat (Rajmahal), Sahibganj, Pirpanti-kahalgaon-Bhagalpur, Munger, Semaria-Begusarai-Barh, Buxar, Ghazipur)	No impact	No impact	Ground Water Pollution due to leaching of pollutants. However it is mandatory for industries to take pollution prevention measures	Ground Water Pollution due to leaching of pollutants. However it is mandatory for ULBS to take pollution prevention measures	No impact	Ground water may get polluted due to leaching of the fertilizers and pesticides used for agriculture	Ground water quality will continue to impacted due to increased developmental and industrial activities in the area
Surface/River Water Quality (Haldia,, Kolkata-Mahesthala,	Surface Water quality will be deteriorated significantly due to	No significant impact, low impact due to increased run-off	Surface Water Pollution due to discharge of untreated/treated effluent in	Surface Water Pollution due to discharge of untreated/treated sewage/contamin	No significant impact, low impact due to increased run-off	Surface water may get contaminated with the run-off from the	Surface water pollution will continue to impact due to increased developmental and

Developments/CERs (Hotspots)	Small Scale Impacts						Large Scale Impacts
	NW-1	EDFC	Development of Industries & Industrial Area/zones/parks/TPPs	Urbanization	Road Development	Irrigation Schemes/Dams	Cumulative Impact
Katwa to Hoogly Ghat, Farakka to Murshidabad, Mangalghat (Rajmahal), Sahibganj, Pirpanti-kahalgaon-Bhagalpur, Semaria-Begusarai-Barh, Patna, Buxar, Ghazipur, Varanasi, Allahabad)	dredging, barge operation and terminal activities		water bodies. However it is mandatory for industries to take pollution prevention measures	ated run-off in water bodies. Sewage generation potential of the districts through which NW-1 traverses is attached as **Annexure 6.4** However it is mandatory for ULBS to take pollution prevention measures. No of the households in each district covered under sewage scheme is also given in **Annexure 6.4.** Surface water quality gets also impacted due to religious rituals performed on Ganga by people and burning and immersion of bones/idols in the Ganga.		agricultural land which may contain pesticides and fertilizers	industrial activities in the area and religious rituals performed on Ganga by people and burning and immersion of bones/idols in the Ganga.. Surface water pollution will be aggravated due to NW-1 project
Natural Drainage Pattern	Construction of infrastructure and related	Natural drainage pattern will be disturbed as	Effects the natural drainage pattern but	Increased sealed surfaces and thus disturbs	Natural drainage pattern will be disturbed as	No significant impact	Natural Pattern will be altered significantly due to

Developments/CERs (Hotspots)	Small Scale Impacts						Large Scale Impacts
	NW-1	EDFC	Development of Industries & Industrial Area/zones/parks/TPPs	Urbanization	Road Development	Irrigation Schemes/Dams	Cumulative Impact
(Haldia, Katwa to Hoogly Ghat, Farakka to Murshidabad, Sahibganj, Patna, Ghazipur, Varanasi)	facilities of waterways may impact the flow of the river and thus the drainage pattern of river	alignment crosses various streams, nallahs & rivers but effect can be minimized by providing cross-drainage structures	impact is insignificant as storm water drainage system is provided to divert the storm water with each such development	natural drainage pattern resulting into urban flooding and water lodging during monsoons. But it can be controlled by developing adequate storm water drainage system for the area	alignment crosses various streams, nallahs & rivers but effect can be minimized by providing cross-drainage structures		continued road & railway development but need of development of road/rail may reduce due to shift of freight from road/rail to IWT
Noise Level (Haldia, Katwa to Hoogly Ghat, Farakka to Murshidabad, Sahibganj, Patna, Ghazipur, Varanasi)	High underground noise due to dredging, pilling and barge movement and high ambient air noise due to dredging operation. Ambient air noise generation due to dredging varies from 80-85 dB(A).	Intermittent noise level will increase in areas along EDFC track. Noise levels vary from 75-90 dB (A) due to movement of trains.	Noise level will increase due to industrial operations but can be controlled using noise control technologies. Noise levels from various industries are as below: steel: 130 dB, plastic molding: 100 dB; TPP: 130 dB; casting: 120-129 dB; mining operations: 109 dB, food processing: 99 dB, Textile: 80-	Noise level will increase due to increased traffic and commercial activities. Existing motorboat movement in the NW-1 also adds to the ambient & underwater noise. As per CPCB data noise level of cities like Mumbai, Pune, Nashik, Aurangabad, Nagpur, Kohlapur etc are higher than the CPCB standards for both night &	Noise level will increase due to increased traffic movement but can be controlled by provision of noise barriers. But noise level will also reduce due to reduction in traffic jams. Noise levels due to various road transport varies from 65-90 dB (A)	No significant impact. Some noise may generate due to operation of pumps. Noise level from pumps varies from 100-120 dB(A)	Noise level will increase in the area due to continued developmental and industrial activities and plying of the motorboats. But noise level along the NW-1 may reduce due to shift if freight from road/rail to IWT.

Developments/CERs (Hotspots)	Small Scale Impacts						Large Scale Impacts
	NW-1	EDFC	Development of Industries & Industrial Area/zones/parks/TPPs	Urbanization	Road Development	Irrigation Schemes/Dams	Cumulative Impact
			89 dB	day time.			
Vibration (Varanasi)	No Impacts	Will increase along the proposed EDFC alignment. Vibration level varies from 75.9 to 79.1 dB at distance of 12.5 m from the track and 60.5 to 62.1 dB at distance of 25 m from track due to movement of train.	No Impacts	No Impacts	No Impacts	Some vibrations may result due to pumping of water.	Vibration will increase in area close vicinity of railway track, i.e. near Varanasi stretch. Impact of these vibrations are analyzed during EDFC study and it is assessed that vibrations impact will dissipate within 100 m.
Terrestrial Ecology (Katwa to Hoogly Ghat, Farakka to Murshidabad, Sahibganj, Semaria-Begusarai-Barh, Patna, Ghazipur)	May require tree cutting for development of civil interventions like involve cutting of 500 trees for development of Sahibganj terminals. NW-1 alignment is app. Udhawa Lake wildlife sanctuary but no significant impact is anticipated on the sanctuary. Green belt will	Tree cutting may be required for development of track and other associated developments. Eco-sensitive zones like sanctuaries/forest may also get disturb as the alignment may pass through these zones. Compensatory plantation will be carried out as per state policy to reduce the impact. For	May require clearance of vegetation and cutting of trees. But it is mandatory to develop 30% area of industrial area/industry as green belt. Compensatory plantation will be carried out as per state policy to reduce the impact	Will disturb both flora & fauna due to increased human intervention. But ecology may improve due as urbanization involves development of avenue plantation and urban forests and parks.	Tree cutting may be required for development of track and other associated developments. Eco-sensitive zones like sanctuaries/forest may also get disturb as the alignment may pass through these zones. Compensatory plantation will be carried out as per state policy to reduce the impact	Natural vegetation in irrigation scheme area will be removed for growing the required crops/plantation	Terrestrial ecology will continue o be impacted due to cutting of trees for development of infrastructure and industries. However development of avenue plantations, compensatory plantation, urban forests may be positive impact on the terrestrial ecology

Developments/CERs (Hotspots)	Small Scale Impacts						Large Scale Impacts
	NW-1	EDFC	Development of Industries & Industrial Area/zones/parks/TPPs	Urbanization	Road Development	Irrigation Schemes/Dams	Cumulative Impact
	be developed around terminals. Compensatory plantation will be carried out as per state policy to reduce the impact	example 27556 will be cut for 222 km long EDFC section from Khurja to Pilkhani.					
Aquatic Ecology (Haldia, Kolkata-Mahesthala, Katwa to Hoogly Ghat, Farakka to Murshidabad, Mangalghat (Rajmahal), Sahibganj, Pirpanti-kahalgaon-Bhagalpur, Munger, Semaria-Begusarai-Barh, Patna, Buxar, Ghazipur, Varanasi, Allahabad)	High impact on aquatic flora & fauna including dolphins, turtles and fishes. May directly impact the primary productivity of water body. NW-1 includes 2 wildlife sanctuaries, i.e. Kashi Turtle Sanctuary & VGDS	May impact aquatic ecology due to construction of bridge piers	Aquatic ecology may be affected to discharge of pollutants in the water bodies but it is mandatory for all industries to treat the effluent to defined standards prior discharging into water body	Aquatic ecology may be impacted due to increased run-off and increase treated/untreated sewage disposal into the water bodies but is guidelines of CPCB for ULBs to treat the sewage to 100% before discharging into water bodies. Another development in the area is Patna River front development	May impact aquatic ecology due to construction of bridge piers	Run-off from the irrigated area may contain pesticides, fertilizers/chemicals	Impact on aquatic ecology will continue to exists and will be escalated due to NW-1 development
Avifauna (Farakka to	NW-1 traverses	Tree cutting will impact habitat of	Tree cutting will impact habitat of	Tree cutting will impact habitat of	Tree cutting will impact habitat of	Agriculture field may provide	Avifauna will continue to be

Developments/CERs (Hotspots)	Small Scale Impacts						Large Scale Impacts
	NW-1	EDFC	Development of Industries & Industrial Area/zones/parks/TPPs	Urbanization	Road Development	Irrigation Schemes/Dams	Cumulative Impact
Murshidabad, Pirpanti-kahalgaon-Bhagalpur, Semaria-Begusarai-Barh, Patna)	through 5 important bird areas. Dredging operations in these areas may impact the avifauna. Development of civil interventions may involve tree cutting which is habitat of avifauna thus again disturbing the avifauna. Compensatory plantation and green belt development may reduce the impact.	avifauna. Compensatory plantation and green belt development may reduce the impact.	avifauna. Compensatory plantation and green belt development may reduce the impact.	avifauna. Urban forests and avenue plantation may reduce the impact.	avifauna. Compensatory plantation and green belt development may reduce the impact.	habitat to avifauna	impacted due to loss of habitat. Impact will increase due to NW-1 and other upcoming developments in the area
Soil Quality (Haldia, Katwa to Hoogly Ghat, Farakka to Murshidabad, Pirpanti-kahalgaon-Bhagalpur, Semaria-	Loss of productive top soil for development of terminals or jetties but impact will be very less. Soil may be required for	Large amount of soil required for construction of embankments	Soil pollution may occur, if appropriate measures for material & waste handling not taken	Soil pollution, soil compaction etc may increase due to improper waste disposal	Large amount of soil required for construction of embankments	Soil may become saline due to excess irrigation and use of fertilizers and pesticides	Soil quality, & fertility will continue to deteriorate due to upcoming developments in the area and will also be impacted due to Jal Marg Vikas Project

Developments/CERs (Hotspots)	Small Scale Impacts						Large Scale Impacts
	NW-1	EDFC	Development of Industries & Industrial Area/zones/parks/TPPs	Urbanization	Road Development	Irrigation Schemes/Dams	Cumulative Impact
Begusarai-Barh, Buxar)	development of embankment o carrying out other bank protection work. This soil can be sourced from agriculture fields. Spillage of materials at site may contaminate the soil in the area						
River Bed Sediment Quality (Ghazipur, Varanasi, Allahabad)	River bed sediments are disturbed due to dredging & piling. I contaminated may lead to release of pollutants in the water. At present river sediments are not contaminated in the entire stretch except Ghazipur, Varanasi & Allahabad	Low Impact	May lead to pollution of river bed sediments due to usage of heavy metals	Low Impact	Low Impact	Pesticides/fertilizers may enter the water bodies and ultimately to sediments along with the runoff from these areas	River bed sediments will further pollute due to continued use of fertilizers and pesticides

Developments/CERs (Hotspots)	Small Scale Impacts						Large Scale Impacts
	NW-1	EDFC	Development of Industries & Industrial Area/zones/parks/TPPs	Urbanization	Road Development	Irrigation Schemes/Dams	Cumulative Impact
	where pesticides were found in traces but they are below the level as per US standard for off-shore disposal. Cadmium levels are found higher in Allahabad, Varanasi & Ghazipur but concentration is below the toxicity level for fishes.						
Soil/Bank Erosion (Farakka to Murshidabad, Sahibganj, Patna, Ghazipur, Varanasi)	Construction of terminals/jetties may lead to bank/soil erosion and bed scouring in upstream and downstream of the developed structure. But shore/bank protection measures & bed scouring protection measures are	Excavation of soil from borrow area may lead to significant soil erosion. Soil erosion may happen at embankments also during rains and storms	Soil quality may be polluted but can be taken care by taking adequate waste management techniques and mulching. Soil erosion may occur if areas left open without any paving or plantation	Soil erosion may increase due to construction of open areas without vegetation	Excavation of soil from borrow area may lead to significant soil erosion. Soil erosion may happen at embankments also during rains and storms	Soil erosion may occur during the rains from agricultural fields but can be controlled using various techniques	Soil erosion will increase in the influence area due to NW-1 and other identified development

Developments/CERs (Hotspots)	Small Scale Impacts						Large Scale Impacts
	NW-1	EDFC	Development of Industries & Industrial Area/zones/parks/TPPs	Urbanization	Road Development	Irrigation Schemes/Dams	Cumulative Impact
	being taken by IWAI already. Erosion is expected in narrow stretches like feeder canal						
Quality of Life-Health & Education (Haldia, Kolkata-Mahesthala, Katwa to Hoogly Ghat, Farakka to Murshidabad, Sahibganj, Pirpanti-kahalgaon-Bhagalpur, Semaria-Begusarai-Barh, Patna, Buxar, Ghazipur, Varanasi, Allahabad)	Increase employment opportunities, reduced transportation cost, reduced accident risk and reduced air emissions and GHG emissions as compared to road/rail thus positive impact on quality of life	Increase employment opportunities, reduced transportation cost, reduced accident risk and reduced air emissions and GHG emissions as compared to road thus positive impact on quality of life	Increase employment opportunities thus will improve quality of life but increased pollution may increase the health issues and pollution problems in the area	Increase employment opportunities, better infrastructure will improve quality of life	Increase employment opportunities and improved connectivity will improve quality of life but increased air and noise pollution will deteriorate the health of the people and living conditions	Increased agriculture productivity & income thus improved quality of life	Quality of life will improve due to industrial and infrastructure development in the area but health and living conditions may deteriorate due to increased pollution
Pressure on Existing Resources (Haldia, Katwa to Hoogly Ghat, Farakka to	Will reduce pressure on railway and NH but may increase pressure on the feeder	Will reduce pressure on IR track and NH but will continue to pressurize the feeder routes and nearby	Will further increase pressure on all the resources significantly	Will further increase pressure on all the resources significantly	Pressure on existing infrastructure will reduce due to development of good road network	No significant impact	Pressure on existing resources will continue to increase due to continued industrial and other infrastructure

Developments/CERs (Hotspots)	Small Scale Impacts						Large Scale Impacts
	NW-1	EDFC	Development of Industries & Industrial Area/zones/parks/TPPs	Urbanization	Road Development	Irrigation Schemes/Dams	Cumulative Impact
Murshidabad, Sahibganj, Ghazipur, Varanasi)	routes and nearby settlements/industrial towns due to induced growth options	settlements/industrial towns due to induced growth options					development. Pressure on IR & road may reduce due to shift of freight to IWT with Jal Marg Vikas Project
New Infrastructure Development (Haldia, Katwa to Hoogly Ghat, Farakka to Murshidabad, Sahibganj, Ghazipur, Varanasi)	Development of new infrastructure in terms of roads & railways is expected near the terminal/jetties location	Development of new infrastructure in terms of roads & railways is expected near the stations	Industrial developments always brings infrastructure development along with it	Urbanization will lead to development of new infrastructure	Infrastructure development will take place as soon as the area gets proper road connectivity	No significant impact	New infrastructure will continue to be developed with the industrial and infrastructure development.
Livelihood-Fishing Activity & loss of Agriculture land (Haldia, Katwa to Hoogly Ghat, Farakka to Murshidabad, Sahibganj, Ghazipur, Varanasi)	Fishing activities may be disturbed due to barge operations and dredging activities. Agricultural land may be required to acquire for development of terminals and other facilities. This will lead to loss of livelihood	Agricultural land is required to acquire for development of track and associated facilities. This will lead to loss of livelihood	Acquisition of land for development of industrial areas or zone will lead to loss of livelihood	Change in land use of agricultural land into residential and commercial will lead to loss of productive agricultural land for urbanization purpose	Agricultural land is required to acquire for development of road. This will lead to loss of livelihood	Agriculture productivity will increase in the area which will enhance the livelihood of the people	Agricultural land will continue to be acquired for various industrial and infrastructural developments. NW-1 development will add to this and also may lead to impact on fishing due to dredging and barge movement

Developments/CERs (Hotspots)	Small Scale Impacts						Large Scale Impacts
	NW-1	EDFC	Development of Industries & Industrial Area/zones/parks/TPPs	Urbanization	Road Development	Irrigation Schemes/Dams	Cumulative Impact
Religious Values (Haldia, Mangalghat (Rajmahal), Sahibganj, Pirpanti-kahalgaon-Bhagalpur, Munger, Semaria-Begusarai-Barh, Patna, Buxar, Varanasi, Allahabad)	Religious sentiments and festivals are associated with River Ganga. Dredging, barge movement and terminal operation facilities impact the religious sentiments of the people	Religious places within the ROW may be required to be relocated or removed due to development of track	No significant impact	No significant impact	Religious places within the ROW may be required to be relocated or removed due to development of road	No significant impact	Religious places and values may be continued to be impacted due to development of rail/railway.
Traffic (Haldia, Kolkata-Mahesthala, Katwa to Hoogly Ghat, Farakka to Murshidabad, Mangalghat (Rajmahal), Sahibganj, Pirpanti-kahalgaon-Bhagalpur, Munger, Patna, Buxar, Ghazipur, Varanasi)	Traffic volume on road/rail will reduce overall due to shift of the freight to the IWT mode. However traffic volume may increase on the roads connecting to the terminals/jetties	Traffic volume on road will reduce overall due to shift of the freight to EDFC. However traffic volume may increase on the roads connecting to the stations	Traffic volume will increase on the roads connected to industrial areas and highways due to transportation of raw material and products	Traffic volume will increase due to shift of population from rural area to urban areas	Traffic volume will increase but the increased road capacity will reduce the traffic jams	No significant impact. Some traffic may increase due to transportation of crops/grains	Traffic volume will increase due to increased development but the traffic volume on road/rail will reduce due to shift of freight to IWT
Land Use	Land may	Land use	Land use may	Expansion of the	Land use	No significant	More change of

Developments/CERs (Hotspots)	Small Scale Impacts						Large Scale Impacts
	NW-1	EDFC	Development of Industries & Industrial Area/zones/parks/TPPs	Urbanization	Road Development	Irrigation Schemes/Dams	Cumulative Impact
(Katwa to Hoogly Ghat, Farakka to Murshidabad, Sahibganj, Patna, Ghazipur, Varanasi)	required to be acquired for construction of various proposed civil interventions which will lead to change in land use.	diversion for track construction from agricultural use. Soil from agricultural land being used for development of borrow areas	change from agricultural land use to industrial use	urban area may require diversion of agricultural land for urban area development	diversion for road construction- significant for green field projects	impact	land use. Diversion of more agricultural and forest land for other uses
Archaeological Sites (Kolkata-Mahesthala, Farakka to Murshidabad, Mangalghat (Rajmahal), Varanasi)	No intervention planned close to archaeological sites at present thus minimal impact but may have impact if any activity is undertaken in future	EDFC alignment at Varanasi is not within 300 m of any of the archaeological site thus no major impact.	Industrial development is generally avoided in close vicinity of such site. If done permission is required from ASI/INTACH and measures are taken to prevent any damage to Archaeological sites	Construction in close vicinity of Archaeological sites is restricted thus no impacts. Pollution & public nuisance in urban area however may impact the aesthetics of these sites	Road construction activities close to these sites may impacts these sites. Measures should be taken to prevent any impact on these sites.	No significant impact	Impacts on Archaeological sites may continue to occur due to developments and the impact may increase if any development related to NW-1 will be undertaken within 300 m of such site

We can say that maximum interaction will take place in the zones experiencing the overlapping impacts due to above mentioned developments. These zones are the zones which are identified in table 6.1, i.e. hotspots, on basis of baseline study and stakeholder consultation as they are the ones which are experiencing or will experience developments. Due to these interactions, CERs in these zones will experience the cumulative impacts, i.e. impact due to these developments individually and impact due to other developments in the surrounding areas. Cumulative impacts anticipated on CERs are listed in the last column of **Table 6.4** above.

6.5. Assessment of Cumulative Impacts

In this section an attempt has been made to quantify the anticipated impact by assigning score to each impact and the development in scale of 1-5 and is defined in **Table 6.5** below. Cumulative impact assessment is carried out for the hotspots identified in Table 6.1 & the criteria for selection of them as hotspot above to assess the magnitude and significance of cumulative impact and is given in **Table 6.6 & Figures 6.14-6.32.**

Table 6.5 : Rating Scale for Average Score

Range of Average Score	Type of Impact	Color Coding
0	Nil	
0.5-1.0	Low (L)	
1.0-1.5	Moderately Low (ML)	
1.5-2.0	Moderate (M)	
2.0-2.5	Moderately High (MH)	
2.5-3.0	High (H)	

Table 6.6 : Cumulative Impacts Due to Existing, Planned and Proposed Developments on Hotspots

CERs/Hotspots	Haldia	Kolkata-Maheshtala	Katwa to Hooghly Ghat	Farakka to Murshidabad	Mangalghat (Rajmahal)	Sahibganj	Pirpanti-Kahalgaon-Bhagalpur	Munger	Semaria-Begusarai- Barh	Patna	Buxar	Ghazipur	Varanasi	Allahabad	Remarks
MC	2 M	1 L	2 M	2 M	1 L	2 M	1.5 ML	0.5 L	1.5 ML	0.5 L	0.5 L	1.5 ML	2 M	1 L	L-M
AQ	2.5 MH	2 M	2.5 MH	2.5 MH	2 M	2 M	2 M	1 L	2 M	2 M	2 M	1.5 ML	2.5 MH	1.5 ML	L-MH
WR/F	2.5 MH	1.5 ML	2 M	2 M	1 L	1.5 ML	1.5 ML	1 L	1.5 ML	1.5 ML	1.5 ML	1 L	1.5 ML	1 L	L-MH
GWQ	2.5 MH	1.5 ML	1.5 ML	1.5 ML	0.5 L	1.5 ML	1.5 ML	2 M	1.5 ML	2 M	1 L	0.5 L	1.5 ML	1.5 ML	L-MH
SWQ	2 M	1.5 ML	2 M	2 M	1.5 ML	1.5 ML	2 M	2 M	2 M	2 M	2 M	1.5 ML	2.5 MH	1 L	L-MH
D	1.5 ML	0.5 L	1.5 ML	1.5 ML	0.5 L	1 L	1 L	0.5 L	1.5 ML	0.5 L	0.5 L	1.5 ML	1.5 ML	1 L	L-ML
NL	2 M	1 L	1.5 ML	2 M	1.5 ML	1.5 ML	1.5 ML	1 L	1 L	1.5 ML	1.5 ML	1 L	2.5 MH	1.5 ML	L-MH
V	0	0	0	0	0	0	0	0	0	0	0	0	1.5 ML	1.5 ML	M
BD	1.5 ML	1.5 ML	2 M	2.5 MH	2 M	2 M	2.5 MH	0.5 L	1.5 ML	2 M	1 L	1.5 ML	2.5 MH	1.5 ML	L-MH
SQ	1.5 ML	0.5 L	1.5 ML	1.5 ML	1.5 ML	1.5 ML	1.5 ML	0.5 L	1 L	1.5 ML	0.5 L	1 L	2 M	2 M	L-M
SE	1 L	0.5 L	0.5 L	2.5 MH	1 L	2.5 MH	1 L	0.5 L	1.5 ML	1 L	1 L	1.5 ML	2 M	1 L	L-MH
QOL	2 M	1.5 ML	2 M	2 M	1.5 ML	1.5 ML	1.5 ML	1 L	1.5 ML	1 L	1 L	1.5 ML	2 M	1.5 ML	L-M
ER	2.5 MH	1 L	2.5 MH	2 M	0.5 L	1.5 ML	0.5 L	0.5 L	1.5 ML	0.5 L	0.5 L	1	2 M	1 L	L-MH
NI	1.5 ML	1 L	1.5 ML	1.5 ML	1 L	1.5 ML	0.5 L	1 L	1.5 ML	1.5 ML	0.5 L	1.5 ML	1.5 ML	1 L	L-ML
LI	1.5 ML	1.5 ML	1.5 ML	1.5 ML	1 L	1.5 ML	1.5 ML	1 L	1 L	1.5 ML	1.5 ML	1 L	1.5 ML	1 L	L-ML
RV	1.5 ML	0.5 L	1 L	1 L	1.5 ML	1.5 ML	1.5 ML	1.5 ML	1.5 ML	1.5 ML	1.5 ML	0.5 L	2 M	1.5 ML	L-M
TV	1.5 ML	0.5 L	1.5 ML	1.5 ML	0.5 L	1.5 ML	0.5 L	0.5 L	1.5 ML	0.5 L	0.5 L	1.5 ML	1.5 ML	0.5 L	L-ML
LU	1 L	0.5 L	2 M	2 M	0.5 L	1.5 ML	0.5 L	0.5 L	1.5 ML	0.5 L	0.5 L	1.5 ML	1 L	0.5 L	L-M
AS	0	1.5	0	0	2	0	0	0	0	0	0	0	2	0	ML-M

		ML			M								M		

***MC-Micro climate, AQ-Air quality, WR/F-Water resources & flow, GWQ-Ground water quality, SWQ-Surface water quality, D-drainage, NL-noise level, V-Vibrations, BD-Bio-diversity (Aquatic +Terrestrial +Avifauna), SQ-Soil & River Bed Sediment quality, SE-soil/Bank erosion, QOL-Quality of life, ER-Pressure on existing resources, NI-New Infrastructure Development, LI-Livelihood (fishing & Agriculture), RV-Religious Values, TV-Traffic Volume, LU-land use, AS-Archaeological sites**

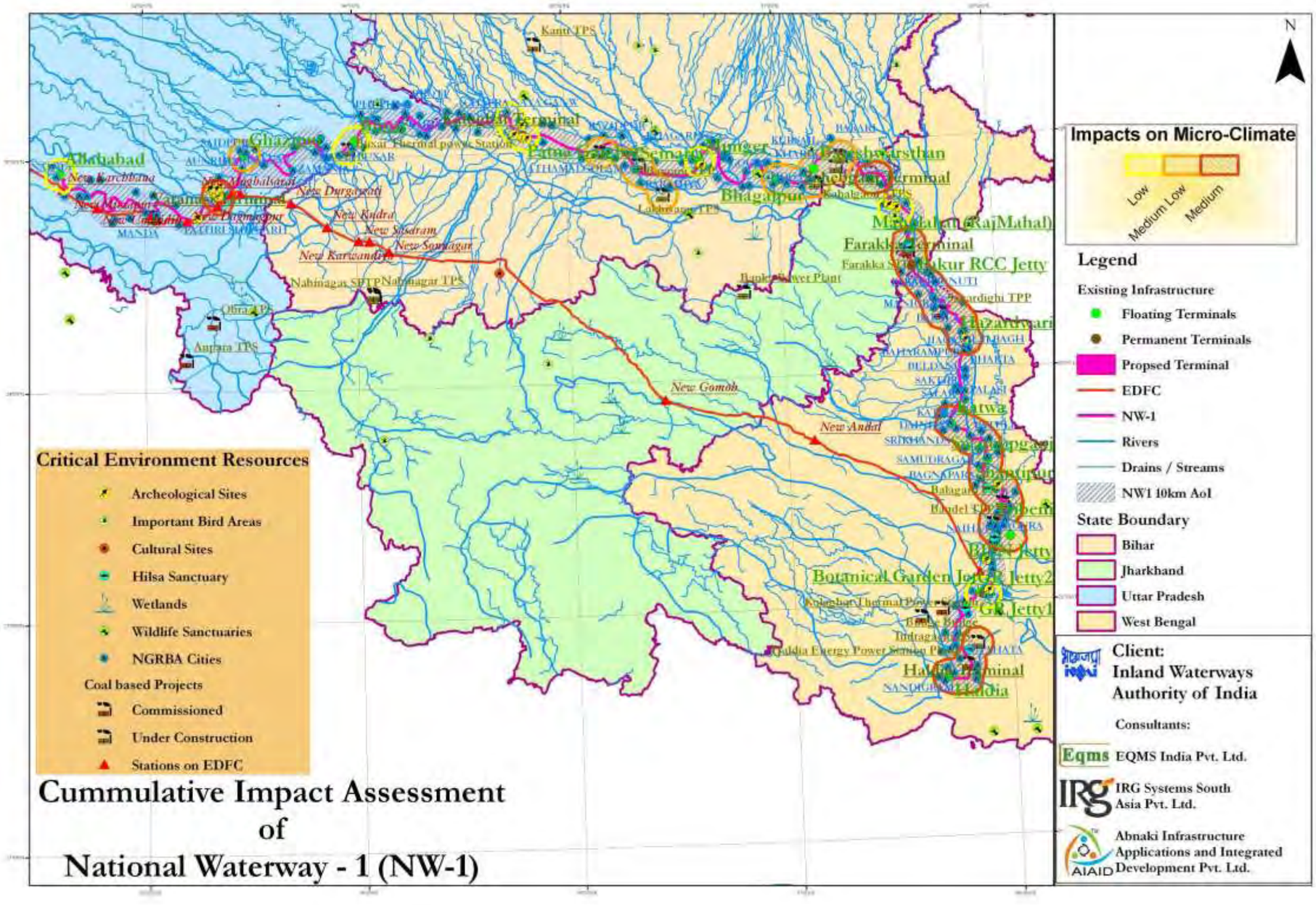


Figure 6.14 : Map depicting Impacts on Micro Climate along NW – 1 Alignment

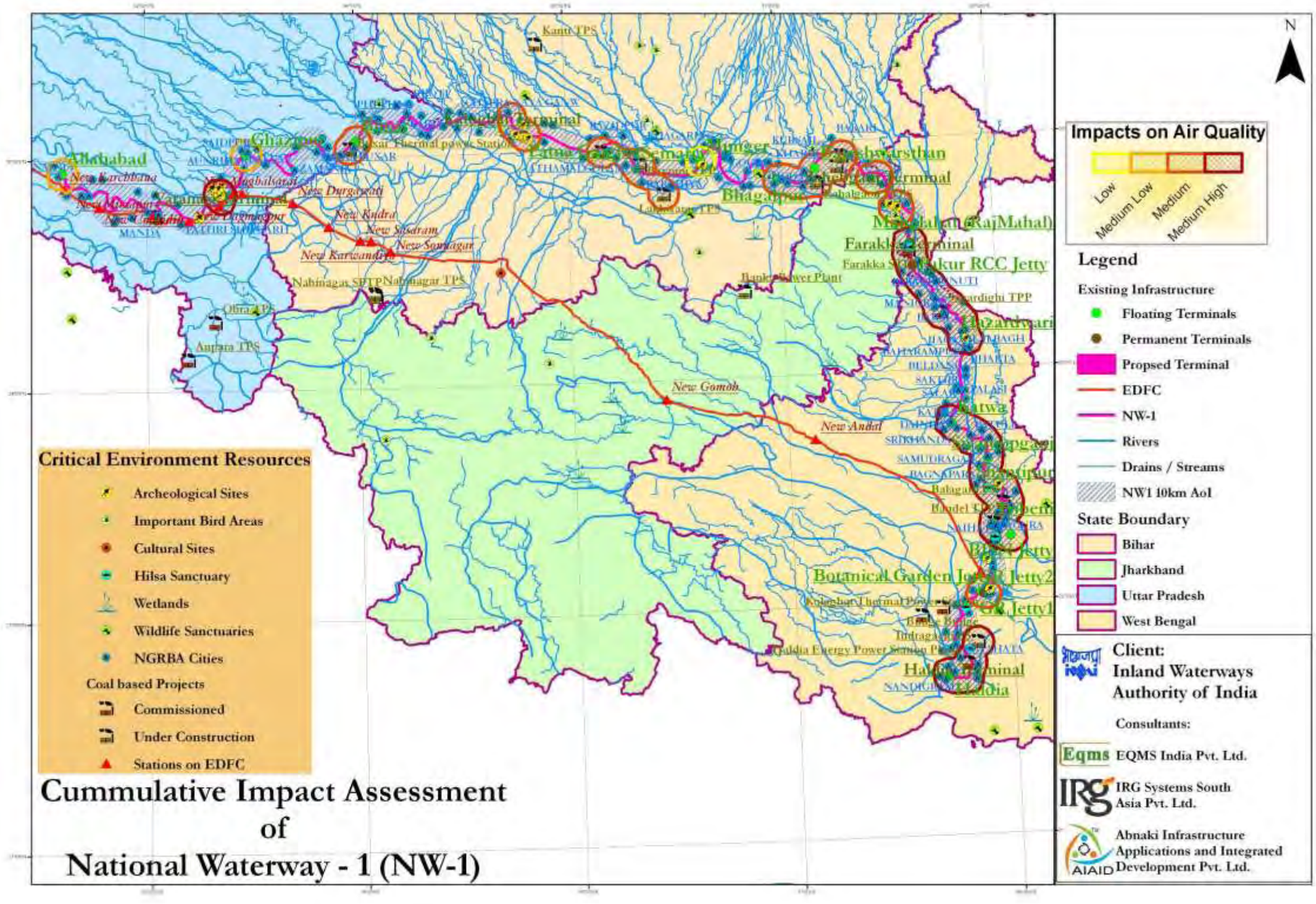


Figure 6.15 : Map depicting Impacts on Air Quality along NW – 1 Alignment

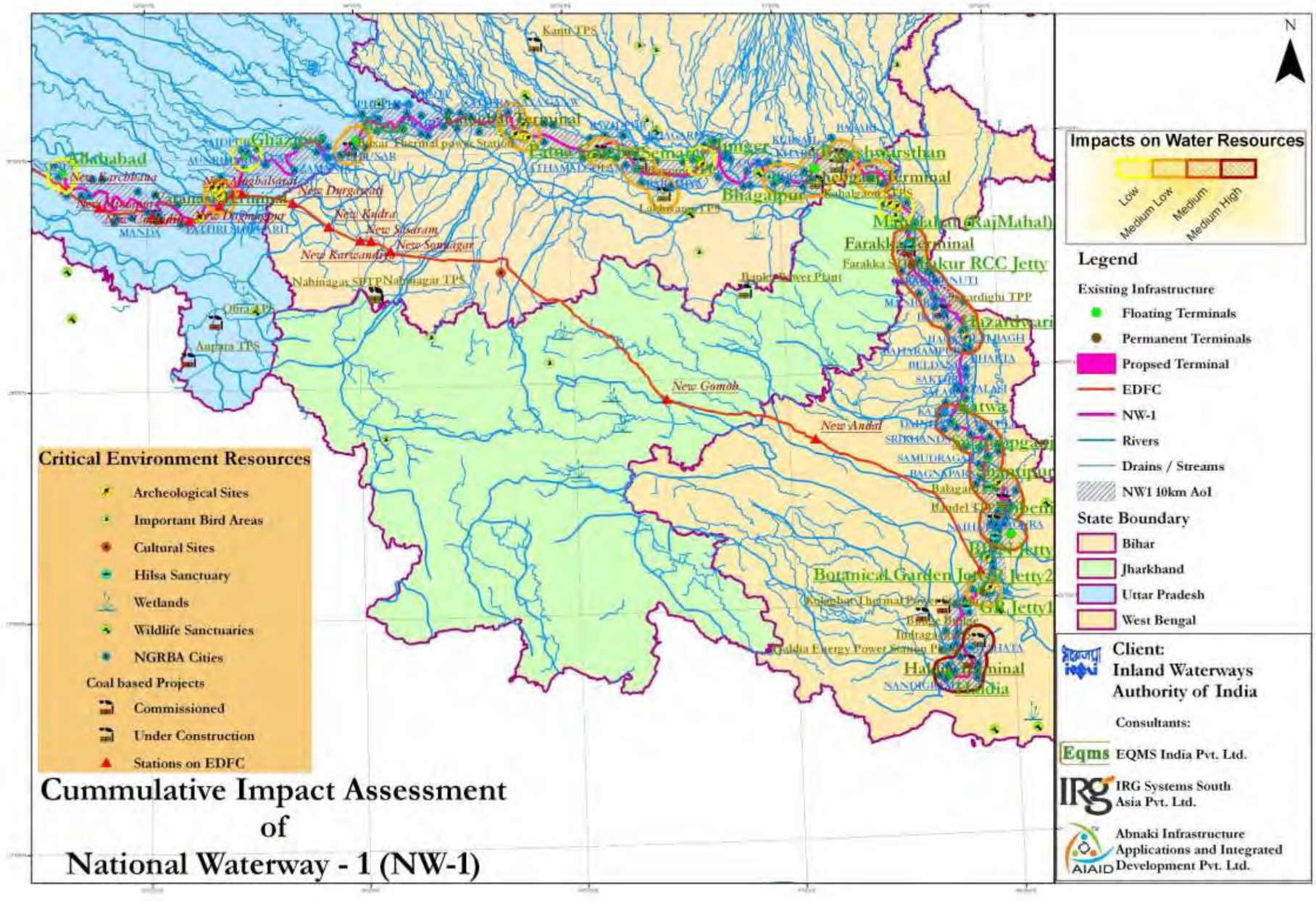


Figure 6.16 : Map depicting Impacts on Water Resources & Flow along NW – 1 Alignment

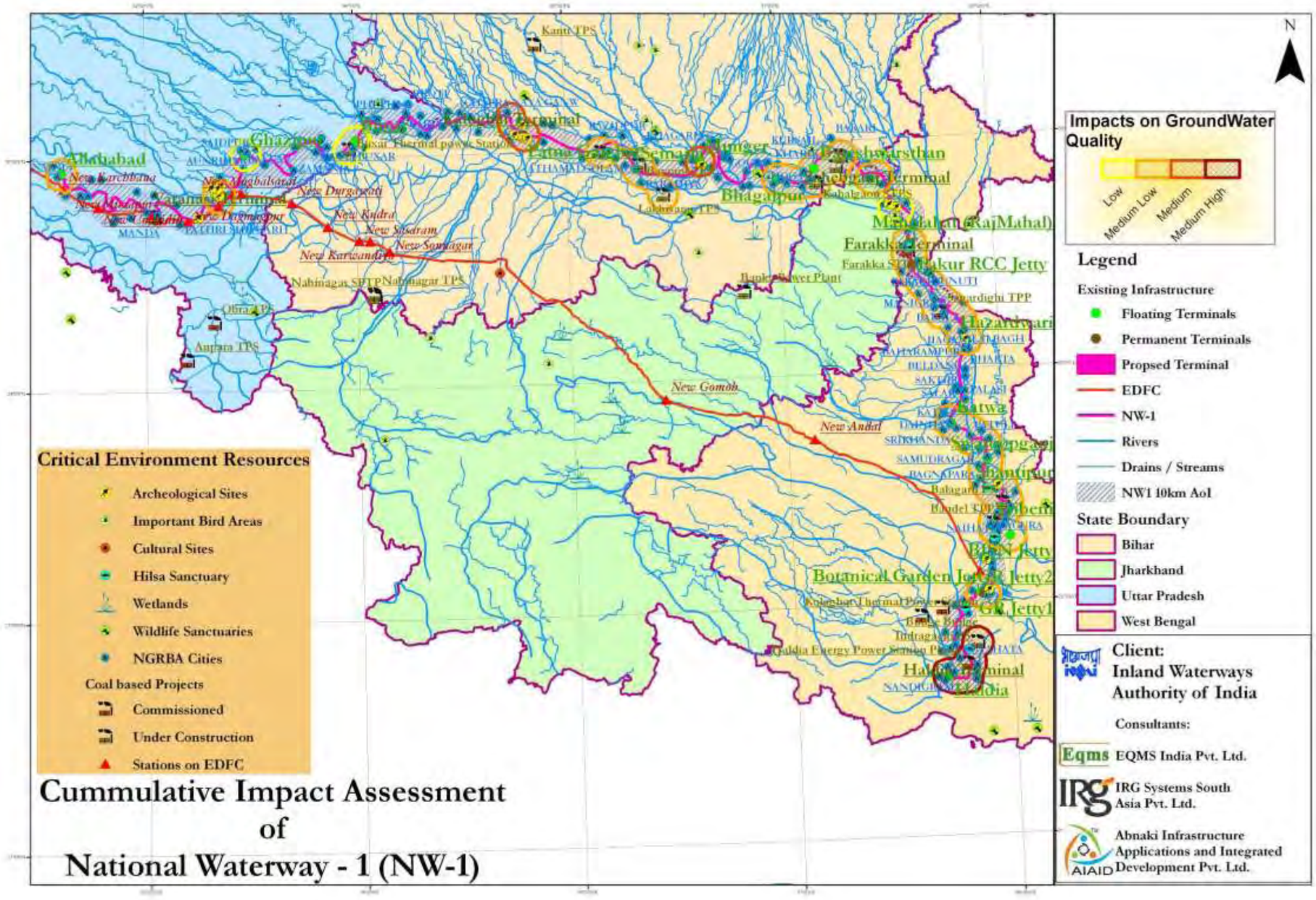


Figure 6.17 : Map depicting Impacts on Ground Water Quality along NW – 1 Alignment

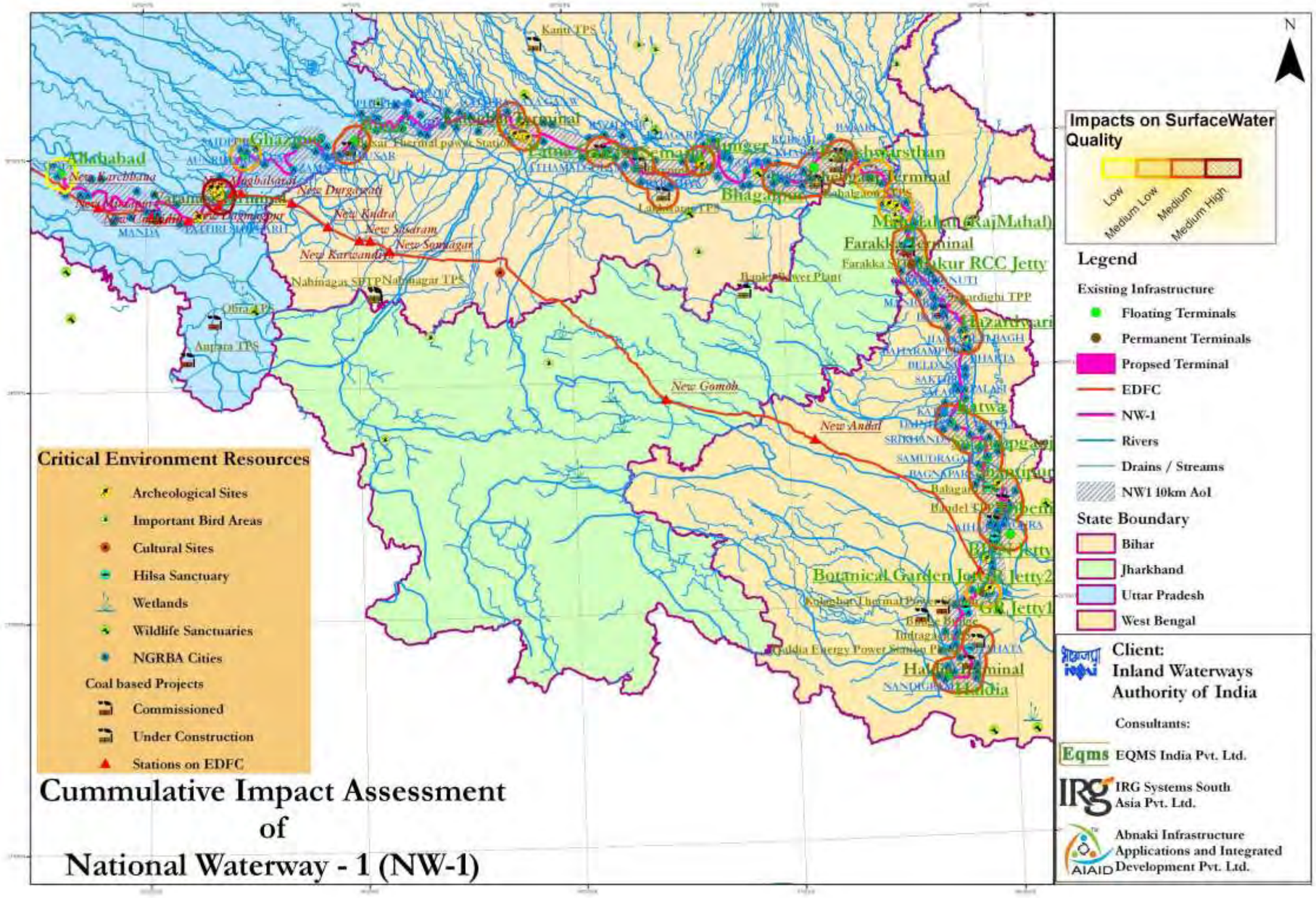


Figure 6.18 : Map depicting Impacts on Surface Water Quality along NW – 1 Alignment

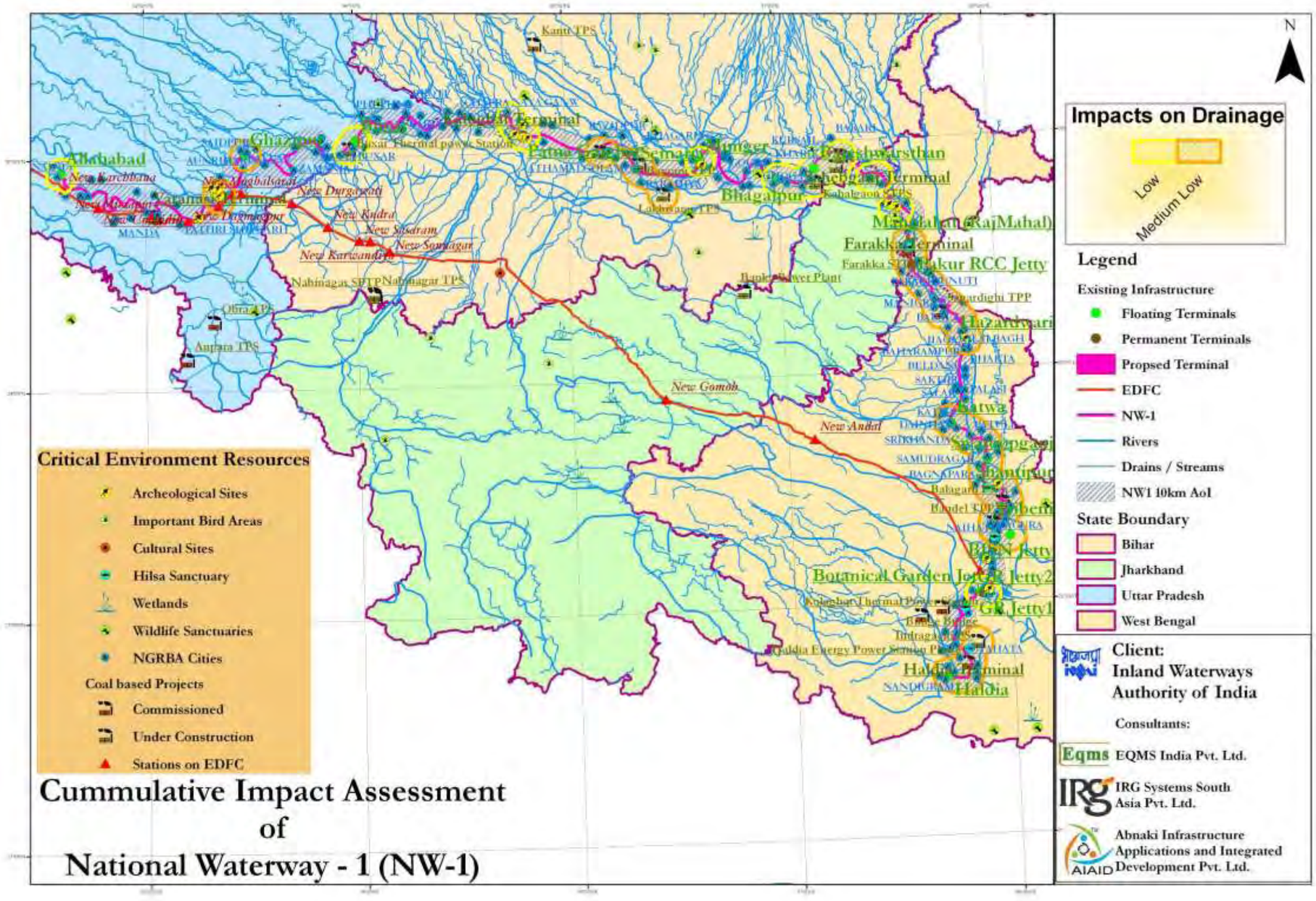


Figure 6.19 : Map depicting Impacts on Drainage along NW – 1 Alignment

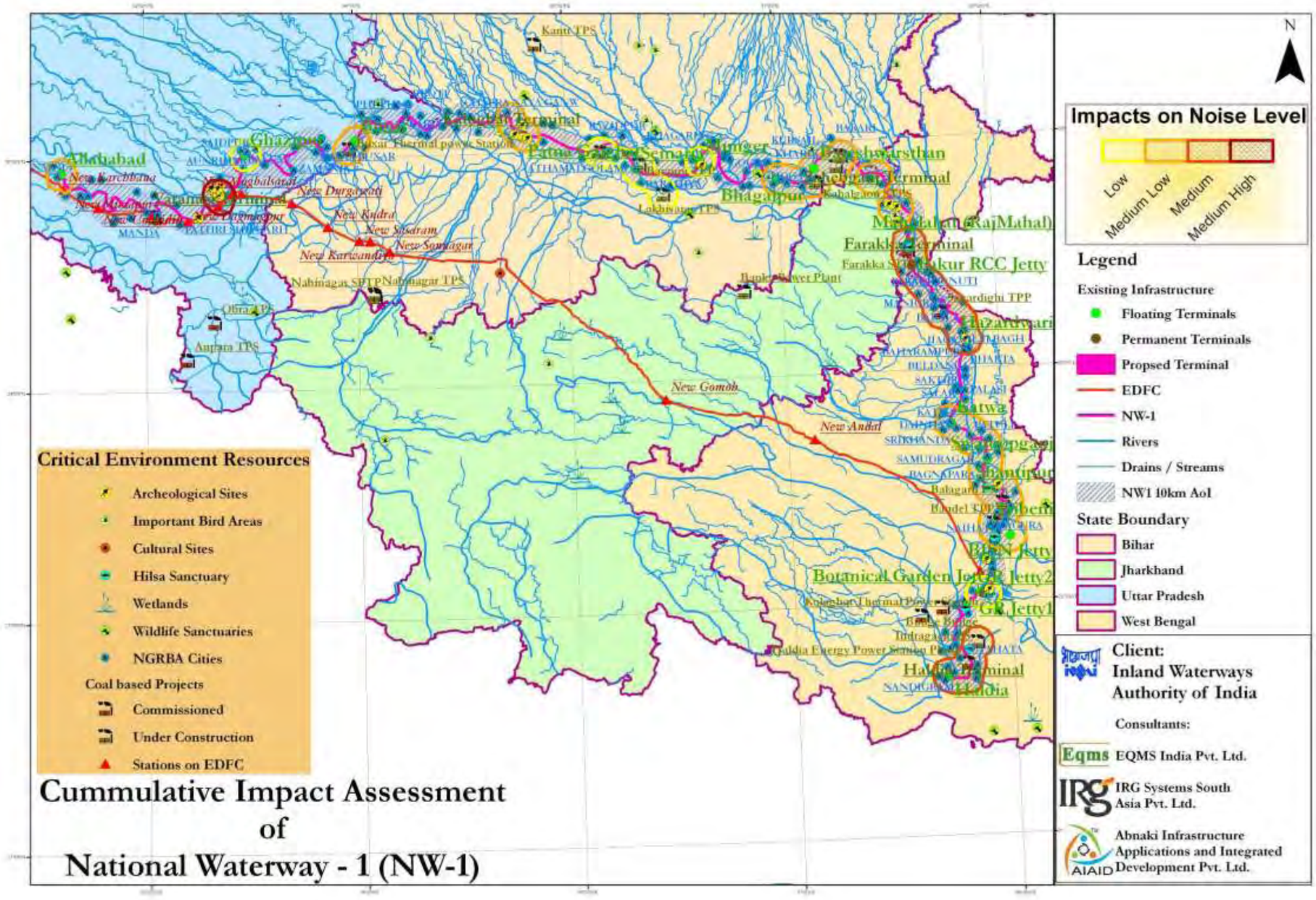


Figure 6.20 : Map depicting Impacts on Noise Level along NW – 1 Alignment

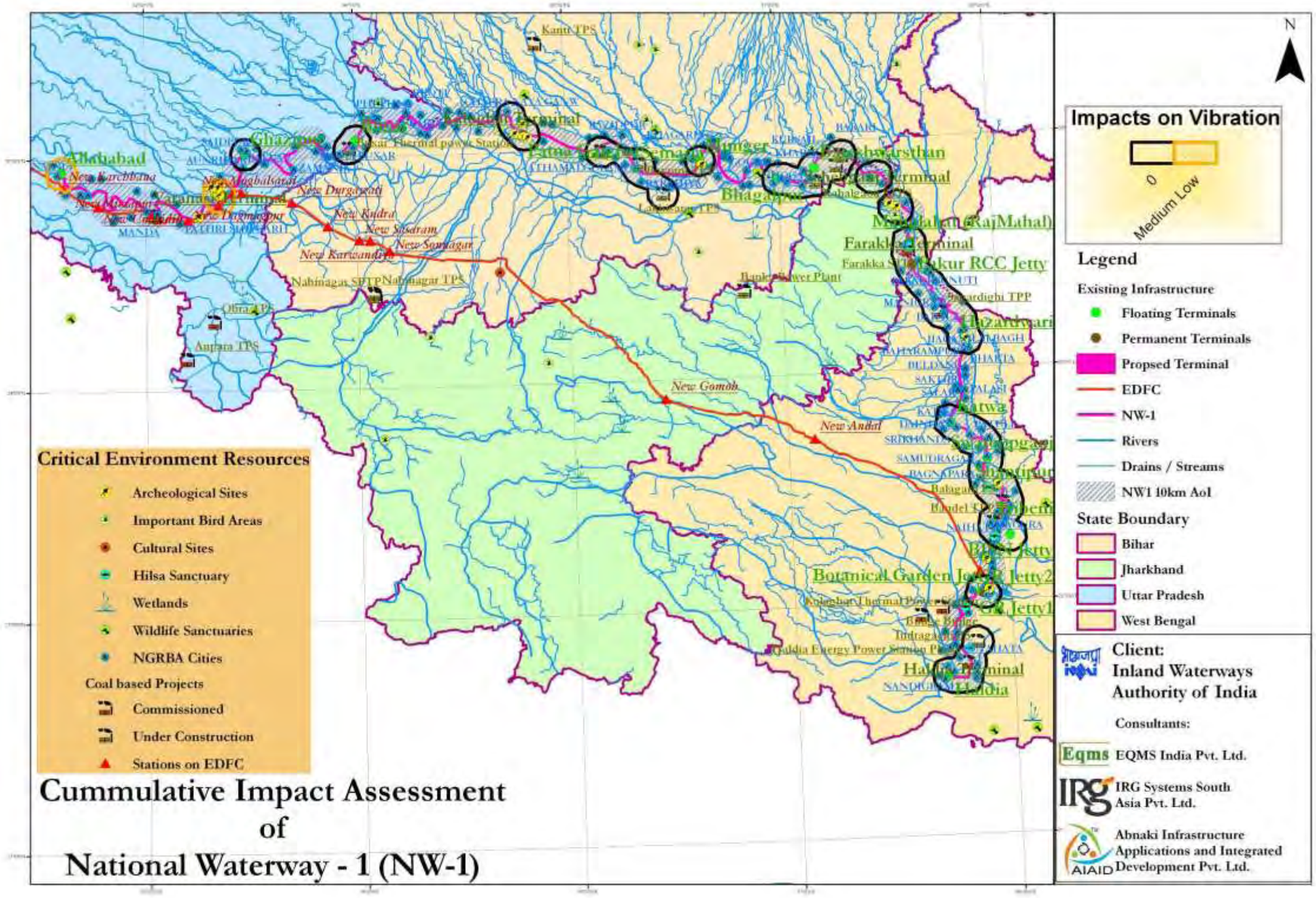


Figure 6.21 : Map depicting Impacts on Vibration Level along NW – 1 Alignment

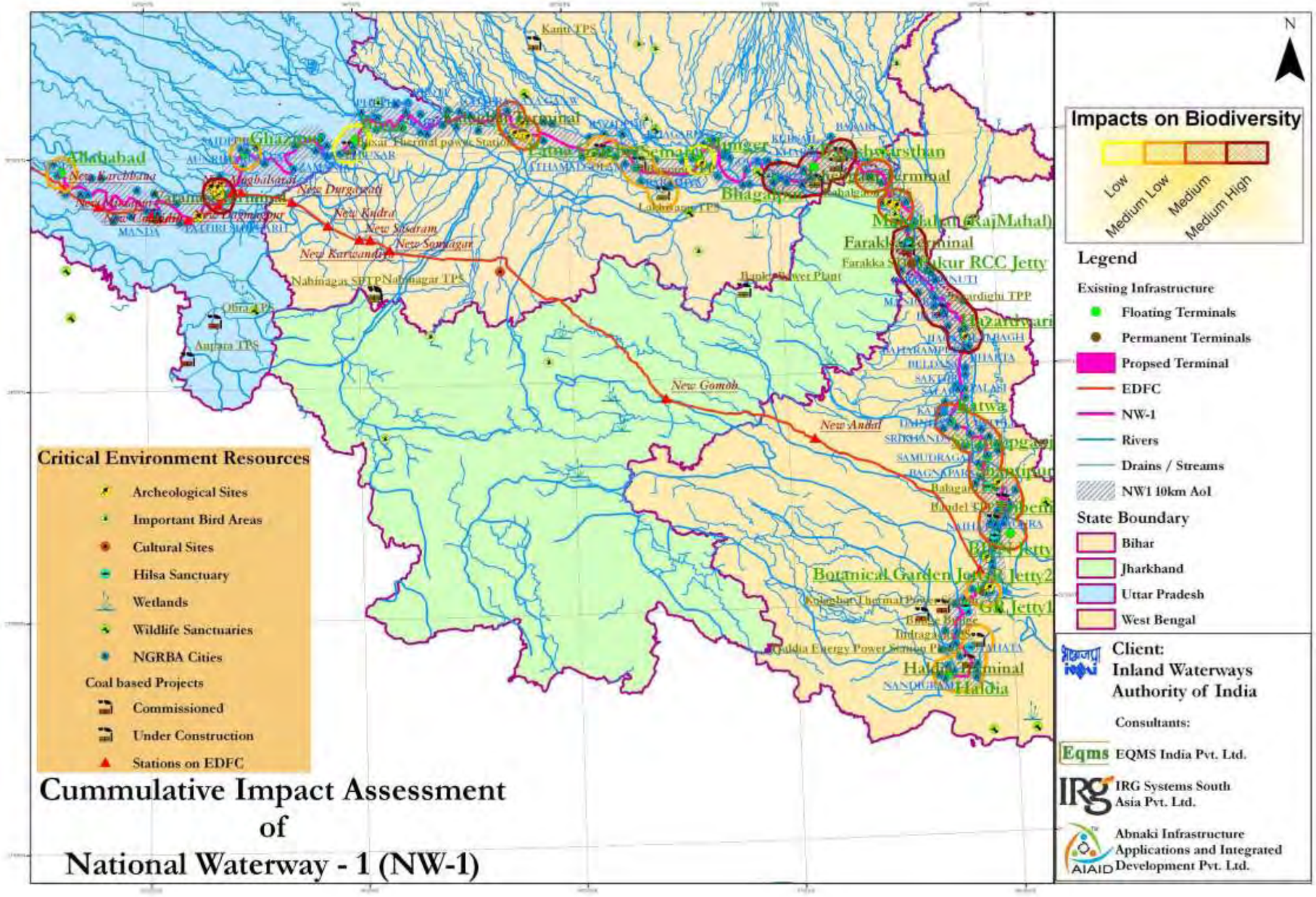


Figure 6.22 : Map depicting Impacts on Biodiversity along NW – 1 Alignment

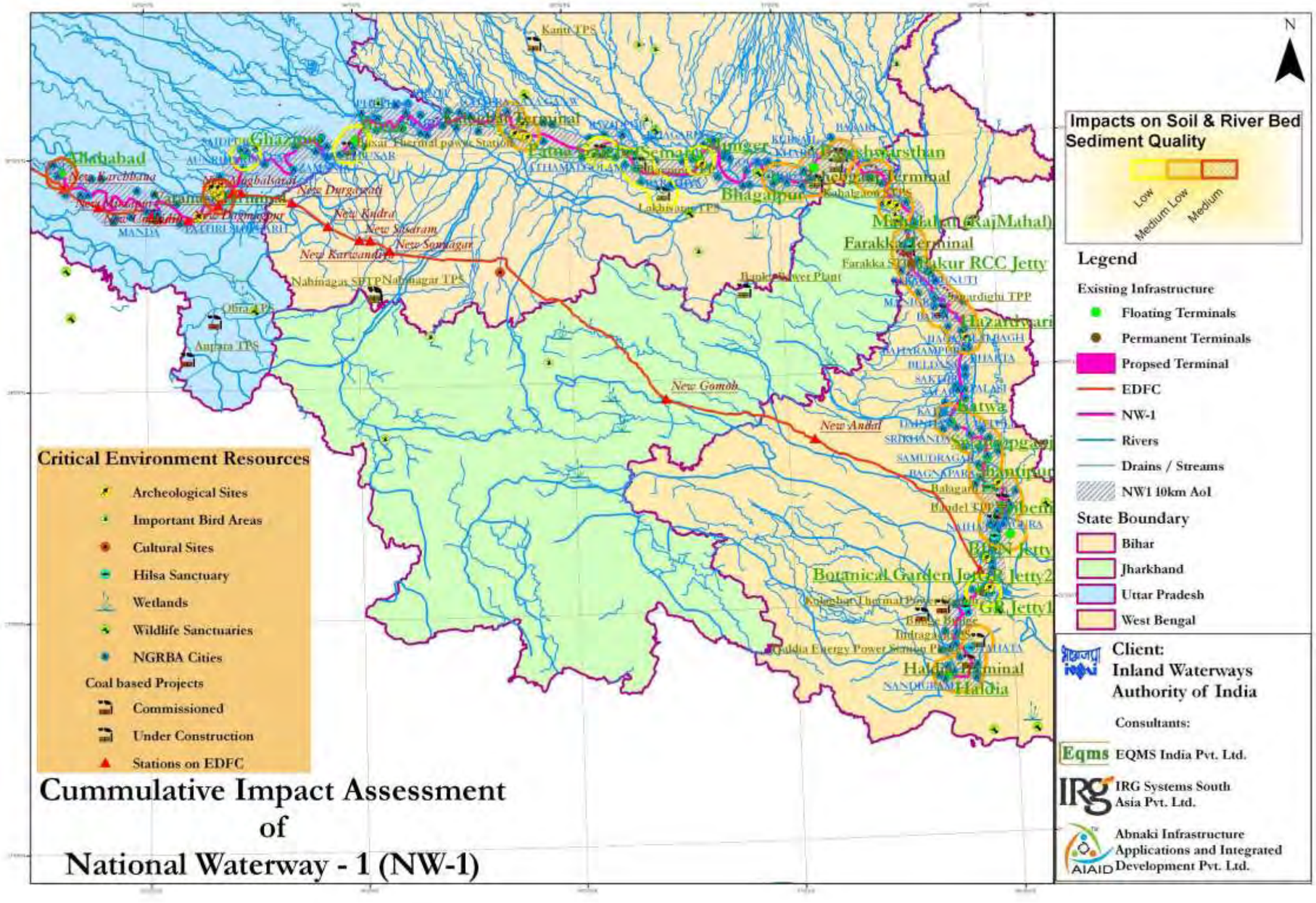


Figure 6.23 : Map depicting Impacts on Soil & River Bed Sediment Quality along NW – 1 Alignment

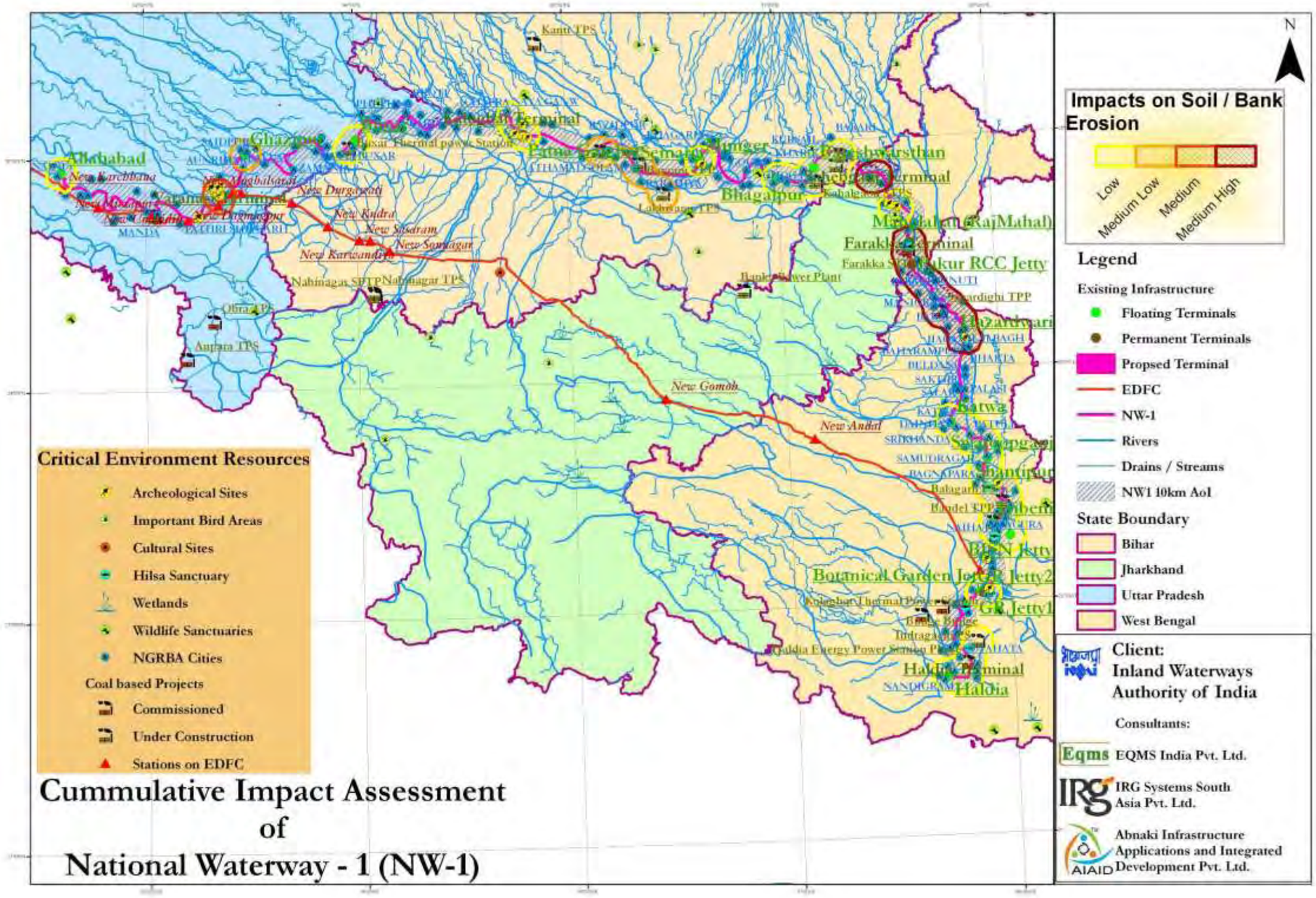


Figure 6.24 : Map depicting Impacts on Soil / Bank Erosion along NW – 1 Alignment

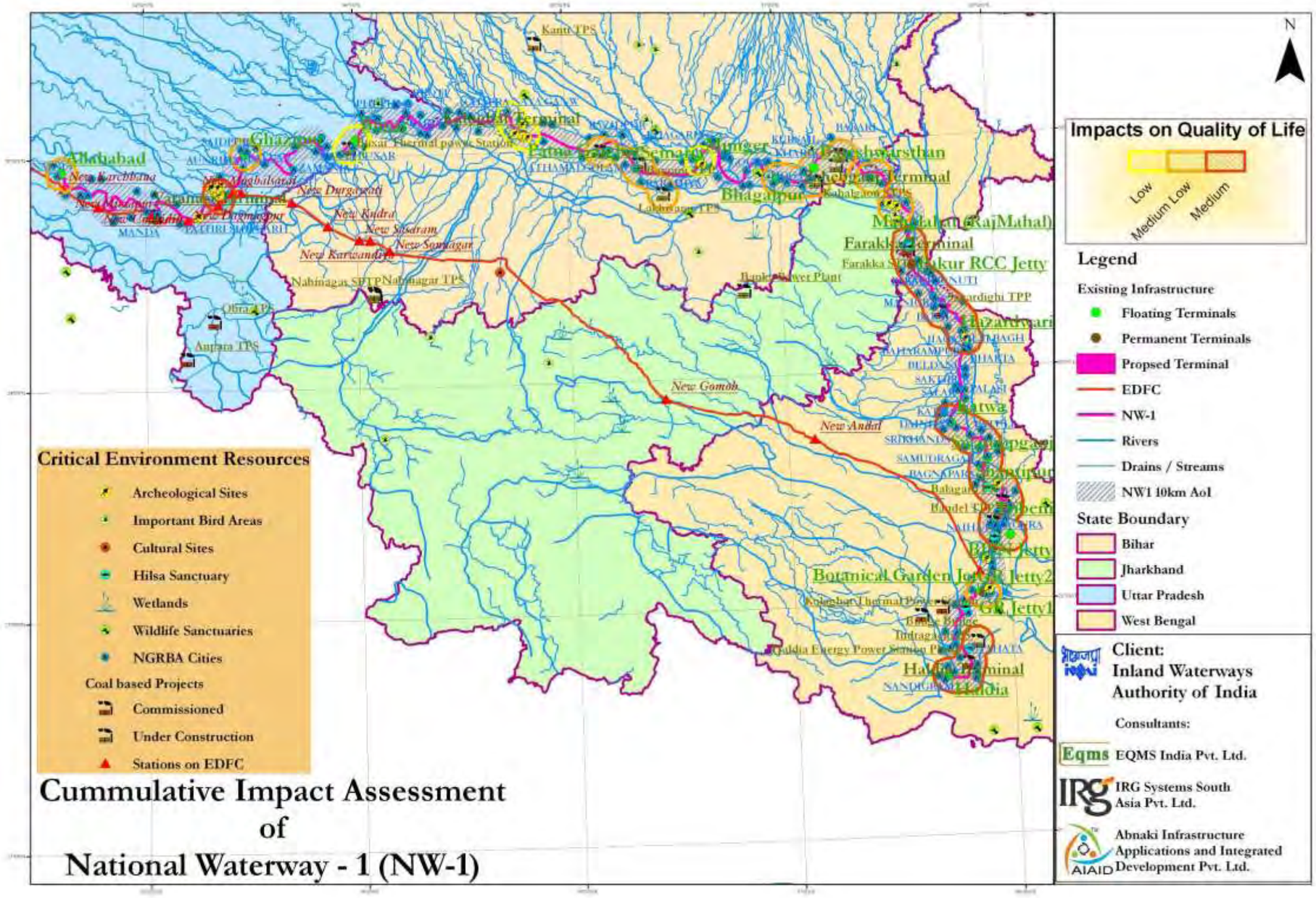


Figure 6.25 : Map depicting Impacts on Quality of Life along NW – 1 Alignment

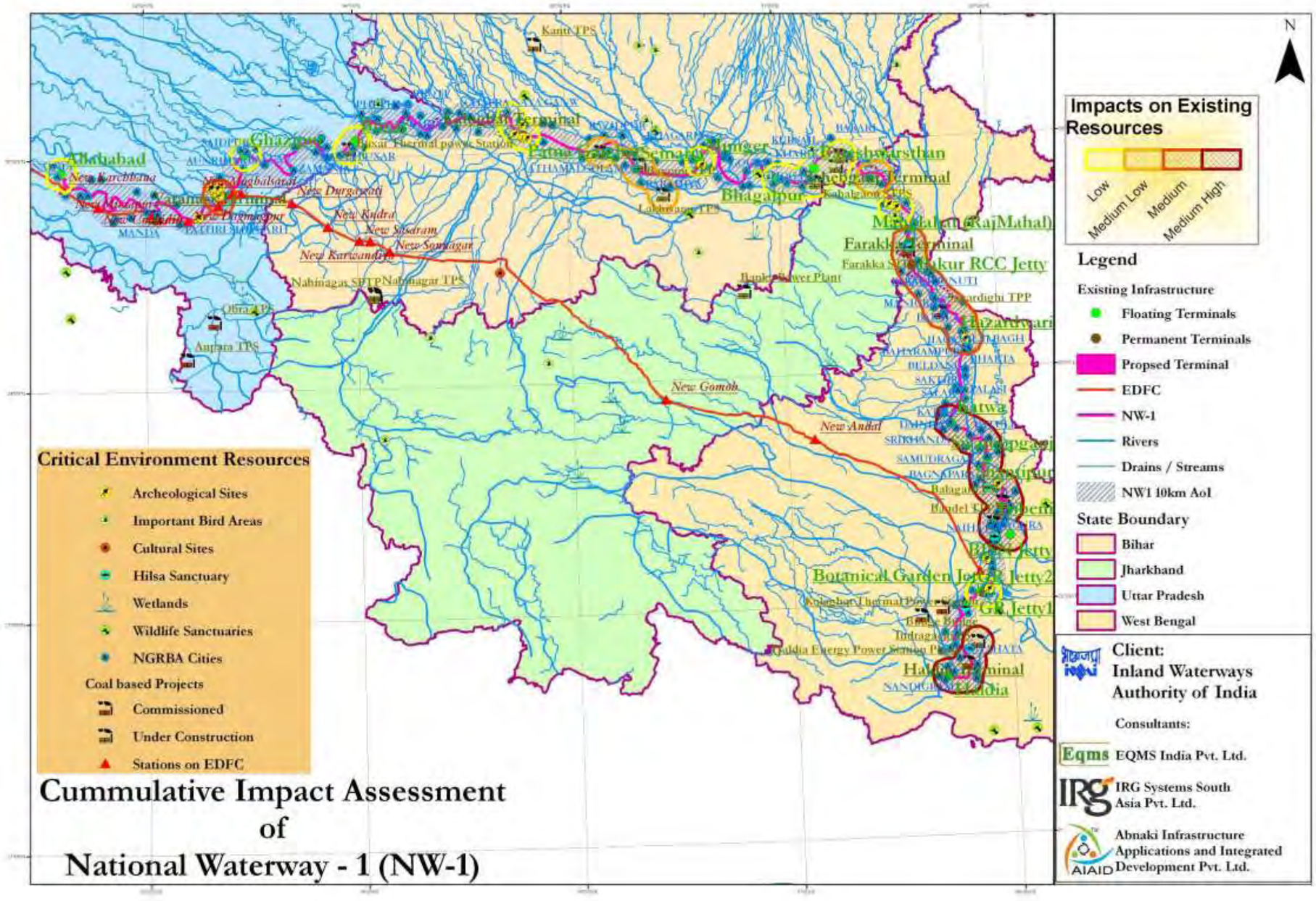


Figure 6.26 : Map depicting Impacts on Pressure on Existing Resources along NW – 1 Alignment

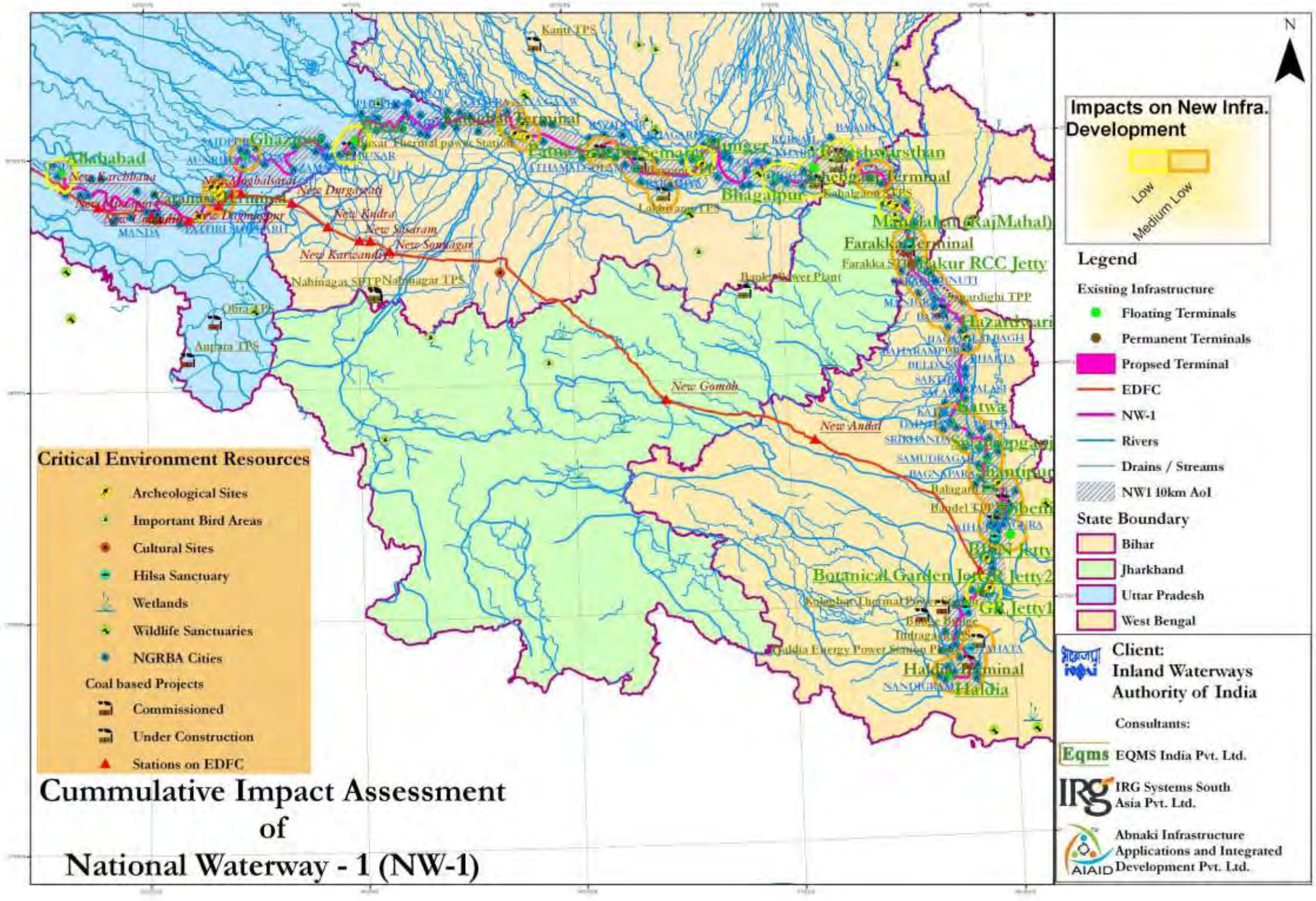


Figure 6.27 : Map depicting Impacts on New Infrastructure Development along NW – 1 Alignment

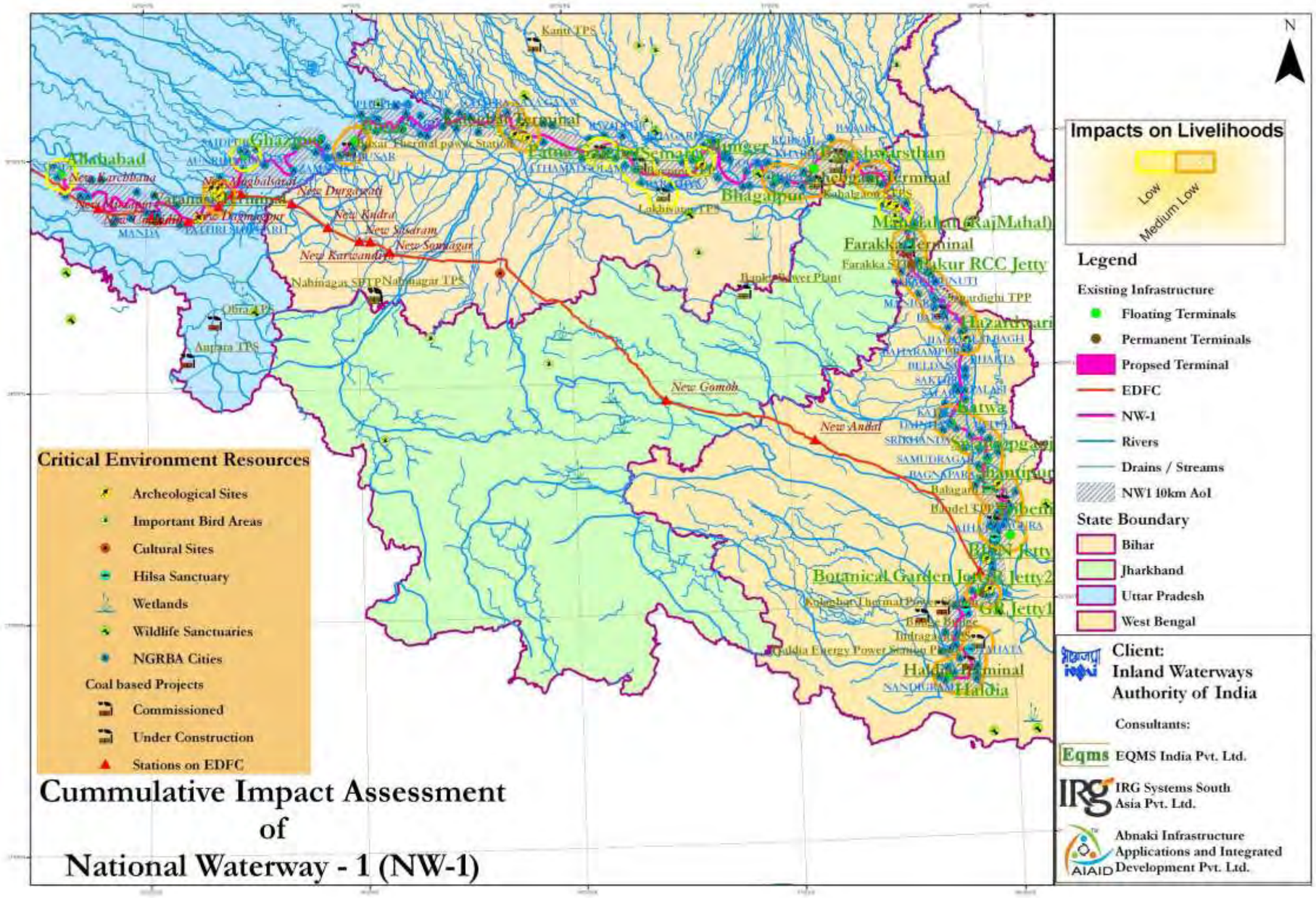


Figure 6.28 : Map depicting Impacts on Livelihoods along NW – 1 Alignment

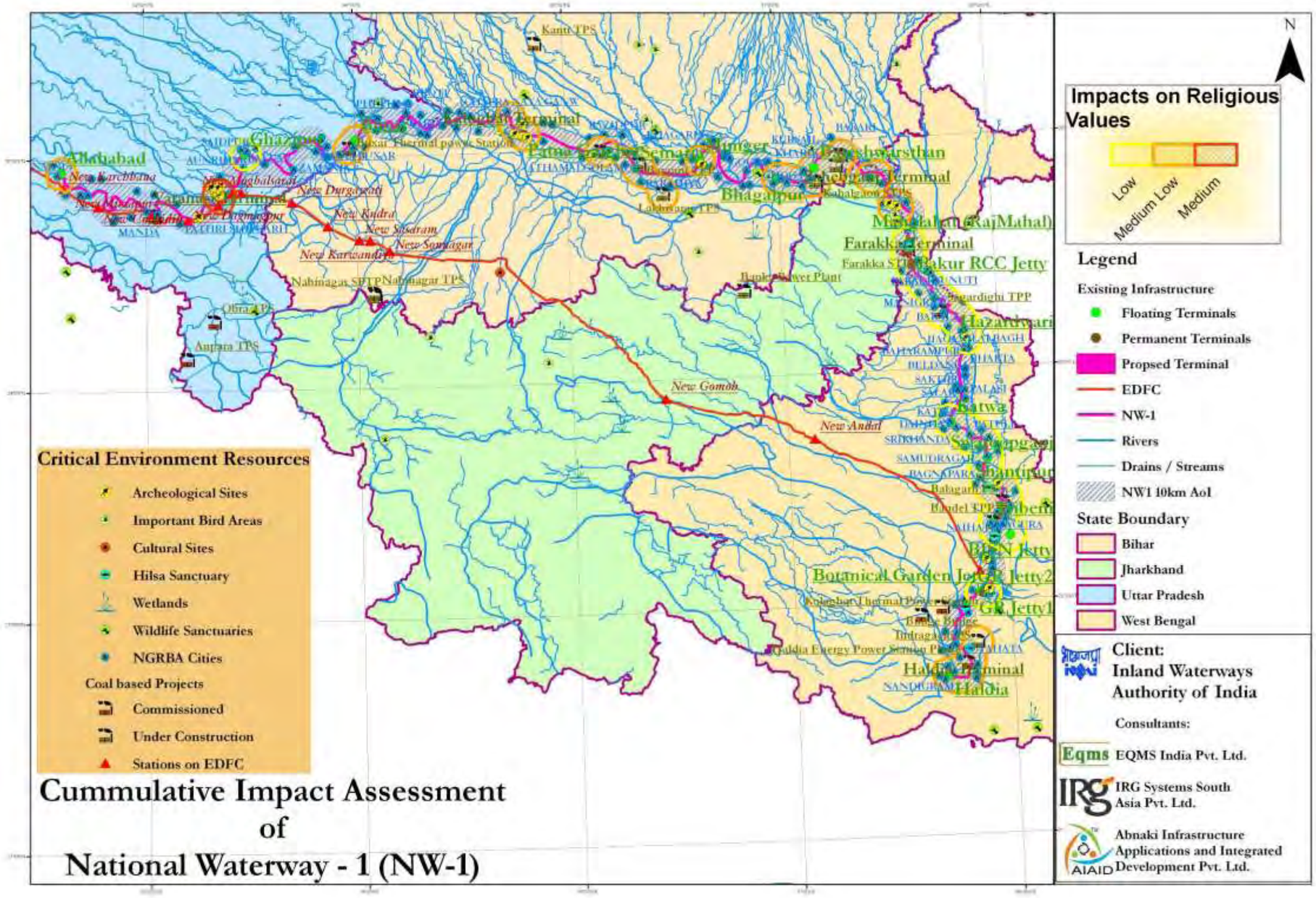


Figure 6.29 : Map depicting Impacts on Religious Values along NW – 1 Alignment

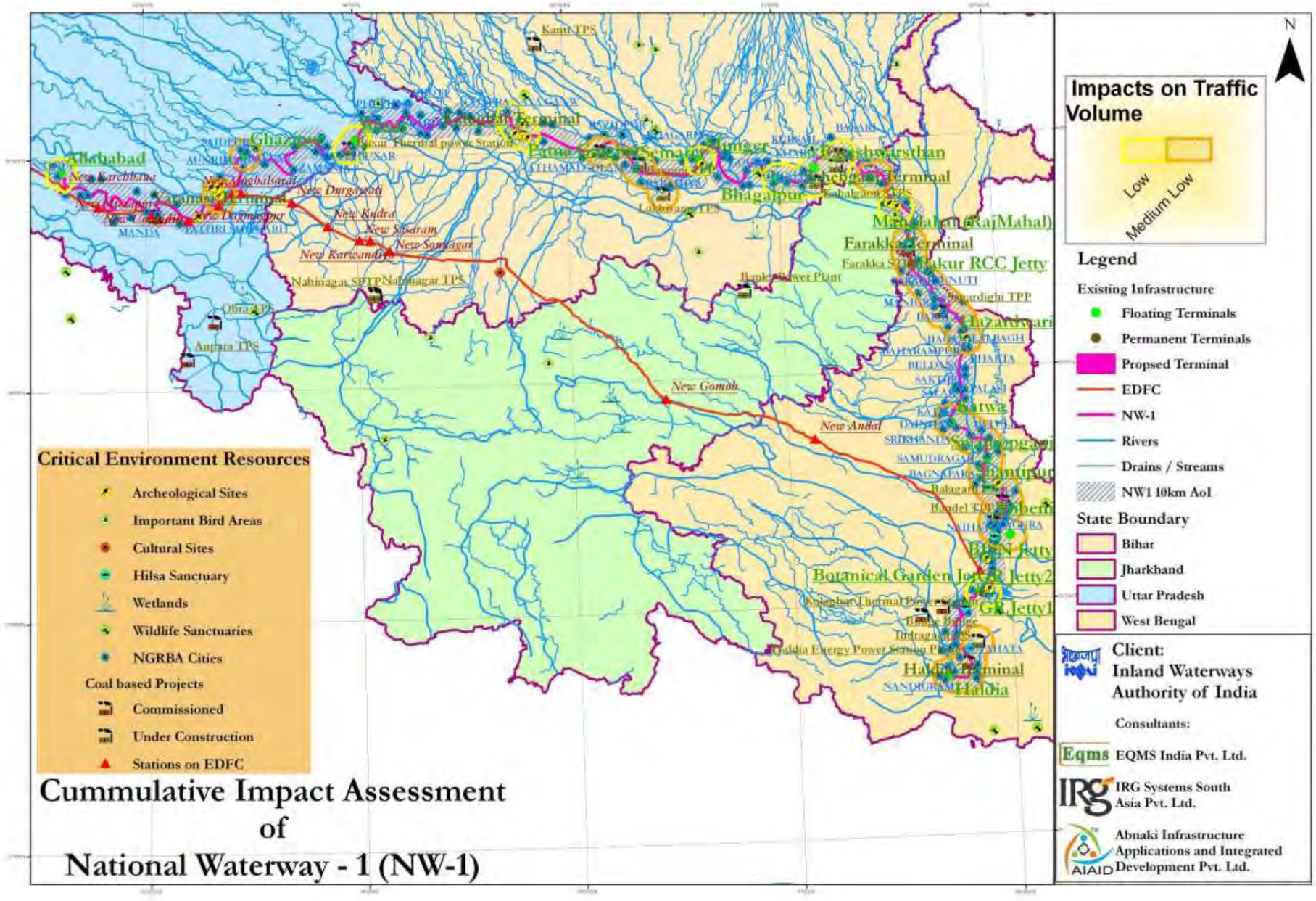


Figure 6.30 : Map depicting Impacts on Traffic Volume along NW – 1 Alignment

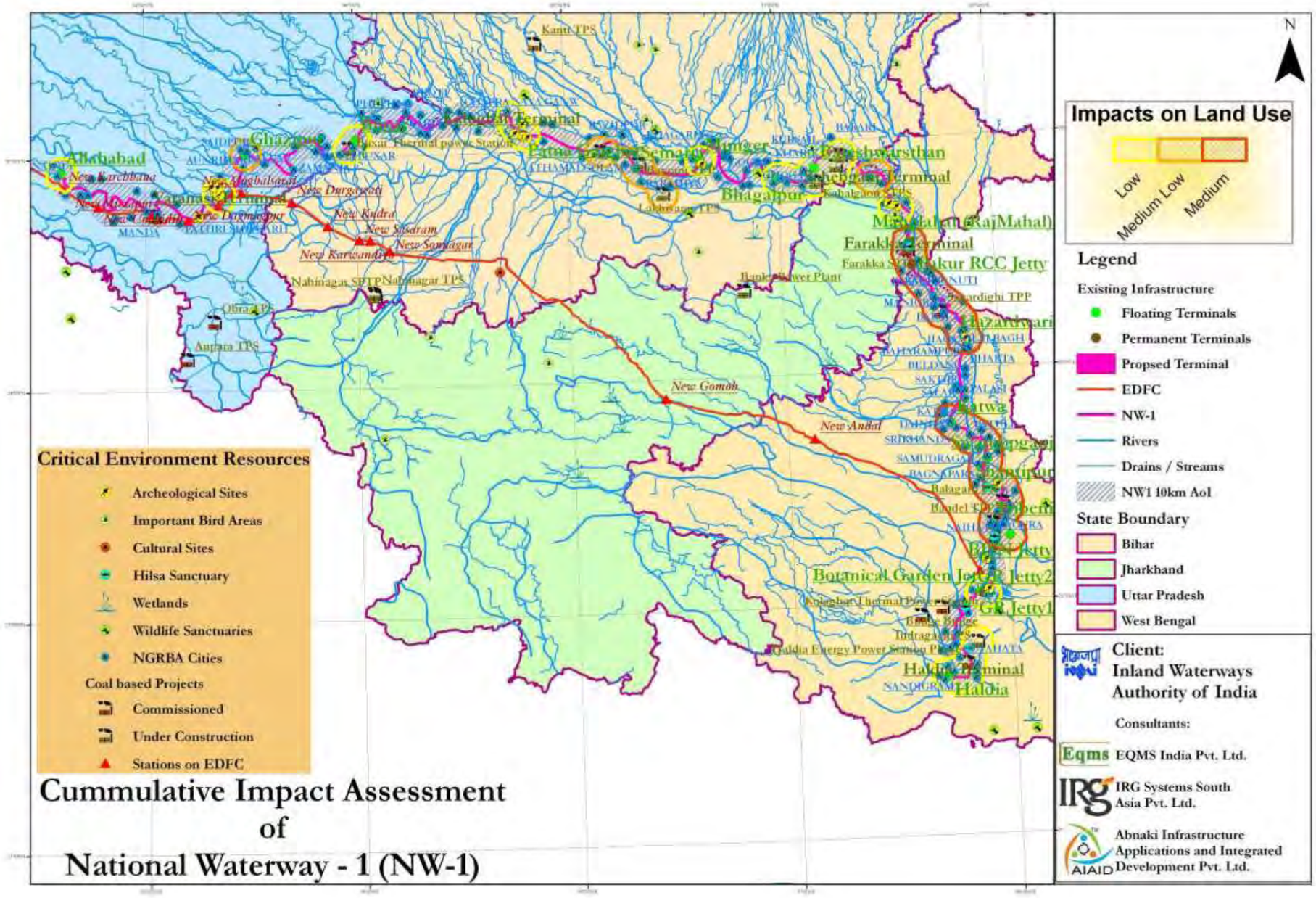


Figure 6.31 : Map depicting Impacts on Land Use along NW – 1 Alignment

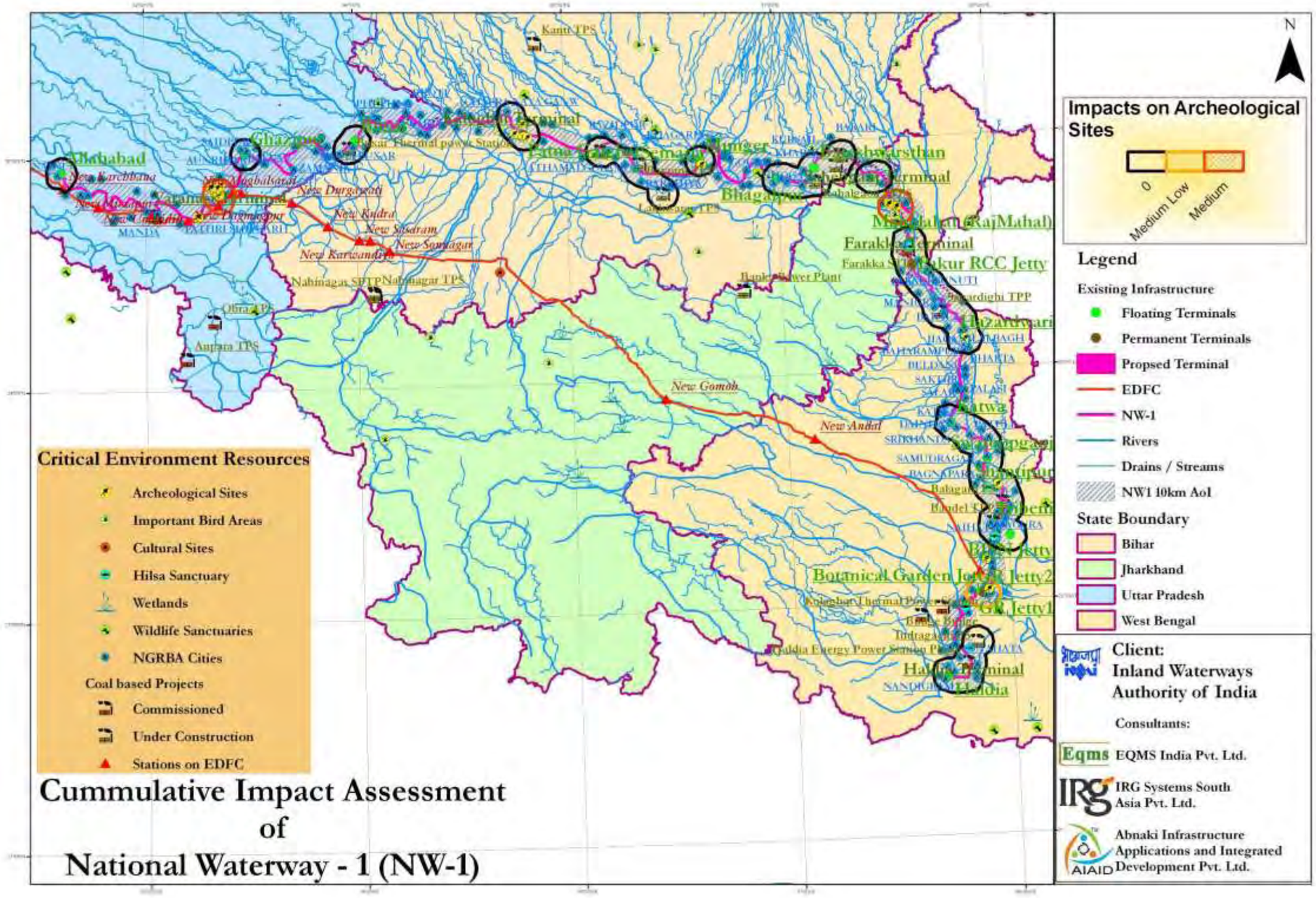


Figure 6.32 : Map depicting Impacts on Archeological Site along NW – 1 Alignment

6.6. Summary of Cumulative Impact Assessment

Type and nature of the cumulative impact has been evaluated on all CERs in each hotspot. It has been identified that nature of impact varied from low to moderately high. For example, Varanasi, Patna and Howrah, air quality of the area is already impacted due to high PM_{10} concentration. Varanasi turtle sanctuary and Dolphin sanctuary are the eco-sensitive zones in NW-1 which are being impacted due to existing development and will be impacted due to development of NW-1 and other upcoming and planned development in the area. Other areas like Barh, Danapur, Bhagalpur etc are sensitive due to presence of important bird area. Varanasi will be the common station of upcoming EDFC and NW-1 ad exchange of material will be taken place between these two points. Depending on the sensitivity of the area and nature of existing & upcoming developments in the area, certain zones are declared as hotspots. Total 14 zones are identified as hotspots. Rating is provided to impact of each identified activity on CERs and it is found that impact on these hotspots due to existing, planned and upcoming development varies from low to moderate. As per the impact assessment it is also found that the identified impacts can be mitigated and mitigation plan for the impacts is described in detail in **Chapter 7.**

Chapter 7. : MITIGATION MEASURES AND MANAGEMENT PLAN

7.1. Introduction

Mitigation measures includes the preventive measures which when taken can either eliminate or reduce the intensity of the impact on the CERs. These mitigation measures ensure the environmental sound implementation of the project and enhance social acceptability of the project. Mitigation plan should be prepared in early stage of the project so as the measures could be define for all the pre-construction, construction and operation phase of the project to ensure minimum damage to environment and society at all the stages of project. Effectiveness of the mitigation measures proposed should also be assessed regularly via monitoring and supervision of the monitoring indicators which defines the status of the CERs. A cell or committee should be formed by the project proponent for the purpose of implementation of these measures and supervision of effectiveness of these measures. This cell should include the environmental, social & safety experts having complete knowledge of project action on the environment and society. Approach followed for describing the mitigation measures and formation of environmental management plan is given in **Figure 7.1** below.

7.2. Review of the Mitigation Measures Proposed in EIA/SIA Study of the Jal Marg Vikas Project

Mitigation measures as proposed in EIA/SIA studies have been reviewed in detail. It has been found that mitigation measures proposed are adequate and address all major and minor issues which may have an impact on environment and society. Impacts are adequately addressed for the construction and operation of proposed civil interventions, barge operation and maintenance dredging and accordingly mitigation measures are proposed and management plans are prepared. After carrying out the CIA study and assessment of the baseline condition of the areas through which proposed NW-1 traverses and nature of developments which this area will experience after & due to development of Jal Marg Vikas Marg, it is learned that some of the proposed measures requires strengthening. Impact assessment of NW-1 and strengthening measures required to be taken are given in **Table 7.1** below

Table 7.1 : Mitigation Measures & Management Plan for Jal Marg Vikas Project & Strengthening Measures Identified to Minimize Cumulative Impacts

S. No.	Cumulatively Impacted CERs	Cumulative Impacts Anticipated (Refer Table 6.4)	Impact of NW-1	Mitigation Measures	Whether addressed in EIA Reports (Y/N)	Enhancement Required (If Yes)	Authorities Responsible	
							Direct	Indirect
1.	Micro-Climate	GHG emission will increase due to increase in developments in business as usual but GHG emission will cut down due to shift of freight from Road/Rail to IWT.	Will reduce GHG emissions due to shift of freight from road/rail to IWT thus positive impacts. GHG emissions may be high near terminals and jetties.	• Compensatory plantation as per state policy • Development of green belt • Usage of LNG based vessels • Usage of low sulphur diesel in dredgers • Usage of low energy embodied material for construction of buildings • Usage of low diesel sulphur in the transportation vehicles • Material transportation vehicles should be regularly services and maintained and should carry PUC certificates. This can be made mandatory for all vehicles by IWAI	**Y**	Yes • Compensatory plantation should be carried out more than the state policy so as to recover carbon sequestration loss at the earliest • Minimizing dredging 9use of dredgers) by using various measures like bandalling, river training methods • Material transportation within all the terminal should be through mechanized system completely • All the terminals should have railway connectivity (EDFC) so as most of the material to & from terminals should be taken by railways. • Electronic crematorium should be constructed and people should be made aware about the benefit	Contractor /IWAI	Material Transport Agencies, ULBs
2.	Air Quality	Air Quality will deteriorate due to increased traffic, urbanization and industrial developm	Air quality will improve due to shift of freight from road/rail to IWT thus positive impacts. Air emissions may be high	**Terminal/Jetty Construction/River Bank Protection Works** • Barricading the site to prevent dust dispersion to nearby areas • Excavation and filling shall be carried out in parallel. Excavation and filling shall be carried out in phases • Excavated soil shall be stored	**Y**	Yes • Compensatory plantation should be carried out more than the state policy so as to recover carbon sequestration loss at the earliest • Minimizing dredging (use of dredgers) by using various measures like bandalling, river training methods • Material transportation within all the	Contractor IWAI	Material Transport Agencies, ULBs

S. No.	Cumulatively Impacted CERs	Cumulative Impacts Anticipated (Refer Table 6.4)	Impact of NW-1	Mitigation Measures	Whether addressed in EIA Reports (Y/N)	Enhancement Required (If Yes)	Authorities Responsible	
							Direct	Indirect
		ent in business as usual but the Air emission will cut down due to shift of freight from Road/Rail to IWT.	near terminals and jetties.	under covered conditions • Transport of loose and fine materials through covered vehicles. • Loading and unloading of construction materials in covered area. • Approach roads shall be paved and widened. • Water spraying on earthworks, unpaved haulage roads, other dust prone areas and construction yard. Flow of water sprinklers shall be maintained to avoid water ponding • Make Provision of PPEs like face masks to workers. • Raw materials like cement, sand and construction debris should be stored under covered conditions • Wheel wash facility shall be provided at exit points of the site • Monitoring of air quality shall be carried out on monthly basis to check the level of pollutants and effectiveness of proposed EMP • Development of green belt at the terminal & lock sites efficient for arresting the particulate matter • Thick green belt shall be developed as per the provision		terminal should be through mechanized system completely • All the terminals should have railway connectivity (EDFC) so as most of the material to & from terminals should be taken by railways. • Electronic crematorium should be constructed and people should be made aware about the benefit		

S. No.	Cumulatively Impacted CERs	Cumulative Impacts Anticipated (Refer Table 6.4)	Impact of NW-1	Mitigation Measures	Whether addressed in EIA Reports (Y/N)	Enhancement Required (If Yes)	Authorities Responsible	
							Direct	Indirect
				already made in the design and maintained all along the periphery and along the roads. The green belt shall be developed in canopy[17] shape with local species of broad leaf variety. • Species selected for development of green belt shall also be tolerant to expected pollutants and shall have the ability to adsorb the pollutants. Suggested species are suitable for different areas are also listed under CPCB guidelines for green Belt development[18]. • LPG should be used as fuel source in construction camps instead of wood. Tree cutting shall not be allowed for fuel wood. • Mixing Plant, crushers and batching plant shall be located on downwind direction of the site fitted with adequate stack height to ensure enough dispersion of exit gases. with appropriate pollution control measures				

[17]Canopy shape green belt design includes three row of trees with middle tree species gore more in height compared to inside and outside tree species. Each of tree will have wider leaf which forms like a curtain and acts as beerier to dust spread. Dust accumulated over leaf falls down within the site boundary. Similarly external dust gets prevented from entering the terminal site. http://cpcb.nic.in/upload/Publications/Publication_513_GuidelinesForDevelopingGreenbelts.pdf
[18] CPCB guidelines for green Belt development http://cpcb.nic.in/upload/Publications/Publication_513_GuidelinesForDevelopingGreenbelts.pdf

S. No.	Cumulatively Impacted CERs	Cumulative Impacts Anticipated (Refer Table 6.4)	Impact of NW-1	Mitigation Measures	Whether addressed in EIA Reports (Y/N)	Enhancement Required (If Yes)	Authorities Responsible	
							Direct	Indirect
				• Loading and unloading of construction materials shall be made at designated locations in project area with provisions of water fogging around these locations • Low sulphur diesel should be used for operating DG sets, dredgers and construction equipment. **Terminal/Jetty Operation** • Material shall be transported in covered vehicles • Transportation vehicle shall be properly serviced and maintain and shall carry PUC certificate • Thick green belt shall be developed as per the provision already made in the design and maintained all along the periphery and along the roads. The green belt shall be developed in canopy[19] shape with local species of broad leaf variety. • Species selected for development of green belt shall also be tolerant to expected pollutants and shall have the ability to adsorb the pollutants.				

[19] Canopy shape green belt design includes three row of trees with middle tree species gore more in height compared to inside and outside tree species. Each of tree will have wider leaf which forms like a curtain and acts as beerier to dust spread. Dust accumulated over leaf falls down within the site boundary. Similarly external dust gets prevented from entering the terminal site. http://cpcb.nic.in/upload/Publications/Publication_513_GuidelinesForDevelopingGreenbelts.pdf

S. No.	Cumulatively Impacted CERs	Cumulative Impacts Anticipated (Refer Table 6.4)	Impact of NW-1	Mitigation Measures	Whether addressed in EIA Reports (Y/N)	Enhancement Required (If Yes)	Authorities Responsible	
							Direct	Indirect
				Suggested species are suitable for different areas are also listed under CPCB guidelines for green Belt development[20]. • Water sprinkling should be carried out during all loading and unloading activities and storage period. • More frequent water sprinkling shall be carried out at coal yard during summer season to prevent spontaneous fire. • It is recommended to provide mechanical conveying system with provision of dust collection system for loading/unloading material from barges • Monitoring of air quality shall be carried out on monthly basis to check the level of pollutants and effectiveness of proposed EMP **Barge Movement:** • Material having potential to generate the dust like coal, sand stone aggregates should be transported under covered conditions. • Air emissions from the vessel should be under the prescribed limits as per MARPOL and the standards. Regular maintenance of vessels engine and				

[20] CPCB guidelines for green Belt development http://cpcb.nic.in/upload/Publications/Publication_513_GuidelinesForDevelopingGreenbelts.pdf

S. No.	Cumulatively Impacted CERs	Cumulative Impacts Anticipated (Refer Table 6.4)	Impact of NW-1	Mitigation Measures	Whether addressed in EIA Reports (Y/N)	Enhancement Required (If Yes)	Authorities Responsible	
							Direct	Indirect
				Propellers. IWAI should develop the stringent norms to be followed by vessel operators and shall develop the system of penalizing based on polluters pay principle in case the standards are not met or violated • Adoption of cleaner fuels such as low sulphur bunker oil as per USEPA norms, 2000 (sulphur content is 0.25% for diesel oil and 2.7% for residual oil) or switching to LNG based vessels				
3.	Water Resources/Flow & Drainage	Water Resources will deplete due to continued urbanization, industrial development and infrastructure development. NW-1 will not have significant impact on water resources	No impact on water resources/flow as no consumption of water is involved. Nor any water storage and diversion structure is proposed on NW-1 which can impact the water resources/flow.	**Terminal/Jetty Construction & River Training Works** • Preference shall be given to surface water from rivers wherever feasible with due permission from authorities. • Temporary rain water storage structures should be provided at the site to store rain water and this water should be used for sprinkling and construction activities • No dumping of waste/wastewater in the ground. Hazardous waste or wastewater shall not be stored in unlined ponds • Permission shall be obtained from irrigation department in case river water is used and from CGWA/CGWB in case	**Y**	• Any new irrigation scheme or dam construction on NW-1 and tributaries will affect the availability of water in NW-1 and water flow. Thus for any such scheme a detailed study of impact navigation in NW-1 should be carried out • Intimations should also be made to IWAI by industries/ULBs if any significant quantity of water withdrawal is planned from NW-1 and tributaries • NW-1 should carry out detailed environmental impact assessment study of water storage structure, if any planned in future for enhancing the navigation in NW-1	Contractor/ IWAI	Irrigation Department, ULBs & Industrial Department

S. No.	Cumulatively Impacted CERs	Cumulative Impacts Anticipated (Refer Table 6.4)	Impact of NW-1	Mitigation Measures	Whether addressed in EIA Reports (Y/N)	Enhancement Required (If Yes)	Authorities Responsible	
							Direct	Indirect
		and flow. But coming up of new dams and irrigation schemes may impact the availability of flow in NW-1 significantly.		ground water is used. **Terminal/Jetty Operation** • Regular checks shall be made for soil erosion along the banks and conditions of bank protection structures effective control. • Regular visual checks and cleaning of drains shall be done along the alignment to ensure that flow of water is maintained through cross drains and other channels/streams. • Drains shall be regularly cleaned and de-silted • Monitoring of water borne diseases due to stagnant water bodies • Storm water drains provided in parking & road areas of the terminal & lock sites, shall be provided with oil & grease traps. Arrangement shall be made to collect the roof water from the building separately into a tank so as this water can be used for horticulture activity. Storm water from other areas like storage yards, stock piles and roads shall be directed into a dump pond. Storm water shall be retained in pond so as to allow the settling of dust and suspended particles in the				

S. No.	Cumulatively Impacted CERs	Cumulative Impacts Anticipated (Refer Table 6.4)	Impact of NW-1	Mitigation Measures	Whether addressed in EIA Reports (Y/N)	Enhancement Required (If Yes)	Authorities Responsible	
							Direct	Indirect
				water, this water should be used for cleaning and dust suppression. Sludge from the dump pond shall be sent for disposal along with other municipal waste • Water conservation fixtures shall be installed in toilets and kitchen area. Some of the water conservation fixtures which can be installed are dual flushing cisterns, sensor taps, low water urinals etc.				
4.	Surface /Ground Water Quality	Surface & Ground water pollution will continue to impact due to increased developmental and industrial activities in the area and religious rituals performed on Ganga by people and	Surface Water quality will be deteriorated significantly due to dredging, barge operation and terminal activities. Construction of infrastructure and related facilities of waterways may impact the natural drainage pattern at the site but the	**Terminal/Jetty Construction & River Training Works** • Washing of vehicle and equipment shall not be carried out at river or any water body. Washing area should be provided with the storm water drains fitted with oil & grease trap. • Piling of the raw materials & debris shall be avoided at the site. Storage of debris and raw material shall be carried out in paved and covered areas. This will minimize interface of run-off with raw material and debris. • Site should be cleaned regularly • Septic tank/soak pit shall be provided at site for disposal of sewage from the toilets at site and from the labour camps.	**Y**	• Detailed EIA study shall be carried out for each of the vessel/barge repair & maintenance facility • Any River front development work being carried out in the influence area of CIA study shall establish a system of wastewater treatment and storm water management so as run-off from these sites shall not impact the water quality of river • Usage of the Bio-pesticides/organic manures should be enhanced so as to minimize flow of the chemicals/pesticides into the river • Any area prone to erosion in the catchment area shall be treated through plantation and other erosion prevention methods so as the water quality degradation can be minimized • Any road/railway construction	IWAI	Irrigation Departments, ULBS, Ministry of Roads & Railways

S. No.	Cumulatively Impacted CERs	Cumulative Impacts Anticipated (Refer Table 6.4)	Impact of NW-1	Mitigation Measures	Whether addressed in EIA Reports (Y/N)	Enhancement Required (If Yes)	Authorities Responsible	
							Direct	Indirect
		burning and immersion of bones/idols in the Ganga.. Surface water pollution will be aggravated due to NW-1 project. Natural Pattern will be altered significantly due to continued road & railway development but need of development of road/rail may reduce due to shift of	impact is minimized by provision of storm water management system	Adequate toilets & bathrooms shall be provided to prevent open defecation. Wherever septic tanks are not provided mobile toilets with anaerobic digestion facility shall be provided and no domestic waste shall be discharged to river. • Water use shall be minimized by using RMC, practicing curing by water sprinkling, maintaining flow of sprinklers, covering the water storage tanks to minimize water evaporation, creating awareness for water conservation and regular inspections at site to monitor the leakages in water storage area • In case RMC is not used then concrete transit mixer should be washed and cleaned daily. Wash from these mixers shall be collected in block work tanks which will allow settling of concrete, removal of aggregates and allowing the waste to wastewater drain. This collected waste concrete can be dried and used for various purpose at site like construction of temporary roads at site and labour colony		should take care the maintenance of natural drainage by provision of cross drainage structures • Any bridge if constructed should carry out detail EIA study to study impact of construction lof bridge piers on river flow & quality and impact of bridge construction on navigation in NW-1 • Dumping of waste material in the river should be restricted & any one found dumping waste in river should be heavily penalizes. Penalty should be proportional to the quantity of waste		

S. No.	Cumulatively Impacted CERs	Cumulative Impacts Anticipated (Refer Table 6.4)	Impact of NW-1	Mitigation Measures	Whether addressed in EIA Reports (Y/N)	Enhancement Required (If Yes)	Authorities Responsible	
							Direct	Indirect
		freight from road/rail to IWT		• Wastewater generated from the washing/cleaning area after passing through oil & grease trap & curing area shall be re-used for water sprinkling and wheel washing • Fuel shall be stored in leak proof containers and containers shall be placed on paved surface Substructure construction should be limited to the dry season and cofferdams may be constructed and utilized to lift the spoil directly out of it and carried to the riverbank for land disposal. • Restoration of changes in the stream, if any, made during construction to its original level • The piling work in river shall be undertaken during low flow period. • Provision shall be made for collection and draining of water for the piling earth. It shall be used for embankment protection or road construction depending on its suitability. • Turbidity traps/curtains should be provided or Geo-Textile synthetic sheet curtain shall be placed around pilling and construction area to prevent movement of sediments and				

S. No.	Cumulatively Impacted CERs	Cumulative Impacts Anticipated (Refer Table 6.4)	Impact of NW-1	Mitigation Measures	Whether addressed in EIA Reports (Y/N)	Enhancement Required (If Yes)	Authorities Responsible	
							Direct	Indirect
				construction waste. • Sedimentation tanks shall be provided at the site so as run-off from site shall enter the sedimentation tanks before discharging into the river. Sedimentation tanks will trap the sediments in the run-off • Provision shall be made for geo Synthetic Screen for arresting silt flowing down stream. • Proper collection, management and disposal of construction and municipal waste from site shall be made to prevent mixing of the waste in run-off and entering the water bodies • Natural Drainage pattern of area around shall be maintained • Dredged soil shall be tested for toxicity & contamination, if toxic/contaminated shall not be disposed back in water and should be send for disposal to TSDF • Monitoring of water quality shall be carried out on monthly basis to check the level of pollutants and effectiveness of proposed EMP **Terminal/Jetty Operation** • Toilets to be provided with running water facility to prevent open defecation.				

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							Direct	Indirect
				• Sewage generated at site should be treated in STP if sewage generation is more than 10 KLD as in case of Varanasi, Sahibganj & Haldia terminal sites and if sewage is less than 10 KLD, sewage can be disposed through septic tanks/soak pits as in case of Farakka lock site • No wastewater shall be received from vessels and vessels should not be allowed to discharge their wastewater and solid waste in river • No waste/wastewater shall be discharged in river or dumped into the ground • Oil/Fuel should be stored in leak proof containers and storage area should be provided with facility of collecting the oil in case of spillage. The storage facility should be so designed that spilled oil shall not enter the storm water and sewage drains or storm water storage pits • Dredged soil shall be tested for toxicity, if toxic shall not be disposed back in water and should be send for disposal to TSDF. • Monitoring of treated water every month				

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							Direct	Indirect
				• Ship design (of capacity > 5000 DWTat Haldia site for coal transhipment) should be as per MARPOL and should be provide with double hulls/double bottoms. Speed of oil carrying vessels should be maintained to prevent accidents due to high speed. Sensors and hooters should be fitted with ships which can notify the closeness of another ship or any other potential matter which can cause accident. • Immediate/quick clean-up of such spills shall be undertaken and ship owners should be liable for the same. • Crew of the ships carrying the oil should be competent and experienced so as they can prevent the accidents to happen as much as possible • IWAI should carry out the inspections of the vessels which are transporting the material to and fro from the terminal. • Monitoring of surface water quality shall be carried out on monthly basis to check the level of pollutants and effectiveness of proposed EMP **Barge Movement** • All waste water and solid waste				

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							Direct	Indirect
				or maintenance waste should be disposed at the designated barge maintenance facility only. • Material having potential to generate the dust like coal, sand stone aggregates should be transported under covered conditions to minimize dust generation and its settlement on river surface. Terminals should have facility to control dust pollution during barge loading and unloading actions. • Provision of oil water interceptors with the bilge tank to separate oil prior discharge of bilge water into river. Bilge water should be discharged as per MARPOL requirements. Bilge water tank should be maintained as per MARPOL requirement. • Usage of non-toxic and non TBT containing anti-fouling paints for painting vessel • Immediate/quick clean-up of oil/other spills shall be undertaken in case of accidental release and ship owners should be liable for the same. • Crew of the vessel carrying especially oil should be competent and experienced so as they can prevent the accidents to happen as much as				

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							Direct	Indirect
				possible • IWAI should develop the stringent norms to be followed by vessel operators and shall develop the system of penalizing based on polluters pay principle in case the standards are not met or violated • Ship design (of capacity > 5000 DWT) should be as per MARPOL and should be provided with double hulls/double bottoms. Speed of oil carrying vessels should be maintained to prevent accidents due to high speed. • Vessels should not be washed or cleaned at terminal/jetty facility and washings should not be discharge at the terminal/jetty location. ***Maintenance Dredging*** • Attempt shall be made to minimizing and optimizing the dredging requirements by effective assessment and study of the Thalweg profiles of the river. This can be achieved some of the following measures: o Increase use of bandalling which helps in diverting the flow of river towards the channel and reduces the quantity of dredging				

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							Direct	Indirect
				o Low draft vessels should be deployed which will reduce the requirement of dredging • Dredged material shall be checked for toxicity and contamination prior its disposal onshore for prevention of contamination of water and its impacts on aquatic life. • Dredging should not be carried out during very low flow seasons so as to minimize the dispersion of fine sediments • Usage of silt or air bubble screens/curtains should be explored to minimize the sediment release during dredging operations. Silt/air bubble screens can hang from surface floats or stands attached to the bottom and held upright by sub-surface floats (PIANC). The use of silt curtains is reported to considerably reduce the loss of suspended sediments from the dredge area, by up to 75% where current velocities are very low. However, they are generally ineffective in areas with high current velocities which exceed 0.5 m/s (UK Marine SACs Projects). • To minimize the sediment dispersal during disposal of				

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							Direct	Indirect
				dredge sediments, it should be place as close to the bed possible preferable at a level of 1m above the bed to minimise the dispersal of sediments. • Provision shall be made of emergency response equipment like floating blooms to deal with any emergency of oil spills or leakages. Regular servicing and maintenance of dredgers should be taken up so as to prevent any leakage of the dredged material. Leakage detection of the sediment transportation pipe shall be carried out regularly to prevent any sediment loss and water pollution at leakage location. Corrective actions should be taken immediately after detection of such leaks. • Cutter head of CSD should be selected according to material to be dredged so as to maximize the dredged material transport from dredging point to suction mouth and prevention of sediment loss and re-suspension. • Ratio of cutter revolutions and pump velocity should be adjusted to ensure that cutter advancement rate is not greater than the ability of the suction				

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							Direct	Indirect
				pump to remove the material that is cut. This will prevent the suspension of the dredged material. • Dredge cuts and lifts should be designed so as to prevent undercutting of material and hence a collapse of material locally at the cutter head, leading to an increase in the sediment being disturbed by dredging. • If dredge material is found contaminated at any particular location that it should be disposed off-shore. Off-shore disposal of dredged material should be carried out only at approved TSDF site such as approved TSDF site of Haldia Dock Complex at Sagar. • Dredge material if disposed on river banks or on land caution should be exercised as per the Dredging and Disposal Management Plan for NW-1 • If dredged material is disposed at land, then the care should be taken that the tail water is collected and made free from sediments prior its discharge back to surface water body. Regular monitoring of the excess water should be done in case dredged material is disposed on				

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							Direct	Indirect
				land. This will help in assessing the efficiency of sediment trap system provided at site and controlling contamination of water by minimizing the sediments.				
5.	Noise Level & Vibrations	Noise level will increase in the area due to continued developmental and industrial activities and plying of the motorboats. But noise level along the NW-1 may reduce due to shift if freight from road/rail to IWT. Vibration will increase in area	High underground noise due to dredging, pilling and barge movement and high ambient air noise due to dredging operation. Ambient air noise generation due to dredging varies from 80-85 dB(A).	**Terminal/Jetty Construction & River Training Works** • All equipment to be timely serviced and properly maintained to minimize its operational noise. • Construction equipment and machinery to be fitted with silencers and maintained properly. • Barricading the construction site to minimize the noise level outside the site boundary • Protection devices (ear plugs or ear muffs) will be provided to the workers operating in the vicinity of high noise generating machines. • Speed control shall be enforced in habitat areas. The ambient noise level as per standard is 55 dB(A) and 45 dB(A). Current level at habitat area meets the standard • Honking shall be prohibited at the project site • Hearing test for the workers shall be undertaken before	**Y**	• Noise monitoring should be carried out in all the urban areas within the CIA influence area by concerned pollution control boards and areas having noise levels more than permissible limits should be demarcated and special regulations for these areas should be prepared • No development of residential zone/facility should be undertaken within 500 m of the terminal/jetty • Thick green belt should be developed on all the haulage roads through which material will be transported • Vibrations due to EDFC should be managed by deployment of adequate technology	Contractor IWAI	SPCBs, UDA, ULBs, Railways

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							Direct	Indirect
		close vicinity of railway track, i.e. near Varanasi stretch. Impact of these vibrations are analyzed during EDFC study and it is assessed that vibrations impact will dissipate within 100 m.		employing them and thereafter shall be done after every six months • Job rotations should be practiced for workers, working in high noise level areas • No noise generating activity shall be carried out between 6:00 AM to 10:00 PM. • Monitoring of Noise levels shall be carried out on monthly basis to check the level of pollutants and effectiveness of proposed EMP **Terminal/Jetty Operation** • Site boundary should be provided which can act as noise barrier • Earplugs should be provided to workers involved in unloading operations • Provision of thick green belt along the boundary and roads which will act as noise buffer • Timely maintenance and servicing of transportation vehicles and the machinery/pumps to be used during operation phase to reduce the noise generation due to friction and abrasion • Honking shall be prohibited at the project site • Hearing test for the workers				

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				shall be undertaken before employing them and thereafter shall be done after every six months • Job rotations should be practised for people, working in high noise level areas • No noise generating activity shall be carried out between 6:00 AM to 10:00 PM • DG sets shall be provided with acoustic enclosure • Monitoring of Noise levels shall be carried out on monthly basis to check the level of pollutants and effectiveness of proposed EMP				
6.	Terrestrial Ecology	Terrestrial ecology will continue o be impacted due to cutting of trees for development of infrastructure and industries. However development of	May require tree cutting for development of civil interventions like involve cutting of 500 trees for development of Sahibganj terminals. NW-1 alignment is app. Udhawa Lake wildlife sanctuary but no significant	**Construction of Terminal/Lock/Jetty & River Training Structures** • Project layout design shall be in a way to minimize tree cutting • Permission shall be obtained from forest department prior tree cutting and only the identified and permitted tree shall be cut and remaining shall be maintained properly • Thick green belt shall be developed at the periphery and along the roads on the project site which will prevent spread of dust and reduce	**Y**	• Compensatory plantation should be carried out in nearby areas to the extent possible. Plantation should be carried out as much as possible • Avenue plantations on all the approach roads of the terminal/lock/jetty should be properly maintained	IWAI	ULBs

S. No.	Cumulatively Impacted CERs	Cumulative Impacts Anticipated (Refer Table 6.4)	Impact of NW-1	Mitigation Measures	Whether addressed in EIA Reports (Y/N)	Enhancement Required (If Yes)	Authorities Responsible	
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		avenue plantations, compensatory plantation, urban forests may be positive impact on the terrestrial ecology	impact is anticipated on the sanctuary. Green belt will be developed around terminals. Compensatory plantation will be carried out as per state policy to reduce the impact	noise propagation. • Areas reserved for future development at site shall also be made green by growing grass and shrubs and herbs • Caution sign shall be placed to prevent hunting of animals • Provision shall be made for strict penalty for hunting/harming any animal • Construction activities shall be restricted to 6:00 Am-10:00 Pm especially noise generating activities. • Compensatory plantation should be carried out as per state forest policy • Green belt to be developed should be mainly naturally growing native species of the area. Green belt should be developed as per the CPCB guidelines proposed above climate section. • Survival rate for compensatory plantation and green belt to be developed at the site shall be monitored regularly and measures shall be taken so as to achieve minimum rate of 70% • All efforts shall be made to minimize the cutting of tree through design changes.				

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							Direct	Indirect
				Layout should be designed in a way so as to minimize the tree cutting. Only trees identified for cutting should be cut • Workers should not use any timber or firewood as fuel for any purpose. LPG should be made available to workers in construction camp. • Tree cutting should be carried out only after obtaining due tree cutting permission from forest department. • No hazardous material or waste shall be disposed in the other land or nearby area as it may harm the animals, if consumed accidently • Speed limit will be regulated to prevent any accidents of animals. Regular maintenance of the dumper shall be done to prevent leakage of oil so as to prevent pollution of the soil and impact on fauna and flora dependant on soil. • Regular Water Sprinkling shall be carried out to minimize dust generation and settling the dust on surface of flora. • Trees retained at the site (after site clearance) should not be disturbed, cut or harmed in				

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							Direct	Indirect
				anyway. These trees should be maintained. • Adequate parking space should be provided within the site for construction vehicle and equipment so as they are not parked in other areas like road side, others agricultural field, open areas etc. to avoid any harm to flora of that area due to movement of heavy vehicles. • Construction camps should not be established inside or near the forest area • Construction activities and vehicle washing should not be undertaken at the river or any other water body or close to the water body • Site should be barricaded to prevent entry of the animal in the site • Hunting, poaching and harming any animal (wild or domestic) by any worker or project related person should be strictly prohibited and monitored • Illumination at the night time should be reduced during the night time (if no activity is going on) as it may disturb the nocturnal animals				

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				• Noise generating activity should not be undertaken during night time to minimize disturbance to animals. Noise levels should be maintained within the prescribed CPCBs limits to the extent possible during the day time. • Workers should not use any timber or firewood as fuel for any purpose **Terminal/Jetty/Lock Operation** • Planted trees, shrubs, and grasses to be properly maintained. • The tree survival audit to be conducted at least once in a year to assess the effectiveness • Regular watering and cleaning of the leaves to remove the accumulated dust on the leaves				
7.	Aquatic Ecology	Impact on aquatic ecology will continue to exists and will be escalated due to NW-1 development	High impact on aquatic flora & fauna including dolphins, turtles and fishes. May directly impact the primary productivity of water body. NW-1 includes 2 wildlife	**Construction of Terminal/Lock/Jetty & River Training Structures** • The area in which the construction of the Berth (jetty) is planned, advisable to carefully determine drop sites before anchor placement to ensure that Dolphin and fish communities that could locally still be present in the area are not unnecessarily damaged. • Before starting piling / dredging		• IWAI should support the dolphin and turtle sanctuary in future also in terms of provision of aids for improving the habitat of these organisms • Local bodies should ensure the maximum sewage of the cities and other areas should enter after treatment from STP. Treated water from STP should be used by local bodies for plantation purpose or can be sold to contractors of building & construction	IWAI	ULBs, Industrial Departments

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			sanctuaries, i.e. Kashi Turtle Sanctuary & VGDS	allow some time to aquatic fauna to displace from the piling area. Bubble curtains can be provided at the time of pilling so as to displace the aquatic fauna prior start of construction activities • The piling/dredging activities must be carried out in shortest possible timeframe as possible • All the debris shall dispose away from river course as per debris management plan of the project. • Decisions on method of construction and type of technology and equipment to be used must consider the noise and vibration levels and extent of siltation being generated. Noise and vibration levels must be far below levels that can cause injury to dolphins and other aquatic life. • Noise reducing devices like mufflers, enclosures shall be fitted with the equipment as much as feasible. Erecting barriers shall also be installed • Fish exclusion devises shall be installed in water column around the pile driving area to prevent fish access • To avoid the construction debris		• All industries should install their STPs and ETPs and should discharge the waste only after tertiary treatment. Industries should achieve zero discharge system to the extent possible • No. of ships which can ply in turtle sanctuary without impacting the turtles is calculated using only noise levels generated due to barge movement. Other noisy operations are not taken care of. Thus minimum distance between two barges shall be atleast 200 m. • Dumping of waste material in the river should be restricted & any one found dumping waste in river should be heavily penalizes. Penalty should be proportional to the quantity of waste		

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				wash or blown into the water the area shall be surrounded by silt screens, which must be placed in the water before the work starts. Geo-Textile synthetic sheet curtain can act silt screen which should be placed around pilling and construction area to prevent movement of sediments and construction waste. The screens should also be placed around storage areas, to prevent waste from blowing away and to prevent sediment run-off into the river. The storm water drain shall be connected to temporary sedimentation pit and collected water shall be used for dust suppression. Run-off from site should also pass through oil/grease traps and flow down to the same sedimentation tank before its reuse • In addition to silt screens, building guidelines of the Bonaire National Marine Park require that storage areas for sand and soil, and all work areas, must be at least 20 meters away from the high water mark and construction equipment must not be cleaned				

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							Direct	Indirect
				or washed within 50 meters of the high water mark. • Piling and dredging activities should be carried out rapidly. Piling should not be carried out during breeding and spawning season means during rainy season. It should be carried out in low water season, i.e. pre-monsoon • Piling/Dredging should be stopped for some time, if any dolphin/turtle/RET species is sighted in activity area • Equipment shall be maintained in good condition to prevent leaks or spills of potentially hazardous materials like hydraulic fluid, diesel, gasoline and other petroleum products • Excavation activities onshore should not be undertaken during monsoon season so as to minimize sediment load of run-off • Workers should be trained to handle the equipment and material at site so as to minimize the spillage of materials and contamination of water • No construction debris/ already accumulated solid waste at site or waste generated from labour				

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				camp/sewage/waste water should be thrown/discharged in river or any drain • Aquatic ecology monitoring should be carried out prior start of construction and after completion of construction so as to assess the impact of construction activities on aquatic life. • Run-off from site should pass through oil/grease traps and sedimentation tank prior discharging into the river • All construction and operation equipment shall be maintained in good condition shall be checked for oil & grease leakage • Dredged soil shall not be disposed in river or its banks especially during breeding spawning seasons of aquatic organisms **Terminal/Jetty Operation** • Propeller shall have net system to avoid any accident with dolphins, international practices shall be adopted. • No wastewater or waste shall be disposed in river from terminal site or from vessel into the water. Penalty shall be imposed on the vessels				

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				reported of disposing waste/wastewater in the river • No contaminated run-off/sewage/effluent from terminal/jetty sites should be allowed to flow in the river • Nesting grounds, breeding & spawning grounds shall be identified and project activities shall be minimized in those areas • Instruction should be given to all vessels and all employee and staff that no dolphin or any other endangered species shall be harmed due to any reason • Instruction shall be given to vessel operator that in case any accident with dolphin occurs that should be reported immediately to terminal authority • Time schedule and the quantity of material allowed shall be strictly checked and monitored for each ship. This will prevent overcrowding of the vessels at terminal site and thus no obstruction will be there on movement of the aquatic organisms due to ships. • Waiting time of vessels shall be reduced at the terminal/lock sites by providing the adequate				

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							Direct	Indirect
				loading and unloading equipment and vehicles. • No developments shall be brought up on other bank of river opposite to terminal/jetty site so as to provide the ground to aquatic organisms for their activities • Dust suppressors shall be used at site and at barge while loading & unloading of material to suppress the dust level and minimize its settling in the river • Quick clean-up operations shall be carried out in case of accidents. Vessel owner shall be responsible for paying the clean-up expenses in case of the accidents and pollution of river water quality **Barge Movement:** • Vessels shall be instructed for not using sharp lights and sounds all the time as they may disturb aquatic organisms • Vessel speed shall be restricted to 2.7 knots in VSDS and Kashi turtle sanctuary areas to reduce the noise generation from propeller. Hooting should also be prohibited in sanctuary areas. • Vessel shall be fitted with the dolphin reflectors • Usage of non-toxic and non TBT				

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				containing anti-fouling paints for painting vessel • Provision of propeller guards with vessel to minimize injury to the aquatic fauna • Barge/vessel movement will be restricted to the designate route only over the Sanctuary area to minimize noise disturbance of Aquatic life. • If any aquatic mammal spotted, then the measures should be taken to push it away through sirens/signals and creating noise signals. • If any accident of aquatic mammal occurs, then that should be reported to IWAI for rescue action through wild life or forests departments. • All vessels should follow MARPOL for managing their liquid and solid waste. No vessel should discharge the liquid and solid waste in the river. All waste shall be discharged at vessel repair facility only. IWAI should develop the stringent norms to be followed by vessel operators and shall develop the system of penalizing based on polluters pay principle in case the standards are not met or violated • Material having potential to				

S. No.	Cumulatively Impacted CERs	Cumulative Impacts Anticipated (Refer Table 6.4)	Impact of NW-1	Mitigation Measures	Whether addressed in EIA Reports (Y/N)	Enhancement Required (If Yes)	Authorities Responsible	
							Direct	Indirect
				generate the dust like coal, sand stone aggregates should be transported under covered conditions to minimize dust generation and its settlement on river surface. • Provision of oil water interceptors with the bilge tank to separate oil prior discharge of bilge water into river. Bilge water should be discharged as per MARPOL requirements. Bilge water tank should be maintained as per MARPOL requirement. • Immediate/quick clean-up of oil/other spills to prevent damage on aquatic organisms shall be undertaken and ship owners should be liable for the same. Facilities should be made to ensure quick rescue and clean-up operations in case of accidents • Crew of the vessel carrying especially oil should be competent and experienced so as they can prevent the accidents to happen as much as possible • Regular maintenance of vessels engine and Propellers. • River training works should be carried out at the bank locations which are prone to erosion to				

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							Direct	Indirect
				minimize sedimentation & impact on water quality &aquatic organisms • Adequate depth to be maintained to prevent grounding under low flow conditions. Information on available depths should be conveyed to the navigators through online systems by IWAI. River Information System being developed by IWAI will serve this purpose. • Maintaining flood plains & riparian corridors wherever possible and limit potential damage to the navigation channel. Restricting the project activities in breeding and spawning ground of the fisheries which are majorly the bends in the meandering river. • Design measures like bandalling and design of groin should be considered which can reduce the dredging requirement and help in meeting depth, width and steerage needs and reduces dredging requirement • Modern design vessels having low draught say 2 m instead of 2.5 m for equal payload should be procured by IWAI for transportation. Modern vessel-				

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							Direct	Indirect
				better technology vessels or with retrofits with quieting techniques to reduce further the noise emissions (specifically cavitation noise). • Regular patrol and inspections should be carried out to monitor the activities in waterway. Also regular monitoring of environmental attributes as proposed in environment planning plan of this should be carried out for the waterway to keep track of the condition of the environmental attributes • Enhancement Measures: • Support for promoting fish productivity through setting up or supporting existing fish nurseries. Also providing training and awareness support through reputed institutes or experts like CIFRI for better fishing techniques. • Provision of supporting Studies for conservation of Dolphin and other sensitive studies shall be made. **Maintenance Dredging** • Dredging plan including timeframe should be prepared for each stretch prior initiating dredging activity. No dredging should be undertaken within				

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							Direct	Indirect
				VGDS, Turtle sanctuary. No dredging shall be carried out in winter season (November to February) along Mokama Taal to minimize impact on aquatic species and avifauna. • Dredging operations should not be carried out during the breeding and spawning season of the valued aquatic species which is from June to August (Monsoon season). • Dredging if required to be taken at critical stretches (Turtle and Dolphin Sanctuaries) as mention above then dredgers should be provided with turtle and Dolphin deflectors. This would prevent the sucking of the animals (fish or turtle) swimming nearby. But such dredgers are inefficient and costly. • Measures like provision of bubble curtains or creation of agitation in water should be carried out prior carrying out dredging operations so as to provide avoidance time and let the species move away from drudging point. and to prevent any injury/mortality. Dredging operations should be halted in case of sighting of aquatic mammal in adjoin locations.				

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							Direct	Indirect
				• Contractors should submit SOPs and action time chart with risk management plan prior to any dredging work. Dredging sub-contractor should follow the defined safety procedures to avoid accidents and spills, and IWAI should ensure that other vessel users are provided with adequate information and instruction to avoid conflict with the dredgers.				
8.	Avifauna	Avifauna will continue to be impacted due to loss of habitat. Impact will increase due to NW-1 and other upcoming developments in the area	NW-1 traverses through 5 important bird areas. Dredging operations in these areas may impact the avifauna. Development of civil interventions may involve tree cutting which is habitat of avifauna thus again disturbing the avifauna. Compensatory	**Maintenance Dredging** • Dredging operations should be restricted to day time only, i.e. 6:00 Am-10:00 Pm only to minimize noise impacts on the avifauna near Important Bird Areas • Dredgers should be equipped with the noise reduction/masking equipment to reduce the noise generation inside and outside water. Noise from dredgers can be reduced at source (dredger) by isolation of exhaust system, by keeping engine room doors shut and by shielding.	**Y**	Yes • Bird areas along the NW-1 stretch should be protected against the poaching & hunting of these birds • Some artificial wetland/ponds can be developed for these birds in these areas which can also act as tourist spots	IWAI	Wildlife Department, ULBs

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							Direct	Indirect
			plantation and green belt development may reduce the impact.					
9.	Soil & River Bed Sediment Quality	Soil quality, & fertility will continue to deteriorate due to upcoming developments in the area and will also be impacted due to Jal Marg Vikas Project. River bed sediments will further pollute due to continued use of fertilizers and pesticides	Loss of productive top soil for development of terminals or jetties but impact will be very less. Soil may be required for development of embankment o carrying out other bank protection work. This soil can be sourced from agriculture fields. Spillage of materials at site may contaminate the soil in the area. River bed sediments are disturbed due to	**Construction of Terminal/Jetty/Lock & River Training Structure** • Excavation and filling operation should be carried out in parallel so as to minimize the soil erosion. Unusable debris material should be suitably disposed at pre designated disposal locations, with approval of the concerned authority. • Compaction of soil shall be undertaken by sprinkling the water to minimize the surface runoff and erosion. • Remaining excavated soil should be reused at site for filling/levelling/ road construction/railway construction/construction activities in nearby areas/restoration of mine pits (Sahibganj) as possible. • Remaining excavated soil should be send for the disposal at designated location or to debris disposal site as approved by IWAI	**Y**	None	IWAI	--

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							Direct	Indirect
			dredging & piling. At present river bed sediments are not contaminated in the entire stretch except Ghazipur, Varanasi & Allahabad where pesticides were found in traces but they are below the level as per US standard for off-shore disposal. Cadmium levels are found higher in Allahabad, Varanasi & Ghazipur but concentration is below the toxicity level for fishes.	• Fuel shall be stored in HDPE containers on paved surfaces with provision of catchment pit to prevent soil contamination from oil spillages. • Municipal waste likely to be generated at site shall be collected in segregated manner with the use of two bin system at site. It shall be segregated into biodegradable and non-biodegradable waste. Provision of bio composter shall be made at site. The biodegradable material shall be decomposed for production of compost for use at site. The non-biodegradable waste shall be disposed to predefined land fill site nearby. The land fill site shall have provision of liners to prevent leachate to ground. • Septic tank or mobile toilets fitted with anaerobic treatment facility shall be provided at construction camp • Aggregates will be sourced from existing licensed quarries. Copies of consent/ approval / rehabilitation plan for a new quarry or use of existing source will be obtained by DBOT contractor and submitted to IWAI.				

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				• Geometric adjustment shall be made if required and technically safe to minimize cutting of the tree. Provision shall be made for additional tree plantation as feasible along the road while finalizing the road alignment and rail alignment as proposed (Access road to be constructed at Sahibganj terminal & Varanasi terminal, realignment of road required at Farakka lock site and at Haldia terminal and Railway link to be provided at Sahibganj terminal site). • Hazardous waste like used oil from DG sets shall be stored in HDPE containers and shall be stored on paved surfaces in isolated location to prevent its spillage and contamination of soil. Used oil shall be disposed through authorized vendors only. • Movement of construction vehicles shall be restricted to the designated haulage roads only • Wash-off from concrete mixing tanks and wash from washing area shall not be allowed to enter the soil. This wash shall be collected through drains into tanks and concrete shall be				

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							Direct	Indirect
				settled, collected, dried and re-used in the site again. **Terminal/Jetty Operation** • Fuel shall be stored in HDPE containers on paved surfaces only to prevent spillage of fuels on the soil and thus soil contamination • Dustbins shall be provided at all the required locations at the site for collection of recyclable and non-recyclable waste. Recyclable waste shall be sold to authorized vendors and non-recyclable waste shall be disposed through authorized agencies and shall not be dumped in open. • Used oil from DG sets and other equipment shall be stored in HDPE containers in isolated location on paved surfaces and shall be disposed through authorized vendors only and shall not be dumped in open. • Room shall be provided for storage of E-waste at site and this waste shall be sold to authorized vendors periodically and shall not be dumped in open. • Bio- medical waste likely to be generated at first aid centre shall be disposed of following				

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				the bio medical waste disposal rules - Dredged soil shall be tested for toxicity prior disposal, if toxic it shall not be disposed back in water and should be send for disposal to TSDF. Dredged soil shall not be dumped onto the terminal site or in open.				
10.	Soil/Bank Erosion	Soil erosion will increase in the influence area due to NW-1 and other identified development	Construction of terminals/jetties may lead to bank/soil erosion and bed scouring in upstream and downstream of the developed structure. But shore/bank protection measures & bed scouring protection measures are being taken by IWAI already. Erosion is expected in narrow stretches like feeder canal	**Construction of Jetty/Terminal/Lock and River Training Structures** • The earth stockpiles to be provided with gentle slopes to prevent soil erosion. • Sedimentation tanks shall be provided with storm water drain to arrest the sediments and these sediments shall be removed and stored with remaining excavated soil • Provision of cross drainage structure like culverts shall be made in the access road if required to maintain the natural drainage pattern and prevent soil erosion. • Provision of side drain shall be made in access road if required to prevent water logging. • Shore protection works like stone pitching, and geo-textile matting along the bank and construction of stone apron in	**Y**	• Bank protection measures shall be taken all along the feeder canal and other narrow stretches where erosion can happen due to barge movement	IWAI	--

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				the river to prevent the scouring of banks shall be undertaken as required to prevent erosions and scour (bank protection required in case of Sahibganj & Varanasi terminal in u/s & d/s of the terminal site and scour protection is required in case of Sahibganj site) • Bio-turfing of embankments shall be made enhance the slop stabilization **Terminal/Jetty Operation** • Periodic checking to be carried to assess the effectiveness of the stabilization measures viz. turfing, stone pitching, river training structures etc. • Necessary measures to be followed wherever there are failures **Barge Movement** • Restricting the ship speed in the stretches where river is narrow and in feeder canal to prevent impact on the river banks. • Regularizing the barge speed to 7-8 knots in bending areas so as bank erosion can be reduced • River bank protection works should be carried out at the bank locations which are prone to erosion. Opt for the bank protection measures in feeder				

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							Direct	Indirect
				canal to maintain the speed of the barges. • Provision of cautionary signage at the navigational hazard locations				
11.	Social Aspects (Quality of life, pressure on existing resources, development of new infrastructure, health & safety, Religious Value, Livelihood & Traffic)	Quality of life and infrastructure in the area is likely to improve with new upcoming developments. However pressure on existing resources will increase. Developmental activities poses threat to health & safety of the population involved with	Increased employment, new infrastructure development, reduction of pressure on existing road and railway, Reduction of traffic, may increase air and noise pollution in close vicinity of terminals/jetties	**Construction of Terminal/Jetty/Lock and River Training Works** • Separate SIA is being carried out and RAP and other social measures should be proposed under SIA and same should be followed. • R & R issues to be settled prior start of construction at site. People have sentiments associated with River Ganga so relocation as required in case of Sahibganj terminal site should also be given to people near River only • Skill training and assistance should be given to people so as they can get other jobs or get into other business. NGOs should be hired for this purpose. Employment should be given to both women & men and preferably to local people • Small loans should be given to the farmers losing the land and wishing to start new business (Sahibganj terminal site) • Infrastructure development in	**Y**	None	IWAI	--

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		development during construction & operation phase		form of small school, hospital, and library can be undertaken in the village as compensation to the disturbance caused • Any common property resources, if removed should be relocated to the other location (should be a private land) as soon as it is removed and location should be acceptable to the local people • Site should be barricaded and should have entry guarded by security guard. Register should be maintained for entry of outsiders. No unauthorized person should be allowed to enter the site especially village children • A board should be displayed at entrance of site displaying name of project, area and hazards associated with the site on entrance and activities prohibited within and near site area in local language • Non-productive lands, barren lands, raised lands; wastelands should be used for setting up labour camps, plant sites and debris disposal site. Agricultural land should be avoided. Land should be used for establishment of construction				

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				camps, debris disposal site and plant site only after obtaining consent from land owner. • Consultations to be done with fishermen prior start of any activity at bank/ in river to avoid any conflicts. Fishermen should be consulted prior restricting fishing activity in the activity area • Care should be taken that fishing gears and the equipment should not be impacted due to construction activities at site • Necessary permits should be obtained from concerned authorities in case any batching plant, and hot mix plant. is set up at site. • All these facilities shall be installed at proposed project site itself if possible. In case these are to be set up away from site than these shall be located at minimum distance of 500 m from habitation, water bodies and 1000 m from forest areas. • Management, rehabilitation and closure of these sites should be as per the Management plans proposed for these sites. Records for starting, maintaining and closure should be maintained and should be approved by site engineers				

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				• Implementation of EMP adequately so as to prevent environmental pollution and its impact on socio-economy due to project development • Adequate illumination should be provided at site during evening and night time till the work is being carried out • Rest area should be provided at site in which workers can rest after the lunch hours • Workers should wear the personal protective equipment like helmet, gum boots, safety shoes, safety jackets, ear plugs, gloves etc. while working • Noise level in the work zone should be maintained and followed as per OSHAS norms • Contractors should adopt and maintain safe working practices. SOPs should be prepared for each and every activity and all activities should be undertaken as per SOPs under supervision of site engineer • Training should be given to workers to handle the heavy equipment so as to prevent accidents • Training should be given to workers to handle emergency situation like fire, earth quake				

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				and flood • Emergency preparedness plan should be available at the site all the time and mock drills for workers should be conducted from time to time • Complete medical check-up should be done for workers prior to joining and after six months of joining • First aid facilities, first aid room, first aid trained personnel and ambulance should be provided at the site 24 X 7. Also tie-ups with local hospital should be done to handle emergency case, if any • List of emergency nos., hospital contacts, ambulance contacts and doctors contacts should be displayed in first aid room, rest area and at all required location • Working hours of labour should not exceed than standard norms as per state factory law • Labour camps should be located at neat and clean location with no water logging issues and should be well ventilated with adequate illumination, kitchen and safe drinking water facility • Construction labour camps and site should be properly cleaned				

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							Direct	Indirect
				and hygiene should be maintained • Proper sanitation facility like toilet and bathing facility should be provided at site and labour camps. Wastewater generated from these facilities should be disposed through septic tanks and soak pit • LPG should be provided as fuel for cooking to workers and open burning of fuel should not be allowed • Wastewater from construction site should not be allowed to accumulate at site as standing water may lead to breeding of mosquitoes. Septic tanks/soak pits should be provided for its disposal • Temporary storm water drainage system should also be provided at camp site and construction site so as to drain the storm water and prevent accumulation of storm water at site and thus breeding of mosquitoes/flies • Safety officers should be appointed at site so as to ensure all safety measures are taken at the site • All construction workers should be provided with personal				

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				protective equipment like helmet, gloves, gumboots, safety jackets etc. and fines should be imposed if found not wearing • Job rotation should be carried out for workers exposed to high noise and dust areas • Activity like smoking and consuming liquor should be prohibited at the site • Awareness on AIDS should be spread among the workers • Traffic manager should be present at the site all the time to manage incoming and outgoing traffic to prevent accidents • Crèche facility should be provided for kids if female workers are employed • Regular inspection for hygiene and safety in labour camps should be done • Provision of cautionary and guiding signage in local and English language indicating the hazard associated with the site & activities. Usage of fluorescent signage, in local language at the construction sites • Speed limit of vehicles should be restricted at site and on haulage roads to prevent any				

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				accidents and fines should be imposed on vehicles if same is not maintained. All construction vehicles should follow the designated routes & timings only. • Construction vehicle movement should be restricted to non-peak hours, i.e. late evening (7-12:00 pm) only. Villagers should also be given intimation of these timings. • Noise level in the work zone should be maintained and followed as per OSHA norm • Employment should be provided preferable to local & affected people • Dustbins should be provided at labour camps for collection of waste and waste should be regularly disposed through the concerned agency • Arrangement of fire-fighting should be made at site and workers should be trained to use the system in case of fire • Site should be barricaded and should have entry guarded by security guard. Register should be maintained for entry of outsiders. No unauthorized person should be allowed to enter the site especially village				

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				children • A board should be displayed at entrance of site displaying name of project, area and hazards associated with the site on entrance and activities prohibited within and near site area in local language • All construction vehicles should be regularly serviced and maintained and carry pollution under control certificate • All proposed environmental pollution measures should be taken during construction of phase of terminal to minimize the harm to existing environmental quality of the area, which is being enjoyed by the residents of that area • Maintenance and repair of the village road should be carried out both before and end of construction by contractor. • Sprinkling of water should be carried out in village road also, so as to minimize dust generation due to movement of construction vehicles. • Any CPR, if removed shall be relocated at the earliest with consent of the villagers and the Gram Panchayat to suitable location in consent with the				

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				villagers (preferably private land). A community temple would be required to be relocated in case of Sahibganj terminal site **Terminal/Jetty/Lock Operation** • Efforts shall be made to make shoulder of approach road to terminal/lock sites completely clear of vegetation. • Regular maintenance of plantation along the roadside • No invasive plantation near the road. • Traffic control measures, including speed limits should be forced strictly. • Further encroachment of squatters within the ROW will be prevented. • Monitor/ensure that all safety provisions included in design and construction phase are properly maintained • Movement of traffic shall be restricted to designate hours and routes • Adequate illumination should be provided at the site during evening • Existence of spill prevention and control and emergency responsive system with the vessel operators & jetty				

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				authority • Emergency plan for vehicles carrying hazardous material • Implementation of the environment management plan as proposed to prevent the environmental pollution during operation phase • Safety norms should be followed for all operational phase activities at terminal • Development activities should be carried out in the village and nearby areas of proposed terminal/lock sites for development of area • Fishing activity should not be restricted in the river. Alternate provision for fishermen should be given in case fishing activity is restricted. • Safety training should be given to the terminal staff for managing the floods, earthquake, fire, ship accidents like situation. Emergency collection area should be designated at the site which is safe. All workers should be directed to collect at this area in case of emergency. • Firefighting facility should be provided at site and trained personnel should be available				

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				at site who can operate the fire extinguishers and other fire-fighting equipment. **Barge Movement** • Vessel movement shall be restricted or regularise during the identified major festival period as listed under description of Environment chapter 4. • No waste in form shall be discharged by vessel in the river. • Enhancement Measures • Support for establishment of small enclosed areas dedicated for female bathing in every village along the NW-1 to allow female maintain their privacy. • Support for improving cleanliness and at existing Ghats at Varanasi and other locations • Provision for improving select Ghats as per the demand raised during public consultation. • Barge/vessel movement will be restricted to the designate navigation route only. Maintenance of buoys, beacons, signs, gauges to mark the navigation channel • Crew of the vessel carrying especially oil should be				

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				competent and experienced so as they can prevent the damage to fishing gears and boats. • Marking of navigation channel through beacons and communicating information about the navigation channel monthly to fishermen and the expected timing or frequency of barges to fishing community so as they can be pre-informed and the damage to their boats and gears can be reduced. Barge movement schedule should be prepared in advance and should be shared with the fishermen • Regularizing the barge speed to 7-8 knots in bending areas so as bank erosion can be reduced due to barge movement resulting in lesser turbidity, enhanced planktonic growth and thus increased fish yield. • River training works should be carried out at the bank locations which are prone to erosion to reduce the turbidity in shallow areas and its impact on fish yield. • All measures to reduce the water quality pollution & to prevent damage to ecology due to barge movement as				

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				proposed above should be adequately addressed and implemented so as to minimise impact on fish yield due to the project. • In case of damage of fishing nets, fishing crafts and other gears of fishers, arising due to barge operation, appropriate and quick compensations may be given to the aggrieved fishers. • The barges may be fitted with powerful searchlight and may sound horn so that fishermen can realize arrival of barge at least from 500 m-1 km away to prevent damage to fishing nets • Regular consultations to be carried out with the fishing communities to get their feedback on the impact due to barge movement on fishing and problems they are facing • Enhancement Measures • Support shall be extended in terms of supporting setting up fish nurseries for improving fish productivity and training awareness of fishermen for better fishing techniques through institute of repute like CIFRI. **Maintenance Dredging**				

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				• Dredging operations should be restricted to day time only, i.e. 6:00 Am-10:00 Pm only to minimize noise impacts on the residents of nearby settlements. Dredgers should be equipped with the noise reduction/masking equipment to reduce the noise generation • Dredgers should be placed in consultation with the fishermen so as to minimize the impact on their equipment/gears and their fishing activities • Dredging should not be carried out in the areas close to Ghats in Varanasi and buffer of 2 km should be maintained for dredging during time of religious gatherings during Chat and Kumbh festivals. • In case contaminated dredged material is disposed on land, then it should be disposed at approved TSDF sites to prevent any harm to community residing in nearby areas. One of such approved TSDF site is located Sagar (Haldia Dock Complex site) • Material to be disposed on land may create nuisance odour due to exposure of anaerobic sediments with air. Thus if land				

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				disposal is involved than disposal site should not be in upwind direction of any settlement area or sensitive locations like hospitals, schools etc. • Log book should be maintained for recording the accidents at site/mortality of the any marine mammal should be maintained. Analysis shall be carried out to assess the reason for the accident/mortality and measures should be taken to prevent repetition of the event. • Contractors having experience of dredging and well trained staff should only be allowed to carry out dredging. This will help in prevention of spillage of dredged material or any accidents during the dredging operations • Dredging plan should be prepared by contractor and submitted to IWAI for approval prior to carrying out dredging operations. Dredging plan should be reviewed considering its location w.r.t environmental sensitive locations/archaeological locations/cultural festival/pollution influx in the area/dredged material quality &				

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							Direct	Indirect
				texture/available depth etc. as given in this EIA report and through local sources and past experience. • Contractors should submit method statement & risk assessment plan prior to carrying out any dredging work. Dredger should follow the defined safety procedures to avoid accidents and spills, and IWAI should ensure that other vessel users are provided with adequate information and instruction to avoid conflict with the dredgers. • Post-dredging monitoring of the sediment nature, rate of sedimentation shall be made part of contractor's job as best dredging practise. This will provide information which can be taken into consideration before the next maintenance dredge is carried out. • Re-use of dredged material should be explored if dredged material is not contaminated. Economically and environmentally feasible options can be adopted to minimize the dredge spoil burdens. Some of such measures include • Dredged sediment can be used				

S. No.	Cumulatively Impacted CERs	Cumulative Impacts Anticipated (Refer Table 6.4)	Impact of NW-1	Mitigation Measures	Whether addressed in EIA Reports (Y/N)	Enhancement Required (If Yes)	Authorities Responsible	
							Direct	Indirect
				for beach nourishment/development of artificial beach/deposition on shoal & thus enrichment of habitat o Dredged material can be explored for its usage for coast/bank protection purpose/flood protection o Use of dredged material can be explored for land filling, as construction material for road foundations, dikes, mounds, noise/wind barriers.				
12.	Land Use	More change of land use. Diversion of more agricultural and forest land for other uses	Land may required to be acquired for construction of various proposed civil interventions which will lead to change in land use.	**Construction of Terminals/Jetties/Locks & River Training Works** • Agricultural land shall not be selected for setting up project, construction camps, borrow area (if any), plant site or any other construction purpose • 15 cm of top soil layer shall be stripped off prior to excavation and shall be stored separately in covered condition and used for landscaping purpose or shall be given to farmers in nearby areas, if required by them	**Y**	None	IWAI	--
13.	Archaeological Sites	Impacts on Archaeolo	No intervention planned close	**Construction of Terminals/Jetties/Locks** • No construction or any	**Y**	• ASI should carry out regular inspection and maintenance of the sites located within the 300 m of the	IWAI	--

S. No.	Cumulatively Impacted CERs	Cumulative Impacts Anticipated (Refer Table 6.4)	Impact of NW-1	Mitigation Measures	Whether addressed in EIA Reports (Y/N)	Enhancement Required (If Yes)	Authorities Responsible	
							Direct	Indirect
		gical sites may continue to occur due to developments and the impact may increase if any development related to NW-1 will be undertaken within 300 m of such site	to archaeological sites at present thus minimal impact but may have impact if any activity is undertaken in future	intervention to be done within 300 m of the identified archaeological sites along NW-1 • Permission should be obtained from ASI/INTACH, if any such development is to be undertaken		NW-1		

7.3. Mitigation Measures for Proposed / Planned & Anticipated Developments within Influence Area

Developments within the influence area are being identified and also the impacts due to each of such development are identified. Mitigation measures which are to be taken up by the concerned departments for these developments is prepared so as the cumulative impact in the influence zone can be minimized. These mitigation plans should be shared by IWAI with the` concerned departments so as they include these measures in their environment management plan. Mitigation measures are detailed in **Table 7.2** below.

Table 7.2 : Mitigation measures for anticipated developments

S. No.	Proposed / Planned / Anticipated Developments	Mitigation Measures	Environment Management Plan	Authorities Responsible	Monitoring Authorities /Agencies	Role of IWAI

1	EDFC development/IR development & expansion	• Essentially to carry out environment impact assessment study to assess the impacts of the project on the existing infrastructure and environmental quality during both construction & operation phase
		• To obtain all the environment and safety related approval as per applicability from concerned authorities
		• Site selected should be free from National Parks, Wildlife sanctuary, Reserve forests, Migratory Route of birds etc, if any permission should be taken from NBWL
		• Public consultations should essentially be undertaken
		• Connectivity should be provided to each of the IWAI terminals
		Mitigation Measures for Management of Land Use, Soil Quality, Soil Erosion & People
		• Selection of borrow areas, plant site, construction labour camps and debris disposal site should be carried out carefully so as to avoid agricultural land and distance from habitation and sensitive location should be minimum 1000 m.
		• Closure of borrow area, debris disposal site, plant site and construction labour camp site should be done so as to restore its original state by filling, relaying top soil and carrying out plantation
		• Any land acquired or used should be with consent of land owner and appropriate compensations should be paid to the land owners as per law of land.
		• Shifting of utilities, if any should be done immediately after removal
		• Workers must be trained and made aware to avoid wastage of resources by mishandling, conserve
			• Environment Management Plan
			  • Air Quality Management Plan
			  • Water Resources Management Plan
			  • Noise Level Management Plan
			  • Soil Quality & erosion Management Plan
			• Bio-diversity Management Plan
			• Quarry management plan
			• Plant Site/Labour camp Management Plan
			• Borrow Area Management Plan
			• Landscaping Plan
			• Disaster Management Plan
			• Occupational Health & Safety Management Plan
			• Traffic Safety Management Plan
				DFCCIL & Indian Railways, Forest Department	MoEF/SEIAA, State Pollution Control Boards, Forest Department	IWAI should share this plan with the DFCCIL. EDFC within influence zone of CIA near Varanasi section

S. No.	Proposed / Planned / Anticipated Developments	Mitigation Measures	Environment Management Plan	Authorities Responsible	Monitoring Authorities /Agencies	Role of IWAI
		energy by following best practices, handle emergency situations • Cautionary and guiding signage should be displayed at site in local language at all required locations like fuel storage area, raw material storage, plant site and entry should be restricted to trained and authorized personnel in risk prone areas • Stone pitching should be carried out in embankments close to water body • Top soil removed should be stored separately and should be re-used for landscaping purpose or should be relayed on the same location after completion of activity • Personal protective equipment should be provided to workers • Safety officer must be deputed to ensure safety of all personnel at the site all the time. Traffic managers should also be deputed to manage the traffic & minimize the accident hazards • First aid facilities including ambulance should be provided at the site. Also tie-ups with local hospital should be done to handle emergency case, if any • Labour camps should be provided with all facilities like drinking water, sanitation, kitchen facility (LPG fuel). Open burning of fuel should be prohibited. Six monthly health check up should be arranged for all workers **Mitigation Measures for Air Quality Management** • Construction material should be sourced from licensed quarry & authorized dealers, nearest to project site • Piling of material and debris at site should be avoided to prevent wastage and air, water and soil pollution	• Environment Monitoring Plan			

S. No.	Proposed / Planned / Anticipated Developments	Mitigation Measures	Environment Management Plan	Authorities Responsible	Monitoring Authorities /Agencies	Role of IWAI
		• Dust emissions from the site should be managed by sprinkling water and low sulhpur diesel should be used in construction vehicles, equipment & DG sets to minimize the emissions • Wheel washing facility should be provided at exit point of construction to minimize the emissions • Material Transportation Vehicles should be covered **Mitigation Measures for Water Resources & Drainage Management** • Construction site should be kept clean and debris should be removed regularly from the site • Storm water from construction site should be managed by providing garland drains, sediment traps etc. to protect the surface water bodies from pollution • Cross drainage structures like balancing culverts should be provided to maintain natural drainage patter. Stone pitching should be provided for slope stabilization near water bodies • Waste management should be carried out at site. Different coilor bins should be provided to collect different type of waste. Recyclable waste should be sold off to authorized dealers and the remaining waste should be sent for land filling to sites identified by Municipal Corporation or to the site identified & approved by client for debris disposal. No waste should be disposed off in any water body • Any hazardous waste, if generated should be stored and disposed off as per Hazardous Waste (Management, handling & Trans-boundary) Rules, 2008 • Wastewater from site should be managed by providing the septic tanks & soak pits. Construction wastewater should be collected and should be re-				

S. No.	Proposed / Planned / Anticipated Developments	Mitigation Measures	Environment Management Plan	Authorities Responsible	Monitoring Authorities /Agencies	Role of IWAI
		used for curing purpose & wheel washing • Curing should be carried out by spraying to conserve water. • Fuel storage and hazardous waste storage area should be located in isolated location and on paved surfaces • Oil interceptor will be provided for accidental spill of oil and diesel • All washing and maintenance effluent from the workshop area of vehicle maintenance area should drain to separate collection areas fitted with oil and grease trap and de- siltation chamber. The treated water shall be used for dust suppression and green belt development. This water shall not be discharged to river at all. **Mitigation Measures for Noise Level & Vibration Management** • Temporary noise barriers should be provided at the locations where high levels of noise may generate. Construction activities should not be carried out during night time • Construction machinery should comply with standards prescribed by CPCB and should be regularly maintained and serviced. • Construction equipment & DG sets should be enclosed in acoustic enclosure • Noise barrier should be provided in the locations close to sensitive receptors like school & hospital during operation phase • Vibrations should be regulated by incorporating adequate design measures **Mitigation Measures for Bio-Diversity Management** • Alignment should be such selected to minimize the tree cutting				

S. No.	Proposed / Planned / Anticipated Developments	Mitigation Measures	Environment Management Plan	Authorities Responsible	Monitoring Authorities /Agencies	Role of IWAI
		• Compensatory plantation should be carried out in ration of 1:2 minimum with assistance of forest area.				

2	Road Development	• Essentially to carry out environment impact assessment study to assess the impacts of the project on the existing infrastructure and environmental quality during both construction & operation phase
		• To obtain all the environment and safety related approval as per applicability from concerned authorities
		• Site selected should be free from National Parks, Wildlife sanctuary, Reserve forests, Migratory Route of birds etc, if any necessary permission from NBWL to be taken as per rules
		• Analysis of alternative alignment should be carried out to minimize impact on environment & society
		• Public consultations should essentially be undertaken
		• Road connectivity should be provided to all the terminal/jetty locations
		Mitigation Measures for Management of Land Use, Soil Quality, Soil Erosion & People
		• Selection of borrow areas, plant site, construction labour camps and debris disposal site should be carried out carefully so as to avoid agricultural land and distance from habitation and sensitive location should be minimum 1000 m.
		• Closure of borrow area, debris disposal site, plant site and construction labour camp site should be done so as to restore its original state by filling, relaying top soil and carrying out plantation
		• Any land acquired or used should be with consent of land owner and appropriate compensations should be paid to the land owners as per law of land.
			• Environment Management Plan
			  • Air Quality Management Plan
			  • Water Resources Management Plan
			  • Noise Level Management Plan
			  • Soil Quality & erosion Management Plan
			• Bio-diversity Management Plan
			• Quarry management plan
			• Plant Site/Labour camp Management Plan
			• Borrow Area Management Plan
			• Landscaping Plan
			• Disaster Management Plan
			• Occupational Health & Safety Management Plan
				National Highways Authority of India / Central Public Works Department / MoEF, State Public Works Department, Forest Department	MoEF/SEIAA/Department of Environment, State Pollution Control Boards, Forest Department	IWAI should share this plan with the Road development authorities. IWAI should consult with road development authorities for expansion and maintenance of approach and haulage road time to time.

S. No.	Proposed / Planned / Anticipated Developments	Mitigation Measures	Environment Management Plan	Authorities Responsible	Monitoring Authorities /Agencies	Role of IWAI
		• Shifting of utilities, if any should be done immediately after removal • Workers must be trained and made aware to avoid wastage of resources by mishandling, conserve energy by following best practices, handle emergency situations • Cautionary and guiding signage should be displayed at site in local language at all required locations like fuel storage area, raw material storage, plant site and entry should be restricted to trained and authorized personnel in risk prone areas • Stone pitching should be carried out in embankments close to water body • Top soil removed should be stored separately and should be re-used for landscaping purpose or should be relayed on the same location after completion of activity • Personal protective equipment should be provided to workers • Safety officer must be deputed to ensure safety of all personnel at the site all the time. Traffic managers should also be deputed to manage the traffic & minimize the accident hazards • First aid facilities including ambulance should be provided at the site. Also tie-ups with local hospital should be done to handle emergency case, if any • Labour camps should be provided with all facilities like drinking water, sanitation, kitchen facility (LPG fuel). Open burning of fuel should be prohibited. Six monthly health check up should be arranged for all workers **Mitigation Measures for Air Quality Management** • Construction material should be sourced from licensed quarry & authorized dealers, nearest to	• Traffic Safety Management Plan • Environment Monitoring Plan			

S. No.	Proposed / Planned / Anticipated Developments	Mitigation Measures	Environment Management Plan	Authorities Responsible	Monitoring Authorities /Agencies	Role of IWAI
		project site • Piling of material and debris at site should be avoided to prevent wastage and air, water and soil pollution • Dust emissions from the site should be managed by sprinkling water and low sulphur diesel should be used in construction vehicles, equipment & DG sets to minimize the emissions • Wheel washing facility should be provided at exit point of construction to minimize the emissions • Material Transportation Vehicles should be covered **Mitigation Measures for Water Resources & Drainage Management** • Construction site should be kept clean and debris should be removed regularly from the site • Storm water from construction site should be managed by providing garland drains, sediment traps etc. to protect the surface water bodies from pollution • Cross drainage structures like balancing culverts should be provided to maintain natural drainage patter. Stone pitching should be provided for slope stabilization near water bodies • Waste management should be carried out at site. Different color bins should be provided to collect different type of waste. Recyclable waste should be sold off to authorized dealers and the remaining waste should be sent for landfilling to sites identified by Municipal Corporation or to the site identified & approved by client for debris disposal. No waste should be disposed off in any water body • Any hazardous waste, if generated should be stored and disposed off as per Hazardous Waste (Management, handling & Trans-boundary) Rules,				

S. No.	Proposed / Planned / Anticipated Developments	Mitigation Measures	Environment Management Plan	Authorities Responsible	Monitoring Authorities /Agencies	Role of IWAI
		2008 • Wastewater from site should be managed by providing the septic tanks & soak pits. Construction wastewater should be collected and should be re-used for curing purpose & wheel washing • Curing should be carried out by spraying to conserve water. • Fuel storage and hazardous waste storage area should be located in isolated location and on paved surfaces • Oil interceptor will be provided for accidental spill of oil and diesel • All washing and maintenance effluent from the workshop area of vehicle maintenance area should drain to separate collection areas fitted with oil and grease trap and de- siltation chamber. The treated water shall be used for dust suppression and green belt development. This water shall not be discharged to river at all. **Mitigation Measures for Noise Level Management** • Temporary noise barriers should be provided at the locations where high levels of noise may generate. Construction activities should not be carried out during night time • Construction machinery should comply with standards prescribed by CPCB and should be regularly maintained and serviced. • Construction equipment & DG sets should be enclosed in acoustic enclosure • Noise barrier should be provided in the locations close to sensitive receptors like school & hospital during operation phase **Mitigation Measures for Bio-Diversity Management** • Alignment should be such selected to minimize the				

S. No.	Proposed / Planned / Anticipated Developments	Mitigation Measures	Environment Management Plan	Authorities Responsible	Monitoring Authorities /Agencies	Role of IWAI
		tree cutting • Compensatory plantation should be carried out in ration of 1:2 minimum with assistance of forest area. • Avenue plantation should be carried out in the Haulage roads and roads to the terminal				

3	Industrial Area/SEZ/Growth Centers/Focal Points Development	• Environmental impacts of the project should assess in detail and environment clearance should be obtained, if applicable
		• To obtain all the environment and safety related approval as per applicability from concerned authorities
		• Structural approval for the buildings should be obtained as applied in NBC, 2005
		• Site selected should be free from National Parks, Wildlife sanctuary, Reserve forests, Migratory Route of birds etc, if any necessary permission from NBWL to be taken as per rules
		• Analysis of alternative alignment should be carried out to minimize impact on environment & society
		• Public consultations should essentially be undertaken
		Mitigation Measures for Management of Land Use, Soil Quality, Soil Erosion & People
		• All industries should taken CLU, if required a
		• Any land acquired or used should be with consent of land owner and appropriate compensations should be paid to the land owners as per law of land.
		• Shifting of utilities, if any should be done immediately after removal
		• Workers must be trained and made aware to avoid wastage of resources by mishandling, conserve energy by following best practices, handle emergency situations
			• Environment Management Plan
			  • Air Quality Management Plan
			  • Water Resources Management Plan
			  • Noise Level Management Plan
			  • Soil Quality & erosion Management Plan
			• Bio-diversity Management Plan
			• Plant Site/Labour camp Management Plan
			• Landscaping Plan
			• Disaster Management Plan
			• Occupational Health & Safety Management Plan
			• Traffic Safety
				Ministry of Commerce & Industry, State Industrial Development Corporation, Forest Department	MoEF, SEIAA, State Pollution Control Boards, Forest Department	IWAI should share this plan with the Industrial Departments and should recommend industrial departments to make these conditions bindings for the major industrieswhich will come up within the influence area of CIA

S. No.	Proposed / Planned / Anticipated Developments	Mitigation Measures	Environment Management Plan	Authorities Responsible	Monitoring Authorities /Agencies	Role of IWAI
		• Cautionary and guiding signage should be displayed at site in local language at all required locations like fuel storage area, raw material storage, plant site and entry should be restricted to trained and authorized personnel in risk prone areas • Top soil removed should be stored separately and should be re-used for landscaping purpose or should be relayed on the same location after completion of activity • Personal protective equipment should be provided to workers • Safety officer must be deputed to ensure safety of all personnel at the site all the time. Traffic managers should also be deputed to manage the traffic & minimize the accident hazards • First aid facilities including ambulance should be provided at the site. Also tie-ups with local hospital should be done to handle emergency case, if any • Labour camps should be provided with all facilities like drinking water, sanitation, kitchen facility (LPG fuel). Open burning of fuel should be prohibited. Six monthly health check up should be arranged for all workers **Mitigation Measures for Air Quality Management** • Construction material should be sourced from licensed quarry & authorized dealers, nearest to project site • Piling of material and debris at site should be avoided to prevent wastage and air, water and soil pollution • Dust emissions from the site should be managed by sprinkling water and low sulhpur diesel should be used in construction vehicles, equipment & DG sets to minimize the emissions	Management Plan • Environment Monitoring Plan			

S. No.	Proposed / Planned / Anticipated Developments	Mitigation Measures	Environment Management Plan	Authorities Responsible	Monitoring Authorities /Agencies	Role of IWAI
		• Wheel washing facility should be provided at exit point of construction to minimize the emissions • Material Transportation Vehicles should be covered All industries coming up in influence area should manage their emission levels **Mitigation Measures for Water Resources & Drainage Management** • Construction site should be kept clean and debris should be removed regularly from the site • Storm water from construction site should be managed by providing garland drains, sediment traps etc. to protect the surface water bodies from pollution • Cross drainage structures like balancing culverts should be provided to maintain natural drainage patter. Stone pitching should be provided for slope stabilization near water bodies • Waste management should be carried out at site. Different color bins should be provided to collect different type of waste. Recyclable waste should be sold off to authorized dealers; compostable waste should be composted within the site. Reacted waste will go for landfilling • Any hazardous waste, if generated should be stored and disposed off as per Hazardous Waste (Management, handling & Trans-boundary) Rules, 2008 • Wastewater from site should be managed by providing the septic tanks & soak pits. Construction wastewater should be collected and should be re-used for curing purpose & wheel washing • Curing should be carried out by spraying to conserve water. • Fuel storage and hazardous waste storage area				

S. No.	Proposed / Planned / Anticipated Developments	Mitigation Measures	Environment Management Plan	Authorities Responsible	Monitoring Authorities /Agencies	Role of IWAI
		should be located in isolated location and on paved surfaces • Oil interceptor will be provided for accidental spill of oil and diesel • All washing and maintenance effluent from the workshop area of vehicle maintenance area should drain to separate collection areas fitted with oil and grease trap and de- siltation chamber. The treated water shall be used for dust suppression and green belt development. This water shall not be discharged to river at all. All industries shall install their own STP & ETP to treat effluent generated. **Mitigation Measures for Noise Level Management** • Temporary noise barriers should be provided at the locations where high levels of noise may generate. Construction activities should not be carried out during night time • Construction machinery should comply with standards prescribed by CPCB and should be regularly maintained and serviced. • Construction equipment & DG sets should be enclosed in acoustic enclosure • Noise barrier should be provided in the locations close to sensitive receptors like school & hospital during operation phase • All industries should manage the noise levels from their units as per CPCB standards **Mitigation Measures for Bio-Diversity Management** • Alignment should be such selected to minimize the tree cutting • Compensatory plantation should be carried out in ration of 1:2 minimum with assistance of forest area, if any tree cutting involve.				

S. No.	Proposed / Planned / Anticipated Developments	Mitigation Measures	Environment Management Plan	Authorities Responsible	Monitoring Authorities /Agencies	Role of IWAI

4	Urbanization/Urban Agglomeration/Mega Projects/Townships/River Front Development Projects	• Environmental impacts of the project should assess in detail and environment clearance should be obtained, if applicable
		• To obtain all the environment and safety related approval as per applicability from concerned authorities
		• Structural approval for the buildings should be obtained as applied in NBC, 2005
		• Site selected should be free from National Parks, Wildlife sanctuary, Reserve forests, Migratory Route of birds etc, if any necessary permission from NBWL to be taken as per rules
		• Analysis of alternative alignment should be carried out to minimize impact on environment & society
		• Public consultations should essentially be undertaken
		Mitigation Measures for Management of Land Use, Soil Quality, Soil Erosion & People
		• Any land acquired or used should be with consent of land owner and appropriate compensations should be paid to the land owners as per law of land.
		• Shifting of utilities, if any should be done immediately after removal
		• Workers must be trained and made aware to avoid wastage of resources by mishandling, conserve energy by following best practices, handle emergency situations
		• Cautionary and guiding signage should be displayed at site in local language at all required locations like fuel storage area, raw material storage, plant site and entry should be restricted to trained and authorized personnel in risk prone areas
		• Stone pitching should be carried out in embankments close to water body
			• Environment Management Plan
			  • Air Quality Management Plan
			  • Water Resources Management Plan
			  • Noise Level Management Plan
			  • Soil Quality & erosion Management Plan
			• Bio-diversity Management Plan
			• Plant Site/Labour camp Management Plan
			• Landscaping Plan
			• Disaster Management Plan
			• Occupational Health & Safety Management Plan
			• Traffic Safety Management Plan
			• Environment Monitoring Plan
				Ministry of Urban Developments / Municipal Corporations / Municipality / State Urban Development Authorities /	MoEF, SEIAA, State Pollution Control Boards, Forest Department	IWAI should share these plan with all concerned departments

S. No.	Proposed / Planned / Anticipated Developments	Mitigation Measures	Environment Management Plan	Authorities Responsible	Monitoring Authorities /Agencies	Role of IWAI
		• Top soil removed should be stored separately and should be re-used for landscaping purpose or should be relayed on the same location after completion of activity • Personal protective equipment should be provided to workers • Safety officer must be deputed to ensure safety of all personnel at the site all the time. Traffic managers should also be deputed to manage the traffic & minimize the accident hazards • First aid facilities including ambulance should be provided at the site. Also tie-ups with local hospital should be done to handle emergency case, if any • Labour camps should be provided with all facilities like drinking water, sanitation, kitchen facility (LPG fuel). Open burning of fuel should be prohibited. Six monthly health check up should be arranged for all workers **Mitigation Measures for Air Quality Management** • Construction material should be sourced from licensed quarry & authorized dealers, nearest to project site • Piling of material and debris at site should be avoided to prevent wastage and air, water and soil pollution • Dust emissions from the site should be managed by sprinkling water and low sulhpur diesel should be used in construction vehicles, equipment & DG sets to minimize the emissions • Wheel washing facility should be provided at exit point of construction to minimize the emissions • Material Transportation Vehicles should be covered **Mitigation Measures for Water Resources & Drainage Management**				

S. No.	Proposed / Planned / Anticipated Developments	Mitigation Measures	Environment Management Plan	Authorities Responsible	Monitoring Authorities /Agencies	Role of IWAI
		• Construction site should be kept clean and debris should be removed regularly from the site • Storm water from construction site should be managed by providing garland drains, sediment traps etc. to protect the surface water bodies from pollution. Storm water during operation should be harvested and re-used/recharged to ground • Cross drainage structures like balancing culverts should be provided to maintain natural drainage patter. Stone pitching should be provided for slope stabilization near water bodies • Waste management should be carried out at site. Different color bins should be provided to collect different type of waste. Recyclable waste should be sold off to authorized dealers; compostable waste should be composted within the site. Reacted waste will go for landfilling • Any hazardous waste, if generated should be stored and disposed off as per Hazardous Waste (Management, handling & Trans-boundary) Rules, 2008 • Wastewater from site should be managed by providing the septic tanks & soak pits. Construction wastewater should be collected and should be re-used for curing purpose & wheel washing • Curing should be carried out by spraying to conserve water. • Fuel storage and hazardous waste storage area should be located in isolated location and on paved surfaces • Oil interceptor will be provided for accidental spill of oil and diesel • All washing and maintenance effluent from the workshop area of vehicle maintenance area should				

S. No.	Proposed / Planned / Anticipated Developments	Mitigation Measures	Environment Management Plan	Authorities Responsible	Monitoring Authorities /Agencies	Role of IWAI
		drain to separate collection areas fitted with oil and grease trap and de- siltation chamber. The treated water shall be used for dust suppression and green belt development. This water shall not be discharged to river at all. **Mitigation Measures for Noise Level Management** • Temporary noise barriers should be provided at the locations where high levels of noise may generate. Construction activities should not be carried out during night time • Construction machinery should comply with standards prescribed by CPCB and should be regularly maintained and serviced. • Construction equipment & DG sets should be enclosed in acoustic enclosure • Noise barrier should be provided in the locations close to sensitive receptors like school & hospital during operation phase **Mitigation Measures for Bio-Diversity Management** • Alignment should be such selected to minimize the tree cutting • Compensatory plantation should be carried out in ratio of 1:2 minimum with assistance of forest area, if any tree cutting involve.				
5	**Irrigation Schemes/Dams**	• Carry out detailed environmental impact assessment study, biological assessment study and obtain environmental clearance form the concerned departments • Structures used for withdrawal of water should not pose threat to navigation **Mitigation Measures for Management of Land Use, Soil Quality, Soil Erosion & People** • Soil quality in the area should be managed by restricting usage of chemical based fertilizers and	• Water Resources/Flow Management Plan • Water Quality Management Plan • Soil Quality Management Plan	Irrigation Department and Water Resources Department	MoEF, SEIAA, State Pollution Control Boards, Forest Department	IWAI should share these plan with all concerned departments. Any such scheme may have impact on available water flow in the area. Existing

S. No.	Proposed / Planned / Anticipated Developments	Mitigation Measures	Environment Management Plan	Authorities Responsible	Monitoring Authorities /Agencies	Role of IWAI
		pesticides • Soil erosion prevention measures should be taken in the area to prevent loss of productive top soil **Mitigation Measures for Water Resources & Drainage Management** • Drip irrigation/sprinkle irrigation measures should be taken up or irrigation and conservation of water • Drainage in area should be maintained by provision of adequate cross drainage structure • Water logging should be prevented by provision of injection wells or drainage of logged water • Surface & ground water pollution should be prevented by preventing usage of chemical fertilizers or pesticides **Mitigation Measures for Noise Level Management** • Pumps used should be provided with noise mufflers and vibration dampeners				Bhagmari siphon is one of the navigational hazard in NW-1

7.4. Environment Management Plan

As per suggestions made in Table 7.1, IWAI should incorporate suggestive enhancement measures in their EMPs and should ensure all these suggestive measures are being complied with. The report should be uploaded on IWAI website so as any new developer or state authorities can know the status of the CERs in the influence area and can plan the development accordingly. As per suggestion made in Table 7.2, environment management plan should be prepared for each development by respective responsible authority. Suggested environment management plans given above will help the agencies to include the cumulative impact in their mind while finalizing the mitigation plans

7.5. Environment Monitoring Plan

Environmental monitoring is essential component of environment management plan as it provides the status of the CERs which helps in assessing the effectiveness of the EMPs proposed. Environment management plan for assessing the quality of CERs along the NW-1 stretch is given in **Table 7.3** below. In addition to this CERs are being monitored continuously by other departments like Pollution Control Boards, Census Department, Industrial Departments, forest Departments and status of the CERs is available in their respective websites

Table 7.3 : Monitoring plan

S. No.	Aspect	Parameters to be monitored	No of sampling locations & frequency	Standard methods for sampling and analysis	Role & Responsibility	
					Implementation	Supervision
Construction Period						
1.	Air Quality (Ambient & Stack)- terminal, lock & jetty sites	PM_{10}, $PM_{2.5}$, SO_2, NO_x, CO	Three Locations up wind and downwind direction including project site. Once in 3 months	• Fine Particulate Samplers for $PM_{2.5}$ • Respirable Dust Sampler for PM_{10}fitted with Gaseous sampling arrangements for SO_2 and NO_x, • CO analyser;	Contractor	IWAI & PMC
2.	Surface Water Quality- terminal, lock & jetty sites	Physical, chemical and biological	River u/s & d/s of the proposed facility Once a month	Grab sampling and analysis by using standard methods	Contractor	IWAI & PMC
3.	Drinking water Quality- terminal,	Physical, chemical and biological	Drinking water for labour camps	Grab sampling and analysis by using standard methods	Contractor	IWAI & PMC

S. No.	Aspect	Parameters to be monitored	No of sampling locations & frequency	Standard methods for sampling and analysis	Role & Responsibility	
					Implementation	Supervision
	lock & jetty sites		Once a month			
4.	Noise Level- terminal, lock & jetty sites	Day time and night time noise level (max, min & Leq levels)	Construction labour camp, construction site and nearest habitation Once a month	Noise meter	Contractor	IWAI & PMC
5.	Soil Quality - terminal, lock & jetty sites	Soil texture, type, Electrical conductivity, pH, infiltration, porosity, etc.,	Construction site, labour camps and debris disposal site Once in 6 months	Collection and analysis of samples as per IS 2720	Contractor	IWAI & PMC
6.	River Bed Sediment- terminal, lock, jetty sites	Texture, type, Electrical conductivity, pH, infiltration, porosity, etc., and biological compounds	River bed near sites of terminals/locks/jetty Once in 6 months	Collection and analysis of samples as per IS 2720	Contractor	IWAI & PMC
7.	Green Belt- terminal & lock site (jetty site if green belt developed)	Plantation survival rate	Green belt area at site-periphery of site and along roads Once in year	Survey, counting, recording & reporting	Contractor	IWAI & PMC
8.	Soil Erosion- terminal/lock & jetty site, site for river bed and bank protection and sites of river training structures development	---	Upstream & downstream of civil intervention sites and sites of river bank protection/river training works Six monthly	Survey & observation; Extent and degree of erosion; Structures for controlling soil erosion	Contractor	IWAI & PMC

S. No.	Aspect	Parameters to be monitored	No of sampling locations & frequency	Standard methods for sampling and analysis	Role & Responsibility	
					Implementation	Supervision
9.	Aquatic ecology-terminal/lock & jetty site, site for river bed and bank protection and sites of river training structures development	Phytoplankton, Zooplankton and species diversity index	U/s and d/s of the civil intervention sites and location of river training works/bank protection works Six monthly	Plankton net of diameter of 0.35 m, No.25 mesh size 63 and analysis by using standard methods.	Contractor	IWAI & PMC
10.	Integrity of embankment-locations of existing & newly constructed embankments along NW-1	---	locations of existing & sites of proposed sites for embankments construction along NW-1	Survey & observation; Extent and degree of erosion; Structures for controlling soil erosion	Contractor	IWAI & PMC
Operation Phase						
1.	Air Quality (Ambient & Stack)-terminal, lock & jetty sites	PM_{10}, $PM_{2.5}$, SO_2, NO_2, HC and CO	Three Locations up wind and downwind direction including project site. Once in 6 months	• Fine Particulate Samplers for $PM_{2.5}$ • Respirable Dust Sampler for PM_{10}fitted with Gaseous sampling arrangements for SO_2 and NO_x • CO analyser	NABL accredited Lab to be contracted by IWAI	IWAI
2.	Surface Water Quality-terminal, lock & jetty sites	Physical, chemical and biological	River u/s & d/s of the proposed facility Once in quarter	Grab sampling and analysis by using standard methods	NABL accredited Lab to be contracted by IWAI	IWAI
3.	Drinking water Quality-	Physical, chemical and biological	Drinking water for staff	Grab sampling and analysis by using standard	NABL accredited Lab to	IWAI

S. No.	Aspect	Parameters to be monitored	No of sampling locations & frequency	Standard methods for sampling and analysis	Role & Responsibility	
					Implementation	Supervision
	terminal, lock & jetty site		Once a quarter	methods	be contracted by IWAI	
4.	Noise Level- terminal, lock & jetty sites	Day time and night time noise level (max, min & Leq levels)	Two locations: Project site & nearest habitation - Once in quarter	Noise meter	NABL accredited Lab to be contracted by IWAI	IWAI
5.	Wastewater Management - terminals	Physical, chemical and biological of sewage and STP treated water	Terminal site, testing of sewage and STP treated water Once in quarter	--	NABL accredited Lab to be contracted by IWAI	IWAI
6.	Plantation- terminal & lock site (jetty site if green belt developed)	Plantation survival rate of 70%	Maintenance and survival loss of existing - Once in year	Survey, counting, recording & reporting	IWAI	IWAI
7.	Soil Erosion- terminal/lock & jetty site, site for river bed and bank protection and sites of river training structures development	---	Upstream & downstream of civil intervention sites and sites of river bank protection/river training works Six monthly	Survey & observation; Extent and degree of erosion; Structures for controlling soil erosion	IWAI	IWAI
8.	Aquatic ecology- terminal/lock & jetty site, site for river bed and bank protection and sites of	Phytoplankton, Zooplankton and species diversity	U/s and d/s of the civil intervention sites and location of river training works/bank protection works	Plankton net of diameter of 0.35 m, No.25 mesh size 63 and analysis by using standard methods.	IWAI	IWAI

S. No.	Aspect	Parameters to be monitored	No of sampling locations & frequency	Standard methods for sampling and analysis	Role & Responsibility	
					Implementation	Supervision
	river training structures development		Six monthly			
9.	River Bed Sediments-terminal, lock, jetty sites	Physio-Chemical Parameters	River bed near sites of terminals/locks/jetty Once in 6 months	Depth Sampler	IWAI	IWAI
10.	Integrity of embankment-locations of existing & newly constructed embankments along NW-1	---	locations of existing & newly constructed embankments along NW-1	Survey & observation; Extent and degree of erosion; Structures for controlling soil erosion	IWAI	IWAI

7.6. Organizational Framework

For effective implementation of the proposed environmental management plan, it is necessary to have permanent organizational set up charged with the task of ensuring effective implementation of EMP and to monitor the implementation efficiency. IWAI has set up a project management unit which is staffed with environmental and social specialists. These specialists would work as an environment and social cell (ESC) within PMU. It is proposed that each field unit will have one designated officer responsible for environment and social aspects who will also coordinate with ESC. Also this cell will keep track of the developments happening within the influence area by maintaining regular contact with the above identified developmental authorities in the area. Regular contact can be maintained through meetings, workshops, seminars and brochure distribution. The major responsibilities of IWAI and of ESC would be:

- To implement the environmental management plan
- To assure regulatory compliance with all relevant rules and regulations
- To ensure regular operation and maintenance of pollution control devices
- To minimize environmental impacts of operations as by strict adherence to the EMP
- To initiate environmental monitoring as per approved schedule
- Review and interpretation of monitoring as per approved schedule
- Review and interpretation of monitoring results and corrective measures in case monitored results are above the specified limit

- Maintain documentation of good environmental practices and applicable environmental laws as ready reference
- Maintain environmental related records
- Coordination with regulatory agencies, external consultant, monitoring laboratories
- Maintain log of public complain and the action taken
- Efforts shall be made for setting up of common conservation cell consisting of one marine biologist, and ecologist, a sociologist and a fishery expert
- To communicate and share this environment management plan with all the identified stakeholders within the influence zone of the CIA through meetings, workshops, seminar, brochures etc

The ESC should have all basic record keeping facilities such as hard ware/software facilities, adequate space, vehicle (transport) and basic furniture and all simple instruments such as GPS, Digital camera, Hand held noise metre etc. The cell should have all basic environmental management data of the project that includes but not limited to the following:

- Environmental Impact Assessment Report (both well preserved soft and hard copy) and Environmental Management Plan
- All valid and up to date regulatory permits and consent papers
- All latest Environmental legislations, policies, codes and manuals for ready references
- A list of consultants on environmental management need to be kept with yearly revision of the list. This will help to receive proper advice in case of an emergency or are requirement and also to implement day to day environmental management activities.

Over a period of time a system to understand and absorb the new revisions and changes in the environmental requirements and practices are to be established. This can only be achieved by regular training and genuine capacity building initiatives. IWAI shall also ensure availability of adequate resources. Institutional framework for the project is given in **Figure 7.1.**

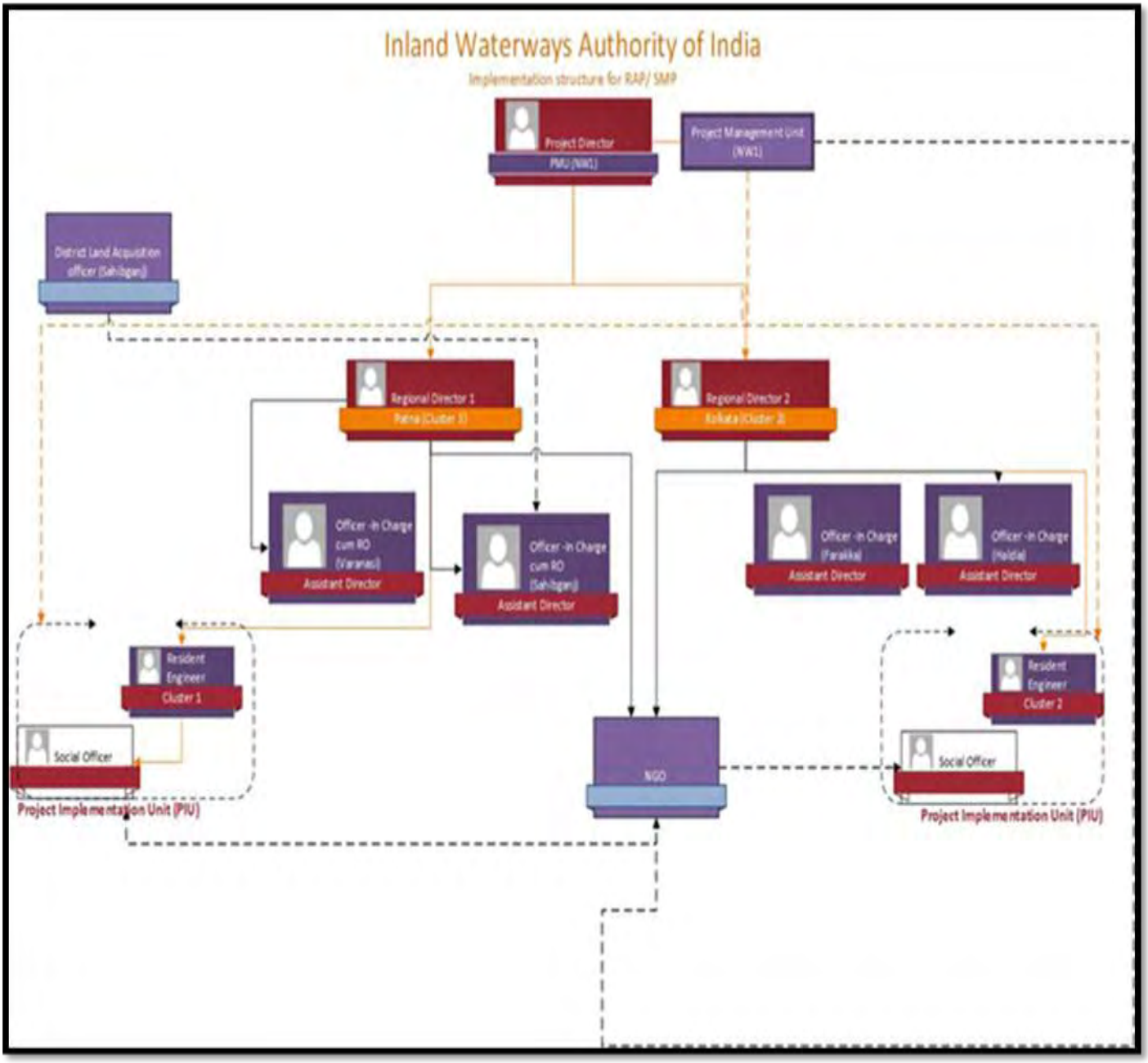

Figure 7.1 : Institutional Framework of IWAI

7.7. Environmental Health & Safety Policy and EHS Management System

An effective environmental health and safety policy is essentially required to be prepared for the project and it should be communicated to the workforce through displaying posters/bill boards/posters/glow boards and campaigning around the work site. Posters should be in Hindi, English & Regional language so as it can be understood by the workforce. Verbal communication through campaigning also should be carried out. Some of the important days such as Environment Day (June 5), Red Cross Month (March), Emergency Preparedness Week (May 1-7), National safety day (4th April), National Health Day (7th April), Fire safety

day (14th April), 20th April (Earth day) can be planned for spreading the awareness for Environment Protection, Cleanliness and safety among work force through campaigning.

For effective and systematic implementation of the project, it is desirable that IWAI (The EA) develops its Environmental and Social management systems which are auditable and effectively enforceable. Parallel can be drawn from the experience of National Highway Authority of India or Delhi Metro Rail Corporation and adopt EHS system on the similar lines. Each contractor should be contractually bound to follow such system and must have EHS management system in line with EA's management system. IWAI should also develop its standard technical guidelines for Environmental Assessment, Management and Reporting

7.8. Mechanism for Feedback and Adjustments

As part of the feedback mechanism, the ESC of PMU shall monitor project compliance based on monitoring reports, audit and inspection reports with respect EMP, EMoP and applicable laws, rules and regulations. ESC will report to PD quarterly. In case, any deviation from the contract requirements with respect to proposed EMP is observed, the same shall be corrected within a fortnight through contractor and PMC and records maintained for the same. ESC will also verify the facts reports through periodic site visits.

Public involvement shall be encouraged and ensured throughout the lifecycle of the project. The ESC shall gather and maintain information on any damage or public concern that may be raised by the local people, NGOs and local authorities. While immediate solutions are to be worked out with the help of contractor, a detailed report will be submitted to the PMU and PD for information or detailed consideration, as the case may be. The PMC and ESC will be responsible to bring it to the notice of the PMU and PD. Resulting decisions shall be communicated back to PMC and contractor for correction and future implementation.

7.9. Grievance Redress Mechanism

The concern/grievances from local/affected people/developmental authorities/pollution control boards/other identified agencies in above sections of the chapter may come up related to inappropriate implementation of various components of EMP. These issues required to be addressed through acknowledgement, evaluation and corrective action and response approach. To resolve grievance from public and other concerned departments a grievance redressal cell is required to be formulated. The cell should be headed by the PMU/Director concerned. Firstly, it should be assessed if the grievances are genuine or suggestion is acceptable through site visits, surveys and consultations immediately after the receipt of grievance. Accordingly, response should be given within 15-30 days by the PMU in consultation with PMC and Director concerned. In case the PMU is unable to resolve the issue, the matter should be forwarded to Project Director at Head Quarter. The corrective action should be started as per the response or action plan indicated to the stakeholder. The outcome shall also form part of quarterly report to World Bank **(Figure 7.2)**. Six monthly meetings with the public and other concerned agencies can also facilitate in identification of grievance and other environmental and social issues within the influence zone.

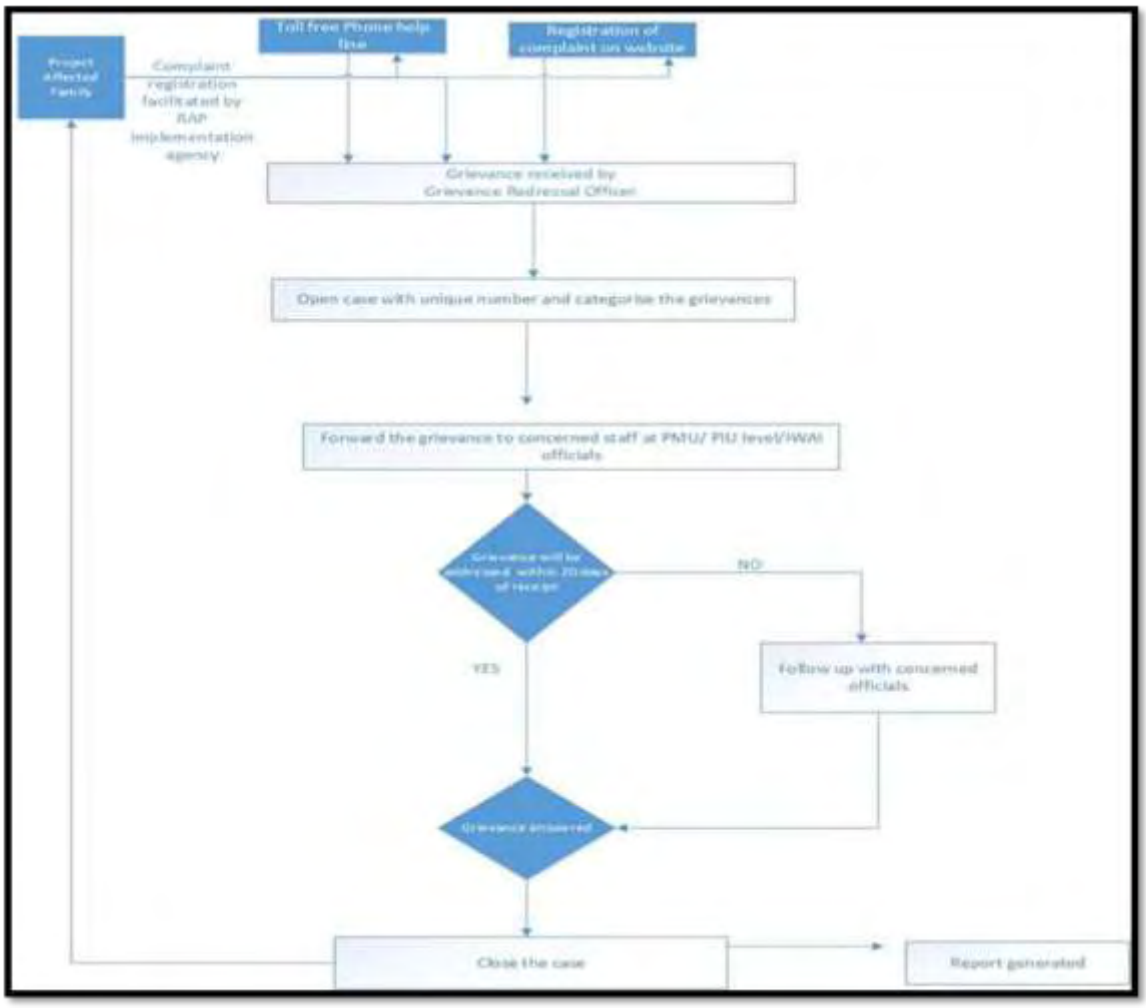

Figure 7.2 : Grievance Redressal Cell

7.10. Conclusion & Recommendations

Environment management plan is prepared for the identified cumulative impacts. IWAI can take up the mitigation measures and remediation measures for controlling the impact on CERs in influence area, however an extended role of IWAI is suggested in this plan so as to manage the cumulative impacts in the influence area. IWAI has an operational and effective institutional framework which will implement the environment management plan as suggested for Jal Marg Vikas Project during all the stages. It is recommended through this plan that IWAI should additionally take up the task of interaction with the ULBs, DAs, PCBs, Industrial Departments, EDFC, Road Development Authorities, NHAI and other concerned department six monthly so as to know their developmental plans, to assess effect of their plans on NW-1 and sharing the suggestive environment management and impact mitigation plan for respective development prepared in this document. This practise can regulate the cumulative impacts to some extent and may help in mitigation of the impacts.

Annexures

Annexure 4.1: List of the stakeholders invited for the consultation meeting at Farakka Lock and Sahibganj Terminal

List of Stakeholders for Farakka Lock

S. No.	Name	Designation	Department	Mobile No.
1	Mrs. Moonmoon Roy	Panchayat Pradhan	Bewa Gram Panchayat	8820194794
2	Mr. Jaihid Hussain	Director	Farakka Welfare Society(NGO)	9732807273
3	Santunu Dutta	Land revenue inspector	Farakka LRO	9851970202
4	Kesang Dhendup Bhutia	BDO & Block Executive Officer	BDO, Farakka	9434770026
5	Mr. Prasun K Dhara	BLRO	Farakka BLRO	9474308250
6	Mr. Santosh Mujherjee	Executive Officer	TINI(NGO)	8906689465
7	Mr. Subhra Khan	Executive Engr.	PWD, Farakka Circle	9433956762
8	Mr. Arnab Chakraborty	Journalist (Malda & Farakka Division)	Journalist from Uttarbanga Sangbad	9609442670
9	Mr. A.K.Paul	Executive Engr.	FBP Welfare Department	7074957614
10	Nikhil Sinha	Executive Engr.	FBP Anti-Erosion Dept	8348886678
11	Prof. Sutapa Dutta	Prof dept. Of Social Science	S. Nurul Hasan College	9434183507
12	Asesh Deyashi	Asst. Director	WB Agriculture Dept. (Farakka Circle)	9563273466
13	--	Officers	MRSW, NGO, Farakka	--

List of Stakeholders for Sahibganj Terminal

S. No.	Name	Designation	Department	Mobile No.
1	Shri Umesh Prasad Singh	Deputy Commissioner	Office of the Deputy Commissioner	06436-222100
2	Shri K.K. Tiwari	Divisional Forest Officer	Divisional Forest Office, Sahibganj	--
3	Mr. Sushil Soren	District Forest Officer	DFO, Van Pramandal Awas, Sakrogarh, Sahibganj	--
4	Sh. Faiku Ram	District Mining Officer	District Mining Department	--
5	Shri Vinay Kumar Mishra	District Land Acquisition Officer	Distt. Land acquisition Department	9934096667
6	Er. Ras Bihari Singh	Executive Engineer	Public Health Engineering Department	9934884808
7	Er. Vishal Chandra Toppo	Executive Engineer	Jharkhand Rajya Vidhut Vitran Nigam Ltd.	9431135857
8	Er. Santosh Kumar Tiwari	Superintending Engineer	Irrigation Circle, Sahibganj	9135308972
9	Er. Abhdesh	Executive Engineer	Ganga Pump Nahar	9431194614

S. No.	Name	Designation	Department	Mobile No.
	Kumar		Pariyojna (Irrigation)	
10	Dr. Bhagwat Marandi	CMO	Health Department	9334776755
11	Shri Mithlesh Kumar Singh	Executive Officer cum BDO	Nagar Parishad	9955229279
12	Er. Shushil Kumar	Executive Engineer	Public Works Department	9431366639
13	Shri Marshel Khalko	District Agriculture Officer	Agriculture Department	9431193417
14	Smt. Munni Gaund	Mukhiya (Samda Nala, Samadaasi Aasharam, SakariBajar)	Gram Panchayat Head	7808789116
15	Smt. Usha Khalko	Mukhiya (HaathiGarhi)	Gram Panchayat Head	9801018326
16	Local People Villages Rampur & Samdha Nalla	--	--	--
17	Shri Niranjan Kumar	A.D.C	DC Office, Sahibganj	--
18	----	District Fisheries Officer	District Fisheries Office, Sahibganj	--
19	Mr. Ram Dayal Ravidas	Assistant Engineer	Drinking Water and Sanitation Department, Sahibganj	--
20	Mr. Vidya Nand Singh	Executive Engineer	Small Irrigation Department, Sahibganj	--
21	---	Additional Principal Chief Conservator of Forest (W/L)	Environment & Forest Department, Sinchai Bhawan, Patna	--
22	--	Conservator of Forest	Bhagalpur, Bihar	--
23	--	District Forest Officer	Bhagalpur, Bihar	--
24	---	Director Ecology	Environment & Forest Department, Sinchai Bhawan, Patna	--
25	--	Principal Chief Conservator of Forest (HOFF)	Environment & Forest Department, Sinchai Bhawan, Patna	--
26	Prof. Subhasis Dey	Professor	Vikramshila Bio-diversity Research and Education Centre, TM Bhagalpur University, Bhagalpur	--
27	Prof. Sunil Chaudhary	Professor	Vikramshila Bio-diversity Research and Education Centre, TM Bhagalpur University, Bhagalpur	--
28	---	Member Secretary	JPCB, Nagar Prashasan Bhawan, HEC, Dhurva, Ranchi, Jharkhand	--
29	--	PCCF Wildlife & CWLW	Department of Forest & Environment, van Bhawan, Doranda, Ranchi	--
30	--	Principal Chief	Department of Forest &	--

S. No.	Name	Designation	Department	Mobile No.
		Conservator of Forest (HOFF)	Environment, van Bhawan, Doranda, Ranchi	
31	--	Officers	Talijari Matsya Jeev Samiti	--
32	--	Officers	Jan Kalyan Abhiyan	--

Annexure 4.2: Copy of Invitation Letter Sent to Stakeholder

Invitation Letter Sent to Government Dept. and NGO's

EQMS
Environment Quality Management Services

EQMS INDIA PVT. LTD.

304-305, III Floor, Rishabh Tower, Plot No. 16
Community Centre, Karkardooma, Delhi - 110 092
Phone : (011) 3000 3200 - 30003219
Fax : (011) 2237 4775
E-mail : eqms@eqmsindia.org
Url : www.eqmsindia.com
CIN : U85199DL1998PTC094954

Date: 13.10.2015

To,
Mr. Vidya Nand Singh
Executive Engineer
Small Irrigation Department
C/O Shankar Jha, Chaudhary Colony
Sahebganj, Jharkhand

Subject: Request for Support & Participation in Public Consultation Meetings at Sahibganj to be Organized by EQMS India Pvt. Ltd. along with JV Partners AIAID & IRGSSA for upcoming Project of IWAI "Capacity Augmentation of Navigational Infrastructure of National Waterway-1, i.e. Haldia to Allahabad"

Dear Sir,

Inland Waterways Authority of India (IWAI) has undertaken above mentioned project to enhance the freight movement along the NW-1. In this regard IWAI has appointed Environmental & Social Consultants to study the associated Environmental & Social Sensitivities of the project. Consultants are carrying out socio-economic survey at Sahibganj at present and have organized a formal public consultation meeting on 16th October, 2015. Details of Venue and Time for meeting is given below

Venue: Ashram, Village Samdha Ghat, Sahibganj

Time: 11:00 AM

We thus request you to kindly attend the meeting to provide the inputs and suggestions for the project.

We look forward to kind cooperation

Thanking you

Sanjay Kumar Jain
Director-Technical
EQMS India Pvt. Ltd.

14/10/15

Annexure 4.3: Proceedings of Informal Consultations for NW-1

Proceedings of Informal Consultation

Sr. No	Date and place of consultation	Name and designation of person with organization name	No of people participated in the consultation	Major outcome: specifically : Have they supported the project or not. Major concern raised.
Informal Consultation in Varanasi				
1.	IWAI, Varanasi & Date:20.06.2015	A.K.Mishra, Deputy Director, IWAI, Varanasi	**1**	According to him site location is suitable for development of terminal from HFL prospective. Other points he added are 1. Economic Feasibility 2. Reduced Air and noise pollution, 3. Increased Employment
2.	Varanasi & Date: 21-6-2015	Group Discussion with Locals, Fishermen and Boatmen, Baluaghat, Varanasi 1. Suresh Saki 2. Hariyan 3. Savajeet Sahni 4. Kashim Nishad 5. Rambabu Nishad 6. Syambabu nishad 7. Sidhunishad 8. Jaikishan 9. Bholusankar 10. Vishunnishad 11. Dablu Sahni 12. Takkan majhi 13. Ramnath Majhi 14. Gopal Nishad 15. Sidhu Sahni 16. Kashi 17. Dakhhi 18. Somnath 19. Hiralal	52	1. People consulted involved local resident of the area, fishermen and boatmen and squatters at Balua Ghat 2. People affected here are indirectly 3. Most of them are educated till higher secondary level. All of them are well aware about the project. 4. Some of them wants this project because more job opportunity will create in the area. 5. Some of the fishermen showed concern the development of project may lead to **fish** kill and in turn will affect the fishing businesses. They expect some allowances from the Government in lieu of their affected income.

Sr. No	Date and place of consultation	Name and designation of person with organization name	No of people participated in the consultation	Major outcome: specifically : Have they supported the project or not. Major concern raised.
		20. Shankar 21. Ramnahe 22. Visnu 23. Syambabu 24. Banarsilal 25. Seva lal 26. Manish 27. Gopal ji 28. Manish kumar 29. Vivek Chorasiya 30. Sankar Sahni 31. Bittu 32. Ramesh 33. Banarsi 34. Gaurisankar 35. Ranku Sahni 36. Pancham Mallah 37. Dilesh Sahni 38. Mirtu Kumari 39. Dhobelal 40. Bichanu 41. Sumeru 42. Bablu kumar 43. Chedi Sahni 44. Raju Sahni 45. Rajesh 46. Mohit 47. Anans Sahni 48. Mote Nath 49. Banarsi lal 50. Chote lal 51. Sri Ram 52. Gopal Ji		
3.	PWD, Varanasi &	M.P Singh (Administrative	1	1. PWD officials are not aware about the project development

Sr. No	Date and place of consultation	Name and designation of person with organization name	No of people participated in the consultation	Major outcome: specifically : Have they supported the project or not. Major concern raised.
	Date: 21-6-2015	Office)		2. When the details were shared with him about the project, he presented a favourable view towards the project 3. He stated that development of waterways will reduce the freight load from highways, will reduce the air and noise pollution in area and will make transportation of goods cheaper. 4. However he suggested that the nearby roads to the terminal facility should be strengthened and widened, as there may be substantial increase in traffic movement in the roads connecting the terminal site after development of terminal. Thus IWAI should carry out traffic assessment due to project development and should coordinate with PWD in this regard.
4.	UPSIDC, Varanasi & Date-22-6-2015	Sushash Tripathi Ph-9935757014	1	1. Development of terminal site may generate necessity of development of industrial zone near the terminal site as industries will be willing to find a location close to terminal site. 2. Development of terminal will facilitate low cost transportation of goods which will enable industries to produce goods at low cost, however no such industry exist in the industrial area at present in the nearby industrial area which may avail the facility of raw material movement by waterways.
5.	Kashi Van Mandal, Kacchua sanctuary, Varanasi & Date: 23.06.2015	Ajay roy, DFO, Kashi Van Mandal, Kacchua sanctuary Varanasi	1	Discussion was carried out to identify environmental issues may associate with Turtle Sanctuary. Following are the main concerns of the officer: 1. There turtle will get impacted due to regular movement of ships and vessels in river. 2. Because the Turtle is very shy in nature the noise generated from the waterway transport will affect them. 3. Siltation during the construction period will create a problem to aquatic fauna. 4. Chance of oil spillage from the ships will contaminate the Ganga water quality. Solid waste generation management shall be done in scientific manner.
6.	District Industry Centre (DIC), Varanasi & Date:	Umesh Kumar Singh (Joint Commissioner, Industry)-09838467078	1	1. They were not aware about the project development. 2. When project information was shared with them they said that there are 2 industrial areas in Chandauli District. These

Sr. No	Date and place of consultation	Name and designation of person with organization name	No of people participated in the consultation	Major outcome: specifically : Have they supported the project or not. Major concern raised.
	23-6-2015			industries are generally agro based, small scale and non-polluting types. However, development of terminal may interest industrialist to develop industries in nearby areas. 3. He suggested waterways are cost effective and environment friendly mode of transportation. However, water pollution may occur, if wastewater is discharged by ships and terminal facility into river. This may also affect the aquatic life of the river and fishing activity.
7.	Banaras Hindu University & Date: 24.06.2015	Dr.B.D. Tripathi, UGC-BSR, BHU, Ganga pollution Research, NMCGA	1	Discussion was carried out with him regarding this project. Following are the main concerns of Dr. Tripathi was: 1. Ganga River has anti bacterial quality on itself. Execution of this project, Ganga will lose its anti bacterial property. 2. Aquatic flora and fauna will disturbs 3. Religious point of view he was not satisfied. 4. Overall he is not in favour of this project.
8.	Irrigation Department, Varanasi & Date: 24.06.2015	E.S.P. Srivastava, Sacchiv, Jal Nigam Irrigation Department, Varanasi	1	1. He is concerned about the vibration generated due to heavy traffic movement can disturb the strata of pump wells located in Ganga River for drinking water purposes.
9.	Ganga Pollution Unit at Varanasi & Date: 24-6-2015	Er. J.B Rai, General Manager	1	1. He was aware about the project development 2. He does not have any favour and opposition for the project development
10.	Public Health department (PHD), Varanasi & Date: 26.06.2015	Dr. M.P.Chaurasiya, (C.M.O), Public Health Department, Varanasi.	1	1. They are not aware about the project 2. They do not have any existing and upcoming health schemes in the area near to the site development. 3. They suggested IWAI should contact them for development of health.
11.	Vikas Bhawan at Varanasi & Date: 26.06.2015	R.k.sharma (DESTRO), Contact:941525214 C.M.srivastava:9451890977, Statics Depatment	2	1. They are not aware about the project 2. They do not have any upcoming development scheme in the area near to site. 3. They did not have any say about the project development.
12.	USPCB, Varanasi & Date:	Dr. Mohd. Sikandar R.O, UPPCB	1	1. He was aware about the project development. 2. He was concerned regarding the water quality issues which may

Sr. No	Date and place of consultation	Name and designation of person with organization name	No of people participated in the consultation	Major outcome: specifically : Have they supported the project or not. Major concern raised.
	27.06.2015	Contact:7800006344		be there due to construction of terminal facility and operation of cargos, spillage in case of accidents, discharge of waste and sewage, oil leakage and other related activities. 3. He suggested environment management plan should be prepared for the construction and operation phase and that should be strictly followed by IWAI and cargo operators to ensure no pollution to occur due to them. 4. In case of accidents, cargo operator should be responsible to clean the spills.
13.	Ralhupur, Village, Varanasi & Date-8-7-2015	Project Affected Families: 1. Dinesh Singh 2. Ashok Singh 3. Santosh Kumar Singh 4. Alok Kumar Singh 5. Gopal Singh 6. NarenderBahadur Singh 7. Laxami Prased Rai and Family.	7	1. People are aware about the project development 2. Discussion was carried out with Farmers, students and PAF regarding the impact of this project. People are well aware about the project. The main issues of the villagers are: ▪ Most of them want this project because more job opportunity will create in the area. ▪ People were expecting permanent job in this project. ▪ Majority of people have positive attitude towards the project. ▪ People also expect infrastructure development such as good roads, water supply, power supply in their area after coming up of proposed terminal. ▪ People expects that the upcoming project is of less polluting industries so as no pollution related problems will observed in the area. ▪ They wished and expect from authority that their compensation should be on current market price. ▪ They got notification from government before acquisition of their land. ▪ As per villagers, officers from block/anchal never talked to them regarding compensation and land acquisition. ▪ They have been growing crops like Jau, Pulse, Arhar, Masoor for a long time on their land but now they have been gradually losing their irrigation land.

Sr. No	Date and place of consultation	Name and designation of person with organization name	No of people participated in the consultation	Major outcome: specifically : Have they supported the project or not. Major concern raised.
				▪ Villagers are requesting that compensation of their land should be as per prevailing market rate, if it is not feasible at least compensation should be disbursed to them on circle rate. 3. Some Project affected families have filed petitions in the court for higher compensation.
14.	Balwa Ghat Ramnagar Date:9.7.2015	Fishermen, Boatmen and Squatters at Ghat and local community. 1. Jaikishan 2. Ramlal 3. Kamlu 4. Roshan Lal 5. Majhi lal 6. Kamlulal 7. Sankar 8. Ramnahe 9. Vivek 10. Aman 11. Banarsi 12. Kamlesh	12	1. Yes, Supporting project 2. Fishermen, Boatmen Squatters at Ghat and local community were happy from the NW-1 3. The main concern of the local community is to provide them the livelihood based activities in the project works. 4. Second concern is to provide them skill based training which can help them to provide employment
15.	Land Owner (Local People), Dated-23.8.2015	Vieswar Dravin, Land owner for proposed access road to Terminal	1(The land belongs to one family of three brothers)	1. Mr. Vieswar has some issues. Total land to be acquired as per the Government notification dated 19th March 2015 is 0.592 ha. The land belongs to one family of three brothers. The owner of the land opined that the valuation of land is being done based on the circle rates and is not justified. He is requesting for the revision of the land value 2. Compensation amount and circle rates for the proposed land should be revised with the consent of the affected families in the meeting before finalization of the circle rates. 3. Loss of this land will lead to loss of livelihood to the family.
Informal Consultation in Sahibganj				

Sr. No	Date and place of consultation	Name and designation of person with organization name	No of people participated in the consultation	Major outcome: specifically : Have they supported the project or not. Major concern raised.
16.	Samda Nala Ghat, Near Project site, Sahibganj **&** Date**:** **1**6-09- 2015	General Public and Fisherman 1. Shiv ji maldar 2. Chanchal kumar yadav 3. Jawahar yadav 4. Rmaan 5. Narayan yadav 6. Shiv Shankar yadav 7. Rupan Mandal 8. Shivshankar yadav 9. Sudeshan Yadav 10. Sushila devi 11. Mahendra yadav 12. Kanhayia yadav 13. Bal Krishna Yadav	13	Participants included farmers, students, affected people, fishermen, Boatmen and females. Most of the people in the area are farmers and depend on agriculture for livelihood. Villagers are aware about the IWAI planning for construction of terminal. Following issues/concerns were raised by the participants. 1. Land owners are highly concerned as they depend on the agriculture and mango plantation for their livelihood 2. Students however see the project as positive development in the area in terms of infrastructure, power, roads and water supply facilities and employment generation 3. Fishermen stated that fish catch will reduce in the area after construction of terminal due to increase in water pollution and killing due to barge movement. 4. Farmer practice river terrace cultivation in the river bed area and they are worried that they will not be allowed to practice the same after construction of terminal due to restrictions by authority.
17.	Ashram, Samda Nala Village **&** Date: 9th -10-2015	Villagers from Rampur & SamdaNala village	10	Participants included farmers, students and females. Following issues/concerns were raised by the participants. 1. Loss of livelihood is major concern due to loss of agriculture land 2. Land owners were demanding compensation should be as per prevailing market rates 3. Local people only should be considered for provision of employment 4. Proper R & R should be done before displacement of affected people. Affected people/land owners are worried about the loss of houses and place of relocation 5. Religious sentiments of locals are associated with River Ganga so they want place near to River Ganga for relocation 6. Employment and home should be provided to affected people before displacement/land acquisition and loss of livelihood 7. Project development will lead to increase in pollution in area and water. Water pollution may significantly impact the fish catch.

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18.	Ashram, Samda Nala Village & Date: 9th -10-2015	Villagers from Rampur, Ashram, Samda Nala Village (8 Participants)	8	Participants included farmers, fishermen & students. Following issues/concerns were raised by the participants. 1. Land owners categorically said that land will be given only, if they will get appropriate compensation 2. Also they require employment, if complete land will be taken away from them 3. They mentioned large nos. of trees are planted in the land which is under planning to be acquired, cutting of large no. of trees will affect the environment of village thus equal nos. of trees should be planted before cutting the trees in nearby land areas 4. They said some dolphins are seen in the water, operation of barges may be danger to life of dolphin. 5. They are scared as they think fishing will be banned in the area after development of terminal which is major livelihood source of most of the people.
19.	Ashram, Samda Nala Village & Date:9th -10-2015	Ashram, Village Rampur	15	Participants included farmers, fishermen & students. Following issues/concerns were raised by the participants. 1. Land owners are expecting appropriate compensation for their land and also assistance in alternative livelihood of their land will be acquired 2. They demanded job for them and their children and they mentioned they should be given skill generation training for job offered as they have practised only agriculture throughout their life 3. They insisted that they worship River Ganga and they will not bear addition of pollutants and waste in the River 4. They want to get assurance about that they can continue fishing activity in the river after construction of terminal. 5. They wanted to ask what other developments will be taken up by IWAI in village for betterment of villagers
20.	Naya Tola & Samda Nala	Villagers from Naya Tola & Samdha Nala	10	Participants included farmers, students and females. Following issues/concerns were raised by the participants.

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	Village & Date:5th-11-2015			1. Farmers whose land will be acquired are worried due to loss of land and loss of livelihood as they are practising agriculture since generation 2. Land owners demanded alternate housing facility and employment prior to land acquisition and displacement 3. Fishing activity will be hampered in the river due to development of terminal and plying of large nos. of cargos 4. Cutting of large nos. of trees within the project site will impact the climate of the area 5. Local people should be considered for providing employment. 6. Community facility in the area, if any to be disturbed should be relocated at the accessible and appropriate location
21.	Asharam Ashram, Naya Tola & Samda Nala Village & Date:8th November, 2015	Villagers from Naya Tola & Samdha Nala	20	Participants included farmers, students and females. People are aware about the project. Following issues/concerns were raised by the participants. 1. Land owners are worried about the compensation rates and the loss of livelihood 2. They demanded provision of employment for the affected people. Authority committed for provision of employment to locals after coming up of project 3. Locals demanded compensation should be given as per market rates 4. Displaced population want the relocation near or inside the village only 5. Assistance should be given for alternate livelihood for affected people 6. Water quality can be affected due to project development, this will affect the aquatic life in the area. 7. Air pollution in the area will increase due to increased movement of vehicles in the area.
22.	Department of Environment and	Dr. D K Shukla Designation: Principal Chief	1	1. Dr. D.K. Shukla gave idea on extent of the dolphin sanctuary. VGDS boundary starts from Sultangunj block boundary and ends

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	Forest, Aranya Bhawan, ShahidPir Ali Khan Path (Riding Road), Shekhpura, Patna-14 **&** Date:15th September 2015	Conservator of Forest (PCCF) Phone: 0612-2545074 Department of Environment and Forest.		at Kahalgaon subdivision boundary. He also advised to meet Chief Wildlife Warden, Bihar for more information on VGDS. He raised the following concern 2. Dolphins will be impacted with barge & cargo movement especially the baby dolphins. 3. Development of terminal may increase the water pollution which will significantly affect the aquatic life 4. Strict norms and measures are required to be followed and taken towards the protection of habitat of the dolphins, if this project is being developed. 5. Discharge of waste in the river should be strictly prohibited by anybody (terminal/vessels/barges). Waste management facilities should be developed at site and waste should be treated and disposed off at other safe locations. 6. Mechanical movement of barges will impact the dolphins thus the speed of the cargos movement in these water should be regularized
23.	Department of Environment and Forest , Aranya Bhawan, ShahidPir Ali Khan Path (Riding Road), Shekhpura, Patna-14 **&** Date:15th-09- 2015	Shri S S Chaudhary Designation: Additional Principal Chief Conservator of Forest (PCCF) and Chief Wildlife Warden, Bihar Phone: 09430919565	1	1. Shri S.S. Chaudhary was aware about the project development. He gave more information about the extent of VGDS. He told that river stretch between Sultanganj and Kahalgaon Pahar (50 kms) is declared as VGDS. Copy of notification for declaration of VGDS as Dolphin Sanctuary was provided by him. He raised the following concerns: 2. Project may have significant impact on dolphin thus proper measures should be taken during operation phase to minimize this impact. 3. It may be required to obtain Wildlife clearance for the project 4. Interference in this zone should be minimized to the extent possible. 5. Minimal disturbance to the dolphin should be done as they are sensitive. 6. Waste management is key requirement. Waste disposal, disposal of coal ash and contaminated run-off to the river may pollute the river water quality significantly which in turn may affect the aquatic

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				life.
24.	Gangetic Plains Regional Centre, Zoological Survey of India, 11-D Rajendra Nagar, Patna - 800 016, 0612-2360054 & Date: 15th-09-2015	Dr. Gopal Sharma Designation: Scientist D and Officer-In-Charge at Gangetic Plains Regional Centre Phone: 09431221918	1	1. Dr. Gopal Sharma was aware about the IWAI Project. He opined that the project will have impact on Dolphins. He told that VGDS extends about 60-65 kms. Coordinates for starting and end points are as follows: ▪ Sultanganj (Ajgaivinath Temple) N 28°15.247' and E 86°44.758' ▪ Kahalgaon (3 hillocks in river) N 25°15.402' and E 87°13.246' 2. He told that this stretch is preferred habitat of the dolphin due to availability of confluence points, meandering locations and deep pools of river. About 127 dolphins have been recorded in VGDS. Other aquatic fauna of VGDS include Otter, gharial, turtle, etc. VGDS provides breeding ground of such species. He raised the following concerns: ▪ VGDS is rich in bio-diversity thus care should be taken that minimal or no disturbance should be caused to aquatic life ▪ Dredged material may contain toxic compounds so should not be dumped on river bank as river banks are habitat for otter, birds feeding on aquatic organisms and other species ▪ Dolphins are affected by the vibrations. Plying vessels create ripples which causes energy losses in dolphin for its movement and carrying out other functions. ▪ At present dolphins are distracted by vessels plying in NW-1. Mitigation measure for propellers to avoid dolphin getting hit should be considered, e.g. propeller guard. ▪ This leads to entanglement of dolphins in fishing nets in Ganga causing mortality. ▪ In the current situation, plying vessels get stuck in lean season. In the event of larger vessels plying in NW-1, the situation will be aggravated. 3. Also there are various sites of socio-cultural importance like

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				Ajgaivinath temple, Sultangunj, which should not be impacted due to project development.
25.	Department of Fisheries, Sahibganj & Date:16th September 2015	Shri Jayant Ranjan, Designation: District Fisheries officer Phone: 09835031630 Email:jayant.ranjan21@gmail.com	1	1. During the consultation, Mr. Jayant Ranjan made the following comments ▪ He appreciated the efforts to engage with local communities through public consultation. ▪ He said app. 5000 fishermen are dependent on fisheries for livelihood in this stretch and their livelihood may get impacted due to development of project ▪ Some of the commercial fisheries in the area are Indian Major carps, singhi, shrimps, Mystus sp. Catfishes &tengra ▪ The river banks at Bejlighar, Maharajpur, Mahadevganj, etc in Sahibganj are known as breeding and spawning grounds. Fish breeding takes place in shallow water. Fish seedlings are collected by fishermen in this region. ▪ During lean season, siltation is high and water current is low. Thus dredging will be required to carry out which will significantly impact the water quality ▪ Dredging may have significant impact on breeding and spawning season ▪ Impacts which may result due to project development are oil spills from barge vessels, cargo spillage, ballast water, anti-fouling paints etc ▪ Dredged material should not be disposed off on the bank of river as they are breeding and spawning grounds of fishes ▪ In Jharkhand District, decline in Rohu fish is recorded. ▪ Project will open up the opportunity for movement of frozen fish in Sahibganj and will open up opportunity for livelihood of local communities 2. There is potential for growth of commercial fisheries including cage culture fisheries, which is being promoted in Jharkhand.
26.	District Forest officer, Bhagalpur, Patna & Date:	Mr. S.K.Sinha, Designation: DFO, Bhagalpur Phone: 09835031630	1	1. Mr. S. K. Sinha made the following comments and suggestion ▪ He discussed that it may require to clear large nos. of trees for development of project

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	16th-09- 2015			▪ He suggested permission should be taken from forest department before cutting any tree ▪ He also suggested that compensatory aforestation should be carried out in lieu of trees cut ▪ He suggested to consider impacts on aquatic life and terrestrial flora & fauna while designing the project and to include mitigation measures in environment management plan ▪ He suggested a thick green belt should be developed all around the boundary of the terminal site 2. He also suggested that terminal boundary should be high enough to prevent entry of cattle/animals
27.	Gram Panchayat, Samda Nala and Rampur village & Date: 9th -09- 2015	Mrs. Munni Gaud Designation: Gram Panchayat Head Phone: 07808789116, 7070603324 Gram Panchayat, Samda Nala and Rampur village	1	1. Mrs. Munni Gaud is aware about the project and she opined the following: ▪ She said the project will bring development in the area and will have positive socio-economic impact on large scale. However people who are losing land will lose their livelihood and their housing ▪ People are expecting employment generation from the project and also the infrastructure development ▪ Traffic may increase in the village and nearby area which will pollute the air so mitigation measures should be taken to minimize air pollution ▪ Villagers have emotional values attached with the River Ganga, thus terminal project should not cause water pollution else there will be opposition from the villagers ▪ Adequate compensation should be given provided to the people. 2. Alternate employment options should be suggested for people who are completely losing their land.
28.	Gram Panchayat, Hathigarhi **&** Date: 9th-09-2015	Mrs. Usha Khalkoo Designation**:** Gram Panchayat Head, Gram Panchayat, Hathigarhi	1	1. Mrs. Usha Khalkoo is aware about the project and she told the following: ▪ Land owners are worried as some are losing their complete land and they will lose their livelihood, if land will

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		Phone:9801018326, 9801352024		be taken away from t hem ▪ Adequate compensation and assistance should be provided to land owners to find new livelihood options. ▪ Employment should b provided to local people preferably ▪ Tree cutting should be minimized and compensation should be provided to owners for all their assets as per law ▪ River water will be polluted due to construction of terminal and villagers may have concerns about this as they worship River Ganga 2. Traffic may increase in the area which may increase chances of accidents.
29.	District Collectorate Office Sahibganj, Jharkhand & Date: 7th-09-2015	Mr Niranjan Kumar Designation: Additional Deputy Collector + Land Acquisition officer, Sahibganj Phone: 09431306331, District Collectorate Office Sahibganj, Jharkhand	1	Meeting was held in the Collectorate office regarding the proposed terminal activities. In the meeting Mr Niranjan kumar ADC Sahibganj told that their office is carrying out the land acquisition which is in progress and it may take some more time to finalize the final individual award list. After completion of the work they can provide the final award list and land details to the IWAI. He also suggested to carry out the SIA activities and they can provide security for survey team as necessary.
Informal consultation in Farakka:				
30.	Bewa village– cognitive interview & Date:5/10/2015	Villagers of Bewa Panchayat 1. Ajay Mondal 2. Arun Ghosh 3. Ashoke Ghosh 4. Banu Ghosh 5. Bapan Ghosh 6. Binoy Ghosh 7. Bharat Ghosh 8. Bikash Ghosh 9. Biren Ghosh 10. Dukhu Sekh 11. Abddul Mannan 12. Barqat Sekh	21	Participants included farmers, indirectly affected local persons and community members. Following issues/concerns were raised by the participants. People were aware about the project. 1. Some of them were doing agriculture on Farakka Barrage project land without any agreement and lease navigational lock to be constructed. 2. They had already given their land to FBP during Farakka barrage project installation in 1965 3. Most of them were disagree with the compensation provided by FBP.

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		13. Gani Sekh 14. Aftab Sekh 15. Hamsad Sekh 16. Ahmad Sekh 17. Tufani Sekh 18. Sarju Sekh 19. Gaju Sekh 20. Siraj Sekh 21. Abdul Sekh		4. Erosion occurs along the bank of feeder canal and that is creating problem. Ship movement has further enhanced erosion.
31.	Near Primary school Ghoraipada village **&** Date:6/102015	Villagers of Ghoraipada village 1. Nikil ghosh 2. Pawan ghosh 3. Pappu ghosh 4. Ravi ghosh 5. Rakesh ghosh 6. Ram Chandra ghosh 7. Ratan Ghosh 8. Sadan Ghosh 9. Sanjay Ghosh.	9	Participants included farmer and small traders. Following issues/concerns were raised by the participants. 1. They demanded job for them and their children and they mentioned they should be given skill generation training for job offered as they have practiced only agriculture throughout their life 2. Most of them were disagree with the compensation provided by FBP. 3. They need compensation for damage of fishing nets and other accessories due to barge movement and project development (if any 4. They need employment during construction and operation phase of the proposed navigation lock.

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32.	Central Inland Fisheries Research Institute ,Barrackpore, 700120, West Bengal & Date:1.07.2015	Director, Central Inland Fisheries Research Institute, Barrackpore,	1	They are aware about the project development. 1. They suggested project will have significant impact on aquatic life and sensitive species like dolphins and turtles 2. Water quality is already polluted and will be affected further due to project development. 3. Dredging activity have significant impact on the aquatic life 4. This will lead to disturbance of the sediments which may contain hazardous material, increase in turbidity which may impact the visibility and gills of the aquatic organisms etc. 5. Mechanical movement of barges will impact the fish and other aquatic animals thus the speed of the cargos movement in these water should be regularized.
33.	Department of Environment, Government of West Bengal & Date-31.06.2015	Mr. Siddhartha Roy, IFS, Senior Environment Officer, Government of West Bengal, Kolkata	1	He was aware about the project and they were highly concerned about the environment issues related with the project development. 1. Clearances and NOCs should be obtained as applicable for the project as per the laws and Acts of Govt. of India 2. Project will significantly reduce air emission, noise level & traffic loads from highways but may add to water pollution 3. Surface water quality may be degraded due to discharge o waste/sewage from ships and lock gate facility, increased human activities near river, accidental spillage, leakage of oils etc. 4. Ground water may also get polluted as this surface water seeps into ground water aquifers.
34.	State Warehousing	Mr. A.K. Sinh, Executive Secretary, WBSWC &	2	The officials were aware about the project and added the following:

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	Corporation, WB & Date -30.06. 2015	Mr. Kaushik Mukherjee, Dy. Commercial Manager, WBSWC		1. They have expressed positive attitude towards project development 2. Project will boost the freight movement, cheap raw material transportation and thus the industrial sector 3. With boost in freight transportation and industrial activity, need of warehouses will increase with time 4. Thus some projects may come near to lock gate sites. 5. Cost effective, energy efficient and environment friendly mode of transportation.
35.	Farakka Block Development Office, Farakka, Murshidabad & Date:8th October 2015	Mr Niranjan Kumar, Kesang Dhendup Bhutia, BDO & Block Executive Office Ph-9434770026 E-mail-bdo.farakka@gmail.com	1	BDO, Farakka was aware and happy with the project development and assured his and local administration cooperation for the project implementation. 1. He was also invited for public consultation meeting. 2. Any kind of toxic pollution by the vessel like oil spillage and chemicals in the river water, transport emissions, needs to be considered.
36.	Divisional Forest Office, Nadia & Murshidabad Range & Date:15th October 2015	Mr. Rana Dutta,IFS, DFO PH: 9434053965 E-mail: dfomnd@rediffmail.com	1	He was aware about the project. He says that there is no reserve and protected forest in the area and also added that there is no sensitive ecosystem present in the area. He was highly concerned about river bank erosion.
37.	Coal India, Kolkata.	Mr. Niranjan Das, CGM (Env.), Coal India, Kolkata.	1	He was aware about the project he further added that the project is highly beneficial. Insufficient transportation facility available at present. 1. Project development will increase the transportation of coal to user agencies, especially NTPC thus enhancing the power generation capacity 2. IWT is environment friendly mode of transportation 3. Transportation of coal should be carried out only in covered cargo 4. However, project can impact the aquatic life by disturbing its habitat. 5. Environment management plan should be prepared and for all the

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				stages of project and should be implemented as suggested to minimize environmental impacts of the project.
38.	Community members of local Villages at PCM	Community members of local Villages at PCM	50	1. The villagers also informed that there is no forest area. Further, they did not anticipate any adverse impacts on their livelihood due to construction works. 2. They further opined that there would be positive impacts on the sources of livelihood due to increased economic opportunities which will provide good earning sources to the local families due to the project implementation. It was also informed that there is no Schedule Tribe (ST) population in the project area. 3. Representatives from Beoa Panchayat extended their support during the construction and operational phase of the proposed project. -They also suggested that public consultation meetings should be held at different places for awareness of the people and Grievance Redressal Committee should be active with timely conflict resolution.
39.	Patna Aranya Bhawan, Shahid Pir Ali Khan Path (Riding Road), Shekhpura, Patna-14 Phone: 0612-2545074 Date: October 15, 2015	Dr. D K Shukla, Principal Chief Conservator of Forest (PCCF), Department of Environment and Forest	1	Wildlife Protection Act, 1972 will be applicable if the project intervention is within the boundary of Vikramshila Gangetic Dolphin Sanctuary (VGDS)
Informal Consultation in Haldia				
42.	Tamluk, East Medinipur & Date: September 21, 2015,	Mr. S K Chakraborty, DFO, East Medinipur Division	1	DFO sought directions from Headquarters of Department of Environment and Forest for providing relevant data.
43.	Tamluk, East	Mr. Satikanta Bairagi,	1	Provided information on Nayachar and Nutanchar Islands in the

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	Medinipur & Date: September 21, 2015	Assistant Director of Fisheries (ADF) in Directorate of Fisheries and Fish Farmers Development Agency		project area of proposed Haldia Terminal.
44.	Tamluk, East Medinipur & Date: September 22, 2015,	Mr. Jay Sengupta, Director (Technical) and Mr. B D Saha, Manager (Process)	2	The officials of Sanjana Cryogenic Storages Ltd. were aware of the proposed terminal at Haldia in the neighbourhood of Sanjana Cryogenic Storages Ltd. The issue of over ground pipeline was raised which runs along the proposed site
45.	Kolkata, September 23, 2015,	Dr R P Saini, Special Additional PCCF and Chief Conservator of Forests (HQ) Department of Environment and Forests	1	Instructions were issued to DFOs in Nadia and East Medinipur Division for collection of relevant data
46.	Haldia Municipality, Haldia, Purba Medinipur & Date: 25th September, 2015	Mr. Deboprasad Mondal Chairman of Haldia Municipality Cell No. 9434940619 Email: haldmuni@yahoo.com	1	Support the project. The main issues are: 1. Hooghly River which is very much close to the proposed terminal 2. Any kind of toxic pollution by the vessel like oil spillage and chemicals in the river water, transport emissions, needs to be considered. 3. He appealed to the authority that they should provide jobs to the local unemployed youth based on their skill and should give business opportunities to the local people. 4. As part of social development the local immersion Ghat at Durgachak (near project site) should be expanded by the project sponsors to overcome the current congestion especially during the local festival. 5. The access road needs to be carpeted as present road is not in good condition. 6. Our request is to develop the road as it will be needed for the proposed terminal access movement also. 7. He requested to make provisions for appropriate parking facilities inside the proposed terminal for better management of container carrying vehicles.

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				8. Finally he gave the assurances that local government (ULB) will give all help for smooth operation of the project activities.
47.	Haldia, P Haldia Development Authority(HDA), Haldia, Purba Medinipur. Date: 28th September 2015	Mr. Purnendu S. Naskar, WBCS Ph: 03224-255927, Email: ceo.hda@gmail.com	1	Support the project, The main issues discussed are: 1. The project sponsors should consider the fact that the vessel navigation should be planned appropriately as there could be an impact to the river bank which is adjacent to the proposed terminal. 2. Due to increased river cargo traffic management of incoming and outgoing vessels in terms of loading and unloading will have to be planned and executed appropriately. 3. During dry and winter season the river water depth is low, this will create issue of cargo movement from and to the terminal. Measures should be taken to address this problem either by ensuring minimum water flow in the river or provide appropriate warehousing facilities for storing the cargo material during the lean period. 4. Oil from vessel may flow into the river and pollute the water. This pollution will affect the terrestrial flora and fauna. Their needs strict control to be imposed by the project sponsors. 5. The IWAI authority have to be prepared for any kind of accidents occurring with maximum preparedness like – having a rescue team on call, good communication with the civil volunteers, fire services and local administration contacts.
48.	Haldia Municipality, Haldia, Purba Medinipur & Date: 25th September, 2015	Mr. Gopal Chandra Das, Vice Chairman, Haldia Municipality Ph:09475038119,Email: haldiamunicipality@gmail.com	1	Support the project, The main issues discussed are: 1. The interviewee raised concerns about the existing high particulate matter concentration in the area and recommended that the proposed project should ensure that no further particulate matter is created by the proposed project. Concerns about oil spillage was raised and hoped that proper emergency response to tackle any accidental spillage would be in place. 2. The access road needs to be widened and upgraded to ensure smooth traffic movement. A traffic management plan needs to be

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				in place. 3. The interviewee suggested that the project should employ local people in the proposed terminal on a priority basis provided they have the required skills.
49.	Haldia Block Development office, Brajlalchak, Haldia Purba Medinipur & Date: 23rd September 2015	Mr. Suman Kumar Sahoo, Fisheries Extension officer PH:-9434506729	1	Support the project, The main issues discussed are: 1. There is no fish sanctuary around the port site. Fish existence is found for three months during the rainy season. During the dry season the water quality is degraded and blackish which is not suitable for the fish. Thus production of fish reduces. 2. Turbulence and wave from plying vessel movement can be a cause of fish resource sheltering in safer waters. This is problem that is difficult to resolve as the waterway fish may migrate. 3. Considering terrestrial flora and fauna, the authority can prepare habitat by tree plantation. 4. There are some fishermen depending on the fishing activity in the Hooghly River for 3-4 months of the year; the authority can support them through livelihood restoration programmes. 5. The authority can prohibit the discharge of oily water into the river during fish breeding period April- May. 6. IWAI authority can invest in fish breeding in the river or nearby water bodies and employ the fishermen who are without a livelihood for nine months in a year.
50.	Sanjana Cryogenic Storages Ltd., Durgachak, Haldia, Purba Medinipur. Cell No: 09332311334, Email: sanjana_haldia@rediffmail.com &	Mr. Joy Sengupta, Director Technical, Sanjana Cryogenic Storages Ltd	1	Support the project, The main issues discussed are: 1. The terminal will be a new addition for carrying the container and goods by the river at lower rate. Once the terminal is in operation they will use it to vessel their export goods which will be cheaper by road transport that they are currently using. ▪ Export import business will be improved for terminal installation. ▪ Employment opportunity will be increase. ▪ The only source of pollution from proposed terminal will be sound pollution. The project implementing agency needs

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	Date: 21st September 2015			to take steps to abate the noise pollution. 2. Our factory is close to the proposed terminal therefore, we will help IWAI authority to operate the terminal smoothly in term of existing pipe line shifting, etc. 3. Need to work in close cooperation with the IWAI to ensure that no water logging takes place due to the project by integrating the drainage systems in the area. 4. Fire team should be available on call to attend to and avoid any kind of disaster situations.
51.	Durgachak, Haldia, Purba Medinipur. Ph No.- 03224-253180, Date: 27th September 2015	Haldia Vigyan Parishad (NGO's, Ph No.- 03224-253180)	3	1. Support the project, The main issues discussed are: ▪ Meaningful community development for the people in the affected areas was demanded ▪ Oil water from vessel washes may pollute the river water which will affect the terrestrial flora and fauna. There needs to be strict control measures to be imposed by the project authority. 2. The proper environment management plan should be prepared before the project operation phase.
52.	Community members living within 1.5km radius of the project location at Durgachawk & Date: 27th September 2015	Community members living within 1.5km radius of the project location at Durgachawk. 1. Sanjay Kumar Maji 2. Arindam Pramanik 3. Sadhan Sardar 4. Sibsankar Patra 5. Pralay Kr. Hazra 6. Atanu Bera 7. Prabir Pusti 8. Biswajit Rana 9. Arjun Metya 10. Kamal Jana	10	1. Interviewees highlighted that the consultation – adapting the company's operations to reflect the views heard – is typically missing. They underlined that if companies wish to conduct meaningful consultation, they should be willing to revise the project terms in response to the feedback received from the community. They noted that they view the objective of the consultation not as merely explaining the project, but revising it as needed to satisfy the affected communities. 2. Consider providing access to alternative methods of gaining adequate livelihoods, such as offering vocational training for specific jobs, in addition to providing monetary compensation for affected structure. 3. Compensation for affected structure payments should be transferred directly to the recipients through community-based organizations. The funds should not be transferred through local authorities, land registries or other entities that could be prone to

Sr. No	Date and place of consultation	Name and designation of person with organization name	No of people participated in the consultation	Major outcome: specifically : Have they supported the project or not. Major concern raised.
				corruption. 4. Put in place grievance mechanisms so that community members have a place to go to voice concerns and resolve the issue.
53.	Durgachak, Haldia, Purba Medinipur & Date - 28th -06-2015	Santanu Ghosh, Local Auto Rickshaw Drivers at Durgachak, Haldia, Purba Medinipur	1	1. We are driving our vehicle in this road from dawn to dusk. 2. We earned and derive our 6-member family by this. 3. If traffic congestion becomes severe than our income will be reduced and will have to divert our profession. 4. We expect the authority will take measures.
54.	Fisherman group at Durgachak & Date: 29th-06, 2015	Sanatan Dinda and other fishermen	1	1. According to the team leader Md. Sanatan Dinda-we are fishing here only 3 to 4 month. 2. Another time we work in the brickfield and some of us pulling rickshaw and van. There are 7-8 people in our team, every day we get 2500 to 3000 rupees by fishing. 3. September is the peak time for high income. Our concern is that if the vessel comes during this time the fishing may be affected which will hamper our livelihood.
Informal Consultations for Barge Movement in Buxar & Patna				
55.	People gathered for Ganga bath & Date: 10th February 2016	Ram Rekha ghat, Buxar	10	1. People were given brief about the project and to be increased frequency of barge movement and large size barges movement in the stretch of River 2. People welcome the project and were interested to know about the employment generation potential for locals due to project 3. No objection was raised to project. 4. People said that if project will lead to congestion then infrastructure should be enhanced accordingly so as local people

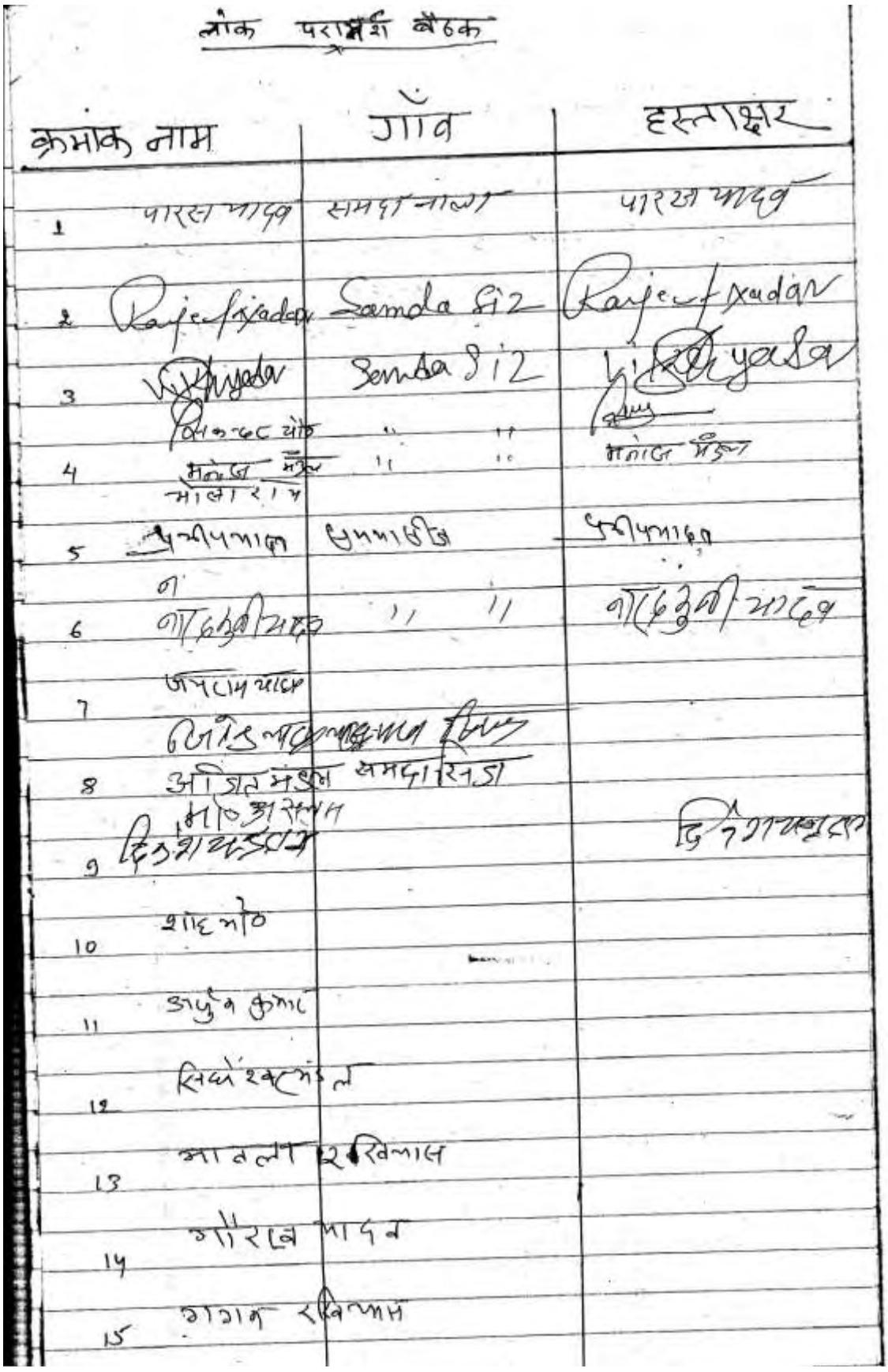
Sr. No	Date and place of consultation	Name and designation of person with organization name	No of people participated in the consultation	Major outcome: specifically : Have they supported the project or not. Major concern raised.
				do not suffer.
56.	Local People gathered for bath in Ganga (Ganga Snan) & Date: 11th February 2016	Adi Nath Ghat, Buxar	6	1. People were not aware about the project and thus brief was given to people about the augmentation of entire NW-1 to enhance the navigation 2. People were told about the increased barge movement in the area 3. People raised their concerns regarding their day to day activity in the river. 4. They inquired if the barge movement will enhance the pollution. They asked for pollution free Ganga 5. They also expect that employment generation should be there due to project development in their area also
57.	Local people gathered for idol emersion. & Date: 14th February 2016	Gai Ghat, Patna	8	1. People were aware about the project as IWAI is nearby 2. Brief was given to people again about the augmentation of entire NW-1 to enhance the navigation 3. People were told about the increased barge movement in the area. 4. People were worried about the enhanced pollution in the river due to project

Annexure 4.4: Attendance sheet for the PCM at Sahibganj

Formal Consultation

सामूहिक परामर्श बैठक
स्थान – आम्रक सम्मेला घाट दिनांक 16-10-2015

क्रमांक	नाम	विभाग	हस्ताक्षर
1.	रवि कान्त	भारतीय अन्तर्देशीय जलमार्ग प्राधिकरण	
2.	जयंत रंजन	जि० मत्स्य पदा० साहेबगंज	
3	विनय कुमार सिंह	जिला भू-अर्जन कार्यालय साहेबगंज	RC
4	प्रशांत कुमार	भारतीय अन्तर्देशीय जलमार्ग प्राधिकरण	
5.	[illegible]	[illegible]	
6.	Rohini R. Mohan	IWAI	Rohi
7.	आभा सिन्हा जैन	WB (consultant)	आभा
8	MRIDULA SINGH	WORLD BANK	
9.	Dr A. [illegible]	Health (CMO)	
10.	Abhay Shanker	KC - (D.L.A.O)	
11.	[illegible]	[illegible] साहेबगंज	16/10
12.	Shankar Al Mohto Anchal Amin	D.L.A Office Sahibganj	16/10/15
13	Rajendra Sah	D.L.A. Office Sahebganj	16/10/15
14.	[illegible]	[illegible]	16/10/15
15.	[illegible]	[illegible]	
16	Kundan Kumar	IRGSSA / EDMC IV	
17	Dr. Sushil Bhadula	DSVV, Haridwar Uttarakhand	
18.	विनोद	IWAI	
19 -	Ravi Ranjan	IWAI	R. Ranjan
20 -	Sanjay Kumar	M.R.D. (Ganga pump Canal)	
21.	Kaushal [illegible]	CRADLE - Ranchi	



लोक परामर्श बैठक

क्रमांक	नाम	गाँव	हस्ताक्षर
1	पारस यादव	समदा नाला	पारस यादव
2	Rajesh yadav	Samda Si2	Rajesh yadav
3	[illegible]	Samda Si2	[illegible]
4	[illegible]	"	"
5	[illegible]	[illegible]	[illegible]
6	[illegible]	"	[illegible]
7	[illegible]		
8	[illegible]	[illegible]	
9	[illegible]		[illegible]
10	[illegible]		
11	[illegible]		
12	[illegible]		
13	[illegible]		
14	[illegible]		
15	[illegible]		

क्रमांक	नाम	गाँव	हस्ताक्षर
16	शिवजी महलदार	— रामपुर	
17	मंगल कुमार यादव	— समदा	
18	जवाहर यादव	— समदा	
19	मन्टू यादव	— समदा	
20	महेश यादव	— अयुन	
21	रामचन्द्र	— समदा	
22	रूपन मंडल	— रामपुर	
23	सुन नारायण यादव	— रामपुर	
24	नारायण यादव	— समदा	
25	शिवशंकर यादव	समदानाला	
26	सुदर्शन यादव	समदाला	
27	सुशिला देवी	समदानाला //	
28	महेन्द्र यादव	— //	
29	कन्हैया यादव	//	
30	बाल कृष्ण यादव	//	

Annexure 4.5: Photographs of Informal Public Consultation

	
Session 1: Consultation with Boatmen and Fishing community	**Session 2: Consultation with Boatmen, Sqatters and Fishing community**
	
Session 3: Consultation with Boatmen and Fishing community	**Photograph of Baluva Ghat**
	
FGD at Gharaipara Village with local villagers.	**Socio-economic survey carried out by AIAID representative**

	
Consultation with villagers in Ashram, Rampur and Samdhanala	**Consultation with villagers in Ashram, Samdhanala**
	
Consultation with villagers in Samdha nala, Naya Tola Asram	**Consultation with fishermen in Sahibganj**
	
Consultation at Samda Nalla Ghat	**Consultation in Village Rampur**

Consultation with fishery Department

Consultation with Villagers in Rampur

Consultation with Villagers in Village Area & Ashram in Rampur Village

Stakeholder Consultation with Mr. Purnendu S. Naskar at HDA office Haldia	SC with Haldia Municipality Chairman Office at Haldia.
	
FGD with local residential at Durgachak,Haldia	**SC with Haldia Block Development Officials at Haldia**
	
KII with local fishermen at Durgachak,Haldia	**Photo from project location at Durgachak,Haldia**
	
BisarjaniGhat at Durgachak which located in nearby proposed project site.	**Consultation with fisherman**

	
Consultation with Fisher man	**Consultation with boat man near Pathakali ghat**
	
Consultation with locals at Ram Rekha Ghat, Buxar	**Consultation with locals at Adi Nath Ghat, Buxar**
	
Consultation with locals at Gai Ghat, Patna	**Consultation with WII, IWAI Officials and DFO, Kashi**

Photographs of Formal Consultation at Samda Nala Village, Sahibganj

Photographs of Formal Consultation Meeting at Farakka

Photographs of Formal Second Stage Consultation Meeting at Patna



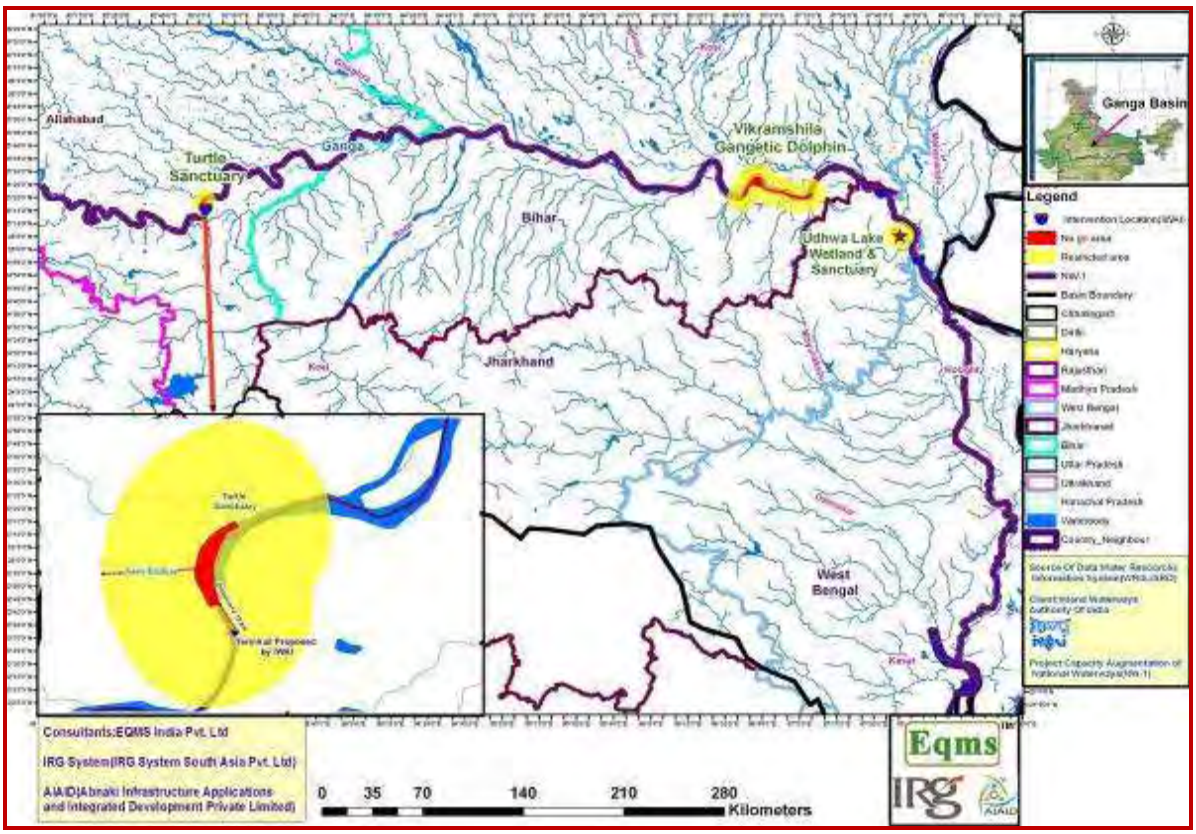




Annexure 5.1: List of Sanctuary

A. Kashi Turtle Sanctuary (KTS), Varanasi, UP

The area of the midsection of the Ganga River, between Ramnagar Fort to Malviya Rail/Road Bridge (Raj Ghat Bridge) measuring around 7-km area is declared as the Turtle Wild Life Sanctuary under the State Administration Forests Act, Section-3, Part -4170/14-3-62 dated 21-12-1989. Along with the turtles, incidentally the other species of aquatic bio-diversity inhabiting this stretch is also protected. The Sanctuary also forms the part of Ganga Action Plan. Location of Kashi Turtle sanctuary in NW-1 is shown at **Figure below**.



Location of Kashi Turtle Sanctuary in NW-1

Throughout the sanctuary many religious Ghats are located on the banks of Ganga River which are used for bathing, boating and cremation purposes. Fishing activity in sanctuary area is completely prohibited. Sand mining in the sanctuary area is also prohibited. Biological resource of the sanctuary comprises of Turtle and fishes.

Gangetic Dolphin, Ganges Soft shelled turtle wintering birds, etc are reported in Kachua vanyajeev Vihar (Turtle WLS), Varanasi[21]. TWS, a notified protected area under Wildlife protected area is located about 2.27 km in north direction, downstream from the proposed Ramnagar terminal in NW-1. Stretches of Varanasi downstream which was not surveyed in 2012 recorded 269 Gangetic Dolphins[22].

21 State of Environment Report- 2010, Uttar Pradesh, p.105, Directorate of Uttar Pradesh.

22http://www.wwfindia.org/?14681/The-Ganga-Dolphin-Census-and-My-Ganga-My-Dolphin-campaign-2015-come-to-a-close-with-a-heartening-1263-in-the-surveyed-3350-km-stretch

As reported in literature freshwater turtles are major biodiversity components of the aquatic ecosystem, often serve as keystone species benefiting other animals and plants. They participate in the web of interacting and co-dependent species that constitute a healthy functioning of ecosystem. In Kashi Turtle Sanctuary mainly *Aspederetes gangetica* (self-shell turtles), Geoclemys hamiltonii, Chitra indica and Lissemys punctata which are carnivorous species and hard shelled herbivorous turtle - Pechra Kachhua, Sundri Kachhua, Tentoria Kachhua, and Tongoka are in abundance. The list of Turtle species with their IUCN's Threatened status is provided in following **Table**. A turtle breeding centre is also set up at Sarnath to propagate its population where turtle (both herbivorous and carnivorous) are hatched, reared for one to two year and then released into Kashi Turtle sanctuary.

Turtle species in Sanctuary Area

Sl. No.	Common name	Species	IUCN Classification
1	Self-shell turtle	*Aspederetes gangeticus*	Vulnerable
2	Indian flap shell turtle	*Lissemys punctata*	Low risk
3	Narrow headed soft shell turtle	*Chitra indica*	Endangered
4	Spotted pond turtle	*Geoclemys hamiltonii*	Vulnerable
5	Crowned river turtle	*Hardella thurjii*	Vulnerable
6	Indian roofed turtle	*Pangshura tecta*	Lower risk
7	Indian tent turtle	*Pangshura tentoria*	Lower risk
8	Tongoka	*Batagur dhongoka*	Endangered

The right bank of the turtle sanctuary provides a perfect habitat for turtle to breed. However, during the site visit as well as literature records no such nesting and breeding sites were observed in KTS as well as in Varanasi area.

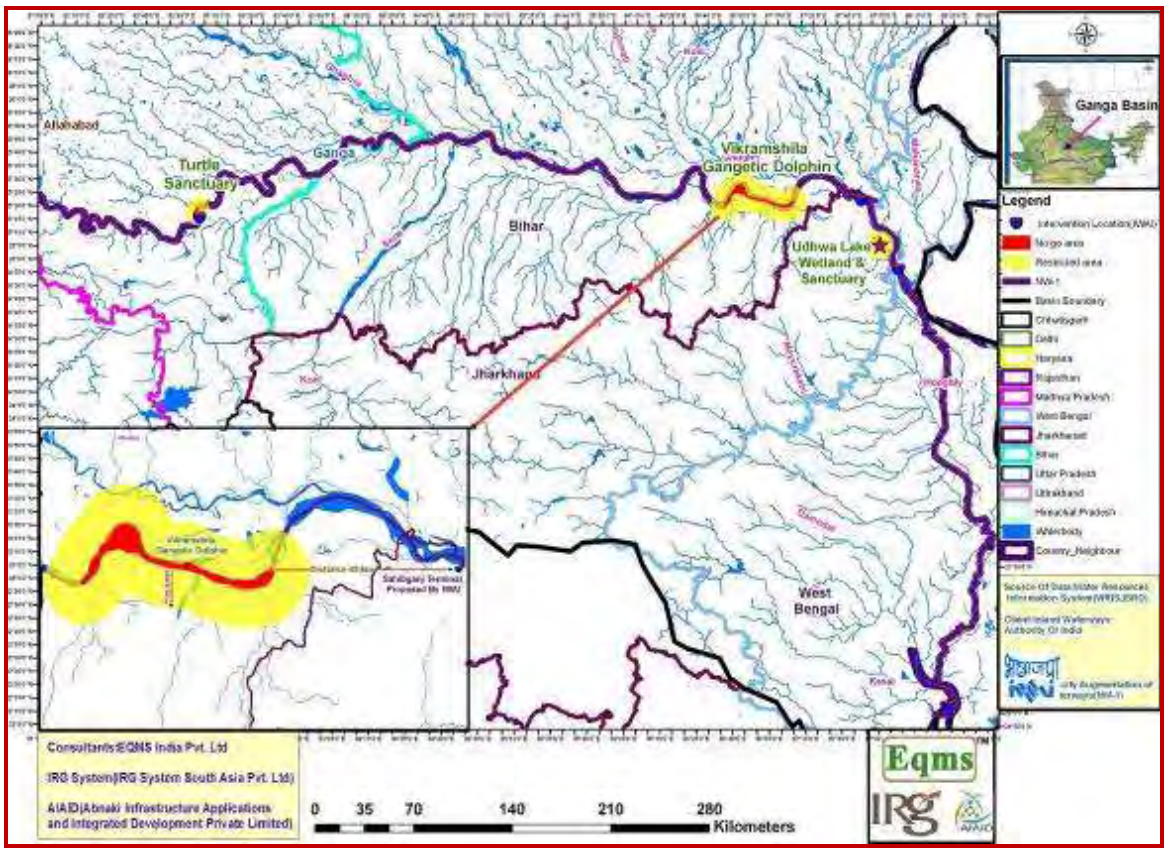
Fishes: In sanctuary area major carps like, Rohu (Labeo rohita) mrigal (Cirrhinus mrigala), katla (Catla catla), kalbasu (Labeo calbasu) and cat fishes like padhan (Wallago attu) tengras (Mystus tengara) and Magur (Clarias batrachus), Singhi (Heteropneutes fossilis), Tilapia (Oreocromis sp.), Kavai (Anabas testudineus) and Mahfish (Barbus sp.) are present.

B. Vikramshila Dolphin Sanctuary, Bihar

Vikramshila Gangetic Dolphin Sanctuary (VGDS) has been notified on 7th August, 1991as Wildlife Sanctuary under Wildlife Protection Act, 1972 for the protection of Dolphin[23].which is categorized as endangered species on the IUCN Red List. VGDS is the only riverine protected area for conservation of Gangetic Dolphin in the eastern Gangetic Plain. The sanctuary includes middle of Ganges between Sultanganj and Kahalgaon Hills (25.254°N to 25.282°N[24]and 86.738°E to 87.229°E)- in Bhagalpur district-. 10 kms area around VGDS is the default Eco Sensitive Zone at present. The proposed nearest Terminal at Sahibganj is located about 48 kms from VGDS. The location of VGDS in NW-1 and proposed terminal at Sahibganj is shown in **Figure below**.

23This species has been included in Schedule- Iof the Indian Wildlife (Protection) Act 1972,Appendix I of the Convention onInternational Trade in Endangered Species(CITES), Appendix II of the Conventionon Migratory Species (CMS) and IUCN red list as endangered species.

24 The coordinates printed in the notification of the Sanctuary falls outside the Ganga River. Coordinates shown here are as per report published by WWF and corresponding to actual situation on ground. However starting and ending locations name are as per the notification.



Location of VGDS in NW-1

Various aquatic species of flora and fauna are found in Vikramshila Gangetic Dolphin Sanctuary. Besides Dolphins, other species of freshwater shrimps, fish and crustaceans can be observed. The area of the sanctuary is also an important bird area and the species such as the Greater Adjutant (Leptoptilos dubius) and Lesser Adjutant (L. javanicus) are present. Other storks present are the Ciconia nigra, Black-necked stork (Ephippiorhynchus asiaticus), White-necked (Ciconia episcopus), and the Asian Openbill (Anastomus oscitans). The Sanctuary is rich in waders. Common Crane (Grus grus), Eurasian Spoonbill (Platalea leucorodia) and various ducks are also seen here. The major carps like, Rohu (Labeo rohita) mrigal (Cirrhinus mrigala), katla (Catla catla), kalbasu (Labeo calbasu) and cat fishes like padhan (Wallago attu), tengras (Mystus tengara) and Magur (Clarias batrachus), Singhi (Heteropneutes fossilis), Tilapia (Oreocromis sp.), Kavai (Anabas testudineus), Mahfish (Barbus sp.) etc. are present in the sanctuary area.

C. Hilsa Sanctuary

Hilsa (Tenualosa ilisha) is assessed as Least Concern species as per IUCN's threatened category (version 3.1) but its population is declining due to over fishing and fragmentation of migratory routes along Farakka barrage. This sanctuary is notified[25] mainly with objective of enhancing Hilsa production. In order to facilitate spawning, all types of fish catching are banned in the Hilsa Sanctuaries during June to August and October to December every year in Hilsa Sanctuary areas (Refer **Table below** and **Figure below**). Fishing of Hilsa is prohibited within 5 square kilometre of the Farakka Barrage (the notified

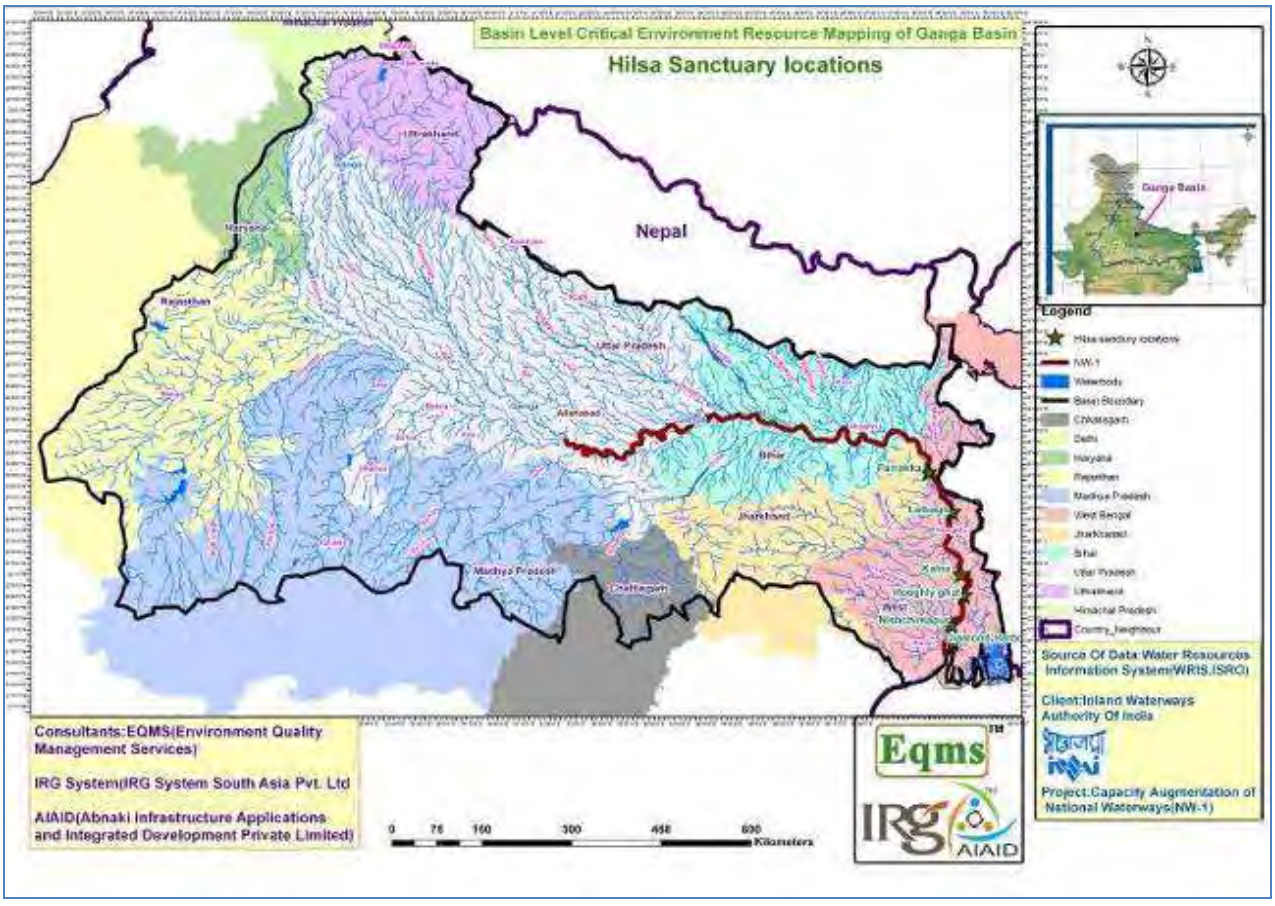
25Notification of Fisheries Department, Government of West Bengal dated Tuesday, April 09, 2013 published in The Kolkata Gazette. The Hilas Sanctuary Is not notified under Wild Life (Protection) Act and as such does not attract any provision of this act.

sanctuary area) round the year to protect the hilsa species and facilitate breeding and spawning in this area.

Location of the Hilsa Sanctuary and their stretch

Sr. No.	Location of the Hilsa Sanctuaries and their stretches
1	Diamond Harbour to Nishchintapur Godakhali
2	Katwa to Hooghly Ghat, part of Burdwan and Hooghly District)
3	Between Lalbagh in Farakka, Murshidabad district
4	5 square kilometres area around Farakka Barrage

Salinity is a critical chemical factor in governing the faunal distribution in this zone. The important families are Catla, Labeo rohita, L. calbasu, L. bata, Cirrhinus mrigala, C. reba, Puntius ticto, P. conchonius, P. sarana, P. sophore, Salmostoma bacaila, Danio devario, Brachygobius nunus, Glossogobius giuris, Pseudapocryptus lanceolatus, Stigmatogobius sadanundio, Periopthalmadon schlosseri, Boleophthalmus dussumiere,Gobioptrus chuno, Bathygobins orbicularis,Tenulosa ilisha, Hilsa kelee, Coilia dussumieri, C. ramcorti, C.reynalidy, Setipinna phasa, S. taty, Liza parsia, L. tade, L. macrolepis, Mugil cephalus, Ailia coila and Eutropiichthys vacha.



Location of Hilsa Sanctuaries in NW-1

Annexure 5.2: Morphology of River (NW-1) in different reached

S. No.	Reach/Stretch	Chainage	Morphology
1.	Sagar Road – Haldia	(0-35)	Split channel with central islands
2.	Haldia – Diamond Sand	(35-60)	Split channel with central islands
3.	Diamon Sand –Howrah Bridge	(60-145)	Sinuous channel
4.	Howrah Bridge -Tribeni	(145-193)	Irregular meandering channel with some sporadic central bars
5.	Tribeni-Balagarh	(193-221)	Irregular meandering channel with split channels and bars. Oxbow lakes and cut-offs visible
6.	Balagarh-Kalna	(221-245)	Tortuous meandering channel showing split channels at bends. Oxbow lakes and cut-offs visible
7.	Kalna-Samudragarh	(245-263)	Irregular meandering channel showing some degree of split at a few locations. Oxbow lakes and cut-offs visible
8.	Samudragarh-nabadweep	(263-280)	Tortuous meandering channel with bars at the near the inner bank of bends
9.	Nabadweep-Patuli	(280-322)	Tortuous meandering channel with chutes at bends and several split channels. Oxbow lakes and cut-offs visible
10.	Patuli-Katwa	(322-345)	Tortuous meandering channel with localised bars and chutes at bends and some degree of split channels. Oxbow lakes and cut-offs visible
11.	Katwa-Palassey	(345-371)	Meandering single channel, wider at bends with some chutes. Cut-offs visible
12.	Palassey-Chaurigacha	(371-400)	Irregular meandering channel showing chutes at bends and split of channels at particular locations. Oxbow lakes and cutoffs visible
13.	Chaurigacha-berhampur	(400-421)	Sinuous channel except for the approximately last 5 km of the reach. In that area the channel shows tortuous meanders and oxbow lakes. Cut-offs also visible
14.	Berhampur-mohammadpur	(421-449)	Irregular meandering single channel. Oxbow lakes visible
15.	Mohammadpur-nasirpur	(449-479)	Tortuous meandering single channel with central bars at certain locations. Oxbow lakes and abandoned meander channels visible
16.	Nasirpur-Jangipur Lock	(479-505)	Tortuous meandering single channel. Cut-off and abandoned meander channels visible
17.	Jangipur Lock-Farraka Lock	(505-544)	Artificial channel
18.	Farakka Lock Rajmahal	(544-583)	Composite river with one main sinuous channel with bars and islands and several sinuous secondary channels. Several oxbow lakes can be seen
19.	Rajmahal-Manihari	(583-633)	Composite river with one main channel with bars and islands and several sinuous side channels
20.	Manihari-Karagola	(633-660)	Split river with sinuous channels with a certain degree of braiding that converts in a single main sinuous channel with several side channels
21.	Karagola-Kahalgaon	(660-690)	Split river with sinuous channels with a certain degree of braiding
22.	Kahalgaon-Bhagalpur	(690-715)	Sinuous channel with a certain degree of braiding showing bars and islands
23.	Bhagalpur-sultanganj	(715-746)	Sinuous channel that shows some degree of braiding. The area shows clear oxbow lakes
24.	Sultanganj-Munger	(746-793)	Sinuous channel that shows some degree of braiding in a stretch of a few kilometres. It is a clear cut-off with the old bendy channel still showing some activity
25.	Munger-Mahendrapur	(793-820)	Anabranched river with channels with a certain degree of braiding showing bars, islands and side channels
26.	Mahendrapur-Semaria	(820-853)	Anabranched river with channels with a certain degree of braiding showing bars, islands and side channels

S. No.	Reach/Stretch	Chainage	Morphology
27.	Semaria-Barh	(853-891)	Anabranched river with channels with a certain degree of braiding showing bars, islands and side channels
28.	Barh-Mehnar	(891-925)	Anabranched river with channels with a certain degree of braiding showing bars, islands and side channels
29.	Mehnar-Patna	(925-955)	Anabranched river with channels with a certain degree of braiding showing bars and islands
30.	Patna-Doriganj	(955-1000)	Split sinuous channels with a high degree of anabranching
31.	Doriganj-Ballia	(1000-1063)	Meandering single channel, wider at bends with some chutes and several subparallel anabranches
32.	Ballia-Buxar	(1063-1124)	Sinuous single channel, wider at bends with some chutes and a sinuous side channel and certain degree of braiding
33.	Buxar-Ghazipur	(1124-1178)	Sinuous single channel, wider at bends with some chutes and a sinuous side channel
34.	Ghazipur-Saidpur	(1178-1254)	Sinuous channel that shows some degree of braiding in a stretch of around 10 kilometres
35.	Saidpur-Varanasi	(1254-1311)	Meandering single channel, wider at bends with some chutes and a side channel
36.	Varanasi-Chunar	(1311-1344)	Meandering single channel, wider at bends with some chutes and a side channel
37.	Chunar-Mirzapur	(1344-1398)	Meandering single channel, wider at bends with several chutes
38.	Mirzapur-Rampur Ghat	(1398-1419)	Sinuous channel that shows some degree of braiding in a stretch of a few kilometres
39.	Rampur Ghat-Sirsa	(1419-1506)	Meandering single channel, wider at bends with some chutes and a sinuous side channel; stretches of few kilometres with split of channels less than 200 m wide
40.	Sirsa-Allahabad	(1506-1547)	Meandering single channel, wider at bends with some chutes and a sinuous side ch

Source: HOWE Engineering Projects (India) Pvt. Ltd. (Design Consultant)

Annexure 5.3: Primary data analysis and observation on water quality

Flow Discharges

The South Asian monsoon system largely defines the climate and hydrology of the Ganga River. The monsoon brings heavy rains three months a year therefore, the Ganga River is characterised by high flows during the monsoon season, approximately from July until October, and low flows during the rest of the year. April and May are in general, the lowest flow months with negligible rainfall and a low base flow into the system. Due to the climate variability the timing of the onset of the monsoon period is uncertain. Climate change predictions suggest that for the River Ganga the monsoon discharges will increase in the future (ref).

Figure 1 and **Figure 2** show the rapid increase and fall of discharges during July and September-October at two locations: Varanasi (chainage 1311) and Farakka (chainage 583). The average values during the low flow season can be of the order of 1 per cent of the discharge during the high flow season.

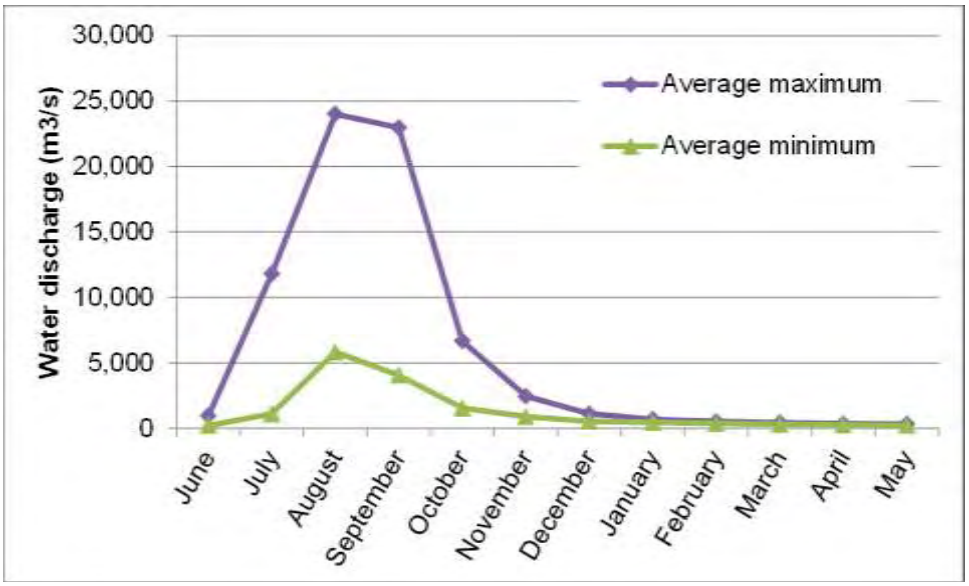


Figure 1: Average of maximum and minimum monthly discharges at Varanasi (chainage 1311)

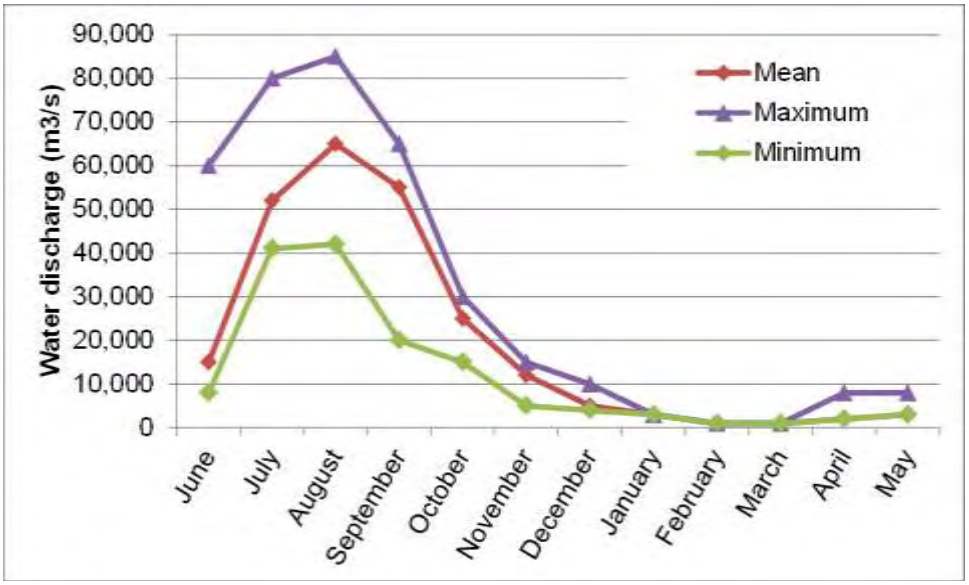


Figure 2: Mean, maximum and minimum monthly discharges at Farakka, chainage 583 (extracted from Jeuland et al, 2013)

Maximum and minimum discharges were provided by IWAI for different years at 3 locations: Allahabad (chainage 1547), Mirzapur (chainage 1398) and Varanasi (chainage 1311). Average monthly discharges for a range of years were provided at Buxar (chainage 1124) and Patna (chainage 955). When comparing this information it is clear (see **Figure 3**) that average discharges increase downstream during the high season (July to November).

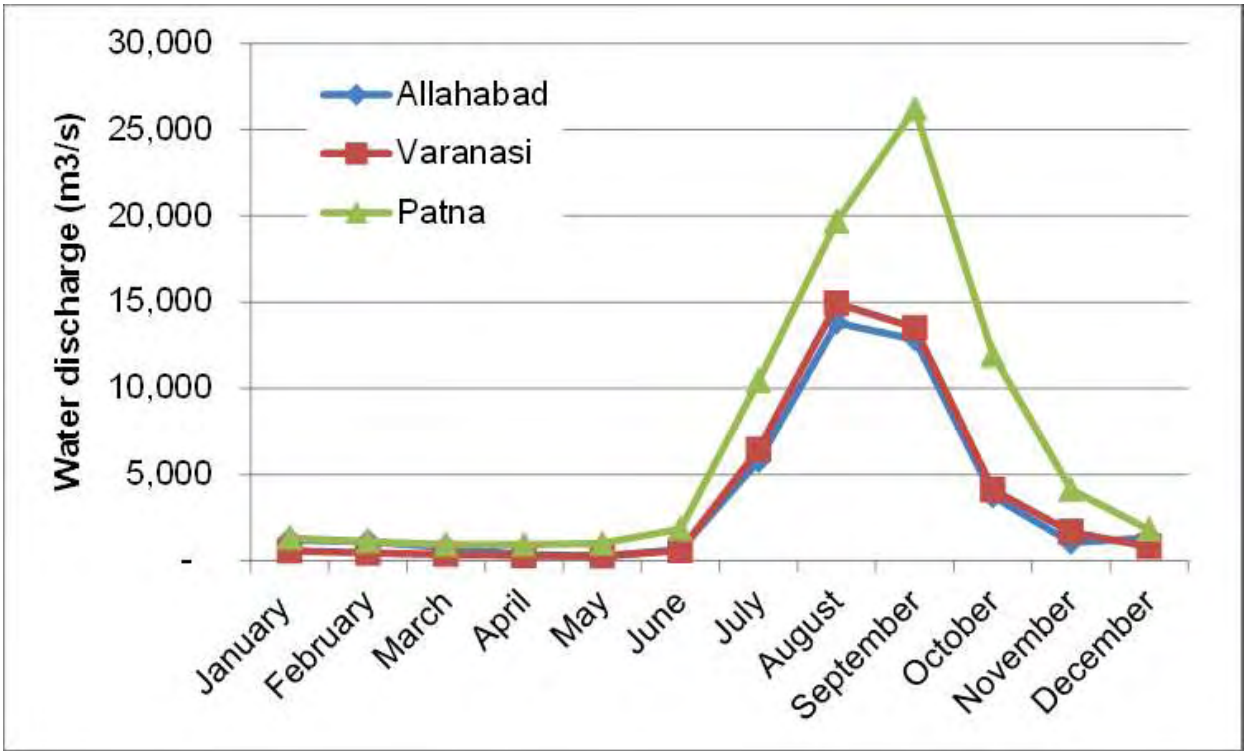


Figure 3: Monthly average discharges over the year at Allahabad, Varanasi and Patna

In addition to the significant seasonal variation within years, there is also a great variability between years. With the time series available at the three upstream gauging sections it is possible to perform a statistical analysis of the lowest flows. **Figure 4** shows, as an example, the extreme analysis performed at Allahabad considering the Generalized Extreme Value (GEV) distribution.

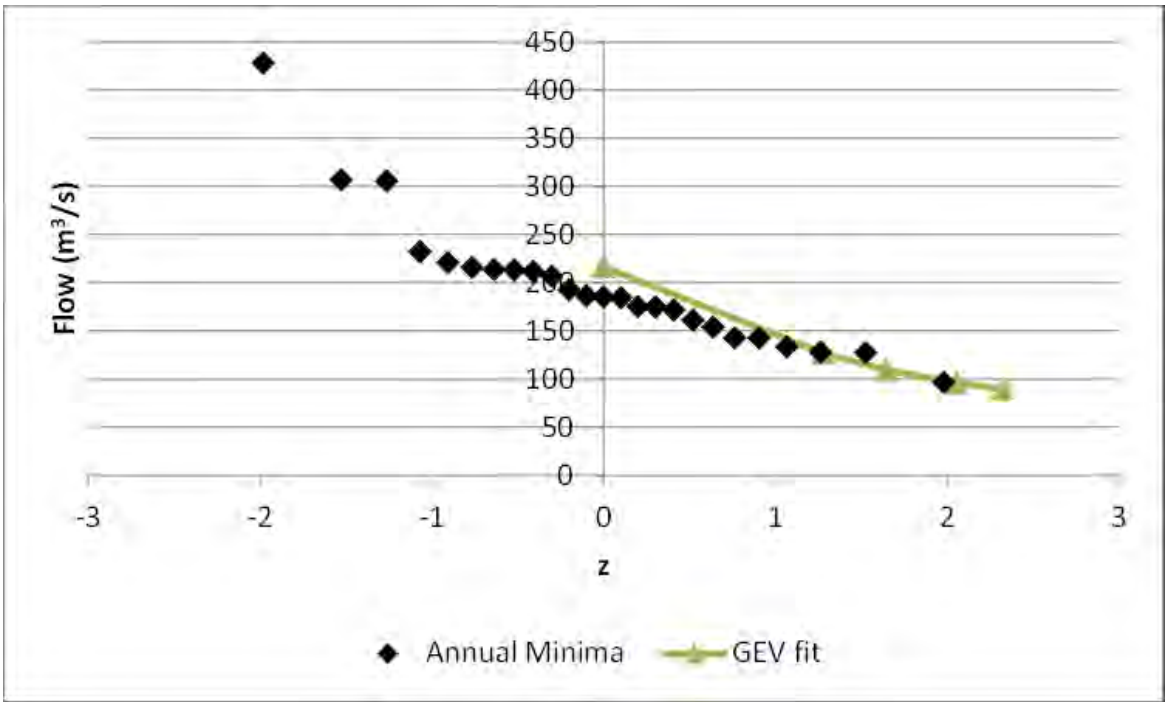


Figure 4: Extremes analysis on the annual minimum flow at Allahabad

The results of the statistical analysis are summarised in the following **Table 1**.

Table 1: Annual minimum discharges obtained from statistical analysis

Discharge (m^3/s) Parameter		Allahabad	Mirzapur	Varanasi
Minimum recorded flow (m^3/s)	96		122	117
1 in 2 year minimum flow (50% annual probability)	188		167	185
1 in 10 year minimum flow (10% annual probability)	117		128	130
1 in 100 year minimum flow (1% annual probability)	90		119	110

Despite data constraint at Buxar & Patna, the available data shows that the lowest flow recorded at Buxar was 225 m3/s and the lowest flow recorded at Patna was 689 m3/s. These flows are considerably lower than the averages for the dry season.

The report "Status on River Ganga: State of the Environment and Water Quality" from the National River Conservation Directorate (2009) provides useful information in terms of understanding water discharges along the upstream reaches of NW-1. The report presents water discharges with a probability of exceedance of 50%, 10% and 90% at 6 stations: Allahabad, Mirzapur, Varanasi, Buxar, Patna and Azamabad during the low flow season. It also presents average post-monsoon flows (in October-November), average flows in December-February and in March-May periods. These values are summarised in Table 16. They are generally higher than the values presented in **Table 2** obtained from the statistical (extremes) analysis of available data at the three gauging stations.

Table 2: Characteristic discharges obtained from the National River Conservation Directorate (2009) report

Flow regime Discharge (m^3/s)	Allahabad	Mizarpur	Varanasi	Buxar	Patna	Azamabad
Q50 (flow with 50% probability of exceedance) during low season	300	300	300	450	1050	1400
Q90 (flow with 90% probability of exceedance) during low season	175	175	175	250	600	1050

Q10 (flow with 10% probability of exceedance) during low season	450	450	450	600	1600	2000
Average in October-November	2000	2200	2400	3100	5500	9500
Average in December-February	500	500	500	750	1300	2200
Average in March-May	400	400	400	500	1000	1500

Source: The National River Conservation Directorate, Ministry of Environment and Forests, Government of India (2009)

Farakka Barrage, with a length of 2.2 km and about 15 km from the border with Bangladesh, regulates the flow of the River Ganga diverting some of the water into the 42 km long Feeder Canal linking with the Bhagirathi River downstream towards Kolkata. The design discharge for this channel is around 1,100 m3/s. The navigation lock at Farakka, as well as the Feeder Canal, are part of the Farakka Barrage Project and become the link between the Bhagirathi-Hugli system and the main River Ganga upstream of the Farakka Barrage.

The existing agreement between India and Bangladesh, includes specific water allocation rules during the low flow season. The treaty establishes that during the period January – May 35,000 cusecs (or approximately 425 m3/s) are shared alternatively through the Farakka Barrage on a 10 day cycle in each month by both countries.

Data extracted from Jeuland et al (2013) shows the historical flows at Farakka for the period 1969-2001 (**Figure 5**).

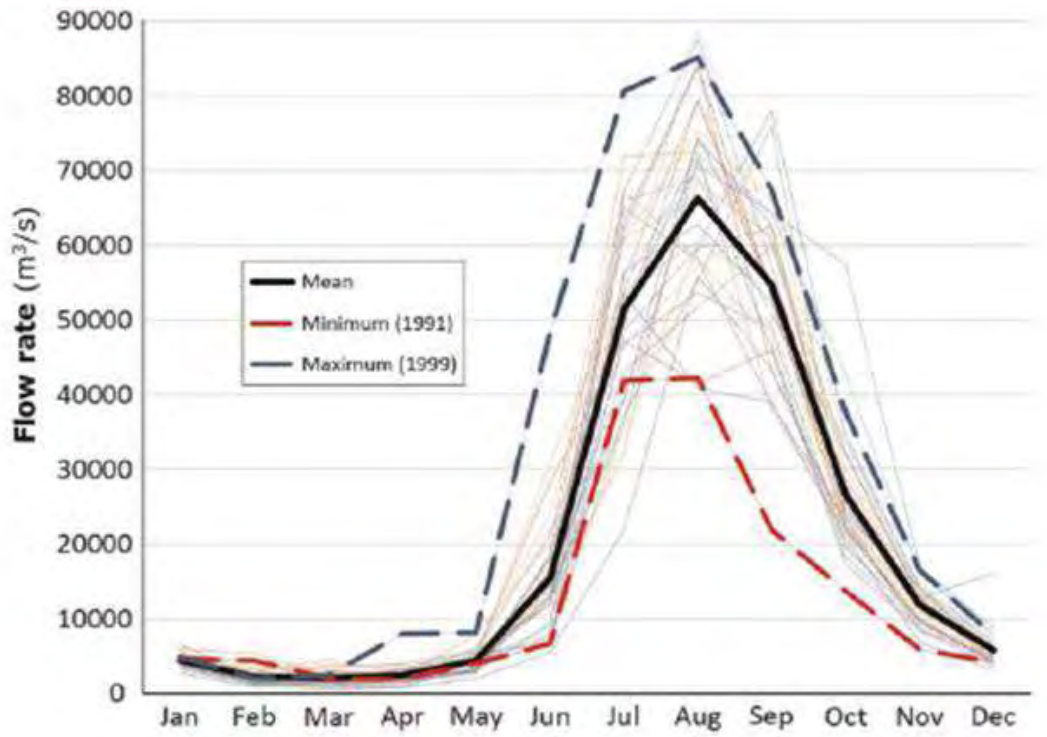


Figure 5: Historical flows at Farakka for the period 1969-2001 (extracted from Jeuland et al, 2013)

Water Levels

Temporal series of water levels have been provided for a number of locations along the waterway between Allahabad and Farakka. The following figures show the variability of monthly water levels, which can be of the order of 10 m during the high season. In general, water levels are at their highest in August-September

and sharply decrease in October-November. In general, they continue to decrease during the whole low flow season, from December to May, and start to raise again in June-July. The variability of water levels during the dry season is lower than during the high season, with variations of the order of 2-3m. The following figures show the maximum and minimum monthly values with the black block representing where 50% of the values concentrate.

The period of the year in which the minimum water level can occur varies with location along the river. In the upstream reaches from Allahabad to Ghazipur the minimum water levels occur from April to July (**Figure 6** and **Figure 7**). Downstream of the three major tributaries, Ghagra, Son and Gandak that join the river near Patna, the minimum water levels can occur between February and June as a result of the influence of snow melt (**Figure 8** and **Figure 9**).

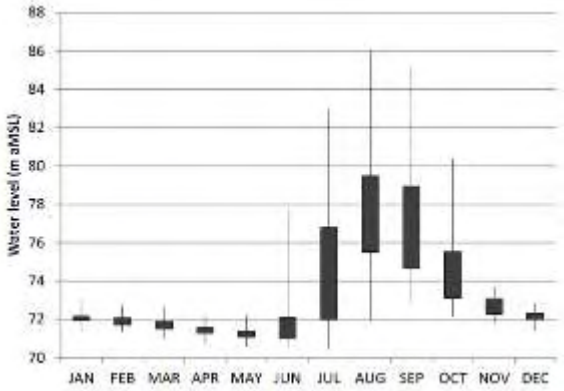


Figure 6: Monthly water levels at Allahabad (chainage 1,547)

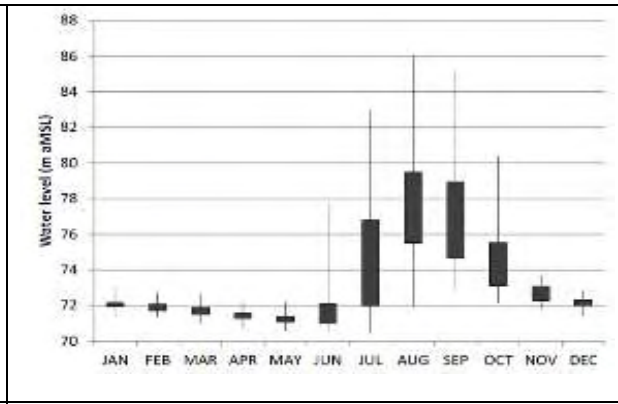


Figure 7: Monthly water levels at Ghazipur (chainage 1,178)

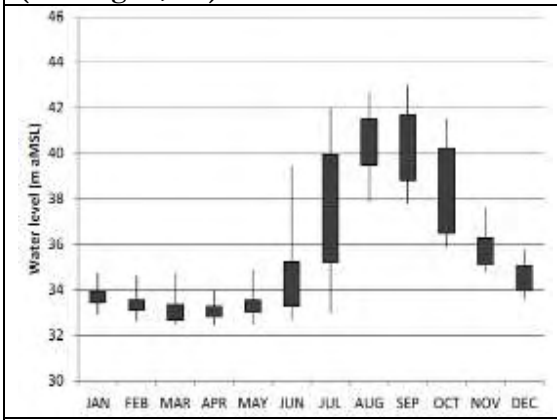


Figure 8: Monthly water levels at Hathida (chainage 850)

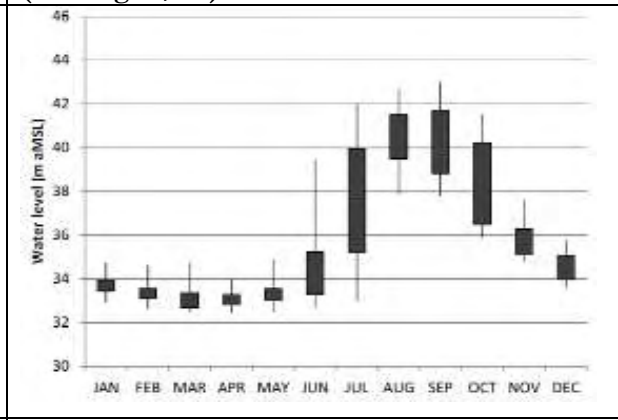


Figure 9: Monthly water levels at Kahalgaon (chainage 690)

Statistical analysis has been performed on the annual minimum and maximum water levels at 7 gauging stations between Allahabad and Farakka. These water levels at each location are given for 3 annual probabilities of occurrence (see **Table 3** and **Table 4**).

Table 3: Minimum water levels for a range of annual probabilities

Location	Minimum water level (m)		
	50%	10%	1%
Allahabad	71.45	70.72	70.38
Mirzapur	63.10	62.58	62.37
Varanasi	58.59	57.91	57.27
Ghazipur	52.45	51.69	51.27
Patna	40.88	40.27	39.56
Hathida	33.28	32.59	32.18
Kahalgaon	23.64	22.96	22.57

Table 4: Maximum water levels for a range of annual probabilities

Location	Maximum water level (m)		
	50%	10%	1%
Allahabad	82.36	85.67	87.22
Mirzapur	75.65	78.77	79.89
Varanasi	70.00	72.48	73.37
Ghazipur	62.88	64.78	65.18
Patna	49.36	50.44	50.91
Hathida	41.78	42.85	43.01
Kahalgaon	30.99	32.70	32.90

Analysis of LAD

Least Available Data (LAD) available from Tribeni to Allahabad was analysed to get an understanding of the variations of water depths in NW-1. Data for the period April 2002 to June 2015 was used to build probability curves of LAD. As an example, two of them are shown in **Figure 10**.

The curves show the probability of having a LAD value lower than the value shown in the graph. For example, in IWAI Reach 20 the probability of having a value less than 6.30 m in August is 90% and the probability of having a value less than 3.60 m is only 10%. As a reference, horizontal lines at 3, 2.5 and 2.2 metres are also shown on the Figures. The graph corresponding to the IWAI Reach 32, Varanasi – Chunar, clearly shows that, based on the existing data, the probability of having depths less than 2.2 m for the period January-May and November-December is 90% or more.

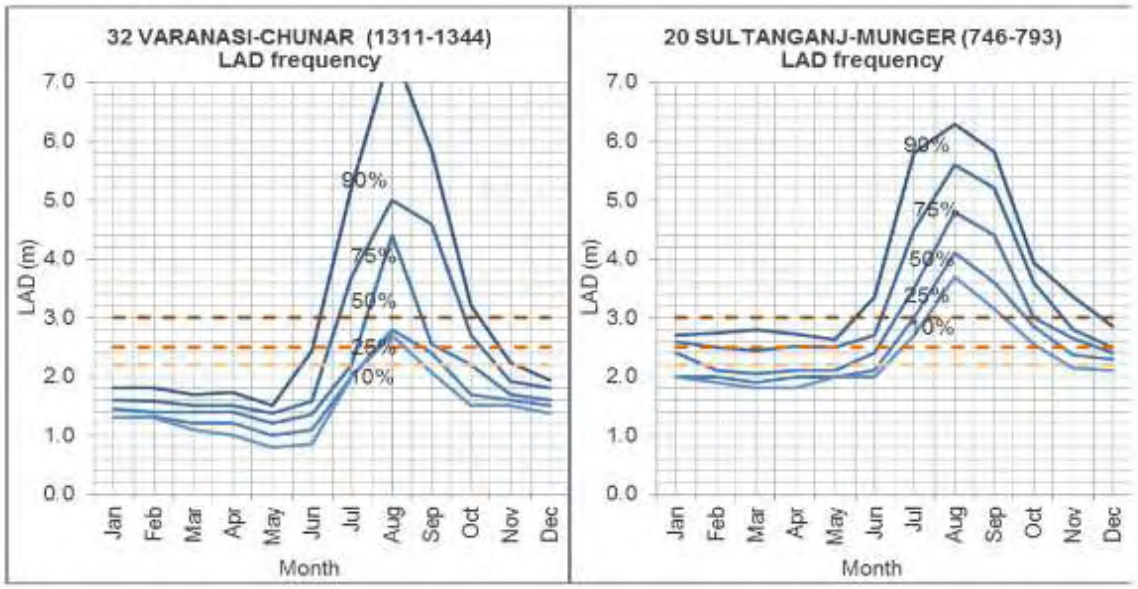


Figure 10: Probability curves of LAD for two different reaches

This statistical information has also been analysed to show the periods when available water depths have a 50% probability to be lower than a certain value (3m, 2.5m and 2.2m). The information is presented in **Table 5** below. It should be analysed in conjunction with other information presented in this report about the length and number of shoals to provide a full picture of the sedimentation processes occurring.

Table 5: LAD with 50% probability (in metres)

Sr. No.	Name	Chainage (km)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Tribeni – Balagarh	193-221	3.00	3.10	3.00	3.00	3.30	3.40	3.80	4.20	3.80	3.60	3.10	3.00

Sr. No.	Name	Chainage (km)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2	Balagarh – Kalna	221-245	3.00	2.90	2.80	2.90	3.00	3.30	3.50	3.95	3.90	3.60	3.05	3.05
3	Kalna - Samudragarh	245-263	3.00	2.80	2.75	2.80	2.90	3.20	3.60	4.00	3.80	3.50	3.20	3.10
4	Samudragarh - Nabadweep	263-280	3.00	2.90	2.80	2.80	2.95	3.25	3.40	4.20	4.20	3.70	3.20	3.10
5	Nabadweep – Patuli	280-322	2.80	2.85	2.85	2.75	2.80	3.10	3.30	3.50	3.70	3.50	3.10	3.00
6	Patuli – Katwa	322-345	3.10	2.90	2.90	2.85	2.90	3.10	3.20	3.40	3.50	3.30	3.00	3.05
7	Katwa – Palassey	345-371	2.80	2.65	2.50	2.50	2.70	3.00	3.00	3.50	3.40	3.10	2.80	2.80
8	Palassey - Chaurigacha	371-400	2.90	2.95	2.80	2.90	3.00	3.10	3.10	3.40	3.40	3.20	3.05	3.00
9	Chaurigacha - Berhampur	400-421	3.40	3.20	3.00	3.05	3.20	3.40	3.70	3.70	3.80	3.55	3.50	3.50
10	Berhampur – Mohammadpur	421-449	3.20	3.00	3.00	3.00	3.10	3.45	3.60	3.95	3.70	3.60	3.40	3.30
11	Mohammadpur - Nasirpur	449-479	3.30	3.20	3.15	3.00	3.20	3.50	3.70	3.80	3.50	3.70	3.50	3.50
12	Nasirpur – Jangipur Lock	479-505	3.75	3.50	3.30	3.40	3.50	4.15	4.30	4.50	4.20	3.95	4.00	4.00
13	Jangipur Lock – Farrakka Lock	505-544	2.70	2.50	2.50	2.30	2.50	2.85	2.80	2.80	2.70	2.75	3.00	2.80
14	Farrakka Lock - Rajmahal	544-583	2.00	2.00	2.00	2.05	2.10	2.20	2.35	2.20	2.10	1.95	2.00	2.00
15	Rajmahal – Manihari	583-633	2.60	2.30	2.35	2.20	2.40	2.65	3.50	4.20	3.90	3.00	2.80	2.85
16	Manihari – Karagola	633-660	2.60	2.40	2.20	2.20	2.45	2.80	3.90	4.60	3.70	3.20	2.95	2.85
17	Karagola - Kahalgaon	660-690	2.20	2.15	2.00	2.00	2.30	2.60	3.95	4.20	4.20	3.00	2.60	2.50
18	Kahalgaon - Bhagalpur	690-715	2.45	2.40	2.20	2.20	2.30	2.50	4.00	4.70	4.10	3.00	2.85	2.70
19	Bhagalpur - Sultanganj	715-746	2.35	2.10	2.10	2.10	2.15	2.50	3.50	4.60	4.10	2.90	2.50	2.35
20	Sultanganj - Munger	746-793	2.40	2.10	2.05	2.10	2.10	2.40	3.50	4.80	4.40	3.00	2.65	2.40
21	Munger - Mahendrapur	793-820	2.20	2.10	2.10	2.15	2.25	2.40	3.70	4.70	3.60	3.10	2.60	2.50
22	Mahendrapur - Semaria	820-853	2.20	2.10	2.10	2.15	2.20	2.45	3.50	5.20	3.90	2.90	2.40	2.30
23	Semaria – Barh	853-891	2.10	2.10	2.00	2.00	2.10	2.30	3.30	4.60	3.40	2.80	2.35	2.20
24	Barh – Mehnar	891-925	2.05	2.00	2.00	2.00	2.00	2.30	3.40	4.50	3.50	2.80	2.40	2.10
25	Mehnar – Patna	925-955	2.00	2.00	2.00	2.00	2.00	2.25	3.40	4.50	3.40	2.70	2.30	2.00
26	Patna – Doriganj	955-1000	2.00	2.00	1.95	1.90	2.00	2.10	3.20	4.30	4.20	2.40	2.10	2.00
27	Doriganj – Ballia	1000-1063	1.60	1.70	1.70	1.70	1.80	1.75	3.00	4.00	3.60	2.30	2.05	1.75
28	Ballia – Buxar	1063-1124	1.70	1.70	1.60	1.60	1.50	1.50	3.00	4.10	3.60	2.40	2.00	1.70
29	Buxar – Ghazipur	1124-1178	1.55	1.60	1.60	1.50	1.30	1.50	2.70	4.40	4.10	2.25	1.80	1.70
30	Ghazipur – Saidpur	1178-1254	1.40	1.30	1.25	1.30	1.10	1.15	2.10	4.40	3.35	2.00	1.65	1.40
31	Saidpur – Varanasi	1254-1311	1.50	1.50	1.30	1.30	1.10	1.20	2.20	4.30	3.10	2.20	1.75	1.45
32	Varanasi – Chunar	1311-1344	1.45	1.40	1.40	1.40	1.20	1.35	2.20	4.40	2.55	2.20	1.70	1.60
33	Chunar – Mirzapur	1344-1398	1.40	1.30	1.20	1.05	0.95	1.00	2.10	3.10	2.75	2.15	1.60	1.40
34	Mirzapur – Rampur Ghat	1398-1419	1.40	1.40	1.30	1.30	1.00	1.10	2.10	3.10	2.70	2.10	1.80	1.40
35	Rampur Ghat - Sirsa	1419-1506	1.50	1.50	1.30	1.40	1.10	1.30	2.10	3.10	3.25	2.05	1.90	1.50
36	Sirsa – Allahabad	1506-1547	1.20	1.10	1.00	0.90	0.80	0.90	2.00	2.80	2.75	1.95	1.50	1.30

Key:

3.0m =< LAD	2.5m =< LAD < 3.0m	2.2m =< LAD < 2.5m	LAD < 2.2m

The different colours in Table 19 show the range of minimum depths available. Green corresponds to the months when available depths are larger than 3 m. The table clearly shows the different behaviour of water depths upstream of Farakka Barrage, where the waterway is not regulated and downstream of Farakka Barrage, where water discharges are regulated by the releases from the Barrage into the Hugli River.

Figure 11 summarises the information provided by the table for the dry season (November to June). It shows the available dry season LAD along the waterway.

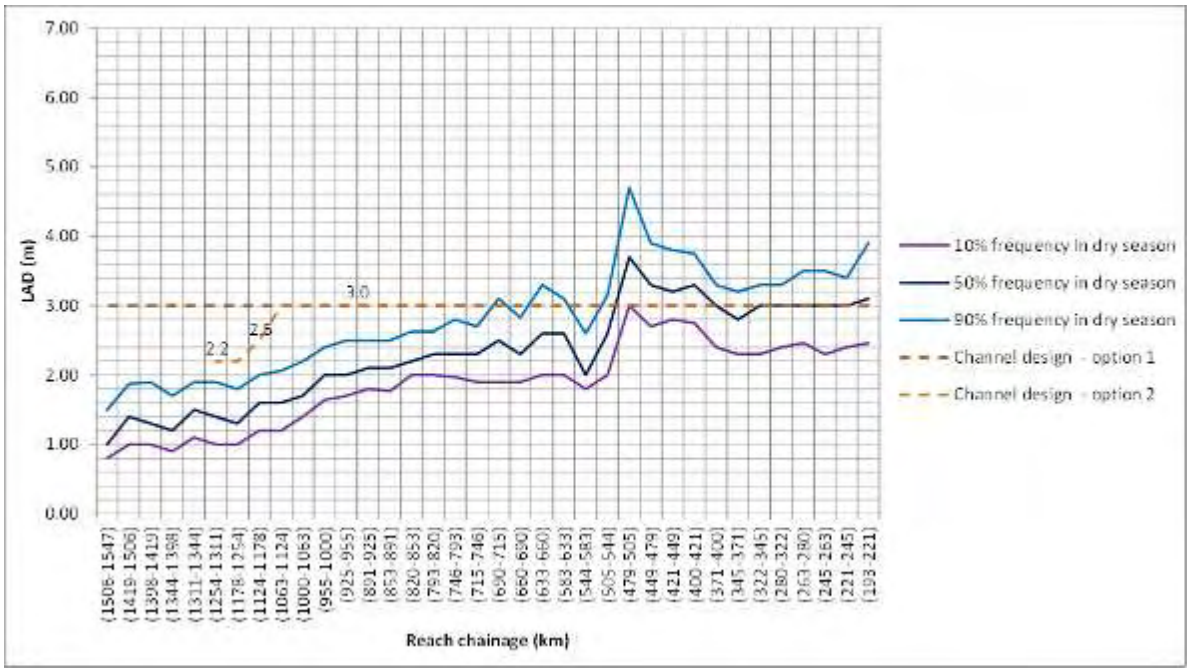


Figure 11: LAD along the waterway for the 10, 50 and 90 per cent frequency values

Annexure 5.4: The details of sampling locations of surface water and analysis results

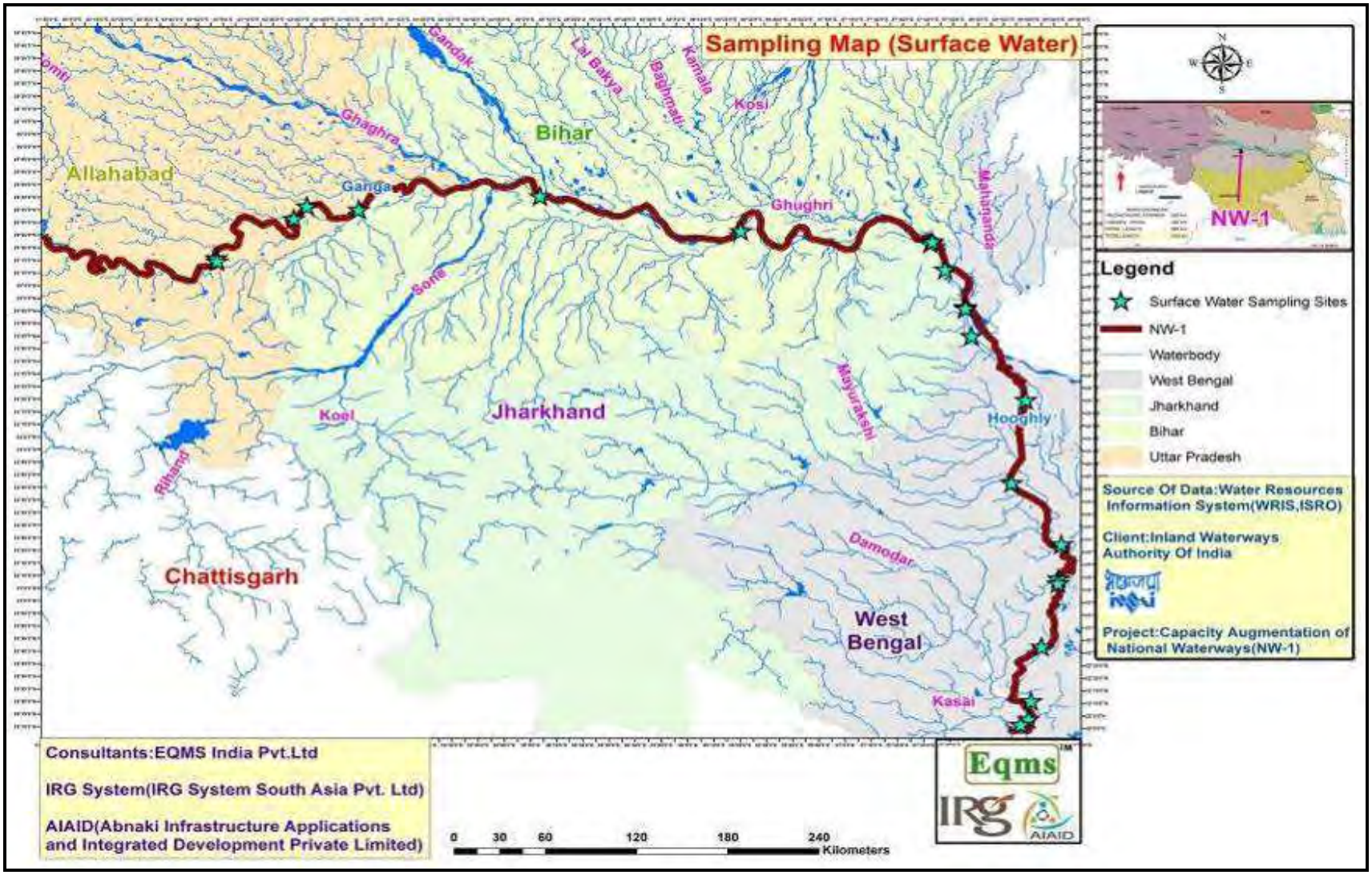
Primary Data

Surface water sample were collected[26] from the upstream and downstream of the proposed and planned terminals/ lock locations and environmental sensitive receptors present all along the NW-1. One sample each were also collected from existing ro-ro/jetty/floating terminals. The water samples were examined for physico-chemical parameters as well as for bacteriological parameters. Samples were analysed for various parameters using the CPCB's BDU Criteria. The name of water sampling locations is given at **Table 4.19** and shown at **Figure 4.19**. The analysis results of surface water are presented in **Table 4.20** to **4.22**. Photograph of water sampling is provided in **Figure 4.20** and **4.21**.

Name of Surface Water Sampling Locations

Sl. No.	Terminal Location	Surface water sampling Location	Location Code	Source
Proposed and Planned Terminals				
1	Haldia Terminal, West Bengal	Hoogly River Upstream of Terminal Site and Green Belt Canal	SW-1	Hooghly River
		Hoogly River downstream of Terminal Site and Green Belt Canal	SW-2	Hooghly River
2	Tribeni Terminal, West Bengal	Ganga River Upstream of proposed Tribeni Terminal Site	SW-3	Ganga River
		Ganga River downstream of proposed Tribeni Terminal Site near Shibpurghat	SW-4	Ganga River
	Farakka Lock, West Bengal	Ganga River Upstream of existing Farakka lock site	SW-5	Ganga River
		Ganga River downstream of existing Farakka lock site	SW-6	Ganga River
	Sahibganj Terminal, Kharkhand	Ganga River Upstream of Terminal site near Samda village	SW-7	Ganga River
		Ganga River Downstream of Terminal site near Samda village	SW-8	Ganga River
	Gazipur Terminal, Uttar Pradesh	Ganga River Upstream of proposed Terminal site at Ghazipur	SW-9	Ganga River
		Ganga River Downstream of proposed Terminal site at Ghazipur	SW-10	Ganga River
	Varanasi Terminal, Uttar Pradesh	Ganga River upstream of Gurha Nala and proposed Terminal site	SW-11	Ganga River
		Ganga River downstream of Gurha Nala and proposed Terminal site	SW-12	Ganga River
Existing Ro/Ro/Jetty/Floating Terminals along NW-1				
1	West Bengal	Diamond Harbour	SW-13	Ganga River
2	West Bengal	Howrah	SW-14	Ganga River
3	West Bengal	Shantipur	SW-15	Ganga River
4	West Bengal	Katwa	SW-16	Ganga River
5	West Bengal	Hazardwari	SW-17	Ganga River
6	West Bengal	Pakur	SW-18	Ganga River
7	Jharkhand	Magalhal	SW-19	Ganga River
8	Uttar Pradesh	Buxar	SW-20	Ganga River
9	Uttar Pradesh	Munger	SW-21	Ganga River
10	Uttar Pradesh	Patna	SW-22	Ganga River
Sensitive Locations (Turtle, Vikramshila Dolphin and Hilsa Sanctuaries)				
1	Near Sanctuary Areas	Three locations per Sanctuary areas	-	Ganga River

26Samples were collected as per the standard protocol. The samples for bacteriological analyses were collected in sterilized bottles.



Surface Water Sampling Locations

Ganga Water Quality NW-1 (near proposed and planned Terminal Site location)

Sl.No.	Parameters	Haldia West Bengal		Tribeni West Bengal		Farakka, West Bengal		Sahibganj Jharkhand		Ghazipur Uttar Pradesh		Varanasi Uttar Pradesh	
		SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7	SW-8	SW-9	SW-10	SW-11	SW-12
1	pH	7.12	7.52	7.22	7.19	6.68	6.54	7.04	6.98	7.8	7.4	7.46	7.45
2	Temperature 0C	24.1	24.6	23.8	24.2	26.2	25.9	25.4	25.8	25.1	25.3	-	-
3	Conductivity, µmhos/cm	858	880	304	335	288	298	340	354	258	262	509	499
4	Turbidity (NTU)	2.1	3.2	3.1	2.5	1.8	1.9	1.6	1.5	1.2	1.8	-	-
5	Total Dissolved solids	484	497	189	208	192	198	208	214	170	178	339	355
6	Total Suspended solids	8	18	12	10	6	8	8	9	12	10	-	-
7	Dissolved Oxygen (mg/litre)	6.9	6.2	7.0	7.6	7.1	6.9	6.9	7.2	7.6	7.4	6.0	6.2
8	BOD, (for 3 days at 270C) (mg/litre)	4.1	2.6	3.6	3.9	2.2	2.3	2.4	2.1	4.8	4.3	7.43	6.85
9	Chemical Oxygen Demand, (mg/litre)	13.2	8.6	12.1	13.0	8.4	8.2	8.6	8.2	15.7	16.2	-	-
10	Total Hardness, mg/l	219	268	180	192	123	116	123	128	114	116	-	-
11	Oil & grease, mg/l	0.2	0.6	0.5	0.4	0.2	0.2	0.4	0.3	0.5	0.3	-	-
12	Chloride, mg. l	172	168	28	26	14	16	14	16	14		-	-
13	Nitrates as NO3, mg/l	1.9	2.4	0.86	0.88	0.16	0.14	0.21	0.20	0.30	0.28	-	-
14	Iron as Fe, mg/l	0.13	0.19	0.42	0.49	0.31	0.33	0.28	0.25	0.41	0.36	-	-
15	Zinc as Zn, mg/l	0.2	0.6	2.2	2.3	2.9	2.8	3.4	3.5	2.9	2.8	-	-
16	Calcium as Ca, mg/l	72	79	37	38	24	22	26	28	22	26	-	-
17	Magnesium as Mg, mg/l	18	19	21	24	15	14.4	14	13	14	12	-	-
18	Cadmium as Cd, mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
19	Copper as Cu, mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
20	Nickel as Ni, mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
21	Lead as Pb, mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
22	Mercury as Hg, mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
23	Total Chromium (Total as Cr), mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-
24	Arsenic as As, mg/l	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	-	-
25	Silica, mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
26	Fecal coliform MPN/100ml	3920	4370	5462	4370	3890	3940	3429	3390	8756	9472	12300	15400
27	Total coliform MPN/100ml	10234	11343	12300	11343	12324	12574	11489	11206	14520	16120	-	-
28	Pesticides (Present /Absence)	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	-	-

Source: Data sampling & Analysis by JV and NABL accredited Lab

Ganga Water Quality Along NW-1 (near Existing Ro-Ro/Jetty/Floating Terminal sites)

		West Bengal						Jharkhand	Bihar		
Sl.No.	Parameters	SW-13	SW-14	SW-15	SW-16	SW-17	SW-18	SW-19	SW-20	SW-21	SW-22
1	pH	7.20	8.1	7.45	7.80	7.65	7.54	7.31	8.1	7.7	8.2
2	Temperature 0C	25.0	26.0	25	24.8	23.8	25.0	24.8	23.8	23.8	24.0
3	Conductivity, µmhos/cm	1230	320	315	405	345	319	327	305	318	290
4	Turbidity (NTU)	2.4	4.2	3.5	4.7	3.1	3.1	2.7	2.5	2.1	4.8
5	Total Dissolved solids	840	201	195	260	204	198	204	196	204	188
6	Total Suspended solids	14	6	5	11	9	11	9	8	10	13
7	Dissolved Oxygen (mg/litre)	5.8	6.5	7.6	6.5	7.2	7.8	7.1	7.8	6.7	8.1
8	BOD, (for 3 days at 270C) (mg/litre)	2.6	5.4	3.5	2.6	2.0	2.4	2.8	2.1	2.3	2.8
9	Chemical Oxygen Demand, (mg/l)	9.4	19	10.6	9.3	7.8	8.9	10	7	8.4	10.4
10	Total Hardness, mg/l	322	168	164	214	168	160	168	156	158	152
11	Oil & grease, mg/l	0.2	1.1	0.3	0.7	0.4	0.4	0.1	0.2	0.4	0.6
12	Chloride, mg. l	212	26	24	34	28	24	26	22	26	22
13	Nitrates as NO3, mg/l	1.6	2.45	2.68	1.87	1.90	2.91	1.68	1.28	1.14	1.10
14	Iron as Fe, mg/l	0.14	1.45	1.28	0.56	0.98	2.21	2.31	1.20	1.08	1.34
15	Zinc as Zn, mg/l	0.22	0.87	0.25	0.45	0.40	0.29	0.45	0.50	0.34	0.67
16	Calcium as Ca, mg/l	92	34	32	38	34	32	34	28	30	31
17	Magnesium as Mg, mg/l	22	20	20	29	20	19	20	21	20	18
18	Cadmium as Cd, mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
19	Copper as Cu, mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
20	Nickel as Ni, mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
21	Lead as Pb, mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
22	Mercury as Hg, mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
23	Total Chromium (Total as Cr), mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
24	Arsenic as As, mg/l	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
25	Silica, mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
26	Fecal coliform MPN/100ml	6120	18456	6450	8760	7890	4580	3890	2340	2460	3890
27	Total coliform MPN/100ml	11720	45680	12400	12988	11340	9890	8790	5430	5980	8790
28	Pesticides (Present /Absence)	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent

Source: Data sampling & Analysis by JV and NABL accredited Lab

Ganga Water Quality near sensitive locations along NW-1

		Hilsa Sanctuary Area			Dolphin Sanctuary			Kashi Turtle Sanctuary		
Sl.No.	Parameters	Farakka Barrage	Near Diamond Harbour	Near Katua	Sultanganj Ghat	Near Vikramshila setu, Bhagalpur	Ganga ghat near Kahalgaon	Near Dashashwamegh ghat	Near Tulsi Ghat	Near AssiGhat
1	pH	7.10	6.95	7.67	6.85	7.43	6.47	7.65	7.23	7.72
2	Temperature 0C	25.4	24.8	24.5	25.2	24.6	24.8	23.6	24.2	24.3
3	Conductivity, µmhos/cm	304	838	400	335	436	368	545	486	532
4	Turbidity (NTU)	2.1	3.0	3.8	1.2	3.8	1.8	6.7	7.2	8.0
5	Total Dissolved solids	200	465	254	208	275	222	368	328	352
6	Total Suspended solids	8	10	9	11	4	6	12	8	14
7	Dissolved Oxygen (mg/litre)	6.7	7.5	7.0	7.8	6.9	7.9	7.3	7.8	7.0
8	BOD, (for 3 days at 270C) (mg/litre)	2.8	3.1	2.8	2.2	2.0	3.1	6.8	5.2	7.2
9	Chemical Oxygen Demand, (mg/l)	9.0	11.3	10.8	6.4	5.8	11.8	19.8	17.2	23.0
10	Total Hardness, mg/l	130	210	208	176	192	170	234	208	222
11	Oil & grease, mg/l	0.4	0.2	0.4	0.1	0.5	0.2	2.1	1.6	2.4
12	Chloride, mg. l	16	158	32	28	48	30	48	32	40
13	Nitrates as NO3, mg/l	0.23	2.3	1.98	0.89	3.82	0.88	0.89	0.67	1.10
14	Iron as Fe, mg/l	0.45	0.67	0.58	2.31	2.50	1.25	1.20	0.98	1.16
15	Zinc as Zn, mg/l	2.45	1.23	0.68	1.06	0.78	1.28	1.10	1.12	1.21
16	Calcium as Ca, mg/l	28	68	34	35	38	36	58	46	48
17	Magnesium as Mg, mg/l	15	10	30	22	24	19	22	23	25
18	Cadmium as Cd, mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
19	Copper as Cu, mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
20	Nickel as Ni, mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
21	Lead as Pb, mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
22	Mercury as Hg, mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
23	Total Chromium (Total as Cr), mg/l	<0.05	0.09	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
24	Arsenic as As, mg/l	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
25	Silica, mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
26	Fecal coliform MPN/100ml	3100	4560	4560	2340	2200	2980	8670	5680	7988
27	Total coliform MPN/100ml	11876	13467	24356	10120	12340	12650	14790	13210	14218
28	Pesticides (Present /Absence)	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent

Source: Data sampling & Analysis by JV and NABL accredited Lab

Ground Water Use pattern

Groundwater is the water present beneath Earth's surface in soilpore spaces and in the fractures of rock formations. It is stored in and moves slowly through geologic formations of soil, sand and rocks called aquifers. The major land use type around the NW-1 is agriculture. The NW-1 area has a vast reservoir of groundwater, replenished every year at a very high rate. The conjunctive use of groundwater for irrigation, even within the canal command areas, not only ensures steady supply to the cultivated fields on time but also helps reduce water logging and salinization due to consequent downward movement of subsurface moisture.

The groundwater usage pattern in the states traversed by NW-1 is given in **Table 4.12**-. The extent of groundwater utilization for irrigation is highest in Uttar Pradesh (45.36 BCM per year), followed by West Bengal (10.84 BCM per year), Bihar (9.39 BCM per year) and Jharkhand (0.7 BCM per year).

Overview of Ground water uses Pattern in States Traversed by NW-1

S. No.	State	Annual Groundwater Draft (BCM per year)			Net annual Groundwater availability (BCM/year)	Projected Demand for Domestic and Industrial uses up to 2025 (BCM per Year)
		irrigation	Domestic and Industrial uses	Total		
2	Uttar Pradesh	45.36	3.42	48.78	70.18	5.30
4	Bihar	9.39	1.37	10.77	27.42	2.14
5	Jharkhand	0.7	0.38	1.06	5.25	0.56
6	West Bengal	10.84	0.81	11.65	27.46	1.24

(Source: Central Groundwater Board, 2008 and Central water commission 2008)

Apart from irrigation, groundwater resources are also being heavily tapped for industrial and domestic activities in urban as well as in rural areas. Throughout the alluvial area of the NW-1, most of the urban water supply schemes are dependent upon groundwater resources. Similarly, a large number of industries also withdraw significant amounts of groundwater, especially from the easily accessible aquifers in the alluvial zone. State wise ground water resources in NW-1 state is given in **Table 4.13**.

State wise Ground water resources in NW-1 (2008)

S. No.	State	Annual Replenishable Groundwater (BCM per Year)	Annual Groundwater Draft (BCM per Year)	Balance available (BCM per year)	Stage of Groundwater Development (%)
2	Uttar Pradesh	76.35	48.78	27.57	70
4	Bihar	29.19	10.77	18.42	39
5	Jharkhand	5.58	1.06	4.52	20
6	West Bengal	30.36	11.65	18.71	42

Source: CWC 2008

Ground Water Quality

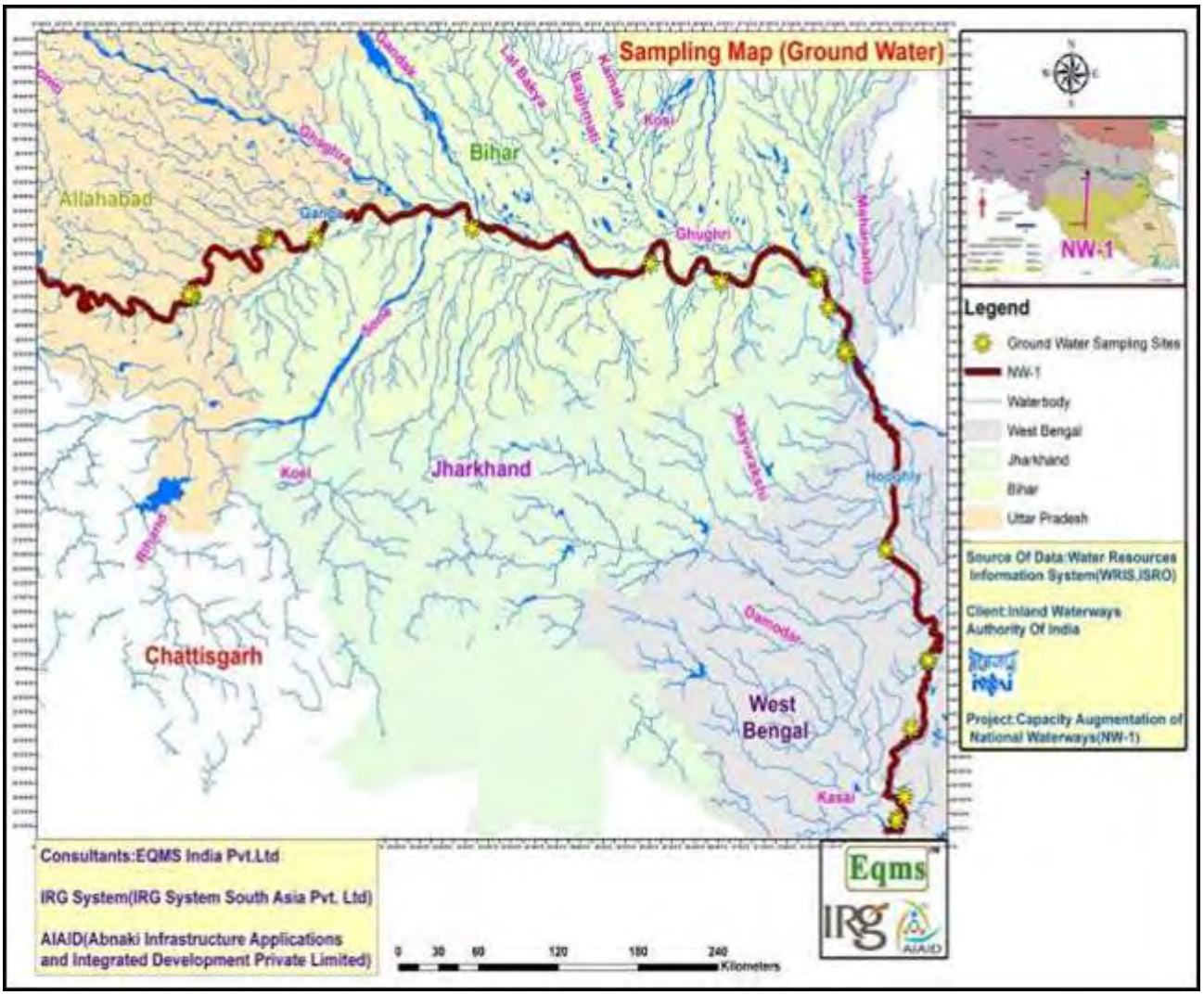
Ground water samples were collected from intervention locations and stretches close to populated zones all along the NW-1[27]. The water samples were examined for physico-chemical parameters as well

27Samples for chemical analyses and bacteriological analyses were collected in polyethylene carboys and in sterilized bottles (APHA Method) respectively.

as for bacteriological parameters. The details of sampling locations are presented in **Table 4.14** and **Figure 4.16**. The Analysis results are presented in **Table 4.15** and **Table 4.16**.

Ground Water Sampling Locations along NW-1

Sl. No.	Terminal Location	Ground water sampling Location	Location Code	Source
Proposed and Planned Terminals				
1	Haldia Terminal, WB	Patikhali	GW-1	Hand pump
		Near terminal site	GW-2	Borewell
		Durgachak	GW-3	Borewell
2	Tribeni Terminal, WB	Near Terminal site, Tap water	GW-4	Borewell
		Tribeni, Tap Market	GW-5	Tap water
	Farakka Lock, WB	Near Farakka lock site	GW-6	Borewell
		Goraipara Village	GW-7	Hand pump
		Farakka Town	GW-8	Hand pump
	Sahibganj Terminal, Kharkhand	Samda Nala Village	GW-9	Hand pump
		Rampur Village	GW-10	Hand pump
		Sakrigali	GW-11	Hand pump
	Gazipur Terminal, Uttar Pradesh	Tarighat, Ghazipur	GW-12	Hand pump
			GW-13	Handpump
		Kalupur	GW-14	Handpump
	Varanasi Terminal, Uttar Pradesh	Terminal Site	GW-15	Borewell
		Milkipur	GW-16	Hand pump
		Ralhupur	GW-17	Hand pump
		Tahirpur	GW-18	Hand pump
		Bhitti	GW-19	Hand pump
		Madarwa	GW-20	Hand pump
Populated areas along NW-1				
1	West Bengal	Diamond Harbour	GW-21	Hand pump
2	West Bengal	Howrah	GW-22	Hand pump
3	West Bengal	Katwa	GW-23	Hand pump
4	Jharkhand	Magalhat	GW-24	Hand pump
5	Bihar	Bhagalpur	GW-25	Hand pump
6	Bihar	Buxar	GW-26	Hand pump
7	Bihar	Munger,	GW-27	Hand pump
8	Bihar	Patna	GW-28	Hand pump



Ground Water Sampling Locations

Ground Water Qualityat Proposed Terminals/Lock area

S.N.	Parameters	Desirable Limit IS: 10500	Permissible Limit IS: 10500	Haldia Terminal (WB)			Triveni Terminal		Farakka Lock (WB)			Sahibganj Terminal		
				GW-1	GW-2	GW-3	GW4	GW5	GW-6	GW-7	GW-8	GW-9	GW-10	GW-11
1	pH	6.5-8.5	No relaxation	7.24	8.04	7.67	7.38	7.31	6.79	6.96	6.71	7.1	6.85	6.91
2	Temp. 0C	-	-	24	24	24	27.4	26.5	24.6	25	24.8	27	26	27
3	Conductivity, mmhos/cm	-	-	950	1982	1164	474	314	551	549	558	316	632	1303
4	Turbidity,NTU	5	10	0.1	0.1	0.2	0.1	0.4	0.1	0.1	0.2	0.1	0.2	0.2
5	TDS, mg/l	500	2000	612	1372	744	299	201	356	369	377	212	429	886
6	TSS, mg/l	-	-	2	1	1	Nil	Nil	1	2	2	2	1	4
7	T Hardness as CaCO3, mg/l	300	600	268	345	279	264	152	244	252	264	132	225	756
8	Chloride asCl, mg/l	250	1000	236	456	276	26	16	18	20	26	18	39	171
9	Alkalinity, mg/l	200	600	186	268	226	95	75	112	126	116	126	167	133
10	Sulphates as, SO4, mg/l	200	400	8.2	3.98	3.34	15	5	6	9	11	8	13	75
11	Nitrates as NO3, mg/l	45	100	2.9	0.06	0.08	0.9	0.6	0.6	0.8	0.9	0.9	1.2	1.48
12	Fluoride as F, mg/l	1	1.5	0.38	0.46	0.49	0.28	0.22	0.4	0.5	0.23	0.3	0.24	0.19
13	Iron as Fe, mg/l	0.3	1	0.46	0.35	0.32	0.56	0.41	0.22	0.34	0.44	0.12	0.44	0.32
14	Zinc as Zn, mg/l	5	15	0.08	0.7	0.9	1.1	1.0	0.6	0.9	0.9	0.8	1	0.9
15	Calcium as Ca	75	200	72	114	68	53	30	50	51	53	27	70	152
16	Magnesium as Mg	30	100	21	14	28	32	19	29	30	32	16	11	91
17	Cadmium as Cd, mg/l	0.01	No relaxation	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
18	Copper as Cu, mg/l	0.05	1.5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
19	Nickel as Ni, mg/l	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
20	Lead as Pb, mg/l	0.05	No relaxation	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
21	Mercury as Hg, mg/l	0.001	No relaxation	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
22	Chromium (Total as Cr, mg/l	0.05	No relaxation	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
23	Arsenic as As, mg/l	0.05	No relaxation	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
24	Phenolic compound	0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
25	Total coliform MPN/100ml	-	-	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
26	Fecal Coliform, MPN/100ml	-	-	Nil	Nil	NI	Nil	Nil	Nil	Nil	NI	Nil	Nil	NI

Source: Data sampling & Analysis by JV and NABL accredited Lab

Ground Water Quality at Proposed Terminals/Lock areas (cont..)

S.N.	Parameters	Desirable Limit IS: 10500	Permissible Limit IS: 10500	Ghazipur Terminal				Varanasi Terminal				
				GW-12	GW-13	GW-14	GW-15	GW-16	GW-17	GW-18	GW-19	GW-20
1	pH	6.5-8.5	No relaxation	7.11	7.11	7.34	7.4	7.14	1.17	7.25	7.5	7.4
2	Temp. 0C	-	-	24.6	25.2	25.0	-	-	-	-	-	-
3	Conductivity, mmhos/cm	-	-	749	648	472	462	490	575	887	493	711
4	Turbidity,NTU	5	10	0.1	0.2	0.3	0.5	0.5	0.6	0.8	1.8	1.6
5	TDS, mg/l	500	2000	472	428	320	318	253	274	501	316	440
6	TSS, mg/l	-	-	2	4	1	2	3	4	4	4	4
7	T Hardness as CaCO3, mg/l	300	600	392	310	168	272	212	220	284	172	312
8	Chloride asCl, mg/l	250	1000	30	28	14	14	7	10	50	16	68
9	Alkalinity, mg/l	200	600	143	124	110	NA	NA	NA	NA	NA	NA
10	Sulphates as, SO4, mg/l	200	400	17	15	8.7	15	13	29	35	5	46
11	Nitrates as NO3, mg/l	45	100	0.84	0.78	1.23	0.95	0.07	0.08	0.75	0.7	0.6
12	Fluoride as F, mg/l	1	1.5	0.46	0.38	0.34	0.4	0.03	0.31	0.64	0.34	0.13
13	Iron as Fe, mg/l	0.3	1	0.48	0.38	0.60	0.12	0.02	0.11	0.012	0.12	0.12
14	Zinc as Zn, mg/l	5	15	1.21	1.21	0.87	1	1	0.9	1.1	0.9	0.8
15	Calcium as Ca	75	200	78	62	32	32	39	35	37	44	50
16	Magnesium as Mg	30	100	48	45	21	47	27	32	47	12.2	46
17	Cadmium as Cd, mg/l	0.01	No relaxation	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
18	Copper as Cu, mg/l	0.05	1.5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
19	Nickel as Ni, mg/l	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
20	Lead as Pb, mg/l	0.05	No relaxation	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
21	Mercury as Hg, mg/l	0.001	No relaxation	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
22	Chromium (Total as Cr, mg/l	0.05	No relaxation	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
23	Arsenic as As, mg/l	0.05	No relaxation	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
24	Phenolic compound	0.001	0.002	<0.001	<0.001	<0.001	-	-	-	-	-	-
25	Total coliform MPN/100ml	-	-	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
26	Fecal Coliform, MPN/100ml	-	-	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

Source: Data sampling & Analysis by JV and NABL accredited Lab

Ground Water Quality at Major Habitation area along NW-1

S.N.	Parameters	Desirable Limit IS: 10500	Permissible Limit IS: 10500	Daimond Harbour	Hoorah	Katwa	Mangalhat	Bhagalpur	Buxer	Munger	Patna
1	pH			7.50	7.36	7.29	7.67	7.56	7.34	6.94	7.23
2	Temp. 0C	-	-	24.0	24.2	24.5	24.8	24.8	23.6	23.8	25.1
3	Conductivity, mmhos/cm	-	-	1148	1240	322	626	637	342	862	674
4	Turbidity,NTU	5	10	1.0	2	1	Nil	2	1	3	1
5	TDS, mg/l	500	2000	754	794	232	420	408	220	646	425
6	TSS, mg/l	-	-	1.1	0.5	0.7	0.8	Nil	0.4	1.2	Nil
7	T Hardness as CaCO3, mg/l	300	600	258	304	100	220	376	138	288	348
8	Chloride asCl, mg/l	250	1000	270	230	12	38	64	20	42	50
9	Alkalinity, mg/l	200	600	236	252	90	164	180	118	160	187
10	Sulphates as, SO4, mg/l	200	400	2.86	1.87	15	18	24	12	16.8	28
11	Nitrates as NO3, mg/l	45	100	2.1	4.2	7.8	1.8	1.13	1.22	11.2	8.4
12	Fluoride as F, mg/l	1	1.5	0.50	0.48	0.53	0.45	0.35	0.43	0.56	0.81
13	Iron as Fe, mg/l	0.3	1	1.20	0.89	0.46	0.87	0.61	0.92	0.046	0.51
14	Zinc as Zn, mg/l	5	15	1.10	0.92	0.74	1.34	1.23	1.10	1.26	1.29
15	Calcium as Ca	75	200	74	102	24	64	75	32	48	70
16	Magnesium as Mg	30	100	18	20.3	9.7	14	46	14	41	42
17	Cadmium as Cd, mg/l	0.01	No relaxation	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
18	Copper as Cu, mg/l	0.05	1.5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
19	Nickel as Ni, mg/l	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
20	Lead as Pb, mg/l	0.05	No relaxation	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
21	Mercury as Hg, mg/l	0.001	No relaxation	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
22	Chromium (Total as Cr, mg/l	0.05	No relaxation	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
23	Arsenic as As, mg/l	0.05	No relaxation	<0.025	<0.025	<0.025	<0.025	0.03	<0.025	0.04	<0.025
24	Phenolic compound	0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001
25	Total coliform MPN/100ml	-	-	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
26	Fecal Coliform, MPN/100ml	-	-	NI	NI	NI	Nil	NI	Nil	Nil	Nil

Source: Data sampling & Analysis by JV and NABL accredited Lab

Observation on Ground Water Quality

The Physico-chemical characteristics of the ground water samples were assessed with respect to prescribed drinking water standard IS: 10500.Few parameters namely TDS, total hardness and chloride values are marginally above the desirable limitsat Haldia and Sahibganj, Howrah and Kolkata but all were within the permissible limits as per prescribed Standard (IS: 10500) except Fe which exceeds the prescribed limits at certain locations. Other heavy metal were either present in traces or below prescribed standards. The arsenic content in ground water sample of Bhagalpur and Munger were found present but lower than the permissible limit.

Annexure 5.5: River bed sediment samples

River Sediment Analysis

This section describes the baseline conditions of riverbed sediment with respect to requirement of dredging to maintain least available depth in stretches between Allahabad to Haldia in NW-1, estimated dredging quantities, the locations of river bed sampling so as to understand the values of selected parameters, their characteristics and analysis of river bed sediment quality.
Presently the IWAI undertakes a programme of dredging with their in-house dredging fleet to assist in providing depth in the waterway. The IWAI currently undertakes about 0.8 Mm^3 of dredging each year. On average each of the dredging plant is reported to achieve production of about 135,000 m^3 during the dredging season which spans from October to June. Other interventions such as bandalling are also undertaken in certain areas[28].
The quantities for dredging have been estimated based on required least available depth in various stretches from Allahabad to Haldia[29] as given in **below.**

Dredging Quantities – Allahabad to Haldia

Stretch	Stretch Length (km)	Average Annual Dredge Volumes (m^3)		
		Present day 2013/14	Option 1 3m LAD	Option 2 3m to Barh 2.5 to Buxar 2.2m to Varanasi
Haldia to Farakka	544	-	1,662,592	1,662,592
Farakka to Barh	347	370,000	5,618,132	5,618,132
Barh to Patna	64	330,000	3,189,534	2,287,099
Patna to Buxar	169		4,999,253	3,262,123
Buxar to Varanasi	187		5,793,355	2,930,650
Varanasi to Allahabad	236		9,816,710	n/a
Total	1547	700,000	31,079,576	15,760,596

In the context of India and NW-1, dumping in landfill and sea (particularly relevant for Haldia) may be suitable. Criteria for Harmful Bottom Sediments of Japan and Criteria for Off-Shore Dumping of Dredged Material in USA and Canada (for offshore dumping of dredged material) may be adopted as given in **below**.

Criteria for Disposal of Harmful Bottom Sediments: No specific standards are defined in India for disposal of dredged material. If dredged material is toxic/ harmful then these sediments should either be disposed off in landfill or in Sea. Criteria followed in Japan[30] is given in the **below**.

Criteria for Harmful Bottom Sediments, Japan (unit: mg/l)

Contaminated Material	Dumping in Landfills (mg/l)	Dumping at sea (mg/l)
Alkylmercuric compounds	Not detectable	Not detectable
Mercury and its compounds	0.005	0.005

[28] *Detailed Feasibility Study for Capacity Augmentation of NW-1 and Detailed Engineering for its Ancillary Works and Processes between Haldia to Allahabad (Jal Marg Vikas Project), Detailed Feasibility Report, March 2016*

[29] *Detailed Feasibility Study for Capacity Augmentation of NW-1 and Detailed Engineering for its Ancillary Works and Processes between Haldia to Allahabad (Jal Marg Vikas Project), Detailed Feasibility Report, March 2016*

[30] *Assessment of the Environment Impact of Port Development, United Nations, New York, 1992*

Cadmium and its compounds	0.1	0.1
Lead and its compounds	1	1
Organophosphorus compounds	1	1
Chromium (VI) compounds	0.5	0.5
Arsenic and its compounds	0.5	0.5
Cyanogen compounds	1	1
PCB	0.003	0.003
Copper and its compounds	-	3
Zinc and its compounds	-	5
Fluoride	-	15

Note: Criteria are based on the examination of dissolution of contaminated materials

Criteria for Off-shore dumping of Dredged material: No criteria is defined for off-shore disposal of dredged material in India, thus reference to the UN standards[31] can be made and is given in **Table below**.

Criteria for Off-Shore Dumping of Dredged Material (unit: ppm or ppb)

Substance	Canada	USA
PCB (ppb)	100	380
Hg (ppm)	0.5	0.15
Cd (ppm)	0.60	0.7
Zn (ppm)	169	105
Cu (ppm)	45	68
As (ppm)	(5 – 25)	12.5
Pb (ppm)	45	33
Organochlorine pesticide (ppb)	10 for any compound	5.0 Sum of DDT, DDE and DDD
Polyaromatic hydrocarbon (ppb)	(1,000) Sum of 16 compounds	680 Sum of six low mol. Wt. compounds 2,690 Sum of 10 high mol. Wt. compounds

Methodology

Sampling of River bed sediment was carried out in February- March 2016 (pre monsoon) in selected stretches of NW-1. Samples of river bed sediments were collected at three levels of depth viz. 0.0 to 1.0, 1.1 to 2.0 and 2.1 to 3.0 in 2 boreholes. Sampling of River bed sediments was conducted in 21 locations given in **Tables below**.

20 parameters (physical, chemical, Pesticides/Insecticides) selected for assessment of river bed sediments and their unit is given in **Table below.**

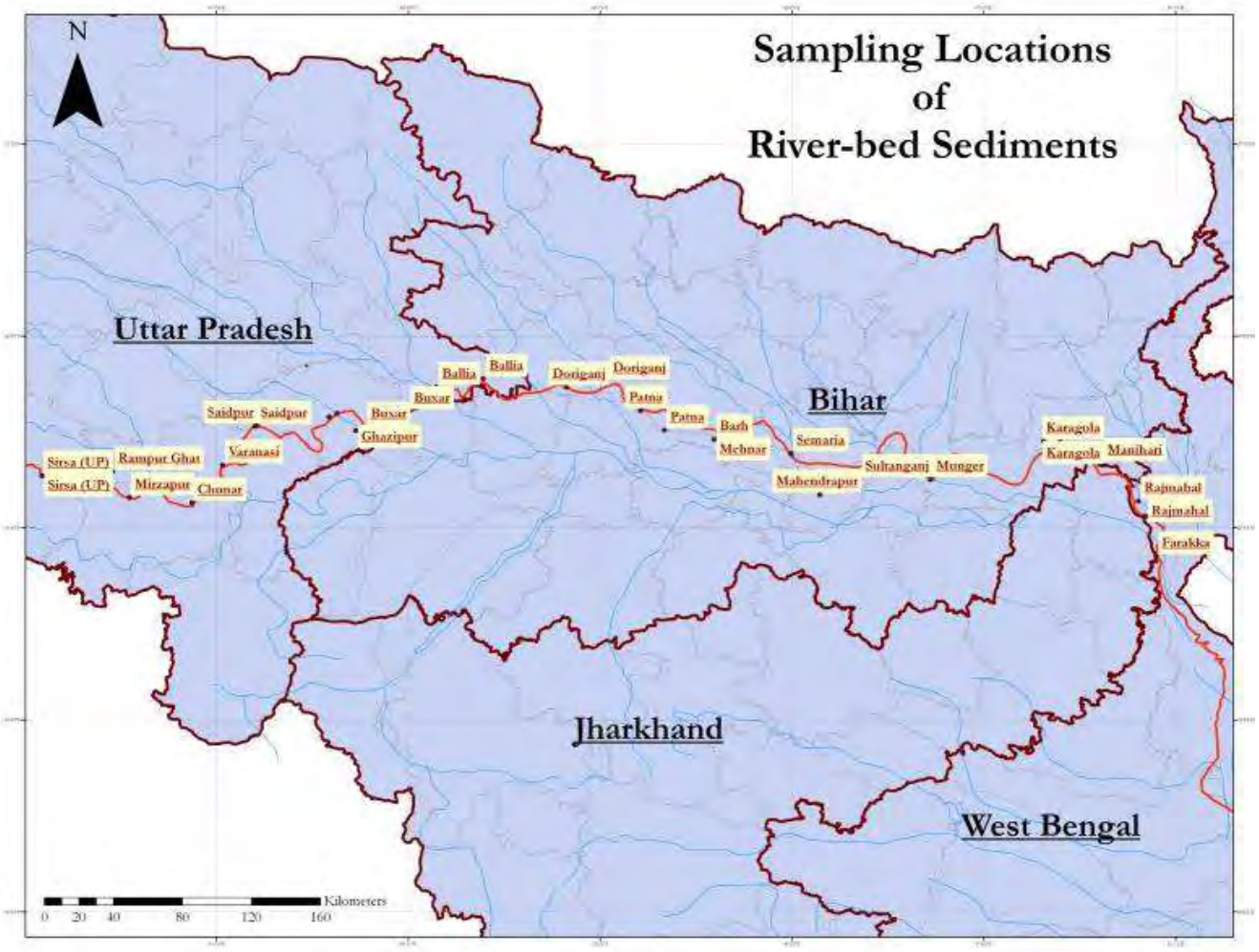
Parameters (physical, chemical, Pesticides/Insecticides) selected for assessment of river bed sediments

Sl. No.	Parameters	Unit
	Physical Parameters	
1	Texture	-

[31] *Assessment of the Environment Impact of Port Development, United Nations, New York, 1992*

Sl. No.	Parameters	Unit
2	Bulk Density	gm/cc
	Chemical Parameters	
3	pH	-
4	Conductivity	µmhos/cm
5	Cation Exchange Capacity (CEC)	meq/100gm
6	Organic Matter	%
7	Chromium (as Cr)	ppm
8	Arsenic (as As)	ppm
9	Mercury (as Hg)	ppm
10	Lead (as Pb)	ppm
11	Iron (as Fe)	ppm
12	Cadmium (as Cd)	ppm
13	Nickel (as Ni)	ppm
14	Zinc (as Zn)	ppm
15	Copper (as Cu)	ppm
	Pesticides/Insecticides	
16	α Endosulphan	ppb
17	β Endosulphan	ppb
18	γ Endosulphan	ppb
19	Methyl Parathion	ppb
20	Lindane	ppb

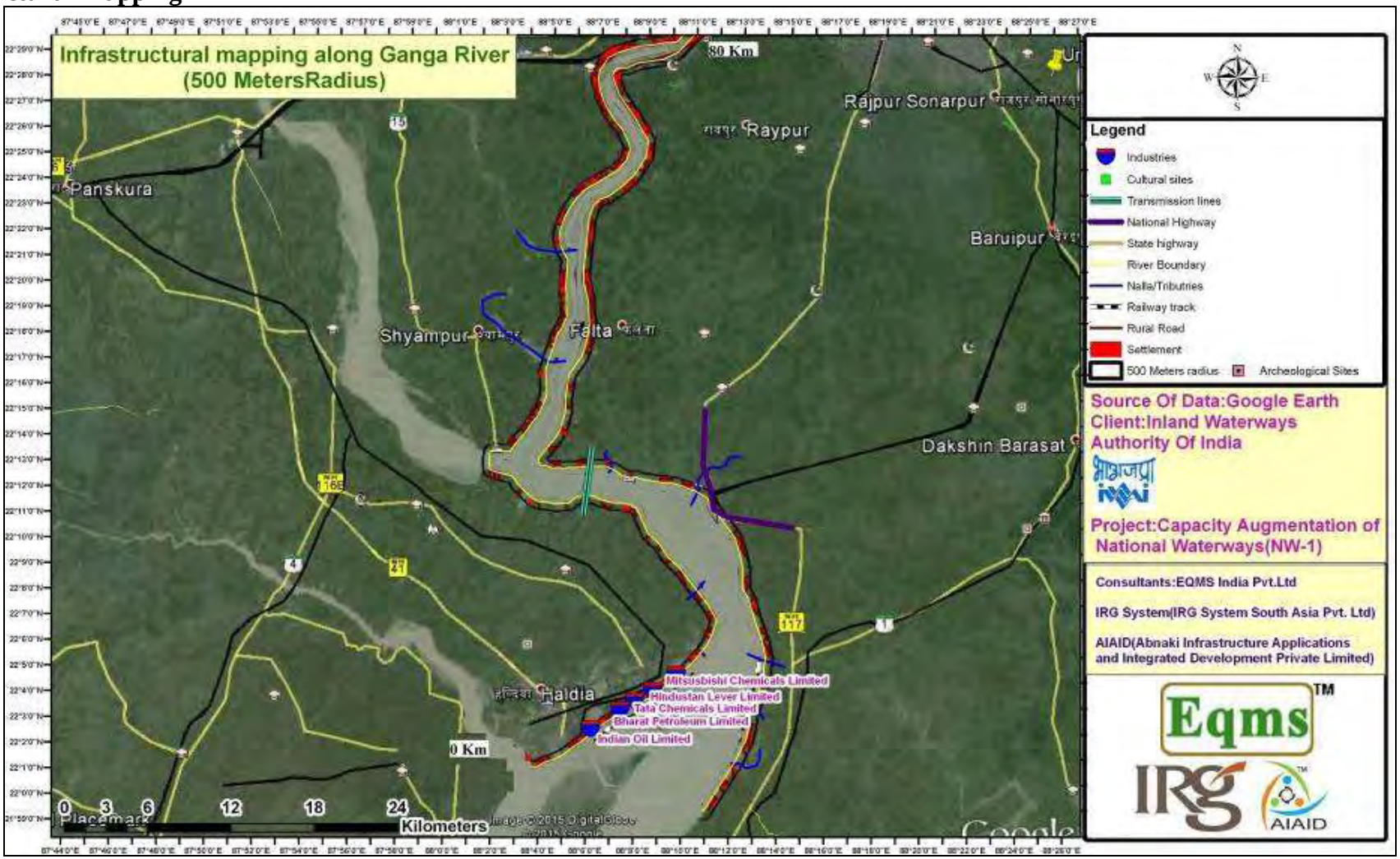
Sampling locations of river bed sediments are shown in **Figure below**.



Sampling locations of river bed sediments

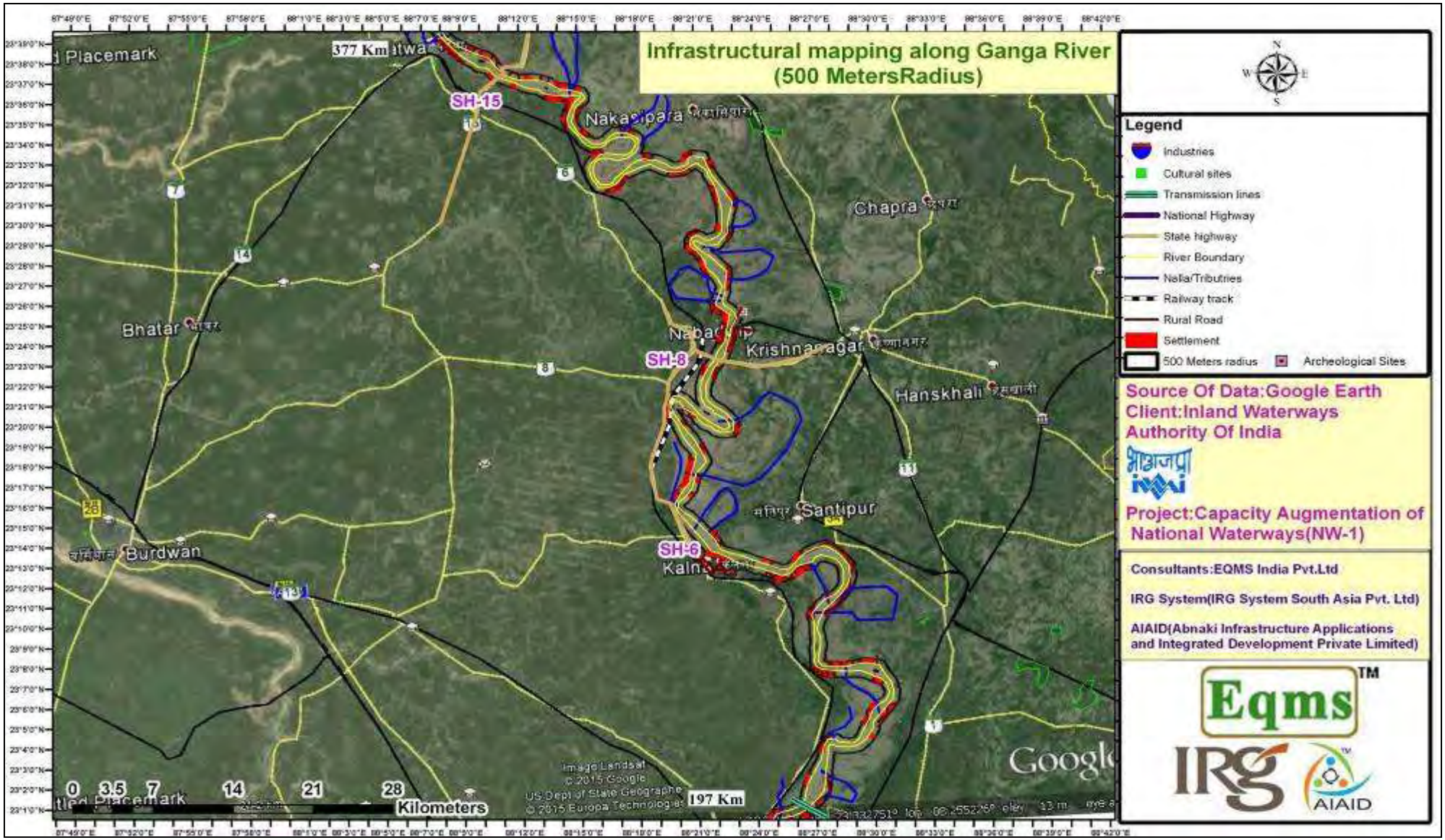
Annexure 5.6: Infrastructural mapping along Ganga River

Infrastructural Mapping

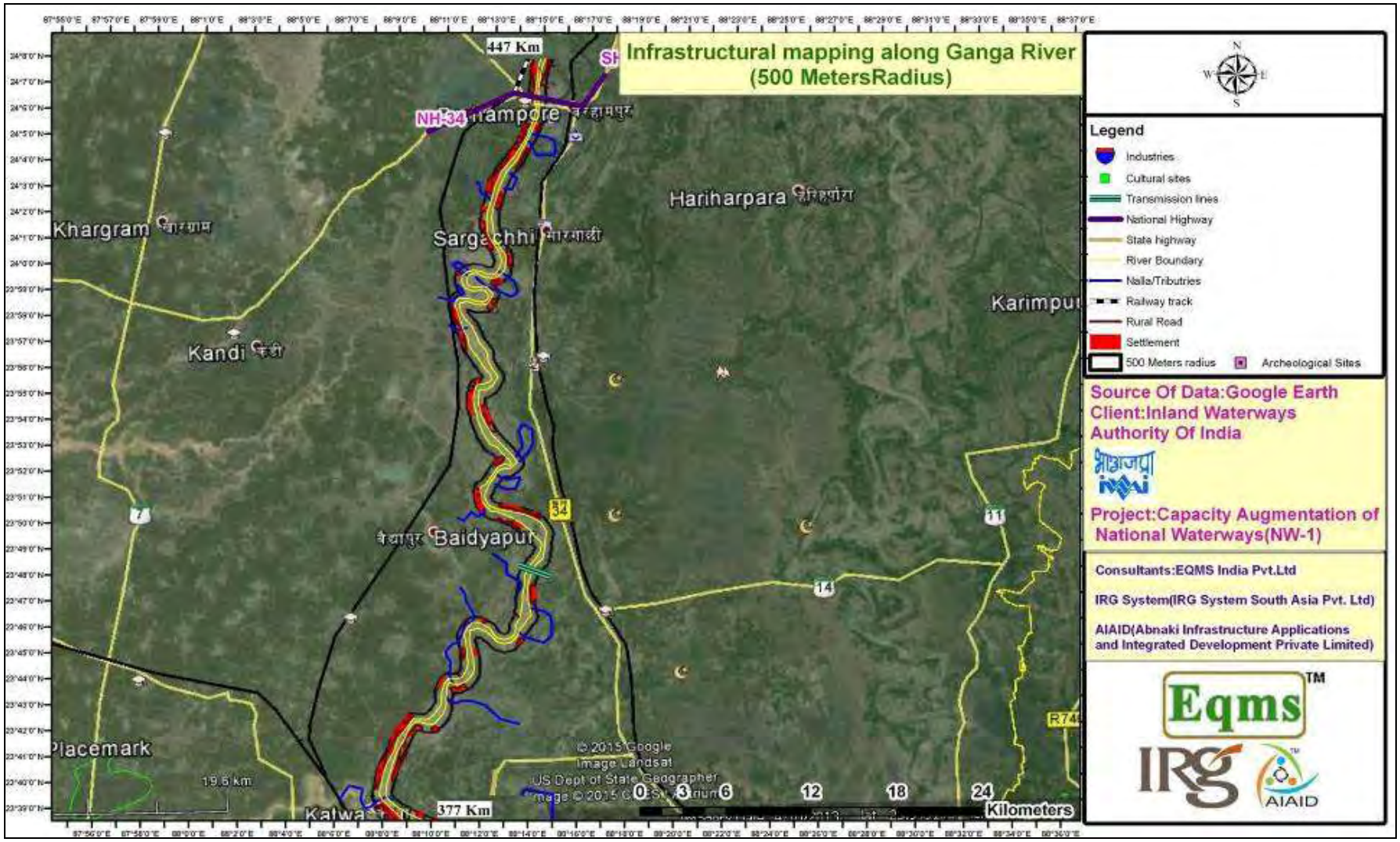


Infrastructural Mapping along 500 m area of NW-1 (Chainage 0-80 km)

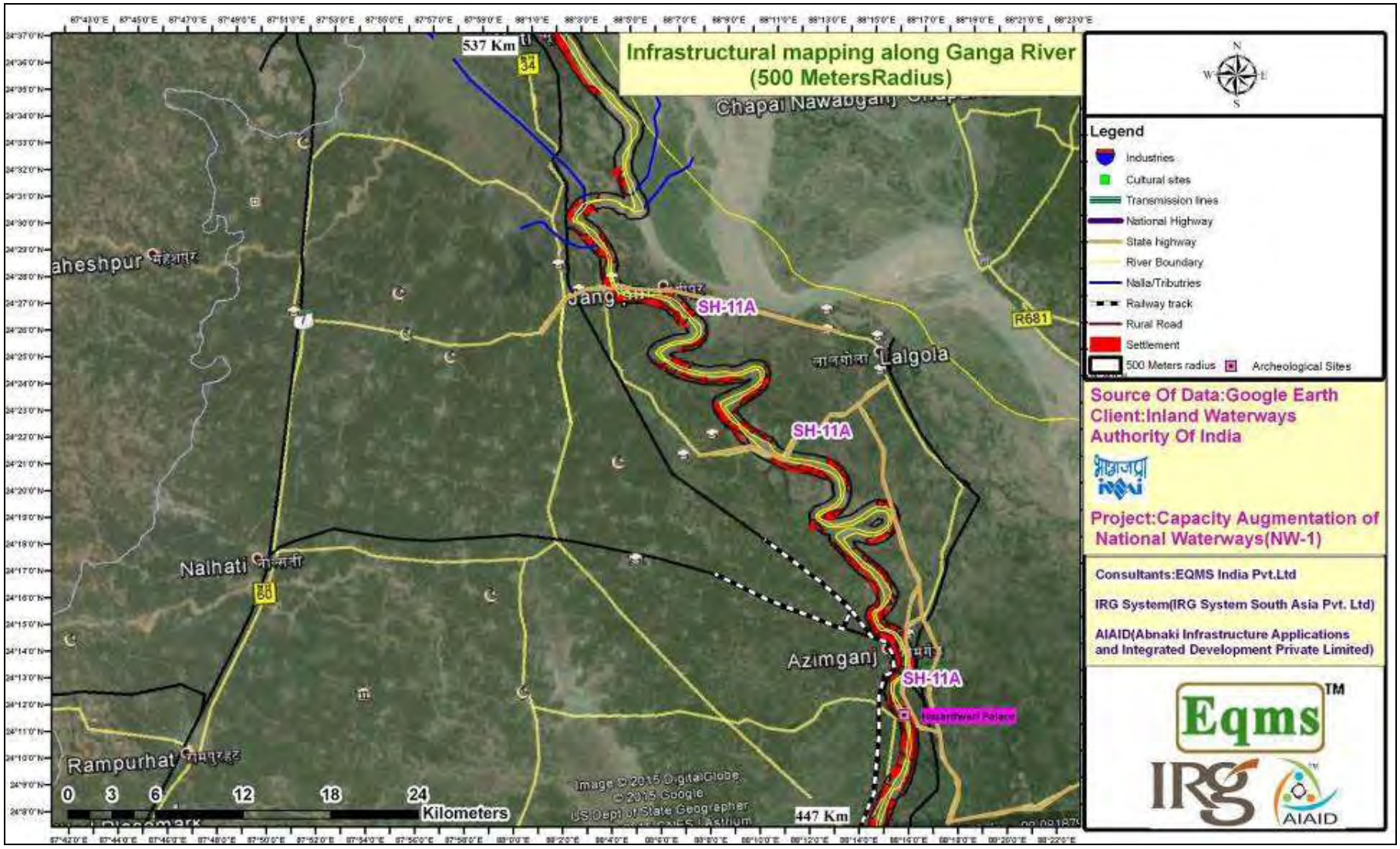
Infrastructural Mapping along 500 m area of NW-1 (Chainage 80-197 km)



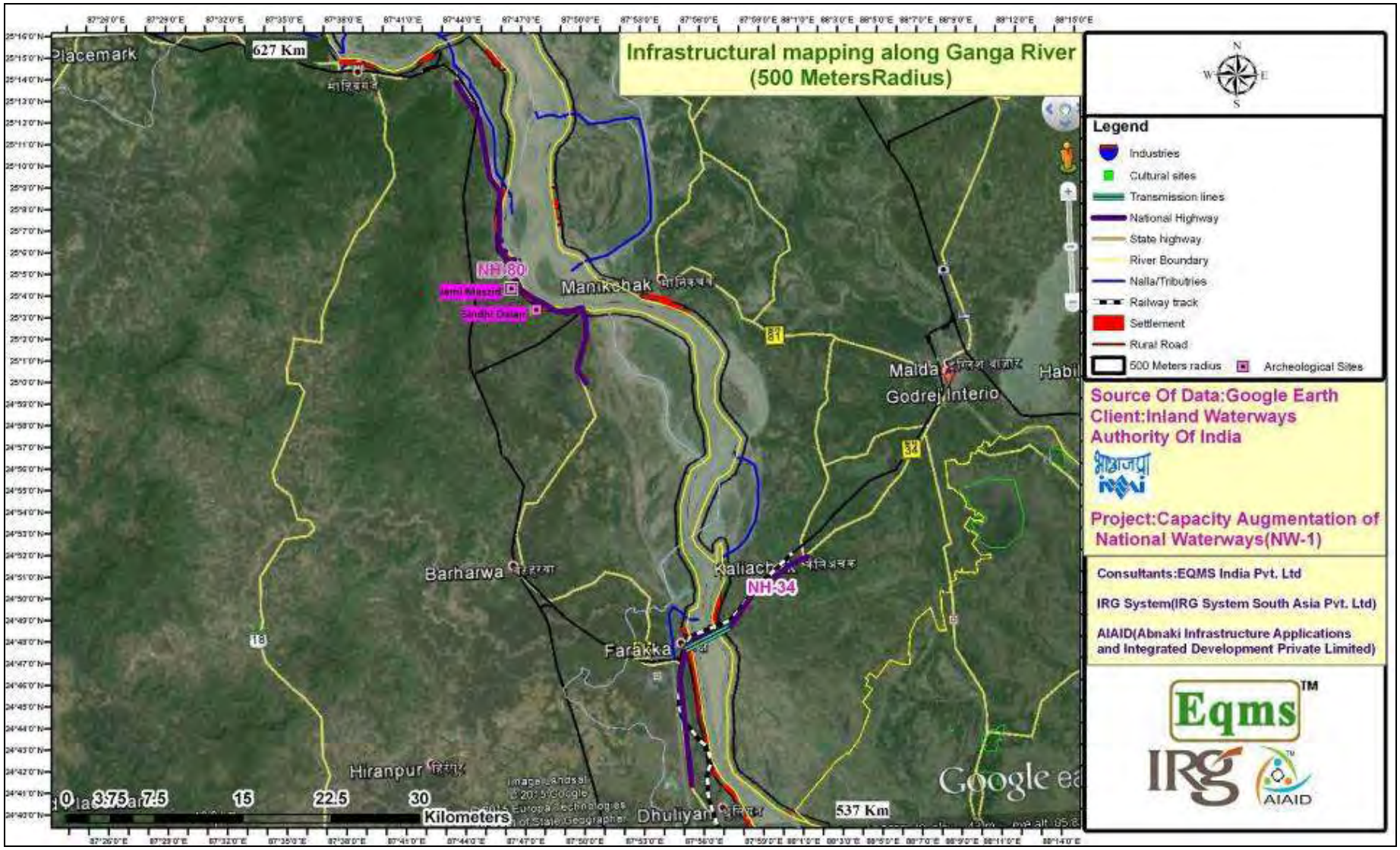
Infrastructural Mapping along 500 m area of NW-1 (Chainage 197-377 km)



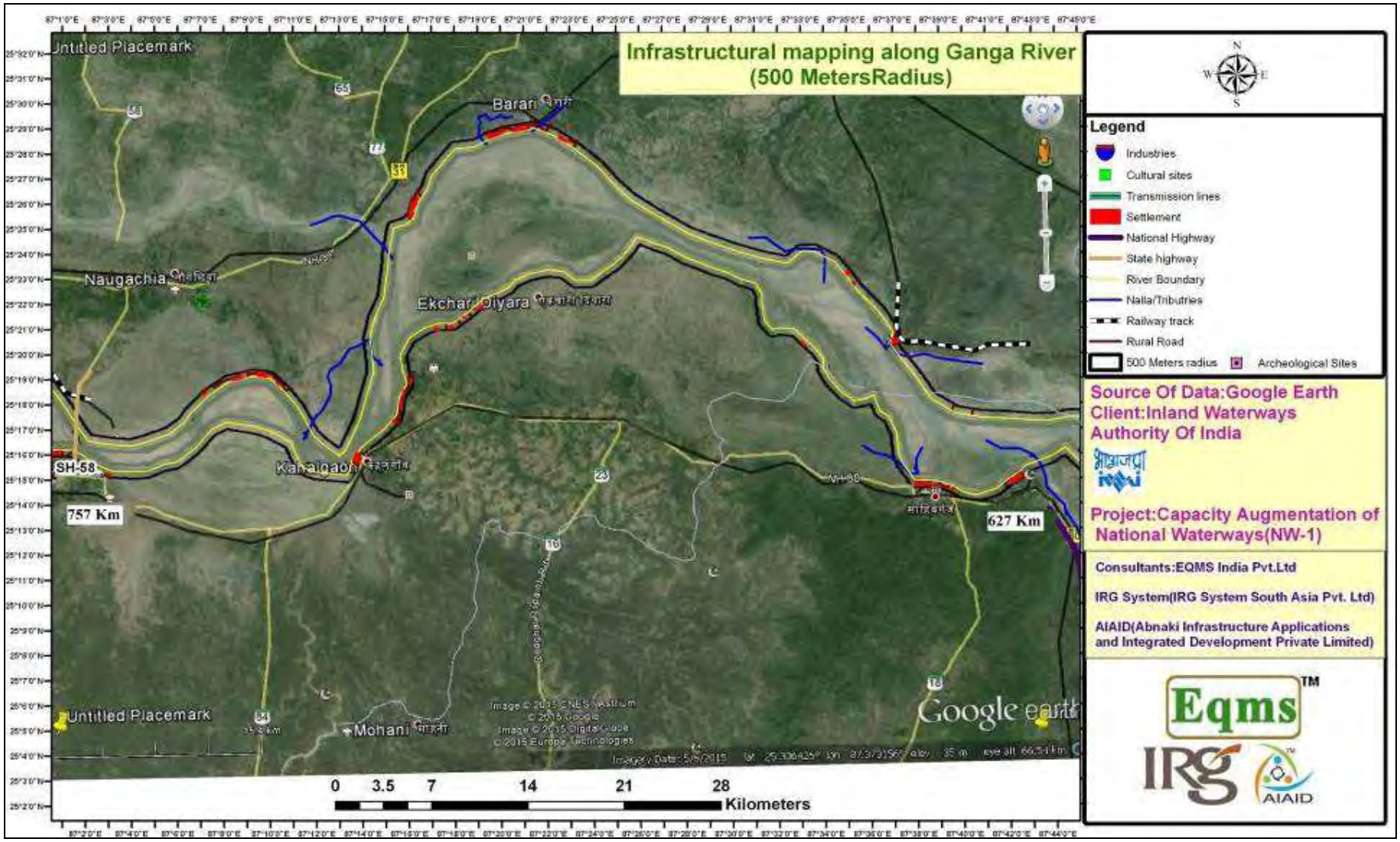
Infrastructural Mapping along 500 m area of NW-1 (Chainage 377- 447 km)



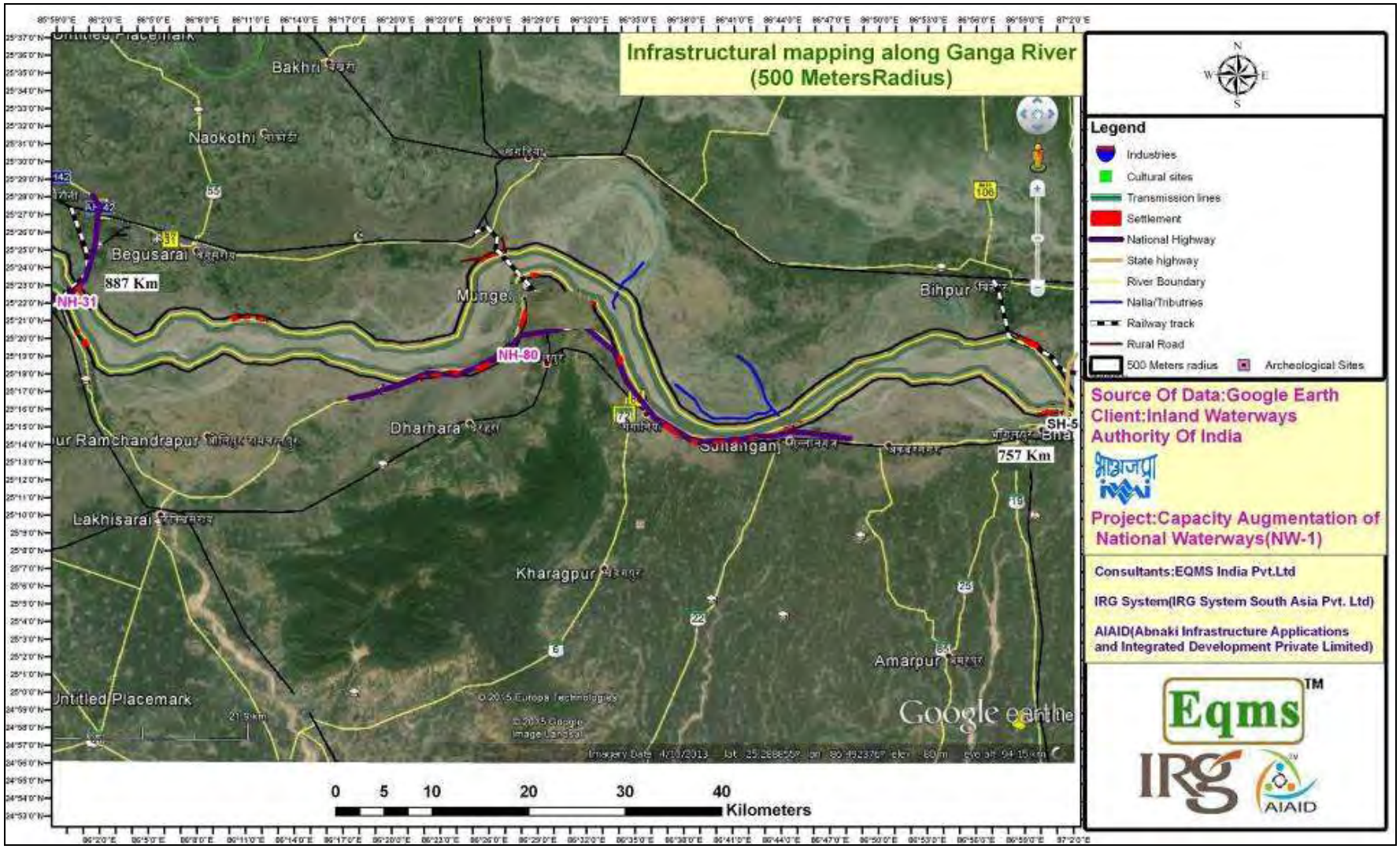
Infrastructural Mapping along 500 m area of NW-1 (Chainage 447-553 km)



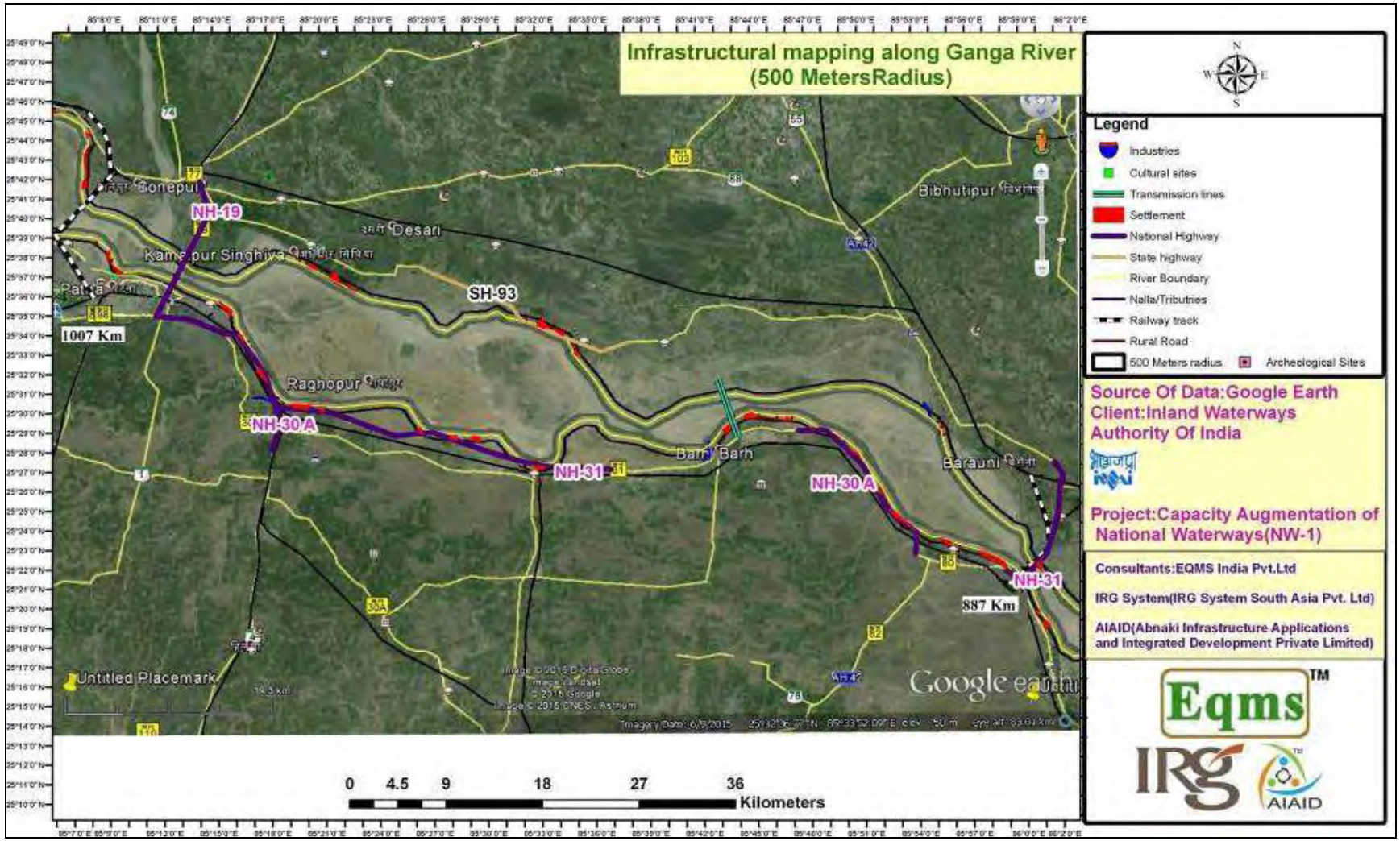
Infrastructural Mapping along 500 m area of NW-1 (Chainage 553-627 km)



Infrastructural Mapping along 500 m area of NW-1 (Chainage 627-750 km)

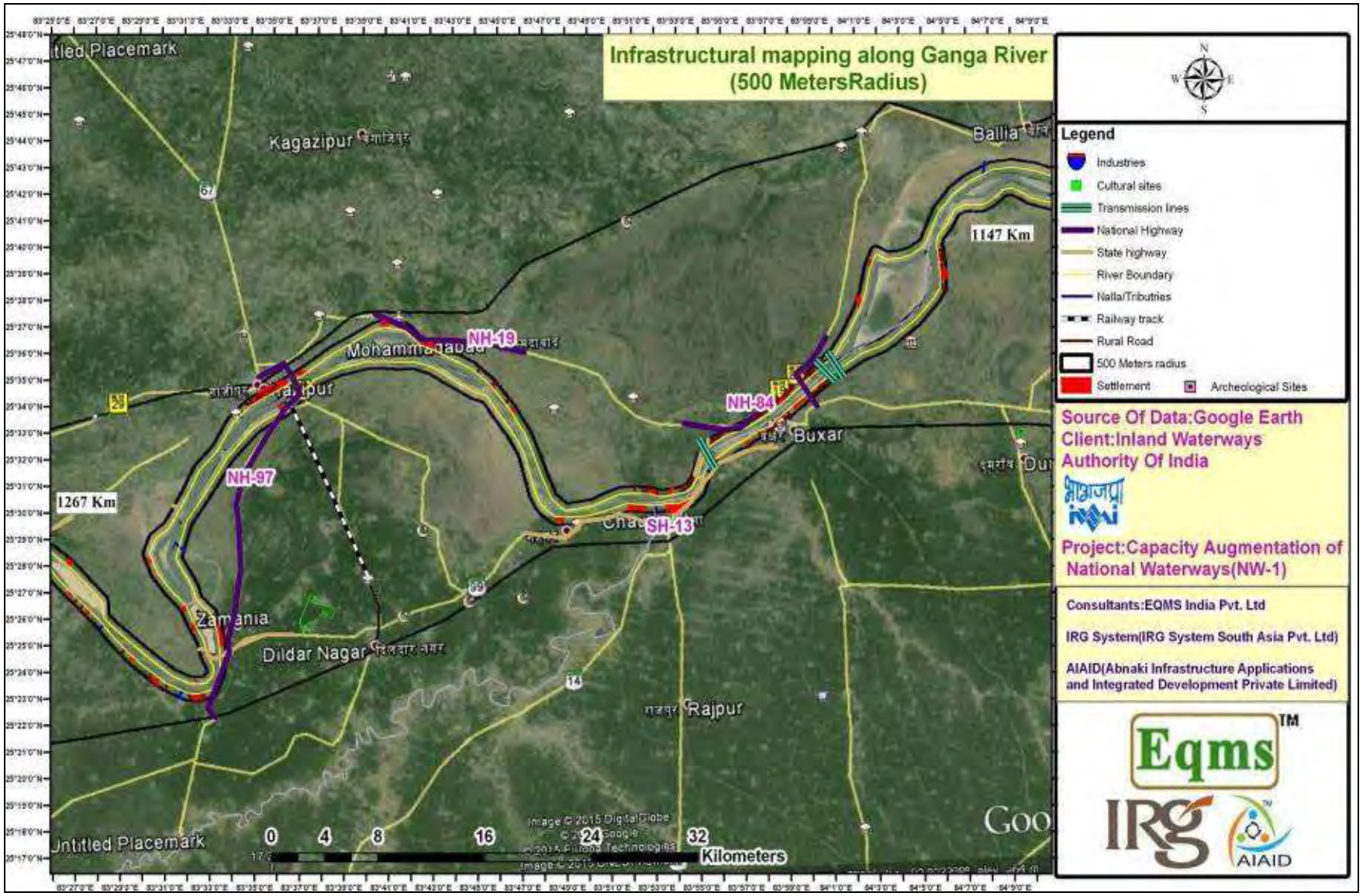


Infrastructural Mapping along 500 m area of NW-1 (Chainage 750-887 km)

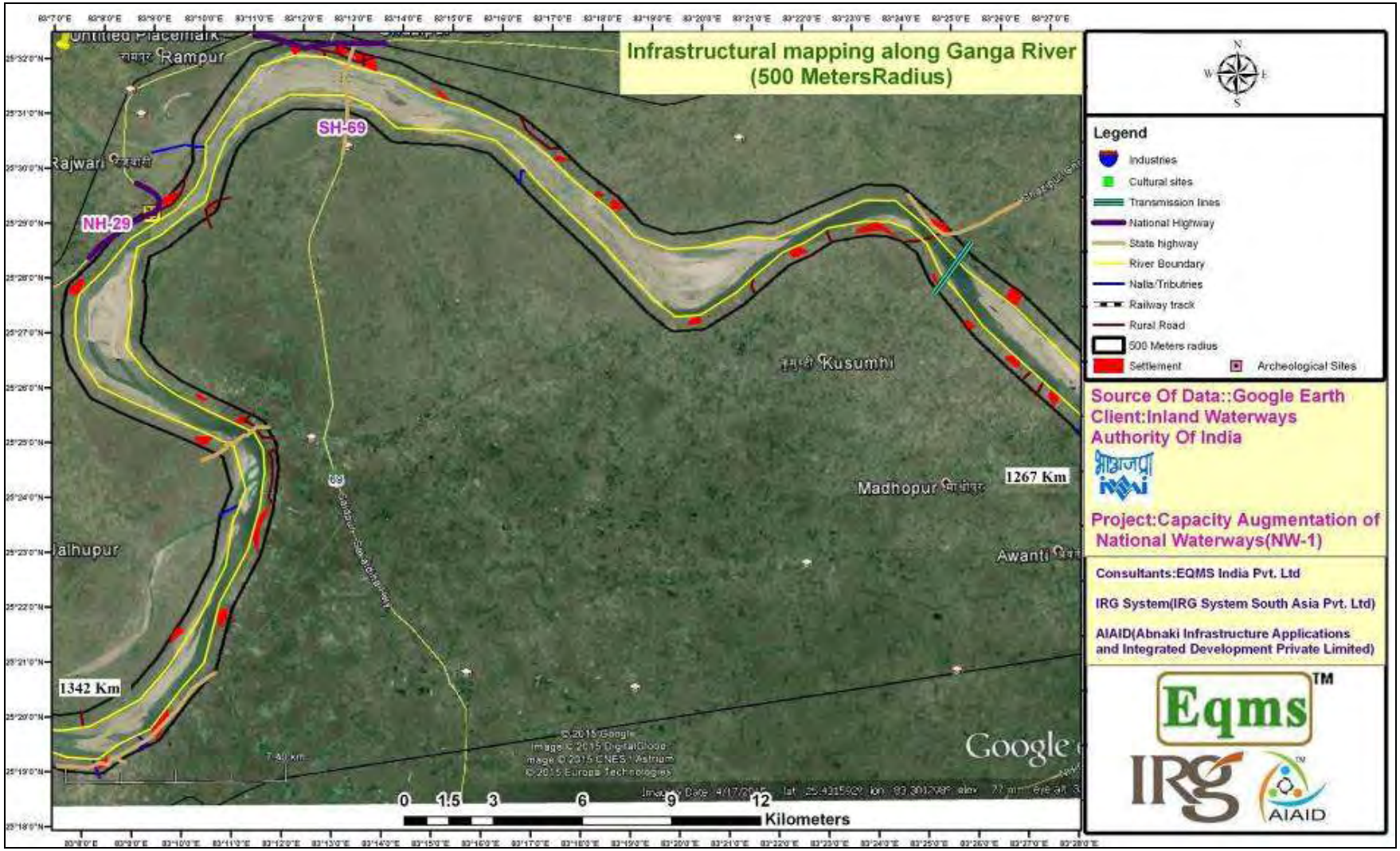


Infrastructural Mapping along 500 m area of NW-1 (Chainage 887-1007 km)

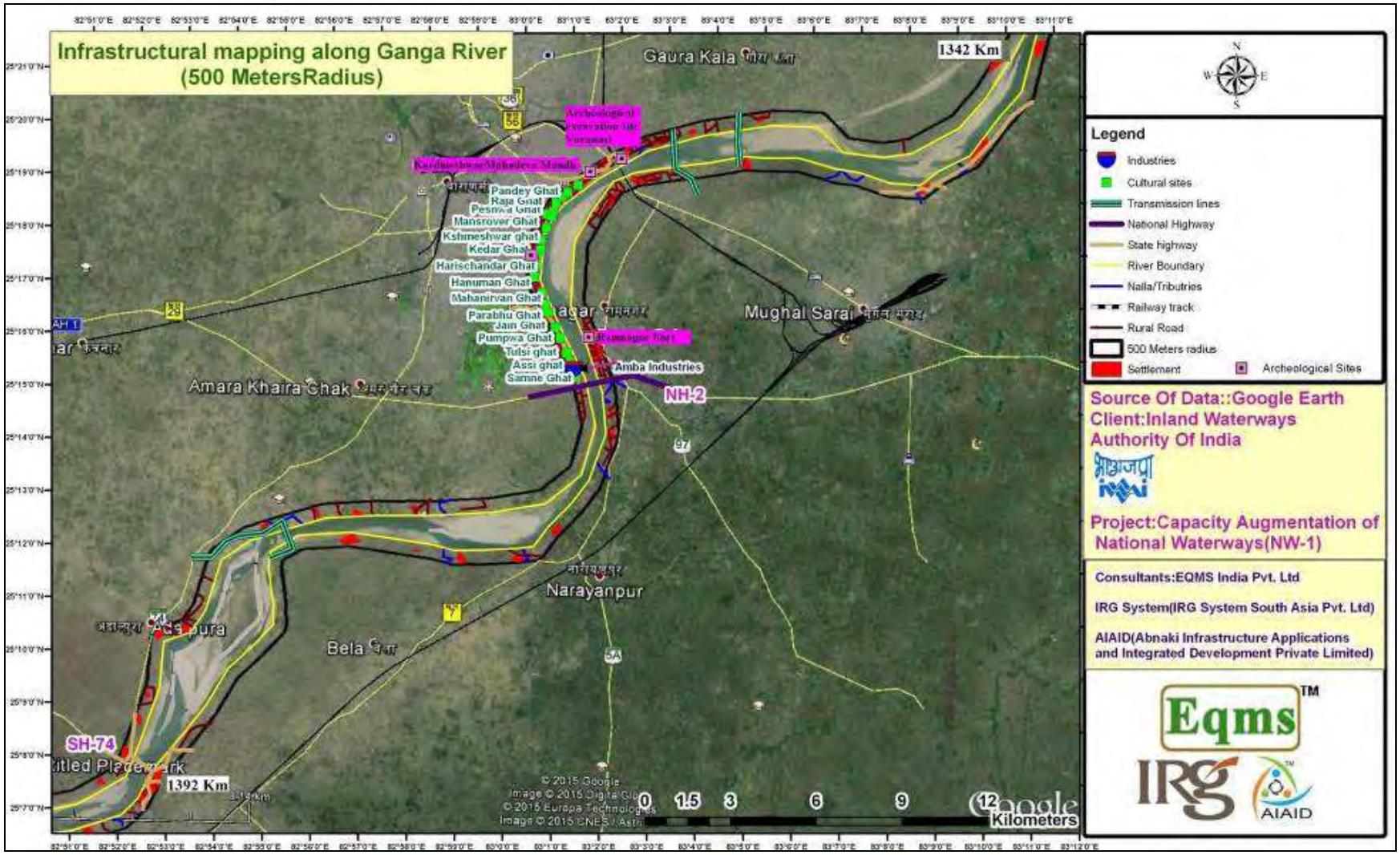
Infrastructural Mapping along 500 m area of NW-1 (Chainage 1007-1147 km)



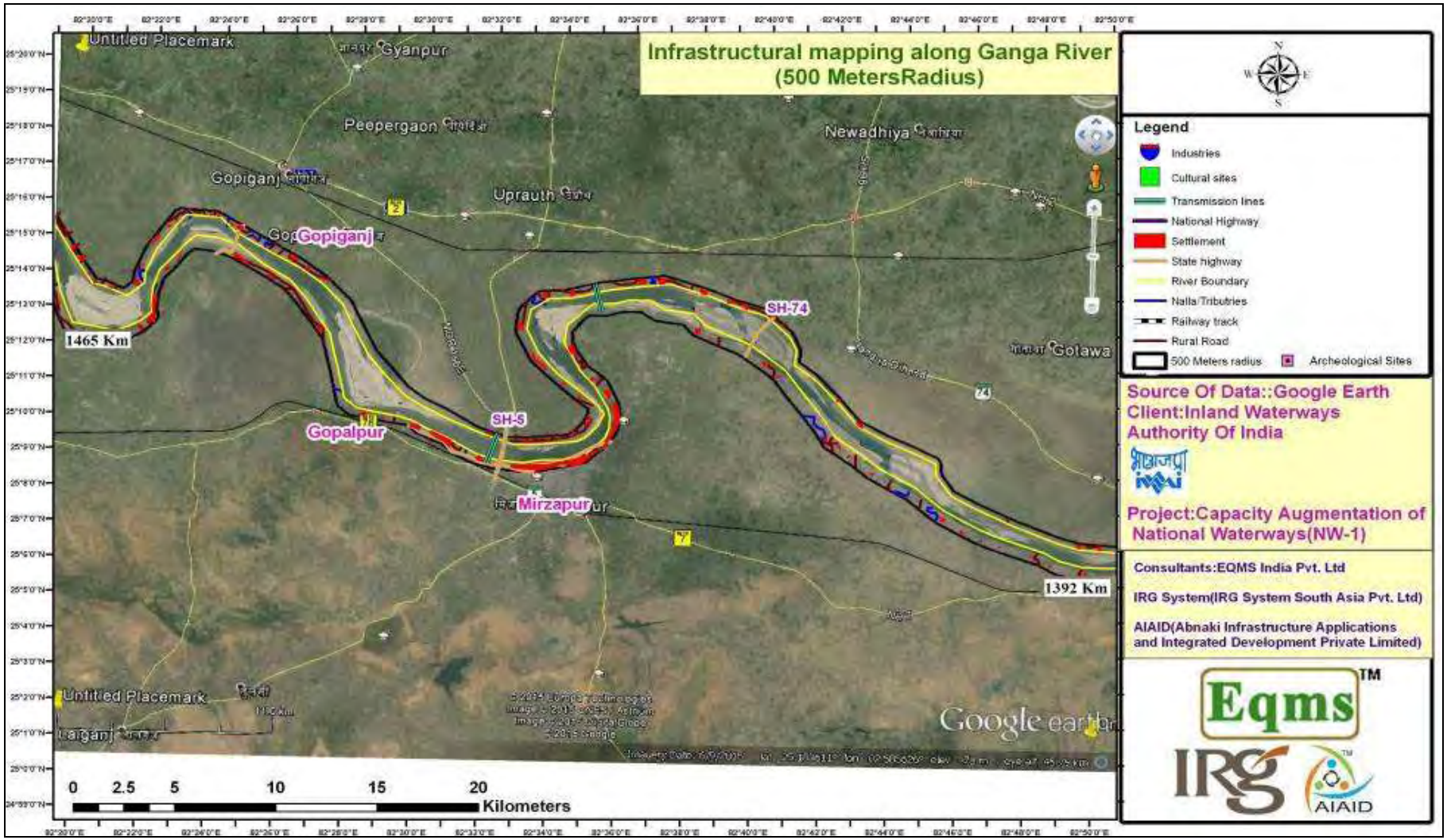
Infrastructural Mapping along 500 m area of NW-1 (Chainage 1147-1267 km)



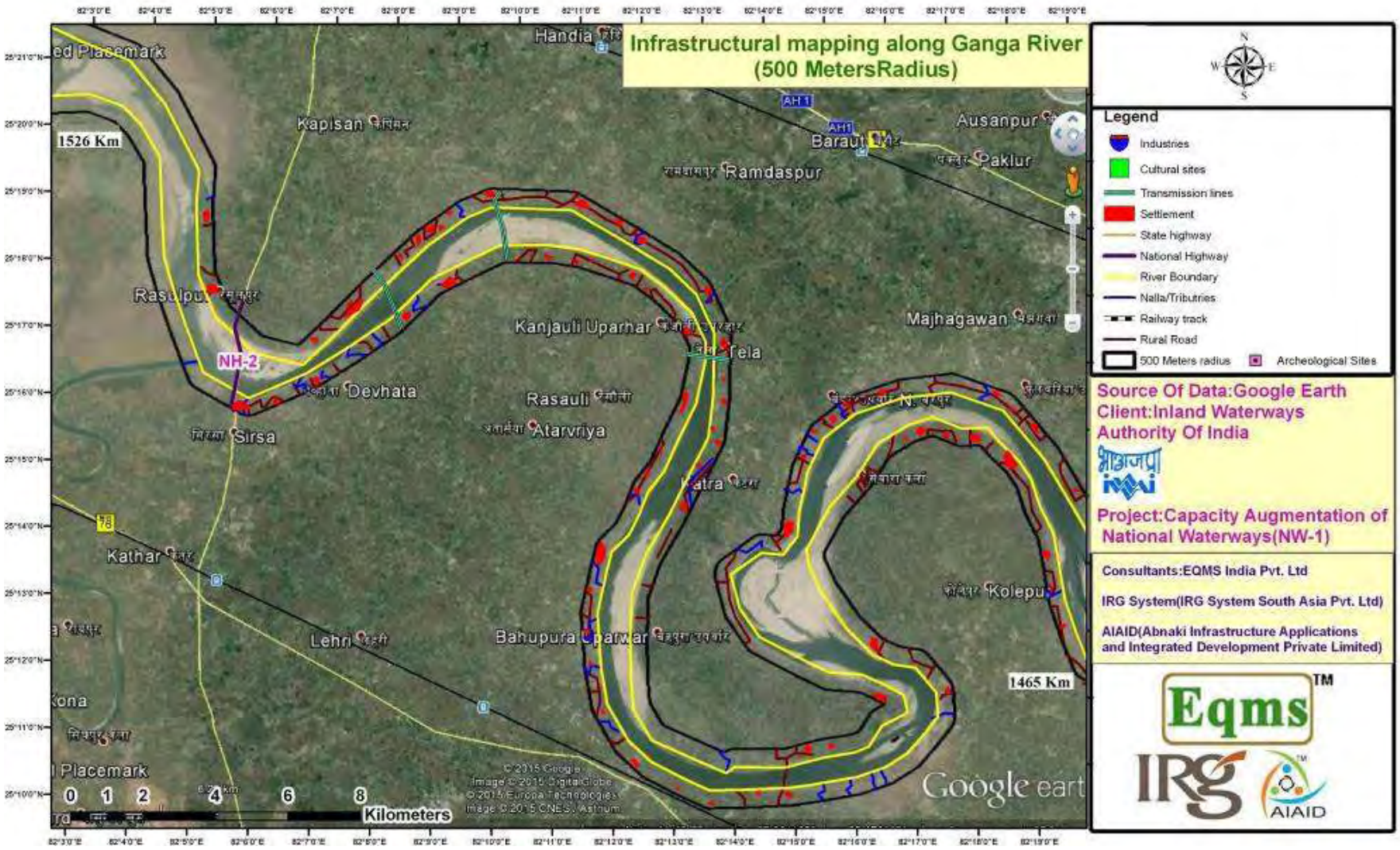
Infrastructural Mapping along 500 m area of NW-1 (Chainage 1267-1342 km)



Infrastructural Mapping along 500 m area of NW-1 (Chainage 1342-1392 km)



Infrastructural Mapping along 500 m area of NW-1 (Chainage 1392-1465 km)



Infrastructural Mapping along 500 m area of NW-1 (Chainage 1465-1526 km)

Infrastructural Mapping along 500 m area of NW-1 (Chainage 1526- km)

Annexure 6.1: GHG emission for transportation of freight

GHG Emissions for Transportation of Freight through IWT, Rail & Road mode Planned to be Transported through Phase I of IWT

Any transport system viz rail, road and IWT has emission of GHG. It is also well established that different mode of transport has different intensity of GHG emission. The analysis given below present the GHG emission levels in all the three mode of transport for similar quantity of cargo movement for transportation between Haldia to Varanasi. This analysis also presents the possibility and benefit of transport model shift from Rail, road to IWT. CO_2 is the main GHG gas which contributes maximum to the warming of atmosphere and increased CO_2 concentration is one of the major driver of climate change. Fuel burning also emit the CO2. GHG emission from IWT is assessed in the form of CO_2 emissions. CO_2 emissionsare calculated based on reported emission factor under various studies. The likely emission level of CO_2 is presented at **Table 1**.

Table 1: Comparative assessment of GHG (CO_2) emissions from Various Modes of Transport

Mode	CO_2 emissions (gCO_2/NTKM)	Avg. Cargo transportation between Haldia and Varanasi in Phase I (tonnes/day)	Distance Considered to be travelled (Haldia to Varanasi)	Net CO_2 emissions (Tonne/day)	Net CO_2 emissions (Tonne/yr)	%Ranking
Road 32	38.1	19000	1065	770.95	281396.75	IV
Railways (Diesel)33	11.9		1037	234.46	85579.98	III
Railway (Electric)	11.22		1037	220.67	80545.86	II
Inland vessels of 1900 DWT and dimension - 110X11.434	6.4		1311	159.41	58187.42	I

[32]Promoting Low Carbon Transport in India, UNEP, "Infrastructure for Low Carbon Transport in India: A case study of the Delhi-Mumbai Dedicated Freight Corridor, IIM Ahmadabad

[33]Promoting Low Carbon Transport in India, UNEP, "Infrastructure for Low Carbon Transport in India: A case study of the Delhi-Mumbai Dedicated Freight Corridor, IIM Ahmadabad

[34]Workshop Inland Navigation CO_2 emissions "Energy efficiency of inland water ships-and how to improve it", DST, Germany

Note: The emissions calculated are only for the section where material transportation will be taken through IWT, i.e. Haldia to Varanasi. Emissions from source of material to the initial point[35] are not considered in any of the mode. These emissions will be common in all the road, railway & IWT mode.
In addition to above calculations GHG emissions, which will be generated due to material transportation within the terminal site, is presented at **Table 2.**

Table 2: GHG (CO_2) emission generation within terminal due to material transportation

S. No.	Terminal Facility	Capacity of Terminals in Phase I (Million metric tonnes)	No. of trucks (15 MT) required to carry the material-2 way movement	Distance to be travelled by trucks within terminal site for material transportation (km)	Standard for CO_2 emission by trucks post 2000 of 6000 cc engine capacity (g.km)	GHG Emissions (tonnes/day)	GHG Emissions (tonnes/yr)
1	Varanasi	0.5	92	184	762.3936	0.07	25.67
2	Haldia	1.57	544	0.45		0.19	68.09
3	Sahibganj	2.24	818	0.7		0.44	159.39
Total GHG (CO_2) Emissions						0.7	253.15
GHG Emissions by IWT estimated in Table 5.10						159.41	58187.42
Total GHG Emissions through IWT Mode						160.11	58440.57

The GHG emission from IWT is estimated to be 58440.57 tonnes per annum which is the least amongst all the other mode of transport. These emissions can be further reduced by design and operational measures. The anticipated model shift will also help in reducing the GHG from RAIL and Road transportation system.

Mitigation Measures

- Adoption of modern designed vessels to be operated having more load carrying capacity and less draught requirement.
- Operating the freight vessels at slow speeds to increase the fuel efficiency and reducing the emissions.
- Adoption and strictly adhering to the standards as prescribed by MARPOL for managing the emissions.

[35]Initial point is referred to as start point of each mode, i.e. Road, railway & IWT in section from Haldia to Varanasi.
[36]Air Quality Monitoring Research Association of India "Air Quality Monitoring Project-India Clean Air Programme (ICAP), CPCB/MoEF & EPA emission factors for rail locomotives, commercial.

- Switching to LNG based vessels. LNG is not only cleaner but have comparatively higher calorific value than gasoline and diesel.

Table 3: Reduction in GHG Emissions Due to Shift of Freight from Road/Rail to IWT

Reduction in GHG due to shift of freight from Road to IWT	222956.18 Tonnes/yr
Reduction in GHG due to shift of freight from Rail to IWT	27139.41 Tonnes/yr

Annexure 6.2: List of Thermal Power Plants

SL. No.	Coal Projects	Latitude			Longitude		
		Degree	Min.	Sec.	Degree	Min.	Sec.
1	Kolaghat Thermal Power Station	22	25	5.56	87	52	19.78
2	Budge Budge	22	27	53.58	88	1	6.03
3	Bandel TPP	22	59	39.37	88	24	10.24
4	Sagardighi TPP	24	22	0.93	88	6	8.33
5	Farakka STPS	24	46	21.32	87	53	40.32
6	Kahalgaon STPS	25	14	26.98	87	16	0.77
7	Barauni TPP	25	23	54.58	86	1	12.05
8	Kanti TPS	26	11	49.36	85	18	5.36
9	Anpara TPS	24	12	12.11	82	47	17.36
10	Obra TPS	24	26	42.29	82	58	51.72
11	Haldia Energy Power Station Phase 1	22	6	8.93	88	10	46.04
12	Barh STPS	25	29	15.3	85	45	9.22
13	Banka Power Plant	24	33	11.62	86	43	44.89
14	Pirpainti TPS	25	20	5.06	87	24	55.95
15	Buxar Thermal power Station	25	33	5.56	83	57	24.46
16	Nabinagar SPTP	24	35	52.02	84	7	24.74
17	Nabinagar TPS	24	36	36.64	84	7	1.93
18	Lakhisarai TPS	25	12	1.64	86	10	49.74
19	Bhagalpur Power Project	25	14	25.48	87	16	0.3
20	Pirpainti Power Station CESC	25	23	56.47	87	27	10.83
21	Pirpainti TPS Ganga Power	25	24	3.15	87	27	15.13
22	Indragachi PS	22	14	8.92	88	15	2.76
23	Balagarh PS	23	7	32.59	88	28	13.6
24	Welspun Energy Mirzapur PS	25	8	12.08	82	33	43.72

Annexure 6.3: Air emissions for transportation of freight

Air Emissions for Transportation of Freight through IWT, Rail & Road mode Planned to be Transported through Phase I of IWT

Exhaust gases from vessel are source of air pollution and GHG gases. However, vessels emit least emissions compared to the air, road and railway modes. The impact on air quality due to vessel movement is anticipated insignificant considering the emission levels and projected vessel traffic. However, an estimation is carried out to arrive at the total emission load from the movement of vessels and corresponding load for transportation of similar amount of cargo by rail and road. Emission levels are calculated for transportation of cargo for about 19000 metric tonnes cargo movement per day for phase I of NW-1 between Haldia to Varanasi[37]. Assessment has been carried out based on emission factors and emissions associated with different mode of transportation for pollutants NO_x, SO_2, CO, PM & HC. The comparative analysis is shown at Table 1. The analysis indicates that IWT transport while will have least emission load (air pollution) amongst all the three mode of transport and will rather have positive impact in the nearby areas due to model shift and corresponding reduction in emission load (air pollution) of rail or road transport.

Table 1: Comparative Analysis of Air Pollution Levels between Rail, Road and IWT

A. Emission Comparisons for NOx, SO2, and CO						
Mode of Transportation	**Emission Factor for NOx (g/tonne km)**	**Emission Load per day for NOx (Tonne/day)**	**Emission Factor for SO2 (g/tonne km)**	**Emission Load per day for SO2 (Tonne/day)**	**Emission Factor for CO (g/tonne km)**	**Emission Load per day for CO (Tonne/day)**
Railway (Diesel Engines)[38,39]	0.4	7.78	0.18	3.50	0.15	2.91
Road [40]	1.37	27.38	0.18	3.59	0.54	10.79
IWT (For inland vessels)[41]	0.26	6.39	0.04	0.98	0.11	2.70

[37]The average of phase I cargo movement in NW-1 between Varansi to Haldia is about 19000 MT. For calculation purposes and considering worst case scenario, it is assumed that 19000 MT cargo will travel full lenth of NW-1 between Varansi to Haldia. The length considered between Varansi to Haldia will vary from one mode to another mode of transport. The length is considered as 1311Km, 1037 Km, 1065 Km for IWT, Rail and Road respectively.

[38] Table 14: Rail Air Pollution Emission, in g/tonne-km (sources: Kurer, 1993-Table 5), The Environmental Effects of Freight, Organization for Economic Co-operation and Development, Paris

[39]Air Quality Monitoring Research Association of India "Air Quality Monitoring Project-India Clean Air Programme (ICAP), CPCB/MoEF & EPA emission factors for rail locomotives, commercial.

[40] Table 9: Truck Air Pollution Emission, in g/tonne-km (sources: Kurer, 1993, Table 5), The Environmental Effects of Freight, Organization for Economic Co-operation and Development, Paris

[41] Table 7: Emissions from vessels Travelling on Inland Waterways (sources: Dutch data from the Centraal Bureau voor de Statistiek, Shoemaker and Bouman, P. 57 US data from US EPA (September 1985), p. II-3.2), The Environmental Effects of Freight, Organization for Economic Co-operation and Development, Paris

B. Emission Comparisons for PM and HC						
Mode of Transportation	**Emission Factor for PM (g/tonne km)**	**Emission Load per day for PM (Tonnes /day)**	**Emission Factor for HC (g/tonne km)**	**Emission Load per day for HC (Tonne /day)**		
Railway (Diesel Engines)	0.07	1.36	0.07	1.36		
Road	0.22	4.40	0.38	7.59		
IWT (For inland vessels)	0.02	0.49	0.05	1.23		

Material to be transported through NW-1 includes building construction materials like sand, stone aggregates, coal, textiles, fertilizers etc. Some of these commodities have potential to generate the dust majorly sand, stone aggregates, coal etc. This dust is required to be managed to prevent air quality degradation during transportation and high wind conditions.

Table 2: Reduction in Air Emission Due to Shift of Freight from Road/Rail to IWT

S. No.	Reduction in SO_2	Reduction in NO_x	Reduction in CO	Reduction in PM	Reduction in HC
	(Tonnes/Yr)				
Shift from Road to IWT	**2.61**	**20.99**	**8.09**	**3.91**	**6.36**
Shift from Rail to IWT	**2.52**	**1.39**	**0.21**	**0.87**	**0.13**

Annexure 6.4: Water demand

Table 1: Water Demand

S. No.	District	Number of Urban Households	Total Urban Population	Water Consumption	Effluent Discharge / Pollution Load	Number of Household Covered by Sewer Systems	% of Households Covered by Sewer Systems
1	Varanasi	253,184	1,597,051	30382080	24305664	167152	66.02
2	Ghazipur	41,569	274,360	4988280	3990624	3201	7.70
3	Mirzapur	55,602	3,47,567	6672240	2003006	16692	30.02
4	Buxar	26,483	164,499	3177960	2542368	1046	3.95
5	Munger	71,010	380,120	8521200	6816960	3188	4.49
6	Patna	429,424	2,514,590	51530880	41224704	72873	16.97
7	Lakhisarai	24,107	143,011	2892840	2314272	926	3.84
8	Bhagalpur	106,303	602,532	12756360	10205088	5868	5.52
9	Saran	55,873	353,202	6704760	5363808	2095	3.75
10	Katihar	**53,564**	273,822	6427680	5142144	2244	4.19
11	Sahibganj	30,967	159,666	3716040	2972832	511	1.65
12	Murshidabad	284,559	1,400,692	34147080	27317664	11212	3.94
13	Bardhwan	659,366	3,078,299	79123920	63299136	78267	11.87
14	Nadia	348,972	1,438,873	41876640	33501312	21566	6.18
15	Hugli	**505,943**	2,128,499	60713160	48570528	41791	8.26
16	Howrah	**669,902**	3,074,144	80388240	64310592	42874	6.40
17	North 24 Pgs	1,355,449	5,732,162	162653880	130123104	148286	10.94
18	South 24 Pgs	482962	2087773	57955440	46364352	21878	4.53
19	Purba Medinipur	125386	592714	15046320	12037056	6545	5.22

Annexure 6.5: List of Dams in Ganga basin and its tributaries

Dams in Ganga basin and its tributaries

Sl. No.	Dam Name	Completion Year	River	Nearest City	Basin	District	Type	Height (m)	Length (m)	Purpose	Status
WEST BENGAL											
1	Bakreshwar Dam			Siuri	Ganga	Birbhum					
3	Bandhu Dam		Bandhu	Puruliya	Ganga	Puruliya	TE	16	1605	Irrigation	Completed
4	Bara Mandira Dam	1977	Baramandira	Asansol	Ganga	Barddhaman	TE	17	853	Irrigation	Completed
5	Barabhum Dam	1991	Nagasai, Barabhum	Puruliya	Ganga	Puruliya	TE	11	1529	Irrigation	Completed
6	Beko Dam	1990		Puruliya	Ganga	Puruliya	TE	16	914	Irrigation	Completed
7	Dangrajhore Dam	1982		Puruliya	Ganga	Puruliya	TE	10	580	Irrigation	
9	Futiary Dam			Puruliya	Ganga	Puruliya	TE	13.7	768	Irrigation	Completed
10	Golamarajore Dam	1989	Golamarajore	Puruliya	Ganga	Puruliya	TE	13		Irrigation	Completed
11	Hanumata Dam	2007	Hanumata	Puruliya	Ganga	Puruliya	TE	19	984.62	Irrigation	Completed
12	Hinglow Irrigation Scheme Dam	1976		Siuri	Ganga	Birbhum	TE	12	1158	Irrigation	Completed
13	Kangsabati Kumari Dam	1965	Kasai	Bankura	Ganga	Bankura		41	10400	Irrigation	Completed
14	Kanjan Dam			Bankura	Ganga	Bankura					
17	Kumari Dam	1984		Puruliya	Ganga	Puruliya	TE + PG	15	1068	Irrigation	Completed
18	Lipania Dam			Puruliya	Ganga	Puruliya	TE	15	750	Irrigation	Completed
20	Moutorejore Dam	1990		Puruliya	Ganga	Puruliya	TE + PG	14	1151	Irrigation	Completed
21	Muruguma Dam	1982		Puruliya	Ganga	Puruliya	TE	19	328	Irrigation	Completed
22	Nachan Irri. Scheme Dam	1977		Durgapur	Ganga	Barddhaman	TE	14	853	Irrigation	Completed
23	Paraga Irri. Scheme Dam	1979		Puruliya	Ganga	Puruliya	TE	16	737	Irrigation	Completed
24	Patloi Dam	2012	Patloi	Puruliya	Ganga	Puruliya	TE	14	952.4	Irrigation	Completed

25	Ramchandrapur Dam	1991	Machkandajore	Puruliya	Ganga	Puruliya	TE	15	899	Irrigation	Completed
27	Saharajore Irri. Scheme Dam	1978		Bankura	Ganga	Bankura	TE	16	2682	Irrigation	Completed
28	Sali Dam	1985	Sali	Bankura	Ganga	Bankura	TE	12	1494	Irrigation	Completed
29	Taragonia Irri. Scheme Dam	1987		Puruliya	Ganga	Puruliya	TE	12	716	Irrigation	Completed
30	Tatko Dam	2013	Tatko	Puruliya	Ganga	Puruliya	TE	15	1468	Irrigation	Completed
JHARKHAND											
1	Amanat Dam		Amanat	Daltenganj	Ganga	Palamu	TE	41	869	Irrigation	Under Construction
2	Anjanwa Dam	1981	Anjanwa	Hazaribag	Ganga	Hazaribagh	TE	16.25	1341.46	Irrigation	Completed
3	Anraj Dam		Arraj	Garhwa	Ganga	Garhwa	TE	27.74	731.52	Irrigation	
4	Babhani Khand Dam		Banki	Garhwa	Ganga	Garhwa	TE	13.1	822.96	Irrigation	
5	Baranadi Dam	1967		Dumka	Ganga	Dumka	TE	19.51	220.98	Irrigation	Completed
6	Barhi Dam	1981	Mahuaghat	Hazaribag	Ganga	Hazaribagh	TE	12.8	1057.66	Irrigation	Completed
8	Batane Dam	1990	Batane	Daltenganj	Ganga	Palamu	TE	24.08	2011.68	Irrigation	Completed
9	Batre Dam	1954	Batare	Daltenganj	Ganga	Palamu	TE	19.33	748.48	Irrigation	Completed
10	Bhairwa Dam		Bhera	Hazaribag	Ganga	Ramgarh	TE	29.57	2469.5	Irrigation	Under Construction
11	Boudha Dam	1978	Agrawa/ Konar	Hazaribag	Ganga	Hazaribagh	TE	15.85	609.26	Irrigation	Completed
12	Bucha Opa Dam	1957	Buchaopa Nala	Ranchi	Brahmani and Baitarni	Ranchi	TE	14.02	1067	Irrigation	Completed
13	Buksa Dam	1982	Baksa	Chatra	Ganga	Chatra	TE	18.78	2667.67	Irrigation	Completed
14	Burhai Dam		Pathro	Devghar	Ganga	Deoghar	TE	29.23	5760	Irrigation	
15	Butanduba Dam	1985		Daltenganj	Ganga	Palamu	TE	22.56	365.85	Irrigation	Completed

17	Chatania Ghat Dam	1980	Kuljhiri Nala	Garhwa	Ganga	Garhwa	TE	19.81	365.76	Irrigation	Completed
19	Chirka Dam	1985	Dhengura	Garhwa	Ganga	Garhwa	TE	22.13	1046.07	Irrigation	Completed
20	Danro Dam	1985	Danro	Garhwa	Ganga	Garhwa	TE	22.37	1371.6	Irrigation	Completed
21	Dhankai Dam	1979	Dhankai Nala	Daltenganj	Ganga	Palamu	TE	10.55	810.77	Irrigation	Completed
23	Diggalpahari Dam	1975	Ashabani River/Reshma Nala	Dumka	Ganga	Dumka	TE	10.37	426.72	Irrigation	
24	Dulaki Dam	1971	Lilajan	Chatra	Ganga	Chatra	TE	16.76	1067	Irrigation	Completed
26	Getalsud Dam	1971	Subarnarekha	Ranchi	Subarnarekha	Ranchi	TE	36.1	3800	Hydroelectric,Irrigation,,Water Storage	
27	Ghaghra Dam	1957	Ghaghra	Hazaribag	Ganga	Hazaribagh	TE + PG	19.82	94.51	Irrigation	Completed
28	Gonda Dam	1954	Gonda	Hazaribag	Ganga	Hazaribagh	TE	13.41	1006.09	Irrigation	Completed
29	Hatia Dam	1963	Subarnarekha	Ranchi	Subarnarekha	Ranchi	TE	24	4525	Irrigation	Completed
30	Hiru Dam	1982	Hiroo	Chatra	Ganga	Chatra	TE	18.3	970.788	Irrigation	Completed
33	Jamunia Dam	1954	Jamunia	Hazaribag	Ganga	Hazaribagh	TE	17.38	1067.1	Irrigation	Completed
38	Karawani Dam	1967	Dararika	Dumka	Ganga	Dumka	TE	18.59	295.66	Irrigation	Completed
40	Kesho Dam		Kesho	Kodarma	Ganga	Kodarma	TE	14.57	2052	Irrigation	Under Construction
41	Khudia Dam	1971	Khudia River	Baghmara	Ganga	Dhanbad	TE		1227.12	Irrigation	
42	Konar Dam	1955	Konar	Hazaribag	Ganga	Hazaribagh	TE + PG	48.77	3806.65	Irrigation	Completed
45	Left Banki Dam	1980	Left Banki	Garhwa	Ganga	Garhwa	TE	14.32	1499.42	Irrigation	Completed
47	Lotia Dam	1978	Chondhi	Hazaribag	Ganga	Hazaribagh	TE	19.74	762.2	Irrigation	Completed

48	Maithon Dam	1957	Barakar	Asansol	Ganga		TE	56.08	4426	Hydroelectric,Water Storage	Completed
49	Malay Dam	1985	North Koel	Daltenganj	Ganga	Palamu	TE	28.8	1684.15	Irrigation	Completed
50	Masanjor JH Dam	1955	Mayurakshi or Mor	Dumka	Ganga	Dumka	TE	36.9	630	Hydroelectric,Irrigation	Completed
54	Nalkari Dam	1968	Nalkari	Hazaribag	Ganga	Ramgarh	TE	36	3074	Irrigation	Completed
56	North Koel Dam		North Koel	Garhwa	Ganga	Garhwa	TE	67.86	343	Hydroelectric,Irrigation	Under Construction
58	Panchat Hill Dam	1959	Damodar	Dhanbad	Ganga	Dhanbad	TE + PG	48	6777	Hydroelectric,Irrigation,,Water Storage	Completed
59	Panchkhero Dam		Panchkhero	Giridih	Ganga	Giridih	TE	19.33	2182	Irrigation	Under Construction
60	Pandarwa Dam	1983	Pandarwa	Garhwa	Ganga	Garhwa	TE	21.8	193.55	Irrigation	Completed
62	Punasi Dam		Ajoy	Devghar	Ganga	Deoghar	TE	21.54	2133.6	Irrigation	Under Construction
65	Salaiya Dam		Barsoti	Kodarma	Ganga	Hazaribagh	TE	18.6	990	Irrigation	Under Construction
69	Sudhari Nala Dam		Sudhari nala	Chatra	Ganga	Chatra	TE	16.46	396.34	Irrigation	Under Construction
70	Sugathan Dam			Godda	Ganga	Godda	TE	21.12	2040	Irrigation	Under Construction
72	Sunder Dam	1976	Sunder	Godda	Ganga	Godda	TE	35.67	1554.48	Irrigation	Completed
74	Suryodi Dam	1974	Surjudi Nala	Pakaur	Ganga	Pakur	TE + PG	12.5	487.68	Irrigation	Completed
75	Tahlay Dam		Tahlay	Daltenganj	Ganga	Palamu	TE	15		Irrigation	Under Construction
78	Temrain Dam	1973		Daltenganj	Ganga	Palamu	TE	12.8	503.05	Irrigation	Completed
79	Tenughat Dam	1978	Damodar	Bermo	Ganga	Bokaro	TE	50.61	6492.24	Hydroelectric,Irrigation	Completed
80	Tilaiya Dam	1953	Barakar	Hazaribag	Ganga	Kodarma	PG	29.7	366	Hydroelectric,Irrigation	Completed
81	Torai Dam		Torai	Pakaur	Ganga	Pakur	TE	24.4	647.	Irrigation	Under

									7		Construction
BIHAR											
1	Ajan Dam	1989	Ajan	Jamui	Ganga	Jamui	TE	39.02	518.3	Irrigation	Completed
2	Amrity Dam	1965		Jamui	Ganga	Jamui	TE	16.65	166.16	Irrigation	Completed
3	Badua Dam	1965	Badua	Banka	Ganga	Banka	TE	56.66	457.32	Irrigation	Completed
4	Barnar Dam			Jamui	Ganga	Jamui	PG	76.75	282.7	Irrigation	Under Construction
5	Baskund Dam	1984	Baskund	Lakhisarai	Ganga	Lakhisarai	TE	17.68	67.07	Irrigation	Completed
6	Belharna Dam	1987	Belharna	Banka	Ganga	Banka	TE	30.1	411.58	Irrigation	Completed
7	Bilasi Dam	2001	Bilasi	Banka	Ganga	Banka	TE	19.9797003	169.8	Irrigation	Completed
8	Chandan Dam	1968	Chandan	Banka	Ganga	Banka	TE	40.4	1555	Irrigation	Completed
9	Durgawati Dam		Durgawati	Bhabhua	Ganga	Kaimur (bhabua)	TE	46.3	1615.4	Irrigation	Under Construction
10	Gaighat Dam		Baghara	Munger	Ganga	Munger					Proposed
11	Jalkund Dam	1968	Jalkund	Munger	Ganga	Munger	TE	15.99	631.1	Irrigation	Completed
12	Job Dam	1977	JOB	Nawada	Ganga	Nawada	TE	18.9	1616	Irrigation	Completed
13	Kailash Ghati Dam	1980	Kailash Ghati	Jamui	Ganga	Jamui	TE	25.9	183	Irrigation	Completed
14	Khargpur Lake Dam	1876	Man	Munger	Ganga	Munger	TE	26.53	221.04	Irrigation	Completed
15	Kohira Dam	1962	Kohira	Bhabhua	Ganga	Kaimur (bhabua)	TE + PG	16	265.24	Irrigation	Completed
16	Kolmahadeo Dam	1966	Kolmahadev(bhusari)	Nawada	Ganga	Nawada	TE	19.2	157	Irrigation	Completed
17	Morwy Dam	1960	Morwe	Lakhisarai	Ganga	Lakhisarai	TE	25.56	533.53	Irrigation	Completed
18	Nagi Dam	1958	Nagi	Jamui	Ganga	Jamui	TE	113.5	1884	Irrigation	Completed
19	Nakti (Bihar) Dam	1980	Nakti	Jamui	Ganga	Jamui	TE	23.61	990.85	Irrigation	Completed
20	Orhni Dam	2000	Orni	Banka	Ganga	Banka	TE	23.774	686	Irrigation	Completed
21	Phulwaria Dam	1988	Tilaiya	Nawada	Ganga	Nawada	TE	25.66	1135	Irrigation	Completed
22	Sindhwarni Dam		Man	Munger	Ganga	Munger	TE	21.34	125.76	Irrigation	Under Construction
23	Srikhandi Dam	1965	Srikhandi	Jamui	Ganga	Jamui	TE	16.65	205.8	Irrigation	Completed
24	Upper Kiul Dam	2004	Kiul	Jamui	Ganga	Jamui	TE	30.48	3673	Irrigation	Completed

UTTAR PRADESH											
1	Adwa Dam	1978	Adwa	Mirzapur	Ganga	Mirzapur	TE	20.48	7906	Irrigation	Completed
2	Afzalgarh Dam			Bijnore	Ganga		TE			Irrigation	
3	Ahraura Dam	1955	GARAI	Chunar	Ganga	Mirzapur	TE	22.87	1219.5	Irrigation	Completed
4	Arjun Dam	1957	ARJUN River	Kulpahar	Ganga	Mahoba	TE	25.88	5200	Irrigation	Completed
5	Aunjhar Dam	1930	AUNJHAR	Mau	Ganga	Chitrakoot	PG	17.6	1056	Irrigation	Completed
6	Bachara Dam	1980		Meja	Ganga	Allahabad	TE	15	660	Irrigation	Completed
7	Baghel Khand Dam	1957	Jamunahwa	Balrampur	Ganga	Balrampur	TE	15.46	3200	Irrigation	Completed
8	Balui Dam		LOCAL	Robertsganj	Ganga	Sonbhadra	TE	14.1	2900	Irrigation	Under Construction
9	Banjari Kalan Dam		LOCAL	Mirzapur	Ganga	Mirzapur	TE	14.1	1470	Irrigation	Under Construction
10	Barkachha Dam	1975	LOCAL	Mirzapur	Ganga	Mirzapur	TE	19	570	Irrigation	Completed
11	Barwa Dam	1967		Jhansi	Ganga	Jhansi	TE	21.03	2815	Irrigation	Completed
12	Barwa Sagar Dam		Barwa Nala	Karwi	Ganga	Chitrakoot	TE	21.03	1067	Irrigation	Completed
13	Barwar Dam	1923	BORA NALA	Garautha	Ganga	Jhansi	TE	20.4	2233	Irrigation	Completed
14	Barwatola Dam	1957		Dudhi	Ganga	Sonbhadra	TE	16.77	1050	Irrigation	Completed
15	Bhagwan Pur Dam	1965		Balrampur	Ganga	Balrampur	TE	11.28	4400		Completed
16	Bhainsora Dam	1926	Marhwa Nala	Chakia	Ganga	Chandauli	TE	11.26	1850.61	Irrigation	Completed
17	Bhonka Dam	1951	BHONKA	Mirzapur	Ganga	Mirzapur	TE	15.3	2012	Irrigation	Completed
18	Chandra Prabha Dam	1966	Chandraprabha	Chakia	Ganga	Chandauli	TE	22.25	1600	Irrigation	Completed
19	Chandrawal Dam	1973	Chandrawal	Charkhari	Ganga	Mahoba	TE	10	5765	Irrigation	Completed
20	Chittaurgarh Dam	1985		Balrampur	Ganga	Balrampur	TE	15.3	11000	Irrigation	Completed
21	Deori Dam	1978	LOCAL	Robertsganj	Ganga	Sonbhadra	TE	21	930	Irrigation	Completed
22	Dhandhraul Dam	1917		ROBERTSGANJ	Ganga		TE	21	7305	Irrigation	Completed
23	Dhenkwan Dam	1985		Chunar	Ganga	Mirzapur	TE	20.85	1700	Irrigation	Completed
24	Dongia Dam	1918	GARAI	Robertsganj	Ganga	Sonbhadra	TE	15.3	2012	Irrigation	Completed
25	Dongri Dam	1986	PAHUJ	Jhansi	Ganga	Jhansi	TE	15.3	2760	Irrigation	Completed
26	Ganeshpur Dam			Balrampur	Ganga	Balrampur					
27	Garhwa Dam	1975	GARHW	Mau	Ganga	Chitrakoot	TE	13	980	Irrigation	Completed

			A								
28	Ghaghar Dam			Robertsganj	Ganga	Sonbhadra					
29	Ghooga Dam		LOCAL	Bahraich	Ganga	Shrawasti	TE	16	520	Irrigation	
30	Ghori Dam	1915		Mirzapur	Ganga	Mirzapur	TE	13.87	1584	Irrigation	Completed
31	Girgity Dam	1966		Balrampur	Ganga	Balrampur	TE	15.18	4800	Irrigation	Completed
32	Gointha Dam	1992	LOCAL	Ghazipur	Ganga	Ghazipur	TE	13.55	500	Irrigation	Completed
33	Govind Sagar Dam	1953	Shahzad River	Lalitpur	Ganga	Lalitpur	TE	18.29	3606	Irrigation	Completed
34	Gularia Dam	1966	GULARIA STREAM	Meja	Ganga	Allahabad	TE	11	3200	Irrigation	Completed
35	Gunta Dam	2003	GUNTA NALA (YAMUNA)	Karwi	Ganga	Chitrakoot	TE	29.5	5200	Irrigation	Completed
36	Hinauti Dam	1964	COL NALA	Mirzapur	Ganga	Mirzapur	TE	10.67	995	Irrigation	Completed
37	Jaiwanti Dam	1928		Mau	Ganga	Chitrakoot	TE	15	3352	Irrigation	Completed
38	Jamini Dam	1973	Jamni	Mahrauni	Ganga	Lalitpur	TE	26.22	6400	Irrigation	Completed
39	Jirgo Dam	1958	JIRGO	Chunar	Ganga	Mirzapur		29.88	6704	Irrigation	Completed
40	Jogendra Dam	1970	JOGENDRA	Mirzapur	Ganga	Mirzapur	TE	10.04	1313	Irrigation	Completed
41	Kabrai Dam	1955		Mahoba	Ganga	Mahoba	TE	18.24	2300.2	Irrigation	Completed
42	Kachnoda Dam	2012		Lalitpur	Ganga	Lalitpur	TE	18.9	4100	Irrigation	Completed
43	Kargara Dam	1978	LOCAL	Robertsganj	Ganga	Sonbhadra	TE	16.84	1410	Irrigation	Completed
44	Keolari Dam	1966		Kulpahar	Ganga	Mahoba	TE	11.73	2836.58	Irrigation	Completed
45	Khairman Dam	1958	HENGA NALA	Balrampur	Ganga	Balrampur	TE	10.6	3020	Irrigation	Completed
46	Khandeha Dam	1929	DASRATH NALA	Mau	Ganga	Chitrakoot	TE	19.9	1200	Irrigation	Completed
47	Khapatia Dam	1916	BORERA	Mau	Ganga	Chitrakoot	TE	16	806	Irrigation	Completed
48	Khirihata Dam	1992	LOCAL	Dudhi	Ganga	Sonbhadra	TE	10.77	178	Irrigation	Completed
49	Kohar Gaddi Dam	1930		Balrampur	Ganga	Balrampur	TE	10.5	2820	Irrigation	Completed
50	Kota Dam	1960	LOCAL	Robertsganj	Ganga	Sonbhadra	TE	14.63	549	Irrigation	Completed
51	Kotra Khambha Dam	1915		Mau	Ganga	Chitrakoot	TE	18	806	Irrigation	Completed
52	Kuba Khurd Dam	1988	LOCAL	Chunar	Ganga	Mirzapur	TE	10.33	1675	Irrigation	Completed
53	Lachura Dam	1910		Mau Ranipur	Ganga	Jhansi	TE + PG	14.94	542.3	Irrigation	Completed

54	Lower Khajuri Dam	1949		Mirzapur	Ganga	Mirzapur	TE + PG	18	640	Irrigation	Completed
55	Majhgawan Dam	1917	GUNCHI NALA	Kulpahar	Ganga	Mahoba	TE	19.43	1402	Irrigation	Completed
56	Matatila Dam	1958		Lalitpur	Ganga	Lalitpur	TE	45.72	6300	Hydroelectric,Irrigation	Completed
57	Maudaha (Swami Brahmanand) Dam	2003		Rath	Ganga	Hamirpur	TE	32.6	3480	Irrigation	Completed
58	Meja Dam	1987	Belan	Mirzapur	Ganga	Mirzapur	TE	40	2000	Irrigation	Completed
59	Moosakhand Dam	1967	KARMNASA	Chakia	Ganga	Chandauli	TE	33.53	2967	Irrigation	Completed
60	Muirpur Dam	1992	LOCAL	Dudhi	Ganga	Sonbhadra	TE	15.3	581	Irrigation	Completed
61	Murtia Dam	1977	LOCAL	Robertsganj	Ganga	Sonbhadra	TE	18.26	1135	Irrigation	Completed
62	Nagwa Dam	1950	KARMANASA RIVER	Robertsganj	Ganga	Sonbhadra	TE	20.31	2810.19	Irrigation	Completed
63	Nanauti Dam	1963	LOCAL	Chunar	Ganga	Mirzapur	TE	13.71	1400	Irrigation	Completed
64	Narson Dam	1988	NARSON	Robertsganj	Ganga	Sonbhadra	TE	14.33	2340	Irrigation	Completed
65	Naugarh Dam	1956	KARMNASA	Chakia	Ganga	Chandauli	TE	18.9	5975	Irrigation	Completed
66	Newari Dam		LOCAL	Robertsganj	Ganga	Sonbhadra	TE	15.44	1218	Irrigation	Under Construction
67	Obra Dam	1970	RIHAND	Robertsganj	Ganga	Sonbhadra	TE + PG	29	2000	Hydroelectric,Irrigation	Completed
68	Ohen Dam	1961	Ohan	Karwi	Ganga	Chitrakoot	TE + PG	24.08	2527	Irrigation	Completed
69	Pachwara Lake Dam	1694	LOCAL	Mau Ranipur	Ganga	Jhansi	TE + PG	13.72	208	Irrigation	Completed
70	Pahari Dam	1912	Local Nalla	Mau Ranipur	Ganga	Jhansi	TE + PG	10	580.95	Irrigation	Completed
71	Pahuj Dam	1909	PAHUJ	Jhansi	Ganga	Jhansi	TE + PG	10.67	2040	Irrigation	Completed
72	Parichha Dam	1886	BETWA	Jhansi	Ganga	Jhansi	TE + PG	16.77	1174.59	Irrigation	Completed

73	Patharai Dam	2002	PATHARI AND SUKHNA I (TRIBUTARY OF DHASAN)	Mau Ranipur	Ganga	Jhansi	TE	18	3800	Irrigation	Completed
74	Pili Dam	1968	Pili	Nagina	Ganga	Bijnor	TE	19	1540	Irrigation	Completed
75	Ragura Dam	1976	Local	Tikamgarh	Ganga		PG	12.05	1189	Irrigation	Completed
76	Raipura Dam	1930		Mahoba	Ganga	Mahoba	TE	13	3509	Irrigation	Completed
77	Rajghat Dam	2000	Betwa	Lalitpur	Ganga	Lalitpur	TE + PG	43.5	11200	Hydroelectric,Irrigation,Water Storage	Completed
78	Rajkhar Dam	1957	LOCAL STREAM	Dudhi	Ganga	Sonbhadra	TE	14.94	970	Irrigation	Completed
79	Rampur Dam	1958	GOINGHAWA NALA	Bahraich	Ganga	Shrawasti	TE	10.5	3820	Irrigation	Completed
80	Rampur Kalyangarh Dam	1925	LOCAL	Karwi	Ganga	Chitrakoot	TE	13	1000	Irrigation	Completed
81	Rampur Pindaria Dam	1974	LOCAL	Mirzapur	Ganga	Mirzapur	TE	10.3	1260	Irrigation	Completed
82	Rihand Dam	1962	Rihand	Dudhi	Ganga	Sonbhadra	PG	91.46	932	Hydroelectric,Irrigation	Completed
83	Rohini Dam	1983	ROHINI	Mahrauni	Ganga	Lalitpur	TE	17.82	1647	Irrigation	Completed
84	Sajnam Dam	1990		Mahrauni	Ganga	Lalitpur	TE	22.34	4524	Irrigation	Completed
85	Saktesh Garh Dam	1989	LOCAL	Chunar	Ganga	Mirzapur	TE	15.66	880	Irrigation	Completed
86	Salarpur Dam	1960	KARDIA	Mahoba	Ganga	Mahoba	TE	11	2975	Irrigation	Completed
87	Saprar Dam	1952		JHANSI	Ganga		TE	16.76	3000	Irrigation	Completed
88	Sarai Garh Dam	1970	LOCAL	Robertsganj	Ganga	Sonbhadra	TE	10.82	735	Irrigation	Completed
89	Sarda Sagar Dam	1962	Sharda	Puranpur	Ganga	Pilibhit	TE	16.15	2220	Irrigation	Completed
90	Semri Dam	1989	LOCAL	Chunar	Ganga	Mirzapur	TE	14.8	666	Irrigation	Completed
91	Shahjad Dam	1992		Lalitpur	Ganga	Lalitpur	TE	18	4160	Irrigation	Completed
92	Siori Lake Dam	1911	Siori	Mau Ranipur	Ganga	Jhansi	TE	13.94	2306	Irrigation	Completed
93	Sirsi Dam	1958	Bakhar Nala	Mirzapur	Ganga	Mirzapur	TE	21.34	3808	Irrigation	Completed
94	Sukhra Dam	1909	SUKHARA NALA	Mirzapur	Ganga	Mirzapur	TE	12.2	1158	Irrigation	Completed
95	Suswar Dam		LOCAL	Mirzapur	Ganga	Mirzapur	TE	14.03	1400	Irrigation	Under

											Construction
96	Upper Khajuri Dam	1958	Chandauli and Shibati	Mirzapur	Ganga	Mirzapur	TE	24.88	2313	Irrigation	Completed
97	Urmil Dam	1994	Urmil	Mahoba	Ganga	Mahoba	TE	25.56	4799	Irrigation	Completed
98	Vijaipur Dam	1983	LOCAL	Mirzapur	Ganga	Mirzapur	TE	14.3	570	Irrigation	Completed

(Source: India-WRIS WebGIS)

Barrages in Ganga basin and its tributaries

Sl. No.	BWA Name	Completion Year	River	Nearest city	Basin	District	Height (m)	Length (m)	Purpose	Status
WEST BENGAL										
1	Bakreswar Barrage	1950		Siuri	Ganga	Birbhum		91		Completed
2	Brahmani Barrage		Brahmani	Rampur Hat	Ganga	Birbhum		126		Completed
3	Dauk Barrage	1988		Islampur	Ganga	Uttar Dinajpur		68		Completed
4	Durgapur Barrage	1955	Damodar	Bankura	Ganga	Bankura	12	692.2		Completed
5	Dwaraka Barrage	1953	Dwaraka	Siuri	Ganga	Birbhum		83.82		Completed
6	Farakka Barrage	1975	Ganga	Jangipur	Ganga	Murshidabad		2240		Completed
9	Kopai Barrage	1955	Kopai	Siuri	Ganga	Birbhum		66		Completed
10	Mahananda Barrage	1986	Mahananda	Siliguri	Ganga	Darjiling		182.88		Completed
11	Sali Weir		Damodar	Bankura	Ganga	Bankura				Completed
12	Tarafeni Barrage	1972		Jhargram	Ganga	Pashchim Medinipur				Completed
14	Tilpara Barrage	1949	Mayurakahi	Siuri	Ganga	Birbhum		309		Completed
JHARKHAND										
1	Ajoy Barrage	2004	Ajoy/ Ajay	Devghar	Ganga	Deoghar		275		Completed
2	Amanat Barrage				Ganga					
3	Anraj Weir		Arraj	Garhwa	Ganga	Garhwa				Completed
5	Batane Pick-up Barrage		Batane	Daltenganj	Ganga	Palamu		95.12		Completed
6	Batre Weir		Batre	Daltenganj	Ganga	Palamu		32.004		Completed
7	Bhora Weir	1974	Jhamarla	Rajmahal	Ganga	Sahibganj		22.86		Completed

9	Birha Weir		Shankh	Latehar	Ganga	Latehar	3.05	48.77		Completed
10	Bishunpur Weir	1967	Phuljhar	Gumla	Ganga	Gumla	0.914	23.77		Completed
12	Chako Weir		Chako	Chatra	Ganga	Chatra		115.82		Completed
13	Chordana Weir				Ganga					
14	Daruwa Weir		Darhwa	Devghar	Ganga	Deoghar		60.96		Completed
16	Ghaghari Weir		Ghagharai	Latehar	Ganga	Latehar	0.46	40.84		Completed
17	Gobai Barrage	1983		Baghmara	Ganga	Bokaro		93.27		Completed
18	Golai Weir	1968		Chatra	Ganga	Chatra	1.2192	73.76		Completed
19	Gumani Barrage		Gumani	Rajmahal	Ganga	Sahibganj		79.55		Completed
20	Harhi Weir		Harhi	Daltenganj	Ganga	Palamu				Completed
21	Harna North Weir		Harna	Godda	Ganga	Godda		43.28		Completed
22	Harna South Weir		Harna	Godda	Ganga	Godda		38.1		Completed
23	Jinjoy Weir		Jinjoy	Daltenganj	Ganga	Palamu		60.96		Completed
24	Jugra Weir	1952	Pakwa Nala	Hazaribag	Ganga	Hazaribagh	1.186	106.68		Completed
25	Kajhia Weir		Kajhia	Godda	Ganga	Godda		164.6		Completed
27	Karantola Weir		Domani	Rajmahal	Ganga	Sahibganj		24.38		Completed
28	Kawaldag Weir		Panda	Garhwa	Ganga	Garhwa	1.22	57.91		Completed
31	Khudia Weir	1971	Khudia River	Dhanbad	Ganga	Dhanbad		54.9		Completed
34	Kutipisi Weir	1963	Tributory of Kewta	Hazaribag	Ganga	Hazaribagh	4.57	46.65		Completed

			Nadi							
36	Left Banki Weir		Banki	Garhwa	Ganga	Garhwa	2.44	72.54		Completed
37	Lilajan Weir	1958	Lilajan	Chatra	Ganga	Chatra		367.285108		Completed
38	Lower Kararbar Weir		Kararwar	Daltenganj	Ganga	Palamu		25.91		Completed
39	Mohamadganj Barrage		North Koel	Garhwa	Ganga	Garhwa		814.75		Completed
40	Nakti Nala Weir		Nakti Nallah	Latehar	Ganga	Latehar	1.52	25.6		Completed
41	Pagla Weir	1974	Pagla	Pakaur	Ganga	Pakur	1.62	79.25		Completed
43	Phulwariya Weir		Phulwaria	Garhwa	Ganga	Garhwa	1.52	25.6		Completed
44	Piri Weir		Piri Nala	Daltenganj	Ganga	Palamu		51.21		Completed
47	Ramghat Weir		North Koel	Latehar	Ganga	Latehar	1.83	45.72		Completed
49	Sadabah Weir		Jinjoy	Daltenganj	Ganga	Palamu	1.52	70.1		Completed
50	Sarswatia Weir		Sarswatia	Garhwa	Ganga	Garhwa		35.05		Completed
52	Sonepur Weir				Ganga					
53	Sonre Weir		Sonre	Daltenganj	Ganga	Palamu		51.82		Completed
57	Triveni / Tribeni Weir	1961		Godda	Ganga	Godda	0.7	121.92		Completed
58	Upper Kararbar Weir		Kararwar	Daltenganj	Ganga	Palamu				Completed
59	Usri Weir	1968	Usri	Giridih	Ganga	Giridih	1.51	40		Completed

60	Uttmahi Weir		Sarswati a	Garh wa	Ga nga	Garhwa		39.62		Complete d
61	Yamuna Weir		Satbahin i	Dalten ganj	Ga nga	Palamu				Complete d
BIHAR										
1	Adri Weir		Adri	Auran gabad	Ga nga	Aurang abad				Complete d
2	Bagara Weir		Baghara	Mung er	Ga nga	Munger		43		Complete d
3	Batane Weir		Batane	Auran gabad	Ga nga	Aurang abad				Complete d
4	Belharna Weir		Belharna		Ga nga					Complete d
5	Chanken Weir			Mung er	Ga nga	Munger				Proposed
6	Chhariyari Weir		Yamune River	Jahana bad	Ga nga	Jehanab ad		30.48 0092		Complete d
7	Dakai Weir			Banka	Ga nga	Banka				Complete d
8	Dhadhar Barrage	2004	Dhadhar	Gaya	Ga nga	Gaya	2.43 4	138		Complete d
9	Dhawa Weir		Dhawa	Auran gabad	Ga nga	Aurang abad				Complete d
10	Durgawati Weir (Kudra)		Durgaw ati	Bhabh ua	Ga nga	Kaimur (bhabua)				Complete d
11	Gandak Barrage	1968	Gandak	Bettia h	Ga nga	Pashchi m Champ aran		739		Complete d
12	Ghogha Weir		Chandan	Banka	Ga nga	Banka		312.4		Complete d
13	Gidheshwar Weir		Kiul	Jamui	Ga nga	Jamui		396.2 4		Complete d
14	Gokhula Weir	1975	Gokhula	Gaya	Ga nga	Gaya				Complete d
15	Ikoria Weir		Chandan	Banka	Ga nga	Banka		244		Complete d
16	Kamla Weir		Kamla	Madh ubani	Ga nga	Madhu bani	1.52	292.5 3		Complete d
17	Kanakbigha Weir		Yamune River	Jahana bad	Ga nga	Jehanab ad		49.98 7351		Complete d
18	Karihari Weir		Karihari	Nawa da	Ga nga	Nawada				Complete d
19	Kohira Weir		Kohira	Bhabh ua	Ga nga	Kaimur (bhabua)		26.22		Complete d
20	Kosi Barrage Bihar	1963	Kosi	Bhimn agar	Ga nga	Bhimna gar		1149		Complete d
21	Kulthi Weir			Bihar Sharif	Ga nga	Naland a				Complete d
22	Kundghat Weir		Bahuar	Jamui	Ga nga	Jamui		34.7		Complete d
23	Libari / Bharthuanandan Weir		Bhutahi	Hilsa	Ga nga	Naland a		54.86 4		Proposed

24	Lokain Weir	1964	Lokain(Falgu)	Hilsa	Ganga	Nalanda		73.152221		Completed
25	Lower Kiul Weir	1965	Kiul	Lakhisarai	Ganga	Jamui		202.5		Completed
26	Lower Morhar Weir	1962	Morhar	Gaya	Ganga	Gaya		289.560873		Completed
27	Mandai Weir		Falgu	Jahanabad	Ganga	Jehanabad		305		Underconstruction
28	Morwe Weir		Morwe	Lakhisarai	Ganga	Lakhisarai				Completed
29	Munahra Weir	2007	Balan	Jhanjharpur	Ganga	Madhubani	2	114		Completed
30	Paimar Barrage		Paimar	Hilsa	Ganga	Nalanda				Completed
31	Panchane Weir		Panchana	Bihar Sharif	Ganga	Nalanda	1.21	230		Completed
32	Paura Weir (Sakri)		Sakri	Nawada	Ganga	Nawada				Completed
33	Punpun Barrage		Punpun	Aurangabad	Ganga	Aurangabad		178		Underconstruction
34	Sone Barrage	1968	sone	Sasaram	Ganga	Rohtas		1407		Completed
35	Sukhnia Weir		Sukhnia	Banka	Ganga	Banka				Completed
36	Surara Weir		Suar	Bhabhua	Ganga	Kaimur (bhabua)				Completed
37	Uderasthan Weir		Falgu	Jahanabad	Ganga	Jehanabad	1	336		Completed
38	Upper Jamuna /Yamuna Weir	1959	Yamune River	Gaya	Ganga	Gaya				Completed
39	Upper Morhar Diversion Weir	1961	Morhar	Gaya	Ganga	Gaya		195.07		Completed
UTTAR PRADESH										
1	Adwa Barrage	1978		Mirzapur	Ganga	Mirzapur		113.5		Completed
2	Banganga Barrage	1956	Banganga	Naugarh	Ganga	Siddharth Nagar	0.92	116		Completed
3	Dakpatthar Barrage	1965	Yamuna	Paonta	Ganga	Dehradun	18.38	516.92		Completed
4	Dhukwan Weir	1905	BETWA	Lalitpur	Ganga	Lalitpur	18.67	1171.9		Completed
5	Duni Barrage	1925		Pilibhit	Ganga	Pilibhit		157.26		Completed
6	Ghaghar Barrage		SONE	Robertsganj and Sonbhadra	Ganga					Completed
7	Girija Barrage	1976	GHAGHRA	Nanpara	Ganga	Bahraich		716		Completed
8	Gokul Barrage	2001		Mathura	Ganga	Mathura		555		Completed

9	Gomti Barrage	1979	GOMTI	Lucknow	Ganga	Lucknow		202.5		Completed
10	Hindan Barrage	1979		Dadri	Ganga	Gautam Buddha Nagar		162		Completed
11	Husainpur Weir		GARAI	Chunar	Ganga	Mirzapur				Completed
12	Kho Barrage	1975		Dhampur	Ganga	Bijnor		203		Completed
13	Lakhani Devi Diversion Weir				Ganga					Completed
14	Latifshah Weir		KARMANASA RIVER	Chakia	Ganga	Chandauli	14.33	217.68		Completed
15	Lower Khajuri Weir				Ganga					Completed
16	Lower Sarda Barrage	1974	SHARDA	Nighasan	Ganga	Kheri		408		Completed
17	Madhya Ganga Barrage (Chaudhary Charan Singh			Jansath	Ganga	Muzaffarnagar		621		Completed
18	Nagwa silhati Weir				Ganga					Completed
19	Narora Barrage	1966	GANGA	Anupshahr	Ganga	Bulandshahr		922.43		Completed
20	New Okhla Barrage		YAMUNA	Dadri	Ganga	Gautam Buddha Nagar		743.11		Completed
21	Parichha Weir	1886	BETWA	Moth	Ganga	Jhansi	16.77	1171.3		Completed
22	Ramganga Barrage	1975	RAMGANGA	Nagina	Ganga	Bijnor		408		Completed
23	Rapti Barrage		Rapti	Bahraich	Ganga	Shrawasti		284.5		Completed
24	Saryu Barrage			Nanpara	Ganga	Bahraich		243.5		Completed
25	Tons Weir			Meja	Ganga	Allahabad		500		Completed

Annexure 6.6: Major medium irrigation projects in Ganga basin and its tributaries

Major medium irrigation projects in Ganga basin and its tributaries

Sl. No.	Project Name		River	Basin	Purpose	Status
	WEST BENGAL					
1	Bandhu Medium Irrigation Project		Kangsabati	Ganga	Irrigation	Completed
2	Barabhum Medium Irrigation Project		Kangsabati	Ganga	Irrigation	Completed
3	Barrage And Irrigation System Of DVC		Damodar	Ganga	Irrigation	Completed
4	Beko Medium Irrigation Project		Kangsabati	Ganga	Irrigation	Completed
5	Berai Canal Medium Irrigation Project		Dwarkeswar	Ganga	Irrigation	Completed
6	Dimu Medium Irrigation Project		Kangsabati	Ganga	Irrigation	Completed
7	Futiary Medium Irrigation Project		Kangsabati	Ganga	Irrigation	Ongoing
8	Golamarajore Medium Irrigation Project		Kangsabati	Ganga	Irrigation	Ongoing
9	Hanumata Medium Irrigation Project		Kangsabati	Ganga	Irrigation	Ongoing
10	Hinglow Medium Irrigation Project		Ajoy	Ganga	Irrigation	Completed
11	Kangsabati Major Irrigation Project		Subernarekha	Ganga	Irrigation	Completed
12	Karatowa Medium Irrigation Project		Teesta	Brahmaputra	Irrigation	Completed
13	Karrior Medium Irrigation Project		Kangsabati	Ganga	Irrigation	Completed
14	Khairabera Medium Irrigation Project		Kangsabati	Ganga	Irrigation	Completed
15	Kumari Medium Irrigation Project		Kangsabati	Ganga	Irrigation	Completed
16	Lipaniajore Medium Irrigation Project		Kangsabati	Ganga	Irrigation	Completed
17	Mayurakshi Major Irrigation Project West Bengal			Ganga	Irrigation	Completed
18	Midnapur Canal Major Irrigation Project		Kangsabati	Ganga	Irrigation	Completed
19	Moutorejore Medium Irrigation Project		Kangsabati	Ganga	Irrigation	Ongoing
20	Parga Medium Irrigation Project		Kangsabati	Ganga	Irrigation	Completed
21	Patloi Medium Irrigation Project		Kangsabati	Ganga	Irrigation	Ongoing
22	Ramchandrapur Medium Irrigation Project		Kangsabati	Ganga	Irrigation	Completed
23	Ranichak Medium Irrigation Project		Kangsabati	Ganga	Irrigation	Ongoing
24	Saharajore Medium Irrigation Project		Kangsabati	Ganga	Irrigation	Completed
25	Sali Medium Irrigation Project		Damodar	Ganga	Irrigation	Completed
26	Sali Reservoir Medium Irrigation Project		Damodar	Ganga	Irrigation	Completed

27	Subernarekha Barrage Major Irrigation Project			Ganga	Irrigation	Ongoing
28	Subernarekha Multipurpose Project West Bengal		Subernarekha	Subarnarekha	Irrigation	Ongoing
29	Suvankar Dangra Medium Irrigation Project		Damodar	Ganga	Irrigation	Completed
30	Taragonia Medium Irrigation Project		Kangsabati	Ganga	Irrigation	Completed
31	Tatko Medium Irrigation Project		Kangsabati	Ganga	Irrigation	Ongoing
32	Teesta Barrage, Phase -I, St.I, Sub Stage I		Teesta	Ganga, Brahmaputra	Irrigation	Ongoing
33	Turga Medium Irrigation Project		Kangsabati	Ganga	Irrigation	Completed
	JHARKHAND					
1	Ajoy Barrage (Siktia) Major Irrigation Project		Ajoy	Ganga	Irrigation	Completed
2	Amanat Reservoir Project		Amanat	Ganga	Irrigation	Completed
3	Anjanwa Resevoir Medium Irrigation Project		Anjanwa	Ganga	Irrigation	Completed
4	Anraj Medium Irrigation Project		Arraj	Ganga	Irrigation	Completed
5	Aradih Weir Medium Irrigation Project			Subarnarekha	Irrigation	Completed
6	Auranga Major Irrigation Project		Auranga	Ganga	Irrigation	Ongoing
7	Babhanikhand Medium Irrigation Project		Banki	Ganga	Irrigation	Completed
8	Baranadi Medium Irrigation Project		Baranadi	Ganga	Irrigation	Completed
9	Barhi Medium Irrigation Project		Mahuaghat	Ganga	Irrigation	Completed
10	Basuki Medium Irrigation Project		South Koel	Subarnarekha	Irrigation	Proposed
11	Batane Major Irrigation Project Jharkhand		Batane	Ganga	Irrigation	Ongoing
12	Bateshwarsthan Pump Canal Major Irrigation		Ganga	Ganga	Irrigation	Ongoing
13	Batre Medium Irrigation Project Jharkhand		Batare	Ganga	Irrigation	Completed
14	Baudha Medium Irrigation Project		Agrawa/ Konar	Ganga	Irrigation	Completed
15	Bhairawa Medium Irrigation Project			Ganga	Irrigation	Ongoing
16	Bhoura Bandh Medium Irrigation Project		Jhamarla	Ganga	Irrigation	Completed
17	Birha Medium Irrigation Project			Brahmani and Baitarni	Irrigation	Completed
18	Bishunpur Medium Irrigation Project		Phuljhar	Ganga	Irrigation	Completed
19	Bishunpur Medium Irrigation Project			Ganga	Irrigation	Completed
20	Brahmani Medium Irrigation Project		Bamni	Subarnarekha	Irrigation	Completed
21	Buchaopa Medium Irrigation Project			Brahmani and Baitarni	Irrigation	Completed

22	Buksa Medium Irrigation Project		Baksa	Ganga	Irrigation	Completed
23	Butanduba Medium Irrigation Project			Ganga	Irrigation	Completed
24	Chako Medium Irrigation Project		Chako	Ganga	Irrigation	Completed
25	Chandan Major Irrigation Project Jharkhand		Chandan\ Tribeni\ Harna	Ganga	Irrigation	Completed
26	Chataniyaghat Medium Irrigation Project			Ganga	Irrigation	Completed
27	Chinda Medium Irrigation Project		Chhinda	Brahmani and Baitarni	Irrigation	Completed
28	Chirka Medium Irrigation Project		Dhengura	Ganga	Irrigation	Completed
29	Chordanda Medium Irrigation Project		Surhar	Ganga	Irrigation	Completed
30	Danro Medium Irrigation Project		Danro	Ganga	Irrigation	Completed
31	Daruwa Medium Irrigation Project		Darhwa	Ganga	Irrigation	Completed
32	Desh Bandh Medium Irrigation Project			Subarnarekha	Irrigation	Completed
33	Dhankai Medium Irrigation Project			Ganga	Irrigation	Completed
34	Dhansinghtoli Medium Irrigation Project			Brahmani and Baitarni	Irrigation	Completed
35	Dhauajore Medium Irrigation Project			Ganga	Irrigation	Completed
36	Diggalpahari Medium Irrigation Project			Ganga	Irrigation	Completed
37	Dulki Medium Irrigation Project			Ganga	Irrigation	Completed
38	Garhi Medium Irrigation Project		Garhi (Damodar)	Ganga	Irrigation	Ongoing
39	Ghaghari Medium Irrigation Project			Ganga	Irrigation	Completed
40	Ghaghra Medium Irrigation Project		Ghaghra	Ganga	Irrigation	Completed
41	Gobai Barrage Medium Irrigation Project		Gabai / Gowai	Ganga	Irrigation	Completed
42	Golai Medium Irrigation Project			Ganga	Irrigation	Completed
43	Gonda Medium Irrigation Project		Gonda	Ganga	Irrigation	Completed
44	Gumani Barrage Major Irrigation Project			Ganga	Irrigation	Ongoing
45	Harhi Medium Irrigation Project			Ganga	Irrigation	Completed
46	Harna Medium Irrigation Project		Harna	Ganga	Irrigation	Completed
47	Hiru Medium Irrigation Project		Hiru	Ganga	Irrigation	Completed
48	Jaipur Medium Irrigation Project		Nakti Nallah	Brahmani and Baitarni	Irrigation	Completed
49	Jamunia Medium Irrigation Project			Ganga	Irrigation	Completed
50	Jenasai Medium Irrigation Project		Karala	Subarnarekha	Irrigation	Completed
51	Jharjhara Medium Irrigation Project		Bamini Nalla	Subarnarekha	Irrigation	Ongoing
52	Jinjoy Weir Scheme Medium Irrigation Project		Jinjoy	Ganga	Irrigation	Completed

53	Jugra Medium Irrigation Project		Pakwa Nala	Ganga	Irrigation	Completed
54	Kajhia Medium Irrigation Project		Kajhia	Ganga	Irrigation	Completed
55	Kanchi Major Irrigation Project		Kanchi	Subarnarekha	Irrigation	Completed
56	Kans Medium Irrigation Project			Subarnarekha	Irrigation	Ongoing
57	Kansjore Medium Irrigation Project			Brahmani and Baitarni	Irrigation	Completed
58	Karantola Medium Irrigation Project			Ganga	Irrigation	Completed
59	Karawani Medium Irrigation Project		Dwarika	Brahmani and Baitarni	Irrigation	Completed
60	Katri Medium Irrigation Project		South Koel	Brahmani and Baitarni	Irrigation	Ongoing
61	Kawaldag Medium Irrigation Project		Panda	Ganga	Irrigation	Completed
62	Kesho Medium Irrigation Project		Kesho	Ganga	Irrigation	Ongoing
63	Khatwa Medium Irrigation Project			Brahmani and Baitarni	Irrigation	Completed
64	Khudia Irrigation Scheme Medium Irrigation		Khudia River	Ganga	Irrigation	Completed
65	Kita Medium Irrigation Project		Urangarha	Subarnarekha	Irrigation	Completed
66	Kitanala Medium Irrigation Project		Kita Nala	Subarnarekha	Irrigation	Completed
67	Kokro Irrigation Scheme Medium Irrigation Project		Raru	Subarnarekha	Irrigation	Completed
68	Konar Major Irrigation Project		Konar	Ganga	Irrigation	Ongoing
69	Kutipisi Medium Irrigation Project			Ganga	Irrigation	Completed
70	Lapasia Medium Irrigation Project			Subarnarekha	Irrigation	Completed
71	Larwa Medium Irrigation Project		Deo	Brahmani and Baitarni	Irrigation	Completed
72	Latratu Medium Irrigation Project		North Karo	Brahmani and Baitarni	Irrigation	Completed
73	Left Banki Weir Irrigation Project		Left Banki	Ganga	Irrigation	Completed
74	Left banki Reservoir Irrigation Project		Left Banki	Ganga	Irrigation	Completed
75	Lorgara Medium Irrigation Project		Kharkhai	Subarnarekha	Irrigation	Completed
76	Lotia Medium Irrigation Project		Chondhi	Ganga	Irrigation	Completed
77	Lower Karrabar Medium Irrigation Project		Kararbar	Ganga	Irrigation	Completed
78	Malay Medium Irrigation Project		North Koel	Ganga	Irrigation	Completed
79	Masaria Medium Irrigation Project			Brahmani and Baitarni	Irrigation	Completed
80	Mayurakshi LBC Jharkhand		Mayurarakshi/ Mor	Ganga	Irrigation	Completed
81	Murahir Reservoir Scheme Medium Irrigation		Lokjheria Nala	Subarnarekha	Irrigation	Completed
82	Murumsona Irrigation Scheme Medium Irrigation		Sana	Subarnarekha	Irrigation	Completed
83	Nakti Medium Irrigation Project		Bijay	Subarnarekha	Irrigation	Ongoing

84	Nakti Nala Weir Scheme Medium Irrigation Project			Subarnarekha	Irrigation	Completed
85	Nandini Medium Irrigation Project		Nandini	Brahmani and Baitarni	Irrigation	Completed
86	North Koel Major Irrigation Project Jharkhand		North Koel	Ganga	Irrigation	Ongoing
87	Pagla Medium Irrigation Project		Pagla	Ganga	Irrigation	Completed
88	Palna Medium Irrigation Project		Ranka Jhuria	Subarnarekha	Irrigation	Completed
89	Panch Khero Medium Irrigation Project			Ganga	Irrigation	Ongoing
90	Pandarwa Medium Irrigation Project		Pandarwa	Ganga	Irrigation	Completed
91	Paras Medium Irrigation Project		Paras	Brahmani and Baitarni	Irrigation	Completed
92	Phuljhar Medium Irrigation Project		Phuljhar	Brahmani and Baitarni	Irrigation	Completed
93	Phulwaria Medium Irrigation Project		Phulwaria	Ganga	Irrigation	Completed
94	Piri Medium Irrigation Project		Piri Nala	Ganga	Irrigation	Completed
95	Punasi Major Irrigation Project		Ajoy	Ganga	Irrigation	Ongoing
96	Putunggara Medium Irrigation Project			Brahmani and Baitarni	Irrigation	Completed
97	Raisa Medium Irrigation Project		Kanchi	Subarnarekha	Irrigation	Completed
98	Rajbhandh Medium Irrigation Project			Subarnarekha	Irrigation	Completed
99	Ramghat Medium Irrigation Project			Ganga	Irrigation	Completed
100	Ramrekha Medium Irrigation Project		Utial Nala	Brahmani and Baitarni	Irrigation	Ongoing
101	Roro Medium Irrigation Project		Roro Gara	Subarnarekha	Irrigation	Completed
102	Sadabah Medium Irrigation Project			Ganga	Irrigation	Completed
103	Sakrigali Pump Canal Medium Irrigation Project			Ganga	Irrigation	Completed
104	Salaiya Medium Irrigation Project			Ganga	Irrigation	Ongoing
105	Saraswatia Medium Irrigation Project			Ganga	Irrigation	Completed
106	Satpotka Medium Irrigation Project		Brahmani	Brahmani and Baitarni	Irrigation	Ongoing
107	Sona Medium Irrigation Project			Subarnarekha	Irrigation	Completed
108	Sonepur Medium Irrigation Project		Dhaulia	Ganga	Irrigation	Completed
109	Sonre Medium Irrigation Project			Ganga	Irrigation	Completed
110	Sonua Medium Irrigation Project			Subarnarekha	Irrigation	Ongoing
111	Sonua Medium Irrigation Project		Sanjay	Subarnarekha	Irrigation	Completed
112	Subernarekha Multipurpose Project Jharkhand		Subernarekha	Subarnarekha	Irrigation	Ongoing
113	Sunder Medium Irrigation Project		Sunder	Ganga	Irrigation	Completed
114	Surangi Medium Irrigation Project		Surangi Nala\ Karkari	Subarnarekha	Irrigation	Ongoing

115	Suru Medium Irrigation Project			Brahmani and Baitarni	Irrigation	Ongoing
116	Suryodi Medium Irrigation Project			Ganga	Irrigation	Completed
117	Tajna Barrage Medium Irrigation Project		Tajna	Subarnarekha	Irrigation	Completed
118	Tapkara Medium Irrigation Project		Kukurdoba	Brahmani and Baitarni	Irrigation	Completed
119	Temrain Medium Irrigation Project			Ganga	Irrigation	Completed
120	Tenughat Medium Irrigation Project		Damodar	Ganga	Irrigation	Completed
121	Torlow Medium Irrigation Project		Torlow	Subarnarekha	Irrigation	Completed
122	Triveni Medium Irrigation Project		Triveni	Ganga	Irrigation	Completed
123	Upper Sankh Medium Irrigation Project		Shankh	Brahmani and Baitarni	Irrigation	Ongoing
124	Upri Karabar Medium Irrigation Project		Kakarbar	Ganga	Irrigation	Completed
125	Usri Medium Irrigation Project		Usri	Ganga	Irrigation	Completed
126	Uttmahi Medium Irrigation Project			Ganga	Irrigation	Completed
127	VIjay Medium Irrigation Project			Subarnarekha	Irrigation	Completed
128	Yamuna Medium Irrigation Project			Ganga	Irrigation	Completed
	BIHAR					
1	Adri Canal Medium Irrigation Project		Adri	Ganga	Irrigation	Completed
2	Ajan (Kukurjhap) Medium Irrigation Project		Ajan	Ganga	Irrigation	Completed
3	Badua Major Irrigation Project		Badua	Ganga	Irrigation	Completed
4	Bansagar Dam Major Irrigation Project Bihar		Sone	Ganga	Irrigation	Completed
5	Barnar Major Irrigation Project		Barnar	Ganga	Irrigation	Ongoing
6	Batane Canal Medium Irrigation Project		Batane	Ganga	Irrigation	Completed
7	Batane Major Irrigation Project Bihar		Batane	Ganga	Irrigation	Ongoing
8	Bateshwarasthan Pump Ph-I Major Irrigation		Ganga	Ganga	Irrigation	Ongoing
9	Belharna Medium Irrigation Project		Belharna	Ganga	Irrigation	Completed
10	Bharthu Nandna Medium Irrigation Project		River Bhutahi (Old Course Of Falgu)	Ganga	Irrigation	Ongoing
11	Bilasi Medium Irrigation Project		Bilasi	Ganga	Irrigation	Completed
12	Chandan Major Irrigation Project Bihar		Chandan	Ganga	Irrigation	Completed
13	Chausa Pump Canal Medium Irrigation Project		Ganga	Ganga	Irrigation	Completed
14	Chhariyari Medium Irrigation Project		Yamune River	Ganga	Irrigation	Completed
15	Dhakranalla Pump Ph - I Medium Project Medium		Dhakranalla	Ganga	Irrigation	OnGoing

16	Dhakranalla Pump Ph - II Medium Project Medium		Dhakranalla	Ganga	Irrigation	OnGoing
17	Dhuwa /Dhawa Medium Project Medium Irrigation		Dhawa	Ganga	Irrigation	Completed
18	Durgavati Major Irrigation Project		Durgawati	Ganga	Irrigation	Ongoing
19	Gandak Major Irrigation Project Bihar		Gandak	Ganga	Irrigation	Completed
20	Gokhula Medium Irrigation Project		Gokhula	Ganga	Irrigation	Completed
21	Job Medium Irrigation Project		JOB	Ganga	Irrigation	Completed
22	Kamla Major Irrigation Project		Kamla	Ganga	Irrigation	Completed
23	Kanak Bigha Medium Irrigation Project		Yamune River	Ganga	Irrigation	Completed
24	Karihari Medium Irrigation Project		Karihari	Ganga	Irrigation	Completed
25	Kohira Dam Major Irrigation Project		Kohira	Ganga	Irrigation	Completed
26	Kolmahadeo Medium Irrigation Project		Kolmahadev(bhusari)	Ganga	Irrigation	Completed
27	Kosi Barrage and Eastern Canal Major Irrigation		Kosi	Ganga	Irrigation	Completed
28	Kulthi Weir Medium Irrigation Project			Ganga	Irrigation	Completed
29	Kundghat Medium Irrigation Project		Bahuar	Ganga	Irrigation	Ongoing
30	Lilajan Major Irrigation Project		Lilajan	Ganga	Irrigation	Completed
31	Lokine Medium Irrigation Project		Lokain(Falgu)	Ganga	Irrigation	Completed
32	Lower Kiul Valley Major Irrigation Project		Kiul	Ganga	Irrigation	Completed
33	Lower Morhar Major Irrigation Project		Morhar	Ganga	Irrigation	Completed
34	Mahabodhi Medium Irrigation Project		Lilajan	Ganga	Irrigation	Completed
35	Mandai Medium Irrigation Project		Falgu	Ganga	Irrigation	Ongoing
36	Morwa Medium Irrigation Project		Morwe	Ganga	Irrigation	Completed
37	Munhara Barrage Medium Irrigation Project		Balan	Ganga	Irrigation	Ongoing
38	Musakhand Dam (Karmanasa Irrigation Project)		KARMANASA RIVER	Ganga	Irrigation	Completed
39	Nagi Medium Irrigation Project		Nagi	Ganga	Irrigation	Completed
40	North Koel Major Irrigation Project Bihar		North Koel	Ganga	Irrigation	Ongoing
41	Orni Medium Irrigation Project		Orni	Ganga	Irrigation	Completed
42	Paimar Barrage Medium Irrigation Project		Paimar	Ganga	Irrigation	Completed
43	Panchane Medium Irrigation Project		Panchana	Ganga	Irrigation	Completed
44	Phulwaria Medium Irrigation Project		Tilaiya	Ganga	Irrigation	Completed
45	Punpun Barrage Major Irrigation		Punpun	Ganga	Irrigation	Ongoing

	Project					
46	Sakri Lower Valley Major Irrigation Project		Sakri	Ganga	Irrigation	Completed
47	Sindhwarni Medium Irrigation Project		Man	Ganga	Irrigation	Ongoing
48	Sone Canals Major Irrigation Project		Sone	Ganga	Irrigation	Completed
49	Sone High Level Canal Major Irrigation Project		Sone	Ganga	Irrigation	Completed
50	Suara Canal Medium Irrigation Project		Suar	Ganga	Irrigation	Completed
51	Surajgarh Pump Canal Medium Irrigation Project		Harohar	Ganga	Irrigation	Completed
52	Tilaiya - Dhadhar Major Irrigation Project		Dhadhar	Ganga	Irrigation	Ongoing
53	Uderasthan Major Irrigation Project		Falgu	Ganga	Irrigation	Completed
54	Upper Jamuna/Yamuna Medium Irrigation Project		Yamune River	Ganga	Irrigation	Completed
55	Upper Kiul Major Irrigation Project		Kiul	Ganga	Irrigation	Completed
56	Upper Morhar Major Irrigation Project		Morhar	Ganga	Irrigation	Completed
57	Western Kosi Canal Major Irrigation Project		Kosi	Ganga	Irrigation	Ongoing
58	Zamania Pump Scheme (Larma) Medium Irrigation		Karamnasa	Ganga	Irrigation	Ongoing
	UTTAR PRADESH					
1	Adwa Dam Project Major Irrigation Project		ADWA	Ganga	Irrigation	Completed
2	Afzalgarh Medium Irrigation Project			Ganga	Irrigation	Completed
3	Agra Canal Major Irrigation Project Uttar Pradesh		YAMUNA	Ganga	Irrigation	Completed
4	Ahraura Dam Medium Irrigation Project			Ganga	Irrigation	Completed
5	Aliganj Major Irrigation Project			Ganga	Irrigation	Completed
6	Arjun Dam Medium Irrigation Project		Arjuna	Ganga	Irrigation	Completed
7	Augasi Pump Canal Major Irrigation Project		YAMUNA RIVER	Ganga	Irrigation	Completed
8	Badaun Major Irrigation Project		RAMGANGA	Ganga	Irrigation	Ongoing
9	Bakhar Marihan Feeder Medium Irrigation Project			Ganga	Irrigation	Completed
10	Balmiki (Ohen) Sarovar Medium Irrigation Project			Ganga	Irrigation	Completed
11	Banganga Canal Major Irrigation Project			Ganga	Irrigation	Completed
12	Bansagar Canal (UP) Irrigation		Sone	Ganga	Irrigation	Ongoing

	Project					
13	Bansagar Dam Major Irrigation Project Uttar			Ganga	Irrigation	Completed
14	Barwa Dam Medium Irrigation Project		BORA NALA	Ganga	Irrigation	Completed
15	Baur Medium Irrigation Project Uttar Pradesh			Ganga	Irrigation	Completed
16	Beewer Feeder Canal Medium Irrigation Project			Ganga	Irrigation	Completed
17	Belan - Tons Canal Major Irrigation Project		BELAN	Ganga	Irrigation	Completed
18	Belan Bhakhar Medium Irrigation Project		BELAN	Ganga	Irrigation	Completed
19	Bevar Feeder Canal Major Irrigation Project			Ganga	Irrigation	Completed
20	Bhaunrat Dam Medium Irrigation Project			Ganga	Irrigation	Ongoing
21	Bhopauli Pump Canal Major Irrigation Project			Ganga	Irrigation	Completed
22	Bijnore Canal Major Irrigation Project			Ganga	Irrigation	Completed
23	Chambal Lift Irrigation Project			Ganga	Irrigation	Completed
24	Chandra Prabha Dam Medium Irrigation Project			Ganga	Irrigation	Completed
25	Chandrawal Dam Medium Irrigation Project			Ganga	Irrigation	Completed
26	Chillimal Pump Canal Medium Irrigation Project		Yamuna	Ganga	Irrigation	Completed
27	Chittaurgarh Reservoir Major Irrigation Project			Ganga	Irrigation	Completed
28	Dalmau Pump Canal Stage - I and Stage - II Major			Ganga	Irrigation	Completed
29	Denkwa Dam Major Irrigation Project			Ganga	Irrigation	Completed
30	Deokali Pump Canal Stage - I Major Irrigation			Ganga	Irrigation	Completed
31	Dhasan Canal Major Irrigation Project			Ganga	Irrigation	Completed
32	Dhoba Pump Canal Medium Irrigation Project			Ganga	Irrigation	Completed
33	Dohrighat Pump Canal Major Irrigation Project			Ganga	Irrigation	Completed
34	Dohrighat Sahyak Major Irrigation Project			Ganga	Irrigation	Completed
35	Dongri Medium Irrigation Project			Ganga	Irrigation	Completed
36	East Baigul Major Irrigation Project			Ganga	Irrigation	Completed

	Uttar					
37	Eastern Ganga Canal Major Irrigation Project		Ganga	Ganga	Irrigation	Completed
38	Eastern Yamuna Canal Major Irrigation Project			Ganga	Irrigation	Completed
39	Gandak Canal Major Irrigation Project Uttar		Gandak	Ganga	Irrigation	Completed
40	Ghaggar Canal Project		GHAGHAR	Ganga	Irrigation	Completed
41	Gularia Dam Medium Irrigation Project			Ganga	Irrigation	Completed
42	Gunta Nalla Medium Irrigation Project			Ganga	Irrigation	Completed
43	Gyanpur Pump Canal Major Irrigation Project			Ganga	Irrigation	Completed
44	Haripur Major Irrigation Project Uttar Pradesh			Ganga	Irrigation	Completed
45	Jahangirganj Branch Medium Irrigation Project			Ganga	Irrigation	Completed
46	Jamni Dam Medium Irrigation Project Uttar Pradesh		JAMINI RIVER	Ganga	Irrigation	Completed
47	Jamrani Multipurpose project Uttar Pradesh			Ganga	Irrigation	Ongoing
48	Jarauli Pump Canal Major Irrigation Project			Ganga	Irrigation	Completed
49	Jirgo Medium Irrigation Project			Ganga	Irrigation	Completed
50	Kabrai Lake Medium Irrigation Project		Arjun	Ganga	Irrigation	Completed
51	Kachnoda Dam Major Irrigation Project		Sajnam	Ganga	Irrigation	Completed
52	Kanhar Major Irrigation Project		PAGAN	Ganga	Irrigation	Ongoing
53	Ken Canal Major Irrigation Project		KEN	Ganga	Irrigation	Completed
54	Keolari Medium Irrigation Project			Ganga	Irrigation	Completed
55	Khara Canal Medium Irrigation Project		YAMUNA RIVER	Ganga	Irrigation	Completed
56	Kishanpur Pump Canal Major Irrigation Project			Ganga	Irrigation	Completed
57	Kosi Irrigation Medium Irrigation Project Uttar			Ganga	Irrigation	Completed
58	Lakhwar Multipurpose Project Uttar Pradesh		YAMUNA RIVER	Ganga	Irrigation	Ongoing
59	Lalitpur Dam Medium Irrigation Project Uttar			Ganga	Irrigation	Completed
60	Lower Ganga Canal Major Irrigation Project		Gnaga	Ganga	Irrigation	Completed
61	Madho Tanda Major Irrigation Project			Ganga	Irrigation	Completed

62	Madhya Ganga Canal Phase - II Major Irrigation		Ganga	Ganga	Irrigation	Completed
63	Madhya Ganga Canal Stage - I Major Irrigation		Ganga	Ganga	Irrigation	Completed
64	Matatila Dam Major Irrigation Project (including		BETWA RIVER	Ganga	Irrigation	Completed
65	Maudaha Dam Major Irrigation Project		BIRMA	Ganga	Irrigation	Completed
66	Meja Dam Major Irrigation Project			Ganga	Irrigation	Completed
67	Moosakhand Dam Major Irrigation Project Uttar		KARMANSA	Ganga	Irrigation	Completed
68	Nagwa Dam Major Irrigation Project		KARNASSA	Ganga	Irrigation	Completed
69	Nanak Sagar Major Irrigation Project Uttar		SARDA	Ganga	Irrigation	Completed
70	Narainpur Pump Canal Major Irrigation Project			Ganga	Irrigation	Completed
71	Naugarh Dam Major Irrigation Project		KARMANASA RIVER	Ganga	Irrigation	Completed
72	Parallel Lower Ganga Canal Major Irrigation			Ganga	Irrigation	Completed
73	Pathrai Dam Medium Irrigation Project		PATHRAI AND SUKHNAI	Ganga	Irrigation	Completed
74	Pili Dam Medium Irrigation Project Uttar Pradesh		Pili	Ganga	Irrigation	Completed
75	Providing Kharif Channel in Hindon Krishi Doab			Ganga	Irrigation	Completed
76	Rajghat Canal Major Irrigation Project		BETWA	Ganga	Irrigation	Completed
77	Rajghat Dam Irrigation Project Uttar Pradesh		Betwa	Ganga	Irrigation	Completed
78	Ramganga Major Irrigation Project		Ramganga	Ganga	Irrigation	Completed
79	Rampur Canal Major Irrigation Project			Ganga	Irrigation	Completed
80	Rangwan Dam Project Uttar Pradesh Major		Banne Nala	Ganga	Irrigation	Completed
81	Rohilkhand Canal Major Irrigation Project			Ganga	Irrigation	Completed
82	Rohini Project Medium Irrigation Project			Ganga	Irrigation	Completed
83	Sajnam Dam Medium Irrigation Project		SAJNAM	Ganga	Irrigation	Completed
84	Saprar Medium Irrigation Project			Ganga	Irrigation	Completed
85	Sarda Canal Major Irrigation Project Uttar			Ganga	Irrigation	Completed
86	Sarda Sagar Stage I Major Irrigation Project		SARDA	Ganga	Irrigation	Completed

87	Sarda Sagar Stage II Major Irrigation Project		SARDA	Ganga	Irrigation	Completed
88	Sarju Pump Canal Major Irrigation Project			Ganga	Irrigation	Completed
89	Saryu Nahar Pariyojana Major Irrigation Project		SARYU	Ganga	Irrigation	Completed
90	Shahganj Medium Irrigation Project			Ganga	Irrigation	Completed
91	Shahzad Major Irrigation Project			Ganga	Irrigation	Completed
92	Sharda Sahayak Major Irrigation Project		SHARDA	Ganga	Irrigation	Completed
93	Sirsi Barundha Feeder Medium Irrigation Project			Ganga	Irrigation	Completed
94	Sone Pump Canal Major Irrigation Project		Sone	Ganga	Irrigation	Completed
95	Suheli Major Irrigation Project			Ganga	Irrigation	Completed
96	Tanda Pump Canal Major Irrigation Project			Ganga	Irrigation	Completed
97	Tehri Dam (Irrigation Share) Irrigation Project		Bhagirathi	Ganga	Irrigation	Completed
98	Tons Pump Canal Major Irrigation Project			Ganga	Irrigation	Completed
99	Trans- Kalyani Medium Irrigation Project			Ganga	Irrigation	Completed
100	Tumaria Reservoir Medium Irrigation Project Uttar			Ganga	Irrigation	Completed
101	Umarahat Pump Canal Phase - I Medium Irrigation			Ganga	Irrigation	Completed
102	Upper Ganga Canal Major Irrigation Project		Ganga	Ganga	Irrigation	Completed
103	Upper Khajuri Medium Irrigation Project		Chandauli and Shibati	Ganga	Irrigation	Completed
104	Urmil Dam Major Irrigation Project Uttar Pradesh		KEN	Ganga	Irrigation	Completed
105	Yamuna Pump Canal Major Irrigation Project			Ganga	Irrigation	Completed
106	Zamania Pump Canal Major Irrigation Project			Ganga	Irrigation	Completed

(Source: India-WRIS WebGIS)