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**THEME: Geo-Budget: Enabling Sustainable Growth**

## **Surveying & Mapping in National Waterways**

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### **1 Introduction**

1.1 Inland Water Transport (IWT) is an economic, fuel-efficient, environment friendly and employment oriented mode of transport. Inland Water Transport has maintained its edge over the other modes of transport in certain areas where it enjoys natural advantage. Today, it is recognized all over the world for its inherent advantage of being the cheapest mode of transport for bulk haulage over long distance between places situated along the waterfront. Its energy efficiency, low pollution and potential for employment generation are universally accepted.

1.2 Keeping the above aspect in view Govt of India has set up Inland Waterways Authority of India (IWAI), a statutory body under Ministry of Shipping in 1986 with the responsibility of regulation and development of National Waterways in the country for shipping and navigation.

1.3 The following inland waterways in the country have so far been declared as National Waterways.

- a. Allahabad- Haldia stretch (1620 km) of the Ganga- Bhagirathi- Hooghly river system as National Waterway No-1;
- b. Sadiya- Dhubri stretch (891 km) of Brahmaputra river as National Waterway No-2;
- c. Kollam- Kottappuram stretch of West Coast Canal along with Champakara canal and Udyogmandal canal (205 km) as National Waterway No-3;
- d. Kakinada- Puducherry stretch of Canals and the Kaluvelly Tank, Bhadrachalam- Rajahmundry stretch of River Godavari and Wazirabad- Vijayawada stretch of River Krishna (1078 km) as National Waterway-4 and
- e. Talcher- Dhamra stretch of Rivers, Geonkhali- Charbatia stretch of East Coast Canal, Charbatia- Dhamra stretch of Matai River and Mahanadi Delta Rivers (588 km) as National Waterway-5

1.4 IWAI is taking up the development of the first three National Waterways in a phased manner with a view to provide it as an alternative mode of transport. Action has already been initiated to develop commercially viable stretches of NW-4 and NW-5

under Public-Private-Partnership (PPP) mode with the financial assistance of Asian Development Bank (ADB)/ Viability Gap Funding (VGF).

1.5 Besides, IWAI is developing and maintaining the Indian side of Sunderbans waterways under the Indo-Bangladesh Protocol for Transit and Trade under which the inland vessels of one country can transit through the specified routes of the other country.

## **2. Type of Surveys carried out by IWAI**

2.1 IWAI started using geospatial technology for undertaking hydrographic surveys in National Waterways and other waterways way back in 1990. Initially analogue satellite images collected from National Remote Sensing Agency (NRSA) was used for preparing base charts for survey purposes and the survey was conducted using conventional methods. With the advent of technology, IWAI started using Automated Hydrographic Survey System (AHSS) since 1996 for which digital charts generated based on the satellite images form the base charts. Horizontal control was based on Global Positioning System (GPS). Since 2002 digital imageries replaced analogue charts and the survey become more accurate. After the establishment of IWAI's own DGPS stations, DGPS rovers replaced ordinary GPS for position fixing thereby improved the position accuracy to sub-metre.

2.2 IWAI possess 18 state-of-the art survey vessels fitted with modern survey equipment. The Surveyors in IWAI are well trained in using these equipment as well as GIS/ Hydrography survey softwares. The following surveys have been carried out in National Waterways:

**2.2.1 Thalweg survey-** single lane longitudinal surveys carried out along the deepest channel for channel monitoring and demarcation on fortnight/ monthly basis

**2.2.2 Detailed survey-** When the depth started decreasing, such locations are identified and detailed surveys are carried out by taking cross-sections at the required interval. Subsequently river conservancy works like bandalling and dredging is undertaken to improve the depth. For monitoring the effect of conservancy works progress surveys and post bandal/ dredging surveys are also carried out

**2.2.3 Terminals survey-** Detailed cross-sectional survey carried out at terminal locations to assess the channel behavior twice in a year, prior to monsoon and post monsoon period. .

**2.2.4 Bank-to-bank survey-** Detailed bathymetric surveys carried out from bank to bank to assess the total river morphology. Based on this decision for appropriate River Training works for channel stabilization/ rectification are being taken. Besides updation of navigational charts are also done based on these survey results.

## **3. Mapping activities in IWAI**

### **3.1 Digital mapping**

Digital maps were initially prepared to use as base chart in automated hydrographic survey system. It was prepared from the analogue satellite images procured from NRSA. Current river course was digitized manually from these imageries, topographical details were incorporated from the respective Survey of India

(SoI) toposheets and thereafter geo-coding was done by following standard procedure. Erdas Imagine and Autocad softwares were used for this purpose digitization and geo-coding. This map was loaded as base maps in Hypackmax survey software to carry out various bathymetric surveys.

### **3.2 Preparation & Publication of River Navigational Charts**

River Navigational Charts (RNC) was prepared subsequently for the entire stretch of NW-1, NW-2, NW-3 and Sunderbans waterways using Caris software. Digital base charts were prepared initially by using LISS + PAN images and bathymetric inputs were imported on it after conducting cross-section surveys in the required scale. In order to demarcate navigational route, thalweg survey was carried out and the input was incorporated in the charts. Other navigational features like position of buoys, channel markings, jetties, terminals, cross-structures etc were also added. Finally the charts were prepared as per International Hydrographic Organisation (IHO) standards in the standard four colour format by following symbology as per INT-1 & 2. These charts are available on sale (@ Rs1000/- per chart) to prospective users/ operators/agencies/ individuals. For details refer IWAI website [www.iwai.nic.in](http://www.iwai.nic.in).

### **3.3 Other Navigational tools**

**3.3.1 River Atlas-** IWAI has already published River Atlas for NW-1, NW-2 and NW-3 which are available on sale. River Atlas of Sunderbans is being published shortly. The River Atlas gives general description of the waterway, A-3 size RNC giving stretch details, two Regulations viz Prevention of Collision on NWs Regulations-2002 & National Waterway, Safety of Navigation and Shipping Regulations-2002, facilities provided in NWs, contact details etc.

**3.3.2 River Pilots-** IWAI also prepared and published River Pilots giving narration of the navigational routes (sailing direction) with details of other available facilities required for a mariner. This will act as supplement to the RNC to the mariners/ users just like the Bay of Bengal Pilot.

**3.2.3 Real-time Navigational Display software-** IWAI has developed a real-time navigational display software called “Nav Display” software for ensuring safe navigation in NWs. This software is available on sale to prospective users on commercial basis. Usage of this software is possible if the vessel is equipped with the following minimum hardware:

- (i) Digital Echo Sounder
- (ii) DGPS/GPS Receiver
- (iii)** Standard PC (minimum P-IV configuration) with suitable display monitor loaded with digital River Charts of the waterway

## **4 GPS/ DGPS for navigation in National Waterways**

**4.1** IWAI has provided/ installed aids to navigation such as lighted buoys, lights fitted on country crafts, shore beacons, channel markings etc. for demarcating the navigational channel in NWs. Besides, promulgation of navigational information by way of issuing River Notices indicating least available depth (LAD) available on

various stretches of NWs to facilitate smooth and effective navigation in NWs. Pilotage assistance to operators during their voyage in NWs by way of escorting and/ or by deputing experienced persons on board the vessels is also being provided on need basis.

- 4.2** As more and more vessels started operation in NWs and also due to the difficulty faced in demarcating the channel (navigational channel is subjected to frequent changes during lean season in mighty rivers like Ganga and Brahmaputra), there emerge a need for looking for a more accurate and reliable technique for navigation. Thus IWAI has decided to introduce “Navigation with DGPS technique” in NWs by establishing its own DGPS network.
- 4.3** A project for establishing DGPS Reference stations with MF link is underway both in NW-1 and NW-2 with a view to provide sub-metre accuracy in position fixing so as to facilitate the operator to navigate their vessel smoothly and effectively along the navigational channel. The expected radial coverage of each station is 150 km (approx). 1620 km of NW-1 will be covered by establishing stations at 4 locations viz Swaroopganj, Bhagalpur, Patna and Varanasi. Similarly 891 km of NW-2 will be covered by setting up Reference Stations at Jogighopa, Silghat and Dibrugarh. The extent of coverage expected is given below:

NW-1

Sagar island	-	upto Budge-Budge (DGLL station)
Swaroopganj	-	Budge-Budge to Farakka
Bhagalpur	-	Farakka to Barh
Patna	-	Barh to Buxar
Varanasi	-	Buxar to Allahabad

NW-2

Jogighopa	-	B'Border to Pandu
Silghat	-	Pandu to Jamuguri
Dibrugarh	-	Jamuguri to Sadiya

The DGPS stations at Swaroopganj, Bhagalpur & Patna in NW-1 and Jogighopa in NW-2 are commissioned and are in operation. The remaining stations will be commissioned shortly. With this any user can navigate safely through the navigational channel by adopting way point navigation method using Real time navigational Display software loaded in the computer on board the vessel with the help of pre-loaded thalweg route, which will be provided by IWAI.

As NW-3 is almost running parallel to the west coast within the aerial distance of approx 10 km, the DGPS Reference Stations already established on the light houses by Director General of Lighthouse & Lightships (DGLL), another organization under the Shipping Ministry, is providing coverage for the entire stretch of NW-3, which can be made use of by the users/ operators. Hence there is no requirement of establishing a separate system.

## **5 Conclusion**

From the above it may be seen that IWAI has been using all types of modern surveying techniques/ equipment and geo-spatial/ GIS technology for production of

charts/ maps. As such it is the endeavor of IWAI to continue to provide such navigational tools to the mariners/ users/ operators for ensuring safe navigation in National Waterways and also to make the inland water transport an alternative mode of transportation.

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