Final Feasibility Report National Waterways-04, Region VI – Krishna River Galgali Bridge to Wazirabad Barrage (636.2km)

SURVEY PERIOD: 20 MAR 2016 TO 20 SEP 2016

Volume - I

Prepared for:

Inland Waterways Authority of India
(Ministry of Shipping, Govt. of India)
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We would like to use this opportunity to pen down our profound gratitude and appreciations **to Shri Pravir Pandey, IA&AS, Chairman IWAI** for spending his valuable time and guidance for completing this Project. IIC Technologies Ltd., would also like to thank, **Shri Alok Ranjan, ICAS, Member (Finance), Shri Shashi Bhushan Shukla, Member (Traffic), Shri S.K. Gangwar, Member (Technical)** for their valuable support during the execution of project**.**

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List of Abbreviations

CD	Chart Datum
DGPS	Differential Global Positioning Systems
PDOP	Position Dilution of Precision
LBS	Left Bank Side
KRS	Krishna
ETS	Electronic Total Station
FRP	Fiber Reinforced Plastic
GPS	Global Positioning Systems
LBM	Local Benchmark
MSL	Mean Sea Level
RL	Reference Level
SD	Sounding Datum
SBAS	Satellite-Based Augmentation System
TBC	Trimble Business Center
GTS	Great Trigonometrically Survey
R.	River
NH	National Highway
SH	State Highway
CWC	Central Water Commission
PWD	Public Work Department
FRL	Full Reservoir Level
HFL	High Flood Level
TBM	Temporary Benchmark
BM	Benchmark
PIA	Project Influence Area

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SALIENT FEATURES AT A GLANCE

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<tr><td>3.</td><td>Waterway stretch, NW #
(from…. to; total length)</td><td>National Waterway No – 04
Galgali Bridge to Wazirabad Barrage (636.2km)</td></tr>
<tr><td>4.</td><td>Navigability Status</td><td>At present partially navigable</td></tr>
<tr><td>a)</td><td>Tidal & non tidal portions
(from… to, length, average tidal variation)</td><td>River Krishna is Non-Tidal</td></tr>
<tr><td>b)</td><td>LAD status (w.r.t. CD)
i) Survey period
(20th Mar 2016 to 20th Sep 2016)
ii) < 1.2 m (km)
iii) 1.2 m to 1.4 m (km)
iv) 1.5 m to 1.7 m (km)
v) 1.8 m to 2.0 m (km)
vi) > 2.0 m (km)</td><td>
<table>
<tr><th>Stretches (km)</th><th><1.2</th><th>1.2-1.4</th><th>1.5-1.7</th><th>1.8-2</th><th>>2</th><th>Total</th></tr>
<tr><td>0-30</td><td>19.6</td><td>0.2</td><td>0.2</td><td>0.3</td><td>9.7</td><td>30</td></tr>
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<tr><td>210-240</td><td>16.9</td><td>0.4</td><td>0.1</td><td>0.4</td><td>12.2</td><td>30</td></tr>
<tr><td>240-270</td><td>30</td><td>0</td><td>0</td><td>0</td><td>0</td><td>30</td></tr>
<tr><td>270-300</td><td>30</td><td>0</td><td>0</td><td>0</td><td>0</td><td>30</td></tr>
<tr><td>300-330</td><td>27.2</td><td>0.2</td><td>0</td><td>0.1</td><td>2.5</td><td>30</td></tr>
<tr><td>330-360</td><td>26.4</td><td>0.1</td><td>0.1</td><td>0.1</td><td>3.3</td><td>30</td></tr>
<tr><td>360-390</td><td>30</td><td>0</td><td>0</td><td>0</td><td>0</td><td>30</td></tr>
<tr><td>390-420</td><td>25.2</td><td>0</td><td>0.1</td><td>0.1</td><td>4.6</td><td>30</td></tr>
<tr><td>420-450</td><td>30</td><td>0</td><td>0</td><td>0</td><td>0</td><td>30</td></tr>
<tr><td>450-480</td><td>30</td><td>0</td><td>0</td><td>0</td><td>0</td><td>30</td></tr>
<tr><td>480-510</td><td>30</td><td>0</td><td>0</td><td>0</td><td>0</td><td>30</td></tr>
<tr><td>510-540</td><td>25.1</td><td>0.2</td><td>0.2</td><td>0</td><td>4.5</td><td>30</td></tr>
<tr><td>540-570</td><td>21.6</td><td>0.1</td><td>0</td><td>0</td><td>8.3</td><td>30</td></tr>
<tr><td>570-600</td><td>28.9</td><td>0</td><td>0</td><td>0</td><td>1.1</td><td>30</td></tr>
<tr><td>600-636.2</td><td>24</td><td>0.2</td><td>0.4</td><td>0.2</td><td>11.4</td><td>36.2</td></tr>
<tr><td>Total</td><td>466.9</td><td>4.7</td><td>4.6</td><td>5</td><td>155</td><td>636.2</td></tr>
</table>
</td></tr>
<tr><td>c)</td><td>Cross structures
i) Dams, weirs, barrages etc
(total number; with navigation locks or not)
ii) Bridges, Power cables etc
[total number; range of horizontal and vertical clearances]</td><td>1. Cross Structures
• Dams: 7 Nos.
• Weirs: 3 Nos.
• Barrages: 3Nos.
• Power House: 3 Nos
Navigation Locks are not present in the river
2. Bridges: 31 Nos.
• Horizontal Clearance : 5.18m to 45m
• Vertical Clearance : 0m to 61.88m w.r.t. HFL
3. HTP: 37 nos.
• Vertical Clearance : 1.382m to 52.858m w.r.t. HFL</td></tr>
<tr><td>d)</td><td>Avg. discharge & no. of days</td><td>Discharge data is not available fom authorities</td></tr>
</table>

<table>
<tr><th>#</th><th>Particulars</th><th>Details</th></tr>
<tr><td>e)</td><td>Slope (1 in ….)</td><td>
<table>
<tr><th colspan="2">Chainage</th><th rowspan="2">Slope (A/B)</th></tr>
<tr><th>From</th><th>To</th></tr>
<tr><td>0</td><td>30</td><td>1 : 0.169</td></tr>
<tr><td>30</td><td>60</td><td>1 : 3.54</td></tr>
<tr><td>60</td><td>90</td><td>1 : 0.004</td></tr>
<tr><td>90</td><td>120</td><td>1 : 0.144</td></tr>
<tr><td>120</td><td>150</td><td>1 : 2.924</td></tr>
<tr><td>150</td><td>180</td><td>1 : 0.193</td></tr>
<tr><td>180</td><td>210</td><td>1 : 0.136</td></tr>
<tr><td>210</td><td>240</td><td>1 : 0.006</td></tr>
<tr><td>240</td><td>270</td><td>1 : 0.073</td></tr>
<tr><td>270</td><td>300</td><td>1 : 0.565</td></tr>
<tr><td>300</td><td>330</td><td>1 : 1.411</td></tr>
<tr><td>330</td><td>360</td><td>1 : 0.545</td></tr>
<tr><td>360</td><td>390</td><td>1 : 0.333</td></tr>
<tr><td>390</td><td>420</td><td>1 : 0.299</td></tr>
<tr><td>420</td><td>450</td><td>1 : 0.908</td></tr>
<tr><td>450</td><td>480</td><td>1 : 1.462</td></tr>
<tr><td>480</td><td>510</td><td>1 : 2.042</td></tr>
<tr><td>510</td><td>540</td><td>1 : 0.403</td></tr>
<tr><td>540</td><td>570</td><td>1 : 0.215</td></tr>
<tr><td>570</td><td>600</td><td>1 : 0.287</td></tr>
<tr><td>600</td><td>636.2</td><td>1 : 0.118</td></tr>
</table>
Average Slope of Krisna is 1 : 0.729
</td></tr>
<tr><td>5.</td><td>Traffic potential</td><td>Non Navigable at present condition</td></tr>
<tr><td>a)</td><td>Present IWT operations, ferry services, tourism, cargo, if any</td><td>

Nargarjuna konda ferry line service from APTDC Lauch Station to Nagarjuna Hill at Nagarjuna Sagar
Tangeda Ferry Treminal to Mattapalle Ferry terminal at Tangeda, Guntur
Tadutla Ferry terminal at Tadutla, Andhra Pradesh

</td></tr>
<tr><td>b)</td><td>Important industries within 50km</td><td>

Agricultural Produce Marketing Committee at Vijayapura is 44.44km away from Hangaragi,Krishna River
Jamkhandi Sugars Limited at Hirepadasalagi is 20.77km away from Galgali, Krishna River
NTPC Kudgi STPP at Shankarnagar, Kudgi is 12.01km away from Maradagi, Krishna River
Bagalkot Cement Factory at Kaulpet is 21.70km away from Chicksangam, Krishna River
Granites industries and Kushtagi Receiving Station, KPTCL at Kushtagi is 45.94km away from Amarawadgi, Krishna River
Hutti Gold Mines at Hatti is 16.32km away from Tanmankal, Krishna River
Ash Pond, KPCL Raichur Thermal Power Plant and RTPS at Deosugur is 2.55km away from Krishna River
Manufacture and suply of edible oil at Adani Wilmar Limited at Mantralayam is 48.26km away from Ganjhalli, Krishna River
Rice mill factories at Yadgir is 30.08km away from Tumkur, Krishna River
Solar Photovoltaic panel at Pullur, Telangana is 14.35km away

</td></tr>
</table>

#	Particulars	Details
		from Seripalle, Krishna River • Cement Factories at Wadi is 54.51km away from Hayyal B, Krishna River • Sree Rayalaseema Alkalies and Allied Chemicals LTD at Gondiparla is 14.35km away from Utukuru, Krishna River • Kurnool Ultra Mega Solar Park and Sakunala Gani Ultra Mega Solar Park at Gani is 2.58km away from Malyala, Krishna River • Granite Industries at Ayinamukkala is 21.83km away from Sundipenta, Krishna River • Cement Factory at Macherla is 12.46km away from Krishna River • Nagarjuna sagar left canal power plant is 1.49km away from Krishna River • Parasakti cement Industries Ltd. Near at Nagarjuna Sagar Tail Pond is 1.26km away from Nagarjuna Sagar Tail Pond dam • India Cements Ltd.,Vishnupuram Vadapalle, Andhra Pradesh is 1.62km away from Krishna River • Deccan Cements Limited.,Vadapalle, Telangana is 2.11km away from Krishna River • Sagar Cements Limited,Mattampally Village & Mandal, near Huzur Nagar, Telangana is 6.73km away from Gundlapalle, Krishna River • My Home Industries Pvt Limited (Cement Manufacture Factory at Mellacheruvu is 15.17km away from Vellatur, Krishna River • Jaypee Balaji Cement Plant at Budawada, Andhra Pradesh is 8.20km away from Muktyala, Krishna River • KCP Cement, Mukteswarapuram, Andhra Pradesh is 2.40km away from Muktyala, Krishna River
c)	Distance of Rail & Road from Industry	• Agricultural Produce Marketing Committee at Vijayapura is 1.79km away from Bijapur Railway Station • Jamkhandi Sugars Limited at Hirepadasalagi is 5.04km away from SH34 • NTPC Kudgi STPP at Shankarnagar, Kudgi is 2.30km away from Telgi Railway station and 1.32km away from SH124 • Bagalkot Cement Factory at Kaulpet is 2.02km away from Bagalkot Railway station • Granites industries and Kushtagi Receiving Station, KPTCL at Kushtagi is 0.11km away from Sholapur-Manglore Hwy. • Hutti Gold Mines at Hatti is 9.74km away from SH20 • Ash Pond, KPCL Raichur Thermal Power Plant and RTPS at Deosugur is 2.58km away from Chiksugar Railway Station and 1.34km from NH167 • Manufacture and suply of edible oil at Adani Wilmar Limited at Mantralayam is 0.68km away from Mantarlayam Railway station • Rice mill factories at Yadgir is 0.09km away from NH150 • Solar Photovoltaic panel at Pullur, Telangana is 1.61km away from NH7 • Cement Factories at Wadi is 1.24km away from Wadi Junction

#	Particulars	Details
		Station. • Sree Rayalaseema Alkalies and Allied Chemicals LTD at Gondiparla 5.85km away from Alampur Railway Station • Kurnool Ultra Mega Solar Park and Sakunala Gani Ultra Mega Solar Park at Gani is 17.66km away from SH60 • Granite Industries at Ayinamukkala is 0.29km away from Doranala – Atmakur Road • Cement Factory at Macherla is 0.38km away from Macherla - Karempudi Road • Nagarjuna sagar left canal power plant is 1.45km away from Nagarjuna sagar Road • Parasakti cement Industries Ltd. Near at Nagarjuna Sagar Tail Pond is 9.12km away from SH2,Rentachintala • India Cements Ltd.,Vishnupuram Vadapalle, Andhra Pradesh is 0.64km away from Miryalaguda - Vadapalle Hwy • Deccan Cements Limited.,Vadapalle, Telangana is 6.29km away from Miryalaguda - Vadapalle Hwy • Sagar Cements Limited,Mattampally Village & Mandal, near Huzur Nagar, Telangana is 8.39km away from Mellacheruvu Railway Station • My Home Industries Pvt Limited (Cement Manufacture Factory at Mellacheruvu is 1.31km away from Mellacheruvu Railway Station • Jaypee Balaji Cement Plant at Budawada, Andhra Pradesh is 11.91km away from Mellacheruvu Railway Station • KCP Cement, Mukteswarapuram, Andhra Pradesh is 1.60km away from Koti Lingala Road
6.	Consultant's recommendation for going ahead with TEF / DPR preparation	A major for improvement of depth and channel design will be required to make the part of the Krishna River as navigable. The design of the waterway cannot be altered to a major extent as this is used mainly for irrigation purpose and drinking water supply. The Dams present in the river stretch is used for irrigation purpose, and the water through the side way canals are used at large extent for cultivation, thus detailed study on the impact of any change in the channel design needs to be carried out for the entire stretch of Krishna River.
7.	Any other information/ comment	Rocky outcrops found along most part of the river stretch.

(Signature)

Date: IIC Technologies Ltd.

1 Introduction

1.1 Background

The stretch of about 636.2km, of Krishna River, from confluence of Krishna Rivers at Wazirabad barrage (NW4-Limit) to the Galgali Bridge approx. 0.5km from Galgali village was identified for Inland Water transport facility as per a study carried out earlier. To assess the feasibility of water transportation over this stretch of river a bathymetric survey and topographic survey was carried out by IIC Technologies Ltd. on behalf of IWAI.

The Krishna River is the fourth biggest river in terms of water inflows and river basin area in India, after the Ganga, Godavari and Brahmaputra. The river is almost 1,300 kilometers (810 mi) long. The river is also called Krishnaveni. It is a major source of irrigation for Maharashtra, Karnataka, Telangana and Andhra Pradesh.

Krishna River originates in the Western Ghats near Mahabaleshwar at an elevation of about 1,300 meters, in the state of Maharashtra in central India. The Krishna river's source is at Mahabaleshwar near the Jor village in the extreme north of Wadi Taluka, Satara District, Maharashtra in the west and empties into the Bay of Bengal at Hamasaladeevi (near Koduru) in Andhra Pradesh, on the east coast. It flows through the state of Karnataka before entering Telangana State. The delta of this river is one of the most fertile regions in India and was the home to ancient Satavahana and Ikshvaku Sun Dynasty kings. Vijayawada is the largest city on the River Krishna.

It causes heavy soil erosion during the monsoon floods. It flows fast and furious, often reaching depths of over 75 feet (23 m). Ironically, there is a saying in Marathi "Santh vaahate Krishnamaai" which means "quiet flows Krishna". This term is used to describe that a person should be as quiet as Krishna.

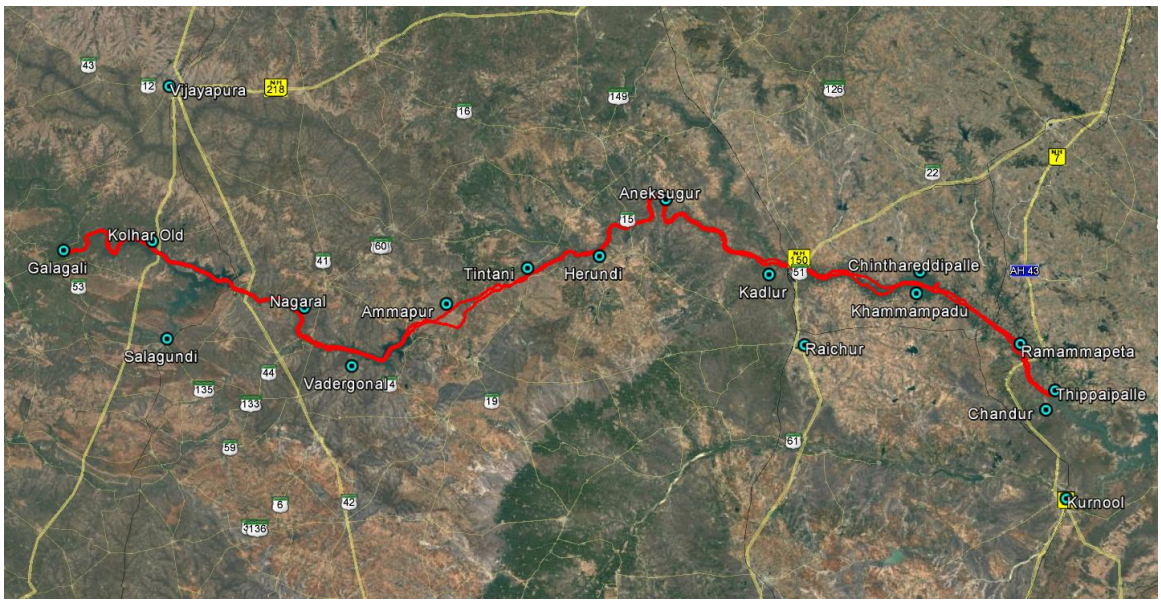


Figure 1 - Locations around Krishna River at zone 43N

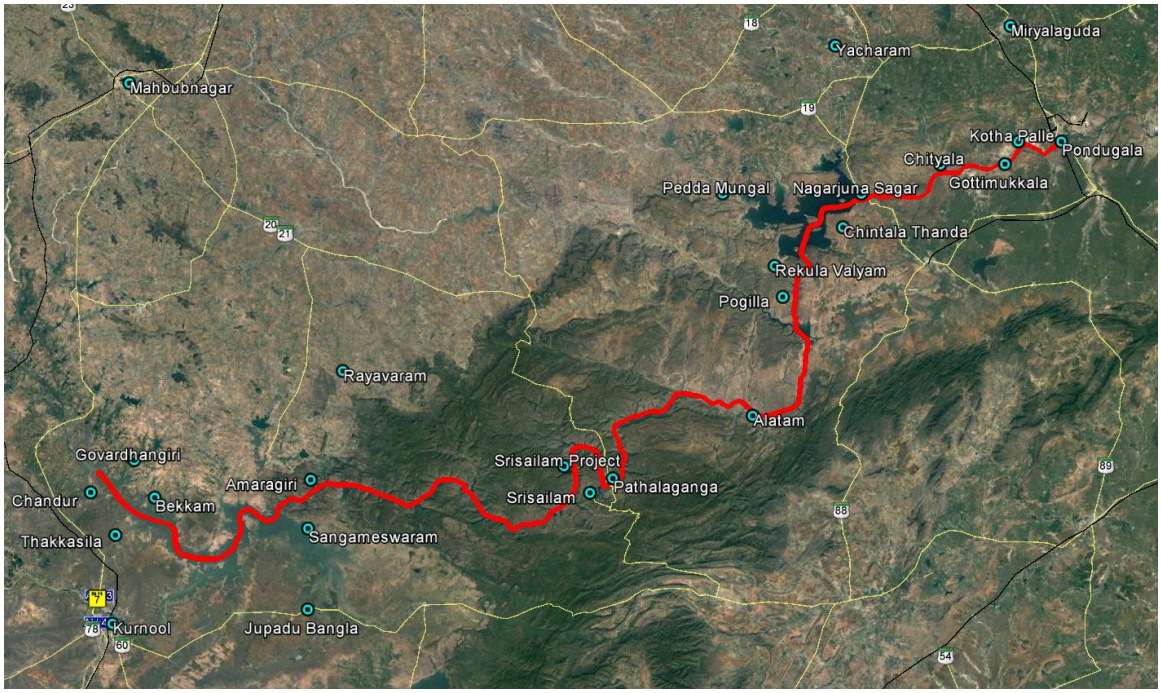


Figure 2 - Locations around Krishna River at zone 44N

1.2 Tributaries of Krishna River

The main Tributaries, which join River Krishna in the respective states are as follows:

In Maharashtra:

Vatali: R. Vatali at viahali and Asari villages, 8km from Wadi joins the Krishna to form the Dhoom Reservoir.

Venna: R. Venna origin at Sahayadri range of hills joins Krishna at Satara.

Koyna: R. Koyna (155km) origin from the Sahayadri range of hills joins Krishna at Karad, Satara district.

Yerla: R. Yerla origin near about Mol, and joins Krishna near Bhilwadi.

Varna: R. Varna (66km) origin at Sahayadri range of hills near about Sangameshwar and joins R. Krishna at Haripur, Sangli districts.

Panchaganga: R. Panchaganga (144km) origin at the Sahayadri range of hills near about Vishalgarh and joins Krishna at Narsobawadi

Other minor tributaries are Urmodi joining at Bargaon; Tarali, Mand at Umraj and Vasna at Tasgaon. Dudhganga along with Vedganga joins Krishna below Kurundwad.

In Karnataka:

Ghataprabha: R. Ghataprabha origin at Western Ghats 283km long and joins Krishna at Chiksangam.

Malaprabha: R. Malaprabha (meaning" full of mud") similar to Ghataprabha, Origin at the eastern Sahayadri spurs. 306kms and joins Krishna at 30km upstream of Narayanpur Dam.

Bhima: R. Bhima origin in Western ghats near about Bhimashankar (Maharashtra), 861kms long, joins Krishna near Devarsugur (Raichur).

Tungabhadra: R. Tungabhadra origin at Gangamula, as Tunga and Bhadra 531km long and joins Krishna 70km above Srisailam. Vedavati is one of the small tributaries.

Don: R. Don is one of the many minor tributaries.

In Telengana State:

Dindi: R. Dindi origin near about Muhalgidda (Mahabubnagar District) and joins Nagarjunasagar through Dindi reservoir.

Muniyeru: R. Muniyeru (196km) origin near about 'Mallampalll 235km long and joins Krishna near Nandigama.

Musi: R. Musi origin in small hills of Western ghat ranges, 240km long and joins Krishna at Wazirabad, 40km below the Nagarjuna Sagar Dam.

Palleru: Rivers Palleru, Peddavagu I, II, Hallia, are all minor tributaries.

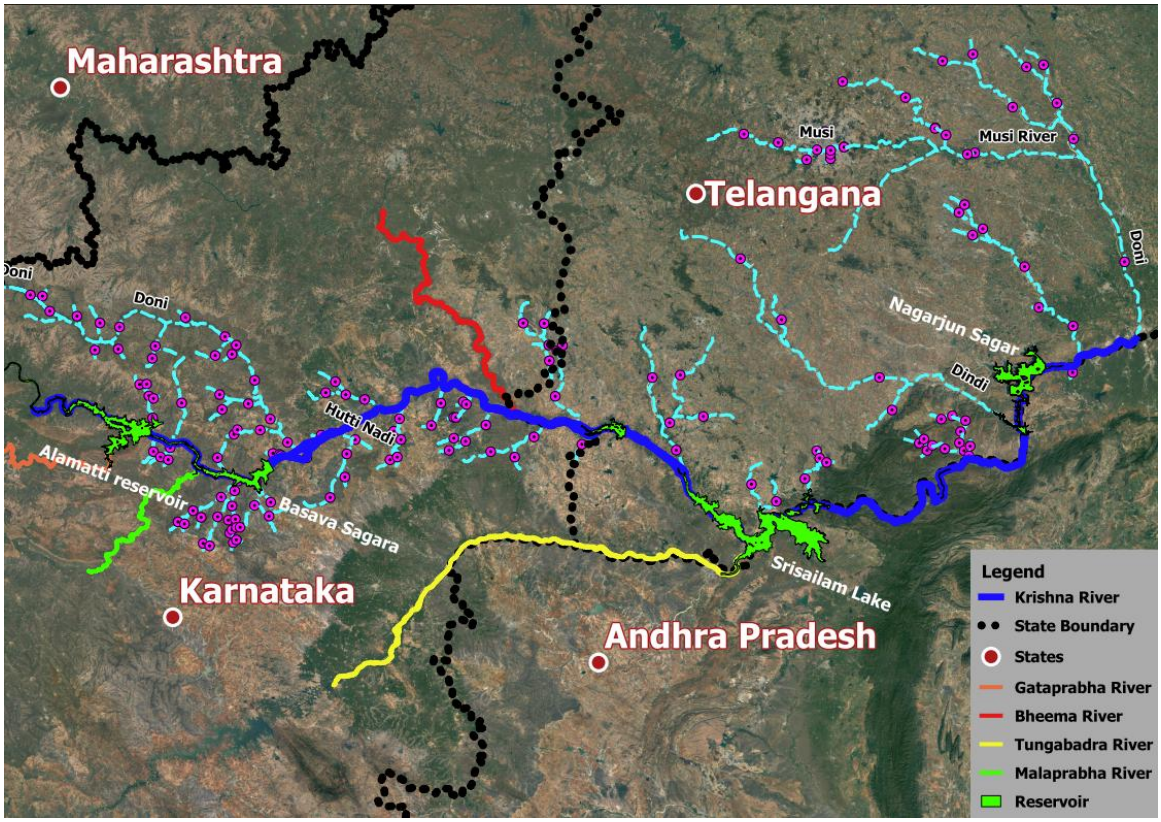


Figure 3 - Tributaries of Krishna River

1.3 State/District through which River passes

The River traverses the districts of Satara, Sangli, and Kolhapur in Maharashtra. Belgaum, Bijapur (Newly named as Vijayapur), Raichur in Karnataka. Kurnool and Guntur in Andhra Pradesh and Mahabubnagar and Nalagonda at Telengana state.

State	Chainage (km)		Length (km)
	From	To	
Telangana-Andhra Pradesh	0	247	247
Telangana	247	338.4	91.4
Telangana-Karnataka	338.4	375.7	37.3
Karnataka	375.7	636.2	260.5

Table 1 - State wise waterway

1.4 Maps

1.4.1 Full course of the waterway

The map displaying the state boundary with road and rail network for the course of water way is represented as below:-

Figure 4 - Full Course of Krishna River

1.4.2 Course of the waterway under study

The map displaying the state boundary with road and rail network for the course of water way is represented as below:

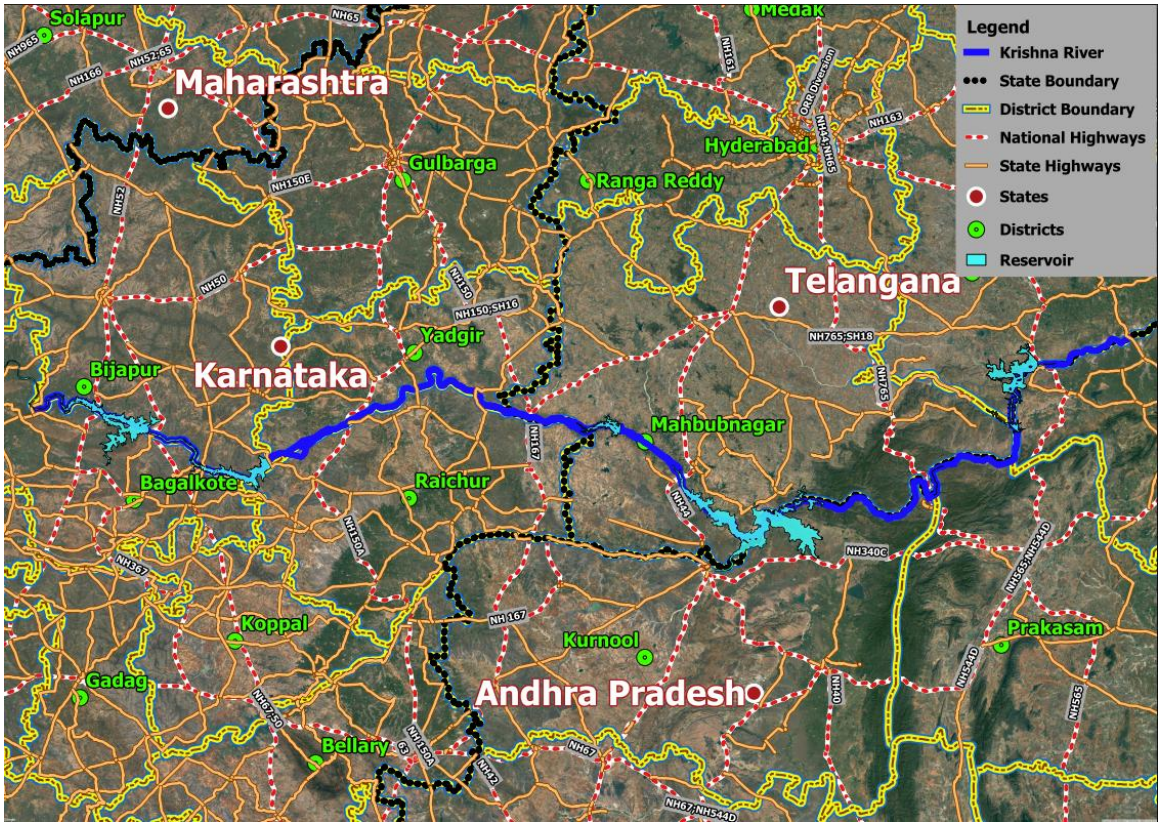


Figure 5 - Course of Krishna River

1.5 Scope of work

The major part of the work is, to conduct detailed hydrographic and topographic survey of the 636.2kms length of the river from Wazirabad Barrage at Lat 16°40'55.99"N, Long 79°39'26.82"E to Bridge near village Galagali Lat 16°25'27.87"N, Long 75°26'18.70"E.

The scope of the work for the conduct of survey of Krishna River includes:

a) Undertake bathymetric and topographic survey of proposed waterway.
b) Establishing horizontal and vertical control stations.
c) Construction of benchmark pillars and establishing its reduced level w.r.to Mean Sea Level.
d) Setting up and deployment of water level gauges.
e) Current velocity and discharge measurements.

f) Collection and analysis of water and bottom samples.
g) Collection of topographic features including existing cross structures.
h) Preparation of inventory of industries in the project influence area (PIA).
i) Analysis of survey data, including assessment of water availability for navigation.
j) Preparation of survey charts and feasibility report.

2 Methodology Adopted to undertake Study

2.1 Recce

Advance recce of the survey area was undertaken in early 15th Mar 2016 by a detach survey party. The detach survey party recovered the CWC gauge at Almatti Dam, Narayanapur Dam, Dhannur (Totally Dry), Deosugur (Totally Dry), PD Jurala dam, Huvinhedgi, Nagarjuna Sagar, and Srisailam.

The following observation has been made.

- The survey area is 636.2km, from Wazirabad Barrage to Galgali Bridge towards upstream.
- River width varied between 300 mtr to 2500 mtr.
- The work of Hydrography and Topography is also very much time consuming and not feasible due to rocks and thick vegetation growth and cliffs on both the banks, Tiger Reserve at both the banks. Presence of Dense forest in maximum region.
- Accessible to the bank for topographic survey was very hard.
- Out of 636.2km, 223Lkm is under forest region.
- Presence of crocodile at some stretches, due to muddy in nature.

It was observed that where ever a water reservoir has been there, up to 50 to 60 Lkm upstream hydrographic surveys can be conductive and the rest of the areas need to be surveyed by topographic. The summary of the same stretch has mentioned below.

The recce was started from Almatti Dam, Almatti village, Bagalkot Dist. In Karnataka till the Sangam of Ghataprabha, Krishna, Bheema and Tungabhadra River in a village near Morvakonda. The stretch was examined at eleven places (Galgali Bridge, Next to Almatti dam, Next to Narayanapur Dam, Gugal Barrage, PD Jurala barrage, Sangameshwara, Srisailam Bridge, N Sagar Dam, Tail Pond Dam of Nagarjuna Sagar, and Wazirabad/vadapalli Bridge).

From Galgali Bridge towards downstream approximately 3.5km was found dry and presence of water is in small packet. Observed water presence from after 3.5km up to Almatti dam. So the possibility of Hydrographic surveys found over this stretch.

In between Almatti and Narayanapur dam it was observed approx. 3 to 4km towards downstream from the Almatti dam Krishna River is full of rocks and thick vegetation and after that towards the Narayanpurdam Presence of water. Bathymetric survey can be conduct over this stretch.

In between Narayanapur to Gugal Barrage it was observed that almost downstream of Narayanapur dam contain Hard and stabbing rocks. And the river flow is just like a Nala like structure having and width of 1 to 2 meters. And near at Gugal Barrage towards upstream up to approx. 30km presence of water. So the maximum area needs to be surveyed by Topographic survey methods and some areas were having the possibility of Hydrographic surveys.

In between Gugal and PD Jurala Barrage, the river flow is same as like as Narayanapur to Gugal. The stretch contain full of hard rocks and found some sand dunes where the river flow is narrow towards downstream. Maximum region in this stretch is dry and found some water packets which was negligible to carry out hydrographic surveys. But towards downstream of 30 to 35km from Gugal Barrage to P.D.Jurala Barrage, found to the possibility of Hydrographic surveys.

PD Jurala to Sangameshwara it was observed that the river flow is just like Nala structure and having a width of 5 to 10 meters and though there was the presence of water in this stretch which was very negligible, so Instead of Hydrographic survey this stretch need to follow the methodology of Topographic to acquire the data.

From Sangameshwara to Srisailam dam and Srisailam dam to Nagarjuna Sagar dam The River was observed presence of water and the river flows in between Nagarjun and Srisailam Tiger reserve which is a dense forest region. As per the local people and from the fisherman instruction the only way to access the bank is waterway, and as per our recce, this stretch was not having any road network to access the river bank. It can only accessible by walking or following the waterway up to Srisailam. So this stretch found to carry out Bathymetric survey.

From Srisailam to Nagarjuna Sagar the river stretch was found same like Sangameshwara to Srisailam. So Hydrographic survey could commence in this stretch.

Towards approx. 10km downstream of Nagarjuna Sagar the river was found dry and full of hard rocks, after that found presence of water up to Nagarjuna Sagar tail pond dam, at Chhatrasala. So this stretch could commence Hydrographic survey methodology and topographic survey methodology for acquiring the data.

From Chhatrasala dam to Wazirabad it was observed that the river was maximum dry and flows Nala like structure and contain rocks and thick vegetation.

Mobilization commenced in earnest on 15th Mar 2016 and was completed on 19th Mar 2016

2.1.1 Survey Resources and Methodology

The actual survey was commenced on 20th March 2016 and was completed on 20th Sep 2016. The survey was undertaken on a scale of 1:4,00,000 for 43N zone, and 1: 2,50,000 for 44N zone with a sounding line spacing, kept at 200 m and plotted on UTM Projection at Zone 43N and 44N as directed in the contract specification.

2.1.2 Survey Launch

The survey boat used for the survey operations throughout the project was positioned by the Differential Global Positioning System (DGPS). Differential corrections were received continuously from the nearest existing DGLL beacons.

The Hemisphere DGPS Receiver was used for positioning of the depths. The position correction details were received from the nearest DGLL Beacon and position data were found to be in differential mode, and in order.

Figure 6 - IIC Survey Launch used for the survey purpose

2.1.3 Survey Equipment

Following equipment were deployed for the survey of the Krishna River**.**

Equipment	Make	Eqpt. Serial No.	Qty. Employed
DGPS Sets	Hemisphere R110	H224	1
Echosounder	Elac Hydrostar L3	308	1
Current Meter	Valeport		1
Grab Sampler	Van Veen	N/A	1
Water Sampler	Niskin	N/A	1
DGPS Sets	Trimble R3/R4	5320436971, 5147477181, 5411458719, 5049457042	4
Auto Level	Sokkia Auto level & Accessories	260242, 229490	2
ETS	Electronic Total Station	120595 & 120768	2
Software	TBC	Version 12	1
Software	AUTOCAD	2015	1
Software	Microsoft Office	2013	1
Software	HYPACK data acquisition	Version 15	1
Software	Data logger	2015	1

Table 2 - Survey Equipment used

2.1.4 Topographic Survey

The survey was commenced on 20th Jan 2016 and completed on 26th Aug 2016. The weather was sunny throughout the period during survey operations. The weather was very favorable for the conduct of surveys and the weather condition remains same for the entire duration of the survey.

The survey was undertaken as per the line plan provided and the spot level points in the cross line were spaced at 20m interval. The plotting of the chart was done on

UTM Projection at Zone 43N and 44N as directed in the contract specifications. The spot levels along the river were obtained by using Trimble DGPS. The data was post processed using Trimble Business Center to get the precise position and MSL height values of the rover locations. The topographic survey for the entire survey stretch was conducted to collect the following data:

- Spot levels
- Delineation of Islands
- Fixing of bridges and marks
- Assess the type of river bank
- Extending the vertical and horizontal control throughout the survey area
- Collection of local information along the river Banks

Figure 7 - Spot Leveling by DGPS

2.1.5 Bathymetric Survey

The survey was carried on WGS 84 Datum. The projection used was Transverse Mercator and the grid used was Universal Transverse Mercator Grid (Zone 43/Zone 44). Differential signal corrections for the DGPS system were automatically obtained from the nearest DGLL Beacon and it was throughout the survey area. HYPACK Ver. 2015 Hydrographic Survey Software developed by Coastal Oceanographically INC., USA was used for the data logging during the survey and for data processing thereafter.

ELAC Hydrostar was used to obtain soundings on-board the survey boat. A working frequency of 210 KHz was used for sounding operations. The digital output from the echo sounder was automatically fed to the HYPACK data logging software on a real-time basis for the acquisition of survey data. No breakdown of equipment was reported and the performance of the equipment was found to be satisfactory during the entire duration of the survey.

The sound velocity was set to 1500 m/s on single beam echo sounder during acquisition. The Daily bar checks were conducted prior to the sounding operation and before the closing of the sounding operation for the day. Being very shallow depths, the echo sounder depths were also cross-checked in between by using demarcated sounding poles during the conduct of the survey.

The sounding lines were run using survey boat to identify the thalweg line of the Krishna River for the possible stretch. The cross lines were run perpendicular to the orientation of river flow (i.e. Perpendicular to the orientation of depth contours) in respective stretches. To check the validity of sounding data logged, the Cross line and thalweg lines were run as perpendicular as possible.

The spot sounding was also carried out in the area where the survey boat cannot be operated due to low depth. The hemisphere DGPS and Sounding Pole were used for Spot sounding at shallow locations on the Krishna River. The DGPS position along with water depths was recorded simultaneously and the tidal reduction was applied to the obtained depths.

Figure 8 - Online Data Acquisition by IIC survey launch

The data logging during the survey was achieved by interfacing both the echo sounder and DGPS receiver to the HYPACK software on a laptop/PC carried aboard the sounding boats. The entire system was supported by battery power and backed by an onboard generator supply. The position and depth data were logged in continuously during the survey, once every 500 milliseconds. All digitally logged data were automatically stored in the assigned files. No significant difficulties were experienced in the operation of the digital surveying system during the survey. The survey was conducted in WGS-84 spheroid with no datum transformation.

2.1.6 Calibration

The equipment used for the survey was calibrated by the equipment supplier. The equipment calibration certificates are placed at Annexure-14 to this report.

2.2 Description of Benchmarks (B.M.) Reference Level

The stations from IWAI BM KRS-01 to IWAI BM KRS-63 were chosen near to the starting and end points of each stretch under study for setting up as a reference station for daily topographic survey operations.

In this 636.2 kilometer stretch, we have found Almatti GTS - 548.245 m (Details collected from the Almatti dam Authority), Narayanapur GTS (Details collected from the Narayanpur Dam Authority), PD Jurala GTS, Srisailam GTS (Details collected from the Srisailam Dam Authority), Nagarjuna Sagar GTS, and Nagarjuna Sagar Tail pond Dam GTS (Details collected from the Nagarjuna Sagar Dam Authority).

Sl. No.	**Station**	**Latitude**	**Longitude**	**Chainage**
01	Almatti	N16°19'38.04132"	E75°53'05.16323"	573.417km
The Details of Almatti:-				
(a)	Zero of Tide Gauge	489.06 m	Source:- Almatti dam Authority	
(b)	Value of Almatti	548.245 m		
(c)	Highest Flood Level	519.600 m (Oct-2014)		
(d)	Minimum Water Level observed so far	489.307 m (June-1990)		

Table 3 - Reference Level Value of Almatti

All the IWAI BMs Starting from KRS-01 to KRS-63 are connected and cross verified with the GTSs as per the stretch distributions. The data logged by Rover GPS systems were post processed to get the position and elevation data.

The Reference station and the nearest IWAI benchmarks mentioned below.

Sl. No.	**Station**	**Chainage (km)**	**Latitude**	**Longitude**	**Ht. Above MSL (m)**	**Source/ Type**	**Refeered Station**
1	ALMATTI	573.417	N16°19'38.04132"	E75°53'05.16323"	548.245	Online Processing	IWAI-BM-KRS-07
2	NARAYANPUR	510.321	N16°13'33.21"	E76°20'36.44"	496.357	Online processing	IWAI-BM-KRS-14
3	HUVINAHEDGI	433.550	N16°29'25.000"	E76°55'12.00"	356.26	-	IWAI-BM-KRS-21
4	PD JURALA	325.560	N16°19'58.21"	E77°42'10.00”	326.00	-	IWAI-BM-KRS31
5	IWAI-BM-TNG-01	245.118	N15°57'48.96046"	E78°17'01.99180"	283.554	Online Processing	IWAI-BM-KRS-36
6	IWAI-TBM-PTG	144.889	N16°04'47.0475	E78°52'52.31985"	274.59	Baseline	IWAI-BM-

Sl. No.	Station	Chainage (km)	Latitude	Longitude	Ht. Above MSL (m)	Source/ Type	Refeered Station
			7"		5	Processing	KRS-48
7	SRISAILAM	144.934	N16°04'25.26615"	E78°52'22.32181"	415.207	Online Processing	IWAI-BM-KRS-48
8	N SAGAR TAIL POND	21.899	N16°37'47.10243"	E79°29'14.10964"	80.442	Online Processing	IWAI-BM-KRS-60
9	PONDUGULA	-0.375	N16°41'04.00"	E79°39'32.00"	59.000	-	IWAI-BM-KRS-63

Table 4 - Referred station and the respective Benchmarks

The station was used as cross verification of MSL value of the initial reference. The vertical control and the Reference Level value of the same were transferred through Auto Level. The leveling data for establishing the reference Level for the newly constructed Benchmark pillars are placed at Annexure –10 to this report. The final accepted WGS 84 coordinates IWAI Benchmark established during the conduct of the survey are as follows:

Sl. No.	Station	Chainage (km)	Latitude	Longitude	Ht. Above MSL (m)	Source/ Type	UTM Zone
1	IWAI-BM-KRS-01	636.151	N16°25'19.0843"	E75°26'14.84271"	527.207	Baseline Processing	43N
2	IWAI-BM-KRS-02	627.023	N16°26'35.42580"	E75°30'05.07260"	517.006	Baseline Processing	43N
3	IWAI-BM-KRS-03	616.064	N16°25'36.38423"	E75°33'04.88898"	515.34	Baseline Processing	43N
4	IWAI-BM-KRS-04	604.741	N16°26'26.17049"	E75°37'50.20622"	514.593	Baseline Processing	43N
5	IWAI-BM-KRS-05	594.537	N16°23'29.38076"	E75°42'11.24742"	514.699	Baseline Processing	43N
6	IWAI-BM-KRS-06	585.131	N16°20'26.17987"	E75°46'50.44634"	512.898	Baseline Processing	43N
7	IWAI-BM-KRS-07	574.699	N16°19'58.33848"	E75°52'11.64658"	513.033	Baseline Processing	43N
8	IWAI-BM-KRS-08	565.692	N16°17'53.46158"	E75°56'51.44369"	495.374	Baseline Processing	43N
9	IWAI-BM-KRS-09	555.204	N16°16'51.33632"	E76°02'12.44172"	492.866	Baseline Processing	43N
10	IWAI-BM-KRS-10	545.377	N16°12'26.66473"	E76°03'50.09014"	494.085	Baseline Processing	43N
11	IWAI-BM-KRS-11	535.652	N16°10'34.04073"	E76°09'07.87553"	498.294	Baseline Processing	43N
12	IWAI-BM-KRS-12	524.694	N16°09'13.32199"	E76°14'47.58716"	493.105	Baseline Processing	43N
13	IWAI-BM-KRS-13	516.079	N16°10'16.89552"	E76°19'09.73424"	491.508	Baseline Processing	43N

Sl. No.	Station	Chainage (km)	Latitude	Longitude	Ht. Above MSL (m)	Source/ Type	UTM Zone
14	IWAI-BM-KRS-14	505.509	N16°14'54.39434"	E76°22'56.10897"	463.149	Baseline Processing	43N
15	IWAI-BM-KRS-15	494.508	N16°14'35.35322"	E76°28'47.72058"	408.738	Baseline Processing	43N
16	IWAI-BM-KRS-16	485.490	N16°17'53.87336"	E76°31'46.39741"	406.536	Baseline Processing	43N
17	IWAI-BM-KRS-17	475.314	N16°20'19.34108"	E76°36'38.66101"	371.267	Baseline Processing	43N
18	IWAI-BM-KRS-18	465.623	N16°22'49.90991"	E76°41'26.07980"	358.46	Baseline Processing	43N
19	IWAI-BM-KRS-19	454.739	N16°25'16.80268"	E76°46'17.96536"	358.206	Baseline Processing	43N
20	IWAI-BM-KRS-20	443.619	N16°27'02.87601"	E76°51'53.63032"	354.734	Baseline Processing	43N
21	IWAI-BM-KRS-21	433.522	N16°29'34.85709"	E76°55'07.69115"	353.089	Baseline Processing	43N
22	IWAI-BM-KRS-22	423.436	N16°32'34.58924"	E76°58'09.85209"	351.665	Baseline Processing	43N
23	IWAI-BM-KRS-23	414.384	N16°31'33.32094"	E77°00'04.64076"	353.46	Baseline Processing	43N
24	IWAI-BM-KRS-24	404.781	N16°30'37.52570"	E77°03'49.29895"	347.489	Baseline Processing	43N
25	IWAI-BM-KRS-25	394.908	N16°28'29.38166"	E77°08'46.29547"	345.558	Baseline Processing	43N
326	IWAI-BM-KRS-26	386.051	N16°25'27.70395"	E77°11'49.52870"	336.622	Baseline Processing	43N
27	IWAI-BM-BHM-15	375.867	N16°24'42.34525"	E77°16'52.94429"	343.563	Baseline Processing	43N
28	IWAI-BM-KRS-27	366.746	N16°22'48.05644"	E77°21'46.56773"	335.244	Baseline Processing	43N
29	IWAI-BM-KRS-28	358.351	N16°21'49.94920"	E77°26'40.35049"	336.193	Baseline Processing	43N
30	IWAI-BM-KRS-29	347.095	N16°20'52.51438"	E77°31'36.16586"	325.671	Baseline Processing	43N
31	IWAI-BM-KRS-30	335.974	N16°20'26.70882"	E77°36'52.69957"	319.356	Baseline Processing	43N
32	IWAI-BM-KRS-31	326.067	N16°19'26.10149"	E77°41'46.81121"	319.033	Baseline Processing	43N
33	IWAI-BM-KRS-32	314.337	N16°17'19.34873"	E77°47'38.36023"	296.131	Baseline Processing	43N
34	IWAI-BM-KRS-33	304.436	N16°14'11.65604"	E77°52'06.75814"	279.533	Baseline Processing	43N
35	IWAI-BM-KRS-34	292.937	N16°09'54.20787"	E77°56'20.55791"	270.614	Baseline Processing	43N
36	IWAI-BM-KRS-35	281.593	N16°04'23.97186"	E77°59'08.81095"	272.793	Baseline Processing	43N
37	IWAI-BM-KRS-36	272.317	N16°01'28.48969"	E78°03'08.02526"	266.099	Baseline Processing	44N
38	IWAI-BM-	262.876	N15°59'36.18464"	E78°08'00.23373"	260.273	Baseline	44N

Sl. No.	Station	Chainage (km)	Latitude	Longitude	Ht. Above MSL (m)	Source/ Type	UTM Zone
	KRS-37					Processing	
39	IWAI-BM-KRS-38	251.421	N15°53'46.75739"	E78°12'56.58664"	283.092	Baseline Processing	44N
40	IWAI-BM-KRS-39	240.999	N16°00'43.57080"	E78°15'40.31295"	259.01	Baseline Processing	44N
41	IWAI-BM-KRS-40	231.325	N16°01'20.45824"	E78°19'49.50502"	259.964	Baseline Processing	44N
42	IWAI-BM-KRS-41	219.637	N16°04'36.91072"	E78°24'15.99977"	252.329	Baseline Processing	44N
43	IWAI-BM-KRS-42	209.065	N16°03'29.93276"	E78°30'02.24178"	256.339	Baseline Processing	44N
44	IWAI-BM-KRS-43	198.975	N16°03'42.04537"	E78°35'13.68727"	254.036	Baseline Processing	44N
45	IWAI-BM-KRS-44	186.561	N16°02'52.88668"	E78°40'02.83856"	259.821	Baseline Processing	44N
46	IWAI-BM-KRS-45	177.512	N16°00'21.82604"	E78°44'22.32896"	259.779	Baseline Processing	44N
47	IWAI-BM-KRS-46	167.238	N16°03'03.64026"	E78°49'05.20916"	254.818	Baseline Processing	44N
48	IWAI-BM-KRS-47	157.804	N16°07'42.98693"	E78°50'22.40371"	257.266	Baseline Processing	44N
49	IWAI-BM-KRS-48	147.516	N16°06'35.48205"	E78°53'07.49154"	269.099	Baseline Processing	44N
50	IWAI-BM-KRS-49	137.394	N16°07'55.14177"	E78°55'33.98633"	179.676	Baseline Processing	44N
51	IWAI-BM-KRS-50	126.344	N16°12'05.32070"	E78°56'39.55992"	165.294	Baseline Processing	44N
52	IWAI-BM-KRS-51	117.131	N16°14'23.65162"	E79°00'49.38565"	167.719	Baseline Processing	44N
53	IWAI-BM-KRS-52	105.565	N16°13'52.99912"	E79°06'41.20201"	166.646	Baseline Processing	44N
54	IWAI-BM-KRS-53	96.021	N16°12'49.31577"	E79°11'33.84060"	167.482	Baseline Processing	44N
55	IWAI-BM-KRS-54	87.700	N16°16'26.64448"	E79°13'24.66898"	164.723	Baseline Processing	44N
56	IWAI-BM-KRS-55	75.752	N16°22'18.17638"	E79°12'58.11307"	163.809	Baseline Processing	44N
57	IWAI-BM-KRS-56	66.308	N16°27'32.09837"	E79°12'45.32396"	166.196	Baseline Processing	44N
58	IWAI-BM-KRS-57	53.675	N16°32'00.45208"	E79°15'29.23182"	244.617	Baseline Processing	44N
59	IWAI-BM-KRS-58	43.555	N16°34'13.02532"	E79°19'11.53255"	94.246	Baseline Processing	44N
60	IWAI-BM-KRS-59	32.499	N16°34'11.72028"	E79°25'04.52092"	86.411	Baseline Processing	44N
61	IWAI-BM-KRS-60	22.464	N16°37'36.60886"	E79°29'02.36476"	70.956	Baseline Processing	44N
62	IWAI-BM-KRS-61	12.929	N16°38'34.93449"	E79°34'00.54348"	61.82	Baseline Processing	44N

Sl. No.	Station	Chainage (km)	Latitude	Longitude	Ht. Above MSL (m)	Source/ Type	UTM Zone
63	IWAI-BM-KRS-62	3.773	N16°39'23.37764"	E79°38'04.58778"	74.447	Baseline Processing	44N
64	IWAI-BM-KRS-63	0.031	N16°40'51.85216"	E79°39'35.97237"	63.519	Baseline Processing	44N

Table 5 - Accepted Benchmark Coordinates in WGS 84

Almatti GTS

Narayanapur GTS

Srisailam GTS

Chhatrasala GTS

Figure 9 - Referred Stations

The details of horizontal and vertical control established and methodology Followed for the conduct of the survey are placed at Annexure –8.

2.3 Tidal Influence Zone and tidal variation

Krishna River is non-tidal river and the survey stretch start from the Wazirabad Barrage to Galgali Bridge. The water level in the river is found to be stable throughout the survey period. This stability in the water level is observed due to the controlled charging of the river. The primary source of water receiving from this stretch is from Almatti Dam, Narayanapur Dam, PD Jurala Barrage, Srisailam Dam and Nagarjuna Sagar Dam.

2.3.1 Methodology to fix Chart Datum / Sounding Datum

All Spot Levels (on ground at banks, rocks, sandchur etc.) are with reference to GTS benchmark situated in between the stretches provided by the local Deputed Authorities. Details are provided at Table No.3 at para i.e. 2.2.

The water level was then connected to MSL for further correlating with the CD values, provided by IWAI.

As instructed by IWAI, datum value in the non tidal region was fixed as average lowest water level for a period of the six years data obtained from CWC upon this stretch from Galgali to Wazirabad bridge.

The datum value for in between benchmarks are derived by interpolation method.

2.3.2 Sounding Datum

The survey stretch of Krishna River is computed in three ways. In dry condition, the least MSL value is computed as CD as per km stretch. The established CD values of the CWC gauges and Ponding limit values which are within the survey stretch and water levels in the barrages were also taken for the computation of SD/CD value.

2.4 Average of 06 years minimum Water Levels used

Krishna River is non-tidal water body having the primary source of water receiving from various Dams present at the stretches. Detailed attempt for obtaining the HFL and LFL of Krishna River was carried out and co-relate to the nearest CWC gauge data present at Krishna River, which was being obtained from CWC. There are CWC Almatti, Narayanpur, PD Jurala, Srisailam, NagarjunSagar, and Pondugula water level data of Krishna River for the average of last 6 years.

Almatti CWC Gauge 2010 - 2015						
Min/Max	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Jan min	517.230	516.590	512.190	510.460	512.890	513.250
Jan max	518.610	518.440	514.840	514.680	515.920	515.270
Feb min	514.800	514.110	509.870	508.560	509.530	511.220
Feb max	517.220	516.510	512.060	510.340	512.810	513.130
Mar min	512.390	511.630	508.170	507.780	508.350	508.480
Mar max	514.760	514.020	509.650	508.550	509.480	511.190
Apr min	511.850	509.610	507.060	507.180	507.740	507.860
Apr max	512.370	511.620	508.140	507.760	508.330	508.370
May min	510.980	**509.210**	506.420	506.670	507.420	**507.180**
May max	511.810	509.600	507.020	507.150	507.720	507.850
Jun min	**510.880**	509.260	**505.960**	**506.580**	**507.300**	
Jun max	514.040	515.020	506.400	512.240	507.410	
Jul min	514.080	515.450	506.120	512.640	507.310	
Jul max	518.960	519.060	515.230	518.490	518.800	
Aug min	518.600	518.550	515.750	517.450	518.180	
Aug max	519.600	519.570	519.510	519.600	519.600	
Sep min	519.340	518.410	519.380	519.360	519.590	
Sep max	519.600	519.600	519.600	519.600	519.600	
Oct min	519.600	519.000	519.040	519.170	518.700	
Oct max	519.600	519.500	519.600	519.600	519.600	
Nov min	519.590	516.990	517.120	518.010	517.270	
Nov max	519.600	518.920	518.990	519.170	518.720	
Dec min	518.480	514.920	514.790	516.010	515.370	
Dec max	519.600	516.960	517.080	517.950	517.270	
Yearly Min.	**510.880**	**509.210**	**505.960**	**506.580**	**507.300**	**507.180**
Yearly Max.	**519.600**	**519.600**	**519.600**	**519.600**	**519.600**	**515.270**
6yr. Min	**505.960**					
6 yr. Max	**519.600**					
6yr. Ave Min	**507.852**					
6yr. Ave Max	**518.878**					
Value of Chart Datum (CD) adopted	**507.852**					

Table 6 - Almatti CWC Gauge 2010 – 2015

Narayanpur Dam 2009 - 2014

Min/Max	2009	2010	2011	2012	2013	2014
Jan min	491.700	491.780	489.980	491.020	490.600	491.320
Jan max	491.900	491.970	491.360	491.720	491.540	491.700
Feb min	490.480	491.430	490.510	487.660	488.120	490.080
Feb max	491.710	491.990	491.330	491.100	490.500	491.560
Mar min	487.160	489.550	487.320	486.900	487.480	487.520
Mar max	490.430	491.900	490.970	487.780	488.120	490.080
Apr min	485.110	487.000	**486.120**	486.730	487.160	**487.260**
Apr max	487.120	489.800	488.320	487.110	487.470	487.520
May min	**484.610**	**486.990**	486.440	486.400	**486.970**	487.310
May max	485.070	487.620	487.020	486.960	487.170	487.980
Jun min	484.920	487.640	486.740	486.050	487.000	488.000
Jun max	485.180	487.900	487.650	486.380	487.600	488.280
Jul min	487.350	488.000	487.400	**485.660**	487.510	487.860
Jul max	491.700	490.420	490.800	487.370	491.800	491.170
Aug min	491.480	489.370	490.270	487.400	491.240	490.900
Aug max	492.060	491.590	490.840	492.020	492.250	492.250
Sep min	491.850	491.060	488.810	491.490	491.560	491.490
Sep max	492.190	491.740	491.550	492.180	492.250	492.100
Oct min	489.680	491.510	490.820	491.700	491.580	491.140
Oct max	492.060	491.950	492.180	492.180	492.250	492.070
Nov min	491.490	490.980	491.510	491.710	491.330	490.330
Nov max	492.140	492.220	491.840	491.850	491.830	491.860
Dec min	491.690	491.340	491.540	490.920	490.800	490.940
Dec max	492.230	491.650	491.800	491.600	491.830	491.910
Yearly Min.	**484.610**	**486.990**	**486.120**	**485.660**	**486.970**	**487.260**
Yearly Max.	**492.230**	**492.220**	**492.180**	**492.180**	**492.250**	**492.250**
6yr. Min	**484.610**					
6 yr. Max	**492.250**					
6yr. Ave Min	**486.268**					
6yr. Ave Max	**492.218**					
Value of Chart Datum (CD) adopted	**486.268**					

Table 7 - Narayanpur Dam 2009 – 2014

P D Jurala 2010 - 2015

P D Jurala 2010 - 2015						
Min/Max	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Jan min	317.950	317.500	318.300	318.300	317.950	317.800
Jan max	318.250	318.050	318.500	318.500	318.500	318.500
Feb min	317.950	317.850	318.350	317.950	318.000	317.200
Feb max	318.300	318.500	318.500	318.300	318.300	317.950
Mar min	318.150	317.300	316.600	315.000	317.850	316.600
Mar max	318.300	318.000	318.450	317.850	318.500	317.550
Apr min	317.450	316.450	313.800	313.350	315.300	**315.350**
Apr max	318.150	317.250	316.450	314.900	317.750	316.550
May min	317.000	315.100	313.400	**313.000**	315.150	315.350
May max	317.400	316.450	314.050	313.300	315.400	315.500
Jun min	316.850	311.650	**313.100**	313.050	**315.100**	
Jun max	318.200	315.900	313.400	314.100	315.350	
Jul min	**315.700**	**311.600**	313.300	313.950	315.200	
Jul max	318.150	317.200	314.450	317.700	317.700	
Aug min	316.350	316.500	314.500	317.350	317.150	
Aug max	317.800	317.900	318.450	318.450	318.600	
Sep min	317.600	317.400	318.000	318.000	317.900	
Sep max	318.000	317.900	318.450	318.450	318.400	
Oct min	317.800	317.800	318.350	318.000	318.100	
Oct max	318.100	318.350	318.500	318.500	318.450	
Nov min	317.550	318.000	318.400	318.200	318.150	
Nov max	318.100	318.450	318.500	318.500	318.450	
Dec min	317.500	318.100	318.400	318.300	318.150	
Dec max	318.100	318.400	318.450	318.500	318.500	
Yearly Min.	**315.700**	**311.600**	**313.100**	**313.000**	**315.100**	**315.350**
Yearly Max.	**318.300**	**318.500**	**318.500**	**318.500**	**318.600**	**318.500**
6yr. Min	**311.600**					
6 yr. Max	**318.600**					
6yr. Ave Min	**313.975**					
6yr. Ave Max	**318.483**					
Value of Chart Datum (CD) adopted	**313.975**					

Table 8 - P D Jurala 2010 – 2015

Srisailam 2010 - 2015						
Min/Max	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Jan min	266.275	266.900	259.175	262.275	267.375	256.675
Jan max	268.175	268.725	261.875	263.300	268.625	258.475
Feb min	261.650	264.450	252.850	261.175	264.575	254.175
Feb max	266.275	266.825	259.050	262.225	267.300	256.600
Mar min	253.375	256.025	246.450	258.075	259.575	245.975
Mar max	261.525	264.450	252.550	261.150	264.425	254.200
Apr min	247.250	246.950	244.925	252.350	253.925	245.275
Apr max	253.200	255.425	246.300	257.850	259.325	246.075
May min	243.825	246.600	243.900	248.000	253.925	**243.825**
May max	247.225	248.000	244.900	252.150	254.750	245.550
Jun min	**243.800**	245.225	243.500	247.225	254.200	
Jun max	246.275	248.050	243.900	248.700	254.650	
Jul min	246.600	**244.450**	**242.125**	**245.575**	**253.450**	
Jul max	256.725	262.875	243.675	268.950	254.325	
Aug min	260.500	263.225	242.200	268.400	254.600	
Aug max	269.725	268.800	255.675	269.750	269.400	
Sep min	269.550	267.900	255.750	268.600	267.925	
Sep max	269.750	269.650	265.500	269.750	269.750	
Oct min	269.300	264.400	263.000	268.600	261.025	
Oct max	269.750	267.700	264.625	269.750	267.600	
Nov min	269.550	263.325	263.150	269.100	260.500	
Nov max	269.725	264.600	264.050	269.750	261.550	
Dec min	268.800	261.900	263.200	268.600	258.300	
Dec max	269.750	263.325	263.325	269.075	260.500	
Yearly Min.	**243.800**	**244.450**	**242.125**	**245.575**	**253.450**	**243.825**
Yearly Max.	**269.750**	**269.650**	**265.500**	**269.750**	**269.750**	**258.475**
6yr. Min	**242.125**					
6 yr. Max	**269.750**					
6yr. Ave Min	**245.538**					
6yr. Ave Max	**267.146**					
Value of Chart Datum (CD) adopted	**245.538**					

Table 9 - Srisailam 2010 – 2015

Nagarjuna Sagar Dam 2009 - 2014						
Min/Max	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Jan min	159.656	162.184	173.919	157.551	**155.661**	164.318
Jan max	164.228	166.604	178.186	159.228	157.643	170.383
Feb min	158.346	160.081	170.109	156.972	155.692	160.965
Feb max	159.656	161.940	173.797	157.765	155.875	164.226
Mar min	157.401	157.856	169.621	156.058	155.692	157.216
Mar max	160.022	159.929	170.353	157.063	157.551	160.873
Apr min	153.621	**156.850**	168.615	156.058	157.643	157.399
Apr max	157.462	157.612	170.536	156.058	158.466	158.374
May min	153.560	157.612	168.463	155.997	158.161	157.734
May max	153.834	158.679	168.920	156.058	158.618	157.886
Jun min	153.772	158.709	168.890	155.692	158.313	157.155
Jun max	154.838	158.953	170.017	155.997	158.618	157.917
Jul min	**153.040**	158.557	168.250	155.448	158.466	**155.600**
Jul max	155.357	158.770	169.896	155.814	161.117	157.063
Aug min	153.162	158.557	167.823	**155.326**	164.592	156.027
Aug max	155.021	175.687	171.084	155.814	179.832	168.006
Sep min	153.619	176.113	171.541	155.357	178.582	168.493
Sep max	163.434	178.735	179.222	161.056	179.832	179.832
Oct min	165.445	178.613	172.639	161.148	178.369	178.125
Oct max	179.466	179.741	178.704	162.855	179.832	179.741
Nov min	170.810	179.192	164.470	161.331	175.412	172.273
Nov max	175.291	179.832	172.273	163.007	179.771	178.217
Dec min	166.756	178.247	**159.380**	157.795	170.444	168.219
Dec max	170.719	179.131	164.348	161.239	175.504	171.999
Yearly Min.	**153.040**	**156.850**	**159.380**	**155.326**	**155.661**	**155.600**
Yearly Max.	**179.466**	**179.832**	**179.222**	**163.007**	**179.832**	**179.832**
6yr. Min	**153.040**					
6 yr. Max	**179.832**					
6yr. Ave Min	**155.976**					
6yr. Ave Max	**176.865**					
Value of Chart Datum (CD) adopted	**155.976**					

Table 10 - Nagarjuna Sagar Dam 2009 – 2014

Pondugula 2001 - 2006						
Min/Max	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Jan min	43.484	43.354	42.854	42.964	43.144	43.044
Jan max	44.034	44.034	43.454	43.504	43.454	43.534
Feb min	43.634	43.384	43.034	43.014	43.084	43.204
Feb max	44.444	43.734	43.434	43.374	43.534	43.534
Mar min	43.509	43.484	42.834	43.054	42.934	43.164
Mar max	45.334	45.134	43.274	43.354	43.224	43.534
Apr min	43.234	43.354	**42.784**	42.854	42.864	42.994
Apr max	44.634	44.934	43.454	43.314	43.204	43.604
May min	43.234	43.134	42.894	42.834	42.844	42.824
May max	44.234	43.624	43.434	43.104	43.264	43.014
Jun min	43.364	**43.034**	42.834	**42.754**	**42.844**	42.884
Jun max	44.134	43.754	43.364	43.004	43.194	43.354
Jul min	43.304	43.564	42.814	42.764	42.874	43.044
Jul max	44.384	44.654	43.114	43.184	43.614	44.354
Aug min	43.494	43.394	42.864	42.794	43.384	**42.374**
Aug max	45.294	44.784	43.634	44.634	56.834	56.534
Sep min	43.664	43.534	42.964	43.334	44.684	43.334
Sep max	48.134	45.084	43.804	44.314	51.934	49.784
Oct min	**43.134**	43.134	42.934	43.164	43.334	43.284
Oct max	46.494	45.284	43.914	45.234	53.084	47.014
Nov min	43.294	43.284	43.054	43.434	43.174	43.174
Nov max	44.614	45.114	43.734	43.714	48.084	43.354
Dec min	43.334	43.054	42.964	43.374	43.044	43.024
Dec max	43.804	43.734	43.684	43.634	43.534	43.394
Yearly Min.	43.134	43.034	42.784	42.754	42.844	42.374
Yearly Max.	48.134	45.284	43.914	45.234	56.834	56.534
6yr. Min	**42.374**					
6 yr. Max	**56.834**					
6yr. Ave Min	**42.821**					
6yr. Ave Max	**49.322**					
Value of Chart Datum (CD) adopted	**42.821**					

Table 11 - Pondugula 2001 - 2006

2.5 Transfer of Sounding Datum

The chart datum for the Almatti GTS at 573.417km chainage of Krishna River is accepted as 515.475 m above MSL. During on field observation, the water level in Krishna River is found to be same for the duration of the survey. The water level detail on the Krishna River was discussed with the Almatti Dam Authority. The water level on the survey stretch is confirmed to be the same due to the controlled charging of the Krishna River from Almatti Dam.

The difference between the MSL value of water level and the Chart Datum at 573.417km Chainage is computed as -0.075 m. The ponding limit of Nagarjana Sagar Tail Pond Dam is carried out for apporx, about 30km as datum. As per the survey it is observed that upstream of Dams contains water whereas the downstream are dried. In these condition the least MSL values perkm is considered as the computed CD. On availability of water at different stretches manual tide pole were deployed at different stretches and CD were established.

2.6 Table indicating tidal variation at different observation points

The survey stretch of the Krishna River is non-tidal in nature and no variation is observed during the conduct of the survey.

The manual Tide pole was being erected at every 10km chainage at each IWAI benchmarks, on availability of water to calculate the rise and fall of water level for processing the bathymetric data as well as for slope calculation. Also was levelled to the nearest GTS.

Figure 10 - Manual Tide Pole

Sl. No.	Tide Gauge	Location	Latitude (N) Longitude (E)	Easting Northing	Chainage (km)	Zero of TP w.r.t CD	UTM Zone
1	KRS-02	Badgi	N16°26'30.8" E75°29'52.3"	553148.862 1817881.033	627.057	-0.235	43N
2	KRS-03	Hanchinal	N16°25'36.4" E75°33'04.6"	558856.018 1816224.17	616.068	-0.406	43N
3	KRS-04	Dhawaleshwar	N16°26'34.3" E75°37'49.8"	567308.744 1818028.051	604.801	-1.361	43N
4	KRS-05	Rolli	N16°23'37.9" E75°42'34.4"	575767.603 1812635.318	594.335	-1.461	43N
5	KRS-06	Beerkabi	N16°20'39.5" E75°46'57.7"	583599.003 1807181.844	585.075	0.436	43N
6	KRS-07	Alur	N16°19'56.2" E75°52'21.2"	593203.298 1805890.245	574.48	0.075	43N
7	KRS-08	Nagral	N16°17'56.40" E75°56'54.00"	613812.215 1792232.47	565.71	-2.257	43N
8	KRS-09	Chick Myageri	N16°16'53.0" E76°02'12.2"	610769.1 1800342.432	555.242	0.134	43N
9	KRS-10	Kudala Sangama	N16°12'28.6" E76°03'53.3"	601315.333 1802244.881	545.319	-0.856	43N
10	KRS-11	Havargi	N16°10'52.2" E76°09'02.6"	623013.063 1789319.47	535.707	0.010	43N
11	KRS-12	Ankanhal	N16°09'33.3" E76°14'56.7"	633544.024 1786956.025	524.643	0.082	43N
12	KRS-13	Kamaldinni	N16°10'30.7" E76°19'14.3"	641184.085 1788767.898	515.77	-0.026	43N
14	KRS-23	Karkihalli	N16°31'34.6" E77°0'22.0"	714103.073 1828217.241	414.515	0.485	43N
15	KRS-24	Kurkihalli	N16°30'38.4" E77°3'50.0"	720289.355 1826551.745	404.785	0.781	43N
16	KRS-25	Googal	N16°28'29.9" E77°8'45.8"	729104.85 1822692.547	394.93	0.921	43N
17	KRS-30	Nagardoddi	N16°20'36.1" E77°36'45.2"	779121.038 1808708.256	336.062	0.777	43N
18	KRS-31	Jurala	N16°19'33.8" E77°41'47.9"	788135.278 1806909.43	326.083	-0.285	43N
19	KRS-40	Sangameshwaram	N16°01'18.2" E78°19'42.7"	214117.484 1773178.623	231.403	1.608	44N
20	KRS-41	Bollaram	N16°04'36.5" E78°24'15.5"	222307.938 1779173.987	219.637	1.653	44N
21	KRS-42	NM-01	N16°03'30.0" E78°30'01.8"	232579.96 1777002.151	209.078	1.952	44N
22	KRS-43	NM-02	N16°03'42.2" E78°35'15.3"	241906.108 1777266.699	198.935	1.371	44N
23	KRS-44	NM-03	N16°02'53.4" E78°40'04.7"	250493.784 1775667.568	186.543	1.803	44N
24	KRS-45	NM-04	N16°00'22.4" E78°44'23.3"	258132.175 1770939.585	177.475	0.642	44N
25	KRS-46	NM-05	N16°03'03.4" E78°49'06.0"	266591.185 1775799.679	167.226	0.312	44N
26	KRS-47	NM-06	N16°07'42.1" E78°50'21.3"	278215.974 1784650.391	157.825	-0.778	44N
27	KRS-48	Domalapenta	N16°06'34.3" E78°53'06.3"	273801.666 1782209.555	147.496	0.314	44N
29	KRS-49	NM-07	N16° 8'43.24" E78°55'7.24"	277436.40 1786137.74	135.739	1.423	44N

Sl. No.	Tide Gauge	Location	Latitude (N) Longitude (E)	Easting Northing	Chainage (km)	Zero of TP w.r.t CD	UTM Zone
30	KRS-49-NM01	NM01-A	N16°07'55.141" E78°55'33.986"	278215.974 1784650.391	133.395	1.543	44N
31	KRS-49-NM02	NM02-B	N16°11'22.22" E78°54'53.42"	277074.98 1791028.97	129.853	1.463	44N
31	KRS-49-NM03	NM03-C	N16°11'45.02" E78°55'34.10"	278290.60 1791717.69	128.464	1.463	44N
33	KRS-50	NM-08	N16°12'06.1" E78°56'39.6"	280242.905 1792346.203	126.338	1.453	44N
34	KRS-51	NM-09	N16°14'24.2" E79°00'49.4"	287704.492 1796518.689	117.127	0.753	44N
35	KRS-52	Alatam	N16°13'52.2" E79°06'40.6"	298125.557 1795436.298	105.591	1.373	44N
36	KRS-53	Alatam	N16°12'51.3" E79°11'32.5"	306778.071 1793486.051	96.044	1.213	44N
37	KRS-54	Hanumapuram	N16°16'25.4" E79°13'26.2"	310212.085 1800037.873	87.712	1.603	44N
38	KRS-55	Pullareddygudem	N16°22'18.8" E79°12'57.4"	309452.077 1810908.762	75.671	1.753	44N
39	KRS-56	Rekula Valyam	N16°27'31.9" E79°12'47.6"	309246.097 1820536.034	66.251	1.463	44N
40	KRS-57	Chintala Thanda	N16°31'56.9" E79°15'21.8"	313890.557 1828642.108	53.758	1.754	44N
41	KRS-59	Ekanam Pet Village	N16°34'45.8" E79°25'08.6"	331330.261 1833690.012	32.299	-0.205	44N
42	KRS-60	Satrasala	N16°37'35.0" E79°29'04.2"	338353.196 1838836.858	22.447	12.751	44N
43	KRS-61	Gottimukkala	N16°38'40.1" E79°33'54.8"	346979.124 1840774.331	13.025	0.301	44N
45	KRS-62	Pulipadu Temple	N16°39'27.1" E79°38'01.9"	354310.618 1842167.628	3.777	0.971	44N
46	KRS-63	Pondugula	N16°40'55.0" E79°39'32.1"	357001.179 1844851.156	0	0.180	44N

Table 12 - Details of Tide Pole Locations

2.7 Salient Features of Dam, Barrages etc.

The details of Dams, Barrages were collected during the conduct of surveys and the details are as follows:

2.7.1 Salient Features of Nagarjuna Sagar Tail Pond Dam

Salient Features of Nagarjuna Sagar Tail Pond Dam				
Attribute	**Value**		**Attribute**	**Value**
Name of the Dam	Nagarjuna Sagar Dam		Dam Status	Completed
River	Krishna		Purpose	Irrigation/Hydroelectric
Nearest City	Macherla		Completion Year	2006
District	Nalagonda/Guntur		Operating and Maintenance Agency	APGENCO
Basin Name	Krishna		Seismic Zone	Seismic Zone-II
Dam Type	Concrete		Max Height above Foundation (m)	30

Salient Features of Nagarjuna Sagar Tail Pond Dam				
Attribute	**Value**		**Attribute**	**Value**
Length of Dam (m)	460.75		Total Volume content of Dam (TCM)	200.48
Type of Spillway	OG		Type of Spillway Gates	RD
Length of Spillway (m)	470.92		Number of Spillway Gates	20
Crest Level of Spillway	59.20		Size of Spillway Gates (m x m)	18.50 x 17.30
Spillway Capacity (cumec)	29		Design Flood (cumec)	53450
Name of Reservoir	Nagarjuna Sagar		Status	Operational
State	Telangana		Basin	Krishna
River	Krishna			
Maximum Water Level (m)	76		Full Reservoir Level (m)	75.50
Minimum Draw Down Level (m)	74.00		Live Storage Capacity (MCM)	8207
Gross Storage Capacity (MCM)	5.66		Submergence Area (Th.Ha.)	-
Water Allocation Irrigation	-		Catchment Area (Sq.Km.)	
				

Table 13 - Salient Features of Nagarjuna Sagar Tail Pond Dam

2.7.2 Salient Features of Nagarjuna Sagar Dam

Salient Features of Nagarjuna Sagar Dam			
Attribute	**Value**	**Attribute**	**Value**
Name of the Dam	Nagarjuna Sagar Dam	Dam Status	Completed

Salient Features of Nagarjuna Sagar Dam			
Attribute	**Value**	**Attribute**	**Value**
River	Krishna	Purpose	Hydro Electric Irrigation
Nearest City	Guruzala	Completion Year	1974
District	Guntur	Operating and Maintenance Agency	Irr &CAD Deptt.
Basin Name	Krishna	Seismic Zone	Seismic Zone-II
Dam Type	Earthen	Max Height above Foundation(m)	26.06
Length of Dam (m)	1,450	Total Volume content of Dam (TCM)	7985
Type of Spillway	OG	Type of Spillway Gates	RD
Length of Spillway (m)	470.92	Number of Spillway Gates	26
Crest Level of Spillway	166.42	Size of Spillway Gates (m x m)	13.716X13.410
Spillway Capacity (cumec)	53450	Design Flood (cumec)	43,600
Name of Reservoir	Nagarjuna Sagar	Status	Operational
State	Telengana	Basin	Krishna
River	Krishna		
Maximum Water Level (m)	181.05	Full Reservoir Level (m)	179.95
Minimum Draw Down Level(m)	155.45	Live Storage Capacity(MCM)	5.563
Gross Storage Capacity(MCM)	11.557	Submergence Area (Th.Ha.)	56.98
Water Allocation Irregation	-	Catchment Area(Sq.Km.)	215,195

Table 14 - Salient Features of Nagarjuna Sagar Dam

2.7.3 Salient Features of Srisailam Dam

Salient Features of Srisailam Dam			
Attribute	**Value**	**Attribute**	**Value**

Salient Features of Srisailam Dam			
Attribute	**Value**	**Attribute**	**Value**
Name of the Dam	Srisailam (N.S.R.P) Dam	Dam Status	Completed
River	Krishna	Purpose	Hydro Electric Irrigation
Nearest City	Nandikotkur	Completion Year	1984
District	Kurnool	Operating and Maintenance Agency	Irr &CAD Deptt.
Basin Name	Krishna	Seismic Zone	Seismic Zone-II
Dam Type	Earthen	Max Height above Foundation (m)	143.26
Length of Dam (m)	512	Total Volume content of Dam (TCM)	1953
Type of Spillway	OG	Type of Spillway Gates	RD
Length of Spillway (m)	270.6	Number of Spillway Gates	12
Crest Level of Spillway	252.98	Size of Spillway Gates (m x m)	18.288X16.746
Spillway Capacity (cumec)	37365	Design Flood (cumec)	53770
Name of Reservoir	N.S.R.S Reservoir	Status	Operational
State	Telengana	Basin	Krishna
River	Krishna		
Maximum Water Level (m)	271	Full Reservoir Level (m)	279.75
Minimum Draw Down Level (m)	260.30	Live Storage Capacity (MCM)	8288
Gross Storage Capacity (MCM)	8723	Submergence Area (Th.Ha.)	61.5
Water Allocation Irrigation	-	Catchment Area (Sq.Km.)	211657

Table 15 - Salient Features of Srisailam Dam

2.7.4 Salient Features of PD Jurala Dam

Salient Features of PD Jurala Dam			
Attribute	**Value**	**Attribute**	**Value**
Name of the Dam	Priyadarshini Jurala	Dam Status	Completed
River	Krishna	Purpose	Hydro Electric Irrigation
Nearest City	Gadwal	Completion Year	1996
District	Telengana	Operating and Maintenance Agency	WRD-Telengana
Basin Name	Krishna	Seismic Zone	Seismic Zone-II
Dam Type	Earthen / Gravity / Masonry	Max Height above Foundation (m)	40.00
Length of Dam (m)	4534	Total Volume content of Dam (TCM)	1516
Type of Spillway	OG	Type of Spillway Gates	RD
Length of Spillway (m)	927	Number of Spillway Gates	62
Crest Level of Spillway	310	Size of Spillway Gates (m x m)	12X8.516
Spillway Capacity (cumec)	35390	Design Flood (cumec)	35396
Name of Reservoir	PD Jurala Reservoir	Status	Operational
State	Andhra Pradesh	Basin	Krishna
River	Krishna		
Maximum Water Level (m)	318.52	Full Reservoir Level (m)	318.52
Minimum Draw Down Level (m)	314.86	Live Storage Capacity (MCM)	192.3
Gross Storage Capacity (MCM)	338.103	Submergence Area (Th.Ha.)	4.731
Water Allocation Irrigation	-	Catchment Area (Sq.Km.)	13000

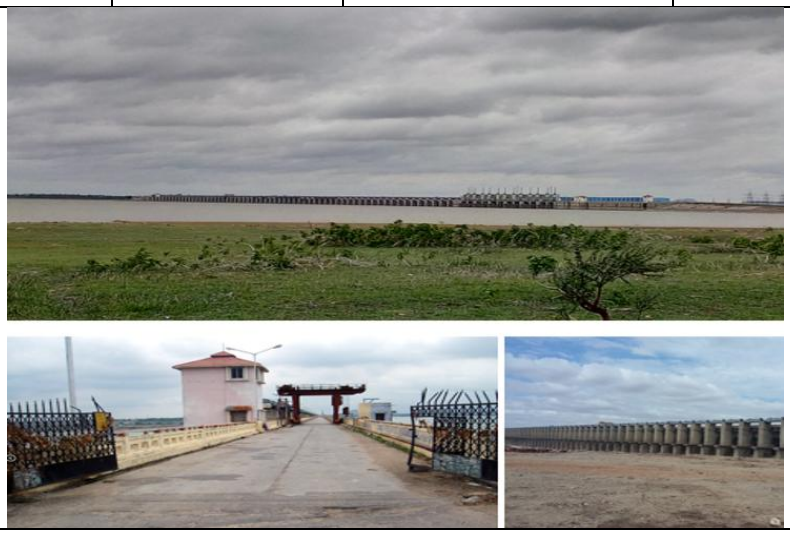


Table 16 - Salient Feature of PD Jurala Dam

2.7.5 Salient Features of Narayanpur Dam

Salient Features of Narayanapur Dam			
Attribute	**Value**	**Attribute**	**Value**
Name of the Dam	Narayanapur Dam	Dam Status	Completed
River	Krishna	Purpose	Hydro Electric Irrigation
Nearest City	Muddebihal	Completion Year	1982
District	Bijapur	Operating and Maintenance Agency	WRD-Karnataka
Basin Name	Krishna	Seismic Zone	Seismic Zone-II
Dam Type	Earthen / Gravity / Masonry	Max Height above Foundation (m)	29.72
Length of Dam (m)	10637.52	Total Volume content of Dam (TCM)	18270
Type of Spillway	OG	Type of Spillway Gates	RD
Length of Spillway (m)	459	Number of Spillway Gates	30
Crest Level of Spillway	459.27	Size of Spillway Gates (m x m)	15 X 12
Spillway Capacity (cumec)	37,945	Design Flood (cumec)	37945
Name of Reservoir	Narayanapura Reservoir	Status	Operational
State	Karnataka	Basin	Krishna
River	Krishna		
Maximum Water Level (m)	492.25	Full Reservoir Level (m)	492.25
Minimum Draw Down Level (m)	481.58	Live Storage Capacity (MCM)	863.04
Gross Storage Capacity (MCM)	1071.55	Submergence Area (Th.Ha.)	14.98
Water Allocation Irrigation	524.415	Catchment Area (Sq.Km.)	47850

Table 17 - Salient Feature of Narayanapur Dam

2.7.6 Salient Features of Almatti Dam

Salient Features of Almatti Dam			
Attribute	**Value**	**Attribute**	**Value**
Name of the Dam	Almatti	Dam Status	Completed
River	Krishna	Purpose	Hydro Electric Irrigation
Nearest City	Basavan Bagevadi	Completion Year	2000
District	Bijapur	Operating and Maintenance Agency	WRD-Karnataka
Basin Name	Krishna	Seismic Zone	Seismic Zone-II
Dam Type	Earthen / Gravity / Masonry	Max Height above Foundation (m)	52.24
Length of Dam (m)	1564.83	Total Volume content of Dam (TCM)	1349.99
Type of Spillway	OG	Type of Spillway Gates	RD
Length of Spillway (m)	486.5	Number of Spillway Gates	26
Crest Level of Spillway	509.02	Size of Spillway Gates (m x m)	15 X 15.24
Spillway Capacity (cumec)	31007	Design Flood (cumec)	31007
Name of Reservoir	Almatti Reservoir	Status	Operational
State	Karnataka	Basin	Krishna
River	Krishna		
Maximum Water Level (m)	512.06	Full Reservoir Level (m)	519.600
Minimum Draw Down Level (m)	506.87	Live Storage Capacity (MCM)	3104.7
Gross Storage Capacity (MCM)	3439.7	Submergence Area (Th.Ha.)	54.011
Water Allocation Irrigation	524.415	Catchment Area (Sq.Km.)	35925

Table 18 - Salient Feature of Almatti Dam

2.7.7 Salient Features of Gugal Barrage

Salient Features of Gugal Barrage		
1	River / Basin	Krishna
2	Latitude	16°28'42.71"N
3	Longitude	77° 8'48.27"E
4	District	Bijapur
5	Location	Gugal village
6	No. of gates	71
7	Length of Barrage	852m
8	Width	7.29m
9	Total Ayacut (Acres)	4.68 hct

Table 19 - Gugal Bridge/ Barrage

2.7.8 Salient Features of Narayanpur Weir

Salient Features of Naraynpur Weir		
1	River / Basin	Krishna
2	Latitude	16°14'53.19"N
3	Longitude	76°22'55.04"E
4	District	Deodurga
5	Location	Narayanpur Rural
6	No. of gates	3
7	Length of Barrage	12.56m
8	Width	4.35m
9	Total Ayacut (Acres)	N/A

Salient Features of Naraynpur Weir


Table 20 - Salient Features of Narayanapur Weir

2.7.9 Salient Features of Yalagundi Weir

Salient Features of Yalagundi Weir		
1	River / Basin	Krishna
2	Latitude	16°16'24.08"N
3	Longitude	76°26'58.23"E
4	District	Raichur
5	Location	Yalagundi
6	No. of gates	5
7	Length of Barrage	40.56
8	Width	4.66m
9	Total Ayacut (Acres)	N/A
		

Table 21 – Salient Features of Yalagundi Weir

2.7.10 Salient Features of Geddalmari weir

Salient Features of Geddalmari Barrage		
1	River / Basin	Krishna
2	Latitude	15°50'31.77"N
3	Longitude	75°42'14.88"E
4	District	Raichur
5	Location	Geddalmari
6	No. of gates	28
7	Length of Barrage	123 m
8	Width	63 m

Salient Features of Geddalmari Barrage		
9	Total Ayacut (Acres)	-

Table 22 – Salient Features of Geddalmari Weir

2.8 Erected IWAI Benchmark Pillars

New benchmark Pillars were constructed as per specification at suitable locations as specified in the contract. The extension of horizontal control was made by the baseline processing of 06 hourly DGPS observations carried out with the nearest reference station. The value of these benchmarks w.r.t. MSL was obtained by Auto leveling from the GTS at Almatti (548.245m MSL), Narayanpur Dam (483.329m MSL), PD Jurala (205.186m MSL), Srisailam (434.796m MSL) and Nagarjuna Sagar Tail Pond Dam (84.387m MSL) provided by the respective DAM Authorities upon that locality and refer the CD of CWC gauge Almatti (507.852m), CWC gauge Narayanpur (486.268m), CWC gauge Huvinhedgi (345.370m), CWC gauge Deosugur (325.745m), CWC gauge PD Jurala (313.975m), CWC gauge K Agraham (271.103), CWC gauge Srisailam (245.538m), CWC gauge Nagarjuna Sagar (155.976m), and CWC gauge Pondugula (42.821m).

The final accepted co-ordinates and reduced level (R.L) values of these Benchmarks and other station established for setting up of reference DGPS base stations are as below:

Sl. No.	Station	Chainage (km)	Location	Latitude (N) Longitude (E)	Easting (E) Northing (N)	Height above MSL (m)	CD w.r.t. MSL (m)	BM Height w.r.t. CD (m)
1	Almatti Dam	573.493	Almatti Dam	N 16°19'54.00" E 75°53'14.00"	594770.339 1805829.405	-	-	507.852
2	Naraynpur Dam	510.321	Narayanpur Dam	N 16°13'33.21" E 76°20'36.44"	643586.996 1794392.961	-	-	486.268
3	Huvinahedgi CWC	433.244	Huvinahedgi	N16°29'24.823" E76°55'23.031"	705275.018 1824140.993	-	-	345.370
4	Deosugur	367.305	Deosugur	N16°22'46.594" E77°21'26.422"	751793.84 1812387.582	-	-	325.745

Sl. No.	Station	Chainage (km)	Location	Latitude (N) Longitude (E)	Easting (E) Northing (N)	Height above MSL (m)	CD w.r.t. MSL (m)	BM Height w.r.t. CD (m)
5	PD Jurala	325.515	Jurala	N16°19'52.680" E77°42'11.452"	788826.985 1807499.378	-	-	313.975
6	K Agraham	308.269	K Agraham	N16°15'30.113" E77°50'26.195"	803633.14 1799622.999	-	-	271.103
7	Srisailam	143.937	SrisailamDam	N16°05'05.454" E78°53'53.661"	275181.446 1779463.561	-	-	245.538
8	Nagarjuna Sagar	44.744	Nagarjuna sagar dam	N16°34'13.331" E79°18'34.852"	319649.963 1832787.014	-	-	155.976
9	Pondugula	-0.159	Pondugula	N16°40'56.110" E79°39'41.666"	357284.611 1844883.37	-	-	42.821
10	IWAI-BM-KRS-01	636.151	Galgali	N16°25'19.084" E75°26'14.842"	546705.03 1815662.43	527.207	505.500	21.707
11	IWAI-BM-KRS-02	627.023	Badgi	N16°26'35.425" E75°30'05.072"	553527.277 1818024.112	517.006	505.500	11.506
12	IWAI-BM-KRS-03	616.064	Hanchinal	N16°25'36.384" E75°33'04.888"	558864.589 1816223.709	515.340	505.500	9.840
13	IWAI-BM-KRS-04	604.741	Dhawaleshwar	N16°26'26.170" E75°37'50.206"	567321.568 1817778.276	514.593	505.500	9.093
14	IWAI-BM-KRS-05	594.537	Rolli	N16°23'29.380" E75°42'11.247"	575081.738 1812371.138	514.699	505.500	9.199
15	IWAI-BM-KRS-06	585.131	Beerkabi	N16°20'26.179" E75°46'50.446"	583385.351 1806771.695	512.898	505.000	7.898
16	IWAI-BM-KRS-07	574.699	Alur	N16°19'58.338" E75°52'11.646"	592919.537 1805954.748	513.033	505.000	8.033
17	IWAI-BM-KRS-08	565.692	Nagral	N16°17'53.461" E75°56'51.443"	601239.885 1802154.229	495.374	489.731	5.643
18	IWAI-BM-KRS-09	555.204	Chick Myageri	N16°16'51.336" E76°02'12.441"	610776.535 1800291.342	492.866	487.829	5.037
19	IWAI-BM-KRS-10	545.377	Kudala Sangama	N16°12'26.664" E76°03'50.090"	613717.212 1792172.503	494.085	487.702	6.383
20	IWAI-BM-KRS-11	535.652	Havargi	N16°10'34.040" E76°09'07.875"	623172.863 1788762.277	498.294	484.000	14.294
21	IWAI-BM-KRS-12	524.694	Ankanhal	N16°09'13.321" E76°14'47.587"	633277.07 1786340.403	493.105	484.000	9.105
22	IWAI-BM-KRS-13	516.079	Kamaldinni	N16°10'16.895" E76°19'09.734"	641051.201 1788342.765	491.508	484.000	7.508
23	IWAI-BM-KRS-14	505.509	Narayanpur	N16°14'54.394" E76°22'56.108"	647717.408 1796915.691	463.149	452.155	10.994
24	IWAI-BM-KRS-15	494.508	Shilahalli	N16°14'35.353" E76°28'47.720"	658161.248 1796403.425	408.738	436.104	-27.366
25	IWAI-BM-KRS-16	485.490	Guntagola	N16°17'53.873" E76°31'46.397"	663420.937 1802544.182	406.536	422.845	-16.309
26	IWAI-BM-KRS-17	475.314	Tanmankal	N16°20'19.341" E76°36'38.661"	672061.408 1807082.228	371.267	409.104	-37.837
27	IWAI-BM-KRS-18	465.623	Bunkaldoddi	N16°22'49.909" E76°41'26.079"	680553.446 1811779.658	358.460	394.220	-35.760
28	IWAI-BM-KRS-19	454.739	Lingadhalli	N16°25'16.802" E76°46'17.965"	689175.552 1816368.941	358.206	375.669	-17.463
29	IWAI-BM-KRS-20	443.619	Anjal	N16°27'02.876" E76°51'53.630"	699104.502 1819719.146	354.734	360.462	-5.728
30	IWAI-BM-KRS-21	433.522	Huvinhedgi	N16°29'34.857" E76°55'07.691"	704817.127 1824445.224	353.089	346.684	6.405
31	IWAI-BM-KRS-22	423.436	Konchapli	N16°32'34.589" E76°58'09.852"	710166.06 1830022.806	351.665	344.183	7.482
32	IWAI-BM-KRS-23	414.384	Karkihalli	N16°31'33.320" E77°00'04.640"	713588.656 1828172.795	353.460	343.102	10.358
33	IWAI-BM-KRS-24	404.781	Kurkihalli	N16°30'37.525" E77°03'49.298"	720268.838 1826524.653	347.489	340.906	6.583
34	IWAI-BM-KRS-25	394.908	Gugal	N16°28'29.381" E77°08'46.295"	729119.718 1822676.766	345.558	340.845	4.713
35	IWAI-BM-KRS-26	386.051	Basawantpur	N16°25'27.703"	734616.325	336.622	332.109	4.513

Sl. No.	Station	Chainage (km)	Location	Latitude (N) Longitude (E)	Easting (E) Northing (N)	Height above MSL (m)	CD w.r.t. MSL (m)	BM Height w.r.t. CD (m)
				E77°11'49.528"	1817149.247			
36	IWAI-BM-BHM-15	375.867	Sangam	N16°24'42.345" E77°16'52.944"	743636.042 1815854.104	343.569	329.228	14.341
37	IWAI-BM-KRS-27	366.746	Deosugur	N16°22'48.056" E77°21'46.567"	752391.389 1812439.626	335.244	325.737	9.507
38	IWAI-BM-KRS-28	358.351	Ramgaddi	N16°21'49.949" E77°26'40.350"	761133.884 1810756.01	336.193	323.670	12.523
39	IWAI-BM-KRS-29	347.095	Agrahar	N16°20'52.514" E77°31'36.165"	769938.341 1809097.153	325.671	319.409	6.262
40	IWAI-BM-KRS-30	335.974	Nagardoddi	N16°20'26.708" E77°36'52.699"	779347.447 1808422.297	319.356	313.975	5.381
41	IWAI-BM-KRS-31	326.067	Jurala	N16°19'26.101" E77°41'46.811"	788106.076 1806672.226	319.033	313.975	5.058
42	IWAI-BM-KRS-32	314.337	Kothapalle	N16°17'19.348" E77°47'38.360"	798600.653 1802914.266	296.131	284.591	11.540
43	IWAI-BM-KRS-33	304.436	Mulakalpalle	N16°14'11.656" E77°52'06.758"	806655.122 1797251.497	279.533	268.669	10.864
44	IWAI-BM-KRS-34	292.937	Banchipalle	N16°09'54.207" E77°56'20.557"	814310.749 1789439.054	270.614	261.222	9.392
45	IWAI-BM-KRS-35	281.593	Pallepadu	N16°04'23.971" E77°59'08.810"	819459.883 1779352.359	272.793	254.620	18.173
46	IWAI-BM-KRS-36	272.317	Yaparla	N16°01'28.489" E78°03'08.025"	184533.189 1773895.937	266.099	248.829	17.270
47	IWAI-BM-KRS-37	262.876	Bheemavaram	N15°59'36.184" E78°08'00.233"	193178.369 1770319.669	260.273	248.305	11.968
48	IWAI-BM-KRS-38	251.421	Santhanikota	N15°53'46.757" E78°12'56.586"	201851.796 1759452.401	283.092	247.613	35.479
49	IWAI-BM-KRS-39	240.999	Veerapuram	N16°00'43.570" E78°15'40.312"	206893.634 1772207.58	259.010	247.122	11.888
50	IWAI-BM-KRS-40	231.403	Sangameshwaram	N16°01'20.458" E78°19'49.505"	214320.788 1773245.469	259.964	248.823	11.141
51	IWAI-BM-KRS-41	219.637	Bollaram	N16°04'36.910" E78°24'15.999"	222322.957 1779186.432	252.329	248.908	3.421
52	IWAI-BM-KRS-42	209.078	NM-01	N16°03'29.932" E78°30'02.241"	232593.071 1776999.924	256.339	248.748	7.571
53	IWAI-BM-KRS-43	198.975	NM-02	N16°03'42.045" E78°35'13.687"	241858.101 1777262.503	254.036	248.748	5.288
54	IWAI-BM-KRS-44	186.561	NM-03	N16°02'52.886" E78°40'02.838"	250438.259 1775652.407	259.821	248.167	11.654
55	IWAI-BM-KRS-45	177.512	NM-04	N16°00'21.826" E78°44'22.328"	258103.105 1770922.252	259.779	248.148	11.631
56	IWAI-BM-KRS-46	167.238	NM-05	N16°03'03.640" E78°49'05.209"	266567.751 1775807.314	254.818	246.768	8.050
57	IWAI-BM-KRS-47	157.804	NM-06	N16°07'42.986" E78°50'22.403"	268952.581 1784371.8	257.266	246.758	10.508
58	IWAI-BM-KRS-48	147.516	Domalpenta	N16°06'35.482" E78°53'07.491"	273837.452 1782245.533	269.099	245.538	23.561
59	IWAI-BM-KRS-49	137.394	NM-07	N16°07'55.141" E78°55'33.986"	278215.974 1784650.391	179.676	162.296	17.380
60	IWAI-BM-KRS-50	126.344	NM-08	N16°12'05.320" E78°56'39.559"	280241.475 1792322.256	165.294	156.286	9.008
61	IWAI-BM-KRS-51	117.131	NM-09	N16°14'23.651" E79°00'49.385"	287703.902 1796501.835	167.719	156.066	11.653
62	IWAI-BM-KRS-52	105.565	NM-10	N16°13'52.999" E79°06'41.202"	298143.662 1795460.699	166.646	155.986	10.660
63	IWAI-BM-KRS-53	96.021	NM-11	N16°12'49.315" E79°11'33.840"	306817.35 1793424.705	167.482	155.976	11.506
64	IWAI-BM-KRS-54	87.700	Hanumapuram	N16°16'26.644" E79°13'24.668"	310166.96 1800076.522	164.723	155.976	8.747
65	IWAI-BM-KRS-55	75.752	Pullareddygudam	N16°22'18.176" E79°12'58.113"	309473.07 1810889.406	163.809	155.976	7.833

Sl. No.	Station	Chainage (km)	Location	Latitude (N) Longitude (E)	Easting (E) Northing (N)	Height above MSL (m)	CD w.r.t. MSL (m)	BM Height w.r.t. CD (m)
66	IWAI-BM-KRS-56	66.308	NM-12	N16°27'32.098" E79°12'45.323"	309178.636 1820542.729	166.196	155.976	10.220
67	IWAI-BM-KRS-57	53.675	Chintala Thanda	N16°32'00.452" E79°15'29.231"	314111.866 1828749.39	244.617	155.976	87.641
68	IWAI-BM-KRS-58	43.555	Vijaypuri South	N16°34'13.025" E79°19'11.532"	320737.336 1832768.523	94.246	68.687	25.559
69	IWAI-BM-KRS-59	32.499	Narareddy puram	N16°34'11.720" E79°25'04.520"	331201.095 1832643.43	86.411	59.539	26.872
70	IWAI-BM-KRS-60	22.464	Satrasala	N16°37'36.608" E79°29'02.364"	338299.185 1838886.722	70.956	47.089	23.867
71	IWAI-BM-KRS-61	12.929	Gottimukkala	N16°38'34.934" E79°34'00.543"	347148.169 1840614.342	61.820	45.747	16.073
72	IWAI-BM-KRS-62	3.773	Pulipadu Temple	N16°39'23.377" E79°38'04.587"	354389.469 1842052.675	74.447	42.821	31.626
73	IWAI-BM-KRS-63	0.031	Pondugula	N16°40'51.852" E79°39'35.972"	357115.243 1844753.635	63.519	42.821	20.698

Table 23 - Accepted Benchmark Coordinates

2.9 Chart Datum / Sounding Datum and Reductions Details

Sl. No.	Benchmark / Tide Gauges	Chainage (km)	Stretch for corrected soundings and topo levels (km)	Established Sounding Datum w.r.t. MSL (m) at col. A.	Sounding Datum of Tide Gauge wrt MSL (m)	Correction in WL data for Bathymetric survey (m)	Topo level data to be converted as depth for volume calculation wrt SD (m)
	A	B	C (50% stretch is to be selected on both side of tide gauge)	D +ve indicates above MSL -ve indicates below MSL	E	F = (E- WL data in MSL)	G = ((E- topo levels in MSL)
1	KRS-63	0	0-1		42.821		
2	KRS-62	3.777	1-8.76		42.821		
3	KRS-61	13.025	8.76-18.8		45.747		
4	KRS-60	22.447	18.8-21.45		47.089		
5	-	-	21.45-21.945		54.582		
6	KRS-59	32.299	21.945-37.5		59.539		
7	-	-	37.5-38		59.221		
8	-	-	38-39		64.275		
9	-	-	39-40		65.185		
10	-	-	40-41		66.063		
11	-	-	41-42		66.935		
12	-	-	42-43		67.832		
13	-	-	43-44.4		68.687		
14	-	-	44.4-45		69.507		
15	KRS-57	53.758	45-60	Ponding Limit of Nagarjuna Sagar Dam - 155.976	155.976		
16	KRS-56	66.251	60-70		155.976		
17	KRS-55	75.671	70-80		155.976		
18	KRS-54	87.712	80-90		155.976		
19	KRS-53	96.044	90-101.9		155.976		
20	KRS-52	105.591	101.9-110.9		155.986		
21	KRS-51	117.127	110.9-121.9		156.066		
22	KRS-50	126.338	121.9-128		156.286		
23	KRS-49-NM03	128.464	128-129.56		157.789		
24	KRS-49-NM02	129.853	129.56-132.63		159.291		

Sl. No.	Benchmark / Tide Gauges	Chainage (km)	Stretch for corrected soundings and topo levels (km)	Established Sounding Datum w.r.t. MSL (m) at col. A.	Sounding Datum of Tide Gauge wrt MSL (m)	Correction in WL data for Bathymetric survey (m)	Topo level data to be converted as depth for volume calculation wrt SD (m)
	A	B	C (50% stretch is to be selected	D	E	F = (E- WL data in	G = ((E- topo levels
25	KRS-49-NM01	133.395	132.63-134.98		160.794		
26	KRS-49	135.739	134.98-136		162.296		
27	-	-	136-137		162.904	Details at Annexure-4	Details placed at Krishna Stretchwise data in excel
28	-	-	137-138		163.589		
29	-	-	138-139		163.764		
30	-	-	139-140		163.939		
31	-	-	140-141		164.321		
32	-	-	141-142		164.328		
33	-	-	142-142.7		164.855		
34	-	-	142.7-143.9		164.855		
35	KRS-48	147.496	143.9-162.5	Ponding Limit of Sri Sailam Dam - 245.538	245.538		
36	KRS-47	157.825	162.5-172.4		246.758		
37	KRS-46	167.226	172.4-182.7		246.768		
38	KRS-45	177.475	182.7-192.7		248.148		
39	KRS-44	186.543	192.7-204.5		248.167		
40	KRS-43	198.935	204.5-214.35		248.748		
41	KRS-42	209.078	214.35-225.9		248.768		
42	KRS-41	219.653	225.9-231.4		248.908		
43	-	231.403	231.4-232		248.823		
44	-	-	232-233		248.809		
45	-	-	233-234		248.763		
46	-	-	234-235		248.37		
47	-	-	235-236		247.947		
48	-	-	236-237		247.602		
49	-	-	237-238		247.133		
50	-	-	238-239		247.005		
51	-	-	239-240		247.053		
52	-	-	240-241		247.122		
53	-	-	241-242		247.143		
54	-	-	242-243		247.188		
55	-	-	243-244		247.261		
56	-	-	244-245		247.314		
57	-	-	245-246		247.366		
58	-	-	246-247		247.403		
59	-	-	247-248		247.459		
60	-	-	248-249		247.515		
61	-	-	249-250		247.582		
62	-	-	250-251		247.613		
63	-	-	251-252		247.613		
64	-	-	252-253		247.73		
65	-	-	253-254		247.749		
66	-	-	254-255		247.841		
67	-	-	255-256		247.898		
68	-	-	256-257		247.948		
69	-	-	257-258		248.022		
70	-	-	258-259		248.179		
71	-	-	259-260		248.257		
72	-	-	260-261		248.275		
73	-	-	261-262		248.292		

Sl. No.	Benchmark / Tide Gauges	Chainage (km)	Stretch for corrected soundings and topo levels (km)	Established Sounding Datum w.r.t. MSL (m) at col. A.	Sounding Datum of Tide Gauge wrt MSL (m)	Correction in WL data for Bathymetric survey (m)	Topo level data to be converted as depth for volume calculation wrt SD (m)
	A	B	C (50% stretch is to be selected	D	E	F = (E- WL data in	G = ((E- topo levels
74	-	-	262-263		248.305		
75	-	-	263-264		248.329		
76	-	-	264-265		248.398		
77	-	-	265-266		248.452		
78	-	-	266-267		248.506		
79	-	-	267-268		248.581		
80	-	-	268-269		248.604		
81	-	-	269-270		248.633		
82	-	-	270-271		248.692		
83	-	-	271-272		248.75		
84	-	-	272-273		248.829		
85	-	-	273-274		250.058		
86	-	-	274-275		250.177		
87	-	-	275-276		250.252		
88	-	-	276-277		250.944		
89	-	-	277-278		251.951		
90	-	-	278-279		252.178		
91	-	-	279-280		253.14		
92	-	-	280-281		253.815		
93	-	-	281-282		254.62		
94	-	-	282-283		254.881		
95	-	-	283-284		255.506		
96	-	-	284-285		256.143		
97	-	-	285-286		258.198		
98	-	-	286-287		257.436		
99	-	-	287-288		258.063		
100	-	-	288-289		258.69		
101	-	-	289-290		259.319		
102	-	-	290-291		259.948		
103	-	-	291-292		260.58		
104	-	-	292-293		261.222		
105	-	-	293-294		261.852		
106	-	-	294-295		262.484		
107	-	-	295-296		263.134		
108	-	-	296-297		263.762		
109	-	-	297-298		264.233		
110	-	-	298-299		264.863		
111	-	-	299-300		265.547		
112	-	-	300-301		266.131		
113	-	-	301-302		266.783		
114	-	-	302-303		267.404		
115	-	-	303-304		267.875		
116	-	-	304-305		268.669		
117	-	-	305-306		269.312		
118	-	-	306-307		269.936		
119	-	-	307-308		270.577		
120	-	-	308-309		271.108		
121	-	-	309-310		273.344		
122	-	-	310-311		275.593		

Sl. No.	Benchmark / Tide Gauges	Chainage (km)	Stretch for corrected soundings and topo levels (km)	Established Sounding Datum w.r.t. MSL (m) at col. A.	Sounding Datum of Tide Gauge wrt MSL (m)	Correction in WL data for Bathymetric survey (m)	Topo level data to be converted as depth for volume calculation wrt SD (m)
	A	B	C (50% stretch is to be selected	D	E	F = (E- WL data in	G = ((E- topo levels
123	-	-	311-312		277.893		
124	-	-	312-313		280.071		
125	-	-	313-314		282.291		
126	-	-	314-315		284.591		
127	-	-	315-316		286.79		
128	-	-	316-317		289.004		
129	-	-	317-318		291.3		
130	-	-	318-319		293.637		
131	-	-	319-320		295.857		
132	-	-	320-321		298.207		
133	-	-	321-322		300.449		
134	-	-	322-323		302.562		
135	-	-	323-324		305.009		
136	-	-	324-325.5		307.297		
137	KRS-31	326.083	325.5-329.3	Ponding Limit of PD Jurala Dam - 313.975	313.975		
138	KRS-30	336.062	329.3-339		313.975		
139	-	-	339-340		315.281		
140	-	-	340-341		317.074		
141	-	-	341-342		317.261		
142	-	-	342-343		317.639		
143	-	-	343-344		318.232		
144	-	-	344-345		319.106		
145	-	-	345-346		319.215		
146	-	-	346-347		319.317		
147	-	-	347-348		319.409		
148	-	-	348-349		319.954		
149	-	-	349-350		320.258		
150	-	-	350-351		320.489		
151	-	-	351-352		320.84		
152	-	-	352-353		321.553		
153	-	-	353-354		321.77		
154	-	-	354-355		322.37		
155	-	-	355-356		322.621		
156	-	-	356-357		322.843		
157	-	-	357-358		323.209		
158	-	-	358-359		323.67		
159	-	-	359-360		323.957		
160	-	-	360-361		324.07		
161	-	-	361-362		324.364		
162	-	-	362-363		324.549		
163	-	-	363-364		325.285		
164	-	-	364-365		325.024		
165	-	-	365-366		325.371		
166	-	-	366-367		325.737		
167	-	-	367-368		326.238		
168	-	-	368-369		326.238		
169	-	-	369-370		326.882		
170	-	-	370-371		326.919		
171	-	-	371-372		327.149		

Sl. No.	Benchmark / Tide Gauges	Chainage (km)	Stretch for corrected soundings and topo levels (km)	Established Sounding Datum w.r.t. MSL (m) at col. A.	Sounding Datum of Tide Gauge wrt MSL (m)	Correction in WL data for Bathymetric survey (m)	Topo level data to be converted as depth for volume calculation wrt SD (m)
	A	B	C (50% stretch is to be selected	D	E	F = (E- WL data in	G = ((E- topo levels
172	-	-	372-373		327.276		
173	-	-	373-374		327.781		
174	-	-	374-375		328.126		
175	-	-	375-376		329.228		
176	-	-	376-377		329.278		
177	-	-	377-378		329.412		
178	-	-	378-379		329.412		
179	-	-	379-380		330.619		
180	-	-	380-381		330.251		
181	-	-	381-382		330.697		
182	-	-	382-383		331.11		
183	-	-	383-384		331.619		
184	-	-	384-385		331.595		
185	-	-	385-386		331.837		
186	-	-	386-387		332.109		
187	-	-	387-388		332.338		
188	-	-	388-389		332.418		
189	-	-	389-390		332.579		
190	-	-	390-391		332.918		
191	-	-	391-392		333.09		
192	-	-	392-393		333.385		
193	-	-	393-394		333.497		
194	-	-	394-395		333.646		
195	KRS-25	394.93	395-399.92	Gugal Barrage LWL - 340.845	340.845		
196	KRS-24	404.785	399.92-410		340.906		
197	-	-	410-411		343.194		
198	-	-	411-412		342.745		
199	-	-	412-413		342.913		
200	-	-	413-414		342.981		
201	-	-	414-415		343.102		
202	-	-	415-416		343.216		
203	-	-	416-417		343.337		
204	-	-	417-418		343.454		
205	-	-	418-419		343.583		
206	-	-	419-420		343.691		
207	-	-	420-421		343.81		
208	-	-	421-422		343.938		
209	-	-	422-423		344.047		
210	-	-	423-424		344.183		
211	-	-	424-425		344.309		
212	-	-	425-426		344.403		
213	-	-	426-427		344.521		
214	-	-	427-428		344.645		
215	-	-	428-429		344.757		
216	-	-	429-430		344.876		
217	-	-	430-431		345.303		
218	-	-	431-432		345.776		
219	-	-	432-433		346.379		
220	-	-	433-434		346.684		

Sl. No.	Benchmark / Tide Gauges	Chainage (km)	Stretch for corrected soundings and topo levels (km)	Established Sounding Datum w.r.t. MSL (m) at col. A.	Sounding Datum of Tide Gauge wrt MSL (m)	Correction in WL data for Bathymetric survey (m)	Topo level data to be converted as depth for volume calculation wrt SD (m)
	A	B	C (50% stretch is to be selected	D	E	F = (E- WL data in	G = ((E- topo levels
221	-	-	434-435		347.178		
222	-	-	435-436		348.333		
223	-	-	436-437		349.83		
224	-	-	437-438		351.308		
225	-	-	438-439		352.866		
226	-	-	439-440		354.245		
227	-	-	440-441		355.881		
228	-	-	441-442		357.432		
229	-	-	442-443		358.83		
230	-	-	443-444		360.462		
231	-	-	444-445		361.985		
232	-	-	445-446		363.553		
233	-	-	446-447		365.018		
234	-	-	447-448		366.564		
235	-	-	448-449		368.023		
236	-	-	449-450		369.499		
237	-	-	450-451		371.101		
238	-	-	451-452		372.705		
239	-	-	452-453		373.669		
240	-	-	453-454		374.669		
241	-	-	454-455		375.669		
242	-	-	455-456		377.193		
243	-	-	456-457		378.742		
244	-	-	457-458		380.414		
245	-	-	458-459		383.403		
246	-	-	459-460		384.937		
247	-	-	460-461		386.491		
248	-	-	461-462		388.107		
249	-	-	462-463		389.508		
250	-	-	463-464		391.024		
251	-	-	464-465		392.569		
252	-	-	465-466		394.22		
253	-	-	466-467		395.684		
254	-	-	467-468		397.385		
255	-	-	468-469		398.647		
256	-	-	469-470		400.308		
257	-	-	470-471		401.691		
258	-	-	471-472		403.121		
259	-	-	472-473		404.632		
260	-	-	473-474		406.077		
261	-	-	474-475		407.616		
262	-	-	475-476		409.104		
263	-	-	476-477		410.565		
264	-	-	477-478		412.032		
265	-	-	478-479		413.235		
266	-	-	479-480		414.729		
267	-	-	480-481		416.047		
268	-	-	481-482		417.976		
269	-	-	482-483		419.362		

Sl. No.	Benchmark / Tide Gauges	Chainage (km)	Stretch for corrected soundings and topo levels (km)	Established Sounding Datum w.r.t. MSL (m) at col. A.	Sounding Datum of Tide Gauge wrt MSL (m)	Correction in WL data for Bathymetric survey (m)	Topo level data to be converted as depth for volume calculation wrt SD (m)
	A	B	C (50% stretch is to be selected	D	E	F = (E- WL data in	G = ((E- topo levels
270	-	-	483-484		420.502		
271	-	-	484-485		422.006		
272	-	-	485-486		422.845		
273	-	-	486-487		424.528		
274	-	-	487-488		426.471		
275	-	-	488-489		427.462		
276	-	-	489-490		428.915		
277	-	-	490-491		430.386		
278	-	-	491-492		432.175		
279	-	-	492-493		432.996		
280	-	-	493-494		434.297		
281	-	-	494-495		436.104		
282	-	-	495-496		437.301		
283	-	-	496-497		438.895		
284	-	-	497-498		440.415		
285	-	-	498-499		441.983		
286	-	-	499-500		443.123		
287	-	-	500-501		444.424		
288	-	-	501-502		446.357		
289	-	-	502-503		447.319		
290	-	-	503-504		448.574		
291	-	-	504-505		450.014		
292	-	-	505-506		452.155		
293	-	-	506-507		453.029		
294	-	-	507-508		454.546		
295	-	-	508-509		457.301		
296	-	-	509-510		460.766		
297	-	-	510-510.4		483.32		
298	KRS-13	515.77	510.4-520	Ponding Limit of Narayanpur Dam	484		
299	KRS-12	524.643	520-530.3	Ponding Limit of Narayanpur Dam - 484.00	484		
300	KRS-11	535.707	530.3-536.2		484		
301	-	-	536.2-537		484.258		
302	-	-	537-538		485.973		
303	-	-	538-539		486.283		
304	-	-	539-540		486.647		
305	-	-	540-541		486.999		
306	-	-	541-542		487.445		
307	-	-	542-543		487.5		
308	-	-	543-544		487.55		
309	-	-	544-545		487.65		
310	KRS-10	545.319	545-549.6		487.702		
311	KRS-09	555.242	549.6-558		487.829		
312	KRS-08	565.71	558-568		489.731		
313	-	-	568-569		492.184		
314	-	-	569-570		492.799		
315	-	-	570-571		493.371		
316	-	-	571-572		495.477		
317	-	-	572-573		496.373		
318	-	-	573-573.3		496.005		

Sl. No.	Benchmark / Tide Gauges	Chainage (km)	Stretch for corrected soundings and topo levels (km)	Established Sounding Datum w.r.t. MSL (m) at col. A.	Sounding Datum of Tide Gauge wrt MSL (m)	Correction in WL data for Bathymetric survey (m)	Topo level data to be converted as depth for volume calculation wrt SD (m)
	A	B	C (50% stretch is to be selected	D	E	F = (E- WL data in	G = ((E- topo levels
319	KRS-07	574.48	573.3-580	Ponding Limit of Alamatti Dam -	505		
320	KRS-06	585.075	580-594	Ponding Limit of Alamatti Dam - 505.00	505		
321	KRS-05	594.335	594-599.4		505.5		
322	KRS-04	604.801	599.4-609		505.5		
323	KRS-03	616.068	609-620		505.5		
324	KRS-02	627.057	620-632.7		505.5		
325	-	-	632.7-636.2		505.5		

Table 24 - CD/SD Reduction Details

2.10 HFL values of Bridges/Cross Structures

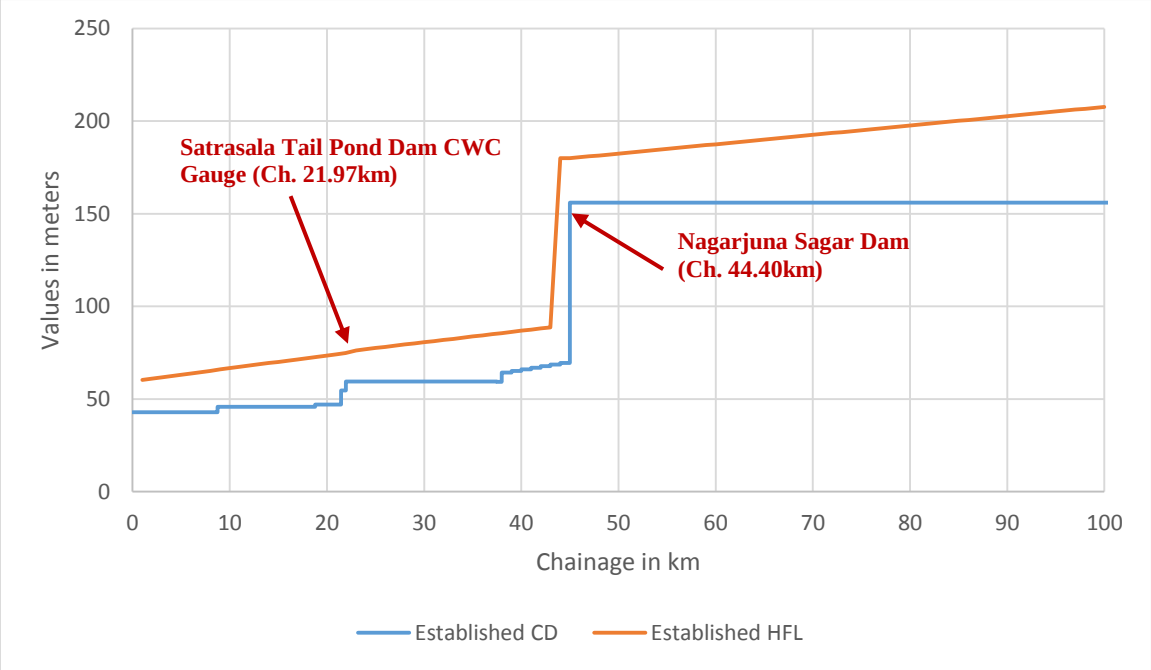
The established HFL value of Almatti Dam 519.600m, and Narayanpur Dam 492.250m, Srisailam Dam 279.750m, and Nagarjuna Sagar Dam 179.950, was obtained from the respective Dam Authorities. The HFL value for the remaining survey stretch is computed for the Krishna River. The details of established and computed HFL values for the entire stretch are as follows:

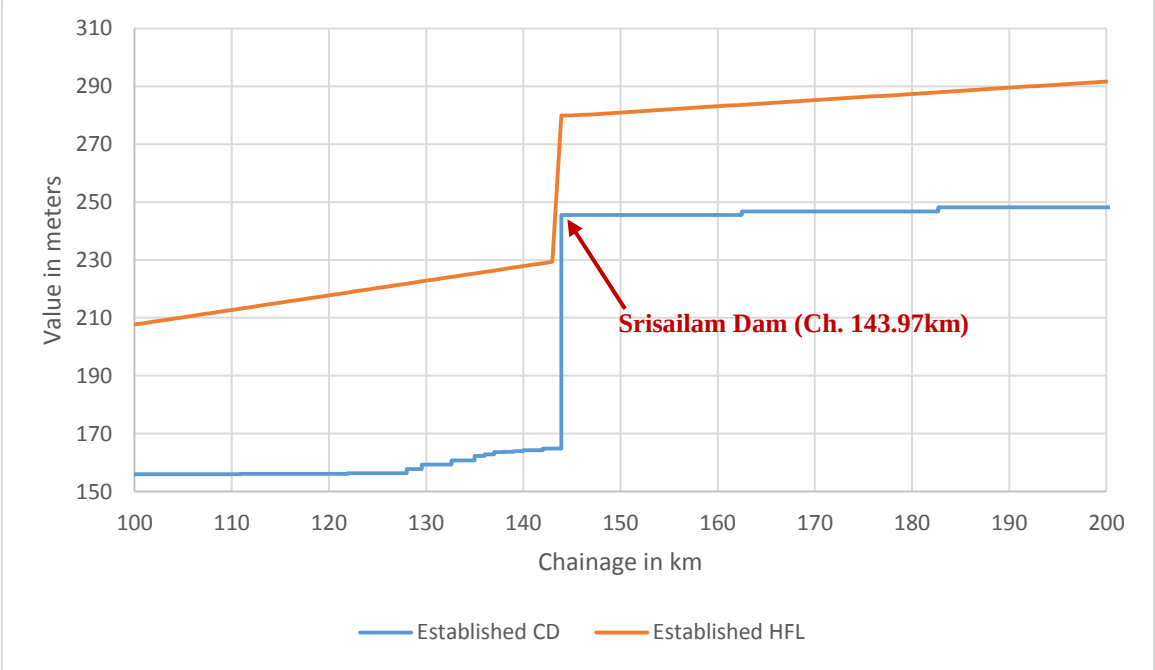
Sl#	Location and description of CWC gauge Barrages / Weirs / Anicut / Barrages / Aqueducts	Cross-structure details	Chainage (km)	Established HFL / FRL w.r.t. MSL (m)	Computed HFL at Cross-Structures w.r.t. MSL (m)
	A	B	C	D	E
1	Galgali	Barrage	636.34	-	532.01
2	Galgali	Highway Bridge	636.21	-	531.96
3	Rolli	Highway Bridge	597.52	524.3	524.33
4	Almatti	Dam	573.48	519.6	-
5	Almatti	Railway Bridge	571.85	-	506.68
5	Almatti	Highway Bridge	571.58	-	506.50
6	Hisur	Highway Bridge	569.60	-	505.78
7	Dhannur	Highway Bridge	541.49	-	495.68
8	Narayanpur	Dam	510.84	492.25	-
10	Narayanpur	Bridge	510.00	-	461.20
11	Narayanpur	Weirs	505.65	-	-
12	Yalgundi	Weirs	498.99	-	-
13	Hanchinal	Bridge	490.96	-	435.19
14	Geddalmari	Weirs	484.14	-	-
15	Banchigaddi	Weirs	481.40	-	-
16	Banchhigadi	Bridge	480.75	-	419.94
17	Yedlabhavi	Bridge	480.66	-	419.59
18	Hunsiholi	Highway Bridge	469.32	-	404.68

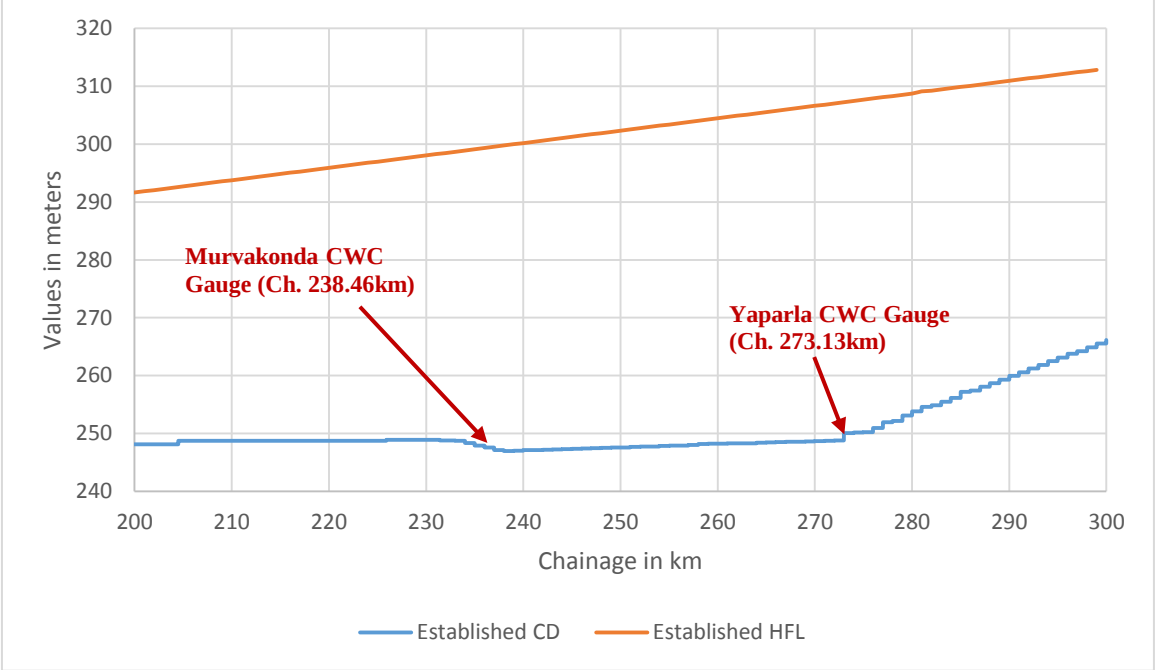
Sl#	Location and description of CWC gauge Barrages / Weirs / Anicut / Barrages / Aqueducts	Cross-structure details	Chainage (km)	Established HFL / FRL w.r.t. MSL (m)	Computed HFL at Cross-Structures w.r.t. MSL (m)
19	Golden Bridge	Highway Bridge	433.54	-	355.44
20	Gugal	Bridge/Barrage	395.09	-	350.51
21	Shakti Nagar	Railway Bridge	370.85	-	336.83
22	Deosugur	Highway Bridge	367.34	-	335.65
23	Jurala CWC		325.515	318.6	-
24	Jurala	Dam	325.57	-	325.65
25	Jurail	Weir	317.53	-	-
26	K Agraham Gauge	Gauge	308.269	284.85	-
27	Yenkampeta	Railway Bridge	307.63	-	314.76
28	Banchhipalli	Highway Bridge	292.80	-	311.66
29	Banchhipalli	Highway Bridge	292.78	-	311.66
30	Srisailam Gauge	Gauge	144.934	269.75	-
31	Srisailam	Dam	143.97	279.75	-
32	Sundipenta	Highway Bridge	142.02	-	229.37
34	Nagarjuna Sagar Dam	Dam	44.744	179.95	-
36	Nagarjuna Sagar	Dam	44.40	-	-
37	Nagarjuna Sagar	Highway Bridge	42.41	-	88.88
38	Satrasala	Tail pond Dam	21.97	-	76.00
39	Pondugula	Railway bridge	0.43	-	60.68
40	Wazirabad	Highway Bridge	0.03	-	60.33

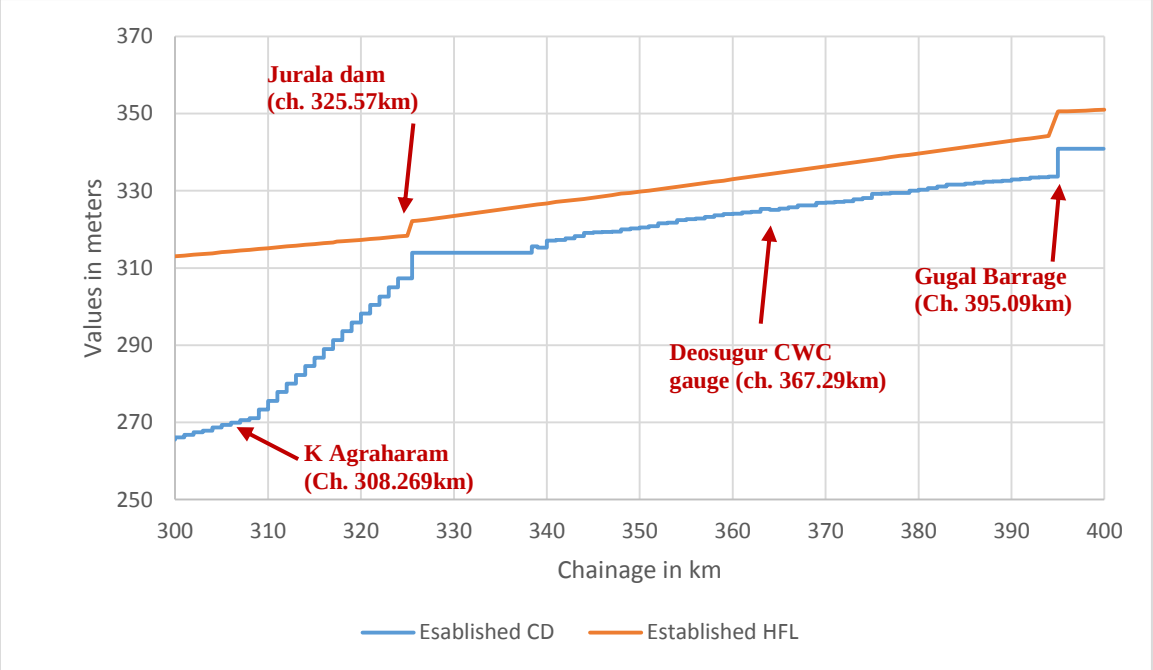
Table 25 - Established and computed HFL

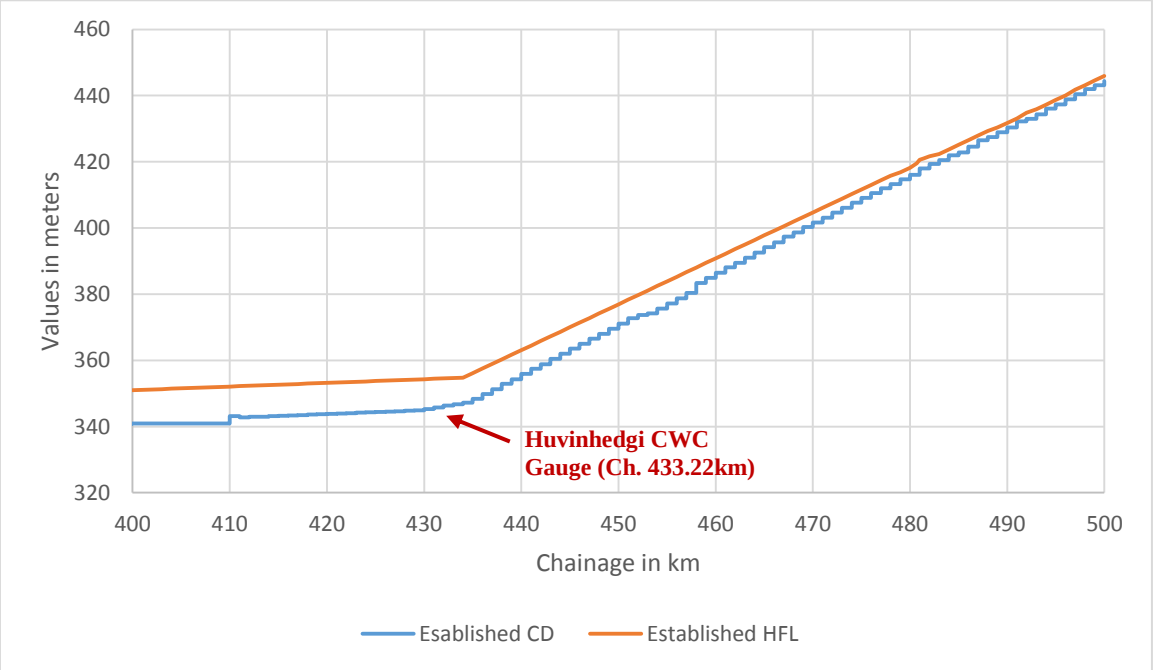
2.11 Graph: Sounding Datum and HFL vs Chainage




310
290
270
250
230
210
190
170
150
Value in meters
100
110
120
130
140
150
160
170
180
190
200
Chainage in km
Srisailam Dam (Ch. 143.97km)
Established CD
Established HFL


320
310
300
290
280
270
260
250
240
Values in meters
200
210
220
230
240
250
260
270
280
290
300
Chainage in km
Murvakonda CWC
Gauge (Ch. 238.46km)
Yaparla CWC Gauge
(Ch. 273.13km)
Established CD
Established HFL


Jurala dam
(ch. 325.57km)
K Agraharam
(Ch. 308.269km)
Deosugur CWC
gauge (ch. 367.29km)
Gugal Barrage
(Ch. 395.09km)
Values in meters
Chainage in km
Eablished CD
Established HFL


Huvinhedgi CWC
Gauge (Ch. 433.22km)
Values in meters
Chainage in km
Eablished CD
Established HFL

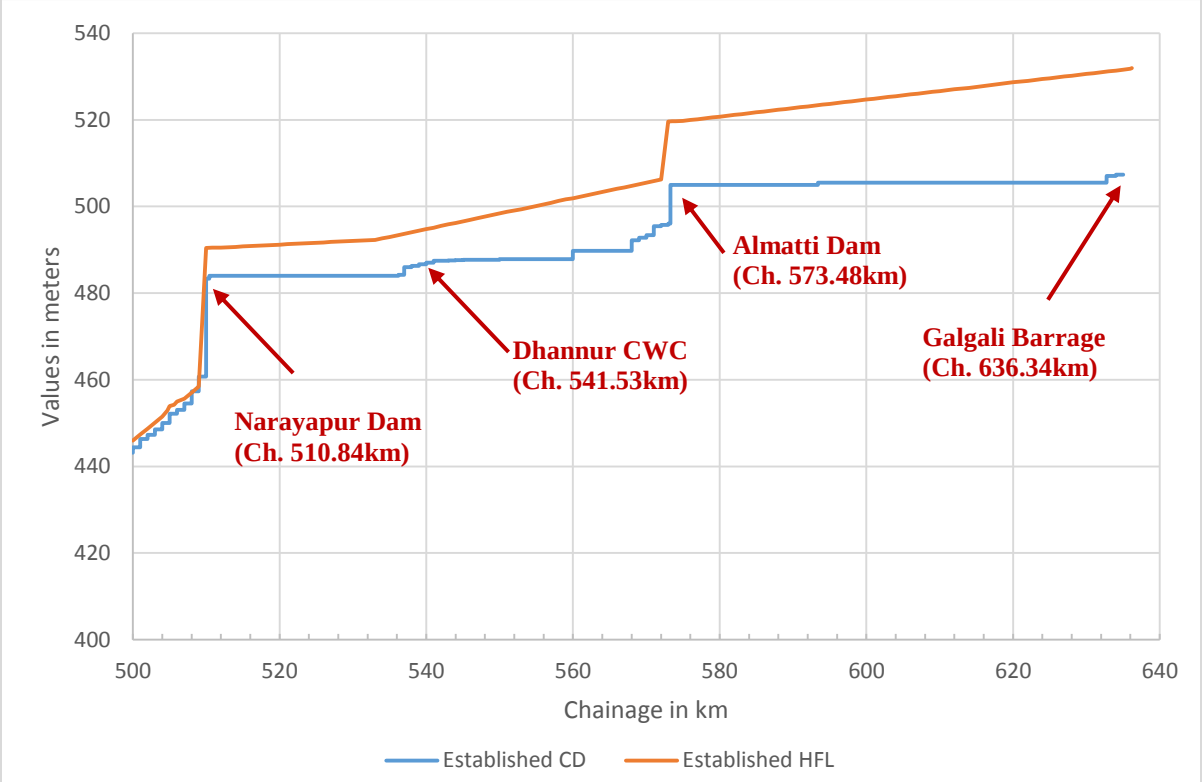


Figure 11 - Sounding Datum and HFL vs Chainage

2.12 Average Bed Slope

The average bed slope of Krishna River is as follows:

Reach and River-bed Level (RBL)		River-bed Level Change (m) (A)	Distance (km) (B)	Slope (A/B)
From	To			
Ch. 0 - RBL_43.821	Ch. 30 - RBL_38.749	5.072	30	1 : 0.169
Ch. 30 - RBL_38.749	Ch. 60 - RBL_144.947	106.198	30	1 : 3.54
Ch. 60 - RBL_144.947	Ch. 90 - RBL_145.06	0.113	30	1 : 0.004
Ch. 90 - RBL_145.06	Ch. 120 - RBL_149.376	4.316	30	1 : 0.144
Ch. 120 - RBL_149.376	Ch. 150 - RBL_237.107	87.731	30	1 : 2.924
Ch. 150 - RBL_237.107	Ch. 180 - RBL_242.909	5.802	30	1 : 0.193
Ch. 180 - RBL_242.909	Ch. 210 - RBL_247.002	4.093	30	1 : 0.136
Ch. 210 - RBL_247.002	Ch. 240 - RBL_247.169	0.167	30	1 : 0.006
Ch. 240 - RBL_247.169	Ch. 270 - RBL_249.356	2.187	30	1 : 0.073
Ch. 270 - RBL_249.356	Ch. 300 - RBL_266.314	16.958	30	1 : 0.565
Ch. 300 - RBL_266.314	Ch. 330 - RBL_308.656	42.342	30	1 : 1.411
Ch. 330 - RBL_308.656	Ch. 360 - RBL_325.018	16.362	30	1 : 0.545
Ch. 360 - RBL_325.018	Ch. 390 - RBL_334.993	9.975	30	1 : 0.333
Ch. 390 - RBL_334.993	Ch. 420 - RBL_343.958	8.965	30	1 : 0.299
Ch. 420 - RBL_343.958	Ch. 450 - RBL_371.206	27.248	30	1 : 0.908

Reach and River-bed Level (RBL)		River-bed Level Change (m) (A)	Distance (km) (B)	Slope (A/B)
From	To			
Ch. 450 - RBL_371.206	Ch. 480 - RBL_415.074	43.868	30	1 : 1.462
Ch. 480 - RBL_415.074	Ch. 510 - RBL_476.336	61.262	30	1 : 2.042
Ch. 510 - RBL_476.336	Ch. 540 - RBL_488.433	12.097	30	1 : 0.403
Ch. 540 - RBL_488.433	Ch. 570 - RBL_494.871	6.438	30	1 : 0.215
Ch. 570 - RBL_494.871	Ch. 600 - RBL_503.495	8.624	30	1 : 0.287
Ch. 600 - RBL_503.495	Ch. 636.2 - RBL_507.783	4.288	36.2	1 : 0.118

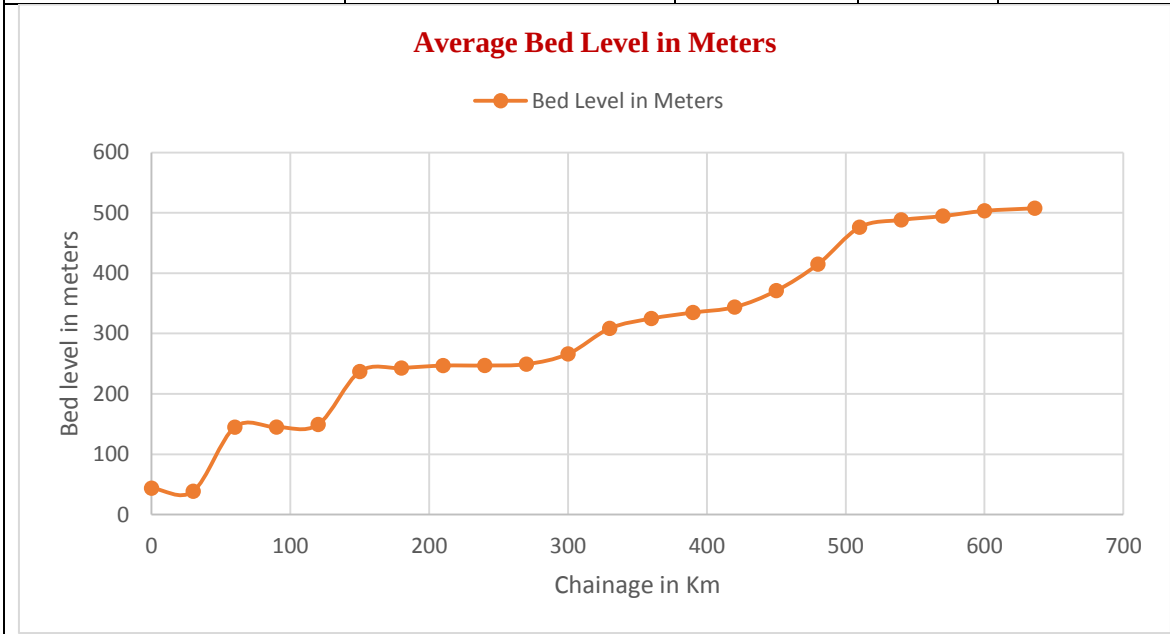


Figure 12 - Average Bed Slope

2.13 Details of Dam, Barrages, Weirs, Anicut

Sl. No.	Structure Name	Ch. (km)	Location	Position (Lat Lon)	Position (UTM)	Length (m)	Width (m)	Height w.r.t MSL (m)	Present Condition
				Left Bank Right Bank	Left Bank Right Bank				
1	Satrasala Check Dam	21.97	Satrasala	**Left Bank:** 16°37'31.4336"N 79°29'27.2423"E **Right Bank:** 16°37'46.2000"N 79°29'14.9900"E	**Left Bank:** 339035.211 1838722.078 **Right Bank:** 338675.551 1839178.695	540	7.5	84.387	Complete and in use
2	Nagarjuna Sagar Dam	44.40	Nagarjuna Sagar	**Left Bank:** 16°34'7.8290"N 79°18'33.6601"E **Right Bank:** 16°34'52.2894"N 79°18'48.2263"E	**Left Bank:** 319613.265 1832618.215 **Right Bank:** 320056.562 1833981.258	1450	10.8	192.249	Complete and in use
3	Srisailam Dam	143.97	Srisailam	**Left Bank:** 16°05'5.8101"N 78°53'52.4719"E **Right Bank:** 16°05'17.3944"N 78°53'42.3479"E	**Left Bank:** 275146.244 1779474.99 **Right Bank:** 274848.941 1779834.203	512	11.2	308.446	Complete and in use

Sl. No.	Structure Name	Ch. (km)	Location	Position (Lat Lon)	Position (UTM)	Length (m)	Width (m)	Height w.r.t MSL (m)	Present Condition
				Left Bank Right Bank	Left Bank Right Bank				
4	Jurial Weir	317.53	Jurial	**Left Bank:** 16°18'12.1866"N 77°46'9.3968"E **Right Bank:** 16°18'51.12"N 77°46'29.44"E	**Left Bank:** 795935.801 1804503.414 **Right Bank:** 796515.07 1805709.4	1349	54.58	292.052	Complete and in use
5	Jurala Bridge/Barrage	325.57	Jurala	**Left Bank:** 16°19'50.8600"N 77°42'11.4400"E **Right Bank:** 16°20'33.7759"N 77°42'15.7782"E	**Left Bank:** 788827.431 1807443.398 **Right Bank:** 788938.73 1808765.039	1286	8.77	324.908	Complete and in use
6	Gugal Bridge/Barrage	395.09	Gugal	**Left Bank:** 16°28'27.9998"N 77°08'46.8788"E **Right Bank:** 16°28'56.0525"N 77°08'49.3276"E	**Left Bank:** 729137.474 1822634.464 **Right Bank:** 729200.949 1823497.741	852	7.29	347.999	Complete and in use
7	Benchigaddi Check Dam	481.40	Benchigaddi	**Left Bank:** 16°19'52.4503"N 76°33'12.8042"E **Right Bank:** 16°19'53.8797"N 76°33'12.5156"E	**Left Bank:** 665958.11 1806208.22 **Right Bank:** 665949.21 1806252.09	45.35	6.18	392.266	Complete and in use
8	Gedalmari Check Dam	484.14	GedalMari	**Left Bank:** 16°18'17.9064"N 76°31'59.2029"E **Right Bank:** 16°19'11.1200"N 76°32'22.1016"E	**Left Bank:** 663795.511 1803285.724 **Right Bank:** 664462.877 1804926.443	2373	22.3	394.561	Complete and in use
9	Yalgundi Weir	498.99	Yalgundi	**Left Bank:** 16°16'18.0300"N 76°27'1.0500"E **Right Bank:** 16°16'27.2200"N 76°26'56.3900"E	**Left Bank:** 654971.627 1799536.57 **Right Bank:** 654831.281 1799818.047	40.56	4.66	409.258	Complete and in use
10	Narayanpur Weir	505.65	Narayanpur	**Left Bank:** 16°14'38.9000"N 76°22'56.2700"E **Right Bank:** 16°14'53.7100"N 76°22'54.6200"E	**Left Bank:** 647725.403 1796439.512 **Right Bank:** 647673.342 1796894.36	12.56	4.35	466.639	Complete and in use
11	Narayanpur Dam	510.84	Narayanpur	**Left Bank:** 16°11'57.4200"N 76°21'35.6500"E **Right Bank:** 16°14'9.7000"N 76°20'10.6400"E	**Left Bank:** 645364.649 1791460.524 **Right Bank:** 642813.601 1795509.437	460.75	6.84	495.921	Complete and in use
12	Almatti Dam	573.48	Almatti	**Left Bank:** 16°19'36.5834"N 75°53'3.6259"E **Right Bank:** 16°20'8.0833"N 75°53'21.9381"E	**Left Bank:** 594464.827 1805292.849 **Right Bank:** 595003.999 1806263.216	1564.83	8.21	529.464	Complete and in use
13	Galgali Barrage	636.34	Galgali	**Left Bank:** 16°25'24.0246"N 75°26'12.3464"E **Right Bank:** 16°25'36.2150"N 75°26'17.5374"E	**Left Bank:** 546630.669 1815814.084 **Right Bank:** 546783.808 1816189.007	419.67	3.9	512.36	Complete and in use

Table 26 - Cross Structures w.r.t. MSL

2.14 Details of Locks

No Locks are present in the survey stretch of the Krishna River.

2.15 Details of Aqueducts

No Aqueducts are present in the survey stretch of the Krishna River.

2.16 Details of Bridges and Crossings over waterway

Sl. No.	Structure Name	Chainage (km)	Location	Position (Lat Long) left bank / Right Bank	Position (UTM) left bank / Right Bank	Length (m)	Width (m)	No. of Piers	Horizontal clearance (Dist. Between piers) (m)	Vertical clearance w.r.t .HFL (m)
1	Highway Bridge	0.03	Wazirabad	**Left Bank:** 16°40'50.6250"N 79°39'35.2222"E **Right Bank:** 16°41'0.5954"N 79°39'19.2057"E	**Left Bank:** 357092.766 1844716.066 **Right Bank:** 356620.360 1845025.703	450	13.75	14	35	7.31
2	Railway Bridge	0.43	Pondugula	**Left Bank:** 16°40'40.6255"N 79°39'25.9997"E **Right Bank:** 16°40'49.5713"N 79°39'12.4493"E	**Left Bank:** 356817.492 1844410.566 **Right Bank:** 356417.923 1844688.222	480	5.2	9	41.5	16.58
3	Highway Bridge	42.41	Nagarjuna Sagar	**Left Bank:** 16°34'31.2394"N 79°19'51.9107"E **Right Bank:** 16°34'49.5288"N 79°19'41.4270"E	**Left Bank:** 321938.991 1833318.425 **Right Bank:** 321632.895 1833883.207	645	10.75	15	36	22.62
4	Ruined Bridge	43.19	Nagarjuna Sagar	**Left Bank:** 16°34'20.7773"N 79°19'23.4647"E **Right Bank:** 16°34'42.4391"N 79°19'21.1843"E	**Left Bank:** 321093.051 1833003.855 **Right Bank:** 321031.013 1833670.281	663.45	13.36	35	18.51	0.80
5	Highway Bridge	142.02	Sundipenta	**Left Bank:** 16°05'39.2584"N 78°54'42.9042"E **Right Bank:** 16°05'55.8618"N 78°54'36.2215"E	**Left Bank:** 276655.696 1780488.126 **Right Bank:** 276462.230 1781000.590	530	9.32	10	45	61.88
6	Highway Bridge	292.78	Beechupalli	**Left Bank:** 16°09'36.6644"N 77°55'54.9857"E	**Left Bank:** 813558.218 1788888.546	948.26	7.52	55	17.5	31.02

Sl. No.	Structure Name	Chainage (km)	Location	Position (Lat Long) left bank / Right Bank	Position (UTM) left bank / Right Bank	Length (m)	Width (m)	No. of Piers	Horizontal clearance (Dist. Between piers) (m)	Vertical clearance w.r.t .HFL (m)
				Right Bank: 16°09'52.4052"N 77°56'22.7468"E	**Right Bank:** 814376.614 1789384.531					
7	Highway Bridge	292.80	Beechupalli	**Left Bank:** 16°09'37.1722"N 77°55'54.6384"E	**Left Bank:** 813547.672 1788904.021	964.37	6.44	27	33.5	33.16
				Right Bank: 16°09'53.0496"N 77°56'22.5912"E	**Right Bank:** 814371.705 1789404.287					
8	Railway Bridge	307.63	Yenkampeta	**Left Bank:** 16°15'14.3585"N 77°50'39.9820"E	**Left Bank:** 804049.672 1799144.194	843.87	3.26	32	23.425	44.32
				Right Bank: 16°15'37.3736"N 77°50'58.5476"E	**Right Bank:** 804591.450 1799859.800					
9	Bridge/Barrage	325.57	Jurala	**Left Bank:** 16°19'50.8600"N 77°42'11.4400"E	**Left Bank:** 788827.431 1807443.398	1286	8.77	62	12.04	2.69
				Right Bank: 16°20'33.7716"N 77°42'15.7780"E	**Right Bank:** 788938.728 1808764.906					
10	Under construction Bridge	346.19	Agrahar	**Left Bank:** 16°21'0.6081"N 77°31'45.7954"E	**Left Bank:** 770221.169 1809349.609	567.44	6.16	22	27.56	0.00
				Right Bank: 16°21'14.4507"N 77°31'58.6250"E	**Right Bank:** 770596.806 1809780.047					
11	Under construction Bridge	348.25	Korvakhurd	**Left Bank:** 16°21'2.0103"N 77°30'46.5549"E	**Left Bank:** 768461.674 1809370.929	289.68	7.65	12	26.04	0.00
				Right Bank: 16°21'9.6883"N 77°30'52.2673"E	**Right Bank:** 768628.365 1809609.142					
12	Highway Bridge	367.34	Deosugur	**Left Bank:** 16°22'47.2881"N 77°21'23.9312"E	**Left Bank:** 751719.712 1812408.190	756.6	7.45	34	18	6.68
				Right Bank: 16°23'12.0945"N 77°21'23.9640"E	**Right Bank:** 751711.833 1813170.982					
13	Railway Bridge	370.85	Shaktinagar	**Left Bank:** 16°23'30.2599"N 77°19'40.4485"E	**Left Bank:** 748632.771 1813694.090	1181.7	11.23	35	32	2.80
				Right Bank: 16°24'8.2962"N 77°19'44.4357"E	**Right Bank:** 748737.691 1814865.020					

Sl. No.	Structure Name	Chainage (km)	Location	Position (Lat Long) left bank / Right Bank	Position (UTM) left bank / Right Bank	Length (m)	Width (m)	No. of Piers	Horizontal clearance (Dist. Between piers) (m)	Vertical clearance w.r.t .HFL (m)
14	Highway Bridge	433.54	Hoovina Hedagi	**Left Bank:** 16°29'35.1100"N 76°55'8.7100"E **Right Bank:** 16°29'18.6000"N 76°55'15.2600"E	**Left Bank:** 704847.272 1824453.286 **Right Bank:** 705046.377 1823947.581	547.92	7.62	17	28.8	8.39
15	Highway Bridge	469.32	Hunsiholi	**Left Bank:** 16°21'53.7653"N 76°39'32.4649"E **Right Bank:** 16°22'11.7435"N 76°39'20.9226"E	**Left Bank:** 677196.159 1810026.074 **Right Bank:** 676849.130 1810575.898	643.93	8.29	20	28.545	50.85
16	Local Bridge	479.43	Benchhigadi	**Left Bank:** 16°20'29.1905"N 76°34'29.7607"E **Right Bank:** 16°20'30.7602"N 76°34'28.6066"E	**Left Bank:** 668233.432 1807355.044 **Right Bank:** 668198.807 1807403.025	35.19	6.02	6	5.46	43.24
17	Local Bridge	480.66	Yedalbhavi	**Left Bank:** 16°19'55.7200"N 76°33'46.3479"E **Right Bank:** 16°19'57.6658"N 76°33'46.2042"E	**Left Bank:** 666952.908 1806316.334 **Right Bank:** 666948.185 1806376.111	24.6	5.46	4	6.31	43.32
18	Local Bridge-4	480.75	Benchhigadi	**Left Bank:** 16°19'56.0632"N 76°33'42.9679"E **Right Bank:** 16°19'57.5159"N 76°33'43.0076"E	**Left Bank:** 666852.511 1806326.114 **Right Bank:** 666853.347 1806370.776	37.64	2.73	6	5.8	39.86
19	Local Bridge-3	482.07	Benchhigadi	**Left Bank:** 16°19'34.8602"N 76°32'58.9501"E **Right Bank:** 16°19'35.5566"N 76°32'57.8717"E	**Left Bank:** 665551.039 1805664.425 **Right Bank:** 665518.870 1805685.588	36.08	2.04	6	5.18	33.58
20	Local Bridge-2	482.66	Benchhigadi	**Left Bank:** 16°19'23.0442"N 76°32'44.1237"E **Right Bank:** 16°19'24.1467"N 76°32'43.7496"E	**Left Bank:** 665113.740 1805297.901 **Right Bank:** 665102.381 1805331.703	34.83	2.06	6	5.38	30.79
21	Local Bridge-1	483.15	Benchhigadi	**Left Bank:** 16°19'15.1647"N 76°32'30.3305"E **Right Bank:**	**Left Bank:** 664706.181 1805052.611 **Right**	38.5	1.92	7	5.2	39.36

Sl. No.	Structure Name	Chainage (km)	Location	Position (Lat Long) left bank / Right Bank	Position (UTM) left bank / Right Bank	Length (m)	Width (m)	No. of Piers	Horizontal clearance (Dist. Between piers) (m)	Vertical clearance w.r.t .HFL (m)
				16°19'16.1666"N 76°32'29.5937"E	**Bank:** 664684.077 1805083.241					
22	Hanchinal-Kadadargaddi Bridge	490.96	Hanchinal	**Left Bank:** 16°16'25.6049"N 76°28'59.2820"E **Right Bank:** 16°16'29.8039"N 76°29'0.4331"E	**Left Bank:** 658479.967 1799794.571 **Right Bank:** 658513.205 1799923.880	126.9	5.56	13	9.64	32.69
23	Local Bridge	494.51	Hanchinal	**Left Bank:** 16°14'28.7969"N 76°28'53.5609"E **Right Bank:** 16°14'35.5251"N 76°28'47.5629"E	**Left Bank:** 658336.118 1796203.166 **Right Bank:** 658156.527 1796408.673	242.32	5.43	15	7.5	32.74
24	Jaladurga-Kote Bridge	500.55	Jaladurga	**Left Bank:** 16°14'49.8389"N 76°25'38.4807"E **Right Bank:** 16°14'55.2182"N 76°25'39.4543"E	**Left Bank:** 652539.274 1796808.759 **Right Bank:** 652567.028 1796974.294	169.94	8.41	4	39.01	13.66
25	Highway Bridge	510.00	Narayanpur	**Left Bank:** 16°13'16.7557"N 76°21'4.9569"E **Right Bank:** 16°13'49.9654"N 76°20'43.4108"E	**Left Bank:** 644437.087 1793892.816 **Right Bank:** 643790.601 1794909.281	1191	10.19	62	17.5	7.21
26	Highway Bridge	541.49	Dhannur	**Left Bank:** 16°11'39.6391"N 76°05'51.4577"E **Right Bank:** 16°12'2.5247"N 76°06'3.4568"E	**Left Bank:** 617328.766 1790746.306 **Right Bank:** 617681.318 1791451.526	767	10.5	8	24.5	10.56
27	Highway Bridge	569.60	Hisur	**Left Bank:** 16°18'51.0287"N 75°55'8.1685"E **Right Bank:** 16°19'17.8523"N 75°55'12.4125"E	**Left Bank:** 598166.840 1803909.281 **Right Bank:** 598289.067 1804734.151	803	11.35	9	27.385	1.98
28	Highway Bridge	571.58	Almati	**Left Bank:** 16°19'6.7673"N 75°54'6.9727"E **Right Bank:** 16°19'33.6168"N 75°54'7.4411"E	**Left Bank:** 596348.644 1804384.827 **Right Bank:** 596358.892 1805209.985	690	10.5	8	26.88	0.67
29	Railway	571.85	Almati	**Left Bank:**	**Left Bank:**	858	3.2	10	20	0.09

Sl. No.	Structure Name	Chainage (km)	Location	Position (Lat Long) left bank / Right Bank	Position (UTM) left bank / Right Bank	Length (m)	Width (m)	No. of Piers	Horizontal clearance (Dist. Between piers) (m)	Vertical clearance w.r.t .HFL (m)
	Bridge			16°19'12.2107"N 75°53'55.4485"E **Right Bank:** 16°19'39.8224"N 75°54'2.2149"E	596005.920 1804550.594 **Right Bank:** 596202.966 1805400.000					
30	Highway Bridge	597.52	Rolli	**Left Bank:** 16°24'16.0946"N 75°41'21.6739"E **Right Bank:** 16°25'52.8265"N 75°41'39.2131"E	**Left Bank:** 573606.353 1813801.576 **Right Bank:** 574116.407 1816775.860	2982	10.8	76	37.2	5.24
31	Bridge	636.21	Galgali	**Left Bank:** 16°25'35.0637"N 75°26'21.7179"E **Right Bank:** 16°25'19.2806"N 75°26'14.8848"E	**Left Bank:** 546907.867 1816153.898 **Right Bank:** 546706.265 1815668.472	525.84	10.3	21	22.4	5.04

Table 27 - Bridges crossing over waterway

2.17 Details of other Cross structures, pipe-lines, underwater cables

Other cross structures found in the survey stretch of Krishna River.

Sl. No.	Structure Name	Ch. (km)	Location	Position (Lat Lon)	Position (UTM)	Length (m)	Width (m)	Height w.r.t MSL (m)	Present Condition
				Left Bank Right Bank	Left Bank Right Bank				
1	Jurial Weir Power House	317.43	Jurial	**Left Bank:** 16°18'43.75"N 77°46'36.50"E **Right Bank:** 16°18'47.9394"N 77°46'38.1513"E	**Left Bank:** 796727.65 1805485.18 **Right Bank:** 796774.948 1805614.704	135.16	67.18	313.677	Complete and in use
2	Benchigaddi Power House	480.69	Benchigaddi	**Left Bank:** 16°19'55.1000"N 76°33'39.2700"E **Right Bank:** 16°19'58.1800"N 76°33'39.0800"E **Right Bank:** 16°16'27.2200"N 76°26'56.3900"E	**Left Bank:** 666742.985 1806295.668 **Right Bank:** 666736.62 1806390.294 **Right Bank:** 654831.281 1799818.047	94.61	18.3	380.65	Complete and in use
3	BPCL-Power Station	504.73	Narayanpur Rural	**Left Bank:** 16°15'12.2637"N 76°23'17.1791"E **Right Bank:** 16°15'10.8554"N 76°23'18.4606"E	**Left Bank:** 648339.260 1797469.131 **Right Bank:** 648377.601 1797426.106	57.52	37.01	454.032	Complete and in use

Table 28 - Other Cross Structures

2.18 Details of High Tension Lines

Sl. No.	Type of line	Chainage (km)	Location	Position (Lat Lon)	Position (UTM)	Vertical clearance w.r.t. HFL(m)	Remarks (complete / under - construction)
				Left Bank Right Bank	Left Bank Right Bank		
1	HTP	0.090	Pondugula	**Left Bank:** 16°40'50.1765"N 79°39'32.2758"E **Right Bank:** 16°40'58.7492"N 79°39'18.2834"E	**Left Bank:** 357005.391 1844702.868 **Right Bank:** 356592.656 1844969.142	33.654	Complete
2	HTP	15.770	Samadanam Peta-1	**Left Bank:** 16°37'44.89"N 79°32'36.85"E **Right Bank:** 16°38'7.57"N 79°32'32.49"E	**Left Bank:** 344657.74 1839094.74 **Right Bank:** 344533.41 1839792.3	13.110	Complete
3	HTP	15.807	Samadanam Peta-2	**Left Bank:** 16°37'42.38"N 79°32'31.16"E **Right Bank:** 16°38'12.76"N 79°32'26.45"E	**Left Bank:** 344488.16 1839018.55 **Right Bank:** 344355.22 1839953.46	12.432	Complete
4	HTP	37.305	Chintalapalem 3	**Left Bank:** 16°34'43.4779"N 79°22'36.4592"E **Right Bank:** 16°35'12.2591"N 79°22'30.5002"E	**Left Bank:** 326819.852 1833654.625 **Right Bank:** 326650.373 1834540.742	18.869	Complete
5	HTP	37.417	Chintalapalem 2	**Left Bank:** 16°34'45.0174"N 79°22'32.3155"E **Right Bank:** 16°35'10.0100"N 79°22'26.9119"E	**Left Bank:** 326697.402 1833702.942 **Right Bank:** 326543.449 1834472.469	20.659	Complete
6	HTP	37.527	Chintalapalem 1	**Left Bank:** 16°34'43.8900"N 79°22'28.5518"E **Right Bank:** 16°35'12.0430"N 79°22'22.5935"E	**Left Bank:** 326585.556 1833669.19 **Right Bank:** 326415.95 1834535.999	18.299	Complete
7	HTP	40.381	Jammanakota 2	**Left Bank:** 16°34'38.2972"N 79°20'51.0023"E **Right Bank:** 16°35'4.2804"N 79°20'53.2628"E	**Left Bank:** 323692.478 1833520.882 **Right Bank:** 323766.061 1834319.022	17.006	Complete
8	HTP	40.478	Jammanakota 1	**Left Bank:** 16°34'34.5684"N 79°20'46.0997"E **Right Bank:** 16°35'2.2232"N 79°20'49.0754"E	**Left Bank:** 323546.203 1833407.461 **Right Bank:** 323641.414 1834256.808	19.251	Complete
9	HTP	42.487	Vijayapuri North-1	**Left Bank:** 16°34'28.9276"N 79°19'52.7959"E	**Left Bank:** 321964.641 1833247.145	15.797	Complete

Sl. No.	Type of line	Chainage (km)	Location	Position (Lat Lon)	Position (UTM)	Vertical clearance w.r.t. HFL(m)	Remarks (complete / under - construction)
				Left Bank Right Bank	Left Bank Right Bank		
				Right Bank: 16°34'47.6768"N 79°19'37.1933"E	**Right Bank:** 321506.92 1833827.323		
10	HTP	42.538	Vijayapuri North-2	**Left Bank:** 16°34'26.81"N 79°19'52.05"E	**Left Bank:** 321941.99 1833182.23	13.362	Complete
				Right Bank: 16°34'46.48"N 79°19'35.68"E	**Right Bank:** 321456.68 1833790.81		
11	HTP	142.527	Eegalapenta 3	**Left Bank:** 16°05'28.2087"N 78°54'31.9746"E	**Left Bank:** 276327.4 1780151.703	33.387	Complete
				Right Bank: 16°05'51.2406"N 78°54'19.2505"E	**Right Bank:** 275956.378 1780863.625		
12	HTP	142.687	Eegalapenta 2	**Left Bank:** 16°05'29.6119"N 78°54'23.6283"E	**Left Bank:** 276079.758 1780197.355	33.387	Complete
				Right Bank: 16°05'56.9747"N 78°54'10.1573"E	**Right Bank:** 275687.894 1781042.656		
13	HTP	143.527	Eegalapenta 1	**Left Bank:** 16°05'11.8556"N 78°54'5.9585"E	**Left Bank:** 275549.011 1779656.782	33.639	Complete
				Right Bank: 16°05'29.1728"N 78°53'52.4180"E	**Right Bank:** 275151.948 1780193.273		
14	HTP	272.474	Seripalle	**Left Bank:** 16°01'34.0866"N 78°03'6.4034"E	**Left Bank:** 184487.387 1774068.79	50.837	Complete
				Right Bank: 16°01'58.7791"N 78°03'27.2621"E	**Right Bank:** 185118.703 1774819.54		
15	HTP	292.024	Beechupalle20	**Left Bank:** 16°09'10.6901"N 77°56'2.5704"E	**Left Bank:** 813795.102 1788092.766	49.012	Complete
				Center: 16°09'21.6532"N 77°56'18.8225"E	**Center:** 814273.466 1788436.899		
				Right Bank: 16°09'34.9972"N 77°56'39.1770"E	**Right Bank:** 814872.73 1788856.029		
16	HTP	294.940	Gurramgadda-1	**Left Bank:** 16°11'3.7978"N 77°55'45.6883"E	**Left Bank:** 813243.614 1791564.912	46.938	Complete
				Right Bank: 16°11'2.3014"N 77°56'2.4782"E	**Right Bank:** 813743.36 1791526.003		
17	HTP	295.134	Gurramgadda-2	**Left Bank:** 16°10'42.7928"N 77°55'24.6158"E	**Left Bank:** 812626.418 1790909.856	45.507	Complete
				Right Bank: 16°10'58.8967"N 77°55'40.8705"E	**Right Bank:** 813102.551 1791412.107		

Sl. No.	Type of line	Chainage (km)	Location	Position (Lat Lon)	Position (UTM)	Vertical clearance w.r.t. HFL(m)	Remarks (complete / under - construction)
				Left Bank Right Bank	Left Bank Right Bank		
18	HTP	313.056	Gadwal Rural	**Left Bank:** 16°17'1.8048"N 77°48'20.0202"E **Right Bank:** 16°17'18.9352"N 77°48'26.2177"E	**Left Bank:** 799845.658 1802391.619 **Right Bank:** 800022.525 1802921.054	37.611	Complete
19	HTP	314.417	Guntipalle	**Left Bank:** 16°17'26.6341"N 77°47'39.7045"E **Right Bank:** 16°17'40.7856"N 77°47'48.7216"E	**Left Bank:** 798637.519 1803138.896 **Right Bank:** 798899.418 1803577.838	34.014	Complete
20	HTP	317.686	Kothapalle	**Left Bank:** 16°18'14.0422"N 77°46'8.2933"E **Right Bank:** 16°18'50.4085"N 77°46'17.8928"E	**Left Bank:** 795902.248 1804560.043 **Right Bank:** 796172.182 1805682.456	22.589	Complete
21	HTP	322.063	Mulamalla-1	**Left Bank:** 16°19'33.1214"N 77°43'59.9491"E **Right Bank:** 16°19'57.1335"N 77°44'15.1491"E	**Left Bank:** 792057.345 1806940.838 **Right Bank:** 792498.855 1807685.439	22.373	Complete
22	HTP	322.457	Mulamalla-2	**Left Bank:** 16°19'40.4573"N 77°43'48.0620"E **Right Bank:** 16°20'1.8699"N 77°44'3.3169"E	**Left Bank:** 791701.275 1807161.731 **Right Bank:** 792145.496 1807826.393	22.320	Complete
23	HTP	323.534	Chintharevula	**Left Bank:** 16°19'51.3397"N 77°43'15.7248"E **Right Bank:** 16°20'15.8971"N 77°43'27.5535"E	**Left Bank:** 790736.407 1807483.582 **Right Bank:** 791077.598 1808243.582	21.908	Complete
24	HTP	348.844	Korvakhurd	**Left Bank:** 16°21'14.2661"N 77°30'31.0359"E **Right Bank:** 16°21'20.8702"N 77°30'36.0981"E	**Left Bank:** 767996.241 1809742.132 **Right Bank:** 768144.035 1809947.077	11.758	Complete
25	HTP	361.895	Ganjhalli	**Left Bank:** 16°21'58.0478"N 77°24'4.7867"E **Right Bank:** 16°22'26.7557"N 77°24'18.3450"E	**Left Bank:** 756512.568 1810949.986 **Right Bank:** 756904.625 1811837.522	5.158	Complete
26	HTP	408.206	Konkal-1	**Left Bank:** 16°30'46.0337"N 77°02'25.3036"E **Right Bank:** 16°31'11.1612"N 77°02'6.0352"E	**Left Bank:** 717774.946 1826760.858 **Right Bank:** 717195.665 1827527.598	8.429	Complete

Sl. No.	Type of line	Chainage (km)	Location	Position (Lat Lon)	Position (UTM)	Vertical clearance w.r.t. HFL(m)	Remarks (complete / under - construction)
				Left Bank Right Bank	Left Bank Right Bank		
27	HTP	408.524	Konkal-2	**Left Bank:** 16°30'39.6601"N 77°02'17.6628"E **Right Bank:** 16°30'59.8303"N 77°02'0.8105"E	**Left Bank:** 717550.31 1826562.613 **Right Bank:** 717044.23 1827177.677	7.619	Complete
28	HTP	432.845	Hovina Hedagi-1	**Left Bank:** 16°29'26.9632"N 76°55'38.1792"E **Right Bank:** 16°29'48.7705"N 76°55'28.9059"E	**Left Bank:** 705723.722 1824211.168 **Right Bank:** 705442.276 1824878.948	8.940	Complete
29	HTP	433.649	Hovina Hedagi-2	**Left Bank:** 16°29'14.0967"N 76°55'15.3359"E **Right Bank:** 16°29'35.6643"N 76°55'2.5578"E	**Left Bank:** 705049.946 1823809.161 **Right Bank:** 704664.638 1824468.592	9.118	Complete
30	HTP	469.591	Hunsiholi	**Left Bank:** 16°21'46.2127"N 76°39'25.9038"E **Right Bank:** 16°22'6.5136"N 76°39'14.8895"E	**Left Bank:** 677003.347 1809792.332 **Right Bank:** 676671.407 1810413.681	52.858	Complete
31	HTP	502.813	Jaladurga	**Left Bank:** 16°14'58.2873"N 76°24'25.3546"E **Right Bank:** 16°15'11.2150"N 76°24'23.2413"E	**Left Bank:** 650366.32 1797053.39 **Right Bank:** 650300.844 1797450.29	25.956	Complete
32	HTP	504.904	Narayanpur Rural	**Left Bank:** 16°15'0.5003"N 76°23'12.9030"E **Right Bank:** 16°15'7.3381"N 76°23'14.8527"E	**Left Bank:** 648214.754 1797106.729 **Right Bank:** 648271.216 1797317.278	2.809	Complete
33	HTP	509.236	Narayanpur Dam	**Left Bank:** 16°13'39.7418"N 76°21'22.3774"E **Right Bank:** 16°14'11.8790"N 76°20'53.0935"E	**Left Bank:** 644949.7 1794602.692 **Right Bank:** 644073.675 1795584.665	9.242	Complete
34	HTP	565.305	Budihal-3	**Left Bank:** 16°17'43.3755"N 75°57'8.0197"E **Right Bank:** 16°18'5.1536"N 75°57'14.9377"E	**Left Bank:** 601733.288 1801846.565 **Right Bank:** 601935.481 1802516.782	12.487	Complete
35	HTP	566.488	Budihal-4	**Left Bank:** 16°18'10.3453"N 75°56'36.3811"E **Right Bank:** 16°18'30.4484"N 75°56'49.1198"E	**Left Bank:** 600790.446 1802671.005 **Right Bank:** 601165.64 1803290.539	13.188	Complete

Sl. No.	Type of line	Chainage (km)	Location	Position (Lat Lon)	Position (UTM)	Vertical clearance w.r.t. HFL(m)	Remarks (complete / under - construction)
				Left Bank Right Bank	Left Bank Right Bank		
36	HTP	570.974	Almatti Dam Area-2	**Left Bank:** 16°19'5.8073"N 75°54'26.1454"E **Right Bank:** 16°19'31.6643"N 75°54'27.4202"E	**Left Bank:** 596917.733 1804357.851 **Right Bank:** 596952.026 1805152.615	1.382	Complete
37	HTP	571.734	Almatti Dam Area-1	**Left Bank:** 16°19'11.4290"N 75°54'0.5265"E **Right Bank:** 16°19'34.3987"N 75°54'3.6935"E	**Left Bank:** 596156.716 1804527.236 **Right Bank:** 596247.58 1805233.521	17.167	Complete

Table 29 - High Tension Lines

2.19 Current Meter and Discharge details

The Valeport801 Velocity meter was used to log the flow rates of the river. The observations were undertaken on upstream and downstream of the Krishna River on availability of water at the respective benchmarks. The locations of current meter deployment are as follows:

Sample No.	Chainage (km)	Position		Observed Depth (m) (D)	Velocity (m/sec.)	Average Velocity (m/sec.)	X-Sectional area (sq. m.)	Discharge (Cu.m)
		Lat/Long	Easting/ Northing (m)		0.5 D			
IWAI-BM-KRS-C2	626.148	N16°26'59.192" E75°29'47.911"	553016.567 1818753.156	1.6	0.00854	0.022	139.943	3.079
IWAI-BM-KRS-C3	615.528	N16°25'26.367" E75°33'27.460"	559534.829 1815917.725	2.3	0.016086	0.069	407.456	28.114
IWAI-BM-KRS-C4	605.399	N16°26'49.114" E75°37'32.305"	566788.521 1818481.662	1.3	0.01567	0.031	286.696	8.888
IWAI-BM-KRS-C5	593.872	N16°23'38.715" E75°42'58.356"	576478.12 1812662.858	0.7	0.030417	0.089	98.59	8.775
IWAI-BM-KRS-C6	582.584	N16°21'53.852" E75°48'56.873"	587125.812 1809480.554	3.5	0.09263	0.093	1545.846	143.764
IWAI-BM-KRS-C7	574.792	N16°20'24.613" E75°52'44.569"	593892.963 1806766.365	5.2	0.0022545	0.133	2629.586	349.735
IWAI-BM-KRS-C8	565.627	N16°17'58.343" E75°57'00.483"	601507.463 1802305.485	2	0.04326	0.028	414.59	11.609
IWAI-BM-KRS-C9	555.26	N16°17'00.558" E76°02'17.604"	610928.322 1800575.514	2.7	0.018039	0.019	1593.11	30.269
IWAI-BM-KRS-C11	535.212	N16°11'02.521" E76°09'17.525"	623454.524 1789639.142	0.9	0.003627	0.021	608.094	12.77
IWAI-BM-KRS-C12	524.701	N16°09'48.470" E76°15'00.189"	633644.823 1787422.873	1.3	0.051234	0.067	583.243	39.077
IWAI-BM-KRS-C13	517.384	N16°10'50.430" E76°18'05.492"	639136.617 1789361.24	1.3	0.023393	0.074	910.001	67.34
IWAI-BM-KRS-C24	405.333	N16°30'57.640" E77°03'43.500"	720090.515 1827141.296	2.5	0.087549	0.153	521.993	79.865
IWAI-BM-KRS-C25	395.507	N16°28'51.750" E77°08'37.210"	728842.884 1823361.635	1	0.36509	0.365	2393.91	873.777
IWAI-BM-KRS-C30	336.48	N16°20'47.000" E77°36'24.890"	778513.644 1809035.741	2.5	0.32522	0.325	1633.834	530.996
IWAI-BM-KRS-C31	326.224	N16°20'07.860"	788159.417	2.4	0.33963	0.34	2863.671	973.648

Sample No.	Chainage (km)	Position		Observed Depth (m) (D)	Velocity (m/sec.)	Average Velocity (m/sec.)	X-Sectional area (sq. m.)	Discharge (Cu.m)
		Lat/Long	Easting/ Northing (m)		0.5 D			
		E77°41'49.180"	1807957.484					
IWAI-BM-KRS-C41	219.662	N16°04'34.650" E78°24'15.390"	222303.953 1779117.135	1.6	0.012949	0.083	1564.845	129.882
IWAI-BM-KRS-C42	209.417	N16°03'37.680" E78°29'52.404"	232303.421 1777241.697	2.3	0.124	0.17	1295.042	220.157
IWAI-BM-KRS-C43	198.897	N16°03'50.743" E78°35'09.647"	241741.091 1777531.353	1.3	0.012949	0.083	1605.191	133.231
IWAI-BM-KRS-C44	186.406	N16°02'56.318" E78°40'17.329"	250870.3 1775753.066	2	0.124	0.17	1289.795	219.265
IWAI-BM-KRS-C45	177.391	N16°00'33.819" E78°44'23.711"	258148.218 1771290.548	2.1	0.33254	0.329	839.33	276.14
IWAI-BM-KRS-C46	167.104	N16°03'02.405" E78°49'12.665"	266789.018 1775767.001	1.8	0.35934	0.359	1794.77	644.322
IWAI-BM-KRS-C47	157.621	N16°07'45.384" E78°50'02.025"	268347.724 1784451.853	1.5	0.32198	0.322	1465.51	471.894
IWAI-BM-KRS-C48	147.529	N16°06'32.093" E78°52'57.966"	273553.276 1782144.241	2	0.37802	0.378	1240.955	469.081
IWAI-BM-KRS-C50	126.301	N16°12'10.990" E78°56'39.733"	280248.362 1792496.5	2.2	0.32543	0.325	1607.693	522.5
IWAI-BM-KRS-C51	117.042	N16°14'29.482" E79°00'50.821"	287748.27 1796680.662	1.4	0.38871	0.389	1370.046	532.948
IWAI-BM-KRS-C52	105.562	N16°13'51.584" E79°06'41.964"	298165.892 1795416.988	2.2	0.40277	0.403	1936.778	780.522
IWAI-BM-KRS-C53	96.07	N16°13'01.329" E79°11'28.755"	306669.561 1793795.321	2.1	0.32344	0.323	2966.325	958.123
IWAI-BM-KRS-C54	86.295	N16°17'05.187" E79°13'46.916"	310837.764 1801255.568	1.5	0.37506	0.375	2929.25	1098.469
IWAI-BM-KRS-C55	75.6	N16°22'17.804" E79°12'41.644"	308984.225 1810882.255	2	0.32492	0.325	3926.83	1276.22
IWAI-BM-KRS-C56	65.561	N16°27'14.372" E79°13'22.823"	310286.189 1819988.013	2	0.32212	0.326	2876.077	937.601
IWAI-BM-KRS-C57	53.32	N16°32'20.616" E79°14'47.859"	312890.505 1829379.879	2	0.29826	0.298	6600.62	1966.985
IWAI-BM-KRS-C59	32.645	N16°34'47.486" E79°24'55.581"	330944.758 1833744.878	1.5	0.38876	0.389	1189.481	462.708
IWAI-BM-KRS-C61	13.152	N16°38'41.930" E79°33'49.351"	346818.071 1840831.737	1	1.794	1.794	135.283	242.698
IWAI-BM-KRS-C62	4.247	N16°39'31.107" E79°37'46.431"	353853.162 1842295.859	1	2.8429	2.843	174.019	494.736
IWAI-BM-KRS-C63	0.529	N16°40'40.533" E79°39'21.241"	356676.499 1844408.672	2	0.53659	0.021	666.733	14.001

Table 30 - Current Meter Deployment Locations

The collected data is forwaded as deliverable data along with this report.

2.20 Soil Samples and Water Samples

River bed soil sampling was undertaken using Vanveen Grab at respective locations. The samples were sent for analysis purpose of soil lab.

Sample No.	Chainage (km)	Latitude	Easting	Depth (m)
		Longitude	Northing (m)	
IWAI-BM-KRS-C2	626.148	N16°26'59.192" E75°29'47.911"	553016.567 1818753.156	1.6
IWAI-BM-KRS-C3	615.528	N16°25'26.367" E75°33'27.460"	559534.829 1815917.725	2.3
IWAI-BM-KRS-C4	605.399	N16°26'49.114"	566788.521	1.3

Sample No.	Chainage (km)	Latitude Longitude	Easting Northing (m)	Depth (m)
		E75°37'32.305"	1818481.662	
IWAI-BM-KRS-C5	593.872	N16°23'38.715" E75°42'58.356"	576478.12 1812662.858	0.7
IWAI-BM-KRS-C6	582.584	N16°21'53.852" E75°48'56.873"	587125.812 1809480.554	3.5
IWAI-BM-KRS-C7	574.792	N16°20'24.613" E75°52'44.569"	593892.963 1806766.365	5.2
IWAI-BM-KRS-C8	565.627	N16°17'58.343" E75°57'00.483"	601507.463 1802305.485	2
IWAI-BM-KRS-C9	555.26	N16°17'00.558" E76°02'17.604"	610928.322 1800575.514	2.7
IWAI-BM-KRS-C10	545.478	N16°12'45.327" E76°03'56.056"	613891.38 1792746.938	0.7
IWAI-BM-KRS-C11	535.212	N16°11'02.521" E76°09'17.525"	623454.524 1789639.142	0.9
IWAI-BM-KRS-C12	524.701	N16°09'48.470" E76°15'00.189"	633644.823 1787422.873	1.3
IWAI-BM-KRS-C13	517.384	N16°10'50.430" E76°18'05.492"	639136.617 1789361.24	1.3
IWAI-BM-KRS-C24	405.333	N16°30'57.640" E77°03'43.500"	720090.515 1827141.296	2.5
IWAI-BM-KRS-C25	395.507	N16°28'51.750" E77°08'37.210"	728842.884 1823361.635	1
IWAI-BM-KRS-C30	336.48	N16°20'47.000" E77°36'24.890"	778513.644 1809035.741	2.5
IWAI-BM-KRS-C31	326.224	N16°20'07.860" E77°41'49.180"	788159.417 1807957.484	2.4
IWAI-BM-KRS-C41	219.662	N16°04'34.650" E78°24'15.390"	222303.953 1779117.135	3.6
IWAI-BM-KRS-C42	209.417	N16°03'37.680" E78°29'52.404"	232303.421 1777241.697	3
IWAI-BM-KRS-C43	198.897	N16°03'50.743" E78°35'09.647"	241741.091 1777531.353	2.6
IWAI-BM-KRS-C44	186.406	N16°02'56.318" E78°40'17.329"	250870.3 1775753.066	3
IWAI-BM-KRS-C45	177.391	N16°00'33.819" E78°44'23.711"	258148.218 1771290.548	3.5
IWAI-BM-KRS-C46	167.104	N16°03'02.405" E78°49'12.665"	266789.018 1775767.001	3
IWAI-BM-KRS-C47	157.621	N16°07'45.384" E78°50'02.025"	268347.724 1784451.853	4.5
IWAI-BM-KRS-C48	147.529	N16°06'32.093" E78°52'57.966"	273553.276 1782144.241	3
IWAI-BM-KRS-C49	137.351	N16°07'56.523" E78°55'30.465"	278111.759 1784693.909	1.5
IWAI-BM-KRS-C50	126.301	N16°12'10.990" E78°56'39.733"	280248.362 1792496.5	3
IWAI-BM-KRS-C51	117.042	N16°14'29.482" E79°00'50.821"	287748.27 1796680.662	3.5
IWAI-BM-KRS-C52	105.562	N16°13'51.584" E79°06'41.964"	298165.892 1795416.988	4.5
IWAI-BM-KRS-C53	96.07	N16°13'01.329" E79°11'28.755"	306669.561 1793795.321	4
IWAI-BM-KRS-C54	86.295	N16°17'05.187" E79°13'46.916"	310837.764 1801255.568	6
IWAI-BM-KRS-C55	75.6	N16°22'17.804" E79°12'41.644"	308984.225 1810882.255	6.5
IWAI-BM-KRS-C56	65.561	N16°27'14.372" E79°13'22.823"	310286.189 1819988.013	7.2
IWAI-BM-KRS-C57	53.32	N16°32'20.616" E79°14'47.859"	312890.505 1829379.879	3
IWAI-BM-KRS-C59	32.645	N16°34'47.486"	330944.758	2.5

Sample No.	Chainage (km)	Latitude Longitude	Easting Northing (m)	Depth (m)
		E79°24'55.581"	1833744.878	
IWAI-BM-KRS-C60	22.391	N16°37'30.142" E79°29'09.624"	338512.803 1838686.321	3.5
IWAI-BM-KRS-C61	13.152	N16°38'41.930" E79°33'49.351"	346818.071 1840831.737	1.8
IWAI-BM-KRS-C62	4.247	N16°39'31.107" E79°37'46.431"	353853.162 1842295.859	1.4
IWAI-BM-KRS-C63	0.529	N16°40'40.533" E79°39'21.241"	356676.499 1844408.672	4

Table 31 - Water and Soil sample locations

2.20.1 Water Samples

Water sampling was undertaken using Niskin Water Samplers at respective locations. The samples were sent for analysis purpose for lab.

Figure 13 - Soil &Water Sampling of Krishna River

2.20.2 Analysis

The collected samples were analyzed for following properties:-

a) **Soil Samples**

- Grain size Specific gravity
- PH Value
- Cu, Cc
- Clay Silt percentage

b) **Water samples**

- Sediment Concentration

A detailed report on sample analysis is placed at Annexure – 11 and 12 to this report.

3 Description of waterway

The Waterway of Krishna River within survey limits can be broadly divided into twenty one stretches in accordance with the gradient of the river. The details are as follows:

3.1 Sub-Stretch-01: Wazirabad to Thimmaipalem (Chainage 0.0km to 30.0km)

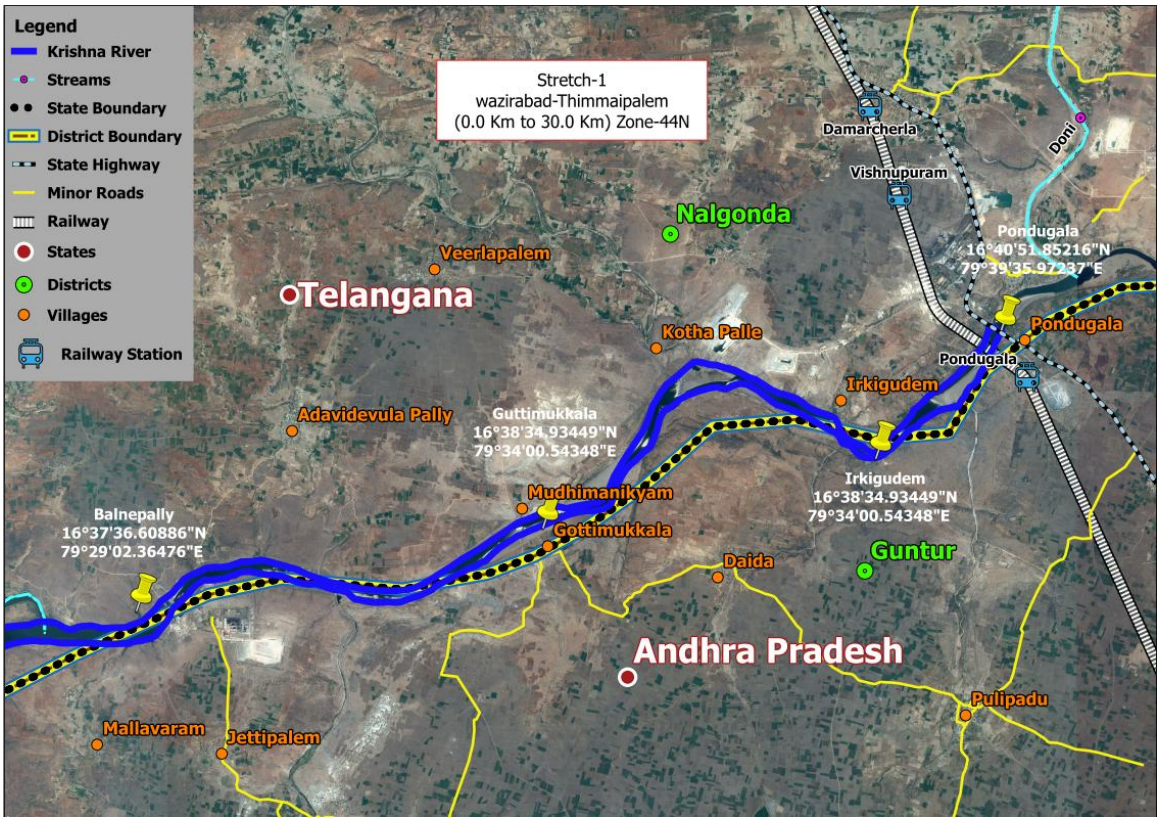


Figure 14 - Stretch-1 Wazirabad to Thimmaipalem

- **Bathymetry Survey**
  a) 27km of the length of the stretch for which the bathymetric survey has been carried out.
- **Topographic Survey**
  b) 3km of the length of the stretch for which h the topographic survey has been carried out.

Wazirabad to Thimmaipalem is 30km stretch. This stretch is partially navigable as surrounded by dry patches and presence of rocks. In this stretch, Krishna River act as like as the border line of Telangana state as well Andhra Pradesh state, whereas on the right bank of the river belongs to Guntur district of Andhra

Pradesh as well the left bank of the river is belong to Nalagonda district of Telangana State.

Wazirabad, Kothapalle, Thallaveerapagudem, Irkigudem, Mudhimanikyam, Veeralapalem, Adavidecullapalle, Balenpally, Chityala, Nadigadda, Thima palm is the nearby villages situated at the right bank of this stretch. These villages are well connected to roadways.

Srinagar, Pullipadu, Daida, Telukutla, Goli, Jettipalem, mallavaram is the nearby villages situated under this right bank of the stretch.

Dachepalli and Myralaguda are the two nearby cities upon this stretch which are coming under Guntur and Nalagonda District of Telangana and Andhra Pradesh States Respectively.

Upon this stretch, IWAI benchmarks from KRS-60 to KRS-63 is constructed. Benchmark number IWAI-BM-KRS-60 is being constructed at left bank of the river at chainage 22.787km at the nearby Chhatrasala village. And KRS-61, 62, and 63 are constructed at 13.288km chainage at Gottimukala village, 3.014km chainage at Pallipadu village and 0.00km chainage at Pondugula village respectively.

At chainage 25.100km a left bank tributary of Krishna called Haliya River is being merged. During a survey, it was found that, two bridges and one Dam are constructed.

At 0.241km chainage a highway bridge is constructed upon the Krishna River, which is under Andhra Pradesh and Telangana state namely as Wazirabad/vadapalli Bridge. This Bridge is connecting way of Guntur and Nalagonda districts.

Figure 15 - Highway Bridge at Wazirabad (ch. 0.03km)

Also a railway bridge found near at 0.66km chainage. This bridge is having a railway connected between Dachepalli of Andhra Pradesh and Myralaguda of Telangana state.

Figure 16 - Pondugula Railway Bridge (ch. 0.43km)

Rentachintala, Gurazala, Dachepalli are the nearby Bus station as well the nearby railway stations constructed upon the right side of the river bank.

State Highway number 2 of Andhra Pradesh state is well attached to this stretch at right bank of the river.

At 4.23km chainage a famous temple was found called Amralingeshwarsamy, which is at Guruzala Mandal of Guntur District.

Figure 17 - Amra Lingeshwar Swamy Temple (ch. 4.23km)

At 21.97km chainage, a dam has constructed which a small dam is called Nagarjuna Sagar Tail pond dam, used for Irrigation and hydroelectric power

purpose. The hydroelectric power project is having the capacity of generate 50MW power. The details of the same is being mentioned below.

Salient Features	
Name of the Powerhouse	Nagarjuna Sagar Tail Pond Power House
State	Telangana
Basin Name	Krishna
Hydroelectric Basin	East Flowing Rivers
Seismic Zone	Seismic Zone-II
Type of Development	Run of the river
Type	Surface
Powerhouse Status	Completed
No. of Turbines/Units (MW)	2
Capacity per turbine (MW)	25
Total Installed Capacity (MW) Sum of IC of all turbines	50
Rated Head (Net RTD) (m)	21
Specific Speed (mkw)	264 mkw
Number of Penstocks	2
Length of Penstock (m)	54.3
Size of Penstocks	Diameter: 6.60 m

Powerhouse at Nagarjuna Sagar Tail pond dam

Table 32 - Power House at Nagarjuna Sagar Tail Pond dam (ch. 21.97km)

As this stretch was found in gravel and crushed stone and three cement industries was found within 5km radius from this stretch. Cement industries are called as Parashakti Cement Industries Limited, India Cement Limited Andhra Cement Limited and Deccan Cement Limited. So did not found much cultivation upon this stretch.

Figure 18 - Cement Industries nearby this stretch

Industries	Latitude/Longitude	Easting/Northing	Chainage (km)
Parashakti Cement Industries	16°37'28.97"N 79°30'22.64"E	340676.37 1838634.17	19.87
India Cement Industries	16°42'0.25"N 79°38'45.04"E	355620.7 1846866.06	-1.25
Deccan Cement Industries	16°42'34.46"N 79°42'38.80"E	362551.66 1847871.59	-5.10
Andhra Cement Industries	16°38'49.63"N 79°42'05.25"E	361512.98 1840967.93	1.36

Table 33 - Cement Industries

From 0.00km chainage of this stretch the river is normally not being so wider having an average width of 200 meter. The bank is normally unprotected. The stretch is having full of rocks and sand patches. Depth varies from 2 to 3 meters. And due to presence of shallow water current flow was vary more upon this stretch.

Also, it was found that at chainage 7.500km chainage the river width was found 700 meters. Where on the left bank a Nala was being merged at Krishna River. No ferry ghat and terminal found upon this stretch.

Figure 19 - Ghat and rock patches upon this stretch

Class	Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity
I	0	30	0	25.12	9870	140,030.71	140,030.71	-2.71	22.09	16000	946,516.66	946,516.66
II	0	30	0	25.12	10070	239,901.87	239,901.87	-2.71	22.09	16100	1,377,403.72	1,377,403.72
III	0	30	0	25.12	10430	431,599.01	431,599.01	-2.71	22.09	17700	2,008,588.85	2,008,588.85
IV	0	30	0	25.12	14260	590,895.78	590,895.78	-2.71	22.09	20800	2,370,414.50	2,370,414.50

Table 34 - Dredging Quantity Details

a) Observed and reduced Bed Profile of the stretch

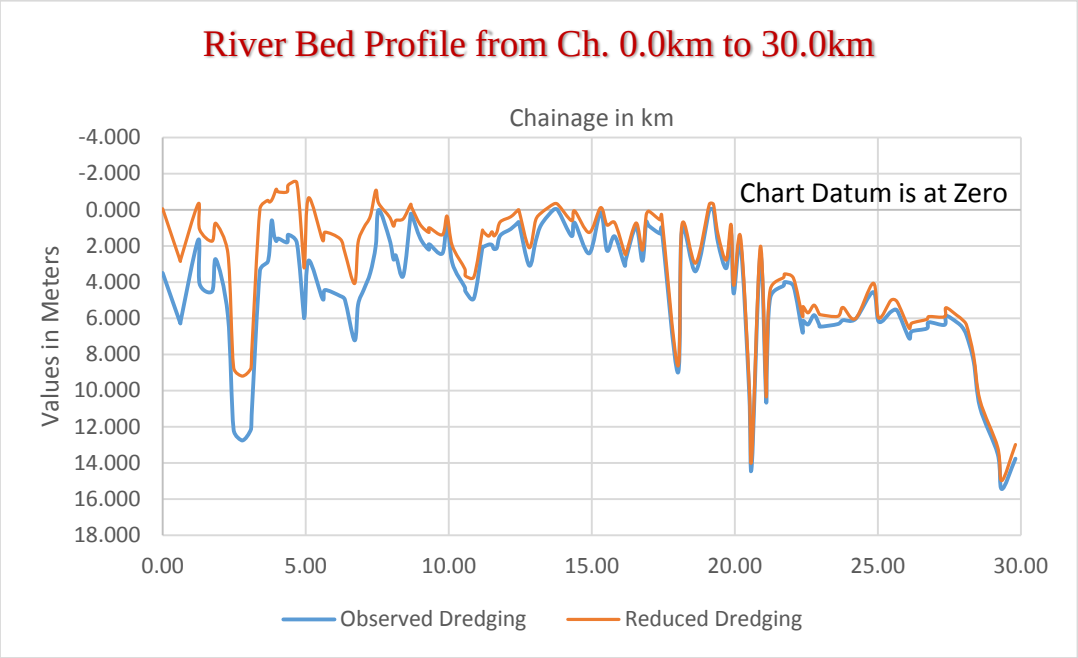


Figure 20 - River Bed Profile

3.2 Sub-Stretch 02: Thimmaipalem to Anupu (Chainage 30.0km to 60.0km)

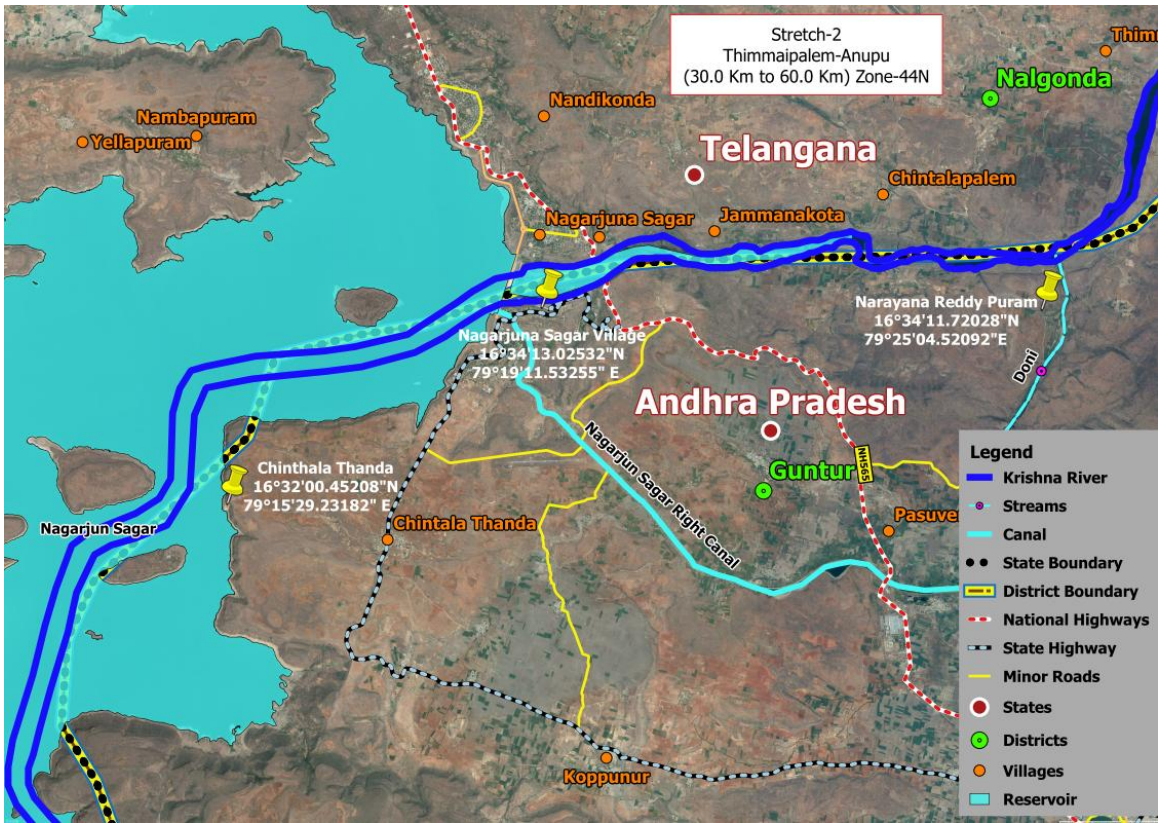


Figure 21 - Stretch-2 Thimmaipalem to Anupu

- **Bathymetry Survey**
  a) 24.1km length of the stretch for which the bathymetric survey has been carried out
- **Topographic Survey**
  b) 5.9km of the length of the stretch for which the topographic survey has been carried out.

In this stretch Damarapadu, Chintalapalem, Nadnikonda, Nellikal, Sunkishala Yellapuram, Konerpuram are the left bank nearby villages. Thallapali, Narareddypuram, Chintalathanda, Vijayapuri are the right bank villages.

Nagarjuna Sagar is the famous place in this stretch. Also found an archaeological tourism place in this stretch.

At a distance of 166km from Hyderabad, 83km from Nalagonda, 149km from Guntur, 551km from Vizag & 190km from Vijayawada, Nagarjuna Sagar located in Nalgonda district of Telangana, is one of the most prominent Buddhist centers

in India. Nagarjuna Sagar is one of the most popular tourist places to visit near Hyderabad and one of the best weekend getaways from Hyderabad city. It is also well known for Nagarjuna Sagar Dam, one of the largest Dam in India

Known in ancient days as Vijayapuri, meaning 'The city of victory', Nagarjuna Sagar takes its present name from Nagarjuna, one of the most revered Buddhist monks lived in the 2nd century AD. It is also a place of immense archaeological significance & excavations revealed this place as a center for the propagation of Buddhist teaching in south India.

One of the early river valley civilizations took birth here. Enthused by the peaceful environs of this place, Buddhists made this land a great hub of learning, setting up one of the four major Viharas here. Further down in history, one of the first Hindu kingdoms of South India, Ikshvakus made this city their capital. Today known as Nagarjuna Sagar, this holy land now boasts one of the world's tallest dams.

Nagarjuna Sagar Dam, Nagarjuna Sagar Wildlife Sanctuary, Nagarjuna Konda Museum, Ettipotalaa Waterfall is the famous attractions of this stretch. Nagarjuna Konda, where the ancient Buddhist excavations are found is in the middle of the waters of Nagarjuna Sagar and can be reached by a boat. Steamboat rides are available to the dam where the turbines cannot see.

Hyderabad airport is the nearest airport, about 153km away. The nearest railway stations are at Macherla (23km) and Nalgonda (83km). Macherla has trains from Guntur, Nadikudi, Vijayawada and Bhimavaram while Nalgonda lies on the Secunderabad-Guntur line and connected with Chennai, Vizag, Tirupati, Vijayawada, Kochi, Coimbatore, etc. Regular buses connect Nagarjuna Sagar with cities like Hyderabad, Warangal, Guntur and Vijayawada.

At chainage 32.33km Ettipotala River a right bank tributary of Krishna River is merged at the confluence of the Krishna River.

Ettipotala waterfall is a 70 foot (21 m) high river cascade, situated in Guntur district, Andhra Pradesh India. Located on the Chandravanka River, which is a tributary of River Krishna joining on its right bank. The waterfall is a combination of three streams, namely Chandravanka Vagu, Nakkala Vagu and Tummala Vagu. It is situated about 11 kilometers (6.8 mi) from Nagarjuna Sagar Dam. The river then joins the Krishna River after the dam after travelling about 3 kilometers (1.9 mi) from the falls. A strategic view point was created by the Andhra Pradesh Tourism department from the adjacent hill. There are Ranganatha and Dattatreya temples in the vicinity. There is a crocodile breeding center of the pond formed by the waterfall. Water from the Nagarjuna Sagar right bank canal is released into the

above streams to keep the waterfall alive or flowing throughout the year for tourism purpose. Ekonampet is the nearby bus-stand for this tourist place. This also famous for crocodile.

Figure 22 - Ettipotala Waterfall (ch. 32.33km)

At 42.41km chainage a highway bridge constructed upon this stretch under Andhra Pradesh state highway no 2, which is a state highway which is connected in between Macherla. Andhra Pradesh state and Myralaguda Telangana State.

Figure 23 - Highway Bridge Downstream of Krishna River (ch. 42.41km)

At chainage 43.19km at Ruined Bridge is found in this stretch, which is submerged during flood, noticed by the local people.

Figure 24 - Broken Bridge at Nagarjuna Sagar (ch. 43.19km)

During the Survey a tallest masonry dam is constructed upon River Krishna at chainage 44.40km.

Nagarjuna Sagar Dam was built across the Krishna river at Nagarjuna Sagar where the river is formed a boundary between the Guntur district of Andhra Pradesh State and Nalgonda district of Telangana state in India. The construction duration of the dam was between the years of 1955 and 1967. The dam created a water reservoir whose gross storage capacity is 11.472 billion cubic meters (405.1×10^9 Cu ft). The dam is 490 feet (150 m) tall from its deepest foundation and 0.99 miles (1.6km) long with 26 flood gates which are 42 feet (13 m) wide and 45 feet (14 m) tall. Nagarjuna Sagar was the earliest in the series of large infrastructure projects termed as "modern temples" initiated for achieving the Green Revolution in India. It is also one of the earliest multi-purpose irrigation and hydroelectric projects in India. The dam provides irrigation water to the Prakasam, Guntur, Krishna, Khammam, West Godavari and Nalagonda districts along with hydro electricity generation. Nagarjuna Sagar dam is designed and constructed to utilize up to the last drop of water impounded in its reservoir of 405 TMC gross storage capacity which is the second biggest water reservoir in India.

Figure 25 - Nagarjuna Sagar Dam (ch. 44.40km)

A hydroelectric power plant was found upon this stretch. The hydroelectric plant has a power generation capacity of 815.6 MW with 8 units (1x110 MW+7x100.8 MW). The first unit was commissioned on 7th March 1978 and 8th unit on 24 December 1985. The right canal plant has a power generation capacity of 90 megawatts (120,000 hp) with 3 units of 30 megawatts (40,000 hp) each. The left canal plant has a power generation capacity of 60 megawatts (80,000 hp) with 2 units of 30 MW each.

Many times, it happens that power generation from the 150 MW canal based units is not optimized when the Nagarjuna Sagar reservoir is overflowing on its spillway and very less water is required for irrigation from the canals during the monsoon floods. Power generation from canal based hydro units can be optimized by running these units during the flooding period by releasing the water fully into the canals. The unwanted canal water can be released into the natural stream when it is crossing the major stream. This run off power can be generated from the water going down unutilized into the river by the canal based power units also.

The water level in the Nagarjuna Sagar reservoir shall be maintained above the minimum level required for these units in most of the time by releasing water from the upstream Srisailam reservoir to optimize the power generation from the canal based units during dry season. Details of the same is mentioned below.

Salient Features		
Hydro Electric Project	Nagarjuna Sagar Hydroelectric Project	
State	Telangana, Andhra Pradesh	
District	Nalagonda	
River	Krishna	
Basin Name	Krishna	
Hydro Electric Region	Southern HE Region	
Total Installed Capacity (MW)	1016	
Type of Project	Major	
Hydroelectric Project Status	Completed	
Project Owner Type	State	
Owner Name	APGENCO	
Inter Basin Project	No	
Project Sharing	None	
International Sharing	None	

Table 35 - Salient Feature of Nagarjuna Sagar Hydro Electric Power Plant (ch. 44.40km)

Two canals are being constructed at both ends of the dam called Nagarjuna Sagar Right bank canal which is famous as Jawaharlal canal, and left bank canal.

There exist three powerhouses one is a main power house which generate 810MW and left bank canal power house generate 60 MW and the right bank power house generate 80 MW. Also, while generating the power the Canal serves as Irrigation as well drinking water purpose for the nearby villages under this stretch.

Upon this stretch, IWAI benchmarks from KRS-57 to KRS-59 is constructed. Benchmark number IWAI-BM-KRS-59 is being constructed on the right bank of the river at chainage 33.123km at the nearby Narareddypuram village. KRS-58, 57, constructed at 44.012km chainage at Vijayapuri village, 54.126km chainage at chintalthanda village.

In this stretch, the artificial lift irrigation based diversion of the river from its natural delta area into Nalagonda district caused erosion of the Florine rich volcanic rocks in Nalagonda and contaminated its ground water supply. It also caused uncertain flows of water into the Krishna River delta area and a shrinkage of the natural wonder The Kolleru Lake. The use of erosion resistant canals interfered with the natural silting process of a river to the deltas and created long term ecological issues to the health of the delta lands.

Upstream of Nagarjuna Sagar upto chainge 60.000km chainage found three Island under this stretch. And one famous Island calls Nagarjuna Konda archaeological tourist place.

Nagarjunakonda the hill that now forms an Island in the middle of the reservoir. A museum at Nagarjunakonda contains Buddhadatu or relics excavated from the valley. The museum at Nagarjunakonda is a structure modelled along the lines of a "Vihara" and contains a number of precious artifacts of all cultural periods through which the valley passed. Carved limestone and stone slabs, inscriptions and sculptures dating to the third and fourth century AD constitute a majority of the exhibits, arranged methodically in five galleries.

The sculpture at Nagarjunakonda brings out the mastery of the Satavahanas and the Ikshvakus. The themes are mainly from episodes involving the Buddha, but the outstanding example of the sculpture of that age is the lifelike depiction of the Enlightened One. The Buddha images, be they in the 'sthanaka (standing) or 'asana (sitting) position, beautifully portray a serene oval face with a moderately-built body and rounded shoulders.

The right hand is held up in the symbolic gesture of 'Abhaya (protection) or 'pravachana (preaching). One can transport oneself into the glorious age through a

model of the submerged valley, exhibited in one of the galleries at the museum. The Nagarjunakonda Island is approachable by motor launch.

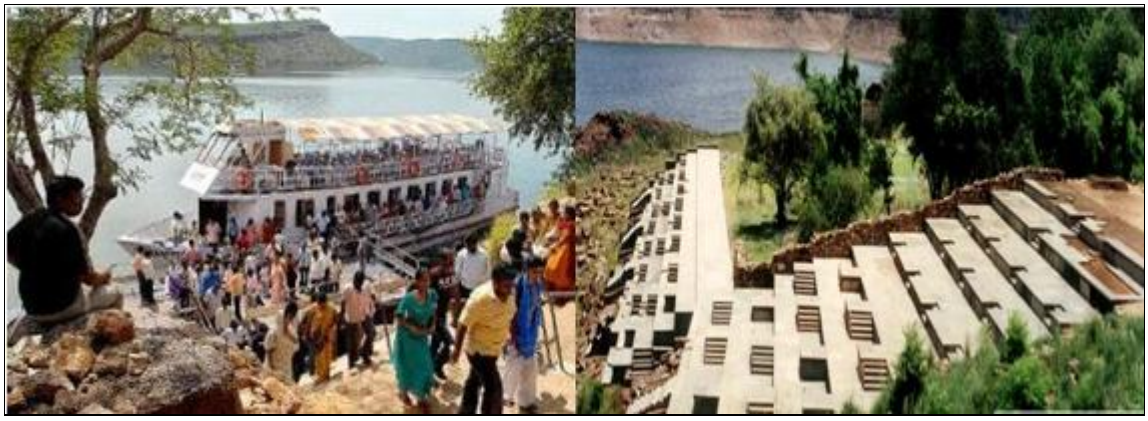


Figure 26 - Ferry services at Nagarjuna Konda and Tourist Place.

Figure 27 - Ferry services at Nagarjuna Sagar to Nagarjunkonda

A ferry services also found from Vijayapuri North to Nagarjunkonda at chainage 45.000km chainage.

At chainage 30.000 to 37.500, the river stretch is having a water depth of minimum 3.00m to a maximum of 12.00m. Also the river bank is not protected as observed highly corrosion at both the bank.

Where ever there is presence of water 3 meters to 5 meters the stretch is having submersible rocks and the presence of rock boulders.

Downstream of the Nagarjuna Sagar Dam was partially dry and though there was the presence of water packets, which was not suitable to carry out bathymetric survey. Topographic survey was conducted from 37.500km chainage to 44.700km chainage.

Figure 28 - Downstream of Nagarjuna Sagar Dam presence of rock boulders and dry patches

Figure 29 - Presence of Rock Boulders in the river

Figure 30 - Erosion at River banks in this stretch

During the survey, it was found that at coordinates 16°30'6.79"N, 79°16'8.51"E a small Ghat was situated, where the fishing boat was park their boats is called Anunupu ghat.

Figure 31 - Ghats near Anupu (ch.57.37km)

At chainage 43.100km near at Pylon colony Nagarjuna Sagar a famous temple was present at left bank of this river stretch. This temple is a holy place, where at Puskarayalu timely people normally take a bath. Namely, as Shivalaayam temple.

Figure 32 - Ghat at Nagarjuna Sagar

Upstream of Nagarjuna Sagar Dam the river width that is from 44.800km chainage to 60.000km chainage the minimum river width is 6km to 7km. Also in between, this stretch three big islands were found. The river is utilized by the local people for cultivation, drinking water and fishing purposes.

From Nagarjuna Sagar towards upstream that is up to Sangameshwara the Krishna River flows in between Nalamala forest region. Which is famously known as Srisailam Nagarjuna Sagar Tiger Reservoir.

Figure 33 - Islands upon this stretch

Class	Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity
I	30	60	0	24.11	7930	322,430.23	462,460.94	-1.77	23.06	8595	402,708.29	1,349,224.95
II	30	60	0	24.11	8105	493,257.88	733,159.75	-1.77	23.06	8685	601,533.85	1,978,937.57
III	30	60	0	24.11	8350	750,308.47	1,181,907.48	-1.77	23.55	9300	899,120.83	2,907,709.68
IV	30	60	0	24.47	8600	910,603.69	1,501,499.47	-1.77	23.55	10000	1,085,305.62	3,455,720.12

Table 36 - Dredging Quantity Details

a) Observed and reduced Bed Profile of the stretch

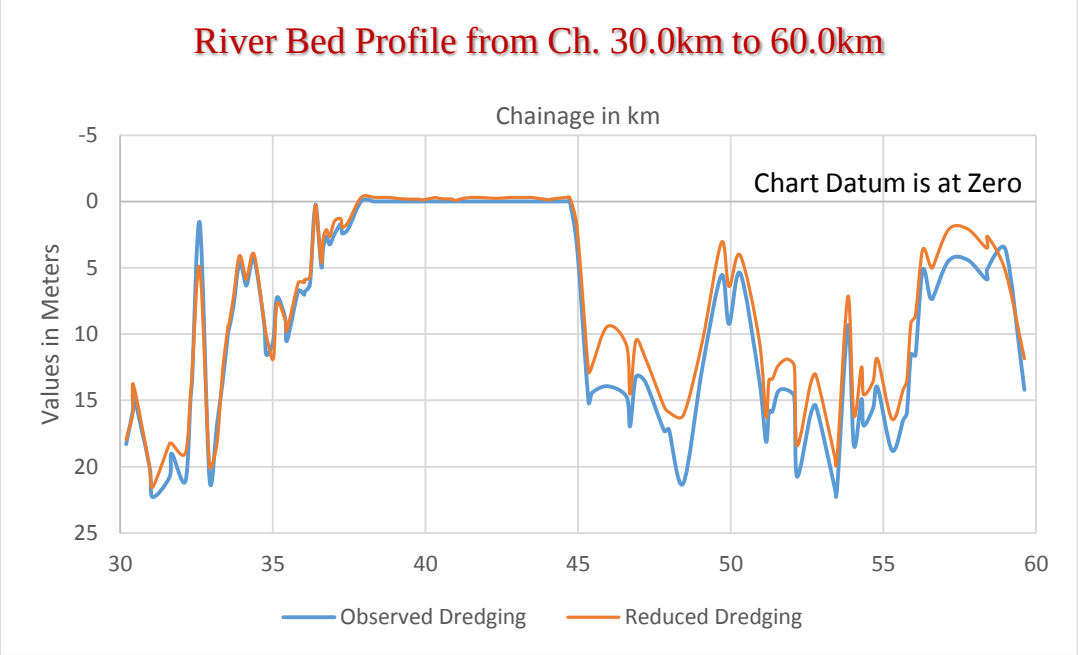


Figure 34 - River Bed Profile

3.3 Sub Stretch 03: Anupu to Hanumapuram (Chainage 60.0km to 90.0km)

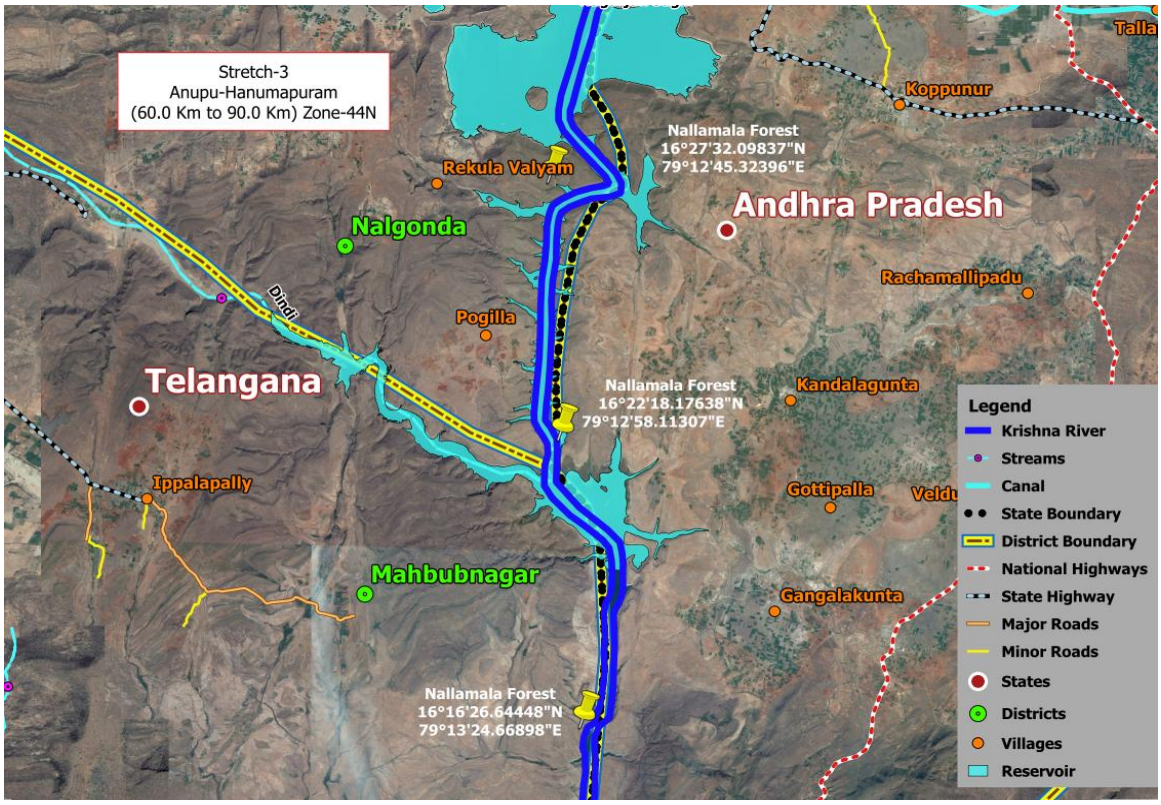


Figure 35 - Stretch-3 Anupu to Hanumapuram

- **Bathymetry Survey**
  a) 30km of the length of the stretch for which the bathymetric survey has been carried out.
- **Topographic Survey**
  b) 0.00km of the length of the stretch for which the topographic survey has been carried out.

This stretch is between 60.0 to 90.0km chainage of Anupu Ghat to Hanumapuram.

Upon this stretch, IWAI benchmarks from KRS-56 to KRS-54 is constructed. Benchmark number IWAI-BM-KRS-56 is being constructed at the left bank of the river at chainage 66.308km in the Nalamala Forest Region. Kopunuru is the nearby village which is situated around 10km from this stretch. And KRS- 55 constructed in 75.752km chainage in the Nalamala forest region, Gangalakunta is the nearby villages which situated approx. 10km from this stretch which is situated on the right bank of the river.

At 87.700km chainage IWAI-BM-KRS-54 is constructed in the Nalamala forest region. Hanumapuram is the nearby village in this region.

Gangalakunta is a Village in Veldurthy Mandal in Guntur District of Andhra Pradesh State, India. It belongs to Andhra region.

Macherla, Vinukonda, Devarakonda, Srisailam Project (Right Flank Colony) Township are the nearby Cities to Gangalakunta.

Hanumapuram is situated 08km away from the river. Hanumapuram is a small village/hamlet in Bollapalle Mandal in Guntur District of Andhra Pradesh State, India. It comes under Garikapadu Panchayath. It belongs to Andhra region. It is located 93km towards west from District headquarters Guntur 21km from Bollapalli.

In this stretch at chainage 77.100km River Dindi, Merges with Krishna River. Dindi River is an important tributary of the Krishna River. The river flows through Mahabubnagar and Nalagonda districts and finally converges with the Krishna River. At this converges point, Krishna River found a width of more than 2km.

This place is border of 3 districts Guntur, Andhra Pradesh. Nalagonda, and Mahabubnagar of Telangana State. This location is very nice to have adventure tourism by air, water and land. AS per the fisherman though there were no villages and population present, this place is named as Jendapenta.

Guttalacheruvu, Allatam, Ponnala Bayalu, Naruthadikala, Suddakunta Penta, Bai Penta, Billagondi Penta, Garini Penta, Madam Chalama' Dara Bayalu, Telugurayani, Cheruvu are the nearby villages at this stretch.

The road and rail connectivity are away from 10km of this stretch. State Highway number 88 of Andhra Pradesh passes at right bank of the river at a distance of 15km from this stretch.

As the river flows in this stretch in a Hilly region and surrounded by a dense forest reservoir called Srisailam Nagarjun Tiger Reservoir, so people are abided from this stretch. So no cultivation found at both the banks of this stretch. Fishing activities found during the survey.

As per the nearby villagers in this stretch, they used to follow the waterway by their small boats for fishing purposes.

Figure 36 - Fishing activities by the local villagers

It is found that the river is having full of water in this stretch, also both the bank is unprotected and highly erosive in nature and having an average depth of 10 to 15 meters. This stretch can be used as a waterway.

Figure 37 - Erosive banks

Class	Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity
I	60	90	11.31	14.7	0	0.00	462,460.94	8.97	12.37	0	0.00	1,349,224.95
II	60	90	10.88	14.7	0	0.00	733,159.75	8.57	12.37	0	0.00	1,978,937.57
III	60	90	10.88	14.72	0	0.00	1,181,907.48	8.57	12.37	0	0.00	2,907,709.68
IV	60	90	10.88	14.72	0	0.00	1,501,499.47	8.57	12.37	0	0.00	3,455,720.12

Table 37 - Dredging Quantity Details

b) Observed and reduced Bed Profile of the stretch

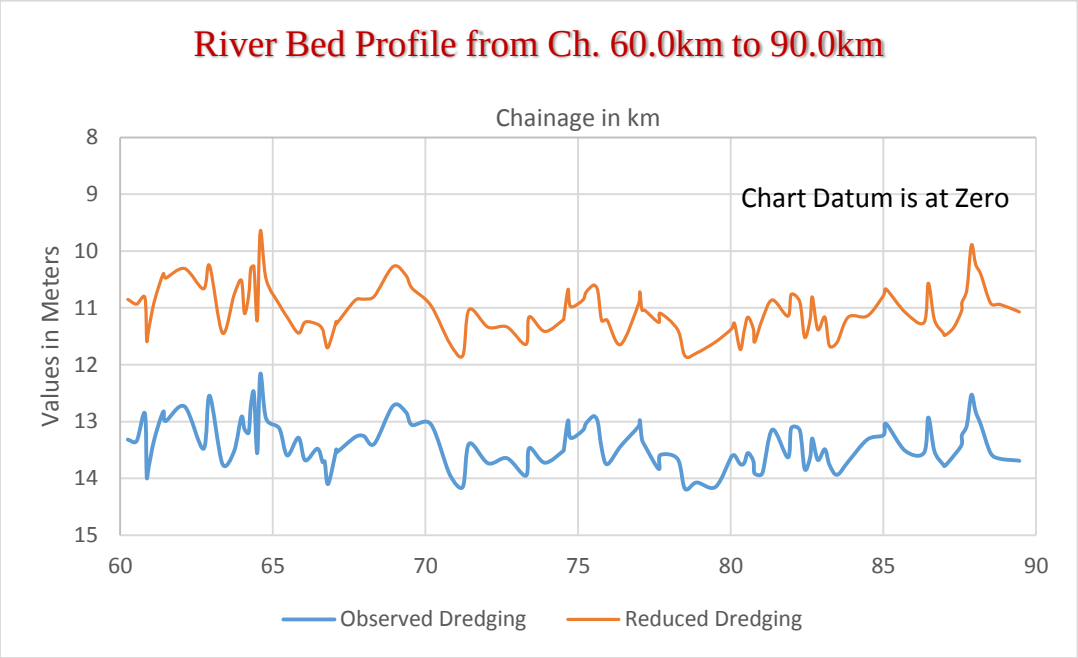


Figure 38 - River Bed Profile

3.4 Sub Stretch 04: Hanumapuram to Palutla (Chainage 90.0km to 120.0km)

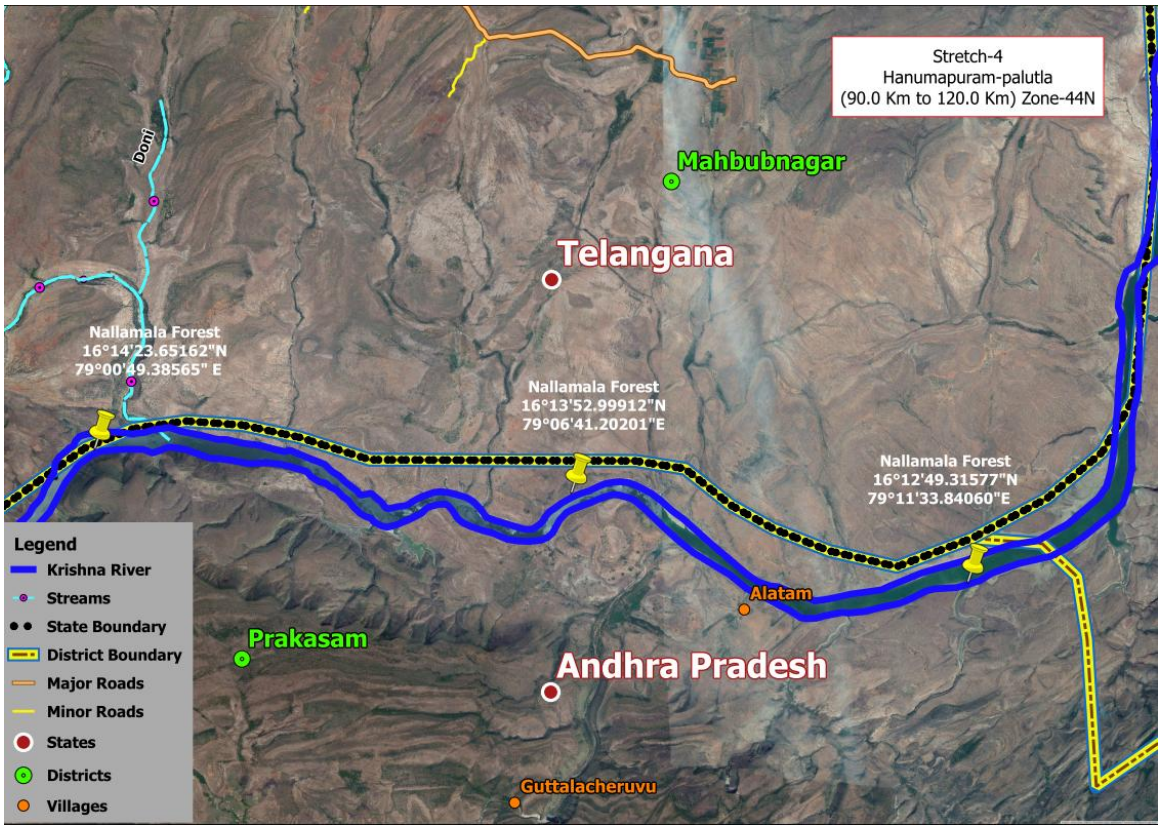


Figure 39 - Stretch-4 Hanumapuram to Palutla

- **Bathymetry Survey**
  a) 30km of the length of the stretch for which the bathymetric survey has been carried out.
- **Topographic Survey**
  b) 0.00km length of the stretch for which the topographic survey has been carried out.

This stretch is between 90.0 to 120km chainage of Hanumapuram to Palutla

Upon this stretch, IWAI benchmarks from KRS-53 to KRS-51 is constructed. Benchmark number IWAI-BM-KRS-53 is being constructed at the right bank of the river at chainage 96.021km in the Nalamala Forest Region. Borugundala is the nearby village which is situated around 15km from this stretch. And KRS-52 constructed in 102.565km chainage in the Nalamala forest region, Altam is the nearby villages which situated approx. 10km from this stretch which is situated on the right bank of the river.

At 117.131km chainage IWAI-BM-KRS-51 is constructed in the Nalamala forest region. Palutla is the nearby village in this region.

Buru Gundala village is located in Yerragondapalem Tehsil of Prakasam district in Andhra Pradesh, India. It is situated 14km away from sub-district headquarter Yerragondapalem and 154km away from district headquarter Ongole. Veerabhadrapuram is the Grampanchayat of Buru Gundala village.

Upon this stretch the depth varies from 10 to 15m. The river is being narrow in nature and varies the width of 200 to 300 mtr. Bank is unprotected in nature and also erosive as well.

Figure 40 - Erosive banks

Though this river flows in hill areas so few numbers of water fall like structure found which drops from a high altitude.

Figure 41 - Water Falls

No cultivation found in between this stretch at both the banks. This stretch can be possible of good waterway. Fishing activities found over upon this stretch.

This stretch is lack of roadways and rail networks. During survey did not find nearby roadways. State highway number 88 followed at a distance of 20km away from this stretch.

Yerragondapalem and Macherla are the nearby cities to this stretch.

Class	Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity
I	90	120	0	14.71	0	0.00	462,460.94	-0.37	12.41	100	305.95	1,349,530.90
II	90	120	0	14.71	0	0.00	733,159.75	-0.37	12.41	150	1,580.36	1,980,517.93
III	90	120	0	14.71	0	0.00	1,181,907.48	-0.37	12.41	500	4,495.89	2,912,205.57
IV	90	120	0	14.71	0	0.00	1,501,499.47	-0.37	12.41	600	6,862.64	3,462,582.76

Table 38 - Dredging Quantity Details

c) Observed and reduced Bed Profile of the stretch

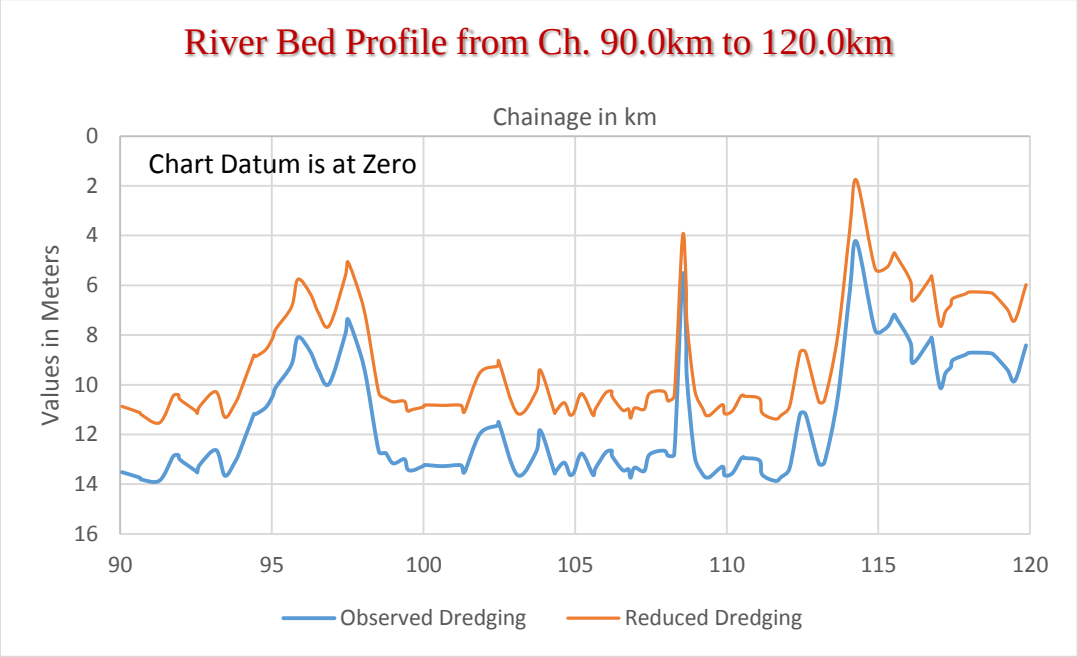


Figure 42 - River Bed Profile

3.5 Sub Stretch 05: Palutla to Domalpenta (Chainage 120.0km to 150.0km)

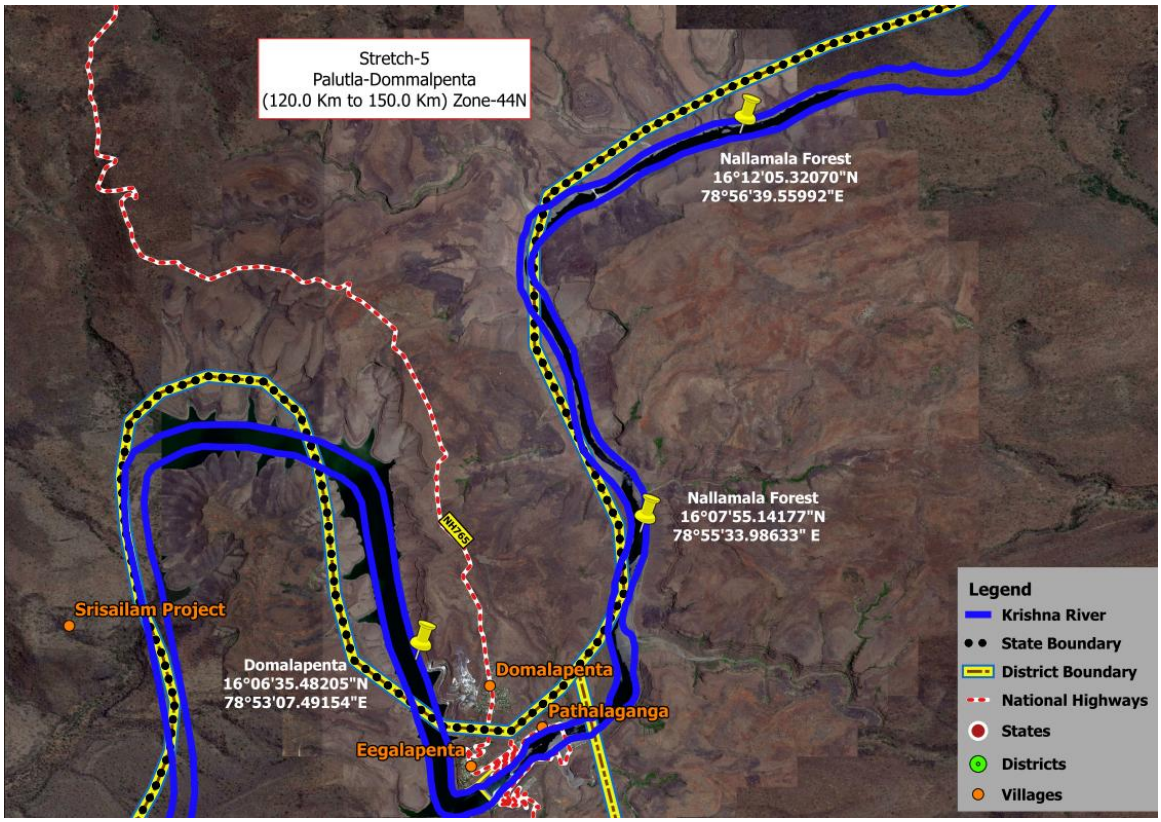


Figure 43 - Stretch 05- Palutla to Domalpenta

- **Bathymetry Survey**
  a) 24km of the length of the stretch for which the bathymetric survey has been carried out
- **Topographic Survey**
  b) 06km of the length of the stretch for which the topographic survey has been carried out.

This stretch is between 90.0 to 120km chainage of Palutla to Dompalapenta

Upon this stretch, IWAI benchmarks from KRS-50 to KRS-48 is constructed. Benchmark number IWAI-BM-KRS-50 is being constructed on the right bank of the river at chainage 126.344km in the Nalamala Forest Region. Palutla is the nearby village which is situated around 15km from this stretch. And KRS-49 constructed in 137.394km chainage in the Nalamala forest region, Nakkipenta is the nearby villages which situated approx. 10km from this stretch which is situated on the right bank of the river.

At 147.516km chainage IWAI-BM-KRS-48 is constructed in the Nalamala forest region. Domalpenta is the nearby village in this region.

The river is flowing through the Nalamala dense forest region, of Srisailam Nagarjuna Tiger Reserve. At chainage 135.00km chainage a tail pond of Srisailam dam is found near to this stretch. Around 8km from this stretch a small village called Sundipenta is being location the only and one approaches to this stretch is a road near to the corridor of the left bank of the river.

Tail pond dam /weir located 14km downstream of Srisailam dam is under advanced stage of construction to hold the water released by the hydro turbines and later pump back into the Srisailam reservoir by operating the turbines in pump mode. The weir portion got breached in November 2015 unable to withstand the normal water release from the hydro power stations

Figure 44 - Check Dam at Srisailam

Sundipenta is a Village in Srisailam Mandal in Kurnool District of Andhra Pradesh State, India. It belongs to Rayalaseema region. It is located 112km towards East from District Kurnool. 5km from Srisailam. 178km from State capital Hyderabad.

Srisailam Project (Right Flank Colony) Township, Markapur, Devarakonda, Macherla is the nearby Cities to this stretch.

Srisailam, Dompalapenta and Eagalapenta are the nearby villages in this stretch.

There is no railway station near to Sundipenta in less than 10km. Kurnool Town Railway Station (near to Kurnool), Kotla Railway Station (near to Kurnool) is the

railway stations reachable from nearby towns. However, Hyderabad Deccan Railway Station is major railway station 172km near to this stretch.

A bridge is found on this stretch at 142.02km chainage which is the connection between Kurnool to Hyderabad via Dornala and Mallapur. It's a small bridge nearly 800 mtr long. Andhra Pradesh state highway number 05 and also called National Highway 765 followed through this bridge.

Figure 45 - Bridge near Sundipenta (Ch.142.02km)

Srisailam is the main tourist place upon this stretch.

Srisailam or Srisailamu is situated in the Kurnool district of Andhra Pradesh, India. It is on the banks of the Krishna River about 212km south of Hyderabad and 179km from Kurnool. It is sometimes spelled Srisailam.

The town (as well as the mandal) of Srisailam is reputed for the shrine of Lord Mallikarjuna on the flat top of Nalamala Hills. It has played a dominant role in the Hindu religious, cultural and social history since ancient times. The epigraphical evidence reveals that the history of Srisailam began with the Satavahana who were the first empire builders in South India. The earliest known historical mention of the hill, Srisailam, can be traced to the King Vasishthiputra Pulumavi's Nasik inscription of the 1st Century A.D.

The Sri Mallikarjuna Swamy Temple located in Srisailam is one of the 12 Jyotirlinga temples dedicated to Lord Shiva. Earlier, it was called Srigiri. The Bhramarambha Temple is also located in the same complex.

It is considered as one of the eighteen Shakti Peethas in India. Bhramarambha is a very ferocious deity. Originally she was worshipped by the Chenchu people. However, during British rule, the temple was taken over by the Pushpagiri Peetham forcibly with the help of the British Government is ruling the Madras Presidency.

Figure 46 - Srisailam Overview

At chainage 143.97km a dam is constructed called NSSR dam also called famous Srisailam Dam. The Srisailam Dam is constructed across the Krishna River on the border of Mahabubnagar District, Telangana and Kurnool district, Andhra Pradesh near Srisailam temple town and is the 2nd largest capacity working hydroelectric station in the country.

The dam was constructed in a deep gorge in the Nalamala Hills in between Mahabubnagar and Kurnool districts, 300 m (980 ft) above sea level. It is 512 m (1,680 ft) long, 145 metres (476 ft) maximum height and has 12 radial crest gates. It has a reservoir of 616 square kilometres (238 sq mi). The project has an estimated live capacity to hold 178.74 Tmcft at its full reservoir level of 885 feet (270 m) MSL.

The minimum draw down level (MDDL) of the reservoir is at 705 feet (215 m) MSL from its river sluice gates.

Figure 47 - Srisailam dam (ch. 143.97km)

A hydroelectric power plant is being constructed near the left bank of the Krishna River at Srisailam Dam.

The details of the same is being mentioned below. The left bank underground power station houses 6 × 150 megawatts (200,000 hp) reversible Francis-pump turbines for pumped-storage operation and the right bank semi underground power station houses 7 × 110 megawatts (150,000 hp) Francis-turbine generators.

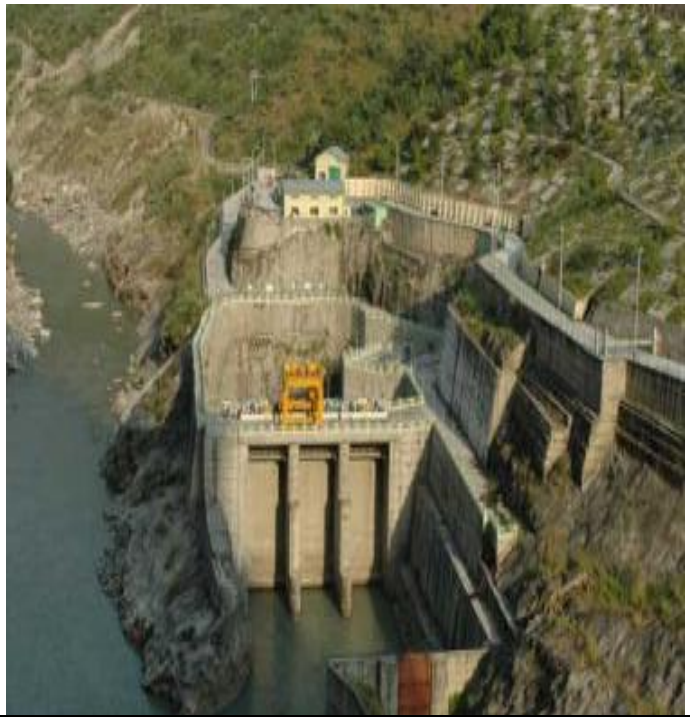
Salient Feature		
Hydro Electric Project	Srisailam Hydroelectric Project	
State Name	Telangana, Andhra Pradesh	
District	Mahabubnagar	
River	Krishna	
Basin Name	Krishna	
Hydro Electric Region	Southern HE Region	
Total Installed Capacity (MW)	1670	
Type of Project	Major	
Hydroelectric Project Status	Completed	
Project Owner Type	State	
Owner Name	APGENCO	

Table 39 - Salient feature of Srisailam Dam

No cultivation found upon this stretch. At chainage 145.600km the river width is 2km. The AP tourism Development Corporation established a small tourist place and a small jetty for tourist people.

The tourist people used to roam in the River Krishna followed through the jetty. Though Srisailam temple is placed at a high altitude, tourist people are facilitated by a ropeway.

Figure 48 - Ropeway Services at Srisailam

Banks are unprotected in nature and also highly erosive. Downstream of Srisailam Dam found with rock outcrops. So survey conducted by topographic method.

Figure 49 - Downstream of Srisailam Dam

Figure 50 - Local Ferry Ghat at Srisailam (ch. 145.10km)

Class	Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity
I	120	150	0	14.51	10450	343,142.40	805,603.34	-1.71	12.16	12920	517,823.60	1,867,354.50
II	120	150	0	14.51	10900	530,014.01	1,263,173.76	-1.71	12.16	13300	773,556.25	2,754,074.18
III	120	150	0	14.64	11300	819,165.54	2,001,073.02	-1.71	12.21	14350	1,160,847.00	4,073,052.57
IV	120	150	0	14.74	11750	1,003,004.50	2,504,503.97	-1.71	12.37	16100	1,403,656.43	4,866,239.19

Table 40 - Dredging Quantity Details

a) Observed and reduced Bed Profile of the stretch

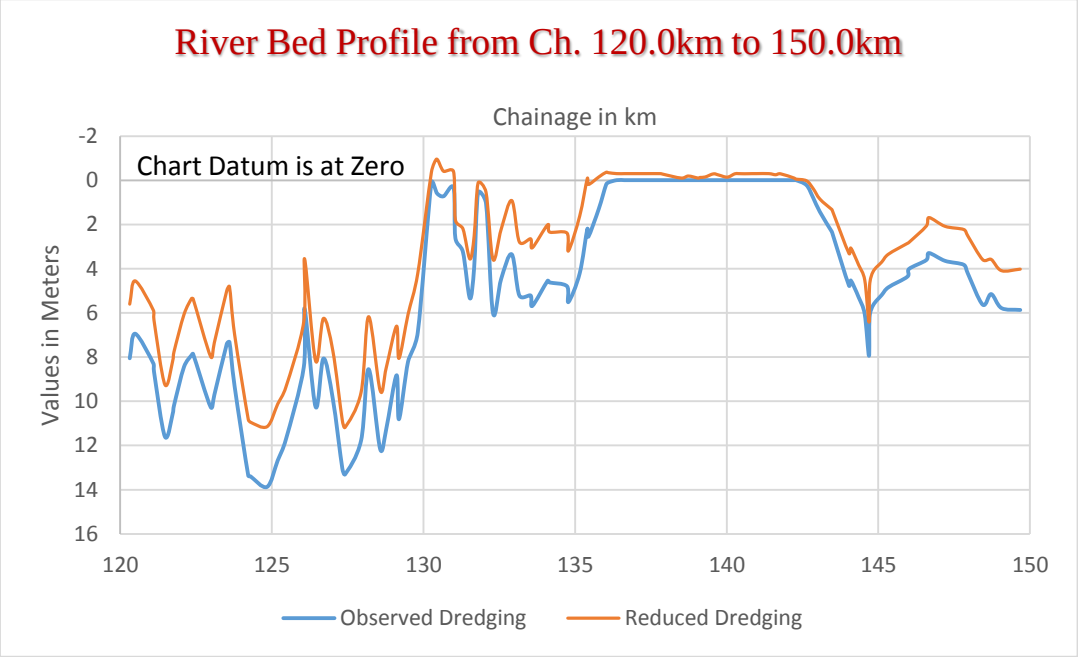


Figure 51 - River Bed Profile

3.6 Sub Stretch 06: Domalapenta to Hatkeshwaram (Chainage 150.0km to 180.0km)

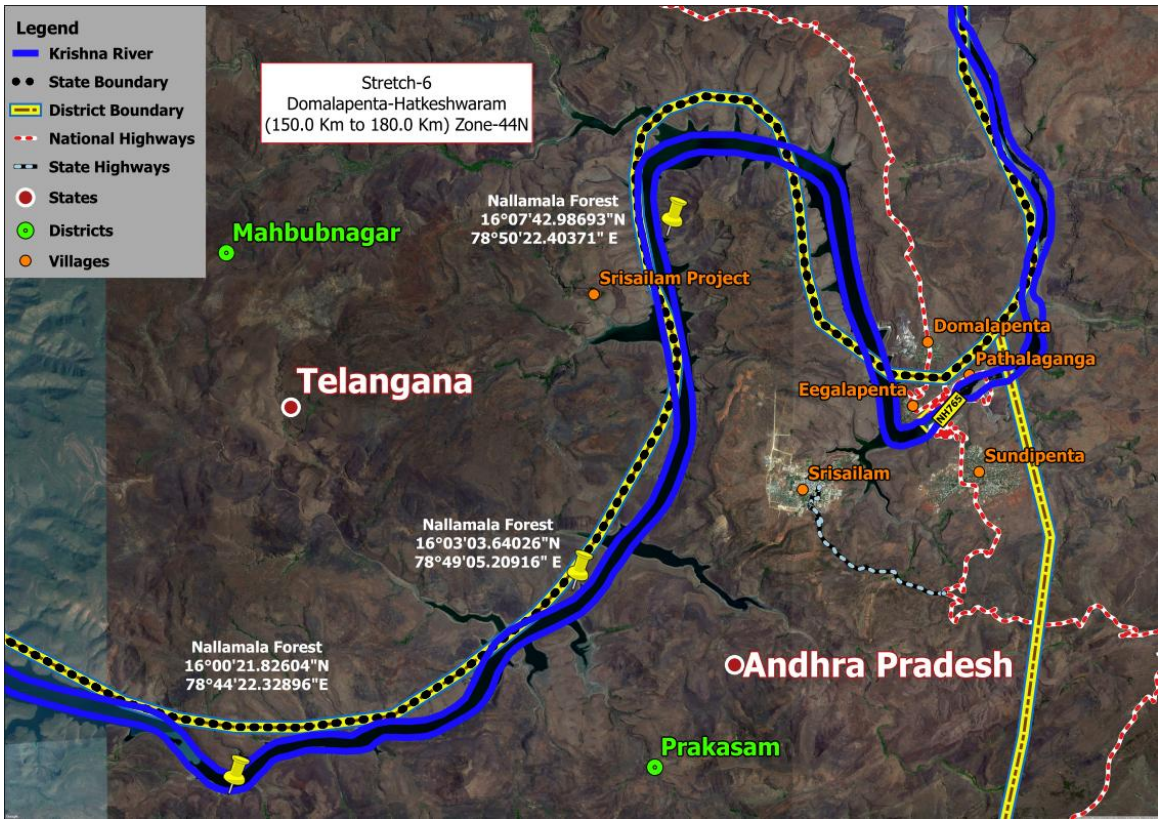


Figure 52 - Stretch 06- Domalapenta to Hatkeshwaram

- **Bathymetry Survey**
  a) 30km of the length of the stretch for which the bathymetric survey has been carried out.
- **Topographic Survey**
  b) 0.00km length of the stretch for which the topographic survey has been carried out.

This stretch is between 150 to 180km chainage of Dompalapenta to Hatkeshwarm.

Upon this stretch, IWAI benchmarks from KRS-47 to KRS-45 is constructed. Benchmark number IWAI-BM-KRS-47 is being constructed on the right bank of the river at chainage 157.804km in the Nalamala Forest Region. Dompalapenta is the nearby village which is situated around 10km from this stretch. And KRS- 46 constructed at 167.238km chainage in the Nalamala forest region, Nakkipenta is the nearby villages which situated approx. 10km from this stretch which is situated

on the right bank of the river. And IWAI-BM-KRS-45 is established at chainage 177.512km.

The River Bank is erosive in nature and not protective, no cultivation was found on both sides of the river bank during the surveys.

No prominent feature exists in this stretch. Also did not find any suitable roadway or rail network in this stretch. Atmakur is the nearby city / Taluk to this stretch.

State Highway number 50 of Andhra Pradesh exist around 16km distance from the right bank of this stretch. Srisailam is the nearby bus station to this stretch.

Class	Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity
I	150	180	2.26	13.56	0	0.00	805,603.34	-0.53	12.01	3550	110,166.04	1,977,520.54
II	150	180	2.26	13.56	0	0.00	1,263,173.76	-0.53	12.01	3710	187,430.89	2,941,505.07
III	150	180	2.26	14.66	0	0.00	2,001,073.02	-0.53	12.01	5600	320,066.19	4,393,118.76
IV	150	180	2.26	14.66	0	0.00	2,504,503.97	-0.53	12.01	6350	433,161.25	5,299,400.44

Table 41 - Dredging Quantity details

a) Observed and reduced Bed Profile of the stretch

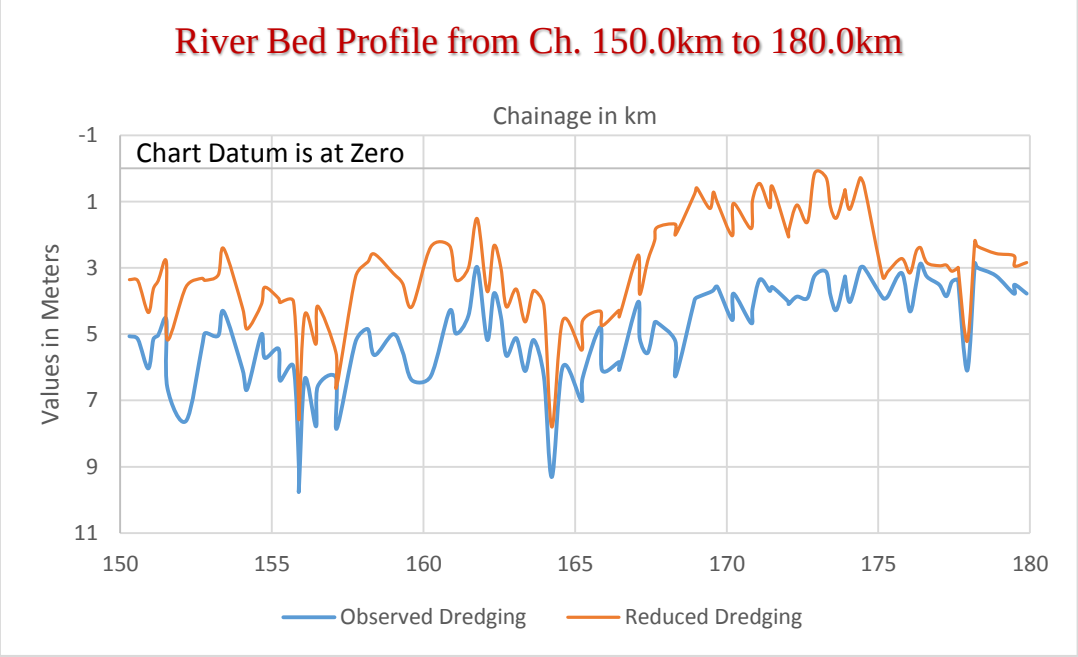


Figure 53 - River Bed Profile

3.7 Sub Stretch 07: Hatkeshwaram to Veerabhadradurgam (Chainage 180.0km to 210.0km)

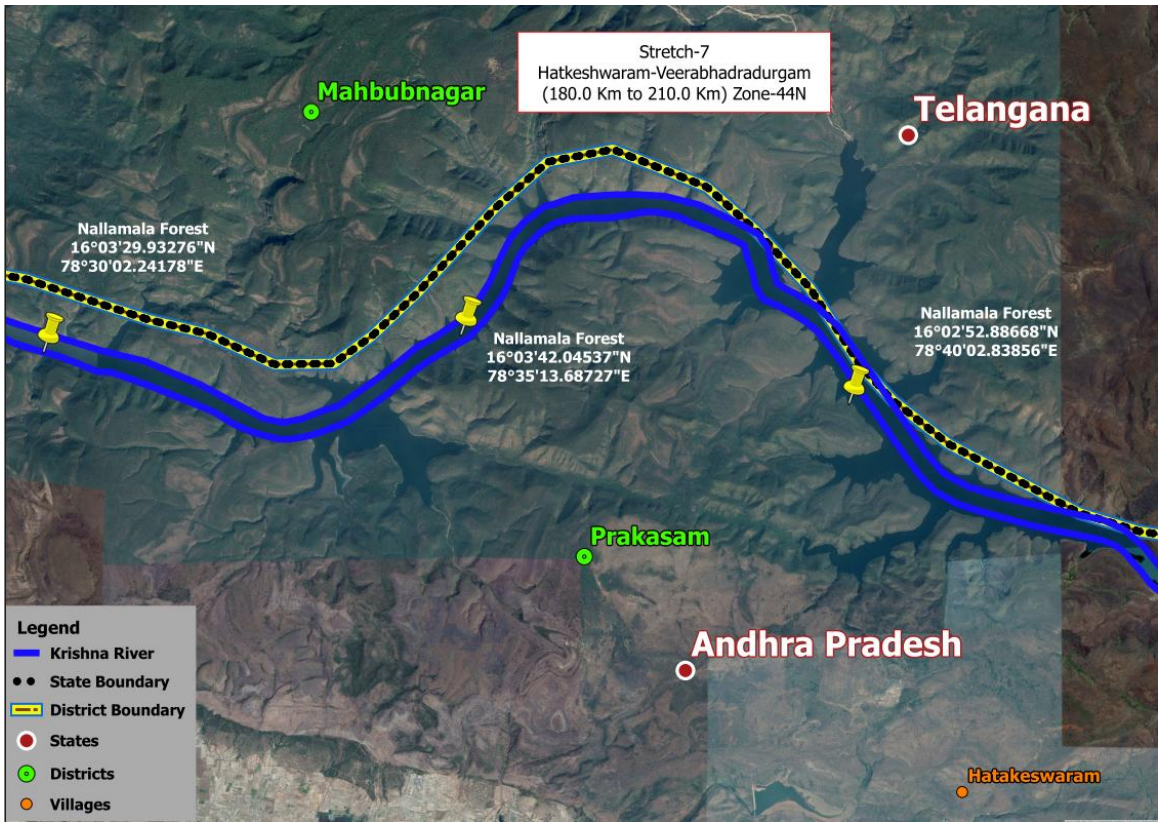


Figure 54 - Stretch 07- Hatkeshwaram to Veerabhadrapuram

- **Bathymetry Survey**
  a) 30km of the length of the stretch for which the bathymetric survey has been carried out.
- **Topographic Survey**
  b) 0.00km length of the stretch for which the topographic survey has been carried out.

This stretch is between 180 to 210km chainage of Hatkeshwaram to Veerabhadradurgam.

Upon this stretch, IWAI benchmarks from KRS-44 to KRS-42 is constructed. Benchmark number IWAI-BM-KRS-44 is being constructed on the right bank of the river at chainage 186.561km in the Nalamala Forest Region. And KRS-43 constructed in 198.975km chainage in the Nalamala forest region, and IWAI-BM-KRS-42 is established at chainage 209.065km.

The right bank of this stretch is surrounded by villages Indireshwaram, Vadlaramapuram, Kottlacheruvu, Buddinennipalem, Guvvalakunda, Verapuram, Kottapalle, Bavapuram which are placed almost 10 to 15km from this stretch, under Guntur District of Andhraparadesh.

Andhra Pradesh state highway number 27 and 60 followed at the right bank of this stretch at a distance of 20km.

Atmakur and Nandyal are the nearby cities to this stretch.

As it was found that this stretch having full of water and depth varies in between 10 to 15m. Fishing activities were found during the survey. Number of Nalas and waterfall present in this stretch.

No prominent feature found during this stretch. Banks are normally not protected in nature.

Figure 55 - Krishna River flow and fishing net during survey

Figure 56 - Fishing done by local villagers by following waterway

Class	Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity
I	180	210	2.27	13.75	0	0.00	805,603.34	0.46	11.81	860	2,264.40	1,979,784.94
II	180	210	2.27	14.61	0	0.00	1,263,173.76	0.46	13.13	1050	7,630.44	2,949,135.51
III	180	210	2.27	14.61	0	0.00	2,001,073.02	0.3	13.13	2620	26,454.17	4,419,572.93
IV	180	210	2.27	14.61	0	0.00	2,504,503.97	0.3	13.13	4250	61,957.83	5,361,358.27

Table 42 - Dredging Quantity details

a) Observed and reduced Bed Profile of the stretch

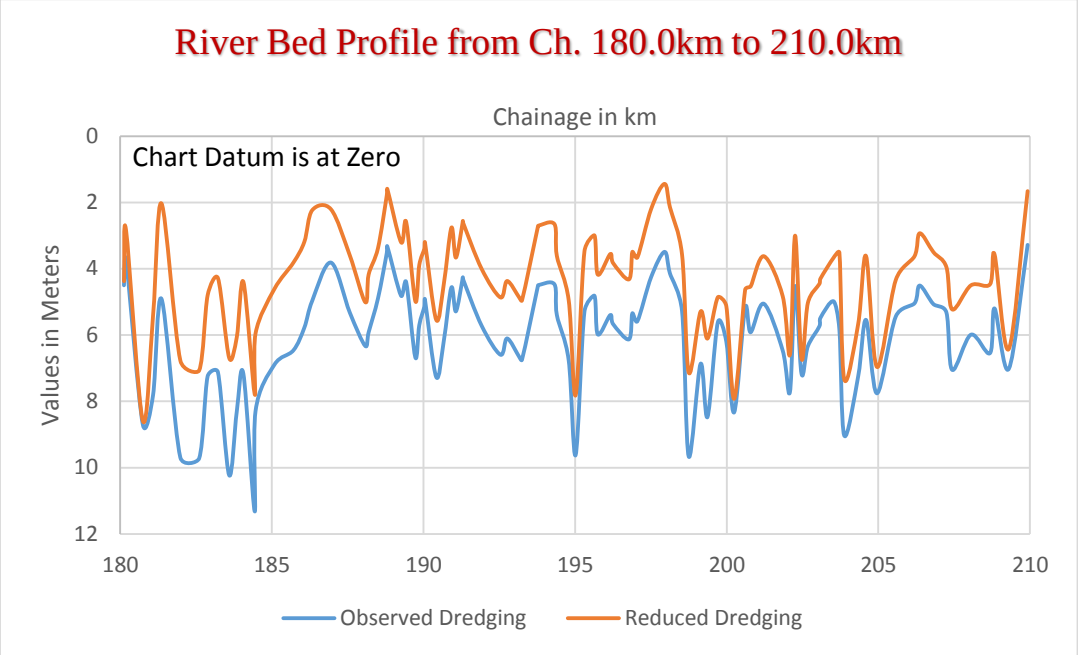


Figure 57 - River Bed Profile

3.8 Sub Stretch 08: Veerabhadradurgam to Veerapuram (Chainage 210.0km to 240.0km)

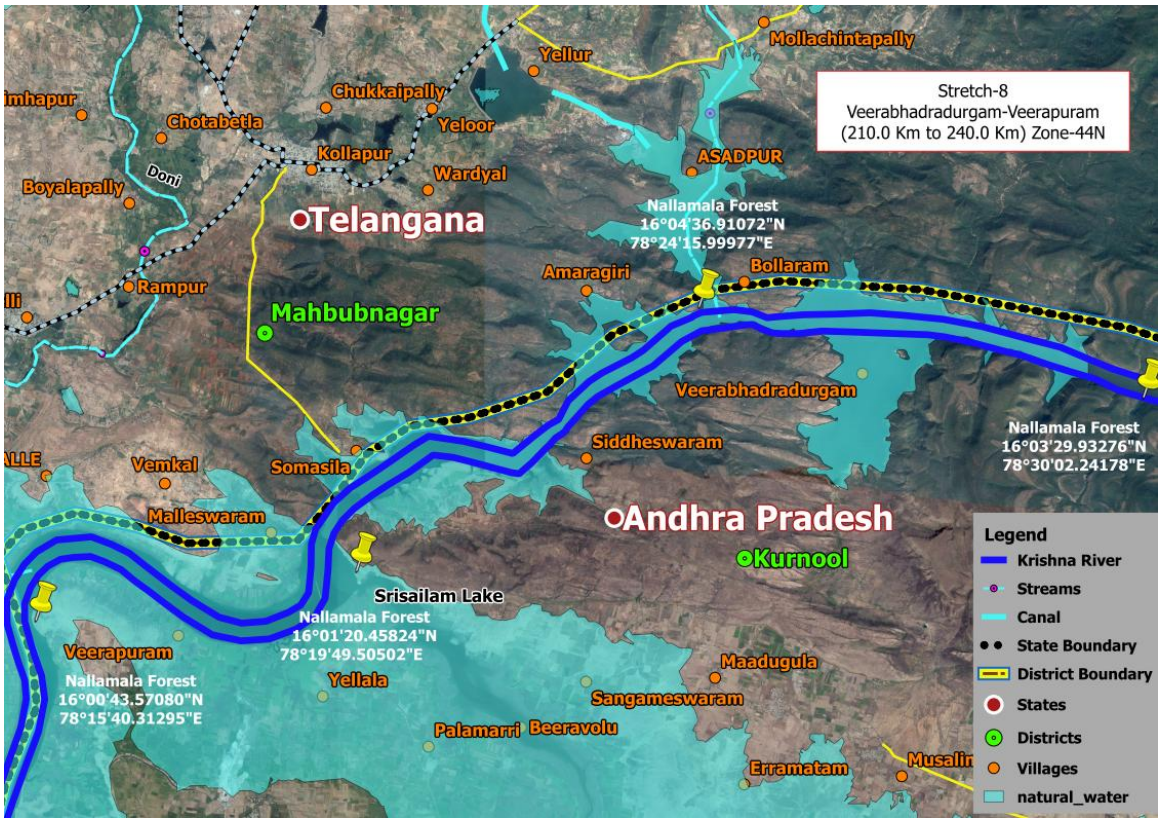


Figure 58 - Stretch 08- Veerabhadradurgam to Veerapuram.

- **Bathymetry Survey**
  a) 21.800km of the length of the stretch for which the bathymetric survey has been carried out.
- **Topographic Survey**
  b) 8.200km length of the stretch for which the topographic survey has been carried out.

This stretch is between 210 to 240km chainage of Veerabhadradurgam to Veerapuram.

Upon this stretch IWAI-BM-KRS-41 constructed on the left bank of the river at a chainage 219.637km and nearby village is Veerabhadradurgam. Another pillar IWAI-BM-KRS-40 is constructed at right bank of the river at a chainage of 231.325km. A famous temple called Sangameshwara is situated at this point.

The river is flowing through the Nalamala forest region, due to unavailability of road communication this stretch could be reached only by river way.

Chimaladibba a small island is being present near to the left bank of the river. Where we found some population of fisherman.

Figure 59 - Chimaladibba Island

The river flow under this stretch is the last forest region of Srisailam and Nagarjuna tiger reservoir. The river is being the border line of Andhra Pradesh and Telangana state.

This stretch is in the border of the Mahbubnagar District and Kurnool District. Kurnool District Pagidyala is south towards this place. It is near to the Andhra Pradesh State Border.

During the survey, it is being observed that Somasila and Sangameshwara are the nearest places.

Somasila is a Village in Kollapur Mandal in Mahbubnagar District of Telangana State, India. It belongs to Telangana region. It is located 99km towards the south from district headquarters Mahabubnagar. 7km from Kollapur. At chainage 228.700km a temple found near Somasila and also a Pushkar Ghat found upon this stretch.

Figure 60 - River flow at Somasila and Ghat of left bank near Somasila

At chainage 231.54km a temple was found during a survey near at Sangameshwara. As per the local villagers of this stretch was notified that this

temple is an ancient temple and during rainy season it is submersible in nature. The Sangameshwara temple is an ancient Hindu temple in the Kurnool district, Andhra Pradesh, India. It is located near Muchumarri at the confluence of the Krishna and Bhavanasi rivers, on the foreshore of the Srisailam reservoir, where it is submerged for part of the time, surfacing when the water level recedes to a sufficient degree. It was first submerged after the Srisailam Dam was constructed in 1981, and first surfaced in 2003.

Figure 61 - Sangameshwara a submersible Temple (ch. 231.54km)

The temple's wooden Lingam, Sangameshwara, is believed to have been installed by Dharma raja, the eldest of the Pandavas, after their visit to the Srisailam Mallikarjuna temple The temple is considered a place of religious sanctity due to being built at the confluence of seven rivers (Bhavanasi, Krishna River and five rivers that merge into it beforehand, namely, Veni, Tunga, Bhadra, Bheemarathi and Malapaharini).

Yellur, Chukkaipally, Pentlavelly, Choutabetla, Ankiraopally are the nearby Villages to this stretch.

Kurnool, Wanaparthy, Nagarkurnool, Srisailam Project (Right Flank Colony) Township are the nearby Cities to this stretch.

At chainage 231.000 the Krishna River found to be widen up to a length of 1.5km at a depth of 2 to 3 meter, also it observed that the river flows like a Nala like structure. At chainage 231.800 upstream towards this stretch was not having enough water to carry out Bathymetric survey. So topographic survey conducted and as per the local villagers it was found that during rainy season presence of water and rest of the reason though there is water but maximum area dry in nature.

No cultivation found in both the Banks of the river. But from Chainage 232.000 both the banks were found which were cultivated by Bajra, Ground nut, and Beans.

The surface is having rock and sand patches. This stretch is partially navigable.

Class	Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity
I	210	240	0	14.82	8600	359,887.66	1,165,491.00	-0.3	13.36	8800	445,965.27	2,425,750.21
II	210	240	0	14.82	8650	548,664.05	1,811,837.81	-0.3	13.36	8930	663,290.30	3,612,425.81
III	210	240	0	14.82	8700	830,676.63	2,831,749.65	-0.3	13.36	10600	991,686.68	5,411,259.61
IV	210	240	0	14.82	8750	1,003,539.97	3,508,043.94	-0.3	13.36	12100	1,214,008.20	6,575,366.47

Table 43 - Dredging Quantity details

a) Observed and reduced Bed Profile of the stretch

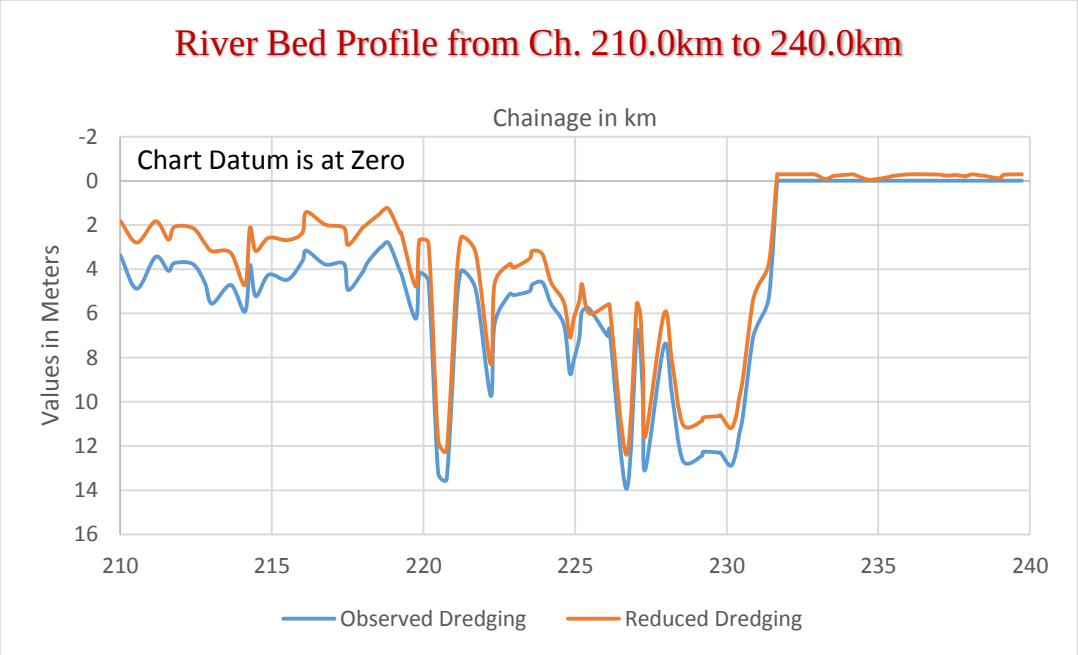


Figure 62 - River Bed Profile

3.9 Sub Stretch 09: Veerapuram to Shalipur (Chainage 240.0km to 270.0km)

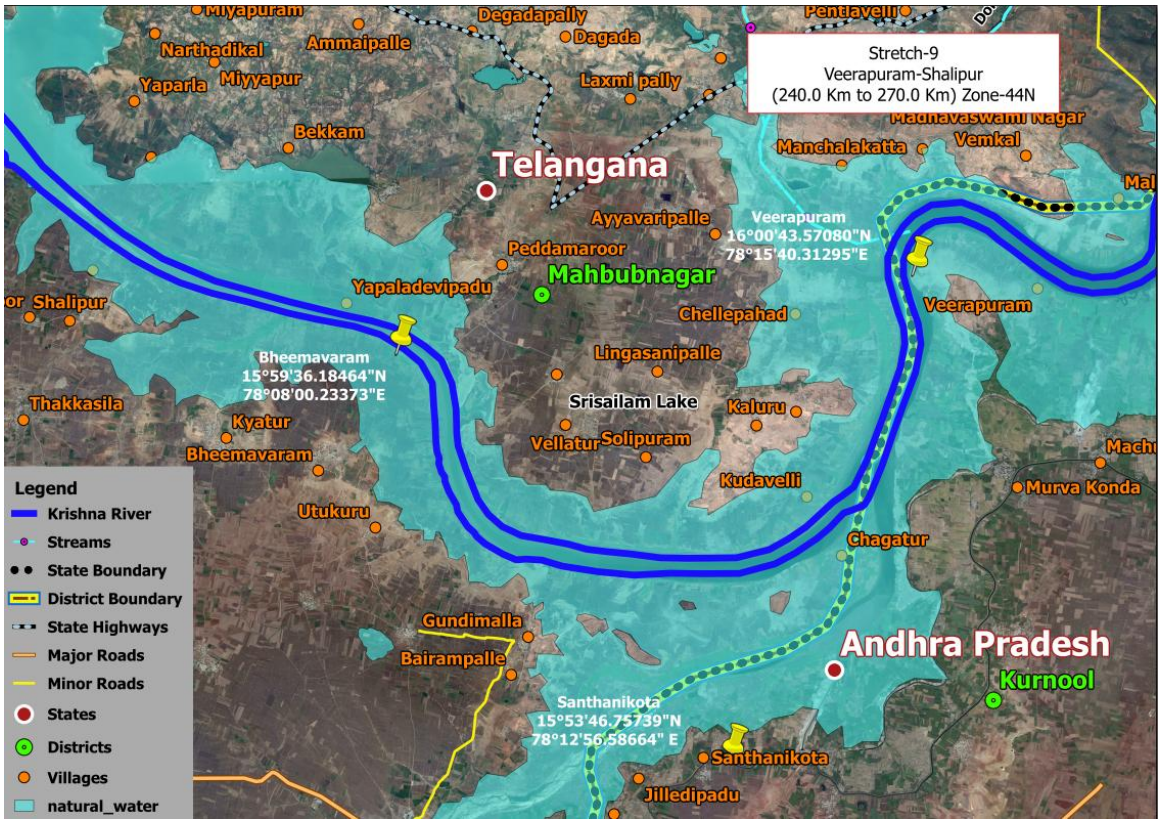


Figure 63 - Stretch 09- Veerapuram to Shalipur

- **Bathymetry Survey**
  a) No bathymetric survey is conducted due to the unavailability of water.
- **Topographic Survey**
  b) 30.00km length of the stretch for which the topographic survey has been carried out.

This stretch is between 240 to 270km chainage of Veerapuram to Shalipur.

Upon this stretch IWAI-BM-KRS-39 constructed on the left bank of the river at a chainage 240.999km and nearby village is Veerapuram. IWAI-BM-KRS-38 is constructed at right bank of the river at a chainage of 251.421km. Nearby village to this benchmark is Snathanikota. IWAI-BM-KRS-37 is constructed at right bank of the river at a chainage of 262.876km. Nearby village to this benchmark is Bheemavaram.

In this stretch Veerapuram is a small village/hamlet in Pagidyala Mandal in Kurnool District of Andhra Pradesh State, India. It comes under Veerapuram

Panchayath. It belongs to Rayalaseema region. It is located 39km towards east from District Kurnool.

Sathanikota is a Village in Nandikotkur Mandal in Kurnool District of Andhra Pradesh State, India. It belongs to Rayalaseema region. It is located 28km towards East from District Kurnool. 200km from State capital Hyderabad.

Bheemavaram is a Village in Nandyal Mandal in Kurnool District of Andhra Pradesh State, India. It belongs to Rayalaseema region. It is located 67km towards East from District Kurnool. 7km from Nandyal. 240km from state capital Hyderabad

This place is on the border of the Kurnool District and Mahbubnagar District. Mahbubnagar District Alampur is west towards this place. It is near to the Telangana State Border. Kurnool, Bethamcherla, Nandyal, Chapirevula is the nearby cities to this stretch.

Yerraguntla, Kakanur, Pulimaddi, Parnapalle, Rayamalpuram, Koppunur, Pullur, Alampur are the nearby villages to this stretch and well connected to roadways.

There is no railway station near to Sathanikota in less than 10km. We can reach from Kurnool to Sathanikota by road. However Bellary junction railway station is major railway station 184km near to Sathanikota.

During the survey, we found that the river is being used for drinking water and cultivation purpose. Near to the river bank mostly Bajra is being cultivated.

At chainage 260.64km Tungabhadra River a major tributary of Krishna River converges. Chhagatur is the point where Krishna and Tungabhadra converges.

Figure 64 - Convergence point of Tungabhadra and Krishna (ch. 260.64km)

During survey was not found any prominent feature alongside the river. It was observed that though the river width is more than 700 to 800 meter, the presence of water was negligible to conduct the bathymetric survey. River bank is not protected upon this stretch, encroachment to the waterways in not found in this stretch.

Class	Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity
I	240	270	0	0	30000	1,295,258.75	2,460,749.75	-0.3	8.82	30000	1,597,730.03	4,023,480.24
II	240	270	0	0	30000	1,972,870.39	3,784,708.20	-0.3	8.82	30000	2,359,338.73	5,971,764.54
III	240	270	0	0	30000	2,981,803.91	5,813,553.56	-0.3	8.82	30000	3,457,425.37	8,868,684.98
IV	240	270	0	0	30000	3,597,954.37	7,105,998.31	-0.3	8.82	30000	4,091,652.19	10,667,018.66

Table 44 - Dredging Quantity details

a) Observed and reduced Bed Profile of the stretch

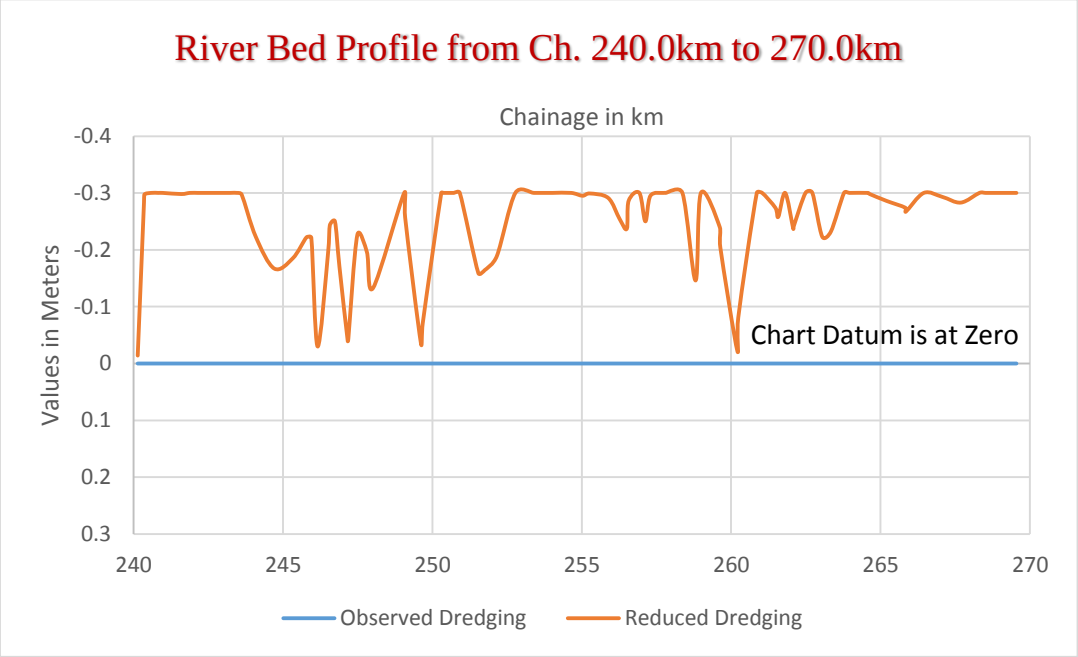


Figure 65 - River Bed Profile

3.10 Sub Stretch 10: Shalipur to Beerole (Chainage 270.0km to 300.0km)

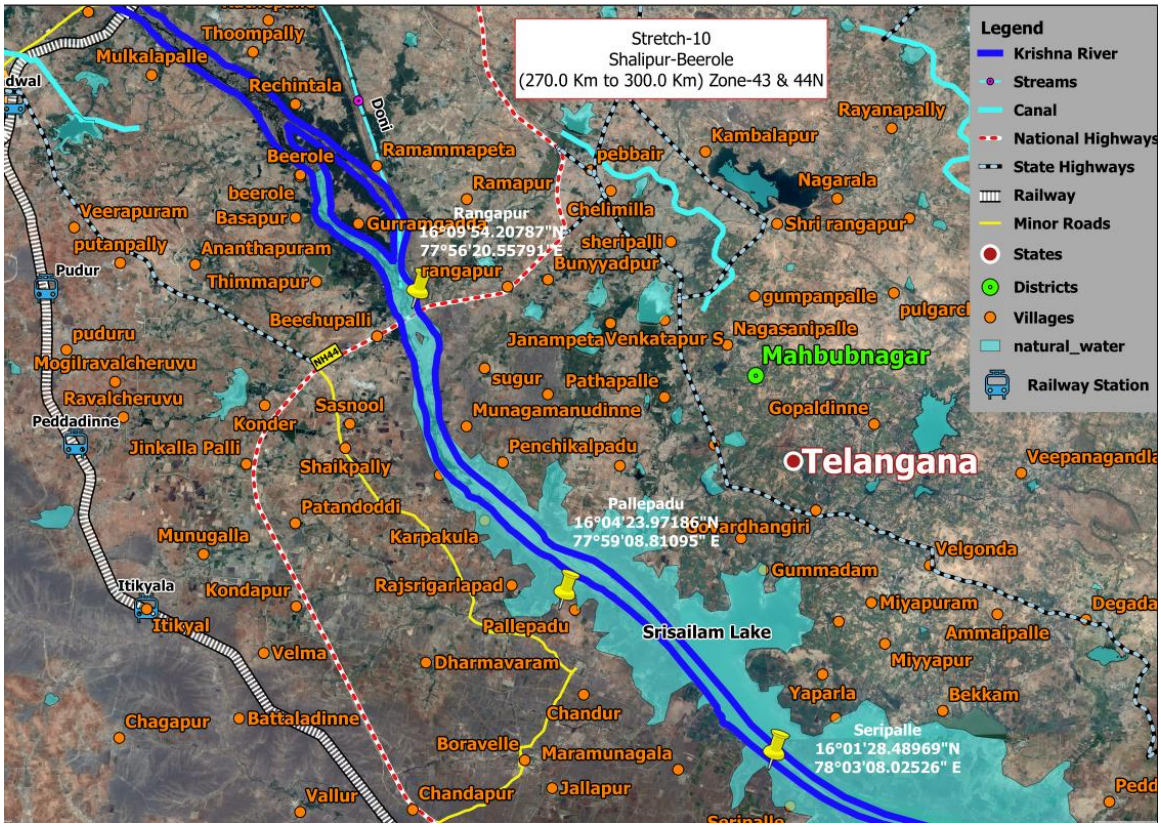


Figure 66 - Stretch 10 - Shalipur to Beeerol

- **Bathymetry Survey**
  a) No bathymetric survey is conducted due to the unavailability of water.
- **Topographic Survey**
  b) 30.00km length of the stretch for which the topographic survey has been carried out.

This stretch is between 270 to 300km chainage of Shalipur to Berol.

Upon this stretch, IWAI-BM-KRS-36 constructed on the right bank of the river at a chainage of 272.317km and nearby village is Seripalli. IWAI-BM-KRS-35 is constructed on the right bank of the river at a chainage of 281.593km. Nearby village to this benchmark is Pallipadu. IWAI-BM-KRS-34 is constructed at the left bank of the river at a chainage of 292.937km. Nearby village to this benchmark is Bichhupalli.

Seripalle is a small village near to PK Pragatur. The stretch is from Seripalli to Bheemavaram. P K Pragatur is a small village/hamlet in Pagidyala Mandal in

Kurnool District of Andhra Pradesh State, India. It comes under Morvakonda Panchayath. It belongs to Rayalaseema region. It is located 39km towards East from District Kurnool.

Bichhupalli is a Village in Itikyal Mandal in Mahbubnagar District of Telangana State, India. It belongs to Telangana region. It is located 87km towards the South from District Mahabubnagar.

Gadwal, Kurnool, Wanaparthy, Yemmiganur are the nearby cities to at this stretch.

During the survey we found one highway bridge is being constructed on Krishna River at a chainage of 292.78km. Which is followed by National Highway no.7

Figure 67 - Bichhupalli Highway Bridge (ch. 292.78km)

Near to this Bridge, we found one Hanuman Temple is being located left bank of the river. Anjaneya Swamy Temple.

Bichupalli Anjaneya Swamy Temple is one of the most famous Hanuman Temple located in the Telangana state. This ancient shrine is located in Mahabubnagar district of Telangana State on National Highway 7. Lord Anjaneya is the governing Lord of the temple. Statue of the Lord Anjaneya belongs to the 16th century. This temple is located on the banks of River Krishna (200 meters far from the river area).

Lord Hanuman (Sri Anjaneya Swamy) is considered as the 11th avatar of Lord Shiva and Rama and worshiped to the most. That is why Lord Anjaneya is praised for being the living of God of the universe. Whatever might be the problems it is believed Lord Anjaneya will solve it for people immediately. He is considered to be strongest and courageous God according to Hindu religion. While there are an uncountable number of temples of Lord Anjaneya in India, but some of these temples are unique and believed to have divine power, and hence people visit them in millions.

Figure 68 - Anjaneya Swamy temple (ch. 292.82km)

Itkyala Railway Station, Peddadinne Railway Station are the very nearby railway stations to this stretch. Arepalli Halt Railway Station (near to Gadwal), Kurnool Town Railway Station (near to Kurnool), Kotla Railway Station (near to Kurnool) Gadwal Railway Station (near to Gadwal) are the railway stations reachable from nearby towns of this stretch.

This river is being used for cultivation and drinking purpose. Both the banks were being cultivated by Bajara, sugarcane, and lemon.

Kurnool, Nandyal, Wanaparthy, Chapirevula are the nearby cities to this stretch.

This stretch is on the border of the Kurnool District and Mahbubnagar District.

Mahbubnagar District Kollapur is north towards this place. It is near to the Telangana State Border.

During the survey, it was found that the entire river found to be dry and rock patches. The river normally flows like Nala. Riverbank is not protected upon this stretch, encroachment to the waterways in not found in this stretch.

Figure 69 - River flow in this stretch

Class	Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity
I	270	300	0	0	30000	1,294,889.56	3,755,639.31	-0.3	7.736	30000	1,554,106.35	5,577,586.59
II	270	300	0	0	30000	1,972,307.28	5,757,015.48	-0.3	7.736	30000	2,304,269.06	8,276,033.60
III	270	300	0	0	30000	2,980,944.69	8,794,498.25	-0.3	7.736	30000	3,390,771.56	12,259,456.54
IV	270	300	0	0	30000	3,596,920.67	10,702,918.98	-0.3	7.736	30000	4,024,288.53	14,691,307.19

Table 45 - Dredging Quantity details

a) Observed and reduced Bed Profile of the stretch

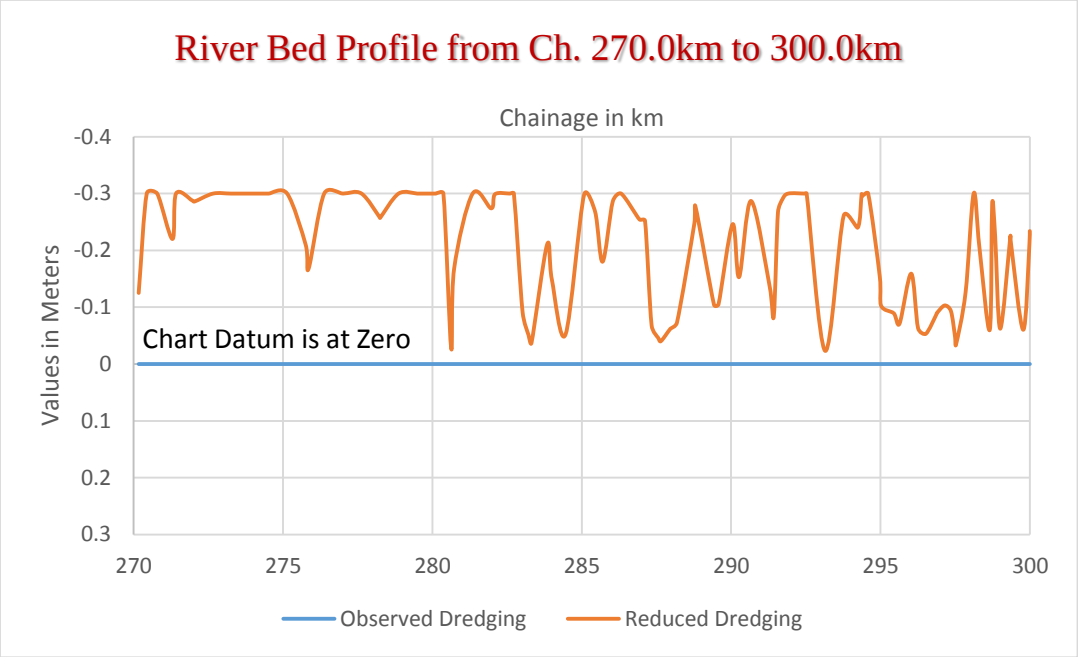


Figure 70 - River Bed Profile

3.11 Sub Stretch 11: Beerole to Khammampadu (Chainage 300.0km to 330.0km)

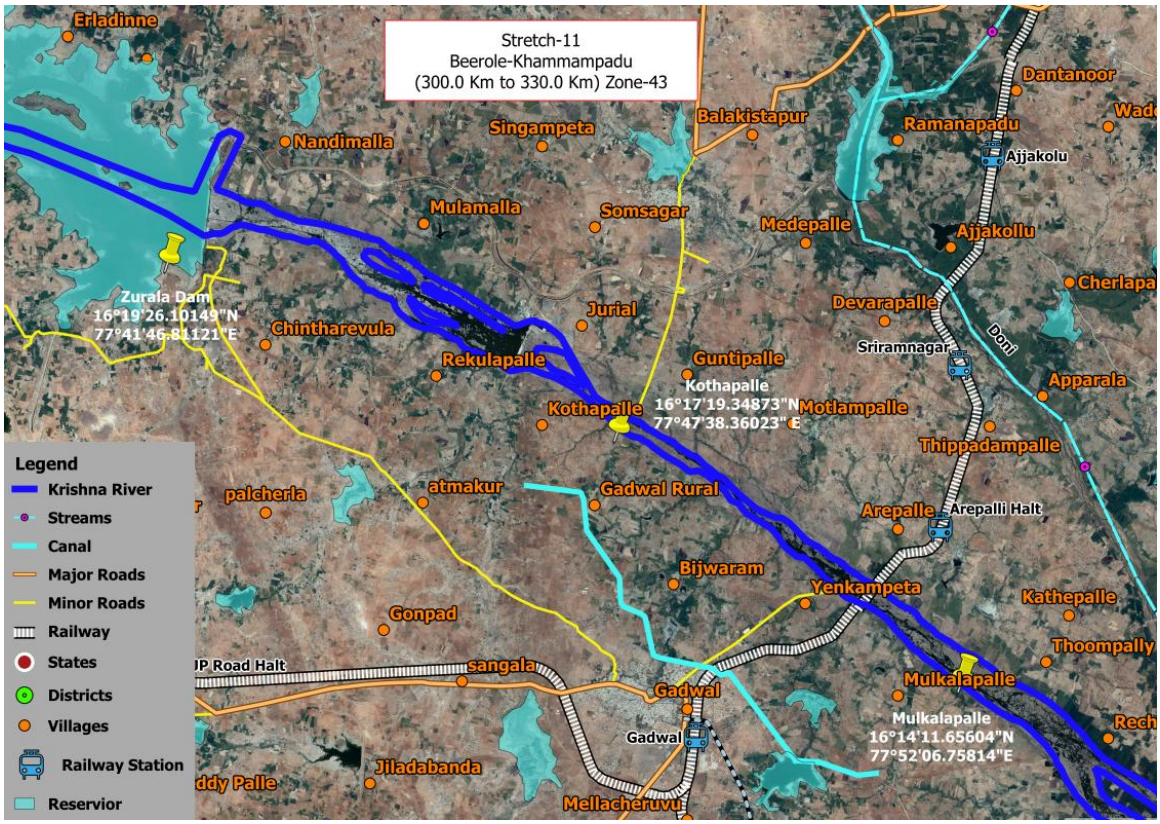


Figure 71 - Stretch 11- Beerole to Khammampadu

- **Bathymetry Survey**
  a) No bathymetric survey is conducted due to the unavailability of water.
- **Topographic Survey**
  b) 30.00km length of the stretch for which the Topographic survey has been carried out.

This stretch is between 300 to 330km chainage of Beerole to Khammampadu.

Upon this stretch, IWAI-BM-KRS-33 constructed at the right bank of the river at a chainage of 304.436km and nearby village is Mulakalpalle. IWAI-BM-KRS-32 is constructed at the right bank of the river at a chainage of 314.337km. Nearby village to this benchmark is Kothapalle. IWAI-BM-KRS-31 is constructed at the left bank of the river at a chainage of 326.067km. Near by village to this benchmark is Beechhupalli.

This stretch starts from Mulakalpalle. Mulakalpalle is a village in Gadwal Mandal in Mahbubnagar District of Telangana State, India. It belongs to Telangana region. It is located 67km towards south from District Mahabubnagar 7km from Gadwal.

Kothapalle is a village in Gadwal Mandal in Mahbubnagar District of Telangana State, India. It belongs to Telangana region. This stretch is located 70km towards south from District head quarters Mahabubnagar.

Rekulapally is a Village in Gadwal Mandal in Mahbubnagar District of Telangana State, India. It belongs to Telangana region. It is located 64km towards south from District Mahabubnagar. 9km from Gadwal.

Arepalle, Kothapalle, Jammiched, Bheema Nagar, Nallakunta are the nearby Villages to this stretch.

Gadwal, Wanaparthy, Kurnool, Raichur are the nearby Cities to this stretch.

Arepalli Halt Railway Station, Gadwal Railway Station are the very nearby railway stations to this stretch. Also, you can consider railway stations from near by town Gadwal. Gadwal railway station, Arepalli Halt Railway Station are the railway stations near to Gadwal.

During survey we found one railway bridge at chainage 307.800km is called Yenkampeta Railway Bridge.

Figure 72 - Yenkampeta Railway Bridge (ch. 307.63km)

At chainage 317.43km found one weir and a small mini hydroelectric project. As per the local villagers, it's a historical hydroelectric power station built by kings in Gadwal.

Then the government has made it as Lower Jurala Hydroelectric power project.it is a major on-going Hydro Electric Project near Mulamalla Village, Atmakur Mandal, Mahabubnagar district, Telangana. The project construction was started in

2008, completed by 2014. But due to the delay, it may complete by end of 2015. There will be 6 units, each can produce 40 MW power. The first unit was synchronized in December 2013 and the second unit was synchronized in January 2014 and connected to the grid.

Due to the quality issues in gates, along with units 1&2, unit-3 nearing erection completion, and assemblies in various stages were inundated on 30 July 2014 late night flood water released from Jurala Project.

Units 3 and 4 were commissioned and declared of commercial operation of 40 MW each unit on 28th July 2016. It's operated by Telangana State Genco.

The weir crest level is at +299.00 Mtr and Maximum and Minimum tail water level are +279.65 and +273.65 mtr. The tail race channel is 2000 mtr long with a bed width of 60 mtr and full supply depth of 8.90 mtr. The project construction was started in 2008, and already two nos.

Kaplan Bulb Turbines have been commissioned. It has been found that observed tail water levels are higher than the designed levels, thus reducing the expected power output. ConTec has submitted a proposal for lowering the tail water level and augmenting the power potential or bringing it to the designed level. The proposal is being reviewed by the Telangana State Power Generation Corporation Limited (TSGENCO).

Figure 73 - Lower Jurala Hydroelectric power project (ch.317.43km)

During the survey we found a dam is being constructed in this stretch called PD Jurala dam. And also a hydroelectric power project is being constructed on the right bank of the river. Also, a canal is being found called NTR canal on the left bank of the river.

The project foundation stone laid by Smt. Priyadarshini Indira Gandhi for the welfare of the district. The Jurala has a full reservoir level of 1045 ft and has a full capacity of 11.94 TMC. The project has an estimated capacity of 9.74 TMC. The Jurala Project was completed in 1995.

Figure 74 - Priyadarshini Jurala Dam/Barrage (ch. 325.57km)

Near to the left bank, a canal is being constructed also called NTR canal. The details are being mentioned below.

Figure 75 - NTR canal.

Salient Features		
1	Irrigation Project Name	Jurala (Priyadarshini) Major Irrigation Project
2	Purpose of Project	Irrigation
3	Type of Project	Major
4	Engineering Type of Project	Lift / Storage
5	Status	Completed
6	State	Telangana
7	Districts Benefitted	Mahbubnagar
8	Basin	Krishna
9	River	Krishna
10	Project Sharing (International/Interstate/Both)	None

Salient Features		
11	International Sharing	None
12	Inter-Basin	No
13	Year of Start of Work	1981
14	Work Started in 5 Year Plan	VI
15	Project Approval Status	PC
16	Year of Approval by Planning Commission	1977
17	Culturable Command Area (CCA) (Th ha)	41.26
18	Ultimate Irrigation Potential (Th ha)	41.3
19	Project Covered under ERM Scheme	No
20	Project Covered under CADA Scheme	No
21	Project Covered under AIBP Scheme	Yes

Table 46 - Salient feature of NTR canal

A hydroelectric power plant is being constructed near the right bank of the river. The details are being mentioned below.

Hydro Electric Project	Priyadarshini Jurala Hydroelectric Project
State Name	Telangana
District	Mahabubnagar
River	Krishna
Basin Name	Krishna
Hydro Electric Region	Southern HE Region
Total Installed Capacity (MW)	234
Type of Project	Major
Hydroelectric Project Status	Completed
Project Owner Type	State
Owner Name	APGENCO

Table 47 - PD Jurala Hydro Electric Power Project

During the survey, it was found that the downstream of the dam is full of rocks and thorny stone. And the maximum area is being dry. Bathymetric survey could

not be carried out. At near Ramammapeta the Doni River converges with Krishna River at chainage 297.83km.

Class	Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity
I	300	330	0	11.12	26700	1,134,034.09	4,889,673.40	-0.3	10.6	26700	1,330,700.51	6,908,287.10
II	300	330	0	11.12	27025	1,731,141.61	7,488,157.09	-0.3	10.6	26850	1,991,094.78	10,267,128.38
III	300	330	0	11.53	27200	2,629,555.09	11,424,053.34	-0.3	11.01	27350	2,959,673.68	15,219,130.22
IV	300	330	0	11.53	27550	3,185,567.33	13,888,486.31	-0.3	11.01	28600	3,534,338.40	18,225,645.59

Table 48 - Dredging Quantity details

a) Observed and reduced Bed Profile of the stretch

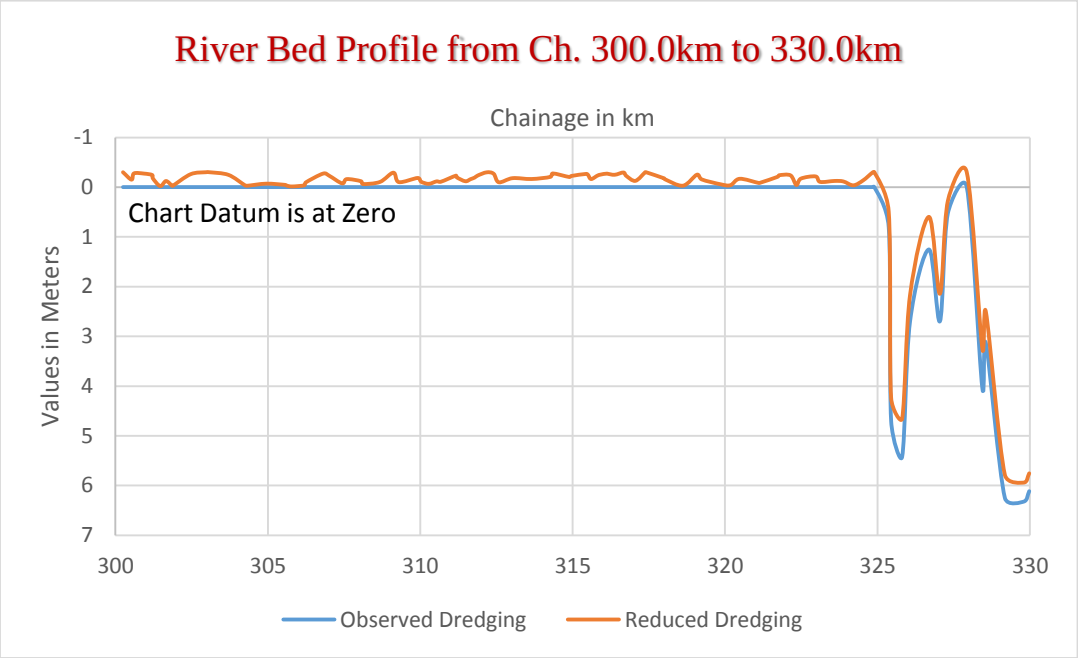


Figure 76 - River Bed Profile

3.12 Sub Stretch 12: Khammampadu to Ganjahalli (Chainage 330.0km to 360.0km)

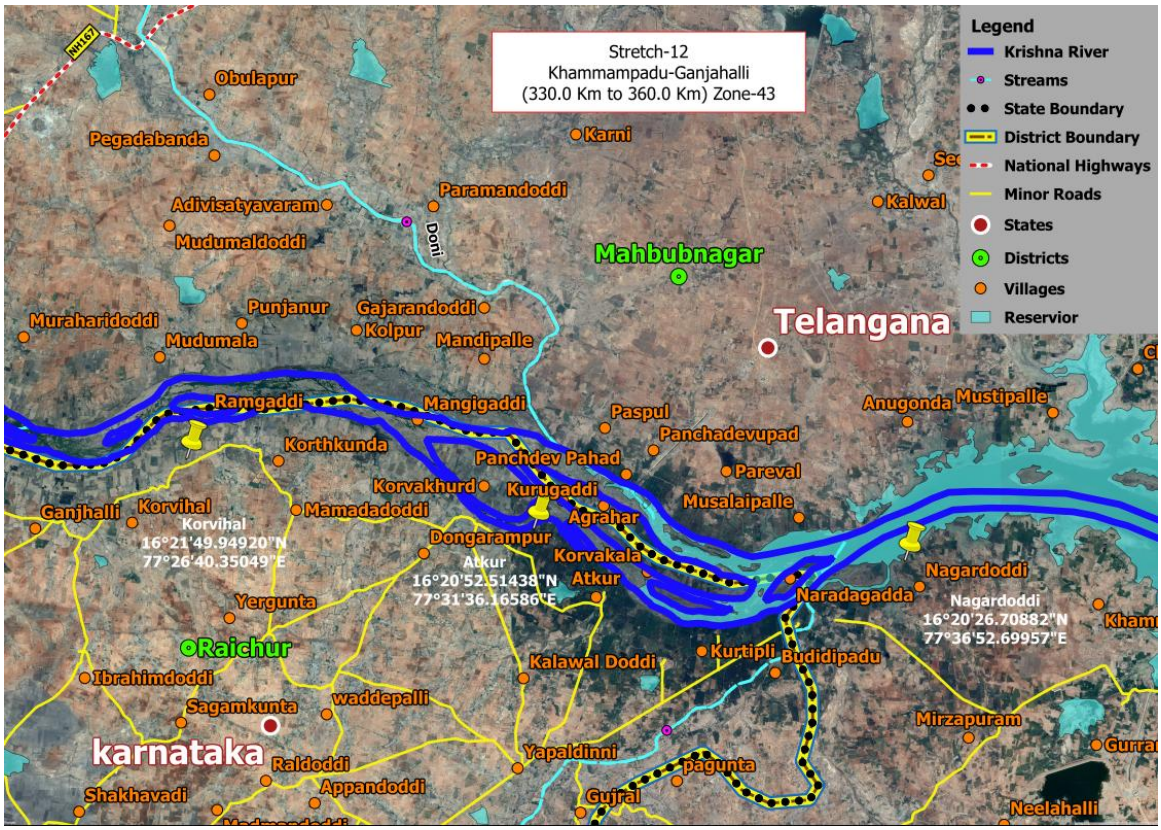


Figure 77 - Stretch 12 – Khammampadu to Ganjahalli

- **Bathymetry Survey**
  a) No bathymetric survey is conducted due to the unavailability of water.
- **Topographic Survey**
  b) 30.00km length of the stretch for which the topographic survey has been carried out.

This stretch is between 330 to 360km chainage of Khammampadu to Ganjahalli. At chainage 338.500 Krishna River flows in Karnataka state. This stretch acts as the border of Andhra Pradesh and Karnataka.

Upon this stretch IWAI-BM-KRS-30 constructed at the right bank of the river at a chainage of 335.974km and nearby village is Nagardoddi which is on Andhra Pradesh state. IWAI-BM-KRS-29 is constructed at the right bank of the river at a chainage of 347.095km. Nearby village to this benchmark is Atkur which is in Raichur district of Karnataka state. IWAI-BM-KRS-28 is constructed at the right bank of the river at a chainage of 358.351km. Nearby village to this benchmark is Korthkunda.

Upon this stretch, Nagardoddi is a village in Maldakal Mandal in Mahbubnagar District of Telangana State, India. It belongs to Telangana region. It is located 96km towards south from District Mahabubnagar 9km from Maldakal. Gadwal is 29km from Nagardoddi. Road connectivity is there from Gadwal to Nagardoddi. From this chainage Krishna River Flows in Karnataka state.

Athkoor is a village in Raichur Taluk in Raichur District of Karnataka State, India. It belongs to Gulbarga Division. 421km from state capital Bengaluru

Korthkunda is a small village/hamlet in Raichur Taluk in Raichur District of Karnataka State, India. It comes under Korthkunda Panchayath. It belongs to Gulbarga Division. 421km from State capital Bengaluru

Vittalapuram, Thatikunta, Jadadoddy, Yelkur, Saterla are the nearby villages to this stretch.

There is no rail connectivity in this stretch. Gadwal is the Nearest Town to Nagardoddi.

Gadwal, Raichur, Manvi, Gadwal, Yemmiganur are the nearby Cities to this stretch. Raichur Railway Station, Yermaras Railway Station are the very nearby railway stations to this stretch.

During the survey we found the river is being little wider and it is surrounded by rocky hills as well as hard stones.

At chainage 338.000km to chainage, 349.500km Krishna River flows in between some rocky patches. As per the local villagers nearby this stretch the rock boulders will submerge during the rainy season.

Figure 78 - Stretch having rock boulder.

Kurugaddi villages are situated in between the Island of Krishna River. During summer people use the dry areas to cross the river, whereas in rainy season local

villagers' use dingi boats to cross over River Krishna. Shree Dattatreya Mandir Shreekshetra is present at this village at chainage 344.90km.

Figure 79 - Shree Dattatreya Mandir Shreekshetra (ch. 344.90km)

At chainage 345.42km chainage we found a small temple called Shri Datta Darbar. Which is present in between Krishna River.

Figure 80 - Datta Darbar Temple (ch. 345.42km)

The presence of rock outcrops and negligible depth, bathymetric survey could not conducted. The topographic method applied to acquire the data. No cross structure available upon this stretch. And maximum portion of this stretch found to be dry in nature.

Wherever the river water is being used for irrigation and drinking purpose. Bajra and sugarcane are the two crops cultivate at both the bank.

Figure 81 - River Krishna upon this stretch

Class	Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity
I	330	360	0	2.9	21700	926,777.99	5,816,451.39	-0.3	11.87	21700	1,160,529.88	8,068,816.98
II	330	360	0	13.39	21775	1,412,121.70	8,900,278.79	-0.3	11.87	21850	1,713,183.55	11,980,311.93
III	330	360	0	13.39	21875	2,136,527.93	13,560,581.27	-0.3	11.87	22100	2,511,282.09	17,730,412.31
IV	330	360	0	13.39	21950	2,580,967.73	16,469,454.04	-0.3	11.87	22300	2,974,272.21	21,199,917.80

Table 49 - Dredging Quantity details

a) Observed and reduced Bed Profile of the stretch

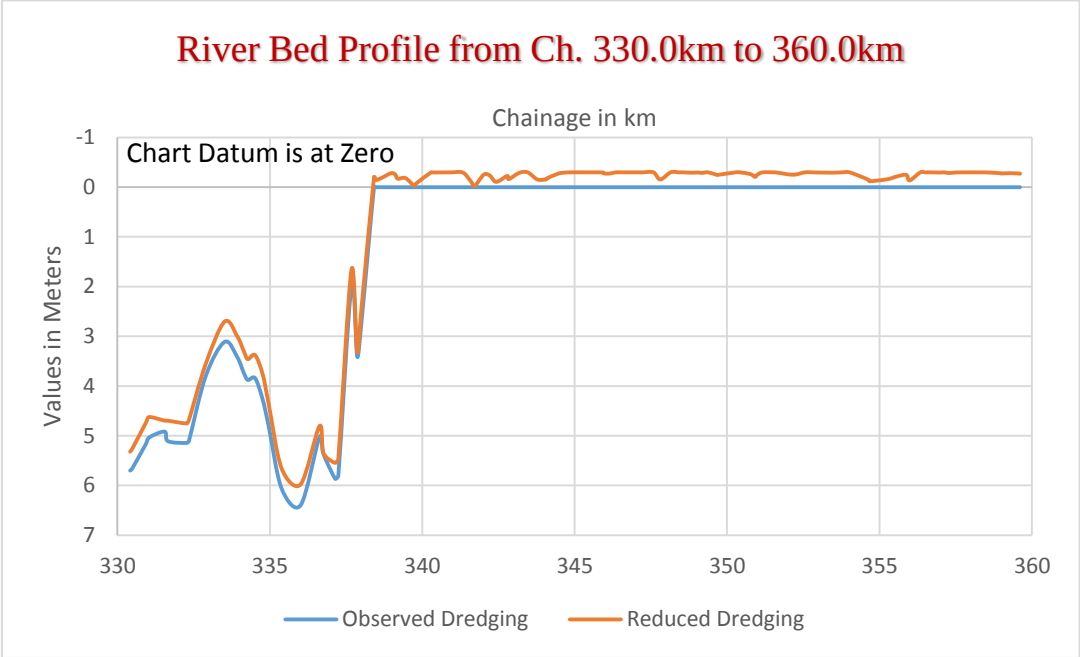


Figure 82 - River Bed Profile

3.13 Sub Stretch 13: Ganjahalli to Gugal (Chainage 360.0km to 390.0km)

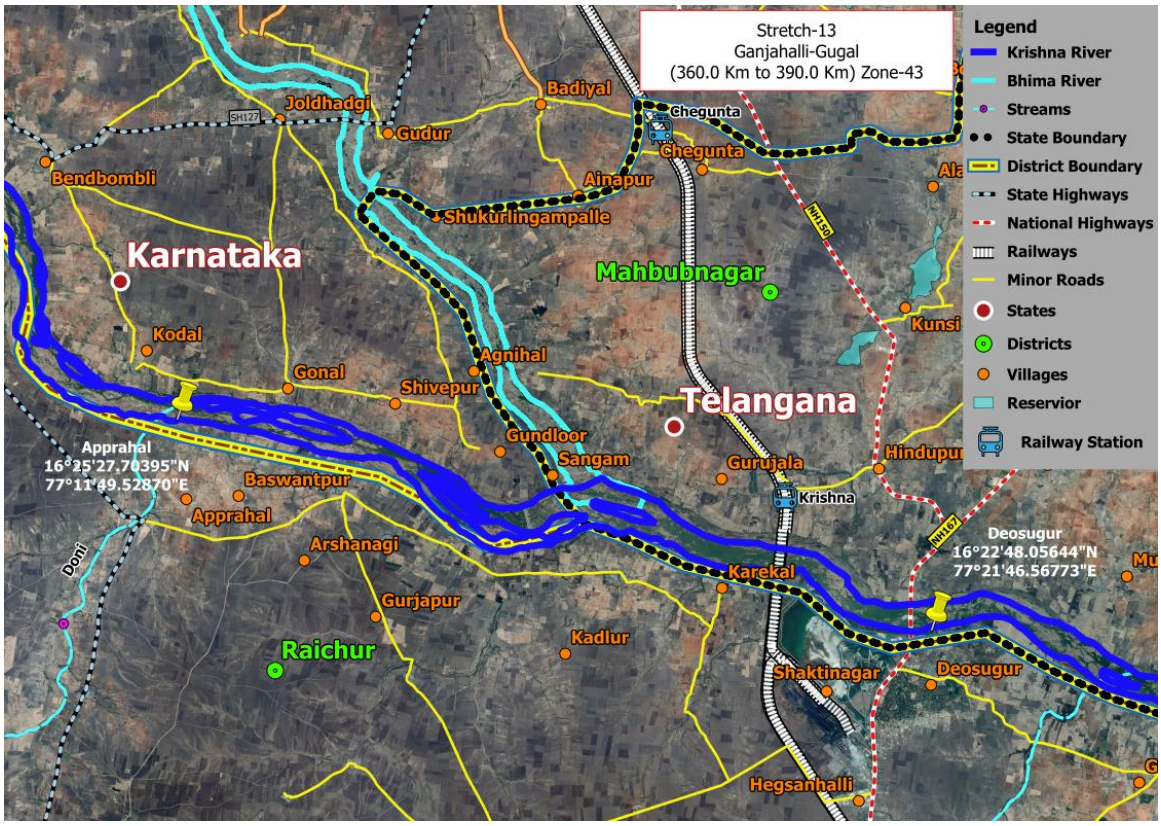


Figure 83 - Stretch 13- Ganjahalli to Gugal

- **Bathymetry Survey**
  a) No bathymetric survey is conducted due to the unavailability of water.
- **Topographic Survey**
  b) 30.00km length of the stretch for which the topographic survey has been carried out.

This stretch is between 360 to 390km chainage of Ganjahalli to Gugal village.

Upon this stretch, IWAI-BM-KRS-27 constructed at the right bank of the river at a chainage of 366.746km and nearby village is Deosugur. IWAI-BM-BHM-15 is constructed on the left bank of the river at a chainage of 375.867km. And nearby village to this benchmark is Gundloor. IWAI-BM-KRS-26 is constructed at a chainage of 386.051km upon the right bank of the river and nearby village is Apprahal.

Upon this stretch, Deosugur is a Village in Raichur Taluk in Raichur District of Karnataka State, India. It belongs to Gulbarga Division. 421km from state capital Bengaluru.

Apprahal is a small village/hamlet in Devadurga Taluk in Raichur District of Karnataka State, India. It comes under Apprahal Panchayath. It belongs to Gulbarga Division. It is located 59km towards west from District Raichur. 456km from State capital Bengaluru.

Shorapur, Shahpur, Yadgir, Manvi, Raichur, Gadwal, Yemmiganur are the nearby Cities to This stretch. Raichur Railway Station, Yermaras Railway Station are the very nearby railway stations to this stretch. This stretch is accessed by good roadways.

At chainage 367.61km chainage we found a big Thermal power plant of KPCL.

The KPCL (Karnataka Power Corporation Limited) is being constructed near to this stretch. Raichur Thermal Power Station (RTPS) is a coal-fired electric power station located in the Raichur district of the state of Karnataka, India. It is operated by the Karnataka Power Corporation Limited (KPCL) and was the first thermal power plant to be set up in the state.

Figure 84 - Raichur Thermal Power plant (ch. 367.61km)

At chainage 367.34km, a highway Bridge is being constructed upon Krishna River. This is being constructed upon NH 167 which is Raichur and Mahbubnagar highway.

Figure 85 - Raichur Hyderabad Highway Bridge at Deosugur (ch. 367.34km)

At chainage 370.85km a Railway Bridge is being constructed upon Krishna River having a length of 1200 mtr. The nearest village is Shakti Nagar. This bridge is the connection between Telangana and Karnataka states. Yadalapur and Krishna are the two nearby station of this crossover at left and right bank of the river.

Figure 86 - Railway Bridge at Shakti Nagar (ch. 370.85km)

At chainage 375.70km Krishna and its major tributaries called Bheema River converges called Sangamam is also called as "Nivrutti Sangamam", near to Gundloor village. As per Sri Guru Charitra, Lord Sripada Srivallabha Swamy (1st Incarnation of Shri Lord Dattatreya) had a holy dip here before reaching Sri Kshetra Kuruvapur from Gokarna Kshetram and thereby this confluence has become such a pious and sacred place. Therefore, whoever will have a holy dip here, will be blessed by Lord Sripada Srivallabha and their sins and karma will be vanished instantly).

A temple is constructed near to the right bank of the river called Nivutrhi Sangamam. A pictorial presentation is shown below.

Figure 87 - Convergence point of Krishna and Bheema (ch. 375.70km)

This river is being utilized for drinking water and cultivation; people were cultivating Rice, Jawar, and Bajra near to the banks of Krishna River.

Figure 88 - Land cultivation at banks of Krishna

During the survey, it was found that this stretch is having rocks as well as thick vegetation which is not suitable for bathymetric surveys. Bath the banks are not protected in nature and encroachment to this stretch is not found a suitable waterway.

Figure 89 - Krishna River at this stretch.

Class	Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity
I	360	390	0	0	30000	1,288,098.95	7,104,550.34	-0.3	0.368	30000	1,617,447.85	9,686,264.83
II	360	390	0	0	30000	1,961,967.04	10,862,245.83	-0.3	0.368	30000	2,383,409.47	14,363,721.40
III	360	390	0	0	30000	2,965,308.40	16,525,889.67	-0.3	0.368	30000	3,488,333.02	21,218,745.33
IV	360	390	0	0	30000	3,578,046.23	20,047,500.27	-0.3	0.368	30000	4,124,499.95	25,324,417.75

Table 50 - Dredging Quantity details

a) Observed and reduced Bed Profile of the stretch

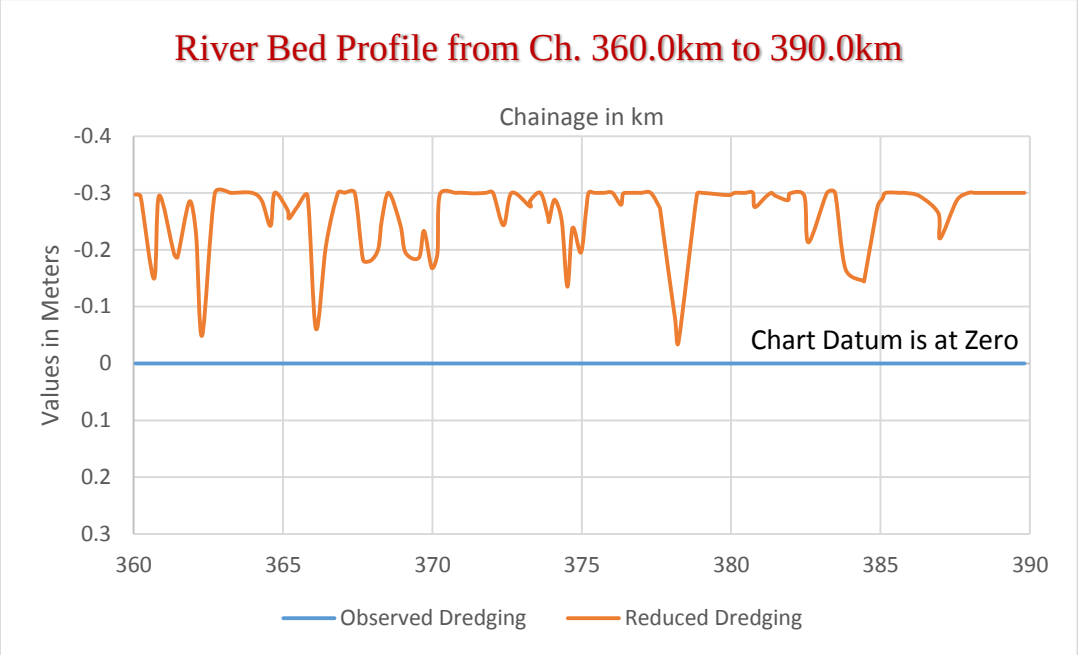


Figure 90 - River Bed Profile

3.14 Sub Stretch 14: Gugal to Konchapali (Chainage 390.0km to 420.0km)

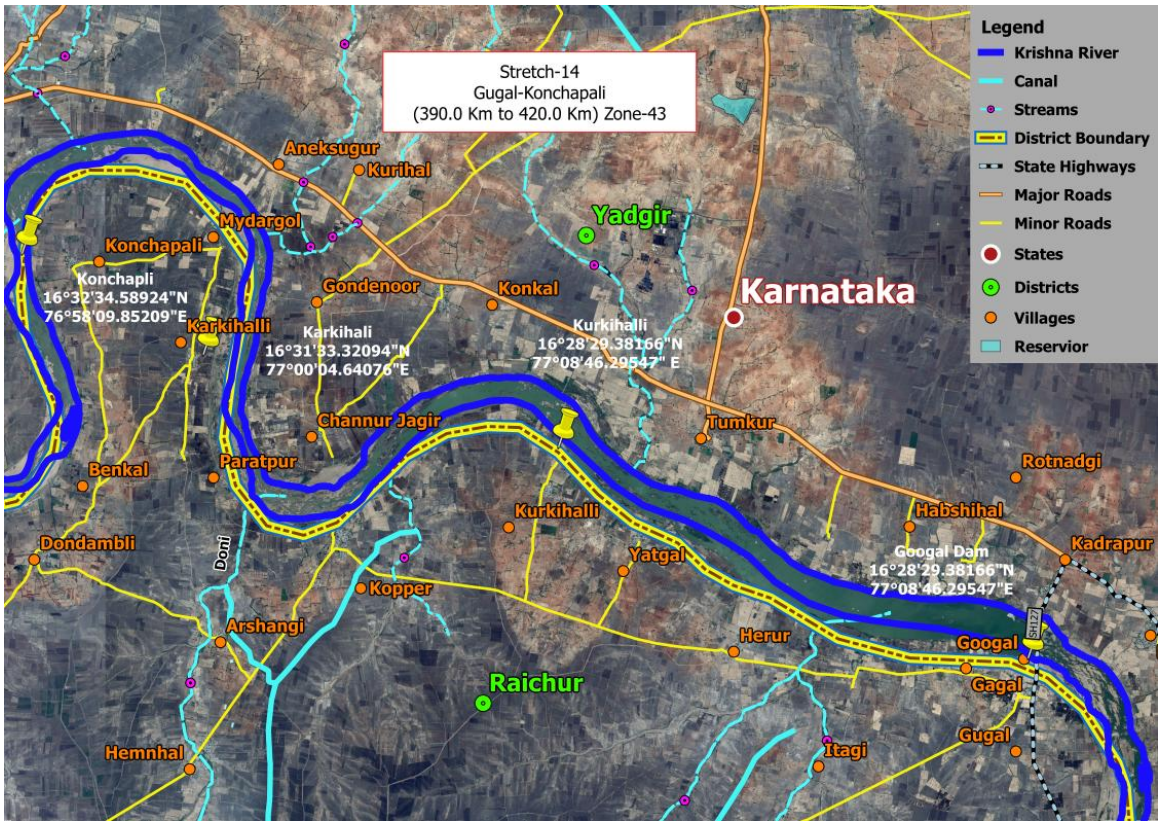


Figure 91 - Stretch 14- Gugal to Konchapali

- **Bathymetry Survey**
  a) 15.600km length of the stretch for which the bathymetric survey has been carried out.
- **Topographic Survey**
  b) 14.400km length of the stretch for which the topographic survey has been carried out.

This stretch is between 390 to 420km chainage of Gugal to Konchapali village.

Upon this stretch, IWAI-BM-KRS-25 constructed at the right bank of the river at a chainage of 394.908km and nearby village is Gugal. IWAI-BM-KRS-24 is constructed at the right bank of the river at a chainage of 404.781km. And nearby village to this benchmark is Kurkihalli. IWAI-BM-KRS-23 is constructed at a chainage of 414.384km upon the right bank of the river and nearby village is Karki halli.

Gugal is a village in Devadurga Taluk in Raichur District of Karnataka State, India. It belongs to Gulbarga Division. It is located 59km towards west from District Raichur.

Kurkihalli is a small village/hamlet in Devadurga Taluk in Raichur District of Karnataka State, India. It comes under Kurkihalli Panchayath. It belongs to Gulbarga Division. It is located 59km towards west from District Raichur.

Gugal Bridge cum barrage at a chainage of 395.09km is constructed at Gugal village of Devdurga Taluk dist, Raichur of Karnataka state. It's a high-level Bridge cum Barrage with vertical gates, which is used by the local villagers for irrigation purpose. And the Bridge is used for to communicating between Yadgir and Raichur district.

Figure 92 - Gugal Bridge cum Barrage (ch. 395.09km)

At the right bank of the river, a small hydel plant found upon this stretch. It's called Gugal SHP (Small Hydel Plant) a 4 X 2.5 MW power project, which was constructed by BHEC (Bengaluru Hydro Engineering and Consultants Pvt Limited), and operated by Karnataka Electricity Regulatory commission. Gugal SHP utilizes surplus water from Gugal Barrage. Turbines are installed in the powerhouse on the left bank of the river. The units are commissioned in 2008. The main components are approach channel, Intake, powerhouse and Tail Channel.

Figure 93 - Small Hydel Power plant at Gugal village (ch. 395.10km)

At chainage 395.21km a small temple was situated at the right bank of the river called, Shri Prabhu Lingeshwar Swamy temple.

At chainage 410.75km upon this stretch, a small temple was found at the right bank of this river called, Shri Koppara Lakshmi Narasimha Temple.

Figure 94 - Koppara Lingeshwar Swamy Temple (ch. 410.75km)

At chainage 408.206km a High Tension Electric pole was constructed at the center of the river.

Figure 95 - High-Tension Line at Koppara village upon Krishna River (ch. 408.206km)

As per the local villagers and notified by the forest department this stretch is full of crocodiles.

Figure 96 - Notified by the forest department

Shorapur, Shahpur, Yadgir, Manvi are the nearby Cities to this stretch. All are well connected to roadway transport. Rice, Jawar, Tur, Bajra, mostly cultivated nearby the villagers, in this stretch.

Karnataka state highway number 127 followed through this stretch.

Gugal, Itagi, Vatgal, Kopper, Arshangi, Hemnal, Benkal, Konchapali are the nearby villages upon the right bank of this stretch and are well connected to the roadway. Yadgir is the nearby city to the left bank of the stretch

Habshihal, Tumkur, Rotnadgi, Konkal, Gindenoor, Kurihal are the nearby villages to the left bank of this stretch. Raichur is the nearby city to the right bank of the stretch.

During survey, it was found that from chainage 393.00km to chainage 408.800km water was present and the depth varies from 4 to 5 meter and was found suitable for carry out the bathymetric survey. Towards upstream water packet found in this stretch, and full of rock boulders.

Figure 97 - Showing rock boulders upon this stretch

Devdurga, Hatti are nearby by towns having road connectivity with Gugal. There is no railway station near to Gugal in less than 10km from near by towns.

Class	Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity
I	390	420	0	5.45	22400	683,374.28	7,787,924.62	-1.77	3.65	25200	1,301,260.08	10,987,524.91
II	390	420	0	5.45	22550	1,063,166.63	11,925,412.46	-1.77	3.65	25575	1,961,333.39	16,325,054.79
III	390	420	0	5.45	22700	1,660,400.07	18,186,289.74	-1.77	3.65	26500	2,947,224.32	24,165,969.65
IV	390	420	0	5.45	24375	2,071,776.86	22,119,277.13	-1.77	3.65	30000	3,546,982.71	28,871,400.46

Table 51 - Dredging Quantity details

a) Observed and reduced Bed Profile of the stretch

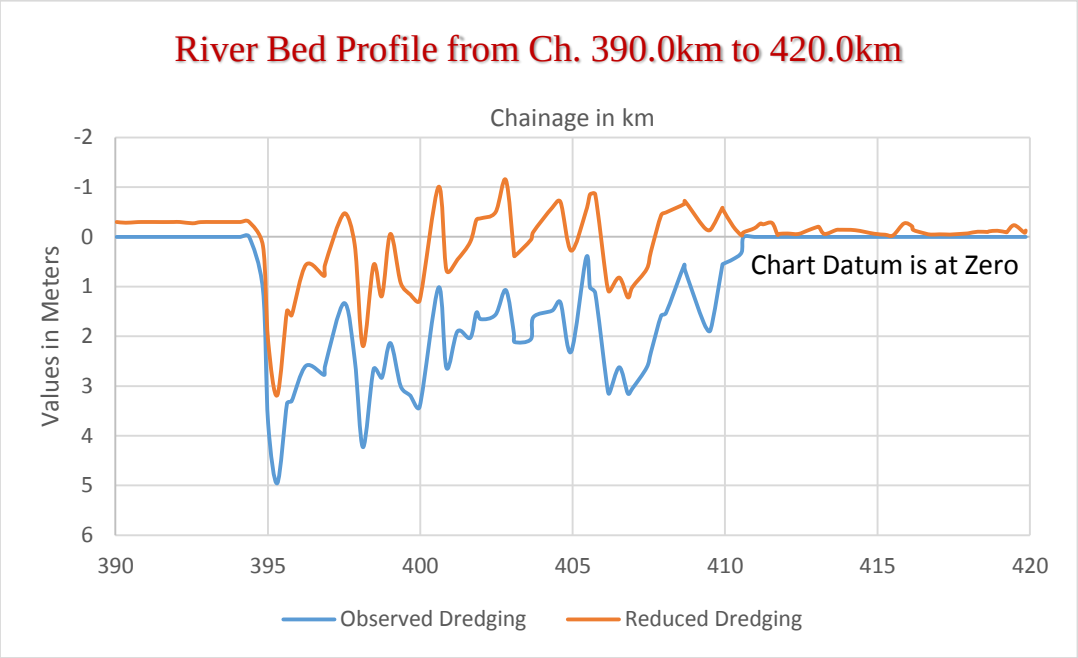


Figure 98 - River Bed Profile

3.15 Sub Stretch 15: Konchapali to Buddinni (Chainage 420.0km to 450.0km)

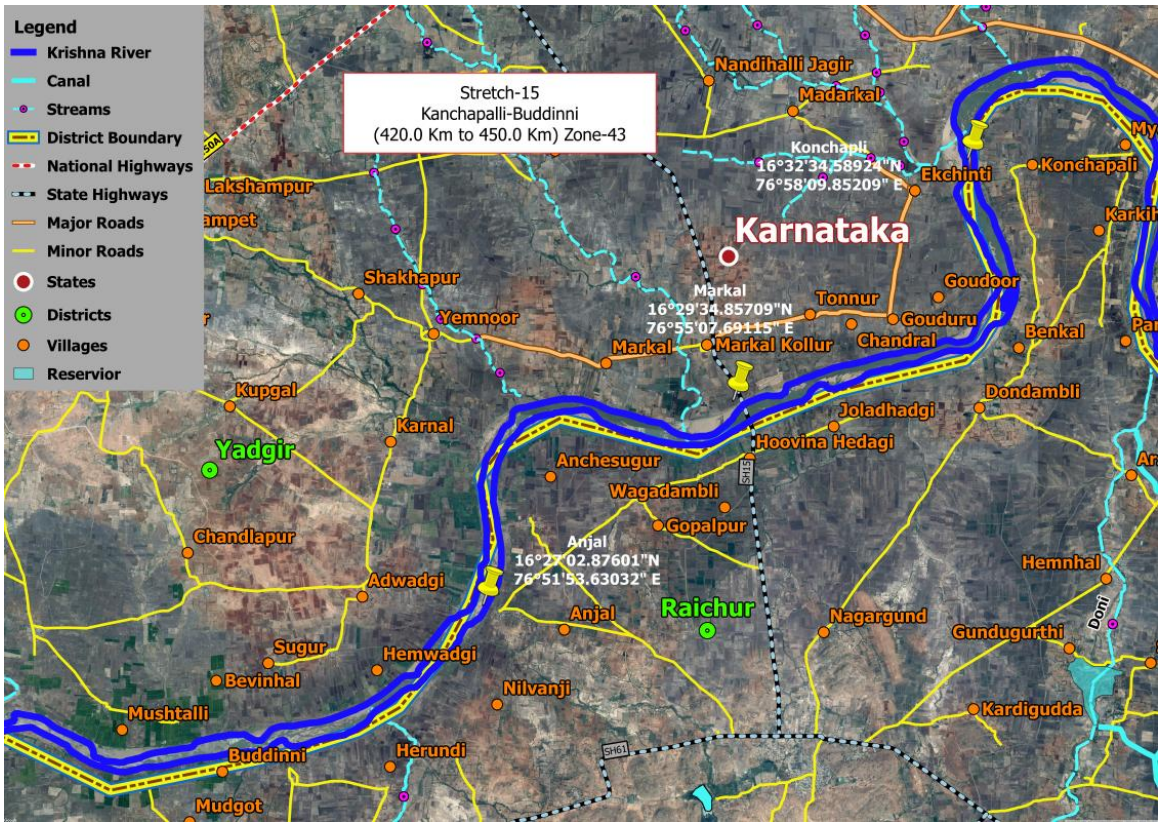


Figure 99 - Stretch 15- Konchapali to Buddinni

- **Bathymetry Survey**
  a) No bathymetric survey is conducted due to the unavailability of water.
- **Topographic Survey**
  b) 30.0km length of the stretch for which the topographic survey has been carried out.

This stretch is between 420 to 450km chainage of Konchapali to Buddinni village.

Upon this stretch, IWAI-BM-KRS-22 constructed at the right bank of the river at a chainage of 423.436km and nearby village is Konchapali. IWAI-BM-KRS-21 is constructed at the right bank of the river at a chainage of 433.522km. And nearby village to this benchmark is Huvinahedgi. IWAI-BM-KRS-20 is constructed at a chainage of 443.619km upon the right bank of the river and nearby village is Anjal.

In this stretch, Konchapali is the starting point of the stretch. Konchapali village is located in Devadurga Tehsil of Raichur District in Karnataka, India. It is situated

18km away from sub-district Devadurga and 78km away from district Raichur. It is in the gram panchayat of Dondavli.

Urkihalli is a small village/hamlet in Devadurga Taluk in Raichur District of Karnataka State, India. It comes under Karkihalli Panchayath. It belongs to Gulbarga Division. It is located 59km towards west from District Raichur.

Anjal is a small village present at the right bank of the Krishna River of Devdurga Taluk of Raichur district Karnataka.

State Highway No 15, which connects Yadgir and Raichur and Bijapur to Deosugur. During survey at chainage 433.54km a highway bridge named Golden Bridge constructed upon Krishna River. Huvinhedgi and Markal Kollur are the nearby villages communicated by this state highway of Karnataka. As per the local villagers, during heavy rainfall and flooding in Krishna River this bridge submerged with water.

Figure 100 - Golden Bridge (ch. 433.54km)

Near to the left bank of the river, it was notified that Kohinoor diamond was found near Krishna River.

Mudgot, Herundi, Anjal, Anchesugur, Wagadambali, Gopalpir, Huvinhedgi, Dondambli, Nagarkund are the nearby villages situated at the right bank of the river of this stretch under Raichur district.

Aralhalli, Yemnoor, Chandlapur, Markal Kollur, Tannur, are the nearby villages to this stretch situated at the lift bank of the river under Yadgir district. Krishna River acts like the border of Raichur and Yadgir district of Karnataka.

Figure 101 - Notice Board of Kohinoor diamond

Due to unavailability of rail transport, communication is only by road transport. Devdurga is the nearest city in this stretch, the stretch is followed through Karnataka state highway no 61 and 16.

Shorapur, Shahpur, Yadgir, Manvi are the nearby cities to this stretch. There is no rail connectivity and nearest road transport are from Devdurga and Hatti. Aneksugur, Ekchinti, Mydarogol are the nearby villages in this survey stretch.

During this stretch, people are cultivating mostly, Bajra, Brinjal, and white grapes.

Due to unprotected river bank and presence of sands and rocks, the bathymetric survey could not be conducted. The topographic method applied to collect the data. Though water packets were found on this stretch, which was too little to depute survey launch to carry out the hydrographic survey, the entire area surveyed by topographical surveys. The pictorial presentation shows the water packets and the sandy areas upon this stretch.

Figure 102 - Rocks and sand Patches.

Class	Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity
I	420	450	0	0	30000	1,289,820.20	9,077,744.82	-0.3	0	30000	1,448,708.94	12,436,233.85
II	420	450	0	0	30000	1,964,585.87	13,889,998.33	-0.3	0.04	30000	2,169,613.26	18,494,668.05
III	420	450	0	0	30000	2,969,275.11	21,155,564.85	-0.3	0.04	30000	3,225,434.25	27,391,403.90
IV	420	450	0	0	30000	3,582,827.52	25,702,104.65	-0.3	0.04	30000	3,850,931.57	32,722,332.03

Table 52 - Dredging Quantity details

a) Observed and reduced Bed Profile of the stretch

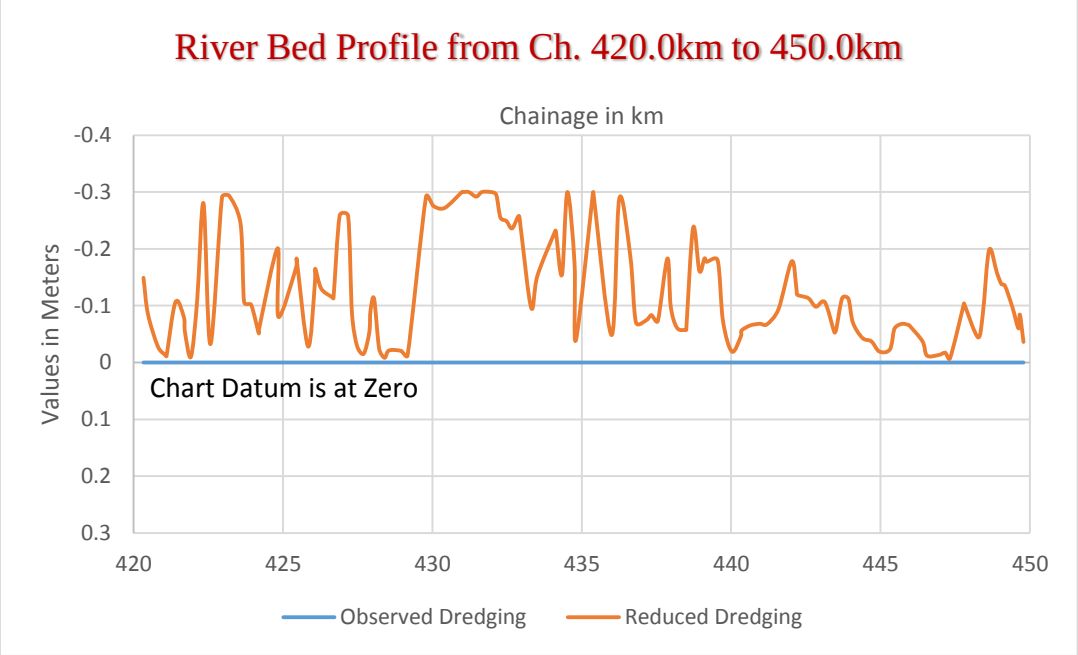


Figure 103 - River Bed Profile

3.16 Sub Stretch 16: Buddinni to Aidbhavi (Chainage 450.0km to 480.0km)

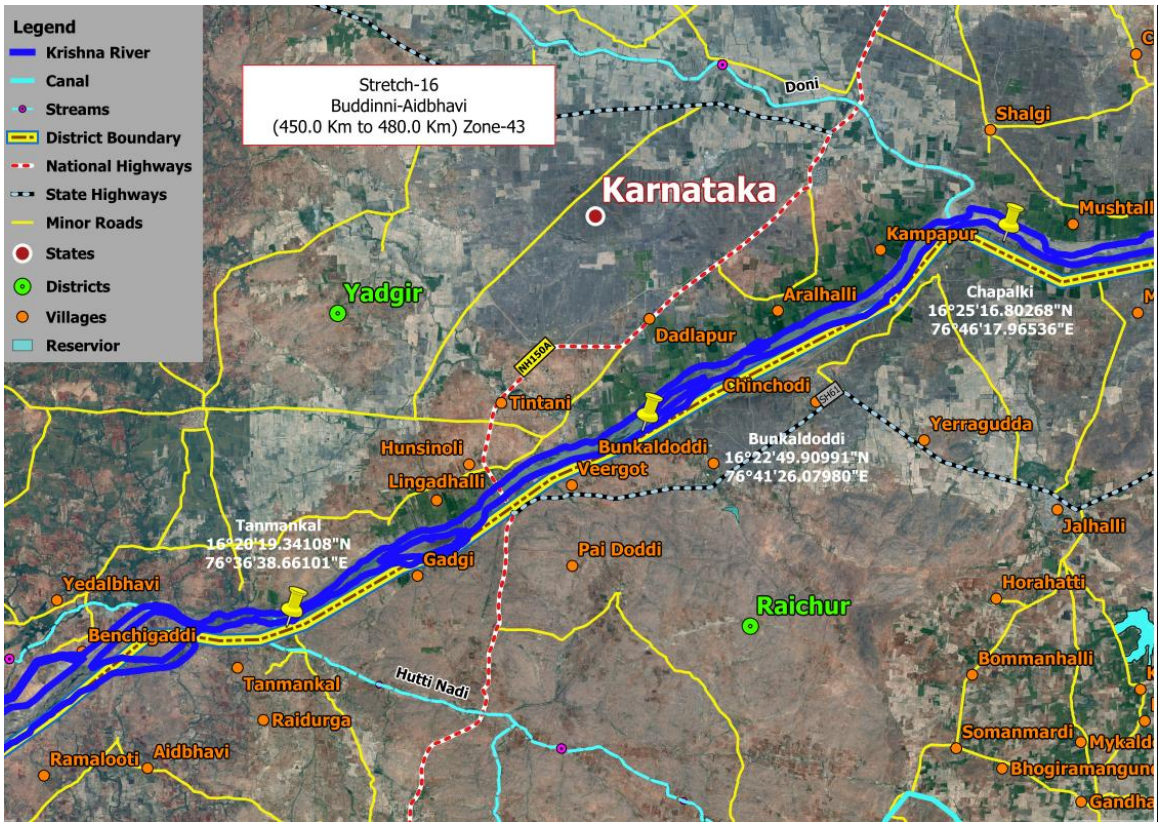


Figure 104 - Stretch 16- Buddinni to Aidbhavi

- **Bathymetry Survey**
  a) No bathymetric survey is conducted due to the unavailability of water of the stretch.
- **Topographic Survey**
  b) 30.000km length of the stretch for which the topographic survey has been carried out.

This stretch is between 450 to 480km chainage of Konchapali to Buddinni village.

Upon this stretch, IWAI-BM-KRS-19 constructed at the right bank of the river at a chainage of 454.739km and nearby village is Lingadahalli. IWAI-BM-KRS-18 is constructed at the right bank of the river at a chainage of 465.623km. And nearby village to this benchmark is Bunkaldoddi. IWAI-BM-KRS-17 is constructed at a chainage of 475.314km upon the right bank of the river and nearby village is Tanmankal.

Lingadahalli is a small village/hamlet in Devadurga Taluk in Raichur District of Karnataka State, India. It comes under Lingadahalli Panchayath. It belongs to Gulbarga Division. It is located 59km towards west from District Raichur.

Bunkaldoddi is a small village/hamlet in Devadurga Taluk in Raichur District of Karnataka State, India. It comes under Bunkaldoddi Panchayath and belongs to Gulbarga Division. It is located 59km towards west from Raichur District.

Tanmankal is a small village/hamlet in Lingsugur Taluk in Raichur District of Karnataka State, India. It comes under Tanmankal Panchayath and belongs to Gulbarga Division. It is located 103km towards west from District Raichur.

During the survey at chainage 469.32km, we found a bridge named Tintani Bridge, having a length of 647.9 mtr and near to Hanshihole Village. Lingadahalli, Tintani, Santpur, Veergot, Paidoddi, Golpalli are the nearest villages to this Bridge. Karnataka State Highway no. 19 followed by this bridge. This connects Lingsugur to Shorapur. Also followed by NH150 A.

Figure 105 - Tintani Bridge (ch. 469.32km)

Mudgot, Buddinni, Bevinhal Sugur are the nearby villages in this stretch. There is no railway station near to this stretch in less than 10km distance. Gulbarga Railway Station is major railway station 112km to Lingadahalli. Karnataka State highway 61 is followed this stretch.

At chainage 467.52km at the left bank of the river, we found one temple called Shree Mouneshwar temple.

Figure 106 - Mouneshwar Swamy Temple (ch. 467.52km)

During the survey, it is found that the river is being used for cultivation and drinking water purpose. But in summer the river became fully dry and the stretch is full of sand and rock outcrops.

At chainage 475.600km to 478.300km an Island was there which divided the flow of the river into two parts, one is at left bank and another one is a right bank. The right bank of the river is full of rocks and the flow is like Nala like structure. And at the left bank of the river is formed as like as canal. Which is from Narayanapur Dam backwater flow.

Lingsugur, Talikota, Muddebihal, Shorapur, Shahpur, Yadgir, Manvi are the nearby Cities to this stretch.

No rail connectivity, only road connectivity is there. Lingsugur is the nearby bus depot to this stretch.

During the survey, it was found that the river is having full of thick vegetation and sand patches and having rock boulders. Due to encroachment and unprotected riverbank waterway is not possible in this stretch.

Figure 107 - Thick Vegetation and Rock outcrops during the surveys

Class	Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity
I	450	480	0	0	30000	1,290,184.52	10,367,929.34	-0.3	0.169	30000	1,509,066.92	13,945,300.77
II	450	480	0	0	30000	1,965,139.78	15,855,138.11	-0.3	0.169	30000	2,246,138.86	20,740,806.91
III	450	480	0	0	30000	2,970,089.10	24,125,653.95	-0.3	0.171	30000	3,318,276.98	30,709,680.88
IV	450	480	0	0	30000	3,583,806.04	29,285,910.69	-0.3	0.171	30000	3,947,421.43	36,669,753.46

Table 53 - Dredging Quantity details

a) Observed and reduced Bed Profile of the stretch

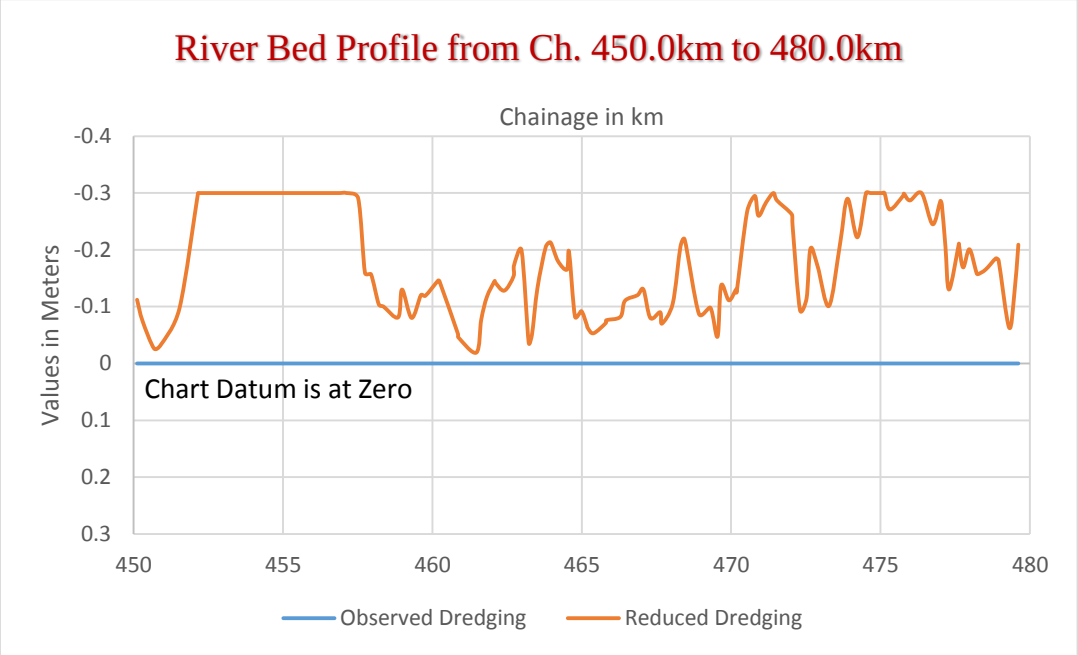


Figure 108 - River Bed Profile

3.17 Sub Stretch 17: Aidbhavi to Chitapur (Chainage 480.0km to 510.0km)

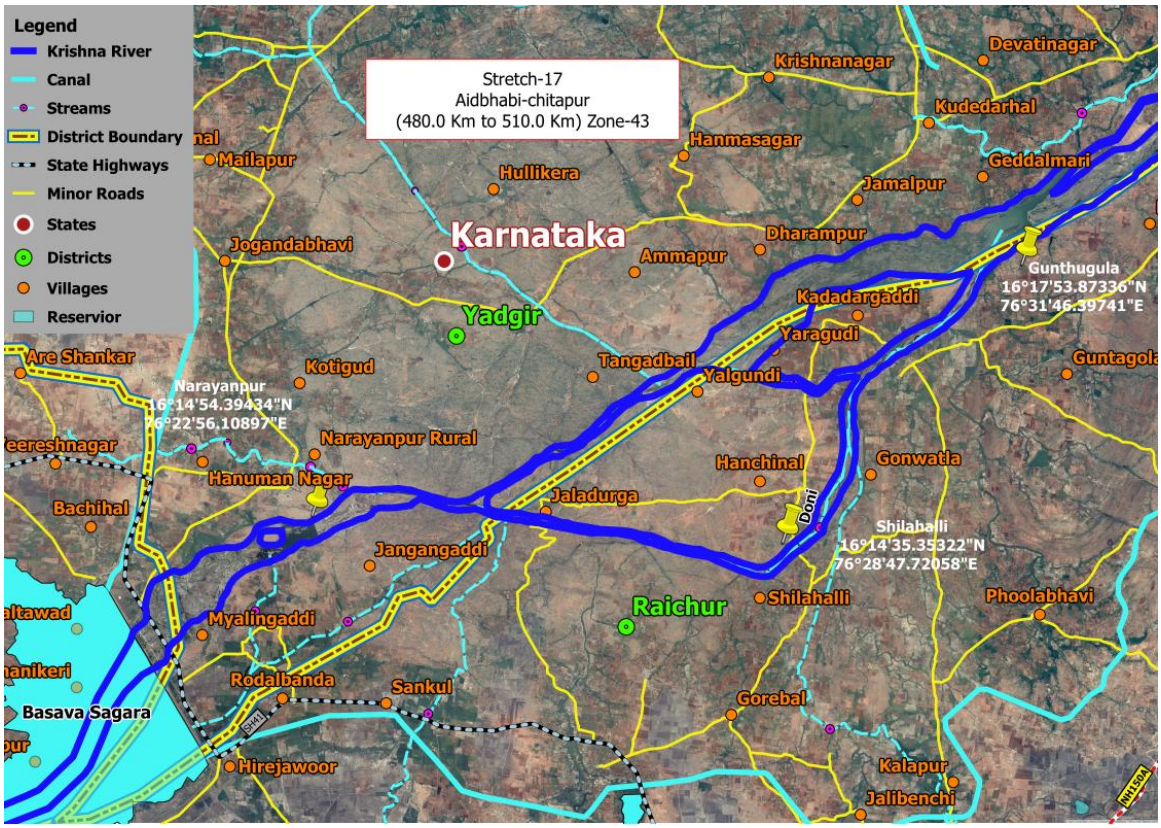


Figure 109 - Stretch 17- Aidbhavi to Chitapur

- **Bathymetry Survey**
  a) 2.000km length of the stretch for which the bathymetric survey has been carried out.
- **Topographic Survey**
  b) 28.000km length of the stretch for which the topographic survey has been carried out.

This stretch is between 480 to 510km chainage of Aidbhavi to Chitapur village.

Upon this stretch IWAI-BM-KRS-16 constructed at the right bank of the river at a chainage of 485.490km and nearby village is Guntagola. IWAI-BM-KRS-15 is constructed at the right bank of the river at a chainage of 494.508km. And nearby village to this benchmark is Bunkaldoddi. IWAI-BM-KRS-14 is constructed at a chainage of 505.509km, upon the right bank of the river and nearby village is Narayanapur.

At chainage 480.69km nearby Banchhigadi village, a small hydel power plant was constructed at the left bank of the river. 24.75 MW Mouneswar and 24.75 MW Basavanna SHEPs are built across River Krishna in Benchagaddi village of Shorpur taluk of Gulbarga District in Karnataka.

The projects have also applied for Carbon credits under the United National Framework Convention on Climate Change (UNFCCC).

The dam/ diversion weir built by the projects is inside the Krishna River bed and diverts the water through a power canal which runs approximately 3kms downstream. The power canal takes most of the water from the river rendering the river dry in the lean season.

Figure 110 - Banchhigadi Hydel power project (ch. 480.69km)

Narayanpur Rural is a panchayat village, in the southern state of Karnataka, India. It is located in the Shorapur Taluka of Yadgir district in Karnataka.

The Bhoruka Power Corporation Ltd., situated in Bengaluru is established to set biggest hydel plant till date with the Chayadevi mini Hydel Power Station, a 24 MW capacity river project. It is located 5kms downstream of the picturesque Narayanpur dam and 120kms from Raichur in Karnataka.

Salient Features of Chayadevi Mini Hydel Power Station		
Location	Near Narayanpur, Shorapur Taluk.	
District / State	Gulbarga / Karnataka.	
Development type	Run of the river plant utilizing head at the location.	
Installed capacity	24 MW (2 x 12 MW)	
River Stream / Canal	River Krishna	
Water conductor system	Diversion structure, Power canal, Fore bay, Intake structure, Penstocks, Power house and tail race channel.	
Penstock	Two nos of 100m length each	
Turbines	Vertical Full Kaplan	

Salient Features of Chayadevi Mini Hydel Power Station		
Rated Discharge	50 cumecs / unit	
Rated Head	29 m	
Generators	Synchronous type	
Power house	43 m (L) x 25 m(B) X 38.8 m(H)	

Table 54 - Salient Features of BPCL Power Station (ch. 504.73km)

At chainage 510.00km chainage, a highway bridge was constructed which is followed by Karnataka State Highway 41 and connect between Lingsugur to Nalatvad.

Figure 111 - Bridge downstream of Narayanapur Dam (ch. 510.00km)

At chainage 505.65km a weir was constructed across the Krishna River, having a length of 500m and formed a lift irrigation scheme, which was lifted by the farmers.

Figure 112 - Weir near downstream of Narayanapur Dam (ch 505.65km)

At chainage 497.000km an Island was there which is having a length of approx. 8km and width of four kilometers. Few habitats observed upon this stretch and three small villagess was there called Jaladurga, Hanchinal, and Yelagundi.

A bridge was constructed across the Krishna River to the island of Jaladurga named as Jaladurga-Kote Road at chainage 500.55km

Figure 113 - Krishna River flow in between the Island at Jaladurga

Hanchinal is a small village/hamlet in Lingsugur Taluk in Raichur District of Karnataka State, India. It comes under Hanchinal Panchayath. It belongs to Gulbarga Division. It is located 103km towards west from District Raichur. Bridge near Hanchinal Village (ch. 490.96km) is a passage to these villages.

Figure 114 - Bridge near Hanchinal village (ch. 490.96km)

Guntagola is a village in Lingsugur Taluk in Raichur District of Karnataka State, India. It belongs to Gulbarga Division. It is located 104km towards west from District Raichur 16km from Lingsugur.

At chainage 484.14km of River Krishna, and on the left bank near Gedalmari Village, another small wier and a small hydel power project is being constructed.

Figure 115 - Geddalmari weir house near Geddalmari village (ch. 484.14km)

Halbhavi, Jaldurga, Yalgundi, Hanchinal, Tangadbali are the villages under this vicinity. Yaragudi, Dharampur, Kaddargaddi, Geddalmari Gonwatla are the nearest village under this stretch.

Lingsugur, Talikota, Muddebihal, Shorapur are the nearby cities to this stretch.

Lingsugur, Mudgal, Ilkal are the nearby towns to Hanchinal having road connectivity to Hanchinal.

There is no railway connectivity in this stretch. Only road connectivity is there. Lingsugur is the nearest bus depot to the stretch.

During the survey, it was found that due to the presence of rocks at the left bank of the river no cultivation was found. Whereas the right bank of this stretch was cultivated by Bajra and Tur.

Rather than some hydel power plants, there were no such big industries found nearby this stretch.

The river bank is erosive in nature and to the downstream of Narayanapur Dam found presence of rock outcrops and thick vegetation. This stretch is not suitable for a good waterway.

Class	Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity
I	480	510	0	0	30000	1,290,641.30	11,658,570.64	-0.3	1.17	30000	1,573,781.30	15,519,082.07
II	480	510	0	0	30000	1,965,810.40	17,820,948.51	-0.3	1.17	30000	2,329,872.91	23,070,679.82
III	480	510	0	0	30000	2,970,216.94	27,095,870.89	-0.3	1.17	30000	3,422,633.82	34,132,314.70
IV	480	510	0	0	30000	3,583,535.67	32,869,446.36	-0.3	1.17	30000	4,056,278.47	40,726,031.93

Table 55 - Dredging Quantity details

a) Observed and reduced Bed Profile of the stretch

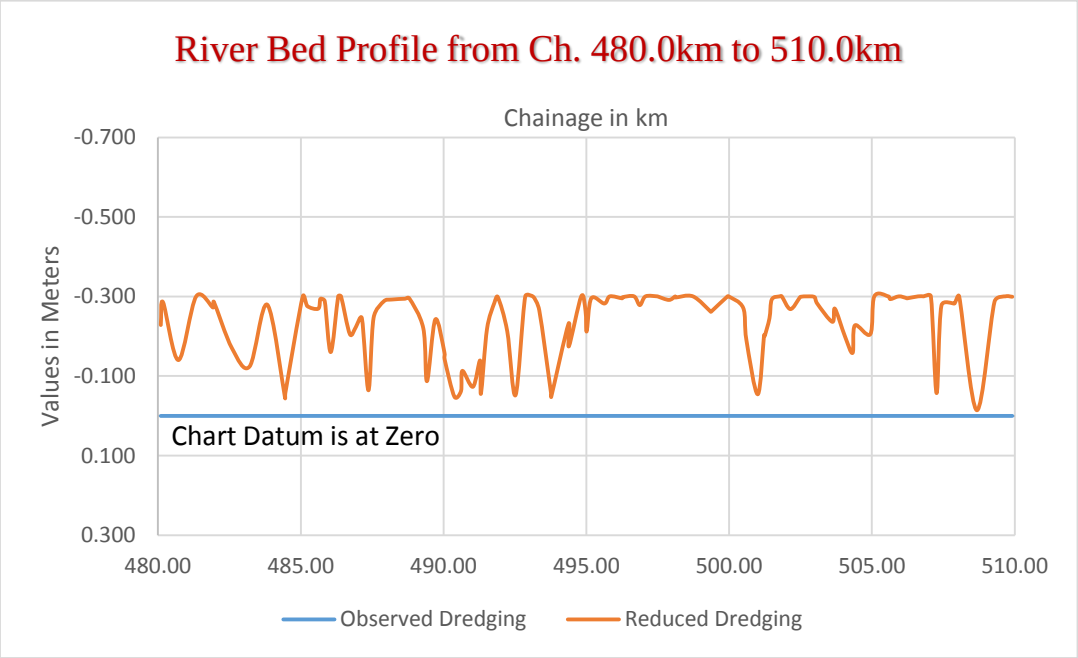


Figure 116 - River Bed Profile

3.18 Sub Stretch 18: Chitapur to Adihal (Chainage 510.0km to 540.0km)

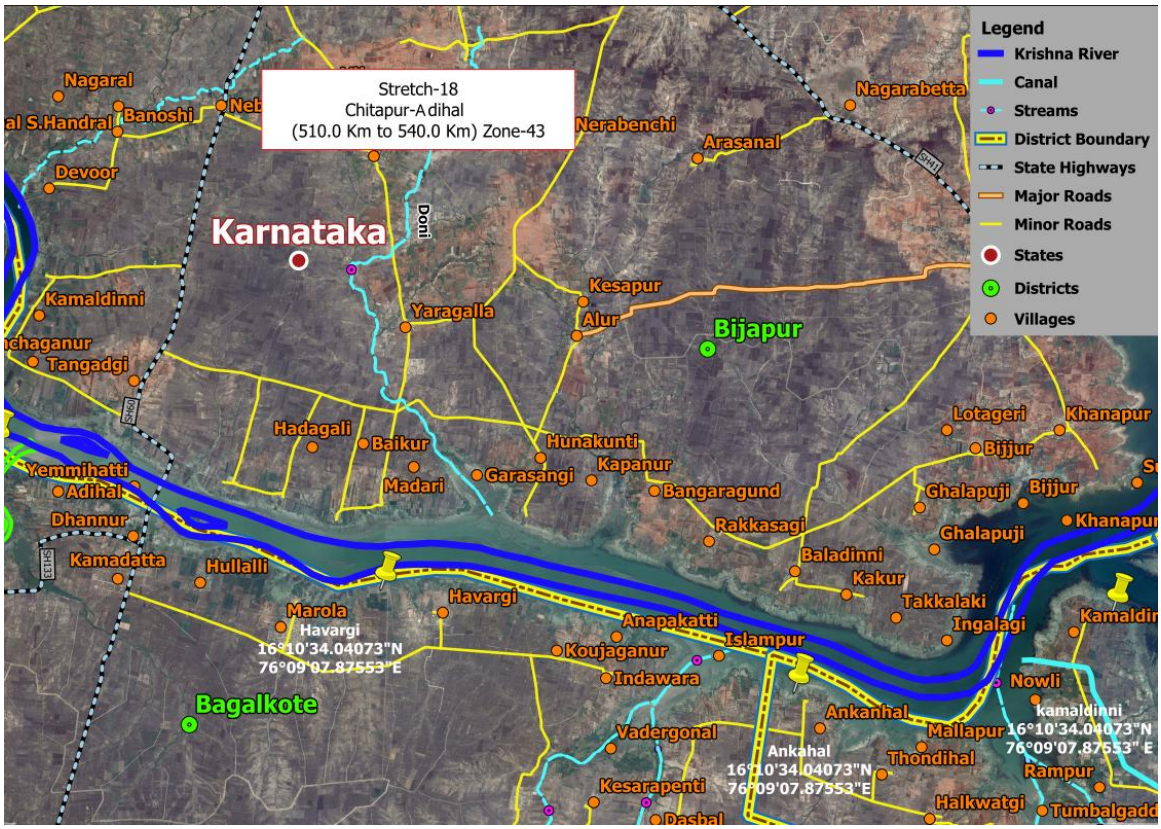


Figure 117 - Stretch 18- Chitapur to Adihal

- **Bathymetry Survey**
  a) 30.000km length of the stretch for which the bathymetric survey has been carried out.
- **Topographic Survey**
  b) 0.00km length of the stretch for which the topographic survey has been carried out.

This stretch is between 510 to 540km chainage of Chitapur to Adihal village.

Upon this stretch, IWAI-BM-KRS-13 constructed at the right bank of the river at a chainage of 516.079km and nearby village is Kamaladinni. IWAI-BM-KRS-12 is constructed at the right bank of the river at a chainage of 524.694km. And nearby village to this benchmark is Ankanhal. IWAI-BM-KRS-11 is constructed at a chainage of 535.652km, upon the right bank of the river and nearby village is Havargi.

Narayanpur Rural is a panchayat village, in the southern state of Karnataka, India. It is located in the Shorapur Taluka of Yadgir district in Karnataka. It is adjacent to and gives its name to the Narayanapur Dam on the Krishna River. Which is situated at chainage 510.84km.

Narayanapur Dam is constructed across the Krishna River at Siddapur Village in Muddebihal Taluk, Bijapur District, of Karnataka, India. The reservoir it impounds is known as Basava Sagar, and has a total storage capacity of 37.965 tmcft (1.075km³), with 30.5 tmcft (0.85km³) live storage. The full reservoir level is 492.25m MSL and the minimum drawn down level is 481.6 m MSL. It was a single purpose project meant only for irrigation, but downstream electrical generation and drinking water considerations enter into its management. This dam is 29 meters high and over 10 kilometers long and has 30 gates for water release. It took Rs. 50.48 crore to complete.

When it was completed in 1982 it provided water to irrigate 4.21 lakh hectares in Jewargi taluk in Gulbarga district, Shahapur and Shorapur talukas in Yadgir district, Sindagi and Indi talukas in Bijapur district, and Lingsugur and Devadurga talukas in Raichur district.

Two of the irrigation gates partially failed in 2005, there was a collapse of one of the gates in the dam and up to lakh cusecs of water was being released before emergency actions were effective. The gate broke open on the morning of 6 October and most of the water flow was stopped by the afternoon of the 9th. Basava Sagar reservoir dropped several meters as a result.

Figure 118 - Narayanapur Dam (ch.510.84km)

During survey, it was found two canals were constructed at right bank as well as left bank of the River Krishna at Narayanapur

Narayanapur left bank canal is having a length of 78 kilometers which is having a capacity of 264.61cusecs and provide an irrigation up to 4,08,747 hectare area.

There are four branch canals which are towards 76km up to Shahpur, 172km up to Indi, 50.800km up to Mudgal and 86.360km up to Jewargi.

Figure 119 - Narayanapur Left Bank canal

Narayanapur right bank canal is having a length of 95km and area irrigated up to 840 square kilometers.

Figure 120 - Narayanpur Right Bank canal

Narayanapur left bank a hydroelectric power project was found one powerhouse was constructed, the salient feature of the powerhouse is mentioned below.

Salient Features	
Hydro Electric Project	Narayanpur LBC Hydroelectric Project
State Name	Karnataka
District	Bijapur
River	Krishna
Basin Name	Krishna
Hydro Electric Region	Southern HE Region
Total Installed Capacity (MW)	11
Type of Project	Small
Hydroelectric Project Status	Completed
Project Owner Type	Private
Owner Name	Murd PC

Table 56 - Narayanapur Dam LBC Powerhouse (ch. 509.72km)

Kamaladinni is a small village/hamlet in Devadurga Taluk in Raichur District of Karnataka State, India. It comes under Kamaladinni Panchayath and belongs to Gulbarga Division. It is located 59km towards west from District Raichur.

Ankanhal is a small village/hamlet in Lingsugur Taluk in Raichur District of Karnataka State, India. It comes under Ankanhal Panchayath and belongs to Gulbarga Division. It is located 103km towards west from District Raichur.

Havargi is a small village/hamlet in Hungund Taluk in Bagalkot District of Karnataka State, India. It comes under Havargi Panchayath and belongs to Belgaum Division. It is located 49km towards East from District Bagalkot.

At chainage 519.80km a small temple is situated on the right bank of this stretch of the river. Nearby village is Rampur.

Figure 121 - Rampur temple near Krishna River (ch. 519.80km)

During the hydrographic survey, we found an island at chainage 539.6km to 540.7km having a width of 200.34mtr and a length of 1.059km, near to Dhannur village.

Figure 122 - Island near Dhannur village.

At chainage 530.700km and 536.600km near Havargi village two narrow channel was found.

Figure 123 - Two canal-like structure at Havargi village

During the survey in this stretch no industries found on both the banks and are not protected in nature. Since the water depth is of 8 to 10 meter there is possibilities of waterway development upon this stretch.

Hungund, Muddebihal, Lingsugur, Ron, Talikota, Shorapur, Shahpur, Yadgir, Manvi are the nearby cities to this stretch.

This stretch is well connected by roadways. State Highway 14 and 41 of Karnataka state passes through this stretch.

Tumalgaddi, Takalki, Ingalangi, Ghalapuji, Narayanpur, Khanapur, Sultanpur, Jawoor, Myalingaddi, Adihal, Tangadgi, Hullali, Koppa, Kamadatta, Hadagalli and Hanuman Nagar are the nearest villages to this stretch of the river.

The river is useful for cultivation and drinking water purpose. Both the banks were cultivated by Rice, Jawar, Tur and Bajra.

At chainage 539.000km, major tributaries of Krishna River converges and the river being found to widen up to 1.5km.

Figure 124 - Confluence of Krishna

Class	Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity
I	510	540	0	9.54	7300	187,193.90	11,845,764.54	-0.3	8.35	8720	297,711.35	15,816,793.42
II	510	540	0	9.54	7550	291,012.69	18,111,961.20	-0.3	8.35	9120	476,520.72	23,547,200.54
III	510	540	0	9.54	8550	461,936.22	27,557,807.11	-0.3	8.35	10290	801,560.52	34,933,875.22
IV	510	540	0	9.54	9600	602,572.43	33,472,018.79	-0.3	8.35	15600	1,099,421.51	41,825,453.44

Table 57 - Dredging Quantity details

a) Observed and reduced Bed Profile of the stretch

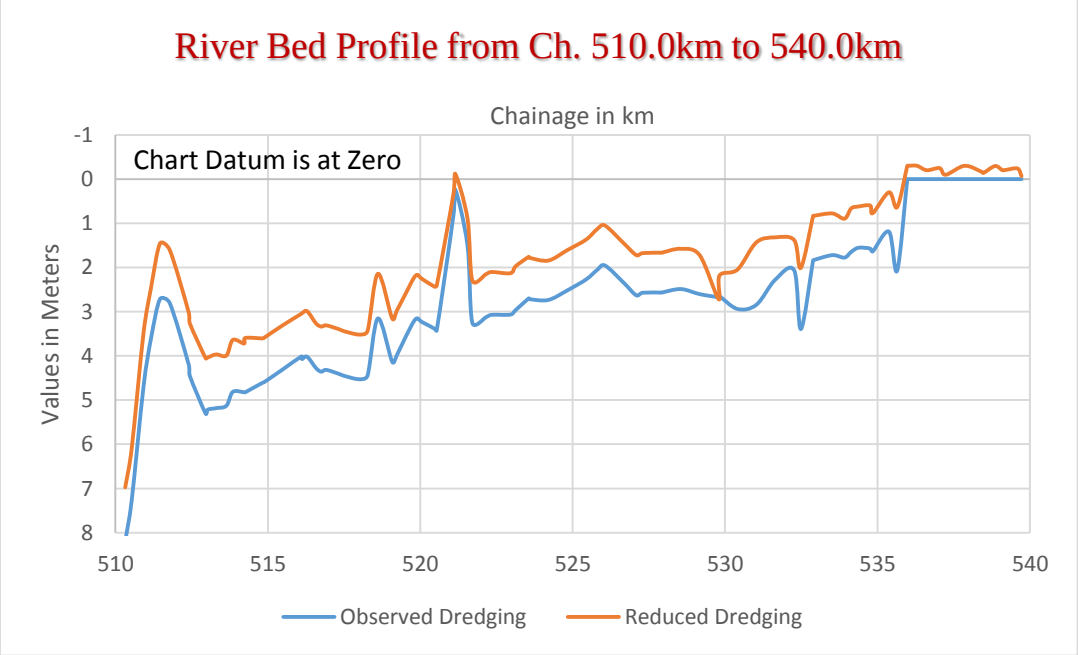


Figure 125 - River Bed Profile

3.19 Sub Stretch 19: Kudal Sangama to Alur (Chainage 540.0km to 570.0km)

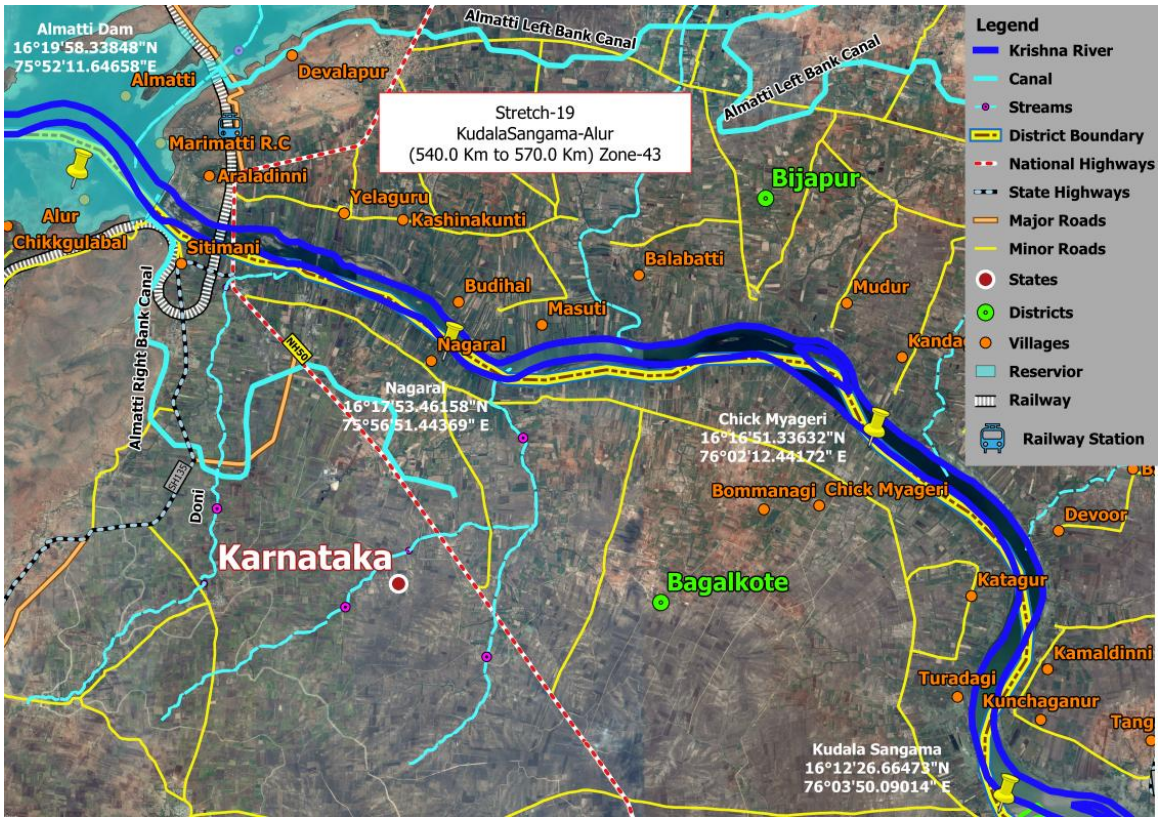


Figure 126 - Stretch 19- Kudala Sangama to Alur

- **Bathymetry Survey**
  a) 25.00km length of the stretch for which the bathymetric survey has been carried out.
- **Topographic Survey**
  b) 05.00km length of the stretch for which the topographic survey has been carried out.

This stretch is between 540 to 570km chainage of Kudala Sangama to Alur village.

This stretch forms the upstream portion of the Kudalasangama Temple, which is the confluence point of Malaprabha River and Krishna River. Basically, it's a Holy place where people usually take birth. The village is at a distance of about 19km (12 mi) from Hungund. Close by is the holy pilgrim center and the renowned temple of Sangameshwara, on the river bank, at the confluence of the Malaprabha River and the Krishna River. Formerly it was known as Kappadi Sangama where Basaveshwara's teacher Ishanaguru lived.

Figure 127 - Temple at confluence of Krishna (ch. 544.74km)

Upon this stretch, IWAI-BM-KRS-10 constructed at the right bank of the river at a chainage of 545.377km and nearby village is Kudalsangam. IWAI-BM-KRS-09 is constructed at the right bank of the river at a chainage of 555.204km. And nearby village to this benchmark is Chikmayegri. IWAI-BM-KRS-08 is constructed at a chainage of 565.699km, upon the right bank of the river and nearby village is Nagral.

Alur is nearest to village Hire Gulabal and is situated near Krishna River left bank in Bagalkot Taluk and District of Karnataka State, India. It belongs to Belgaum Division. It is located 38km towards north from District Bagalkot.

A highway bridge found near Dhannur village at this stretch at chainage 541.49km and is followed by State Highway no 60.

Figure 128 - Dhannur Bridge (ch.541.49km)

A small ferry service is developed to cross the river from Chick Myageri to Kandaganur which is having the length of 0.84km. Nagral is a small village/hamlet in Bilge Taluk in Bagalkot District of Karnataka State, India. It comes under

Nagral Panchayath and belongs to Belgaum Division. It is located 22km towards North from District Bagalkot.

At chainage 569.60km, found one highway bridge constructed upon River Krishna near to village Hissur, National Highway no 13 is followed by this bridge.

Figure 129 - Sholapur Mangalore Highway Bridge (ch. 569.60km)

Chick Myageri is a small village/hamlet in Bagalkot Taluk in Bagalkot District of Karnataka State, India. It comes under Chick Myageri Panchayath and belongs to Belgaum Division. It is located 1km towards East from District Bagalkot.

Mankani, Hollur, Wadawadgi Arladinni, Almatti, Yelagur, Wadawadaggi, Sitamini, and Dharmanagar are the nearest villages under this vicinity. Bagalkot is 63 km from this stretch.

Mudhol, Muddebihal, Rampur, Ron Baglkot, Bijapur, Mahalingpur, Rabkavi Banhatti are the nearby cities upon this stretch.

Bagalkot is the nearby railway station in this stretch.

Both side of the bank cultivated by Lemon, Grapes, Rice, Bajra, Tur, and Beans.

Figure 130 - Cultivation at banks of this stretch

Class	Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity
I	540	570	0	12.72	8100	304,741.06	12,150,505.60	-0.3	11.81	9035	398,668.47	16,215,461.89
II	540	570	0	12.72	8300	468,053.60	18,580,014.80	-0.3	11.81	9240	601,873.01	24,149,073.55
III	540	570	0	12.72	8950	719,801.34	28,277,608.45	-0.3	11.81	9900	917,987.28	35,851,862.50
IV	540	570	0	12.72	9000	885,244.59	34,357,263.38	-0.3	11.81	10450	1,131,990.97	42,957,444.41

Table 58 - Dredging Quantity details

a) Observed and reduced Bed Profile of the stretch

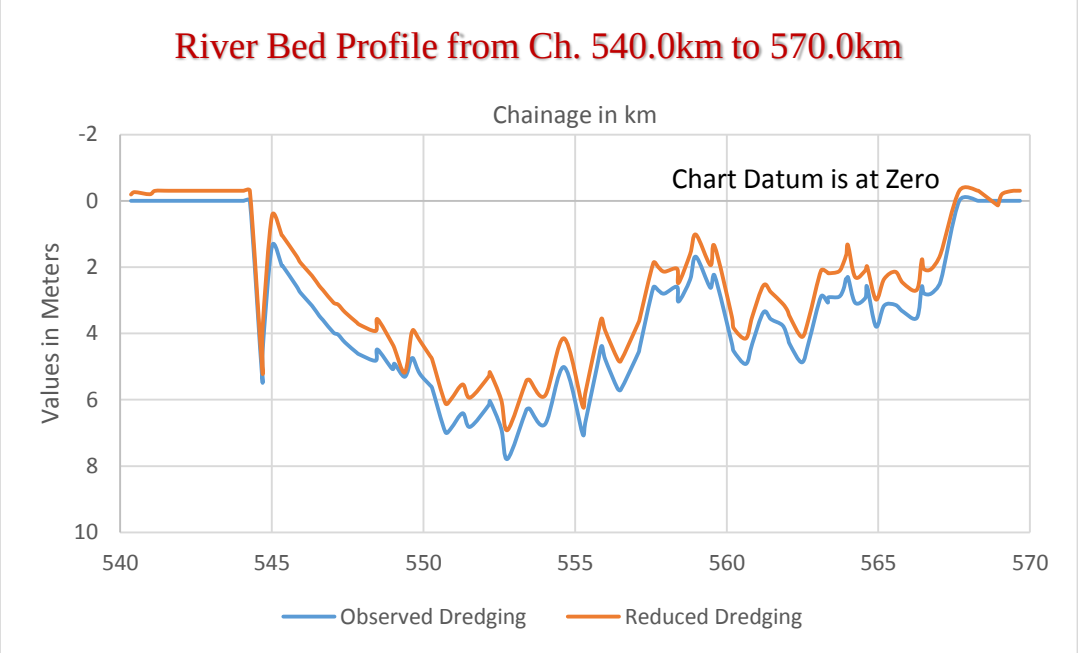


Figure 131 - River Bed Profile

3.20 Sub Stretch 20: Alur to Dhawaleshwar (Chainage 570.0km to 600.0km)

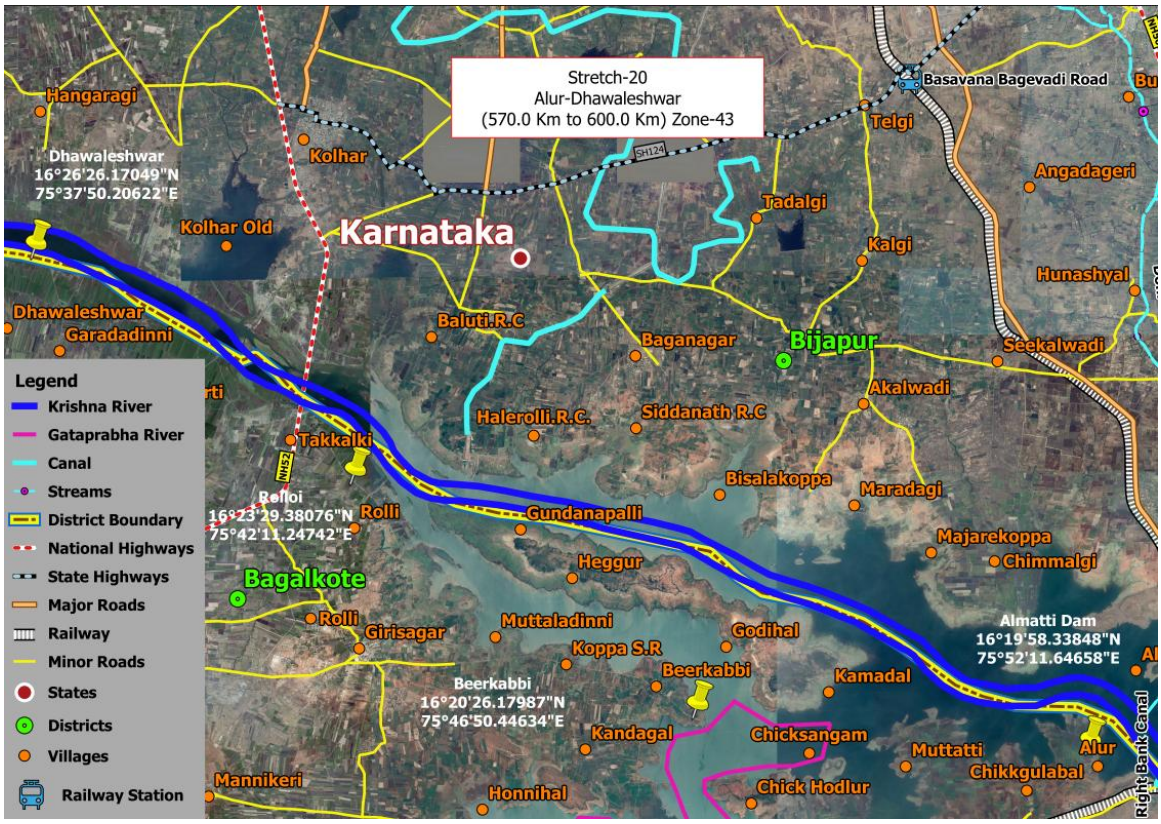


Figure 132 - Stretch 20- Alur to Dhawaleshwar

- **Bathymetry Survey**
  a) 30.000km length of the stretch for which the bathymetric survey has been carried out.
- **Topographic Survey**
  b) 0.00km length of the stretch for which the topographic survey has been carried out.

This stretch is between 570 to 600km chainage of Alur to Dhawaleshwar village.

Upon this stretch, IWAI-BM-KRS-07 is constructed at a chainage of 574.699km, on the right bank of the river and nearby village is Alur. IWAI-BM-KRS-06 constructed at the right bank of the river at a chainage of 585.131km and nearby village is Beerkabi. IWAI-BM-KRS-05 is constructed at the right bank of the river at a chainage of 594.537km and nearby village to this benchmark is Rolli.

Almatti Dam is constructed in this river stretch at a chainage of 573.48km and Sholapur Mangalore Bridge is also being constructed in this stretch.

The Almatti Dam is the main reservoir of the upper Krishna Irrigation Project; the 290 MW power station is located on the right side of the Almatti Dam. The facility uses vertical Kaplan turbines: five 55MW generators and one 15MW generator. Water is released into the Narayanapur reservoir after using for power generation to serve the downstream irrigation needs.

Figure 133 - Almatti Dam (ch. 573.48km)

The Almatti Dam is a hydroelectric project on the Krishna River in North Karnataka, India which was completed in July 2005. The target annual electric output of the dam is 560 MU (or GWh).

Figure 134 - Almatti dam powerhouse (ch. 572.88km)

Salient Features	
Hydro Electric Project	Almatti Hydroelectric Project
State Name	Karnataka
District	Bagalkot
River/Basin Name	Krishna
Hydro Electric Region	Southern HE Region
Total Installed Capacity (MW)	290
Type of Project	Major
Hydroelectric Project Status	Completed
Project Owner Type	State
Owner Name	KPCL
Inter Basin Project	No
Project Sharing	None
Inter State Agreement (Ratio like 50:50)	N/A
International Sharing	None

Table 59 - Salient feature of Almatti dam hydroelectric power project

A canal was constructed on the right bank of the dam. The hydroelectric power plant is being operated by KPCL (Karnataka Power Corporation Limited).

Figure 135 - Hydro Electric Power plant at Almatti Dam right bank (ch. 573.48km)

At chainage 571.85km found one railway bridge was constructed upon Krishna River at Almatti. Alur is the nearby railway station at the right bank of this stretch. Almatti is the nearby railway station at the left bank of this stretch.

Figure 136 - Korthi Kohar Railway Bridge (ch. 571.85km)

Near Almatti at a chainage 571.58km a highway bridge found across the river. Which is a high level bridge of Basavana Bagewadi Taluk of Bijapur District.

Figure 137 - Highway Bridge at Almatti village (ch. 571.58km)

Dhawaleshwar is a small village situated near Sonna village of Bagalkot District.

Sonna is a village in Bilagi Taluk in Bagalkot District of Karnataka State, India and belongs to Belgaum Division. It is located 33km towards north from District Bagalkot, 10km from Bilge.

Rolli is a small village in this stretch situated near Girisagar village. Girisagar is a village in Bilge Taluk in Bagalkot District of Karnataka State, India and belongs to Belgaum Division. It is located 22km towards north from District Bagalkot. 10km from Bilge.

The Bilge, Bennur, Herkal, Sunag, Sonna chik Sangam, Mutati, Godiahal, Majerkoppa, Chimmalgi are the nearest villages under this vicinity. Inam -

Hanchinal, Siddapur, Teggi and Hire - Gulbal are the nearby villages to this stretch. Mudhol, Bijapur, Rabkavi Banhatti, Mahalingpur are the nearby cities to this stretch.

At chainage 597.52km in this stretch found one highway bridge which is followed by National Highway no 218 at nearby Rolli village. This is the longest bridge in southern India having a length of 3 kilometers. This bridge is well known as Korthi Kollar Bridge, and connects Gulbarga, Bijapur, and Hubli.

Figure 138 - Korthi Kolhar Bridge at Rolli (ch 597.52km)

Both the riverbank is cultivated by Tur, Bajra, and Rice. Krishna River is being used mainly for cultivation and drinking water purpose.

At Chik Sangam, chainage 580.24km a tributary converges with Krishna River and there exists a submersible temple.

Figure 139 - Chick Sangam temple near convergence point of Krishna (ch. 580.24km)

State Highway no 124 of Karnataka was surrounded by this stretch.

At this point, Krishna River was widened up to 6 kilometers. Also found one island of length 10km and width of 1km. Though there was no habitat present upon this island, was cultivated by local people.

River banks were normally found unprotected in nature and water depth varies from 8 to 10-meter.

Bagalkot is the nearby railway station to this stretch. This stretch is accessible by good road network. No industries found near to this stretch.

Class	Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity
I	570	600	0	12.89	12700	295,101.70	12,445,607.30	-0.3	11.95	15200	438,051.74	16,653,513.63
II	570	600	0	12.89	12825	462,544.99	19,042,559.79	-0.3	11.95	15370	676,274.23	24,825,347.78
III	570	600	0	12.96	13675	728,832.40	29,006,440.85	-0.3	12.02	15700	1,053,802.53	36,905,665.03
IV	570	600	0	12.96	13900	918,276.95	35,275,540.33	-0.3	12.02	15900	1,317,903.62	44,275,348.03

Table 60 - Dredging Quantity details

a) Observed and reduced Bed Profile of the stretch

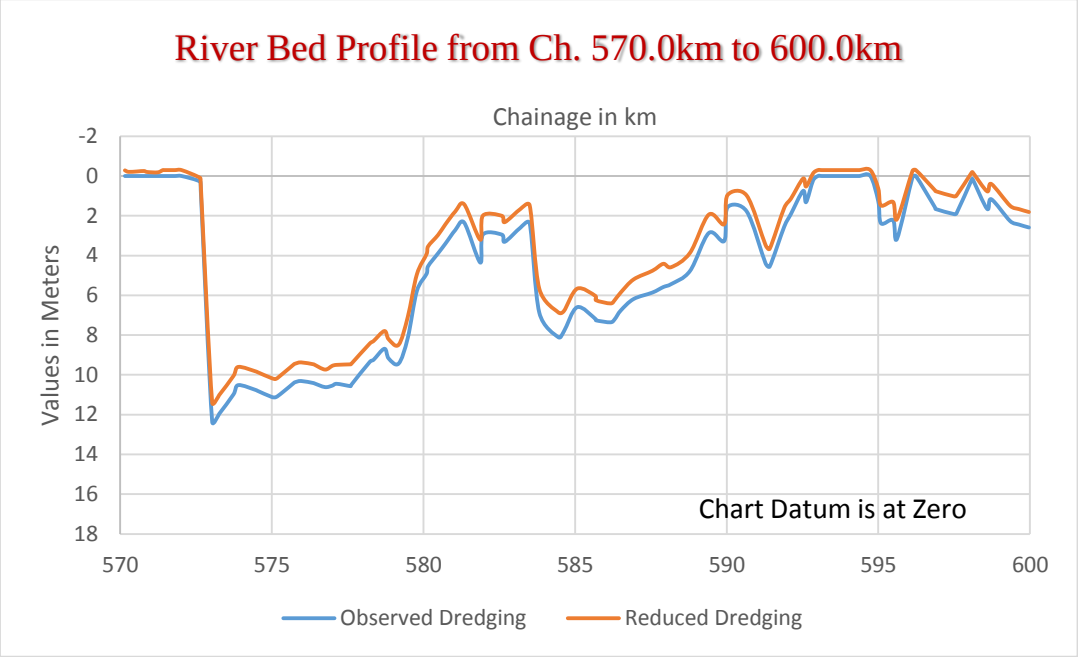


Figure 140 - River Bed Profile

3.21 Sub Stretch 21: Dhawaleshwar to Galgali (Chainage 600.0km to 636.2km)

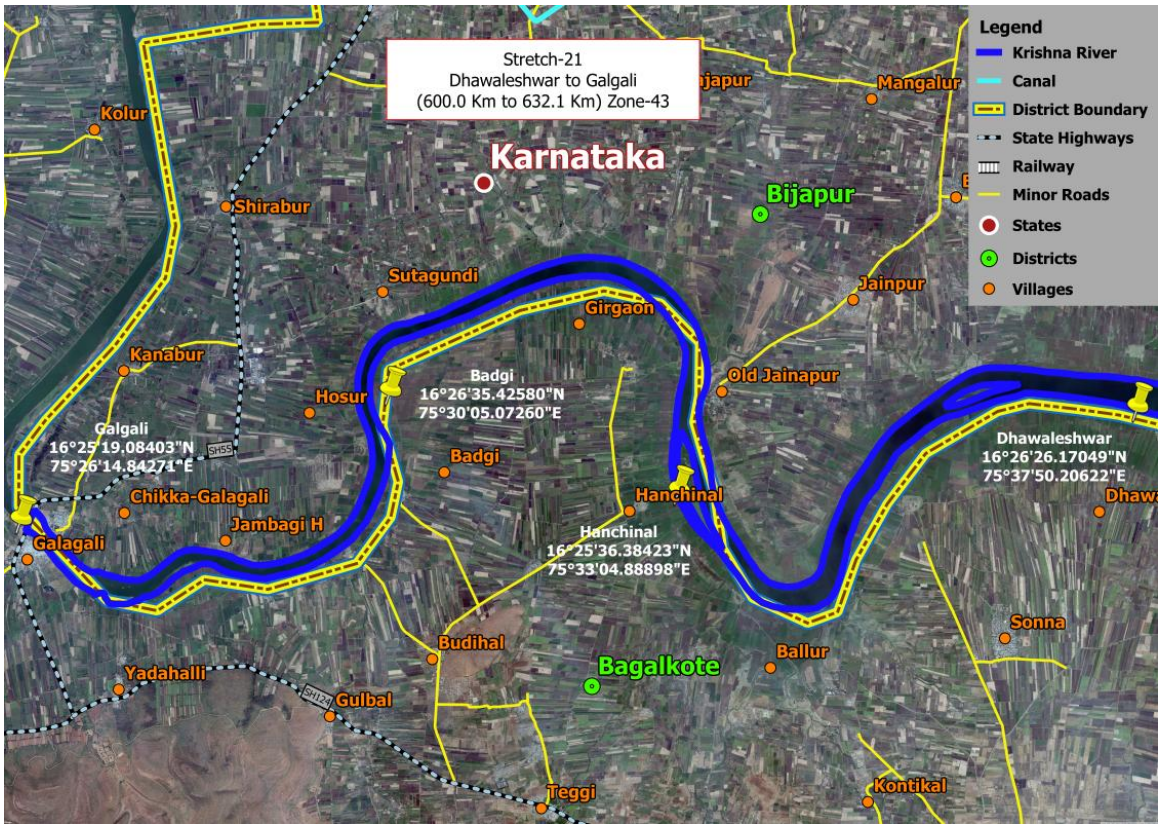


Figure 141 - Stretch 21- Dhawaleshwar to Galgali

- **Bathymetry Survey**
  a) 20.000km length of the stretch for which the bathymetric survey has been carried out.
- **Topographic Survey**
  b) 16.2km length of the stretch for which the topographic survey has been carried out.

This stretch is between 600 to 636.200km chainage of Dhawaleshwar to Galgali village.

Upon this stretch, IWAI-BM-KRS-04 is constructed at a chainage of 604.741km, on the right bank of the river and nearby village Dhawaleshwar. IWAI-BM-KRS-03 constructed on the right bank of the river at a chainage of 616.064km and nearby village is Hanchinal. IWAI-BM-KS-02 is constructed on the right bank of the river at a chainage of 627.023km and nearby village to this benchmark is Badgi. IWAI-BM-KRS-01 is constructed at a chainage of 636.151km, on the right bank of the river and nearby village is Galgali.

Inam - Hanchinal is a Village in Bilge Taluk in Bagalkot District of Karnataka State, India. It belongs to Belgaum Division. It is located 36km towards north from District Bagalkot 14km from Bilge.

Badagi is a village in Bilge Taluk in Bagalkot District of Karnataka State, India. It belongs to Belgaum Division. It is located 34km towards north from District Bagalkot 12km from Bilge.

Galgali is a village in Bilge Taluk in Bagalkot District of Karnataka State, India. It belongs to Belgaum Division. It is located 22km towards north from District Bagalkot.

Near to Bilge village at chainage 602.100 to 603.600km found one island having a length of 1.5km and width of 185m.

Figure 142 - Krishna Flow at Bilge

At chainage 636.2km a highway bridge found constructed which followed by Karnataka State Highway no 55.

Figure 143 - Galgali Bridge (ch. 636.2km)

Sonna, Siddapur, Teggi, Hire - Gulbal, Bilagi, Teggi, Siddapur, Hire - Gulbal, Bilagi are the nearby villages to this stretch. All these villages are well connected to roadways.

Bagalkot, Mudhol, Bijapur, Rabkavi, Banhatti, Mahalingpur are the nearby cities to this stretch. During surveying, it was found that the river is being used for cultivation and drinking water purpose. Bajra, rice, ground nut, urad dal are the famous crops cultivated along the bank.

No industries were found nearby this stretch. Bagalkot is the nearby railway junction to this stretch. From chainage 636.34km towards upstream of Krishna River up to Galgali Barrage the nature of the river found to be dry, river banks were mostly not protected, and encroachment to the river found partially.

Class	Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity
I	600	636.2	0	9.31	10705	288,376.25	12,733,983.55	-0.3	8.72	14985	428,682.30	17,082,195.93
II	600	636.2	0	9.31	10800	457,924.04	19,500,483.83	-0.3	8.72	15435	689,300.04	25,514,647.82
III	600	636.2	0	9.31	14120	749,309.83	29,755,750.68	-0.3	8.72	17450	1,153,362.77	38,059,027.80
IV	600	636.2	0	9.31	14200	995,622.76	36,271,163.09	-0.3	8.72	21100	1,534,510.55	45,809,858.58

Table 61 - Dredging Quantity details

a) Observed and reduced Bed Profile of the stretch

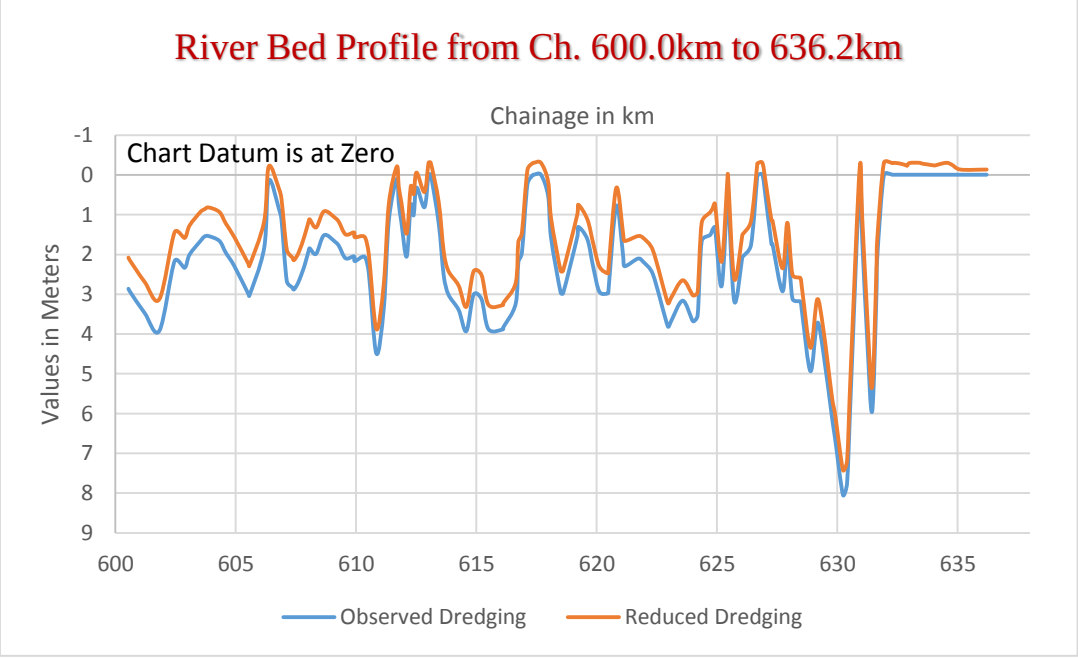


Figure 144 - River Bed Profile

3.22 Other aspects of waterway

3.22.1 Details of Irrigation Canals and Outlets

In this stretch we found there were four big dams constructed upon Krishna River for irrigation purposes, two dams were in Karnataka state and two dams in Andhra Pradesh / Telangana states. Almatti and Narayanpur dam present in Karnataka state and Srisailam and Nagarjuna Sagar dam are in Andhra Pradesh and Telangana state.

The Upper Krishna Project consists of the construction of two dams across the river Krishna and a network of canals.

The main storage is at Almatti Dam, a few kilometers downstream of the confluence of Ghataprabha River and Krishna River. A lower dam, Narayanapur Dam, situated at Narayanapur a few kilometer downstream of the confluence of Ghataprabha River and Krishna River, will serve as a diversion dam. The Project is planned to be implemented in different stages and phases. Stage-I of the project plans to utilize 119 TMC of water to irrigate 4,25,000 Hectares and in Stage-II 54 TMC of water will be utilized, to irrigate 1,97,120 Hectares.

The command areas of drought prone districts of Northern Karnataka viz: Gulbarga, Yadgir, Raichur, Bijapur, and Bagalkot are to be irrigated under UKP Stage-I and II with total utilization 173 TMC of water. Already the project of UKP Stage-I and II is almost completed and irrigation potential 6.08 Lakh Hectares is created.

Srisailam right main canal (SRMC) is constructed with 44,000 cusecs capacity at full supply level of 267.92 meters (879 ft) MSL to feed Veligodu reservoir, Brahmamsagar Reservoir, Alaganoor reservoir, Gorakallu reservoir, Owk reservoir, Gandikota reservoir, Mylavaram reservoir, Somasila reservoir and Kandeleru reservoir.

This canal also supplies water to Telugu Ganga project which supplies Krishna River water to Chennai city for its drinking purpose. This main canal by feeding water to K. C. Canal, Srisailam right bank canal, Telugu Ganga canal and Galeru Nagari canal irrigates vast area in Kurnool, Kadapa, Chittoor and Nellore districts.

Nagarjuna Sagar Project is one of the Major Multipurpose river valley projects in Andhra Pradesh, across River Krishna. The work on the project was inaugurated in the year 1955.

The project comprises of a Dam across River Krishna with two main canals taking off one on either side, the Nagarjuna Sagar Right Main Canal to create Irrigation

Potential in an extent of 4.75 Lakh Hectares (11.737 lakh Acres) in Guntur and Prakasam Districts and the Nagarjuna Sagar Left Main Canal to create Irrigation Potential in an area of 4.20 lakh Hectares (10.378 lakh Acres) in Nalgonda, Khammam, and Krishna Districts.

The work on N.S.Dam, Main Canals, and all Branch Canals and distributary system are completed, except I.P.creation to an extent of 27441 Ha. (67807 acres) and the same is being taken up under Accelerated Irrigation Benefit Programme.

3.22.2 Irrigation/Drinking water

The Krishna River is utilized mainly for irrigation projects and cultivation with own lifting by farmers. It also supplies the drinking water for Hyderabad City. There are lot of drinking water pumping facility found throughout the stretch of Krishna River.

3.22.3 Crops

Kharif and Rabi crops are grown mainly under rainfed conditions in the survey area. In recent periods, bore wells are being drilled in the command area, but their number is small. The crops that are grown in Kharif season are groundnut, maize, cotton, chilly etc.

Pulses, oil seeds, sugarcane and the crops growing in Rabi season are sorghum, wheat, bengal gram, etc.

Figure 145 - Crops cultivated on both the banks of Krishna River

3.22.4 Fishing

During the survey stretch wherever water is availability, it was observed that the local villager's source of living is fishing. And a maximum number of coracles were being used for fishing.

Figure 146 - Coracles used for fishing purpose

Figure 147 - Fish breeds found in the survey stretch

3.22.5 Industries

Throughout the Krishna River, we found Coal Power Plant near Raichur, Karnataka state. Thermal Power Plant near Yermaras, Karnataka state and lots of cement industries at Andhra Pradesh and Telangana state.

During this stretch also found some small hydel power project and wherever dams were there hydroelectric power plant constructed nearby the banks of the river. The Hydroelectric power plants were constructed nearby Almatti Dam, Nagarjuna Sagar Dam, Srisailam Dam and Narayanpur Dam.

Raichur Thermal Power Station (RTPS) is a coal-fired electric power station located in the Raichur district of the state of Karnataka, India. It is operated by the Karnataka Power Corporation Limited (KPCL) and was the first thermal power plant to be set up in the state. The power station was commissioned during various periods from 1985 and it accounts for about 40% of the total electricity generated in Karnataka.

Yermarus Thermal Power Station is an upcoming coal-based thermal power plant located in Yermarus and Yedlapur villages in Raichur District, Karnataka. The power plant is owned by the Karnataka Power Corporation. Bharat Heavy Electricals is the EPC contractor for this power project.

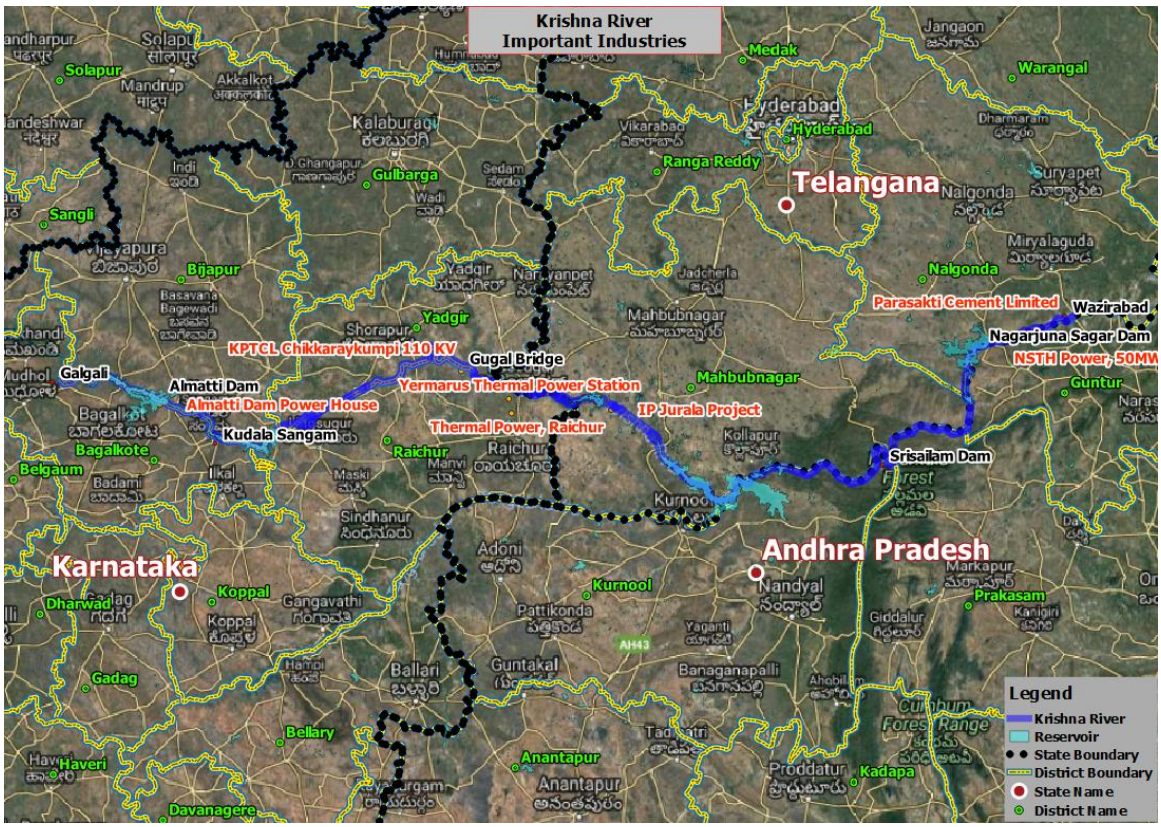


Figure 148 – Important industries along Krishna River

Figure 149 - Industries nearby Krishna River

3.22.6 Important cities/towns

During Survey the stretch from Galgali to Wazirabad, the river flows in three states, Karnataka, Andhra Pradesh and Telengana. The important cities and towns in each state are as mentioned below.

Raichur, Gulbarga, Bijapur, and Bagalkot are the nearby cities of Krishna River of Karnataka State.

Warangal, Khammam, Nalgonda are the nearby cities of Krishna River of Telangana state.

Kurnool, Guntoor, and Ananthapur are the nearby cities in Andhra Pradesh state.

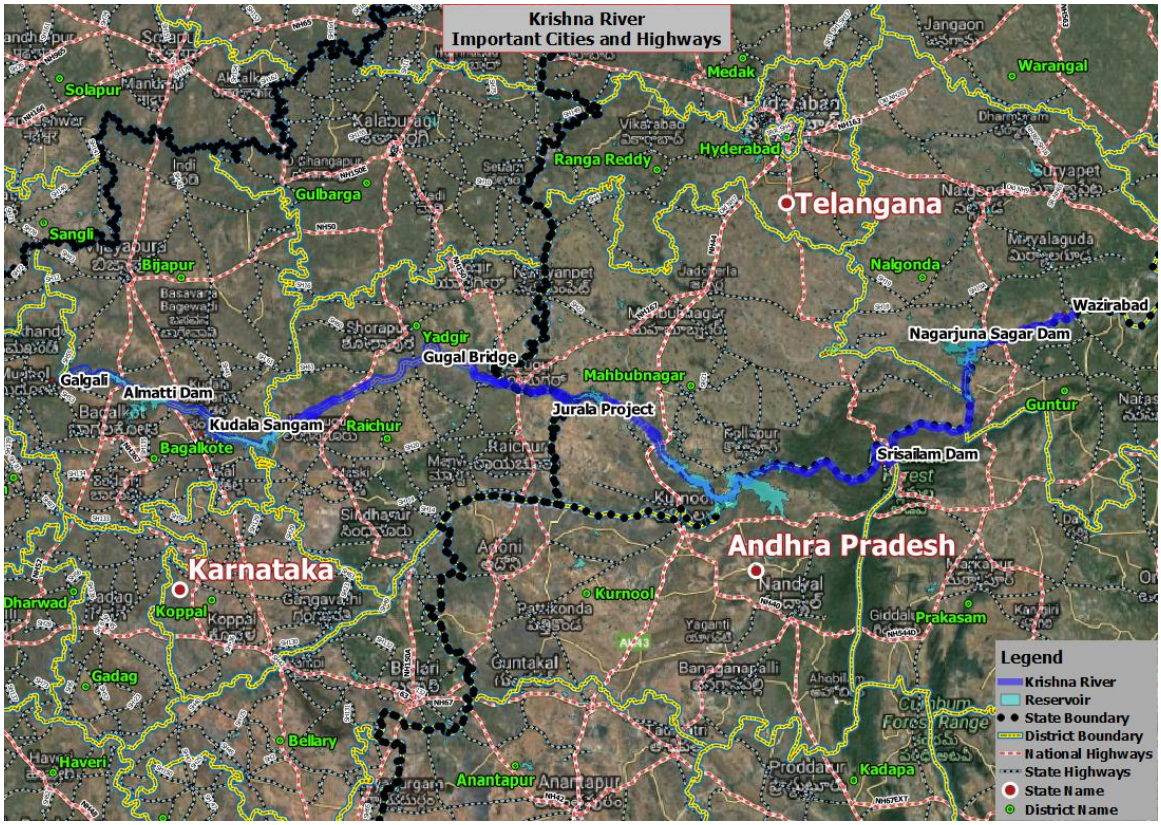


Figure 150 – Important Cities/Towns and Road Network

3.22.6.1 National Highway

National highway number 52, 150A, 167, 44, 765, 565, 544D are followed in the survey area of Krishna River.

NH No	Route	River Location
52	Punjab To Ankola	Bilgi/ Karnataka
50	Bidar To Hoepet	Almati, Karnataka
150A	Jewargi To Chamarajnagar	Tintani, Karnataka
167	Haggadi To Jadcheral	Raichur, Karnataka
44	SriNagar to Kanyakumari	Gadwal,Telengana
765	Hyderabad To Tokapelle	Sundipenta,Andhra Pradesh
565	Nakrikal to ReniGunta	Nagarjuna Sagar, Telengana

Table 62 - National Highways passed upon Krishna River.

3.22.6.2 State Highway

Most of the state highways of State of Karnataka, few state highways of Andhra Pradesh and only 2 state highways of Telangana State passes through the River Krishna. State highways of Karnataka passing through Krishna River are 55, 124, 135, 133, 41, 60, 14, 61, 128, 15, and 51. State Highway numbers of Andhra Pradesh are 50, 05, 60, 89, 02 and state Highway numbers 21 and 19 is passes through Telangana State.

3.22.6.3 Major District Roads

S.No.	Route	Description
01	Raichur to Bijapur	SH 15 and SH 16 (Karnataka)
02	Raichur to Gulberga	SH 15 (Karnataka)
03	Kurnool to Gulberga	NH44 (Andhra Pradesh and Karnataka)
04	Guntur to Bijapur	SH122 (Andhra Pradesh Karnataka)

Table 63 - Major district roads

3.22.7 Railway Network

In this river stretch, we found only four numbers of rail networks which are being connected to the nearby cities. The rail networks are as mentioned below. The maximum stretches are connected by road only. So the easiest ways to approach the stretches are roadways.

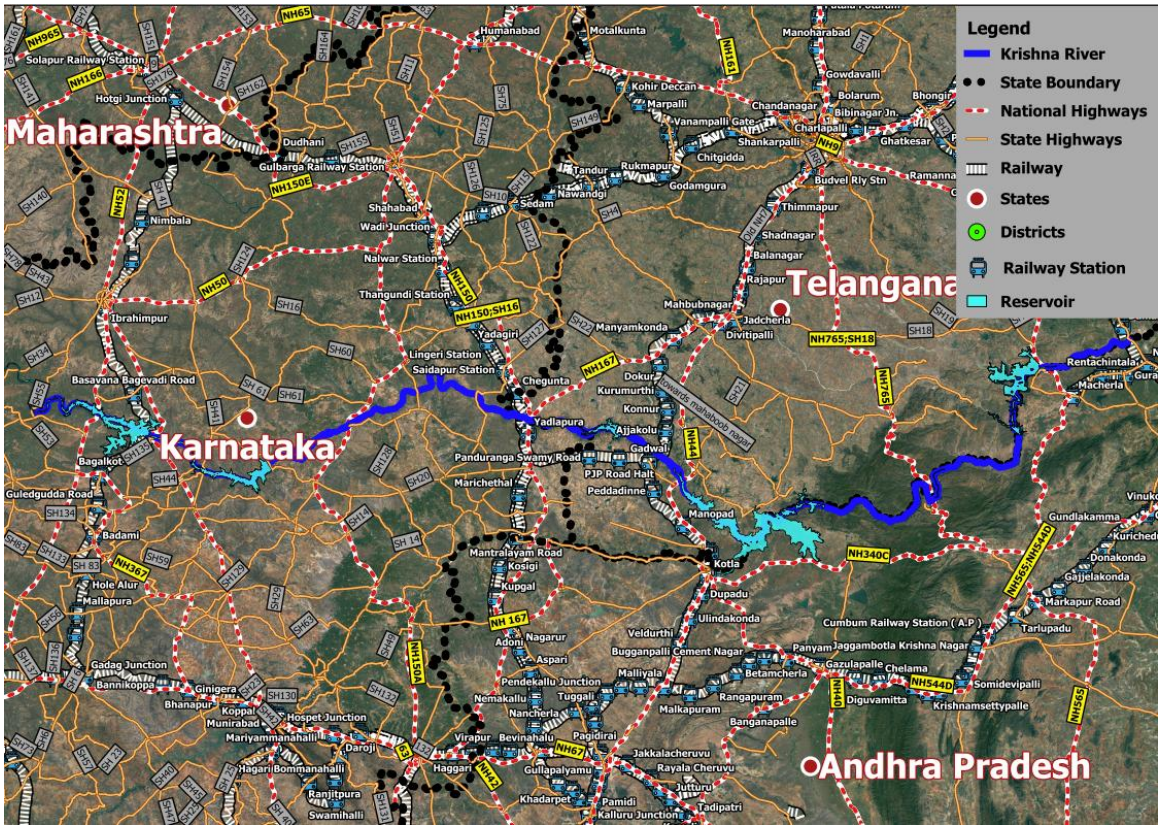


Figure 151 - Maps of Rail Network

Location	Passage	Station Names
16°20'46.40"N 75°54'03.330E	Gadag to Solapur	Almati
16°23'05.78"N 77°19'38.80"E	Raichur to Yadgiri	Yedlapur
16°16'14.33"N 77°51'46.40"E	Ghadwal to Hyderabad	Arepalli
16°42'17.69"N 79°38'20.87"E	Dachipalli to Myralaguda	Vishnupuram

Table 64 - Rail station and description nearby Krishna River

3.22.8 Land Use

Krishna basin extends over an area of 258,948 square kilometers which is nearly 8% of the total geographical area of the country. The basin lies in the states of Andhra Pradesh (113,271km^2), Karnataka (76,252km^2) and Maharashtra (69,425km^2). Most part of this basin comprises rolling and undulating country except the western border which is formed by an unbroken line of ranges of the Western Ghats.

An average annual surface water potential of 78.1km^3 has been assessed in this basin. Out of this, 58.0km^3 is utilizable water. Culturable area in the basin is about 203,000km^2, which is 10.4% of the total Culturable area of the country. In 2009 October heavy floods occurred, isolating 350 villages and leaving millions homeless, which is believed to be the first occurrence in 1000 years. The flood

resulted in heavy damage to Kurnool, Mahabubnagar, Guntur, Krishna and Nalagonda Districts.

3.22.9 Construction Material

The important soil types found in the basin are black soils, red soils, laterite and lateritic soils, alluvium, mixed soils, red and black soils and saline and alkaline soils. Which produces the hard stone which is helpful for the production of cement.

3.22.10 Conditions of banks

The condition of the bank is not protected in nature, during the survey of entire stretch did not find any protection at both the bank.

3.22.11 Jetties and Terminals

The Survey stretch is a lack of jetties and terminals.

3.22.12 Cargo Movement

No cargo movement found during the survey of allocated area.

3.22.13 Passenger Ferry Services

During the survey stretch, we found three passenger ferry services, Chick Myageri to Kandaganur, near to Nagarjuna Sagar Dam and Srisailam Dam.

It is found that near Pathalganga which is a holy place where the pilgrims take bath, APTDC is constructed a small ferry ghat. People usually use this point to roam near to the river and for sight scene of Srisailam Dam.

Sl. No.	Place Name	Chainage (km)	Lat/Long		Easting/Northing	
			From	To	From	To
1	Nagarjunakonda Ferry Line, Nagarjuna Sagar Dam	45.5	16°33'49.03"N 79°18'26.83"E	16°31'20.90"N 79°14'53.23"E	319405.91 1832042.05	313033.78 1827542.82
2	APTDC Ropeway Ferry	145.0	16° 4'45.75"N 78°52'39.32"E	16° 4'51.43"N 78°52'46.80"E	272965.50 1778880.47	273189.64 1779052.82
3	Chick Myageri Ferry Line, Kandaganur	555.3	16°16'51.97"N 76° 2'12.50"E	16°17'15.29"N 76° 2'16.81"E	610778.16 1800310.82	610902.45 1801028.12

Table 65 – Passenger ferry services in Krishna River

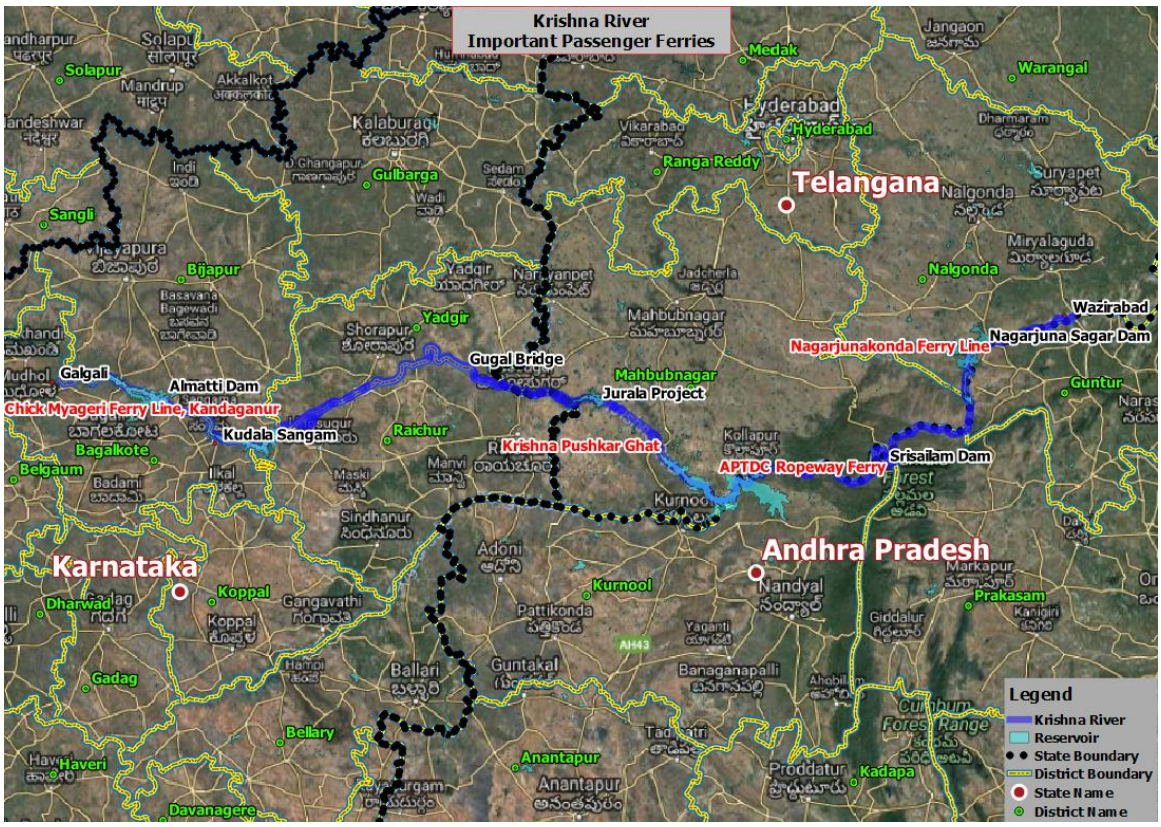


Figure 152 – Important passenger ferry services in Krishna River

Figure 153 - Passenger ferry services at Srisailam

Near to the right bank of Nagarjuna Sagar dam, a small ferry ghat is created. Tourists usually use this point to visit Nagar Konda museum.

Figure 154 - Passenger ferry services at Nagarjuna Konda

3.22.14 Historic importance

This river is revered by Hindus as sacred. The river is also believed to remove all sins of people by taking a bath in this river. The center of attraction is the Krishna Pushkaram fair which is held once in twelve years on the banks of the Krishna River. There are many pilgrimage places in Maharashtra, Karnataka, Telangana and Andhra Pradesh on the course of the river.

The first holy place on the river Krishna is "Dakshin Kashi Wai", known for the Mahaganpati Mandir and Kashivishweshwar temple. It has seven ghats along the river. Temples like Dattadeva temple, which is revered by the people of Maharashtra, are located on the banks of Krishna at Nrusinha Waadi and Audumbar near Sangli. Also, located on the banks of the river Krishna are the Sangameshwar Shiva temple at Haripur, goddess Durga temple in Vijayawada and Ramlinga temple near Sangli, Mallikarjuna temple (Srisailam), Amareshwara Swamy temple (Amaravati (state capital)), Dattadeva temple, Sangameshwara Shiva temples at Alampur in Telangana, Ramlinga temple, etc. as well as, villages such as Jihe.

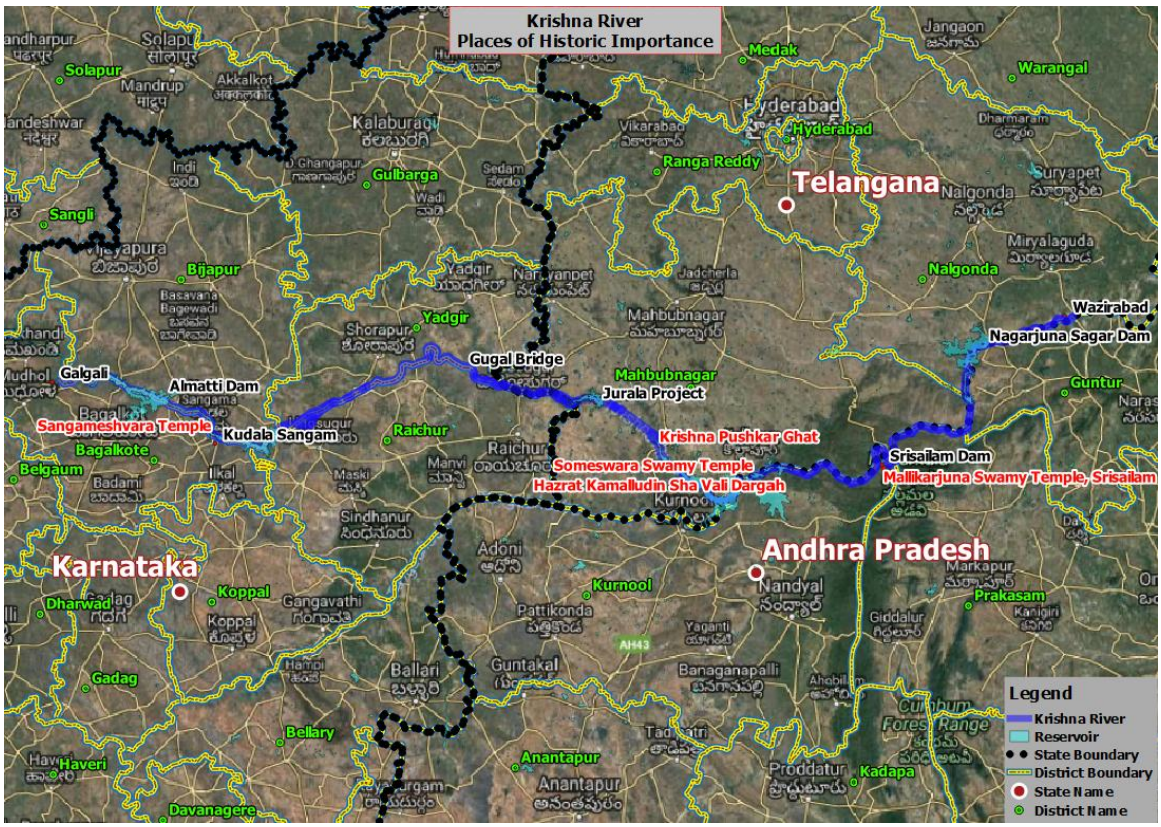


Figure 155 – Places of historic importance along Krishna River

3.22.15 Tourism

A man made garden was constructed near Almatti dam which is a major tourist place. Inside this garden, a small artificial lake is created which is suitable for boating. And also an artificial forest is created. It is a good place for amusement activities.

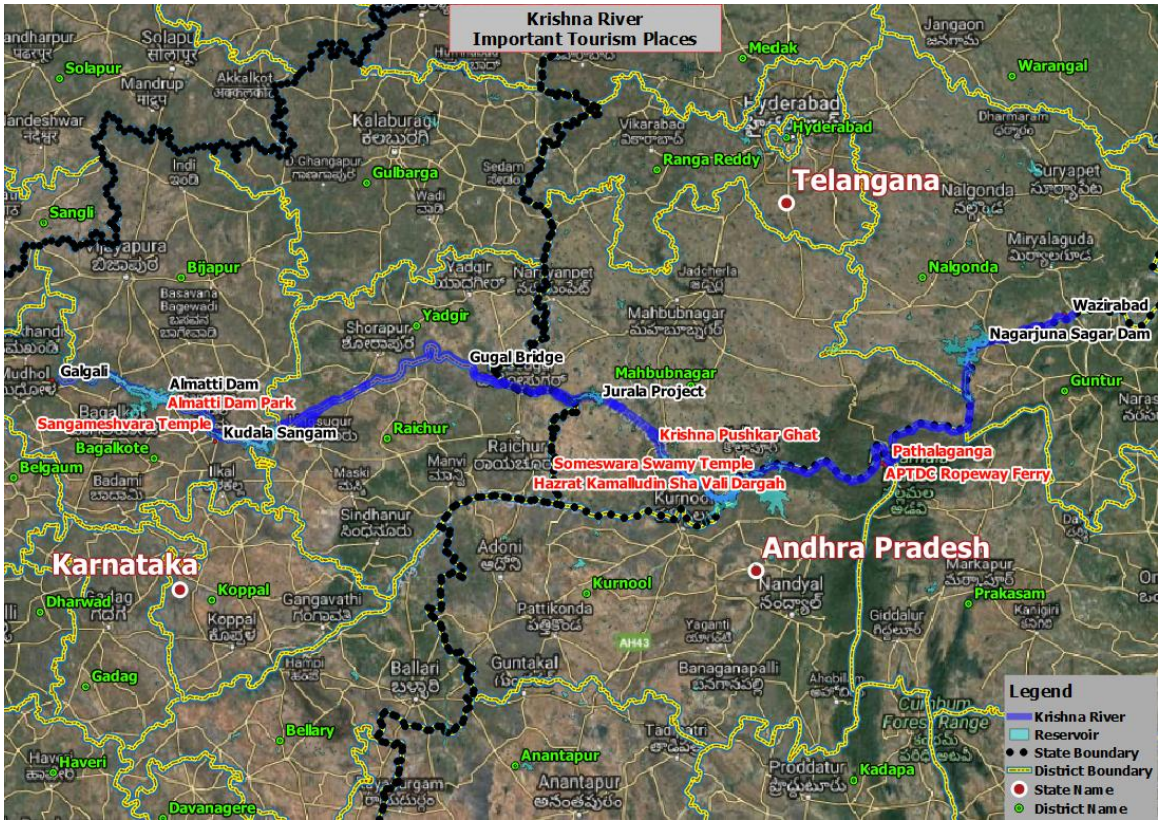


Figure 156 – Important tourist places along Krishna River

Figure 157 - Tourism place nearby Almatti dam at the survey stretch

Srisailam Sanctuary is the main attraction that covers an area of 3568 sqkms. The sanctuary is home to a large number of animals, which include tiger, leopard, deer, sloth bear, jungle cat, spotted deer, hyena, bonnet macaque and pangolin.

Srisailam Dam is another attraction. The dam is built on the Krishna River and is 512km in length. The down waters Srisailam dam is home to a variety of crocodiles. The local government supports a breeding program which has been highly successful.

Bhramaramba Mallikharjunaswamy Temple is another important landmark in Srisailam. The temple is perched atop a hill on the south bank of the Krishna. **Sikhareswara Swamy Temple** is also a popular temple in Srisailam. The temple is dedicated to Lord Shiva.

Hyderabad is the nearest airport. Markapur Road on the Guntur-Hubli meter gauge line. Srisailam is well connected by APSRTC and Devasthanam buses with Hyderabad, Mahaboobnagar, Nalgonda, Devorkonda, Guntur, Vijayawada and Kurnool

Figure 158 - Temple near Srisailam.

Popularly known Nagarjuna Sagar Dam, is approximately 170km from Hyderabad. The dam is an engineering marvel stretching across the mighty River Krishna. The barrage also has another distinction to its credit – it has created one of the world's largest man-made lake.

This dam has played an important role in development in the agricultural sector of the state.

Nagarjunakonda was the largest and most important Buddhist centers in South India. The place derives its name from Acharya Nagarjuna, a renowned Buddhist scholar and philosopher, who had migrated here from Amaravati to propagate and spread the Buddha's message of universal peace and brotherhood.

Not too far from Nagarjunakonda is Anupa, where a Buddhist University and Stadium were excavated.

Reaching Nagarjuna Sagar: Hyderabad, 170km away is the nearest airport. The nearest railhead is Macherla (22km), on the Hyderabad-Guntur-Vijaywada railway line. Nagarjuna Sagar is well connected by road from Hyderabad and Vijaywada

Figure 159 - Nagarjuna Sagar Dam (ch. 44.40km)

Kudala Sangama the place where the great social revolutionist of 12th century lord "Basavanna" was educated. The galaxy of Sharana's lived in this Holy Land is itself a matter of pride.

Ghataprabha River meets with Krishna River at Kudalsangam, which is a very holy place.

Figure 160 - Kudalsangam Temple at merging point of Ghataprabha and Krishna

3.22.16 Wild Life Sanctuary

Nagarjunasagar Srisailam Sanctuary (NSS) is one of the famous tiger sanctuaries in Andhra Pradesh and Telangana spread over the forests of Nalgonda and Mahbubnagar districts in Telangana, Kurnool, Prakasam and Guntur districts in Andhra Pradesh. It is also known as Nagarjunasagar Srisailam Tiger Reserve.

History of the NSS starts from the third century B.C. The ruins of a fort believed to be built by Ikshwaku Chandragupta during 3rd century B.C.E are still present in the sanctuary area. The forests covered in NSS went under the control of different dynasties and kingdoms from 3rd century B.C. to Kakatiya dynasty during 1083 A.D.to 1323 A.D. Southern half of the NSS area was under the control of the British in India while the northern half was under the control of the princely State of Hyderabad before Indian Independence in 1947.

The northern half of the sanctuary area was maintained as a hunting reserve for royalty by the rulers of the princely State of Hyderabad. Later the NSS was notified in the year 1978 covering the forests under the rulers of princely State of Hyderabad and British rulers in India after Independence. The NSS forests came under the protection of Project Tiger in the year 1983. The reserve under the protection of Project Tiger was renamed as Rajiv Gandhi Wildlife Sanctuary in the year 1992.

The NSS area comprising different types of forests is a home for different species of plants, birds and wild animals. Nagarjunasagar Srisailam Sanctuary mainly comprises southern tropical dry mixed deciduous forests, Hardwickia forests and Deccan thorn scrub forests etc.

Floristic combination found in the sanctuary area include important plant species such as Anogeissus latifolia (axlewood), Cleisthanthus collinus (odcha), Terminalia spp., Pterocarpus marsupium, Hardwickia binata (anjan tree), Boswellia serrata (Indian frankincense or Salai), Tectona grandis (teak), Mundulea sericea and Albizia spp. (silkplants) etc.

Faunal group found in the NSS area include. Bengal tiger, Indian leopard, sloth Bear, dhol, Indian Pangolin, chital, sambar deer, Chevrotain, blackbuck, chinkara and chowsingha etc. Other wild animals found in the sanctuary area include mugger crocodile, Indian python, king cobra etc. Ornithologists recorded occurrence of different species of endangered species of birds such as Indian peafowl etc.

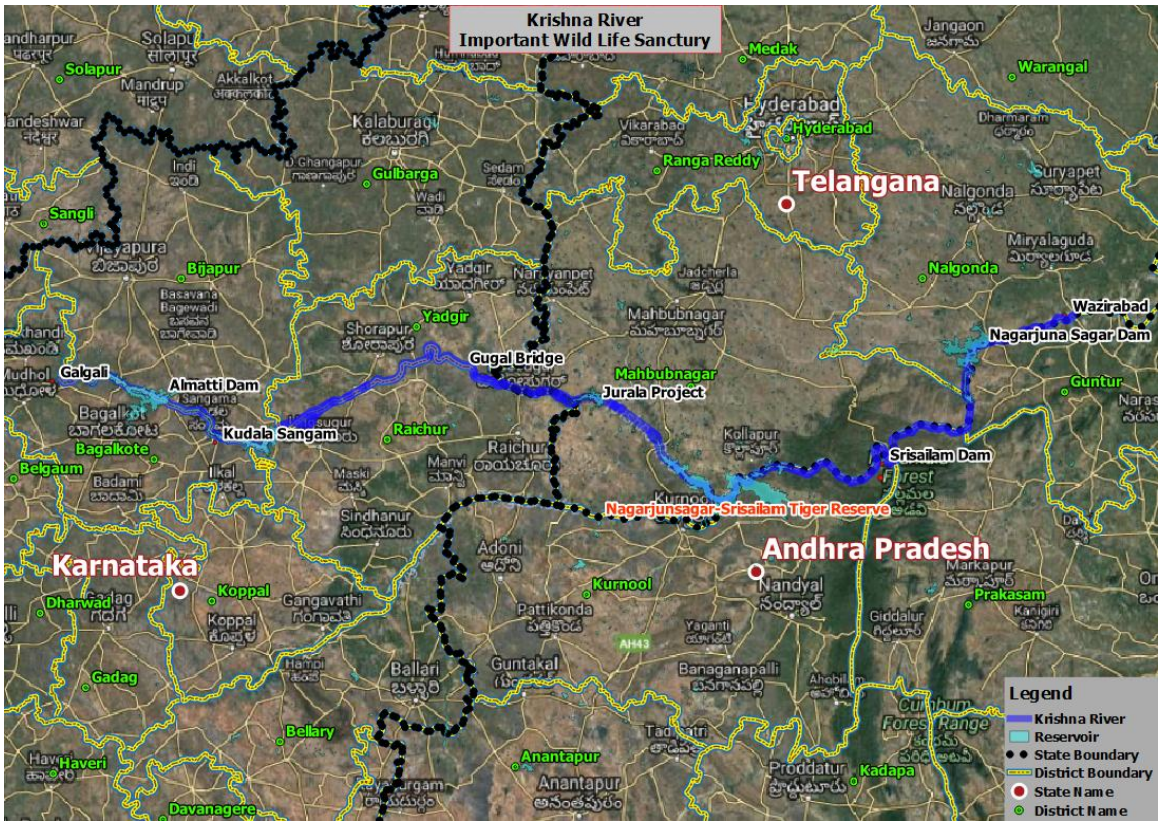


Figure 161 – Important wildlife sanctuary along Krishna River

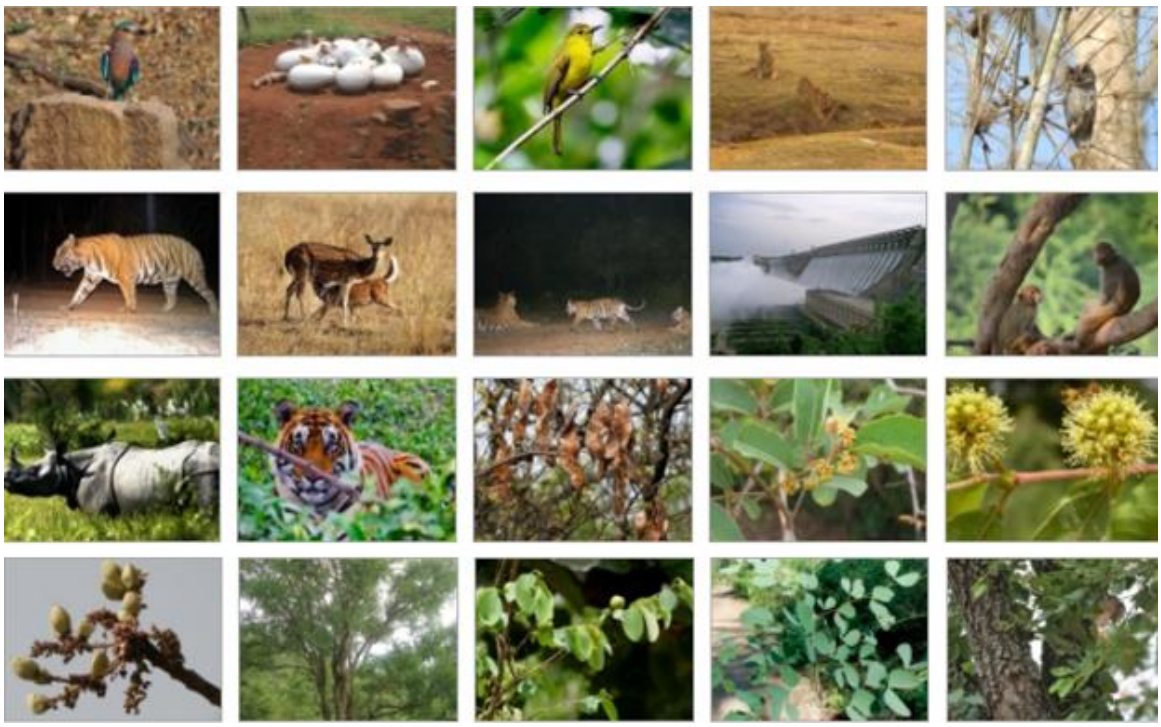


Figure 162 – Flora & Fauna of Nagarjunasagar Srisailam Tiger Reserve

Nagarjunasagar Srisailam Sanctuary is situated in the forests spread in five districts, in which two districts belong to Telangana (Nalagonda, Mahbubnagar) and four districts belong to Andhra Pradesh State (Guntur, Prakasam, Kadapa and Chittoor districts). The NSS area consists mostly of the Nallamala Hills with the varying features of plains to precipitous cliffs. More than 80% of the NSS forest area comprise gently rolling to hilly with the characteristic features of High hills, deep valleys and gorges etc.

The hill ranges in the NSS area contains number of plateaus and valleys etc. The NSS spans an area of 3,568 sqkm (1,378 sq miles) in the forests spread in the five districts belonging to Andhra Pradesh and Telangana states. Average elevation of the sanctuary area is 917 meters (3,009 feet). Several water reservoirs and ancient temples are present in the sanctuary area. The NSS area is presently under the governance of Project Tiger, Ministry of Environment and Forests, Government of India. Nagarjuna Sagar Srisailam Tiger Reserve is also known as the largest Tiger reserve in India with the core area of 1,200 sqkm (463.3 sq miles).

4 Terminals

4.1 Details of Terminal survey carried out

During the survey in this river, we could not find any adequate proposed terminal, due to the unavailability of continuous water.

4.2 Proposed locations for construction of new terminals

Sl No	Location	Lat	Long	Land Use	Owner
01	Alur	16°19'51.01"N	75°52'15.08"E		Govt. Land
	The proposed location is 2.50km from Bagalkot Almatti Road and is 5.0km from Almatti. The area is well connected with the road network and is very near to the place of interest for tourism activities like Almatti. The Depth in the area need to be improved for the berthing of boats throughout the period. There is no industries situated near to the proposed location thus scope of development in cargo movement aspect is very less. Bagalkot is the nearby town situated 40km from this location. Almatti and Chick Sitimani are the two nearby railways stations. Bagalkot is the major rail head nearby this stretch.				
Sl No	Location	Lat	Long	Land Use	Owner
02	Gugal	16°28'31.87"N	77°8'35.78"E	Bathing Place	Govt. Land
	The proposed location is 2km from Raichur and Yadgir road and is 25km from Raichur Town, Karnataka. The area is well connected with road network and the area is one of the prominent place between Raichur and Bagalkot. The Depth in the channel is need to be improved for the berthing of boats throughout the period. Raichur Thermal power plant and Yermaras power plant is nearby this location. Raichur is the nearby rail head to this location situated 25km from this point. Scope of cargo movement aspect may be extendable for further future.				
Sl No	Location	Lat	Long	Land Use	Owner
03	Khammampadu	16°19'11.77"N	77°40'48.76"E	Fishing	Govt. Land
	The proposed location is 3km from Ghadwal Road and is 14km from Gadwal Town, Andhra Pradesh. The proposed. The area is well connected with the road network. This can be developed as the terminal for the ferry system for transportation of Men and material from Gadwal to Raichur. The Depth in the channel needs to be improved for the berthing of boats throughout the period.				
Sl No	Location	Lat	Long	Land Use	Owner
04	Sangameshwar	16° 1'21.25"N	78°19'45.21"E	Fishing	Govt. Land
	The proposed location is 5km from Atmakur Road and is 45km from Kurnool Town, Andhra Pradesh. The proposed. The area is well connected with the road network. This can be developed as the terminal for the ferry system for transportation of Men and material from Kurnool to Srisailam. The Depth in the channel needs to be improved for the berthing of boats throughout the period. This is the end of the roadways as the presence of Srisailam Nagarjuna Sagar tiger reservoir.				
Sl No	Location	Lat	Long	Land Use	Owner
05	Srisailm	16° 4'52.97"N	78°52'49.74"E	Fishing /Ferry	Govt. Land
	The proposed location is 3km from Kurnool and Hyderabad Road and is 85km from Kurnool Town, Andhra Pradesh. This location is having a small bathing Ghat and tourism place of Srisailam dam developed by APTDC. The area is well connected with the road network. This can be developed as the terminal for the ferry system for transportation of Men and material from Kurnool to Srisailam. The Depth in the channel needs to be improved for the berthing of boats throughout the period. This is the end of the roadways as the presence of Srisailam Nagarjuna Sagar tiger reservoir.				

Sl No	Location	Lat	Long	Land Use	Owner
06	Anupu	16°30'8.69" N	79°16'6.33" E	Fishing /Ferry	Govt. Land
	The proposed location is 8km from Macherla and Hyderabad Road and is 20km from Macherla Town, Andhra Pradesh. This location is having a small bathing Ghat and presence of fishing boats. The area is well connected with the road network. This can be developed as the terminal for the ferry system for transportation of Men and material from Macherla to Srisailam. The Depth in the channel needs to be improved for the berthing of boats throughout the period.				

5 Fairway development

5.1 Fairway Dimensions

As per the specification of the survey, dredging quantity was required to be estimated for a channel dimension of 50m x 2m with side slope of 1:5, along with the deepest route.

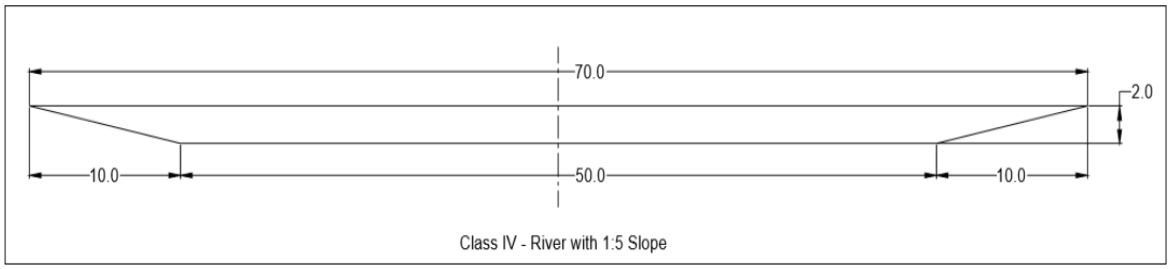
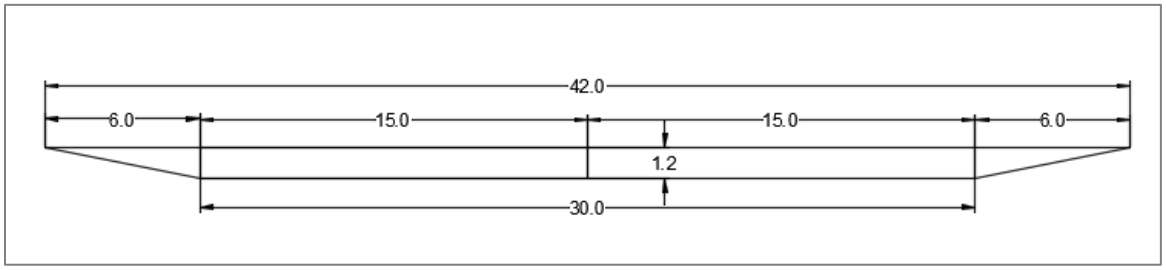


Figure 163 - Fairway Channel Dimensions 50m X 2m

5.2 Calculation of Dredging Quantity

The dredge volume calculations were accomplished using the HYPACK dredge volume computation utility. A channel profile of dimensions mentioned at para 2.3.9 in RFP. For clarity and ease of calculations, the complete channel profile was divided into segments of 1km each (enclosed at Annexure 2). The Tin v/s Channel with Hypack Standard algorithm was used to calculate the dredge volume in each segment. The stretch wise summary of the dredge volume is as follows:

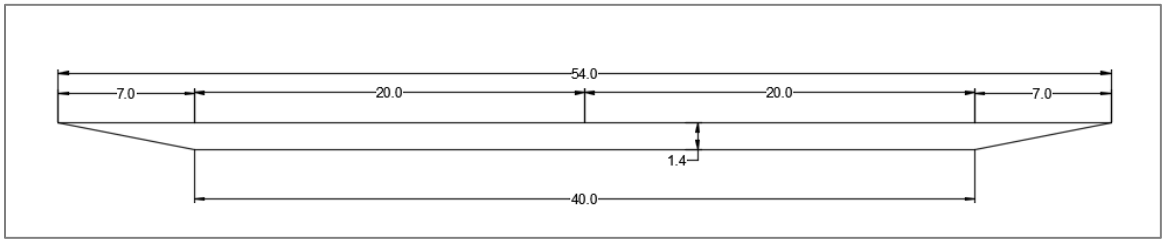
5.2.1 Class I



Class I													
Location		Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
From	To	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity
Wazirabad	Timmapapalem	0	30	0	25.12	9,870	140,030.71	140,030.71	-2.71	22.09	16,000	946,516.66	946,516.66
Timmapapalem	Anupu	30	60	0	24.11	7,930	322,430.23	462,460.94	-1.77	23.06	8,595	402,708.29	1,349,224.95
Anupu	Hanumapuram	60	90	11.31	14.7	0	0.00	462,460.94	8.97	12.37	0	0.00	1,349,224.95
Hanumapuram	Palutla	90	120	0	14.71	0	0.00	462,460.94	-0.37	12.41	100	305.95	1,349,530.90
Palutla	Domalpenta	120	150	0	14.51	10,450	343,142.40	805,603.34	-1.71	12.16	12,920	517,823.60	1,867,354.50
Domalpenta	Hatkeshwaram	150	180	2.26	13.56	0	0.00	805,603.34	-0.53	12.01	3,550	110,166.04	1,977,520.54
Hatkeshwaram	Veerabhadradurgam	180	210	2.27	13.75	0	0.00	805,603.34	0.46	11.81	860	2,264.40	1,979,784.94
Veerabhadradurgam	Veerapuram	210	240	0	14.82	8,600	359,887.66	1,165,491.00	-0.3	13.36	8,800	445,965.27	2,425,750.21
Veerapuram	Shalipur	240	270	0	0	30,000	1,295,258.75	2,460,749.75	-0.3	8.82	30,000	1,597,730.03	4,023,480.24
Shalipur	Beerole	270	300	0	0	30,000	1,294,889.56	3,755,639.31	-0.3	7.736	30,000	1,554,106.35	5,577,586.59
Beerole	Khammampadu	300	330	0	11.12	26,700	1,134,034.09	4,889,673.40	-0.3	10.6	26,700	1,330,700.51	6,908,287.10
Khammampadu	Ganjahalli	330	360	0	2.9	21,700	926,777.99	5,816,451.39	-0.3	11.87	21,700	1,160,529.88	8,068,816.98
Ganjahalli	Gugal	360	390	0	0	30,000	1,288,098.95	7,104,550.34	-0.3	0.368	30,000	1,617,447.85	9,686,264.83
Gugal	Konchapali	390	420	0	5.45	22,400	683,374.28	7,787,924.62	-1.77	3.65	25,200	1,301,260.08	10,987,524.91
Konchapali	Buddinni	420	450	0	0	30,000	1,289,820.20	9,077,744.82	-0.3	0	30,000	1,448,708.94	12,436,233.85
Buddinni	Aidbhavi	450	480	0	0	30,000	1,290,184.52	10,367,929.34	-0.3	0.169	30,000	1,509,066.92	13,945,300.77
Aidbhavi	Chitapur	480	510	0	0	30,000	1,290,641.30	11,658,570.64	-0.3	1.17	30,000	1,573,781.30	15,519,082.07
Chitapur	Adihal	510	540	0	9.54	7,300	187,193.90	11,845,764.54	-0.3	8.35	8,720	297,711.35	15,816,793.42
Kudal Sangama	Alur	540	570	0	12.72	8,100	304,741.06	12,150,505.60	-0.3	11.81	9,035	398,668.47	16,215,461.89
Alur	Dhawaleshwar	570	600	0	12.89	12,700	295,101.70	12,445,607.30	-0.3	11.95	15,200	438,051.74	16,653,513.63
Dhawaleshwar	Galgali	600	632	0	9.31	10,705	288376.25	12,733,983.55	-0.3	8.72	14,985	428,682.30	17,082,195.93
						Total	**12,733,983.55**				**Total**	**17,082,195.93**	

Table 66 - Class I Dredge Volumes

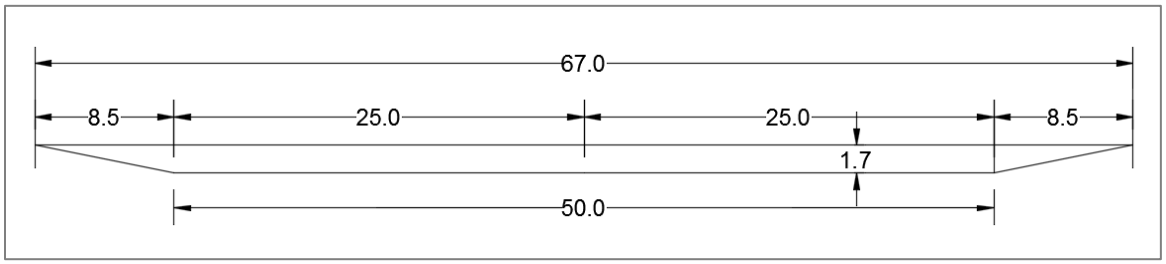
5.2.2 Class II



Class II													
Location		Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
From	To	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity
Wazirabad	Timmapapalem	0	30	0	25.12	10,070	239,901.87	239,901.87	-2.71	22.09	16,100	1,377,403.72	1,377,403.72
Timmapapalem	Anupu	30	60	0	24.11	8,105	493,257.88	733,159.75	-1.77	23.06	8,685	601,533.85	1,978,937.57
Anupu	Hanumapuram	60	90	10.88	14.7	0	0.00	733,159.75	8.57	12.37	0	0.00	1,978,937.57
Hanumapuram	Palutla	90	120	0	14.71	0	0.00	733,159.75	-0.37	12.41	150	1,580.36	1,980,517.93
Palutla	Domalpenta	120	150	0	14.51	10,900	530,014.01	1,263,173.76	-1.71	12.16	13,300	773,556.25	2,754,074.18
Domalpenta	Hatkeshwaram	150	180	2.26	13.56	0	0.00	1,263,173.76	-0.53	12.01	3,710	187,430.89	2,941,505.07
Hatkeshwaram	Veerabhadradurgam	180	210	2.27	14.61	0	0.00	1,263,173.76	0.46	13.13	1,050	7,630.44	2,949,135.51
Veerabhadradurgam	Veerapuram	210	240	0	14.82	8,650	548,664.05	1,811,837.81	-0.3	13.36	8,930	663,290.30	3,612,425.81
Veerapuram	Shalipur	240	270	0	0	30,000	1,972,870.39	3,784,708.20	-0.3	8.82	30,000	2,359,338.73	5,971,764.54
Shalipur	Beerole	270	300	0	0	30,000	1,972,307.28	5,757,015.48	-0.3	7.736	30,000	2,304,269.06	8,276,033.60
Beerole	Khammampadu	300	330	0	11.12	27,025	1,731,141.61	7,488,157.09	-0.3	10.6	26,850	1,991,094.78	10,267,128.38
Khammampadu	Ganjahalli	330	360	0	13.39	21,775	1,412,121.70	8,900,278.79	-0.3	11.87	21,850	1,713,183.55	11,980,311.93
Ganjahalli	Gugal	360	390	0	0	30,000	1,961,967.04	10,862,245.83	-0.3	0.368	30,000	2,383,409.47	14,363,721.40
Gugal	Konchapali	390	420	0	5.45	22,550	1,063,166.63	11,925,412.46	-1.77	3.65	25,575	1,961,333.39	16,325,054.79
Konchapali	Buddinni	420	450	0	0	30,000	1,964,585.87	13,889,998.33	-0.3	0.04	30,000	2,169,613.26	18,494,668.05
Buddinni	Aidbhavi	450	480	0	0	30,000	1,965,139.78	15,855,138.11	-0.3	0.169	30,000	2,246,138.86	20,740,806.91
Aidbhavi	Chitapur	480	510	0	0	30,000	1,965,810.40	17,820,948.51	-0.3	1.17	30,000	2,329,872.91	23,070,679.82
Chitapur	Adihal	510	540	0	9.54	7,550	291,012.69	18,111,961.20	-0.3	8.35	9,120	476,520.72	23,547,200.54
Kudal Sangama	Alur	540	570	0	12.72	8,300	468,053.60	18,580,014.80	-0.3	11.81	9,240	601,873.01	24,149,073.55
Alur	Dhawaleshwar	570	600	0	12.89	12,825	462,544.99	19,042,559.79	-0.3	11.95	15,370	676,274.23	24,825,347.78
Dhawaleshwar	Galgali	600	632	0	9.31	10,800	457,924.04	19,500,483.83	-0.3	8.72	15,435	689,300.04	25,514,647.82
						Total	19,500,483.83				Total	25,514,647.82	

Table 67 - Class II Dredge Volumes

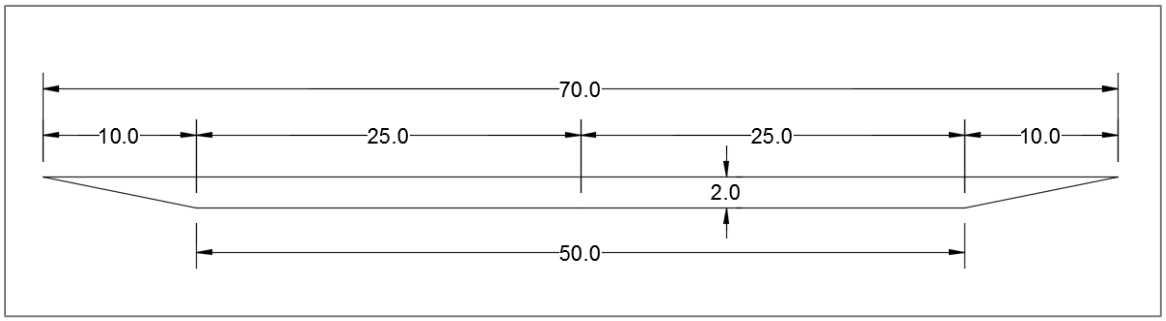
5.2.3 Class III



Class III														
Location		Chainage (km)		Observed					Reduced w.r.t. Sounding Datum					
From	To	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity
Wazirabad	Timmapapalem	0	30	0	25.12	10,430	431,599.01	431,599.01	-2.71	22.09	17,700	2,008,588.85	2,008,588.85
Timmapapalem	Anupu	30	60	0	24.11	8,350	750,308.47	1,181,907.48	-1.77	23.55	9,300	899,120.83	2,907,709.68
Anupu	Hanumapuram	60	90	10.88	14.72	0	0.00	1,181,907.48	8.57	12.37	0	0.00	2,907,709.68
Hanumapuram	Palutla	90	120	0	14.71	0	0.00	1,181,907.48	-0.37	12.41	500	4,495.89	2,912,205.57
Palutla	Domalpenta	120	150	0	14.64	11,300	819,165.54	2,001,073.02	-1.71	12.21	14,350	1,160,847.00	4,073,052.57
Domalpenta	Hatkeshwaram	150	180	2.26	14.66	0	0.00	2,001,073.02	-0.53	12.01	5,600	320,066.19	4,393,118.76
Hatkeshwaram	Veerabhadradurgam	180	210	2.27	14.61	0	0.00	2,001,073.02	0.3	13.13	2,620	26,454.17	4,419,572.93
Veerabhadradurgam	Veerapuram	210	240	0	14.82	8,700	830,676.63	2,831,749.65	-0.3	13.36	10,600	991,686.68	5,411,259.61
Veerapuram	Shalipur	240	270	0	0	30,000	2,981,803.91	5,813,553.56	-0.3	8.82	30,000	3,457,425.37	8,868,684.98
Shalipur	Beerole	270	300	0	0	30,000	2,980,944.69	8,794,498.25	-0.3	7.736	30,000	3,390,771.56	12,259,456.54
Beerole	Khammampadu	300	330	0	11.53	27,200	2,629,555.09	11,424,053.34	-0.3	11.01	27,350	2,959,673.68	15,219,130.22
Khammampadu	Ganjahalli	330	360	0	13.39	21,875	2,136,527.93	13,560,581.27	-0.3	11.87	22,100	2,511,282.09	17,730,412.31
Ganjahalli	Gugal	360	390	0	0	30,000	2,965,308.40	16,525,889.67	-0.3	0.368	30,000	3,488,333.02	21,218,745.33
Gugal	Konchapali	390	420	0	5.45	22,700	1,660,400.07	18,186,289.74	-1.77	3.65	26,500	2,947,224.32	24,165,969.65
Konchapali	Buddinni	420	450	0	0	30,000	2,969,275.11	21,155,564.85	-0.3	0.04	30,000	3,225,434.25	27,391,403.90
Buddinni	Aidbhavi	450	480	0	0	30,000	2,970,089.10	24,125,653.95	-0.3	0.171	30,000	3,318,276.98	30,709,680.88
Aidbhavi	Chitapur	480	510	0	0	30,000	2,970,216.94	27,095,870.89	-0.3	1.17	30,000	3,422,633.82	34,132,314.70
Chitapur	Adihal	510	540	0	9.54	8,550	461,936.22	27,557,807.11	-0.3	8.35	10,290	801,560.52	34,933,875.22
Kudal Sangama	Alur	540	570	0	12.72	8,950	719,801.34	28,277,608.45	-0.3	11.81	9,900	917,987.28	35,851,862.50
Alur	Dhawaleshwar	570	600	0	12.96	13,675	728,832.40	29,006,440.85	-0.3	12.02	15,700	1,053,802.53	36,905,665.03
Dhawaleshwar	Galgali	600	636.2	0	9.31	14,120	749,309.83	29,755,750.68	-0.3	8.72	17,450	1,153,362.77	38,059,027.80
						Total	29,755,750.68				Total	38,059,027.80	

Table 68 - Class III Dredge Volumes

5.2.4 Class IV



Class IV														
Location		Chainage (km)		Observed					Reduced w.r.t. Sounding Datum					
From	To	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Quantity
Wazirabad	Timmapapalem	0	30	0	25.12	14,260	590,895.78	590,895.78	-2.71	22.09	20,800	2,370,414.50	2,370,414.50
Timmapapalem	Anupu	30	60	0	24.47	8,600	910,603.69	1,501,499.47	-1.77	23.55	10,000	1,085,305.62	3,455,720.12
Anupu	Hanumapuram	60	90	10.88	14.72	0	0.00	1,501,499.47	8.57	12.37	0	0.00	3,455,720.12
Hanumapuram	Palutla	90	120	0	14.71	0	0.00	1,501,499.47	-0.37	12.41	600	6,862.64	3,462,582.76
Palutla	Domalpenta	120	150	0	14.74	11,750	1,003,004.50	2,504,503.97	-1.71	12.37	16,100	1,403,656.43	4,866,239.19
Domalpenta	Hatkeshwaram	150	180	2.26	14.66	0	0.00	2,504,503.97	-0.53	12.01	6,350	433,161.25	5,299,400.44
Hatkeshwaram	Veerabhadradurgam	180	210	2.27	14.61	0	0.00	2,504,503.97	0.3	13.13	4,250	61,957.83	5,361,358.27
Veerabhadradurgam	Veerapuram	210	240	0	14.82	8,750	1,003,539.97	3,508,043.94	-0.3	13.36	12,100	1,214,008.20	6,575,366.47
Veerapuram	Shalipur	240	270	0	0	30,000	3,597,954.37	7,105,998.31	-0.3	8.82	30,000	4,091,652.19	10,667,018.66
Shalipur	Beerole	270	300	0	0	30,000	3,596,920.67	10,702,918.98	-0.3	7.736	30,000	4,024,288.53	14,691,307.19
Beerole	Khammampadu	300	330	0	11.53	27,550	3,185,567.33	13,888,486.31	-0.3	11.01	28,600	3,534,338.40	18,225,645.59
Khammampadu	Ganjahalli	330	360	0	13.39	21,950	2,580,967.73	16,469,454.04	-0.3	11.87	22,300	2,974,272.21	21,199,917.80
Ganjahalli	Gugal	360	390	0	0	30,000	3,578,046.23	20,047,500.27	-0.3	0.368	30,000	4,124,499.95	25,324,417.75
Gugal	Konchapali	390	420	0	5.45	24,375	2,071,776.86	22,119,277.13	-1.77	3.65	30,000	3,546,982.71	28,871,400.46
Konchapali	Buddinni	420	450	0	0	30,000	3,582,827.52	25,702,104.65	-0.3	0.04	30,000	3,850,931.57	32,722,332.03
Buddinni	Aidbhavi	450	480	0	0	30,000	3,583,806.04	29,285,910.69	-0.3	0.171	30,000	3,947,421.43	36,669,753.46
Aidbhavi	Chitapur	480	510	0	0	30,000	3,583,535.67	32,869,446.36	-0.3	1.17	30,000	4,056,278.47	40,726,031.93
Chitapur	Adihal	510	540	0	9.54	9,600	602,572.43	33,472,018.79	-0.3	8.35	15,600	1,099,421.51	41,825,453.44
Kudal Sangama	Alur	540	570	0	12.72	9,000	885,244.59	34,357,263.38	-0.3	11.81	10,450	1,131,990.97	42,957,444.41
Alur	Dhawaleshwar	570	600	0	12.96	13,900	918,276.95	35,275,540.33	-0.3	12.02	15,900	1,317,903.62	44,275,348.03
Dhawaleshwar	Galgali	600	636.2	0	9.31	14,200	995,622.76	36,271,163.09	-0.3	8.72	21,100	1,534,510.55	45,809,858.58
						Total	36,271,163.09				Total	45,809,858.58	

Table 69 - Class IV Dredge Volumes

6 Conclusion

The aim is to undertake bathymetric survey, topographic survey, collection of data on cargo movement, industry survey, tourism facilities etc. in the project area; prepare detailed hydrographic survey charts, topographic survey charts, and feasibility report.

The survey was to conduct for assessing the river stretch from Wazirabad to Galgali, for surface navigation by vessels. The area has been adequately sounded and all conspicuous objects within and in the vicinity of the survey area has been fixed. The deliverable sheets contain shoal based depth information, important landmarks with state of the river banks. The survey is considered complete in all respects.

The stretch wise minimum and maximum width range, average width and average slope of the waterway are as below:-

Sl.No.	Location		Chaiange (km)		Width Range of Water Way (m)		Average Width (m)	Average Slope (in m/km)
	From	To	From	To	Min	Max		
1	Wazirabad	Timmapapalem	0	30	210.71	724.52	390.92	1 : 0.169
2	Timmapapalem	Anupu	30	60	202.33	797.9	486.56	1 : 3.54
3	Anupu	Hanumapuram	60	90	344.76	600.38	512.02	1 : 0.004
4	Hanumapuram	Palutla	90	120	414.38	606.52	506.36	1 : 0.144
5	Palutla	Domalpenta	120	150	344.58	590.21	467.00	1 : 2.924
6	Domalpenta	Hatkeshwaram	150	180	433.03	644.35	535.33	1 : 0.193
7	Hatkeshwaram	Veerabhadradurgam	180	210	477.86	611.21	551.63	1 : 0.136
8	Veerabhadradurgam	Veerapuram	210	240	482.66	973.91	555.54	1 : 0.006
9	Veerapuram	Shalipur	240	270	526.18	801.28	691.97	1 : 0.073
10	Shalipur	Beerole	270	300	627.29	2895	984.80	1 : 0.565
11	Beerole	Khammampadu	300	330	323.59	2596	900.06	1 : 1.411
12	Khammampadu	Ganjahalli	330	360	12.907	2932	1264.75	1 : 0.545
13	Ganjahalli	Gugal	360	390	9.703	1424	859.02	1 : 0.333
14	Gugal	Konchapali	390	420	246.48	1152	689.08	1 : 0.299
15	Konchapali	Buddinni	420	450	273.67	692.07	484.87	1 : 0.908
16	Buddinni	Aidbhavi	450	480	420.67	1735	578.11	1 : 1.462
17	Aidbhavi	Chitapur	480	510	259.37	7944	1665.82	1 : 2.042
18	Chitapur	Adihal	510	540	801.52	4196	1699.22	1 : 0.403
19	Kudal Sangama	Alur	540	570	590.68	1420	850.96	1 : 0.215
20	Alur	Dhawaleshwar	570	600	490.64	5754	2652.99	1 : 0.287
21	Dhawaleshwar	Galgali	600	636.2	286.03	895.92	523.39	1 : 0.118

Table 70 - Stretch wise Average width and slope of waterway

6.1 Description of Waterways

In the present form, the river is navigable between Nagarjuna Sagar dam to srisailam check dam and srisailam dam to Sangameshwarm without dredging

requirement. To assess the feasibility of navigation beyond Sangameshwaram to Priyadarshini Jurala dam, capital dredging would be required for which a Detailed Project Report and geotechnical investigation.

In between Narayanpur Dam and downstream up to Hunsiholi Water way is not feasible due to presence of so many weirs and small bridges and hard rocks.

The wild life sanctuary for breeding and conservation of Tigers falls in this stretch however the water way has adequate clearance from the Nagarjunsagar Srisailam Tiger Reserve.

A lot of fishing activity was seen on the Krishna River. There are five terminals proposed for facilitation of cargo in Wazirabad to Galagali stretch. They are at Anupu, Pathalganga at Srisailam, Sangameshwar and Alur.

6.2 Condition of River bed

From Wazirabad to Nagarjuna Sagar tail pond dam the rver is mostly sandy and Rocky in nature. And from Nagarjuna sagar tail pond dam to Nagarjuna sagar the river is found to partially Rocky in surface.

From Nagarjuna sagar to Sangameshwar the river bed is muddy in nature and bank are highly irrosive in nature. And due to the impoundness of the river flow due to presence of Dams, bed is mostly siltation basis.

During the survey it was observe that from Sangameshwar to PD Jurala dam upstream the rver found to dry in nature and flow is just like Nala, and the bank to bank River observed that presence of Mud, hard Rocks and sand patches.

From Huvinahedgi to Gugal barrage River is found sandy, and people usualy use the sand for construction purpose.

6.3 Methods for making waterway feasible

For developing a navigational channel having 50m bottom width 2.5 m depth below CD with 1:5 side slope the estimated quantity of dredging about 25,514,647.82cu.m.

Suitable bank protection measures are to be provided almost throughout the river.

All the low lying structures are to be re-constructed to provide the requisite horizontal and vertical clearance for the vessel movement. The class-wise details of reduced dredging quantities of the waterways are as tabulated below:-

Reduced Dredging Quantity

Class	I	II	III	IV
0-30 (km)	946,516.66	1,377,403.72	2,008,588.85	2,370,414.50
30-60 (km)	402,708.29	601,533.85	899,120.83	1,085,305.62
60-90 (km)	0.00	0.00	0.00	0.00
90-120 (km)	305.95	1,580.36	4,495.89	6,862.64
120-150 (km)	517,823.60	773,556.25	1,160,847.00	1,403,656.43
150-180 (km)	110,166.04	187,430.89	320,066.19	433,161.25
180-210 (km)	2,264.40	7,630.44	26,454.17	61,957.83
210-240 (km)	445,965.27	663,290.30	991,686.68	1,214,008.20
240-270 (km)	1,597,730.03	2,359,338.73	3,457,425.37	4,091,652.19
270-300 (km)	1,554,106.35	2,304,269.06	3,390,771.56	4,024,288.53
300-330 (km)	1,330,700.51	1,991,094.78	2,959,673.68	3,534,338.40
330-360 (km)	1,160,529.88	1,713,183.55	2,511,282.09	2,974,272.21
360-390 (km)	1,617,447.85	2,383,409.47	3,488,333.02	4,124,499.95
390-420 (km)	1,301,260.08	1,961,333.39	2,947,224.32	3,546,982.71
420-450 (km)	1,448,708.94	2,169,613.26	3,225,434.25	3,850,931.57
450-480 (km)	1,509,066.92	2,246,138.86	3,318,276.98	3,947,421.43
480-510 (km)	1,573,781.30	2,329,872.91	3,422,633.82	4,056,278.47
510-540 (km)	297,711.35	476,520.72	801,560.52	1,099,421.51
540-570 (km)	398,668.47	601,873.01	917,987.28	1,131,990.97
570-600 (km)	438,051.74	676,274.23	1,053,802.53	1,317,903.62
600-636.2 (km)	428,682.30	689,300.04	1,153,362.77	1,534,510.55
Total	**17,082,195.93**	**25,514,647.82**	**38,059,027.80**	**45,809,858.58**

Table 71 - Class-wise Reduced Dredging quantity

No cargo movement or passenger movement is envisaged through this River. However, if adequate depth and width is maintained with bank protection measures, the river is having high potential for tourism activities, particularly for boat operation between the Nagarjuna Sagar to Srisailam Dam.

Sl.No.	Chaiange (km)		< 1.2		1.2 - 1.4		1.5 - 1.7		1.8 - 2.0		> 2.0	
	From	To	Availability of Depth (km)	% of availability	Availability of Depth (km)	% of availability	Availability of Depth (km)	% of availability	Availability of Depth (km)	% of availability	Availability of Depth (km)	% of availability
1	0	30	19.60	65%	0.20	1%	0.20	1%	0.30	1%	9.70	32%
2	30	60	17.50	58%	0.40	1%	0.40	1%	0.20	1%	11.50	38%
3	60	90	1.70	6%	0.00	0%	0.10	0%	0.00	0%	28.20	94%
4	90	120	14.70	49%	0.20	1%	0.10	0%	0.00	0%	15.00	50%
5	120	150	19.80	66%	0.30	1%	0.40	1%	0.40	1%	9.10	30%
6	150	180	9.60	32%	0.80	3%	1.30	4%	2.10	7%	16.20	54%
7	180	210	8.70	29%	1.60	5%	1.20	4%	1.10	4%	17.40	58%
8	210	240	16.90	56%	0.40	1%	0.10	0%	0.40	1%	12.20	41%
9	240	270	30.00	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%
10	270	300	30.00	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%
11	300	330	27.20	91%	0.20	1%	0.00	0%	0.10	0%	2.50	8%
12	330	360	26.40	88%	0.10	0%	0.10	0%	0.10	0%	3.30	11%
13	360	390	30.00	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%
14	390	420	25.20	84%	0.00	0%	0.10	0%	0.10	0%	4.60	15%
15	420	450	30.00	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%
16	450	480	30.00	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%
17	480	510	30.00	100%	0.00	0%	0.00	0%	0.00	0%	0.00	0%
18	510	540	25.10	84%	0.20	1%	0.20	1%	0.00	0%	4.50	15%
19	540	570	21.60	72%	0.10	0%	0.00	0%	0.00	0%	8.30	28%
20	570	600	28.90	96%	0.00	0%	0.00	0%	0.00	0%	1.10	4%
21	600	636.2	24.00	80%	0.20	1%	0.40	1%	0.20	1%	11.40	31%
		Total	**466.90**	1556%	**4.70**	15%	**4.60**	14%	**5.00**	16%	**155.00**	475%

Table 72 - Class-wise availability of reduced depth of the waterway

6.4 Modifications/ improvement measures

Presence of dams in this stretch do not have a provision of navigational lock in original scheme; however, I & CAD are contemplating a navigational lock at this site on the request of IWAI. Locks can be provided either on earthen dam section in the left bank or through a diversion/ by pass channel from upstream of Dam to the downstream of dam by a twin lock to negotiate the required level difference, at each dam.

Bridges Clearances less than Class			High Tension lines Clearances less than Class
Class	**Horizontal**	**Vertical**	**Vertical**
I	0	5	0
II	0	5	
III	0	5	
IV	0	6	

Table 73 - Bridges and HTL Clearances less than Class no.

6.1 Recommendation

There are no major industries existed in the stretch of Wazirabad to Galgali. The riverbanks are well connected with roads and other infrastructures.

Improvement measures for overhead clearance and depth improvement are required on the first phase of the development. River bank is mostly non protective in nature, hence the chances of encroachment are not as much on bankside. The construction of protective wall will further prevent encroachment and erosion of river banks.

Already the water utilisaton in Krishna river basin is touching the maximum limit constraining the salt export to the sea. A detailed study is required to conduct by experts to decide the minimum water needed for the salt export to the sea and the required water quality to be maintained.

Krishna Basin Authority should be headed by a panel of experts representing environment, irrigation, agriculture, ground water, geology, health, ecology, etc to protect the river basin area for its long term sustainable productivity and ecology. Krishna River is the first major Indian River where water utilization has reached more than 80% of average water availability mainly for agriculture and drinking purpose. It will facilitate development of capital city Amaravati (Vijayawada) during its early development stage by transporting substantial material.

Smaller ferry jetties can be constructed along the Wazirabad to Galgali stretch in order to control land traffic congestion and to control. It will help in saving cost of transportation. Moreover, Ro-Ro services on the route will provide intra-city transporation of passengers and vehicles. It will improve connectivity to tourist and pilgrimage places in and around Nagarjuna Sagar, Srisailam, Vijayawada and Amaravati and nearby places of the stretch.

The purpose of the survey was for assessing the river stretch from Wazirabad to Galgali, for development of water transport facilities in the new National Waterway (NW-4). All conspicuous objects within and in the vicinity of the survey area have been fixed. The deliverable sheets contain mean sea level values of elevation information, important landmarks with the state of the river banks. The survey is considered complete in all respects.

7 Details of Annexures