# INLAND WATERWAYS AUTHORITY OF INDIA (IWAI)

# FEASIBILITY STUDY OF CEMENT TRANSPORT FROM NALAGONDA THROUGH WATERWAYS FROM MUKTYALA TO BAY OF BENGAL AT MACHILIPATNAM



## REVISED FINAL REPORT


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# EXECUTIVE SUMMARY

## 1.0 Introduction

1.1 Inland Water Transport (IWT) has the potential to form the most economic, reliable, safe and environment friendly mode of transport. When developed for use by modern inland waterway vessels, it can reduce investment needs in rail and road infrastructure, promote greater complementarities in the riparian states, enhance intra-regional trade and, through increased economies of scale, significantly reduce transport costs for the benefit of the entire economy and India's global trade competitiveness.

1.2 Inland Waterway Authority of India (IWAI) intends to explore Feasibility of cement transport from Nalagonda through waterways from Muktyala to Bay of Bengal at Machilipatnam. The proposed waterway route is to be developed as alternate mode of transportation for cargo. This development would help to decongest traffic of road and railway by shifting it to waterway. This region uses only roadway and railway as primary means of transportation for trade.

1.3 The southeast part of Telangana, especially the Nalgonda district, along the Krishna belt is rich in high-grade limestone, which is the main raw material for the cement industry and houses many large-scale cement industries as well as clinker grinding units. Major cement players in the region include NCL industries, Sri Veeranjaneya Cement Industries, Penna Cement, India Cements Limited, and others. Most of the cement processed in the region is moved to other states for consumption. There is proposed expansion of the production capacity in the region also demand of the cement in the region would increase due to proposed development in the region. The Government of Andhra Pradesh is developing a deep-sea port in Machilipatnam to handle large volumes of bulk cargo produced in the states of Andhra Pradesh and Telangana, including coal, iron ore, and liquid bulk. With the development of the port, cement traffic from Nalgonda may also be attracted at the Port due to a likely reduction in travel time, and hence cost.

1.4 This stretch is 168 km long, and passes through Nalagonda, Palnadu, NTR, Guntur and Krishna districts. The following map shows stretch from Muktyala to Machilipatnam through Bandar Canal. The proposed waterway comprises of the following stretches:-

| | | |
|---|---|---|
| Muktyala to Prakasam Barrage (Part of NW-4) | - | 82km |
| Prakasam Barrage to Sea/Machilipatnam | - | 86km |
| **Total Length of waterway** | **-** | **168 km** |




***Fig. 1 Stretch from Muktyala to Machilipatnam***

## 2 Site Conditions

Study stretch of Krishna River passes through Nalagonda, Palnadu, NTR, Guntur and Krishna districts from Muktyala to Praksam Barrage in Vijayawada. The canal originates from Prakasam Barrage on Krishna River and passes through the Vijayawada, Machilipatanam and enters into the Bay of Bengal. Nalgonda and Machilipatnam ports are connected via NH-65 which runs along the states of Maharashtra, Karnataka, Telangana, and Andhra Pradesh. Machilipatnam Railway Station is the nearest rail connectivity to Machilipatnam Port. The port is connected to Nalgonda via Guntur Junction on a double line, which then diverts onto a broad-gauge single-line railway line.

## 3 Preliminary Field Surveys

WAPCOS has conducted a Single line longitudinal survey (Bathymetric survey) in the deepest depths for the canal section, with the help of DGPS using Automatic Hydrographic Survey System. In the river section, thalweg survey from Muktyala to Prakasam Barrage carried out by IWAI, Vijaywada Office in June 2022 which has been referred to assess the present condition of waterway.

**River Section:**

- **Stretch 1 :Vijayawada to Harichandrapuram (Ch. 0.0 km– 17.275km)**
  Average depths from chainage 0-10km are around 6.0 m and from ch.10-17.27 km is around 5m**.**

- **Stretch 2: Harichandrapuram to Chintapalli (Ch. 17.275 km– 59.680 km)**
  Average depths upto ch. 23 km are around 5.0m. After Ch.23 km, LAD in this stretch is less than 1m.

- **Stretch 3:Chintapalli to Muktyala (Ch. 59.680km– 82km)**
  LAD from Ch. 59 to Ch. 63 is less than 1m. From 63km- 82km, LAD of 1-2m is available.

**Canal Section:**

- **Stretch 1: Prakasam Barrage to Bandar Lock (Ch. 0.0km– 1.5 km)**
  Average water depth in the stretch is 3.66m.

- **Stretch 2: Bandar Lock to Enamalakudru Lock (Ch. 1.5 km– 7.738 km)**
  Average water depth in the stretch is 3.00m.

- **Stretch 3: Enamalakudru Lock to Kankipadu Lock(Ch. 7.738 km– 20.362 km)**
  Average water depth in the stretch is 2.50m.

- **Stretch 4: Kankipadu Lock to Veeranki(Ch. 20.362 km- Ch.39.555 Km)**
  Average water depth in the stretch is 2.7m.

- **Stretch 5: Veeranki Lock to Nidumolu Lock(Ch.39.555 Km- Ch. 59.585)**
  Average water depth in the stretch is 2.4m.

- **Stretch 6: Nidumolu Lock to Akumaru lock (Ch. 59.585 -Ch.69.268 Km)**
  Average water depth in the stretch is 2.7m.

- **Stretch 7: Akumaru lock to Bandar Tidal Lock (Ch.69.268 Km -Ch. 79.312)**
  Average water depth in the stretch is 1.5m.

- **Stretch 8: Bandar Tidal Lock to Sea (Ch. 79.312- Ch. 86.35)**
  The area is tidal affected zone. At Ch 85 km dredging activity is in progress

## 4 Market Assessment

Installed Capacity of Cement in India was witnessed to be ~556.9 MTPA in FY-2020 with a production of 334.4 MTPA, which declined to ~545 MTPA capacity and 232.5 MTPA production in FY-2021, largely owing to the COVID-19 pandemic. The majority of the cement plants in India are located in South India with a total installed capacity as of FY-2020 of ~159.13 MTPA and a production volume of 132.7 MTPA, accounting for ~40 % of the national cement production. A good number of cement plants are located in Andhra Pradesh and Telangana, accounting for ~45% of the total installed cement capacity of southern India.

The government of Andhra Pradesh is developing a deep-sea port in Machilipatnam to handle large volumes of bulk cargo produced in the states of

Andhra Pradesh and Telangana, including coal, iron ore, and liquid bulk. With the development of the port, cement traffic from Nalgonda may also be attracted at the Port due to a likely reduction in travel time, and hence cost. A traffic and demand assessment study is developed by WAPCOS Limited for the assessment of the export of cement produced in Nalgonda via Machilipatnam Port.

- **Cement Market in Hinterland**

  The study involves an analysis of the relevant cement market in the district of Nalgonda in Telangana state. This includes estimation of EXIM traffic of cement produced in Nalgonda and Jaggayyapeta across various competing ports. The primary hinterland for the transportation of cement from Muktyala to Machilipatnam lies in the states of Andhra Pradesh and Telangana in general and specifically in the districts of Nalgonda, NTR, Guntur, and Krishna. Cement industries have been identified in these districts.

  The total production capacity of cement in Telangana is ~36 MTPA, of which 64% is located in Nalgonda. However, only ~13 MTPA of cement was produced in Nalgonda, which was ~72% of the state's production. The total production capacity of cement in Andhra Pradesh is ~78 MTPA, of which ~34% is located in the Guntur and Krishna districts. However, only 10.5 MTPA of cement was produced in these districts, which was ~35% of the state's cement production. These cement industries were consulted on best effort basis to understand the potential of handling cement via IWT and the likely issues and challenges in operations. The key takeaways from discussions with these stakeholders are as mentioned below.

  - Currently, there is no export of cement from industries in the study region.
  - Cement, from India, is only exported to Sri Lanka and Bangladesh. However, the selling cost of cement in these countries is much lower than the transportation cost of cement via sea, thus, making it unviable to export.
  - Cement produced in the region is largely domestically consumed in the states of Telangana, Andhra Pradesh, Karnataka, Orissa, Tamil Nadu, Kerala, Maharashtra, and Pondicherry.
  - ~7-8 MTPA of cement produced in Telangana is consumed domestically and the rest is transported to other states for consumption.
  - ~95% of the traffic movement in the region is via road.
  - Cement handling via rail is largely not preferred as multiple handling damages the cement bags and also increases the cost further.
  - Cement traffic via rail is currently only moved to a few parts in Maharashtra due to longer haulage and cost advantage.

- **Existing OD Pattern in Hinterland**

  The total production capacity and production output in FY-2020 for selected districts in our study area was 49.5 MTPA and 23.3 MTPA respectively. Based on stakeholders' discussions, the distribution of cement from these districts to neighboring states was observed to be as identified in the table below.

*Table 1: Movement via rail and road to key consumption centres*

| Major Consumption centres | Road Share (%) | Rail share (%) | Road Volume (MTPA) | Rail Volume (MTPA) |
|---|---|---|---|---|
| **Vijaywada, Amravati** | 100% | 0% | 10.0 | - |
| **Bhubaneswar, Cuttack** | 75% | 25% | 1.8 | 0.6 |
| **Chennai, Coimbatore** | 90% | 10% | 1.1 | 0.1 |
| **Bangalore, Mysore, Raichur** | 70% | 30% | 0.5 | 0.2 |
| **Nanded, Solapur** | 60% | 40% | 0.4 | 0.2 |
| **West Bengal, Kerala, Pondicherry** | 80% | 20% | 0.3 | 0.1 |
| | **95% (average)** | **5% (average)** | **22.0** | **1.3** |

*Source: Stakeholders Discussions; Consultant assessment*

For the total cement produced in the selected districts, ~95% is moved via road whereas only ~5% is moved via rail.

- **Competitive Impact Assessment**

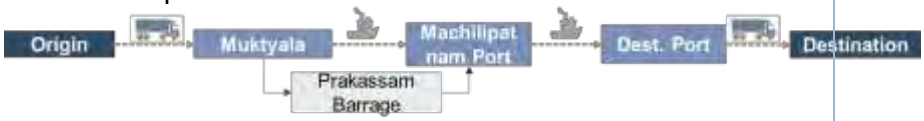
Machilipatnam Port is located close to some of the key ports, including Krishnapatnam Port on the south and Kakinada Port, Gangavaram Port, and Vishakhapatnam Port towards the north. Of this, Vishakhapatnam port is the only major port. Additional two ports are also upcoming which include Ramayapatanam port to the south and Bhavanapadu port to the extreme north, near the border of Andhra Pradesh with Odisha.

In FY-2021 and FY-2022, 248 thousand tonnes and 9 thousand tonnes of cement were handled at Kakinada Port. The port would also likely impose high competition on the Machilipatnam Port/Anchorage. Ramayapatnam Port is also located at a distance of 290km from Nalgonda. Cement can be transported from Nalgonda railway station to Singarayakonda railway station which is 33.3km from Ramayapatnam Port. Thus, it would also likely impose strong competition on the Machilipatnam Port/Anchorage. However, Vishakhapatnam Port, Gangavaram Port, and Bahvanapadu Port, being farther to the Port, would likely have comparatively lower competitive impact.

- **Potential of Shifting to IWT**

Total logistics costs have been evaluated based on existing ODs as well as the cost of transportation via different modes. The same has been used to calculate probable shifts to IWT in different scenarios, as discussed below.

| Supply Chain | Description |
|---|---|
| **Supply Chain 1: Via road** | It indicates the existing logistics cost for cement transportation in the region via road. |

| Supply Chain | Description |
|---|---|
| |  |
| **Supply Chain 2: Combination of Rail and Road** | It assesses the logistics cost of cement movement via rail and feeder transportation via road.<br>  |
| **Supply Chain 3: Combination of Road, and IWT** | It assesses the logistics cost of cement movement via IWT and feeder transportation via road.<br>  |
| **Supply Chain 4: Combination of Rail, Road, and IWT** | It assesses the logistics cost of cement movement via IWT and feeder transportation via road and rail.<br>  |

Based on TLC calculated across modes, the shift percentage from the existing used mode to the mode where TLC is lowest was calculated using a probability function based on the Diversion Curve Technique.

The Diversion Curve suggests that the cement traffic moving from Nalgonda and Jaggayyapeta to Vijaywada, Amravati, and Chennai would only likely shift to IWT, while the rest of the traffic would be largely moving via road due to cost and time advantage. The shift estimated from the diversion curve method has been further triangulated based on stakeholder discussions. Based on this, the shift of cement traffic to Chennai via coastal shipping will likely be only 25% of the estimated shift (25% of estimated 93%= 23%), serving only the Metropolitan Region located close to Chennai Port to avoid multiple handling of cement.

- **Traffic Forecast**

The percentage of shift identified for different states has been used to estimate the potential shift of traffic to IWT. It is considered that the NW-4 would likely begin operations from FY-2024 and the traffic realized in the first year of commencement is assumed to be 40%, which would gradually increase to 100% by FY-2027.

This traffic has been further estimated to be handled at NW-4 and Bandar Canal. (from Muktyala to Prakassam Barrage) and Bandar Canal (from Prakassam Barrage to Machilipatnam Port). All the IWT-based cement traffic moving from the Nalgonda and Jaggayyapeta region would be loaded at Muktyala and offloaded at Prakassam Barrage, constituting the traffic at NW-4.
Further, traffic destined to the Vijaywada and Amravati would be offloaded at Prakassam Barrage and moved via road. The remaining traffic, to be transported to other states, would be moved via Bandar Canal to Machilipatnam Port for coastal shipping. As per the TLC assessment, cement traffic moving to Chennai

Metropolitan Region may likely be shifted to Bandar Canal which has been highlighted in the table below.

*Table 2: Cement Consumption Forecast in Telangana and Andhra Pradesh (in MTPA)*

| | FY-20 | FY-25 | FY-30 | FY-35 | FY-40 | FY-45 | FY-50 | FY-55 |
|---|---|---|---|---|---|---|---|---|
| **Cement traffic at NW-4 (destined to Vijayawada)** | 0.00 | 0.56 | 1.16 | 1.43 | 1.68 | 1.98 | 2.32 | 2.74 |
| **Cement traffic at Bandar Canal (destined to Chennai)** | 0.00 | 0.09 | 0.20 | 0.23 | 0.25 | 0.26 | 0.27 | 0.28 |

## 5. Functional Panning

While considering various options available for navigation in order to transport cement salient features of the waterway are taken into consideration. The approach taken is first to consider the size of the vessels that could ply in the waterway with the navigational facilities developed for waterway dimensions. The fairway dimensions would be fixed based on size & type of design vessel.
The following range of self-propelled barge sizes are considered for operation in all phases.

**River Section - Muktyala Terminal to Ibrahimpatnam/ Harischandrapuram Terminal**

***Table 3: Barge Size in River Section***

*All dimensions are in m*

| Tonnage | Length (L) | Beam (B) | Draft (D) |
|---|---|---|---|
| 500 | 58 | 9 | 1.5 |
| 300 | 45 | 8 | 1.2 |
| 100 | 32 | 5 | 1.0 |

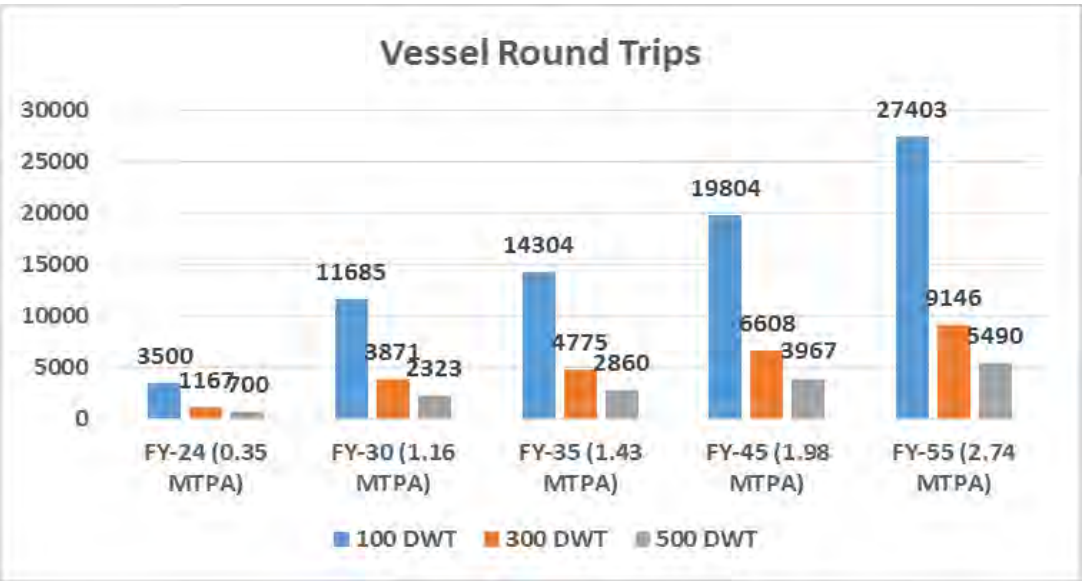



***Fig. 2 Vessel Roundtrips in River Section***

After analysis with above mentioned barge sizes it is concluded that the operation will be better manageable with 500 DWT vessels than lower capacity barges. Because of very high number of round trips of the lower capacity barges, operations would be quite difficult and unmanageable and will create queuing in the channel.

**Canal Section - Ibrahimpatnam Terminal to *Machhlipatnam***

The following range of self-propelled barge sizes are considered for operation in Canal Section

***Table 4: Barge Size in Canal Section***

*All dimensions are in m*

| Tonnage | Length (L) | Beam (B) | Draft (D) |
|---|---|---|---|
| 100 | 32 | 5.0 | 1.0 |
| 50 | 20 | 3.5 | 1.0 |

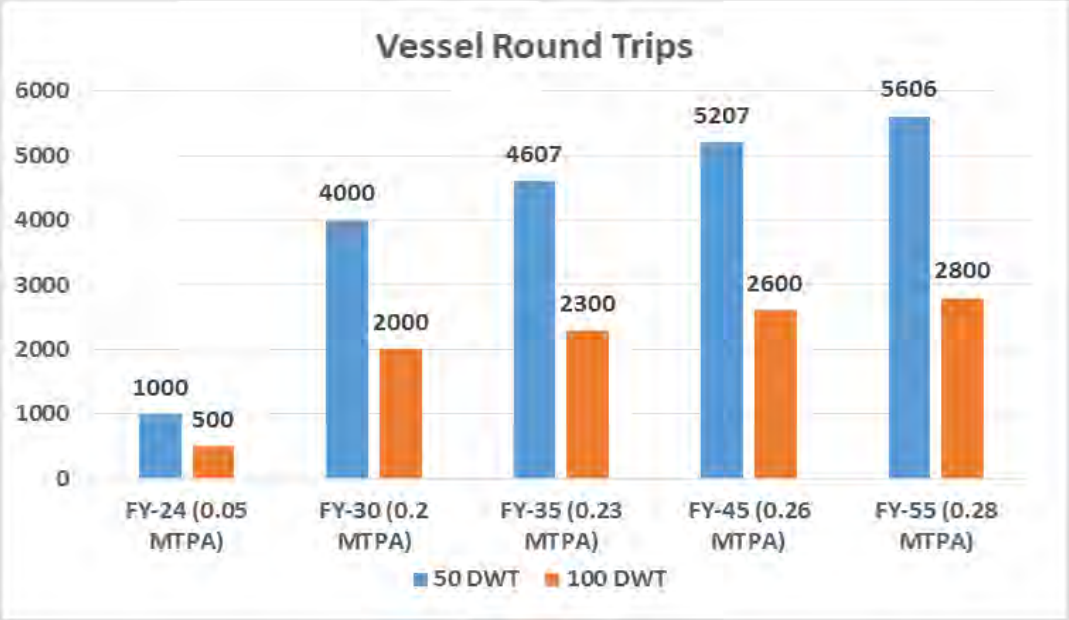



***Fig. 3 Vessel Roundtrips in Canal Section***

Similarly in canal section also the operation will be better manageable with 100 DWT vessels than lower capacity barges. Because of very high number of round trips of the lower capacity barges, operations would be quite difficult and unmanageable and will create queuing in the canal.

## 6 Issues & Challenges

- Width Restrictions of Proposed Lock at Parkasam Barrage
- Deteriorated Condition of Existing Locks
- Width Restriction of Bandar Canal at Tail Reaches/Lock Gate sites
- Inadequate Horizontal & Vertical Clearances in the Bridges
- Depth Restriction in River Krishna

## 7 Planning of Waterway & Infrastructure

The largest sized vessel that can ply in the waterway would depend on whether 1- way or 2 - way navigation is to be catered to, the waterway width and depth.

**River Section**

Fairway dimension for River Section has been kept on the basis of IWAI norms for the Class-I, Class-II & Class-III. The following vessel and dimensions are taken for functional planning of River Section:

***Table 5: Vessel Dimension***

| Class | Tonnage | Length (L) | Beam (B) | Draft (D) |
|---|---|---|---|---|
| Class III | 500 | 58m | 9m | 1.5m |

Fairway dimension of above classes of waterway are given below:

***Table 6: Fairway Dimension***

| Class | Tonnage | Fairway Width (m) | Fairway Depth (m) | Side slope (H:V) |
|---|---|---|---|---|
| Class III | 500 | 50m | 1.7m | 5:1 |

**Vessel considered for canal section is tabulated below:**

The following vessel and dimensions are taken for functional planning of Canal Section:

***Table 7: Vessel Dimension***

| Class | Tonnage | Length (L) | Beam (B) | Draft (D) |
|---|---|---|---|---|
| Class-I | 100 | 32m | 5.0m | 1.0m |

**Widening of Canal**

There is a width restriction in Bandar Canal, After Veeranki lock which is about 40 Km downstream of Prakasam Barrage, maximum available width of the canal is 12m only and minimum width is 4.8m. Class-II & Class-III cannot ply in Bandar canal as sufficient width is not available and widening of canal is not possible within city limits. However, for both options, minimum 20m width is required for safe navigation. It may please be noted that within city limits, 33m of width is available. Canal need to be widened for approx. 46km length from Veeranki to Machhalipatnam Port/Anchorage to get requisite fairway width for navigation purpose.

To maintain 1.5m water depth throughout canal, the Discharge calculations have been worked out as given below. In Bandar Canal, 771 cusec discharge is available upto 59.585 km from Prakasam Barrage, which is equivalent to the minimum discharge required for maintaining 1.5m water depth for Option 1. In case of option 2, sufficient discharge is available upto 59.585 km. However, the available discharges in tail reach i.e. after 59.585 Km is less than the required minimum discharge for both options.

**Estimation of Dredging/Excavation Quantities:**

The dredging quantities have been computed for River Section as well as Canal Section.

**In River section**, Dredging quantity is computed as 2.7M Cum, considering navigation through Class-III (500 DWT) vessel.

**In Canal section,** excavation quantity has been computed on the basis of fairway requirement after adding 1m free board in the required depths. Excavation quantity is computed as 2.6 $Mm^3$

Cutter Section Dredger (CSD) may be considered for dredging in order to maintain the depth in the waterway.

**Modification Requirement in existing Bridges & Locks**

**River Section:**

There is no existing bridge from Muktyala to Parkasam as of now. However, one bridge is under construction near Suryapalem ($16^0$ 32' 59'' N $80^0$ 34' 01''E) having sufficient clearances. Therefore, there is no need of any modification in River section.

**Canal Section:**

There are total 67 bridges in Bandar Canal including a Railway Bridge at chainage 0.7km and two under Construction Road Bridges at Ch. 7.25 km (Near Enamalakudru) & at Ch. 67.91 (Near Kaza-Machilipatnam). Except four bridges all other bridges have to demolish & Re-constructed as they are not conforming to respective requirement of vertical clearance and horizontal clearance.

Railway Bridge (3-Lines) cannot be demolished & reconstructed as it will hamper major railway operations and it will be very difficult to get necessary permissions from the competent authorities.

**Modification of Locks in Bandar Canal:**

The site survey shows clearly that the existing locks are in dilapidated state. However, Lock Chambers are generally in good condition. There appears to be no requirement for reconstruction of existing concrete civil structures. But, at few locks site, width of the lock is not sufficient for negotiating 50t / 100t vessels. In those cases lock will need to be modified. It is to be noted that gates are in filthy conditions and need to replace with new hydraulic gates. Fendering and mooring bollards should be provided inside the lock chambers. Dense hyacinth should be removed from all lock site.

*Table 8: Modification in Length and Width of Existing Locks*

| Sr. No | Name of Lock | Length | Width | Class-I | |
|---|---|---|---|---|---|
| | | | | Modification in Length (m) | Modification in Width (m) |
| 1 | Prakasam Lock | 195m | 4.75m | Not Required | Proposed Width 6m |
| 2 | Bandar Lock | 55m | 6m | Not Required | Not Required |
| 3 | Enamalakudru (Old) | 55m | 6m | Not Required | Not Required |
| | (New) | 55m | 4m | Not Required | Proposed Width 6m |
| 4 | Kankipadu | 25m | 6m | Proposed Length 40m | Not Required |
| 5 | Veeranki | 25m | 6m | Proposed Length 40m | Not Required |
| 6 | Nidumolu | 25m | 6m | Proposed Length 40m | Not Required |
| 7 | Akumaru | 25m | 6m | Proposed Length 40m | Not Required |
| 8 | Bandaru Tidal Lock | 25m | 6m | Proposed Length 40m | Not Required |

**Existing Terminals:**

Three RO-RO terminals at Muktyala (Ch. 82), Harischandrapuram (Ch. 21.2 km) & Ibrahimpatnam (Ch. 12.5) are under construction.

- **Muktyala terminal**

Muktyala terminal is on upstream of the confluence of small stream (Paleru) and the river krishna. Exact coordinates of the terminal is 16°49'22.49"N, 80° 5'0.44"E"E. Land acquisition of 8.57 Acres is in process for creation of land side facilities. RO-RO route is Muktyala-Madipadu-Muktyala. Main cargo at this terminal will be Cement.

- **Harischandrapuram Terminal**

Harischandrapuram terminal is located on the upstream of Prakasam barrage at right bank of River Krishna. Exact coordinates of the terminal is 16°34'22.10"N, 80°25'56.62"E. Land acquisition of 3.63 Acres is in process for creation of land side facilities. RO-RO route is Ibrahimpatnam-Harishchandrapuram—Ibrahimpatnam. Main cargo at this terminal will be agricultural products, HSD, sand and other constructional materials.

- **Ibrahimpatnam Terminal**

Ibrahimpatnam Terminal is locqated on the upstream of Prakasam barrage at right

bank of River Krishna. Exact coordinates of the terminal is 16°34'49.48"N, 80°30'49.02"E. Land acquisition of 5.5 Acres is in process for creation of land side facilities. RO-RO route is Ibrahimpatnam-Harishchandrapuram—Ibrahimpatnam & Lingyapalem-Ibrahimpatnam. Main cargo at this terminal will be agricultural products, HSD, sand and other constructional materials.

**Berth Length proposed**

***Table 9: Berth Length proposed***

| FY | Traffic Volume (MTPA) | Muktyala Terminal (m) | Ibrahimpatnam Terminal (m) | Harishchandrapuram Terminal (m) |
|---|---|---|---|---|
| 24 | 0.35 | 75 | 75 | 75 |
| 30 | 1.16 | 150 | 150 | 150 |

## 8. Cost Estimate:

Total cost for development of waterway for navigation with 500 DWT vessel in River Section & 100 DWT vessel in Canal Section is given below.

***Table 10: Cost Estimate***

| S.No. | Estimated Cost | ( Rs. in Lakhs ) |
|---|---|---|
| (A) | Dredging (River Section) | 10600 |
| (B) | Excavation (Canal widening) | 4515 |
| (C) | Land Acquisition for widening of Canal | 20730 |
| (D) | Terminal | 4320 |
| (E) | Modification of Bridges | 35000 |
| (F) | Modification of Locks | 12000 |
| (G) | Bypass Channel Lock System at Railway Bridge | 3500 |
| (H) | Navigational aids | 250 |
| **Total Cost (A+B+C+D+E+F+G)** | | **92295** |
| Contingency @3% | | 2769 |
| Total Incl. Contingency | | 95064 |
| Supervision Charges@7% | | 6461 |
| Total Incl. Contingency & Supervision charges | | 101525 |
| Plus GST @18% | | 18274 |
| Total Incl. GST | | 119799 |
| (+) Labour Welfare Cess @1% | | 1198 |
| Total | | **120997** |
| | | **Say Rs 1210 Crore** |

The capital cost worked out is including land acquisition cost for widening of canal, modification of navigational locks, excavation, dredging and cost of demolition and reconstruction of bridges etc. Out of Rs 1210 Crores, Rs 1000 Crores cost has been estimated for development of navigation in Canal Section only with Class-I Waterway.

## 9 Recommendations

Based on functional planning, it is found that in River section, navigation with Class-I & Class-II vessels would be quite difficult and unmanageable due to excessive round trips. Therefore, in River section, navigation with class-III vessel is proposed.

In canal section, projected traffic in initial year is only 0.05 MTPA and capital cost for development of canal section has been estimated as Rs. 1000 crores which a huge investment compared to the traffic to be handled. Besides this, 63 bridges have to be demolished and reconstructed which is a huge challenge in itself. Keeping this into consideration, navigation through Bandar canal may not be a viable proposition.

Given the navigability challenges and associated issues in the Bandar Canal, transporting cement from Nalgonda to Machilipatnam is not deemed a technically feasible option.

# CHAPTER-1
# INTRODUCTION

## 1.0 General Background

1.1 Inland Water Transport (IWT) has the potential to form the most economic, reliable, safe and environment friendly mode of transport. When developed for use by modern inland waterway vessels, it can reduce investment needs in rail and road infrastructure, promote greater complementarities in the riparian states, enhance intra-regional trade and, through increased economies of scale, significantly reduce transport costs for the benefit of the entire economy and India's global trade competitiveness.

1.2 Inland Waterway Authority of India (IWAI) intends to explore Feasibility of cement transport **from Nalagonda through waterways from Muktyala to Bay of Bengal at Machilipatnam** This stretch is 168 km long, and passes through Nalagonda, Palnadu, NTR, Guntur and Krishna districts. The following map shows stretch from Muktyala to Machilipatnam through Bandar Canal.




***Fig. 1.1 Stretch from Muktyala to Machilipatnam***

The proposed waterway comprises of the following stretches:-

| | | |
|---|---|---|
| 1) | Muktyala to Prakasam Barrage (Part of NW-4) | 82km |
| 2) | Prakasam Barrage to Sea/Machilipatnam | 86km |
| | **Total Length of waterway** | 168 km |

**1.4** The work Consultancy Services for **"Feasibility study for transportation of cement from Nalagonda through waterways from Muktyala to Bay of Bengal at Machilipatnam"** has been awarded to WAPCOS Limited vide Work order No. F NO. IWAI/Feasibility study/Machilipatnam/2022 dated 8/07/2022 by IWAI. The scope of work of the study is as given below:

- Identification of all the existing cross structures on proposed route and identify horizontal and vertical clearances. Modification required for increasing these clearances for passage of vessels recommended along indicative cost
- Collection & review of data, reports, available with Inland Waterways of India (IWAI) & State water resource Department.
- Preliminary Survey/Reconnaissance Survey of the Study Stretch
- Assessment of water availability for the entire period of the year to carry out efficient and continuous navigation in the waterway
- Study/identify the vulnerable stretches/recurring shoals/navigational impediments and other difficult areas with respect to navigation.
- Selection suitable types of cargo vessels for the cargo, workout the details of the type of vessels.
- Traffic studies for Proposed Cargo potential i.e. Cements in the waterways
- To study requirement of infrastructure for development of IWT with sufficient details which should include fairway development, landing terminals/wharves.
- Planning of waterway
- Modification of existing navigational lock for passage of the vessel

## 1.5 Need for the project

1.5.1 Inland Waterways are economic multipliers, as they induce factors in development of an area, both through planned development policies and by the unplanned growth of related industries thus providing space for industrial clusters. They also nurture growth of other related industries like ship repairs and dredging activities. The clustering of related activities improves the competitive advantage of players by augmenting their productivity and reducing costs in movement and also paving the way for technological innovation. So, Inland Waterways create a kind of value chain of interrelated activities of the hinterland that are mutually supportive and continuously growing.

1.5.2 Due to the surge in road traffic, Govt. of India focused attention in widening and relaying of National Highways including construction of major time bound projects. In similar fashion, dedicated rail corridors for the movement of goods by rail are in the implementation stage by the Government. Hence, it is evident that all modes of transport need to be developed and the vital role which inland waterways can play in meeting the ever increasing transport needs for a faster economy could not be ignored.

1.5.3 The proposed waterway route is to be developed as alternate mode of transportation for cargo. This development would help to decongest traffic of road and railway by shifting it to waterway. This region uses only roadway and railway as

primary means of transportation for trade.

1.5.4 The southeast part of Telangana, especially the Nalgonda district, along the Krishna belt is rich in high-grade limestone, which is the main raw material for the cement industry and houses many large-scale cement industries as well as clinker grinding units. Major cement players in the region include NCL industries, Sri Veeranjaneya Cement Industries, Penna Cement, India Cements Limited, and others. Most of the cement processed in the region is moved to other states for consumption. There is proposed expansion of the production capacity in the region also demand of the cement in the region would increase due to proposed development in the region.

1.5.5 The Government of Andhra Pradesh is developing a deep-sea port in Machilipatnam to handle large volumes of bulk cargo produced in the states of Andhra Pradesh and Telangana, including coal, iron ore, and liquid bulk. With the development of the port, cement traffic from Nalgonda may also be attracted at the Port due to a likely reduction in travel time, and hence cost.

## 1.6 Purpose of the project

Transport has been considered as a primary factor of economic development. Inland waterways transportation is one of the oldest economic and environmental sustainable modes of transportation for passengers and cargo. In some areas, it is the only means of mobility and access to basic services. The sector encompasses various types and sizes of vessels, operating on waterways in major rivers of India. Inland waterways play a vital role in economic development, especially in remote areas. The potential opportunities for IWT sector depends considerably on the specific regional context, such as geographical conditions, level of road development and socio-economic conditions. Developing and maintaining proposed waterway route is an opportunity to improve sustainable development of this waterway and the hinterland.

1.7 The present report deals with the various options, analysis and estimates of suggested developmental works in proposed waterway route. The results and analysis of field surveys and available data have been considered for planning purpose. The present report consists of following chapters:

| | |
|---|---|
| Chapter 1 | Introduction |
| Chapter 2 | Site Conditions |
| Chapter 3 | Preliminary Field Surveys |
| Chapter 4 | Market Assessment |
| Chapter 5 | Functional Panning |
| Chapter 6 | Issues & Challenges |
| Chapter 7 | Planning of Waterway & Infrastructure |
| Chapter 8 | Cost Estimates |
| Chapter 9 | Conclusions and Recommendations |

# CHAPTER-2
# SITE CONDITIONS

## 2.1 INTRODUCTION

The waterway under study comprises of river section in River Krishna and canal section in Bandar canal and the Total length of stretch is around 168km. River section starts from Muktyala to Prakasam barrage & Canal section starts from Prakasam Barrage and extends up to Bay of Bengal. Bandar canal which is part of Krishna eastern canal system.

The proposed waterway comprises of the following stretches:-

| | | |
|---|---|---|
| 1) | Muktyala to Prakasam Barrage (Part of NW-4) | 82km |
| 2) | Prakasam Barrage to Sea/Machilipatnam | 86km |
| | **Total Length of waterway** | 168 km |

## 2.2 RIVER COURSE

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.




***Fig. 2.1 Full course of river Krishna***

### 2.2.1 LENGTH OF STUDY STRETCH IN RIVER SECTION

Study stretch of Krishna River passes through Nalagonda, Palnadu, NTR, Guntur and Krishna districts from Muktyala to Praksam Barrage in Vijayawada. Length of river stretch is approx. 82 km.

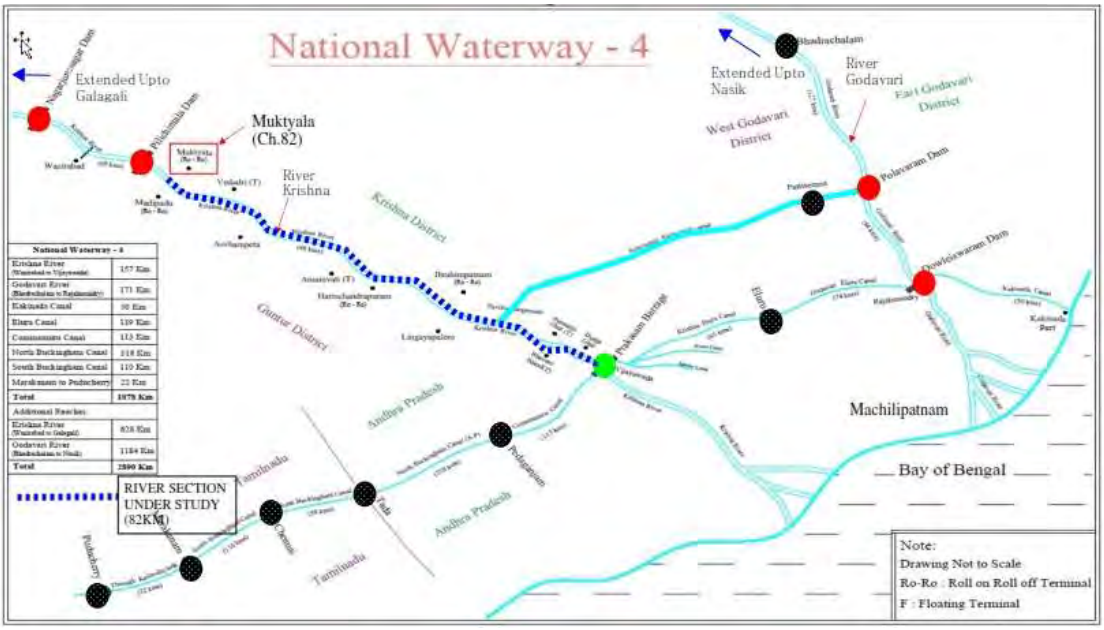



***Fig. 2.2 Length of Study Stretch in River Section***

## 2.3 CANAL COURSE

Bandar canal takes off from the Krishna River at Prakasam Barrage in Vijayawada. Bandar Canal is one of the three branch canals of Eastern Canal System of River Krishna. Bandar Canal is also called as Machilipatanam canal. The canal originates from Prakasam Barrage on Krishna River and passes through the Vijayawada, Machilipatanam and enters into the Bay of Bengal.

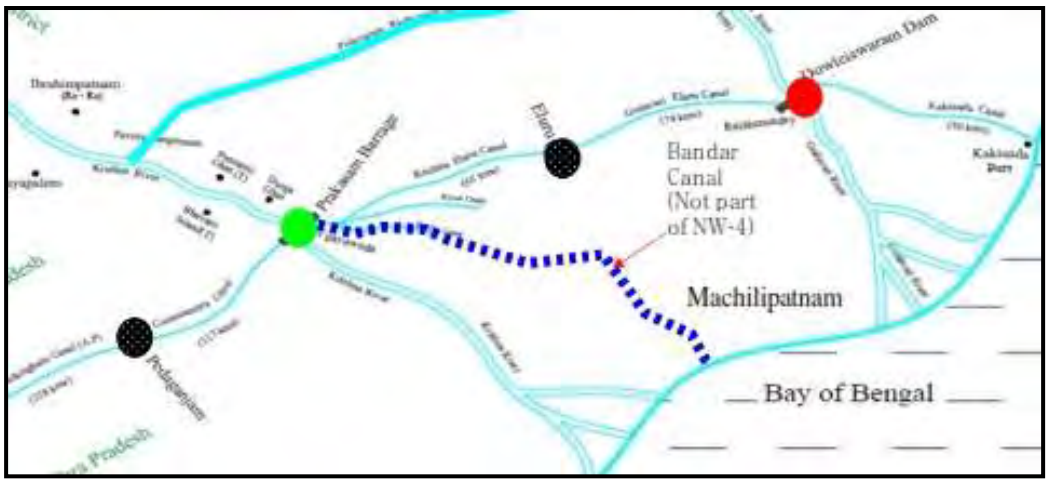



***Fig. 2.3 Canal Course***

### 2.3.1 LENGTH OF CANAL SECTION

Length of canal section is approx. 86 km. Study stretch of Bandar Canal is from Prakasam Barrage to Sea at Bay of Bengal.

## 2.4 CLIMATE CONDITIONS

The specific meteorological data at Vijayawada has been taken from Climatological Tables, Indian Meteorological Department.

### 2.4.1 TEMPERATURE

The average annual temperature in Vijayawada is 28.2 °C. May is the warmest month of the year. The average temperature in May is 33.5 °C. December is the coldest month of the year. The average temperature in December is 33.5 °C.

### 2.4.2 RAINFALL

The annual rainfall is 974 mm. The driest month is January, with 6 mm of rain. In August, the precipitation reaches its peak, with an average of 179 mm.

### 2.4.2 RELATIVE HUMIDITY

Relative humidity varies from month to month, being maximum during monsoon and minimum during winter. The month with the highest relative humidity is October (78.66 %). The month with the lowest relative humidity is May (51.69 %).

***Table 2-1 Climatic Conditions at Vijayawada***

| | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept. | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Avg. Temp °C** | 24.3°C | 26.2°C | 29°C | 31.3°C | 33.5°C | 31.3°C | 29.2°C | 28.4°C | 28.1°C | 27.1°C | 25.5°C | 24.3°C |
| **Min. Temp °C** | 19 °C | 20.6°C | 23.3 °C | 26.2°C | 28.6°C | 27.6°C | 26.3 °C | 25.7 °C | 25.3°C | 23.9°C | 21.4°C | 19.3 °C |
| **Max. Tempe °C** | 30.1 °C | 32.8°C | 35.7°C | 37.8 °C | 39.4 °C | 35.5°C | 32.7 °C | 31.7°C | 31.7°C | 31.1°C | 30.1°C | 29.4°C |
| **Rainfall (mm)** | 6 | 9 | 10 | 15 | 54 | 142 | 172 | 179 | 179 | 135 | 59 | 14 |
| **Humidity (%)** | 67% | 62% | 60% | 60% | 52% | 60% | 69% | 74% | 77% | 79% | 74% | 69% |

### 2.4.4 WIND

The mean wind speed prevailing in the area is around 4.2 km/hr. Maximum wind speed prevails in July – August with an average of 6-7 Km/hr. Minimum wind speed prevails in Jan– Feb with an average of 3 Km/hr.

## 2.5 RAIL/ROAD CONNECTIVITY

### 2.5.1 ROAD CONNECTIVITY

Nalgonda and Machilipatnam ports are connected via NH-65 which runs along the states of Maharashtra, Karnataka, Telangana, and Andhra Pradesh. Major cities on this route are Pune, Solapur, Hyderabad, Suryapet, Vijayawada, and Machilipatnam. The section between Hyderabad and Vijayawada is known as Vijayawada–Hyderabad Expressway and is a major expressway.

### 2.5.2 RAIL CONNECTIVITY

Nalgonda and Machilipatnam Port fall in the south-central region of the Indian railways. Machilipatnam Railway Station is the nearest rail connectivity to Machilipatnam Port. The port is connected to Nalgonda via Guntur Junction on a double line, which then diverts onto a broad-gauge single-line railway line.

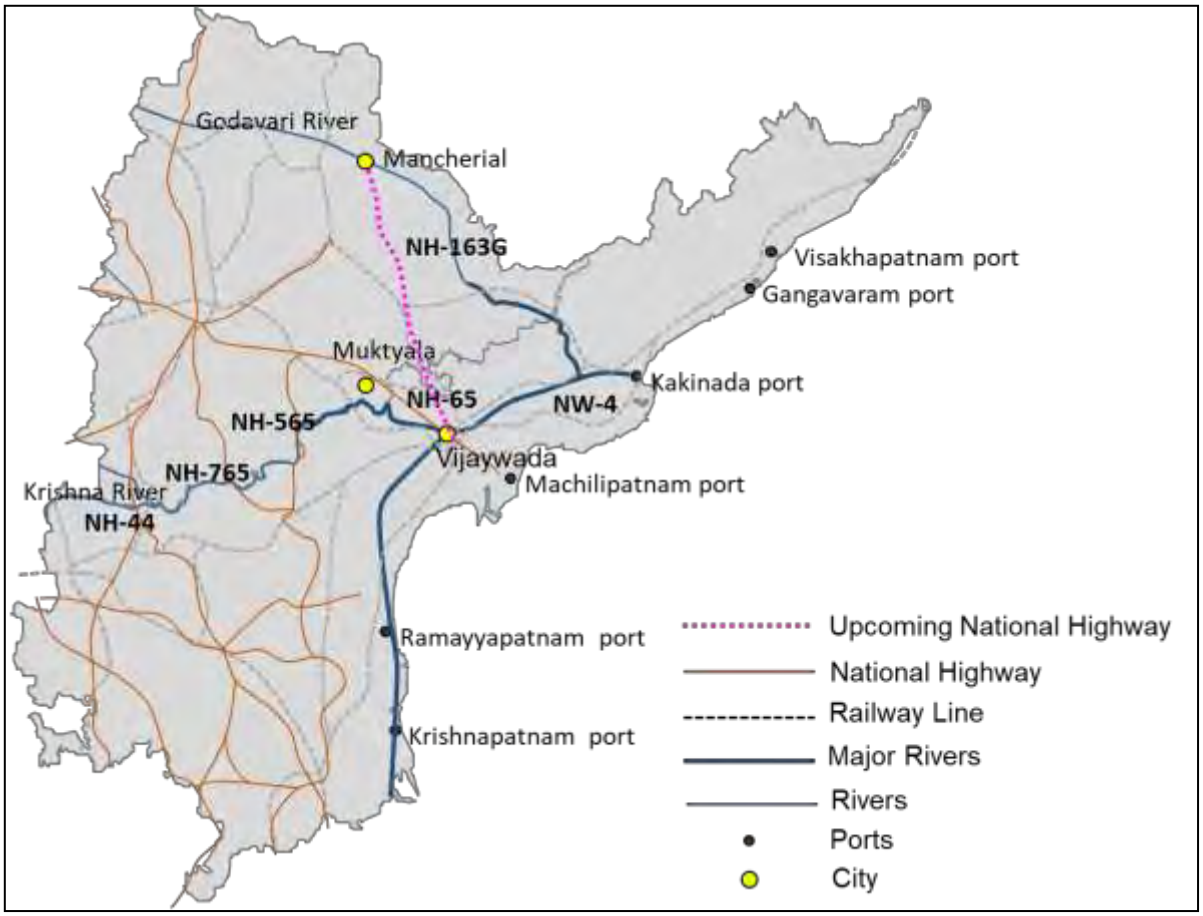



***Fig. 2.4 Connectivity between Nalgonda and Machilipatnam***

# CHAPTER-3
# PRELIMINARY FIELD SURVEYS

## 3.1 Hydrographic Survey

WAPCOS has conducted a Single line longitudinal survey (Bathymetric survey) in the deepest depths or lowest height lands, with the help of DGPS using Automatic Hydrographic Survey System. Bathymetric survey in the canal has been carried out in the deepest route. Deepest route can be accessed by taking two or three longitudinal line soundings at equal interval. Topographic survey is carried out at lowest ground levels, which can be decided on visual assessment.

Details about cross structures viz. bridges, regulators, locks, aqueducts, electric lines, telephone lines, pipe lines, cables enroute has been collected and indicated on the chart and also included in the report along with their co-ordinates, location and photographs. Horizontal clearance (pier to pier distance) and vertical clearances above FSL shall be collected for cross structures on the canal. Details of Barrages, Canal diversion, Water intake structures, Locks enroute are also collected during survey.

However, for river section, thalweg survey from Muktyala to Prakasam Barrage carried out by IWAI, Vijaywada Office in June 2022 has been referred to assess the present condition of waterway.

## 3.2 Sounding operations

Bathy-500 DF was used to obtain soundings onboard the survey boat. A working frequency of 210 KHz was used for sounding operations. The digital output from the echo sounder was fed to the HYPACK data logging software for acquisition of survey data in real time. The performance of the echo sounder was found to be satisfactory during the entire duration of the survey.

Sound velocity set on the echo sounder was 1499 meters per second. The echo sounder transducer was mounted on the side of the boat, in all cases. The DGPS Receiver Antenna was mounted exactly above the transducer without any offset to ensure accuracy in the position of soundings. The bar-checks were carried out before/after each sounding session. On all such occasions the error observed was zero or near zero. Therefore, no corrections were necessary.

The sounding 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 by normal lines, Cross lines were run on an opportunistic basis wherever feasible.

## 3.3 Sounding Datum (River Section)

As per thalweg survey conducted by IWAI, control point details in river krishna is tabulated below:

***Table 3.1: Sounding Datum (River Section)***

| S. No. | Bench mark | Chain age (Km) | Location | Lattitude | Longitude | BM height above MSL | Sounding Datum |
|---|---|---|---|---|---|---|---|
| 1. | VW-1 | 0 | Prakasam Barrage | $16^0$ 30' 43.04" N | $80^0$ 36' 23.18" E | 19.097 | 17.38 |
| 2. | VW-2 | 07-08 | Suraya Palern | $16^0$ 32' 26.83" N | $8o^0$ 32' 13.86" E | 18.636 | 18.02 |
| 3. | VW-3 | 20-21 | Harischand Puram | $16^0$ 34' 19.56" N | $80^0$ 26' 24.66" E | 24.013 | 19.76 |
| 4. | VW-4 | 30 | Amaravati | $16^0$ 34' 19.50" N | $80^0$ 21' 39.64" E | 26.661 | 19.843 |
| 5. | VW-5 | 40 | Malladi | $16^0$ 35' 15.40" N | $80^0$ 16' 13.78" E | 29.174 | 20.689 |
| 6. | VW-6 | 48-50 | Konuru | $16^0$ 36' 29.16" N | $80^0$ 11' 48.06" E | 26.264 | 21.423 |
|  | VW-6 | 58-59 | Near Chamarru | $16^0$ 39' 36.16" N | $80^0$ 07' 38.51" E | 26.708 | 22.224 |
| 7. | VW-7 | 68-69 | Tadvai | $16^0$ 44' 52.17" N | $80^0$ 08' 08.84" E | 36.586 | 23.049 |
| 8. | VW-8 | 78 | Madipadu suri | $16^0$ 49' 11.00" N | $80^0$ 06' 29.02" E | 41.581 | 23.84 |
| 9. | VW-9 | 88 | Pulichintala Dam | $16^0$ 46' 05.87" N | $80^0$ 03' 28.56" E | 54.186 | 36.407 |
| 10 | GTS | - | - | $16^0$ 30' 25.36" N | $80^0$ 37' 43.25" E | 19.097 |  |

- **Canal Section:**

Data collected from Irrigation Department Vijaywada, AP

***Table 3.2: Canal Section***

| | Bed Level (m) | Full Supply Level (m) | Full Supply Depth(m) |
|---|---|---|---|
| **Reach 1: 7.738 to 20.362** | | | |
| **Start** | 11.83 | 15.49 | 3.66 |
| **End** | 11.57 | 13.55 | 1.98 |
| **Reach 2: 20.362 to 39.555** | | | |
| **Start** | 9.27 | 12.07 | 2.8 |
| **End** | 8.05 | 10.65 | 2.6 |

| | Bed Level (m) | Full Supply Level (m) | Full Supply Depth(m) |
|---|---|---|---|
| **Reach 3: 39.555 to 59.585** | | | |
| **Start** | 5.7 | 8.14 | 2.44 |
| **End** | 4.09 | 6.53 | 2.44 |
| **Reach 3: 59.585to 69.628** | | | |
| **Start** | 2.28 | 4.9 | 2.71 |
| **End** | 1.83 | 4.54 | 2.71 |
| **Reach 3: 69.628 to 79.312** | | | |
| **Start** | 0.32 | 2.12 | 1.80 |
| **End** | 0.24 | 1.89 | 1.65 |

- **Details of Cross-structures in Krishna River**

***Table 3.3 - Electric Lines in Krishna River (Muktyala to Prakasam Barrage)***

| Sl No | Cross-Structure Name | Chainage (km) | Location | Position (Lat Long) | | Approx. Vertical clearance w.r.t HFL |
|---|---|---|---|---|---|---|
| | | | | Left Bank | Right Bank | |
| 1 | HT Line | 7.343 | Bhawani Island | 16°33'3.45"N 80°33'11.19"E | 16°32'13.84"N 80°32'18.34”E 23.6907"E | 30 |
| 2 | HT Line | 7.512 | Lingayapalem | 16°33'7.02"N 80°33'6.68"E | 16°32'17.9453"N 80°32' 20.3854"E | 30 |
| 3 | HT Line | 7.775 | Lingayapalem | 16°33'13.86"N 80°33'0.66"E | 16°32'23.7238"N 80°32' 14.1474"E | 30 |
| 4 | HT Line | 11.165 | Ibrahimpatnam | 16°34'26.36"N 80°31'35.63"E | 16°32'57.8214"N 80°30' 41.7681"E | 28 |
| 5 | HT Line | 11.306 | Ibrahimpatnam | 16°34'28.14"N 80°31'32.11"E | 16°33'1.406"N 80°30' 36.5619"E | 28 |
| 6 | HT Line | 11.466 | Ibrahimpatnam | 16°34'30.52"N 80°31'27.84"E | 16°33'21.6224"N 80°30' 42.3052"E | 28 |
| 7 | HT Line | 11.564 | Ibrahimpatnam | 16°34'33.52"N 80°31'25.67"E | 16°33'20.4067"N 80°30' 37.9586"E | 28 |
| 8 | HT Line | 21.060 | Vykuntapuram | 16°36'8.43"N 80°25'7.84"E | 16°34'26.07"N 80°25'40.09"E | 27 |
| 9 | HT Line | 45.837 | Kastala Agraharam | 16°37'17.48"N 80°13' 2.96"E | 16°35'38.61"N 80°13'26.40"E | 26 |
| 10 | HT Line | 55 | Pokkunuru | 16°38'24.87"N, 80° 9'24.89"E | 16°39'4.87"N, 80° 9'49.53"E | 30 |

*Table 3.4 – Bridges and Cross Structure in Krishna River (Muktyala to Prakasam Barrage)*

| Sl No | Structure Name | Chainage (km) | Location | Position (Lat Long) | Length (m) | Width (m) | No of Piers | Vertical Clearance | Horizontal clearance (Distance Between piers) (m) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Prakasam Barrage | 0.000 | Vijayawada | Left Bank 16°30'41.14"N 80°36'23.38"E<br><br>Right Bank 16°30'5.50"N 80°36'11.48"E | 1138.73 | - | - | - | - |
| 2 | Suryapalem Bridge | 1.84 | Krishna District | Left Bank 16°30'41.14"N 80°36'23.38"E<br><br>Right Bank 16°30'5.50"N 80°36' 11.48"E | 2611.00 | Under Construction | | | |

- **Details of Cross-structures in Bandar Canal**

*Table 3.5 - Electric Lines in Bandar Canal*

| Sl No | Cross-Structure Name | Chainage (km) | Position (Lat Long) | | Approx. Vertical clearance w.r.t HFL |
|---|---|---|---|---|---|
| | | | LAT | LONG | |
| 1 | ELECTRIC LINE | 2.85 | 16 28 53.3161 N | 80 40 18.6663 E | 4.7 |
| 2 | ELECTRIC LINE | 3.27 | 16 28 57.206 N | 80 41 3.0997 E | 5.2 |
| 3 | ELECTRIC LINE | 3.29 | 16 28 52.2927 N | 80 41 29.3417 E | 5.4 |
| 4 | ELECTRIC LINE | 3.63 | 16 28 16.292 N | 80 42 5.3341 E | 6.5 |
| 5 | ELECTRIC LINE | 3.93 | 16 28 15.9718 N | 80 42 5.5373 E | 6.2 |
| 6 | ELECTRIC LINE | 3.95 | 16 28 11.9832 N | 80 42 12.164 E | 6.5 |
| 7 | TV LINE | 4.00 | 16 28 12.1419 N | 80 42 44.2588 E | |
| 8 | TV LINE | 4.47 | 16 28 11.7381 N | 80 42 47.1613 E | 6.3 |
| 9 | ELECTRIC LINE | 4.76 | 16 28 6.1488 N | 80 43 18.3804 E | 4.3 |
| 10 | ELECTRIC LINE | 4.80 | 16 28 0.8 N | 80 43 29.7292 E | 5 |
| 11 | ELECTRIC LINE | 6.25 | 16 27 59.2238 N | 80 43 31.8896 E | 5.5 |
| 12 | TV LINE | 6.40 | 16 27 58.8667 N | 80 43 32.0591 E | 4.9 |
| 13 | ELECTRIC LINE | 7.75 | 16 27 49.9705 N | 80 43 51.1434 E | 5.2 |
| 14 | TV LINE | 9.09 | 16 27 48.6916 N | 80 43 51.9353 E | 6.7 |
| 15 | TV LINE | 9.89 | 16 27 36.1614 N | 80 44 5.5531 E | 6.8 |
| 16 | TV LINE | 11.62 | 16 27 35.9492 N | 80 44 5.8498 E | 4.2 |
| 17 | ELECTRIC LINE | 11.63 | 16 27 35.4845 N | 80 44 6.1155 E | 4.9 |
| 18 | ELECTRIC LINE | 11.87 | 16 27 35.3271 N | 80 44 6.1569 E | 5 |

| Sl No | Cross-Structure Name | Chainage (km) | Position (Lat Long) | | Approx. Vertical clearance w.r.t HFL |
|---|---|---|---|---|---|
| | | | LAT | LONG | |
| 19 | ELECTRIC LINE | 12.84 | 16 27 34.3952 N | 80 44 6.5747 E | 4.8 |
| 20 | ELECTRIC LINE | 12.92 | 16 27 32.837 N | 80 44 8.5986 E | 5.5 |
| 21 | HTL | 13.87 | 16 27 11.785 N | 80 44 26.243 E | 8.5 |
| 22 | ELECTRIC LINE | 14.25 | 16 27 1.0203 N | 80 44 35.0791 E | 5.2 |
| 23 | TV LINE | 14.33 | 16 26 54.1041 N | 80 44 41.0229 E | 5 |
| 24 | TV LINE | 14.34 | 16 26 42.5139 N | 80 44 51.4172 E | 5.1 |
| 25 | ELECTRIC LINE | 14.97 | 16 26 2.6049 N | 80 45 24.6853 E | 4 |
| 26 | ELECTRIC LINE | 15.00 | 16 25 59.6851 N | 80 45 28.406 E | 5.3 |
| 27 | TV LINE | 15.25 | 16 25 49.0584 N | 80 45 34.5259 E | 4.2 |
| 28 | TV LINE | 15.56 | 16 25 43.2192 N | 80 45 39.1578 E | 2.5 |
| 29 | TV LINE | 15.57 | 16 24 3.7089 N | 80 46 8.3943 E | 6.7 |
| 30 | ELECTRIC LINE | 15.58 | 16 23 50.5915 N | 80 46 12.6359 E | 5.1 |
| 31 | ELECTRIC LINE | 15.60 | 16 23 39.7129 N | 80 46 16.6735 E | 3.2 |
| 32 | TV LINE | 15.63 | 16 23 36.3971 N | 80 46 18.3243 E | 1 |
| 33 | ELECTRIC LINE | 15.70 | 16 23 15.6526 N | 80 46 25.2748 E | 4.2 |
| 34 | TV LINE | 16.54 | 16 22 15.1739 N | 80 47 9.5278 E | 3.5 |
| 35 | ELECTRIC LINE | 16.96 | 16 22 5.7745 N | 80 47 29.6432 E | 3.9 |
| 36 | ELECTRIC LINE | 17.24 | 16 20 54.5939 N | 80 48 45.6805 E | 4.6 |
| 37 | ELECTRIC LINE | 17.71 | 16 20 10.7586 N | 80 49 23.2153 E | 4.8 |
| 38 | ELECTRIC LINE | 17.81 | 16 19 43.198 N | 80 49 48.0108 E | 4.3 |
| 39 | ELECTRIC LINE | 19.29 | 16 19 36.9723 N | 80 49 52.9216 E | 6.5 |
| 40 | ELECTRIC LINE | 19.42 | 16 19 35.0965 N | 80 49 54.6673 E | 7.2 |
| 41 | TV LINE | 19.79 | 16 18 40.1877 N | 80 50 45.5355 E | 3.2 |
| 42 | TV LINE | 20.00 | 16 18 4.4695 N | 80 51 19.1291 E | 6.2 |
| 43 | TV LINE | 23.19 | 16 17 34.1413 N | 80 51 53.6064 E | 3.2 |
| 44 | ELECTRIC LINE | 23.62 | 16 17 26.2926 N | 80 52 8.227 E | 5.6 |
| 45 | TV LINE | 23.97 | 16 17 53.1712 N | 80 54 16.5219 E | 3.2 |
| 46 | ELECTRIC LINE | 24.09 | 16 17 53.2618 N | 80 54 16.7729 E | 4.8 |
| 47 | TV LINE | 24.76 | 16 18 0.5903 N | 80 54 31.0621 E | 3.8 |
| 48 | ELECTRIC LINE | 27.07 | 16 18 56.2569 N | 80 56 21.0431 E | 5.5 |
| 49 | ELECTRIC LINE | 27.73 | 16 19 6.2649 N | 80 57 0.5586 E | 5.3 |
| 50 | ELECTRIC LINE | 30.91 | 16 19 6.2713 N | 80 57 1.2016 E | 6.2 |
| 51 | ELECTRIC LINE | 32.66 | 16 19 6.3959 N | 80 57 2.5358 E | 4.7 |
| 52 | ELECTRIC LINE | 33.78 | 16 19 5.3594 N | 80 57 20.4561 E | 5.8 |
| 53 | ELECTRIC LINE | 34.03 | 16 19 4.8123 N | 80 57 23.184 E | 4.7 |
| 54 | ELECTRIC LINE | 34.10 | 16 19 4.2402 N | 80 57 28.2468 E | 6.5 |
| 55 | TV LINE | 36.37 | 16 19 4.0639 N | 80 57 28.6344 E | 3.6 |
| 56 | ELECTRIC LINE | 37.87 | 16 19 3.4247 N | 80 57 30.3806 E | 3.5 |
| 57 | ELECTRIC LINE | 39.24 | 16 19 1.4591 N | 80 57 37.7015 E | 3.4 |

| Sl No | Cross-Structure Name | Chainage (km) | Position (Lat Long) | | Approx. Vertical clearance w.r.t HFL |
|---|---|---|---|---|---|
| | | | LAT | LONG | |
| 58 | ELECTRIC LINE | 39.73 | 16 18 57.1226 N | 80 57 50.4707 E | 3.8 |
| 59 | ELECTRIC LINE | 43.72 | 16 18 55.9436 N | 80 57 53.1609 E | 3.4 |
| 60 | TV LINE | 43.73 | 16 18 52.2702 N | 80 58 2.2999 E | 3.2 |
| 61 | ELECTRIC LINE | 44.26 | 16 18 44.3261 N | 80 58 23.4323 E | 5.2 |
| 62 | ELECTRIC LINE | 47.89 | 16 17 37.7646 N | 80 59 51.478 E | 4.1 |
| 63 | ELECTRIC LINE | 49.12 | 16 16 15.596 N | 81 00 20.4656 E | 3.5 |
| 64 | ELECTRIC LINE | 49.13 | 16 30 11.2107 N | 80 37 57.978 E | 5.5 |
| 65 | ELECTRIC LINE | 49.17 | 16 30 3.979 N | 80 38 9.7895 E | 2.8 |
| 66 | ELECTRIC LINE | 49.70 | 16 30 3.9439 N | 80 38 10.5694 E | 4.8 |
| 67 | ELECTRIC LINE | 49.78 | 16 29 58.0923 N | 80 38 20.3593 E | 4.9 |
| 68 | ELECTRIC LINE | 49.93 | 16 29 52.8689 N | 80 38 28.7203 E | 5.2 |
| 69 | ELECTRIC LINE | 49.95 | 16 29 52.5719 N | 80 38 29.183 E | 5 |
| 70 | ELECTRIC LINE | 50.01 | 16 29 51.5817 N | 80 38 30.7749 E | 5 |
| 71 | RAILWAY ELECTRIC LINE | 50.23 | 16 29 43.1894 N | 80 38 44.1479 E | 5.3 |
| 72 | TV LINE | 50.63 | 16 29 38.3952 N | 80 38 52.6512 E | 1.6 |
| 73 | ELECTRIC LINE | 50.72 | 16 29 37.7044 N | 80 38 53.5143 E | 4.7 |
| 74 | ELECTRIC LINE | 51.01 | 16 29 18.7086 N | 80 39 38.098 E | 4.6 |
| 75 | ELECTRIC LINE | 51.68 | 16 29 18.1085 N | 80 39 42.7242 E | 5.5 |
| 76 | ELECTRIC LINE | 55.12 | 16 11 46.1723 N | 81 04 32.8129 E | 3.8 |
| 77 | ELECTRIC LINE | 57.80 | 16 11 40.2378 N | 81 04 41.522 E | 4.5 |
| 78 | ELECTRIC LINE | 59.67 | 16 11 32.693 N | 81 04 51.9238 E | 4.2 |
| 79 | ELECTRIC LINE | 63.29 | 16 11 26.7883 N | 81 05 0.549 E | 3.6 |
| 80 | TV LINE | 63.61 | 16 11 17.0128 N | 81 05 14.1146 E | 4.8 |
| 81 | TV LINE | 69.16 | 16 10 16.3514 N | 81 06 28.1021 E | 2.1 |
| 82 | ELECTRIC LINE | 69.47 | 16 10 15.8375 N | 81 06 28.7346 E | 2.3 |
| 83 | ELECTRIC LINE | 73.12 | 16 10 15.4424 N | 81 06 29.3264 E | 3.5 |

***Table 3.6 – Bridges and Cross Structure in Bandar Canal***

| Sl No | Structure Name | Chainage (km) | Location | Position (Lat Long) | Length (m) | Width (m) | No of Piers | Horizontal clearance (Distance Between piers) (m) | Vertical Clearance (m) |
|---|---|---|---|---|---|---|---|---|---|
| **Stretch 1: Prakasam Barrage to Bandar Lock** | | | | | | | | | |
| 1. | Prakarsam Barrage | 0.00 | Vijayawada | 16°30'41.14"N 80°36'23.38"E | 1138.73 | - | - | - | - |
| 2 | Prakasam Old Lock | 0.00 | Vijayawada | 16°30'42.06"N 80°36'24.33"E | 40.2 | - | - | - | - |
| 3 | Prakasam New Lock | 0.00 | Vijayawada | 16 30 42.7905 N 80 36 28.9753 E | 40.2 | 7 | 5 | - | - |
| 4 | Kanaka Durga Flyover | 0.07 | Vijayawada | 16 30 42.7955 | 120 | 25 | 3 | 20 | 10 |

| Sl No | Structure Name | Chainage (km) | Location | Position (Lat Long) | Length (m) | Width (m) | No of Piers | Horizontal clearance (Distance Between piers) (m) | Vertical Clearance (m) |
|---|---|---|---|---|---|---|---|---|---|
| **Stretch 1: Prakasam Barrage to Bandar Lock** | | | | | | | | | |
| | Bridge | | | N 80 36 31.6461 E | | | | | |
| 5 | Bridge Near Vijyawada Municipal Corporation | 0.31 | Vijayawada | 16 30 42.1543 N 80 36 39.9476 E | 63 | 18 | 3 | 7 | 2 |
| 6 | Pipe Line Piers | 0.36 | Vijayawada | 16°30'42.05"N 80°36'40.42"E | 65 | - | 5 | 15 | 2 |
| 7 | Krishna Veri School Road New | 0.63 | Vijayawada | 16 30 40.2426 N 80 36 50.4623 E | 57 | 5 | 3 | 14 | 3 |
| 8 | Train Line -1 | 0.71 | Vijayawada | 16 30 39.8587 N 80 36 53.1418 E | 70 | 10 | 3 | 8 | 3 |
| | Train Line -2 | 0.72 | Vijayawada | 16 30 39.7669 N 80 36 53.2925 E | 70 | 10 | 3 | 8 | 3 |
| | Train Line -3 | 0.73 | Vijayawada | 16 30 39.7246 N 80 36 53.5034 E | 70 | 10 | 3 | 8 | 3 |
| 9 | Bus Stand Road | 1.02 | Vijayawada | 16 30 37.722 N 80 37 3.2831 E | 53 | 20 | 2 | 15 | 8 |
| 10. | Bridge Near Bandar Lock -1 | 1.37 | Vijayawada | 16 30 35.5428 N 80 37 14.857 E | 40 | 8 | 2 | 10 | 8 |
| 11. | Lock Gate Old | 1.46 | Vijayawada | 16 30 34.8792 N 80 37 17.9062 E | 45 | 6 | - | - | - |
| 12. | Bandar Lock | 1.50 | Vijayawada | 16 30 34.4505 N 80 37 19.284 E | 35 | 5.7 | 6 | 4 | 6 |
| **Stretch 2: Bandar Lock to Enamalakudru Lock** | | | | | | | | | |
| **Sl No** | **Structure Name** | **Chainage (km)** | **Location** | **Position (Lat Long)** | **Length (m)** | **Width (m)** | **No of Piers** | **Horizontal clearance (Distance Between piers) (m)** | **Vertical Clearance (m)** |
| 13. | Hanging Bridge | 1.99 | Krishnalanka | 16 30 26.6499 N 80 37 33.0533 E | 30 | 3 | - | 30 | 8 |
| 14 | Bridge Near VMR Rao Statue-1 | 2.09 | Krishnalanka | 16°30'24.74"N 80°37'36.12"E | 50.3 | 6.3 | 2 | 8 | 4 |
| 15. | Bridge Near VMR Rao Statue-2 | 2.1 | Krishnalanka | 16 30 24.5998 N 80 37 36.3982 E | 50.3 | 6.3 | 2 | 8 | 4 |
| 16. | Bridge Near American Hospital | 2.7 | Krishnalanka | 16 30 14.1507 N 80 37 53.4006 E | 44.8 | 4.7 | 3 | 10 | 6 |
| 17. | Bridge Near Veterinary Hospital | 3.47 | Balaji Nagar | 16 30 0.816 N 80 38 15.6962 E | 48.7 | 9.3 | 2 | 5 | 6 |
| 18. | NH-65 Twin Bridge/Benz Circle | 4.81 | Ramalingeswara | 16 29 37.5491 N 80 38 53.8542 E | 55 | 9.67 | 0 | 50 | 6 |
| 19. | Krishnaveri School Road With Pipe Line | 5.56 | Ramalingeswara | 16 29 25.2831 N 80 39 15.8794 E | 46 | 4.6 | 2 | 15 | 6 |
| 20. | Krishnaveri School | 5.58 | Ramalingeswara | 16 29 25.117 N | 45.6 | 7.8 | 2 | 15 | 8 |

| Sl No | Structure Name | Chainage (km) | Location | Position (Lat Long) | Length (m) | Width (m) | No of Piers | Horizontal clearance (Distance Between piers) (m) | Vertical Clearance (m) |
|---|---|---|---|---|---|---|---|---|---|
| **Stretch 1: Prakasam Barrage to Bandar Lock** | | | | | | | | | |
| | Road New | | | 80 39 16.3992 E | | | | | |
| 21. | Walking Bridge Near Kanaka Durga Amaveri Mandir Vijyawada | 6.39 | Ramalingeswara (Sai Nagar) | 16 29 17.808 N 80 39 42.4956 E | 40 | 1.5 | 2 | 13 | 6 |
| 22. | Yanamala Kuduru New Bridge | 6.65 | Jd Nagar | 16 29 14.4448 N 80 39 50.6392 E | 41 | 7.6 | 4 | 8 | 9 |
| 23. | Under Construction Bridge | 7.25 | Lakulu | 16 28 59.8198 N 80 40 3.5129 E | 0 | 0 | 0 | 0 | 0 |
| 24. | Lock Gate Old | 7.35 | Lakulu | 16 28 57.5259 N 80 40 6.2755 E | 47.2 | 4 | 5 | 3.7 | - |
| 25 | Lock Gate New (Under Construction) | 7.45 | Lakulu | 16°28'56.35"N 80°40'7.73"E | - | - | - | - | - |
| **Stretch 3 Enamalakudru Lock to Kankipadu Lock** | | | | | | | | | |
| 26. | Pappula Mill Road Bridge | 8.61 | Ashok Nagar | 16 28 57.6204 N 80 40 46.8695 E | 45.6 | 7.5 | 3 | 10 | 8 |
| 27. | Kamayyathpu Bridge Walking Bridge | 9.22 | Kamayyathopu | 16 28 56.9127 N 80 41 7.3578 E | 66.8 | 1.7 | 2 | 20 | 8 |
| 28. | Bridge In Front Of Vrsec Entrance | 9.85 | Kanuru | 16 28 52.9696 N 80 41 28.4441 E | 31.4 | 5.6 | 2 | 10 | 8 |
| 29. | Tadigadapa Road Bridge | 10.74 | Tadigadapa | 16 28 42.3998 N 80 41 55.9547 E | 41.48 | 7.5 | 1 | 12 | 6 |
| 30. | Tadigadapa Road Bridge Old | 10.76 | Tadigadapa | 16 28 41.8447 N 80 41 56.5026 E | 30.5 | 3 | 1 | 11 | 7 |
| 31. | Penamaluru Bridge Old | 13.65 | Penamaluru | 16 28 9.0248 N 80 43 11.5897 E | 29 | 4 | 2 | 10 | 6 |
| 32. | Penamaluru Bridge New | 13.69 | Penamaluru | 16 28 8.7498 N 80 43 12.0899 E | 32.4 | 7.5 | 2 | 10 | 8 |
| 33. | Power Station Bridge Road | 15.57 | Ganguru | 16 27 36.088 N 80 44 5.6665 E | 39.4 | 5.25 | 3 | 10 | 8 |
| 34 | Bridge near Nalanda vidya niketan | 16.43 | Edupugullu | 16°27'14.62"N, 80°44'23.91"E | 45 | 6.0 | 3 | 11 | 8 |
| 35. | Uppuluru Edupugallu Madduru Road Bridge Old | 17.48 | Gosala | 16 26 48.1159 N 80 44 46.2692 E | 35 | 5 | 3 | 10 | 8 |
| 36. | Uppuluru Edupugallu Madduru Road Bridge New | 17.49 | Gosala | 16 26 47.6796 N 80 44 46.5844 E | 35 | 5 | 3 | 10 | 8 |
| 37. | Royyuru Road Bride | 19.92 | Kankipadu | 16 25 45.2942 N 80 45 37.1749 E | 40 | 6.3 | 3 | 10 | 9 |
| 38. | Kankipadu Bridge | 20.335 | Kankipadu | 16°25'33.44"N, 80°45'42.54"E | 15 | 5 | - | - | - |
| **Stretch 4 Kankipadu Lock to Veeranki Lock** | | | | | | | | | |
| 39. | Boddapadu Bridge | 23.60 | Boddapadu | 16 23 50.6402 N 80 46 12.8118 E | 22.8 | 4.3 | 1 | 11 | 9 |
| 40. | Bridge On Sh-280 | 29.98 | South Valluru | 16 21 16.9261 N | 62.2 | 7.7 | 1 | 10 | 8 |

| Sl No | Structure Name | Chainage (km) | Location | Position (Lat Long) | Length (m) | Width (m) | No of Piers | Horizontal clearance (Distance Between piers) (m) | Vertical Clearance (m) |
|---|---|---|---|---|---|---|---|---|---|
| **Stretch 1: Prakasam Barrage to Bandar Lock** | | | | | | | | | |
| | | | | 80 48 25.793E | | | | | |
| 41. | OLD BRIDGE ON SH-280 | 30.02 | South Valluru | 16 21 16.1184 N 80 48 26.5522 E | 16 | 5 | 0 | 0 | 5 |
| 42. | KANAKAVALLI-PENAMAKURU ROAD RIDGE | 32.83 | Mantada | 16 20 6.0303 N 80 49 27.5569 E | 40 | 3 | 3 | 10 | 7 |
| 43. | VUYYURU-ILLURU ROAD BRIDGE | 34.86 | Vuyyuru | 16 19 35 N 80 49 54.9562 E | 20 | 5 | 2 | 8 | 10 |
| 44. | AMEENAPURAM BRIDGE | 36.75 | Ameenapuram | 16 18 30.3193 N 80 50 54.6799 E | 20.9 | 4.5 | 2 | 7 | 7 |
| 45. | VEERANKI ROAD BRIDGE (NOT CONNECTED) | 37.82 | Veeranki | 16 18 4.6942 N 80 51 18.8846 E | 30 | 5 | 2 | 10 | 8 |
| 46 | Veeranki Old Bridge | 39.447 | Veeranki | 16°17'30.06"N 80°51'59.48"E | | | | | |
| 47. | VEERANKILAKU BRIDGE | 39.47 | Veerankilaku | 16 17 29.8922 N 80 52 0.2378 E | 20.20 | 4.70 | 3.00 | 5.00 | 10.00 |
| **Stretch 5: Veeranki Lock to Nidumolu Lock** | | | | | | | | | |
| 48. | KANUMURU-KUCHIPUDI ROAD BRIDGE | 43.73 | Inampudi | 16 17 53.5429 N 80 54 16.7006 E | 30.00 | 6.00 | 2.00 | 10.00 | 6.00 |
| 49. | URUTURU ROAD BRIDGE | 47.43 | Uruturu | 16 18 49.3328 N 80 56 7.1293 E | 12.00 | 4.00 | 1.00 | 6.00 | 6.00 |
| 50 | SH-328 & CHALLAPALLI ROAD BRIDGE NEW | 50.09 | Pamarru | 16 19 3.012 N 80 57 33.3359 E | 13.00 | 10.00 | 0.00 | 0.00 | 6.00 |
| 51. | SH-328 OLD BRIDGE USE FOR PIPE LINE | 50.11 | Pamarru | 16 19 2.7827 N 80 57 34 E | 15.00 | 4.00 | 0.00 | 0.00 | 5.00 |
| 52. | JUJJAVARAM-RAPARLA ROAD BRIDGE | 54.45 | Kavatavaram | 16 17 57.0402 N 80 59 40.4494 E | 25.00 | 5.00 | 1.00 | 5.00 | 7.00 |
| 53. | BRIDGE TO NIBHANUPUDI VILLAGE | 56.32 | Nemmikuru | 16 17 0.516 N 81 00 1.0991 E | 30.00 | 3.00 | 1.00 | 15.00 | 7.00 |
| 54. | SH-152 BRIDGE NEW | 57.60 | Nidumolu Laku | 16 16 21.6725 N 81 00 18.0375 E | 15.00 | 5.00 | 1.00 | 8.00 | 6.00 |
| 55. | SH-152 BRIDGE OLD | 57.63 | Nidumolu Laku | 16 16 20.4826 N 81 00 18.5129 E | 13.00 | 4.00 | 1.00 | 6.00 | 6.00 |
| 56 | Nidumolu Road Bridge | 59.54 | Nidumolu | 16°15'23.75"N 81° 0'44.20"E | 23.8 | 4.1 | 2 | 8 | 5 |
| 57. | NIDUMOLUKUCHIPUDI RAOD,SH-253 | 59.56 | NIDUMALU | 16 15 23.2407 N 81 00 44.442 E | 90 | 7 | 4 | 12 | 6 |
| **Stretch 6: Nidumolu Lock to Akumaru Lock** | | | | | | | | | |
| 58. | TARAKATURU VILLAGE ROAD BRIDGE | 63.3 | Tarakaturu | 16 13 53.0353 N 81 02 6.8144 E | 23.8 | 4.1 | 2 | 8 | 6.00 |
| 59. | UNDER CONSTRICTION BRIDGE AT KAZA-MACHILIPATNAM | 67.91 | Rayavaram | 16 12 9.7966 N 81 03 58.7728 E | - | - | 2 | 10 | - |

| Sl No | Structure Name | Chainage (km) | Location | Position (Lat Long) | Length (m) | Width (m) | No of Piers | Horizontal clearance (Distance Between piers) (m) | Vertical Clearance (m) |
|---|---|---|---|---|---|---|---|---|---|
| **Stretch 1: Prakasam Barrage to Bandar Lock** | | | | | | | | | |
| | ROAD,SH-50 | | | | | | | | |
| 60. | KAZA-MACHILIPATNAM ROAD,SH-134 | 69.35 | AKUMARRU | 16 11 42.5927 N 81 04 38.0781 E | 11.00 | 6.00 | 1 | - | 6.00 |
| **Stretch 7: Akumaru Lock to Bandar Tidal Lock** | | | | | | | | | |
| 61. | KOTHHURU BRIDGE | 70.75 | KOTHHURU | 16 11 15.4993 N 81 05 16.0737 E | 17.80 | 5.00 | 2.00 | 5.00 | 6.00 |
| 62. | SN GOLLAPALEM-BV THOTA ROAD BRIDGE,SH-102 | 72.09 | GOLLAPALEM | 16 10 47.1102 N 81 05 50.2276 E | 20.00 | 5.00 | 1.00 | 6.00 | 8.00 |
| 63. | UNDER CONSTRUCTION BRIDGE AT MACHLIPATNAM BYPASS ROAD SH-188 | 73.42 | KRISHANA | 16 10 19.3268 N 81 06 24.5178 E | 12.00 | 10.00 | 0.00 | 0.00 | 10.00 |
| 64. | MACHLIPATNAM BYPASS ROAD,SH-188 | 73.79 | JALAL PET | 16 08 56.4971 N 81 08 46.8242 E | 20.00 | 10.00 | 1.00 | 5.00 | 10.00 |
| 65. | BANDAR ROAD | 74.51 | JALAL PET | 16 10 17.1668 N 81 06 27.0117 E | 20.00 | 8.00 | 0.00 | 0.00 | 9.00 |
| 66. | Road Bridge | 78.485 | JALAL PET | 16° 8'56.41"N, 81° 8'46.57"E | 20 | 5.0 | - | 10.00 | 10.00 |
| 67. | NEAR KARA AGRAHARAM | 79.49 | Kojjilipeta | 16 09 56.3998 N | 10.00 | 5.00 | 0.00 | 10.00 | 10.00 |

- **Details of Lock in Bandar Canal**

***Table 3.7-Details of Lock in Bandar Canal***

| Sl No | Structure Name | Chainage (km) | Location | Position (Lat Long) | Length (m) | Width (m) |
|---|---|---|---|---|---|---|
| 1 | Bandar Lock | 1.5 | Bandar Lock | 16°30'35"N, 80°37'19"E | 55 | 6 |
| 2 | Enamalakudru | 7.738 | Enamalakudru | 16°28'57.08"N, 80°40'8.20"E | 55 | 6 |
| 3 | Kankipadu | 20.362 | Kankipadu | 16°25'35.38"N, 80°45'41.47"E | 25 | 6 |
| 4 | Veeranki | 39.555 | Veeranki | 16°17'31.10"N, 80°51'57.87"E | 25 | 6 |
| 5 | Nidumolu | 59.585 | Nidumolu | 16°15'25.08"N, 81° 0'43.73"E | 25 | 6 |
| 6 | Akumaru | 69.268 | Akumaru | 16°11'43.62"N, 81° 4'36.67"E | 25 | 6 |
| 7 | Bandaru Tidal Lock | 79.312 | Machhlipatnam | 16° 8'57.52"N, 81° 9'12.42"E | 25 | 6 |

## 3.4 DESCRIPTION OF WATERWAY

### 3.4.1 FOR RIVER SECTION

- **Stretch 1 :Vijayawada to Harichandrapuram (Ch. 0.0 km– 17.275km)**

This stretch falls in Prakasam Barrage Pondage Area. One of its widest is at Harichandarapuram (4.15 km approx.). It narrows down upto 1.4 km near Prakasam Barrage at Vijayawada. Islands seen from Vijayawada to Guntapalli with forests. High sand dunes, number of channels and creeks are present in this river stretch. Water flow is very slow due to pondage area of barrage. NTPC power plant is situated on left bank at Ibrahimpatnam. Depth of this area is considered suitable for navigation.

Small fishing boats and sand carrying boats were noticed steaming on this stretch of the river. Sand mining activity is predominant in this stretch of the river.

State government has closed the navigation lock at Prakasam barrage. To resume the navigation, it has to be excavated and re-designed.

Both bank of the river is proliferated with numerous Ghats and tourist jetties all along the City of Vijayawada on left bank. Both banks of river are mainly unprotected with some area of manmade structures present close to Prakasam Barrage.




***Fig. 3.1 Stretch 1 :Vijayawada to Harichandrapuram (Ch. 0.0 km– 17.275km)***

Roads run along the bank of river on either side of the river in this stretch. There are no locks, except for the Prakasam barrage at start point. In this stretch, total 7 Nos. of High Tension lines crosses the river. Average depths from chainage 0-10km are around 6.0 m and from ch.10-17.27 km is around 5m**.**

**Stretch 2: Harichandrapuram to Chintapalli (Ch. 17.275 km– 59.680 km)**

This stretch is of about 42.405 km from Harichandrapuram to Chintapalli. The river in this stretch is braided in nature. It comprises of number of shallow channels due to formation of central islands. The main River flow gets narrowed and depth is very shallow. The navigable portion of the river flows close to the right bank upto Chintapalli. The navigable stretch is widest near Amravati (about 600 m) and narrowest off Konuru (200 m). Few dry/ very shallow channels were also noticed along the main navigable channel in the form of arteries. The tributary Munneru river joins Krishna river at chainage 34.5 km from left bank and forms a shallow channel.

The riverbed in this part is mainly sandy and can be dredged with ease. Sand mining activity was witnessed in this part of the river stretch also. Boulders exposed in river near Amravati at places sheet of rocks available through out the bed. Right bank of this patch of river is well connected with Road via Amaravati, Didugu and Achampet, but connectivity on left bank of this patch is very far from NH-9. Average depth upto ch. 23 km is 5.0m. After ch.23 km ,LAD in this stretch is less than 1m. Rocky outcrops are present at vedadri & Usthe Palli & at ch.53 near Kogantivaripalem. This should be dredged with cutter section.




***Fig. 3.2 Stretch 2: Harichandrapuram to Chintapalli (Ch. 17.275 km– 59.680 km)***

- **Stretch 3:Chintapalli to Muktyala (Ch. 59.680km– 82km)**

The river stretch from Chintapalli to Muktyala is about 22 km long. The average width of the navigable portion is about 300 m.

The riverbed in this stretch is sandy with rock outcrops and boulders from Chintapalli to Putlagudem. Special care is to be taken during dredging from Chintapalli to Putlagudem. The river width gradually decreases near Putlagudem. In some areas, banks are very steep. Vehicle crosses the river by boats at 2 locations, 1st is Putlagudem to Ramanpeta and 2nd is Madepadu to Muktyala. In these 2 locations,

river bed is very deep (Approx. 20 mtr.). No cross-structures are noticed in this stretch of river. Around 6 cement factories were observed from Muktyala Village to Pulichintla Dam on left bank of the river. LAD in from Ch. 59 to Ch. 63 is less than 1m. From 63km- 82km, LAD of 1-2m is available.

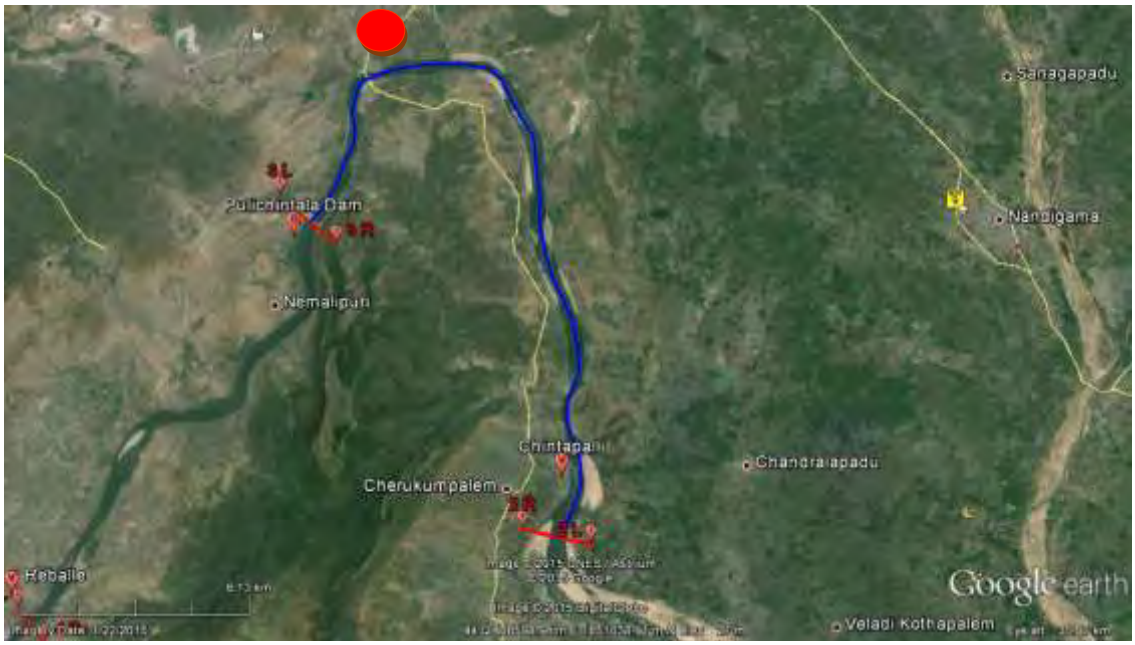



***Fig: 3.3 Stretch 3:Chintapalli to Muktyala (Ch. 59.680km– 82km)***

## 3.5 FOR CANAL SECTION

### 3.5.1 DESCRIPTION OF WATERWAY FOR BANDAR CANAL

The Bathymetric survey of Bandar canal July 2022 was commenced on 22 July 2022 and completed on 30 July 2022. The weather during the entire period of survey was Very hot, and Rainy. While the Canal conditions were conducive for surveying. The area intended to be surveyed has been completely sounded as per the required specifications, expert the area 100m Upstream of every lock and the areas blocked by dense hyacinth and non-navigable that would require further sounding. Non-navigable areas are marked in the drawing which is negligible on a scale of 1:10000 The bathymetric survey was carried out using a inflatable motor boat. There were trees and brushes between lock to lock which interrupted the survey.

- **Stretch 1: Prakasam Barrage to Bandar Lock (Ch. 0.0km– 1.5 km)**

The canal stretch from Prakasam Barrage to Bandar Lock is about 1.5 km long. The average top width of the canal is about 60 m. Roads run along the bank of canal on either side of the canal in this stretch. There is one Bandar lock at ch. 1.5km. Also, it may please be noted that there is one proposed lock on left bank of Prakasam Barrage . Both banks of river are mainly unprotected except at some area of manmade structures present close to Prakasam Barrage. There are total 7 Bridges including 1 railway bridge & No HT lines in the stretch. Average water depth in the stretch is 3.66m.




*Fig: 3.4 Stretch 1: Prakasam Barrage to Bandar Lock (Ch. 0.0km– 1.5 km)*

- **Stretch 2: Bandar Lock to Enamalakudru Lock (Ch. 1.5 km– 7.738 km)**

The canal stretch from **Bandar Lock to Enamalakudru Lock** is about 6.2 km long. The average top width of the canal is about 60 m. Roads run along the bank of canal on either side of the canal in this stretch. There are 2 locks i.e Bandar Lock & Enamalakudru lock, at ch.1.5 & at ch.7.738 along the canal. Both banks of river are mainly unprotected .There are total 11 Bridges including 1 under construction bridge & 13 HT/EL/TV lines in the stretch. Average water depth in the stretch is 3.00m.




*Fig: 3.5 Stretch 2: Bandar Lock to Enamalakudru Lock*

- **Stretch 3: Enamalakudru Lock to Kankipadu Lock(Ch. 7.738 km– 20.362 km)**

The canal stretch from **Enamalakudru Lock to Kankipadu Lock** is about 13 km long. The average top width of the canal is about 60 m. Roads run along the bank of canal on either side of the canal in this stretch. There is a lock at **Kankipadu** (Ch.20.362)

along the canal. Both banks of river are mainly unprotected. There are total 12 Bridges & 29 HT/EL/TV lines in the stretch. Average water depth in the stretch is 2.50m.

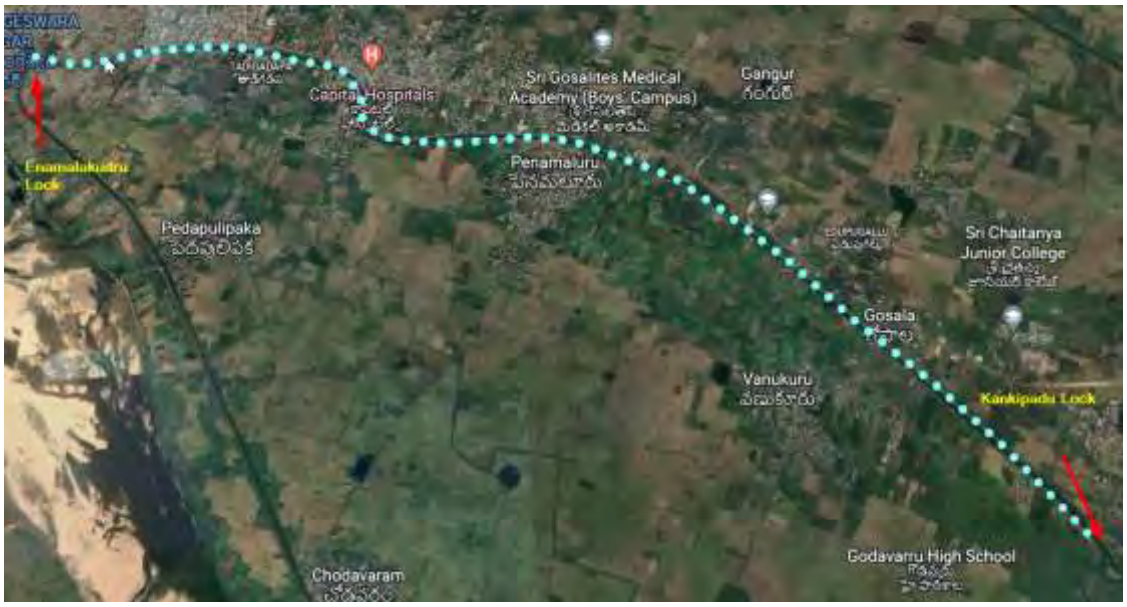



***Fig: 3.6 Enamalakudru Lock to Kankipadu Lock(Ch. 7.738 km– 20.362 km)***

- **Stretch 4: Kankipadu Lock to Veeranki(Ch. 20.362 km- Ch.39.555 Km)**

The canal stretch from **Kankipadu Lock to Veeranki Lock** is about 20 km long. The average top width of the canal is about 48.5 m. There is a lock at **Veeranki lock** (Ch.39.555) along the canal. Both banks of river are mainly unprotected. There are total 7 Bridges & 16 HT/EL/TV lines in the stretch. Average water depth in the stretch is 2.7m.

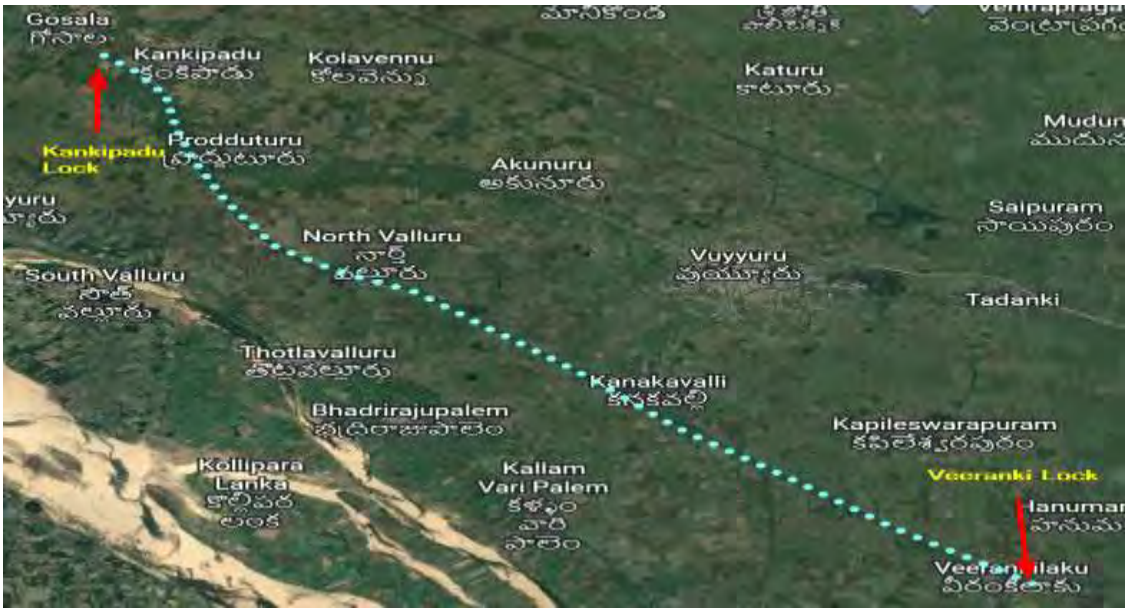



***Fig: 3.7 Stretch 4: Kankipadu Lock to Veeranki(Ch. 20.362 km- Ch.39.555 Km)***

- **Stretch 5: Veeranki Lock to Nidumolu Lock(Ch.39.555 Km- Ch. 59.585)**

  The canal stretch from **Veeranki Lock to Nidumolu Lock** is about 20 km long. The average top width of the canal is about 36.8 m. There is a lock at **Nidumolu lock** (Ch.59.585) along the canal. Both banks of river are mainly unprotected. There are total 9 Bridges & 20 HT/EL/TV lines in the stretch. Average water depth in the stretch is 2.4m.

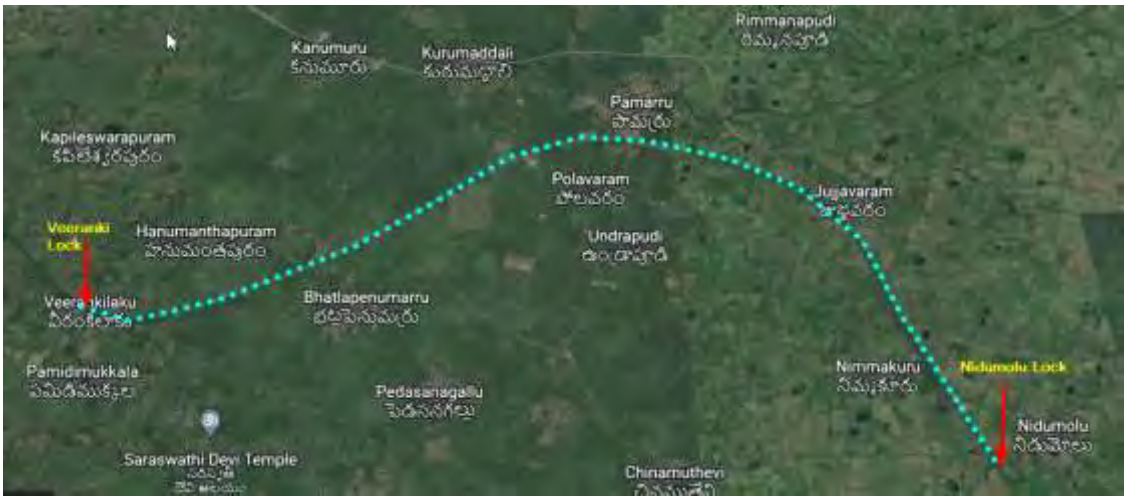



*Fig: 3.8 Stretch 5: Veeranki Lock to Nidumolu Lock(Ch.39.555 Km- Ch. 59.585)*

- **Stretch 6: Nidumolu Lock to Akumaru lock (Ch. 59.585 -Ch.69.268 Km)**

  The canal stretch from Nidumolu Lock to Akumaru lock is about 10 km long. The average top width of the canal is about 31.88 m. There is a lock at Akumaru lock (Ch.69.268) along the canal. Both banks of river are mainly unprotected. There are total 3 Bridges including 1 under construction bridge & 4 HT/EL/TV lines in the stretch. Average water depth in the stretch is 2.7m.

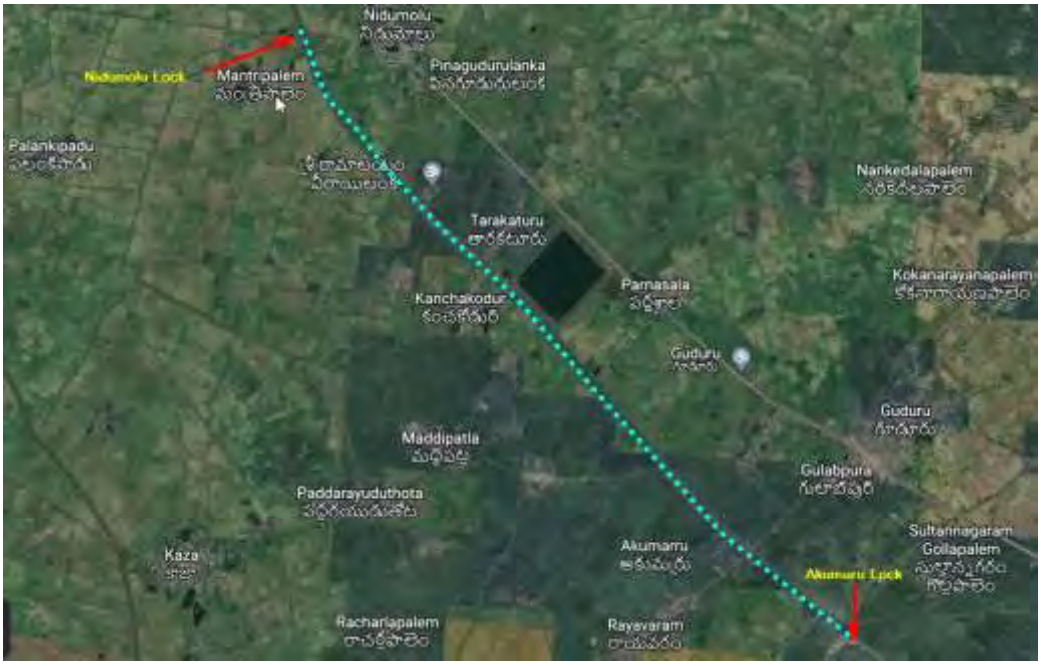



*Fig: 3.9 Stretch 6: Nidumolu Lock to Akumaru lock (Ch. 59.585 -Ch.69.268 Km)*

- **Stretch 7: Akumaru lock to Bandar Tidal Lock (Ch.69.268 Km -Ch. 79.312)**

  The canal stretch from **Akumaru lock to Bandar Tidal Lock** is about 10 km long. The average top width of the canal is about 23.3 m. There is a lock at Machilipatnam called **Bandar Tidal lock** (ch.79.312) along the canal. Both banks of river are mainly unprotected. There are total 9 Bridges & 1 Electric lines in the stretch. Average water depth in the stretch is 1.5m.

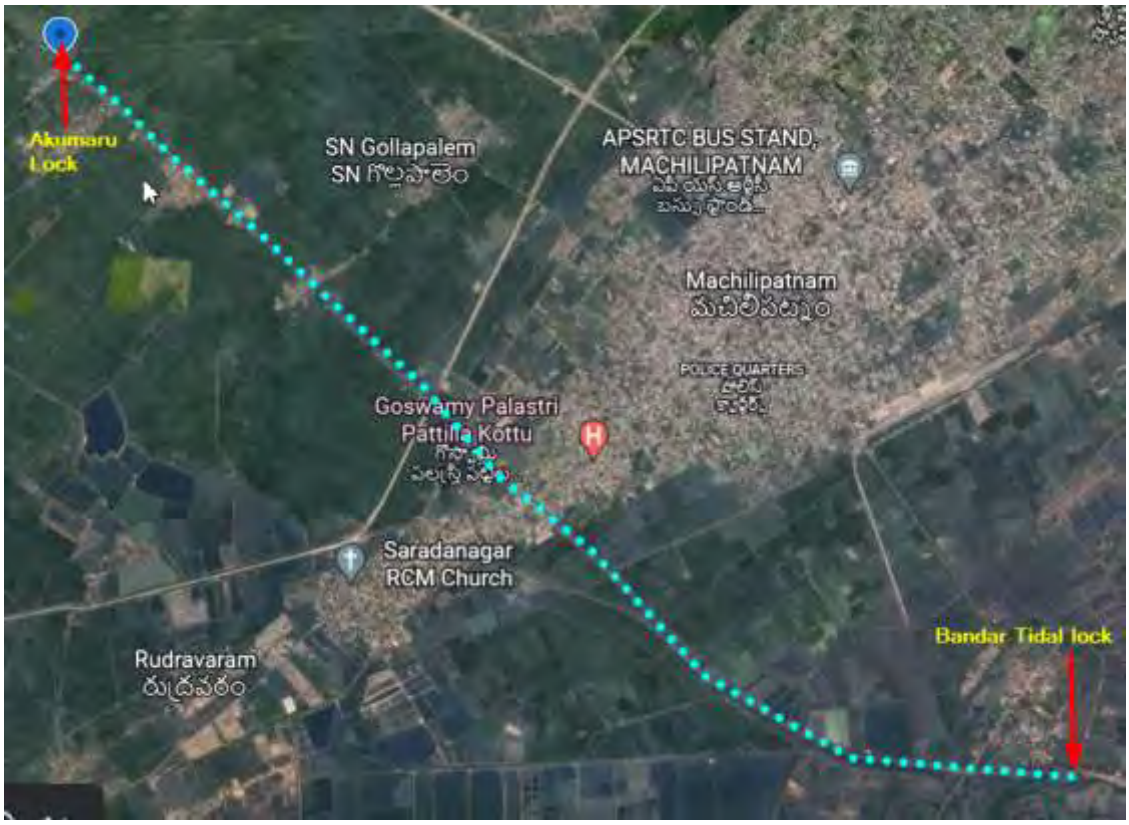



*Fig: 3.10 Stretch 7: Akumaru lock to Bandar Tidal Lock (Ch.69.268 Km -Ch. 79.312)*

- **Stretch 8: Bandar Tidal Lock to Sea (Ch. 79.312- Ch. 86.35)**

  The area is tidal affected zone. This is densely populated area, This area is known as Machilipatnam fishing port. At Ch 85 km dredging activity is in progress. At Ch 81 km, some creeks and Nallah are there. Bander port office is at Ch 84.2 km.



*Fig: 3.11 Stretch 8: Bandar Tidal Lock to Sea (Ch. 79.312- Ch. 86.35)*

# CHAPTER -4
# MARKET ASSESSMENT

## 4.0 OUR UNDERSTANDING

The Installed Capacity of Cement in India was witnessed to be ~556.9 MTPA with a production of 334.4 MTPA in FY-2020, which declined to ~545 MTPA capacity and 232.5 MTPA production in FY-2021, owing to the COVID-19 pandemic. The majority of the cement plants in India are located in South India with a total installed capacity of cement plants ~159.13 MTPA as of FY-2020 and a production volume of 132.7 MTPA, accounting for ~40% of the national cement production. A good number of cement plants are located in Andhra Pradesh and Telangana, accounting for ~45% of the total installed cement capacity of southern India.

The southeast part of Telangana, especially the Nalgonda district, along the Krishna belt is rich in high-grade limestone, which is the main raw material for the cement industry and houses many large-scale cement industries as well as clinker grinding units. Major cement players in the region include NCL industries, Sri Veeranjaneya Cement Industries, Penna Cement, India Cements Limited, and others. Most of the cement processed in the region is moved to other states for consumption. A significant share of cement produced in and around Nalgonda is also exported via Kakinada Port and Vishakhapatnam Port.

The government of Andhra Pradesh is developing a deep-sea port in Machilipatnam to handle large volumes of bulk cargo produced in the states of Andhra Pradesh and Telangana, including coal, iron ore, and liquid bulk. With the development of the port, cement traffic from Nalgonda may also be attracted at the Port due to a likely reduction in travel time, and hence cost.

A traffic and demand assessment study has been initiated by WAPCOS Limited for the assessment of the export of cement produced in Nalgonda via Machilipatnam Port. Under the subject assignment, the consultant is required to understand the cement hinterland in Nalgonda, explore intermodal combinations through Total Logistics Cost (TLC) assessment, and estimate the future cement traffic projections from Nalgonda to Machilipatnam Port.

## 4.1 OBJECTIVE OF MARKET AND TRAFFIC ASSESSMENT COMPONENT

A high-level market and traffic assessment has been undertaken for the upcoming Machilipatnam Port/Anchorage for the movement of cement from manufacturing industries at Nalgonda. With the development of the Machilipatnam Port/Anchorage, it would likely serve as a major attraction for various industry players/ sectors.

The study involves an analysis of the relevant cement market in the district of Nalgonda (in Telangana state). This includes the estimation of EXIM traffic of cement produced in Nalgonda and Jaggayyapeta across various competing ports.

To meet the objectives of the assignment, the consultant has assessed the hinterland through a combination of secondary and primary research. This included an

understanding of the existing cement market in the region (in terms of cargo profile, value chain, key stakeholders, the current mode of transport, etc.) and a projection of the anticipated cement market in the future years. The forecast has been performed by taking into account all likely future developments and thereby estimating cement that may be handled at Machilipatnam Port/Anchorage. Inputs received from a series of stakeholder interactions and other secondary databases have been used to assess likely cargo movement. Demand assessment provides future traffic projections for the movement of cement from Nalgonda and Jaggayyapeta to Machilipatnam Port/Anchorage till FY-2052.

The objective of the assignment can be described as:

- Characterize the current size of the cement market at Nalgonda (in Telangana state and Jaggayyapeta in NTR District)
- Identify potential capacity, demand, and growth potential of the significant segments of the cement market in Nalgonda and Jaggayyapeta;
- Consider key factors that may influence the cement market (e.g., geographic/regional variations; vertical market segmentation);
- Forecast the traffic of cement over the horizon of 30 years, 40 years, and 50 years.

## 4.2 APPROACH AND METHODOLOGY

Our in-depth knowledge of our focus transportation sectors, backed by intensive research and rigorous analysis of our client's specific contexts, helps define project strategies, frameworks, and implementable action plans. Our approach is driven by the following key factors:

- **Growth of background/ regional traffic -** Depends on ongoing socioeconomic, industrial, and demographic development of the catchment area served by the proposed development; and
- **Changes in competitive positioning of the target assets**- This reflects changes in handling capacity of competing assets and relative changes in service levels (time, congestion, price, etc.) for the asset, and its competitors/ possible alternatives.

Our approach framework depicts our four-stage approach as discussed below:




*Fig.4.1 Hinterland Mapping Report*

## 4.3 PROJECT INCEPTION AND DATA ASSESSMENT

### 4.3.1 PROJECT INCEPTION

Our team initiated the assignment through a kick-off discussion with key personnel of the client to develop an understanding of the strategic objectives and expected outcomes of the proposed exercise. It included the following points:

- Understanding of preliminary concept for the proposed assignment;
- Confirmation of the goals and objectives for undertaking the exercise;
- Revalidation of the methodology adopted and work plan for the assignment;
- Study of the available earlier studies/ reports (RITES Report) and development plans proposed by various developmental agencies in connection with the development of industries in the region;
- Identification of relevant secondary information and data (concerning existing industrial infrastructure, hinterland connectivity, historic traffic generation in the PIA, operation, and utilization of infrastructure, etc.) available with various stakeholders.

### 4.3.2 BACKGROUND REVIEW OF THE STUDY AREA AND PREVIOUS STUDIES

Apart from reviewing the traffic and demand assessment study taken up by M/s RITES in FY-2020, our team reviewed other relevant studies that have been previously done to understand and validate the market scenario that prevails in the project influence area. This helped in the identification and validation of locational advantage/ disadvantage, market type and the cement traffic in the region, data gaps, and the finalization of possible alternatives.

Some of the relevant sources of secondary information and data would include, but are not limited to -

- Cement Manufacturers Association in India (CMAI);
- Strategic Plans (expansion) of cement industries in Nalgonda and Jaggayyapeta;
- Secondary research on key upcoming investments/development pertaining to cement traffic in the region;
- Historic traffic performance, infrastructure, and efficiency parameters of the competing ports

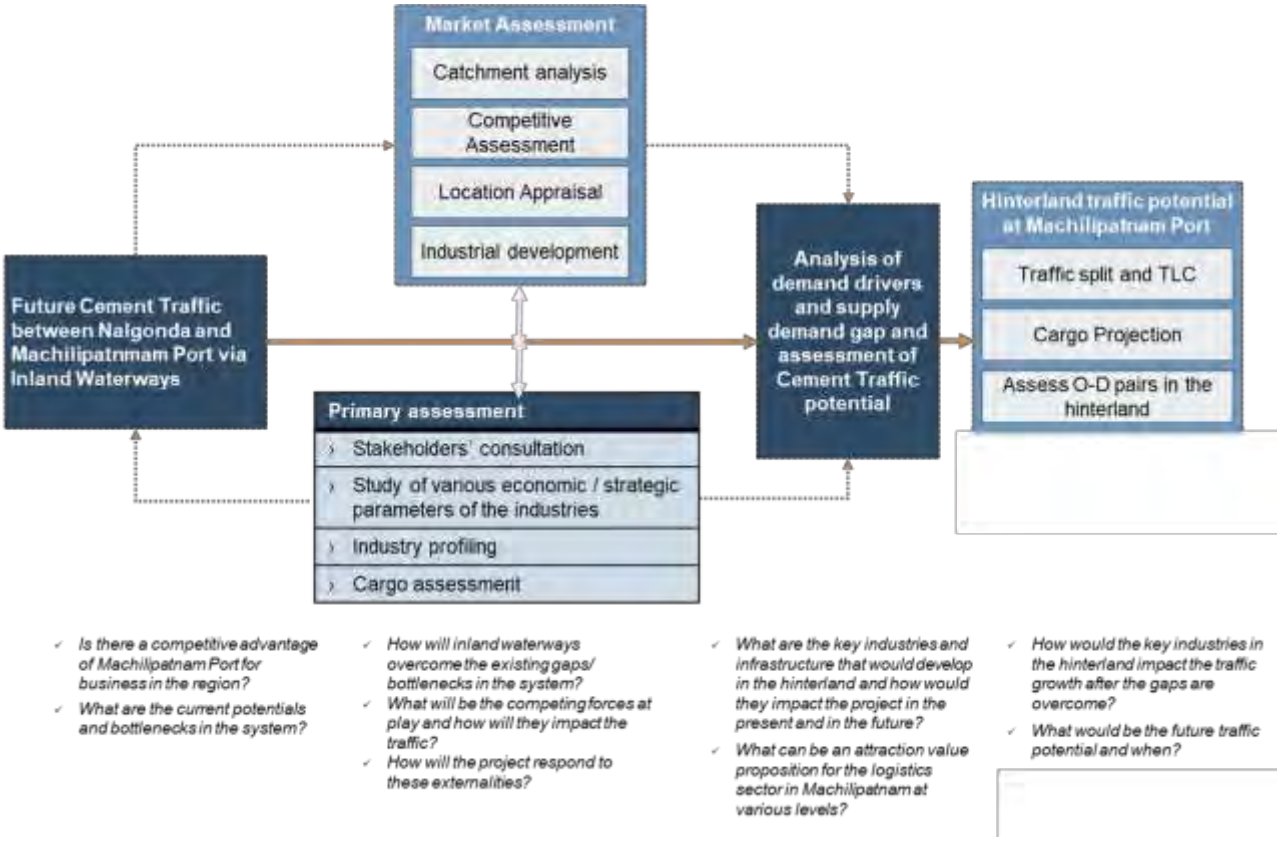
## 4.4 LOCATION APPRAISAL

The analysis assisted in understanding general trends of the region around the location identified for transportation of cement from Nalgonda and Jaggayyapeta to Machilipatnam Port/Anchorage. Location appraisal has been conducted to understand the following aspects for determining the impact of cement traffic to the port:

- Assessment of macro-economic, demographic, and geographic parameters to understand the growth of cement production in Nalgonda and Jaggayyapeta;

- Analysis of economic factors including GDP, FDI, and others and identify the gaps and then review them for the traffic analysis;
- Development of the region over the years;
- Key upcoming investments/development in the region;
- Identification and analysis of various existing and upcoming infrastructural developments, including transport and logistics infrastructure.

## 4.5 MARKET ASSESSMENT




*Source: Consultant Assessment*

***Fig.4.2 Market Assessment***

### 4.5.1 Demarcation of Hinterland and High-level Assessment of the Hinterland Potential Identification

The analysis assisted in validating the cement-producing hinterlands at Nalgonda and Jaggayyapeta. It has been conducted to understand the following aspects:

- Key cement industries that are dependent on Ports for inward and outward movement;
- Industrial developments in the hinterland;

- Production and consumption pattern and the gap;

The study does not include any fresh Origin-Destination (OD) and Classified Total Volume Count (Classified TVC) surveys and is limited to secondary assessment and focused stakeholders' consultations.

### 4.5.2 INDUSTRIAL PROFILING

This stage helped with an understanding and analyzing the information on the manufacturing hubs in the region that facilitate cement traffic at Ports in Andhra Pradesh and that would likely facilitate traffic at the Machilipatnam Port/Anchorage.

- Identification and analysis of potential industries and businesses in Nalgonda and Jaggayyapeta;
- Identification and analysis of upcoming cement industries in the region to understand capacity additions over the coming years;

### 4.5.3 STAKEHOLDER CONSULTATIONS

Based on the availability of the relevant information, our team has developed the stakeholder interaction framework. The team has conducted select stakeholders' consultations to understand the market profile in the region, including industrial and infrastructural profiles of cement at Nalgonda and Jaggayyapeta. These stakeholders majorly include manufacturers, freight forwarders, truck fleet operators, warehouses and storage yards, etc.

Some of the significant concerns which were consulted with the stakeholders are listed below.

| Key questions answered |
|---|
| › What are the current issues and bottlenecks faced by your company in handling cement cargo? (in terms of connectivity, availability, and utilization of terminals, warehousing, customs, etc.) |
| › What is the typical Origin-Destination of the service provided/cargo handled? |
| › What is the volume of cement handled? (in terms of export, import, and domestic cargo) |
| › What are the industrial and infrastructural developments in the hinterland of the port? |
| › Are there any plans for future expansion and the planned capacity additions in the hinterland? |
| › What are the demand drivers for cement in the port and the key constraints for the same? |

## 4.6 INFRASTRUCTURE AND TRAFFIC ASSESSMENT

### 4.6.1 COMPETITIVE ASSESSMENT

This analysis helped in understanding and analysing the information on the upcoming competing facilities in the region or the existing ones with plans of expansion plans, which may provide competition to the movement of cement traffic from Nalgonda and Jaggayyapeta to Machilipatnam Port/Anchorage.

The assessment consisted of the following aspects:

- Potentials and Constraints in the shift of cement traffic produced in Nalgonda and Jaggayyapeta to Machilipatnam Ports/Anchorage from the competing Ports;
- Demand drivers for the growth of traffic by identifying gaps in demand/ supply.

### 4.6.2 TRAFFIC ANALYSIS

The freight traffic analysis helped in understanding the trend of handling various commodities in the hinterlands. An independent assessment has been undertaken to assess and validate:

- Current mode-wise share of cement movement to understand the preferred modes and the development potential of these modes, including roadways, railways, and inland waterways;
- Identification of the volume-wise key O-D pairs in the hinterland;

### 4.6.3 TLC ASSESSMENT

A high-level TLC Assessment has been conducted based on market assessment and infrastructure assessment to understand the flow of cement traffic that can take place via the inland waterway between Nalgonda and Jaggayyapeta and Machilipatnam Port/Anchorage based on the comparative cost for transporting via other modes of transport i.e rail and road.

### 4.6.4 TRAFFIC FORECAST

The consultant has critically analysed the demand drivers of the traffic and forecasted the traffic for cement movement from Nalgonda and Jaggayyapeta to Machilipatnam Port/Anchorage for a horizon of 30 years.

## 4.7 REGIONAL PROFILE AND MARKET CHARACTERISTICS

### 4.7.0 LOCATION APPRAISAL

4.7.1 The project involves the transportation of cement from Nalgonda and Jaggayyapeta to Machilipatnam Port/Anchorage along National Waterway 4 in the states of Telangana and Andhra Pradesh.

Telangana is situated on the south-central stretch of the Indian. Major cities in the state include Warangal, Nizamabad, Khammam, Karimnagar, Siddipet, and Ramagundam. Several major manufacturing industries are located mainly around Hyderabad. Automobiles and auto components, spices, mines and minerals, textiles and apparel, pharmaceutical, horticulture, and poultry farming are the main industries in Telangana. Krishna river flows between the border of the states of Telangana and Andhra Pradesh along the district of Nalgonda and Jaggayyapeta.

Andhra Pradesh is strategically located on the South-East coast of India. The state has plenty of natural resources (coal, limestone, bauxite, and several other minerals), fertile land, water, and fertile river basins (Godavari, Krishna & Pennar), an extensive canal system, and favorable agro-climatic conditions. The Government of Andhra Pradesh has envisaged accelerated development in the state with the development of industrial corridors. The state has the second largest coastline after Gujarat and has 5 ports which further enhances its connectivity.

Limestone is the chief raw material in the cement industry. Andhra Pradesh is the leading producer of cement in the country. The state is endowed with extensive deposits of limestone. Significant deposits of cement and flux grade limestones are available in the Kurnool and Palnad sub-basins, Putnur Limestone in the Pakhal Basin, and Shahbad Formation in the Bhima Basin. These formations are spread over the districts of Cuddapah, Kurnool, Mahbubnagar, Nalgonda, Guntur, Krishna, Adilabad, Karimnagar, and Ranga Reddy. Minor deposits of limestones are also found in parts of Khammam, Nellore, Visakhapatnam, and West Godavari districts.

4.7.2 The study area, covering from Nalgonda and Jaggayyapeta to Machilipatnam, falls along NW-4 on river Krishna along the stretch of Muktyala to Vijayawada. The stretch passes through the central cluster of Andhra Pradesh and has the Krishna district on the left bank and Guntur District on the right bank as the primary hinterland.

An overview of these selective districts is given below:




*Source: Consultant Assessment*

***Fig.4.3 Identified Hinterland for Cement Traffic along NW-4***

### 4.7.3 KRISHNA DISTRICT

Krishna District with its district headquarters at Machilipatnam is the coastal district of Andhra Pradesh. The district is well served by Roads and Railways. Gudivada is the Major Railway Junction in the District and Machilipatnam is the Major Station in the District. The district houses an aerodrome at Gangavaram and a non-major seaport at Machilipatnam.

| | | | |
|---|---|---|---|
| Area: | 3,773 Sqkm | Coastal line: | 88 Km |

Within the Krishna District, both cement and flux grade limestone associated with the Narji Limestone is located. Cement grade limestone deposits are at Budavada, Jayantipuram, Ravirala and Vedadri. These deposits support many cement plants in the area.

### 4.7.4 NTR DISTRICT

NTR District is a newly proposed distric created a mark of respect and recognition of Sri Nandamuri Taraka Rama Rao Garu, who officiated for 3 times as Chief Minister of Combined Andhra Pradesh. NTR District with its district headquarters at Vijayawada formerly called as Bezawada.

### 4.7.5 GUNTUR DISTRICT

Guntur district is one of the nine districts in the Coastal Andhra region of the Indian state of Andhra Pradesh. The district has a coastline of approximately 100 km on the right bank of the Krishna River, which separates it from the Krishna district and NTR district.

| | | | |
|---|---|---|---|
| Area: | 11,391 Sqkm | Coastal line: | 100 Km |

Large deposits of cement and flux-grade limestone occur in the Palnad area in the vicinity of Piduguralla, Dachepalle, Karempudi, and Macherla. These are being used by a number of cement plants and lime kilns in the area.

### 4.7.6 NALGONDA DISTRICT

Nalgonda is a district in the southern part of Telangana and is crossed by many rivers. The district is spread over an area of 2,449.79 square kilometers. River Krishna forms the Southern boundary of the district and travels 85 km along the Southern Mandals.

Major minerals are found in Nalgonda include limestone. The presence of Gold and Diamond is indicative whereas non-major minerals found are Quartz, Feldspar, Granite, Road Metal, Gravel, Morrum, and Ordinary Earth.

## 4.8 TRANSPORT CONNECTIVITY BETWEEN NALGONDA AND JAGGAYYAPETA AND MACHILIPATNAM PORT/ANCHORAGE

### 4.8.1 ROAD CONNECTIVITY

Nalgonda and Jaggayyapeta and Machilipatnam ports are connected via NH-65, which runs along the states of Maharashtra, Karnataka, Telangana, and Andhra Pradesh. Major cities on this route are Pune, Solapur, Hyderabad, Suryapet, Vijayawada, and Machilipatnam. The section between Hyderabad and Vijayawada is known as Vijayawada–Hyderabad Expressway and is a major expressway.

### 4.8.2 RAILWAY CONNECTIVITY




*Source: Consultant*

***Fig.4.4 Railway Connectivity***

Nalgonda and Jaggayyapeta and Machilipatnam Port fall in the south-central region of the Indian railways. Machilipatnam Railway Station is the nearest rail connectivity to Machilipatnam Port. The port is connected to Nalgonda via Guntur Junction on a double line, which then diverts onto a broad-gauge single-line railway line.

**Nalgonda Station:** Nalgonda Railway station is situated in Nalgonda, Telangana.

**Machilipatnam Station:** Machilipatnam, station code MTM, is a railway station in the Krishna district of the Indian state of Andhra Pradesh, India. It is under the administrative control of the Vijayawada Division of the South Coast Railway zone of the Indian Railways.

### 4.8.3 WATERWAY CONNECTIVITY

Nalgonda and Jaggayyapeta is connected to Machilipatnam via National Waterway-4. Kakinada-Puducherry stretch of canals and the Kaluvelly tank, Bhadrachalam-Rajahmundry stretch of river Godavari and Wazirabad - Vijayawada stretch of river Krishna with a total length of 1,078 km were declared as National Waterway-4 (NW-4) in 2008.

The stretch was further extended up to Nashik in the case of Godavari and up to Galagali in the case of river Krishna, in the states of Andhra Pradesh, Karnataka, Maharashtra, Tamil Nadu, and Puducherry under the National Waterways Act, 2016.

The nearest end to Nalgonda and Jaggayyapeta on NW-4 is Muktyala and for Machilipatnam is Vijayawada. However, the Inland Waterways Authority of India is further assessing the feasibility of connecting Machilipatnam Port/Anchorage to Vijaywada via the Bandar canal.




*Source: Consultant Assessment*

***Fig.4.5 Connectivity between Nalgonda and Jaggayyapeta and Machilipatnam Port/Anchorage***

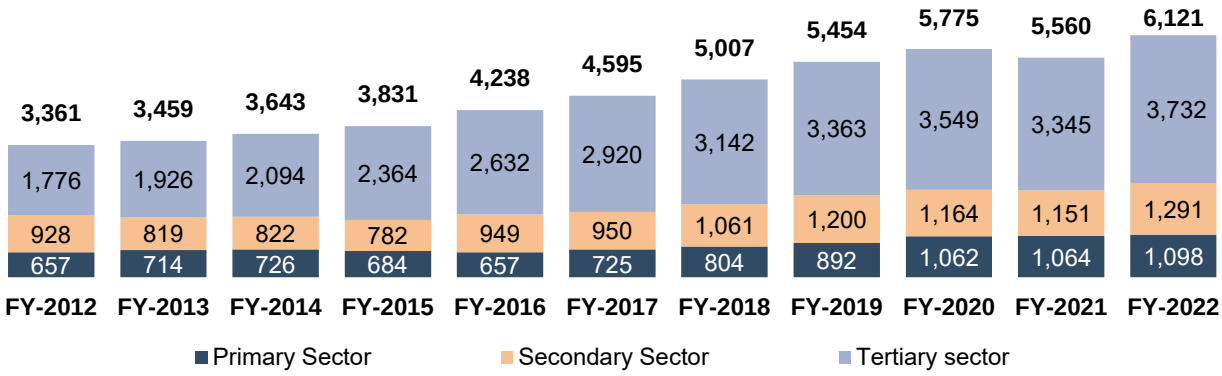
### 4.8.4 ECONOMIC OVERVIEW OF TELANGANA

As the project focuses on the transportation of cement from the Nalgonda district which lies within the state of Telangana, it is crucial to look into the economy of the state. As per the figures from the Directorate of Economics and Statistics of Telangana, released by the Ministry of Statistics and Programme Implementation (MoSPI) in March 2022, the Gross State Value Added (GSVA) of Telangana at a constant price (FY-2012) in FY-2022 was witnessed to be INR 6,121 billion. Between FY-2012 and FY-2021, Telangana, on average, accounted for ~4.1% of India's total GVA.

› The average growth rate of Telangana's GSVA between FY-2012 and FY-2020 was ~7%. The GSVA declined by 3.7% in FY-2021, owing to the COVID-19 pandemic. The state GSVA, however, grew by 10.1% in FY-2022, which is the highest since FY-2016.

› The primary sector includes Agriculture, Forestry, and Fishing as well as activities related to Mining and Quarrying. The secondary sector includes the manufacturing of goods, production of electricity, gas, water, and other utility services as well as

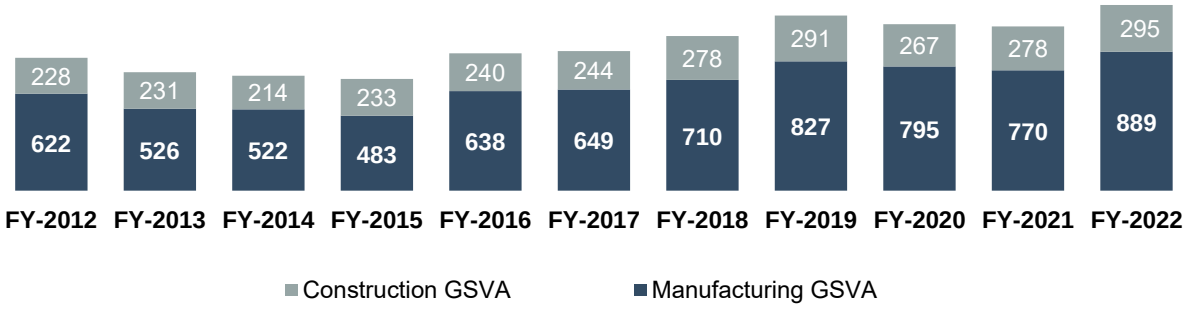
construction activities. The tertiary sector includes the output of service-based industries. As per MoSPI, between FY-2012 and FY-2022, Primary Sector, Secondary Sector, and Tertiary Sector in the state have grown at a CAGR of 5%, 3%, and 8% respectively.




*Source: MoSPI, GoI*

***Fig.4.6 GSVA of Telangana (in Billion INR)***

In FY-2022, the Manufacturing sector (Secondary Sector) contributed ~15% to the state's total GSVA and the contribution of the construction sector was ~5%. The growth of the manufacturing sector in the state would likely have a direct impact on the growth of cement-producing industries in the state, whereas the growth of the construction sector has a direct impact on the demand for cement. The manufacturing industry has grown at an average year-on-year growth rate of 4.4% between FY-2012 and FY-2022 and the construction sector grew by 2.8%.




*Source: MoSPI, GoI*

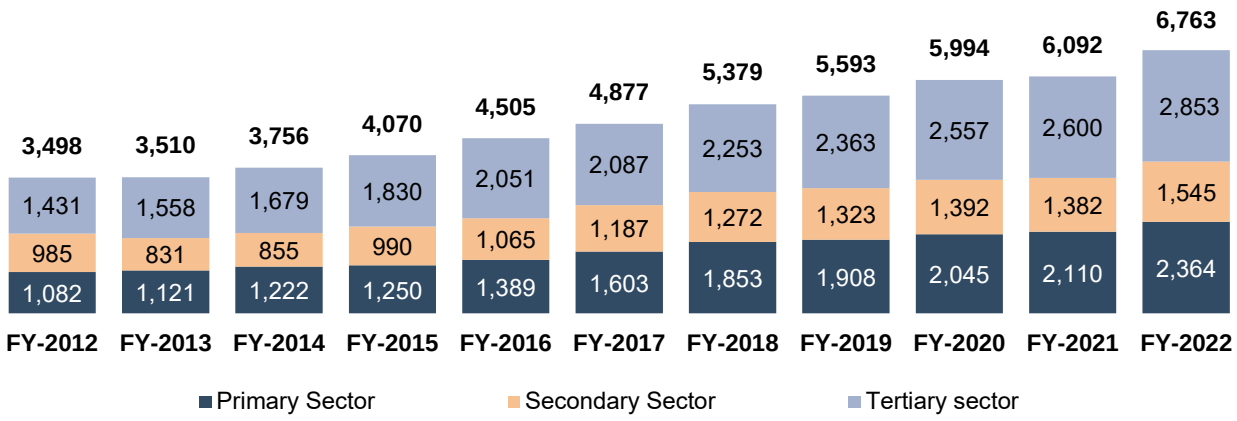
***Fig.4.7 GSVA of Manufacturing and Construction Sector in Telangana (in Billion INR)***

### 4.8.5 ECONOMIC OVERVIEW OF ANDHRA PRADESH

Similar to Telangana, the economy of Andhra Pradesh has also been studied to understand the industrial activities in the state. There are large cement industries present along the NW-4 connecting Nalgonda and Machilipatnam Port/Anchorage, i.e Vijayawada to the Muktyala stretch of Krishna River.

The GSVA of Andhra Pradesh at a constant price (FY-2012) in FY-2022 was witnessed to be INR 6,763 billion. Between FY-2012 and FY-2021, Andhra Pradesh, on average, accounted for ~4.4% of India's total GSVA.

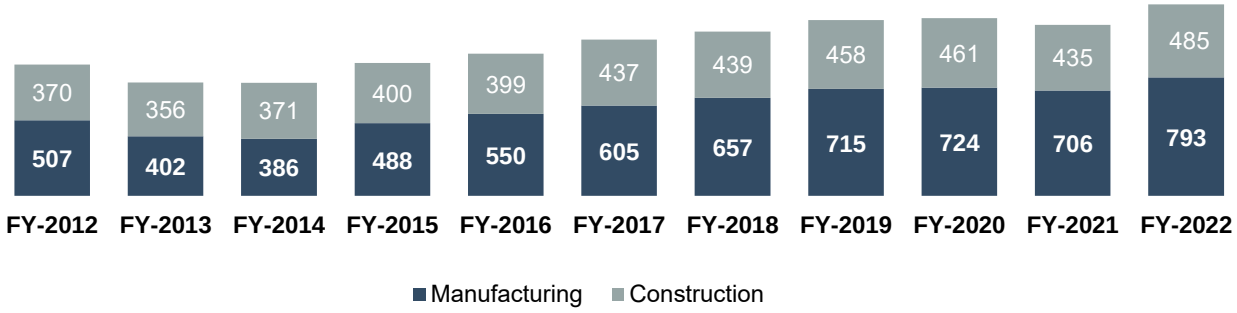
- Owing to the COVID-19 pandemic, the average growth rate of Andhra Pradesh's GSVA between FY-2012 and FY-2020 was ~7%. The GSVA grew by only 1.6% in FY-2021. The state GSVA, however, grew by ~11% in FY-2022, which is the highest since FY-2012.
- As per MoSPI, between FY-2012 and FY-2022, the Primary, Secondary, and Tertiary Sector have grown at a CAGR of 8%, 5%, and 7%, respectively.




*Source: MoSPI, GoI*

***Fig.4.8 GSVA of Andhra Pradesh (in Billion INR)***

In FY-2022, the Manufacturing sector (Secondary Sector) contributed 12% to the state's total GSVA whereas the construction sector contributed 7%. The manufacturing industry grew at an average year-on-year growth rate of 5.3% between FY-2012 and FY-2022 and construction GSVA grew by 2.9%.




*Source: MoSPI, GoI*

***Fig.4.9 GSVA of Manufacturing Sector in Andhra Pradesh (in Billion INR)***

## 4.9 KEY INFRASTRUCTURE PROJECTS IN HINTERLAND

### 4.9.1 BHARAT MALA PROJECT

Bharatmala Pariyojana (Project) is a centrally sponsored and funded road and highways project of the Government of India. Bharatmala Project would interconnect 550 District Headquarters (from the current 300) through a minimum 4-lane highway by raising the number of corridors to 50 (from the current 6) and move 80% of freight traffic (40% currently) to National Highways by interconnecting 24 logistics parks, 66 inter-corridors (IC) of total 8,000 km (5,000 mi), 116 feeder routes (FR) of total 7,500 km (4,700 mi) and 7 northeast Multi-Modal waterway ports.

The total investment for 83,677 km committed to new highways under Bharatmala Program has been estimated at INR 5.35 lakh crore (USD 75 billion), making it the single largest outlay for a government road construction scheme. Bharatmala Pariyojana comprises about 65,000 km of Highways / Roads. Out of total length under Bharatmala Project, 24,800 km Highways along with 10,000 km residual NHDP stretches were to be constructed under Phase-I of Bharatmala Project over 5 years, i.e. from FY-2018 to FY-2022. The deadline for completion of Phase 1 of the project has been extended to FY-2027 as only 20,632 km or 59.3% has been awarded and just 7,375 km or 21.19% of the target had been constructed till December 2021.

A few of the projects that would impact the connectivity between Telangana and Andhra Pradesh are:

- Nagpur-Vijayawada Corridor (NH 163 G)

National Highway Authority of India (NHAI) approved the construction of the Vijayawada-Nagpur Express Highway. The Highway would likely improve Andhra Pradesh's connectivity with the state of Maharashtra via Telangana. The NHAI has approved the plan to lay a total of 457 km of roads for INR 14,000 crore across the

passing states. The Greenfield-Brownfield Express Highway would connect Vidarbha in Maharashtra to further accelerate the transportation of industrial and agricultural products.

The feasibility report and DPRs were finalized and the Vijayawada-Nagpur Express Highway would be constructed under five packages: Vijayawada-Khammam, Khammam-Warangal, Warangal-Mancherial packages would be constructed under the Greenfield Express Highways while the Mancherial-Repallewada and Repallewada-Chandrapur packages would be constructed as Brownfield Express Highways. The existing 4-lane Express Highway between Chandrapur and Nagpur would also be connected to this highway. A total of 310 km of Greenfield and 147 km of Brownfield Express Highway would be developed under this project. NHAI aims to complete the construction of this express highway by 2025.

Vijayawada is located 67.5 Km away from Machilipatnam port/Anchorage and the nearest location to Nalgonda district on the expressway would be Khammam. The expressway would likely act as an alternative route to the IWT connection between Nalgonda and Machilipatnam port/Anchorage.

- Hyderabad (Suryapet)-Vishakhapatnam (Devarpalle) Corridor (NH 365BB)

The national highway commences from Suryapet and connects Mothe, Khammam, Wyra, Tallada, Mittapalli, Kallur, Sattupalli, and Aswaraopet in Telangana. Later, it passes through Jeelugumilli, Buttaigudem, Kannaipuram, Pattiseema, and Tallapudi and terminates at the junction with NH-16 near Kovvur in Andhra Pradesh.

The highway was planned under the National Highways Act. The existing highway is two lanes wide and is proposed to be converted to four lanes, given its national highway status, with two lanes in each direction.

The end location of the highway at Suryapet is within 50 Kms of the Nalgonda district while the other end would be closer to Kakinada port. The expressway would likely act as an alternative route to the IWT connection as it would lead the traffic to the competitive port of Kakinada. The work on the project has partially been completed.

### 4.9.2 SAGAR MALA PROJECT

To improve the performance of the logistics sector in India, the Government of India launched the Sagar mala program in the year 2015. The program aims at utilizing the potential of the waterways and coastlines of India.

Under the broad umbrella of Sagar Mala, in the state of Andhra Pradesh, 110 projects requiring investment worth INR 1,654 billion (INR 165,467 crore) are under discussions or completed for setting up of new mega ports, modernization of India's existing ports, development of Coastal Employment Zones (CEZs) and Coastal Employment Units, enhancement of port connectivity via road, rail, multi-modal logistics parks, pipelines, and waterways and promote coastal community development.

### 4.9.3 OTHER INFRASTRUCTURE PROJECTS

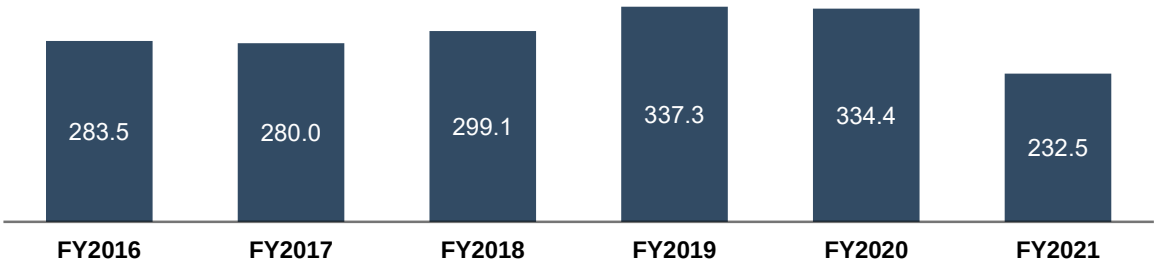
| | |
|---|---|
| **East Coast Economic Corridor (ECEC)** | • ECEC running along the entire east coast of India from Kolkata to Kanyakumari is a multimodal, regional maritime corridor that can play a vital role in unifying the large domestic market, as well as integrating the Indian economy with the dynamic global value chains of Southeast and East Asia.<br>• The corridor's core principle is port-based industrial growth along India's eastern coastal strip, which aligns with the Sagarmala initiative's objectives.<br>• Phase 1 of ECEC is the Visakhapatnam-Chennai Industrial Corridor (VCIC), which was initiated in October 2016.<br>• ECEC is being developed jointly by the Asian Development Bank and the Government of India.<br>• Once operational, the corridor would likely attract large industrial developments and would likely add to the traffic at East Coast Ports. |
| **Vizag Chennai Industrial Corridor (VCIC)** | • VCIC's long coastline and proximity to strategically located ports provide it with an opportunity to create multiple international gateways to connect India with the vibrant global production networks of Southeast and East Asia that form the bedrock of global manufacturing today.<br>• VCIC extends north-south over 800 kilometers along the coast connecting major economic nodes.<br>• The corridor includes National Highway 5, which is a part of the Golden Quadrilateral, the Kolkata– Chennai rail route, and seven non-captive operational ports. It traverses through nine districts with proximity to urban centers of Visakhapatnam, Vijayawada, and Chennai.<br>• When fully implemented, VCIC is expected to increase GDP in corridor districts by 6 times, increase manufacturing share from 9.4% in 2017 to more than 20% in 2045, and create 9.5 million jobs by 2045.<br>• Four economic nodes were identified for priority development at the conceptual planning stage, namely: Visakhapatnam, Machilipatnam, Donakonda, and Srikalahasti-Yerpedu. |

## 4.10 ASSESSMENT OF CEMENT INDUSTRY

### 4.10.1 OVERVIEW OF THE CEMENT INDUSTRY IN INDIA

India is the second largest cement producer in the world, accounting for ~8% of the global cement production with an estimated production capacity of ~545 MTPA in FY-2021. As per the Bureau of Energy Efficiency, Government of India, per capita cement consumption in India is 195 kg which is far less than the world average of ~500 kg and ~1000 kg in China. The major production in India is largely dependent on private companies, where the top 20 companies account for almost 70% of the total production.

Between FY-2016 and FY-2020, cement production grew on an average year-on-year percentage of 4.4. The cement production in India in FY-2021 was 232.5 MTPA which was almost 31% lower than in FY-2020.




*Source: Indian Minerals Yearbook- Cement*

***Fig.4.10 Cement Production in India***

- **Future outlooks**

  As per the outlook of various cement industries, the demand for cement is expected to reach 550-600 MTPA by FY-2025 because of the demand in different sectors, i.e., housing, commercial construction, road development, and industrial development. Other driving factors are an increase in rural income and growth in the development of public infrastructure.

  Additionally, national initiatives are likely to boost the demand for cement production. The launch of "PM Gati Shakti- National Master Plan (NMP)" for multimodal connectivity, focuses on the development of 100 smart cities, modernization of 500 cities, affordable housing for all, cement concreting of national highways, provision of sanitation facilities, etc., which are likely to be the main drivers for the growth of Indian Cement Industry.

- **Issues faced**

  Cement production faced issues related to its consumption, transportation, as well as production.

  **Consumption:** Contradicting the constant and gradual growth of cement production over the past few years, production of cement was much lower in FY-2021 due to COVID-19. Because of the pandemic, there was a worldwide lockdown which caused restrictions on construction activities as well.

  **Production:** Costs associated with cement production have increased due to rising coal and pet coke costs worldwide.

  **Transportation:** The increase in fuel prices raised the cost of transportation of cement. Freight costs significantly impact the cement industry. Basic raw materials like limestone and coal are low value, high bulk commodities, transportation of which adds in significant freight expenses (typically account for 33% of variable costs). Additionally, cement is often delivered over a long distance because raw material sources are typically located far from the major consumption centers.

### 4.10.2 OVERVIEW OF CEMENT INDUSTRY IN THE SOUTHERN STATES OF TELANGANA AND ANDHRA PRADESH

Southern states play a key role in the production of cement and have the potential to become a cement hub for future development across India. Of the total 210 large cement plants in India, approximately 77 are situated in the states of Andhra Pradesh, Karnataka, and Tamil Nadu with a combined capacity of ~159.13 MTPA as of FY-2020 and a production volume of 132.7 MTPA.

Together these states formed South India Cement Manufacturers' Association (SICMA) as an association of their own in 2021. The association was formed to be an interface between the southern cement manufacturers and the government to help achieve the Prime Minister's vision of affordable housing for all and infrastructure for the future.

Our primary hinterland for the transportation of cement from Muktyala to Machilipatnam lies in the states of Andhra Pradesh and Telangana in general and specifically in the districts of Nalgonda, NTR, Guntur, and Krishna.. Cement industries were identified in these districts.

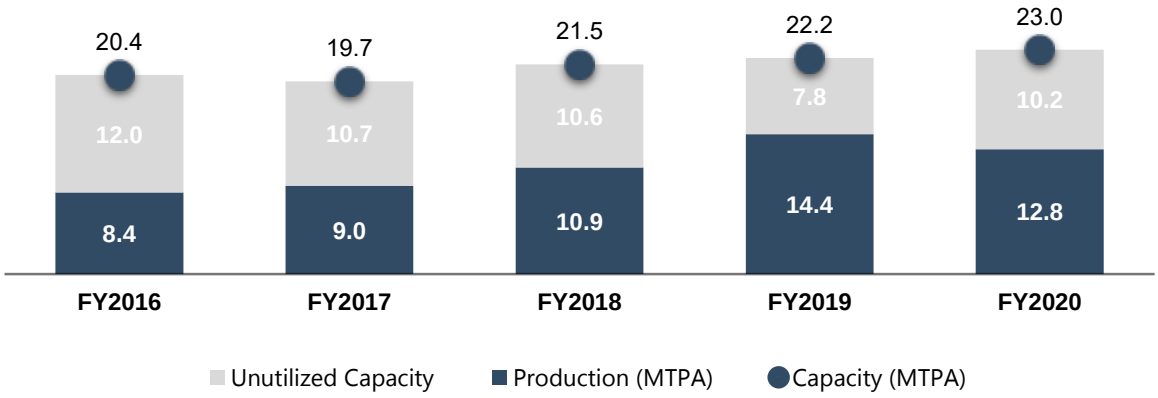
#### a. Cement Industries in Nalgonda District of Telangana

Some of the key cement manufacturing plants are located in the Nalgonda district which is adjacent to the Krishna River and the Andhra Pradesh border. The cluster of cement industries is within a ~100km radius of the proposed Inland Water Terminal at Muktyala.

The graph below shows the combined production capacity and the corresponding output of the cement industries located in the Nalgonda district between FY-2016 and

FY-2020. Considering FY-2021 was a COVID-19 year and the demand for consumer goods was impacted, FY-2021 has been left out of our assessment.

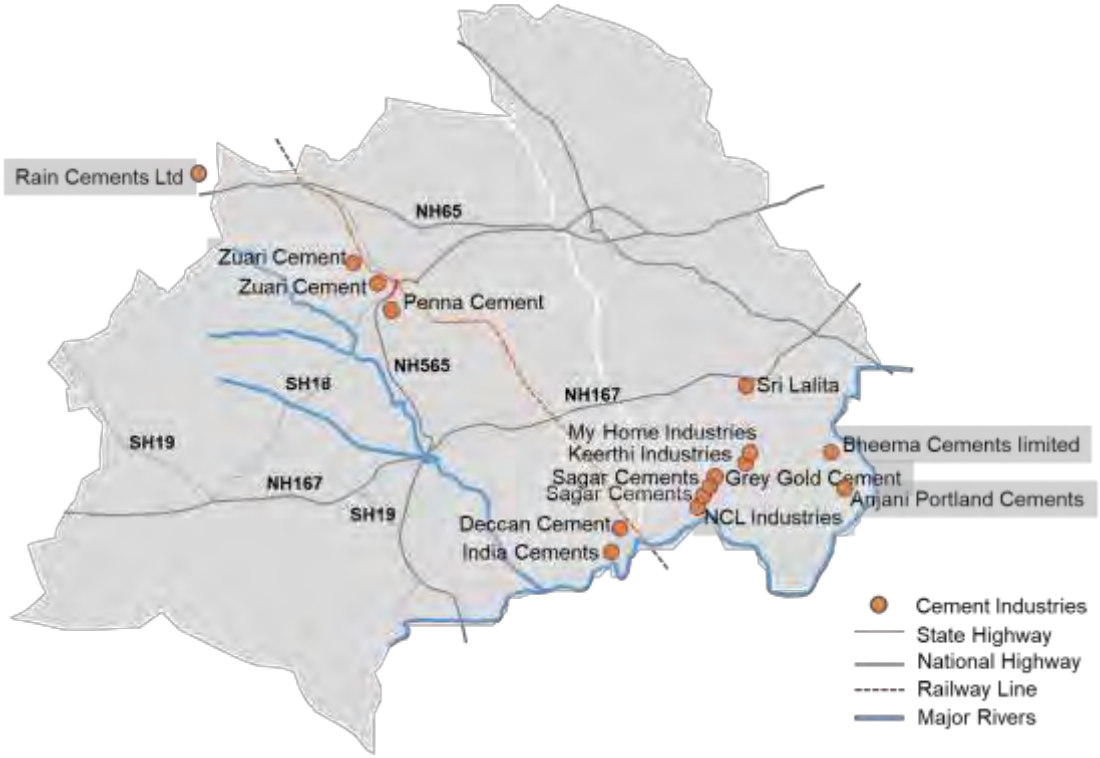
On average, only 11.09 MTPA of Cement was produced during this period against the average production capacity of 21.36 MTPA. The under-utilization of cement production capacity will be understood from Industry Interactions.




*Source: Indian Minerals Yearbook- Cement*

***Fig.4.11 Production Capacity and Actual Production of Nalgonda-based Cement Industries***

Geographically these industries have been marked in the figure below and **Table 4-1** summarises the production capacity of these industries and their production output in the year FY-2020. The total production capacity of cement in Telangana is ~36 MTPA, of which 64% is located in Nalgonda. However, only ~13 MTPA of cement was produced in Nalgonda, which was ~72% of the state's production.




*Source: Consultant's Assessment*

***Fig.4.12 Cement Industries in Nalgonda District***

***Table 4-1: Cement Industries in Nalgonda District***

| Location | Industry Name | Manufacturing Capacity in FY-2020 (in MTPA) | Manufacturing Volume in FY-2020 (in MTPA) | Capacity Utilization in FY-2020 |
|---|---|---|---|---|
| Mellacheruvu | Anjani Portland Cements (Chettinad formally) | 1.92 | 0.82 | 43% |
| Nalgonda | Bheema Cement (Earlier Coromandel Cements) | 0.90 | - | 0% |
| Janpahad | Deccan Cement | 1.80 | 1.50 | 83% |
| Nalgonda | Grey Gold Cement | 0.05 | 0.04 | 80% |
| Vishnupuram | India Cements Ltd | 3.50 | 1.60 | 46% |
| Mellacheruvu | Keerthi Industries (Formerly Suvarna Cement) | 0.59 | 0.41 | 69% |
| Mellacheruvu | My Home Industries Ltd | 3.50 | 2.20 | 63% |
| Simhapuri | NCL Industries | 2.00 | 1.40 | 70% |

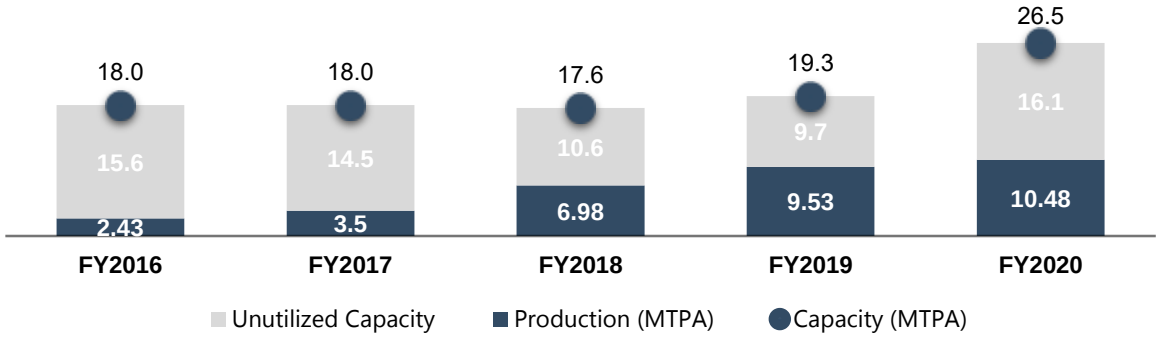
| Location | Industry Name | Manufacturing Capacity in FY-2020 (in MTPA) | Manufacturing Volume in FY-2020 (in MTPA) | Capacity Utilization in FY-2020 |
|---|---|---|---|---|
| Ganeshpahad | Penna Cement Industries Ltd | 1.20 | 1.60 | 133% |
| Ramapuram | Rain Cements Ltd (Ramapuram Cement Plant) | 1.50 | 0.90 | 60% |
| Mattampally | Sagar Cements | 3.30 | 1.40 | 42% |
| Pedaveedu | Sagar Cements | 0.35 | - | 0% |
| Mattampally | Sri Lalita | 1.00 | - | 0% |
| Sitapuram | Zuari Cement Ltd | 1.40 | 0.94 | 67% |
| Nalgonda | Kakatiya Cement & Sugar Ind. Ltd | - | - | 0% |
| | TOTAL AT NALGONDA | 23.01 | 12.81 | |
| | TOTAL AT TELANGANA | 35.74 | 17.86 | |
| | % share | 64% | 72% | |

*Source: Indian Minerals Yearbook- Cement*

**b. Cement Industries in Guntur and NTR/Krishna District of Andhra Pradesh**

Similar to the Nalgonda district, some of the key cement manufacturing plants of the Guntur and Krishna districts are located along the Krishna River.

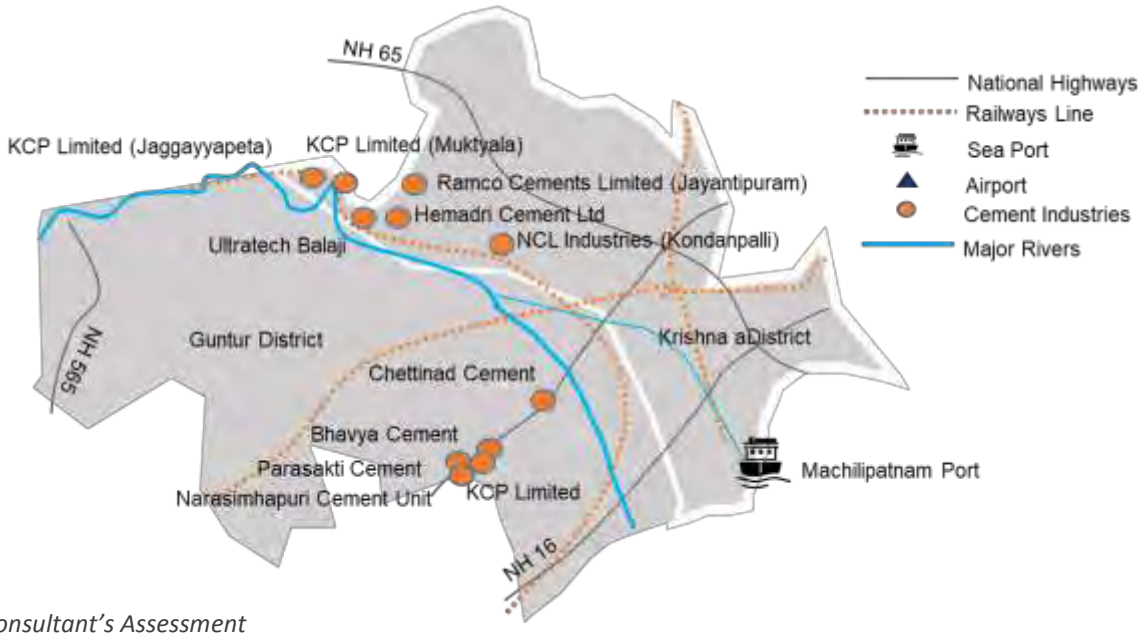
The graph below shows the combined production capacity and the corresponding output of the cement industries located in the Guntur and Krishna district between FY-2016 and FY-2020. On average, only 6.58 MTPA of Cement was produced during this period against the average production capacity of 19.88 MTPA.




*Source: Indian Minerals Yearbook- Cement*

***Fig.4. 13 Production Capacity and Actual Production of Guntur and NTR/Krishna District based Cement Industries***

Geographically, these industries have been marked in the figure below and **Table 4-2** summarises the production capacity of these industries and their production output in the year FY-2020. The total production capacity of cement in Andhra Pradesh is ~78 MTPA, of which ~34% is located in the Guntur and Krishna districts. However, only 10.5 MTPA of cement was produced in these districts, which was ~35% of the state's cement production.




*Source: Consultant's Assessment*

***Fig.4.14 Cement Industries in Guntur and NTR/Krishna District of Andhra Pradesh***

***Table 4-2: Cement Industries in Guntur and NTR/Krishna District of Andhra Pradesh***

| Location | Industry Name | Manufacturing Capacity in FY-2020 (MTPA) | Manufacturing Volume in FY-2020 (MTPA) | Capacity Utilization in FY-2020 |
|---|---|---|---|---|
| Guntur | Durga Cement Works (Andhra Cement, Jaypee Group) | 2.31 | 0.37 | 16% |
| Guntur | Bhavya Cement | 1.40 | 0.80 | 57% |
| Guntur | Chettinad Cement (Dachepalli) | 3.50 | - | 0% |
| Guntur | KCP Limited (Macherla) | 0.82 | 0.30 | 37% |
| Guntur | Parasakti Cement | 1.26 | 0.80 | 63% |
| Guntur | Narasimhapuri Cement Unit (Sri Chakra Cements) | 0.31 | - | 0% |

| Location | Industry Name | Manufacturing Capacity in FY-2020 (MTPA) | Manufacturing Volume in FY-2020 (MTPA) | Capacity Utilization in FY-2020 |
|---|---|---|---|---|
| Krishna | Hemadri Cement Ltd (Vedadri) | 0.25 | 0.19 | 76% |
| Krishna | KCP Limited (Jaggayyapeta) | 3.52 | 1.72 | 49% |
| Krishna | NCL Industries (Kondanpalli) | 0.99 | - | 0% |
| Krishna | Ramco Cements Limited (Jayantipuram) | 3.65 | 1.70 | 47% |
| Krishna | KCP Limited (Muktyala) | 3.52 | 1.70 | 48% |
| Krishna | Balaji Cement (Ultratech) | 5.00 | 2.90 | 58% |
| | TOTAL AT GUNTUR AND KRISHNA | 26.53 | 10.48 | |
| | TOTAL AT ANDHRA PRADESH | 77.96 | 29.66 | |
| | % share | 34% | 35% | |

*Source: Indian Minerals Yearbook- Cement*

### c. Existing Cement Supply Chain in Hinterland

Calcareous (Limestone Obtained from mines), argillaceous materials (Clay, Bauxite), and Iron are the commonly used raw materials in the manufacture of cement.

All the raw materials are available locally in the region or within 100 km proximity to the industries. The table below summarises the location of key raw materials with respect to the location of the identified districts along the Krishna river.

***Table 4-3: Raw materials availability in Guntur and Krishna District***

| | | | | |
|---|---|---|---|---|
| |  |  |  |  |
| **District/ Raw Material** | **Limestone** | **Bauxite** | **Clay** | **Iron Ore** |

| | | | | |
|---|---|---|---|---|
| **Krishna District** | Budavada, Jayantipuram, Ravirala and Vedadri. Jaggayyapeta | Found in the East Godavari District on the hill ranges to the west of Gurtedu, Peddakonda, and adjacent hill ranges to the north and northwest of Pallanagi, Katamrajukonda , Y.Ramavaram, Chidipalem, Pedda Addapalli, and Addatigala. | Along the Krishna River | Jaggayyapeta, Dachupalem |
| **Guntur District** | Palnadu area in the vicinity of Piduguralla, Dachepalle, Karempudi, and Macherla | | | Tummurukotain Palnad |
| **Nalgonda District** | Mellacheruvu, Vishnupuram | | | Khammam District (60-80 Kms away from Nalgonda) |

Source: Stakeholders' Consultations

### 4.10.3 INDUSTRY INTERACTIONS

To understand the supply chain of cement in the selective districts of Telangana and Andhra Pradesh, the consultant connected with a few of the cement players in the region. The list of the key stakeholders consulted is highlighted below.

| S. No. | Company | Contact Person | Designation | Date |
|---|---|---|---|---|
| 1 | **NCL Industries Limited** | Mr. Shyam Prakash | Vice President Sales and Marketing | 18th July 2022 |
| 2 | **My Home Industries** | Mr. Suresh | Regional Manager, Nalgonda Plant | 18th July 2022 |
| 3 | **Sagar Cements** | Mr. Shankar Narayan | Head of Marketing, Mattampally Plant | 19th July 2022 |
| 4 | **Zuari Cements** | Mr. Hari Prasad Rao | Zonal Head | 19th July 2022 |
| 5 | **Department of Industries, A.P** | Mr. Srinivasam Rao | Deputy Director | 27th July 2022 |
| 6 | **KCP Limited** | Mr. V. Madhusudan | Vice President (Muktyala Plant) | 27th July 2022 |
| 7 | **Ultractech Cement** | Mr. Ranga Kumar | Vice President | 27th July 2022 |
| 8 | **Bhavya Cement** | Mr. Mastan Babu | Assistant Manager | 28th July 2022 |
| 9 | **Penna Cement** | Mr. Ramakrishnan | Regional Manager | 28th July 2022 |
| 10 | **Chambers of Commerce and Industry Federation, A.P.** | Mr. Potluri Bhaskara Rao | President-elect | 28th July 2022 |

| S. No. | Company | Contact Person | Designation | Date |
|---|---|---|---|---|
| 11 | **Chambers of Commerce and Industry Federation, A.P.** | Mr. Sambasiva Rao V | Industrialist, Importer-Exporter | 28th July 2022 |
| 12 | **Maha Cement** | Mr. Sripathi A. | Sr. Marketing Manager | 28th July 2022 |
| 13 | **Ultratech Cement** | Mr. K. Satyanarayana | Channel Relationship Manager | 28th July 2022 |
| 14 | **Ultratech Cement** | Mr. Madan Jayagopal | Regional Logistics Head | 28th July 2022 |
| 15 | **National Real Estate Development Council** | Mr. G.V.N.V Sudheer | Vice-President, State GC Member | 28th July 2022 |
| 16 | **KCP Limited** | Mr. G. Hemanth Kumar | Sr. Regional Marketing Manager | 28th July 2022 |
| 17 | **KCP Limited** | Mr. Sri Nivas | Regional Marketing Manager | 28th July 2022 |
| 18 | **Ramco Cements Limited** | Mr. P. Vishnu | AGM-Marketing | 28th July 2022 |
| 19 | **Sagar Cements** | Mr. Srinivas | Administrative Head | 28th July 2022 |

Based on these industry interactions, key conclusions drawn are listed in the table below:

*Table 4-4: Raw materials availability in Guntur and Krishna District*

| | |
|---|---|
| **Cement manufacturing industry in Telangana and Andhra Pradesh** | › On average, the state of Telangana produces ~18-20 MTPA of cement whereas Andhra Pradesh produces ~30 MTPA cement.<br>› Cumulative cement consumption in both the states is ~25-26 MTPA.<br>› Existing cement industries in the Nalgonda region are located along the Krishna River, in the regions around Suryapet, Mellacheruvu, Janpahad, Ganeshpahad, and Mattampally.<br>› The state of Andhra Pradesh is the largest producer of cement in India. Large cement plants are located in the southern and central regions of the state.<br>› Some of the cement plants located in the districts of Guntur and Krishna may be advantageous for drawing the traffic along the Krishna river.<br>› The average capacity utilization of Cement plants in Telangana and Andhra Pradesh is ~60-70%. This is due to the lower demand for cement in the states, thus, reducing the cement demand from the smaller cement plants. |

| | |
|---|---|
| **EXIM from Machilipatnam Port** | › Currently, there is no export of cement from industries in the study region.<br>› Cement, from India, is only exported to Sri Lanka and Bangladesh. However, the selling cost of cement in these countries is much lower than the transportation cost of cement via sea, thus, making it unviable to export.<br>› The maximum cement that might be exported to Sri Lanka from the nation is 25,000 per month.<br>› Coastal movement of cement would largely depend on the savings in logistics cost and time. |
| **Domestic OD** | › Cement produced in the region is largely domestically consumed in the states of Telangana, Andhra Pradesh, Karnataka, Orissa, Tamil Nadu, Kerala, Maharashtra, and Pondicherry.<br>› ~7-8 MTPA of cement produced in Telangana is consumed domestically and the rest is transported to other states for consumption.<br>› In a month, ~1.5-2 lakh tons of cement is transported each, to Orissa and Tamil Nadu, depending on the demand in the states.<br>› ~60,000 tons per month are moved to Maharashtra and ~50,000 tons per month to Maharashtra.<br>› For a large plant (typically 2-3.5 MTPA), ~60-70% of the cement produced is consumed in Telangana and Andhra Pradesh, ~7-8% is transported to Tamil Nadu, 1-2% to Kerala, 5% to Karnataka, 2-3% to Maharashtra, ~10% to Odisha, and a small fraction is also moved to West Bengal to Madhya Pradesh.<br>› For a small plant, cement produced is consumed in the states of Telangana and Andhra Pradesh only. |
| **Modal Share** | › For a larger plant, the cement is sent to end customers both via rail and road depending on the distance. The nearest railway stations are Nalgonda station (average lead distance of 15-20 Km), Bonakalu station (average lead distance of ~30-40km), and the nearest junction is Guntur.<br>› ~95% of the traffic movement in the region is via road.<br>› Cement handling via rail is largely not preferred as multiple handling damages the cement bags and also increases the cost further.<br>› Cement traffic via rail is currently only moved to a few parts in Maharashtra due to longer haulage and cost advantage.<br>› For small plants, from where cement is largely sent to sites within Telangana and Andhra Pradesh, cement is transported 100% via road. |

| | |
|---|---|
| | › NCL industries have explored transportation of cement via rakes from the factory itself and then packaging it near the port but due to multiple handling, the option was not considered viable.<br>› NCL industries have also run trials for coastal shipping for transportation of cement to other neighboring states but existing ports are 300-500 Km away from the cement industries.<br>› A small volume of cement is exported from Krishnapatnam Port, roughly ~1-2 MTPA, which is mostly by the industries located in the southern districts around Kurnool. While most of the cement traffic is exported from Chennai Port. |
| **Raw Materials Procurement** | › In terms of procurement of raw materials-limestone is mined within the plant complex, bauxite is imported from Warangal, and Panduru by trucks, coal is imported at Krishnapatnam port and from there moved by road, and gypsum is imported at Vishakhapatnam port and similarly moved via road. |
| **Cost of Transportation** | › The average transportation cost via road is ~INR 4.5-5/tonne/km.<br>› Cement in the region is handled manually. INR 110-140/ton is the cost of manually handling cement (loading only).<br>› The average rail transportation cost is 2-3 Rupees cheaper. |
| **Upcoming/ proposed Developments in the Region** | › Shree Cement is undergoing expansion and is planning to operate a 2 MTPA plant.<br>› NCL has an expansion plan under which the capacity would be increased by 3500 tons/day.<br>› The existing plant of Maha Cement at Nalgonda is also being expanded for an additional 2.5 MTPA by September.<br>› In Nalgonda, Penna Cements has a plant of 3.5 MTPA capacity. Another 1 MTPA is proposed for expansion. |
| **Key Issues and Challenges** | › The export of cement is discouraged by the high coal prices as well as the cost of transportation of cement from industries to ports. The majority of the cement industries in southern India are located away from the ports (the nearest port is 300-500 Km away) which makes the transportation of cement unfeasible.<br>› Small industries are currently focused on improving the capacity utilization at the plants, which is currently impacted by the lower demand in the immediate hinterland.<br>› A higher value of the dollar is also a factor in no export of cement from India to Sri Lanka. Whereas, because of the distance, Singapore mainly imports cement from Malaysia.<br>› Jaggaiahpet (location of many cement industries) to Machilipatnam port, there is rail connectivity, so the scope of utilization of IWT is |

| | |
|---|---|
| | likely to be limited.<br>› Since there are railway stations located both near the origin and destination of the cement supply chain, railways are likely to have a preferred advantage for longer haulage distances.<br>› During peak season, rakes are not available easily, and hence, there is more dependence on the road.<br>› Similar to rail, the supply chain via vessel is likely to be beneficial for longer haulages.<br>› Import of cement is a seasonal activity. The major requirement is from Jan-June. The water level has to be high during these months for the flow of cement via the Krishna River. |
| **Potential for NW-4** | › Challenges faced in the existing supply chain via road include increasing diesel costs, multiple times loading/unloading, insufficient availability of truck fleets and drivers, and increasing toll charges. This may lead to the shift of traffic from road to inland waterways, depending on the logistics cost and time.<br>› Machilipatnam is the nearest port and it would be highly feasible to export cement via the same.<br>› Bandar Canal connects Machilipatnam Port/Anchorage with the Nalgonda region from the Krishna River. The canal is currently used for irrigation purposes. In the existing conditions, Bandar Canal doesn't have adequate width, and water flow, and the barge capacity is not more than 2,000 tons to handle large cement vessels. Only small quantities of cement might flow through Bandar Canal which may be economically unviable. This may also impose a huge challenge for the cement movement.<br>› NW-4 may be preferred only if the transportation rates are lower and also the connectivity is established directly to the ports.<br>› A large volume of cement, ~1-1.5 Lakh tonnes is currently moved from Nalgonda to Vijayawada. This movement may be studied for feasibility via Inland Waterways.<br>› Also, with the proposed large-scale developments such as Vishakhapatnam Chennai Industrial Corridor (VCIC) and New Amravati, the demand for cement in the region would further increase. However, these developments have been on hold for many years previously.<br>› NW-4 may also be a feasible option for importing the raw materials for the cement plant, which are currently imported at Krishnapatnam Port and moved to industries via road. |

Source: Stakeholders' Consultations

## 4.11 COMPETITIVE ASSESSMENT




*Source: Consultant's Assessment*

*Fig.4.15 Competitive ports in the hinterland*

Machilipatnam Port/Anchorage is an upcoming deep-sea port on the coast of the Bay of Bengal, in the Krishna District of Andhra Pradesh.

Machilipatnam Port is located close to some of the key ports, including Krishnapatnam Port on the south and Kakinada Port, Gangavaram Port, and Vishakhapatnam Port towards the north. Of this Vishakhapatnam port is the only major port. Additional two ports are also upcoming which include Ramayapatanam port to the south and Bhavanapadu port to the extreme north, near the border of Andhra Pradesh with Odisha.

These ports pose the largest competition to Machilipatnam Port. Large-scale investments are being witnessed along with these competing ports which would likely increase the demand for these ports in the coming years.

**Machilipatnam Port**

Machilipatnam Port is an upcoming port located 65 km away from Vijayawada in the Krishna District. The port, once developed, would have a draft of 14.5 m and a capacity of ~26 MTPA.

The port is located 5.8 Km from the existing South Central Railway Line and 14 km away from the existing NH-65 which connects the port to the Nalgonda District.

The port is poised for massive development with an investment of close to INR 5,200 crores. During the first phase, the Machilipatnam port would likely be developed as deep water, all-weather multipurpose port with 4 berths to cater to cargo originating from the primary hinterland of Krishna, West Godavari, and Guntur Districts in Andhra Pradesh.

The port also has the potential for handling cement plants spread over the Krishna Belt. Machilipatnam Port is located at a distance of 262 km from Nalgonda, which is the largest cement manufacturing hub in the region. In the existing conditions or absence of functional NW-4, cement is being transported from Nalgonda via road. Machilipatnam Port also has direct rail connectivity from Nalgonda via Nalgonda Railway Station and is

5.8km from Machilipatnam port. The location of Machilipatnam concerning Nalgonda is nearest compared to other ports and therefore Machilipatnam Port would have a location advantage.

The section below describes the competition from the adjacent ports.

**1. Visakhapatnam Port**

Visakhapatnam Port is one of the 11 major ports of India. It is located midway between the ports of Chennai and Kolkata Ports on the Bay of Bengal. With a capacity to handle more than 136.39 MTPA, it is capable of handling all types of cargoes.

The nearest Railway line (Visakhapatnam railway) is just 3.5kms from the port. It has well-established rail and road connectivity to the hinterland thereby providing smooth access for cargo movement to the local hinterland and ICDs at NCR, Nagpur, Hyderabad, and Raipur.

Efficient cargo evacuation infrastructure is developed by the port for the transportation of cargo by rail and road. The Port owns and operates a Railway network of about 185 km, which is linked to the South Central Railway and East Coast Railway of the Indian Railways. Nearly 52% of the cargo handled at the port is moved by rail. Visakhapatnam Port has a distance of 534 km from Nalgonda. Cement can be transported from Nalgonda railway station to Visakhapatnam railway station.

In FY-2020 and FY-2021, 7 thousand tonnes and 16 thousand tonnes of cement were handled at Visakhapatnam Port. However, cement plants in the Nalgonda district are increasingly shifting their cargo to the Krishnapatnam Port and Chennai Port for EXIM activities. Thus, VPT may likely impose comparatively lower competition on the Machilipatnam port.

The Wharfage charged for Cement clinker (including cement) at VPT is INR 28/tonne for foreign vessels and INR 17/tonne for coastal vessels.

**2. Krishnapatnam Port**

Krishnapatnam Port in the Nellore District of Andhra Pradesh is the largest private port on the East Coast of India. It is an all-weather deep-water port with a draft of 18.5m and a capacity of 64 MTPA, capable of handling containers, liquid cargo, and dry bulk.

The port is being operated by Adani Ports and Logistics Limited, through a mandate awarded by the Andhra Pradesh government to develop the existing minor port into modern, deep water and high productivity port, on BOST (Build–Operate-Share-Transfer) concession basis for 50 years.

The port is a major economic gateway that caters to the southern hinterland of India with multimodal connectivity. Major dry bulk commodities handled at Krishnapatnam Port include coal, fertilizers, Agri, mines and minerals, and steel & project cargo. The Port is equipped with all the requisite material handling facilities such as Ship Unloaders, Shore Cranes, Conveyor systems, Loaders, Excavators, Tippers, etc. Bulk

Cargo being Handled by Mechanized Handling Systems at Dedicated Storage Areas provides clean and contamination-free handling facilities for Bulk and Break-Bulk Cargo. The port also has covered, open storage areas and special demarcated concrete storage yards with enormous capacity. The terminal has cargo-wise dedicated rail sidings for smooth and faster evacuation. Wagon loading silos for efficient evacuation of cargo.

Krishnapatnam Port has a distance of 380 km from Nalgonda. Cement can be transported from Nalgonda railway station to Nellore railway station which is 29km from Krishnapatnam Port. The Wharfage charged for Cement/Clinker is INR 45/ MT. At Krishnapatnam port, there is a priority for Penna Cements Limited's cement export vessel at Berth-NW1.

In FY-2021 and FY-2022, 0.988 MTPA and 1.185 MTPA of cement were handled at Krishnapatnam Port. The port would likely impose high competition on the Machilipatnam Port/Anchorage.

**3. Kakinada Port**

Kakinada Deep Water Port is located on the East Coast of India. It is in the East Godavari district of Andhra Pradesh and is strategically located between the major Ports of Vishakhapatnam and Chennai. The main jetty at the terminal operates with 7 berths and one OSV berth.

Kakinada forms the main gateway port for the rich agricultural belt of Andhra Pradesh and Telangana. The port is surrounded by districts of East and West Godavari, Krishna, Guntur, and the entire Telangana region. Kakinada handles large baskets of cargoes viz; Coal, Fertilizers, Iron Ore, Cement Clinker, White Minerals, etc.

Kakinada Port has an average draft of 14.5 m and a handling capacity of 22 MTPA. The port has good railway connectivity with a railway line coming to the port. Cement can be transported from Nalgonda railway station to Kakinada Port railway station since the railway connectivity is direct to the port. The total distance between Nalgonda and Kakinada is around 410 km. The Wharfage charged for Cement & Cement clinker per 1000 Kg is INR 53.55.

In FY-2021 and FY-2022, 248 thousand tonnes and 9 thousand tonnes of cement were handled at Kakinada Port. The port would also likely impose high competition on the Machilipatnam Port/Anchorage.

**4. Gangavaram Port**

Gangavaram has been developed as an all-weather, multipurpose port with water depths up to 21 m. The port with its deep draft berths and ability to handle larger vessels efficiently has resulted in substantial savings for trade and port users.
Gangavaram Port provides efficient cargo handling services for a variety of bulk and break bulk cargo groups including Coal, Iron Ore, Fertilizer, Limestone, Bauxite, Raw Sugar, Project Cargo, Alumina, Steel products, etc.

The port has 9 berths with a handling capacity of 64 MTPA. Cement can be transported from Nalgonda railway station to Duvvada railway station which is 39 km from Gangavaram Port. The total distance is around 543 km. According to the tariff structure of the port, the Wharfage charged for cement bags is INR 30 per metric tonne of Bagged Cargo.

In the past years, no cement has been handled at the port. However, due to the large distance of the Nalgonda district from the Gangavaram Port, it may likely impose comparatively lower competition to the Machilipatnam port/Anchorage.

*Amongst the upcoming ports are:*

1. **Ramayapatnam Port**

Ramayapatnam Port is located in the Prakasam district, about 90 km north of the Krishnapatnam port. The port enjoys excellent connectivity to NH 16 and South-Central Railway Line, both within 5 km.

Andhra Pradesh Maritime Board has plans for effective outlays to develop the port. In the first phase, 4 berths would be built with a deep draft of 15.5 m to handle 15 MTPA of cargo. Aiming for integrated development of the coastline, close to 2000 acres of land is being allocated for setting-up port-based industries.

The primary hinterland of Ramayyapatnam Port encompasses the districts of Prakasam, Guntur, Kurnool, and Kadapah in Andhra Pradesh and Nalgonda, Mahaboobnagar, Rangareddy, and Hyderabad districts in Telangana.

Ramayapatnam Port is located at a distance of 290km from Nalgonda. Cement can be transported from Nalgonda railway station to Singarayakonda railway station which is 33.3km from Ramayapatnam Port. Thus, it would likely impose strong competition on the Machilipatnam Port/Anchorage.

2. **Bhavanapadu Port**

Bhavanapadu Port is located in the Srikakulam District of Andhra Pradesh. The port can act as an epicenter of development impacting not just its primary hinterland, but also the bordering districts of Chhattisgarh, Jharkhand, and South Orissa.

Just 75 km from Srikakulam town, the port is well-connected to National Highway-16 and the existing East Coast Railway line, both within 15 km of the port.

The port would be built with 4 berths to handle cargo, and with a deep draft of 17.5 m, the port would be able to handle 15 MTPA of cargo.

The port is located at a distance of 699 km from Nalgonda and is farthest compared to the other ports. Cement can be transported from Nalgonda railway station to East Coast Railway Line which is around 15km from Bhavanapadu Port. Thus, due to the large distance of the Nalgonda district from the Bhavanapadu Port, it may likely impose comparatively lower competition to the Machilipatnam port/Anchorage.

*Table 4-5: Annual Reports of Ports; Consultants Assessment*

*Source: Annual Reports of Ports; Consultant's Assessment*

| Parameters | *Units* | Targeted Port | Existing Ports | | | | Upcoming Ports | |
|---|---|---|---|---|---|---|---|---|
| | | Machilipatnam | Vishakhapatnam | Krishnapatnam | Kakinada | Gangavaram | Ramayapatnam | Bhavanapadu |
| Average Draft | *m* | 14.5 | 14.5 (inner harbor) | 18.5 | 14.5 | 21 | 15.5 | 17.5 |
| Bulk Handling Capacity | *MTPA* | 23 | 126.9 | 64 | 25 | 64 | 15 | 15 |
| Bulk Handled in FY-2022 | *MTPA* | - | 69.0 | 40.1 | - | 30.0 | - | - |
| Port Utilization in FY-2022 | *%* | - | 54.4 | 62.7 | NA | 46.9 | - | - |
| Cement Handled in FY-2021 | *MTPA* | - | 0.016 | 0.988 | 0.248 | - | - | - |
| Wharfage | *INR/Tn* | - | Foreign-28 Coastal-17 | 45 | 53.55 | 30 | - | - |
| Distance from Nalgonda District | *Km* | 262 | 534 | 380 | 410 | 543 | 290 | 699 |
| Nearest Railway Line | | South Central Railway line - 5.8 km | Visakhapatnam – 11 km | (KAPT) Krishnapatnam – 4.45 Km | Kakinada Port – 0 km | Visakhapatnam – 25 km | Tettu Railway station – 10 km | East Coast Railway Line -15 km |

## 4.12 TRAFFIC FORECAST

The traffic forecast of cement from Nalgonda and Jaggayyapeta to Machilipatnam Port via inland waterways is based on two parameters:

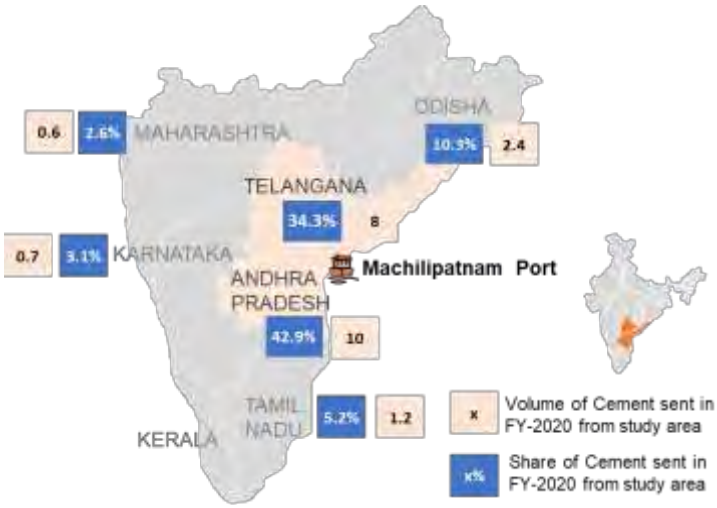
1. **Growth of background/ regional traffic**- Depends on ongoing socioeconomic, industrial, and demographic development of the catchment area served by the proposed development; and
2. **Competitive positioning of the IWT**- This reflects changes in handling capacity and logistics costs of competing modes and relative changes in service levels (time, congestion, losses due to multiple handling, etc.)

### 4.12.1 TLC OF CEMENT TRANSPORTATION BETWEEN SELECTED ODs ACROSS MODES

Total logistics costs have been evaluated based on existing ODs as well as the cost of transportation via different modes. The same has been used to calculate probable shifts to IWT in different scenarios.

1. EXISTING OD

The total production capacity and production output in FY-2020 for selected districts in our study area was 49.5 MTPA and 23.3 MTPA respectively. Based on stakeholders' discussions, the distribution of cement from these districts to neighboring states was observed to be as identified in the figure below:




Cement produced in manufacturing plants around Nalgonda and Jaggayyapeta is largely consumed in the states of Telangana and Andhra Pradesh, accounting for a cumulative share of ~77%. In Andhra Pradesh, Vijaywada and Amravati are the major consumption centres.

A large share of the production is also moved to consumption centres in other states including Bhubaneswar and Cuttack in Odisha, Chennai and Coimbatore in Tamil Nadu, Bangalore

*Source: Stakeholders Discussions*

***Fig.4.16 Distribution of cement from districts in the study area***

Further, based on key discussions, the rail and road split was identified for the identified consumption centres and is summarised in the table below:

***Table 4-6: Movement via rail and road to key consumption centres***

| Major Consumption centres | Road Share (%) | Rail share (%) | Road Volume (MTPA) | Rail Volume (MTPA) |
|---|---|---|---|---|
| **Vijaywada, Amravati** | 100% | 0% | 10.0 | - |
| **Bhubaneswar, Cuttack** | 75% | 25% | 1.8 | 0.6 |
| **Chennai, Coimbatore** | 90% | 10% | 1.1 | 0.1 |
| **Bangalore, Mysore, Raichur** | 70% | 30% | 0.5 | 0.2 |
| **Nanded, Solapur** | 60% | 40% | 0.4 | 0.2 |
| **West Bengal, Kerala, Pondicherry** | 80% | 20% | 0.3 | 0.1 |
| | **95% (average)** | **5% (average)** | **22.0** | **1.3** |

*Source: Stakeholders Discussions; Consultant assessment*

For the total cement produced in the selected districts, ~95% is moved via road whereas only ~5% is moved via rail.

2. TLC ASSUMPTIONS

The potential of cement transportation via IWT has been estimated by comparing the Logistics Cost of the competing modes. To calculate, the Total Logistics Cost (TLC), assumptions related to the cost of transportation via different modes were made which are given below:

***Table 4-7: Cost Assumptions for different modes***

| **Road Transportation Cost** | | | | |
|---|---|---|---|---|
| **Type of Cost** | **Unit** | **Cost** | | **Source** |
| **Road Haulage Cost** | *INR/tonne/km* | 5.00 | | *Stakeholders' Consultations* |
| **Loading/ Unloading cost on truck** | *INR/tonne* | 120.00 | | |
| | | | | |
| **Rail Transportation Cost** | | | | |
| **Type of Cost** | **Unit** | **Max. Haulage** | **Cost** | **Source** |

| Road Transportation Cost | | | | |
|---|---|---|---|---|
| | | Distance | | |
| Rail Haulage Cost | *INR/tonne* | 125 | 215.80 | *Rates Circular No. 09 of 2021, Railway Board, Ministry of Railway, GOI* |
| | *INR/tonne* | 200 | 329.90 | |
| | *INR/tonne* | 350 | 532.00 | |
| | *INR/tonne* | 375 | 565.60 | |
| | *INR/tonne* | 550 | 807.00 | |
| | *INR/tonne* | 600 | 867.10 | |
| | *INR/tonne* | 650 | 944.40 | |
| | *INR/tonne* | 750 | 1,081.00 | |
| | *INR/tonne* | 1000 | 1,417.00 | |
| | *INR/tonne* | 1100 | 1,552.30 | |
| **Loading/ Unloading cost on truck** | *INR/tonne* | 120.00 | | *Stakeholders' Consultations* |

| Inland Waterways Transportation Cost | | | |
|---|---|---|---|
| **Type of Cost** | **Unit** | **Cost** | **Source** |
| **Cost along NW-4** | *INR/tonne/km* | 0.95 | *Stakeholders' Consultations* |
| **Cost along Bandar Canal** | *INR/tonne/km* | 0.85 | |
| **Cost for Coastal Shipping** | *INR/tonne/km* | 1.05 | |
| **Loading/ Unloading costs on vessels** | *INR/tonne* | 120.00 | |

Assumptions related to first mile/last mile distances for total logistics costs calculation are:

***Table 4-8: Average Distances assumed for different modes***

| Distance Leg | Average Distance | Unit |
|---|---|---|
| **Average Lead Distance of Industries to Railway Station** | 50 | km |
| **Average Lead Distance of Industries to Muktyala Terminal** | 20 | km |
| **Distance from Muktyala to Prakassam Barrage** | 85 | km |
| **Length of Bandar Canal** | 80 | km |

*Source: Consultant's Assessment*

3. TLC CALCULATIONS

Total Logistics Cost (TLC) is calculated for different modes and across their combinations for cement cargo destined to key consumption centres from origin defined as industries near Nalgonda District. Four Supply chains were considered for TLC calculation as listed below:

***Table 4-9: Description of Supply Chains considered for TLC Comparison***

| Supply Chain | Description |
|---|---|
| **Supply Chain 1: Via road** | It indicates the existing logistics cost for cement transportation in the region via road.<br>  |

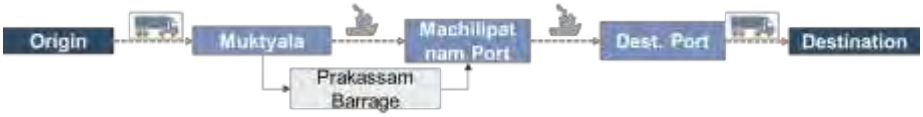
| | |
|---|---|
| **Supply Chain 2: Combination of Rail and Road** | It assesses the logistics cost of cement movement via rail and feeder transportation via road.<br>  |
| **Supply Chain 3: Combination of Road, and IWT** | It assesses the logistics cost of cement movement via IWT and feeder transportation via road.<br>  <br>Cement produced at industries near Nalgonda and Jaggayyapeta may likely be loaded at Mukltaya (nearest IWT terminal near Nalgonda) via a Class-III vessel along NW-4 and would be offloaded at Prakassam Barrage at Vijaywada. Cargo destined to Vijayawada and Amravati would be further moved to their destinations via road.<br>Whereas, traffic destined to other states would be loaded at Prakassam Barrage and moved to Machilipatnam Port via a Class-I vessel along Bandar Canal, and would be further transported coastally outward from Machilipatnam Port. |
| **Supply Chain 4: Combination of Rail, Road, and IWT** | It assesses the logistics cost of cement movement via IWT and feeder transportation via road and rail.<br>  <br>Cement produced at industries near Nalgonda and Jaggayyapeta may likely be loaded at Multaya (nearest IWT terminal near Nalgonda) via a Class-III vessel along NW-4 and would be offloaded at Prakassam Barrage at Vijaywada.<br>Traffic destined to other states would be loaded at Prakassam Barrage and further moved to Machilipatnam Port via a Class-I vessel along Bandar Canal, and would be further transported coastally outward from Machilipatnam Port. On reaching the Destination Port the cement cargo would be further loaded at Rail Yard in the Station and would be moved to the largest consumption centre via rail and would be redistributed to small consumption centres via road. |

Table 4-10 shows the TLC calculated for each consumption centre based on assumptions discussed under TLC ASSUMPTIONS. Highlighted Bars show the lowest TLC for each consumption centre across supply chains.

*Table 4-10: TLC Calculations along different supply chains (in INR/Tonne)*

| Destination | Supply Chain 1 | Supply Chain 2 | Supply Chain 3 | Supply Chain 4 |
|---|---|---|---|---|
| **Vijayawada** | 990.00 | 1,324.90 | 925.75 | Not Required |
| **Amravati** | 1,040.00 | 1,374.90 | 975.75 | Not Required |
| **Bhubaneswar** | 4,990.00 | 2,437.00 | 3,073.75 | 2,979.55 |
| **Chennai** | 3,065.00 | 2,037.10 | 2,016.25 | 2,256.25 |

| Destination | Supply Chain 1 | Supply Chain 2 | Supply Chain 3 | Supply Chain 4 |
|---|---|---|---|---|
| **Coimbatore** | 5,590.00 | 2,547.30 | 4,566.25 | 2,888.25 |
| **Bangalore** | 3,740.00 | 2,076.00 | 6,388.75 | 5,185.75 |
| **Nanded** | 2,340.00 | 1,585.60 | 7,973.75 | 6,358.15 |

*Source: Consultant's Assessment, Note: Further details are given as part of the annexure*

## 4. SHIFT OF TRAFFIC TO NW4/BANDAR CANAL FOR COASTAL SHIPPING

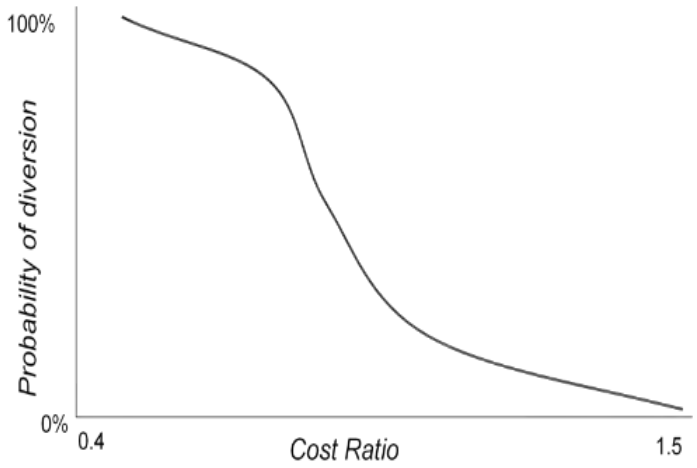



***Fig. 4-17: Presentation of Diversion curve***

Based on TLC calculated across modes, the shift percentage from the existing used mode to the mode where TLC is lowest was calculated using a probability function based on the diversion curve technique. This method uses the proportion of the cost of movement of goods in the new system and the cost of movement in the old system.

These curves represent an empirically derived relationship showing the proportion of traffic that is likely to be diverted to a new facility. The following equation have been used –

$P$ = 100 / (1 + ($Cr$) ^ 6), Where, Cr = Cost on new system / Cost on old system

Considering 95% of the cement cargo moves via road in the existing conditions, the cost of the old system was considered as the TLC on supply chain 1 i.e., via road. And based on cost-benefit analysis, since only for Amravati, Vijayawada, and Chennai, the cost of the new system i.e via NW-4/and or coastal shipping the cost of transportation was coming less compared to via road, the shift was estimated for these 3 locations.

***Table 4-11: Probable Shift to NW-4 and/or Bandar Canal***

| Destination | Supply Chain 1 | Supply Chain 2 | Supply Chain 3 | Supply Chain 4 |
|---|---|---|---|---|
| **Vijayawada** | 40% | 0% | 0% | 60% |
| **Amravati** | 41% | 0% | 0% | 59% |
| **Bhubaneswar** | 100% | 0% | 0% | 0% |
| **Chennai** | 7% | 0% | 93% | 0% |
| **Coimbatore** | 100% | 0% | 0% | 0% |
| **Bangalore** | 100% | 0% | 0% | 0% |

| Destination | Supply Chain 1 | Supply Chain 2 | Supply Chain 3 | Supply Chain 4 |
|---|---|---|---|---|
| **Nanded** | 100% | 0% | 0% | 0% |

*Source: Consultant's Assessment*

As per the above table, the cement traffic moving from Nalgonda and Jaggayyapeta to Vijaywada, Amravati, and Chennai would only be shifted to IWT, while the rest of the traffic would be largely moving via road due to cost and time advantage.

The shift estimated from the diversion curve method has been further triangulated based on stakeholder discussions. Based on this, the shift of cement traffic to Chennai via coastal shipping will likely be only 25% of the estimated shift (25% of estimated 93%= 23%), serving only the Metropolitan Region located close to Chennai Port to avoid multiple handling of cement.

## 4.13 CEMENT PRODUCTION IN THE STUDY AREA

The short-term cement cargo forecast has been estimated based on the growth of cement industries in the identified districts as well as the utilization of the existing industries to efficient levels.

Some of the key future expansion plans of manufacturing industries located around Nalgonda and Jaggayyapeta have been identified below.

***Table 4-12: Cement Industries Expansion Plans***

| Industry | Unit | Increase in Capacity | Likely Year for Expansion |
|---|---|---|---|
| **Shree Cement** | *MTPA* | 2.00 | FY-2025 |
| **NCL Industries** | *MTPA* | 1.16 | FY-2026 |
| **Maha Cement** | *MTPA* | 2.50 | FY-2023 |
| **Penna Cements** | *MTPA* | 1.00 | FY-2025 |
| **Total** | ***MTPA*** | **6.66** | **-** |

*Source: Consultant's Assessment*

Based on standard industry practices, it is assumed that these industries would likely be utilized up to 80% of their proposed capacities. The realizable production output from these industries has been gradually increased in the initial years, based on the following assumption.

***Table 4-13: Assumptions for Traffic Realization in Industries***

| Year from Commencement | Traffic Realized |
|---|---|
| **1st Year** | *40%* |
| **2nd Year** | *60%* |
| **3rd Year onwards** | *80%* |

*Source: Standard Industry Practices*

In addition to the upcoming plants, the capacity utilization of existing plants would also likely increase with the increasing demand for cement in the hinterland. The average capacity utilization of existing plants near Nalgonda and Jaggayyapeta is ~47%. This is assumed to likely increase to 75% based on the average CAGR growth rate of Manufacturing GSVA of Telangana and Andhra Pradesh.

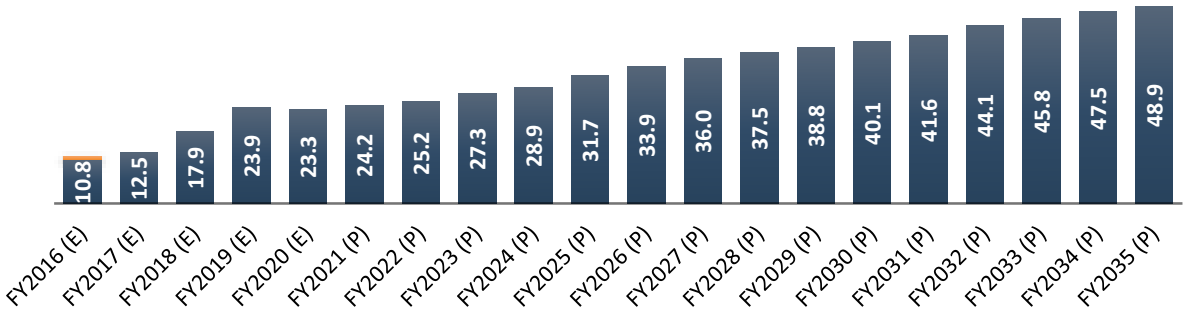
For the long-term production forecast, the CAGR growth rate of the previous 5 years of production has been considered from FY-2033 and is further reduced by 1% in FY-2035, as highlighted in the table below.

*Table 4-14: Incremental Cement Production in the Nalgonda and Jaggayyapeta region (in MTPA)*

| | FY-20 | FY-25 | FY-30 | FY-35 | FY-40 | FY-45 | FY-50 | FY-55 |
|---|---|---|---|---|---|---|---|---|
| **Traffic due to New Expansion Plans** | **-** | **3.20** | **5.32** | **5.32** | **5.32** | **5.32** | **5.32** | **5.32** |
| Increased Capacity Utilization at Existing Plants | 47% | 57% | 70% | 75% | 75% | 75% | 75% | 75% |
| **Traffic due to increased capacity utilization** | **23.29** | **31.68** | **40.15** | **42.48** | **42.48** | **42.48** | **42.48** | **42.48** |
| **Long Term CAGR Growth Rate** | **-** | **-** | **-** | 2.8% | 2.8% | 2.8% | 2.8% | 2.8% |
| **Total Cement Production** | **23.29** | **31.68** | **40.15** | **48.89** | **56.20** | **64.60** | **74.26** | **85.36** |

*Source: Consultant's Assessment*

The graph below depicts the future cement production in the region. The cement production would likely increase to ~49 MTPA in FY-2035, as compared to the production of 23.3 MTPA in FY-2020, growing at a CAGR growth rate of 5.1%.




*Source: Consultant's Assessment; Note: (E) stands for the Existing Traffic and (P) stands for Projected Traffic*

***Fig. 4-18: Projection of Cement Production in the study area (in MTPA)***

## 4.14 CEMENT CONSUMPTION IN TELANGANA AND ANDHRA PRADESH

As per the stakeholders' consultations, in FY-2020, cement consumption in the state of Telangana and Andhra Pradesh was witnessed to be ~8 MTPA and ~10 MTPA, respectively.

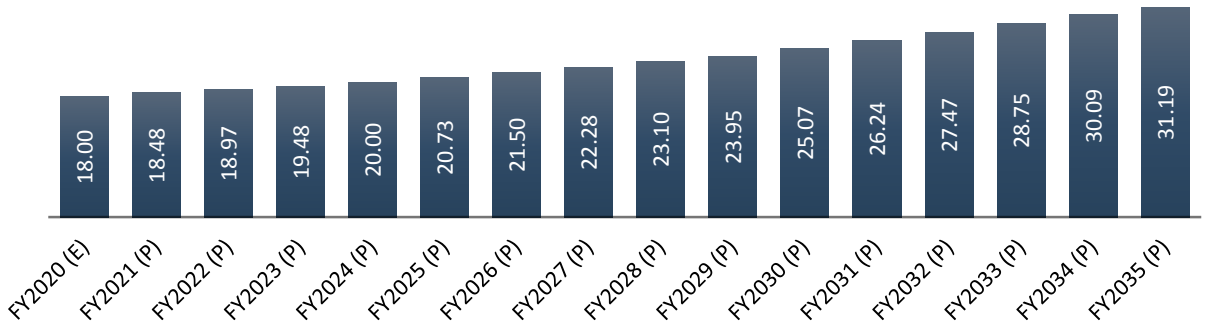
The existing cement consumption in the region would likely increase with the increase in construction activities and is projected based on the average Construction GSVA in the states of Andhra Pradesh and Telangana, which is estimated to be 3.7%. However, owing to the upcoming/ planned infrastructure developments like New Amravati, VCIC Corridors, and new Ports in Andhra Pradesh, cement demand would further increase, as indicated in the table below.

*Table 4-15: Cement Consumption Forecast in Telangana and Andhra Pradesh (in MTPA)*

| | FY-20 | FY-25 | FY-30 | FY-35 | FY-40 | FY-45 | FY-50 | FY-55 |
|---|---|---|---|---|---|---|---|---|
| **Rate of growth of cement consumption** | - | 3.7% | 4.7% | 3.7% | 3.7% | 3.7% | 3.7% | 3.7% |
| **Total Cement Consumption** | **18.00** | **20.73** | **25.07** | **31.19** | **37.36** | **44.73** | **53.57** | **64.14** |

*Source: Consultant's Assessment*

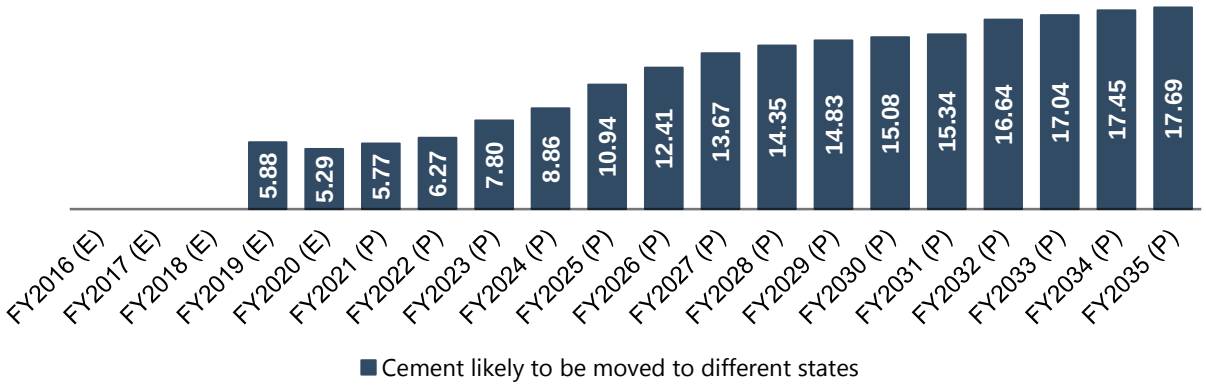
The graph below depicts the future cement consumption in the region. The cement consumption would likely increase to ~31 MTPA in FY-2035, as compared to the consumption of 18 MTPA in FY-2020, growing at a CAGR growth rate of 3.7%.




*Source: Consultant's Assessment; Note: (E) stands for the Existing Traffic and (P) stands for Projected Traffic*

***Fig. 4-19: Cement consumption in Telangana and Andhra (in MTPA)***

The balance of cement produced and consumed in the study area is considered to forecast cement that is likely to be moved out to different states for consumption.

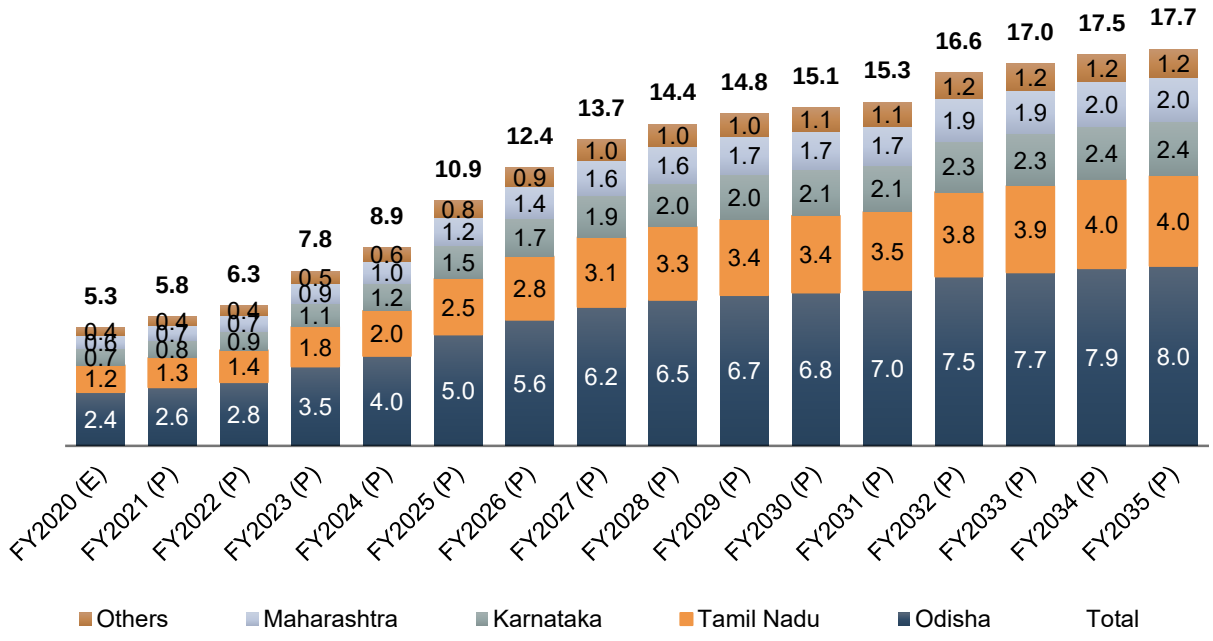



*Source: Consultant's Assessment; Note: (E) stands for the Existing Traffic and (P) stands for Projected Traffic*

***Fig. 4-20: Cement consumption and balance outward movement in the identified districts (in MTPA)***

## 4.15 OUTWARD MOVEMENT OF CEMENT TO OTHER STATES

The existing share of outward cement movement to other states, as discussed in Fig.4-21, has been assumed to remain the same in the future, and is highlighted in the figure below.




*Source: Consultant's Assessment; Note: (E) stands for the Existing Traffic and (P) stands for Projected Traffic*

***Fig. 4-21: Outward cement movement by state (in MTPA)***

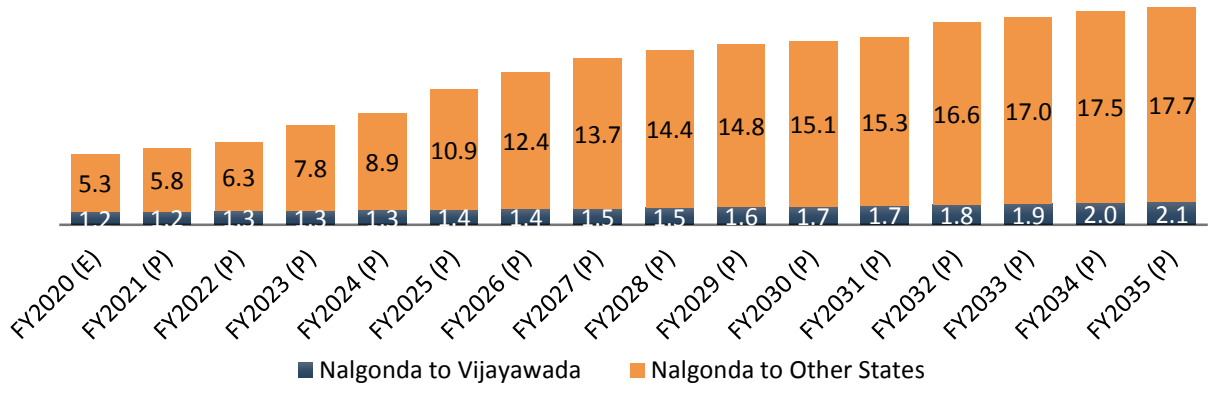
Also, as per the stakeholders' consultations, a large volume of cement, ~1 lakh tonnes/ month is currently moved from Nalgonda and Jaggayyapeta to Vijayawada. This movement is also considered as the probable traffic that can be moved via NW4, from Muktyala to Prakassam Barrage. This has been further forecasted based on the growth rate of cement consumption in the states of Telangana and Andhra Pradesh, as highlighted in Table 4-16.

*Table 4-16: Cement Movement from Nalgonda and Jaggayyapeta to Vijaywada (in MTPA)*

| | FY-20 | FY-25 | FY-30 | FY-35 | FY-40 | FY-45 | FY-50 | FY-55 |
|---|---|---|---|---|---|---|---|---|
| **Rate of growth of cement consumption** | - | 3.7% | 4.7% | 3.7% | 3.7% | 3.7% | 3.7% | 3.7% |
| **Total Cement Movement from Nalgonda to Vijaywada** | **1.20** | **1.38** | **1.67** | **2.08** | **2.49** | **2.98** | **3.57** | **4.28** |
| **Cement transportation to other states** | | | | | | | | |
| **Odisha** | 2.40 | 4.97 | 6.84 | 8.03 | 8.55 | 9.01 | 9.39 | 9.63 |
| **Tamil Nadu** | 1.20 | 2.48 | 3.42 | 4.01 | 4.27 | 4.51 | 4.69 | 4.81 |
| **Karnataka** | 0.72 | 1.49 | 2.05 | 2.41 | 2.56 | 2.70 | 2.82 | 2.89 |
| **Maharashtra** | 0.60 | 1.24 | 1.71 | 2.01 | 2.14 | 2.25 | 2.35 | 2.41 |
| **Others** | 0.37 | 0.77 | 1.05 | 1.24 | 1.32 | 1.39 | 1.45 | 1.48 |
| **Outward Cement Movement to other states** | **5.29** | **10.94** | **15.08** | **17.69** | **18.84** | **19.87** | **20.69** | **21.22** |

*Source: Consultant's Assessment*

The graph below depicts the outward cement transportation from Nalgonda and Jaggayyapeta . The cement transportation would likely increase to ~20 MTPA in FY-2035, as compared to the transportation of 6.5 MTPA in FY-2020.




*Source: Consultant's Assessment; Note: (E) stands for the Existing Traffic and (P) stands for Projected Traffic*

***Fig.4-22: Outward Cement Transportation from Nalgonda and Jaggayyapeta (in MTPA)***

## 4.16 Shift of Traffic to NW4/FOR COASTAL SHIPPING

The percentage of shift identified for different states, as identified from the TLC assessment in Section 0, has been used to estimate the potential shift of traffic to IWT. It is considered that the NW-4 would likely begin operations from FY-2024 and the traffic realized in the first year of commencement is assumed to be 40%, which would gradually increase to 100% by FY-2027.

This traffic has been further estimated to be handled at NW-4 and Bandar Canal. (from Muktyala to Prakassam Barrage) and Bandar Canal (from Prakassam Barrage to Machilipatnam Port). All the IWT-based cement traffic moving from the Nalgonda and Jaggayyapeta region would be loaded at Muktyala and offloaded at Prakassam Barrage, constituting the traffic at NW-4.

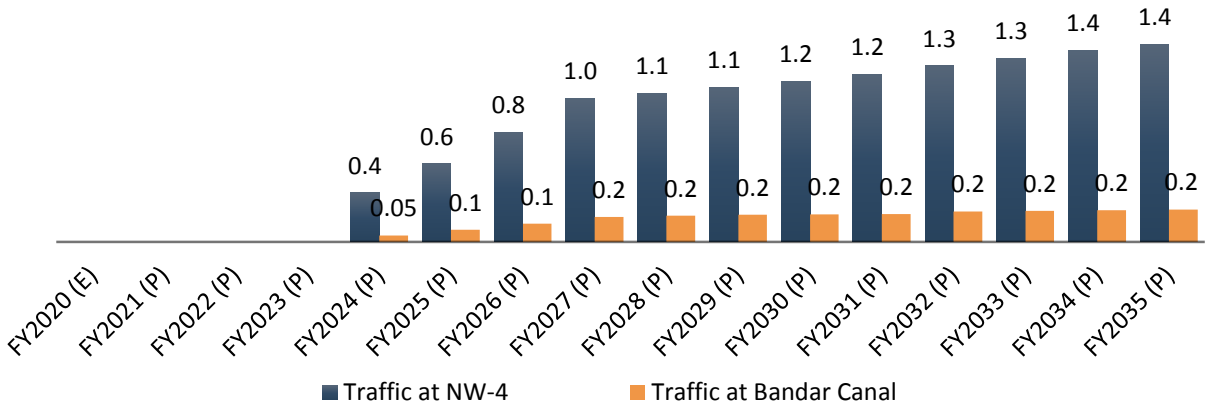
Further, traffic destined to the Vijaywada and Amravati would be offloaded at Prakassam Barrage and moved via road. The remaining traffic, to be transported to other states, would be moved via Bandar Canal to Machilipatnam Port for coastal shipping. As per the TLC assessment in Section 0, cement traffic moving to Chennai Metropolitan Region may likely be shifted to Bandar Canal which has been highlighted in the table below.

*Table 4-17: Cement Consumption Forecast in Telangana and Andhra Pradesh (in MTPA)*

| | FY-20 | FY-25 | FY-30 | FY-35 | FY-40 | FY-45 | FY-50 | FY-55 |
|---|---|---|---|---|---|---|---|---|
| **Cement traffic at NW-4 (destined to Vijayawada)** | 0.00 | 0.56 | 1.16 | 1.43 | 1.68 | 1.98 | 2.32 | 2.74 |
| **Cement traffic at Bandar Canal (destined to Chennai)** | 0.00 | 0.09 | 0.20 | 0.23 | 0.25 | 0.26 | 0.27 | 0.28 |

*Source: Consultant's Assessment*

The graph below depicts the outward cement transportation from Nalgonda and Jaggayyapeta . The cement transportation along NW-4 would likely increase from 0.4 MTPA in FY-2024 to ~1.4 MTPA in FY-2035. After considering the consumption at Vijaywada and Amravati, the remaining cement traffic would move to other states via Bandar Canal. Cement traffic at Bandar Canal would likely increase from 0.05 MTPA in FY-2024 to ~0.2 MTPA in FY-2035.




*Source: Consultant's Assessment; Note: (E) stands for the Existing Traffic and (P) stands for Projected Traffic*

***Figure 4-23: Cement Traffic along IWT (in MTPA)***

## 4.17 ANNEXURES

### 4.17.1 MINUTES OF MEETING

- NCL INDUSTRIES LIMITED

| Meeting with | NCL Industries Limited |
|---|---|
| **Category** | Private Cement Manufacturing Company |
| **Date** | 18th July 2022 |
| **Location** | Telephonic Conversation |
| **Meeting Attended by** | 1. Mr. Shyam Prakash (Vice President Sales and Marketing)<br>2. Mr. Nivesh Chaudhary<br>3. Ms. Shikha Kosta<br>4. Ms. Yamini Khurana |

Minutes of Meeting

| | |
|---|---|
| **Key Activities** | Deals in cement manufacturing in Nalgonda |
| **Production/ output** | NA |
| **Production capacity** | NA |
| **Key consumption centres** | Telangana, Andhra Pradesh, Karnataka, Orissa, Tamil Nadu, Kerala, Maharashtra, and Pondicherry |
| **Transportation** | Movement mostly through road |
| **Key issues discussed** | |
| − Currently, there is no export of cement from NCL. Cement is only sent domestically within Telangana and to Andhra Pradesh, Karnataka, Orissa, Tamil Nadu, Kerala, Maharashtra, and Pondicherry. The export of cement is discouraged by the high coal prices as well as the cost of transportation of cement from industries to ports. The majority of the cement industries in southern India are located away from the ports (the nearest port is 300-500 Km away) which makes the transportation of cement unfeasible.<br>− The cost for transportation of cement bags is INR 40/bag to the nearest port.<br>− NCL industries have also explored transportation of cement via rakes from the factory itself and then packaging it near the port but due to multiple handling, the option was not considered viable.<br>− If the cement bags are sent via container to the port then the cost turns out to be INR 2200/ton on the surface. The nearest ports are Krishnapatnam and Chennai Port.<br>− Existing cement industries in the Nalgonda region are located along the Krishna River only.<br>− Bandar Canal is primarily used for irrigation purposes. At the time of the Britishers, the canal was used extensively for the transportation of goods.<br>− NCL industries have also run trials for coastal shipping for the transportation of cement to other neighbouring states. The cost of transportation via road is INR 2300-2500/ton. Via rail is INR 2100-2300/ton and a hybrid of rail and coastal shipping is INR 1800-1900/ton.<br>− For a container, the cost of transportation is INR 8-10/bag or INR 160/ton.<br>− The nearest railway station is Nalgonda station (15-20 Km) and the nearest junction is Guntur.<br>− The company has an expansion plan under which the capacity would be increased by 3500 tons/day.<br>− Machilipatnam is the nearest port and it would be highly feasible to export via the same. | |

| |
|---|
| – In the nearby region, Shree Cement is also undergoing expansion and is planning to operate a 2 MTPA plant. |
| Outlook for the proposed NW-4 route for transportation of cement to Machilipatnam |
| – Positive<br>– Concerns regarding Bandar Canal |
| References provided |
| – NA |

### 4.17.2 MY HOME INDUSTRIES

| Meeting with | My Home Industries |
|---|---|
| **Category** | Private Cement Manufacturing Company |
| **Date** | 18th July 2022 |
| **Location** | Telephonic Conversation |
| **Meeting Attended by** | 1. Mr. Suresh (Regional Manager, Nalgonda Plant)<br>2. Mr. Nivesh Chaudhary<br>3. Ms. Shikha Kosta<br>4. Ms. Yamini Khurana |

Minutes of Meeting

| | |
|---|---|
| **Key Activities** | Deals in cement manufacturing in Nalgonda |
| **Production/ output** | NA |
| **Production capacity** | 3.5 MTPA |
| **Key consumption centres** | Telangana, Andhra Pradesh, Karnataka, Tamil Nadu, Kerala, Maharashtra, and Madhya Pradesh |
| **Transportation** | Movement mostly through rail |
| **Key issues discussed** | |
| − There is no export of cement from the plant. Domestically 7% of the produce goes to Tamil Nadu, 4% to Kerala, 5% to Karnataka, 2-3% to Maharashtra and Madhya Pradesh each, and the remaining 80% is distributed within Telangana and Andhra Pradesh.<br>− To Karnataka, the cement is sent via rail or road and to all the other states it is sent via rail.<br>− Transportation cost via road to Karnataka is INR 55/Bag and to Telangana and Andhra Pradesh is INR 30/Bag. On average the cost of transportation via rail is INR 40/Bag.<br>− The manufacturing cost of cement is INR 400/Bag.<br>− The existing plant at Nalgonda is being expanded for an additional 2.5 MTPA by September. | |
| Outlook for the proposed NW-4 route for transportation of cement to Machilipatnam | |
| − Positive | |
| References provided | |
| − NA | |

### 4.17.3 SAGAR CEMENTS

| Meeting with | Sagar Cements |
|---|---|
| Category | Private Cement Manufacturing Company |
| Date | 19th July 2022 |
| Location | Telephonic Conversation |
| Meeting Attended by | 1. Mr. Shankar Narayan (Head of Marketing, Mattampally Plant)<br>2. Mr. Nivesh Chaudhary<br>3. Ms. Shikha Kosta<br>4. Ms. Yamini Khurana |

Minutes of Meeting

| | |
|---|---|
| **Key Activities** | Deals in cement manufacturing in Mattampally |
| **Production/ output** | ~3 MTPA |
| **Production capacity** | ~5 MTPA |
| **Key consumption centres** | Telangana, Andhra Pradesh, Tamil Nadu, Odisha, and Maharashtra |
| **Transportation** | Movement mostly through road |

**Key issues discussed**

- The cement industry currently produces ~3 MTPA of cement against the existing capacity of ~5 MTPA. This is largely due to the lower demand in the immediate hinterland.
- ~1.5 MTPA of the cement produced in the plant is consumed in Telangana State, while the rest is moved to other states for consumption in construction industries.
- ~30% of the total production is moved to Andhra Pradesh, mostly in the regions around Vijayawada via road.
- Another 15-20% is further moved to Tamil Nadu and the southern regions of Odisha.
- A small fraction is also moved to Maharashtra, mostly via road.
- 90-95% of the traffic movement is via road. Cement handling via rail is largely not preferred as multiple handling damages the cement and also increases the cost further. Cement traffic via rail is currently only moved to a few parts in Maharashtra due to longer haulage and cost advantage.
- There is no export of cement from the plant.
- Average transportation cost via road is ~INR 1000-1100/tonne for moving the cargo from the industry to Krishnapatnam Port, while the same from rail accounts for ~800-900/tonne plus handling cost (which includes loading/unloading, storage, and other miscellaneous charges). Thus, rail is only advantageous at longer haulage.
- Currently, the industry is aiming to increase capacity utilization at the plant.
- In the previous financial year, capacity utilization was only ~60% which went down to 50-55% in the earlier COVID-impacted years.
- NW-4 may be preferred only if the transportation rates are lower and also the connectivity is established directly to the ports.
- However, Bandar Canal doesn't have adequate width currently to handle cement vessels. This may also impose a huge challenge for cement movement.

Outlook for the proposed NW-4 route for transportation of cement to Machilipatnam

- Concerns about cement movement through Bandar Canal

References provided

- NA

### 4.17.4 ZUARI CEMENTS

| Meeting with | Zuari Cements |
|---|---|
| Category | Private Cement Manufacturing Company |
| Date | 19th July 2022 |
| Location | Telephonic Conversation |
| Meeting Attended by | 1. Mr. Hari Prasad Rao (Zonal Head)<br>2. Mr. Nivesh Chaudhary<br>3. Ms. Shikha Kosta<br>4. Ms. Yamini Khurana |

Minutes of Meeting

| **Key Activities** | Deals in cement manufacturing in Telangana and Andhra Pradesh |
|---|---|
| **Production/ output** | ~1 MTPA |
| **Production capacity** | ~1.5 MTPA |
| **Key consumption centres** | Telangana and Andhra Pradesh |
| **Transportation** | Movement mostly through road |
| Key issues discussed | |
| − Currently, two Zuari cement manufacturing industries are operating in Andhra Pradesh, One is at Sitapuram while the other is located at Yerraguntla and is towards the southern part of the state.<br>− The Sitapuram-based plant has a capacity of ~1.5 MTPA with a production of ~1 MTPA.<br>− Cement produced in the state is only consumed in the states of Telangana and Andhra Pradesh, with 100% movement via road.<br>− On average, the state of Telangana produces ~18-20 MTPA of cement. Only 7-8 MTPA is consumed in the state while the rest is transported to other states. Over 60% of the cement traffic comes to Andhra Pradesh.<br>− Similarly, Andhra Pradesh produces ~30 MTPA cement. It is the largest cement-producing state.<br>− Cumulative cement consumption in both the states is ~25-26 MTPA. While the rest is moved out.<br>− Currently, Zuari Cements does not handle any export in the region.<br>− A small volume of cement is exported from Krishnapatnam Port, roughly ~1-2 MTPA, which is mostly by the industries located in the southern districts around Kurnool. While most of the cement traffic is exported from Chennai Port.<br>− The average transportation cost via road is ~INR 10-11/tonne/km.<br>− The average rail transportation cost is 2-3 Rupees cheaper. The nearest railway station to the industry is located at Bonakalu, which is ~50km from the Sitapuram Plant. | |
| Outlook for the proposed NW-4 route for transportation of cement to Machilipatnam | |
| − Positive | |
| References provided | |
| − NA | |

### 4.17.5 KCP LIMITED

| Meeting with | KCP Limited |
|---|---|
| **Category** | Private Cement Manufacturing Company |
| **Date** | 27th July 2022 |
| **Location** | Telephonic Conversation |
| **Meeting Attended by** | 1. V. Madhusudan Vice President (Muktyala Plant)<br>2. Srinivasam Rao, Deputy Director, Department of Industries, A.P<br>3. Ms. Shikha Kosta<br>4. Ms. Yamini Khurana |

## Minutes of Meeting

| | |
|---|---|
| *Key Activities* | Deals in cement manufacturing |
| *Production/ output* | ~(2.7+0.6) MTPA |
| *Production capacity* | ~(3.8+0.8) MTPA |
| *Key consumption centres* | Telangana, Andhra Pradesh, Orissa, Tamil Nadu |
| *Transportation* | Movement mostly through road |

**Key issues discussed**

- KCP has two plants in Andhra Pradesh-one in Macherla in Guntur (0.8 MTPA) and another in Mukteswarapuram in Muktyala (3.8 MTPA). Both the plants are operating at 70% capacity only.
- In terms of procurement of raw materials-limestone is mined within the plant complex, bauxite is imported from Warangal, and Panduru by trucks, coal is imported at Krishnapatnam port and from there moved by road, and gypsum is imported at Vishakhapatnam port and similarly moved via road. Clay is not required in cement manufacture at the plant.
- 40% of the produce goes via road and 60% via rail to Bhubaneshwar in Orissa and Chennai in Tamil Nadu.
- Local Consumption in Andhra Pradesh is 25-30%.
- Clinker export to Sri Lanka and Bangladesh are not viable because of the higher value of the dollar.
- Singapore imports clinker from Malaysia.
- Transport of cement to Chennai via Machilipatnam is not viable because of multiple handling issues. Direct rail connectivity exists. Nearest Railway station at Jaggaiahpet on Vijayawada -Hyderabad line.
- No Future Expansion Plans

**Outlook for the proposed NW-4 route for transportation of cement to Machilipatnam**

- Machilipatnam Port will be more viable to import raw materials than exporting cement via NW-4 as in the existing conditions coal and gypsum are imported at Krishnapatnam and Vishakhapatnam ports which are 300-500 Km away from the cement industry's locations.

**References provided**

- NA

### 4.17.6 ULTRACTECH CEMENT

| Meeting with | Ultratech Cement |
|---|---|
| **Category** | Private Cement Manufacturing Company |
| **Date** | 27th July 2022 |
| **Location** | Telephonic Conversation |
| **Meeting Attended by** | 1. Ranga Kumar, Vice President<br>2. Srinivasam Rao, Deputy Director, Department of Industries, A.P<br>3. Ms. Shikha Kosta<br>4. Ms. Yamini Khurana |

## Minutes of Meeting

| | |
|---|---|
| *Key Activities* | Deals in cement manufacturing |
| *Production/ output* | - |
| *Production capacity* | - |
| *Key consumption centres* | Telangana, Andhra Pradesh, Orissa, Tamil Nadu |
| *Transportation* | Movement mostly through road |
| **Key issues discussed** | |
| – At Bandar Canal, Barge Capacity is not more than 2,000 tons and only small quantities of cement can be worked out. For large quantities, cement flow through Bandar Canal is not economically viable.<br>– Jaggaiahpet to Machilipatnam port, there is rail connectivity, so scope of utilization of NW-4 will be limited.<br>– Export of cement clinkers can be explored.<br>– Cement bag movement via barrage will be difficult due to multiple handling.<br>– During peak season, rakes availability is less. So, more dependence on the road.<br>– If Machilipatnam port comes, the import of raw materials can be explored. | |
| **Outlook for the proposed NW-4 route for transportation of cement to Machilipatnam** | |
| – Positive for import of raw materials | |
| **References provided** | |
| – NA | |

### 4.17.7 BHAVYA CEMENT

| Meeting with | Bhavya Cement |
|---|---|
| **Category** | Private Cement Manufacturing Company |
| **Date** | 27th July 2022 |
| **Location** | In-Person Meet |
| **Meeting Attended by** | 1. Ranga Kumar, Vice President<br>2. Ms. Shikha Kosta<br>3. Ms. Yamini Khurana |

## Minutes of Meeting

| | |
|---|---|
| *Key Activities* | Deals in cement manufacturing |
| *Production/ output* | 0.96 MTPA |
| *Production capacity* | 1.2 MTPA |
| *Key consumption centres* | Bangalore, Tamil Nadu, Maharashtra |
| *Transportation* | Movement mostly through road |

**Key issues discussed**

- One cement plant is located in Tangeda village in Guntur with an 80-90k production capacity per month.
- 100% movement via road
- Around 2000 hectares of cement plant with 1000 hectares used for limestone mining
- In a month, 30,000 tons of cement are exported to Andhra Pradesh, 25,000-30,000 tons of cement to Telangana, and another 5,000-7,000 tons to Karnataka (Bangalore). Some amount is also sent to Chennai and Nanded in Maharashtra.
- Nadikudi Railway Station is nearest to the plant (13 Km).
- Transportation cost per km varies according to distance. INR 600/metric ton in Krishna district from plant to Vijayawada. (INR 25-30 per bag)
- Within Guntur district- INR 18-30/bag, Krishna – INR 30-39/bag, Hyderabad – INR 39-40/bag.
- Loading charges are INR 5/bag or INR 100/metric ton.
- Bhavya Cement has no expansion plans
- Andhra Cements is being taken over by Sagar Cements.
- NCL cement is being expanded by 1.5 MTPA in Guntur.
- Overall 15-20 industries in Macherla and Jaggaiahpet combined.
- Only Penna Cements is exporting, the rest all domestically.

**Outlook for the proposed NW-4 route for transportation of cement to Machilipatnam**

- Positive for import of raw materials

**References provided**

- NA

### 4.17.8 PENNA CEMENT

| Meeting with | Penna Cement |
|---|---|
| **Category** | Private Cement Manufacturing Company |
| **Date** | 27th July 2022 |
| **Location** | In-Person Meet |
| **Meeting Attended by** | 1. Mr. Ramakrishnan, Regional Manager<br>2. Ms. Shikha Kosta<br>3. Ms. Yamini Khurana |

## Minutes of Meeting

| | |
|---|---|
| *Key Activities* | Deals in cement manufacturing |
| *Production/ output* | - |
| *Production capacity* | - |
| *Key consumption centres* | Andhra Pradesh, Telangana, Orissa, West Bengal, Karnataka |
| *Transportation* | Movement mostly through road |
| **Key issues discussed** | |
| – Penna has a plant in Ganeshpahad.<br>– Penna Cements exports to Sri Lanka via Ship. Export via Krishnapatnam port where Penna owned 3 ships exist.<br>– In Maharashtra, the export is to ICL + Ultratech via road.<br>– In Nalgonda, Penna has a plant of 3.5 MTPA capacity. Another 1 MTPA is being added under expansion.<br>– Export Bifurcation<br>o Andhra Pradesh, 1 lakh tonne via road<br>o Orissa, 40,000 tonnes via rail<br>o West Bengal, 25,000 tonnes via rail<br>o Karnataka, 60,000 tonnes via road<br>o Telangana, 1.2 MTPA via road<br>o Tamil Nadu, 60,000 tonnes via road<br>– Transportation cost 4.25/per km/ton | |
| **Outlook for the proposed NW-4 route for transportation of cement to Machilipatnam** | |
| – Positive for import of raw materials | |
| **References provided** | |
| – NA | |

### 4.17.9 ANDHRA PRADESH CHAMBERS OF COMMERCE AND INDUSTRY FEDERATION

| Meeting with | Andhra Pradesh Chambers of Commerce and Industry Federation |
|---|---|
| **Category** | Private Cement Manufacturing Company |
| **Date** | 27th July 2022 |
| **Location** | In-Person Meet at the office of Andhra Pradesh Chambers of Commerce and Industry Federation |
| **Meeting Attended by** | 1. Potluri Bhaskara Rao, President-elect of Andhra Pradesh Chambers of Commerce and Industry Federation<br>2. Sripathi A, Sr. Marketing Manager, Maha Cement<br>3. K. Satyanarayana, Channel Relationship Manager, Ultratech Cement<br>4. Madan Jayagopal, regional Logistics Head, AP, Ultratech<br>5. G.V.N.V Sudheer, Vice-President, State GC Member, National Real Estate Development Council<br>6. Sambasiva Rao V, Industrialist, Importer-Exporter, Director AP Chamber of Commerce and Industry Association<br>7. G. Hemanth Kumar, Sr. Regional Marketing Manager, The KCP Limited<br>8. Sri Nivas, The KCP Limited<br>9. P. Vishnu, AGM-Marketing, The Ramco Cements Limited<br>10. Sri Nivas, Administrative, Sagar Cements<br>11. Ms. Shikha Kosta<br>12. Ms. Yamini Khurana |

## Minutes of Meeting

| | |
|---|---|
| *Key Activities* | Deals in cement manufacturing, logistics and construction activities |
| *Production/ output* | NA |
| *Production capacity* | NA |
| *Key consumption centres* | NA |
| *Transportation* | NA |
| **Key issues discussed** | |
| − For Ultratech cement, the existing movement is by road only. Major consumption centres are Telangana and Orissa.<br>− Among the major challenge in cement transportation is the increasing cost of diesel. Transportation via rail is not viable because of the small size of packages.<br>− Ultratech has plants to cater to Tamil Nadu separately, hence no need for rail even for longer haulages.<br>− From the cement plants in Nalgonda, more than 1 lakh tonnes of cement per month to Vijayawada for re-distribution.<br>− Another challenge faced in cement transportation is the loading and unloading of small-sized packages which | |

| |
|---|
| makes the supply chain inefficient if done multiple times.<br>– Similar to rail, the supply chain via vessel will also be beneficial for longer haulages.<br>– The major movement of cement via road in Vijayawada. It is one of the largest logistics hubs in India. Vijayawada also has one of the largest railway junctions as well.<br>– Both rail and road infrastructure of Andhra Pradesh is well-established.<br>– All large cement plants have 2 or more plants. Cement plants are mostly set up to serve local demands because of large transportation costs in longer haulages.<br>– Andhra Pradesh in itself is also a large consumer of cement.<br>– More than 1 lakh tonnes per month of cement is sent from the Ultratech plant to Vijayawada for re-distribution.<br>– The existing cement cost of production is very high. Parallelly there is a low demand for cement as well. Therefore, low-capacity utilization in mostly all plants.<br>– INR 110-140/ton is the cost of manually handling cement (loading only)<br>– INR 600/ton is the cost of transportation of cement up to 120-150 Km.<br>– INR 2500/ton is the cost of transportation via wagon.<br>– An issue while transportation of cement via road is the unavailability of drivers.<br>– While transporting cement via vessel, an issue will be the lack of storage place near the port.<br>– Import of cement is a seasonal activity. The major requirement is from Jan-June. The water level has to be high during these months for the flow of cement via the Krishna River.<br>– In a month, 1-1.5 lakh tons of cement are exported to Orissa, and 50,000 tons to Maharashtra.<br>– The maximum cement that might be exported to Sri Lanka from nation is 25,000 per month.<br>– The cement plants have low production capacities because the consumption levels have reduced as well as the cost of production has gone up.<br>– There is no export of cement to Bangladesh as the distance is more and hence the cost of transportation will be high.<br>– From Nalgonda, 40-50% is consumed within Andhra Pradesh and Telangana.<br>– In summary, the challenges faced in the existing supply chain via road are increasing diesel costs, multiple times loading/unloading, availability of drivers, the availability of the fleet, and toll charges. |
| **Outlook for the proposed NW-4 route for transportation of cement to Machilipatnam** |
| – Required storage facilities, warehouses near the port<br>– Clear route map, points of loading and unloading |
| **References provided** |
| – NA |

## 4.18 Total Logistics Cost

*Table 4-18: TLC along Supply Chain 1- Road*

| Destination | Lead Distance | Transportation Cost | Loading/ Unloading Cost | TOTAL |
|---|---|---|---|---|
| | *km* | *INR/tonne* | *INR/tonne* | *INR/tonne* |
| **Vijaywada** | 150 | 750 | 240 | 990 |
| **Amravati** | 160 | 800 | 240 | 1,040 |
| **Bhubaneswar** | 950 | 4,750 | 240 | 4,990 |
| **Chennai** | 565 | 2,825 | 240 | 3,065 |
| **Coimbatore** | 1070 | 5,350 | 240 | 5,590 |
| **Bangalore** | 700 | 3,500 | 240 | 3,740 |
| **Nanded** | 420 | 2,100 | 240 | 2,340 |

*Table 4-19: TLC along Supply Chain 2- Road + Rail + Road*

| Destination | 1st Leg: Road | | | 2nd Leg: Rail | | | 3rd Leg: Road | | | TOTAL | Cost Saving |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Distance | Transportation Cost | Loading/ Unloading Cost | Distance | Transportation Cost | Loading/ Unloading Cost | Distance | Transportation Cost | Loading/ Unloading Cost | | Supply Chain 1 |
| | *km* | *INR/tonne* | *INR/tonne* | *km* | *INR/tonne* | *INR/tonne* | *km* | *INR/tonne* | *INR/tonne* | *INR/tonne* | *%* |
| **Vijaywada** | 50 | 250 | 240 | 200 | 329.9 | 240 | 5 | 25 | 240 | 1,324.9 | -34% |
| **Amravati** | 50 | 250 | 240 | 200 | 329.9 | 240 | 15 | 75 | 240 | 1,374.9 | -32% |
| **Bhubaneswar** | 50 | 250 | 240 | 1,000 | 1,417 | 240 | 10 | 50 | 240 | 2,437 | 51% |
| **Chennai** | 50 | 250 | 240 | 600 | 867.1 | 240 | 40 | 200 | 240 | 2,037.1 | 34% |
| **Coimbatore** | 50 | 250 | 240 | 1,100 | 1,552.3 | 240 | 5 | 25 | 240 | 2,547.3 | 54% |
| **Bangalore** | 50 | 250 | 240 | 750 | 1,081. | 240 | 5 | 25 | 240 | 2,076 | 44% |
| **Nanded** | 50 | 250 | 240 | 375 | 565.6 | 240 | 10 | 50 | 240 | 1,585.6 | 32% |

*Table 4-20: Supply Chain 3- Road + NW4 + Bandar Canal + Coastal Shipping + Road)*

| Destination | 1st Leg: Road | | | 2nd Leg: NW-4 | | | 3rd Leg: Bandar Canal | | |
|---|---|---|---|---|---|---|---|---|---|
| | Distance | Transportation Cost | Loading/ Unloading Cost | Distance | Transportation Cost | Loading/ Unloading Cost | Distance | Transportation Cost | Loading/ Unloading Cost |
| | *km* | *INR/tonne* | *INR/tonne* | *km* | *INR/tonne* | *INR/tonne* | *km* | *INR/tonne* | *INR/tonne* |
| **Vijaywada** | 20 | 100 | 240 | 85 | 80.7 | 240 | - | - | - |
| **Amravati** | 20 | 100 | 240 | 85 | 80.7 | 240 | - | - | - |
| **Bhubaneswar** | 20 | 100 | 240 | 85 | 80.7 | 240 | 80 | 68 | 240 |
| **Chennai** | 20 | 100 | 240 | 85 | 80.7 | 240 | 80 | 68 | 240 |
| **Coimbatore** | 20 | 100 | 240 | 85 | 80.7 | 240 | 80 | 68 | 240 |
| **Bangalore** | 20 | 100 | 240 | 85 | 80.7 | 240 | 80 | 68 | 240 |
| **Nanded** | 20 | 100 | 240 | 85 | 80.7 | 240 | 80 | 68 | 240 |

| Destination | 4th Leg: Coastal Shipping | | | 5th Leg: Road | | | TOTAL | Cost Saving | Cost Saving |
|---|---|---|---|---|---|---|---|---|---|
| | Distance | Transportation Cost | Loading/ Unloading Cost | Distance | Transportation Cost | Loading/ Unloading Cost | | Case-1 (Road) | Case-2 (Rail) |
| | *km* | *INR/tonne* | *INR/tonne* | *km* | *INR/tonne* | *INR/tonne* | *INR/tonne* | *%* | *%* |
| **Vijaywada** | - | - | - | 5 | 25 | 240 | 925.7 | 6% | 30% |
| **Amravati** | - | - | - | 15 | 75 | 240 | 975.7 | 6% | 29% |
| **Bhubaneswar** | 1,000 | 1,050 | 240 | 115 | 575 | 240 | 3,073.7 | 38% | -26% |
| **Chennai** | 350 | 367.5 | 240 | 40 | 200 | 240 | 2,016.3 | 34% | 1% |
| **Coimbatore** | 350 | 367.5 | 240 | 550 | 2,750 | 240 | 4,566.3 | 18% | -79% |
| **Bangalore** | 2,800 | 2,940 | 240 | 400 | 2,000 | 240 | 6,388.7 | -71% | -208% |
| **Nanded** | 3,500 | 3,675 | 240 | 570 | 2,850 | 240 | 7,973.7 | -241% | -403% |

*Table 4-21: Supply Chain 4- Road + NW4 + Bandar Canal + Coastal Shipping + Rail + Road*

| Destination | 1st Leg: Road | | | 2nd Leg: NW-4 | | | 3rd Leg: Bandar Canal | | |
|---|---|---|---|---|---|---|---|---|---|
| | Distance | Transportation Cost | Loading/ Unloading Cost | Distance | Transportation Cost | Loading/ Unloading Cost | Distance | Transportation Cost | Loading/ Unloading Cost |
| | *km* | *INR/tonne* | *INR/tonne* | *km* | *INR/tonne* | *INR/tonne* | *km* | *INR/tonne* | *INR/tonne* |
| **Vijaywada** | 20 | 100 | 240 | 85 | 80.75 | 240 | - | - | - |
| **Amravati** | 20 | 100 | 240 | 85 | 80.75 | 240 | - | - | - |
| **Bhubaneswar** | 20 | 100 | 240 | 85 | 80.75 | 240 | 80 | 68 | 240 |
| **Chennai** | 20 | 100 | 240 | 85 | 80.75 | 240 | 80 | 68 | 240 |
| **Coimbatore** | 20 | 100 | 240 | 85 | 80.75 | 240 | 80 | 68 | 240 |
| **Bangalore** | 20 | 100 | 240 | 85 | 80.75 | 240 | 80 | 68 | 240 |
| **Nanded** | 20 | 100.00 | 240 | 85 | 80.75 | 240 | 80 | 68.00 | 240 |

| Destination | 4th Leg: Coastal Shipping | | | 5th Leg: Rail | | | 6th Leg: Road | | | TOTAL | Cost Saving | Cost Saving | Cost Saving |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Distance | Transportation Cost | Loading/ Unloading Cost | Distance | Transportation Cost | Loading/ Unloading Cost | Distance | Transportation Cost | Loading/ Unloading Cost | | Case-1 | Case-2 | Case-3 |
| | *km* | *INR/tonne* | *INR/tonne* | *km* | *INR/tonne* | *INR/tonne* | *km* | *INR/tonne* | *INR/tonne* | *INR/tonne* | *%* | *%* | *%* |
| **Vijaywada** | - | - | - | - | - | - | 5 | 25 | 240 | 925.75 | 6% | 30% | 0% |
| **Amravati** | - | - | - | - | - | - | 15 | 75 | 240 | 975.75 | 6% | 29% | 0% |
| **Bhubaneswar** | 1,000 | 1,050 | 240 | 125 | 215.8 | 240 | 5 | 25 | 240 | 2,979.55 | 40% | -22% | 3% |
| **Chennai** | 350 | 367.5 | 240 | - | - | 240 | 40 | 200 | 240 | 2,256.25 | 26% | -11% | -12% |
| **Coimbatore** | 350 | 367.5 | 240 | 550 | 807 | 240 | 5 | 25 | 240 | 2,888.25 | 48% | -13% | 37% |
| **Bangalore** | 2,800 | 2,940 | 240 | 350 | 532 | 240 | 5 | 25 | 240 | 5,185.75 | -39% | -150% | 19% |
| **Nanded** | 3,500 | 3,675 | 240 | 650 | 944.4 | 240 | 10 | 50.00 | 240 | 6,358.15 | -172% | -301% | 20% |

# CHAPTER – 5
# FUNCTIONAL PLANNING

## 5.1 General

5.1.1 Inland Waterways Authority of India (IWAI) intends to transport cement through waterway from Muktyala to Bay of Bengal. Muktayala is located along the River Krishna at 82 km upstream of Prakasam Barrage. From Prakasam Barrage, Bandar canal is originating and connecting the sea near Machhlipatanam. Various Cement industries are located near Nalagonda. All the IWT-based cement traffic moving from the Nalgonda region would be loaded at Muktyala and unloaded at Ibrahimpatnam terminal, constituting the traffic at NW-4. Further, traffic destined to the Vijayawada and Amravati would be unloaded at Ibrahimpatnam terminal and moved via road. The remaining traffic, to be transported to other states, would be moved via Bandar Canal to Machilipatnam Port/Anchorage for coastal shipping.

5.1.2 There would be 24 hrs. barges movements in the waterway. At Muktyala Terminal loading will be done by cranes having handling capacity ranging from 150 tph to 600 tph for different time horizons. At Ibrahimpatnam terminal, there will be unloading of cements with the cranes having same handling capacity. Traffic destined to Machhlipatnam Port/anchorage for coastal shipping will be loaded with cranes having handling capacity ranging from 50 tph to 450 tph for different time horizons. At Machhlipatnam Port/anchorage cement will be loaded through barges for coastal shipping in to bigger size coastal vessels.

## 5.2 Traffic Projection

The table below depicts the outward cement transportation from Nalgonda. The cement transportation along river stretch of NW-4 would likely to increase from 0.35 MTPA in FY-2024 to 2.74 MTPA in FY-2055. After considering the consumption at Vijayawada and Amravati, the remaining cement traffic would move to other states via Bandar Canal. Cement traffic at Bandar Canal would likely increase from 0.05 MTPA in FY-2024 to 0.28 MTPA in FY-2055.

***Table 5.1 : Traffic Projection***

| Stretch | FY-24 | FY-30 | FY-35 | FY-40 | FY-45 | FY-50 | FY-55 |
|---|---|---|---|---|---|---|---|
| **Cement traffic at NW-4 (destined to Vijayawada)** | 0.35 | 1.16 | 1.43 | 1.68 | 1.98 | 2.32 | 2.74 |
| **Cement traffic at Bandar Canal (destined to Chennai)** | 0.05 | 0.20 | 0.23 | 0.25 | 0.26 | 0.27 | 0.28 |

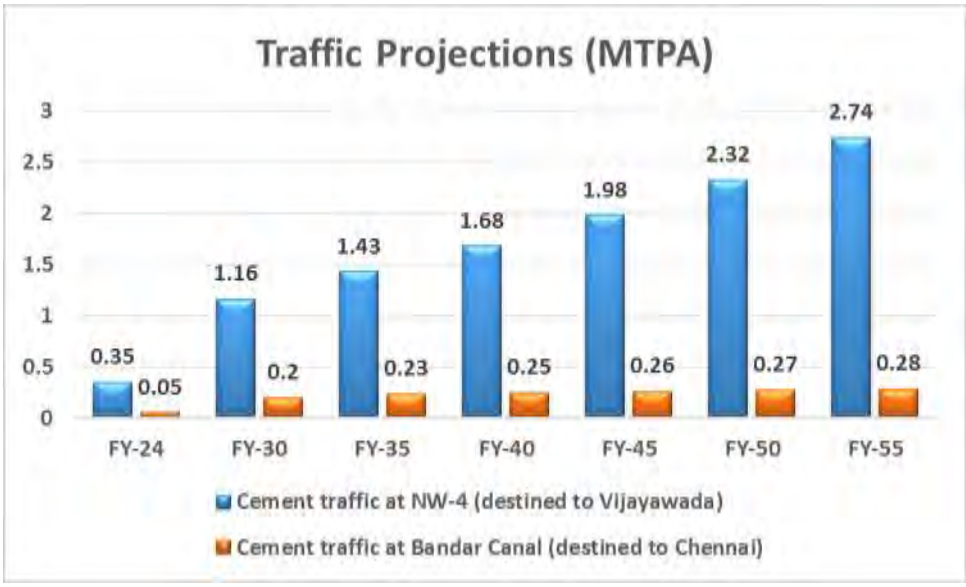



***Fig. 5.1 Traffic Projections***

## 5.3 Options Considered for IWT

5.3.1 The navigational feasibility would play an important role in the IWT of cement as the cement is to be transported via Bandar Canal. Navigational feasibility in real terms is navigability, but navigability is itself a relative concept. A waterway may be navigable by vessels of certain dimensions i.e. length, beam (width), draft, air-draft etc. and not by larger vessels. Therefore, in ascertaining navigability of any waterway, the first thing that needs to be determined is the size of the `design' vessel or the largest vessel to ply on the waterway. It is self evident that the characteristic dimensions of the waterway themselves have a great and sometimes even decisive influence on the size of the largest / typical vessel. In other words these are inter- dependent factors. Also, dimensions of waterways as well as of vessels can be modified at a cost, of course making it important to arrive at an optimised match.

While considering various options available for navigation in order to transport cement salient features of the waterway are taken into consideration from the forgoing chapters. The approach taken is first to consider the size of the vessels that could ply in the waterway with the navigational facilities developed for waterway dimensions. The fairway dimensions would be fixed based on size & type of design vessel. If any modifications of fairway dimensions and / or vessel dimensions appear to be advisable these would be considered.

As waterway width is different in River Krishna and Bandar Canal so in this option barges of different sizes according to waterway have been considered. The following range of self propelled barge sizes are considered for operation in all phases.

**River Section - Muktyala Terminal to Ibrahimpatnam Terminal**

***Table 5.2: River Section - Muktyala Terminal to Ibrahimpatnam Terminal***

*All dimensions are in m*

| Tonnage | Length (L) | Beam (B) | Draft (D) |
|---|---|---|---|
| 500 | 58 | 9 | 1.5 |
| 300 | 45 | 8 | 1.2 |
| 100 | 32 | 5 | 1.0 |

Movement of different size barges are discussed here under:

**I. 500 DWT size barge movement**

In this section we have considered 500 DWT size vessel. Based on functional parameters cited above the following operational parameters are evaluated:

***Table 5.3: 500 DWT size barge movement***

| Description | FY-24 | FY-30 | FY-35 | FY-45 | FY-55 |
|---|---|---|---|---|---|
| Annual throughput for planning (MTPA) | 0.35 | 1.16 | 1.43 | 1.98 | 2.74 |
| loading rate per ship (t/day) (Effective) | 1061 | 3515 | 4333 | 6000 | 8303 |
| Total service time per barge (hrs.) | 27.73 | 27.73 | 27.73 | 27.73 | 27.73 |
| No. of Working Hours of vessel per year | 7920 | 7920 | 7920 | 7920 | 7920 |
| Total No. of Round Trips per year | 700 | 2323 | 2860 | 3967 | 5490 |
| No. of Vessels required | 3 | 9 | 10 | 14 | 20 |

At initial stage, 3 number of 500 DWT barges would be required having a total round trip of 700 and at ultimate stage when throughput to be transported would be 2.74 mtpa, the barge operation with 500 DWT would require 20 number of barges having total round trip of 5490 per annum.

**II. 300 DWT size barge movement**

In this section we have considered 300 DWT size vessel. Based on functional parameters cited above the following operational parameters are evaluated:

***Table 5.4: 300 DWT size barge movement***

| Description | FY-24 | FY-30 | FY-35 | FY-45 | FY-55 |
|---|---|---|---|---|---|
| Annual throughput for planning (MTPA) | 0.35 | 1.16 | 1.43 | 1.98 | 2.74 |

| Description | FY-24 | FY-30 | FY-35 | FY-45 | FY-55 |
|---|---|---|---|---|---|
| loading rate per ship (t/day) (Effective) | 1061 | 3515 | 4333 | 6000 | 8303 |
| Total service time per barge (hrs.) | 24.40 | 24.40 | 24.40 | 24.40 | 24.40 |
| No. of Working Hours of vessel per year | 7920 | 7920 | 7920 | 7920 | 7920 |
| (Total) No. of Round Trips per year | 1167 | 3871 | 4775 | 6608 | 9146 |
| No. of Vessels required | 4 | 12 | 15 | 21 | 29 |

At initial stage, 4 number of 300 DWT barges would be required having a total round trip of 1167 and at ultimate stage when throughput to be transported would be 2.74 mtpa, the barge operation with 300 DWT would require 29 number of barges having total round trip of 9146 per annum.

### III. 100 DWT size barge movement

In this section we have considered 100 DWT size vessel. Based on functional parameters cited above the following operational parameters are evaluated:

***Table 5.5: 100 DWT size barge movement***

| Description | FY-24 | FY-30 | FY-35 | FY-45 | FY-55 |
|---|---|---|---|---|---|
| Annual throughput for planning (MTPA) | 0.35 | 1.16 | 1.43 | 1.98 | 2.74 |
| loading rate per ship (t/day) (Effective) | 1061 | 3515 | 4333 | 6000 | 8303 |
| Total service time per barge (hrs.) | 21.07 | 21.07 | 21.07 | 21.07 | 21.07 |
| No. of Working Hours of vessel per year | 7920 | 7920 | 7920 | 7920 | 7920 |
| Total No. of Round Trips per year | 3500 | 11685 | 14304 | 19804 | 27403 |
| No. of Vessels required | 10 | 31 | 38 | 53 | 73 |

At initial stage, 10 number of 100 DWT barges would be required having a total round trip of 3500 and at ultimate stage when throughput to be transported would be 2.74 mtpa, the barge operation with 100 DWT would require 73 number of barges having total round trip of 27403 per annum.

The above analysis shows that the operation will be better manageable with 500 DWT vessels than lower capacity barges. Because of very high number of round trips of the lower capacity barges, operations would be quite difficult and unmanageable and will create queuing in the channel.

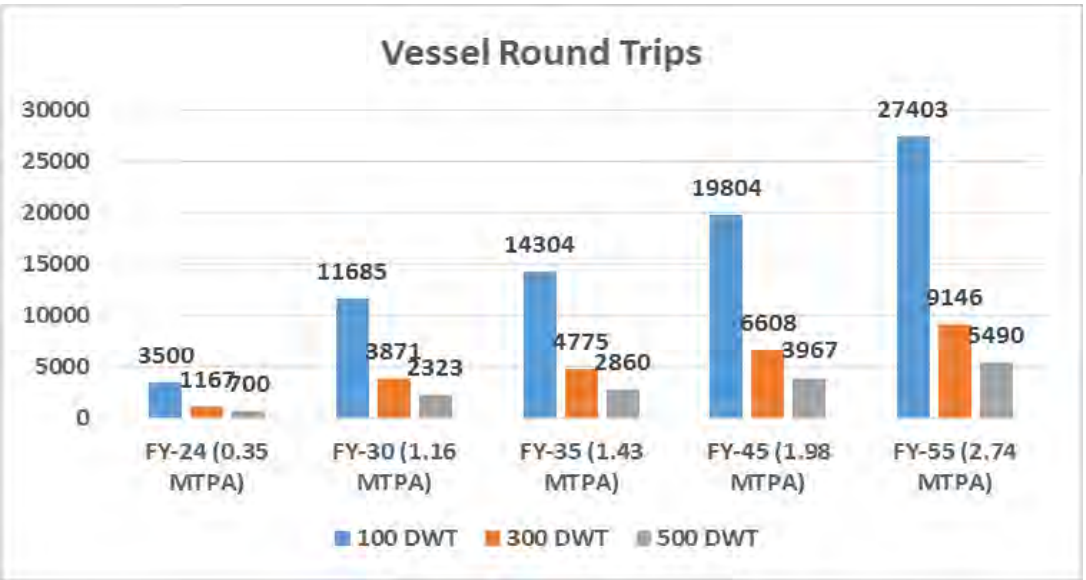



***Fig. 5.2 Vessel Roundtrips in River Section***

**Canal Section - Ibrahimpatnam Terminal Terminal to Machhlipatnam**

The following range of self-propelled barge sizes are considered for operation in Canal Section

***Table 5.6: Canal Section - Vijayawada Terminal to Machhlipatnam***

*All dimensions are in m*

| Tonnage | Length (L) | Beam (B) | Draft (D) |
|---|---|---|---|
| 100 | 32 | 5.0 | 1.0 |
| 50 | 20 | 3.5 | 1.0 |

**I. 100 DWT size barge movement**

In this section we have considered 100 DWT size vessel. Based on functional parameters cited above the following operational parameters are evaluated:

***Table 5.7: 100 DWT size barge movement***

| Description | FY-24 | FY-30 | FY-35 | FY-45 | FY-55 |
|---|---|---|---|---|---|
| Annual throughput for planning (MTPA) | 0.05 | 0.20 | 0.23 | 0.26 | 0.28 |
| loading rate per ship (t/day) (Effective) | 152 | 606 | 697 | 788 | 848 |
| Total service time per barge (hrs.) | 21.87 | 21.87 | 21.87 | 21.87 | 21.87 |
| No. of Working Hours of | 7920 | 7920 | 7920 | 7920 | 7920 |

| Description | FY-24 | FY-30 | FY-35 | FY-45 | FY-55 |
|---|---|---|---|---|---|
| vessel per year | | | | | |
| Total No. of Round Trips per year | 500 | 2000 | 2300 | 2600 | 2800 |
| No. of Vessels required | 2 | 2 | 7 | 8 | 8 |

At initial stage, 2 number of 100 DWT barges would be required having a total round trip of 500 and at ultimate stage when throughput to be transported would be 0.28 mtpa, the barge operation with 100 DWT would require 8 number of barges having total round trip of 2800 per annum.

### II. 50 DWT size barge movement

In this section we have considered 50 DWT size vessel. Based on functional parameters cited above the following operational parameters are evaluated:

***Table 5.8: 50 DWT size barge movement***

| Description | FY-24 | FY-30 | FY-35 | FY-45 | FY-55 |
|---|---|---|---|---|---|
| Annual throughput for planning (MTPA) | 0.05 | 0.20 | 0.23 | 0.26 | 0.28 |
| loading rate per ship (t/day) (Effective) | 152 | 606 | 697 | 788 | 848 |
| Total service time per barge (hrs.) | 21.03 | 21.03 | 21.03 | 21.03 | 21.03 |
| No. of Working Hours of vessel per year | 7920 | 7920 | 7920 | 7920 | 7920 |
| Total No. of Round Trips per year | 1000 | 4000 | 4607 | 5207 | 5606 |
| No. of Vessels required | 3 | 11 | 13 | 14 | 15 |

At initial stage, 3 number of 50 DWT barges would be required having a total round trip of 1000 and at ultimate stage when throughput to be transported would be 0.28 mtpa, the barge operation with 50 DWT would require 15 number of barges having total round trip of 5606 per annum.

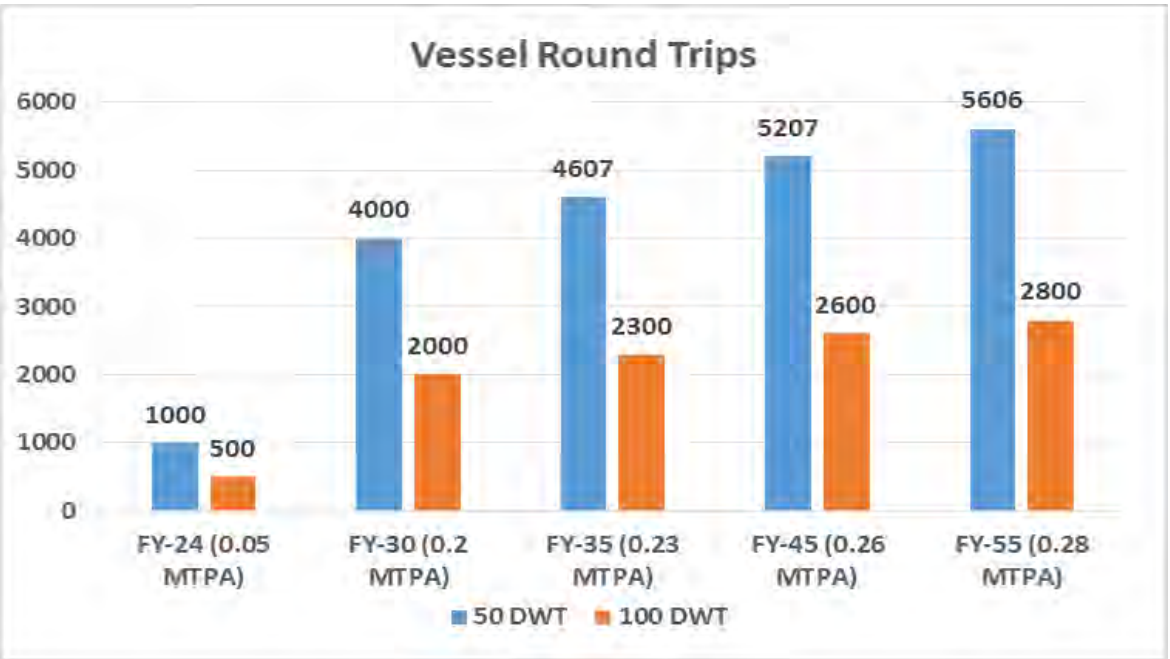



***Fig. 5.3 Vessel Roundtrips in Canal Section***

# Chapter-6
# Issues & Challenges

## 6.1 General

India's inland water transport sector is relatively underdeveloped compared to other large economies due to matrix of natural reasons and policy lacunae. The Technical Key issues or challenges in present water way under study is mentioned below:

## 6.2 River Section (Muktayala to Vijayawada – 82 km)

### 6.2.1 Depth Restriction in River Krishna

Based on Thalweg survey, Ponding effect of Prakasam barrage is upto 23km. Sufficient depth are available till 23km. Average depths from chainage 0-10km is around 6.0 m and from ch.10-20km is around 5m & Ch. 20-23km is around 1.5m. Accordingly, we can say that, average depth in first 23km is around 4m-5m.

However, **Sufficient water depth are not available from Ch.23km to Ch. 63km**. LAD in this stretch is less than 1m. Rocky outcrops are present at vedadri & Usthe Palli & at ch.53 near Kogantivaripalem. This should be dredged with cutter section.

From 63km- 82km, LAD of 1-2m is available. Therefore, minimum dredging is required for channel maintenance & for smooth navigation.

## 6.3 Canal Section (Vijayawada to Machilipatnam– 86 km)

### 6.3.1 Width Restrictions of Proposed Lock at Parkasam Barrage (Ch.0)

The proposed lock at Prakasam Barrage will serve as a crucial gateway for transporting cargo from the Krishna River to the sea via Bandar Canal. WAPCOS, along with officials from IWAI Vijayawada, conducted a joint visit on July 15, 2022, to assess the proposed lock at Prakasam Barrage. During this visit, they discovered that the proposed lock site on the left bank of the barrage was filled with soil following the construction of a retaining wall.

Historical imagery indicates that there was originally a lock beside the Prakasam Barrage, which was fully operational at that time. In 2016, the lock was filled with soil after the construction of a new sluice at Prakasam. Google imagery from 2010, January 2016, November 2016, and 2022 is shown below for reference:




*Fig. 6.1 Google imaginary (Prakasam barrage Lock)-Year 2010*




*Fig. 6.2 Google imaginary (Prakasam barrage Lock)- Jan 2016*




*Fig. 6.3 Google imaginary (Prakasam barrage Lock)- Nov 2016*

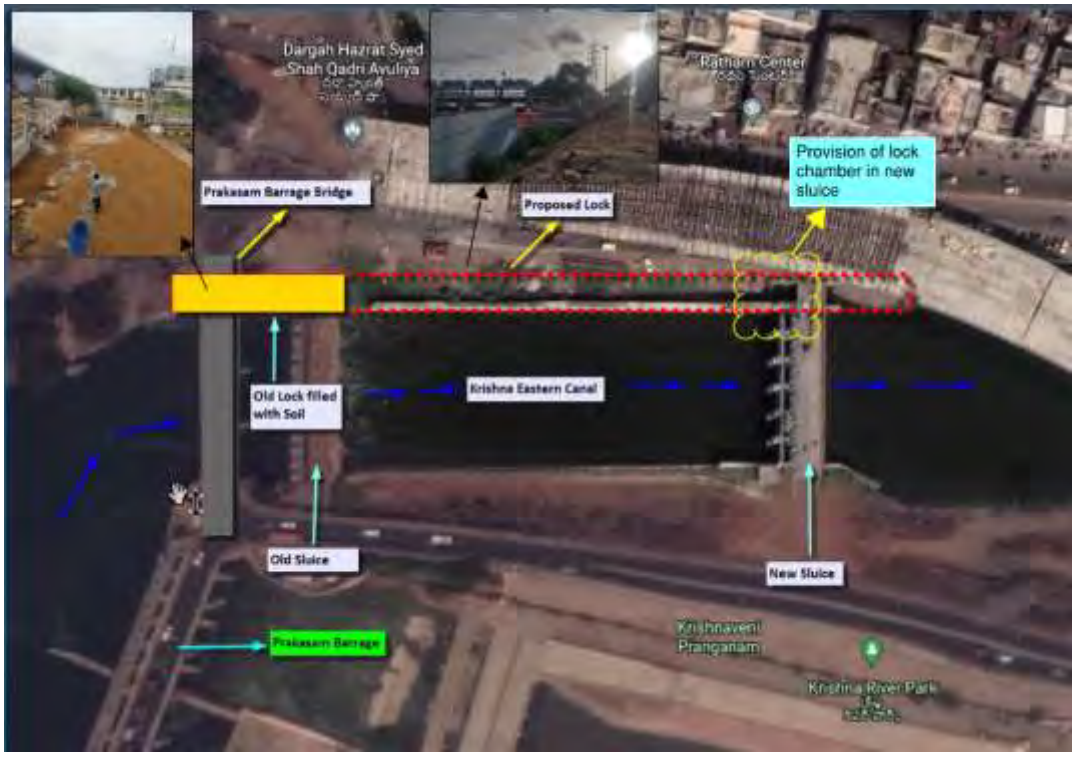



*Fig. 6.4 Present Condition of Prakasam barrage Lock*

To resume the navigation, Soil filled chamber should be excavated & redesigned.

It is to be noted that there is a width restriction for the proposed lock, which is only 4.75 meters wide. Vessels up to 3.5 meters in width can pass through this lock.

### 6.3.2 Deteriorated Condition of Existing Locks

**Details of Locks**

*Table 6.1 Existing locks along with chainages*

| Sr. No | Name of Lock | Chainage (Km) | Co-ordinates |
|---|---|---|---|
| 1 | Bandar Lock | 1.50 | 16°30'35"N, 80°37'19"E |
| 2 | Enamalakudru | 7.738 | 16°28'57.08"N, 80°40'8.20"E |
| 3 | Kankipadu | 20.362 | 16°25'35.38"N, 80°45'41.47"E |
| 4 | Veeranki | 39.555 | 16°17'31.10"N, 80°51'57.87"E |
| 5 | Nidumolu | 59.585 | 16°15'25.08"N, 81° 0'43.73"E |
| 6 | Akumaru | 69.268 | 16°11'43.62"N, 81° 4'36.67"E |
| 7 | Bandaru Tidal Lock | 79.312 | 16° 8'57.52"N, 81° 9'12.42"E |

*Table 6.2 Existing Dimensions of Lock*

| Sr. No | Name of Lock | Length | Width |
|---|---|---|---|
| 1 | Bandar Lock | 55m | 6m |
| 2 | Enamalakudru (Old) | 55m | 6m |
| | (New) | 55m | 4m |
| 3 | Kankipadu | 25m | 6m |
| 4 | Veeranki | 25m | 6m |
| 5 | Nidumolu | 25m | 6m |
| 6 | Akumaru | 25m | 6m |
| 7 | Bandaru Tidal Lock | 25m | 6m |

- **Bandar Lock (Ch. 1.5km)**

The Bandar Lock is located approximately 1.5 km from the Prakasam Barrage. While the lock chamber is in good condition, the lock gates are in a dilapidated state and are currently non-functional. The area around the upstream lock gates, approximately 100 meters, is covered with dense hyacinth, making it non-navigable. Additionally, the banks are unprotected, and there is no control room for operating the lock gates.




*Fig: 6.5 Bandar Lock (Ch. 1.5km)*

*Table 6.3: Bandar Lock Assessment*

| | **Bandar Lock (Ch. 1.5)** |
|---|---|
| **Length** | 55m |
| **Width** | 6m |
| **Condition** | Deteriorated |

- **Enamalakudru Lock (Ch. 7.738)**

The Enamalakudru Lock is located approximately 7.7 km from the Prakasam Barrage. The lock is situated on both the old and new cross-regulators. While the lock chamber is in good condition, the lock gates are rusted and non-functional. Additionally, the area around the upstream lock gates, approximately 100 meters, is covered with dense hyacinth, making it non-navigable. The banks are unprotected, and there is no control room for operating the lock gates. The new cross-regulator, currently under

construction, includes a provision for a lock.




*Fig: 6.6 Enamalakudru Lock (Ch. 7.738)*

***Table 6.4: Enamalakudru Lock Assessment***

| | **New Lock** |
|---|---|
| **Length** | 55m |
| **Width** | 4m |
| **Condition** | Shabby State |
| | **Old Lock** |
| **Length** | 55m |
| **Width** | 6m |
| **Condition** | Gates and chamber are in very shabby condition |

- **Kankipadu Lock (Ch. 20.362)**

  The Kankipadu Lock is located approximately 20 km from the Prakasam Barrage. The lock chamber is in good condition; however, the lock gates are rusted and operated manually. The area around the upstream lock gates, approximately 100 meters, is covered with dense hyacinth, making it non-navigable. Additionally, the banks are unprotected, and there is no control room for operating the lock gates.




*Fig: 6.7 Kankipadu Lock (Ch. 7.738)*

***Table 6.5: Kankipadu Lock Assessment***

| | **New Lock** |
|---|---|
| **Length** | 25m |
| **Width** | 6m |
| **Condition** | Shabby State |

- **Veeranki Lock (Ch. 39.555)**

  The Veeranki Lock is located approximately 40 km from the Prakasam Barrage. While the lock chamber is in good condition, the lock gates are rusted and operated manually. Additionally, the area around the upstream lock gates, approximately 100 meters, is covered with dense hyacinth, making it non-navigable. The banks are unprotected, and there is no control room for operating the lock gates.




*Fig: 6.8 Veeranki Lock (Ch. 39.555)*

*Table 6.6: Veeranki Lock Assessment*

| | **New Lock** |
|---|---|
| **Length** | 25 |
| **Width** | 6m |
| **Condition** | Shabby State |

- **Nidumolu Lock (Ch. 59.585)**

  The Nidumolu Lock is located approximately 59.5 km from the Prakasam Barrage. The lock chamber is in good condition; however, the lock gates are rusted and operated manually. The area around the upstream lock gates, approximately 100 meters, is covered with dense hyacinth, making it non-navigable. Additionally, the banks are unprotected, and there is no control room for operating the lock gates.




*Fig: 6.9 Nidumolu Lock (Ch. 59.585)*

***Table 6.7 : Nidumolu Lock Assessment***

| | **New Lock** |
|---|---|
| **Length** | 25 |
| **Width** | 6m |
| **Condition** | Shabby State |

- **Akumaru Lock (Ch. 69.268)**

  The Akumaru Lock is located approximately 69 km from the Prakasam Barrage. The lock chamber is in good condition; however, the lock gates are rusted and operated manually. The area around the upstream lock gates, approximately 100 meters, is covered with dense hyacinth, making it non-navigable. Additionally, the banks are unprotected, and there is no control room for operating the lock gates.




*Fig: 6.10 Akumaru Lock (Ch. 69.268)*

*Table 6.8: Akumaru Lock Assessment*

| | **New Lock** |
|---|---|
| **Length** | 25 |
| **Width** | 6m |
| **Condition** | Shabby State |

- **Bandar Tidal Lock (Ch. 79.312)**

The Bandar Tidal Lock is located approximately 79.5 km from the Prakasam Barrage. The lock chamber is in good condition. However, it should be noted that there are no lock gates. Instead, a bund has been constructed to prevent the intrusion of seawater into the freshwater system. Additionally, the banks are unprotected.




*Fig: 6.11 Bandar Tidal Lock (Ch. 79.312)*

*Table 6.9: Bandar Tidal Lock Assessment*

| | **New Lock** | **Recommendation** |
|---|---|---|
| **Length** | 25 | Installation of Hydraulic Gates |
| **Width** | 6m | |
| **Condition** | Shabby State | |

### 6.3.3 Width Restriction of Bandar Canal at Tail Reaches/Lock Gate sites

Based on the data received from WRD, Vijayawada office, it is quite evident that there is a width restriction in Bandar Canal. Within city limits, bed width of the canal is 33m. In between Kankipadu lock to Veeranki lock, bed width is 21.5m. After Veeranki lock which is about 40km downstream of Prakasam barrage, maximum available width of the canal is 12m only and minimum width is 4.8m

## 6.4 Inadequate Horizontal & Vertical Clearances in the Bridges

As per IWAI norms, for Class-1, horizontal clearance of 20m & vertical clearance of According to IWAI norms, Class-1 navigation requires a horizontal clearance of 20 m and a vertical clearance of 4 meters for safe passage.

A preliminary survey has revealed that most bridges do not meet these requirements. Specifically, all except four bridges will need modifications to conform to Class-1 standards.

For Special Class (50 DWT) navigation, a horizontal clearance of 15 meters and a vertical clearance of 4 meters are required. Out of 67 bridges, 51 will need modifications to meet these specifications.

# Chapter-7
# Planning of Waterway & Infrastructure

## 7.1 Planning of waterway

In India, the inland waterways are classified into seven categories for rivers as well as canals by the Inland Waterways Authority of India (IWAI) vide GOI Gazette Notification dated 26 January 2007& 07 November 2016 including amendments for safe passage of self-propelled vessels up to 2000 dead weight tonnage (DWT) and tug barge formation in push tow units of carrying capacity up to 8000 tonnes

The classification of waterways is given below

### A. Classification of Inland waterways for Rivers

*Table 7.1: Inland Waterway classification for Rivers*

| Class of Waterway | Rivers | | | | |
|---|---|---|---|---|---|
| | Minimum Depth | Bottom Width | Bend Radius | Vertical Clearance | Horizontal Clearance |
| I. | 1.2 m | 30 m | 300 m | 4 m | 30 m |
| II. | 1.4 m | 40 m | 500 m | 5 m | 40 m |
| III. | 1.7 m | 50 m | 700 m | 6 m | 50 m |
| IV. | 2.0 m | 50 m | 800 m | 8 m | 50 m |
| V. | 2.0 m | 80 m | 800 m | 8 m | 80 m |
| VI. | 2.75 m | 80 m | 900 m | 8 m | 80 m |
| VII. | 2.75 m | 100 m | 900 m | 8 m | 100 m |

### B. Classification of Inland waterways for Canals

*Table 7.2: Inland Waterway classification for Canals*

| Class of Waterway | Canals | | | | |
|---|---|---|---|---|---|
| | Minimum Depth | Bottom Width | Bend Radius | Vertical Clearance | Horizontal Clearance |
| I. | 1.5 m | 20 m | 300 m | 4 m | 20 m |
| II. | 1.8 m | 30 m | 500 m | 5 m | 30 m |
| III. | 2.2 m | 40 m | 700 m | 6 m | 40 m |

| Class of Waterway | Canals | | | | |
|---|---|---|---|---|---|
| | Minimum Depth | Bottom Width | Bend Radius | Vertical Clearance | Horizontal Clearance |
| **IV.** | 2.5 m | 50 m | 800 m | 8 m | 50 m |
| **V.** | - | - | - | - | - |
| **VI.** | 3.50 m | 60 m | 900 m | 8 m | 60 m |
| **VII.** | - | - | - | - | - |

The above classification for Rivers and Canals shall be effective if:

- Minimum depth of channel should be available for about 330 days in a year (about 90% days in a year).
- Vertical clearance at cross structures over the waterway should be available at least in central 75% portion of each of the spans in entire width of the waterway.

**C. Vertical Clearance for Power Cables / Telephone Lines for all Classes**

- Telephone lines and Low Voltage lines 16.5 m
- High Voltage Transmission lines not exceeding 110 KV – 19 m
- High Voltage Transmission lines exceeding 110 KV – 19 m + 1 cm per each KVIn case of underground pipe / power lines and other cables norms to be decided as per conditions and navigational requirement

**D. Reference level for vertical clearance for different types of channels**

- For rivers – over navigational HFL which is highest flood level at frequency of 5% in any year over a period of last 20 years
- HTL for tidal channels
- For channels design FSL

**E. Type of vessels to be used in different class waterways**

***Table 7.3: Type of vessels to be used in different class of waterways***

| Class | Self-propelled vessel | Tug with barges |
|---|---|---|
| **I.** | Self-propelled, carrying capacity 100 DWT, Size (32m X 5m), Loaded draft 1m | 1 Tug + 2 barges – 200 DWT, length 80m X breadth 5m , loaded draft 1m |
| **II.** | Self-propelled, carrying capacity 300 DWT, Size (45m X 8m), Loaded draft 1.2m | 1 Tug + 2 barges – 600 DWT, length 110m X breadth 8m , loaded draft 1.2m |

| Class | Self-propelled vessel | Tug with barges |
|---|---|---|
| **III.** | Self-propelled, carrying capacity 500 DWT, Size (58m X 9m), Loaded draft 1.5m | 1 Tug + 2 barges – 1000 DWT, length 141m X breadth 9m , loaded draft 1.5m |
| **IV.** | Self-propelled, carrying capacity 1000 DWT, Size (70m X 12m), Loaded draft 1.8m | 1 Tug + 2 barges – 2000 DWT, length 170m X breadth 12m , loaded draft 1.8m |
| **V.** | Self-propelled, carrying capacity 1000 DWT, Size (70m X 12m), Loaded draft 1.8m | 1 Tug + 2 barges – 2000 DWT, length 170m X breadth 24m , loaded draft 1.8m (moulded with 24 m) |
| **VI.** | Self-propelled, carrying capacity 2000 DWT, Size (86m X 14m), Loaded draft 2.5m | 1 Tug + 2 barges – 4000 DWT, length 210m X breadth 14m , loaded draft 2.5m |
| **VII.** | Self-propelled, carrying capacity 4000 DWT, Size (86m X 14m), Loaded draft 2.9m | 1 Tug + 4 barges – 8000 DWT, length 210m X breadth 28m , loaded draft 2.5m |

All structures to be constructed across waterway classified should conform to respective requirement of vertical clearance and horizontal clearance before construction of any structure across the national waterway.

## 7.2 Proposed Waterway:

Dimensions of waterway principally include the width and depth. Dimensioning or designing of waterway is of critical importance for safety and efficiency of barge operations in the waterway. The design parameters are depth, breadth and alignment. Cross sections of waterway may be expected to satisfy following requirements:

- The waterway must be deep enough to prevent vessels from running a ground or being difficult to steer
- The waterway must be sufficiently wide to enable the standard traffic flow to pass safely and speedily
- Vessels must be able to reach a reasonable speed to keep down the cost of transport
- The cross current must not be too large and therefore uneconomical

The largest sized vessel that can ply in the waterway would depend on whether 1- way or 2 - way navigation is to be catered to, the waterway width and depth. There are several guidelines which have been evolved by various countries and

authorities about the relationship between the dimensions of any restricted waterway and the vessels that may ply in it. However, the recommendations may vary widely from country to country or waterway to waterway. Waterway under study comprises of River section & Canal section.

### 7.2.1 River Section

Fairway dimension for River Section has been kept on the basis of IWAI norms for the Class-I, Class-II & Class-III. The following range of vessels and their dimensions are taken for functional planning of River Section:

***Table 7.4: Vessel Dimension***

| Class | Tonnage | Length (L) | Beam (B) | Draft (D) |
|---|---|---|---|---|
| Class I | 100 | 32m | 5m | 1.0m |
| Class II | 300 | 45m | 8m | 1.2m |
| Class III | 500 | 58m | 9m | 1.5m |

Fairway dimension of above classes of waterway are given below:

***Table 7.5: Fairway Dimension***

| Class | Tonnage | Fairway Width (m) | Fairway Depth (m) | Side slope (H:V) |
|---|---|---|---|---|
| Class I | 100 | 30m | 1.2m | 5:1 |
| Class II | 300 | 40m | 1.4m | 5:1 |
| Class III | 500 | 50m | 1.7m | 5:1 |

**Generic Figure of Fairway is shown below:**

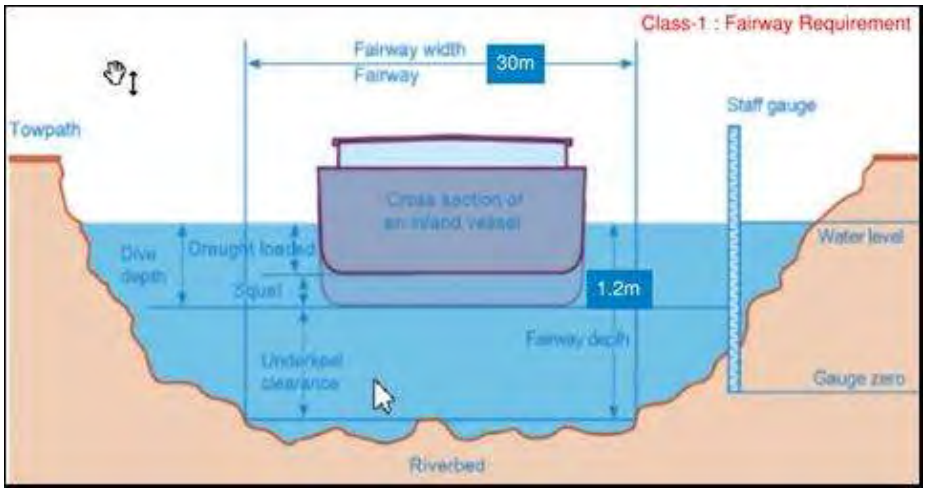



***Fig. 7.1: Fairway Dimension***

### 7.2.2 Canal Section:

**Vessel considered for canal section is tabulated below:**

*Table 7.6: Vessel Dimension*

| Tonnage | Length (L) | Beam (B) | Draft (D) |
|---|---|---|---|
| 100 | 32m | 5.0m | 1.0m |

In present case, fairway dimension has been kept on the basis of IWAI norms for the Class-I.

## 7.3 Widening of Canal

As mentioned previously, there is a width restriction in the Bandar Canal after the Veeranki Lock, which is approximately 40 km downstream of the Prakasam Barrage. The maximum available width of the canal is 12 meters, and the minimum width is 4.8 meters. Due to these constraints, Class-II and Class-III vessels cannot navigate the Bandar Canal as the width is insufficient, and widening the canal within city limits is not feasible. Safe navigation requires a minimum width of 20 meters.

It should be noted that within city limits, a width of 33 meters is available. To achieve the necessary fairway width for navigation, the canal needs to be widened along approximately 46 km from Veeranki to Machhalipatnam Port.

To maintain a water depth of 1.5 meters throughout the canal, discharge calculations have been determined as outlined below.

**Discharge required:**

*Table 7.7: Sectional Area Ratio*

| Tonnage | Required Depth | Required Width | Side Slope | Water Surface Slope | Area |
|---|---|---|---|---|---|
| 100 | 1.5m | 20m | 1.5:1 | 1 in 6507 | 33.38 |

| Wetted Perimeter | Rugosity coefficient | $R^{2/3}$ | Velocity | Required Discharge (Cusec) |
|---|---|---|---|---|
| 25.41 | 0.025 | 1.197 | 0.65 | 770 |

As indicated in the Discharge Table, in the Bandar Canal, a discharge of 771 cusecs is available up to 59.585 km from the Prakasam Barrage, which meets the minimum requirement for maintaining a water depth of 1.5 meters. However, beyond this point in the tail reach, the available discharge is less than the required minimum.

*Table 7.8: Discharge at Bandar Canal*

| Reaches | Full Supply Depth (m) | Discharges Cusec/Cumec |
|---|---|---|
| **Reach 1: 7.738 to 20.362** | | |
| **Start** | 3.66 | 5056 |
| **End** | 1.98 | 1782 |
| **Reach 2: 20.362 to 39.555** | | |
| **Start** | 2.8 | 1583 |
| **End** | 2.6 | 1238 |
| **Reach 3: 39.555 to 59.585** | | |
| **Start** | 2.44 | 771 |
| **End** | 2.44 | 771 |
| **Reach 3: 59.585to 69.628** | | |
| **Start** | 2.71 | 335 |
| **End** | 2.71 | 335 |
| **Reach 3: 69.628 to 79.312** | | |
| **Start** | 1.80 | 130 |
| **End** | 1.65 | 111 |

## 7.4 Estimation of Dredging/Excavation Quantities:

The dredging quantities have been computed for River Section as well as Canal Section.

**In River section**, Dredging quantity is computed as 2.7M Cum, considering navigation through Class-III (500 DWT) vessel.

In Canal section, excavation quantity has been computed on the basis of fairway requirement after adding 1m free board in the required depths. Excavation quantity is computed as 6.15 $Mm^3$.

Cutter Section Dredger (CSD) may be considered for dredging in order to maintain the depth in the waterway.

## 7.5 Modification Requirement in existing Bridges & Locks

**River Section:**

There is no existing bridge from Muktyala to Parkasam as of now. However, one bridge is under construction near Suryapalem ($16^0$ 32’ 59’’ N $80^0$ 34’ 01’’E) having sufficient clearances. Therefore, there is no need of any modification in River section.

**Canal Section:**

There are total 67 bridges in Bandar Canal including a Railway Bridge at chainage 0.7km and two under Construction Road Bridges at Ch. 7.25 km (Near

Enamalakudru) & at Ch. 67.91 (Near Kaza-Machilipatnam).

Navigation through Class-I Vessel- except four have to demolish & Re-constructed as they are not conforming to respective requirement of vertical clearance and horizontal clearance.

Railway Bridge (3-Lines) cannot be demolished & reconstructed as it will hamper major railway operations and it will be very difficult to get necessary permissions from the competent authorities. In connection to that, WAPCOS has studied two proposals for navigation.

Proposal 1: Navigation through Eluru canal (On left Bank)
Proposal 2: Navigation through Underground canal (On Right Bank)

## 7.6 Proposal 1: Navigation through Eluru canal (On left Bank)

As discussed earlier, there is a railway bridge at Ch. 0.7 km that does not meet the required horizontal and vertical clearances for safe navigation. The bridge currently provides only 8 meters of horizontal clearance, falling short of the required 15 meters, and 3 meters of vertical clearance, compared to the necessary 4 meters. Therefore, navigation under the Railway Bridge is currently not feasible.

To address this issue, a bypass channel can be constructed on the left side. This channel would allow vessels to travel from the Bandar Canal to the Eluru Canal and back to the Bandar Canal, circumventing the railway bridge. It should be noted that the existing high elevated bridge running parallel to the Bandar Canal already meets sufficient horizontal and vertical clearances. Therefore, there is no need for the demolition and reconstruction of the existing high elevated bridge. An overview of this proposal is provided below.

**Proposal 1: Navigation through Eluru canal (On left Bank)**

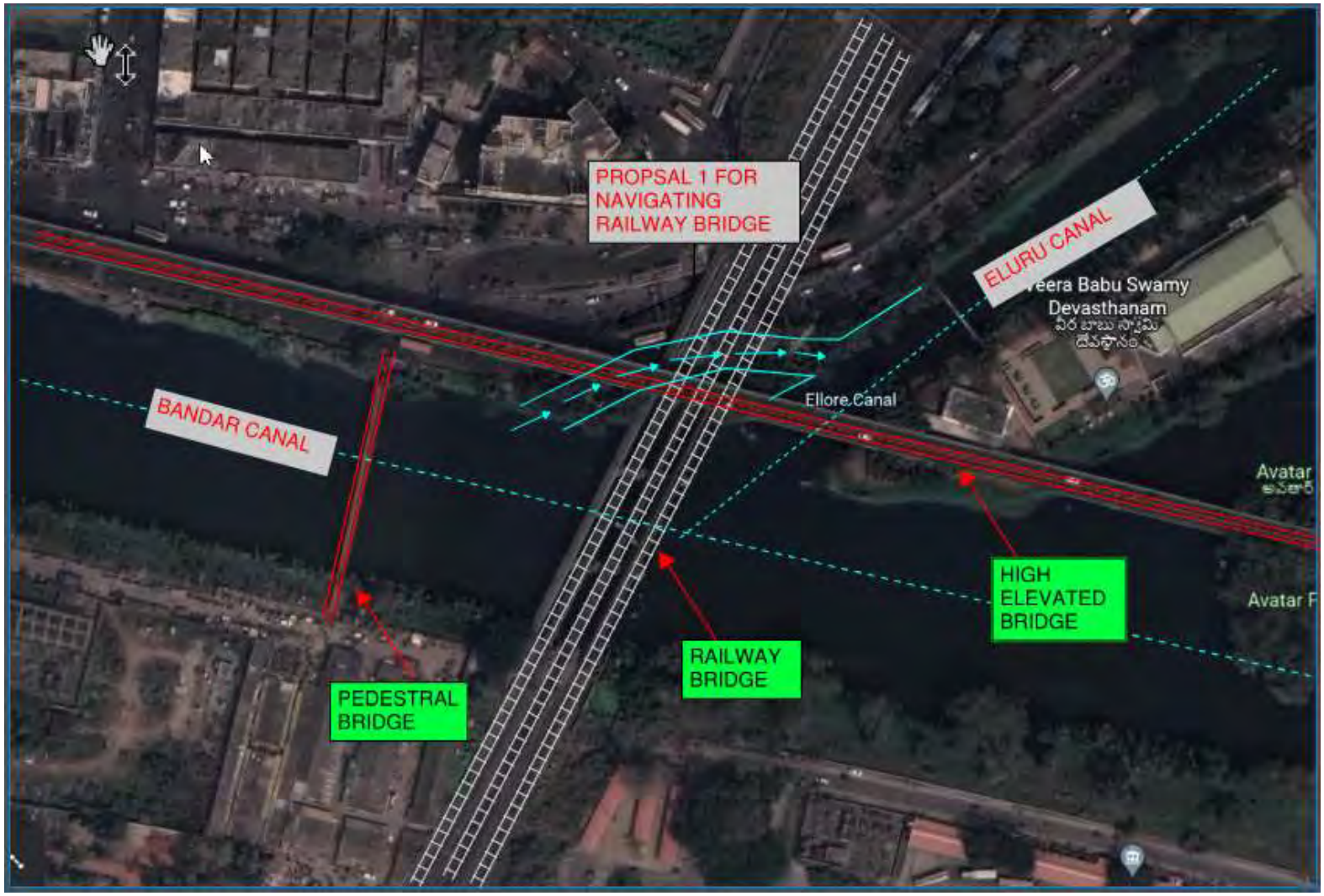



*Fig. 7.2: Proposal 1: Navigation through Eluru canal (On left Bank)*

## 7.7 Proposal 2: Navigation through Underground canal (On Right Bank)

Another proposal to facilitate navigation below the Railway Bridge involves constructing an underground canal with lock arrangements. The right bank of the canal near the Railway Bridge is renowned for its flower market and is government-owned land, eliminating any land acquisition issues. One significant advantage of this proposal is the manageable traffic on the right bank during implementation. Additionally, it offers enhanced safety for vessels as there are no sharp turns or bends, unlike the first proposal. An overview of this plan is detailed below.

It's important to note that thorough studies should precede the implementation of either proposal. Detailed topographic and geotechnical investigations are essential to solidify the plans. Model studies must assess the feasibility and safety of navigation. Detailed risk analysis is crucial to mitigate any unforeseen challenges.

Studies to be conducted:

1. Detailed Project Report (DPR) to finalize the proposal.
2. Comprehensive topographic surveys of each bank.
3. Geotechnical investigations.
4. Manoeuvrability studies for vessel safety.
5. Risk analysis to anticipate and manage potential risks.
6. Finite Element Method (FEM) analysis to understand the behavior of the Railway Bridge.

Among the two proposals, Proposal-I may not be feasible due to width restrictions in the Eluru canal for vessel turning and safety concerns regarding sharp turns. Therefore, Proposal 2 warrants further exploration for its potential in facilitating navigation.

**Proposal 2: Navigation through underground canal (On Right Bank)**

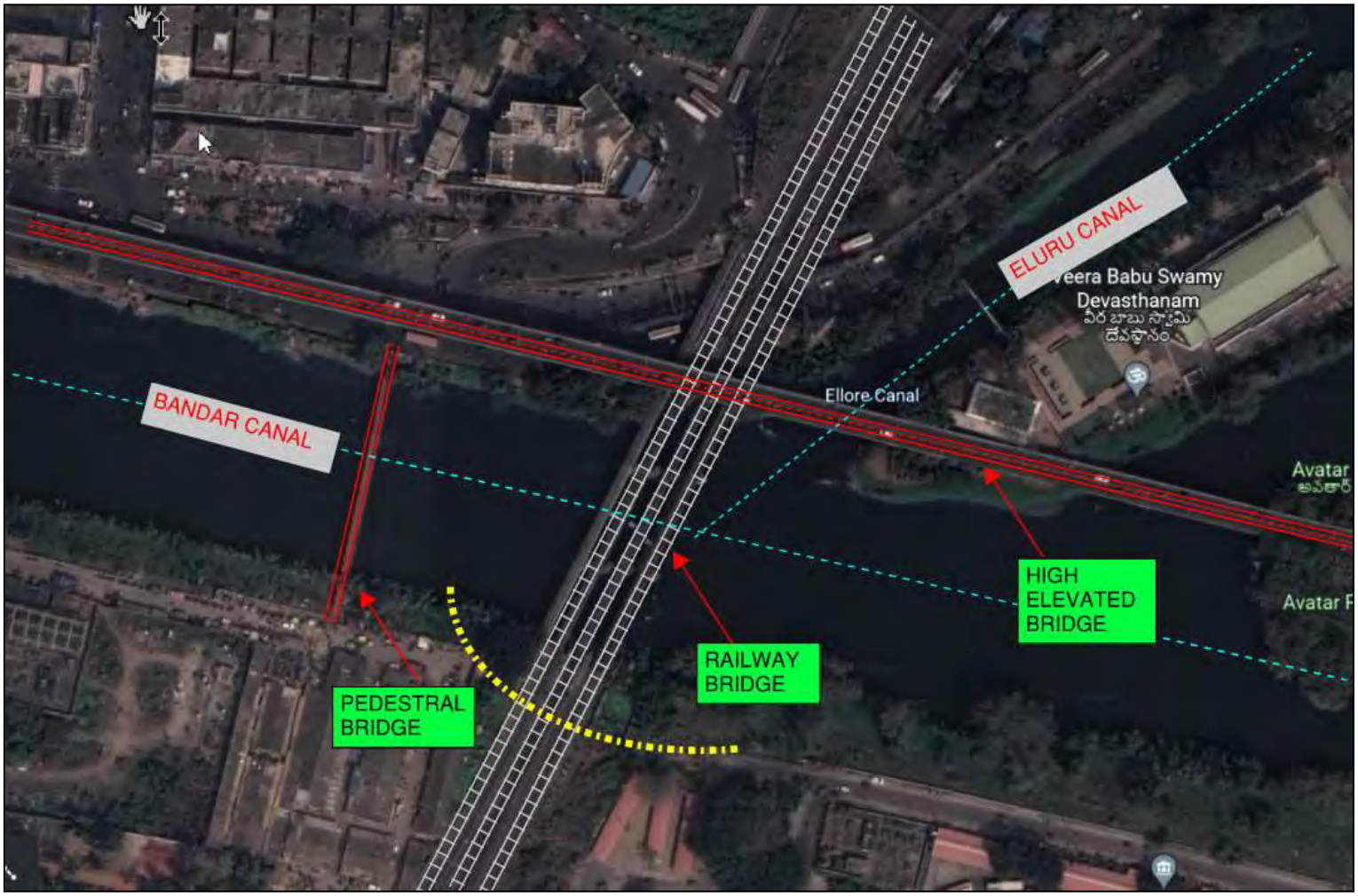
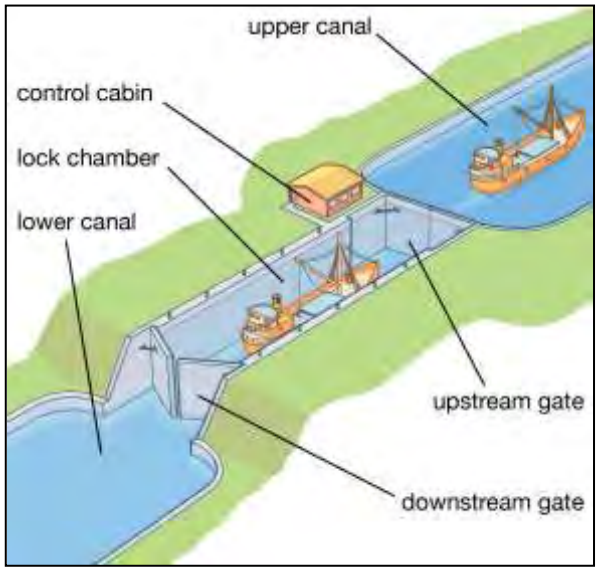



*Fig. 7.3: Proposal 2: Navigation through underground canal (On Right Bank)*

## 7.8 Modification of Locks in Bandar Canal:




Navigation lock is a structure in the waterway provided to create a safe navigation passage between two water pools which are not at the same level.

Lockage is completed by using a system of valves to raise and lower the water level in the lock chamber. This is an elevator system for boats; raising or lowering the water adjusts the boats to the necessary pool level.

There are two sets of valves on the lock. The filling valves, located near the upper gate, are opened to allow water to enter the chamber, making it the same height as the upper pool. The emptying valves, located near the lower gate, are opened to allow water to drain out, making the chamber the same height as the lower pool. During the process, no pumps are used; the water is moved solely by gravity.

The site survey shows clearly that the existing locks are in dilapidated state. However, Lock Chambers are generally in good condition. There appears to be no requirement for reconstruction of existing concrete civil structures. But, at few locks site, width of the lock is not sufficient for negotiating 50t / 100t vessels. In those cases lock will need to be modified. It is to be noted that gates are in filthy conditions and need to replace with new hydraulic gates. Fendering and mooring bollards should be provided inside the lock chambers. Dense hyacinth should be removed from all lock site. The details of existing locks in Bandar Canal are as under

***Table 9: Modification of Locks in Bandar Canals***

| Sr. No | Name of Lock | Chainage (Km) |
|---|---|---|
| 1 | Prakasam Lock Gate | 0.000 |
| 2 | Bandar Lock | 1.500 |
| 3 | Enamalakudru | 7.738 |
| 4 | Kankipadu | 20.362 |
| 5 | Veeranki | 39.555 |
| 6 | Nidumolu | 59.585 |
| 7 | Akumaru | 69.268 |
| 8 | Bandaru Tidal Lock | 79.312 |

## 7.9 Proposed Gates:

**Mitre Gate:**

A mitre gate has two leaves that provide a closure at one end of the lock. The mitre gate derives its name from the fact that the two leaves meet at an angle pointing upstream to resemble a mitre joint. Horizontally framed mitre gates have many advantages over other gate types and have been used on more locks than any other type gate. Mitre gates are rugged and do not involve complicated construction problems. Mitre gates are also easily serviced and fast operating. Therefore, all lock gates should be replaced with 2 sets of hydraulically operated Mitre gates.

**Proposed gate should be replaced/Installed at following lock gate site lock gate sites**

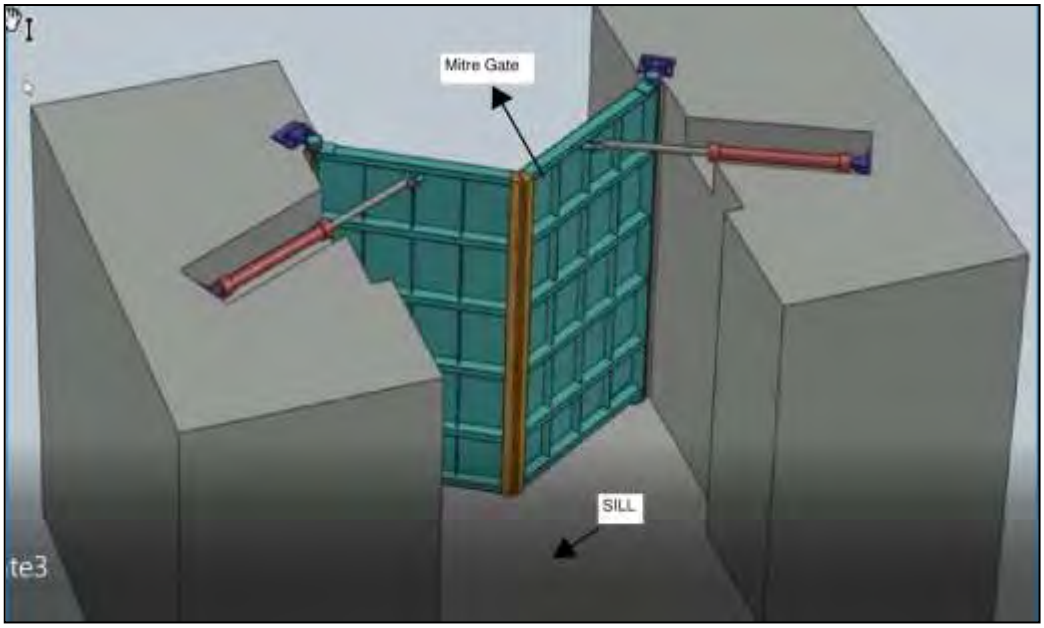



***Fig. 7.4: Typical Mitre Gate***

## 7.10 Proposed Width of Locks:

Proposed width of the locks is based on the assumption that almost half meter clearance for navigation on each side should be provided. This assumption has been made on the ground that there should be minimum disturbance with the modifications.

Based on survey and site visits carried out by WAPCOS, dimensions of the existing locks and proposed lock are tabulated below;

*Table 7.10: Modification in Length and Width of Existing Locks*

| Sr. No | Name of Lock | Length | Width | Class-I | | Special Class (50 DWT) | |
|---|---|---|---|---|---|---|---|
| | | | | Modification in Length (m) | Modification in Width (m) | Modification in Length (m) | Modification in Width (m) |
| 1 | Prakasam Lock | 195m | 4.75m | Not Required | Proposed Width 6m | Not Required | Not Required |
| 1 | Bandar Lock | 55m | 6m | Not Required | Not Required | Not Required | Not Required |
| 2 | Enamalakudru (Old) | 55m | 6m | Not Required | Not Required | Not Required | Not Required |
| | (New) | 55m | 4m | Not Required | Proposed Width 6m | Not Required | Proposed Width 6m |
| 3 | Kankipadu | 25m | 6m | Proposed Length 40m | Not Required | Not Required | Not Required |
| 4 | Veeranki | 25m | 6m | Proposed Length 40m | Not Required | Not Required | Not Required |
| 5 | Nidumolu | 25m | 6m | Proposed Length 40m | Not Required | Not Required | Not Required |
| 6 | Akumaru | 25m | 6m | Proposed Length 40m | Not Required | Not Required | Not Required |
| 7 | Bandaru Tidal Lock | 25m | 6m | Proposed Length 40m | Not Required | Not Required | Not Required |

## 7.11 Planning of Terminal/Jetty:

**General Review:**

Terminal is a place where a particular type of cargo is handled. Terminals can be classified as general cargo terminal, bulk cargo terminal and passenger terminals. Inland water terminals are different from sea terminals in the sense that water levels during flood and dry season varies considerably.

Terminals are the centres of receipt, export, storage, distribution of cargo and embarkation of passengers. Terminals form the hub of connection at transit through various means and modes of transportation. They are the shelters where vessels can berth and load or unload cargo and get its supplies. With development of waterway transport many small and big cities at the same time have grown into political, cultural, economic and trade centres.

In order to meet the need of rapid economic development in the country and also in view of congestion faced in other modes of transport like road and railway, the capacity of inland water transportation has to be increased / created and many

terminals along the route have to be built.

### 7.11.1 Existing Terminals:

Three RO-RO terminals at Muktyala (Ch. 82), Ibrahimpatnam & Harischandrapuram are under construction.

- **Muktyala Terminal (Ch. 82)**

The Muktyala terminal is situated upstream of the confluence of the Paleru small stream and the River Krishna, located precisely at coordinates 16°49'22.49"N, 80°5'0.44"E. Currently, there is an ongoing process for the acquisition of 8.57 acres of land to develop land-side facilities.

The terminal will primarily serve the RO-RO (Roll-on/Roll-off) route between Muktyala and Madipadu, facilitating efficient transport of goods. The main cargo handled at this terminal will be cement, catering to the regional transportation needs and enhancing logistical capabilities along the river route.

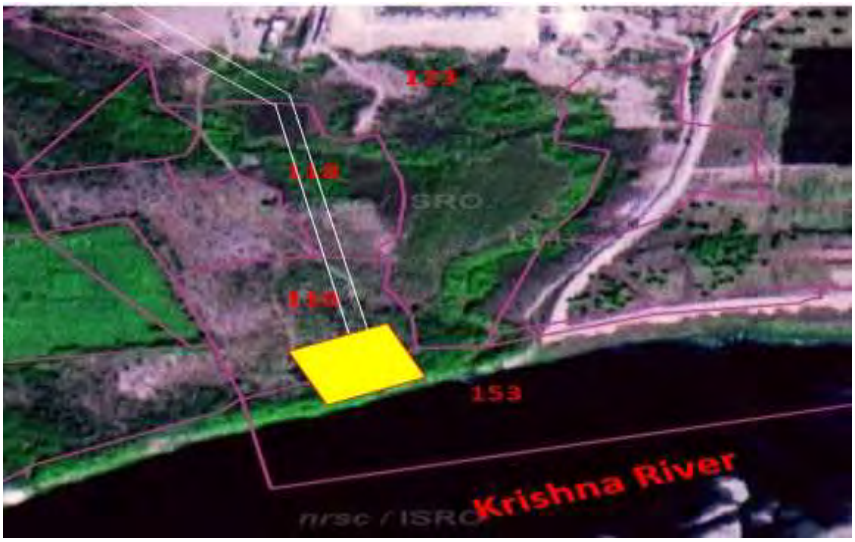



***Fig. 7.5: Muktyala Terminal (Temporary Ro-Ro jetty)***

- **Ibrahimpatnam Terminal (Ch. 12.5)**

The Ibrahimpatnam Terminal is situated upstream of the Prakasam Barrage on the right bank of the River Krishna, precisely located at coordinates 16°34'49.48"N, 80°30'49.02"E. Currently, there is an ongoing process to acquire 5.5 acres of land for the development of land-side facilities.

This terminal will serve as a crucial point for the RO-RO (Roll-on/Roll-off) routes connecting Ibrahimpatnam to Harishchandrapuram and Lingyapalem, enhancing regional connectivity. The primary cargo handled at this terminal will include agricultural products, HSD, sand, and various other construction materials, supporting the local economy and infrastructure development.



*Fig. 7.6: Ibrahimpatnam Terminal (Temporary Ro-Ro jetty)*

**Harischandrapuram Terminal (Ch. 21.2 km):**

The Harischandrapuram Terminal is situated upstream of the Prakasam Barrage on the right bank of the River Krishna, precisely located at coordinates 16°34'22.10"N, 80°25'56.62"E. Currently, efforts are underway to acquire 3.63 acres of land for the development of land-side facilities.




*Fig. 7.7: Ibrahimpatnam Terminal (Temporary Ro-Ro jetty)*

Since IWAI has already proposed Muktyala and Ibrahimpatnam terminals for cargo handling, there is no necessity for an additional terminal. The existing terminal facilities at both locations can effectively accommodate cargo operations.

At Muktyala (Ch. 82 km), a fixed jetty measuring 75 meters in length and 10 meters in width is required initially to handle cement traffic. Similarly, at Ibrahimpatnam, a jetty of 100 meters by 10 meters is needed for loading and unloading cement during

the initial phases. As traffic is expected to increase fourfold by FY 30, the jetty at Muktyala should be extended to 150 meters, while the Ibrahimpatnam jetty should be extended to 200 meters to meet the growing demand.

Beyond FY 30, the extended berth lengths will adequately support traffic requirements up to FY 55. This approach ensures that infrastructure investments align with projected cargo volumes, optimizing operational efficiency at both terminals.

### 7.11.2 Planning Criteria

The basic criteria for effecting the planning are as follows:
No. of operating days available per annum – 330
Berth occupancy permissible for a Tw/Ts ratio ( ratio of waiting time to services time) of 0.75 – 1.0 with random arrival condition and Erlangian K-2 services for

| | | |
|---|---|---|
| Single berth | - | 0.6 |
| 2 berth | - | 0.71 |
| 3 berth | - | 0.80 |
| 4 berth and more | - | 0.85 |

For optimum functioning of the system, the maximum allowable berth occupancies for different number of berths (defined as the ratio of total time of berthing of vessels to the total time available for working in year) are arrived at based on queuing theory. These berth occupancies are a function of the ratio of waiting time to service time (Tw/Ts) of 100 t, 300 T and 500 t range of barges.

**Number of Berths Required**

Number of berths is arrived at by considering the expected throughput at the terminal, handing rate, parcel size and mechanical efficiency. A typical is shown below:

| | | |
|---|---|---|
| Total throughput | - | 0.35 MTPA |
| Average unloading rate (Notional) | - | 150 tph |
| Mechanical efficiency | - | 0.8 |
| Parcel size (Notional) | - | 500 t |

Time taken by each ship - 5.17 hrs.
No. of barges - 700
Required to be handled
Services hours required to - 3619 hrs.

It may be noted that the effective berth hours available per annum (taking the berth occupancies into account is:

4 berth system - 26928 hrs
3 berth system - 19008 hrs
2 berth system - 11246 hrs
Single berth system - 4752 hrs.

Therefore, single berth is required for the above case. Berth occupancy will be 0.46. Similar calculations are made for other values of throughput and various range of barges.

- **Berth Length at Muktyala Terminal**

***Table 7.11 : Berth Length (m) at Muktyala Terminal***

| FY | Traffic Volume (MTPA) | Barge Size (t) | | |
|---|---|---|---|---|
| | | 500 | 300 | 100 |
| 24 | 0.35 | 75 | 56 | 40 |
| 30 | 1.16 | 150 | 112 | 120 |
| 35 | 1.43 | 150 | 112 | 120 |
| 45 | 1.98 | 150 | 112 | 160 |
| 55 | 2.74 | 150 | 168 | 200 |

- **Berth Length at Vijaywada (*Ibrahimpatnam*) Terminal**

***Table 7.12 : Berth Length (m) at Vijayawada Terminal***

| FY | Traffic Volume (MTPA) | Barge Size (t) | | |
|---|---|---|---|---|
| | | 500 | 300 | 100 |
| 24 | 0.35 | 75 | 56 | 40 |
| 30 | 1.16 | 150 | 112 | 120 |
| 35 | 1.43 | 150 | 112 | 120 |
| 45 | 1.98 | 150 | 112 | 160 |
| 55 | 2.74 | 150 | 168 | 200 |

- **Berth Length at Harischandrapuram Terminal**

*Table 7.13 : Berth Length (m) at* **Harischandrapuram** *Terminal*

| FY | Traffic Volume (MTPA) | Barge Size (t) | | |
|---|---|---|---|---|
| | | 500 | 300 | 100 |
| 24 | 0.35 | 75 | 56 | 40 |
| 30 | 1.16 | 150 | 112 | 120 |
| 35 | 1.43 | 150 | 112 | 120 |
| 45 | 1.98 | 150 | 112 | 160 |
| 55 | 2.74 | 150 | 168 | 200 |

# CHAPTER – 8

# COST ESTIMATE

## 8.1 General Assumptions

The technical aspects of development of present waterway stretch for handling of the projected traffic are dealt with in the previous chapters. In the present chapter project cost estimates has been done. In order to arrive at capital cost for the proposal it is necessary to ascertain, unit rates of materials used for construction, dredging, excavation etc. Accordingly, efforts were made to obtain the above information from the relevant sources.

## 8.2 Basis of Costing

A block estimate of the capital cost of various facilities for the proposed terminals is made. The cost arrived are based on the in house database available on cost estimates and rates prevailing in the region.

The items and costs have been arrived at broadly on the following:

- Rates taken from current works of similar nature
- Updated rates of work of similar nature completed in the past.
- Consultant's in house data bank of cost estimates and budgetary quotations.

## 8.3 Development Cost

## 8.4 Capital Expenditure

The block estimate of capital cost is made for the 500 DWT vessel in River Section & 100 DWT vessel in Canal Section.

The cost estimates for different items involved in developing Stage I waterway are given below:

### i) Cost for land Acquisition

As already discussed in previous chapters, it is required to acquire 60m width of corridor to develop 20m width canal portion.

The cost involved in acquiring land is given below:

| Sl. No. | Item Description | Unit | Area of land Reqd. | Rate (Rs) | Amount Rs (Lakhs) |
|---|---|---|---|---|---|
| 1. | CH 39 km - CH 59 km | ha | 74 | 10000000 | 7400 |
| 2. | CH 59 km - CH 69 km | ha | 45 | 10000000 | 4500 |
| 3. | CH 69 km - CH 79 km | ha | 44 | 10000000 | 4400 |
| 4. | CH 79 km - CH 86 km | ha | 44 | 10000000 | 4400 |
| | | | | **Total** | **20700** |

**ii) Cost for River Dredging**

The cost for dredging in stretches of development is tabulated below:

| Sl. No. | Item Description | Unit | Quantity | Rate (Rs) | Amount Rs (Lakhs) |
|---|---|---|---|---|---|
| 1. | CH 23 km –CH 63 km | $m^3$ | 270,000 | 1200 | 3240 |
| | | | 2,430,000 | 300 | 7290 |
| | | | | **Total** | **10530** |

**iii) Cost for Canal widening (Excavation)**

The cost for excavation in stretches of development is tabulated below:

| Sl. No. | Item Description | Unit | Quantity | Rate (Rs) | Amount Rs (Lakhs) |
|---|---|---|---|---|---|
| 1. | CH 39 km –CH 86 km | $m^3$ | 1700000 | 210 | 3570 |
| | | $m^3$ | 900000 | 105 | 975 |
| | | | | **Total** | **4515** |

**iv. Cost for Locks**

On the basis of details of locks discussed in Chapter 6, it is understood that a total no. of 8 locks are lying across the proposed waterway. It is noted that these locks are not sufficient enough to provide passage for movement of 100 ton barge. It has also been observed that most of these locks are in bad condition and therefore require urgent modification/reconstruction in order to make them navigable for 100 t barges.

It is therefore proposed to have a provision of Rs. 1500 Lakhs per lock for reconstruction as per navigational requirements Therefore, total cost for reconstruction of these locks is calculated below:

8 locks @ Rs. 1500 Lakhs per lock = 8x1500=**12000 Lakhs**

**v. Cost for Bridges**

It has been observed that there are certain RCC road bridges lying across various stretches of proposed waterway which do not satisfy the criteria of horizontal clearance as well as vertical clearance for movement of 100t barges. It is therefore required to provide new RCC road bridges as per navigational requirements.

The cost has been worked out as Rs. 75,000 per sqm accordingly total cost for providing these bridges are given below:

1. Cost for Re-construction of RCC road bridge
= 30000 Lakhs

2. Cost for Demolition of RCC road bridge
= 5000 Lakhs

**Total cost for bridges= Rs. 35000 Lakhs**

**vi Cost for Terminals**

The summary of cost estimate for following terminals lying in proposed waterway is tabulated below:

| S. No. | Name of Terminal | Cost of Terminal (Rs. In lakhs) |
|---|---|---|
| 1 | Muktayala | 1900 |
| 2 | Harischandrapuram | 1900 |
| 3 | Ibrahimpatnam | 1900 |
| | **TOTAL** | **5700** |

Total cost for development of waterway for navigation with 500 DWT vessel in River Section & 100 DWT vessel in Canal Section is given below.

*Table 8.1: Cost Estimate*

| S.No. | Estimated Cost | ( Rs. in Lakhs ) |
|---|---|---|
| (A) | Dredging (River Section) | 10600 |
| (B) | Excavation (Canal widening) | 4515 |
| (C) | Land Acquisition for widening of Canal | 20730 |
| (D) | Terminal | 5700 |
| (E) | Modification of Bridges | 35000 |
| (F) | Modification of Locks | 12000 |
| (G) | Bypass Channel Lock System at Railway Bridge | 3500 |
| (G) | Navigational aids | 250 |
| **Total Cost (A+B+C+D+E+F+G)** | | **92295** |
| Contingency @3% | | 2769 |
| Total Incl. Contingency | | 95064 |
| Supervision Charges@7% | | 6461 |
| Total Incl. Contingency & Supervision charges | | 101525 |
| Plus GST @18% | | 18274 |
| Total Incl. GST | | 119799 |
| (+) Labour Welfare Cess @1% | | 1198 |
| Total | | **120997** |
| | | **Say Rs 1210 Crore** |

The capital cost worked out is including land acquisition cost for widening of canal, modification of navigational locks, excavation, dredging and cost of demolition and reconstruction of bridges etc.

# CHAPTER-9
# CONCLUSIONS AND RECOMMENDATIONS

## 9.1 Conclusion

### 9.1.1 Available Depths

Based on the thalweg survey of the River Krishna from Muktyala to Prakasam Barrage and the preliminary survey conducted by WAPCOS in the Bandar Canal, the available water depths in the waterway are summarized below:

**In River Krishna:**

- Average depth from chainage 0-10 km is around 6.0 meters.
- Average depth from chainage 10-20 km is around 5.0 meters.
- From chainage 20-23 km, the average depth is around 1.5 meters

Thus, it can be inferred that the average depth in the first 23 km is approximately 4-5 meters due to the ponding effect of Prakasam Barrage, thus, making it suitable for navigation.

However, beyond chainage 23 km up to chainage 63 km, sufficient water depths are not available, with the least available depth (LAD) being less than 1 meter. Rocky outcrops are present at Vedadri, Usthe Palli, and near chainage 53 at Kogantivaripalem, necessitating dredging with a cutter section dredger.

From chainage 63 km to 82 km, depths range from 1 to 2 meters. Therefore, minimal dredging is required for channel maintenance to ensure smooth navigation along this stretch.

**Canal Section:**

Sufficient water depths are available in Bandar canal. Average water depths in Bandar canal upto Kankipadu is 3.0 m. From Kankipadu to Akumaru, average depth is around 2.5m. In the tail reaches water depth is around 1.5m.

### 9.1.2 Market Assessment Forecast:

The percentage of shift identified for different states, as identified from the TLC assessment has been used to estimate the potential shift of traffic to IWT. It is considered that the NW-4 would likely begin operations from FY-2024 and the traffic realized in the first year of commencement is assumed to be 40%, which would gradually increase to 100% by FY-2027.

This traffic has been further estimated to be handled at NW-4 and Bandar Canal. (From Muktyala to Prakassam Barrage) and Bandar Canal (from

Prakasam Barrage to Machilipatnam Port). All the IWT-based cement traffic moving from the Nalgonda region would be loaded at Muktyala and offloaded at Prakassam Barrage, constituting the traffic at NW-4.

Further, traffic destined to the Vijayawada and Amravati would be offloaded at Prakasam Barrage and moved via road. The remaining traffic, to be transported to other states, would be moved via Bandar Canal to Machilipatnam Port for coastal shipping. As per the TLC assessment, cement traffic moving to Chennai Metropolitan Region may likely be shifted to Bandar Canal. This has been highlighted in the table below.

***Table 9.1: Traffic Projection***

| | FY-25 | FY-30 | FY-35 | FY-40 | FY-45 | FY-50 | FY-55 |
|---|---|---|---|---|---|---|---|
| **Cement traffic at NW-4 (destined to Vijayawada)** | 0.56 | 1.16 | 1.43 | 1.68 | 1.98 | 2.32 | 2.74 |
| **Cement traffic at Bandar Canal (destined to Chennai)** | 0.09 | 0.20 | 0.23 | 0.25 | 0.26 | 0.27 | 0.28 |

### 9.1.3 Proposed terminal & Berth Length

The development plans for Muktyala, Harischandrapuram and Ibrahimpatnam terminals are strategically aligned with the projected increase in cargo traffic. At Muktyala (Ch. 82 km), the construction of a 75m x 10m fixed jetty is essential for handling cement traffic efficiently. Similarly, at Ibrahimpatnam and Harischandrapuram a 75m x 10m jetty will facilitate the initial loading and unloading operations for cement.

As traffic volume is expected to quadruple by FY 30, extending the Muktyala, Ibrahimpatnam and Harischandrapuram jetty to 150 meters. These expansions will accommodate the anticipated growth and sustain operational needs until FY 55.

These proactive measures ensure that the infrastructure investments support the region's economic development, enhance logistical capabilities, and facilitate smoother navigation and cargo handling along the River Krishna.

Land acquisition is already in process for Muktyala, Harischandrapuram & Ibrahimpatnam terminal; therefore, only fixed jetty has to be constructed for loading/Unloading of cement at these locations.

### 9.1.4 Planning of Waterway:

In the present study, for river section, fairway width & depth for Class-I, Class-II & Class-III vessels has been kept as per IWAI norms. Similarly, In canal section, fairway dimension of Class-I has been adopted, as per IWAI norms for cost estimation purpose.

#### 9.1.4.1 Modification Requirement in existing Bridges & Locks

**River Section:**

There is no bridge from Muktyala to Parkasham as of now. However, one bridge is under construction near Suryapalem ($16^0$ 32' 59'' N $80^0$ 34' 01''E) and bridge has sufficient clearances.

Therefore, there is no need of any modification in River section.

**Canal Section:**

There are total 67 bridges in Bandar Canal including a Railway Bridge at chainage 0.7km and two Under Construction Bridge at Ch. 7.25 km (Near Enamalakudru) & Ch. 67.91 (Near Kaza-Machilipatnam).

**Navigation through Class-I Vessel**

All bridges except four bridges have to be demolished & Re-constructed as they are not conforming to respective requirement of vertical clearance and horizontal clearance.

#### 9.1.4.2 Widening of Canal

Addressing the width restriction in the Bandar Canal is crucial for enhancing navigational capabilities. After Veeranki Lock, the canal narrows significantly, with a maximum width of only 12 meters and a minimum of 4.8 meters in the tail reaches. This limitation prevents Class-II and Class-III vessels from navigating due to inadequate width, and expanding the canal within city limits is impractical.

For Class-I navigation, a minimum width of 20 meters is essential for safe passage. While 33 meters of width is available within city limits, approximately 46 km of the canal must be widened to meet navigational requirements. The excavation quantity required for this widening, based on fairway needs with an additional 1 meter freeboard, is computed as 6.15 million cubic meters.

Maintaining a consistent water depth of 1.5 meters throughout the canal is vital, necessitating a discharge of 24 cumec to ensure adequate navigational conditions. These considerations underscore the importance of infrastructure

planning and management to support efficient and safe waterway transport in the region.

### 9.1.4.3 Dredging Quantities:

The dredging quantities for the River Section have been estimated at approximately 2.7 million cubic meters, assuming navigation by Class-III vessels (500 DWT). These estimates are preliminary and subject to adjustment pending a comprehensive bank-to-bank survey to determine the exact dredging requirements.

It is noteworthy that the Canal Section currently maintains sufficient depth for navigation, obviating the need for dredging operations in that area. This strategic approach ensures that resources are allocated efficiently to enhance river navigation while minimizing environmental impact and optimizing logistical operations along the waterway.

### 9.1.4.4 Modification of Lock gates:

The site survey has confirmed that while the existing locks are generally in dilapidated condition, many of them require major modifications to accommodate 100 DWT vessels due to insufficient width. Specifically, the locks at Enamalakudru and Prakasam Barrage need to be widened to 6 meters to facilitate the movement of larger vessels.

Additionally, it is recommended to replace all lock gates with hydraulic mitre gates to enhance operational efficiency and reliability. Furthermore, installing fendering and mooring bollards inside the lock chambers will improve safety and maneuverability during vessel operations.

These proposed upgrades ensure that the lock facilities meet current navigation demands, optimize vessel traffic efficiency, and uphold safety standards along the waterway.

### 9.1.4.5 Cost Estimate

The estimated cost for the development of the waterway stretch from Muktyala to Machilipatnam/Anchorage through Bandar Canal, encompassing terminal construction, dredging, excavation, lock modifications, and bridge demolition and reconstruction, totals **Rs. 1210 Crores**, inclusive of Contingency, supervision charges, and GST. Out of Rs 1210 Crores, Rs 1000 Crores cost has been estimated for Canal Section only with Class-I Waterway.

## 9.2 Recommendations

- Based on functional planning, it has been determined that navigation with Class-I and Class-II vessels in the River section would involve excessive round trips, making it difficult and impractical. Therefore, the recommendation is to proceed with navigation using Class-III vessels in the River section.

- In the canal section, the projected traffic volume for the initial year is only 0.05 MTPA, while the estimated capital cost for canal section development stands at Rs. 1000 crores, a significant investment considering the anticipated traffic. Additionally, the reconstruction of 63 bridges poses a substantial logistical challenge. Taking these factors into account, navigation through the Bandar canal may not be viable.

- Given the navigability challenges and associated issues in the Bandar Canal, transporting cement from Nalgonda to Machilipatnam is not deemed a technically feasible option.