Final Report for Sagarmala (Vol. V)

Ministry of Shipping, Indian Ports Association

November 2016

- Master Plan for Mormugao Port
- Master Plan for Mumbai Port
- Master Plan for New Mangalore Port
- Master Plan for Paradip Port
- Master Plan for V.O. Chidambaranar Port
- Master Plan for Visakhapatnam Port

Final Report for Sagarmala (Vol. V)

Prepared for

Ministry of Shipping
Government of India

Ministry of Shipping / Indian Ports Association

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“In 2015 the Ministry of Shipping instructed McKinsey & Company and AECOM to provide fact-based analysis and insights from best practice around the world into [potential future trends in container shipping, options for infrastructure and potential approaches to financing ports development].

The Ministry will evaluate this advice, along with inputs and advice from a variety of internal and external experts, and determine the most appropriate strategy to give effect to the Cabinet’s decision of 25 March, 2015. McKinsey’s advice, in the form of the following confidential report, was provided in November, 2016.

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Master Plan for Mormugao Port

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1.0 INTRODUCTION

1.1 Background

The Sagarmala initiative is one of the most important strategic imperatives to realize India's economic aspirations. The overall objective of the project is to evolve a model of port-led development, whereby Indian ports become a major contributor to the country's GDP.

As shown in **Figure 1.1**, the Sagarmala project envisages transforming existing ports into modern world-class ports, and developing new top notch ports based on the requirement. It also aspires to efficiently integrate ports with industrial clusters, the hinterland and the evacuation systems, through road, rail, inland and coastal waterways. This would enable ports to drive economic activity in coastal areas. Further, Sagarmala aims to develop coastal and inland shipping as a major mode of transport for the carriage of goods along the coastal and riverine economic centres.

As an outcome, it would offer efficient and seamless evacuation of cargo for both the EXIM and domestic sectors, thereby reducing logistics costs with ports becoming a larger economy.

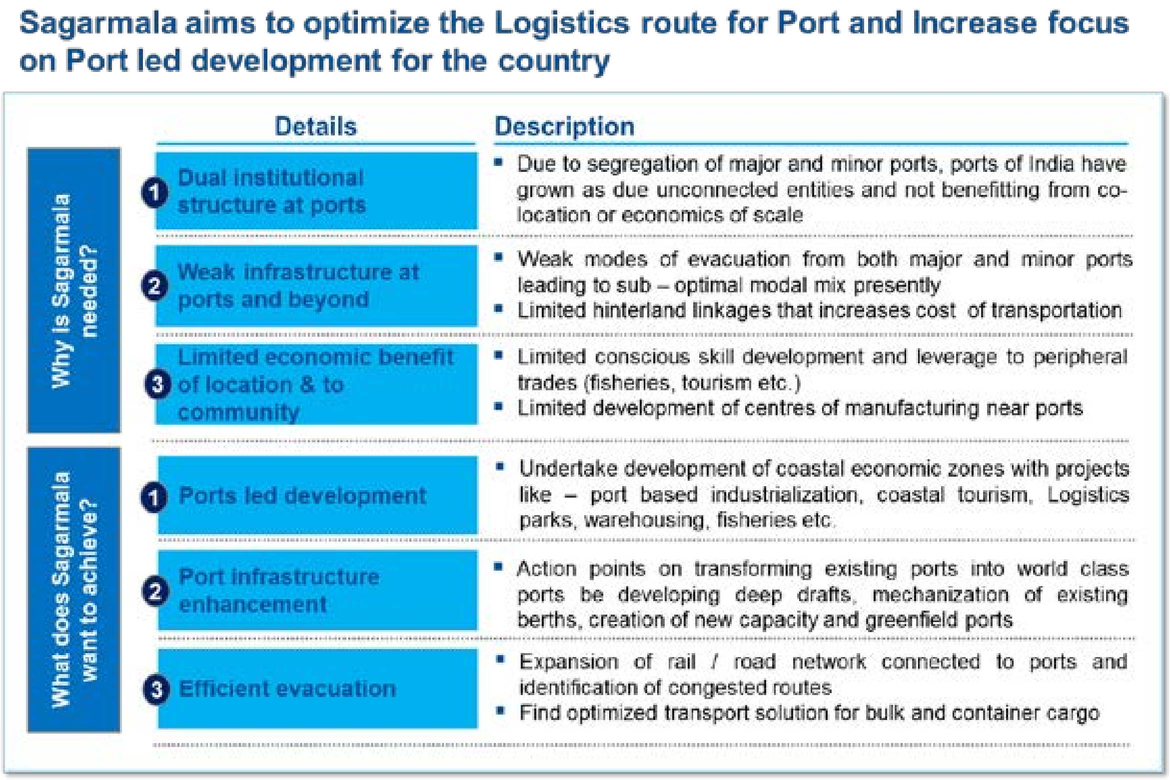


Figure 1.1 Aim of Sagarmala Development

In order to meet the objectives, Indian Port Association (IPA) appointed the consortium of McKinsey and AECOM as Consultant to prepare the National Perspective Plan as part of the Sagarmala Programme.

1.2 Scope of Work

The team of McKinsey and AECOM distilled learnings from the experience in port-led development, the major engagement challenge to develop a set of governing principles for our approach is shown in **Figure 1.2.**

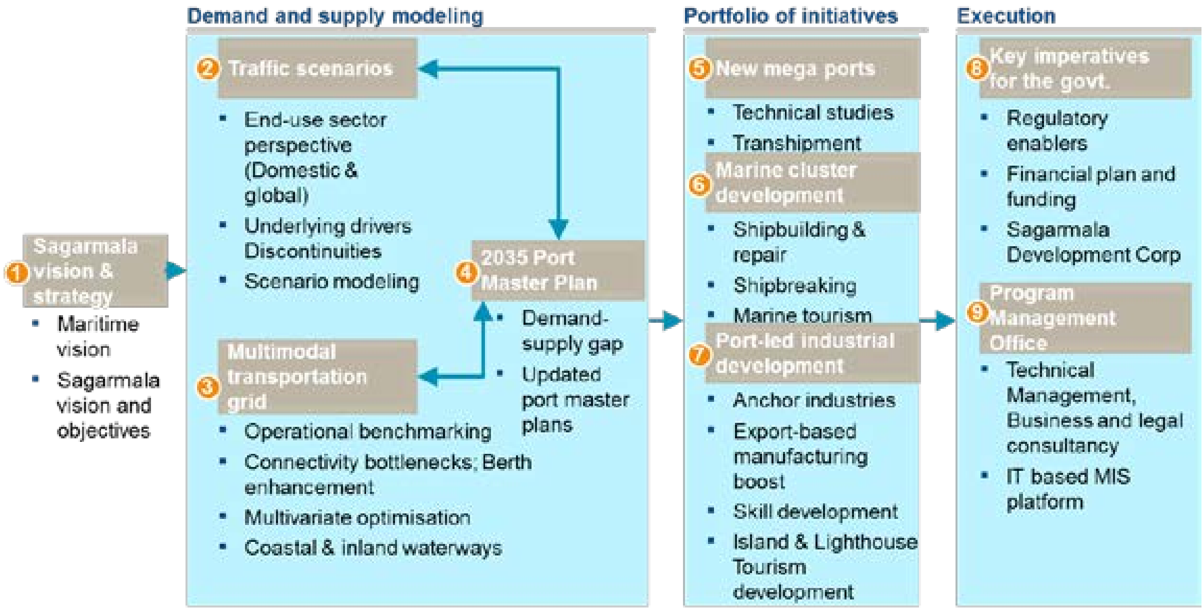


Figure 1.2 Governing Principles of Our Approach

As indicated above, the origin-destination of key cargo (accounting for greater than 85% of the total traffic) in Indian ports have been mapped to develop traffic scenarios for a period of next 20 years. The forces and developments that will drive change in the cargo flows shall also be identified. This would lead to the identification of regions along the coastline where the potential for expansion of existing port exists. The various activities involved in the port led developments are charted in **Figure 1.3**.

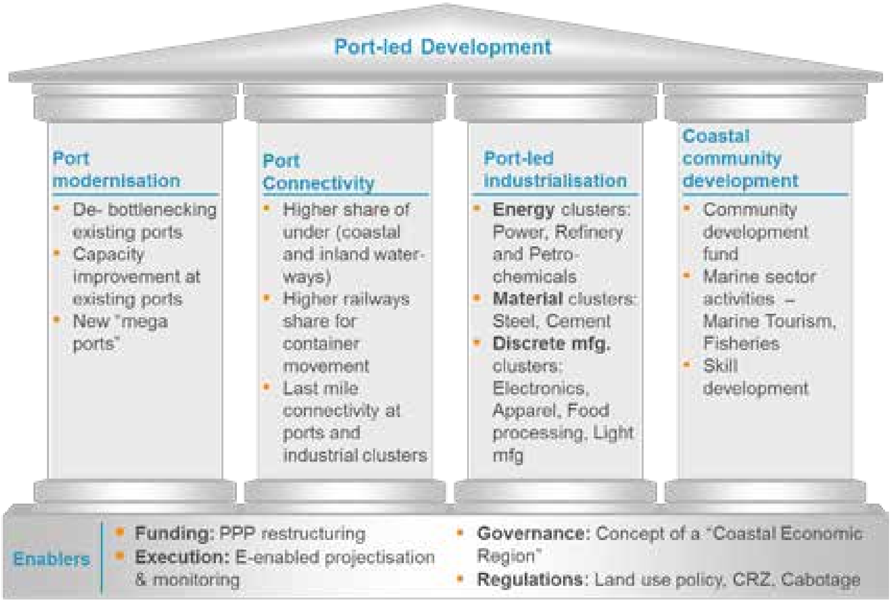


Figure 1.3 Port Led Developments

As part of the assignment, we are also expected to coordinate with the team working on "Benchmarking Operational Improvement Roadmap for Major Ports in India" study (which is being carried out simultaneously along with this assignment) and identify current and future logistic constraints (at the Major Ports) for the top 85% cargo categories based on analysis of current port capacity, productivity levels in comparison to international benchmark and evacuation bottlenecks in the logistics chain. This understanding should be an input in defining the 2035 Master Plan for each port.

Accordingly, this Master Plan report has been prepared taking into consideration the inputs provided on the future traffic and the benchmarking and operational improvements suggested for this port.

1.3 Present Submission

The present submission is the Final Report for Development of Master Plan for Mormugao Port as part of SAGARMALA assignment. This report is organised in the following sections:

Section 1 : Introduction

Section 2 : The Port and Site Conditions

Section 3 : Details of Existing Facilities

Section 4 : Performance, Options for Debottlenecking & Capacity Assessment

Section 5 : Details of Ongoing Developments

Section 6 : Traffic Projections

Section 7 : Capacity Augmentation Proposals

Section 8 : Scope for Future Capacity Expansions

Section 9 : Shelf of New Projects and Phasing

2.0 THE PORT AND SITE CONDITIONS

2.1 Mormugao Port as at Present

The Mormugao Port is a leading Major Port, located at the entrance of Zuari estuary on the west coast of India (State of Goa) at Latitude 15º 25’ North and Longitude 73º 47’ East. Mormugao Port is an excellent natural harbour and over the years, the port has deepened the channel and the harbour areas. Further, deepening of the channel and harbour basin is in process to enable handling of fully loaded capesize ships at the port. The port has good rail and road connectivity. The location of Mormugao Port in the state of Goa and its present layout is shown in **Figure 2.1**.

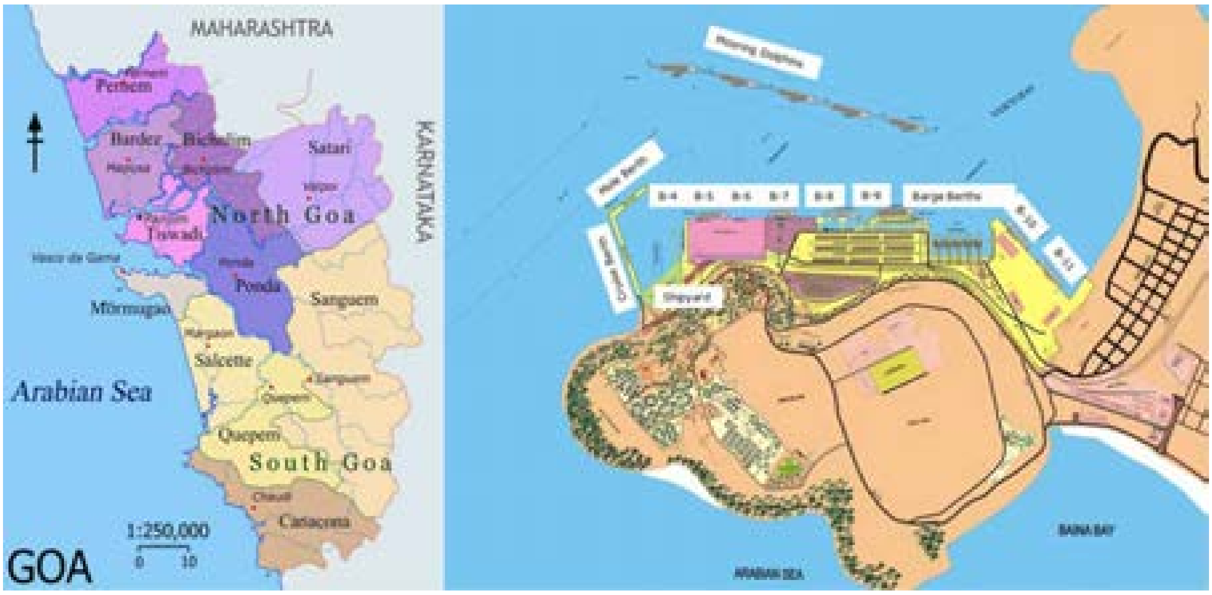


Figure 2.1 Location of Port and Berthing Facilities

Mormugao port has traditionally been one of the leading iron ore exporting port of India. Due to Hon'ble Supreme Court's ban on iron ore exports from Goa and subsequent restrictions on iron ore exports, the cargo volumes handled by Mormugao have fallen sharply. Today, the port is set to diversify into other commodities including containers. Coal/Coke is a major commodity handled at the port. During the year 2013-14, more than 7.5 MT of coal was handled at Mormugao Port. There are two dedicated coal terminals (berth 6 & 7) which are being operated by private operators. The demand for coal imports through Mormugao Port remains very strong. Along with the demand for coal, the general cargo traffic has witnessed a spurt during the past two years.

2.2 Road Connectivity

Mormugao Port is well connected with all major towns of not only Maharashtra and Karnataka, but the rest of India as well via the following National and State Highways:

- NH 17 (Panvel – Panaji – Mangalore – NH 47 Junction in Kerala)
- NH17A (Cortalim - Mormugao)
- NH17B (Ponda – Verna - Vasco)
- NH 4A (Panaji - Belgaum)

All-important destinations in India whether on the North, West or East could be accessed through any one of the above mentioned Highways as shown in **Figure 2.2**.

Figure 2.2 Road Connectivity to Mormugao Port

NH 17B passes along the port and have significant influence on Port Traffic movement. The port presently has 3 gates they're Gate 1, Gate 2 and Gate 9. Presently Gate 1 and Gate 9 are in use. Major vehicular movement is from Gate 9, whereas Gate 2 is mainly used for the passenger vehicles. The location of these gates is shown in **Figure 2.3**.

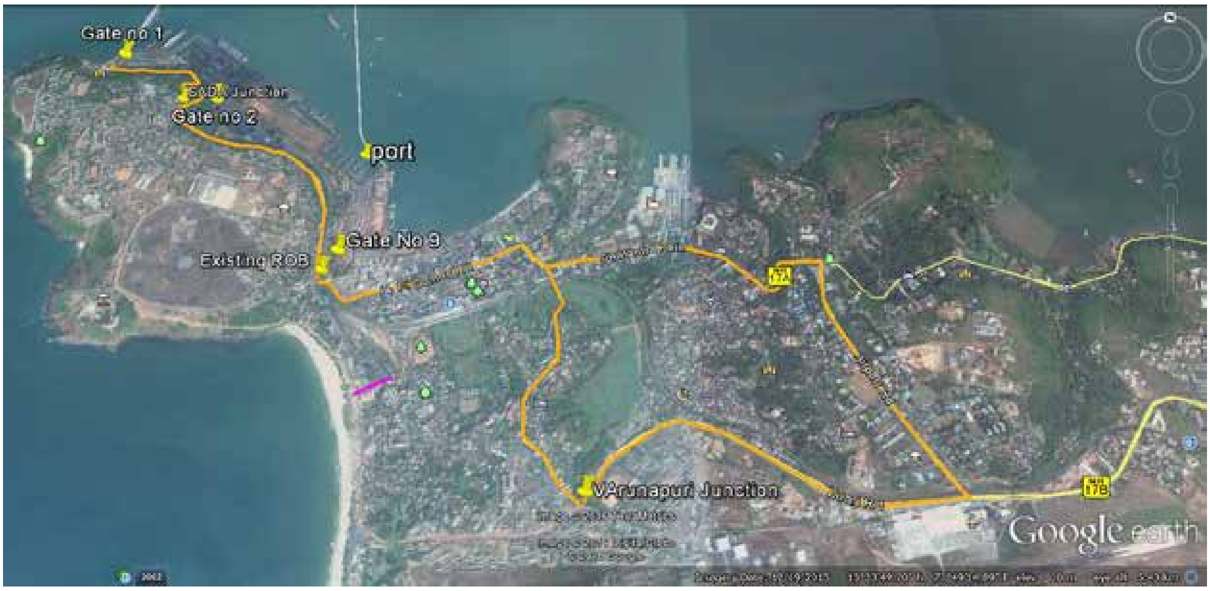


Figure 2.3 Location of Entry / Exit Gates at Mormugao Port

2.3 Rail Connectivity

The broad gauge railway system of the port serves the general cargo berths. Port Railway system is connected to south western railway through which it is also linked to Konkan Railway. Both these railway together facilitate easy access to the port from any part of the country through the vast network of broad gauge railway system.

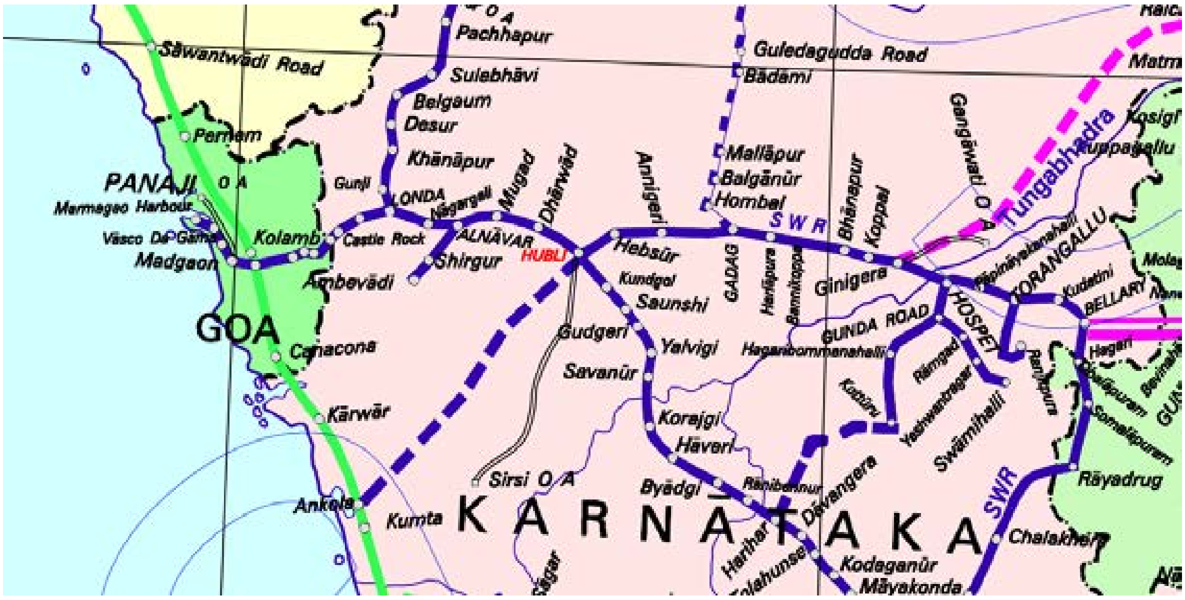


Figure 2.4 Rail Connectivity to Mormugao Port

Route No.	Rail Routes	Traffic Directions
1.	Vasco – Majorda – Madgaon – Loliem - Manglore	South (Along the coast)
2.	Vasco – Majorda – Madgaon – Kulem – Castle Rock – Londa -Belgaum – Miraj	East & North bound traffic
3.	Vasco – Majorda – Madgaon – Kulem – Castle Rock – Londa –Dharwad -Hubli – Hospet - Bellary	East & South East bound
4.	Vasco- Cansulim – Verna – Mapusa – Pernam – Ratnagiri -Mumbai	West (along the coast)

Vasco da Gama, the nearest railway station, is connected to the Port Trust Railway System from the south by double tracks which pass through the port rail gate. Also south of the port is a shop and engine house complex belonging to the Port Trust Railway. This complex has short tracks for storage of wagons and locomotives. Within the Port Trust rail gates, a spur track serves Berth 10 and Berth 11. Inside the port area there are presently four tracks dedicated to receipt and despatch (R&D) of single rakes. From the R&D lines, two lead tracks extend north for Berths 5A & 6A. These leads serve three tracks of 450 m for loading coal and steel coil. The port has taken up the work of augmenting the capacity of rail within the port. Additional lines will now be laid in the R&D yard. Separate rail facilities have been planned for berths 5A & 6A, berth 7, berth 11 and west of breakwater berths.

2.4 Site Conditions

2.4.1 Meteorology

2.4.1.1 Winds

The mean wind speed varies from 2 on Beaufort scale in November (3.4 to 5.4 m/s) to 4 (5.5 to 7.9 m/s) in July, the annual mean wind speed being 13.6 km/h. In an average year, there are 316 days with wind speed varying from 0 to 3 on Beaufort scale (0.0 to 5.4 m/s) and 48 days with winds scaling 4 to7 on Beaufort scale (5.5 to 17.1 m/s), and one calm (0.0 to 0.2 m/s) day.

The predominant wind direction changes with the time of the year. During June to September wind direction is from W and SW and during the remaining period the direction is from NE and ESE.

2.4.1.2 Rainfall

The average annual rain fall in Mormugao is about 2,611.7 mm and the average number of rainy days in a year are100. During June to September, Mormugao receives 89% of the annual rainfall.

2.4.1.3 Air Temperature

Mean dry bulb temperature varies from 24.3° C in January to 29.8° C in May. The mean daily maximum temperature varies from 27.8° C in August to 31.5° C in May and the mean daily minimum temperature from 21.4° C in January to 26.9° C in May. The annual average daily maximum and minimum temperatures are 29.5° C and 23.7° C respectively.

2.4.2 Oceanography

2.4.2.1 Tides

The tide prevailing at Mormugao harbour is mainly semi-diurnal exhibiting two high and two low waters in a tidal day. The mean tidal variation is of the order of 1.6 m at spring tides and 0.7 m at neap tides. The Chart Datum is 4.8449 m below the principal Bench Mark established by the port.

Based on this datum and Indian Naval Hydrographical Chart No. 2020 the tide levels are as follows:

§	Higher High Water at Spring	(HHWS)	+ 2.3 m
§	Mean Higher High Water	(MHHW)	+ 1.9 m
§	Mean Lower High Water	(MLHW)	+ 1.8 m
§	Mean Higher Low Water	(MHLW)	+ 1.0 m
§	Mean Lower Low Water	(MLLW)	+ 0.5 m
§	Mean Sea Level	(MSL)	+ 1.3 m

2.4.2.2 Currents

The currents in the region outside the sheltered harbour have been found to be generally less than one knot during fair weather season and are mainly caused by the tidal flow. Within the sheltered harbour, indicated current strengths are of the order of 0.30 to 0.40 m/s. During heavy monsoon rains, the current pattern is altered from that during the fair season but the current strengths do not get altered appreciably.

2.4.3 Geotechnical Data

Based on the geotechnical investigations carried out at port from time to time within the port during its growth it is observed that the seabed is generally covered by soft sand / silty sand / silty clay, though at few places, the seabed is covered with dense to very dense, silty, fine to medium sand. General characteristics of the Soil strata based on site investigations at Vasco Bay are as under:

- Top layer 8 – 10 m Loose silty sand with value of N = 0 to 5
- Next layer 10 m thick Medium to dense sand " N = 15 to 30
- Bottom layer 24 – 26 m Weathered to hard rock " N > 100

The characteristics of soil strata in the area 250 m away from the face of Berths 10 and 11 indicate that the silty clay deposit varies in depth from 5 m to 10 m. This layer is intercepted at places by sand, shells, and kankar patches. A layer of medium to dense fine sand underlies this soft layer. Beyond 27 to 32 m, the hard rock is noticed.

3.0 DETAILS OF EXISTING FACILITIES

3.1 Approach Channel

The approach channel of the port comprises an outer channel 5,200 m long and an inner channel 2,300 m long. The channel is 250 m wide. The harbour basin has two turning circles of 480 m diameter each.

The outer channel is dredged up to -14.4 m CD. The inner channel and the turning circle are dredged to -13.1 m CD. The channel is one way navigation channel. The details of Approach Channel are as follows:

- Length of Outer Channel : 5.2 km
- Length of Inner Channel : 2.3 km
- Width of Channel : 250 m
- Depth : 14.4 m to 13.1 m below CD
- Turning Basins : 2 no. of 480 m diameter
- Tidal Range : Springs- 2.3 m / Neaps-1.0 m

The port has already awarded the contract for deepening the channel to -19.8 m CD to enable handling of cape size ships.

3.2 Breakwater

The port has a 522 m long breakwater aligned slightly east of north at the western end of the port/berthing facilities. A mole of 270 m long runs from the tip of the breakwater in an easterly direction. The breakwater and the mole give protection to the berths from W and NW waves during monsoons.

3.3 Berthing Facilities

The location plan of the berths is shown in the **Figure 3.1**

Figure 3.1 Existing Berthing Facilities

The details of all the berthing facilities are provided in the **Table 3.2**.

Table 3.2 Berthwise Details

Berth No.	Type of Berth	Designed / Depth (m)	Quay Length (m)	Planned for Maximum Size of Vessel	
				Length Overall (m)	DWT Approx. (T)
1, 2 and 3	Shipyard	-	-	-	-
4	Non-cargo berth	8	194	190	-
5	General Cargo	13.1	210	190	50,000
6	General Cargo / Coal	14.1	240	225	70,000
7	Coal Cargo	14.5	300	300	1,60,000
8	Liquid Bulk	13.1	116 / 298*	260	1,25,000
9	Iron Ore	14.1	222 /357.5*	335	2,75,000
10	General Cargo	13.1	250	225	55,000
11	General Cargo	13.1	270	225	65,000
-	Non-Cargo Berth New cruise Terminal (along the breakwater	9.50	450	-	-
-	Mole Berth (along the mole)	9.50	250	200	-
-	Between Mooring Dolphins no.1&2	14.1	340	225	70,000

Berth No.	Type of Berth	Designed / Depth (m)	Quay Length (m)	Planned for Maximum Size of Vessel	
				Length Overall (m)	DWT Approx. (T)
-	Between Mooring Dolphins no.2&3	14.1	340	225	70,000
-	Between Mooring Dolphins no.3&4	14.1	340	225	70,000
-	Between Mooring Dolphins no.4&5	14.1	340	225	70,000
-	Between Mooring Dolphins no.5&6	14.1	340	225	70,000
-	East of Mooring Dolphins no.1	12.8	-	-	-

** Length between extreme mooring dolphins*

Brief descriptions of the above berthing facilities are given below.

3.3.1 Berth 1, 2 and 3 (Shipyard)

Berth 1, 2 and 3 form part of a modern ship repair complex with floating dry dock facilities leased to M/s Western India Shipyard Limited (WISL)

3.3.2 Berth 4 (Non Cargo Berth)

Berth 4 is a Non Cargo Berth, presently being used for port crafts berthing. This berth can accommodate vessel up to LOA 190 m.

3.3.3 Berths 5 and 6 (Steel Products and Coal)

The Berths 5 and 6 are operated by SWPL (subsidiary of JSW). Berth 5 is dedicated for export of steel products from JSW steel plant in Tornagallu in Vijayanagara, located about 410 km from the Mormugao port and berth 6 is dedicated for import of coking coal that is required at the plant.

The total length for berths 5 and 6 is about 450 m with an available draft of -14.1 m CD. These berths are planned for handling about 70,000 DWT vessels. These berths are equipped with 3 mobile harbour crane having a total discharge capacity of 40,000 TPD. The receiving conveyors (from berth to stackyard) have a rated capacity of 3,000 TPH and the despatch conveyors (from stackyard to despatch) have a rated capacity of 1,800 TPH.

The stackyard has the cargo storage capacity of about 180,000 T (3 stockpiles of 280 m long with 10 m stacking height) served by two Stacker / Reclaimer units of 2,400 TPH nominal capacity for stacking and 1,800 TPH nominal capacity for reclaiming.

An in-motion wagon loading station connected by pipe conveyor has been installed for loading one full rake of 59 wagons (3,600 T) in about 1 hour. The wagon loading station has a silo of 4,000 T.

3.3.4 Berth 7 (Coal)

Berth 7 is leased to M/s. Adani Mormugao Port Terminal Private Limited (AMPTPL). This berth with a length of 300 m has a design draft of -16.5 m CD and is designed for handling upto 160,000 DWT ships. The berth is equipped with two mobile harbour cranes, each with a rated capacity of 1,750 TPH.

The fully mechanised material handling system consisting of conveyor systems, two tripping conveyors in the yard closer to the berth and one stacker cum reclaimers unit with stacking capacity of 3,500 TPH and reclaiming capacity of 2,500 TPH has been provided, in the other yard parallel to the berth. The stackyard has a total area of 97,000 m^2 with effective storage area of about 54,000 m^2.

An in-motion wagon loading system with a silo of capacity 4,000 T is provided for faster evacuation through rail. Two truck loading stations, with an independent hopper of capacity of 500 T, are provided for evacuation through trucks.

3.3.5 Berth 8 (Liquid Bulk)

Specialised facilities are available at berth 8 for handling petroleum products and other liquid cargoes like caustic soda, ammonia, molasses etc.

Generally, hoses are used to transfer bulk liquids between the tankers and onshore pipeline system. A mobile mechanical unloading arm is provided to handle Ammonia.

3.3.6 Berth 9 and Barge Jetties (MOHP)

The berth 9 is dedicated for the handling of Iron Ore with Mechanized Ore Handling Plant (MOHP). This berth is 357 m long and having dredged level of -14.1 m CD. It can handle vessel up to LOA 335 m. However, due to the Supreme Court's ban on iron ore exports from Goa and subsequent restrictions on iron ore exports, the berth is not being utilised at present.

The port also has total 5 numbers of barge berths for unloading of iron ore, brought to the port through barges. The details of MOHP are presented in **Table 3.1**:

Table 3.1 Details of MOHP

S. No.	Description of Equipment	No.	Rated Capacity (TPH)
1.	Barge Unloaders	8	750
2.	Continuous Barge Unloader	1	1,250
3.	Stackers	3	4,000
4.	Reclaimers	2	4,000
5.	Ship Loaders	2	4,000

Stackyard at MOHP has an area of 80,000 sqm and have a storage capacity of 1.0 MT of iron ore.

3.3.7 Berths 10 and 11 (Bulk and Breakbulk)

These two berths have combined length of about 520 m and are operated as general cargo berths by port. The major cargo handled in the berths include containers, steel coils, granite blocks, MOP, wood chips etc. Some quantity of Phosphoric acid and petroleum products are also handled at these berths.

3.3.8 Mooring Dolphins

Six mooring dolphins capable of accommodating panamax size vessels are also available for handling ore and other bulk cargo using ship's own gears.

3.3.9 Cargo Handling Equipment for General Cargo/Containers

The details of cargo handling equipment are provided in the **Table 3.2**.

Table 3.2 Details of General Cargo / Containers Handling Equipment

S. No.	Description	No.	Capacity
1.	Mobile Harbour Crane	1	100 T capacity
2.	Reach stacker	2	40 T capacity each
3.	Plug points of suitable capacity to cater to the reefer containers	84	440 V
4.	Locomotive	2	1400 HP

3.4 Berths for Cruise Ships

The berth along lee side of the Breakwater is used for berthing of the Cruise Ships.

3.5 Berth for Navy/Coast Guard Vessels

The mole berth adjoining the head of breakwater is used for berthing of the Navy and Coast Guard Vessels.

3.6 Storage Facilities

Storage facilities comprise of covered storage area in the form of transit sheds, warehouses and open storage area and tanks for liquid cargo area as presented in **Table 3.3** and **Table 3.4** below:

Table 3.3 Details of the Storage Facilities for General Cargo / Containers

Description	No. of Plots/Sheds	Area (m^2)	Storage Capacity (T)
Covered Storage			
§ **Owned by the Port**	7 sheds	24,985	47,497
§ **Owned by Others: FCI/CWC**	4 sheds	14,480	22,216
Total Covered storage	**11 sheds**	**39,465**	**69,713**
For Containers	-	14,823	(489 ground slot / 862 TEUs)
Open Storage for other cargo	-	131,681	292,895
Total Open Storage	**-**	**146,504**	**304,726**

Table 3.4 Details of Storage Facilities for Liquid Cargo

S. No.	Commodity	No. of Tanks	Capacity (in KL)
1.	**POL Product**		
a	IOC -Vasco	5	34,660
b	HPCL - Vasco	8	33,700
c	ZIL - Zaurinagar	4	27,500
d	Ganesh Benzoplast- Sada	2	46,000
2.	**Phosphoric Acid**		
a	ZIL- Zaurinagar	3	13,670
3.	**Caustic Soda Molasses & Other Liquids**		
a	Ganesh Benzoplast- Sada	2	46,000
b	IMC- Harbour (Port area)	9	15,000
c	JRE (Port Area)	2	7,800
4.	**Ammonia**		
a	ZIL- Zaurinagar	1	3,000 T
b	ZIL- Sada/Jetty	1	5,000 T

4.0 PERFORMANCE, OPTIONS FOR DEBOTTLENECKING & CAPACITY ASSESSMENT

4.1 General

The total cargo handled through the existing facilities, during the past 5 years is presented in the **Table 4.1**.

Table 4.1 Cargo Handled During Last 5 Years (in MT)

Commodity	2011-12	2012-13	2013-14	2014-15	2015-16
Liquid Cargo	1.4	1.0	0.9	1.1	1.06
Iron Ore Including Pallet	29.4	7.4	0.3	0.8	3.96
Fertilizer	0.1	0.08	0.2	0.2	0.22
Thermal Coal	1.2	0.77	0.0	1.9	3.73
Coking Coal	5.7	6.61	7.5	6.6	7.81
Coke	0.4	0.43	0.3	0.7	0.74
Container	0.2	0.21	0.2	0.2	0.35
Steel	0.5	0.8	1.3	1.7	0.84
Other	0.2	0.34	1.1	1.4	2.07
Total	**39.0**	**17.6**	**11.7**	**14.7**	**20.78**

4.2 BCG Benchmarking Study

BCG, as part of their benchmarking study, has looked into the operation of the berths and has suggested various measures for improving the performance. The report of BCG pertaining to Mormugao Port is given in the **Appendix 1**. The key observations and relevant details for the port master planning are as follows:

4.2.1 SWPL (JSW) Terminal (Berth 6)

The port has planned for deepening of the channel to a level of -19.8 m CD along the approach channel, turning circle, JSW terminal and to a level of -16.5 m CD at Adani terminal. It was suggested that upgradation of the terminal infrastructure should also take place for handling cape size vessels so that current throughput could be increased.

4.2.2 General Cargo Berths 10 & 11

According to BCG, General Cargo berths 10 & 11 are having high berth occupancy and also they are being operated at low productivity. Additionally, evacuation is also seen as a major constraint. The following are the initiatives suggested by BCG:

§ Minimising the loss of time during the shift change by way of implementing hot seat change, bookings through hand held devices etc.

§ Performance improvement of HMC operators by way of training.

§ Deployment of an additional HMC at the berths.

§ Improvement of gate process is required through automation and process simplification for greater throughput.

4.3 Capacity Assessment of Existing Facilities

4.3.1 General

The cargo handling capacity of port is based on many factors like the vessel size, fleet mix, equipment provided, possible handling rates, time required for peripheral activities, capacity of stackyard, number of users, grades, capacity of evacuation system etc.

Another factor that is important while arriving at the berth capacity is the allowable berth occupancy which is expressed as the ratio of the total number of days per year that a berth is occupied by a vessel (including the time spent in peripheral activities) to the number of port operational days in a year. High levels of berth occupancy will result in bunching of ships resulting in undesirable pre-berthing detention. For limited number of berths and with random arrival of ships, the berth occupancy levels have to be kept low to reduce this detention. The norms generally followed for planning the number of berths in modern port to minimise the pre-berthing detention are given in **Table 4.2**.

Table 4.2 Recommended Berth Occupancy

No. of Berths	Recommended Berth Occupancy Factor
1	60%
2	65%
3 & above	70%

The capacity of existing berths/terminals is calculated assuming the type of cargo being currently handled at these berths and the corresponding parcel sizes.

4.3.2 Coal Berths

4.3.2.1 Berth 6

Berth 6 is equipped with three mobile harbour cranes with connected hoppers. The coal unloaded from ship is discharged to the mobile hoppers with connected conveyor system, which takes the coal to stackyard.

It is understood that while this berth substructure can cater to the higher dredged levels and the cape size ships, the existing equipment is not suitable for unloading the capesize ships. Significant modifications to the berth superstructure would be needed for either installing the ship unloaders or providing high capacity mobile harbour cranes.

This berth handles coking coal, lime stone, met coke, steam coal etc. which are brought in different parcel sizes and therefore the handling rate is also different. The average productivity achieved at this berth is in the range of 25,000 TPD only, which is on a lower side considering the fully mechanised system and handymax to panamax size ships calling at the berth. The capacity and cycle time of existing mobile harbour cranes appear to the reason for low handling rate. Considering optimal berth occupancy of only 70% for this captive berth, the annual capacity works out to only 6.2 MTPA, against which it handled over 8 MT during last year but at very high berth occupancy, which resulted in significant waiting time of ships. For increasing the berth productivity, there is an urgent need for the upgradation of handling system not only for increasing the handling rate but also to be able to cater to the cape size ships.

4.3.2.2 Berth 7

Berth 7 is equipped with two mobile harbour cranes, which are of much higher capacity as compared to the mobile harbour cranes provided at berth 6. This berth is highly underutilised and handled only 0.86 MT of cargo last year. The average parcel size of ships handled was also low at about 40,000 T and therefore the productivity achieved was about 25,000 TPD as against an average of about 35,000 TPD that could have been achieved at this berth based on the equipment provided. Based on the equipment, the capacity of this berth is calculated as about 8.5 MTPA, at berth occupancy of about 70%. The effective stackyard area for the berth 7 is only about 45,000 m^2. Based on the stacking arrangement at the yards, it is observed that about 0.2 MT of coal could only be stacked. To match the berth capacity output the coal stored would need to have a turnover ratio of 48 (i.e. dwell time of 7 days), which is very high meaning that the stackyard area would remain a key constraint to the capacity of the terminal.

4.3.3 Berth 8 (Liquid Cargo)

Berth 8 handles various liquid cargoes like Caustic Soda, Furnace Oil, H.S.D., Liquid Ammonia, motor spirit, palm oil etc. These products are received in smaller tankers carrying low parcel size. The unloading rate is governed by on board ship pumps and is relatively very low. The average productivity achieved at this berth is about 9,000 TPD only. The capacity of this berth is calculated as about 2.2 MTPA at berth occupancy of about 70%.

4.3.4 Breakbulk Cargo

4.3.4.1 Berth 5

Berth 5 mainly handles captive cargo of JSW comprising of steel products using the mobile harbour cranes or ship's gears (when the mobile harbour cranes are deployed on berth 6). The cargo comprises of Steel Coils (Cold Rolled), G. I. Coils, HR Sheets, HR Steel Coils (Hot Rolled), Steel Bar Rods, Steel Plates and Sheets, Steel Slabs and Steel Coils (Wire Rolled). It is observed that an average productivity achieved is about 7,000 TPD, which seems broadly in order considering the diverse nature of products handled. Accordingly, the capacity of this berth is assessed as about 1.7 MTPA at allowable berth occupancy of 70%.

However, it may be noted that consequent to the deepening of the channel and the berthing areas, capesize vessels would be able to call at the port. This would mean that berth 5 and 6, which have a total berth length of 450 m would be able to handle one cape size ship only. This would affect the availability of berth 5 resulting in low throughput.

4.3.4.2 Berths 10 and 11

Table 4.3 illustrates the quantity handled by multipurpose berths 10 and 11 and their performance.

Table 4.3 Performance of Multipurpose Berths 10 and 11

Cargo	Working Time at Berth (Hrs)	Total Cargo Handled (T)	Productivity (TPD)
Granite Blocks	1,873	2,07,784	2,218
Alumina	344	21,000	1,220
Containers (Import / Export)	1,499	2,62,677	3,505
Steel Products	2,784	6,51,433	4,680
Iron Ore Lumpy	166	80,065	9,646
Iron Ore Pellets	79	49,158	12,393
Liquid Cargo (Aviation Oil + HSD + Furnace Oil+ LSHF + Kerosene Oil + Phosphoric Acid)	1,008	5,55,100	11,012
Machinery, Spares, Accessories & Appliance	5	80	331
Muriate of Potash	1,127	2,24,900	3,992
Nickel & Nickel Products	173	14,021	1,623

Cargo	Working Time at Berth (Hrs)	Total Cargo Handled (T)	Productivity (TPD)
Sugar	100	35,513	7,085
Urea	151	12,902	1,715
Wood (Logs, Timber, Bamboos, etc.)	1,876	4,19,633	4,475
Bauxite	157	1,08,500	13,800
Grand Total	**11,342**	**26,42,766**	

Berths 10 and 11, though named separately, form a single quay and even three small ships could be handled simultaneously. It could be seen that currently the average productivity at these berths is about 4,700 TPD. These berths are deployed with only one mobile harbour crane and therefore most of the cargo is handled using the ship's gear. Basis above the current total capacity of these two berths is only about 2.3 MTPA at 70% occupancy.

The capacity of any multipurpose berth depends upon the type of cargo handled, vessel parcel size, mode of handling, capacity of equipment deployed, speed of evacuation and so on. The type of cargo handled at these berths is highly variable in terms of density, mode of handling (grab, hook etc.) and therefore the handling rate achieved would significantly vary from cargo to cargo.

In order to improve the productivity and hence the berth capacity additional equipment needs to be deployed. In addition any hindrances to the traffic movement from berth to yard and vice versa need to be removed.

Deployment of mobile harbour cranes and effective operations is constraint in part of the berth 10 due to the presence of shed T2. It is suggested that the cargo like granite, machinery etc. that are brought in smaller parcel sizes should be handled at berth 10 using ships gears. The annual capacity of this berth could then be taken as about 1.0 MTPA considering average productivity of about 4,000 TPD for handling such cargo. However, in the eventuality other cargo may also be handled at this berth as per requirements.

The quay on the berth 11 side should be prioritised for handling of bulk and other breakbulk cargo like alumina, wooden chips, iron ore lump etc. using the mobile harbour cranes. The existing mobile harbour crane needs to be augmented with another one so that the two cranes together can effectively unload ship for faster turnaround time. Matching equipment for transfer of cargo between yard and berth would also need to be provided. This would enable higher productivity at this berth and capacity of the single berth itself could go upto 2.5 MTPA considering average productivity of about 10,000 TPD. Therefore the overall capacity of berths 10 and 11 at 70% occupancy works out to about 3.0 to 3.5 MTPA.

5.0 DETAILS OF ONGOING DEVELOPMENTS

5.1 Construction of 4 Lane Road from Verna Junction on NH-17 to the Port

The Tripartite Agreement between National Highway Authority of India (NHAI), Murmugao Port Trust (MPT) and Govt. of Goa (GoG) has been signed on 02.11.2014. The subject work is to be executed by GoG as per the directives of the Hon'ble Supreme Court. The GoG had appointed M/s. S.N. Bhobe & Associates, Mumbai as consultant for preparation of project reports, designs, drawings & estimates etc. for the work.

Figure 5.1 4 Lane Road to Varunapuri Junction to the Port

As per the Tripartite Agreement, a new 4 lane road is proposed to be constructed from Varunapuri Junction at chainage 13+100 to the Port. It has partial elevated section and partial at-grade section from Varunapuri junction and continues at grade till chainage 14+080. After this, it is elevated and near Rabindra Bhawan it is split into two arms. One arm takes eastern direction after crossing ROB passes through the existing temporary shed after which it comes at grade level. The other arm goes straight and comes down at grade after traversing a length of about 650 m and ends at Desterro. Then it continues further at grade and reaches at SADA junction. In addition, two ramps have been proposed connecting the arm leading to the port.

5.2 Augmentation of Railway Network

In order to cater to the increased traffic due to various projects like Development of Berth 7, Berth 11 and west of breakwater, the rail cargo handling capacity was augmented by providing additional lines. The work of laying of additional tracks has been completed in July 2014. Construction of the Signalling building is in progress and will be completed in September 2016. Tendering work for Signalling and Telecommunication of Railway yard is in progress.

There is a proposal to provide additional rail lines 7, 8 over and above the existing lines 1 to 6 and also provide 30 m paved area along the additional lines for storing the rail bound cargo.

5.3 Deepening of Approach Channel for Capesize Vessels at Mormugao Port

Mormugao Port has taken up the work to deepen the existing channel to facilitate handling of cape size vessels under annuity model. The work is to deepen the outer channel from -14.4 m to -19.8 m CD and inner turning circle from -14.1 m to -19.5 m CD. The work has already been awarded to Dredging Corporation of India (DCI).

5.4 Redevelopment of Berths 8, 9 & Barge Berths

Mormugao Port has already taken up the redevelopment of berths 8, 9 and barge berths to create facilities for coal and breakbulk handling. This would require shifting of the liquid handling at some other location or new berth would need to be developed. The work has already been awarded to Vedanta.

6.0 TRAFFIC PROJECTIONS

6.1 General

The port of Mormugao currently handled roughly 14.7 MTPA of cargo, in the year 2014-2015, catering primarily to the hinterlands of South Maharashtra, Northern Karnataka and Goa. One of the major bottlenecks hindering the growth of the port is the lack of good connectivity due to the Western Ghats. The port used to be the largest gateways of Iron Ore from the country which was largest export from the port but with the mining ban and Brazil taking over the China market for the supply of ore, the volumes at the port have gone down drastically.

The origin-destination of key cargo (accounting for greater than 85% of the total traffic) for all Indian ports and development of traffic scenarios for a period of next 20 years has been carried out by **McKinsey & Co.** as mandated for this project. Accordingly, based on a macro-level analysis the future traffic for Mormugao up to 2035 has be derived as presented in this section.

6.2 Major Commodities and their Projections

6.2.1 Coking Coal

The port currently imports 6.6 MTPA of coking coal from Australia and South Africa. This coking coal is primarily used by Steel plants in the vicinity of the port; JSW Vijaynagar consumes nearly 5 MTPA and JSW Dolvi consumers the remaining 1.6 MTPA.

Going into the future the volumes of steel handled at the port is expected to grow with the steel multiplier relative to the GDP. The overall traffic of coking coal is expected to grow to 14 MTPA by 2020, 19-21 MTPA by 2025 and 34-40 MTPA by 2035.

6.2.2 Thermal Coal

The port currently imports 1.9 MTPA of coal primarily for non-thermal power plant purposes. Going into the future the demand is expected to grow to roughly 2.6 MTPA by 2020, 3.5 MTPA by 2025 and 5-6 MTPA by 2035.

6.2.3 Steel

Being close to key JSW steel plants, the port is an ideal location to export finished steel products from these plants both coastal and to locations outside India. The port exports ~1 MTPA HR Steel Coils from the nearby plants, going into the future with natural steel multiplier growth we expect the volumes of exports to grow up to 2.4 MTPA by 2020, 3-4 MTPA by 2025 and 6-7 MTPA by 2035.

6.2.4 Iron Ore

During the peak of Iron ore exports from the country prior to the ban on mining in Goa the Mormugao port used to export around 41 MTPA of Iron Ore (2010-11), in the last few years the volumes have gone down significantly and now the port only exports ~0.6 MTPA.

Even after lifting of the ban the high landed price of Iron Ore from India has led to sluggish growth rather as Brazil has taken up a major chunk of the markets and the global prices has fallen down to as low as USD 45 / T owing to oversupply of ore in the market as shown in **Figure 6.1**.

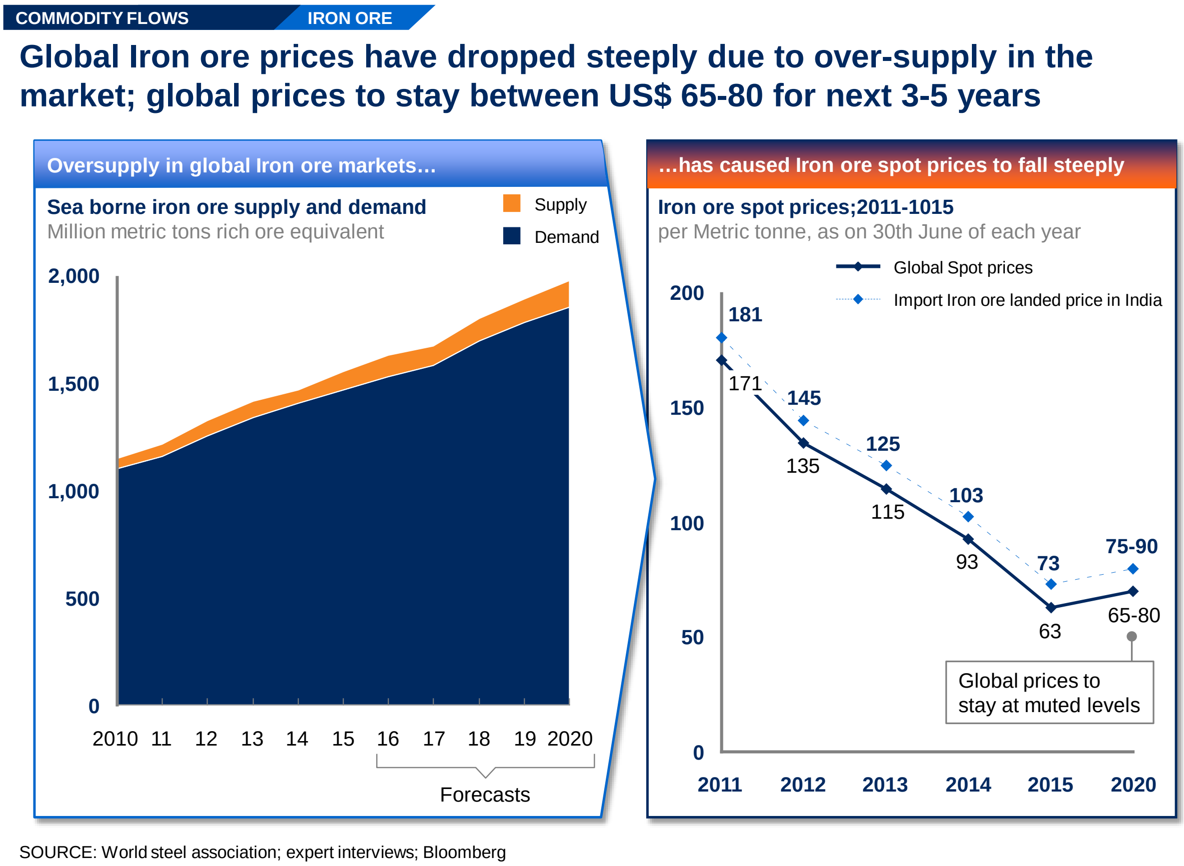


Figure 6.1 Trend of Iron Ore Prices

Unless the market rates pick up it is expected the volumes of the ore exported from the port to be muted at below 18 MTPA till 2035. If the prices pick up only then one can expect to see traffic of ~50 MTPA by 2035.

6.2.5 Additional Potential

There is an additional potential of handling ~11 MTPA by 2025 once the Betul port takes off. The traffic projections for 2025 include commodities like wood chips, gypsum, bauxite, granite, steel coil, LPG, edible oil, cement and sand.

6.2.6 Overall Traffic Projections

The overall commodity wise projections for the port (including those expected to be handled at Betul port) are shown below in **Table 6.1**:

Table 6.1 Traffic Projection for Mormugao Port

Units: MMTPA (except Containers)

Mormugao Port - Traffic Projections

xx Base Scenario xx Optimistic Scenario

Commodity	2014-15	2020	2025		2035		Remarks
Liquid Cargo							
POL product	0.6	1.0	1.5	1.8	2.2	2.7	Some part of crude might be imported if a green-field mega refinery comes up in southern Maharashtra- the impact of the same has not been taken in traffic projections
Chemicals	0.5	0.7	0.8	1.0	1.3	1.9	
Dry and Break Bulk Cargo							
Thermal Coal (Loading)	0.0	0.0	0.0	0.0	0.0	0.0	
Thermal Coal (Unloading)	1.9	2.6	3.4	3.6	5.7	6.4	▪ Overseas imports likely to decline; may attract ~14 MT from Belekeri
Coking Coal	6.6	14	19	21	34	40	
Coke	0.7	1.0	1.3	1.4	2.4	2.8	
Iron Ore	0.8	8	11	35	18	50	▪ Exports; includes pellets; Optimistic case is related to volumes handled before ban
Steel	1.7	2.4	3.3	3.5	5.8	6.7	
Fertilizers	0.2	0.5	0.7	0.7	1.0	1.1	
Containers and other Cargo							
Containers (MnTEU)	0.02	0.04	0.10	0.13	0.15	0.18	
Others	1.4	2.4	3.1	3.3	5.2	5.9	▪ Highly fragmented
Others (once Betul port takes off)	NA	9.0	10.0	12.0	16.6	21.5	▪ Major commodities: woodchips, gypsum, bauxite, granite, steel coil, LPG, Edible oil, cement and sand
Total (MMTPA)	**14.7**	**42.1**	**55.35**	**84.9**	**94.1**	**141.3**	

Conversion Factor Used for Containers Projections: 1 TEU = 12.5 Tons

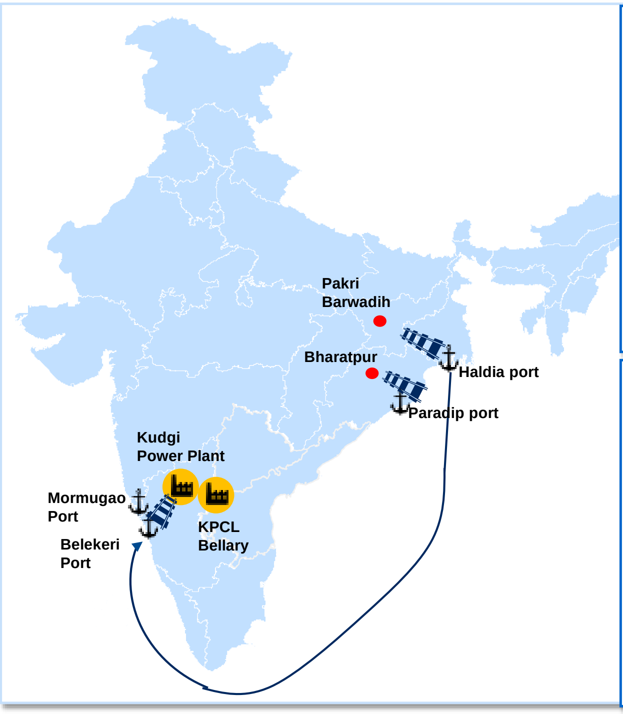
6.3 Coastal Shipping Potential

Apart from the above mentioned traffic, there is additional opportunity of coastal shipping that can be potentially tapped. Thermal coal can form the significant share in coastal shipping while small volumes of other commodities like steel can be moved coastally.

- **Thermal coal:** Coal can prove to be a major commodity which can be coastally shipped to the port of Mormugao. The plants of NTPC Kudgi and KPCL Bellary can shift to coastal shipping and receive their coal from the Mormugao port, if Belekeri port doesn't come up in the near future.

COMMODITY TRAFFIC | COAL

~11 MTPA Coal can be moved from Pakri Barwadih to Kudgi[1] and ~2.4 MTPA from Bharatpur to Bellary via coastal shipping through Mormugao port



Pakri Barwadih to Kudgi (Optimimum route: 1)

S. No.	Route (Modal combination)	Distance Kms	Cost Rs/tonne
1	Road-Rail-Port-Road-Rail	3,833	2,883
2	Road-Rail	2,035	3,300

Bharatpur to Bellary (Optimimum route: 1)

S. No.	Route (Modal combination)	Distance Kms	Cost Rs/tonne
1	Rail-Port-Rail	3,308	2,250
2	Rail	1,435	2,298

1 Considering linkage rationalization from Pakri Barwadih to Talcher does not happen

Figure 6.2 Coastal Shipping Potential of Coal from Pakri Barwadih to Kudgi and Bharatpur to Bellary

The overall outlook of coastal shipping from Mormugao port is as shown in **Table 6.2**:

Table 6.2 Mormugao Port – New Opportunities Possible via Coastal Shipping

Mormugao Port – New Opportunities Possible via Coastal Shipping

Units: MMTPA (except Containers)

Commodity	2020	2025	2035
Thermal Coal (Unloading)	13.37	13.37	13.37
Steel (Loading)	0.49	0.65	1.17
Steel (Unloading)	0.67	0.89	1.59
Cement (Loading)	0.39	0.52	0.93
Cement (Unloading)	0.01	0.02	0.03
Fertilizer (Loading)	0.03	0.04	0.06
Fertilizer (Unloading)	0.06	0.07	0.10
Food Grains (Loading)	0.00	0.00	0.00
Food Grains (Unloading)	0.14	0.18	0.26

- Additional Coastal shipping Potential if Belekeri is not built and NTPC Kudgi I in Bijapur and KPCL Bellary adopt coastal shipping

7.0 CAPACITY AUGMENTATION R PROPOSALS

7.1 General

The capacity augmentation requirements shall be based on the difference between the projected traffic for the particular commodity and the capacity of the port available (after debottlenecking and physical improvements) for handling that particular commodity.

7.2 Summary of Debottlenecked Port Capacity

Based on the analysis of existing port infrastructure, the current capacity of the port is assessed as given in **Table 7.1**.

Table 7.1 Existing Port Capacity

Berths	Cargo Handled	Capacity (MTPA)
Breakbulk - Berth 5	Steel Products	1.7
Coal - Berth 6	Coking Coal	6.2
Coal - Berth 7	Thermal Coal	8.5
Liquid - Berth 8	Oil	2.2
General Cargo - Berths 10 and 11	Breakbulk, Containers	3.5
Iron Ore - Berth 9 and barge berths	Iron Ore	0
Total		**22.1**

[Note: The capacity of offshore mooring is not considered in the above and it is assumed that berth 9 and barge berths do not handle any cargo as they are in the process of redevelopment]

7.3 Requirement for Capacity Expansion

Even though prima facie it appears that the overall capacity is slightly more than the overall traffic, there is shortfall on facilities for handling specific cargo. There is also a need to improve the operational efficiency in cargo handling and storage by way of better circulation plan of traffic of breakbulk cargo.

The traffic projections indicate the significant capacity augmentation requirement for the coal unloading facilities over a period of time. Apart from that additional facilities would also be needed for steel cargo and other breakbulk cargo. The phase wise incremental facilities required are indicated in **Table 7.2**.

Table 7.2 Capacity Augmentation Required

Cargo Handled	I/E	Current Capacity (MTPA)	2020		2025		2035	
			Projected Traffic (MTPA)	Capacity Augmentation Required Over Current (MTPA)	Projected Traffic (MTPA)	Capacity Augmentation Required Over Current (MTPA)	Projected Traffic (MTPA)	Capacity Augmentation Required Over Current (MTPA)
Coal & Coke	I	14.7	17.6	2.9	23.7	9.0	42.1	27.4
Breakbulk and Container	I/E	5.2	5.8	0.6	8.4	3.2	13.9	8.7
Iron Ore	E	0.0	8.0	8.0	11.0	11.0	18.0	18.0
Crude/ POL	I	2.2	1.7	0.0	2.3	0.1	3.5	1.3
Total	**I/E**	**22.1**	**33.1**	**11.5**	**45.4**	**23.3**	**77.5**	**55.4**

Notes:

1. The capacity of offshore mooring is not considered in the above table

2. If additional cargo projected on account of Betul shall be handled there only and not at Mormugao Harbour

It may be noted that with regard to the iron ore traffic, the current market outlook does not necessitate providing any additional facility for iron ore and the small projected throughput could be handled at the moorings. However, in an optimistic scenario, significant quantity of iron ore is expected to be handled at the port for which additional facilities would need to be created.

As per **Table 7.2** above, it could be seen that additional facilities for coal unloading, breakbulk cargo and containers are required to be augmented at the port in a phased manner.

7.4 Assessment of Rail Capacity

The traffic projections for any port are based on the unconstrained cargo flow in and out of the port. However, the actual cargo that could be handled at a port would be limited by least of the berth capacity, storage capacity and the evacuation capacity. In particular case of Mormugao port, it is assessed that capacity of rail evacuation may pose a constraint to cargo handling capacity of the port. The same is assessed as below:

Presently, the port is connected to Vasco da Gama yard with a double line leading from the yard of the Port to Vasco da Gama station. The length of this link is approximately 3 km. The existing yard at the port has 6 lines and handles approximately 10-11 rakes every day. There is a space available for the expansion of this yard by another 3 lines. With the addition of these 3 lines and a properly designed yard it should be in a position to send out 30 rakes per day.

A double line link between the port and Vasco da Gama yard is capable of carrying over 30 rakes for onward destinations. However, this can only happen if Vasco da Gama yard is remodelled i.e. expansion of the yard takes place. In other words, more full length lines would be required to be added. It is however noted that there is no space for expansion of the yard unless more land is acquired by the Indian Railways for the purpose. If the additional land is acquired for adding another 2 to 3 lines, it should be possible to cater to the outward traffic of 30 rakes, without which the capacity may be limited to about 15 rakes only. Vasco da Gama yard is sandwiched on both sides with heavily built up areas. Experience shows that acquisition of such areas for the projects of this type generally becomes a long drawn process.

Beyond Vasco da Gama the connectivity of Railways is only towards one direction as Vasco da Gama is a dead end. This connectivity is through a single line section for over 300 km. Even if we expand the yard, the single line section would pose to be a bottleneck. Railways doubling project was initiated a few years back, with railways sanctioning the grants for doubling the line from Goa to Hospet. The works from the port to Hospet at each intermediate station are at different stages of completion.

§ The stretch between Hospet and Tinai Ghat (241 km) is under progress and expected to be complete by 2017.

§ The stretch between Tinai Ghat and Castle Rock is 12.5 km long; survey work is under progress and forest land to be transferred to railway. It is expected to be complete by 2019.

§ The stretch between Castle Rock and Kulem (25 km) is one of the steepest gradients in the country making it technically challenging and is expected to complete by 2019.

§ The stretch between Kulem and MPT is 58 km long. 10 ha. of land patches to be acquired however it is stalled from past 3 years due to constraints in land acquisition.

Doubling of the line has to be completed with last mile connectivity by 2019 in order to improve the port's evacuation capacity. Local government has to be pressurized from the centre for the completion of doubling of the line.

It should be noted that the stretch between Castle Rock and Kulem of about 25 km has the distinction of having the steepest gradient (1 in 37) encountered anywhere on the Indian Railway system. It is understood that 5 locos have to be attached to the rake passing through this section. This significantly reduces the line capacity and it is assessed that even after doubling the capacity of this stretch shall be limited to 25 to 30 rakes only. Considering that this stretch passes from ecologically sensitive area involving Wild Life Sanctuary, tripling of the line is unlikely.

Therefore the rail evacuation capacity from the port is likely to be limited to 30 rakes each way only even after completion of the proposed projects.

7.5 Redevelopment of Berths 8, 9 and Barge Berths into Multipurpose Terminal

Berth 8 is currently handling liquid cargo and berth 9 has a mechanised iron ore export system, which is lying ideal. It is proposed that the liquid traffic be shifted from berth 8 either to offshore moorings or to a new berth located east of berths 10 and 11. The combined berths 8, 9 and full/part of barge berths could provide a continuous quay length.

It also needs to be ensured that the berth is contiguous to the backup area for optimal utilisation and the structural arrangement would need to be devised accordingly. One of the possible options is to provide a frontage with the touch piles to act as an earth retaining structure and the same shall be anchored by rows of piles in the rear. This scheme would necessitate shifting of berthing line to the front by about 5 m. The exact details could be worked out during detailed engineering stage.

The possible alternative schemes of redevelopment are shown below:

7.5.1 Scheme 1

In this scheme, a continuous quay is built utilising the entire face of the berths 8, 9 and barge jetties. The total quay length that could be created in this scheme is about 1050 m. The backup area is created by means of filling behind the berth (**Figure 7.1**).

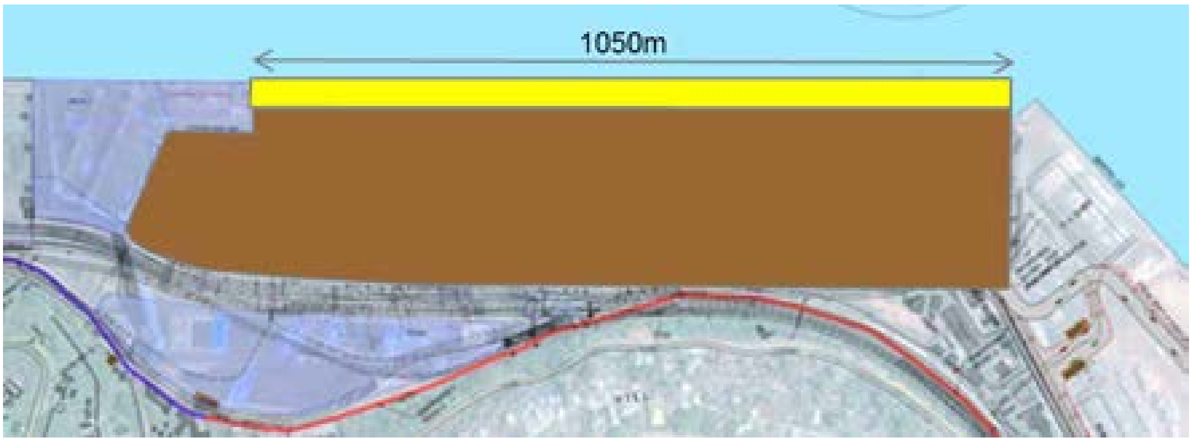


Figure 7.1 Scheme 1 - Revedelopement of Berth 8, 9 and Barge Berths

7.5.2 Scheme 2

In this scheme, a continuous quay is built utilising the entire face of the berths 8, 9 and only part of barge jetties. The total quay length that could be created in this scheme is about 850 m. This berth length is adequate to cater to one coal berth and two multipurpose berths (350 m + 250 m +250 m) Apart from that two barge jetties would be available i.e. one perpendicular to the face of the new quay and two on either side of the finger jetty. As in scheme 1 the backup area is created by means of filling behind the berth.

It is apparent that in scheme 2, there would be a benefit of having barge jetties that would enable handling of barges utilised in coastal movement or IWT. Apart from that one of the barge jetties could also be used for port crafts. The additional berth length of 200 m obtained in scheme 1 is not of much significance but that option can anyway be exercised later depending upon the performance of the barge jetties. It is therefore suggested to adopt scheme 2 for implementation.

It is proposed that 300 m length of the quay adjacent to berth 7 shall be installed with fully mechanised coal unloading system comprising of two gantry type ship unloaders and connecting single stream of conveyor. The existing stackyard of MOHP shall be utilised for stacking of coal using stackers. The coal shall be reclaimed from the stackyard using reclaimers and then loaded to wagons using in motion wagon loading system.

Figure 7.2 Scheme 2 – Redevelopement of Berth 8, 9 and Barge Berth

The remaining 500 m of berth length would be adequate for handling of breakbulk cargo. It is proposed to deploy two mobile harbour cranes on the south western part of the quay for handling the steel products and other heavy cargo. The cargo handling at the central berth is proposed utilising the ship's gears and therefore no specific equipment is planned. If the coal throughput picks up this berth could later be converted to an exclusive coal berth by installing a fully mechanised coal handling system. Similarly, in case, iron ore traffic picks up a mechanised iron ore loading system could be provided at one of these berths.

7.6 Finger Jetties at Vasco Bay for Liquid Cargo, Coastal, Passengers and Fishing

Due to the proposed redevelopment of the berth 8 for handling bulk and breakbulk cargo, it is required to build a liquid cargo handling berth. There is also a requirement to develop the coastal berth, passenger berth and the fishing jetties at the port. It is proposed to develop all these facilities towards the east side of berths 10 and 11.

The location and layout of the proposed facilities are shown in **Figure 7.3**.

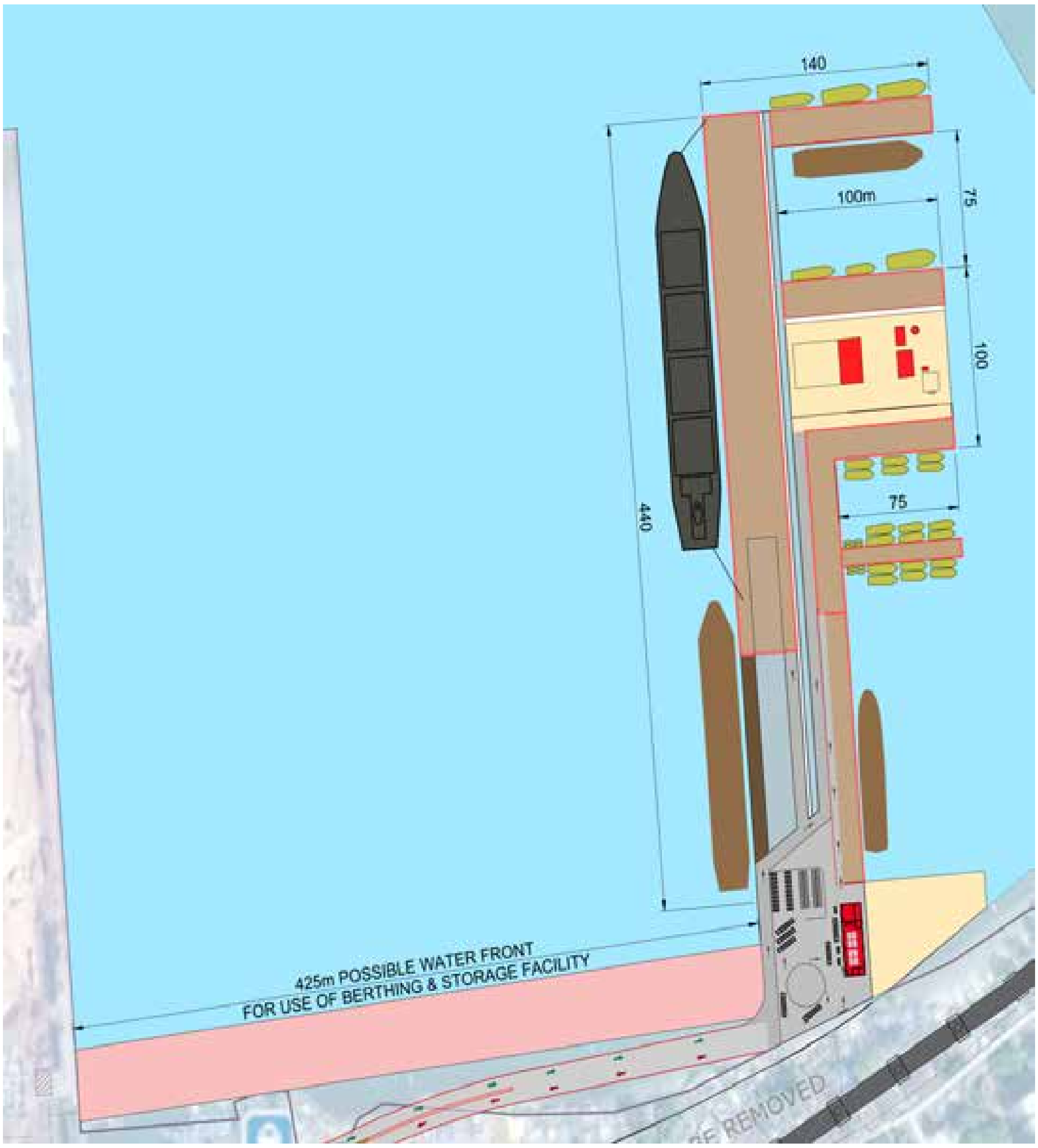


Figure 7.3 Proposed Layout of Liquid Jetty, Passenger Jetty, Fishing Jetty and Coastal Berth

Details of the proposed facilities are provided below:

- The overall length of the cargo handling berth is proposed to be 440 m out of which northern side shall be used for handling liquid cargo and the southern side for coastal cargo. The total width of the berth/ backup area shall be 30 m beyond which a boundary wall of 3 m high shall be built to separate these berths from the facilities on the eastern side.
- The eastern side would have a passenger terminal closer to the shore at an appropriate area. The berth face of 440 m can also be used for handling the large cruise ships. The passengers shall be transferred to this berth by buses after they have checked in at the terminal building located onshore. Adequate turning space shall be kept available at the liquid berth by suitable aligning the pipelines.
- A fish landing centre on a platform of size 150 m × 100 m size shall be built, towards north of passenger jetty, to provide facilities such as net mending, net drying, auction hall, refrigeration etc. A total quay length of about 225 m shall be provided for fishing boats.
- Towards north of fish landing centre with a total quay length of about 300 m shall be provided for berthing of the port crafts.
- The entire construction shall be on piled foundation so that flow conditions in the bay are not affected and thus minimising any issues from fishermen, who would be relocated towards the eastern side.
- A provision for the future berth, perpendicular to the southern end of berth 11, is kept to handle future traffic in terms of break bulk cargo. However, due to the limited backup area these berths would be suitable for handling liquid cargo or a limited amount of breakbulk cargo with deployment of suitable equipment for shifting the cargo to storage area located away from the berths.

The proposed arrangement is conceptual only and needs to be finalised after due discussions with the various stakeholders at the DPR stage.

7.7 Development of Two Berths with Connecting Flyover for Indian Navy and Coast Guard at Vasco Bay

It is proposed to provide dedicated berths for Navy and Coast Guard at north of Vasco Bay as shown in the **Figure 7.4**. The proposed facility shall have the total berth length of 700 m with reclamation of about 10 acres and these berths shall be dredged to -11.0 m CD. These berths shall be connected by an elevated roadway. These facilities shall be for exclusive use of the Navy and Coast Guard and not for EXIM cargo. However, these shall be constructed by MPT.

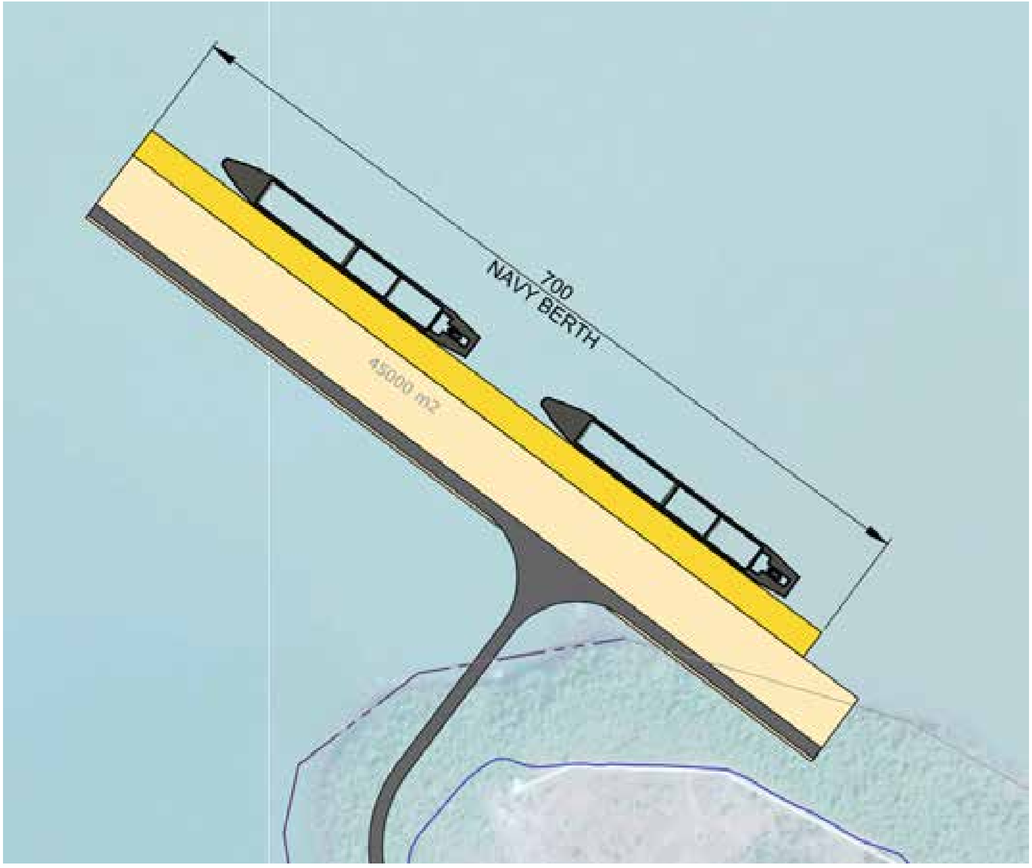


Figure 7.4 Dedicated Navy and Coast Guard Berth at Vasco Bay

7.8 Development of Workshop Area at Baina

The workshop area at Baina is lying unutilized and the possibility of developing it as CFS needs to be explored. Once the new PPP multipurpose berth becomes operational there will likely to be demand for a CFS.

7.9 Circulation Plan for Ease of Movement of Break Bulk Cargo

7.9.1 Traffic Circulation

It is proposed to segregate the vehicular traffic movement of the port. The present Gate no. 1 is proposed to be used by ADANI and JSW while the other traffic (from berths 10, 11, proposed PPP terminal) will use the new 4 lane flyover and new 4 lane road.

7.9.1.1 Traffic Circulation from Present / New Gate no. 9

A 4 lane highway with significant elevated portion has been planned for the faster evacuation of cargo. The landing point of that highway is at the end of temporary shed adjacent to shed 3 of the general cargo terminal i.e. berths 10 and 11. Therefore a proper traffic circulation planning is proposed so as to have entry-exit gates, weigh bridges at appropriate locations duly considering the existing sheds and current as well as proposed future operational areas.

It is understood that the rail sidings serving half rake at berths 10 and 11 shall be removed and the rail cargo shall be handled at the new sidings developed. Therefore it is proposed that the new 4 lane road at grade shall be taken around T3 shed and taken upto the location of existing road from gate no. 9 to provide new entry/ exit gates. Thereafter, the road shall be taken towards the proposed PPP terminal and in between a rotary shall be provided for entry/exit for berths 10, 11. Adequate queuing space shall be provided for the vehicles intended to use the weighing bridge / Container screening machine. Necessary slip / service road will be provided to have smooth traffic movement.

The overall road circulation plan for movement to berths 10, 11, new PPP terminal, liquid/ passenger/ coastal terminals is shown in **Figure 7.5**.

Figure 7.5 Overall Road Circulation Plan

This circulation plan would provide additional backup area for the berths 10 and 11. While it is proposed to retain the shed T1 and T3 initially, in the long run these old sheds would need to be dismantled and relocated so as to free up more storage area for the bulk and breakbulk cargo requiring open storage space.

One of the possible locations for locating these sheds is the IOC tankfarms lying contiguous to the southern boundary and store hazardous cargo. After the lease expiry, they can be relocated at Zuarinagar.

This would enable port getting the contiguous area for handling the bulk and breakbulk cargo at berths 10 and 11, which would improve the productivity and enable faster turnaround time of cargo.

7.9.1.2 Proposed Traffic Circulation from Present Gate No. 1

Presently, the Gate no. 1 is manually operated and need to be upgraded in future to handle more traffic.

Present road connecting Gates 1 and 2 needs to be upgraded for uniform configuration. The present road is of concrete pavement. It is proposed to maintain 12 m wide configuration throughout the length as shown in **Figure 7.6**. Further the traffic will use existing NH 17B till Sada junction before meeting with the new 4 lane road.

Figure 7.6 Traffic Circulation Plan from Gate 1

8.0 SCOPE FOR FUTURE CAPACITY EXPANSION

8.1 Outer Harbour for Iron Ore/ Coal Terminal

With the development of the proposed 8, 9 and barge berths as well as the new liquid and passenger jetty, the port facilities would be adequate to handle the projected traffic upto 2025.

In case the ban on iron ore is lifted and its traffic goes up as projected in optimistic scenario in **Table 6.1** additional iron ore export berth (apart from berth 9A being planned at present) would be needed. The ideal location for this could be in a harbour basin protected by a new breakwater towards the west side of the existing breakwater. The harbour would have deep water iron ore export berths apart from handling barge jetties for bringing iron ore through the IWT mode. The indicative layout of the iron ore terminal is shown in **Figure 8.1** below.

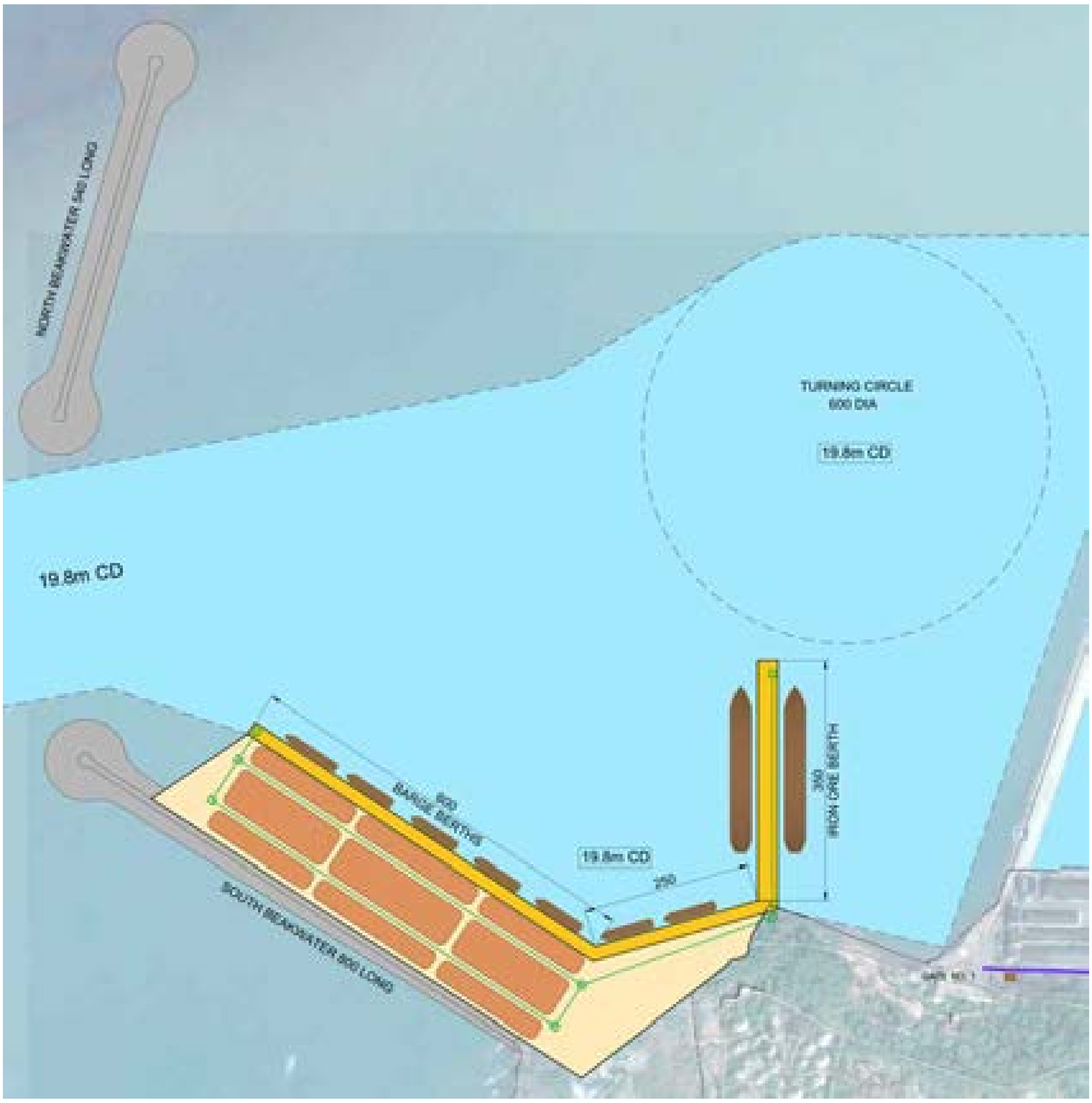


Figure 8.1 **Proposed Layout of the Iron Ore Terminal**

Similarly, there is requirement of significant capacity augmentation for coal unloading. The facility for the same could also be provided in outer harbour, though the layout could be slightly different as shown in **Figure 8.2** shown below:

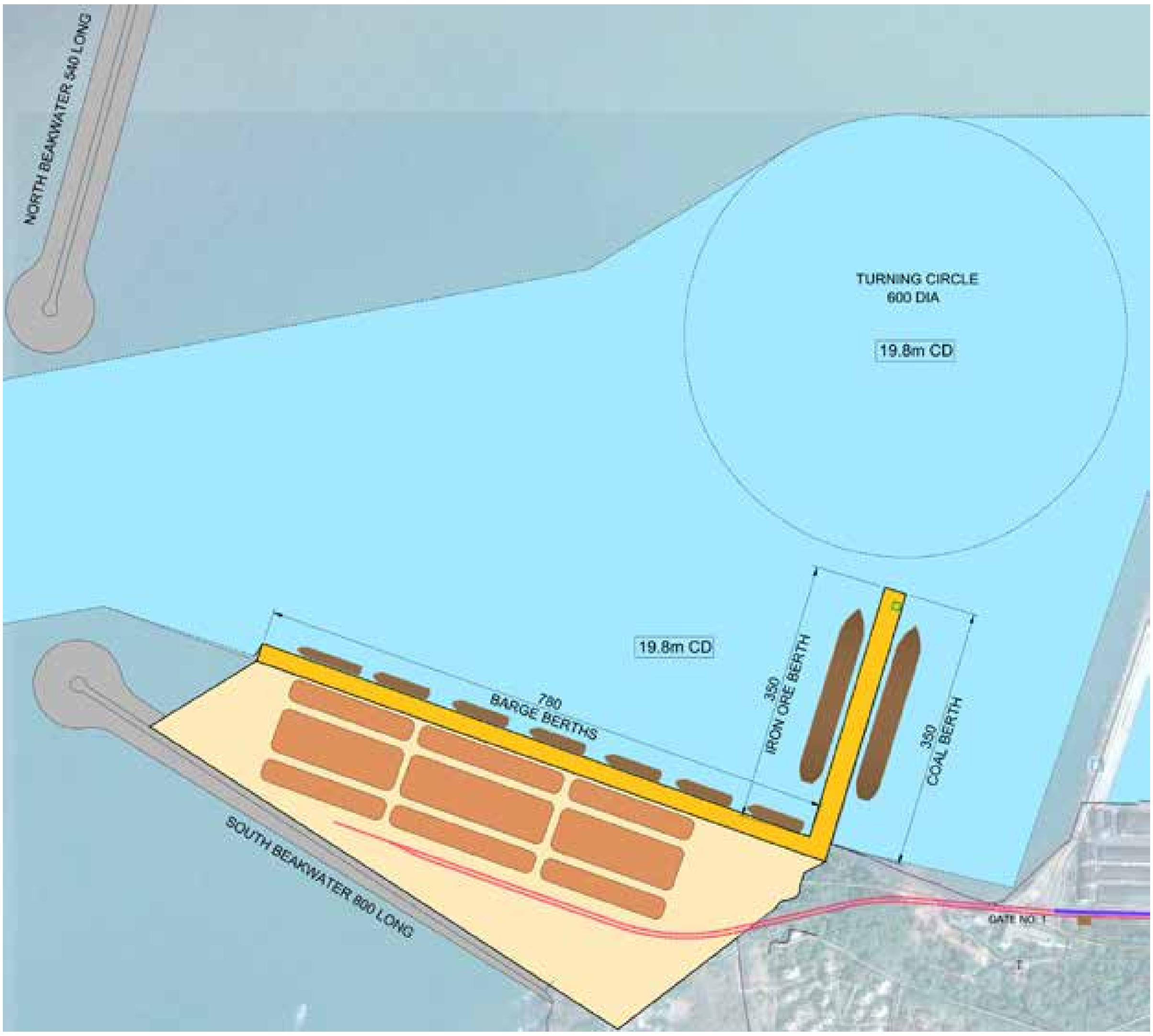


Figure 8.2 Coal / Iron Ore Handling at Outer Harbour

The exact layout of outer harbour shall however need to be worked out depending upon the specific requirement of cargo handling envisaged at the implementation phase and also the proper testing of the layout through mathematical model studies to assess its suitability and impact on the existing features.

8.2 Multipurpose Terminal at Betul

Bauxite mines are located at Betul about 35 km south of the Mormugao port. There are significant bauxite reserves at this location (over 200 MT). Therefore Mormugao Port can explore the possibility of developing a port at Betul for export of Bauxite. The port at this location can also be used for handling some quantity of iron ore brought by trucks.

The location plan of the proposed port site and the Bauxite mines is shown in **Figure 8.3** below.

Figure 8.3 Location of Project Site

This could either be a developed as a direct loading port for all weather or fair weather operations. Alternatively, a barge terminal could be planned at Betul for loading the mother ships inside the Mormugao harbour. The logistically most optimum solution could be worked out by a way of a detailed study.

However, at this initial stage without having any information on the exact site characteristics in terms of bathymetry and more particularly the rock levels and onshore area available for development, only initial alternative layouts have been developed to assess the magnitude of development. It is assessed that only one breakwater would be adequate to provide the tranquil operating conditions round the year.

§ ***Alternative 1*** involves offshore harbour option where the harbour area is located away from the shore. This alternative involves longer time of construction and more cost for breakwater but less for dredging.

§ ***Alternative 2*** is a coastal harbour option where the harbour area is located close to the shoreline. As compared to alternative 1, this layout involves high dredging and but requires smaller breakwater.

The indicative alternative layouts are shown in **Figure 8.4** and **Figure 8.5** respectively.

Figure 8.4 Betul Port Layout - Alternative 1

Figure 8.5 Betul Port Layout - Alternative 2

These layouts need to be refined during the DFR/DPR stage after completing the site surveys and investigations and mathematical model studies duly supported by the specific study on potential traffic that could be handled at this location.

9.0 SHELF OF NEW PROJECTS AND PHASING

As part of the Mormugao Port Master Plan several projects have been identified which need to be taken up in phased manner with the built up in traffic. The proposed phasing, capacity addition and the likely investments are discussed in paragraphs below.

It may be noted that apart from these projects there could be several other projects which port would be implementing as part of the routine operations and maintenance of the port facilities. Further the phasing proposed is not cast in stone but could be reviewed periodically and revised based on the economic scenario and demand for port at that particular point of time.

9.1 Ongoing Projects

The details of the projects which have already been awarded and development is ongoing are given below in **Table 9.1**

Table 9.1 Ongoing Projects

S. No.	Project Name	Investment Required (Cr)	Capacity Addition (MTPA)	Mode of Implementation
1.	Deepening of Approach Channel	193	2.0	Port's funds

9.2 Projects to be completed by Year 2020

The details of the projects which are envisaged to be completed by year 2020 are given below in **Table 9.2**

Table 9.2 Projects to be completed by Year 2020

S. No.	Project Name	Investment Required (Cr)	Capacity Addition (MTPA)	Mode of Implementation
1.	Road circulation plan for ease of movement of break bulk cargo	50	-	Port's funds
2.	Redevelopment of berths 8 and 9 – Coal Terminal	400	10.0	PPP
3.	Finger Jetty at Vasco Bay for Liquid Cargo, Passenger and Fishing	250	5.0	Port's funds
4.	Development of Two Berths with Connecting Flyover for Indian Navy and Coast Guard at Vasco Bay	500	-	Navy's funds
5.	Vasco Yard Expansion	25	-	Port's funds

The port layout after completion of ongoing projects shall be as shown in **Figure 9.1**.

Figure 9.1 Layout Plan 2020

9.3 Projects to be completed by Year 2025

The details of the projects which are envisaged to be completed by year 2025 are given below in **Table 9.3**

Table 9.3 Projects to be completed by Year 2025

S. No.	Project Name	Investment Required (Cr)	Capacity Addition (MTPA)	Mode of Implementation
1.	Redevelopment of berths 8 and 9 - Ore and Multipurpose berths	685	15.0	PPP
2.	Multipurpose Terminal at Betul	1200	6.0	PPP

The port layout after completion of projects mentioned above shall be as shown in **Figure 9.2**.

Figure 9.2 Layout Plan 2025

9.4 Projects to be completed by Year 2035

The details of the projects which are envisaged to be completed by year 2035 are given below in **Table 9.4**

Table 9.4 Projects to be completed by Year 2035

S. No.	Project Name	Investment Required (Cr)	Capacity Addition (MTPA)	Mode of Implementation
1.	Outer Harbour for Iron Ore/ Coal Terminal	1400	30	PPP

The port layout after completion of mentioned above shall be as shown in **Figure 9.3**.

Figure 9.3 Layout Plan 2035

Appendix 1 - **BCG Benchmarking Study for Mormugao Port**

Master Plan for Mumbai Port

Prepared for

Ministry of Shipping
Government of India

Ministry of Shipping/ Indian Ports Association

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Revision	Description	Prepared by/ date	Reviewed by/ date	Approved by/ date

Document Revision Register

Issue no.	Date of issue	Section	Revision Details	Revision By Name & Position
1.	01.07.2016		Comments on Draft Master Plan Report	Amit Magadum Associate
2.	11.08.2016		Comments on Final Master Plan Report	Amit Magadum Associate

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1.0 INTRODUCTION

1.1 Background

The Sagarmala initiative is one of the most important and strategic imperatives to realize India's economic aspirations. The overall objective of the project is to evolve a model of port-led development, whereby Indian ports become a major contributor to the country's GDP.

As shown in **Figure 1.1**, the Sagarmala project envisages transforming existing ports into modern world-class ports, and developing new top notch ports based on the requirement. It also aspires to efficiently integrate ports with industrial clusters, the hinterland and the evacuation systems, through road, rail, inland and coastal waterways. This would enable ports to drive economic activity in coastal areas. Further, Sagarmala aims to develop coastal and inland shipping as a major mode of transport for carriage of goods along the coastal and riverine economic centres.

As an outcome, it would offer efficient and seamless evacuation of cargo for both the EXIM and domestic sectors, thereby reducing logistics costs with ports becoming larger drivers of economy.

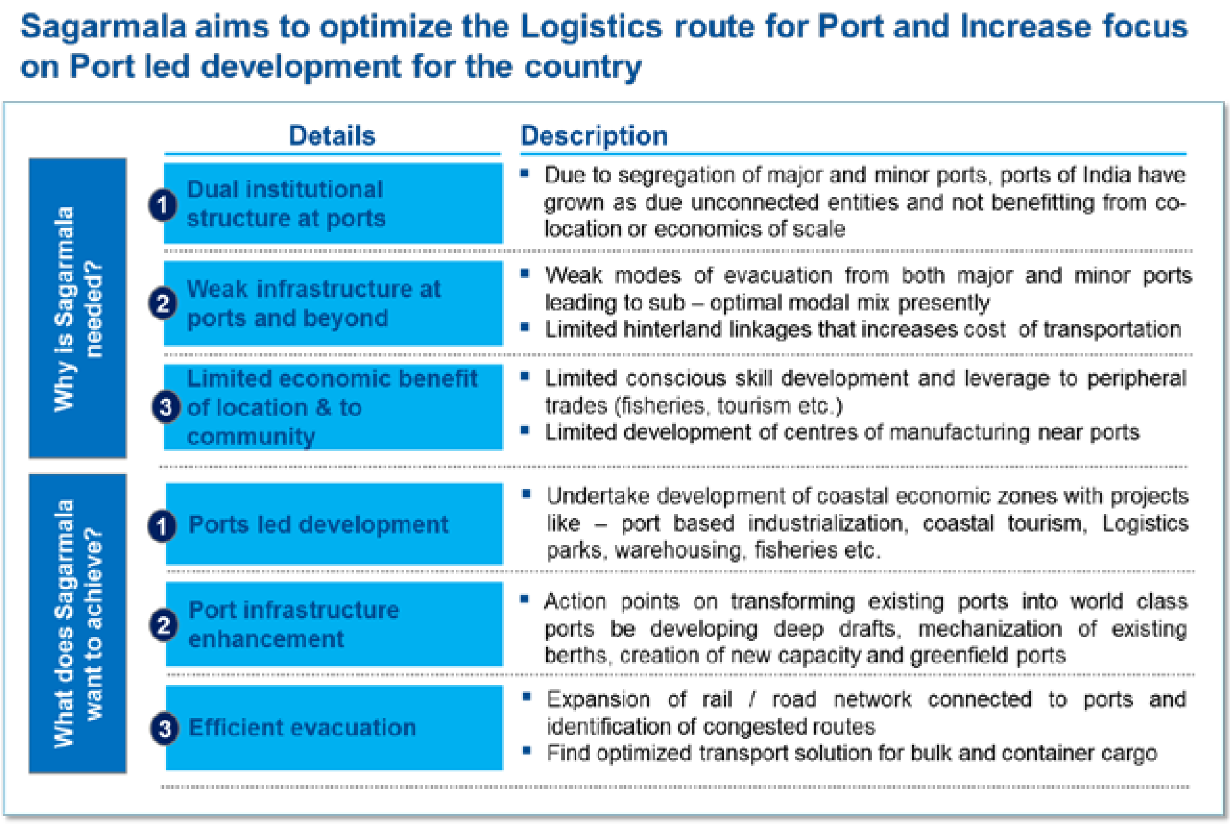


Figure 1.1 Aim of Sagarmala Development

In order to meet the objectives, Indian Port Association (IPA) appointed the consortium of McKinsey and AECOM as Consultant to prepare the National Perspective Plan as part of the Sagarmala Programme.

1.2 Scope of Work

The team of McKinsey and AECOM distilled learnings from the experience in port-led development, the major engagement challenge to develop a set of governing principles for our approach is shown in **Figure 1.2**.

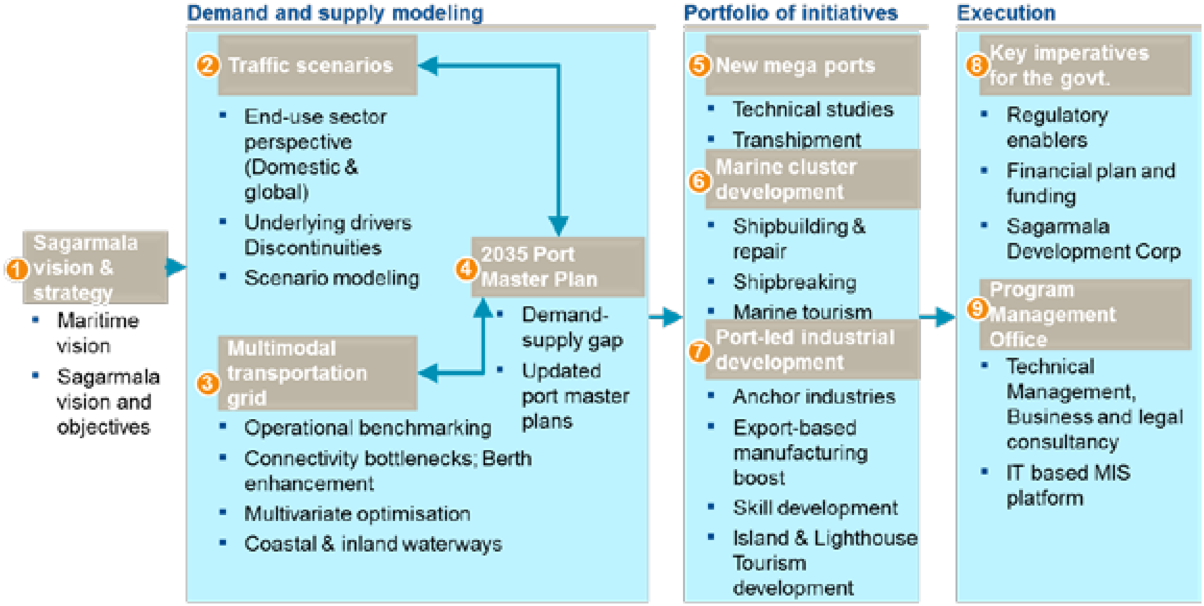


Figure 1.2 Governing Principles of Approach

As indicated above, the origin-destination of key cargo (accounting for greater than 85% of the total traffic) in Indian ports have been mapped to develop traffic scenarios for a period of next 20 years. The forces and developments that will drive change in the cargo flows shall also be identified. This would lead to the identification of regions along the coastline where the potential for expansion of existing port exists. The various activities involved in the port led developments are charted in **Figure 1.3**.

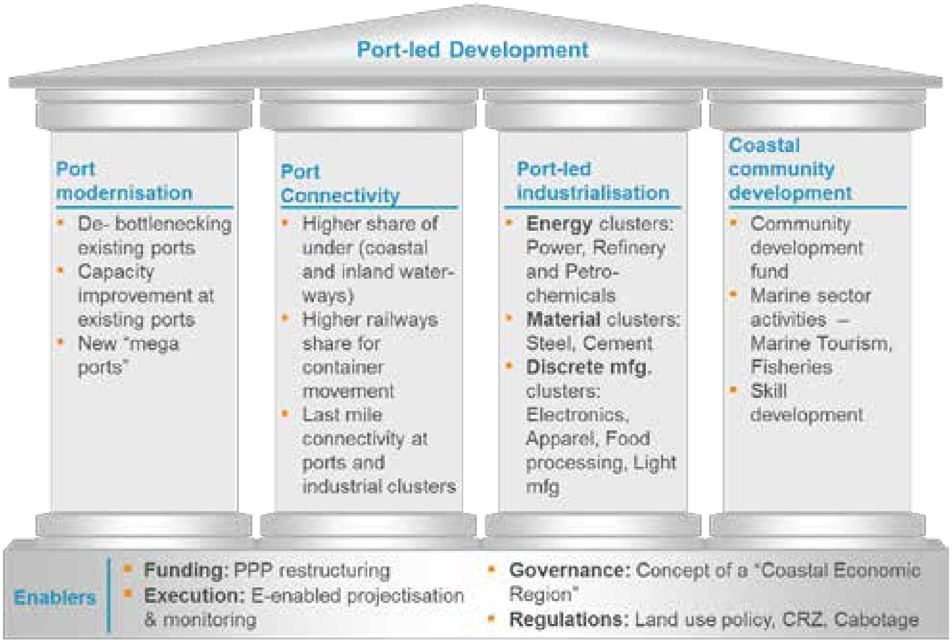


Figure 1.3 Port Led Developments

As part of the assignment, it is also expected to coordinate with the team working on “Benchmarking Operational Improvement Roadmap for Major Ports in India” study (which is being carried out simultaneously along with this assignment) and identify current and future logistic constraints (at the Major Ports) for the top 85% cargo categories based on analysis of current port capacity, productivity levels in comparison to international benchmark and evacuation bottlenecks in the logistics chain. This understanding should be an input in defining the 2035 Master Plan for each port.

Accordingly, this Master Plan report has been prepared taking into consideration the inputs provided on the future traffic and the benchmarking and operational improvements suggested for this port.

1.3 Present Submission

The present submission is the Final Report for Development of Master Plan for Mumbai Port as part of Sagarmala assignment. This report is organised in the following sections:

Section 1 : Introduction

Section 2 : The Port and Site Conditions

Section 3 : Details of Existing Facilities

Section 4 : Performance, Options for Debottlenecking & Capacity Assessment

Section 5 : Details of Ongoing & Planned Developments

Section 6 : Traffic Projections

Section 7 : Capacity Augmentation Requirements and Proposals

Section 8 : Shelf of New Projects and Phasing

2.0 THE PORT AND SITE CONDITIONS

2.1 Mumbai Port

Mumbai Port is one of the major ports located on the west coast of India, commissioned more than a century ago is a natural harbour, situated at latitude 18° 54' N and longitude 72° 49' E, protected on the east by mainland and sheltered by Mumbai Peninsula on the west. The location of the port is shown in the **Figure 2.1**.

Figure 2.1 Location Plan of Mumbai Port

The bay nearly rectangular in shape, measures about 36 km north to south and about 15 km east to west. The entrance to the harbour is from the southwest between Pong's reef at the southernmost tip of Mumbai and Thal Reef lying off the mainland to the southwest. The distance between these reefs is about 11 km. The main harbour channel is, for the greater part, a natural channel following the longitudinal axis of the harbour approaching to the docks. The main harbour accommodates the Indira Dock and the Ballard Pier. Further northeast of the harbour is located Jawahar Dweep accommodating the POL berths. The Pir Pau chemical berth is at the northern extremity of the harbour's deep water. In addition, there are 63 general ship anchorages straddling the main harbour channel from south Karanja buoy northwards as far as the Indira Dock approach channel.

Crude and POL products are handled from the jetties at Jawahar Deep and chemicals are handled at Pir Pau. Dry bulk, break bulk, automobiles and passengers are handled at Indira dock and Ballard Pier.

2.2 Rail and Road Connectivity

2.2.1 Road Connectivity

Mumbai Port is well connected to the hinterland through major arterial road network of suburbs of Mumbai city. The main road networks connecting the hinterland to Mumbai Port are as follows:

- **NH-8 connecting Delhi – Jaipur – Gandhi Nagar – Surat – Mumbai**
  This is a six lane road network connecting cargo generation clusters in the North to JNPT port. It is a part of the golden quadrilateral project. The majority of the cargo from Gujarat and Rajasthan hinterland will utilize this route.

- **NH-3 connecting Delhi – Agra – Bhopal – Nashik – Panvel**
  This is a four lane road network connecting cargo generation clusters in UP and MP via Agra. This road will serve the requirement of Central Maharashtra and part of Northern Cluster.

- **NH-4 connecting Thane – Pune – Belgaum – Bangalore – Ranipet - Chennai**
  This is a four lane network connecting 3 main industrial networks at Pune, Chennai and Bangalore. NH9 merges into NH4 at Pune.

- **NH-17 connecting Cochin – Mangalore - Goa - Panvel**
  This is a road connecting Cochin to Panvel via Goa. The south bound cargo utilizes this route. NH 17 is a four lane road and part of the stretch is two lane roads which are being widened to 4 lane with a provision to expand to six lanes to accommodate future expansions.

The NH-8 from North & Gujarat, NH-3 from Central part and Nashik, NH-4, Mumbai – Pune Expressway and NH-17 from Southern Part of country bring the traffic to Mumbai port.

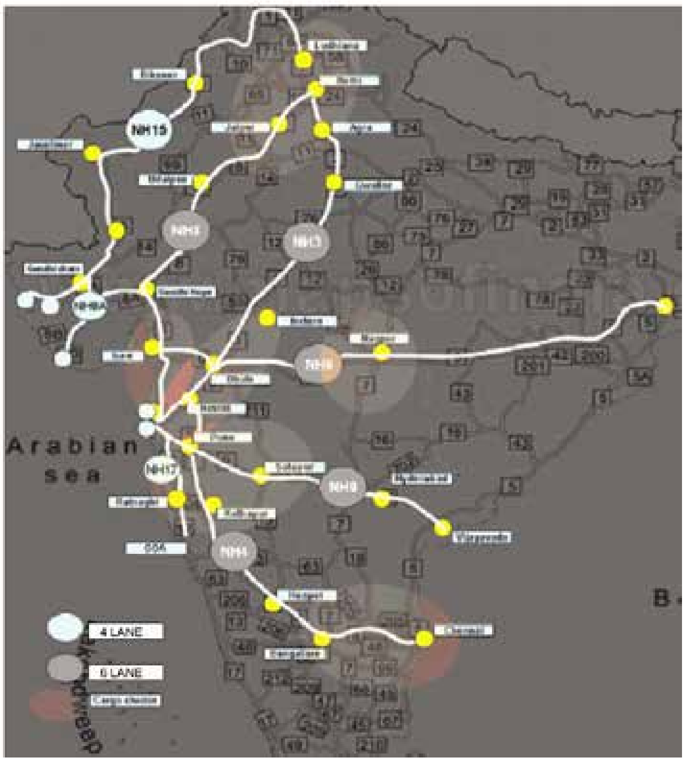


Figure 2.2 Existing Road Connectivity to Mumbai Port

2.2.2 Rail Connectivity

MbPT railway system is connected to Indian Railways at Raoli Junction, Wadala for receiving and dispatching the traffic generated from and to hinterland.

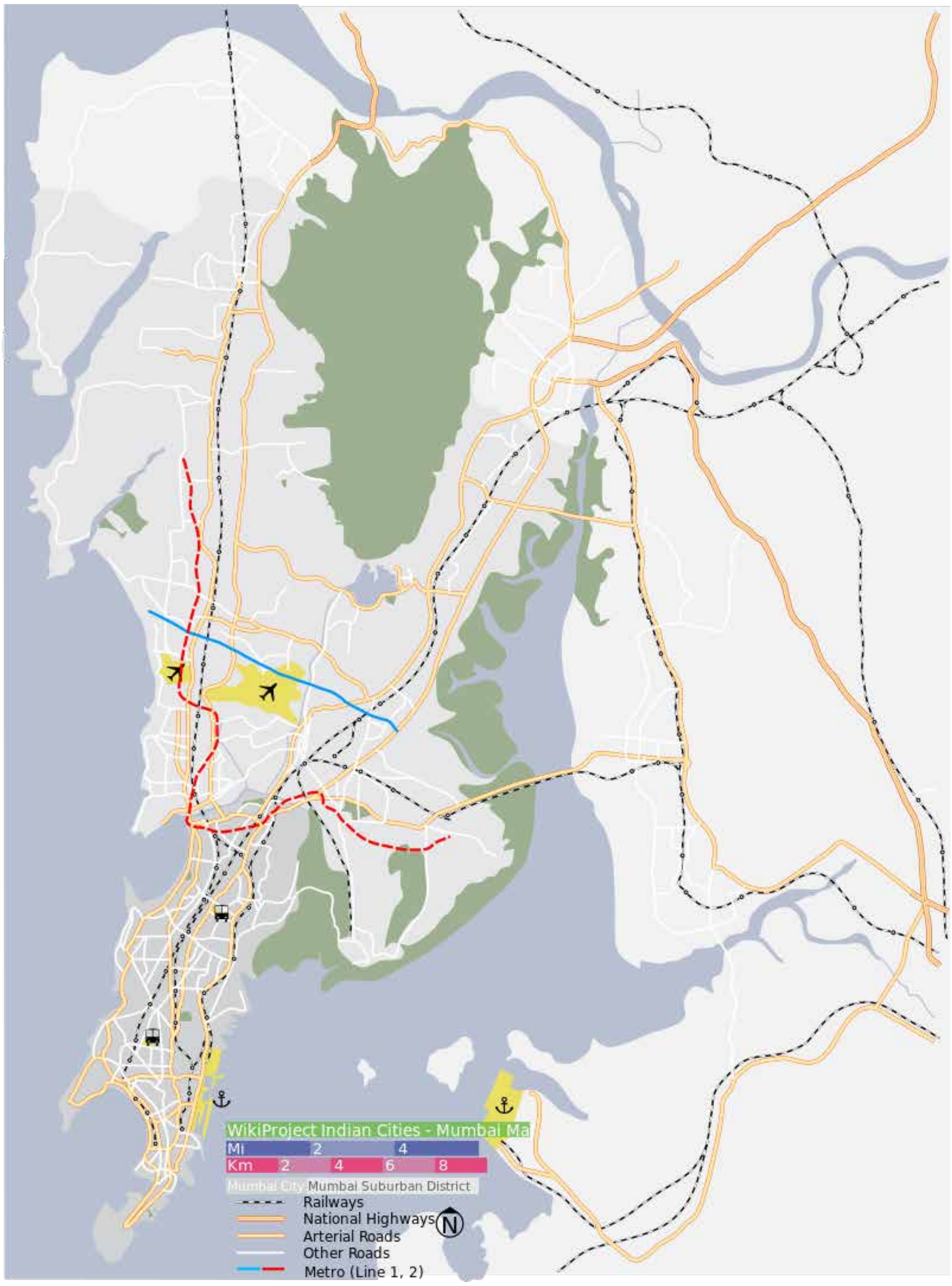


Figure 2.3 Rail Connectivity to Mumbai Port

2.3 Site Conditions

2.3.1 Meteorology

The climate of Mumbai generally shows a regular seasonal variation and the general character of the weather is more nearly related to the season. Mumbai is subject to the influence of both the SW and NE monsoon winds prevalent over the sub-continent. However, the former is more strongly marked along the west coast than the latter. The fair weather period is from October to June when it is generally sunny and dry. In the latter half of May, the weather becomes hot, sultry and humid as the conditions build up for the onset of SW monsoon. The "break" of the monsoon is accompanied by heavy rains, often lasting for several days. For the next two or three months there are periods of heavy rains interspersed with periods of less intensity. Towards the end of August, the monsoon begins to slacken and eventually recedes from Mumbai by the end of September.

2.3.1.1 Winds

During the fair weather period from October to June, the general wind direction is from the NW-NE quarter. Form June, for two or three months, the wind has an almost constant SW direction. The south-west monsoon winds are relatively stronger than the north-east winds. The maximum wind speed recorded is 150 kmph during the cyclonic storm of 1948.

2.3.1.2 Rainfall

The SW monsoon period starting about mid-May is the season for heavy rains. Nearly all the rainfall in Mumbai occurs during this period. The average yearly rainfall is about 2098 mm, of which 1965 mm (93.66%) occur during June to September. Usually maximum monthly rainfall occurs in July. The average monthly rainfall in July is 709 mm. There is practically no rainfall from December to April.

2.3.1.3 Temperature

The mean of the highest air temperature recorded in Mumbai is 35° C in the months of March, April and May while the mean lowest is 16° C recorded in the month of January. Mean daily maximum and minimum temperatures are 31° C and 24° C respectively.

2.3.1.4 Visibility

At Bombay from November to March smog hangs over the land, obscuring everything in view. This happens only for short periods most often shortly after sunrise but also occasionally in the evenings. Visibility is generally good for most part of the year.

2.3.1.5 Relative Humidity

Mean yearly relative humidity at 0830 hours is 77% while the same at 1730 hours is 71%. The monthly average is lowest in February (62%) and highest in July to September (85%).

2.3.1.6 Cyclone

In general the west coast of India is less prone to cyclonic storms compared to the east coast. From the information reported by India Meteorological Department (IMD) a total of 1034 disturbances occurred in the Bay of Bengal during the period 1891 to 1970 of which 363 intensified to cyclonic storms, the rest being 'depressions'. On an average the number of cyclonic disturbances per year during this period was about 13. However, if the data is updated to 1990, the number of cyclonic events per annum works out to be 16, varying from a minimum of 8 to a maximum of 18. It is observed from the tracks of the cyclones in the Arabian Sea from 1877 to 1992 that only 10 storms endangering the Mumbai coast have occurred in the above said period i.e. at a frequency of once in 12 years.

2.3.2 Oceanography

2.3.2.1 Tides

The tides in the Mumbai region are of the semi-diurnal type i.e. characterised by occurrence of two High and two Low Waters every day. There is a marked inequality in the levels of the two low waters in a day. The various tide levels with respect to Chart Datum reported at Mumbai are shown below:

Highest High Water	:	*+5.39 m*
Mean High Water Springs (MHWS)	:	*+4.42 m*
Mean High Water Neap (MHWN)	:	*+3.30 m*
Mean Sea Level (MSL)	:	*+2.51 m*
Mean Low Water Neap (MLWN)	:	*+1.85 m*
Mean Low Water Springs (MLWS)	:	*+0.76 m*
Lowest Low Water	:	*- 0.44 m*

The distance from the Mumbai floating light to the Elephanta deep is 26 km, and it will take 1½ to 2 hours to navigate this distance. Probability curves for HHW and tide levels 1 and 2 hours before HHW indicate that virtually on all occasions the tide level will exceed + 2.7 m two hours before high water and + 3.0 m one hour before high water. Hence larger vessels taking advantage of this tide, should therefore, enter the channel between two and one hour before high water and berth within one hour after high water.

2.3.2.2 Currents

The currents in the Mumbai region in the near shore zone are tide induced with reversal at high and low waters. The currents in the creeks are also affected by the freshets which result in not only increasing the strength of the ebb current but also limiting the propagation of the tide upstream. The normal maximum currents inside the harbour are about 2 to 3 knots although 4 knots occur on ebb flow during the monsoons.

2.3.2.3 Waves

The significant waves entering the harbour are the long period swell waves generated by deep sea storms. These mainly arise just before and during the monsoon and their direction of approach is normally from South – West. Whatever the wave-front orientation outside the harbour, the waves running up the harbour tend to be refracted in to a constant pattern. Waves are also substantially attenuated by the time they reach the berthing facilities in the harbour.

As the Mumbai harbour is sheltered, no significant wave climate exists within the harbour area. The wave height reaches a maximum of 1.5 m under normal conditions with wave period ranging from 6 to 10 s.

The offshore and nearshore wave rose diagram is as shown in **Figure 2.4**.

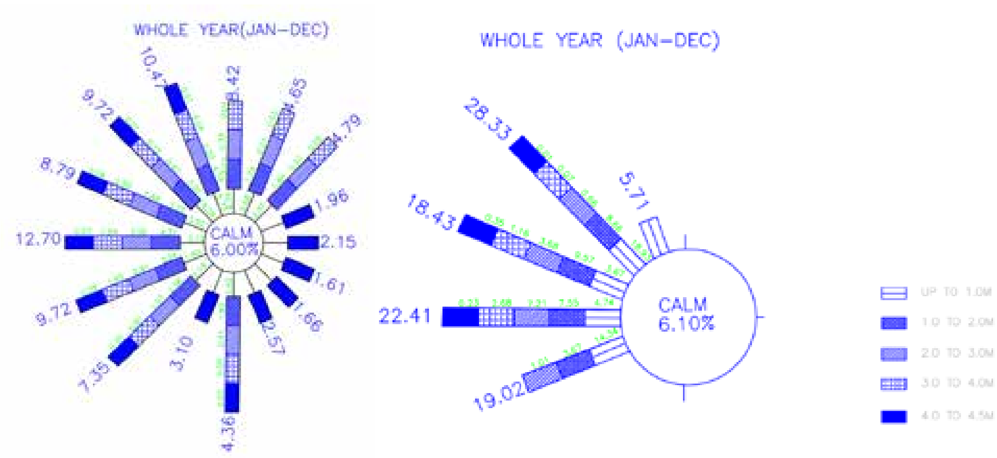


Figure 2.4 Offshore and Nearshore Waverose Diargram

2.3.3 Geology of the Area

The geological origin of rocks in the Mumbai region is that of the Deccan traps- a series of vast lava flows accompanied by volcanic eruptions at the close of Cretaceous period. Over the Deccan Plateau, the flow strata have remained nearly horizontal, but in the Mumbai area, they are inclined as much as 150 towards west. The type of rock is amygdaloidal basalt showing different grades of weathering from slightly to completely weathered.

This basalt layer is overlain by residual soil which in turn is overlain by marine clay. In general, the colour of marine clay is grey to dark black and its nature is soft to very soft. These are silty marine clays. At some places, these are mixed with fine to medium sized sand and gravels and at some places with gravels of weathered rock. The thickness of this layer is variable. The residual soil is the weathering product of underlying basalt. These are reddish brown in colour. These are hard to very hard in strength.

The Deccan trap basalt are of two types viz: amygdaloidal basalt and compact basalt. The difference between these two is that amygdaloidal basalt contains gas cavities whereas compact basalt does not. The basalt in the area of Pir Pau and Jawahar Dweep are of amygdaloidal type. These basalts are fine grained and show thin to thick bands of weathering. At some places, these rocks are highly jointed and show weathering and staining along these joints. Otherwise these are fresh and are strong to very strong in strength.

AECOM

3.0 DETAILS OF EXISTING FACILITIES

3.1 Mumbai Port

The port is geographically spread into different areas based on the type of cargo to be handled.

- Main Harbour in Colaba area – for handling dry bulk, breakbulk, general cargo, automobiles
- Jawahar Dweep (Butcher island) – for handling Crude and POL products
- Pir Pau – for handling chemicals

Mumbai port was handling coal at Haji Bunder and this has recently been discontinued due to environmental considerations. The Princess & Victoria Docks in the Main Harbour have been closed and filled up to create stackyard for containers.

The relative locations of port facilities are as shown in **Figure 3.1**.

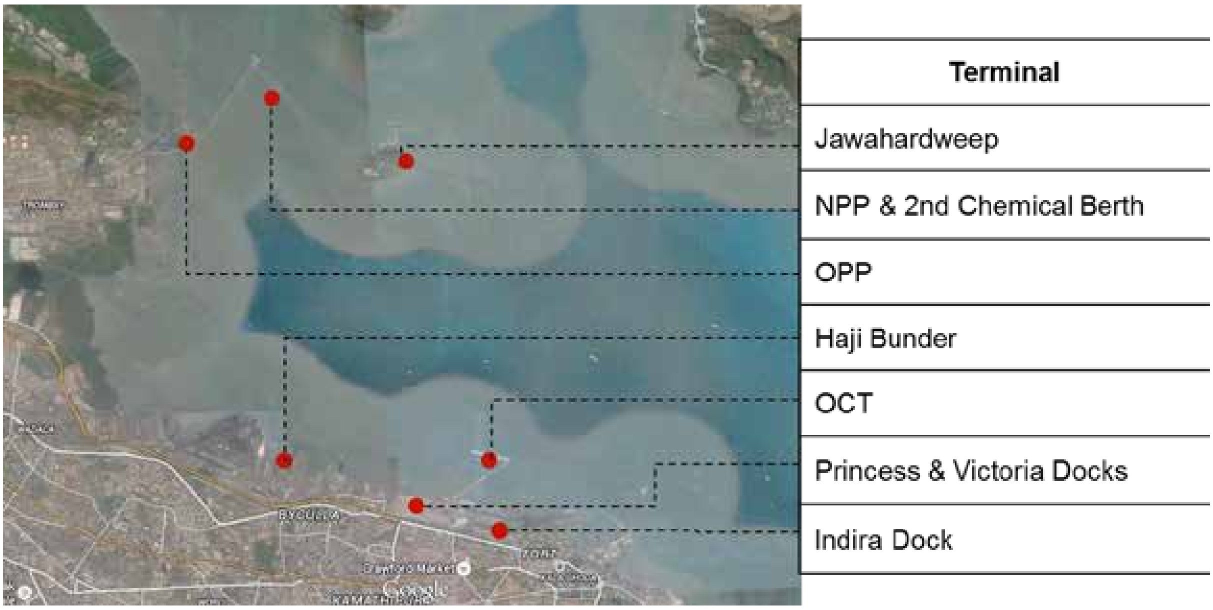


Figure 3.1 MbPT Relative Locations of Existing Facilities

3.2 Port Navigational Channel

The main navigational Harbour Channel is, for the great part, a natural deep-water fairway and the channel has been deepened to 11 metres only close to facilities. With a mean high water neap tide of 3.3 metres, the channel is adequate to meet the requirement of most of the cargo vessels, passenger ships and tankers. With good lighting arrangements navigation is allowed at the port round the clock. This channel also acts as a common channel to Mumbai and JN port.

The Mumbai harbour channel is presently maintained at a depth of 10.7 m to 11 m CD. The total length of the dredged channels of Mumbai Port is about 30.4 km. A major part of the dredged channels (length 23.1 km) is the main harbour channel running between the Prong's Reef at the western end of the harbour and the oil berths at Jawahar Dweep. The entrance channel to the Indira Dock and Harbour wall berths take off from the main harbour channel at a distance of about 10km from the Prongs reef. There is a dredged channel about 2 km long which takes off from the northern end of Jawahar Dweep to the Pir Pau Oil terminal.

Figure 3.2 Navigational Channel to Mumbai Port

The details of approach to the various berthing facilities are given in **Table 3.1**.

Table 3.1 Approach to Various Berthing Facilities

Approach From Main Channel	Length (km)	Min Width (m)	Min Depth (m)
Pilot Station to Jawahar Dweep	7.0	325	13.5
Jawahar Dweep to Pir Pau	2.5	200	8.7
To Indira Dock	1.7	300	7.6

3.3 Berthing Facilities

The berthing facilities are in three groups: Main Harbour comprising Indira Dock berths and Ballard Pier berths handling dry bulk, general cargo, break bulk, cars etc.; Jawahar Dweep berths handling crude and POL products and Pir Pau berths handling chemicals. Their details are given hereunder.

3.3.1 Indira Dock

The Indira dock works on a lock-gate system with a lock length of 228.6 m and a width of 30.5 m, through which vessels can enter and leave the docks at any state of tide. There are 21 berths inside the basin and 5 berths along the harbour wall (**Table 3.2**). The design depth available inside dock and at outside berths is 8.8 m and 7.5 m, respectively. The depth of berths inside the basin can be further increased by 1.2 m by impounding water by electric pumps.

The layout of Indira Dock berths with back-up spaces and sheds is shown in **Figure 3.3** hereunder.

Figure 3.3 Layout of Berths in Indira Dock with Back up Space & Sheds

Figure 3.4 Numbering of Berths in Indira Dock

Table 3.2 Berth-wise Details at Indira Dock

Name of Berth	Width of Wharf (m)	Length of Wharf (m)	Designed Draft (m)	Berth Type
1 Indira Dock	13.72	180	8.84 to 9.14	Container
2 Indira Dock	13.99	158	8.84 to 9.14	Container
3 Indira Dock	13.84	158	8.84 to 9.14	Container
4 Indira Dock	13.84	158	8.84 to 9.14	Container
5 Indira Dock	13.82	158	8.84 to 9.14	Container
6 Indira Dock	13.84	158	8.84 to 9.14	Multi-purpose berth
7 Indira Dock	18.36	152	8.84 to 9.14	Multi-purpose berth
8 Indira Dock	18.36	152	8.84 to 9.14	Multi-purpose berth
9 Indira Dock	13.42	152	8.84 to 9.14	G.Cargo+Tanker
J/E Indira Dock	18.97	130	8.84 to 9.14	Heavy lifts
10 Indira Dock	18.29	152	8.84 to 9.14	Multi-purpose berth
11 Indira Dock	18.29	152	8.84 to 9.14	Multi-purpose berth
12 Indira Dock	13.72	152	8.84 to 9.14	Multi-purpose berth
12A Indira Dock	18.26	180	8.84 to 9.14	Multi-purpose berth
12B Indira Dock	18.26	180	8.84 to 9.14	Multi-purpose berth
13B Indira Dock	16.61	180	8.84 to 9.14	Multi-purpose berth
13A Indira Dock	16.61	180	8.84 to 9.14	Multi-purpose berth
13 Indira Dock	16.61	158	8.84 to 9.14	G. Cargo + Bulk cargoes
14 Indira Dock	20.29	158	8.84 to 9.14	G. Cargo + Bulk cargoes
15 Indira Dock	20.29	158	8.84 to 9.14	G. Cargo + Bulk cargoes
16 Indira Dock	16.30	158	8.84 to 9.14	Multi-purpose berth
17 Indira Dock	16.54	158	8.84 to 9.14	Multi-purpose berth
18 Indira Dock	9.22	183	7.5 CD	Multi-purpose berth
19 Indira Dock	27.13	168	7.5 CD	Multi-purpose berth
20 Indira Dock	18.26	168	7.5 CD	Multi-purpose berth
21 Indira Dock	18.26	168	7.5 CD	Multi-purpose berth
22/23 Indira Dock		431	6.1 to 6.4	

As can be seen from the figures, berths 1 to 17 are inside the dock basin and berths 18 to 23 are outside along the dock wall. Inside berths 6 to 9 are used for berthing port crafts and are not used for handling cargo. Berth no. 17 is also not operated since it is close to the lock gate.

The principal cargo handled are steel, sugar, yellow peas, fertilisers, project cargo, cars and containers. There are 12 sheds with a total area of 76,740 m^2. In addition there are 26 open plots with a total area of 56,939 m^2. There are three 16 T electric Wharf Cranes serving Berth 2, 3 and 4 of the dock. Apart from these there are eight 10 T cranes, which are used at various berths according to the requirements.

The port also uses six 14 T Mobile Harbour Cranes (MHC), one Tower crane of 20 T. Forklifts of capacity, 3 × 16 T, 20 × 3 T and 2 × 1 T are also owned by the port to aid to its handling capacity.

3.3.2 Ballard Pier Berths

There are two berths on the southward extension of Indira Dock named Ballard Pier. The Ballard Pier Extension (BPX) and the Ballard Pier Mole Station (BPS) are the two berths. The BPX has a modern passenger terminal building which houses check-in baggage facilities, a lounge, duty-free shop, curios and handicraft stalls, toilets etc.

Table 3.3 Berth-wise Details at Ballard Pier

Name of Berth	Width of Wharf (m)	Length of Wharf (m)	Designed Draft (m)	Berth Type
Ballard Pier Station	10.24	244	10 CD	Break-bulk berth
Ballard Pier Extension	22.38	244	9.5 CD	Passenger cum Cargo Berth

The layout of BPS & BPX berths with back-up space and Passenger Terminal is shown in **Figure 3.5**.

Figure 3.5 Layout of BPS & BPX Berths with Back up Space & Passenger Terminal

3.3.3 Jawahar Dweep Marine Oil Terminal

For handling Crude oil and Petroleum products, there are four jetties at Jawahar Dweep (Butcher Island). The layout of Jawahar Dweep with the four oil jetties are shown in **Figure 3.6** hereunder. While JD 1, JD 2 and JD 3 were commissioned first during 1950s, JD 4 was commissioned during 1980s. The first three jetties can handle panamax tankers and JD 4 can handle suez max tankers dead freighted to the permissible draft. The physical parameters of the berths are given in **Table 3.4**.

Figure 3.6 Marine Oil Terminal at Jawahar Dweep

Table 3.4 Jawahar Dwep Berths for Handling Crude Oil & POL products

Name of Berth	Length (m)	Designed Draft (m)
Jawahar Dweep -1	244	11.58
Jawahar Dweep -2	244	10.97
Jawahar Dweep -3	244	11.58
Jawahar Dweep -4	493	14.30

JD 1, JD 3 and JD 4 have 5 × 12” marine loading arms each while JD 2 has 3 × 12” marine loading arms. These jetties handle crude oil, white oil and black oil POL products. The berths at Jawahar Dweep are connected to the mainland by a set of submarine pipelines as detailed in the **Table 3.5** hereunder. These pipelines are, in turn, connected to the two oil refineries of BPCL and HPCL and also to the marketing terminal of IOC.

Table 3.5 Details of Submarine Pipelines at Jawahar Dweep

S. No.	Nomenclature	Product	Diameter (inches)
1.	C	Crude	42
3.	B1	Black oil	36
4.	W1	Naphtha	30
5.	W2	HSD	30
6.	W3	SKO	30
7.	FW	Fresh water	8

All the berths have been provided with firefighting facilities as per statutory requirement.

At Jawahar Dweep BPCL have 8 tanks for storing HSD/SKO/FO with a total capacity of 182,864 KL while Mumbai Port has 8 tanks for storing LDP/Naphtha/Ballast with a total capacity of 34,456 KL.

3.3.4 Pir Pau Chemical Terminal

All Chemicals and LPG are handled at the two berths at Pir pau. These are located at the northern extremity of the harbour's deep waters. While the old jetty is nearer to the shore, the new jetty, constructed during 1996, is located about 2 km offshore of the old one. The location of Pir Pau berths along with the tankage terminal onshore is shown in the **Figure 3.7** hereunder.

Figure 3.7 Chemical Terminal at Pir Pau

Table 3.6 Details of Pir Pau Jetties

Name of Berth	Length (m)	Designed Draft (m)
Pir Pau Jetty - old	174	7.5
Pir Pau Jetty - new	197	12.0

Both the jetties have 1 × 12"; 2 × 10"; 3 × 8" marine unloading arms and 11 pipelines as follows: 1 × 600 mm; 1 × 350 mm; 7 × 300 mm and 2 × 200 mm. Onshore, Aegis has 55 chemical tanks of total capacity 210,000 KL along with 2 spheres for LPG of total capacity 20,000 KL while Chemical Terminal Trombay Ltd. has 22 chemical tanks with a total capacity of 41,000 KL.

3.4 Ship Repair Facilities

Mumbai Port has two systems of repair facilities – slipways in Workshop area at Clerk Bunder adjoining Mazagon Docks and Hughes Dry Dock within Indira Dock. The relevant details are furnished hereunder.

3.4.1 Slipways at Clerk Bunder Workshop Area

There are 6 slipways at Clerk Buner Workshop area. These are used for repair of small port crafts, barges, small yachts and other smaller size vessels with less than 1.5 m draft. This location is adjacent to Mazagon Docks Ltd., India's largest naval shipyard. This location is open to the sea and is exposed to cyclones and subject to heavy siltation. The MbPT workshop has more than 200 skilled workforce who are involved in supporting ship repair to port crafts including hauling up and down the vessels on slipways and also working as crew in workshop flotilla. The location of the slipways is shown in the **Figure 3.8**.

Figure 3.8 Slipways at Clerk Bunder Workshop Area

The broad features and capacity of the slipways are presented in **Table 3.7**.

Table 3.7 Slipway Features and Capacity

Slipway No.	Length (m)	Beam (Transverse) (m)	Cradle Height from Ground (m)	Capacity as Weight of Craft that can be Hauled up	Gradient
1.	87.782	8.4	1.00	150 T	1 in 16
2.	96.012	8.4	1.00	150 T	1 in 14
3.	87.604	8.2	1.00	150 T	1 in 14
4.	87.604	8.4	1.00	150 T	1 in 14
5.	65.659	4.7	0.81	40 T	1 in 14
6.	43.891	4.9	0.83	40 T	1 in 10.5

3.4.2 Hughes Dry Dock (HDD) at Indira Dock

MbPT has a dry dock at Hughes Dock. The dimensions of this dry dock are presented in **Table 3.8**:

Table 3.8 Dry Dock Dimensions

Dock	Length (m)	Width (m)	Depth (m)
Hughes Dry Dock	304.8	30.08	9.75

The length can be divided into two compartments of variable length. Two caissons can be used but presently there is only one caisson. The maximum size of the vessel that can be dry docked is 190 m in length and 27 in width. Views the dry dock with vessels docked inside are presented in **Figure 3.9** to **Figure 3.12**.

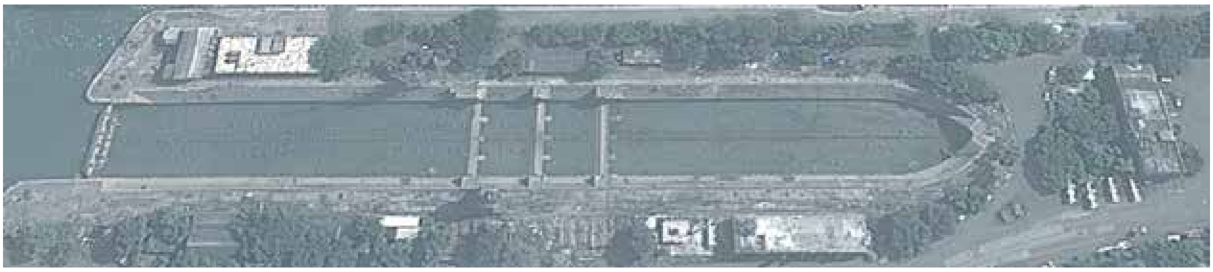


Figure 3.9 General View of Hughes Dry Dock

Figure 3.10 View of Dry Dock with Two Vessels Docked

Figure 3.11 View of Dry Dock with Three Vessels Docked

Figure 3.12 View of Dry Dock with Single Vessel Docked

Facilities available at the Dry Dock:

- There is one substation on each side of the Dry Dock with multiple power sockets along the length of the dock for using equipment and machinery and for giving power supply to the vessels dry docked. One motor generator frequency- converter for supply of power at 60 cycles, 380 volts is also fitted in the east substation. The substation caters to the utilities at the Dry Dock.
- There is one ELL crane of 20 T capacity on the west side and one ELL crane of 5 T capacity on the east side operable throughout the length of the Dry Dock. However, the 20 T crane can only be operated under a derated capacity of 10 T.
- There are 5 capstans each of 10 T capacity (2 no. at the entrance, 2 no. at mid dock and 1 no at the end) along with 4 no. intermediate capstans of 6 T capacity.
- For firefighting, there are two pumps of 170 m^3/hr capacity each with working pressure of 7 bar fitted in the HDD pumping station. The fire line with hydrants is provided all around the Dry Dock.
- One salt water pump of 170 m^3/hr capacity with working pressure of 7 bar fitted in the HDD pumping station. The fire line runs along the length of the west side of the Dry Dock.
- 3 nos. air compressors 850 CFM, auto working at 7 bars are fitted in Compressor House along with accessories and two air vessels of 10 m^3 capacity. The distribution line runs throughout the east length of the Dry Dock.
- 7 lighting masts of 20 m height to provide adequate lighting in the Dry Dock and its working are have been provided.
- Chipping & painting (moving) equipment include 4 no. water jet pumps for hull cleaning with fresh water; 4 no. grit blasting machine with two nozzles to clean area of 25 m^2/hr/nozzle; 6 no. spray painting machine; 8 no. scaffolding sets (quick assembly type) each set containing about 110 members; 1 no. of caisson and 13 no. of sluices with associated power packs.

As at present, the responsibility of the Port is only upto docking of the vessel in the Dry Dock. The vessel owners have to make their own arrangement of carrying out the required repairs. For this purpose, the Port issues licences from year to year to approved contractors/agents, granting them permission to undertake work in connection with the vessels in the Dry Dock and no other person will be allowed to undertake any such work unless holding the Port licence. The Contractors/agents desirous of obtaining the licence for carrying out works in the Dry Dock shall submit an application to the Chief Mechanical Engineer stating clearly the nature of work intended to be carried out in the Dry Dock, viz. either chipping and painting or ship repair work. In case of ship repair work they should further mention whether they want to carry out hull repairs or repairs to stern gear or both.

The Contractors/agents desiring to carryout chipping and painting work inside the Dry Docks shall be necessarily registered with the Mumbai Dock Labour Board and they must have facilities such as enough number of painting gears and other necessary tools for chipping, scrapping, etc. including tested ropes, slings and chains, pulley blocks necessary for various operations required in connection with chipping and painting work inside the Dry Dock. They shall be bound to employ foremen and tindalls of experience to supervise the work of chipping and painting and such foremen and tindalls shall be bound to take care to prevent accidents.

The Contractors/agents desiring to carry out repairs to hull, stern gear etc. shall have a workshop of their own, which shall be equipped at least with the following:

- Portable air compressor
- Portable diesel/transformer/rectifier/welding sets for either AC or DC arc welding along with necessary accessories
- Pneumatic caulking, drilling & riveting machines
- Lathes and power saws
- Grinding, boring, shaping and milling machines
- Pipe drilling machine
- Gas cutting equipment with necessary accessories

They should also have ready stock of materials for carrying out general repair works on vessels. They should also have all safety equipment required by their workmen to enable them to carry out work in an efficient and safe manner. The Contractors/agents should have a qualified Engineer in overall charge of the work, technically competent supervisors and adequate strength of skilled and unskilled workers for undertaking repairs on vessels.

3.5 Flotillas and Harbour Craft Facilities

For effective operations and management, the port has good fleet of flotillas, i.e., dredgers, hopper barges, dock tugs, harbour tugs, pilot and survey vessels. Six pilot launches and 9 other launches are also part of the port flotilla. Port also owns a survey vessel called ‘Sanshodhinee’, equipped with ‘State-of-the-Art’ navigation and survey equipment for carrying out hydrographic surveys in the harbour.

3.6 Port Railways

MbP is having its own rail network system from the Dock to Wadala the Central Railways Interchange point. The Railway runs about 10 km of straight route between Ballard Pier and Wadala and has an extensive network of track of about 100 km. It serves the Docks as well as the important installations and factories on the Port Trust Estates. It has its own fleet of 5 diesel locomotives. The Railway handled around 1.014 million tons of traffic during 2002-03. For handling ICD traffic, a full-fledged Rail Container Deport has been set up at Cotton Depot with facilities for reception, stacking etc. of containers. It can handle two trains of 45 wagons with double discharge facilities.

At Wadala, the port has developed marshalling yard where the port’s rail borne cargo is interchanged with Trunk railways. Central railways allow 3 movements of rakes at Wadala towards North for MbP’s freight trains during non-peak hours without affecting the city passenger traffic windows.

Thus, Central Railways locomotives run up to Wadala, the interchange point for MbPT’s locomotives. MbPT’s locomotives take over between Wadala and the MbP’s Docks.

At present, all rail borne traffic from MbPT undergo this change over due to the availability of Over Head Electric (OHE) system only up to Wadala and non-availability of OHE system between Wadala and port’s docks.

3.7 Internal Road Connectivity

Mumbai Port Trust owns and maintains about 63 km long Roads in MbPT Estate. The Main Roads are about 20 km in length and the secondary roads are about 43 km in length as shown in **Figure 3.13**.

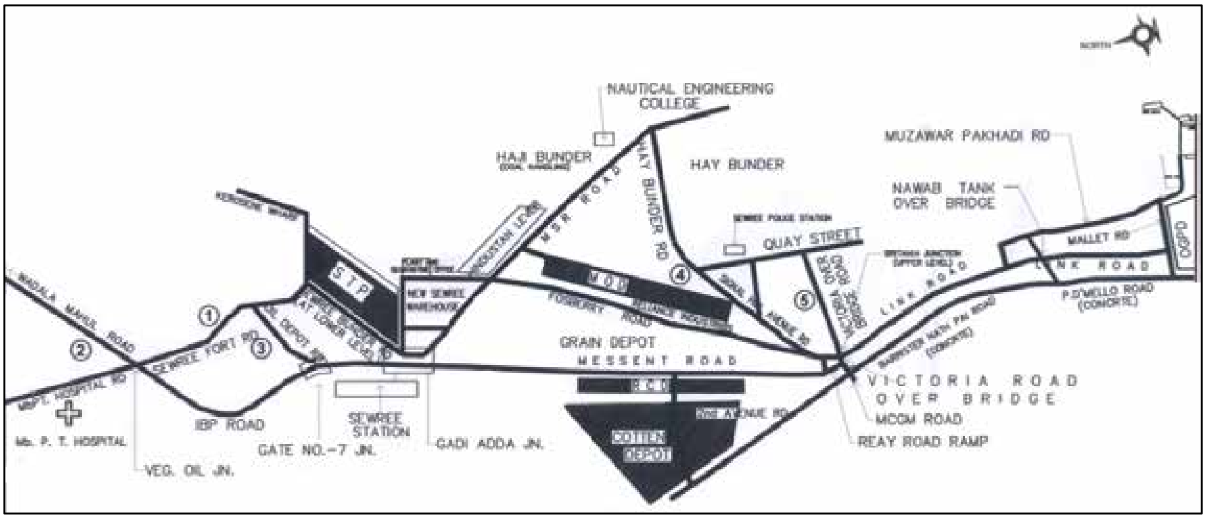


Figure 3.13 Internal Road Connectivity in Mumbai Port

4.0 PERFORMANCE, OPTIONS FOR DEBOTTLENECKING & CAPACITY ASSESSMENT

4.1 General

The total cargo handled at Mumbai Port during the past 5 years is presented in the following **Table 4.1**.

Table 4.1 Cargo Handled During Last 5 Years

Commodity	FY 11	FY 12	FY 13	FY 14	FY 15
POL+ Crude + Product	33.23	33.31	34.79	35.98	36.29
Fertilizer	0.49	0.40	0.51	0.30	0.17
Coal	3.87	4.32	4.02	4.22	4.30
Others	16.34	17.60	17.89	18.23	20.0
Containers	0.65	0.55	0.83	0.45	0.54
Grand Total	**54.59**	**56.19**	**58.04**	**59.18**	**61.31**

The grand total of the traffic includes traffic handled at stream through lighterage/transhipment operations and also POL including crude & products moved through pipelines. The actual traffic handled at alongside berths will be about 50 to 55% only.

4.2 BCG Benchmarking Study

BCG, as part of their benchmarking study, has looked into the operation of the berths and has suggested various measures for improving the performance. The report of BCG pertaining to Mumbai Port is given in the **Appendix 1**. The key observations are as follows:

§ Only 55% cargo (≈34 MT) is handled by MbPT. The rest is directly managed by third parties

§ Due to draft and beam size limitations, Indira dock manages only 6 MTPA on 27 berths. Modern vessels have an average beam size of 32 meters, which the lock gate limits entry into the inside berths as it has beam size limitations of 27–28 meters. As a result, inside berths are underutilized and have low occupancy while the outside berths have extremely high occupancy.

§ Old infrastructure / lack of mechanization, difficult to sustain mechanization: The port's cranes are of extremely low capacity, which brings down productivity. Low capacity cranes also necessitate reliance on ship cranes as the berth infrastructure is so old that it cannot withstand modern equipment and heavy cranes, rendering mechanization difficult to sustain

§ Mumbai port has recently decided to discontinue coal handling at Haji Bunder (1.8 MT) because of significant pollution issues in the nearby areas.

- Analysis has revealed that container handling at MbPT proves to be more costly for customers than JNPT. Multiple handling charges at MbPT limit the cost effective catchment area from MbPT to only around 8 km from the port. Further deep-dive and customer interviews have revealed several reasons why MbPT will not receive substantial container volumes in the future. With JNPT in its proximity, and given JNPT's scale, it is unlikely that MbPT will be able to compete with JNPT for container volumes
- Despite a minor dip last year, steel volumes at MbPT have picked up. The total volume of steel handled last year was around 4.7MT, which was at a CAGR of 13% over the last three years given the immense signs of growth in the manufacturing and construction sectors, these volumes are only expected to grow in the near future. Current steel productivity can be increased by installing multipurpose gantry cranes on the berth. Currently, steel cargo at the berth is being handled by ship cranes that limit berth productivity owing to their design and limited capacity. BPS already has sufficient load bearing capacity strength to handle a 35.5 MT crane, and also has the rail track to support a rail mounted crane. The only capital expenditure required is in terms of purchasing and installation of the crane. MbPT can evaluate the opportunity of handling steel using a multipurpose crane at BPS on a PPP mode
- The Offshore Container Terminal berth is built to have two berths in phase 1. The OCT was planned to handle container volumes, however, after careful evaluation of the prospects for OCT, not much container traffic can be expected at the terminal. Therefore, MbPT should consider handling alternate commodities at OCT.
- Vehicle volume at Mumbai port has increased by 80% over the last 3 years due to a significant increase in exports. 83% of the vehicles exported are from Maharashtra belt, which currently are operating as captive customers. 17% of the remaining export is from Haryana (Maruti Suzuki), which is largely because of the vessel sharing agreements that the company has with other OEMs.
- Evacuation through busy Mumbai: Since the port is located in the southern-most part of Mumbai, evacuation through road leads to cargo going through the busy Mumbai city traffic, which makes evacuation very slow and inefficient.

4.3 Performance of the Berths

AECOM has carried out a detailed analysis of the performance of the berths during 2014 -15 and the results are furnished in the tables hereunder. This analysis looks into the port operations in three groups: POL and Chemical traffic, general cargo traffic and Steel products traffic.

4.3.1 Performance in Handling of Liquid Products

POL traffic is being handled at Jawahar Dweep Berths and Chemical traffic is being handled at the Pir Pau berths. The performance of these berths has been discussed below:

Table 4.2 Peformance of Jawahar Dweep Pol Berths During 2014 - 15

S. No.	Berth	Occupancy	Cargo	Volume	No. of Ships	Ship Category	Maximum	Minimum	Average
1.	JD 4	64.09%	Crude - Imports	1,25,49,704	148	Ship size	1,65,209	1,59,539	1,33,039
						Parcel size	1,00,827	26,230	84,795
			Crude - Exports	4,00,570	7	Ship size	1,56,516	73,580	97,219
						Parcel size	87,850	50,143	57,224
				1,29,50,274	**155**				
2.	JD 3	57.76%	Crude - Imports	1,77,389	5	Ship size	73,655	73,580	73,620
						Parcel size	49,788	26,404	35,478
			Crude - Exports	12,03,928	24	Ship size	93,322	73,531	77,931
						Parcel size	51,334	45,286	50,164
			POL - Imports	4,45,805	24	Ship size	76,586	29,990	47,012
						Parcel size	43,732	3,831	18,575
			POL - Exports	10,72,214	39	Ship size	75,570	28,610	46,439
						Parcel size	40,027	6,000	27,493
				28,99,336	**92**				
3.	JD 2	40.54%	POL - Imports	4,23,628	25	Ship size	47,999	28,610	41,818
						Parcel size	36,033	323	16,945
			POL - Exports	6,89,143	32	Ship size	50,605	28,810	44,038
						Parcel size	35,703	5,252	21,536
				11,12,771	**57**				
4.	JD 1	59.91%	Crude - Imports	4,27,586	14	Ship size	93,322	73,580	76,438
						Parcel size	50,099	25,358	30,549
			Crude - Exports	21,24,345	46	Ship size	93,322	73,531	77,446
						Parcel size	51,712	4,992	46,181
			POL - Imports	4,02,349	21	Ship size	39,979	8,968	19,158
						Parcel size	21,337	3,900	14,273
			POL - Exports	11,02,834	38	Ship size	93,322	28,610	46,439
						Parcel size	46,742	3,588	29,022
				40,57,114	**119**				

Table 4.3 Peformance of Pirpau Chemical Berths During 2014 - 15

S. No.	Berth	Occupancy	Cargo	Volume	No. of Ships	Ship Category	Maximum	Minimum	Average
1.	NPP	80.91%	Chemicals	16,74,017	277	Ship size	47,076	7,088	20,617
						Parcel size	32,121	480	6,057
			POL	74,000	11	Ship size			
						Parcel size			
				17,48,017	**288**				
2.	OPP	40.38%	Chemicals	3,34,686	77	Ship size	35,208	10,000	15,131
						Parcel size	12,076	514	4,406
			POL	1,18,086	24	Ship size			
						Parcel size			
				4,52,772	**101**				

Observations:

§ *POL berths at Jawahar Dweep*: It can be seen that the berths have reasonable occupancy level. The capacity of the berths varies with the average parcel size. While JD 4 handled almost 13 million tonnes, JD 1 could handle only about 3 million tonnes, primarily because of the average parcel size.

§ *Chemical berths at Pir Pau*: The new chemical berth handled about 1.8 million tonnes with a high 85% occupancy level. This is once again related to the average parcel size which is only about 6,000 tonnes.

4.3.2 Performance in General Cargo Handling

The general cargo is handled at the Main harbour which includes Indira Dock inside berths, Indira Dock outside berths and Ballard Pier berths BPX and BPS.

Indira Dock inside berths: There are 16 cargo handling berths. Because of the limitation on the size and draft of the vessels that could be handled inside added with the lack of shore based equipment, the performance of these berths are far below par. All the berths, together, have handled about 1.53 million tonnes during 2014-15. Out of which 0.56 million tonnes are steel products.

Indira Dock outside berths: There are 4 cargo handling berths. These berths also lacked shore based equipment to handle cargo. However, during 2014-15, these four berths handled cargo volumes totalling 1.64 million tonnes more than the inside berths. Out of this 1.14 million tonnes are steel products.

Ballard Pier berths: There are 2 berths and these also do not have handling equipment on shore. During 2014-15, both these berths handled total traffic of over 3 million tonnes, almost as much as all the Indira Dock berths, out of which 2.45 million tonnes are steel products.

Table 4.4 Peformance of Main Harbour Berths During 2014 - 15

S. No.	Berth	Occupancy	Cargo	Volume	No. of Ships	Ship Category	Max.	Min.	Avg.
1.	Indira Dock inside berths (1 to 16)	35.76%	Steel - Imports	3,98,737	62	Ship size	31,755	4,545	17,256
						Parcel size	20,270	352	4,691
			Steel - Exports	1,61,295	30				
			Others - Imports	6,40,329	124				
			Others - Exports	3,31,133	39				
				15,31,494	**255**				
2.	Indira Dock outside berths (18 to 21)	57.6%	Steel - Imports	8,81,105	47	Ship size	63,618	22,130	47,123
						Parcel size	51,018	1,401	18,747
			Steel - Exports	3,04,944	21	Ship size	61,114	34,167	54,872
						Parcel size	26,432	595	14,521
			Others - Imports	3,34,405	54				
			Others - Exports	1,17,096	57				
				16,37,550	**179**				
3.	Ballard Pier berth BPS	~100%	Steel - Imports	10,11,327	49	Ship size	63,123	17,224	44,543
						Parcel size	39,128	773	20,639
			Steel - Exports	49,533	5				
			Others - Imports	2,05,726	23				
			Others - Exports	5,346	6				
				12,71,932	**83**				
4.	Ballard Pier berth BPX	84.91%	Steel - Imports	13,87,488	51	Ship size	72,871	28,418	53,339
						Parcel size	39,792	3,927	27,206
			Steel - Exports	6,159	2				
			Cars - Imports	15,582	5				
			Cars - Exports	1,76,255	58				
			Others - Imports	1,91,372	51				
			Others - Exports	78,664	32				
				18,55,520	**199**				

4.3.3 Performance in Handling of Steel Products

It can be observed that out of over 6 million tonnes of cargo handled in the Main Harbour berths almost 70% is steel products. In view of the significant traffic in steel products, the performance of these berths in this aspect is specifically examined in the following paras.

Table 4.5 Peformance with Reference to Handling of Steel Products During 2014 – 15

Berth No.	No of Ships	Import	Export	Total Cargo	Average Parcel Size	Working Time at Berth in Days	Productivity in TPD
ID 1	1	2,078	-	2,078	2,078	0.71	2934
ID 2	9	33,950	50,595	84,545	9,394	33.54	2521
ID 3	6	32,847	16,393	49,240	8,207	19.13	2575
ID 4	5	22,770	15,383	38,153	7,631	15.71	2429
ID 5	1	-	6,239	6,239	6,239	4.96	1258
ID 12	7	28,200	1,270	29,470	4,210	11.29	2610
ID 12A	13	79,062	19,271	98,333	7,564	34.17	2878
ID 12B	7	47,162	10,997	58,159	8,308	22.63	2571
ID 13	8	31,728	17,258	48,986	6,123	24.25	2020
ID 13A	2	6,039	3,567	9,606	4,803	4.58	2096
ID 13B	3	5,176	4,543	9,719	3,240	4.08	2380
ID 14	3	24,409	-	24,409	8,136	3.83	6368
ID 15	13	50,293	4,531	54,824	4,217	23.63	2321
ID 16	7	35,013	11,248	46,261	6,609	11.79	3923
TOTAL 1	**85**	**3,98,727**	**1,61,295**	**5,60,022**	**6,588**	**214**	**2777**
ID 18	31	5,14,171	1,24,439	6,38,610	20,600	83.42	7656
ID 19	25	2,66,039	68,327	3,34,366	13,375	52.79	6334
ID 21	10	1,00,895	1,12,178	2,13,073	21,307	30.25	7044
TOTAL 2	**66**	8,81,105	3,04,944	**11,86,049**	**17,970**	166	**7011**
BPS	53	10,11,327	49,533	10,60,860	20,016	127.42	8326
BPX	51	13,87,488	6,159	13,93,647	27,326	170.00	8198
TOTAL 3	**104**	23,98,815	55,692	**24,54,507**	**23,601**	297	**8262**
	255	**36,78,647**	**5,21,931**	**42,00,578**	**16,473**	**678**	**6194**

It could be seen from the above table that the productivity of the inner berths of Indira Dock is the lowest. This is mainly because of the limitation in the size of vessels to be handled there. Without going into the intricate components of productivity, it could be seen that, prima facie, the ship and parcel sizes influence it. With the ship and parcel sizes increasing at the outer berths as well as the Ballard Pier berths, the productivity also increases.

4.4 Enhancing Performance in Handling of Steel & Other Cargo

As indicated earlier that steel products constitute a major share in the total dry bulk and general cargo handled at the Main Harbour. There is a good potential for this traffic to increase in future also. Hence it is suggested that handling of all the steel products be shifted to the new offshore container terminal.

This was planned as an exclusive container terminal to handle about 1.24 MTEU in the first phase. However, contrary to expectations, the container traffic at Mumbai port hovers between 40,000 to 50,000 TEU only per annum. Though the two berths have been completed with proper approaches, no container handling equipment has been installed either at the berth or at the stackyard. In view of this the Port has already permitted the licensee to handle automobile exports through a mutually agreed special revenue share.

Under such circumstances, this suggestion is made to shift handling of steel products to these berths. To start with each berth can be equipped with one 100 T Harbour Mobile Crane. This supplemented by ship's gear can provide a productivity of about 12,000 TPD. With allowable berth occupancy of 65%, each berth will be able to handle about 2.7 MTPA. Both the berths will be able to handle the present traffic and also the future growth up to 30%. When the traffic grows beyond this limit, another crane can be supplemented to increase the berth capacity.

This arrangement will have the following advantages to the customers, viz.

§ Bigger ship with larger parcels could be handled

§ Ships could be turned around faster than at present

§ With two exclusive berths with higher capacity, pre-berthing detention will be manageable

The port has already taken up the OCT project for rebidding, it is expected that the new player will compete with MbPT for cargo including steel.

With the steel products shifted to OCT, the other berths will be available to handle the other cargo. All the six berths – BPX, BPS, ID 18, 1D 19, and ID 20 & ID 21 - can handle the other cargo, whose traffic at the present is less than 3 MTPA. It may be necessary to equip berths BPX and BPS with quay based cranes to increase the productivity. Thus, in long term there may not be need for utilising the Indira Dock inner harbour berths with their inherent deficiencies. Such a move will be welcome by the trade as they stand to gain.

5.0 DETAILS OF ONGOING DEVELOPMENTS

In order to meet the growing traffic demands, Mumbai Port Trust has taken slew of developmental projects which are in various stages of implementation. The expansion projects which are developed and are currently ongoing as well as those that are planned are discussed in this section.

5.1 Development of Offshore Container Terminal

MbPT awarded the license to develop an offshore container terminal to Indira Container Terminal (ICT) Pvt. Ltd. through a global tendering process on DBFOT basis for a period of 30 years. ICT Pvt Ltd. is a special purpose vehicle promoted by Gammon India Ltd. & Gammon Infrastructure Projects Ltd., collectively called the Gammon Group and Dragados SPL, Spain. The license was awarded during December 2007.

The project involved construction of two offshore container berths for a total length of 700 m capable of handling 6000 TEU container vessels about 1 km away from the junction of Victoria Dock and Indira Dock; filling up of Princess and Victoria Docks and with the surrounding areas to get a stackyard space of 35 hectares; create a railway container depot with 3 sidings and equipped with rail mounted gantry cranes; equip the berth with quay side gantry cranes; provide requisite RTGs and other container handling equipment at the yard; provide all the other infrastructure and service facilities associated with a full-fledged container terminal.

Owing to the delay in Licensee achieving the financial closure and the delay in finalising the EPC contract, the actual construction work could start only during early 2011. By the later part of 2014 the berths with approaches were completed as also filling up of Princess and Victoria Docks. As of now, the berths have been constructed as shown in the **Figure 5.1**.

Figure 5.1 Offshore Container Terminal as at Present

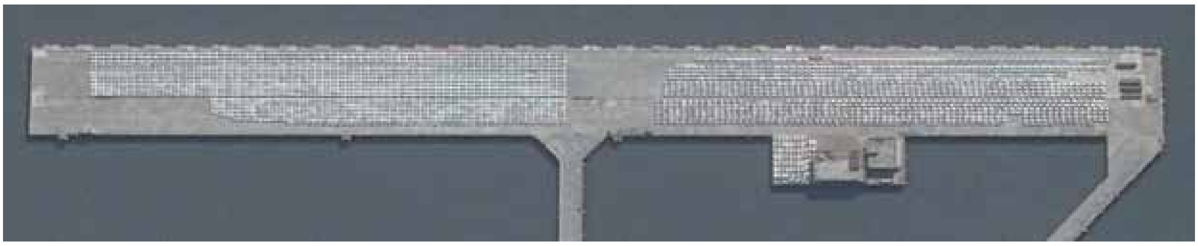


Figure 5.2 Car Units Waiting for Export at Offshore Container Terminal

5.2 Development of 2nd Chemical Jetty at Pir Pau

Currently the chemicals and LPG are handled at Old Pir Pau (OPP) jetty and at New Pir Pau (NPP) jetty. The old jetty has limited capacity. With the increase in the throughput, NPP has been consistently operating at high berth occupancy of over 85%. Hence MbPT felt the requirement of 2nd Chemical jetty and initiated action for its construction. This jetty has been completed and the capital dredging work is substantially completed. Non-hazardous cargo vessels are being handled since June, 2015. The berth would handle liquid Chemicals/Specialised grades of POL product.

The proposed berth is located 650 m away from the first chemicals berth in the same alignment on south of first chemical berth. The sea bed beyond the first chemical berth (present depth 6.5 to 7.5 m below low water) is dredged to -9m CD and maintained at -8.7m CD. This will permit fully laden vessels up to 35,000 DWT (or partially loaded 47,000 DWT size) to sail through and navigate at high tide to the second chemical berth. The area in front of the berth will be dredged to a depth of -15.0 m CD.

The overall length of the berth is 260 m between outer mooring dolphins. The berth comprises a double decked service platform of size 35 m × 15 m; two berthing dolphins each of 14m × 14 m; four mooring dolphins each of 10 m × 19 m and one multi-stories control room of size 10 m × 15 m. The overall width of the approach trestle is 11.5 m.

The second chemical berth has marine unloading arms for handling cargo. The existing fourteen pipelines in addition to two service lines are being extended up to second chemical berth from the first chemical berth with the provision for two service pipelines (fresh water and firefighting) on the new pipeline. The firefighting system at the first jetty is being upgraded by providing an additional pump and two water pipelines – 450 mm & 300 mm to meet the OISD guidelines and this will serve as a common facility for the both the jetties.

The location and layout of the 2nd chemical jetty is shown in the **Figure 5.3**.

Figure 5.3 Location and Layout of 2nd Chemical Jetty

5.3 Additional Crude Oil Jetty at Jawahar Dweep JD 5

Presently, the jetty JD 4 at Jawahar Dweep, which was commissioned in 1984 capable of accommodating tankers up to 125,000 T displacement, handles the crude oil imports of the two refineries at Mumbai. Now MbPT has initiated action for the construction of an additional jetty JD 5 to supplement JD 4. This move is initiated consequent to the following developments:

§ Due to recent leakage of crude oil pipelines and deteriorated approach trestle structure from the island to JD 4, it is felt that it could not be repaired for further use. Hence a new approach trestle is required.

§ During an interaction with the two oil companies having their refinery at Mumbai viz. BPCL & HPCL during December 2014, they desired that with their proposed expansion proposals it would be preferable to have a jetty which will be able to handle fully loaded suez max tankers and partially loaded VLCCs to avail the freight advantage.

§ During this meeting the requirement of additional crude oil pipeline from the island to Pir Pau was also discussed. The existing 42" crude submarine pipeline is presently used by BPCL/HPCL for transfer to crude oil to Pir Pau. However, Oil companies required a separate submarine pipeline for each company. Accordingly MbPT is proposing to use the existing 36" ONGC pipeline abandoned in 2010. This pipeline shall be tested and upgraded during the construction of J5.

The location and other details of the proposed JD 5 are presented in the **Figure 5.4**.

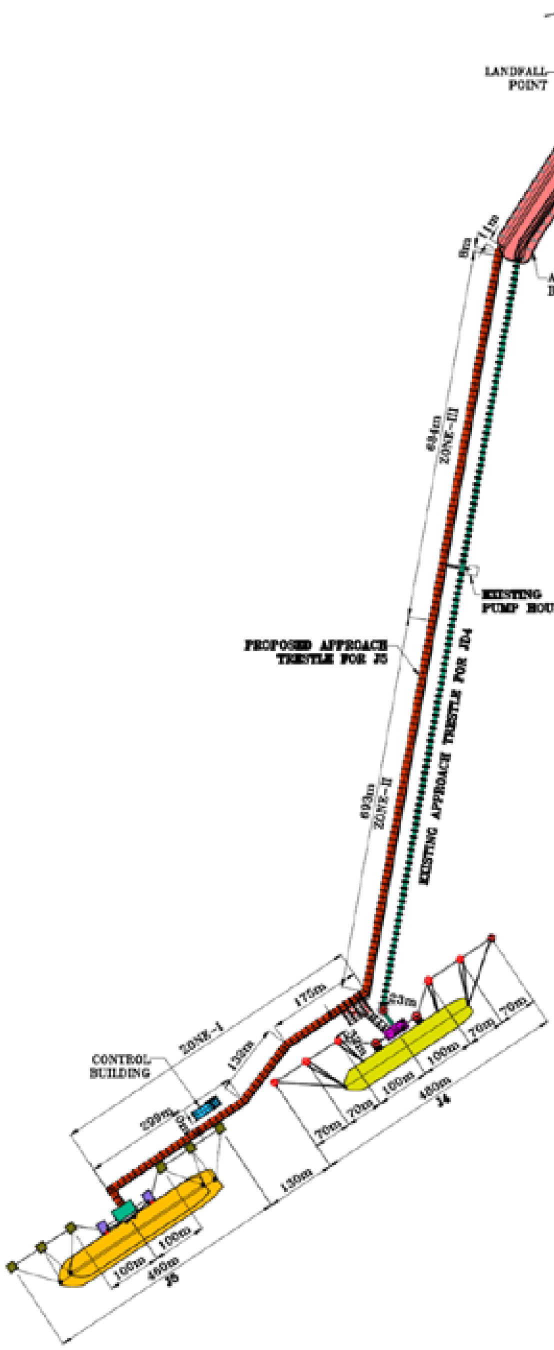


Figure 5.4 Location and New Approach Trestle to JD 5 & JD 4

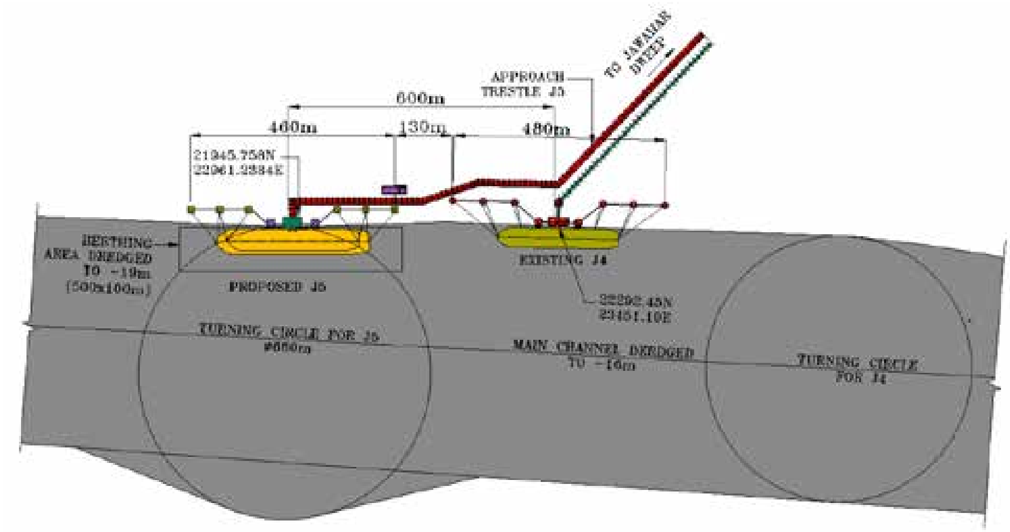


Figure 5.5 **Relative Locations of JD 4 & JD 5**

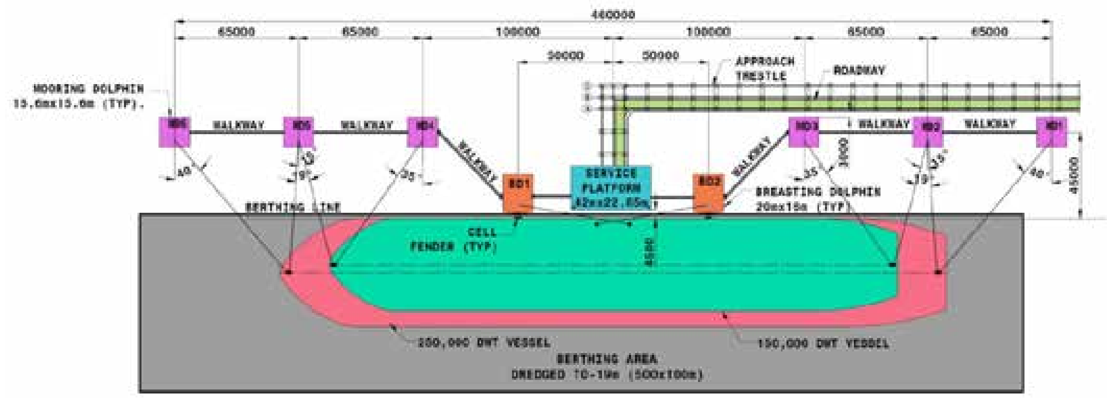


Figure 5.6 **Layout Details of JD 5**

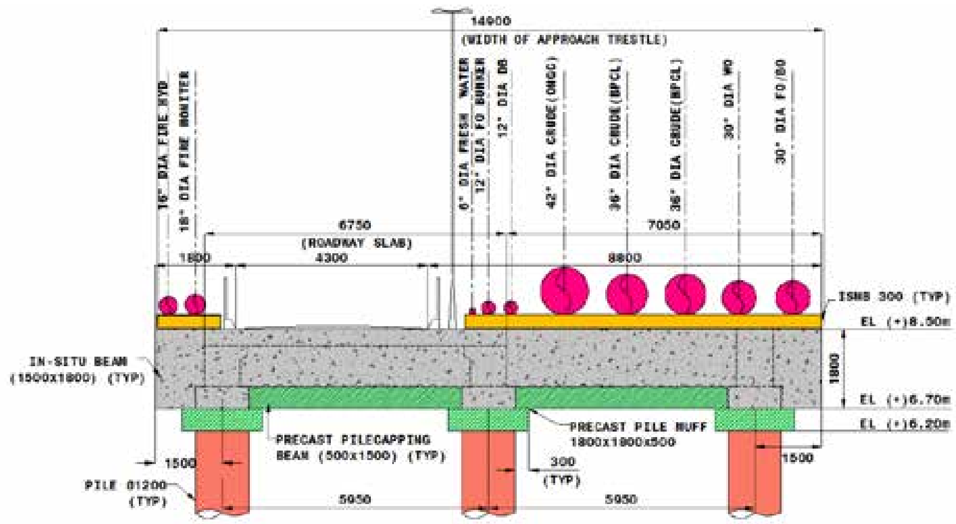


Figure 5.7 **Cross Section of New Appoach Trestle**

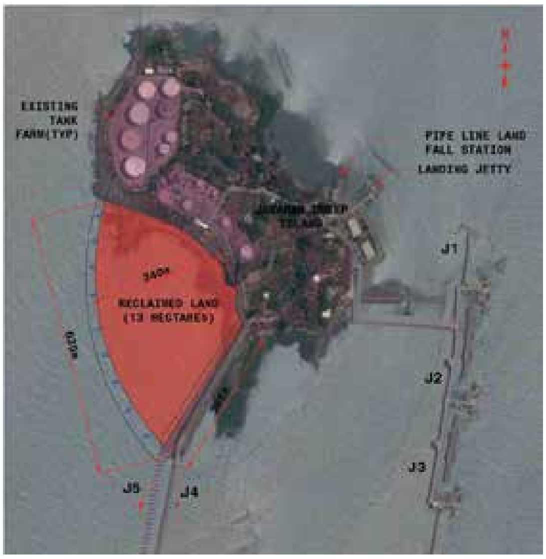


Figure 5.8 Location of Land to be Reclaimed for Tank Farm

5.4 Setting up of a Bunkering Terminal at Jawahar Dweep

Mumbai port proposes to set up a bunker terminal to supply fuel to ships calling at the port. On an average about 4,000 vessels enter Mumbai Port every year. Currently bunkering is done at the port through barges. But the intake of bunker fuel is limited because of the higher cost as compared to Singapore. Hence, traditionally India has never been an attractive place for establishing a bunkering terminal. However, with the recent reductions in excise and customs duties on fuel, MbPT felt that they can try establishing a proper bunkering terminal. Based on a DPR prepared by a consultant the port has initiated action in this regard.

BPCL and HPCL have their own refineries at Trombay which produce bunker fuel. These two intend to aggressively market the same in and around Mumbai Port and increase sales volumes through competitive pricing. Hence it was decided that MbPT join hands with them and develop a Bunkering Terminal at Jawahar Dweep. Accordingly MbPT issued Letter of Intent to BPCL and HPCL during June 2015 and later signed a formal Memorandum of Understanding with them during December 2015. The objective of this MOU is to provide a financial, legal, authoritative and functional framework for development and operation of a Bunkering Terminal at Jawahar Dweep by MbPT, BPCL and HPCL.

Based on this MOU, MbPT will dedicate JD 2, which has consistently been having relatively lesser occupancy than the other three jetties, for this bunkering terminal. This jetty will be modified to accommodate barges also. The structural modifications to JD 2 will be carried out by MbPT at an estimated cost of about INR 11.40 crores and this cost will be borne equally by BPCL and HPCL. While BPCL is having its own tanks and pumps at Jawahar Dweep for bunkering, HPCL will take over the existing 6 tanks of MbPT including the land at Jawahar Dweep and refurbish these tanks and pumps for their use for bunkering. These barge bunkering facilities are expected to be commissioned within 2 years of signing of the MOU.

The capacity of this Bunkering Terminal is expected to be 2.0 MTPA. However, to start with, both BPCL and HPCL will guarantee to the port a minimum traffic of 0.25 MTPA each totalling 0.50 MTPA.

5.5 Setting up of a Floating Storage & Regasification Unit (FSRU)

In order to meet the growing demand of natural gas in the markets along the western coast of India, MbPT has decided to pursue the opportunity of setting up a Floating Storage and Regasification Unit (FSRU) in Mumbai harbour area. It is envisaged that the project will be implemented on a Public-Private Partnership (PPP) mode. In this connection MbPT has already got a feasibility report prepared.

The project will come up on the Karanja spoil ground near Uran, about 50 km from Mumbai. The plan is to connect the terminal to the national pipeline grid so that the natural gas can be transported further across the country to places of need.

The FSRU will be stationed alongside an offshore jetty with a twin berthing facility. It will be connected to the landfall point by a 5 km long submarine pipeline. The mother vessel will be berthed on the other berthing face and LNG transferred to the FSRU through marine unloading arms. The size of the FSRU will be 170,000 m^3 and this terminal is planned to handle 5 MTPA.

The location map is shown in **Figure 5.9** and the FSRU terminal is shown in **Figure 5.10**.

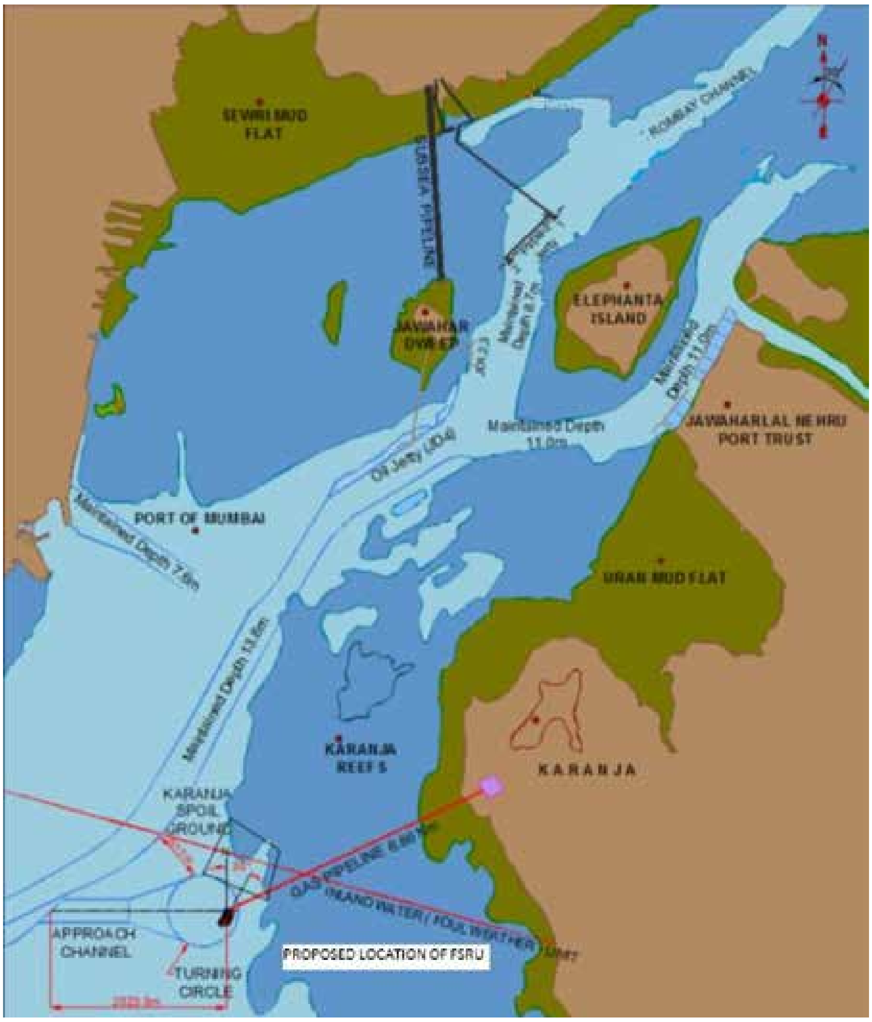


Figure 5.9 Location of FSRU Terminal

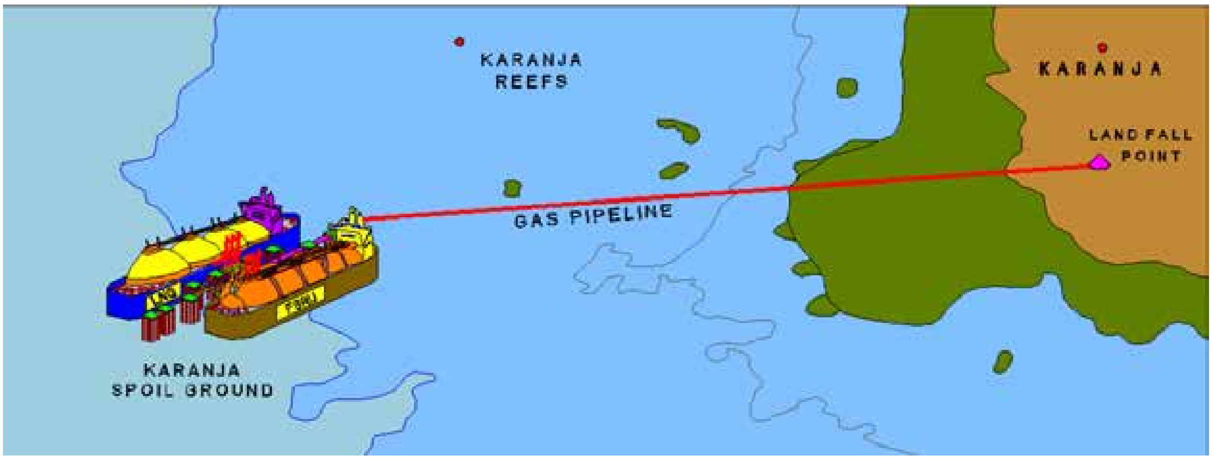


Figure 5.10 FSRU Terminal with Submarine Pipeline to Landfall Point

5.6 Wadala Kurla Dedicated Freight Rail Link

A dedicated freight line has been proposed between Wadala-Kurla (4.41 km) to decongest the Harbour Line. The third line that is being built between Kurla and Wadala stations will ferry freight and cargo trains that right now criss-cross suburban trains leading to their detention. At Kurla, an elevated corridor will carry this goods line over the two lines, completely segregating them and further take them on the fifth and sixth lines. The 4.41 km new Kurla-Wadala line would be linked to the 1,483 km national dedicated freight corridor of the western region.

This project comprise of laying a dedicated freight line of 4.41 km length from Raoli Junction Wadala to Kurla to establish a direct link between MbPT rail network and 5th and 6th lines being laid between Kurla to Kalyan by central railway to facilitate smoother evacuation.

The estimated project cost of this project is INR 176 cr. which is being implemented by Central Railways. MbPT has already entered into MOU with central railways as well as MMRDA for project implementation.

6.0 TRAFFIC PROJECTIONS

6.1 Projections Based on OD Study at National Level

The origin-destination of key cargo (accounting for greater than 85% of the total traffic) for all Indian ports and development of traffic scenarios for a period of next 20 years has been carried out by **McKinsey & Co.** as mandated for this project. Accordingly, based on a macro-level analysis the future traffic for Mumbai up to 2035 has be derived as presented in this section. This section covers the traffic projections for the port of Mumbai.

In terms of volumes, Mumbai is the 4th largest major port in the country handling more than 60 MTPA of cargo. Mumbai is situated strategically located in one of the busiest industrial hinterlands of the country and is additionally well connected to serve the North and Western hinterlands of the country like Rajasthan, Delhi-NCR, Punjab and Haryana.

Currently the port handles 61.7 MTPA of cargo out of which POL is the largest component. Other key commodities include Thermal Coal (imports), construction intensive commodities like Steel and Cement and Iron ore.

6.2 Major Commodities and their Projections

6.2.1 Thermal Coal

The port imported ~7.4 MTPA of thermal coal in 2014-15. Out of the 7.4 MTPA, ~2 MTPA was for the 140 MW capacity Trombay plant, ~2.3 MTPA was at Haji Bunder and ~3 MTPA was at Dharamtar. A recent decision by the port to not handle any coal that enters city limits, the handling of coal at Haji Bunder has been stopped. Also the Tata power plant cannot expand beyond the current capacity due to paucity of land. Due to these reasons, it is envisaged that the volume of coal handled at the port might remain constant or even go down in the worst case in the future.

Consequently in 2020, the total coal traffic is expected to be around 5.2 MTPA, 4.6 MTPA of which would be thermal coal and ~0.6 MTPA would be coking coal. This 4.6 MTPA would constitute 3 MTPA of thermal coal for Tata power plant in Trombay and remaining would be handled at Dharamtar for small coal traders. The traffic is expected to remain the same in 2025 as well. In 2035, the total coal traffic is expected to be around 6 MTPA out of which 5 MTPA would be thermal coal and 1 MTPA would be coking coal.

6.2.2 Steel

In 2014-15, the port handled 4.1 MTPA of steel in imports for the steel multiplier industries present in the Mumbai hinterland and exports of roughly 0.6 MTPA of steel from the JSW Dolvi plant. Going into the future, the volumes of steel handled at the port is expected to grow with the steel multiplier relative to the GDP.

The overall volume of steel handled at the port is expected to grow to 7-8 MTPA by 2025 and 13-15 MTPA by 2035. This traffic would primarily be led by the huge steel demand coming from the hinterlands of Mumbai region led by automobile growth, industrial growth and increased construction activity.

6.2.3 Cement

The real estate hub of Mumbai's demand is catered to by the port. The total cement at the port is 1.3 MTPA – most of which is handled at the railway yard currently. This is expected to change moving forward with traffic from railways becoming negligible. This traffic would be replaced by 1.0 MTPA of coastally shipped cement from surplus areas like Gujarat. Going into the future the volumes are expected to grow to 1.25 MTPA by 2025 and 2.0 MTPA by 2035.

6.2.4 POL

The port imported 25.7 MTPA of crude, large part of which is used for two refineries in Mumbai - BPCL and HPCL Mumbai. The HPCL refinery is expected to increase its capacity by 3 MTPA by 2025 and hence the volume of crude handled the port is expected to go up by similar quantum. It should be noted that some of this crude from Bombay High oilfields is not actually handled at the port but just passes through the pipelines. Beyond 2025, the Mumbai port could also feed some of the crude requirement of a Greenfield refinery expected to come up in Maharashtra. For the traffic projections, it has been assumed that less than 10% of this new refinery's capacity will be served by the Mumbai port. It has to be noted that this is contingent to increase in crude production capacity at Bombay High by 5 MTPA.

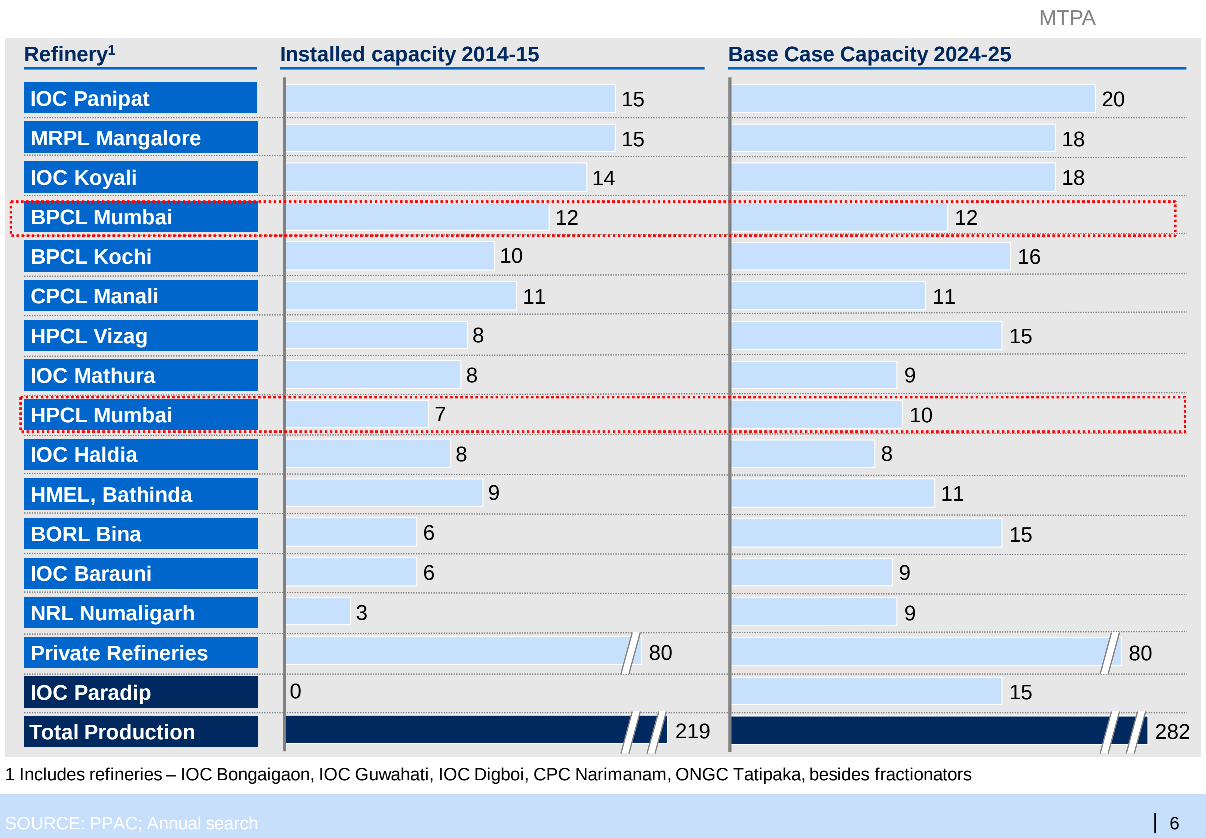


Figure 6.1 Refineries served by Mumbai Port

The port also handled traffic of ~10.6 MTPA of POL product due to EXIM and coastal movement of POL products. This traffic is expected to go up in the next 10 years as the regional demand of product is met by the excess product produced by refineries in Gujarat. Due to limited expansionary plans of refineries in Mumbai, the region currently served by these refineries is expected to face a deficit of ~5 MTPA in next 10 years. Some part of this deficit could be met by imports at Mormugao port and ports in Southern Gujarat as they will be closer. But a bulk of the traffic would continue to be at Mumbai port as the major demand centres in Maharashtra lie close to the port. By 2025, it is expected that ~ 3MTPA of product could be coastally shipped to Mumbai port from refineries in Gujarat to cater to the growing demands of the clusters around the Mumbai metropolitan region. In addition, there would be some organic growth of LPG. LPG imports in 2013-14 were ~0.2 MTPA which increased to 0.5 MTPA this year and are expected to increase to 1 MTPA by 2025. Besides LPG, traffic of POL product (both coastal and imported) would grow organically with incremental traffic of ~2MTPA by 2025.

The split of the current POL traffic and the projected volumes in 2025 are as shown in **Figure 6.2**.

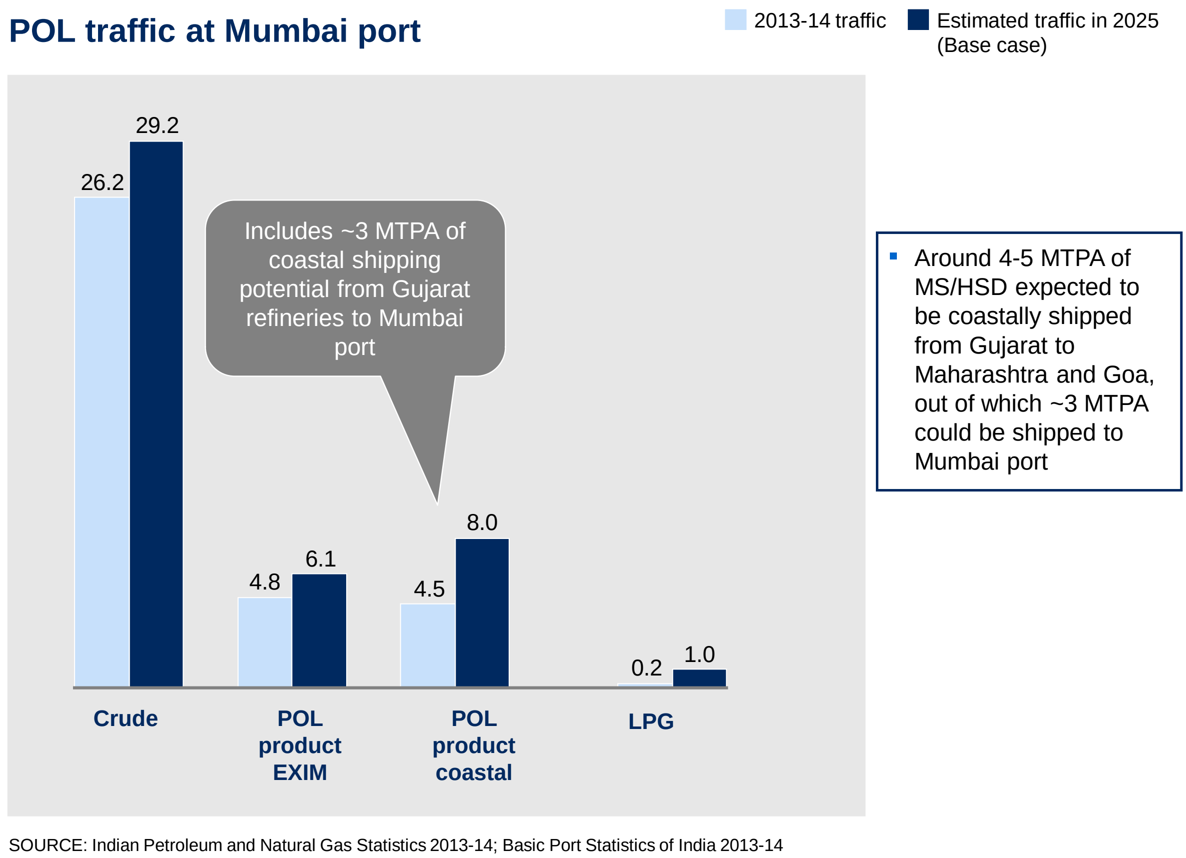


Figure 6.2 POL Traffic at Mumbai Port

The overall traffic of POL (Crude and product) at the port is expected to reach ~39 MTPA by 2020, 44-50 MTPA by 2025 and 53-61 MTPA by 2035 owing to the refinery expansion, coastal shipping of product and greenfield refinery coming in the region.

6.2.5 Iron Ore

The port caters to the demand of Iron ore for the JSW Dolvi plant which imported 5.2 MTPA in 2014-15. This traffic is handled at the midstream and as JSW is expected to import this iron ore at its own port, the import of iron ore are expected to go down in the future to ~1-2 MTPA.

6.2.6 Automobiles

Mumbai port serves as a port for exporting automobiles manufactured in the Pune cluster. The port handled around ~1.3 lakh vehicles in 2014-15. Most of these exports were from manufacturing plants of Volkswagen (Chakan), Tata Motors (Pune), Ashok Leyland (Bhandara), Mahindra and Mahindra (Chakan, Kandivali, Nashik) and General Motors (Pune). Mumbai plant is closest to these manufacturing plants and hence logistic cost to export from these plants via Mumbai port is the lowest.

SIAM is targeting ~10 million units of exports by 2025 from India. Out of these 10 million units, 2 - 2.5 million units are expected to be passenger vehicles and 0.3-0.5 million units will be commercial vehicles. Based on the growth over last few years, it seems difficult that India would be able to meet these export targets in 2025. Hence, it has been assumed that the country will meet these targets in the optimistic case in 2025 and base case in 2035.

Using the targets set by SIAM and available data on growth plans of the manufacturing plants in the vicinity of Mumbai port, Mumbai port can expect traffic of 2.4 lakh units in 2020, 2.9 lakh units in 2025 and 3.9 lakh units in 2035 in the base case. Out of the 2.4 lakh units in 2020, passenger cars could be around 1.7 lakhs and remaining would be commercial vehicles. Similarly in 2025, 2.2 lakh vehicles would be passenger cars and 0.7 would be commercial vehicles. In 2035, out of the total vehicular traffic of 3.9 lakh units, passenger vehicles would be ~2.7 lakh and 1.2 would be commercial vehicles. It is to be noted that most of this export traffic is contingent on expansionary plans of Volkswagen plant in Chakan. They have announced planned expansion to 2 lakh units per annum from their current capacity of 1.3 lakh.

It is also worth pointing out that the above analysis doesn’t take into account exports of two and three wheelers manufactured in the hinterland region. Bajaj has manufacturing plants in Aurangabad and Chakan where they manufacture both two and three wheelers. Similarly, Piaggio vehicles have a plant in Baramati where they manufacture two wheelers. But as these vehicles are largely moved as part of containerised cargo, JNPT is their preferred port. Hence they have not been considered as part of the analysis.

6.2.7 Others Cargo

Commodities included under others cargo are rock phosphate, sulphur, vegetable oil, pulses, sugar, motor vehicles, molasses, metcoke, limestone, dolomite, millscale and other miscellaneous cargo. Some of this traffic is handled midstream as well. While total ‘others’ cargo handled at Mumbai port is 4.1 MTPA, around 1.5 MTPA was handled midstream. Going forward in 2025, total others cargo handled actually at the port would be 4.4 MTPA and 2.2 MTPA would be handled midstream.

The overall commodity wise projections for the port are shown in **Table 6.1**.

Table 6.1 Overall Commodity Wise Projctions

Units: MMTPA (except Containers)

Mumbai Port - Traffic Projections (Total)

xx Base Scenario xx Optimistic Scenario

Commodity	2014-15	2020	2025 (Base)	2025 (Optimistic)	2035 (Base)	2035 (Optimistic)	Remarks
Liquid Cargo							
POL	36.3	39.3	44.2	49.5	53.1	61.5	▪ Coastal shipping of ~3 MTPA from Gujarat
Chemicals	2.0	2.4	3.2	3.4	5.3	6.1	
Dry and Break Bulk Cargo							
Thermal Coal (Unloading)	5.8	4.6	4.6	5.0	5.0	6.0	
Coking Coal	1.6	0.6	0.6	0.6	1.0	1.0	
Iron Ore	5.2	1.3	1.3	1.5	1.5	2.0	▪ As JSW's port picks up, the amount of iron ore to decrease at Mumbai
Steel	4.7	7.0	7.4	7.9	13.2	15.3	
Cement	1.3	1.0	1.25	2.0	2.0	2.5	
Fertilizers	0.2	0.5	0.7	0.7	1.0	1.1	▪ Doesn't include coastal shipping potential
Containers and other Cargo							
Containers (Mn TEU)	0.05	0.08	0.10	0.13	0.15	0.18	
Motor Vehicles	0.3	0.5	0.6	0.8	0.8	1.3	
Others[1]	3.8	4.6	6.2	6.5	10.2	11.6	▪ 1.4 MTPA in 2014-15 is handled midstream
Total (MMTPA)	**61.7**	**62.7**	**71.0**	**79.3**	**94.7**	**110.3**	

1. Others cargo include commodities like rock phosphate, sulphur, vegetable oil, pulses, sugar, molasses, metcoke, limestone, dolomite, millscale and other miscellaneous cargo

Conversion Factor Used for Containers Projections: 1 TEU = 10.7 Tons

A part of the above mentioned traffic projections include cargo that is not actually handled at Mumbai port (ONGC Bombay High Crude to refineries and JNP, POL product at OPL Wadala). The amount of cargo actually handled at the port is shown in **Table 6.2**. It should be noted that the cargo handled midstream at Mumbai port (Iron ore, some part of Coal and other commodities) is included in this.

Table 6.2 Mumbai Port Traffic Projections

Units: MMTPA (except Containers)

Mumbai Port - Traffic Projections (Handled[1])

xx Base Scenario xx Optimistic Scenario

Commodity	2014-15	2020	2025 (Base)	2025 (Optimistic)	2035 (Base)	2035 (Optimistic)	Remarks
Liquid Cargo							
POL	23.8	27.3	32.2	37.5	41.1	49.5	
Chemicals	2.0	2.4	3.2	3.4	5.3	6.1	
Dry and Break Bulk Cargo							
Thermal Coal (Unloading)	5.8	4.6	4.6	5.0	5.0	6.0	
Coking Coal	1.6	0.6	0.6	0.6	1.0	1.0	
Iron Ore	5.2	1.3	1.3	1.5	1.5	2.0	▪ As JSW's port picks up, the amount of iron ore to decrease at Mumbai
Steel	4.7	7.0	7.4	7.9	13.2	15.3	
Cement	1.3	1.0	1.25	2.0	2.0	2.5	▪ 2014-15 cement is handled at the railway yard
Fertilizers	0.2	0.5	0.7	0.7	1.0	1.1	
Containers and other Cargo							
Containers (Mn TEU)	0.05	0.08	0.10	0.13	0.15	0.18	
Motor Vehicles	0.3	0.5	0.6	0.8	0.8	1.3	
Others[2]	3.8	4.6	6.2	6.5	10.2	11.6	▪ 1.4 MTPA in 2014-15 is handled midstream
Total (MMTPA)	**49.3**	**50.7**	**59.1**	**67.3**	**82.7**	**98.3**	

1. Includes midstream cargo but excludes ONGC BH Crude to refineries , ONGC BH Crude to JNP, OPL Wadala
2. Others cargo include commodities like rock phosphate, sulphur, vegetable oil, pulses, sugar, motor vehicles, molasses, metcoke, limestone, dolomite, millscale and other miscellaneous cargo

Conversion Factor Used for Containers Projections: 1 TEU = 10.7 Tons

Out of the above traffic, traffic handled midstream is around 4.2 MTPA in 2020, 4.7 MTPA in 2025 and 7 MTPA in 2035. This would include some part of coal traffic, all of iron ore traffic and most of other commodities cargo.

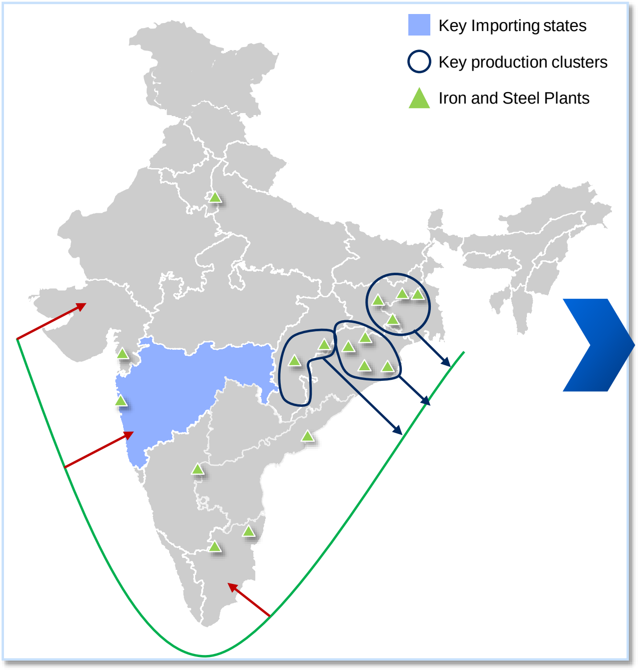
6.3 Coastal Shipping Potential

Mumbai is strategically positioned to serve the large demand hinterland of Mumbai and the adjoining areas through coastal shipping, Steel and fertilizers can be major commodities to Mumbai in case coastal shipping revolution takes place in the country (**Figure 6.3**).

§ **Steel:** ~2 MTPA of steel can be coastally shipped to Mumbai port primarily from Odisha and Jharkhand. Small quantities can come from West Bengal and Andhra Pradesh.

COASTAL SHIPPING IRON AND STEEL

~1.8 MTPA steel can be coastally shipped to Mumbai port by 2025 primarily from Odisha and Jharkhand



Key ODs with coastal shipping potential to Mumbai Port

Route[1]	Volume, '000 TPA
Jharkhand to Maharashtra	614
Odisha to Maharashtra	392
West Bengal to Maharahtra	165
AP to Maharashtra	156

1 Small quantities can come from a number of other ODs via Mumbai Port

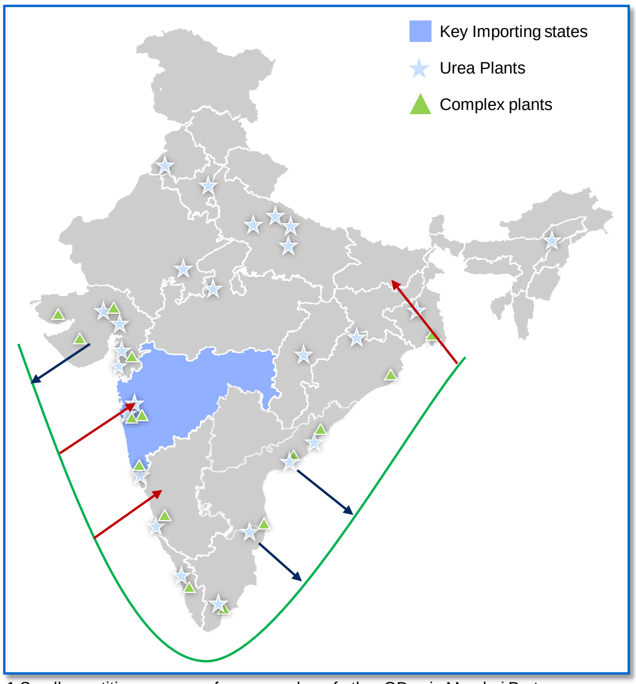
SOURCE: DGCIS data 2013-14

Figure 6.3 Coastal Shipping Potential- Steel

§ **Fertilizers:** ~2 MTPA of fertilizers can be coastally shipped to Mumbai port primarily from Andhra Pradesh and Gujarat (**Figure 6.4**).

COASTAL SHIPPING FERTILISERS

~2 MTPA fertilizer can be shipped to Mumbai Port by 2025; AP and Gujarat will be the key source states



Key ODs with coastal shipping potential to Mumbai Port

Route[1]	Volume, '000 TPA
Gujarat to Maharashtra	1,284
AP to Maharashtra	606

1 Small quantities can come from a number of other ODs via Mumbai Port

SOURCE: DGCIS data 2013-14

Figure 6.4 Coastal Shipping Potential- Fertilizer

The **Table 6.3** summarizes the potential of coastal movement for key commodities.

Table 6.3 Possible Opportunities Via Coastal Shipping

Mumbai Port – New Opportunities Possible via Coastal Shipping

Units: MMTPA (except Containers)

Commodity	2020	2025	2035
Steel (Loading)	0.45	0.60	1.07
Steel (Unloading)	1.03	1.37	2.47
Cement (Loading)	-	-	-
Cement (Unloading)	-	-	-
Fertilizer (Loading)	0.28	0.34	0.50
Fertilizer (Unloading)	1.73	2.11	3.12
Food Grains (Loading)	0.01	0.01	0.02
Food Grains (Unloading)	0.01	0.01	0.01

* The coastal opportunity identified is contingent on a number of enablers like last mile connectivity, availability of handling infrastructure at the ports, rationalization of port charges, availability of aggregators for different commodities wherever individual parcel sizes are small.

7.0 CAPACITY AUGMENTATION REQUIREMENTS AND PROPOSALS

7.1 Vision for the Port

Mumbai port being located within a busy commercial city is slowing moving towards handing of the cleaner cargo. The coal handling operations have already stopped and there is no growth likely for other dry bulk cargo being handled at the dock or berths.

Keeping in view the Mumbai being financial capital of India, one of the tourist destinations and also high net worth individuals residing there is a demand for development of facilities for leisure, tourism etc. for which suitable waterfront needs to be reserved.

Also there is a great demand for having repair facilities for these vessels and the Hughes dry dock in the current set up is not being able to meet this requirement.

The above aspects need to be kept in mind while suggesting the capacity augmentation proposals for the port.

7.2 Dry Docking Facilities

7.2.1 Performance of Hughes Dry Dock

To start with, the performance of the HDD during the past 5 years is presented in the **Table 7.1**.

Table 7.1 Peformance of Hughes Dry Docks Over the Past 5 Years

Year	Port Crafts		Others' Crafts		Total Crafts		Occupancy In Days
	No.	GRT	No.	GRT	No.	GRT	
2010 - 11	12	2,874	66	1,33,542	78	1,36,416	289
2011 - 12	1	32	66	1,69,488	67	1,69,520	322
2012 - 13	10	2,035	64	94,548	74	96,583	303
2013 - 14	7	1,458	55	67,048	62	68,506	302
2014 - 15	4	885	40	1,07,446	44	1,08,331	289

The organisations that have utilised the Dry Dock and the number of vessels dry docked by each are presented in the **Table 7.2**.

Table 7.2 Organisations Using Hughes Dry Dock

Organization	No. of Vessels Occupying Dry Dock						
	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-16 up to Nov 15	Average Stay per Vessel
Navy	0	2	0	4	5	0	14 to 20 days
Coast Guard	6	11	7	2	2	5	15 to 23 days
SCI	5	7	6	4	1	1	13 to 17 days
MDL	2	3	0	1	1	2	14 to 26 days
MbPT	4	1	10	8	5	3	5 to 17 days
Coastal (Indian Flag)	38	39	48	38	30	35	5 to 18 days
Foreign Flag	3	3	3	4	0	0	5 to 15 days
Total	**58**	**66**	**74**	**61**	**44**	**46**	

It could be seen that the dry dock has been occupied almost for the whole year which shows it popularity. It also shows that the majority of the vessels are coastal vessels, mainly vessels related to activities of offshore oil fields such as offshore supply vessels, Anchor handling tugs, material barges etc. It is also understood that with the closure of Mereweather dry dock, there is always a long waiting list of vessels requiring dry docking.

7.2.2 Limited Operations at Hughes Dry Dock

As already explained under section 3, the responsibility of the Port in dry dock activities is only upto docking the vessels. The actual repair or refurbishing work is done through licenced private contractors/agents arranged by the vessel owners themselves.

Presently HDD is being unproductively utilised. The reason being the matching onshore infrastructure i.e. workshops, equipment for the ship repair is not available at the dry dock. Further HDD requires investment on its upkeep and the regular maintenance. Most of the infrastructure with the dry dock is several decades old and have outlived their economic life. The material handling equipment including cranes are in bad state and working at far lower than their rated capacity. This has affected the productivity of dry dock substantially and increased costs for undertaking ship repair activity. This is discouraging ship-owners to use it for serious repairs rather it is being used to undertake minor repairs resulting in lesser revenue.

Since no workshop facilities are available for repair of merchant vessels at the port, the ship owners, hiring the dry dock, have to engage contractors to undertake the repair works. The engagement of the contractors and getting the works done are the responsibility of the ship owner and the port does not come into the picture. The mobilization and transportation of manpower, machines and raw materials to work site, causes avoidable delays. Further, as a mandatory requirement, for certain work such as chipping and painting, the ship owners have to hire Dock Labour Board workers. There workers have different work culture and their productivity is poor. Besides shiprepair activity is considered as secondary activity and as such receives a relatively lower priority from the Port.

Mumbai Port Trust is not keen to make any investments on the dry dock and revive its working condition. Ship repair using dry docks is not the core activity of Mumbai Port. It is understood from the port official in charge of dry docks that there is always a great demand for the dry docks. While the dry dock caters to 60 to 70 vessels in a year, there is always a queue of about 100 vessels.

Apart from development and operation of dry dock infrastructure, the port is also facing constrains of manpower required for operating drydock. It is understood that the port workers attending to the drydocks are old and by 2017, most of them will retire. This will leave a big manpower gap which the port will not be able to meet.

At this point of time, developing drydock infrastructure by Mumbai Port would require extensive investment on physical infrastructure and recruitment and training of manpower to operate dry dock. Since, dry docking is not the core business of the port and it contributes less than 5% of total revenue generated, it is commercially not attractive to make investment in upgrading infrastructure. In such circumstances, it would be commercially attractive to integrate the project with ship repair infrastructure and allow private parties to develop and operate it.

Developing a ship repair yard at Mumbai Port trust is a win-win situation for all stakeholders. Mumbai Port Trust generates additional source of revenue from ship repair activity in the form of fixed rentals and profit-sharing. Ship Repair Company finds a semi-developed industrial land for setting up ship repair yard. The shipping companies with ships deployed in Mumbai region and coast of India find the most suitable location and infrastructure for getting their ships repair. In the absence of repair infrastructure in Mumbai the companies had to spend large sums of money to relocate their vessels to international waters to get their ships repaired.

7.2.3 Market Potential at Mumbai Region for Ship Repair

In order to examine the prospects of developing ship repair infrastructure at the port, Mumbai Port has appointed a consultant to conduct a Feasibility Study and later prepare a Detailed Project Report for development of Dry Dock in Mumbai Port and advise the port on the technical and financial feasibility of the project. The consultants have already submitted the draft DPR which is under examination by the port.

According to them Mumbai is one of the prominent maritime centres of India with the largest offshore oil & gas field, a naval base, two major ports and five active non-major ports. In the present scenario of ship repair industry in India, it has been found that there is large demand-supply gap of infrastructure, especially in Mumbai. This has led to more than 200 ships permanently stationed in Mumbai and more than 5000 ships visiting the region for trading acticvity. A demand – supply assessment for high value vessels with less than 28 m beam shows the need for at least 4 repair berths in Mumbai Port. As against this, only one dry dock HDD is available. With the use of caisson at the centre, a second dock is created by which two ships could be accommodated at a time. Hence, developing a ship repair yard through private participation of an established ship repair company could provide a win-win situation to all stakeholders.

Due to its strategic location, custom-built infrastructure specially designed for ship repair activity and the availability of suitable support system, MbPT ship repair yard could be the most competitive yard for ships less than 100 m long on the west coast of India. A ship repair yard located closer to the region of deployment of vessels, generally wins contract compared to the ship repair yard located in far – off location. For the repair yard located in the vicinity, even though its cost of repair is high, the mobilisation, demobilisation costs and overhead costs are far more lower compared to a repair yard which is located at a far off location.

7.2.4 Dry Docking Facility

The first step should be to refurbish the existing HDD. Considering the present situation and the constraints of MbPT to make any investments, it is preferable to develop HDD separately as an independent unit by partnering with a private ship repair company. In addition to replacing the current cranes and other equipment, it is necessary to set up self-contained workshops to take care of all ship repair requirements.

To support each dry docking facility there is a requirement of at least one wet berth for afloat repairs. There will be many instances where the ships might only need afloat repairs. Therefore adequate number of wet berth needs to be provided to complement the dry docking facility. The inner berths 1, 2 and 3 could be allocated for this purpose along with the backup space of boundary as marked in red in **Figure 7.1**. The building currently being used for CISF could also be made part of the integrated dry docking facility for use as an office area and worker amenities.

HDD can be used to repair one large vessel (with LOA about 210 m long corresponds to beam limitation of 28 m at lock gate) or two small vessels (of LOA of about 120 m) simultaneously. With modernisation it c.an be used to handle significantly large number of vessels.

Considering that the major demand is for the repair of OSVs and other smaller vessels, any additional dry docking facility should be developed to cater to ships with size limited to about 120 m only. Such vessel will have docking draft in the range of 3.5 m to 4.0 m. This would rule out the options of providing slipways or marine lifts. There is not adequate space available to develop a Graving dock. Therefore the options for additional dry docking facility would be limited to either a floating dock or shiplift.

Providing shiplift would require creating significant fixed infrastructure in the form of dry berths, transfer bays, shiplift support structures at much higher cost as compared to floating dock. On the other hand floating dock could be brought to the site, even on hire basis, and demobilised in case of non-utilisation. Therefore floating dock is considered as a complementing facility for the HDD and could be taken up as a separate projects alongwith the HDD development. The proposed scheme is shown in **Figure 7.1**.

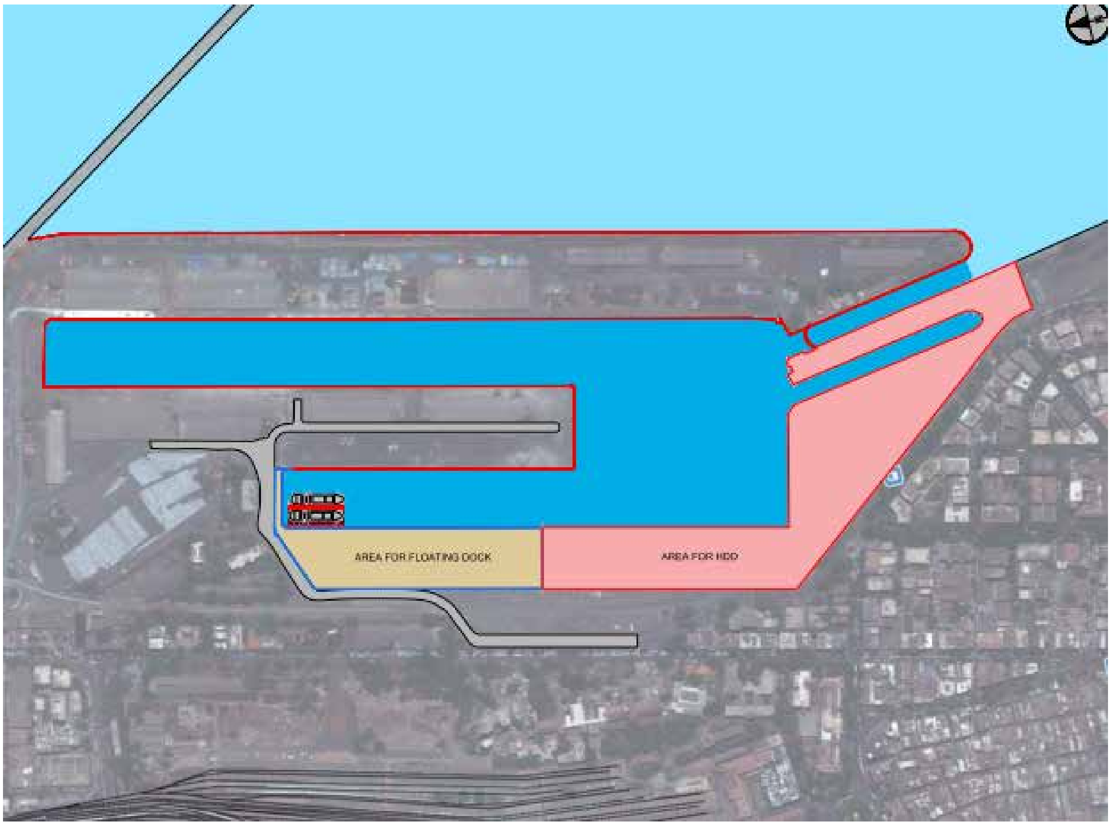


Figure 7.1 Proposed Plan for Creating Dry Docking Facilities at Indira Dock

7.3 Redevelopment of Indira Dock

The location, features, limitations and performance during 2014-15 have all been described in the earlier sections 3 and 4. However, the salient aspects are recaptured hereunder.

- Indira Dock (renamed Alexandra Dock) is more just over 100 years having being constructed during 1904-1914
- It works on a lock-gate system with a lock length of 228.6 m and a width of 30.5 m, through which vessels can enter and leave the docks at any state of tide.
- The normal ships are limited to 175.26 m LOA; 24.38 Beam and 8.84 m to 9.14 m draft while certain berths can handle ships up to 190.5 m LOA; 25.91m Beam and 9.14 m draft
- There are 21 berths out of which 16 are used for handling cargo.
- These berths do not have ship-shore transfer cranes and have to depend on the ships' own gear.
- Absence of shore cranes along with small size of ships, the productivity of these berths is very low.
- During 2014 -15, the 16 inside berths handled about 1.5 million tonnes of cargo through 255 ships whereas the 4 outside berths handled about 1.6 million tonnes through 179 ships. During the same period the two Ballard Pier berths BPX and BPS handled 3.1 million tonnes through 282 ships.
- Of the 1.5 MT handled during 2014-15, about 0.56 MT was steel products.
- The principal cargo handled are steel, sugar, yellow peas, fertilisers, project cargo, cars and containers.

7.3.1 Options for Redevelopment of Indira Dock

In view of the limitation of Indira dock to handle vessels with beam over 28 m, only less than half the vessels carrying breakbulk visit these berths which results in the low capacity utilisation. Many of the berths either remain unutilised or used for parking of the vessels under rough weather conditions.

Two options are considered for redevelopment of Indira Dock viz. complete closure of the dock including the berths and the dry dock, filling it up and using the reclaimed area for using the space for commercial purposes or partial closure of the dock keeping the dry dock open and operational. These two options are further discussed in detail in the following sub sections.

7.3.1.1 Option 1: Complete Closure of Indira Dock

In this option the entire dock basin including the dry dock will be filled up and area reclaimed. It is shown in the **Figure 7.2**.

Figure 7.2 Option 1 - Complete Clouser of Indira Dock

In this option, Indira Dock inner basin along with Hughes Dry Dock will be closed and filled up as shown in the **Figure 7.2**. The outer wall could be extended to accommodate one more berth. The water front and the backup area could be redeveloped with new sheds and shore based cranes for handling cargo. The available area could be used for hospitality industry, tourism activities and for accommodating important government offices.

However, the crucial impact of this option is the closure of the popular Hughes Dry Dock. Mumbai is a bee-hive of marine activities related to the offshore oil fields, Western Naval Command etc. and hence, there is always a heavy demand for ship repair facilities. The Port has already closed and filled up the Mereweather Dry Dock within Princess Dock. If Hughes Dry Dock is also closed, there will not be any facility for ship repair. The slipways in the workshop area can handle only very small crafts.

By letting out the space for purposes other than port related activities, the primary role of the port as a service unit gets defeated. In this context it has to be noted that the earlier Port's attempt to attract agencies for setting up Flotel and Floating Restaurants has not been successful with no or poor response. These units may appear incongruous in such a port environment and with the adjoining Western Naval Command.

7.3.1.2 Option 2: Complete Closure of Indira Dock

In this option the dock shall be closed partially, keeping the dry dock open and operational. This option is not preferred as it would not only take away the available berthing space but also devoid the small crafts using the dock during inclement weather conditions.

7.3.1.3 Recommended Option

It is proposed that the entire western arm be utilised for lay berths for the dry docking facilities and the berths on eastern side shall handle the cargo and other port usages such as storage of cargo etc. The proposed plan is shown in **Figure 7.1**.

7.4 Cruise Terminal

Mumbai port is already handling cruise vessel and currently these are being handled at BPX berth. However this berth being one of the deeper berths at the port is in great demand and vessels having higher draft are first lightened here and then proceed to India dock or to harbour wall berths. The adjacent berth BPS is also a deep water berth and being used for cargo handling. Handling passenger traffic and cargo at the same berth is not an ideal situation and detriment for development of a modern international class cruise terminal. Keeping in view of the location of BPS and BPX berths being close to the city, it is suggested that a long terms view be taken to develop these berths and the entire backup area for a cruise terminal and associated facilities.

7.5 Requirement for Capacity Augmentation for Cargo Handling

7.5.1 Oil Handling Facilities

7.5.1.1 Berths

As regards the liquid cargo, it is assessed that with the development of JD5, second chemical berth and the FSRU for LNG, there may not be any additional requirement for berths.

7.5.1.2 Storage Area

The storage tanks associated with berth JD5 are already being developed on the area to be reclaimed on the Jawahar Dweep. As could be seen from the traffic projections there is an opportunity to handle additional liquid cargo by way of coastal shipping. While there will be adequate capacity of berths, additional tankfarms would need to be developed. For this purpose suitable area as shown in **Figure 7.3**, towards the eastern side of Jawahar Dweep Island could be reclaimed.

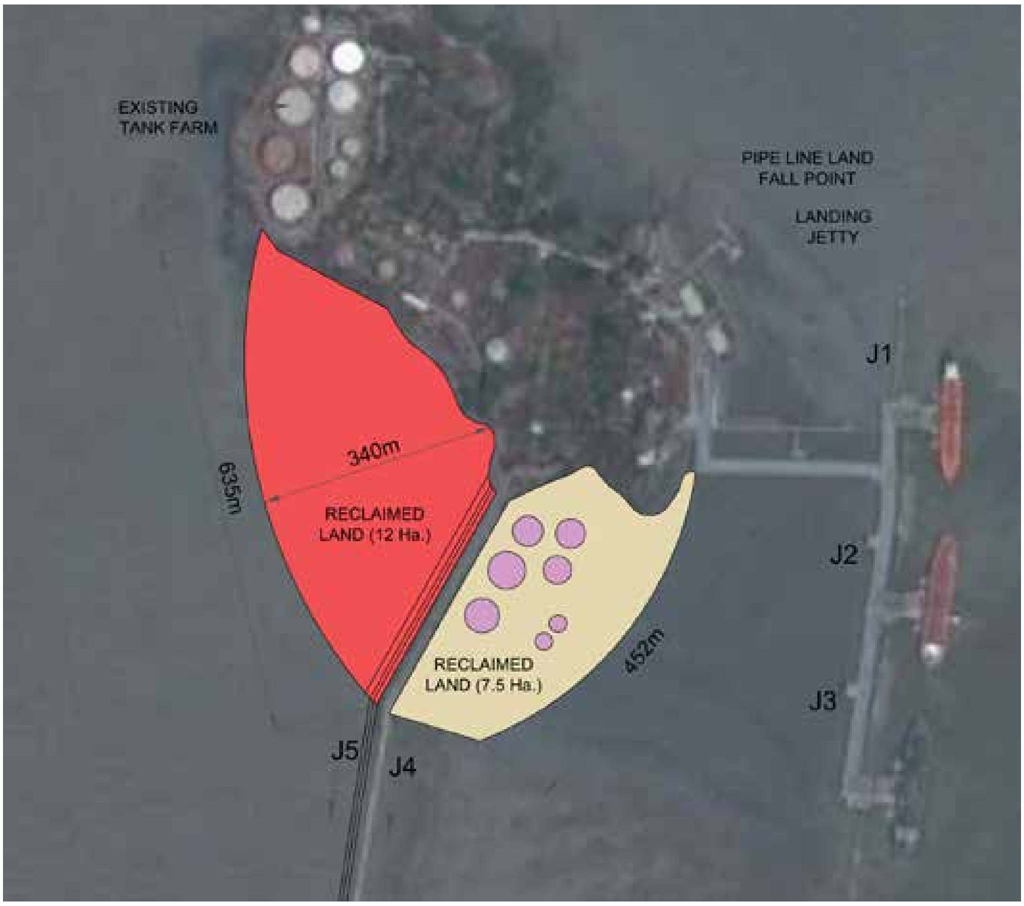


Figure 7.3 Proposed Reclamation for Additional Storage Tanks

7.5.2 Requirements of Berths for Breakbulk, Containers and Cars

The assessment for the required berths for the key cargo like Breakbulk, containers and Cars has been made considering the profile of vessel visiting the port, parcel sizes, existing handling system and possible improvements etc. Accordingly, based on the projected traffic, the following requirement for berths has been assessed for break bulk, containers and cars (**Table 7.3**).

Table 7.3 Berth Requirement

S. No.	Commodity	Total Berths Needed		
		2020	2025	2035
1.	Break Bulk	3	4	8
2.	Iron and Steel	3	4	6
3.	Ro-Ro Cars and Containers	2	2	2
	Total Number of Berths	**8**	**10**	**16**

Though it may appear the number of berths available currently at Indira dock and outside are adequate for the projected traffic, the following factors need due consideration:

§ Indira dock has a limitation due to which vessels with beam over 28 m cannot enter. The maximum permissible draft is 8.8 to 9.1 m.

§ The harbour wall berths have a maximum permissible draft is 7.5 m.

§ BPS and BPX berths are deeper having draft of 10 m and 9.5 m respectively. As per the long term planning these berths shall be fully dedicated for cruise terminal.

§ OCT berths were required to be deepened for a depth of 15 m below CD but the dredging undertaken till date is upto 12 m below CD only due to presence of rock. As now siltation has taken place, the current water depths are about 11 to 11.5 m below CD.

§ It may also be noted that the OCT project stalled and discussions are ongoing to revive it by rebidding. The availability of OCT and its backup area would be dependent on conclusion of the ongoing negotiations.

§ The Western arm of Indira dock shall be used for providing the floating dry dock and lay berths and shall not be available for cargo handling.

§ It is observed that permissible draft of vessels is a constraint at port due to which vessels have to be lightened / top loaded at the anchorage or deeper berths. This results in higher handling costs. It is therefore required that additional berths having deeper draft are provided at the port to reduce the handling expenses.

§ Over 50% of the vessels carrying steel and over 35% of vessels carrying other break bulk are having beam over 28 m and therefore these cannot be handled at inner berths of Indira dock.

It is therefore assessed that total of 14 berths outside dock would be needed to cater to the traffic projected for master plan horizon for breakbulk, steel and containers. Against this only 3 berths are available at harbour walls and 2 or 3 available at OCT. With the increase in cruise ships over a period of time the availability of berth BPS and BPX for cargo handling operations will be very much limited.

The suggested plan for augmentation of berthing facilities is as below:

- Year 2020 - Existing berths would be adequate to cater to projected traffic. Cars, Containers and part of Steel shall be handled at OCT.
- Year 2025 - Provide additional berth of 300 m length and 35 m width along OCT for steel.
- Year 2030/35 - Provide additional berths (total 600 m length and 35 m width) with berthing line slightly west of the berthing line of OCT (to clear off the turning circle). This shall be preferably connected to the approach trestle of OCT, which is wide enough to support the proposed traffic.

In view of the limited traffic for containers, there may not be a need to deploy dedicated rail mounted container quay cranes and instead mobile harbour crane could suffice, which could be used for handling containers as well as steel products. The placement of mobile harbour crane would however need to be carefully planned such that their pads transfer the loads directly on the beams, which are spaced 7 m c/c along the berth length. Alternatively gantry type rail mounted harbour mobiles cranes could be deployed.

It is expected that the deck which has been designed for the UDL of 3 T/m^2 as well as IRC class 70R and class AA loads could support handling of steel coils which are anyway to be placed directly onto the trailers.

The proposed layout of the additional berthing facilities is attached as **Figure 7.4**.

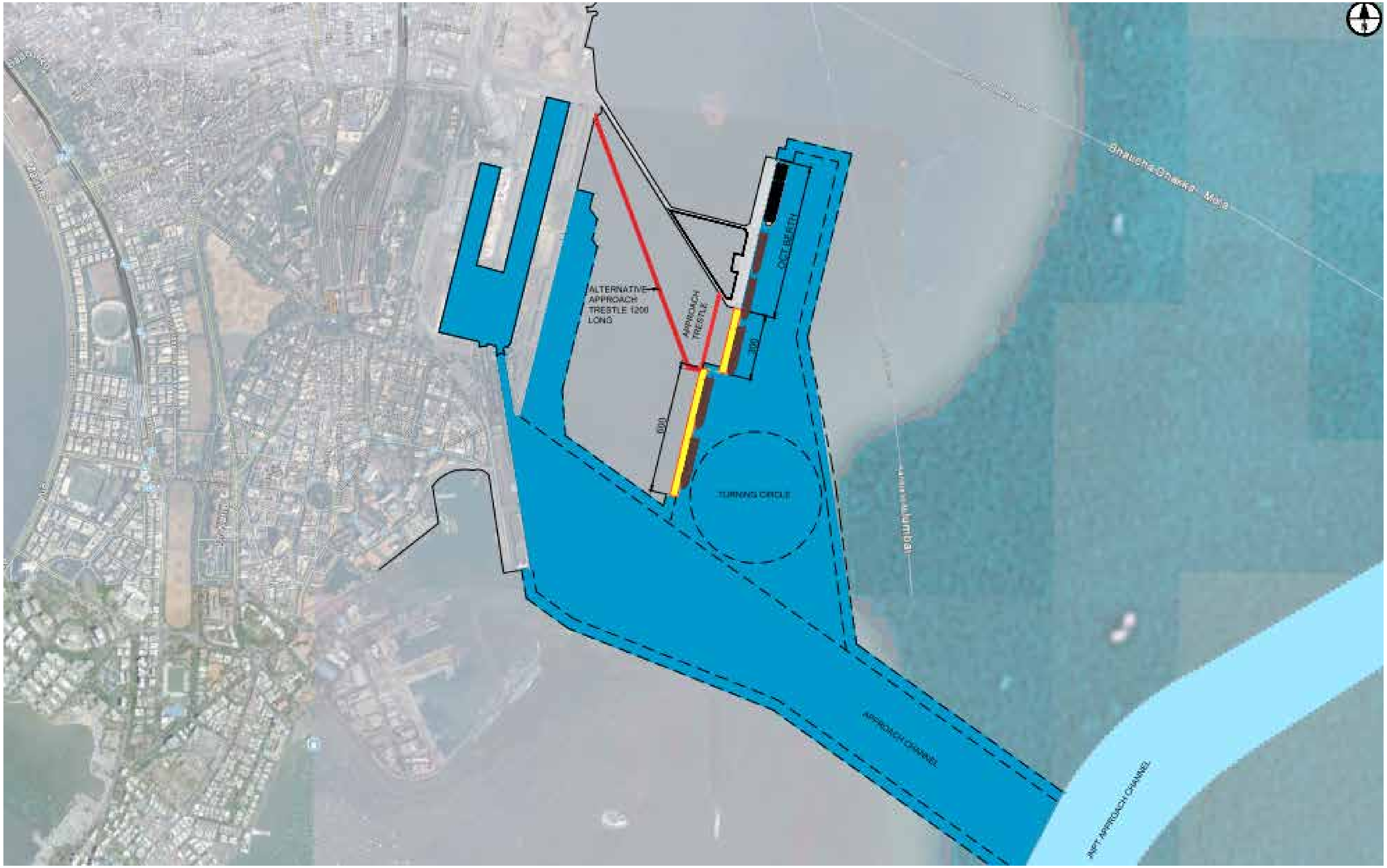


Figure 7.4 Proposed Layout of Additional Berthing Facility

7.5.3 Storage Space Requirement for Containers, Break Bulk and Steel

7.5.3.1 Required Storage Area

Currently, the storage area for the above cargo is located at Indira dock. For containers the yard is being built as part of OCT development.

The factors to be taken into account in determining the size of the storage areas are cargo throughput and dwell time, stacked densities, angle of repose, maximum and average stacking height, aisle space, peaking factor, etc. Out of these one of the key factors is the dwell time of cargo at the port. The following assumptions have been made with regards to the cargo dwell time:

1. Containers - 5 days
2. Steel - 16 days
3. Other Break bulk - 7 days

For cars it is assumed that a space to store maximum of 5600 cars is needed. Also based on the discussions with port personnel it is assumed that space for storage of about 80,000 T of pulses would be needed. Basis these assumptions, the storage area required for the breakbulk, steel and containers has been worked out as shown **Table 7.4**:

Table 7.4 Estimated Storage Space

S. No.	Commodity	Requirement of Storage Area (m²)		
		2020	2025	2035
1.	Breakbulk	53,496	64,918	94,289
2.	Iron and Steel	46,027	51,945	100,603
3.	Ro-Ro Cars	100,800	100,800	100,800
4.	Containers	10,204	16,582	22,959
Total Storage Area Required (Ha)		**21**	**23**	**32**

7.5.3.2 Area Currently Available for Storage

Considering the proposals for allocating the back space for Hughes dock and proposal for locating the floating dock along the western arm, the actual area that would be available for cargo storage is given below:

1. Open Storage - 80,000 Sqm
2. Covered storage - 60,000 Sqm

The above does not take into consideration the storage area being developed as part of yard for OCT.

7.5.3.3 Recommendations

It could be seen from the above that the total storage space needed is higher than currently available around Indira dock. Therefore part of the cargo would need to be stored at the yard being developed for OCT.

It could be observed that significantly higher storage area is mainly on account of considering the time horizon of 2035. Before that the additional storage space would be needed on account of cars only (about 9.0 Ha). It is therefore suggested that part of the area at OCT yard (about 10 Ha) be kept reserved for future augmentation requirements. Initially this area could be developed at minimal expenditure for parking of cars. This would utilise the part of land area created by erstwhile Victoria dock.

In case it is observed that that is a need of additional area on account of increased traffic, multilevel car parking be planned to reduce the area requirement for cars. Similarly, additional storage areas be planned away from berths for the cargo that dwell longer at port.

Also as part of OCT yard development, there is a proposal to provide rail sidings and it is suggested that this area be also reserved as part of cargo handling activities and access corridor and utilised for faster evacuation of steel and containers.

7.6 Development of Marina

It is observed that even after reserving the storage area required for cargo projected to be handled by year 2035, there will still be sufficient space available at the backup yard developed for OCT. It is suggested that in this balance area the possibility of developing a Marina with associated facilities be explored. Only few issues as below would need to be addressed:

- It would involve dredging part of the area reclaimed in the Princess dock.
- The port is not a clean environment and yachtsmen do not like having their yachts covered in grime. However, a properly managed marina will have mechanisms in place to minimize this negative aspect.
- Currently, this area is inside the port security zone. This situation is unacceptable for a marina which, by definition, implies leisure use and visits by family and friends. The obvious solution is to move the ISPS line such that the allocated area is no longer subject to this regime.
- Boats would still have to pass through the port's ISPS waters when moving to and from the marina but this should not be a problem because it is a situation that occurs in hundreds of ports worldwide, and anyway such boats will be under visual and radar observation throughout by the port control tower.

To develop this into an international class marina and waterfront, the backup land on west side has to be suitably planned for:

- Modern yacht club
- Boating-related commercial retail premises (e.g. chandlers, sea school, boat sales, cafe).
- A boatyard for servicing the yachts.
- Hotels / Restaurants
- Adequate car parking in support of the foregoing
- Extensive landscaping so as to create a pleasant environment.

The conceptual layout is attached as **Figure 7.5**.

Figure 7.5 Conceptual Layout of Victoria and Princess Dock Development

7.7 Workshop Area

The workshop area is located at the Clarke Basin, as mentioned in para 3.4.1, has small slipways which are capable of repairing only small crafts. Due to the heavy siltation this facility is currently even not be effectively used for this purpose also. Upgradation of this area for repairing of the bigger ships will be very cost intensive and may not be financially viable. Approximately 4 ha including 0.9 ha of covered area is available and it is suggested that the port may find an alternative use for this land parcel which could be either leasing it out to MDL, who has facilities adjacent to it, or use it for the purpose of storage of cargo being handled at port.

8.0 SHELF OF NEW PROJECTS AND PHASING

As part of the Mumbai Master Plan several projects have been identified which need to be taken up in phased manner with the built up in traffic. The proposed phasing, capacity addition and the likely investments are discussed in paragraphs below.

It may be noted that apart from these projects there could be several other projects which port would be implementing as part of the routine operations and maintenance of the port facilities. Further the phasing proposed is not cast in stone but could be reviewed periodically and revised based on the economic scenario and demand for port at that particular point of time.

8.1 Ongoing Projects

The details of the projects which have already been awarded and development is ongoing are given in **Table 8.1**.

Table 8.1 Ongoing Projects

S. No.	Project Name	Capacity Addition (MTPA)	Investment Required (INR in Crores)	Mode of Implementation
1.	Offshore Container Terminal	7.7	600	Port's funds
2.	Additional Crude Oil Jetty at Jawahar Dweep, JD 5	20.0	811	Port's funds
3.	Bunkering Terminal at Jawahar Dweep	2.0	50	Port's funds
4.	Capital dredging of 5th Oil Berth	_	66	Port's funds

8.2 Projects to be completed by Year 2020

The details of the projects which are envisaged to be completed by year 2020 are given in **Table 8.2**.

Table 8.2 Projects to be Completed by Year 2020

S. No.	Project Name	Capacity Addition (MTPA)	Investment Required (INR in Crores)	Mode of Implementation
1.	Handling of Steel Cargo at OCT	4.0	100	Port's funds
2.	Development of Marina at Victoria and Princess Dock	_	200	PPP
3.	Setting up of a Floating Storage & Regasification Unit (FSRU)	5.0	2,740	PPP
4.	Upgradation of Cruise Terminal at BPX	_	54	Port's funds
5.	Dry Docking Facility at Indira Dock	_	50	PPP

8.3 Projects to be completed by Year 2025

The details of the projects which are envisaged to be completed by year 2025 are given in **Table 8.3**.

Table 8.3 Projects to be Completed by Year 2025

S. No.	Project Name	Capacity Addition (MTPA)	Investment Required (In Crores)	Mode of Implementation
1.	Extension of OCT berth by 300 m	4.5	150	PPP

8.4 Projects to be completed by Year 2035

The details of the projects which are envisaged to be completed by year 2035 are given in **Table 8.4.**

Table 8.4 Projects to be Completed by Year 2030

S. No.	Project Name	Capacity Addition (MTPA)	Investment Required (In Crores)	Mode of Implementation
1.	Extension of OCT berth by another 600 m	2.5	100	PPP

Appendix-1: BCG Benchmarking Study for Mumbai Port

Master Plan for New Mangalore Port

Prepared for

Ministry of Shipping / Indian Ports Association

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1.0 INTRODUCTION

1.1 Background

The Sagarmala initiative is one of the most important and strategic imperatives to realize India's economic aspirations. The overall objective of the project is to evolve a model of port-led development, whereby Indian ports become a major contributor to the country's GDP.

As shown in **Figure 1.1**, the Sagarmala project envisages transforming existing ports into modern world-class ports, and developing new top notch ports based on the requirement. It also aspires to efficiently integrate ports with industrial clusters, the hinterland and the evacuation systems, through road, rail, inland and coastal waterways. This would enable ports to drive economic activity in coastal areas. Further, Sagarmala aims to develop coastal and inland shipping as a major mode of transport for carriage of goods along the coastal and riverine economic centres.

As an outcome, it would offer efficient and seamless evacuation of cargo for both the EXIM and domestic sectors, thereby reducing logistics costs with ports becoming larger drivers of economy.

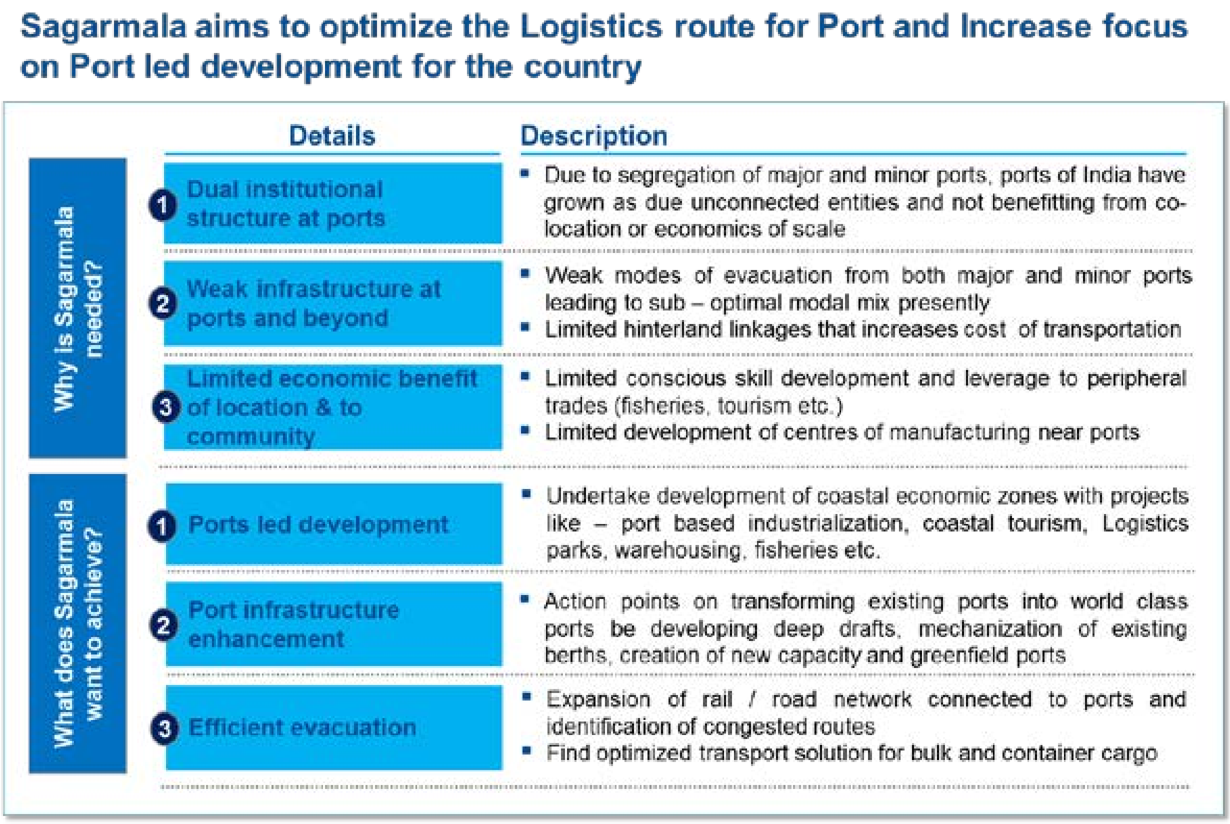


Figure 1.1 **Aim of Sagarmala Development**

In order to meet the objectives, Indian Port Association (IPA) appointed the consortium of McKinsey and AECOM as Consultant to prepare the National Perspective Plan as part of the Sagarmala Programme.

1.2 Scope of Work

The team of McKinsey and AECOM distilled learnings from the experience in port-led development, the major engagement challenge to develop a set of governing principles for our approach is shown in **Figure 1.2**.

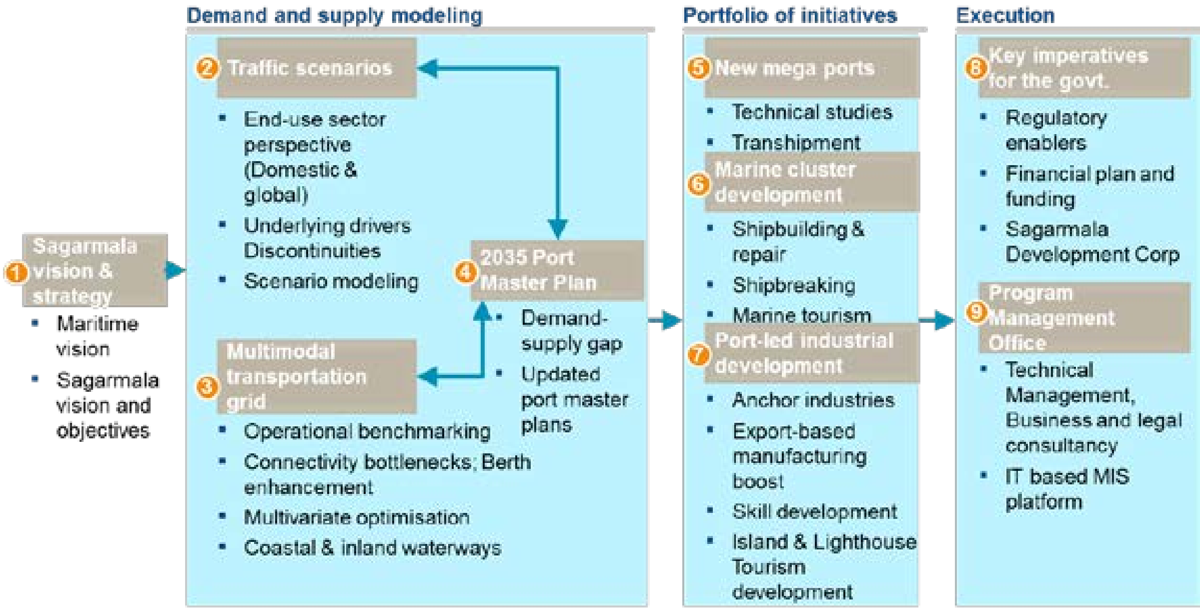


Figure 1.2 Governing Principles of Approach

As indicated above, the origin-destination of key cargo (accounting for greater than 85% of the total traffic) in Indian ports have been mapped to develop traffic scenarios for a period of next 20 years. The forces and developments that will drive change in the cargo flows also been identified. This would lead to the identification of regions along the coastline where the potential for expansion of existing port exists. The various activities involved in the port led developments are charted in **Figure 1.3**.

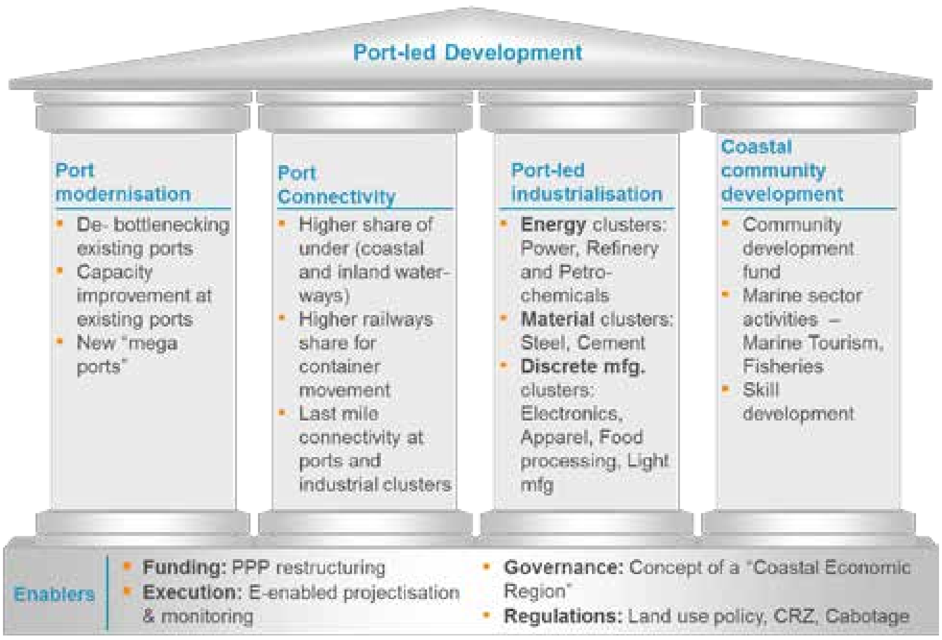


Figure 1.3 Port Led Developments

As part of the assignment, it is also expected to coordinate with the team working on "Benchmarking Operational Improvement Roadmap for Major Ports in India" study (which is being carried out simultaneously along with this assignment) and identify current and future logistic constraints (at the Major Ports) for the top 85% cargo categories based on analysis of current port capacity, productivity levels in comparison to international benchmark and evacuation bottlenecks in the logistics chain. This understanding should be an input in defining the 2035 Master Plan for each port.

Accordingly, this Master Plan report has been prepared taking into consideration the inputs provided on the future traffic and the benchmarking and operational improvements suggested for this port.

1.3 Present Submission

The present submission is the Final Report for Development of Master Plan for New Mangalore Port as part of Sagarmala assignment. This report is organised in the following sections:

Section 1 : Introduction
Section 2 : The Port and Site Conditions
Section 3 : Details of Existing Facilities
Section 4 : Performance, Options for Debottlenecking & Capacity Assessment
Section 5 : Details of Ongoing and Planned Developments
Section 6 : Traffic Projections
Section 7 : Capacity Augmentation Proposals
Section 8 : Port External Connectivity and Infrastructure
Section 9 : Scope for Future Capacity Augmentation
Section 10 : Shelf of New Projects and Phasing

2.0 THE PORT AND SITE CONDITIONS

2.1 New Mangalore Port

New Mangalore Port was declared as 9th Major Port on May 4, 1974. It is located on the West Coast of India and out of 12 major ports of India; it is the only major Port in the state of Karnataka.

The coordinates of port are Latitude 12° 55' North and Longitude 74°48' East (**Figure 2.1)**.

Figure 2.1 New Mangalore Port Location

New Mangalore Port is a lagoon type harbour with a long approach channel artificially created by dredging. The Port is a modern all-weather port situated at Panambur, Mangalore (Karnataka state in south India), on the West Coast of India, 170 nautical miles south of Mormugao and 191 nautical miles north of Cochin Port.

The port comprises three dock systems viz. Eastern Dock arm, Oil Dock arm and the western dock arm; it has in all 15 berths. The maximum draft available is 14.0 m at some of these berths. The port is approached through a 7.5 km long channel with water depths in the outer channel being 15.4 m and that of the inner channel being 15.1 m. The Port has a total land area of approximately 822 ha and water spread area of 120 ha.

2.2 Rail and Road Connectivity

2.2.1 Road Connectivity

The Port is connected with 3 National Highways. The main road networks connecting the hinterland to New Mangalore Port are as follows:

§ **NH-66 connecting Kochi – Mangalore – Goa – Mumbai**

The National Highway NH 66 stretches from Kochi to Mumbai linking many important cities and towns in its route. The south bound cargo utilizes this route. NH 66 is a four lane road and part of the stretch is two lane roads which are being widened to 4 lanes with a provision to expand to six lanes to accommodate future expansions.

§ **NH-75 connecting Bangalore – Hassan - Mangalore**

The NH 75 connects directly Mangalore to Bangalore via Hassan. This road serves the requirement of eastern and southern Karnataka. National Highway 75 is getting widened and upgraded to the 60-meters wide, 4-lane highway.

§ **NH-50 connecting Mangalore – Shimoga – Chitradurga – Bijapur – Sholapur**

NH 50 aligned north-east connects Mangalore to Sholapur. The north bound traffic utilises this route. This highway is a 2 lane highway which is undergoing upgradation to 4 lanes.

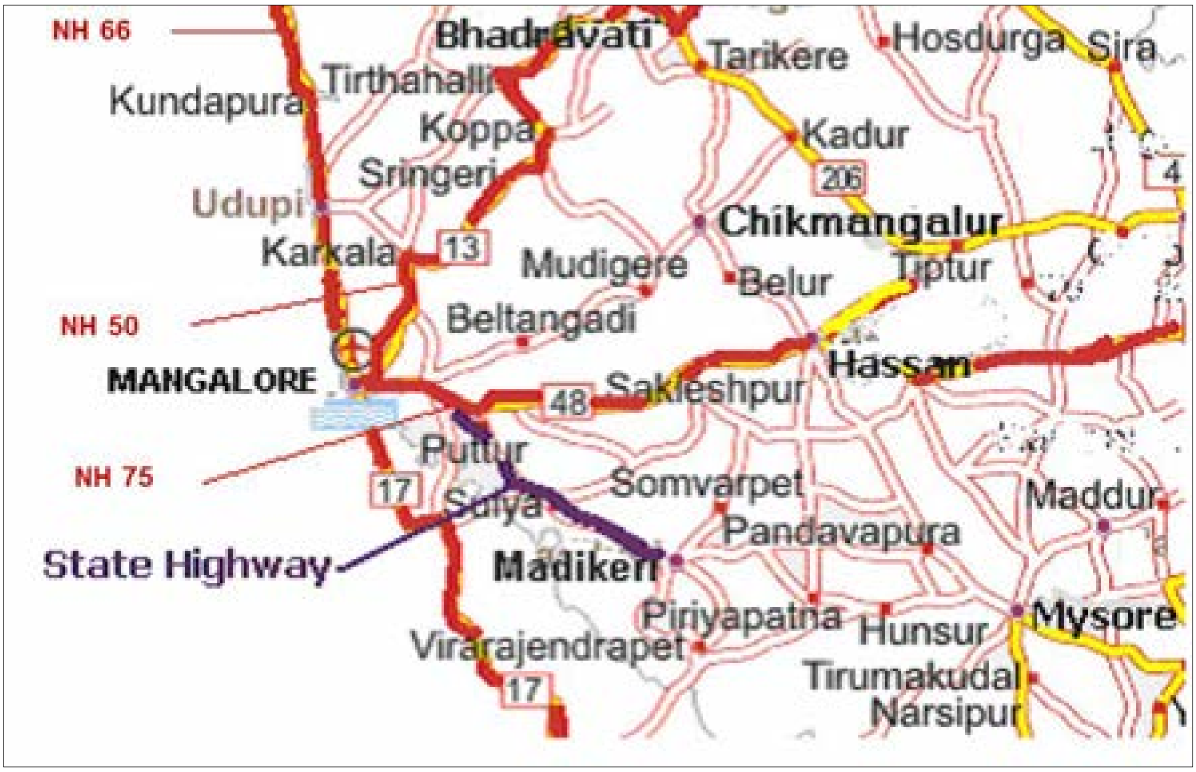


Figure 2.2 **Road Connectivity to New Mangalore Port**

2.2.2 Rail Connectivity

New Mangalore Port is connected to the Indian Railway Network through Southern Railway, South Western Railway and Konkan Railway. The Railway Marshalling Yard at Panambur, inside the New Mangalore Port, is a part of the Southern Railway. This is connected to the Konkan rail network at Thokur providing access to Mumbai via Coastal Karnataka and Goa and to the South Western railway at Kankanady providing access to the Karnataka heartland and Bangalore and Mysore via Hassan and to Kerala through the southern railway. The rail connectivity to New Mangalore Port is as shown in **Figure 2.3**.

Figure 2.3 Rail Connectivity to New Mangalore Port

2.3 Site Conditions

2.3.1 Meteorology

The climate at Mangalore is governed by the monsoons. During the months June-September, the south-west monsoon occurs. The later period is often indicated as the post-monsoon period.

2.3.1.1 Winds

Wind in Mangalore during monsoon months of June, July and August are predominantly from south-west and west with a maximum intensity of 5 on the Beaufort scale.

2.3.1.2 *Rainfall*

The average annual rainfall is approximately 3,467 mmm. The rainfall is concentrated in the SW monsoon (June, July, August and September). During this period, the average rainfall is as much as 84% of the total annual rainfall. The maximum rainfall is observed to be in July (1,102.7 mm), and it decreases gradually to 1.9 mm in February.

2.3.1.3 *Temperature*

Mangalore experiences moderate temperature throughout the year. The temperature varies from 22° C to 36° C. The low temperature occurs during south west monsoon in December and January. The hottest months are from March to May. The mean temperature in the hottest month, before the onset of SW monsoon, is from 33° C to 37° C and lowest temperature recorded is 16.7° C.

2.3.1.4 *Visibility*

Generally visibility is excellent except for a few days during monsoon. During SW monsoon, thick haze develops in Mangalore with a maximum of 3 no. of foggy days.

2.3.1.5 *Cyclones*

While the average frequency of cyclonic storms in the Arabian Sea is about one per year, there have been years when two or three such storms have occurred. There have also been years without any storms. The maximum wind speed so far recorded has not exceeded 62 kmph (16.9 m/s), except once during 1965 when the maximum speed recorded was 97 kmph (26.9 m/s).

2.3.1.6 *Relative Humidity*

The humidity is high throughout the year. From June to September during monsoon the humidity ranges from 90% to 100%. From October to January it comes down to 50% to 70%. During summer months of February to May average humidity is about 60%.

2.3.2 Oceanography

2.3.2.1 *Waves*

The predominant direction of waves at open sea in the vicinity of Mangalore Port during the monsoon months of June, July and August is W and SW whereas the predominant direction during the fair weather months is NW and N. Analysis of the data collected from ships in and around Mangalore revealed that 0.4% of the waves have a height of 4.9 m above. The wave heights in the non-monsoon months are much less.

Inside the harbour, generally calm conditions prevail throughout the year as it is well protected from outside waves by long breakwater on either side of the outer approach channel.

2.3.2.2 *Tides*

The tides at Mangalore are semi-diurnal in nature with tidal levels, relative to the Chart Datum (CD) as follows:

	Level wrt CD (m)
Highest High Water Spring (HHWS)	+1.68
Mean Highest High Water (MHHW)	+1.48
Mean Lowest High Water (MLHW)	+1.26
Mean Sea Level (MSL)	+0.95
Mean Lowest Low Water (MLLW)	+0.26
Lowest Low Water Spring (LLWS)	+0.03

2.3.2.3 *Currents*

The currents along the coast during SW monsoon (from February to September) are generally towards S (from 160° to 200°). During the northeast monsoon (from November to January) the currents are found to be towards N (from 0° to 40° and 320° to 360°).

In the approach channel region covered by breakwater, the current direction lags 6° to 8° behind the coastal currents. The current in the lagoon area further lags behind the approach channel current by another 6°. The subsurface current on an average leads the surface current by 10° to 15°. The magnitude of the current outside the lagoon area during the monsoon season is about 1 to 1.5 knots has been experienced by pilots.

2.3.2.4 *Littoral Drift*

Seasonal drift distribution has indicated that during NE monsoon, littoral drift is towards N, whereas during SW monsoon and non-monsoon period the drift is towards S. The northwards drift is comparatively less than the southward drift. The average littoral drift in the region is of the order of 0.58 lakh cum towards south during southwest monsoon and non-monsoon period and 0.08 lakh cum towards N in NE monsoon. The average net littoral drift is 0.5 lakh cum per year towards S.

Major portion of siltation in the port occurs during the monsoon months of June to September every year. The quantity of maintenance dredging is of the order of 5 million cum per annum.

2.3.3 Geotechnical Data

As per the available soil investigation data, inside the lagoon at existing turning circle several rock patches exists in the shallow portion which is approximately in the range of -15 m CD to -17 m CD. Soil in this location is composed of medium to stiff clay at the top layers and ends with rock stratum of hard granite rock with approximately 100 MPa. From the entrance of the lagoon area between the seawalls towards the approach channel up to 1.5 km the soil composition is medium sand and stiff clay with hard rock starting from a depth of -18 m CD. In the approach channel beyond 1.5 km from the mouth of the lagoon area silty clay material is prominent. As the top layer of the approach channel comprises of a very weak soil slopes of 1:6, 1:10 & 1:20 has been assumed after dredging in the lagoon, breakwater area and in the outer channel areas.

The rock blasting has to be carried out as hard rock patches are starting from a depth of -15 m CD inside the lagoon and from -18 m CD from the mouth of the lagoon up to 1.5 km towards the approach channel.

2.3.4 Topography

The New Mangalore Port located on the alluvial plain, is about 10 km north of the mouth of Gurupur and the Netravathi Rivers. The old port of Mangalore is located at the confluence of these two rivers and is roadstead port. This port is operational only during the fair weather season viz. 15th September to 15th May.

The hinterland of new Mangalore port consists of flat land, rolling and hilly areas. The flat land is mainly utilised as paddy fields and Mangalore city is located in the rolling area.

3.0 DETAILS OF EXISTING FACILITIES

3.1 General

Presently, NMPT handles various POL (IOC/BPCL) , Crude Oil (MRPL), LPG, Fertilizer, Wooden Logs, Edible Oil, Coal, Liquid Ammonia, Phosphoric Acid, Cement, Mechanical Cargos, Limestone, Containerised cargo , Iron Ore Pellets, Iron Ore Fines, Granite stone. All the dry bulk cargo comprising of Coal, Iron Ore, pellets, Gypsum, Food grains etc., are mainly handled through Road and rail network at the marshalling yard. This section discusses facilities at NMPT in detail.

New Mangalore Port has 3 docks.

§ Eastern dock arm

§ Western dock arm

§ Oil dock arm

The location of these docks is shown in the following **Figure 3.1**.

Figure 3.1 Location of the Three Docks of NMPT

The eastern dock comprises of 7 multipurpose berths and western dock with 2 berths. A deep draft multipurpose berth exists between eastern and western dock area. The southern arm comprise of 5 jetties to handle liquid bulk and POL.

The layout plan and locations of various berths are shown in the following **Figure 3.2**.

Figure 3.2 Existing Facilities at New Mangalore Port

3.2 Navigational Channel, Turning Circle

Length of Channel	-	About 7.5 km
Depth of Outer Channel	-	-15.4 m CD
Width of Channel	-	245 m (Side slopes of the navigational channel measures 1:20 from start of the channel up to the breakwater line and 1:10 in the zone from line connecting the breakwater ends and base line).
Turing Circle diameter	-	570 m
Depth of Harbour Basin	-	-15.1 m CD (Side slopes are maintained to 1:6).

3.3 Breakwaters

Two number of rubble mound breakwaters, one each on north and south, with length of 770 m each have been constructed in three stages on either side of the approach channel with an in between distance of 1,362 m at the root. The breakwaters terminate at a depth of about -6.0 m CD.

3.4 Existing Facilities at New Mangalore Port

3.4.1 Berth Details

NMPT has 1 SBM and 15 berths (**Table 3.1**), out of which berth 1 to berth 9 and berth 18 are multi-purpose berths and berth 13 to 17 are handling bulk liquids, POL, Chemicals, LPG and LNG. SBM is dedicated for MRPL to handle crude traffic. Berth 9 is a captive coal berth dedicated to UPCL.

Table 3.1 Berth Details at New Mangalore Port

S. No.	Old Berth No.	Revised Berth No.	Type of Berth	Designed / Actual depth (m)	Quay Length (m)	Max. LOA (m)	Max. DWT (m)	Capacity in MTPA
1.	Berth 1	Berth 1	General & Bulk Cargo /Container / Passenger Vessel	7.0	125	90	4,000	0.75
2.	Berth 2	Berth 2	General & Bulk Cargo / Container /Passenger Vessel	10.50	198	190	30,000	0.90
3.	Berth 3	Berth 3	General & Bulk Cargo / Container /Passenger Vessel	10.30	198	190	30,000	1.4
4.	Berth 4	Berth 4	General & Bulk Cargo /Container /Passenger Vessel / Liquid Ammonia / Phosphoric Acid	9.50	198	190	30,000	1.0
5.	Berth 5	Berth 5	General & Bulk Cargo /Container /Passenger Vessel / Bulk Cement /Edible Oil	9.50	198	190	30,000	2.8
6.	Berth 6	Berth 6	General & Bulk Cargo / Container / Passenger Vessel	9.50	198	190	30,000	1.5
7.	Berth 7	Berth 7	General & Bulk Cargo / Container /Passenger Vessel	9.50	200	190	30,000	1.65
8.	Berth 14	Berth 8	General & Bulk Cargo / Container /Passenger Vessel	14.0	350	300	90,000	6.6
9.	Berth 15	Berth 9	Coal (UPCL)	14.0	300	230	90,000	5.40
10.	Berth 9	Berth 13	LPG/ POL	10.50	330	235	45,000	4.5
11.	Berth 10	Berth 14	Crude Oil / POL	14.00	320	245	85,000	6.5
12.	Berth 11	Berth 15	Crude Oil / POL	14.00	320	245	85,000	6.5
13.	Berth 12	Berth 16	POL / Chemical / Edible Oil	12.50	320	230	50,000	5.87
14.	Berth 13	Berth 17	Crude Oil / POL / LPG / Chemical	14.00	350	245	85,000	7.80
15.	Berth 8	Berth 18	Iron Ore / General & Bulk Cargo	12.50	300	245	60,000	6.60
16.	SPM	SPM	Crude Oil	-	-	-	300,000	18

3.4.2 Berths at Eastern Dock Arm (Berths 1 to 7)

The eastern dock arm has 7 berths. Out of these, berth 1 is a shallow berth with a draft of -7 m CD and is used to handle general cargo and passenger vessels. General cargo is handled in Berth 2 & 3 and is having a dredged depth of 10.5 m.

Berth 4 handles general cargo, phosphoric acid and liquid ammonia. Berth 5 handles general cargo, palm oil, edible oil, cement. Berth 6 & 7 handles bulk cargos. These berths have a dredged depth of -9.5 m CD.

3.4.3 Berth 8

This berth is a deep draft multipurpose handling general cargo. The berth has the dredged depth of -15.1 m CD. About 7 acres of land just behind Berth 8 has been designated for storage for this berth.

3.4.4 Berths at Western Dock Arm (Berth 9)

Berth 9 is a captive berth for Udupi Power Corporation Limited. It is a fully mechanized berth which includes grab unloaders, conveyor belt system connected to stackyard and rail loading silo at the western side marshalling yard. This berth has a capacity of handling 5.4 MTPA which is currently handling about 2.7 MT as per the existing requirement. The area of the stackyard is approximately 5.2 ha.

Figure 3.3 Mechanised Coal Handling Arrangement at Berth 9

The berth is equipped with 2 gantry type grab unloaders of 1,600 TPH capacity, associated conveyors of 3,200 TPH and one stacker and one stacker cum reclaimer of 3,200 TPH capacity. The storage yard is connected to the 2 in motion wagon loading system for rail evacuation. The stackyard has the storage capacity of 1.8 lakh T.

3.4.5 Berths at Oil Dock Arm (Berth 13 to 17)

All these berths are dedicated oil berths. POL products are transported through pipeline for MRPL and other oil firms.

3.4.6 Berth 18

This berth is designated for handling Iron ore for Kudremukh iron ore plant and has a capacity of 6.6 MTPA for importing iron ore and exporting pallets.

3.4.7 Offshore Single Buoy Mooring

MRPL have set up a single buoy mooring at about 17.5 km offshore at about 30 m water depth for handling Very Large Crude Carriers up to 330,000 dwt for handling the crude oil imports for their refinery. This has been constructed with an understanding and long relationship with the port. This is connected through submarine pipelines to Booster Pumping Station on the onshore within the NMPT limits and utilizing 0.3 MT capacity of ISPRL's Mangalore Cavern (of 1.5 MT total capacity) as intermediate storage to receive and transfer crude oil from SPM to refinery tankages. The submarine pipeline is of 48" diameter.

3.4.8 Storage Facilities

The port has storage facilities, in the form of an open storage area and closed storage area such as warehouses and silos.

Storage facilities comprise of covered storage area in the form of transit sheds, warehouses and open storage area and tanks for liquid cargo area as presented in **Table 3.2** and **Table 3.3**.

Table 3.2 Details of the Storage Facilities for General Cargo and Containers

Storage Shed	No. of Plots/Sheds	Area (sqm)	Capacity (T)
Transit Shed	2	7,752	19,380
	2	7,000	17,500
Over Flow Sheds	2	7,200	18,000
	1	7,150	16,000
Warehouses	15	53,204	132,720
Container Yard	-	40,000	-
Open Storage for other cargo	-	120,504	-

Few of the sheds are pretty old at this port and in order to augment the closed storage three new storage sheds of 35,000 m^2 with a storage capacity of 10,500 T are currently under construction.

Table 3.3 Details of Storage Facilities for Liquid Cargo

S. No.	Owned By	No.	Area (sqm)	Capacity
1.	IOC	25	99,472	113,000 KL (POL products)
2.	IMC	19	23,878	52,000 KL (Chemicals)
3.	IPWC	8	16,619	52,845 KL (Molasses & Edible Oil)
4.	Universal Agro Exports	3	14,164	128,000 KL (Edible Oil)
5.	MCF	1	12,733	10,000 T (Liquid Ammonia)
6.	MCF	2	12,733	16,000 T (Phosphoric acid)
7.	Mangalore Liquid Impex	2	6,836	7,500 T (Edible Oil)
8.	Ultra Tech	3 (silo)	11,700	15,000 T (Cement)

There are 63 bulk liquid storage tanks including 3 silos for cement storage, out of which 55 storage having the capacity of 154,133 KL and 8 having the capacity of 44,000 T.

3.4.9 Cargo Handling Equipment

S. No.	Description of Equipment	Rated Capacity	No.
1.	Hindustan 2021 Front End Loader	Bucket Capacity of 1.53 m^3	1
2.	Marine Unloading Arm for handling Liquid Ammonia (M/s. Connex, West Germany)	700 TPH Test Pressure Allowable 38 Bars	1 Unit
3.	Handling Equipment for Phosphoric Acid: *Note: The units are installed , operated and maintained by M/s. Mangalore Chemicals & Fertilizers Ltd.*	Working Pressure: 25 bars Diameter : 8“	-
4.	Mechanical Iron Ore Loading Equipment at Kudremukh Iron Ore Berth *Note: This unit is installed, operated and maintained by M/s. KIOCL*	6000 to 8000 TPH	-
5.	Unloading arms for handling Crude & POL products at two OIL jetties (6 nos.in each jetty) (M/s. Nigata Engg. Co. Ltd. Japan) *Note: These unloading arms have been installed, operated and maintained by MRPL.*	Crude: Crude/LSHS/FO: MS/HSD/SKO/ATF: **Total:** Capacity:2000 m^3 /hr Design Pressure: 32 kg/cm^2	2 2 2 **6**
6.	Unloading Arm for handling LPG at the existing oil jetty (M/s. Kanon Loading Equipment, Netherlands) *Note: The unloading arm is installed, operated and maintained by M/s. HPCL.* Another unloading arm has also been installed by M/s. ELS Gas	Capacity: 160-305 m^3/hr: 80-153 m^3/hr: Design Pressure:31 kg/cm^2 Operating Pressure:16-22 kg/cm^2	1 1

3.5 Harbour Craft Facilities

For effective operations and management, the port has good fleet of harbour tugs, pilot and survey vessels. Port owns 5 tugs, 5 mooring launches and 3 pilot launches.

Table 3.4 Details of Floating Crafts

S. No.	Description	Capacity	No.
1.	Tugs	32 T BP	2
		50 T BP	1
		50 T BP	2 (hired)
2.	Pilot Launches	2 × 650 BHP	1
		2 × 600 BHP	1
		2 × 400 BHP	1 (hired)
3.	Mooring Launches	108 BHP	1
		110 BHP	1
		140 HP	2

3.6 Port Railways

New Mangalore Port is connected to the Indian railways network through Southern, South Western and Konkan railways. The marshalling yard located on the northern side of the port at Panambur is operated by the Southern railway (**Figure 3.4**). The yard has 14 broad gauge lines (Line 5 to Line 10), out of which 6 lines of the port are utilised for Receipt and Dispatch of cargos. The marshalling yard is connected to Mangalore Chemicals and Fertilisers Ltd.

Within the secured port boundary there is only 1 rail line (Line 4) running parallel to the boundary wall extended to the dead end of berth 1 to 7 and there are no rail tracks in use on/ for any of the existing terminals. This line is utilised for loading of coal and limestone.

Line 1 to 4 is utilised by KIOCL. Line 11 to 13 is utilised by UPCL for coal loading. MCF has one take off point from the extended coal/ limestone loading line.

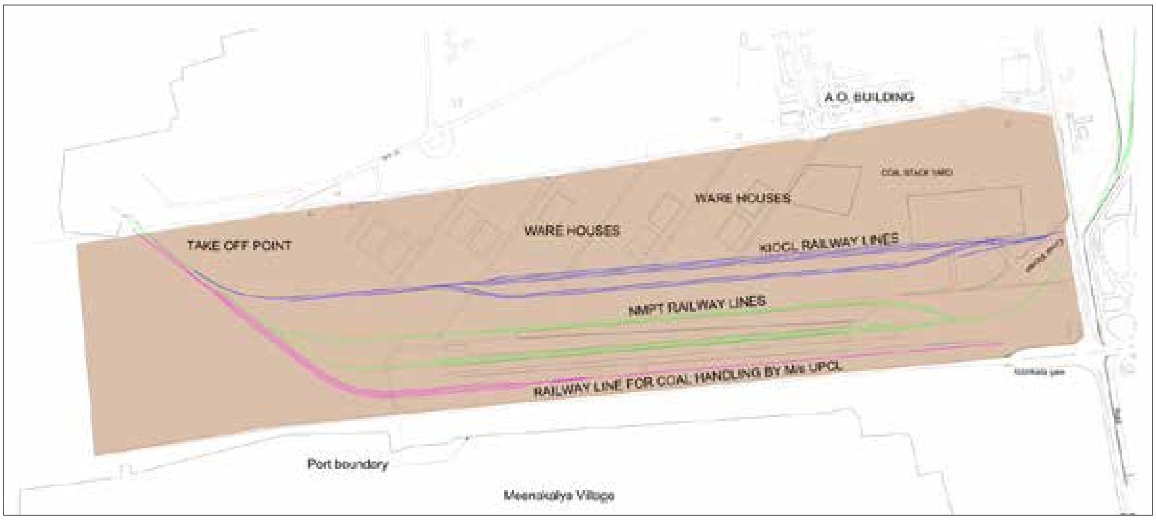


Figure 3.4 Port Internal Rail Connectivity

3.7 Internal Road Connectivity

All cargo is transported by trucks within in the port boundary, due to the lack of rail connectivity at various terminals. Within the secured port boundary wall, there is only one rail track in use which is used for loading coal and limestone. All the terminals are well connected with the internal road network as shown in **Figure 3.5**.

The port has a truck parking area outside the port boundary of 12,000 m^2.

Figure 3.5 Port Internal Road Connectivity

4.0 PERFORMANCE, OPTIONS FOR DEBOTTLENECKING & CAPACITY ASSESSMENT

4.1 General

The total cargo handled through the existing facilities, during the past 5 years is presented in the following **Table 4.1**.

Table 4.1 Cargo Handled During Last 5 Years (MTPA)

Commodity	2010-11	2011-12	2012-13	2013-14	2014-15
Liquid Bulk	22.49	23.30	25.31	25.61	24.23
Dry Bulk	8.20	8.48	10.75	12.65	11.31
Break Bulk	0.29	0.52	0.29	0.35	0.11
Containers	0.57	0.64	0.69	0.75	0.92
Grand Total	**31.55**	**32.94**	**37.04**	**39.36**	**36.57**

4.2 BCG Benchmarking Study

BCG, as part of their benchmarking study, has looked into the operation of the berths and has suggested various measures for improving the performance. The report of BCG pertaining to New Mangalore Port is given in the **Appendix 1**. Subsequently some of the recommendations were revisited and the final key observations of the study are as follows:

§ NMPT has average berth occupancy of 36%. Berth occupancy on general cargo berths is low and only berth 8 is highly utilized. Berth 8 handles mostly coal and fertilizer cargo and is equipped with 2 Private MHCs. Berth occupancy on POL berths is moderate and SPM is 35% occupied.

§ Net profits have been declining since 2012 due to higher berthing and mooring costs, and lower cargo handling revenue.

§ Cargo volumes decreased by ~2 MT in 2014–2015 due to decrease in iron ore and POL.

§ Berth productivity for containers at NMPT is significantly lower than other container handling ports.

§ Fertilizer volumes at NMPT have decreased by 30% since 2008-09.

4.2.1 Key Recommendations

As per BCG Report productivity at New Mangalore Port may be improved by following measures:

- Hinterland connectivity
- Install a mobile harbour crane for container handling on a PPP mode to increase productivity by 50%.
- Improving Service level of containers & providing equipment at berth no. 8 for handling containers.
- Setup an LNG terminal in NMPT.
- Setup a mechanized facility for fertilizer handling.
- Reduce overtime cost in marine equipment through 3-shift deployment.

4.2.1.1 Hinterland Connectivity

Hinterland connectivity from NMPT has been the major hindrance in attracting container cargo. Western Ghats have limited hinterland connectivity to customers in Mysore, Madikeri, Hassan, Shimoga and Bangalore.

- 4-lane highway to Mysore via Madikeri is under improvement and is now capable of handling trailers for 40 feet containers.
- Connectivity to Hassan has significantly improved by strengthening of the Shiradi Ghat section.
- 6 lanes of Bangalore Mysore NH 275 have been approved in 2014.
- Rail connectivity to Bellari and Hospet region to improve significantly post construction of missing link from Hubli and Ankola.

4.2.1.2 Install Mobile Harbor Crane for Container Handling

Installation of a quay crane or MHCr to increase productivity by 50%.

- Significant investment required in setting up MHCr and the private party that will setup the MHC needs to recover the investment from cargo volumes. IRR calculations suggest that the crane operator will be able to recover a healthy IRR of 20% on his investment of 40 crores if container traffic reaches 1.5 Lakh TEUs per year.
- Berth productivity will increase from 17 moves per hour to 25 moves per hour, and yard efficiency will ensure seamless feeding at the berth.

Basis the above recommendations port has already planned for privatisation of berth 8 for handling containers.

4.2.1.3 Providing Equipment at Berth No. 8 for Handling Containers

Yard occupancy at NMPT is 95% and is significantly higher than recommended utilization of 75%. On certain days the occupancy is above 100%. This is evident from containers lying on the berth and on the roadside. There is a need to allocate additional yard space of 20,000 sqm to support the increased traffic volumes of 1.5 lakh TEUs per year.

Currently, port owns three reach stackers that are operated by a private party. There is a requirement of 3 RTGC/reach stackers per crane operating at the berth to improve service level of containers.

§ 1 RTGC to load the export container.

§ 1 RTGC to unload the import container.

At the given time, there are at least 2 vessels cranes operating on the berth and, hence there is a requirement of 6 RTGCs/reach stackers. Since the port currently owns 3 reach stackers, it should invite a third party to invest and operate 3 additional reach stackers. Recommendations are as below:

§ Allocate additional yard space for the container storage.

§ Installing 3 additional reach stackers.

4.2.1.4 Setup an LNG Terminal in NMPT

§ MRPL + OMPL: ONGC's two entities have a combined demand of 0.6 MT per year.

§ Mangalore Chemicals and Fertilizers operate on Naphtha and have upgraded their equipment to consume LNG. There is a demand of ~0.4 MT per year in the existing plant. Additionally they are planning to setup a new plant of 1 MT of Urea which shall require additional 0.5 MTPA of LNG every year.

§ Tannirbhavi Power plant which was recently shifted to Kakinada will return back to Mangalore if an LNG terminal was to setup. The demand from the power plant is expected to be close to 0.4 MTPA.

§ Smart City: Mangalore has been declared as a smart city which increases the power requirement of the city and it is expected that an additional demand of 0.4 MTPA will be created.

Setting up of a ~2-2.5 MT LNG terminal at NMPT will result in additional revenues of ~Rs. 25 crores per year to the port.

4.2.1.5 Setup a Mechanized Facility for Fertilizer Handling

Mechanizing the fertilizer handling will avoid double handling and reduce total handling costs by ~ 40% making NMPT attractive for fertilizer imports. Port should setup a mechanized berth on a PPP basis. Shore off loaders to discharge fertilizer on a conveyor which will transport it to silos from where it will be fed into a hopper for the mechanized bagging plant.

Total cost of handling fertilizer from discharge to rake loading is ~Rs. 710/T. There are two inefficiencies in the process driving the cost high:

§ Double handling due to lack of storage and bagging facilities inside the port.

§ Labour involvement in manual bagging and stitching

NMPT should setup a mechanized berth for fertilizer handling on a PPP basis to reduce handling costs and attracting more cargo. New berth to have following handling process:

- Mechanized discharge from shore off loader to a conveyor belt.
- Conveyor belt to feed fertilizer into Silo storage facilities located inside the port.
- Silo storage to feed directly into hoppers of mechanized bagging plant.

Post mechanization the handling costs of fertilizers will go down from Rs. 710/T to Rs. 430/T. The ~40% cost saving will be an incentive for fertilizer importers, and cargo volumes will grow to ~1 MT per year from current 0.65 MT.

4.2.1.6 Reduce Overtime Cost in Marine Equipment Through 3-Shift Deployment

Migrating to 3-shift deployment for tugs, pilot launches and mooring boats will eliminate overtime for marine equipment. Hence, outsourcing mooring activities and migrating to a 3-shift deployment will result in overtime cost savings of ~Rs. 4.3 crores. However implementation of this recommendation is subject to the decision of high court to whom labour unions have approached.

4.3 Capacity Assessment of Existing Facilities

4.3.1 General

The capacity of existing berths is assessed assuming the mix of cargo being currently handled at these berths and the corresponding parcel sizes.

Another factor that is important in arriving at the berth capacity is the allowable Berth occupancy which is expressed as the ratio of the total number of days per year that a berth is occupied by a vessel (including the time spent in peripheral activities) to the number of port operational days in a year. High levels of berth occupancy will result in bunching of ships resulting in undesirable pre-berthing detention. For limited number of berths and with random arrival of ships, the berth occupancy levels have to be kept low to reduce this detention. The norms generally followed for planning the number of berths in modern port to minimise the pre-berthing detention are given in **Table 4.2**.

Table 4.2 Recommended Berth Occupancy

No. of Berths	Recommended Berth Occupancy Factor
1	60 %
2	65 %
3 & above	70 %

4.3.2 Cargo Handled at Various Berths

The available berths and the cargo handled at each of these berths during FY 15 are presented in **Table 4.3** below:

Table 4.3 Cargo Handled at Various Berths at NMPT

Cargo Handled	Liquid Bulk (T)	Dry Bulk (T)	Break Bulk (T)	Containers (T)
Berth 1	-	1,159	3,035	-
Berth 2	-	369,723	9,153	95,226
Berth 3	-	233,722	11,822	548,321
Berth 4	182,305	7,500	2,996	42,597
Berth 5	310,397	335,630	48	-
Berth 6	166,428	181,035	53,295	76,913
Berth 7	-	418,129	25,225	77,498
Berth 8 (18)*	-	2,002,846	-	-
Berth 9 (13)	1,095,554	-	-	-
Berth 10 (14)	4,987,587	-	-	-
Berth 11 (15)	6,316,474	-	-	-
Berth 12 (16)	992,946	-	-	-
Berth 13 (17)	334,520	-	-	-
Berth 14 (8)	-	5,019,976	4,725	80,577
Berth 15 (9)	-	2,725,636	-	-
SPM	9,853,340	-	-	-
Total	**24,239,551**	**11,295,356**	**110,299**	**921,132**

() – Number is bracket indicates new berth numbers

4.3.3 Productivity at Berths

4.3.3.1 Bulk, Break Bulk and Container Cargo

Based on the above, the average parcel size of bulk, break bulk and container cargo handled at port and average handling rate are assessed as shown in **Table 4.4**.

Table 4.4 Details of Bulk, Break Bulk and Container Cargo Handled at Port

S. No.	Cargo Type	Cargo	No. of Ships	Total Cargo Handled (T)	Average parcel size (T)	Working Time at Berth (Days)	Average Handling Rate (TPD)
1.	**Breakbulk**	Steel plates/ mach.	17	14,960	880	18	831
		Granite	3	10,528	3,509	5	2,106
		Machinery	11	14,295	1,300	12	1,191
		Timber	7	68,366	9,767	46	1,486
2.	**Container**	Container	103	921,132	8,943	195	4,724
3.	**Dry Bulk**	Soda ash	2	2,859	1,430	5	527
		Iron ore	36	1,550,049	43,057	100	1,550
		M.O.P	13	275,603	21,200	41	6,722
		Urea	6	314,733	52,456	56	7,676
		Ammonium sulphate	1	17,500	17,500	2	8,750
		Coal	158	8,177,578	51,757	410	19,945
		D.A.P	2	43,936	21,968	13	3,380
		Maize	1	6,600	6,600	6	1100
		Sulphur	2	27,500	13,750	6	4,583
		Cement	39	3,32,130	8,516	107	3,104
		Bentonite powder	1	28,500	28,500	4	7,125
		Rock phosphate	3	54,860	18,287	13	4,220
		Bauxite	2	84,100	42,050	6	14,017
		Gypsum	6	3,40,872	56,812	26	13,110
		Limestone	1	27,500	27,500	3	9,167
		Building material	1	2,150	2,150	3	717

4.3.3.2 *Liquid Cargo*

Currently, the port is handling liquid ammonia, phosphoric acid, crude, palm oil, sunflower oil, LPG, POL, crude, mix-xylene, butylene acrylic, methanol, sulphuric acid, benzene, para xylene. The proportion of handling of these cargoes is as shown in **Figure 4.1**.

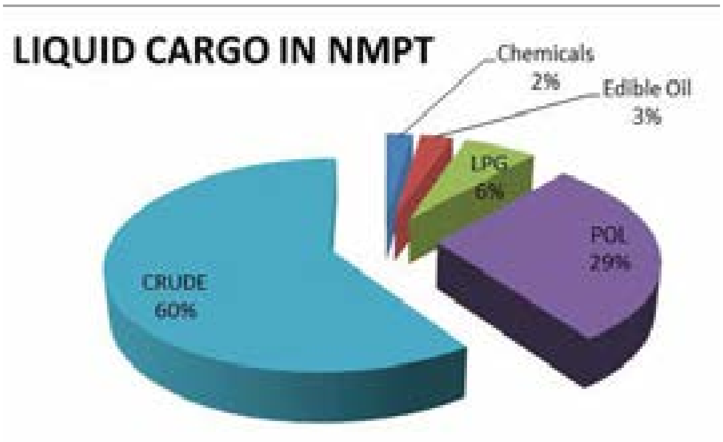


Figure 4.1 Liquid Bulk Traffic Share at NMPT

It may be noted that major portion of this cargo is crude for MRPL refinery. The average parcel size of liquid cargo handled at port and average handling rate are assessed as shown in **Table 4.5**.

Table 4.5 Liquid Cargo Handling at Oil Berth

S. No.	Cargo Type	Cargo	No. of Ships	Total Cargo Handled (T)	Average Parcel Size (T)	Working Time at Berth (days)	Average Handling Rate (TPD)
1.	Liquid Bulk	Liquid Ammonia	12	47,979	3,998	7	6,854
2.		Phosphoric acid	14	1,34,326	9,595	16	8,395
3.		Crude palm oil	76	631,810	8,313	125	5,055
4.		Palm oil	6	31,287	5,215	8	3,911
5.		Sunflower oil	3	13,941	4,647	2	6,971
6.		LPG	136	1,520,608	11,099	341	4,459
7.		POL	180	6,819,944	37,889	341	20,000
8.		Crude	128	14,170,894	110,710	204	69,465
9.		Mix-xyline	1	10,448	10,448	1	10,448
10.		Butylene acrylic	4	2,302	576	1	2,302
12.		Methanol	11	38,862	3,533	6	6,477
13.		Sulphuric acid	1	7,100	7,100	1	7,100
14.		Benzene	10	55,614	5,561	10	5,561
15.		Para xylene	25	264,441	10,578	33	8,013
16.		Sty. Monomer	11	12,731	1,157	5	2,546

4.3.3.3 *Productivity at Berths*

The cargo throughput of New Mangalore port in FY 15 is 35.78 MTPA, ~10% less than that of the previous year (as per NMPT data). Of the aggregate traffic of 555.1 MTPA handled in the preceding fiscal by all the major ports combined, the port accounted for about 6.4%.

The New Mangalore port handles liquid bulk as its major cargo which accounts for 66% of the total traffic.

Presently, New Mangalore Port handles dry cargo at its 10 general cargo berths and 5 oil jetties to handle liquid bulk viz., crude, POL, LPG, edible oils and chemicals. Both these facilities have a combined capacity of 77.77 MTPA, which includes dry handling design capacity of 28.6 MTPA and liquid cargo handling design capacity of 49.17 MTPA. Against this capacity, a total of 36.57 MTPA was handled at New Mangalore Port resulting in lower berth occupancy in FY 15 as depicted in **Figure 4.2** and **Figure 4.3**

The average productivity for various berths have been assessed as indicated in **Table 4.6**.

Table 4.6 Average Productivity of Cargo Berths at NMPT

Cargo Handled	Liquid Bulk	Dry Bulk	Break Bulk	Containers	Average Productivity (TPD)	Average Parcel size (T)
Berth 1	-	1,159	3,035	-	599	1,049
Berth 2	-	369,723	9,153	95,226	5,926	16,348
Berth 3	-	233,722	11,822	548,321	5,630	12,404
Berth 4	182,305	7,500	2,996	42,597	6,539	6,923
Berth 5	310,397	335,630	48	-	3,778	8,731
Berth 6	166,428	181,035	53,295	76,913	4,303	9,951
Berth 7	-	418,129	25,225	77,498	6,593	17,960
Berth 8 (18)	-	2,002,846	-	-	13,442	42,614
Berth 9 (13)	1,095,554	-	-	-	4,603	15,216
Berth 10 (14)	4,987,587	-	-	-	29,512	56,040
Berth 11 (15)	6,316,474	-	-	-	29,108	54,452
Berth 12 (16)	992,946	-	-	-	5,516	7,134
Berth 13 (17)	334,520	-	-	-	7,117	9,041
Berth 14 (8)	-	5,019,976	4,725	80,577	16,849	48,622
Berth 15 (9)	-	2,725,636	-	-	30,973	77,875
SPM	9,853,340	-	-	-	77,585	1,38,779
Total	**24,239,551**	**11,295,356**	**110,299**	**921,132**	**17,200**	**35,432**

The berth occupancy as indicated by the port is presented in **Figure 4.2** and **Figure 4.3**.

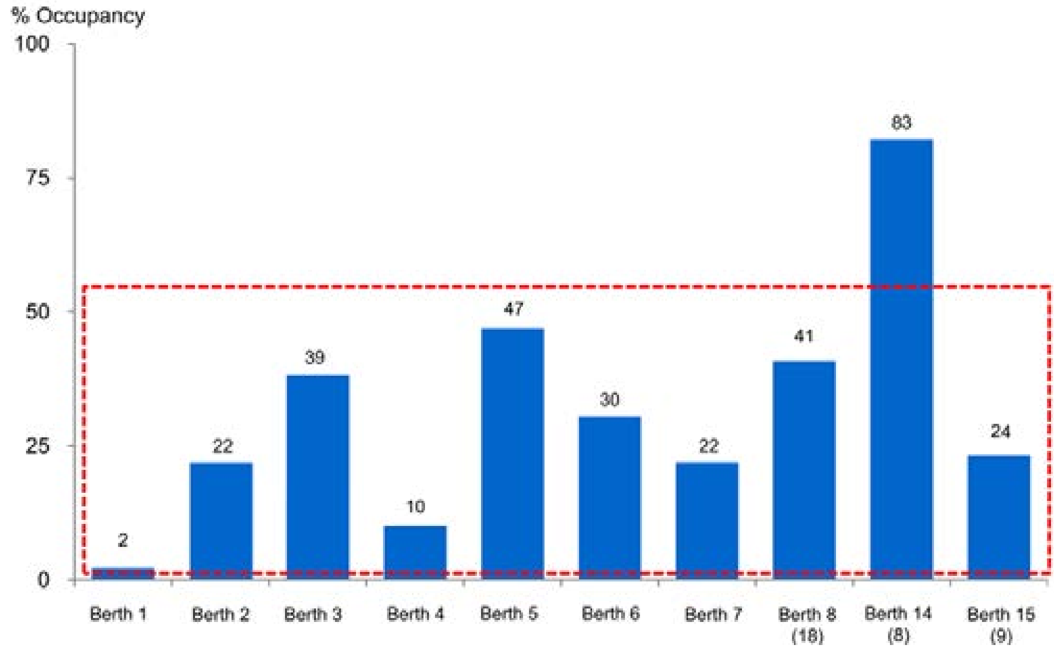


Figure 4.2 Berth Occupancy Details of Dry Cargo Berths

It may be noted from the above analysis, that except berth 14 (8) rest all of the multipurpose berths are highly underutilised with an average occupancy of ~25%.

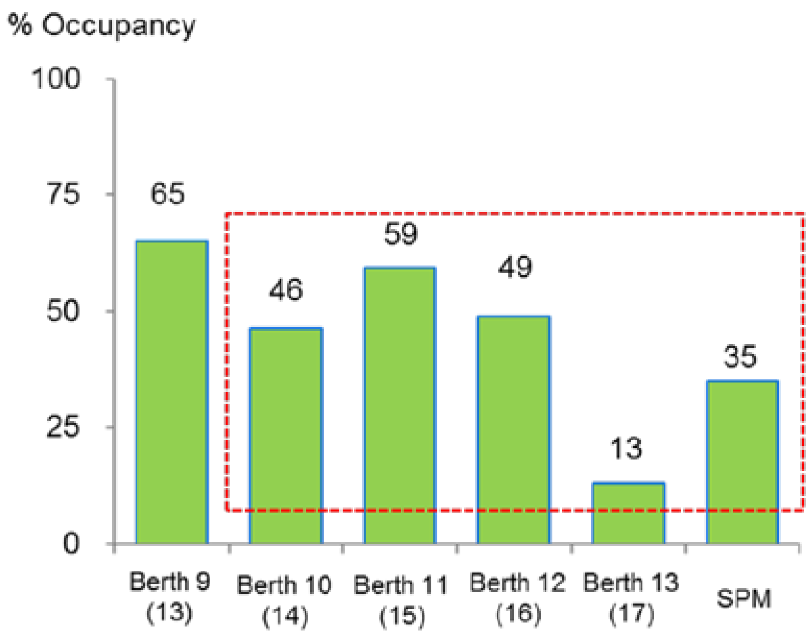


Figure 4.3 Berth Occupancy Details of Liquid Bulk Berths

Similarly for handling liquid cargo, except berth 13, all the liquid handling berths including the SPM have the spare capacity for utilisation.

5.0 DETAILS OF ONGOING AND PLANNED DEVELOPMENTS

5.1 Mechanisation of Berth 12

At present there are not many projects that are being taken up by New Mangalore Port Trust for improving the capacity of the port, except that of the mechanisation of berth 12 (**Figure 5.1**) with a capacity to handle 6.7 MTPA of bulk cargo.

Figure 5.1 Mechanisation of Berth 12

The concession has been awarded to the consortium of M/s. Chettinad Builders Private Limited on revenue sharing basis. This project is taken up on the PPP mode of development for a 30 year period.

The port would provide the berthing facilities and storage area while the concessionaire shall develop the top side facilities, equipment for handling the cargo. The estimated investment for mechanization and development of the backup area of 25 ha (21.4 ha behind the berth and 2.85 ha. in the rail marshalling yard for loading operations) would be around INR 469.46 crores.

5.2 Deepening of Port

The existing infrastructure in the port can cater to vessels up to 90,000 DWT. The existing north and south breakwaters are approximately 770 m each which protects the lagoon area for safe handling operations as well as restrict the littoral drift and also provide the adequate stopping distance to ships. The eastern arm dock can cater to vessels up to a maximum size of 30,000 DWT. General cargo, liquid ammonia; phosphoric acid, bulk cement and edible oil are the main commodities which are handled in this area. Cruise vessels which call upon New Mangalore Port are also handled in this area.

The western dock arm caters to bulk cargo traffic. Udupi Power Corporation Limited has a captive coal berth which can handle panamax vessels of up to 80,000 DWT. This berth has been designed for panamax ships only and would need significant cost and down time to be upgraded to handle cape size ships.

Further most of the crude oil, which require VLCC and Suezmax size vessels, can be handled at the SPM developed by Mangalore Refinery and Petrochemicals Limited, while POL products can be handled at existing berths.

The technical feasibility assessment was carried out for handling 180,000 DWT vessels having a draft of 18 m at the port. It was observed that this would involve lot of dredging of rock having strength of more than 100 MPa. This type of rock cannot be dredged but blasting (controlled) would be needed at a very high cost (capex of over INR 2,700 crores) and would be very time consuming (over 4.5 years).

Further, it was observed that only two existing berths (existing multipurpose berth–8 and future berth beside the Kudremukh iron ore berth–18) could be benefitted as other berths are not designed for this draft. As there is no significant traffic growth in bulk traffic expected, deepening in the lagoon and channel for handling 180,000 DWT vessels does not prove to be a feasible option.

6.0 TRAFFIC PROJECTIONS

6.1 General

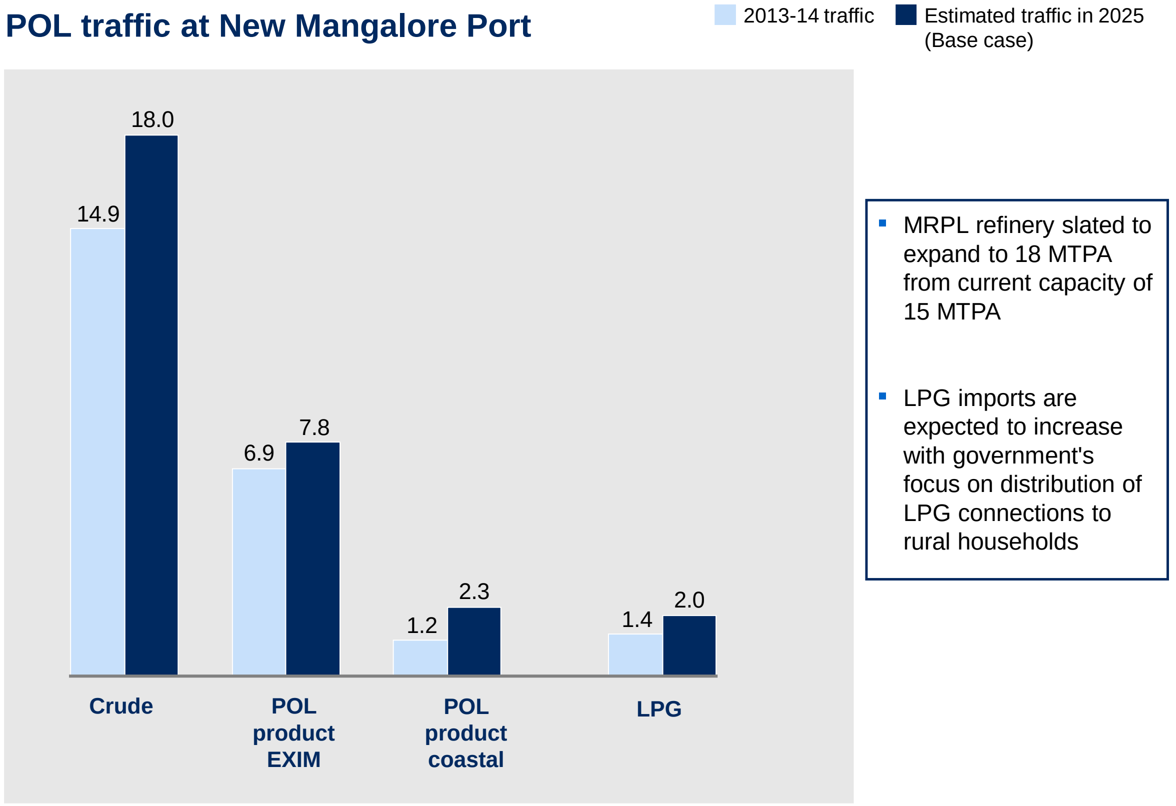
NMPT is the only major port in Karnataka located in southern part of Karnataka. The port has 15 berths - 9 general cargo berths, 5 for POL and 1 for coal - UPCL. Total traffic handled by the port in 2014-15 was ~37 MTPA, with POL accounting for ~63% of total traffic. Cargo traffic is expected to increase to ~44 MTPA by 2020 and 53-63 MTPA by 2025.

The origin-destination of key cargo (accounting for greater than 85% of the total traffic) for all Indian ports and development of traffic scenarios for a period of next 20 years has been carried out by **McKinsey & Co.** as mandated for this project. Accordingly, based on a macro-level analysis the future traffic for New Mangalore up to 2035 has be derived as presented in this chapter.

6.2 Major Commodities and their Projections

6.2.1 POL

NMPT currently handles ~23 MTPA of POL. ONGC is the captive customers for POL, handling 15 MTPA of crude imports and 8 MTPA of refined products exports. NMPT has the highest productivity in POL amongst Indian ports. Over the last years, POL volumes have reduced by 1 MTPA due to reduction in MRPL's refined product exports. Going forward, MRPL refinery is slated to expand to 18 MTPA from the current capacity of 15 MTPA. LPG imports are expected to increase with government's focus on distribution of LPG connections to rural households. Cumulatively, the POL volume is expected to reach 25 MTPA by 2020 and 30-33 MTPA by 2025. The split of 2013-14 POL traffic and the projected volumes in 2025 is shown in **Figure 6.1**.



SOURCE: Indian Petroleum and Natural Gas Statistics 2013-14; Basic Port Statistics of India 2013-14

Figure 6.1 POL Traffic Forecast for New Mangalore Port

6.2.2 Coal

NMPT handles 8.2 MTPA of coal, primary customer being Udupi Power plant which is based on imported thermal coal. Shutting down of coal handling in Chennai port has also provided some spill over traffic to NMPT. There is limited opportunity for additional coal volumes at NMPT, mainly because of the connectivity issues to Bellari and Hospet (Shiradi Ghat). Due to this, it is more economical to transport coal through Krishnapatnam and Mormugao. Going forward coal volume is expected to reach ~12 MTPA by 2020 on the back of Udupi power and import substitution, and 13-14 MTPA by 2025.

6.2.3 Containers

NMPT currently handles ~63,000 TEUs with most of the cargo getting transhipped from other ports. Karnataka is the only hinterland for the port. The cargo handled at the port is majorly coffee exports from the hinterland and cashew imports. There is potential to increase the container volumes from Mysore, Bangalore, Hassan and Bellari, provided the connectivity is improved and mechanized facility is installed. Due to poor connectivity, most of the container traffic moves to Chennai port. Going forward, the container traffic is expected to marginally increase to 0.1-0.12 MTEUs by 2025 driven by growth of the hinterland.

COMMODITY TRAFFIC | CONTAINER

Mangalore is the only hinterland for Mangalore port

Primary hinterland of port

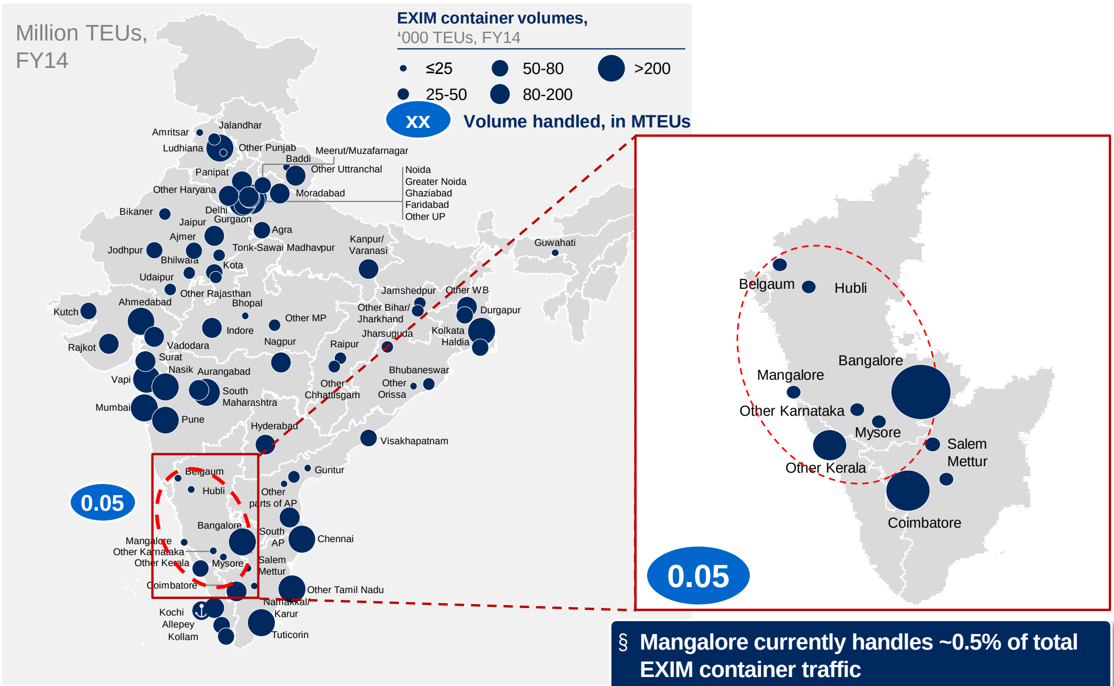
EXIM container volumes, '000 TEUs, FY14	JNPT	Mundra	Chennai	Pipavav	Tuticorin	Haldia	Cochin	Visakha-patnam	Mangalore
NCR+Punjab	936	1,264	0	329	0	0	0	0	0
Maharashtra	2,121	54	0	0	0	0	0	0	0
Tamil Nadu	0	0	1,240	0	484	0	0	0	0
Gujarat	552	262	0	169	0	0	0	0	0
Uttar Pradesh	228	274	0	107	0	0	0	0	0
West Bengal	0	0	0	0	0	458	0	0	0
Rajasthan	43	448	0	60	0	0	0	0	0
Karnataka	94	0	163	0	66	0	0	0	50
Kerala	0	0	0	0	0	0	351	0	0
Andhra Pradesh	75	0	65	0	0	0	0	110	0
Madhya Pradesh	43	70	0	14	0	0	0	29	0
Bihar/Jharkhand	0	0	0	0	0	85	0	8	0
Uttaranchal	95	0	0	0	0	0	0	0	0
Orissa	0	0	0	0	0	12	0	69	0
Chhatisgarh	15	18	0	14	0	0	0	15	0
North East	0	0	0	0	0	7	0	0	0
Port total	4,202	2,390	1,468	693	551	562	351	263	50

SOURCE: APMT; Expert interviews

Figure 6.2 Hinterland Analysis for New Mangalore Port

COMMODITY TRAFFIC | CONTAINER

EXIM container generating hinterland for Mangalore port



- Mangalore currently handles ~0.5% of total EXIM container traffic
- Almost all of the traffic gets transshipped

SOURCE: APMT; IPA statistics; Stakeholder interviews

Figure 6.3 Container Generating Hinterland for New Mangalore Port

6.2.4 Other Cargo

NMPT has 1.5 MTPA of KIOCL's captive cargo which includes 0.9 MTPA of iron ore fines imports and 0.5 MTPA of iron ore pellets exports. There is limited scope to expand here due to the mining ban and fall in the iron ore prices globally.

NMPT also handled ~0.7 MTPA of fertilizers in 2015. The volumes have fallen by ~30% since 2008, as it has moved to other ports like Krishnapatnam. There is potential to increase the volume by reducing the handling costs through mechanization.

The **Table 6.1** summaries the traffic potential for key commodities for New Mangalore port.

Table 6.1 Mangalore Port Traffic Projections

Mangalore Port - Traffic Projections

Units: MMTPA (except Containers)

xx Base Scenario xx Optimistic Scenario

Commodity	2014-15	2020	2025		2035		Remarks
Liquid Cargo							
POL	22.98	25.1	30.3	33.3	37.2	41.1	• MRPL refinery expansion and possibility of LNG terminal in optimistic case
Dry and Break Bulk Cargo							
Thermal Coal (Loading)	0.0	0.0	0.0	0.0	0.0	0.0	
Thermal Coal (Unloading)	2.73	11.2	12.9	14.3	21.4	25.5	• Udupi Power and import substitution
Coking Coal	5.43	1	1	1.2	1.2	1.4	• Diversion of traffic by JSW Dolvi is expected to reduce traffic at the port
Iron Ore	1.55	1.5	1.5	6.0	4.9	6.0	• Import of fines and export of pellets (KIOCL)
Fertilizers	0.75	0.9	1.1	1.1	1.7	1.8	
Containers and other Cargo							
Containers (MnTEU)	0.06	0.08	0.10	0.12	0.17	0.21	
Others	2.21	2.5	3.4	3.5	5.6	6.3	• Highly fragmented
Total (MMTPA)	**36.5**	**43.4**	**51.7**	**61.2**	**74.5**	**85.2**	

Conversion Factor Used for Containers Projections: 1 TEU = 14.6 Tons

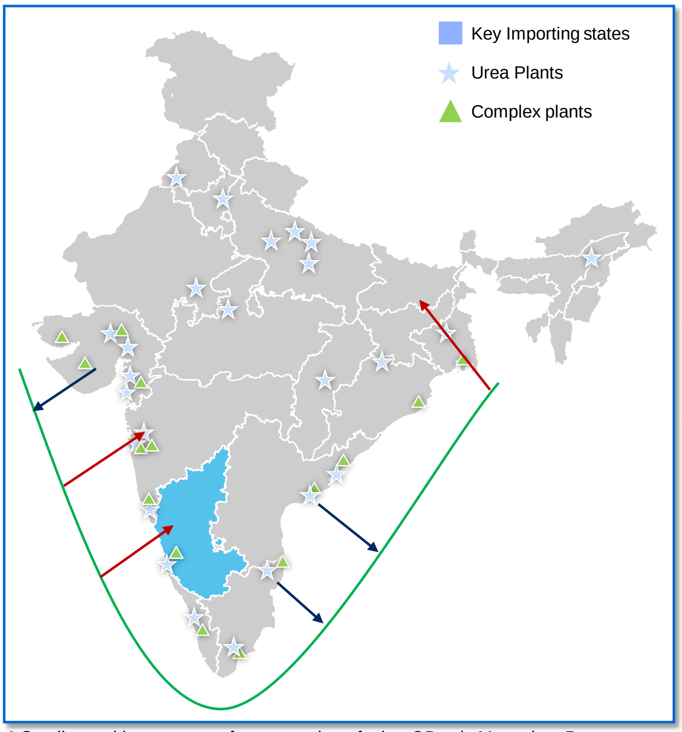
6.3 Coastal Shipping Potential

Apart from the above mentioned traffic, there is additional opportunity of coastal shipping that can be potentially tapped:

§ **Fertilizers:** There is a potential to coastally ship ~1.5 MTPA of fertilizers to Mangalore port by 2025. This movement would primarily be from the source states of Tamil Nadu, Andhra Pradesh, Gujarat and Odisha.

COASTAL SHIPPING FERTILISERS

~1.5 MTPA fertilizer can be shipped to Mangalore Port by 2025



Key ODs with coastal shipping potential to Mangalore Port

Route[1]	Volume, '000 TPA
Tamil Nadu to Karnataka	442
Andhra Pradesh to Karnataka	245
Gujarat to Karnataka	239
Odisha to Karnataka	218

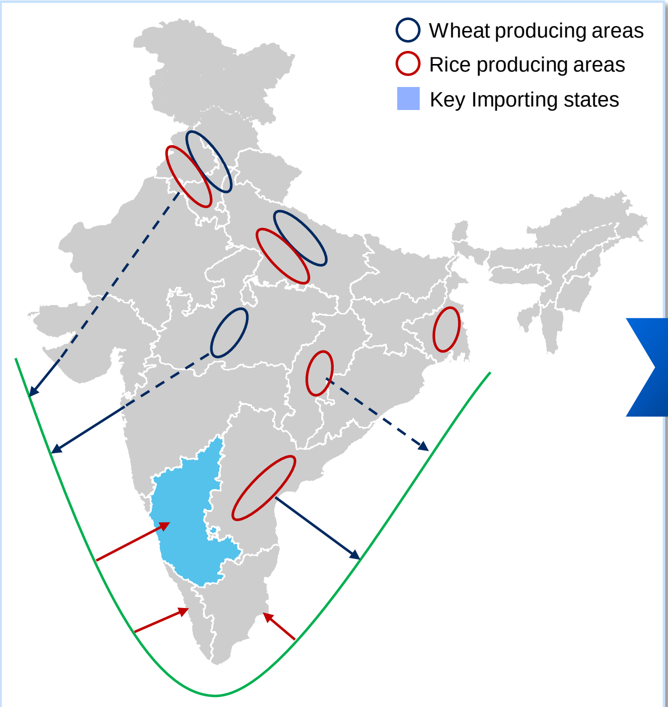
1 Small quantities can come from a number of other ODs via Mangalore Port

Figure 6.4 Coastal Fertlizer Traffic Forecast

§ **Food grains:** There is a potential to coastally ship ~6 MTPA of food grains to Mangalore port by 2025 from Punjab and Haryana via ports in Gujarat. Small movements can also happen from Uttar Pradesh and Chhattisgarh.

COASTAL SHIPPING FOODGRAINS

~6 MTPA of food grains can be coastally shipped to Mangalore Port by 2025; Punjab and Haryana being key source states



Key ODs with coastal shipping potential to Mangalore Port

Route[1]	Volume, '000 TPA
Punjab to Karnataka	2,888
Haryana to Karnataka	1,294
UP to Karnataka	401
Chattisgarh to Karnataka	225

1 Small quantities can come from a number of other ODs via Mangalore Port

Figure 6.5 Coastal Food Grain Traffic Forecast

§ **Cement:** ~2.5 MTPA of cement can be coastally shipped to Mangalore port from the proposed cement cluster in Andhra Pradesh by 2025 contingent on the development of central AP port.

COMMODITY TRAFFIC CEMENT

Additional ~2.5 MTPA can be coastally shipped to Mangalore Port from the proposed cement cluster in AP by 2025

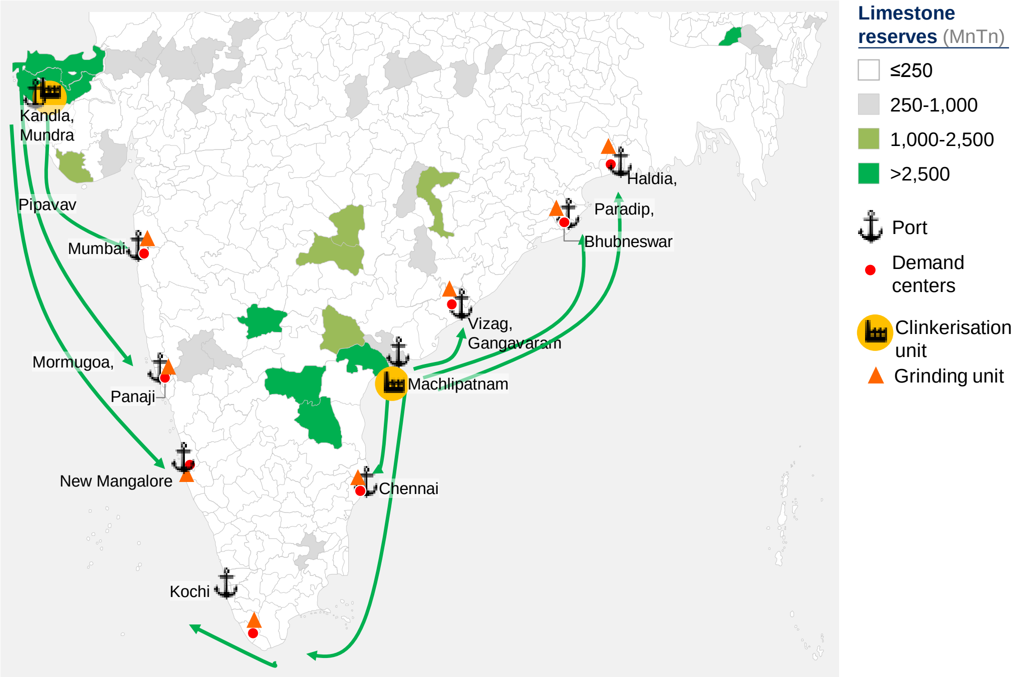


Figure 6.6 Coastal Cement Traffic Forecast

The **Table 6.2** summarizes the potential of coastal movement for key commodities.

Table 6.2 Mangalore Port – New Opportunities Possible via Coastal Shipping

Units: MMTPA (except Containers)

Commodity	2020	2025	2035
Steel (Loading)	0.11	0.15	0.27
Steel (Unloading)	0.07	0.10	0.17
Cement (Loading)	0.03	0.04	0.06
Cement (Unloading)	0.00	2.50	2.50
Fertilizer (Loading)	0.02	0.03	0.04
Fertilizer (Unloading)	1.32	1.60	2.37
Food Grains (Loading)	-	-	-
Food Grains (Unloading)	4.85	5.90	8.73

- 2.5 MMTPA can be shipped from Central AP cement cluster (If Central AP port comes up)

7.0 CAPACITY AUGMENTATION PROPOSALS

7.1 General

The capacity of the existing berths has been worked out as presented in **Table 7.1**.

Table 7.1 Capacity of Existing Berths

Cargo Berths	Cargo Handled	I/E	Current Capacity (MTPA)
Liquid Bulk			**49.17**
§ SPM	Crude	I	18.0
§ Berth 13	LPG/ POL	I/E	23.37
§ Berth 14	Crude Oil / POL	I/E	
§ Berth 15	Crude Oil / POL	I/E	
§ Berth 16	POL / Chemical / Edible Oil	I/E	
§ Berth 17	Crude Oil / POL / LPG / Chemical	I/E	7.8
Break Bulk			**23.20**
§ Berths 1-8	Breakbulk & Dry& Liquid Bulk (Edible Oil and FRM-Liquid at Berth no.4, 5, 6) – Multiple Cargo berths	I/E	16.60
§ Berth 18	Iron ore Pellets (KIOCL) & Dry Bulk	I/E	6.60
Dry Bulk			**5.4**
§ Berth 9	Coal (UPCL)	I/E	5.4
Total			**77.77**

At present the port is working at about 44% of its capacity i.e. 36.5 MTPA was handled in the year 2014-2015.

7.2 Requirement for Capacity Expansion

Even though prima facie it appears that the overall capacity is slightly more than the overall traffic, there is shortfall on facilities for handling specific cargo. While comparing the existing capacities for New Mangalore port with the traffic projections as shown in **Table 7.2**, it could be seen that in 2025 there would be a shortfall of capacity for dry bulk cargo.

Table 7.2 Requirement of Capacity Addition Over Master Plan Horizon (MTPA)

Commodity	Current Capacity (MTPA)	2020		2025		2035	
		Forecast Traffic (MTPA)	Capacity Augmentation over current (MTPA)	Forecast Traffic (MTPA)	Capacity Augmentation over current (MTPA)	Forecast Traffic (MTPA)	Capacity Augmentation over current (MTPA)
Liquid Cargo	49.17	25.1	0	30.3	0	37.2	0
LNG	0	0	0	0	0	0	0
Break Bulk/Dry bulk/other liquid bulk/ Containers	16.60	4.6	0	5.96	0	9.782	0
Iron Ore/other Dry Bulk	6.60	1.5	0	1.5	0	4.9	0
Coal (UPCL)	5.4	12.2	6.8	13.9	8.5	22.6	17.2
Total	**77.77**	**43.4**	**6.8**	**51.7**	**8.5**	**74.5**	**17.2**

It is therefore necessary that action be initiated immediately for the development of Coal handling facility so that the projected throughput for year 2020 could be handled at port. Augmentation of coal handling facilities would be needed in subsequent phases of development.

Similarly, with the proposed upcoming Kochi-Mangalore-Bangalore pipeline, there might be the possibility of importing LNG from Kochi taking away NMPT’s share. Therefore, the possibility of setting up of terminal facilities for LNG handling has been explored.

7.3 Opportunities for Mechanisation

Following are the opportunities available at NMPT for mechanisation to improve the productivity at berths:

7.3.1 Mechanisation of Fertiliser Handling

There is a requirement for handling of fertilizers through mechanised/semi mechanised means and bagging facility at port. Currently, the port is handling 0.7 MTPA of fertiliser which is expected to increase to 1.7 MTPA by 2035. Apart from this, there is a possible opportunity for fertiliser handling through coastal shipping. It has been assessed that the coastal shipping is 1.3 MTPA in 2020 increasing to the tune of 2.4 MTPA by 2035.

7.3.2 Mechanisation of Food Grain Handling

Similarly, in view of the significant throughput of food grains import expected at the port through coastal movement, it is suggested to provide a fully mechanised bulk grain handling facility comprising of unloader, conveyor system, storage silos, bagging machine etc.

7.3.3 Dedicated Facility for Container Stacking with Effective Space Utilisation

At present the containers are stacked at various areas of port. As no specialised equipment are used and without any specific planning, the space is not being effectively utilised. It is therefore suggested to allocate a dedicated space for container stacking with suitable infrastructure.

8.0 PORT EXTERNAL CONNECTIVITY AND INFRASTRUCTURE

8.1 General

For the efficient performance of a port, the effective hinterland connectivity through the national highway and trunk railway routes are essential to ensure faster receipt and evacuation of cargo. Accordingly, the existing situation at New Mangalore Port and constraints and proposals to ensure seamless traffic movement are described in this section.

Containerized cargo at NMPT has been growing at a fast pace since 2008 and there is significant hinterland demand that currently goes to other East coast ports. The main container cargo generating centres to the port are Hassan – agro based products, Mysore. There are four key challenges that need to be addressed to attract additional container cargo apart from the movement of other cargo:

§ Widening of Shiradi Ghat section

§ Widening of NH 66 stretch between BC Road to Kundapura

§ Widening of Stretch of NH-50 between Mangalore and Shimogha

§ Widening of Hubli Ankola Road Stretch

§ Widening of Road from Mani to Mysore (NH275) and thereon to Nanjangudu

8.2 External Road Network

8.2.1 Widening of Shiradi Ghat Stretch of NH 75

Hassan is one of the main container cargo generating hub for Mangalore port. Cargoes like agro based products, coffee, cashew are exported from this place which is also a home for many other small scale industries. NH 75 is one of the main connectivity, connecting Hassan and Bangalore to Mangalore. NH 75 passes through towns of Nelamangala, Kunigal, Channarayapatna, Hassan, Sakleshpura, Uppinaangadi and reaches Mangalore. It climbs the Western Ghats through the Shiradi range. Total length of this highway is 328 km. The NH 75 passing through Shiradi Ghat section is as shown in **Figure 8.1**.

Shiradi Ghat is most narrow and steep section. The stretch of 26 km passing through the Western Ghat is a major nightmare in this highway. The Shiradi Ghat section is the dreaded section in this highway. The condition of this national highway gets worse during monsoon (rainy) season especially in ghat section. The road most of the time of the year is filled with potholes and the problem of the pothole ridden stretch does not seem to be getting solved as large and heavy trucks pass through this stretch on their way to the seaport at Mangalore (**Figure 8.2**). Travellers avoid this route and take either Bangalore – Mysore –Kushalnagara - Mangalore or Charmadi route during rains from month of June to October, even if it takes longer time. The trucks and trailers carrying LPG and other petroleum products from MRPL to Bangalore have been frequent cause of accidents in this road.

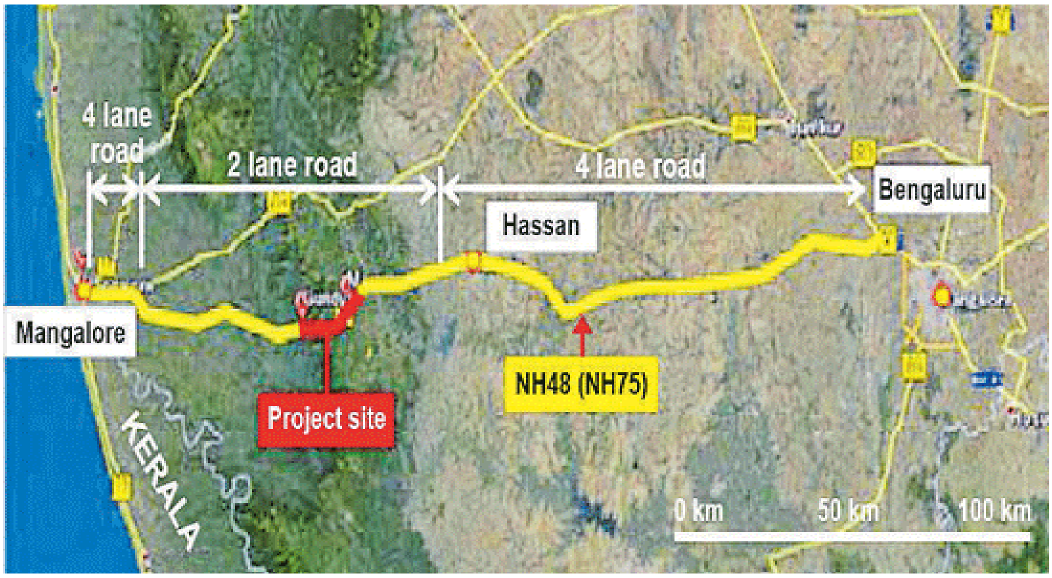


Figure 8.1 NH 75 passing thorugh Shiradi Ghat Section

Figure 8.2 Shiradi Ghat Stretch on NH 75

Currently, the section between Mangalore and Shiradi Ghat is a 2 lane road which needs to be widened for smooth traffic flow. In order to overcome these recurring hassles, the state PWD has taken up the task of developing the Shiradi bypass road as shown in **Figure 8.3**.

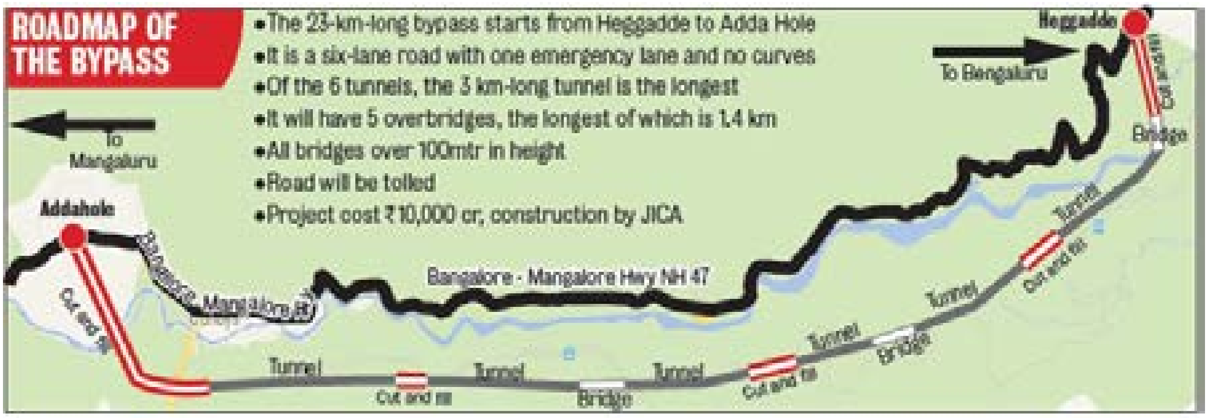


Figure 8.3 Proposed Shiradi Bypass Road

In the 23 km, this road will have six tunnels, five over-bridges and a six- lane road. The estimated cost of the project is Rs. 10,000 crore and the 23 km of by-pass road will be constructed between Heggadde village near Sakleshpura to Addahole near Gundiya.

NH 75 is getting widened and upgraded to the 60-meters wide, 4-lane highway. Mangalore - B.C Road (45 m wide) and Hassan – Nelamangala (60 m wide) section has been upgraded to 4-lane highway. Widening of the stretches from Mangalore to Gundiya into 6 lanes, from Gundiya to Sakleshpura into 4 lanes and Sakleshpur to Bengaluru into 6 lanes will increase the business of NMPT with the improvement of cargo flowing into the port.

8.2.2 Widening of Road from Mani to Mysore (NH275) and thereon to Nanjangudu

The Mangalore Mysore highway is currently a 2 lane State Highway 88. This highway starts from its junction with NH-75 near Bantwala connecting Puttur, Sulya, Madikeri, Priyapatna, Mysore, Srirangapattana, Mandya, Channapatnam, Ramanagaram and terminating at its junction with new NH No. 75 on Bengaluru. The route connects the port city with Mysore and Nanjangudu which are the main cargo generating centres to the port. In order to enhance the movement of traffic, the government has taken up the task of widening the current 2 lane road to 4 lanes. This road would then be NH275.

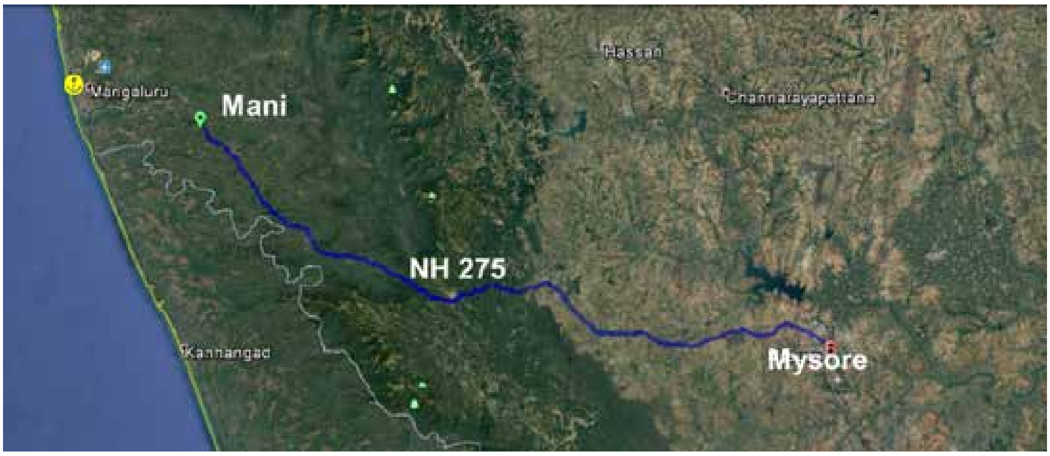


Figure 8.4 Connectivity from Mani to Mysore

Figure 8.5 Road Strech Connecting Bangalore to Mysore and Nanjangudu

The Karnataka Government's INR 3,000 cr. proposal to convert the Bangalore-Mysore road into a six-lane national highway has been approved. The 123 km six-lane highway stretch would now be part of NH275 and NHAI will be funding for the entire project.

From Nanjangudu goods like tyre, cloths, coffee, special coffee and automobile spare parts will flow towards NMPT if the connectivity between Mysore, Bengaluru with New Mangalore Port gets improved. This in turn increases the cargo of NMPT significantly.

8.2.3 Widening of NH 66 Stretch between BC Road to Kundapur

NH 66 is passing in front of the port, which connects B C (BANTWAL CROSS) road and Kundapur which is heavily congested. From the current situation the road is fully saturated and it needs to be widened from 4 lanes to 6 lanes, which will allow the free movement of traffic from the NMPT.

Figure 8.6 NH 66 – Stretch Between BC Road and Kundapur

8.2.4 Widening of Stretch of NH-50 between Mangalore and Shimoga

NH 50 connects Mangalore to Sholapur which has a total length of 691 km. It is a 4 lane road and some stretches are 2 lanes and some stretch is being upgraded to 4 lanes. Though the road is a national highway, it is narrow along many stretches, which causes frequent mishaps. In particular, the stretch between Chitradurga and Hospet is extremely bad and with heavy truck traffic.

The stretch of 50 km between Shimoga and Mangalore which is a 2 lane road causes heavy congestion of traffic passing through Moodabidri, Karkala, Sringeri, Koppa and Thirthahalli. It is proposed to widen the stretch into a four-lane, 60 m wide grade separated highway. The road would be widened to four lanes between Mangalore and Moodbidri and Karkala. As the forest department does not allow the widening of the roads going through the Western Ghats, it is expected that a tunnel would be required to be built, similar to the NH75 tunnel to the Shiradi Ghat. A tunnel would reduce travel time by 3 hours, reduce fuel usage, and increase the productivity of the industries around. It will also provide an alternative route for the trucks transporting materials to the seaport and air-cargo facility at Mangalore.

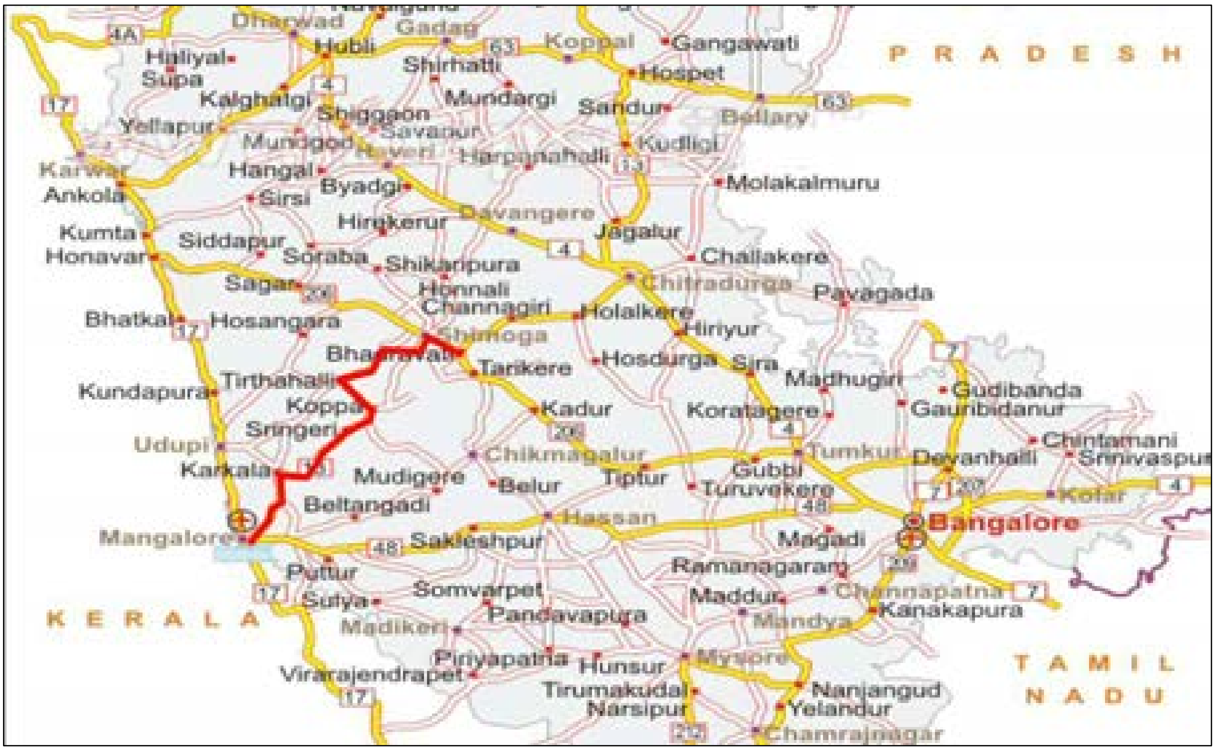


Figure 8.7 Stretch Between Mangalore and Shimoga

8.2.5 Widening of Hubli Ankola Road Stretch

NH 63 linking Ankola to Hubli is the lifeline for goods vehicles in the vast Hubli-Dharwad, Bellary and North Karnataka hinterland to Mangalore Port. NH 63 is currently a two lane highway. Its significance is borne by the fact that approximately 28,000 vehicles pass over it every day. Many of these are heavy vehicles overloaded with granite and other cargoes to the port. A highway on which more than 15,000 vehicles run daily, is qualified for four-laning and that NH 63, with 28,000 vehicles is still a two-lane highway. Traffic jams and the vehicles skidding frequently have become common. The journey between Hubli and Karwar or Hubli and Ankola has become laborious and time-consuming because buses and light vehicles should run slow.

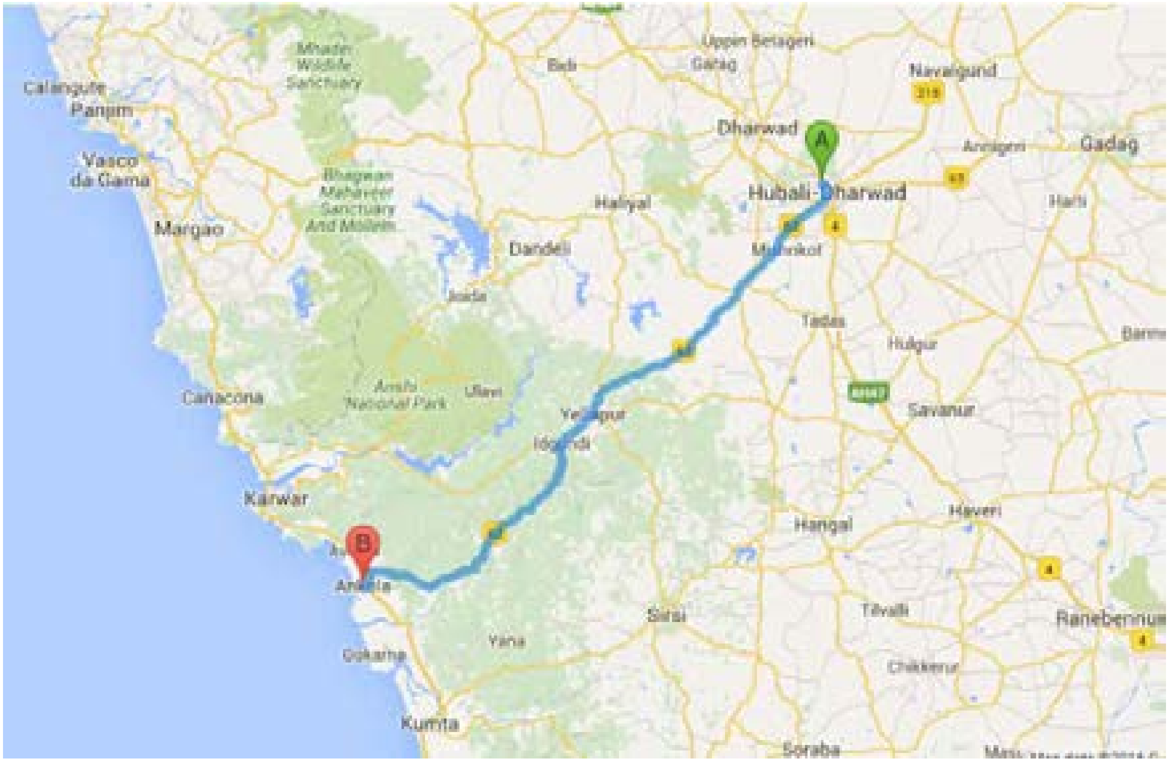


Figure 8.8 Road Stretch Connecting Hubli and Ankola

For efficient movement of cargoes to the port and from the port to the hinterland, it is proposed to widen NH 63 from Ankola to Hubli to 4 lanes from the existing 2 lanes. However, the prerequisite for the widening of this highway would be the Clearance from the Union ministry for Forests and Environment as NH-63 runs through a thick evergreen valley and forests of the Arabial Ghat (part of Western Ghats).

8.3 Rail Connectivity

The evacuation of cargo through New Mangalore port is predominantly by road. However, some portion of cargo is handled by rail as well. Currently, the port handles 6 rakes per day apart from 3 passenger trains daily along the Hassan Mangalore line, which has the capacity of 10 – 12 rakes per day. This route has still has the spare capacity to carry additional cargo rakes to cater the augmented port capacity.

Similarly, along the Mangalore-Udangudi-Goa-Mumbai line only 3 rakes/day of coal are plying along this route to Udangudi but it is likely to go up once additional coal traffic required for the power plants in hinterland materialises. However, it is assessed that the port has adequate rail evacuation capacity to meet the currently projected traffic to be handled by rail.

9.0 SCOPE FOR FUTURE CAPACITY AUGMENTATION

9.1 FSRU for LNG Terminal

9.1.1 General

The New Mangalore Port is in the close proximity of Middle East Countries and has been identified as one of the LNG import ports in India. A terminal can be constructed to handle LNG, which will enhance the port capacity.

The main requirement would be to locate a berthing facility which is away from the navigational areas and other berthing facilities by at suitable safety distance. Apart from that the transit storage tanks should also be at a suitable safety distance from the other port facilities. The safety distances are governed by the risk assessment studies but as per industry practice with a radius of 250 m from the transfer point no shipping/cargo handling activity should take pace.

9.1.2 LNG Potential

Mangalore is in the eco-sensitive area of the Western Ghats, the industries are keen to use clean energy, LNG, to meet the statutory requirement. At present MRPL, OMPL and MCF require around 1.0 MT of LNG per annum. MCF is also planning to expand its capacity, thereby there may be additional requirement of 0.5 MT, after 4 years. That apart, Ministry of Urban Development, Govt. of India has declared Mangalore as Smart City and there would be requirement of 0.5 MT of LNG for domestic consumption.

Considering the current throughput limited to 2 MTPA only, it is suggested that a facility with an FSRU could be built, so that the significant investment on the very expensive and fixed infrastructure such as liquefied storage tanks and regasification units is avoided.

9.1.3 Location to Setup LNG Facility at NMPT

At present the memorandum of understanding (MoU) has been signed between ONGC-MRPL and NMPT for setting up of an LNG facility at the port.

AECOM carried out the initial assessment of the most optimum location for this facility. As per the industry practice for initial planning the LNG jetty should be located such that the jetty head (or the transfer point) is at a distance of 250 m to 500 m from the areas of port activities. This was accordingly considered while arriving at the location of the jetty.

The various locations examined at shown in **Figure 9.1**.

Figure 9.1 Alternative Locations for Development of LNG Facility at NMPT

The summary details of the evaluation are as under:

- Alternative location 1 has an adequate space for locating the berthing facility as well as has adequate backup area for onshore infrastructure. The main issue however at this location seems to be that the safety distance of only about 250 m is available between the LNG berth and the other port facilities.
- Alternative location 2 in the lee of the north breakwater is exposed to the predominant south west monsoon waves and therefore may result in some downtime at berth. The ships would first need to enter the basin and then shall be brought back to the berth outside harbour. Further the backup area available is proposed to be utilised for berths 12 and 11, leaving no space for LNG facilities. Also on the rear side of north breakwater is the Panambur beach and development of such a facility to the tourist vicinity pose a severe safety concerns. Further at this location a safety distance of even 250 m is not available.
- Alternative location 3 is protected from SW monsoons but constraint like navigation as in alternative location 2. However, the backup area as available for alternative location 1 can be utilised for onshore facilities.
- Alternative 4 requires creation of a new harbour altogether for LNG terminal only. This would involve construction of 2200 m long breakwater and dredging in the channel and harbour basin at relatively higher capital cost. The backup area as available for alternative location 1 can be utilised for onshore facilities.

As could be seen from the evaluation above, alternative locations 1, 3 and 4 appear to be suitable for setting up of the LNG FSRU terminal. The indicative cost estimates for development of basic marine infrastructure for alternatives 1, 3 and 4 are presented in **Table 9.1** below:

Table 9.1 Cost Comparision of Marine Infrastructure

S. No.	Item	Capital Cost (INR in Crores)		
		Alternative 1	Alternative 3	Alternative 4
1.	Breakwater	-	-	278
2.	Berth and Approach Trestle	156	160	165
3.	Dredging	-	-	155
Total		**156**	**160**	**598**

It is observed from the above table Alternative 4 involving an outer harbour, would involve considerable investment as compared to alternative 1 and 3. It is to be further noted that the proposed investment of Rs. 598 crores is for the basic infrastructure of LNG terminal only. The total cost of the LNG terminal including top side handling facilities and other backup infrastructure would be in the range of Rs. 2,500 crores.

It is therefore essential that detailed site specific mooring, navigation simulation and safety studies are required to be carried out for Alternative 3, to establish whether the safety distances offered at these sites are acceptable or not. Only thereafter the detailed studies for alternative 4 should be taken up.

9.2 Utilisation of Berth 8 and Backup Area as Container Terminal

The port is growing aggressively towards handling the containers and accordingly looking for the options of developing a full-fledged container terminal. Currently, the port is carrying out the container storage operations in the stackyard near the entrance gate and at the area behind berth 4 (**Figure 9.2**). With these are the two different areas of operation, results in the handling inefficiencies and high operational costs.

Based on the traffic forecast, NMPT has the potential to attract more container cargoes as depicted in traffic forecast section. Accordingly, there is a need to provide a full-fledged container handling facilities.

Figure 9.2 Scattered Storage of Containers

With a view of providing the full-fledged container handling facility, it is proposed that berth 8 and its backup area be developed as a container terminal on PPP basis (**Figure 9.3**).

Figure 9.3 Container Handling Facility at Berth 8

6 bays of RTGs shall be provided perpendicular to the berth 8. The RTGs capable of stacking 5 high shall be provided. With this arrangement, it would be possible to provide about 1,350 ground slots. With a dwell time of 3 days, an average stacking height of 3.5 and 25% peaking factor, this container yard can cater to the annual container throughput of about 400,000 TEUs, which is well within the projected traffic. The advantage of locating the container yard at this location is that in the event of berth 8 being occupied the containers could be handled at berths 6 and 7 also.

9.3 Berths 10 and 11

Based on the traffic forecast, additional capacity would be needed for coal handling facilities. In this regard berths 10 and 11 are most suitable to be developed in stages with fully mechanised system for bulk cargo handling. Being the fully mechanised system, the storage area could be located away from the berths. The possible storage area for these berths could be located in the proposed additional stacking area as shown in **Figure 9.5**.

9.4 Additional Stacking Area for Bulk and Breakbulk Cargo

With the proposed container terminal and the ongoing development of berth 12, there would be requirement for storage area for cargo that would be handled at berth 10 and 11. The area availability for berth 8, 9 and 12 is as shown in **Figure 9.4**.

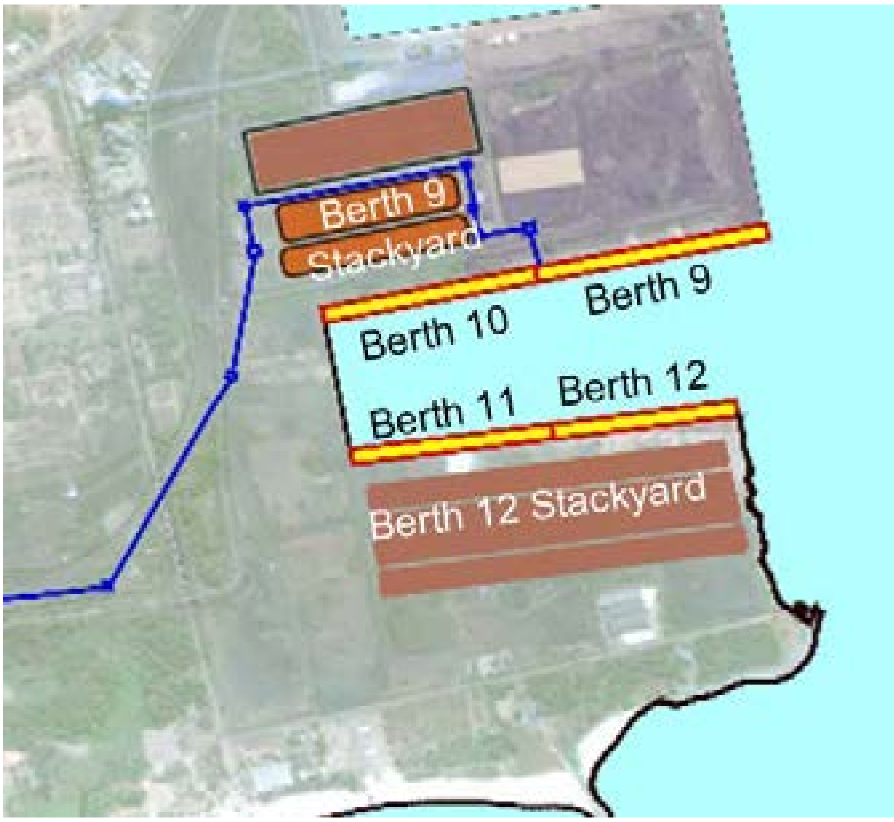


Figure 9.4 Storage Area for Berth 8, 9 and 12

It is proposed to annex the area of the port marshalling yard within the port custom boundary with a view to provide the additional storage area for bulk and breakbulk cargo. This arrangement would provide an overall area of 120 ha (i.e. 300 acres) of land, as shown in shown in **Figure 9.5**, for port operations and storage.

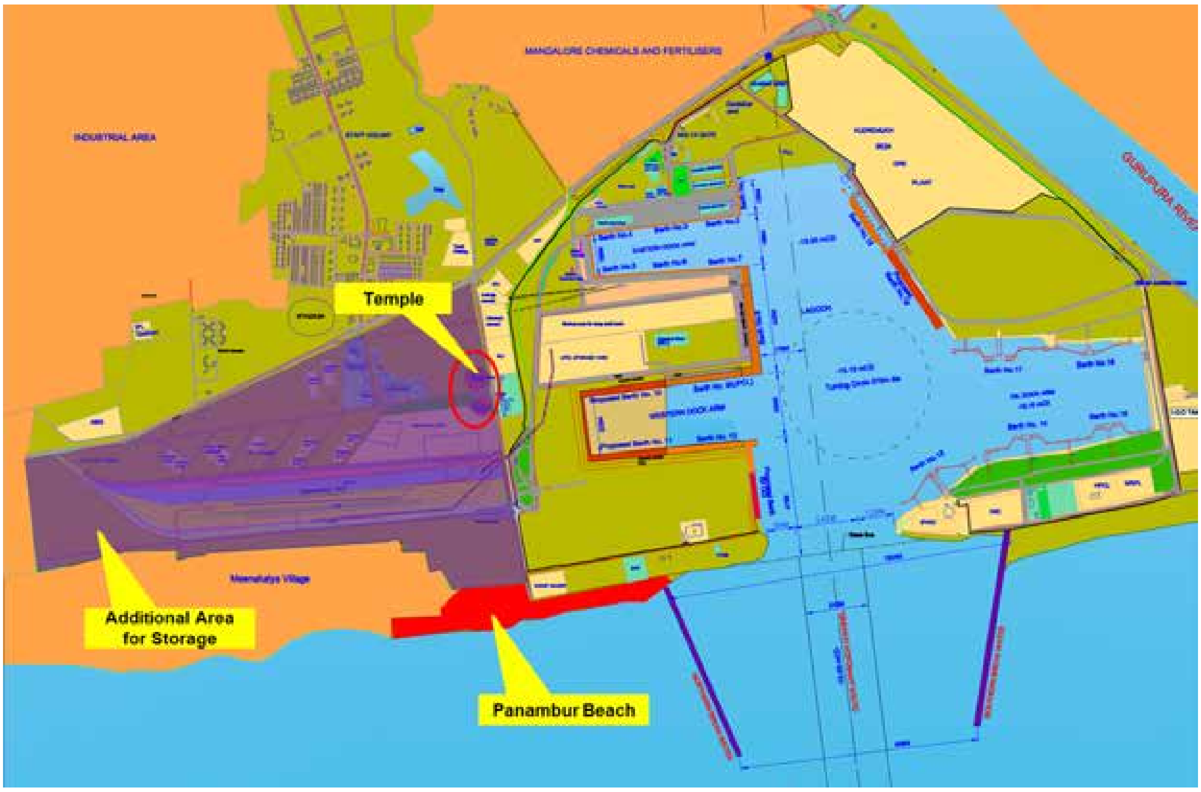


Figure 9.5 Possible Stacking Area for Bulk and Breakbulk Cargo

However it needs to be ensured that while doing so the free access to Panambur beach, which is one of the tourist spot, and access to two of the temples along this road, is not blocked. It is therefore suggested to provide an elevated corridor from the temple up to the beach. The current approach road to the temple may be retained.

9.5 Potential for Mechanisation

9.5.1 Mechanised Fertilizer Handling Facility

Currently, the port is handling the fertiliser at Berth 2 through conventional means by dumping the fertiliser on the berths and transporting to the respective storage sheds for neem coating and bagging facility. In order to provide a clean cargo handling, it is proposed to provide mobile hoppers at berth where the grab/ ship gear transfer the cargo from ship to hopper for truck loading (**Figure 9.6**).

Figure 9.6 Mobile Hopper for Truck Loading

The above arrangement is suitable till the traffic reaches a threshold level of about 1.5 MTPA utilising the potential offered by coastal shipping, beyond which it is suggested to fully mechanized berth 2 for fertilizer handling. This would comprise of Unloaders (mobile Harbour cranes) at berth, conveyor belt to feed fertilizer into covered storage facilities and thereafter to the mechanized bagging plant having bagging and stitching machines.

Figure 9.7 Mechanised Fertiliser Handling Facility

9.5.2 Mechanised Food Grain Handling Facility

In line with the government's vision of promoting coastal shipping as an alternative to rail movement of food grains, it is envisaged that a large mechanized food grain loading facilities will be installed in Kandla to export wheat, maize and oil cakes from a single integrated mechanized facility. It is noted that Mangalore port will be one of the important recipients of food grains in bulk from such facility more particularly wheat in bulk. If the significant traffic projections for food grain import materialises then there would be a rationale for setting up a mechanised grain unloading terminal in NMPT. The system envisaged includes a mobile tyre mounted grain unloader, and conveying them through a closed pipe conveyor on to storage silos. The evacuation of stored grains from silos will be through an automatic grain evacuator, an automatic bagging machine and conveying to bags into the Lorries directly and loading automatically without any manual handling. It is suggested to utilise berth 3 for installing the mechanised food grain facility.

Figure 9.8 Mechanised Food Grain Unloading Facility

9.6 Additional Deep Draft Berths at Port

9.6.1 General

NMPT has berth 8 as its only deep draft berth capable of handling vessels in the range of 80,000 – 100,000 DWT vessels. This berth handles majorly the dry bulk cargo. This berth handled a total of 4.9 MTPA of cargo in 2014-15 of which 88% of the cargo constituted to be coal. With the conversion of Berth 8 to full fledge container terminal, there is a requirement of development of deep draft berth at the port. In this regard, AECOM explored the following options to provide deep draft berth at NMPT.

9.6.2 Option1- Deepening of Eastern Arm

Eastern arm has 6 berths (berth 2 to 7) with the draft varying from -9.5 m CD to -10.5 m CD. The cargo complexion handled in this arm is as shown in **Table 9.2**.

Table 9.2 Cargo Complexion Handled in Eastern Arm

Cargo Handled	Berth 2	Berth 3	Berth 4	Berth 5	Berth 6	Berth 7
Liquid Bulk	-	-	1,82,305	3,10,397	1,66,428	-
Dry Bulk	3,69,723	2,33,722	7,500	3,35,630	1,81,035	4,18,129
Break Bulk	9,153	11,822	2,996	48	53,295	25,225
Containers	95,226	5,48,321	42,597	-	76,913	77,498
Total	**4,74,102**	**7,93,865**	**2,35,398**	**6,46,075**	**4,77,671**	**5,20,852**

The average occupancy of these berths is about 28%. The low berth occupancy is attributed to the following.

§ Cargo complexion is fragmented and is handled in small parcel sizes.

§ Cargoes are handled through ship gears and no equipment are deployed on berth

It may be noted from the above table that approximately 91% of container traffic is handled at berths in the eastern arm. With the proposed new container terminal, all the container cargo would shift to berth 8. Berth 5 & 6 which predominantly handles non-hazardous liquid (palm/ edible oil) cargo, cement and fertiliser for which necessary infrastructure like pipelines, conveyors are in place.

The eastern arm is approximately 600 m long with the tapered width varying from 195m to 160m. In order to cater deep draft vessels of panamax ships, it is required to provide the dock width of approximately 220 m to 250 m.

The berths in the eastern arm were constructed when the port was commissioned i.e. 1975. Most of these berths have attained their design life and need retrofits. Given the established infrastructure along berth 5-7, it is proposed to increase the width of the dock along berth 1-3.

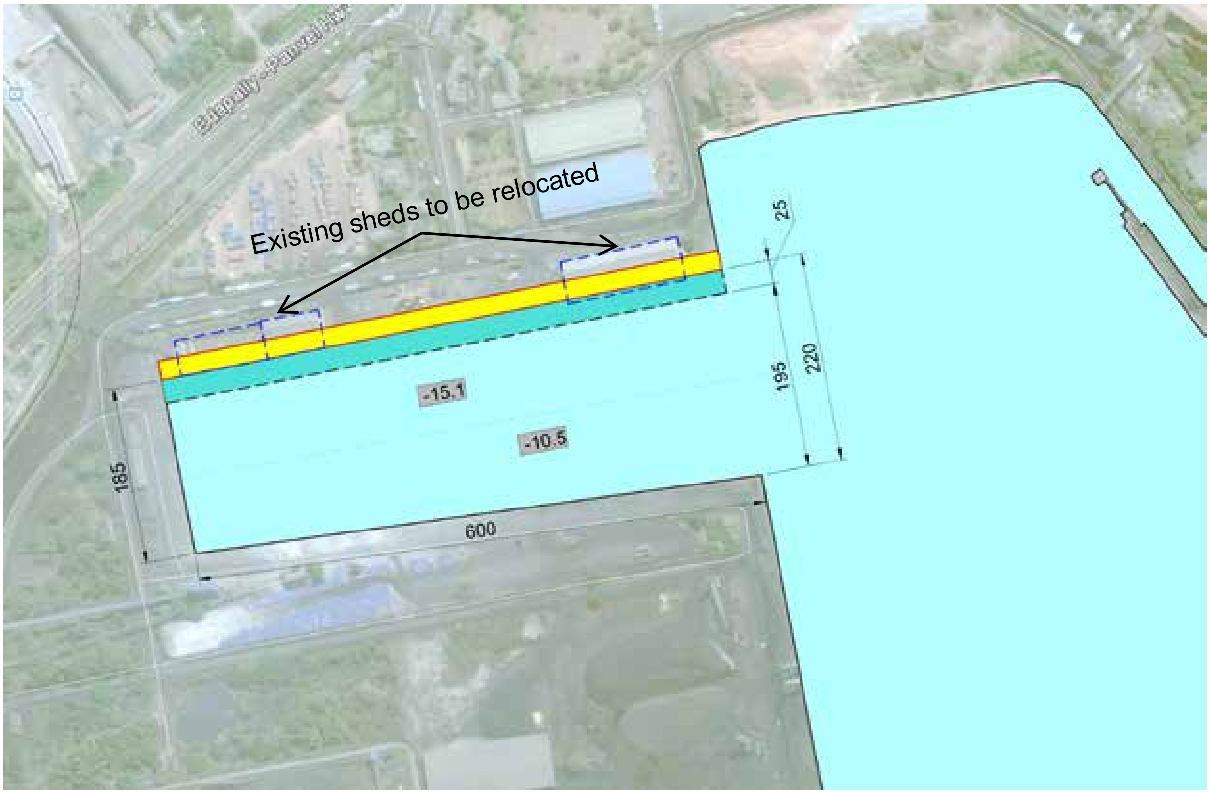


Figure 9.9 Option 1 Modified Arrangement of Eastern Arm

Following are the merits and demerits of this option.

- This option involves demolition of dilapidated berths 2-4 which need to be retrofitted.
- 2 deep draft berths could be developed to cater the bigger size vessels
- The existing storage and cruise shed need to be relocated;
- Constraint on storage area and circulation.

The overall cost estimate for this option is INR 1,200 crores.

9.6.3 Option 2: Providing Independent Deep Draft Berth beside Berth 18

A new deep draft berth is proposed beside the iron ore berth (Berth 18). The required open area and sheds for storage are proposed in the vacant area behind the berth.

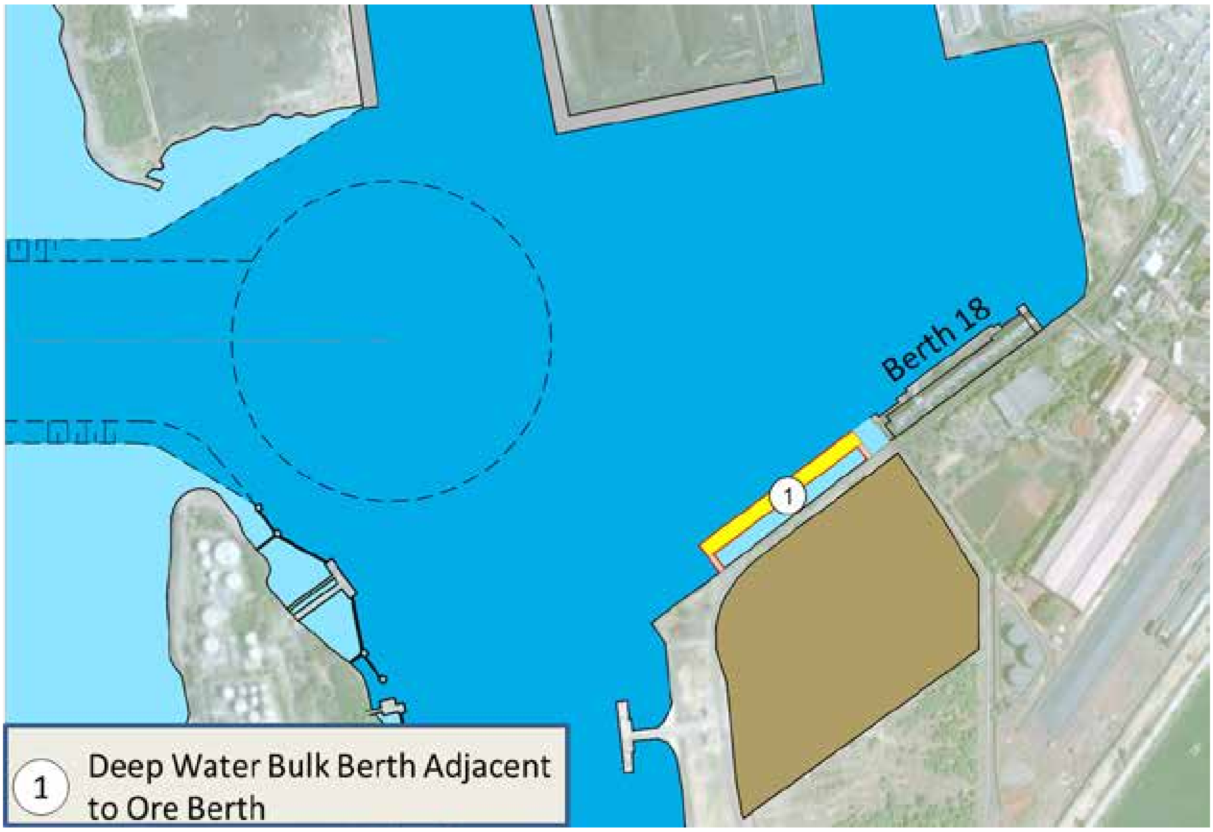


Figure 9.10 Proposed New Deep Draft Multipurpose Cargo Berth

This option has the following merits.

§ Independent deep draft berth to the existing facility

§ New storage area free from space/ area constraint

The overall cost estimate for this option is INR 120 crores.

9.6.4 Recommendation

Based on the above, it may be noted that retrofitting of berths could be taken up as and when required. To address the downtime during the implementation of retrofitting there is a requirement of deep draft berth. It is therefore prudent to develop a new independent deep draft berth as shown in **Figure 9.10**. While upgradation of the eastern arm berths is undertaken the cargo could be shifted to deep draft berth during the downtime period.

9.7 Concept of Satellite Port

It is evident that there are limitations in increasing the draft at port for handling of cape size ships. Further the available waterfront within the port limits is almost exhausted with little scope for expansion. Another issue at the current port location is the limited capacity for evacuation of cargo by rail, which limits its suitability for handling of cargo for deep hinterland.

Under such circumstances, the port should identify nearby minor ports under the State Port Directorate for adoption and development as a satellite port. NMPT can consider developing satellite port near Ankola. The port development at this place is however subject to approval of the rail link between Hubli and Ankola.

10.0 SHELF OF NEW PROJECTS AND PHASING

As part of the NMPT master plan, several projects have been identified which need to be taken up in phased manner to commensurate traffic. The proposed phasing, capacity addition and the likely investments are discussed in paragraphs below.

It may be noted that apart from these projects there could be several other projects which port would be implementing as part of the routine operations and maintenance of the port facilities. Further, the phasing proposed is not cast in stone as the port master plan is a dynamic document and could be reviewed periodically and revised based on the economic scenario and demand for port at that particular point of time.

The requirement and rationale of these projects are discussed in brief in the sections below.

10.1 Ongoing Projects

The details of the projects which have already been awarded and development is ongoing are given below in **Table 10.1**.

Table 10.1 Ongoing Projects

S. No.	Project Name	Investment Required (INR in Crores)	Capacity Addition (MTPA)	Mode of Implementation
1.	Mechanization of Berth 12	469.46	6.73	PPP

The port layout after completion of ongoing projects shall be as shown in **Figure 10.1**.

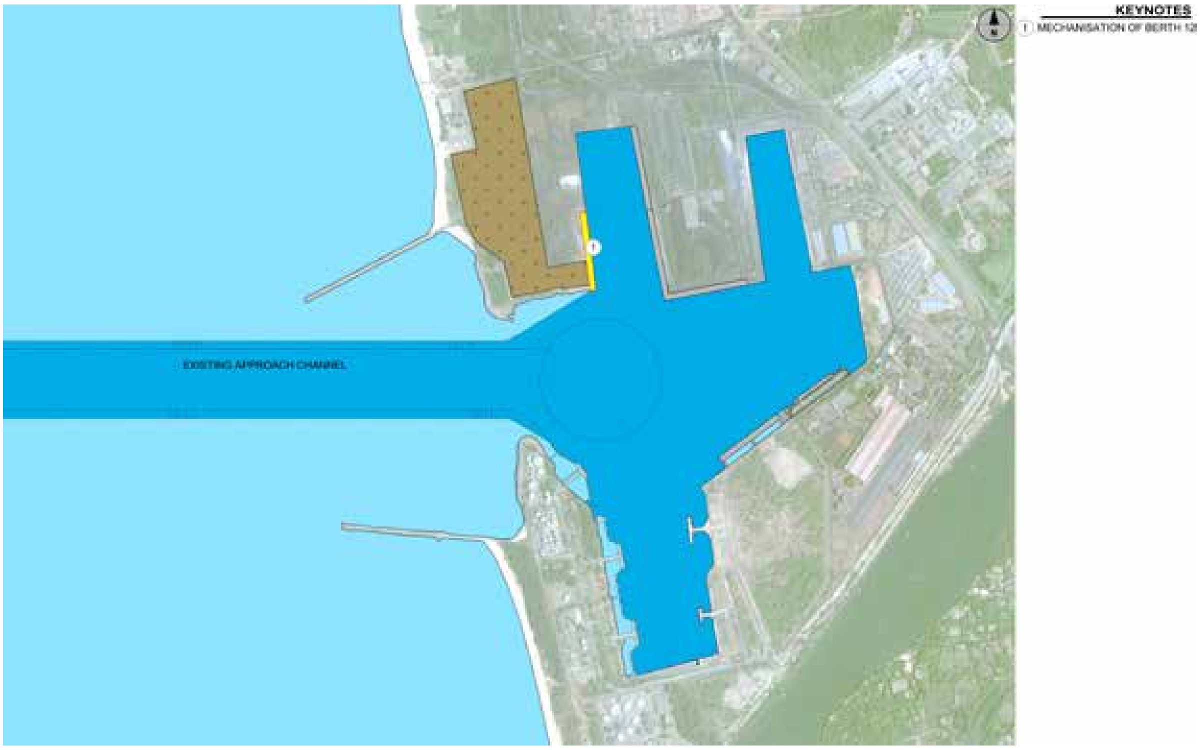


Figure 10.1 Port Layout along with Ongoing Developments

10.2 Projects to be Completed by Year 2020

The details of the projects which are envisaged to be completed by year 2020 are given below in **Table 10.2**.

Table 10.2 Projects to be Completed by Year 2020

S. No.	Project Name	Investment required (INR in Crores)	Capacity Addition (MTPA)	Mode of Implementation
1.	Development of 30 acres of stack yard and ancillary roads for parking of Ro-Ro cargoes and cars	25.00	-	Port's funds
2.	Utilisation of Berth 8 and Backup area as Container Terminal	277.19	4.0 Lakh TEU's	PPP
3.	Deep water break bulk berth adjacent to ore berth	150.00	5.0	Port's funds

The 2020 port layout plan with the above mentioned projects is as shown in **Figure 10.2**.

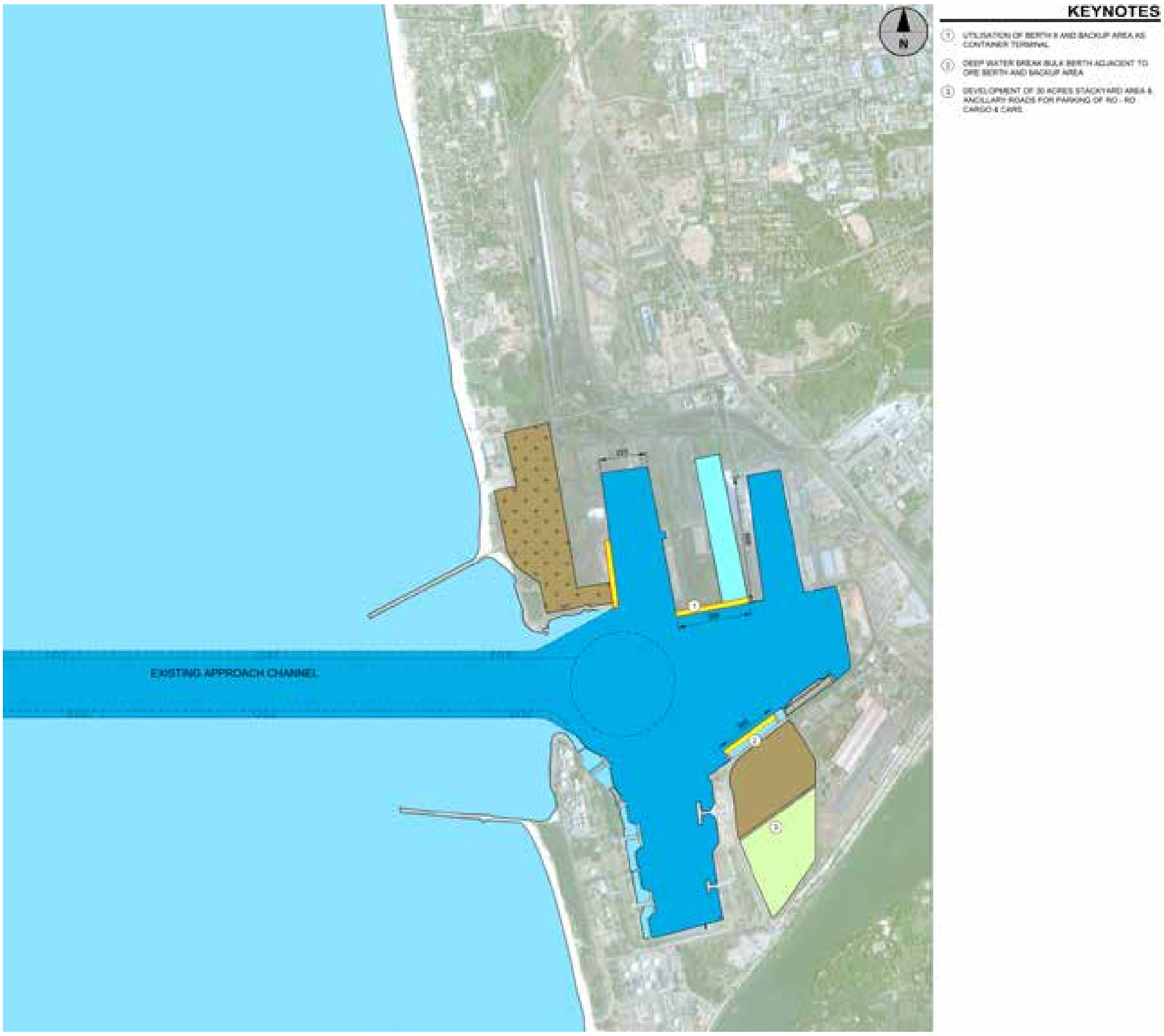


Figure 10.2 2020 Port Development Plan

10.3 Projects to be Completed by Year 2025

The details of the projects which are envisaged to be completed by year 2025 are given below in **Table 10.3**.

Table 10.3 Projects to be Completed by Year 2025

S. No.	Project Name	Investment required (INR in Crores)	Capacity Addition (MTPA)	Mode of Implementation
1.	Deepening of Eastern dock	1,200	3.0	Port's funds
2.	FSRU for LNG handling	2,500	2.0	PPP
3.	Mechanised Fertilizer Handling Facility	155	3.0	PPP
4.	Mechanised Food Grain Handling Facility	120	0.5	PPP
5.	Development of Berth 10 for handling bulk cargo	500.	5.0	PPP
6.	Additional Storage area for bulk cargoes	50	-	Port's funds

The 2025 port layout plan with the above mentioned projects is as shown in **Figure 10.3**.

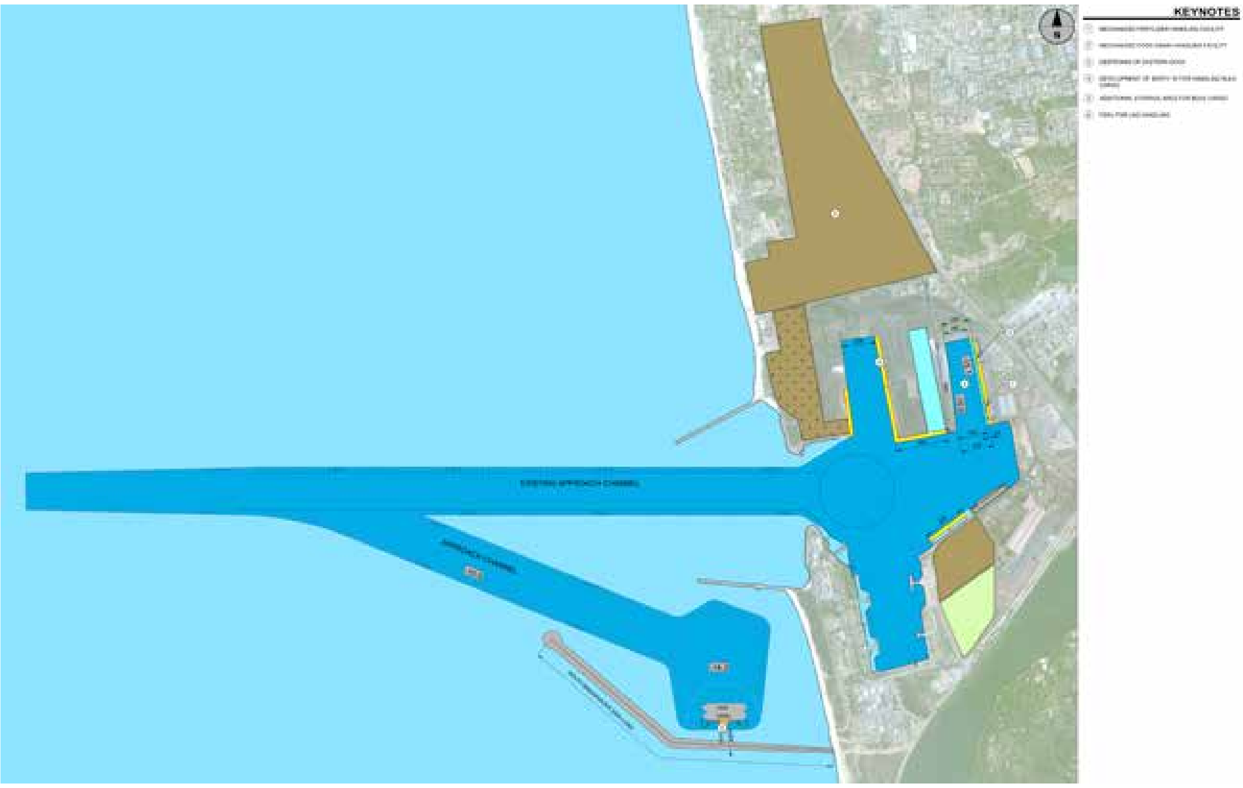


Figure 10.3 2025 Port Development Plan

10.4 Projects to be Completed by Year 2035

The details of the projects which are envisaged to be completed by year 2035 are given below in **Table 4.5**.

Table 10.4 Projects to be Completed by Year 2035

S. No.	Project Name	Investment required (INR in Crores)	Capacity Addition (MTPA)	Mode of Implementation
1.	Development of Berth 11 for handling bulk cargo	500	5.0	PPP

The 2035 port layout plan with the above mentioned projects is as shown in **Figure 10.4**. This layout depicts the overall port master master plan over 2035 horizon.

Figure 10.4 2035 Port Development Plan

Appendix 1 - **BCG Benchmarking Study for New Mangalore Port**

Master Plan for Paradip Port

Prepared for

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Government of India

Ministry of Shipping/ Indian Ports Association

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Revision	Description	Prepared by/ date	Reviewed by/ date	Approved by/ date

Document Revision Register

Issue no.	Date of issue	Section	Revision Details	Revision By Name & Position
1.	02.06.2016		Comments on Draft Master Plan Report	Marshal Praveen (Engineer II)
2.	03.08.2016		Comments on Final Master Plan Report	Ritu Paliwal (Sr. Consultant)
3.	25.08.2016		Comments on Final Master Plan Report	Himanshu Mahajan (Engineer I)

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1.0 INTRODUCTION

1.1 Background

The Sagarmala initiative is one of the most important strategic imperatives to realize India's economic aspirations. The overall objective of the project is to evolve a model of port-led development, whereby Indian ports become a major contributor to the country's GDP.

As shown in **Figure 1.1**, the Sagarmala project envisages transforming existing ports into modern world-class ports, and developing new top notch ports based on the requirement. It also aspires to efficiently integrate ports with industrial clusters, the hinterland and the evacuation systems, through road, rail, inland and coastal waterways. This would enable ports to drive economic activity in coastal areas. Further, Sagarmala aims to develop coastal and inland shipping as a major mode of transport for the carriage of goods along the coastal and riverine economic centres.

As an outcome, it would offer efficient and seamless evacuation of cargo for both the EXIM and domestic sectors, thereby reducing logistics costs with ports becoming a larger economy.

Sagarmala aims to optimize the Logistics route for Port and Increase focus on Port led development for the country

		Details	Description
Why is Sagarmala needed?	1	Dual institutional structure at ports	▪ Due to segregation of major and minor ports, ports of India have grown as due unconnected entities and not benefitting from co-location or economics of scale
	2	Weak infrastructure at ports and beyond	▪ Weak modes of evacuation from both major and minor ports leading to sub – optimal modal mix presently ▪ Limited hinterland linkages that increases cost of transportation
	3	Limited economic benefit of location & to community	▪ Limited conscious skill development and leverage to peripheral trades (fisheries, tourism etc.) ▪ Limited development of centres of manufacturing near ports
What does Sagarmala want to achieve?	1	Ports led development	▪ Undertake development of coastal economic zones with projects like – port based industrialization, coastal tourism, Logistics parks, warehousing, fisheries etc.
	2	Port infrastructure enhancement	▪ Action points on transforming existing ports into world class ports be developing deep drafts, mechanization of existing berths, creation of new capacity and greenfield ports
	3	Efficient evacuation	▪ Expansion of rail / road network connected to ports and identification of congested routes ▪ Find optimized transport solution for bulk and container cargo

Figure 1.1 Aim of Sagarmala Development

In order to meet the objectives, Indian Port Association (IPA) appointed the consortium of McKinsey and AECOM as Consultant to prepare the National Perspective Plan as part of the Sagarmala Programme.

1.2 Scope of Work

The team of McKinsey and AECOM distilled learnings from the experience in port-led development, the major engagement challenge to develop a set of governing principles for our approach is shown in **Figure 1.2**.

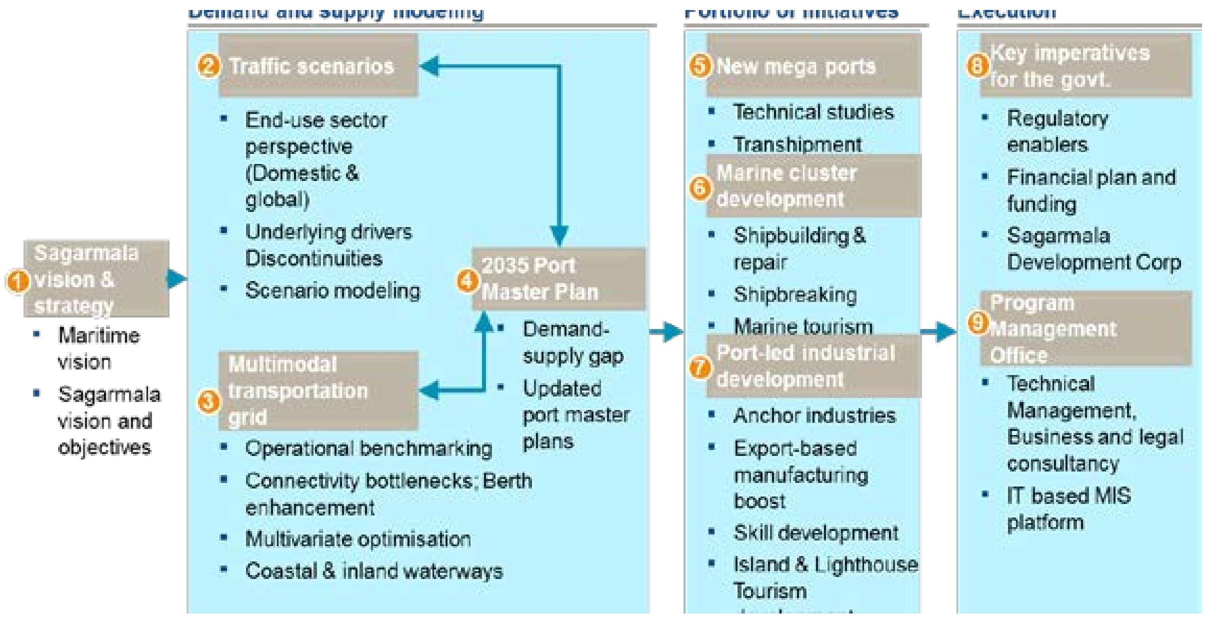


Figure 1.2 Governing Principles of Approach

As indicated above, the origin-destination of key cargo (accounting for greater than 85% of the total traffic) in Indian ports have been mapped to develop traffic scenarios for a period of next 20 years. The forces and developments that will drive change in the cargo flows have also been identified. This would lead to the identification of regions along the coastline where the potential for expansion of existing port exists. The various activities involved in the port led developments are charted in **Figure 1.3**.

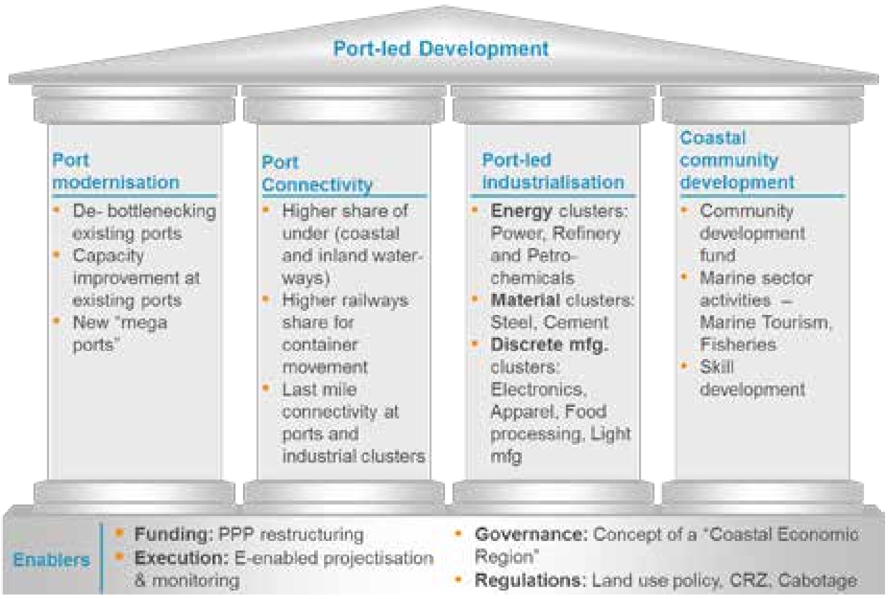


Figure 1.3 Port Led Developments

As part of the assignment, it is also expected to coordinate with the team working on “Benchmarking Operational Improvement Roadmap for Major Ports in India” study (which is being carried out simultaneously along with this assignment) and identify current and future logistic constraints (at the Major Ports) for the top 85% cargo categories based on analysis of current port capacity, productivity levels in comparison to international benchmark and evacuation bottlenecks in the logistics chain. This understanding should be an input in defining the 2035 Master Plan for each port.

Accordingly, this Master Plan report has been prepared taking into consideration the inputs provided on the future traffic and the benchmarking and operational improvements suggested for this port.

1.3 Present Submission

The present submission is the Final report for Development of Master Plan for Paradip Port as part of SAGARMALA assignment. This report is organised in the following sections:

Section 1 : Introduction
Section 2 : The Port and Site Conditions
Section 3 : Details of Existing facilities
Section 4 : Performance, Options for Debottlenecking & Capacity Assessment
Section 5 : Details of Ongoing Projects
Section 6 : Traffic Projections
Section 7 : Capacity Augmentation Requirements
Section 8 : Port Connectivity and Infrastructure
Section 9 : Scope for Future Capacity Expansion
Section 10 : Shelf of New Projects and Phasing

2.0 THE PORT AND SITE CONDITIONS

2.1 Paradip Port as at Present

Paradip Port (20°15‘55.44” N and 86°40‘27.34” E) is one of the 12 major ports in India. It is an artificial, deep-water port on the East coast of India in Jagatsinghpur district of Odisha. It is situated at confluence of the Mahanadi River and the Bay of Bengal. It is about 210 nautical miles south of Kolkata and 260 nautical miles north of Visakhapatnam. The location plan of Paradip Port is shown in the **Figure 2.1**.

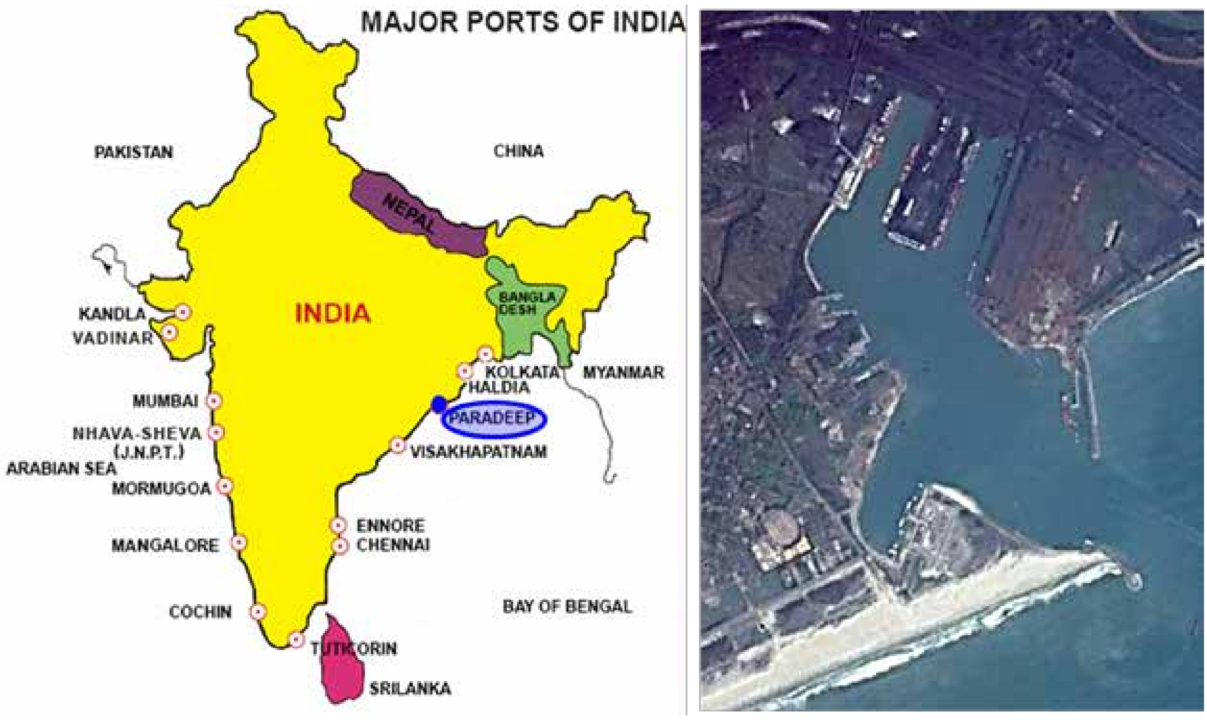


Figure 2.1 Location Plan of Port

2.1.1 Road Connectivity

Paradip Port is connected via road with Cuttack and Chandikhole, which are two of the major cities in Odisha.

§ Cuttack and Paradip are connected by SH-12 (2 lanes).

§ Cuttack and Chandikhole are connected by NH-5A (4 lanes).

All-important destinations in India whether on the North, West or East could be accessed through any one of the above mentioned Highways as shown in **Figure 2.2**.

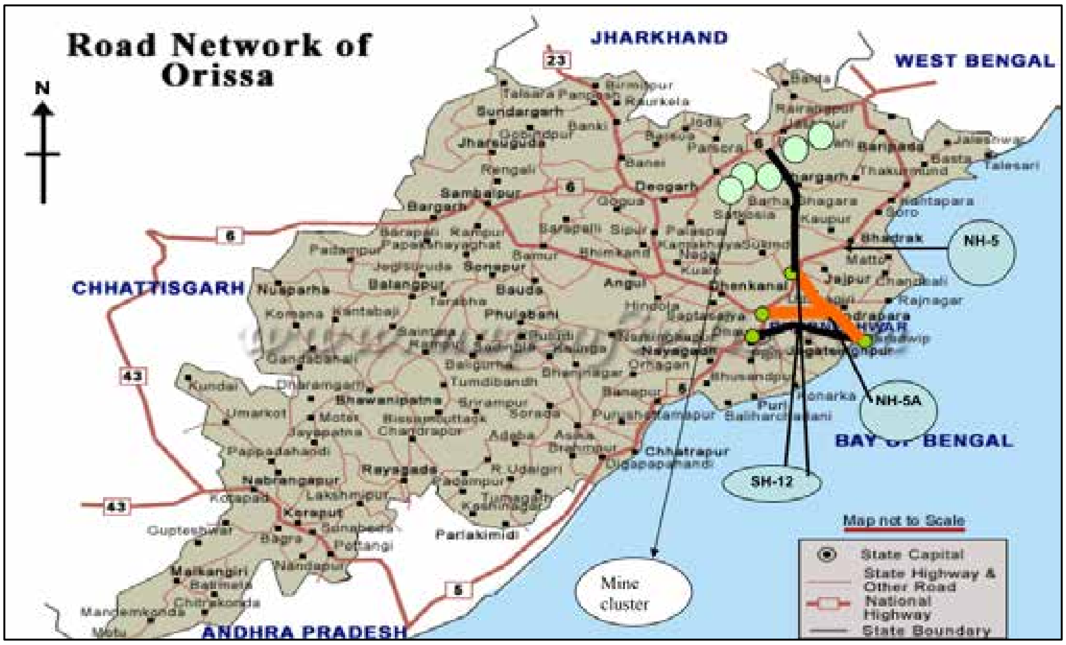


Figure 2.2 Road Connectivity to Paradip

2.1.2 Rail Connectivity

Paradip port Rail network is a part of the East Coast Railway System and is connected to the Hinterland via Cuttack by a broad gauge rail link. Cuttack is around 90 km from Paradip and connects Port to Howrah-Chennai main line. Howrah-Chennai line connects Paradip to Kolkata (route length of about 500km) on the North and Chennai on the South (route length of about 1,340 km). The current rail connectivity to Paradip Port is shown in **Figure 2.3**.

Figure 2.3 Rail Connectivity to Paradip

2.2 Site Conditions

2.2.1 Meteorology

The climate at Paradip is governed by the monsoon. In the months of June to September, the south-west monsoon occurs, followed by the north-east monsoon in October- December. The later period is often indicated as the post-monsoon period. January-February is the winter period and March-May is usually the hot weather period.

2.2.1.1 Winds

Monthly Wind Rose diagrams for Paradip Port are presented in **Figure 2.4**. The predominant wind direction during the months of March to September is South – Southwest and the highest wind speed during this period was recorded to be 18 m/s. During the period November to January the predominant wind direction changes to North-Northeast. The months of October and February are observed to be transition months, where a marked variation in the wind direction was observed. The Wind Rose diagram at Paradip Port is presented in **Figure 2.4**.

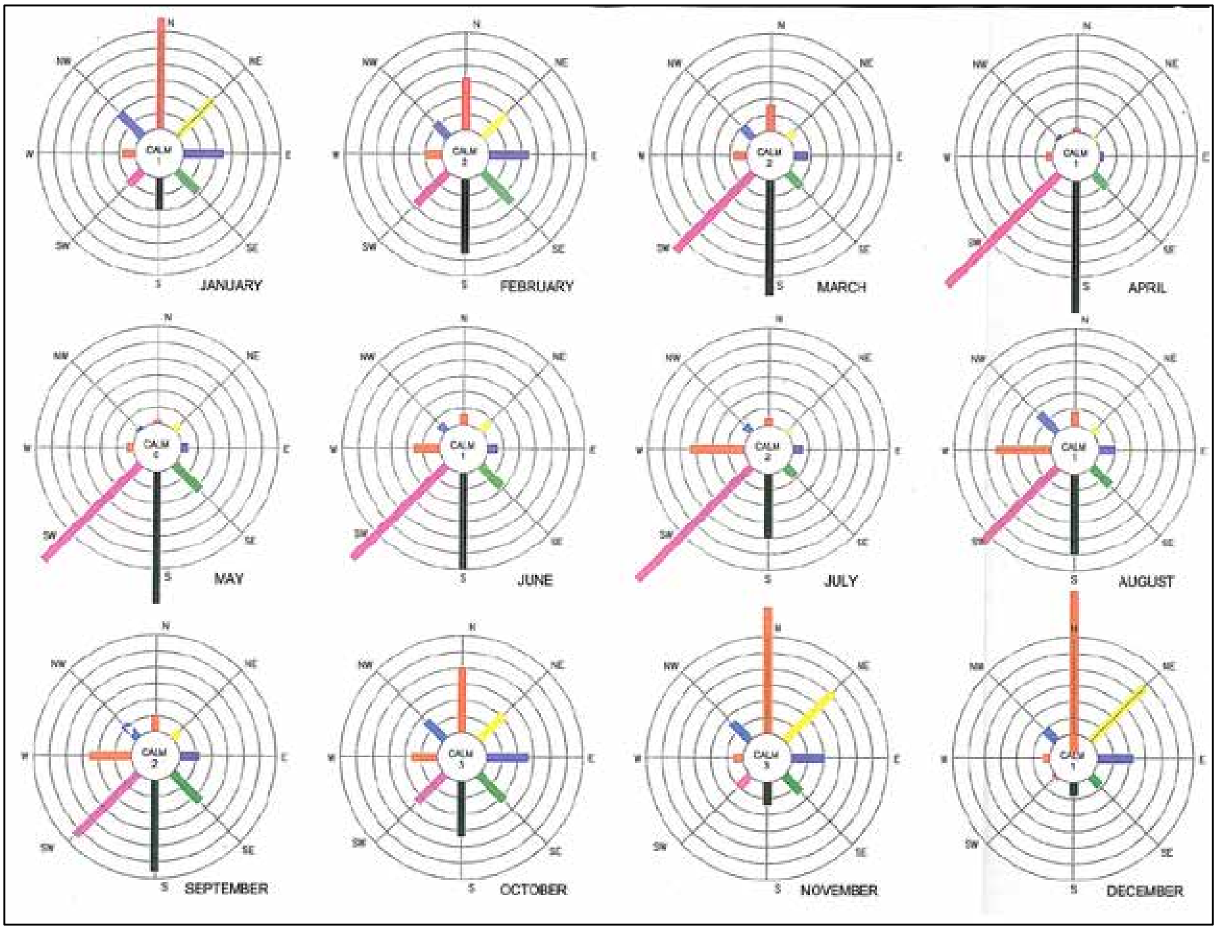


Figure 2.4 Wind Rose Diagram

2.2.1.2 Rainfall

Annual average rainfall at Paradip is about 1,400 mm per annum, about 75% of which is received during the South-Western Monsoon season, i.e., between June and September. October contributes to about 8% of the annual rainfall as presented in **Table 2.1**.

Table 2.1 Average Monthly Distribution of Rainfall

Month	Average Rainfall (mm)	Maximum Rainfall (mm)	Minimum Rainfall (mm)
January	10.0 - 12.0	27.7	0.0
February	36.0 - 40.0	76.7	6.1
March	48.0 - 50.0	177.4	15.0
April	38.0 - 42.0	67.2	16.0
May	42.0 - 44.0	139.9	4.2
June	235.0 - 245.0	451.6	81.6
July	268.0 - 276.0	577.9	135.3
August	308.0-316.0	362.4	235.8
September	245.0-255.0	331.4	15.3
October	116.0-120.0	331.4	15.3
November	12.0-14.0	41.1	0.0
December	36.0-40.0	134.2	0.0

2.2.1.3 Air Temperature

The mean maximum and minimum temperature were observed to be 35.96° C and 13.30° C respectively. The maximum temperature at Paradip ranges between 28.6° and 35.8° C, while minimum temperature varies between 13.3° to 22.5° C. Month wise Maximum and Minimum Temperature at the port vicinity is presented in **Table 2.2**.

Table 2.2 Maximum and Minimum Temperature-Monthwise

Month	Mean of Maximum Temperature (°C)	Mean of Minimum Temperature (°C)
January	29.52	13.30
February	30.44	15.54
March	31.38	19.12
April	33.94	20.96
May	35.82	22.54
June	34.52	22.44
July	35.96	22.50
August	33.20	21.26
September	34.14	24.88
October	33.94	22.00
November	33.42	17.66
December	28.68	13.62

2.2.1.4 Visibility

Generally, the visibility in the region is very good; visibility in the monsoon normally deteriorates during rains and occasional squalls. Visibility is recorded at Paradip daily at 08:30 hrs and at 17:30 hrs and records are available since 1975. Normally lowest range of visibility occurs at sunrise or at sunset and as the times of recording at Paradip observatory are fixed, lowest values are not available. Records are maintained in coded form (WMO code 4377) as approved by World Meteorological Organization. On analysis, the records maintained by I.M.D. for a particular year (1985) 87% of the readings were in scale 96.6% in scale 95 and 7% in scale 97. For other years it was comparable. Only one reading over the years was in scale 92. From these records it may be stated that during day light hours between 08:30 hrs and 17:30 hrs visibility at Paradip does not present any problem for navigation.

2.2.1.5 Relative Humidity

The average humidity ranges from nearly 84% in August to about 71% in December.

2.2.2 Oceanography

2.2.2.1 Tides

The tides at Paradip are semi-diurnal in nature with a tidal range, relative to the Chart Datum (CD), as follows:

Highest High Water Level (HHWL)	+ 3.50 m
Lowest Low Water Level (LLWL)	+ 0.40 m
Mean High Water Springs (MHWS)	+ 2.58 m
Mean Low Water Springs (MLWS)	+ 0.71 m
Mean High Water Neaps (MHWN)	+ 2.02 m
Mean Low Water Neaps (MLWN)	+ 1.32 m

The above levels are with respect to chart datum, which is approximately the level of Lowest Astronomical Tide.

2.2.2.2 Currents

The flood and ebb currents during spring tides were reported to be of the order of 0.6 knots (0.3 m/s) and during the neap tides 0.45 knots (0.23 m/s). Maximum currents reported did not exceed 1.2 knots (0.6 m/s).

2.2.2.3 Cyclone

Paradip Port is a cyclone prone area and is affected by the cyclones developing in the Bay of Bengal. During cyclonic conditions wind speeds may exceed 248 kmph as recorded during the 1999 super cyclone.

2.2.3 Geotechnical Data

Borehole data collected by Paradip Port trust indicates that the seabed sub-strata generally comprises of silty clay with average N value of 15 up to 7.0 m depth below seabed. Soil below 7.0 m to 14 m consists of silty sand with average N value of 15. Below 14m soil consist of clayey silt and sand up to a depth of 30 m with average N varies in the range of 20 to 30.

3.0 DETAILS OF EXISTING FACILITIES

3.1 General

Paradip Port presently handles commodities such as iron ore, thermal coal, coking coal, fertilizers and other break bulk cargo. The port also handles substantial quantities of POL through SBMs and pipelines. The total area available with the port is 6,521 acres and is located south of Atharabanki Creek. The dock area, surrounded by a boundary wall is about 1,500 acres.

The Port of Paradip is an artificial lagoon type harbour protected by two rubble mound breakwaters and is connected to deep water by a dredged channel. The details are as mentioned in **Table 3.1** below. The locations of various berths are shown in the following **Figure 3.1**.

Figure 3.1 **Existing Facilities at Paradip Port**

The features of the existing harbour are as follows:

Table 3.1 Details of Breakwater, Channel & Turning Basin

Breakwaters	
§ North breakwater	538 m long on the north- eastern side of the port
§ South breakwater	1,217 m long on the south-eastern side of the port
Approach channel	
§ Length	2,020 m
§ Width	190 m
§ Depth	18.7 m below CD
Entrance Channel	
§ Length	500
§ Width	160
§ Depth	17.1 m below CD
Turning Basin	
§ Diameter	520 m
§ Depths	17.1 m below CD

3.2 Existing Docks and Quays

Paradip port is having two docks namely Eastern and Central dock with 14 Berths (**Figure 3.1**). These docks are located at the lee of the Northern Breakwater. The Central Dock has three multipurpose berths, 1 multipurpose berth and 2 fertiliser berths, while the Eastern dock has 3 general cargo berths, 2 coal berths, 1 iron ore berth and 1 oil berth on the lee of north breakwater. In addition to 14 berths, the port has three Single Point Moorings which are dedicated to Indian Oil Company Ltd (IOCL). **Table 3.2** provides details of all the berths at Paradip Port.

Table 3.2 Berthwise Details

S. No.	Berth Name (No. of berths)	Length (in m)	Dredged Depth (m)	Present Capacity (MTPA)	Cargo Handled
1.	North Oil Jetty(1)	350	13.5	7.50	POL import/export
2.	Coal Berths (2)	520	14.5	21.00	Thermal coal exports
3.	Iron Ore Berth (1)	210	13	6.39	Iron ore exports
4.	East Quay (3)	686	11.0 -13.0	9.69	Dry bulk cargo imports/exports
5.	Southern Quay (1)	265	13.0	4.76	Multi cargo import / export
6.	Central Quay – 3 (1) (Licensee - Essar)	230	15.0	6.55	Dry bulk cargo import/ export
7.	Central Quay -1, 2 (2)	525	15.0	12.10	Multi cargo import / export
8.	Fertilizer Berth – I (1) (Captive – PPL)	250	15.0	3.47	Fertilizer RM, edible oil import
9.	Fertilizer Berth – II (1) (Captive –IFFCO)	250	15.0	4.03	Fertilizer RM, edible oil import
10.	Multipurpose cargo berth (1)	235	15.0	3.45	Dry and liquid bulk cargo import/export
11.	RO-RO Jetty (1)	50	5.50	1.00	Project Cargo import
12.	SPM (3) (Captive IOCL)		23.0	37.00	Crude import
13.	New South Oil Jetty	350	17.0	10.00	Crude import/ product exports
			Total	**126.94**	

3.2.1 Eastern Quay (EQ)

It has a quay length of 686 m and contains three berths viz. EQ 1, EQ 2 and EQ 3. EQ 1 and 2 can handle 45,000 DWT vessels with a draft of 11 m and East Quay III can handle 60,000 DWT vessels with a draft of 12.0 m. All quays are multi-purpose berths handling thermal coal, coke, fertilizers, and other bulk cargos.

3.2.2 Central Quay (CQ)

Central Quay has three berths (CQ 1, CQ 2, CQ 3) with length of 755 m and a draft of 14.5 m and it can accommodate vessel sizes of 60,000 – 65,000 DWT. Out of these CQ1 and CQ2 berths are multipurpose berths whereas CQ 3 berth is mechanised berth with one ship loader and connected conveyor system for handling ore pallets.

3.2.3 South Quay (SQ)

South Quay is a single berth having 13.0 m draft and 265 m of quay length. It is also a multi-purpose berth and handles iron ore, POL and coking coal.

3.2.4 Fertilizer Berth (FB)

There are two fertilizer berths (FB I and FB II), with a quay length of 250 m each and depth of 15.0 m. These berths are captive facilities and handle fertilizer and fertilizer raw material (FRM) for Paradip Phosphate Ltd. (PPL) and Indian Farmers Fertilizers Cooperative Ltd. (IIFCO). These berths together handle nearly 7.5 million tonnes of cargo and can accommodate vessels up to 65,000 DWT.

3.2.5 Iron Ore Berths (IOB)

The iron ore berth is one of the oldest berths of Paradip Port and is located in the eastern dock. It has a dredged depth of 13.5 m and the length of 210 m. It is a fixed jetty having a R.C.C. deck supported on steel tubular piles and connecting shore arms. There are four mooring dolphins two on either side having dimensions 7.5 m × 9.5 m and 9.5 m × 10.5 m.

The berth is equipped with a mechanised ore loading system with twin wagon tipplers, conveyor system, stackers, reclaimers and one ship loader.

The iron ore loading stream comprises:

§ 1 Shiploader with rated capacity of 3,000 TPH.

§ 2 bucket wheel type Reclaimers with rated capacity of 3,000 TPH each.

§ 2 Stacker cum Reclaimer with rated capacity of 3000 TPH each

§ 2 Rotary type wagon tipplers with rated capacity 1,500 TPH each (each tippler is capable of tippling 25 wagons/hr).

3.2.6 Coal Handling Berths (CB)

The Port has two mechanized coal jetties at the northern end of Eastern Quay with State-of-the-Art equipment. Each jetty has a dredging depth of 14.5 – 15.0 m and 260 m length. It can accommodate vessel sizes up to 60,000 to 75,000 DWT. These berths are also equipped with a mechanical coal handling facilities for unloading of coal from the trains, stacking, reclaiming and loading coal into the bulk carriers. This terminal has a Merry-Go-Round (MGR) system for unloading of BOBRN wagons (2×4,000 TPH capacity).

The salient features of the handling plant are given below:

§ 2 Stackers with rated capacity of 4,000 TPH each.

§ 2 Reclaimers with rated capacity of 4,000 TPH each.

§ 2 Ship loaders with rated capacity of 4,000 TPH each.

§ 2 Track hoppers at RRS with capacity of 4 Wagons/table.

3.2.7 POL Jetty

The port has an oil jetty of 350 m length with dolphin to dolphin facility, located in the lee of the north breakwater. This berth handles petroleum, oil and lubes (POL). The draft at this berth is 13.5 m and handles tankers up to 65,000 DWT with Length Overall (LOA) up to 260 m.

3.2.8 New Oil Jetty

The port has commissioned new oil jetty with 360 m length with dolphin to dolphin facility, located in the southern dock of the harbour. This is a captive jetty commissioned by IOCL for loading of products and unloading of crude oil. Two Unloading Arms for Crude & eight Loading Arms for products are also installed at Jetty top. One crude pipeline, eight product pipelines (Motor Spirit, High Speed Diesel, Naphtha, Dual Purpose Kerosene, Propylene and Propylene vapour) and 3 utilities pipelines are laid from South Oil Jetty to IOCL Paradip Refinery.

3.2.9 General Cargo/ Multi-Purpose Berths

Eight General Cargo/ Multi-Purpose Berths have been constructed along the western face of Eastern Dock, eastern face of Central Dock and on the Southern face of the pier.

3.3 Equipment for Breakbulk Cargo

Apart from the mechanized Coal and Iron handling plants the port has the following equipment for efficient and smooth loading/unloading of its operations:

§ Mobile Crane 75 T

§ Pay loader 13.5 Cum

§ 2 Pay loaders 4.7 Cum

It is important to mention that besides these, other private equipment are permitted time to time wherever necessary.

The port has a 500 TEU capacity container yard served with two railway sidings and 15 reefer plug points. The port has one 75 T and one 30 T Mobile crane, 2 spreaders of 40 feet and 20 feet to handle containers in the yard.

3.4 Single Point Mooring Terminals

Total 3 Single point moorings (SPM) with capacity 37 MTPA are provided at the Paradip port to handle the captive crude oil for IOCL. All the SPMs are located towards the southern side of the existing port in about 30 m water depth, about 20 km away from shore, and connected to shore by means of submarine pipelines. The location plan of the SPMs and the pipelines is presented in **Figure 3.2**.

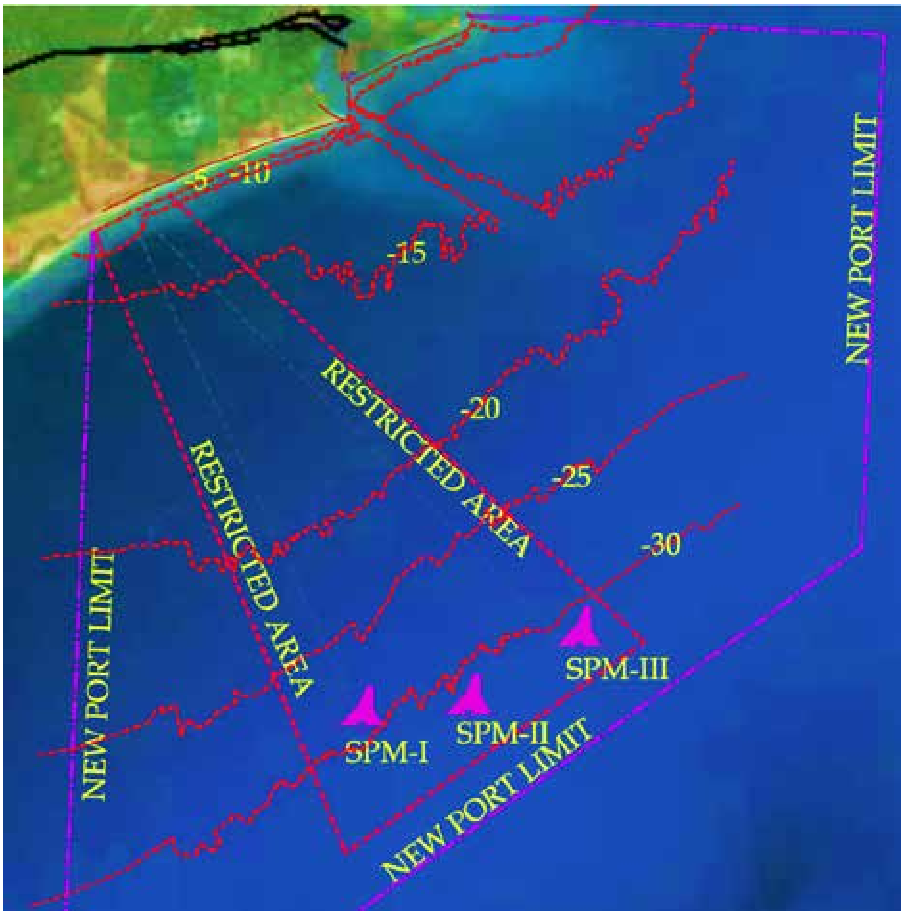


Figure 3.2 Location of SPMs

3.5 Storage Facilities

The port operations are supported by extensive storage arrangements. In addition to the open stackyard, there are four Transit Shed and two Warehouses outside the Port area as detailed in **Table 3.3** and **Table 3.4**

Table 3.3 Details of the Storage Facilities

Description of Storage Area	Area (m^2)	Capacity (T)
Warehouse No. I	1,711	4,000
Warehouse No. II	6,000	14,000
Open Stack Yard No. I	8,50,000	15,00,000
Open Stack Yard No. II	1,00,000	1,75,000

Table 3.4 Details of Open Areas for Stacking

Open Area	Area (m^2)
Rail Sidings	8,22,200
Mechanical Ore	1,05,000
Mechanical MCHP	1,22,200
Without Siding	7,45,000
Covered	9,111
Concreted	1,01,000
Others	93,915
Total	**19,98,426**

3.6 Port Railways

Paradip Port trust has its own railway system. The route length is 7.5 km and track length is 88 km. At present, there are 7 no's of locomotives as follows:

1,400 BHP	04 (DLW-WDS-6)
1,350 BHP	02 (DL-WDS-6A/D)
3,100 BHP	01 (DLW-WDG-3A)

The port has railways sidings capable of handling 19 full rake lengths and 11 half rake lengths. The rail terminal consists of 15 yard lines and 25 sidings inside its main terminal. The port has an open and closed wagon handling facility for coal handling (bottom discharge) and wagon tipplers facilities for iron ore handling. However, the existing rail network doesn't have signalling, so shunting and rail operations are being done manually.

3.7 Pilotage and Towage Facilities

The pilotage is compulsory for all vessels having capacity of more than 200 T Gross Tonnage. The ports has 3 tugs having BP more than 35 T and 2 port tugs having BP more than 50 T. Mooring boats are also available for passing the mooring lines to berth or jetty.

3.8 Repairing Facility

The port has a 500 T slipway along with workshop for repair and maintenance of port crafts and barges. A wet basin is provided for port crafts close to slipway. The dry dock is also available, which is 75 m long, 15 m wide and 11 m deep to repair crafts.

4.0 PERFORMANCE, OPTIONS FOR DEBOTTLENECKING & CAPACITY ASSESSMENT

4.1 General

The total cargo handled through the existing facilities, during the past 5 years is presented in the following **Table 4.1**.

Table 4.1 Cargo Handled during Last 5 Years (MTPA)

Commodity	2010-11	2011-12	2012-13	2013-14	2014-15
POL	12.85	15.09	16.47	17.70	17.98
Iron Ore	13.85	6.55	1.83	5.59	2.18
Thermal Coal	13.28	16.40	21.40	25.03	30.13
Coking Coal	6.20	5.51	4.91	7.04	7.87
Fertilizer Raw material (Dry)	4.23	4.55	4.00	3.93	4.38
Fertiliser	0.18	0.28	0.14	0.12	0.05
Container	0.06	0.11	0.17	0.10	0.07
Container (TEUs)	3,527	7,853	13,072	8,675	4,312
Others	5.39	5.76	7.63	8.49	8.35
Total (MT)	**56.03**	**54.25**	**56.55**	**68.00**	**71.01**

4.2 BCG Benchmarking Study

BCG, as part of their benchmarking study, looked into the operation of the berths and has suggested various measures for improving the performance.

Paradip Port Trust (PPT) has potential to handle additional cargo volume but it is constrained by the low productivity. In order to improve the overall productivity and performance, BCG has suggested the following measures:

Mechanized Coal Handling Plant (MCHP)

§ Productivity can be increased by changing berthing policies, productivity norms and reduction in non-working time (NWT).

§ Five Major customers, who have exported ~95% of volume at MCHP, have used only 70% of the storage yard, while remaining five smaller customers exported ~5% of volume have used 30% of the storage yard. This imbalance can be amended by rationalization of the land. For this they have suggested two options i.e.,

– Creating a common pool of land area of about 20,000 m2 at MCHP for the use of smaller players.

– Cargo of smaller players to be moved to IHP consequently releasing the 36,000 m2 of storage yard that is being used by smaller players.

§ According to BCG second option is preferred as it will help effective utilization of MCHP while also storing cargo in the IHP land area will also improve the utilization of IHP land.

§ Development of additional merry-go-round at MCHP to handle additional rakes after debottlenecking the MCPH berth and yard.

Iron Ore Handling Plant (IHP)

Iron Ore Handling Plant (IHP) in PPT is dedicated for iron ore export. However, due to fall in demand of exporting iron ore, IHP had very low overall occupancy of ~42%. IHP is capable of handling export thermal coal from productivity varying 8000 T/day to 17,000 T/day. Therefore using IHP as additional thermal coal terminal will increase thermal coal handling capacity at the port. This is however, subject to assumption that iron ore traffic would continue to remain low in future as well.

Conventional Berths

Conventional Berths CQ1, CQ2, EQ1, EQ2, EQ3, SQ and MPB handles cargo using HMCs combined with loaders and dumpers for evacuation. Together, these berths handled ~23 MT of cargo. These conventional berths have high berth occupancy~ 80-85% but low productivity and high non-working time (~30%) In order to overcome the issues they have suggested the following measures:

§ Existing HMCs have low availability, inadequate HMC hours compared to berth requirement and hence need for additional new HMCs.

§ Productivity norms needs to be established at PPT and this shall increase the cargo volume by 6 MT.

§ Cargo evacuation from the wharf is delayed due to low productivity arising from high cargo storage, high cargo stack height and very slow dumper (conventional) unloading. Thus creation of addition storage yard with siding would ease congestion and storage constrains

§ Norms for Storing cargo in port land with in custom area needs to be established which will lead to increase in efficiency of using port land.

§ PPT does not have adequate no. of dumpers to meet higher productivity requirement of HMCs for evacuation cargo. Dumper evacuation from wharf to the yard should match the HMC productivity rate this mains to addition of new dumpers. They have estimated ~340 dumpers considering 30min waiting at stockyard.

§ Mechanization of EQ 1-3 and CQ 1-2 to cater additional cargo (both import and export) However development should be staggered to prevent a sudden unavailability of conventional berths to handle import cargo at PPT.

The recommendations of BCG report for improvement of port operations are presented in **Appendix 1**.

4.3 Capacity Assessment of Existing Facilities

4.3.1 General

The cargo handling capacity of port facilities is based on many factors like the vessel size, fleet mix, equipment provided and the possible handling rates, time required for peripheral activities, capacity of stackyard, number of users, grades, capacity of evacuation system etc.

4.3.2 Capacity of Berths

4.3.2.1 General

The capacity of existing berths is calculated assuming the mix of cargo being currently handled at these berths and the corresponding parcel sizes.

Another factor that is important in arriving at the berth capacity is the allowable Berth occupancy which is expressed as the ratio of the total number of days per year that a berth is occupied by a vessel (including the time spent in peripheral activities) to the number of port operational days in a year. High levels of berth occupancy will result in bunching of ships resulting in undesirable pre-berthing detention. For limited number of berths and with random arrival of ships, the berth occupancy levels have to be kept low to reduce this detention. The norms generally followed for planning the number of berths in modern port to minimise the pre-berthing detention are given in **Table 4.2**.

Table 4.2 Recommended Berth Occupancy

No. of Berths	Recommended Berth Occupancy Factor
1	60 %
2	65 %
3 & above	70 %

The available berths and the cargo handled at each of the berths during last year are presented in **Table 4.3** below:

Table 4.3 Cargo handled at Berths during FY 15-16

CARGO	OJ	IOB	EQI	EQII	EQIII	SQ	CQI	CQII	CQIII	CBI	CBII	FBI	FBII	MPB	SPM	SPMII	SPMIII	TOTAL
EXPORT																		
C. COAL		84,696	97,913	43,247	6,000		55,300	13,037	24,800					25,900				3,50,893
CH. CON					2,021													2,021
CH. ORE					22,000													22,000
CONTAINER			24,331	9,901	11,035	6,990	3,589	174						265				56,285
FE. CR		16,865	46,649	19,738	8,225			2,600	12,600									1,06,677
I PAL									22,78,683					55,000				23,33,683
IORE		1,20,597	59,775	50,550	25,750		30,380		49,413					1,65,565				5,02,030
L/S				11,525														11,525
HSD	2,73,649																	2,73,649
M. SPIRIT	2,10,295																	2,10,295
NAPTHA	1,03,726																	1,03,726
SKO	74,876																	74,876
PIGI			75,000						26,999					44,000				1,45,999
PROJECT MAT.				509														509
S. COAL		69,822	63,050				69,020							9,350				2,11,242
T. COAL		64,562								1,15,03,772	1,21,87,284							2,37,55,618
TOTAL EXPORT	**6,62,546**	**3,56,542**	**3,66,718**	**1,35,470**	**75,031**	**6,990**	**1,58,289**	**15,811**	**23,92,495**	**1,15,03,772**	**1,21,87,284**	**-**	**-**	**3,00,080**	**-**	**-**	**-**	**2,81,61,028**
IMPORT																		
A. COAL		16,200	85,986	1,32,770	37,001									35,800				3,07,757
B. LUMPS									15,000									15,000
C. COAL		82,367	4,56,645	8,32,089	11,30,612	14,33,719	13,64,395	16,71,337						1,63,515				71,34,679
COKE BREEZE			44,066		20,300													64,366
CONTAINER			24,398	9,654	8,286	8,248		9,733						4,830				65,149
DOLOMITE			10,600	88,129	69,934	68,183	25,209							62,906				3,24,961
AMMONIA												2,91,427	339790	40,701				6,71,918
MOP												53,000	27500					80,500
P. ACID												2,70,313						2,70,313
ROCK PHOS												10,50,034	2491954					35,41,988
SUL. ACID												3,57,550	606602					9,64,152
SULPHUR												2,36,810	501787					7,38,597
GYPSUM			51,000	17,000	1,46,517	2,44,468		20,000						1,48,700				6,27,685
H. COAL			33,036	37,349	89,539	1,14,930	46,500	92,598						20,000				4,33,952
H.R. COILS			19,155															19,155
I. PAL														52831				52,831
L. COKE				22,121	18,538	21,930	9,574							38,500				1,10,663
L/S		1,06,177	1,97,473	4,75,991	6,39,743	6,01,154	2,40,697	74,990						9,52,650				32,88,875
M. COKE		11,326	34,199	70,696	73,074	22,850	35,860	43,500						34,123				3,25,628
N. C. COAL					98,578		55,100	30,900										1,84,578
OLIFLUX			34,555				1,44,248	82,389										2,61,192
ALKYLATE	11,473														34,40,493	78,34,385	68,32,105	1,81,18,456
CRUDE OIL																		-
HSD	1109392																	11,09,392
M. SPIRIT	563248																	5,63,248
SKO	113493																	1,13,493
P.COKE		2,001	75,561	64,190		75,044	10,000	42,500						1,82,181				4,51,477
PCI COAL				24,201	60,188	54,236	1,02,762	1,85,802										4,27,189
PROJEECT MAT			8,628	4,207		527												14,253
PYROXENITE			27,691	10,865		20,360	34,170	58,140						64,541				2,15,767
S.COAL		73,230	5,96,681	8,33,372	8,34,029	10,87,187	13,30,040	16,89,813	41,924					8,23,178				73,09,454
S.COIL			19,658															19,658
STEEL BAR			10,826	5,427			5,341							5,151				26,745
STEEL SLAB			14,331		24,585									6,150				45,066
TOTAL IMPORT	**17,97,606**	**2,91,301**	**17,44,489**	**26,28,061**	**32,50,924**	**37,52,836**	**34,03,896**	**40,01,702**	**56,924**	**-**	**-**	**22,59,134**	**39,67,633**	**26,35,757**	**34,40,493**	**78,34,385**	**68,32,105**	**4,78,98,137**
TOTAL TRAFFIC	**24,60,152**	**6,47,843**	**21,11,207**	**27,63,531**	**33,25,955**	**37,59,826**	**35,62,185**	**40,17,513**	**24,49,419**	**1,15,03,772**	**1,21,87,284**	**22,59,134**	**39,67,633**	**29,35,837**	**34,40,493**	**78,34,385**	**68,32,105**	**7,60,59,165**

4.3.2.2 MCHP

Based on the above considerations of berth occupancy, capacity of MCHP has been calculated as shown in **Table 4.4**.

Table 4.4 Capacity of MCHP

S. No.	Particulars	Unit	Cargo
			Coal
1.	Traffic	MTPA	21.08
2.	Average Parcel size	T	60,000
3.	No. of Ship Calls per Annum	No.	351
4.	Handling Rate	TPD	60,000
5.	Time Required at Port Per Ship		
a.	Handling Time	Days	1.00
b.	Berthing / Deberthing & Miscellaneous Time	Days	0.17
	Total Time per Ship	Days	1.17
6.	Total Berth Days Required	Days	410
7.	Berth Days Available per Berth	Days	350
8.	Berth Occupancy	%	
	Number of Berths		
	1		117%
	2		59%
	3		39%
9.	**Capacity of Berths at 70% Occupancy considering 2 berths**		**25.20**

It may be noted that the above berth capacity has been calculated based on the international norms which are recommended to keep the waiting time of ships to minimum and also optimal equipment utilisation while allowing for scheduled maintenance. Theoretically, the berth capacity could be much higher if higher berth occupancy of 80 to 85% is adopted.

The stacking capacity of the existing coal stackyard for MCHP has been calculated as shown below in **Table 4.5**:

Table 4.5 Stacking Capacity of the Existing Coal Stackyard for MCHP

Parameters	Units	Stack type 1	Stack type 2
Bulk Density	T/cum	1	1
Angle of Repose	degrees	37	37
Overall Length	m	200	200
Overall Width	m	65	65
Height of Stack	m	10	10
No. of Yards	Nos.	5	5
Capacity of Stockpile		4,83,387	4,83,387
Total Stacking Capacity	**T**	**9,66,775**	

It may be seen that the stacking capacity calculations shown above considers a number of stockpiles (10 no.) for various users and/or various grades of cargo. Additional numbers of stockpiles would further reduce the stacking capacity.

Considering the standard 70% utilisation of yard and dwell time of 10 days (export cargo), the capacity of terminal based on the stacking capacity works out to about 25 MTPA, which matches the berth capacity. As could be seen that the dwell time of cargo i.e. the average time cargo is stacked at the yard between receipt and despatch has a significant bearing on the capacity of the stackyard.

Currently, there are two set of track hoppers to receive the coal rakes for coastal exports, the turnaround time achieved is about 10 rakes per day per hopper, which allows for the capacity of cargo receipts to be about 25 MTPA, considering effective 350 days for rail working per annum.

It is therefore observed from the above that the optimal capacity of MCHP is limited to about 25 MTPA only. Theoretically these berths can handle more cargo at higher berth occupancy but higher waiting time for ships is also likely the strain the equipment and would not provide adequate time for their scheduled maintenance.

4.3.2.3 Conventional Berths

Conventional Berths CQ1, CQ2, EQ1, EQ2, EQ3, SQ and MPB handle cargo using HMCs combined with loaders and dumpers for evacuation. These 7 berths handle variety of cargo of different characteristics and brought in ships in different parcel sizes. Mainly bulk cargo like coking coal, thermal coal, fertilizers, iron ore, iron pallets, limestone, gypsum and also containers are handled at these berths using ship's gear or using mobile harbour cranes.

The capacity of the berth handling multiple commodities is governed by the type of cargo handled, average parcel sizes and the possible handling rate that could be achieved for that particular cargo. Berth capacity calculations of a typical multipurpose terminal are shown in **Table 4.6** below:

Table 4.6 Berth Capacity of a Typical Multipurpose Berth

S. No.	Particulars	Unit	MHCr		Ship's Gear	
			Bulk	Break Bulk	Bulk	Break Bulk
1.	Traffic	MTPA	4.00	4.00	4.00	4.00
2.	Average Parcel size	T	45,000	15,000	45,000	15,000
3.	No. of Ship Calls per Annum	No.	89	267	89	267
4.	Handling Rate	TPD	20,000*	8,000	12,000	6,000
5.	Time Required at Port Per Ship					
a.	Handling Time	Days	2.25	1.88	3.75	2.50
b.	Berthing / De-berthing & Miscellaneous Time	Days	0.25	0.25	0.25	0.25
	Total Time per Ship	Days	2.50	2.13	4.00	2.75
6.	Total Berth Days Required	Days	222	567	356	733
7.	Berth Days Available per Berth	Days	350	350	350	350
8.	Berth Occupancy	%				
	Number of Berths					
	1		63%	162%	102%	210%
	2		32%	81%	51%	105%
9.	**Capacity of Berths at 70% occupancy**		**4.41**	**1.73**	**2.76**	**1.34**

* The value would reduce with reduction in vessel size and for export cargo (where the handling rate is lower than import cargo)

As could be observed from above that capacity of multipurpose berth is affected significantly by the type of cargo handled at the berth and the equipment for ship handling. As the mix of cargo are being handled in all the multipurpose berths with higher proportion of bulk, the average capacity of each berth of all the 7 available multipurpose berths for the purpose of planning could be considered as about 2.75 MTPA.

For berths EQ1 to 3, which handled various cargo in different throughputs the specific berth capacity calculations have been carried out as presented in **Table 4.7**.

Table 4.7 Berth Capacity Assessment for Berths EQ1 to EQ3

S. No.	Particulars	Unit	Cargo					
			Coal	Iron Ore and Pellets	Gypsum	Limestone	Other Cargo	Containers
1.	Traffic	MTPA	4.18	0.35	0.46	0.97	0.74	0.05
2.	Average Parcel size	T	45,000	40,000	30,000	40,000	40,000	5,000
3.	No. of Ship Calls per Annum	No.	93	9	15	24	18	10
4.	Handling Rate	TPD	15,000	18,000	12,000	15,000	10,000	5,000
5.	Time Required at Port Per Ship							
a.	Handling Time	Days	3.00	2.22	2.50	2.67	4.00	1.00
b.	Berthing / Deberthing & Miscellaneous Time	Days	0.25	0.25	0.25	0.25	0.25	0.25
	Total Time per Ship	Days	3.25	2.47	2.75	2.92	4.25	1.25
6.	Total Berth Days Required	Days	302	22	42	71	79	12
			527					
7.	Berth Days Available per Berth	Days	350					
8.	Berth Occupancy	%						
	Number of Berths							
	1		151%					
	2		75%					
	3		50%					
9.	**Capacity of Berths at 70% occupancy**		**9.34**					

It could be observed that the capacity of the three berths combined is about 8.31 MTPA and it would vary depending upon the proportion of cargo handled.

Similar calculations undertaken for CQ1 and CQ2 indicate their total capacity as 6.43 MTPA at 70% berth occupancy. The capacity would be higher if these berths were to handle a single commodity say coal where higher unloading rates could be achieved.

4.3.2.4 Liquid Berths

The capacity of the liquid berths is governed by the type of product handled, pumping rate of the tankers, size of the pipelines provided and distance of tank farms. A berth handling liquid cargo in smaller tankers would have lower capacity as compared to the berth handling crude oil as shown in **Table 4.8**.

Table 4.8 Typical Capacity Calculations for Oil Terminal

S. No.	Particulars	Unit	Type of Cargo	
			Crude	**POL**
1.	Traffic	MTPA	10.00	4.00
2.	Average Parcel size	T	65,000	40,000
3.	No. of Ship Calls per Annum	No.	154	100
4.	Handling Rate	TPD	60,000	25,000
5.	Time Required at Port Per Ship			
a.	Handling Time	Days	1.08	1.60
b.	Berthing / Deberthing & Miscellaneous Time	Days	0.25	0.25
	Total Time per Ship	**Days**	**1.33**	**1.85**
6.	Total Berth Days Required	Days	205	185
7.	Berth Days Available per Berth	Days	350	350
8.	Berth Occupancy	%		
	Number of Berths			
	1		59%	53%
	2		29%	26%
9.	**Capacity of Berths at 65% Occupancy**		**11.09**	**4.92**

The above calculations are only indicative and the outcome would vary significantly on the size of ship used and also the composition of the POL products, which in many cases are handled in smaller parcels. As at Paradip, the existing berth handles crude oil as well as products, the average berth capacity considered is about 7.5 MTPA. The newly constructed berth has been planned to handle only crude and therefore its capacity could be considered as 10.0 MTPA.

5.0 DETAILS OF ONGOING PROJECTS

5.1 General

Paradip Port Trust has taken many developmental projects which are in various stages of implementation. The details and locations of these projects are shown below in **Figure 5.1** and **Figure 5.2**.

Figure 5.1 Ongoing Developments 1

Figure 5.2 Ongoing Developments 2

5.2 Development of Deep Draft Coal Import Berth

This project is planned to provide a deep draft coal import berth for handling cape size ships within the inner harbour and the Concession Agreement has been signed with the SPV "Essar Paradip Terminal Ltd." on 10/11/2009 with revenue share of 31.00%. The terminal capacity envisaged is 10 MTPA. The location plan of berth and stackyard is shown in **Figure 5.3.**

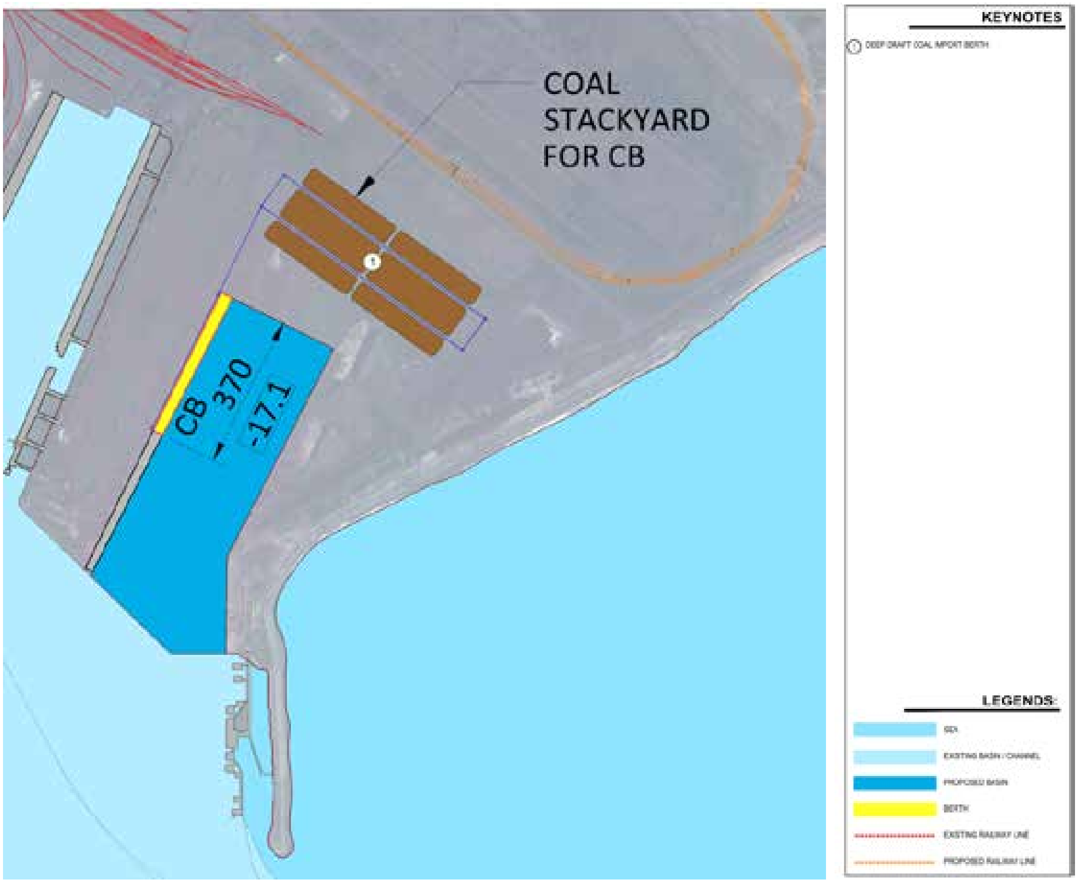


Figure 5.3 Location of Deep Draft Coal Import Berth

As per the details provided in the project report the coal berth would be 370 m long and 24 m wide. Two gantry type unloaders having rated capacity of 2,000 TPH each are connected with a separate conveyor system of same capacity. The area of stackyard allocated for the terminal is about 14.7 ha. and Stacker and Reclaimer of matching capacities have been provided at the stackyard. In motion wagon loading system has been proposed for wagon loading.

Based on the area of stackyard, it is assessed that only about 0.55 MT of coking coal could be stacked. A typical 30 days dwell time for bulk import cargo will limit the terminal capacity to only 5.0 MTPA. To achieve the required terminal capacity of 10 MTPA either the dwell time of cargo will need to be reduced to 15 days by the concessionaire.

5.3 Development of Multi-Purpose Berth to Handle Clean Cargo

A multipurpose berth of total 450 m length is proposed for handling of clean cargo such as steel products, iron and containers. The Concession Agreement has been signed with the SPV "Paradip International Cargo Terminal (Pvt) Ltd." with revenue share of 11.044%. The terminal capacity envisaged is 5.0 MTPA. The location plan of berth is shown in **Figure 5.4.** The construction is yet to start.

Figure 5.4 Location of Multipurpose Berth

The detailed project report for the project envisages handling of steel products and containers at this berth. In view of the requirement to handle different cargos, two mobile harbour cranes are suggested at the berth. Considering that the containers are brought in small vessels having average parcel size limited to only 500 TEUs, maximum of only two cranes can be deployed at the vessel. There is unlikely that the parcel size would increase over a period of time. Therefore it is assessed that the proposed clean cargo berth of 450 m length can handle two vessels simultaneously and thus has a capacity of about 350,000 TEUs per annum i.e., about 5.0 MTPA, if used exclusively for containers only. Similarly if the berth is used for handling steel products the annual throughput may be limited to about 4.0 MTPA.

5.4 Development of New Iron Ore Berth for Handling of Iron Ore Exports

A new iron ore berth is proposed for handling of iron ore exports, the Concession Agreement has been signed with the SPV “JSW Paradip Terminal Pvt. Ltd.” on 29.06.2015 with revenue share of 21.00%. The terminal capacity envisaged is 10.0 MTPA. The location plan of berth and stackyard is shown in **Figure 5.5**.

The stackyard allocated to for the terminal has an area of **8.21 ha**. and it is envisaged that maximum 0.7 MT of iron ore could be stacked, which provides adequate area to meet the terminal throughput of 10.0 MTPA.

Figure 5.5 Location Plan of New Iron Ore Berth and Stackyard

5.5 Mechanization of EQ1 to EQ3 Berths

In order to enhance the existing capacity of EQ1, EQ2 and EQ3 berths (proposed to be used for thermal coal exports) from 9.69 MTPA to 30 MTPA, PPT plans to mechanize these berths. Mechanization of these berths will involve the following provision will be made:

- All three existing berths shall be strengthened and converted to two berths of adequate length to receive two panamax size ships simultaneously.
- Coal Stackyard within the existing bulb of the rail tracks.
- Addition of two more loops along with track hopper for unloading of BOBRN wagons
- The coal unloaded from track hoppers shall be received at the yard by two stream of conveyors with Stacker cum Reclaimer arrangement

§ From yard the coal shall be conveyed to berths using two streams of conveyors and loaded to ships using one ship loader on each berth

The location plan of berths and stackyard is shown in **Figure 5.6**.

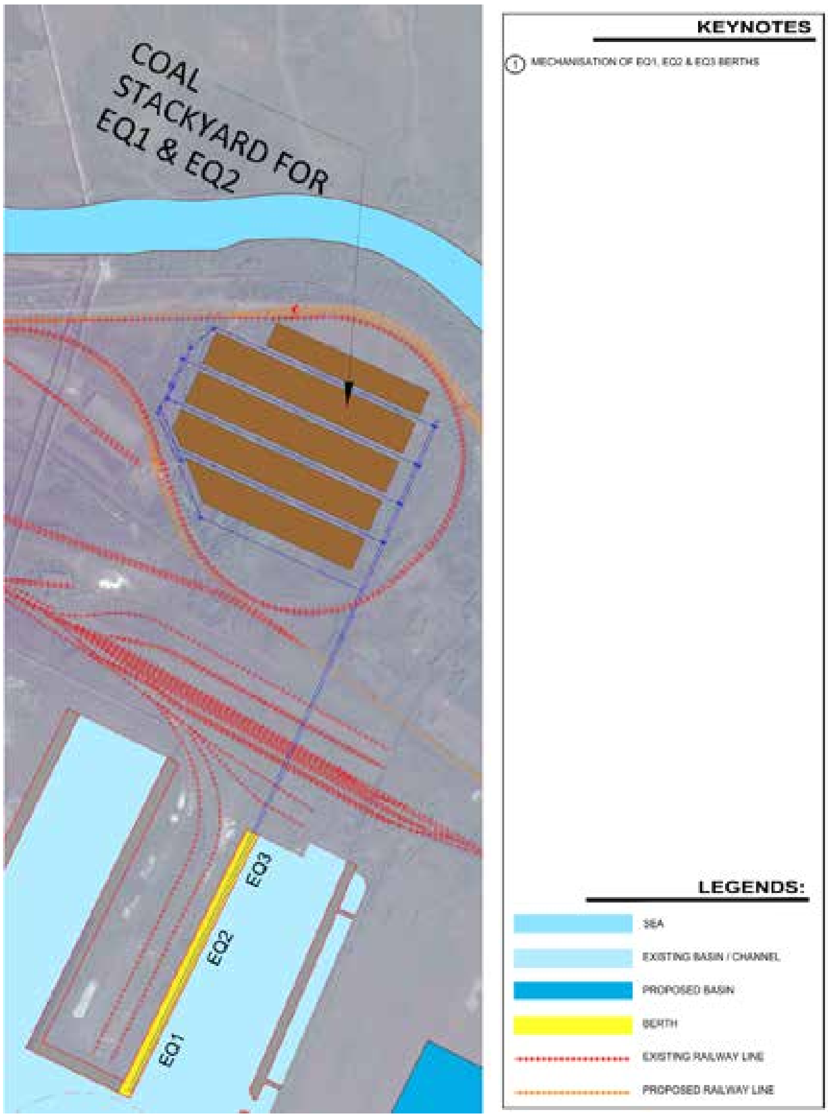


Figure 5.6 Location Plan of EQ 1 to EQ 3 Berths and Stackyard

The storage capacity of the stackyard is only about 1.0 MT and corresponding to the dwell time of 10 days it can support the terminal throughput of 30 MTPA.

5.6 LPG Terminal in South Oil Jetty

The South Oil jetty is the captive IOCL jetty is planning to expand storage and handling of LPG by setting up LPG Import Facility. LPG will be imported in VLGCs at South Oil Jetty constructed by IOCL Paradip Refinery where space for putting up Butane / Propane unloading facility is available. Imported Butane / Propane would be transferred to LPG Import Facility through 2 no. underground pipelines. Imported Butane and Propane will be stored in aboveground mounded storage vessels and sent to market as LPG after blending of Butane & Propane.

The terminal is being planned for the capacity of 2 MTPA which would be developed at a cost of INR. 690 cr.

6.0 TRAFFIC PROJECTIONS

6.1 General

In terms of volumes, Paradip is one of the largest major ports in the country handling more than 70 MTPA of cargo. Paradip is strategically in the mineral rich state of Odisha.

Currently the major commodities handled in the port are coal and POL. Roughly 23 MTPA of coal is exported from the port and is coastally shipped to the South and the Western hinterlands of the country. Additionally, the port imports around 16 MTPA of POL primarily to serve the IOCL refineries at Paradip and Haldia.

6.2 Major Commodities and their Projections

6.2.1 Coal

Coal deposits are mainly confined to eastern and south central parts of the country. The states of Jharkhand, Odisha, Chhattisgarh, West Bengal, Madhya Pradesh, Andhra Pradesh and Maharashtra account for nearly all of the total coal reserves in the country. The State of Jharkhand is the largest producer of coal in the country as of March 2014 followed by Odisha and Chhattisgarh. Since one of the key objectives of Sagarmala is optimizing logistics efficiency for mega-commodities, the main focus area is thermal coal.

Presently, the power plants located in Maharashtra consume the highest quantity of coal- about 77 MTPA, followed by power plants in Chhattisgarh and Uttar Pradesh, at 62 MTPA and 60 MTPA respectively. Overall, ten states account for more than 80% of current thermal coal requirement for power generation in India as shown in **Figure 6.1**.

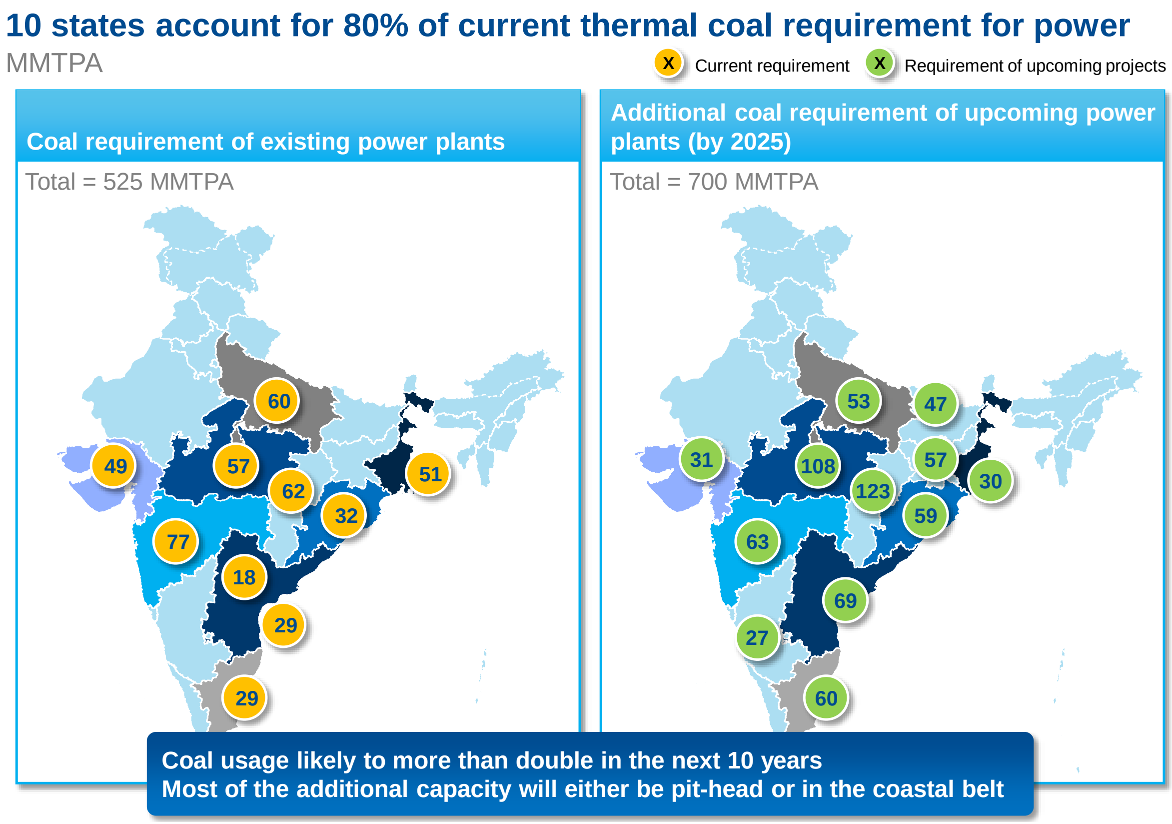


Figure 6.1 Thermal Coal Requirement of Existing and Upcoming Power Plants

Therefore, while coal production is concentrated mostly in Eastern and Central parts of India, it is transported for power generation to nearly all corners of the country as shown in **Figure 6.2**. For example, 26 MTPA is sent from Odisha to Tamil Nadu. Similarly, volumes of coal also move from Chhattisgarh to Maharashtra (19 MTPA) and Gujarat (14 MTPA). Coal imported from Indonesia and South Africa arrives at various ports and then moves inland.

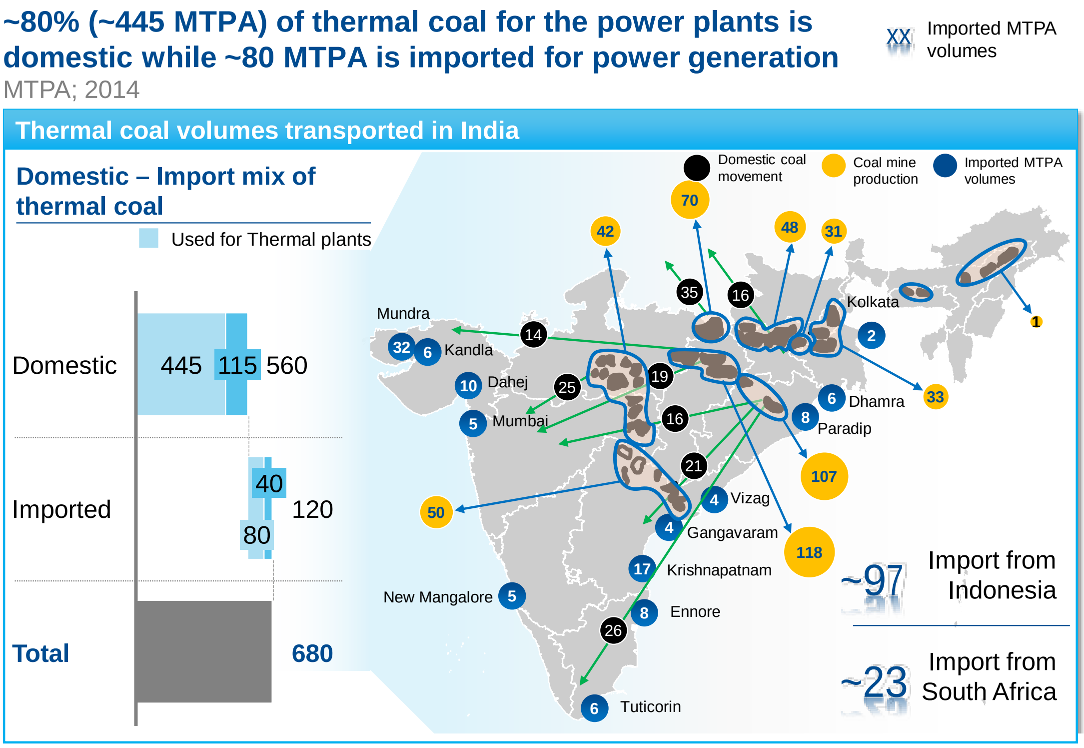


Figure 6.2 Current Coal Movement

Rail is currently the preferred mode with 61% share in overall domestic volume movement, while coastal shipping has a negligible share. Rail freight is INR 1.2-1.5 per tonne-km for coal movement; the same for coastal shipping is nearly one-sixth as shown in **Figure 6.3** .

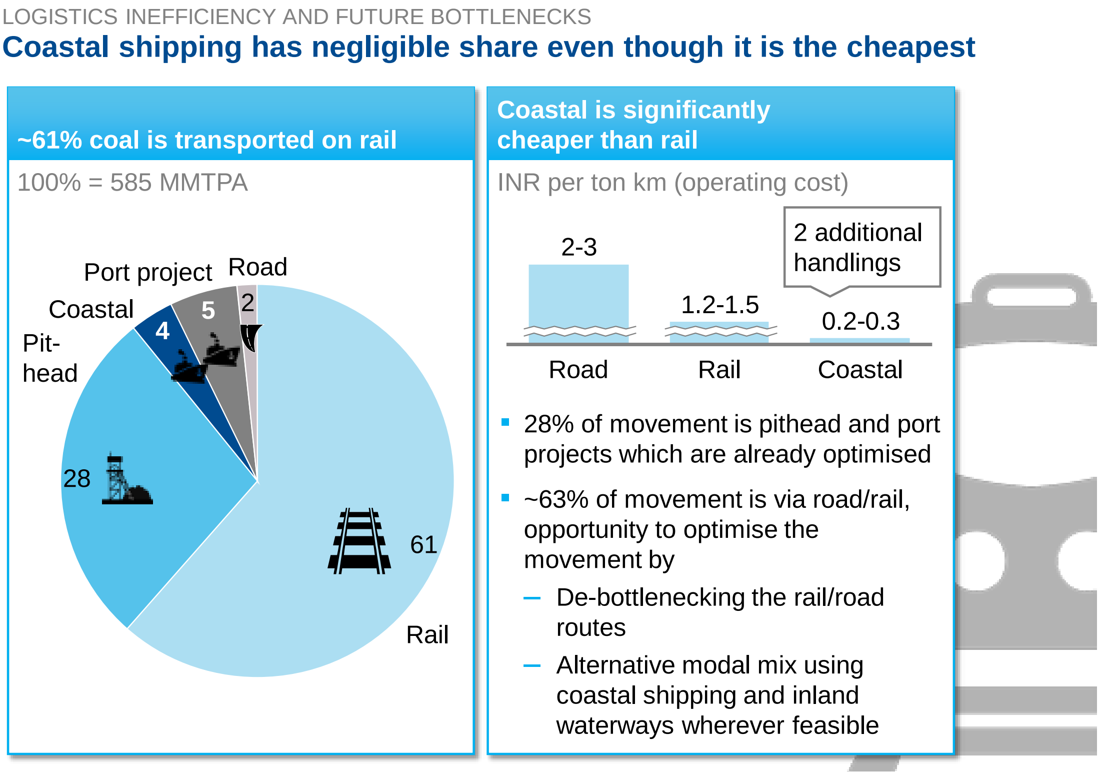


Figure 6.3 Coal Movement by Road Rail and Coastal Shipping

Further, the current rail network is already congested and industry experts believe that it cannot suffice for the future freight load projected due to growth in power generation facilities and industrial corridors. Congested rail lines cause high dwell time, resulting in an average freight speed of only 25 kmph. More than 90 per cent of rail routes relevant for coal movement have more than 100% utilisation as shown in **Figure 6.4**.

Ports are facing severe shortage of rolling stock, which causes overstocking of coal the ports and using of sub-optimal methods of conventional handling and road transportation. The expansion of rail network is slow to keep up with coal capacity needed. In the past few years rail network has only grown at 0.7 per cent year on year.

LOGISTICS INEFFICIENCY AND FUTURE BOTTLENECKS

Current rail network is congested and will not be able to support future volumes

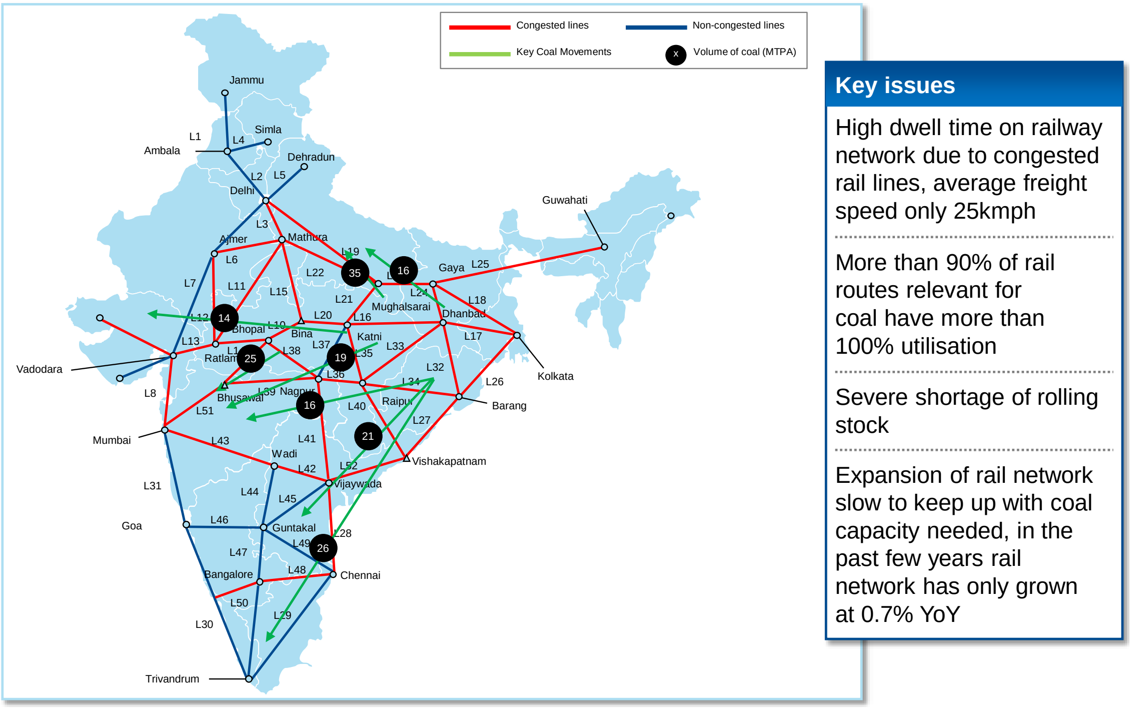


Figure 6.4 Current Rail Network

While rail is the primary mode of transport used for long distance coal movement currently, analysis based on research data and industry expert opinions indicate that there is a significant cost reduction potential in causing a modal mix shift towards coastal shipping. Therefore, focus on coastal shipment of thermal coal has been identified as a key component of the overall Sagarmala vision.

An in-depth study was conducted across 400 operational thermal power plants in the country to examine the origination, destination and mode of coal movement used presently as shown in **Figure 6.5**. At the same time, a cost comparison of all possible combinations of modal mix under different scenarios of vessel capacity was also done as shown in **Figure 6.6**. For example, for movement between Talcher in Orissa to a power plant at Mundra port in Gujarat, the cost for movement via rail is INR 2,980 per ton while the same via rail supported coastal shipping could be much lower at INR 1,320 per ton (i.e. a potential cost saving of as high as 56 per cent).

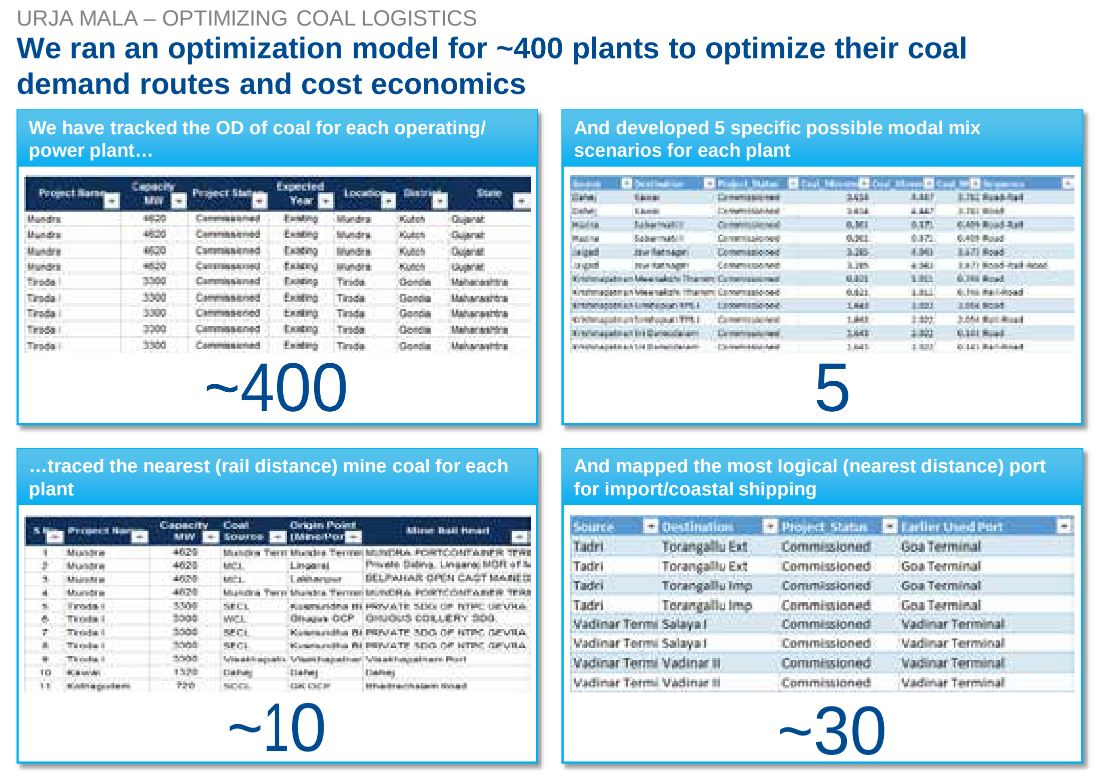


Figure 6.5 Optimization Model for Coal Logistics

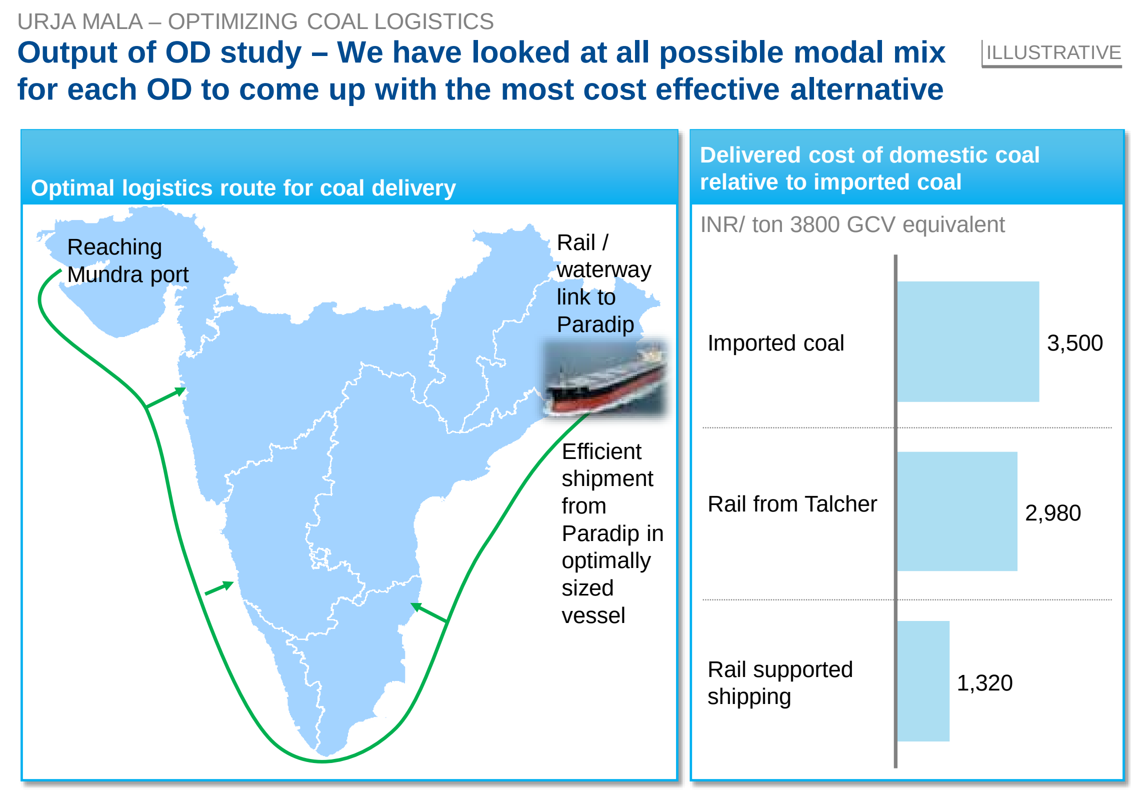


Figure 6.6 Output of O-D Study

Eventually, coastal shipping potential has been identified for ~130 MTPA of thermal coal. In some cases, the cost economics give a very marginal advantage to coastal shipment, but overall railway congestion implies that there still may be a case for coastal shipment to be undertaken in such plants. Even in a conservative scenario, ~80 MTPA of thermal coal can be coastally shipped. **Table 6.1** provides the list of power plants identified as having the potential to move to coastal shipping.

Table 6.1 List of Power Plants with Coastal Shipping

List of Power Plants with Potential for Coastal Shipping: ~ 130 MTPA

Source	Power Plant	State	Coal Movement at 80% PLF (MTPA)	Capacity (MW)	Status
MCL – Lingaraj	Andhra Pradesh Power Generation Corporation Limited, Dr. N. Tata Rao - Krishna	Andhra Pradesh	8.1	1760	Existing
MCL - Lingaraj	Andhra Pradesh Power Generation Corporation Limited, Rayalseema - Cuddapah	Andhra Pradesh	2.9	1050	Existing
MCL - Lingaraj	Andhra Pradesh Power Generation Corporation Limited, Sri Damodaram - Nellore	Andhra Pradesh	4.6	1600	Existing
MCL - Lakhanpur	Gayatri Projects Limited/Sembcorp Utilities, Thermal Powertech I - Krishnapatnam	Andhra Pradesh	3.0	660	Existing
MCL - Lakhanpur	Gayatri Projects Limited/Sembcorp Utilities, Thermal Powertech I (Partly Commissioned) - Krishnapatnam	Andhra Pradesh	3.0	660	Under construction
MCL - Lingaraj	Meenakshi Energy Private Limited, Meenakshi Thamminapatnam II - Nellore	Andhra Pradesh	3.2	700	Under construction
MCL - Lingaraj	Nagarjuna Construction Company/Gayatri Projects Limited, Muthukur Mandal I - Nellore	Andhra Pradesh	3.0	1320	Under construction
MCL - Lakhanpur	Adani Power Limited, Mundra - Kutch	Gujarat	4.6	990	Existing
MCL - Lingaraj	Adani Power Limited, Mundra - Kutch	Gujarat	4.6	990	Existing
MCL - Samaleswari	Ind Barath Power Infra Limited, Ind Barath Madras I - Tuticorin	Tamil Nadu	3.0	660	Under construction
MCL - Lingaraj	KVK Energy and Infrastructure Private Limited, Nagai - Nagapattinam	Tamil Nadu	1.4	300	Under construction
MCL - Hingula-II	National Thermal Power Corporation Limited/Tamilnadu Electricity Board, Vallur I - Thiruvallur	Tamil Nadu	6.9	1500	Existing
MCL - Hingula-II	Neyveli Lignite Corporation Limited/Tamilnadu Electricity Board, Tuticorin NLC - Tuticorin	Tamil Nadu	2.3	500	Existing
MCL - Samaleswari	Neyveli Lignite Corporation Limited/Tamilnadu Electricity Board, Tuticorin NLC (Partly Commissioned) - Tuticorin	Tamil Nadu	2.3	500	Under construction
MCL - Lakhanpur	OPG Power Gen Limited, Chennai I - Thiruvallur	Tamil Nadu	0.4	77	Existing
MCL - Lakhanpur	OPG Power Gen Limited, Chennai II - Thiruvallur	Tamil Nadu	0.4	77	Existing
MCL - Lakhanpur	OPG Power Gen Limited, Chennai III - Thiruvallur	Tamil Nadu	0.4	80	Existing
MCL - Jagannath/Jagannath Extn.	Tamilnadu Electricity Board, Ennore - Thiruvallur	Tamil Nadu	2.1	450	Existing
Mandakini B - Mandakini B	Tamilnadu Electricity Board, Ennore II - Thiruvallur	Tamil Nadu	3.0	660	Under construction
MCL - Jagannath/Jagannath Extn.	Tamilnadu Electricity Board, Mettur - Salem	Tamil Nadu	6.6	1440	Existing
MCL - Jagannath/Jagannath Extn.	Tamilnadu Electricity Board, North Chennai - Thiruvallur	Tamil Nadu	8.4	1830	Existing
MCL - Jagannath/Jagannath Extn.	Tamilnadu Electricity Board, Tuticorin - Tuticorin	Tamil Nadu	4.8	1050	Existing
	Total		**79.0**		
MCL - Lakhanpur	Andhra Pradesh Power Generation Corporation Limited, Rayalseema IV - Kadapa	Andhra Pradesh	2.8	600	Under construction
MCL - Samaleswari	Hinduja National Power Corporation Limited, Vishakhapattnam - Vishakhapatnam	Andhra Pradesh	4.8	1040	Under construction
MCL - Hingula-II	National Thermal Power Corporation Limited, Simhadri - Krishna	Andhra Pradesh	7.8	1700	Existing
ECL - Khottadih OC	National Thermal Power Corporation Limited, Simhadri - Krishna	Andhra Pradesh	1.4	300	Existing
SECL - Dipka	Gujarat State Electricity Corporation Limited, Gandhi Nagar - Gandhinagar	Gujarat	4.0	870	Existing
SECL - MANIKPUR OC	Gujarat State Electricity Corporation Limited, Sikka Rep. - Jamnagar	Gujarat	2.3	490	Existing
SECL - MANIKPUR OC	OPG Power Gen Limited, Mundra OPG - Kutch	Gujarat	1.4	300	Under construction
MCL - Bharatpur	Karnataka Power Corporation Limited, Bellary Tps - Bellary	Karnataka	2.3	1000	Existing
MCL - Ananta	Karnataka Power Corporation Limited, Raichur - Raichur	Karnataka	2.8	600	Existing
MCL - Bharatpur	Karnataka Power Corporation Limited, Raichur - Raichur	Karnataka	1.2	250	Existing
Pakri Barwadih - Pakri Barwadih	National Thermal Power Corporation Limited, Kudgi I - Bijapur	Karnataka	11.1	2400	Under construction
MCL - Lakhanpur	Indiabulls Power Limited, Nasik I - Nasik	Maharashtra	1.2	270	Existing
SECL - Dipka	Reliance Power, Dhanu - Thane	Maharashtra	2.3	500	Existing
MCL - Lingaraj	Telangana State Power Generation Corporation Limited, Kothagudem II - Khammam	Telangana	2.3	1000	Existing
	Total		**47.7**		

Note: Cases where cost advantage from coastal shipping may be marginal are marked in RED

Based on these projections it was concluded that given Paradip is the nearest port to the cluster of coal mines which are suitable for coastal shipping of coal, Paradip will have a step jump in terms of coastally shipped coal. From the current traffic of 23 MTPA, we can expect traffic of nearly 95 MTPA by 2020, 135-140 MTPA by 2025 and 200 MTPA by 2035. In order to realize this potential many connectivity projects need to be undertaken in order to feed the requisite amount of coal to the port, these projects are discussed in later portions of this report.

6.2.2 Coking Coal

Another major commodity imported in Paradip is coking coal. To service the demand of blast furnace-based steel production, around 60 to 65 MTPA of coking coal is transported in the country, and around 54 MTPA is consumed for the production of steel. Around 80 percent of the coking coal consumed is imported due to insufficient coking coal reserves in India.

Eastern India (West Bengal, Jharkhand, Odisha and Chhattisgarh) is the biggest cluster of steel production in the country with 45 MTPA (around 40 percent) of total installed steel capacity.

While the current coking coal evacuation is facing challenges due to limited availability of rakes at unloading ports and rail line capacity at key train routes around 21 MTPA of new steel capacity at key steel plants (1 MTPA and above blast furnace based) is under construction (**Figure 6.7**) and would need around 18-20 MTPA of coking coal to be evacuated on the same rail routes which are currently running at above 100 percent utilization.

According to estimates, the coking coal demand for steel would reach around 130-140 MTPA in 2035 based on increased steel demand in the country for programs like Make in India and construction impetus. Also, historically the steel growth has been growing faster than GDP with the multiplier being GDP: 1.14. However, it is also important to note that steel being a cyclical industry is subject to ups and downs of the economy.

The evacuation capability at the relevant unloading ports and the railway routes will need to be improved for optimal evacuation of coking coal.

Based on these projections we expect the traffic at Paradip to increase to 16 MTPA in the next 5 years, ~20 MTPA by 2025 and ~30 MTPA by 2035. The growth till 2020 will primarily be driven by the new Tata Kalinganagar plant and the expansion of the Bhushan Steel plant in Meramandali.

Coking coal volumes projected at Paradip port for key steel plants

Steel plants	**Coking coal volume 2020** (MMTPA)
TISCO	0.9
SAIL, Rourkela	2.8
Bhushan steel, Sambalpur	1.4
JSPL, Raigad	0.4
Neelachal Ispat Nigam, Odisha	0.6
Tata, Kalinganagar	3.5
JSPL, Patratu	2.5
Bhushan steel, Meramandali	1.7

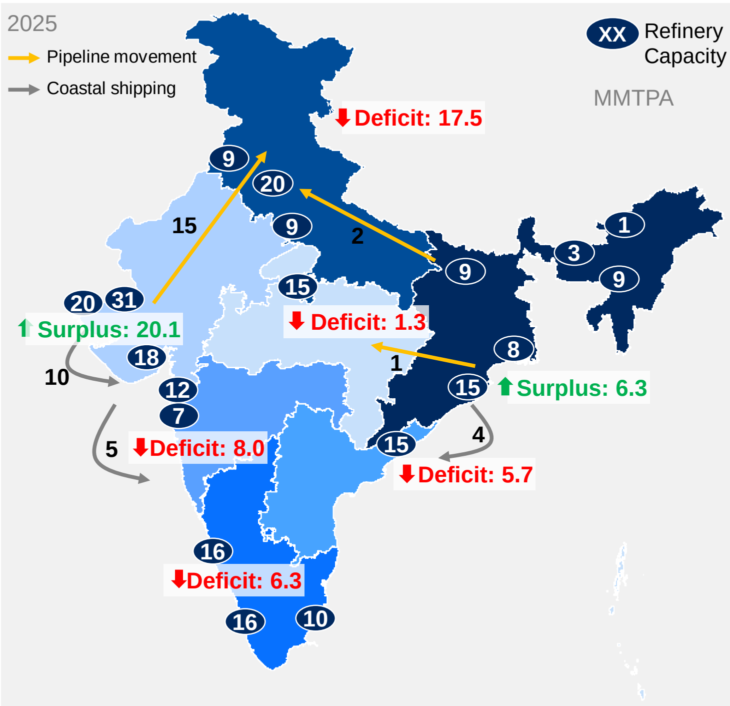
SOURCE: Origin destination analysis

Figure 6.7 Steel Plants relevant for Coking Coal

6.2.3 POL

In addition to coal and coking coal, POL is another key commodity for Paradip port. The port currently handles ~18 MTPA of POL which includes ~16 MTPA of crude import at IOCL refineries and ~2 MTPA of coastal movement of POL products from Paradip. By 2025, crude oil import is expected to rise to ~34 MTPA considering Paradip refinery getting operational. LPG imports are expected to rise considering government's focus on distribution of LPG connections to rural households. Additional 4-5 MTPA of MS/HSD is expected to be coastally shipped from Paradip to cater to the demand of Andhra Pradesh and Telangana as shown in **Figure 6.8**.

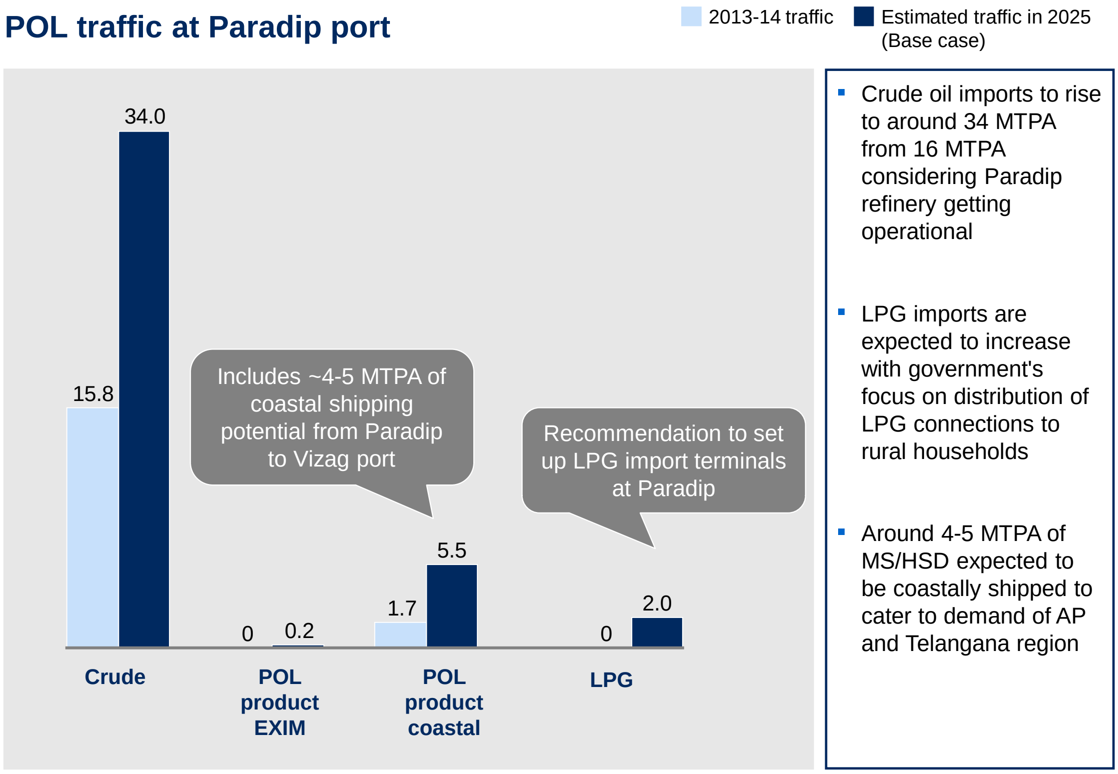
There is a potential for coastal shipping of ~5 MMTPA of MS/HSD from Paradip to Vizag port by 2025



1. Assumes RIL Jamnagar and Essar Oil export nothing while Reliance SEZ exports 100% product

Figure 6.8 Coastal Shipping Possibilities

The split of the current traffic of POL and the projected traffic for 2025 is as shown in **Figure 6.9**.



SOURCE: Indian Petroleum and Natural Gas Statistics 2013-14; Basic Port Statistics of India 2013-14

Figure 6.9 POL Traffic – Paradip Port

6.2.4 Other Commodities

Other key commodities handled at Paradip port include iron ore, limestone, fertilizers, gypsum, etc. In the base case scenario we expect the exports of Iron Ore from the port to be depressed due to the crashing of the global prices and the non-competitiveness of the Indian ore in the export markets.

Fertilizer traffic is also projected to grow to roughly 7 MTPA by 2025 due to the presence of IFFCO and good connectivity to agricultural areas in Bihar and UP. **Table 6.2** summaries the traffic potential for key commodities for Paradip port.

Table 6.2 Paradip Port – Traffic Projections

Paradip Port - Traffic Projections

Units: MMTPA (except Containers)

xx Base Scenario xx Optimistic Scenario

Commodity	2014-15	2020	2025		2035		Remarks
			Base	Optimistic	Base	Optimistic	
Liquid Cargo							
POL	17.9	35.2	41.8	45.4	47.5	51.2	▪ Mainly Crude oil imports by IOCL Paradip, IOCL Haldia and coastal shipping
Dry and Break Bulk Cargo							
Thermal Coal (Loading)	23	95	135	142	200	201	▪ Driven by coastal shipping from MCL mines
Thermal Coal (Unloading)	7.0	6.0	7.5	8.5	9.0	11.0	▪ Imported Coal for power likely to be reduced as CIL production increases
Coking Coal	7.9	16.3	19.0	21.0	28.0	32.0	▪ TATA Kalinganagar and Bhushan Steel Meramandli expansion
Iron Ore	2.2	6.5	7.5	15.9	10.0	30.1	▪ Mostly exports; likely to remain low. JSW captive berth cargo considered. Optimistic case is related to the volumes handled before ban. Pellets are part of others
Limestone	2.2	3.1	4.3	4.5	7.6	8.8	
Dolomite	0.7	1.0	1.35	1.44	2.4	2.8	
Gypsum	0.8	1.1	1.5	1.6	2.7	3.1	
Fertilizers	4.4	5.6	7.0	7.3	10.5	11.7	
Containers and other Cargo							
Containers (MnTEU)	0.004	0.02	0.10	0.13	0.15	0.18	
Others	4.6	6.1	8.2	8.6	13.6	15.4	▪ Highly fragmented
Total (MMTPA)	**71.0**	**176.2**	**234.8**	**258.4**	**333.8**	**370.1**	

Conversion Factor Used for Containers Projections: 1 TEU = 16.75 Tons

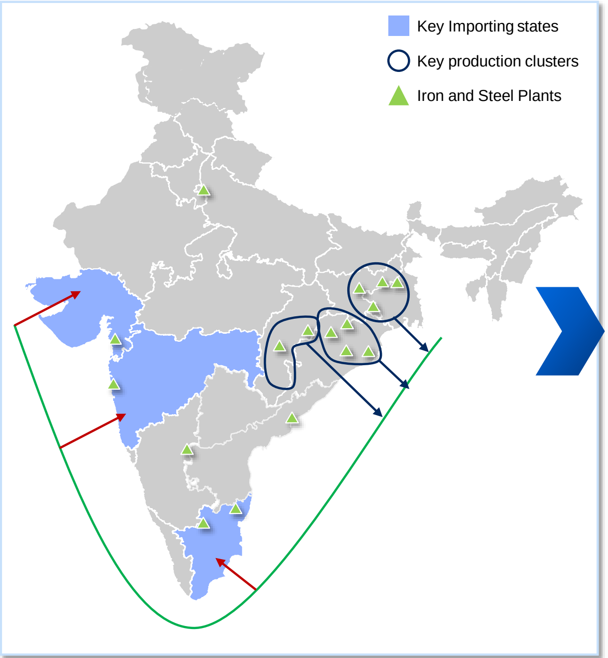
6.2.5 Coastal Shipping Potential

Paradip is strategically positioned to serve large areas in the hinterland of the country through coastal shipping. Steel can be major commodities from Paradip in case coastal shipping revolution takes place in the country.

§ **Steel:** 5-6 MTPA of steel can be coastally shipped to demand states of Maharashtra, Tamil Nadu, Andhra Pradesh and Gujarat by 2025. The key plants which will lead to the advent of coastal shipping of steel from Paradip are SAIL Rourkela, BPSL Sambhalpur, BSL Meramandli, JSPL Angul, etc. as shown in **Figure 6.10**.

COASTAL SHIPPING IRON AND STEEL

~5-6 MTPA of steel can be coastally shipped from Odisha to demand states of Maharashtra, Gujarat, AP and TN by 2025



Key plants with coastal shipping potential from Paradip Port

Plant	Location	Volume Potential to shift to coastal (in MTPA)
SAIL	Rourkela	1.3-1.4
BPSL	Sambalpur	0.4-0.5
BSL	Meramandali	0.9-1.0
JSPL	Angul	0.8-0.9
Tata Steel	Kalinganagar	0.4-0.5
NINL	Duburi	0.4-0.5

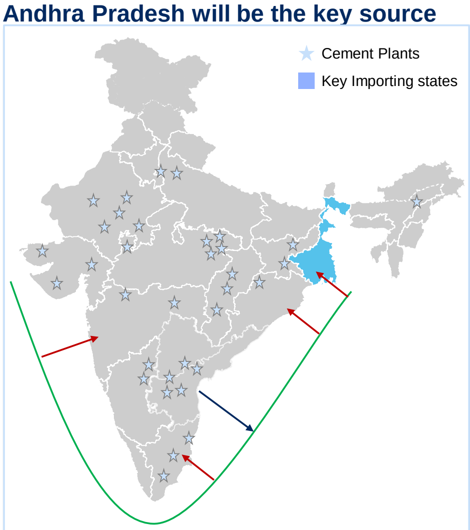
SOURCE: DGCIS data 2013-14; Team analysis

Figure 6.10 Coastal Shipping - Steel

§ **Cement:** 1-2 MTPA of cement can be coastally shipped to Paradip port from Andhra Pradesh by 2025 as shown in **Figure 6.11** and **Figure 6.12.** Additional ~2.5 MTPA can be coastally shipped from the proposed cement cluster in AP by 2025 if the central AP port comes up.

COASTAL SHIPPING CEMENT

~ 1-2 MTPA of cement can be coastally shipped to Paradip Port by 2025; Andhra Pradesh will be the key source



Key ODs with coastal shipping potential to Paradip Port

Route	Volume, '000 TPA
Andhra Pradesh to Odisha	1,690

SOURCE: DGCIS data 2013-14

Figure 6.11 Coastal Shipping – Cement

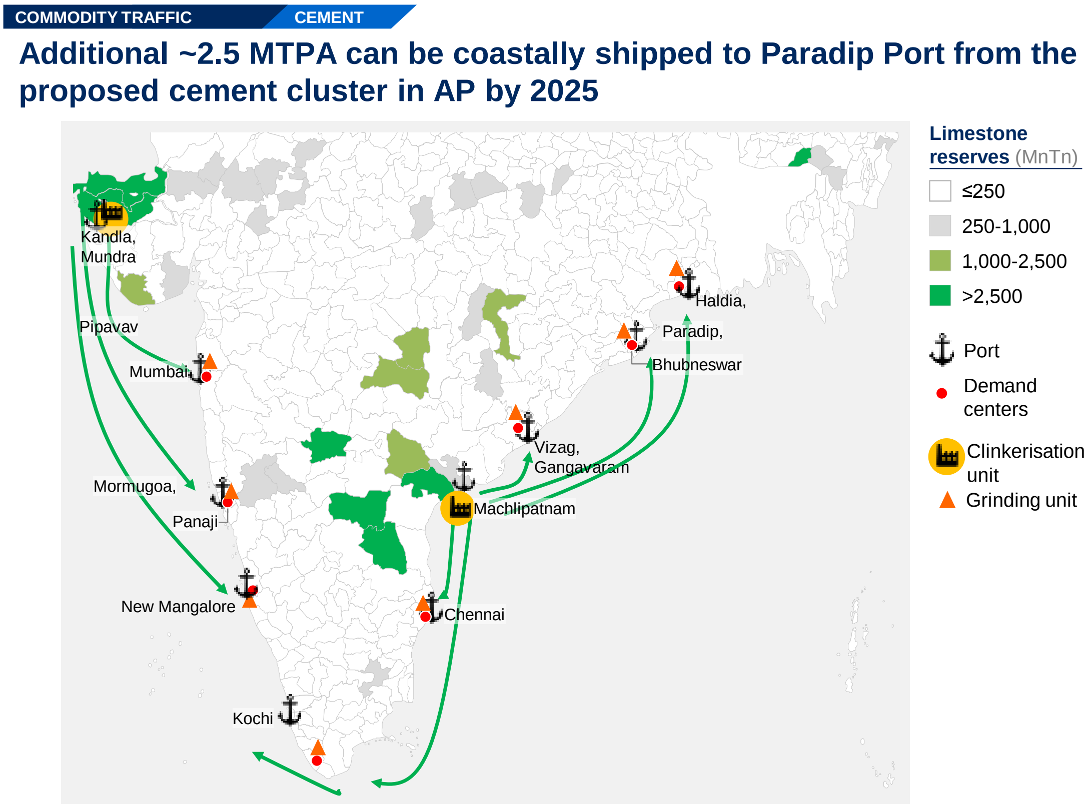
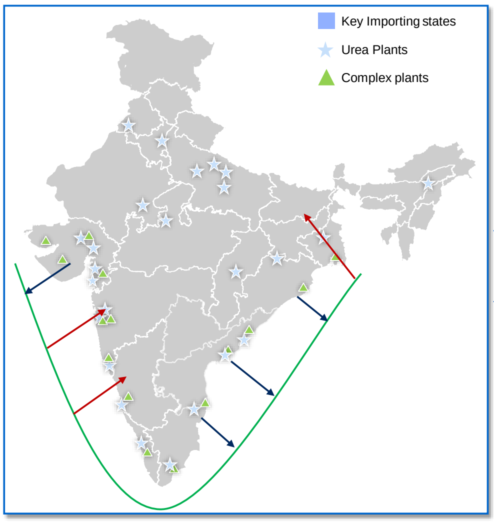


Figure 6.12 Coastal Shipping – Cement Cluster

§ **Fertilizers:** ~1 MTPA of fertilizers can be coastally shipped from Paradip port by 2025 to Andhra Pradesh, Karnataka, Tamil Nadu and Maharashtra as shown in **Figure 6.13**.

COASTAL SHIPPING FERTILISERS

~1 MTPA of fertilizer can be coastally shipped from Paradip Port by 2025; Andhra Pradesh will be the key source



Key ODs with coastal shipping potential from Paradip Port

Route[1]	Volume, TPA
Odisha to Andhra Pradesh	483
Odisha to Karnataka	218
Odisha to Tamil Nadu	133
Odisha to Maharashtra	116

1 Small quantities can come from a number of other ODs via Paradip Port

Figure 6.13 Coastal Shipping – Fertiliser

Table 6.3 summarizes the potential of coastal movement for key commodities.

Table 6.3 Paradip Port – Coastal Shipping Opputunity

Paradip Port – New Opportunities Possible via Coastal Shipping

Units: MMTPA (except Containers)

Commodity	2020	2025	2035
Steel (Loading)	3.91	5.23	9.37
Steel (Unloading)	0.50	0.67	1.19
Cement (Loading)	0.01	0.01	0.02
Cement (Unloading)	1.27	4.2	5.5
Fertilizer (Loading)	0.87	1.06	1.57
Fertilizer (Unloading)	0.39	0.47	0.70
Food Grains (Loading)	0.40	0.49	0.72
Food Grains (Unloading)	-	-	-

- 2.5 MMTPA can be shipped from Central AP cement cluster (If Central AP port comes up)

7.0 CAPACITY AUGMENTATION REQUIRMENTS

7.1 Port Capacity after On-Going Developments

The capacity of the existing berths and that of proposed berths have been worked out and the same is presented in **Table 7.1**.

Table 7.1 Existing and Proposed Capacity of Berths (MTPA)

Area of Expansion	Cargo Handled	I/E	Current Capacity	Additional Capacity after Debottlenecking	Addition with Upcoming New Facility / Mechanisation	Total Capacity
MCHP	Coal - Export	E	23.50	-	-	23.5
EQ1,2,3	Coal - Export	E	9.69	-	20.31	30.0
CQ1,2	Coal – Import	I	12.10	-	7.90	20.0
IOB	Iron Ore	E	6.39	-	-	6.39
Southern Quay	Breakbulk	I/E	4.76	-	-	4.76
FB1,2	Fertiliser	I	7.50	-	-	7.50
North Oil Jetty	Crude/ HSD	I	7.50	-	-	7.50
CQ 3	Dry bulk	E	6.55	-	-	6.55
MPB		I/E	3.45	-	-	3.45
Essar Coal Berth	Coal	I	-	-	10.00	10.00
JSW Iron Ore berth	Iron ore	E	-	-	10.00	10.00
South Oil Jetty (IOCL New Oil Jetty)	Crude	I	10	-	-	10.00
New MPB	Clean Cargo	I/E	-	-	5	5.00
3 SBM (IOCL)	POL	I/E	37.0			37.00
Total Capacity (MTPA)			**128.44**	**0**	**53.21**	**181.65**

It may be noted that the capacity of the berths has been worked out based on the allowable level of berth occupancy so as to limit the waiting time of ships and also allow sufficient time for the repair and maintenance of handling equipment.

7.2 Requirement for Capacity Expansion

While comparing the existing and planned capacities for the Paradip port with the traffic projections as shown in **Table 7.2** it could be seen that by 2020 there would be a shortfall of capacity for the thermal coal export.

It is therefore necessary that action be initiated immediately for the capacity augmentation of handling bulk export cargo and other cargo so that the projected could be completed by year 2020.

In addition to that there is likely to be significant demand for berths for Breakbulk and other cargo.

Table 7.2 Additional Need in Capacity by 2020, 2025 and 2035

Cargo Handled	I/E	Current Capacity (MTPA)	2020		2025		2035	
			Projected Traffic (MTPA)	Capacity Augmentation required over current (MTPA)	Projected Traffic (MTPA)	Capacity Augmentation required over current (MTPA)	Projected Traffic (MTPA)	Capacity Augmentation required over current (MTPA)
Coal - Export	E	33.21	95.00	61.79	135.00	101.79	200.00	166.79
Coal – Import	I	12.10	22.30	10.20	26.50	14.40	37.00	24.90
Breakbulk	I/E	14.76	11.64	0.00	17.03	2.27	28.81	14.05
Iron Ore	E	6.39	6.50	0.11	7.50	1.11	10.00	3.61
Fertiliser	I	7.50	5.60	0.00	7.00	0.00	10.50	3.00
Crude/ POL	I	54.50	35.20	0.00	41.80	0.00	47.50	0.00
Total		**128.46**	**176.24**	**72.10**	**234.83**	**119.57**	**333.81**	**212.35**

8.0 PORT CONNECTIVITY AND INFRASTRUCTURE

8.1 Constraints in Rail and Road Connectivity to the Port

8.1.1 General

The current cargo receipt/evacuation modal split is shown in **Figure 8.1**.

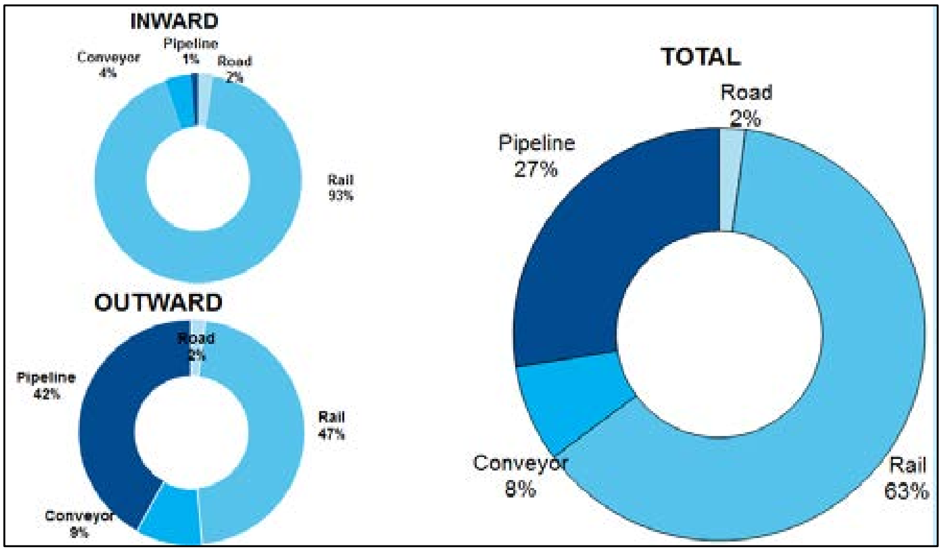


Figure 8.1 Evacuation Modal Spilit

It could be seen that railway is the key for receipt /evacuation of cargo to/from port of the current cargo. Considering that the future traffic projections are also mainly for the bulk commodities, railway shall continue to play the key role for the port infrastructure.

8.1.2 Road Connectivity

Paradip Port is connected by NH-5A (4 lane) and SH-12 (2 lane) to Chandikhole and Cuttack respectively. During the iron ore boom period NH-5A witnessed frequent congestion; however the same seems to be eased out for the time being. With the growth in traffic of breakbulk and containers over a period of time, congestion on NH-5A would increase requiring additional lane to be provided. The existing 4 lane road can be upgraded to 6 lane road by NHAI with equity contribution from PPT and other stakeholders.

Further the junction points near approach to the port need to be widened for smooth traffic flow. Also adequate space for the parking of trucks entering the port needs to be provided.

8.1.3 Rail Connectivity

Thermal coal is the key cargo being brought to Paradip from Talcher. The route details are given below:

- § Distance from Talcher to Cuttack is 112 km and that from Cuttack to Paradip is 84 km.
- § Presently 20-24 rakes each side totalling to 40 rakes per day are handled.
- § The number of outgoing rakes from Talcher currently is of the order of 40 rakes per day (average). Out of these, 20 rakes per day (max.) reach Paradip and balance 20 rakes go to other destinations.

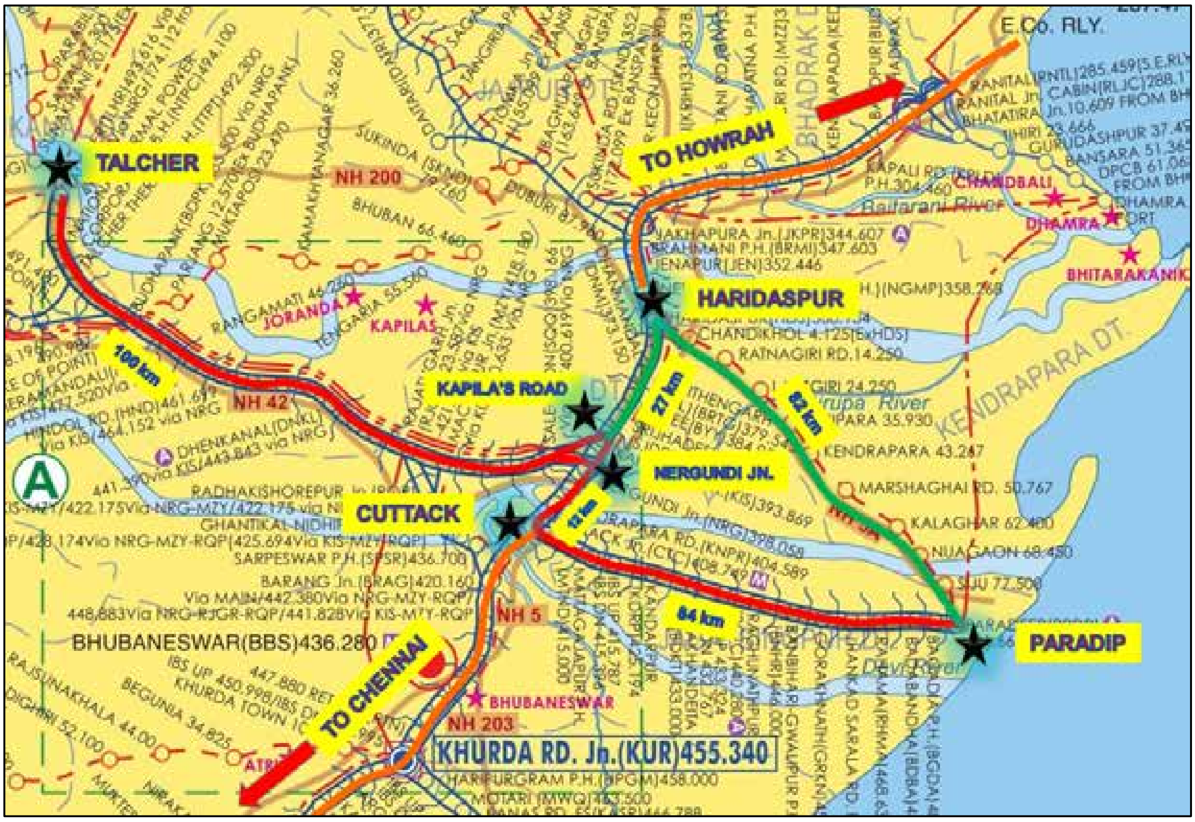


Figure 8.2 Rail Connectivity

There are several issues on the effective movement of rakes to the Paradip Port. As could be seen from **Figure 8.2**, the rake movement from Talcher to Paradip involves an overlap with Howrah-Chennai mainline for a stretch of about 41 km between **Talcher – Kapilas Road – Cuttack**. Passenger trains between Howrah- Chennai stretch is given priority over coal rakes and therefore an exclusive **single line between Kapilas Road – Cuttack** is needed.

There are many other lines between Talcher and Cuttack, as shown in **Figure 8.3** which are over utilised and the work for their upgradation is in progress.

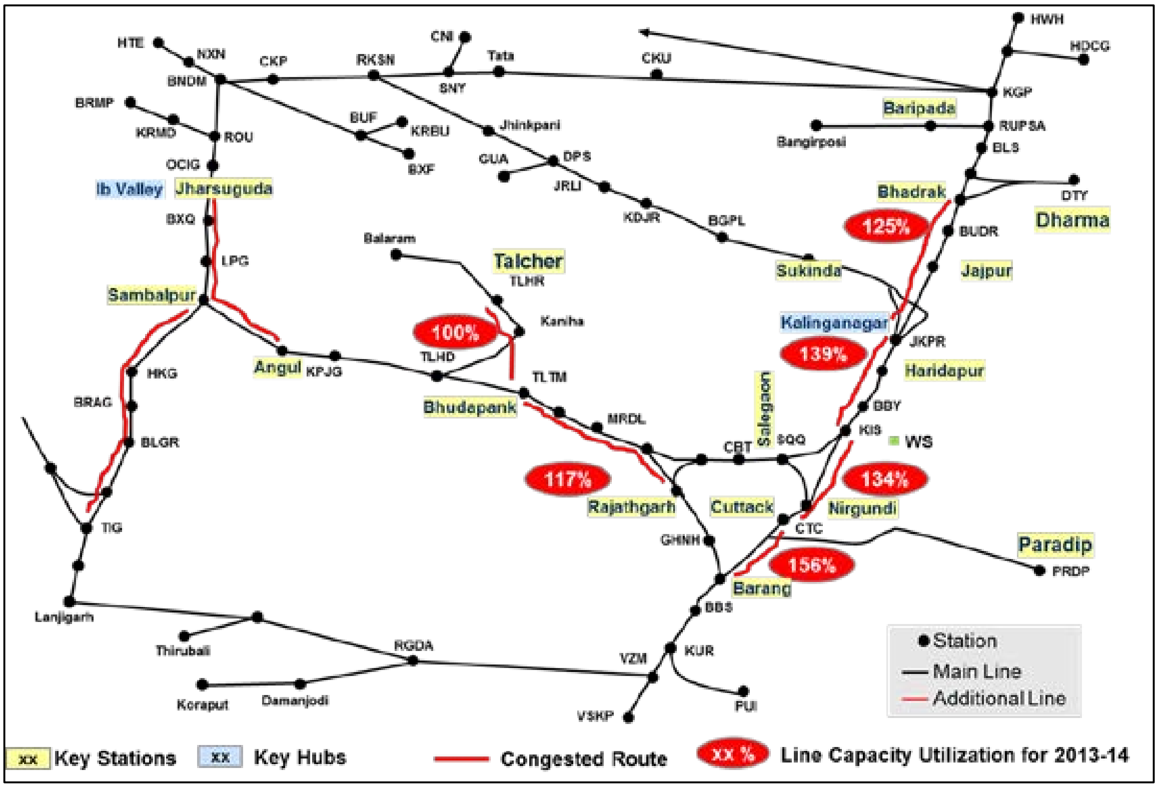


Figure 8.3 Key Rail Routes Between Talcher/Ib Valley and Paradip/Dharma

Some interventions required for effective transfer of coal mined from Talcher and Ib Valley to Paradip is presented in **Figure 8.4**.

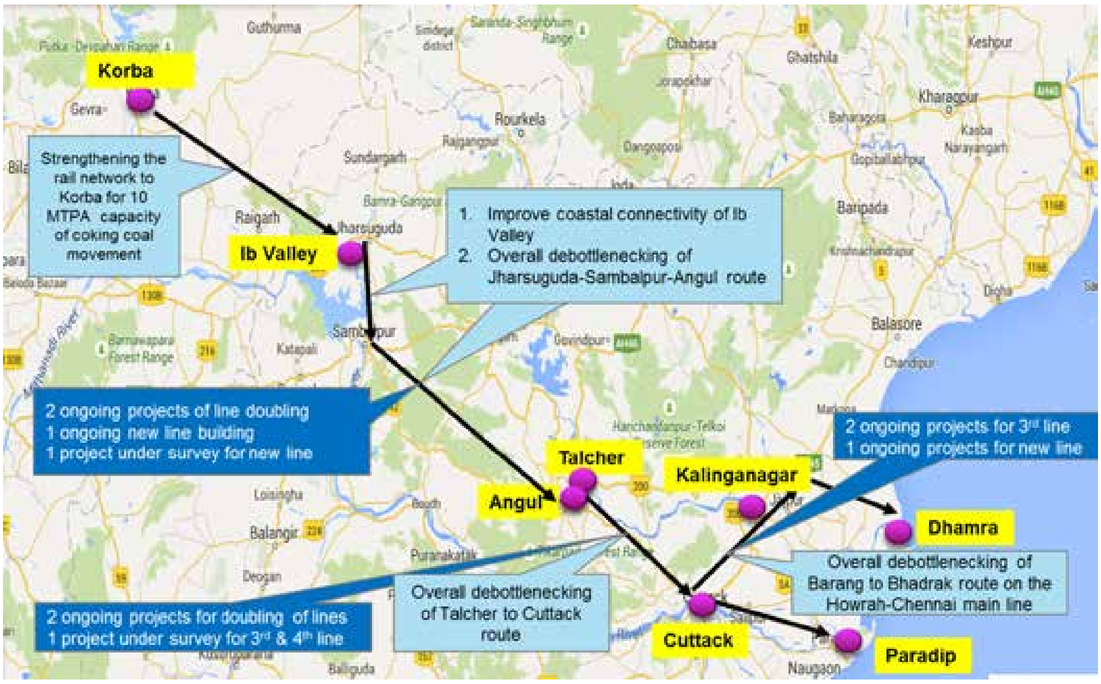


Figure 8.4 Interventions required for Effective Transfer of Coal Mined from Talcher and Ib Valley to Paradip

Many of the rail upgradation projects are already in progress with the current status as shown in **Table 8.1**.

Table 8.1 Status of Rail Evacuation Projects Critical to Coastal Coal Movement

S. No.	Project Name	Project Status
1.	IB Signalling in Talcher-Cuttack-Paradip route for 192 km	Completed
2.	New Line from Haridaspur - Paradip (82 km)	Completion by 2017
3.	New Line from Angul - Sukhinda road (99 km)	Completion by 2016
4.	Doubling of line from Titlagarh - Sambalpur	Completion by 2017
5.	Doubling of line from Sambalpur - Talcher	Completion by 2018
6.	Doubling of line from Rajathgarh - Barang	Completion by 2016
7.	Doubling of line from Barang - Cuttack	Completed
8.	Budhapank - Salegaon via Rajathgarh (3rd and 4th Lane)	To be started post financial closure. Critical Project
9.	Third lane from Bhadrak - Nergundi	Status to be confirmed
10.	Third lane from Jakhapura - Haridaspur	Status to be confirmed
11.	Increase track weight handling capacity from 22.5 to 25 T axle load	Completion in 4-5 years
12.	Build long haul loop for 192 km on Paradip- Talcher route	Completion in 4-5 years
13.	Bypass railway line from Salegaon to Kandarapur	DPR in progress

With the completion of above projects the total rake movement could go up to about 80 rakes per day each way. To further increase the capacity of coal movement through rail, there would be a need to ply a dedicated heavy haul rail line between the mines and port, the feasibility of which has been taken by government in a separate assignment.

At the port end there would be many initiatives required to increase the rake handling capacity and these are discussed in subsequent sections.

8.2 Intersections in Rail & Traffic Conflict

8.2.1 Locations of Intersections

The rail networks inside the Port boundary are grouped into 6 sub-divisions as shown in the **Figure 8.5**. This results in incoming & outgoing traffic crossing each other. Each such conflict slows down the traffic. With the total volume of rail traffic projected in next sections, it is clearly required to remove such traffic conflict as much as possible.

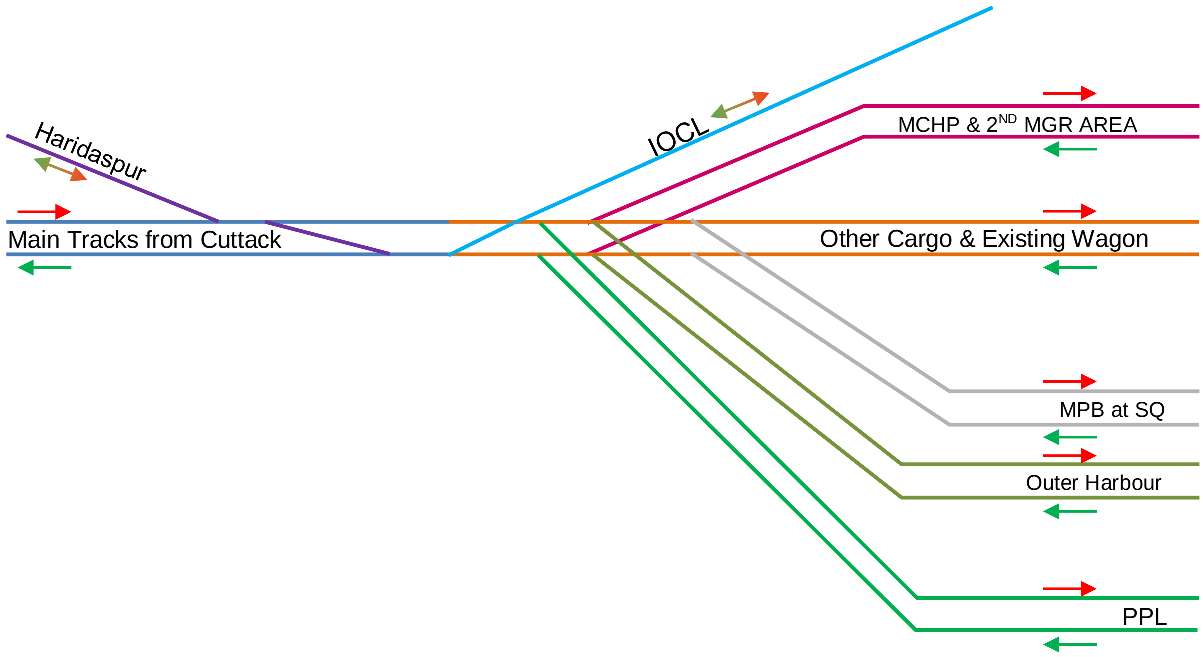


Figure 8.5 Rail Traffic Intersection in Present Scenario

8.2.2 Main Tracks from Cuttack

As per the traffic estimated, the main tracks from Cuttack need to be expanded to 4 (2 up + 2 down) for traffic projections for the year 2025.

Two options for developments are proposed as under:

Option 1: The main line tracks west of Paradip station shall be upgraded to 2 up + 2 down tracks with 2 up tracks on one side & 2 down tracks on the other. Near the PPL Level crossing, one up track has to the raised to pass over the crossing down track (via flyover) and shall come down at the existing exchange yard. Up Traffic for Outer Harbour and MPB at SQ shall be routed through this. Schematic of this option is shown in **Figure 8.6**.

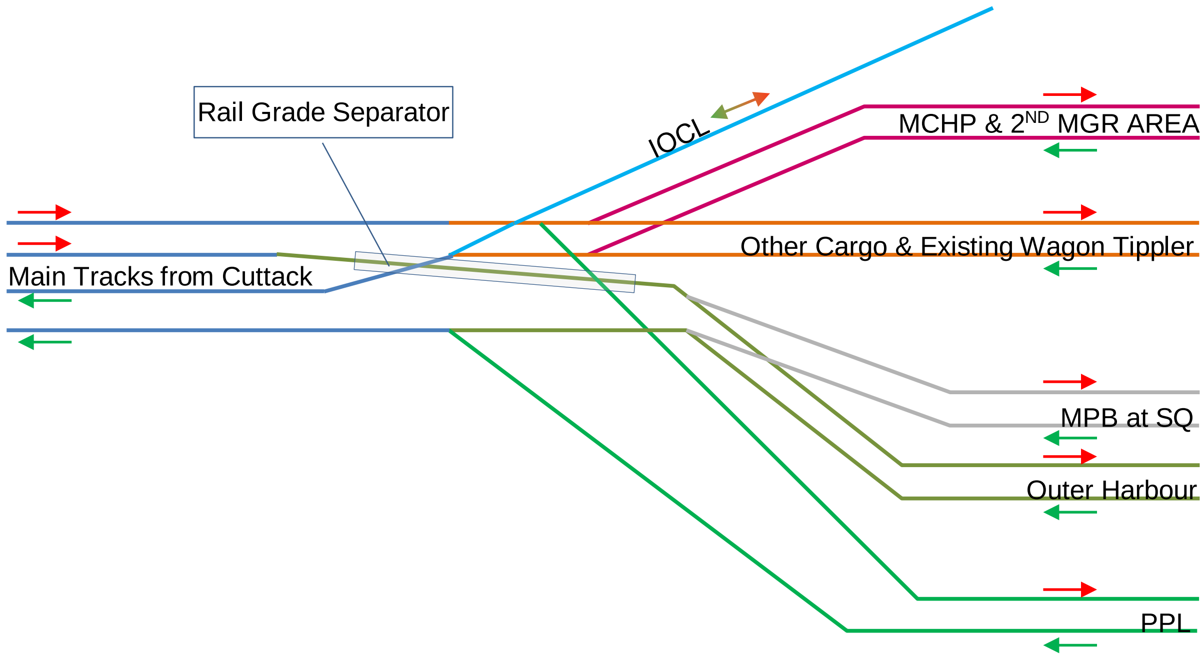


Figure 8.6 Option 1 for Development of Rail Tracks

Option 2: In this option, the new set of up & down tracks shall be laid on one side of the existing tracks. New up track shall be passed over the existing down track at place near Barabandha station and a location & conceptual layout for the same is suggested in **Figure 8.8**.

This option effectively segregates the existing harbour network from outer harbour. The traffic of PPL & MPB at SQ is proposed to be handled by this new network. A schematic of the proposed layout is shown in **Figure 8.7**.

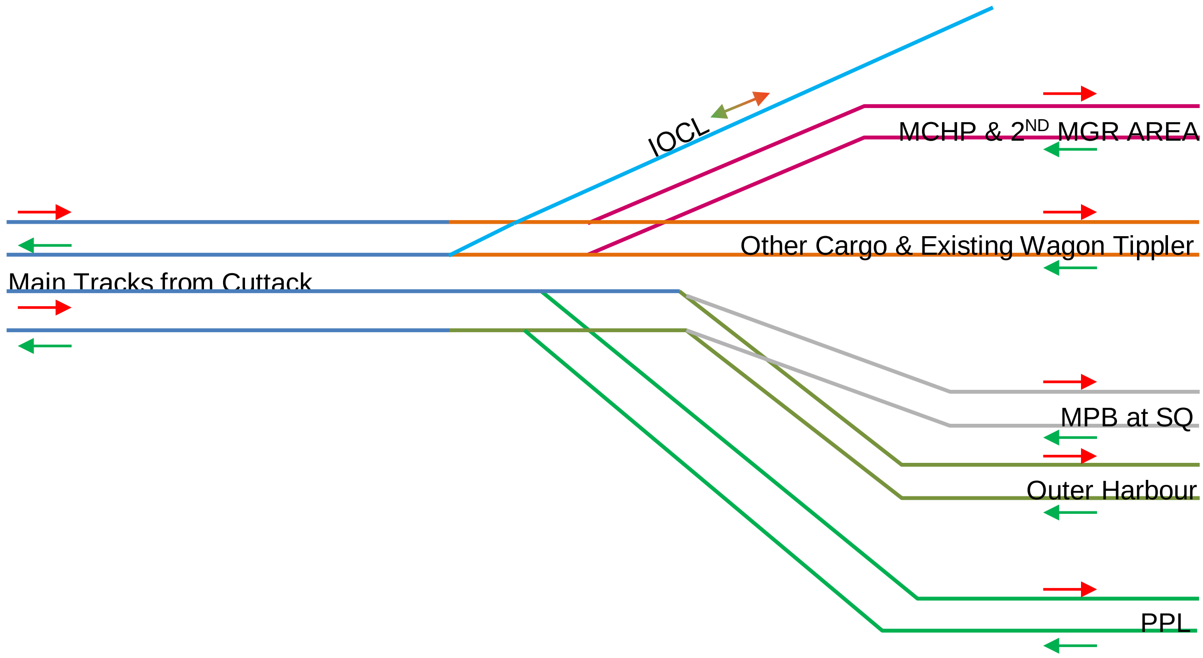


Figure 8.7 Option 2 for Development of Rail Tracks

Figure 8.8 Location and Conceptual Layout of Rail Grade Separator Near Barabandha Station

Table 8.2 Comparison of Two Options

Description	Option 1	Option 2
Traffic Separation of 2 networks	Up/Incoming traffic shall be segregated. However, Down/ Outgoing traffic shall have some intersection remaining (e.g. up PPL traffic shall intersect down traffic from existing harbour).	Up & Down traffic shall be completely segregated.
Location of proposed developments	Other than laying of additional tracks, most of the development works are nearby the Paradip station & Paradip Exchange Yard	Rail Flyover shall be nearby Barabandha Station. Track adjustments at Paradip exchange yard.
Effects to Existing Paradip station	Up ramp for the proposed flyover shall become a visual obstruction in front of the Paradip station.	No effect
Land acquisition	Very minor around Paradip station for the Up ramp. Down ramp will be within Port Land.	Some land may have to be acquired. However, being in the open field and in river plains in uninhibited area, it may not be difficult
Track reconfiguration	Existing main down track shall become main up track. New down tracks shall be laid. All points and exchange tracks have to be suitably relocated/ modified.	Existing up & down tracks shall remain as they are and shall function in the same way too. Only points and exchanges for up traffic leading to PPL is to be shifted to new up track.

8.2.3 Tracks to Haridaspur

Also, the new track from Haridaspur (single track) is planned to connect at the existing dead end near the IOCL Flyover. Then this track shall become connected to the existing main up track. For traffic going to Haridaspur area (imported coal mainly) has to cross-over to the existing up track first before being moved out to the new track. This shall create a major traffic conflict point and needs to be solved.

Figure 8.9 Existing DE for Haridaspur Connectivity

For down traffic to Haridaspur, a separate grade separator flyover is proposed near by the existing DE where the track shall be leading into. Conceptual layout of the same is proposed in **Figure 8.10**. There shall be some land to be acquired for this development. The land marked is seen to be presently unoccupied.

Figure 8.10 Conceptual Layout of Flyover for Down Track to Haridaspur

Figure 8.11 Land on the Other Side of DE for Haridaspur Track

8.3 Internal Rail Connectivity

Material handling in most area of the Port is either already by mechanized means or in the process of mechanization. Proposed new facilities within the existing harbour & new outer harbour are proposed to be fully mechanized. Rated rake handling capacities of various facilities are mentioned in the **Table 8.3** below:

Table 8.3 Rated Rake Handling Capacities of Material Handling Facilities

Facility	Capacity	
	Rakes / day	MTPA
Existing Track Hoppers in MCHP Area – 2 No.	24	30
Existing Wagon Tipplers (T-149 & T-150) – 2 No.	10	12
Proposed Track Hoppers for CQ Mechanization – 2 No.	24	30
Proposed Iron Ore Wagon Tippler for JSW – 1 No.	8	10
Proposed Wagon Loaders for Essar – 1 No.	10	10
Proposed Wagon Loaders for CQ Mechanization – 2 No.	20	20

Proposed facilities for Outer Harbour shall be planned to suit with the traffic demands.

8.3.1 Evaluation of Rail Networks

Overall traffic in the rail network has been calculated and presented in attached, **Table 8.4** & **Table 8.5** for the year 2020 & 2025 respectively.

Table 8.4 Rail Traffic Projections for Year 2020

Commodity	Berth	Projected Traffic (MTPA)	Proportion		Projected Rail Traffic (MTPA)	Type of Rake	Ratio of BOBRN/ BOXN to total	Rakes/day		Probability of backloading	Possible for backloading	Empty Out	Empty In	Effective rakes/day	
			Rail	Road/Conv.				Incoming	Outgoing					Incoming	Outgoing
Existing Harbour															
Coal - Export	CB1, CB2, EQ	65.0	100%	0%	65.0	BOBRN	0.77	40.0		33%	13.3	26.7		40.0	26.7
						BOXN	0.23	12.0		100%	12.0	8.3		12.0	8.3
Coal - Import	ESSAR, CQ	21.3	100%	0%	21.3	BOBRN			13.3					0.0	13.3
						BOXN			3.7					0.0	3.7
Breakbulk	MPB(JMB), CQ3, MPB	11.3	25%	75%	2.8	BCNA		3.4	2.3	60%	2.0	0.9	0.2	3.6	3.2
Iron Ore	JSW	2.8	100%	0%	2.8	BOXN		2.2		100%	2.2	2.2		2.2	2.2
Fertiliser	FB1, FB2	5.6	10%	90%	0.6	BCNA			0.4	100%				0.0	0.4
Outer Harbour															
Coal - Export		30	100%	0%	30.0	BOBRN		24.0		0%	0.0	24.0		24.0	24.0
Coal - Import		0	100%	0%	0.0	BOXN			0.0	0%	0.0		0.0	0.0	0.0
													Total	**81.8**	**81.8**

With Auto-Signalling
Capacity of a track for handling incoming & outgoing rakes 50 /day
No. of tracks required at the entrance to the port 2

Table 8.5 Rail Traffic Projections for Year 2025

Commodity	Berth	Projected Traffic (MTPA)	Proportion		Projected Rail Traffic (MTPA)	Type of Rake	Ratio of BOBRN/ BOXN to total	Rakes/day		Probability of backloading	Possible for backloading	Empty Out	Empty Transfer from/to OH	Empty In	Effective rakes/day	
			Rail	Road/Conv.				Incoming	Outgoing						Incoming	Outgoing
Existing Harbour																
Coal - Export	CB1, CB2, EQ	75.0	100%	0%	75.0	BOBRN	0.77	46.2		33%	15.4	32.2			46.2	32.2
						BOXN	0.23	13.8		100%	13.8		13.8		13.8	0.0
Coal - Import	ESSAR, CQ	17.4	100%	0%	17.4	BOBRN			13.9						0.0	13.9
						BOXN			0.0						0.0	0.0
Breakbulk	MPB(JMB), CQ3, MPB	15.4	25%	75%	3.8	BCNA		3.1	3.1	60%	1.8	0.6		1.2	4.3	3.6
Iron Ore	JSW	2.8	100%	0%	2.8	BOXN		2.2		100%	2.2		2.2		2.2	0.0
Fertiliser	FB1, FB2	8.2	10%	90%	0.8	BCNA			0.7						0.0	0.7
Outer Harbour																
Coal - Export		60	100%	0%	60.0	BOBRN		48.0		0%	0.0	48.0			48.0	48.0
Coal - Import		10	100%	0%	10.0	BOXN			8.0	0%	0.0	8.1	16.1	0.0	0.0	16.1
														Total	114.5	114.5

With Auto-Signalling
Capacity of a track for handling incoming & outgoing rakes 50 /day
No. of tracks required at the entrance to the port 2.0

Overall schematic layout of the future port rail network is presented in **Figure 8.12**. For detailed evaluation of various operational areas of the port rail networks, the entire area is marked up in separate zones; namely:

Zone 1. Exchange Yard for Existing Harbour at Paradip Station (**Figure 8.19**)

Zone 2. Existing MCHP Area & MGR line (**Figure 8.13**)

Zone 3.	Proposed BOT Lines and 2nd MGR (Merry-go-round) (**Figure 8.14**)
Zone 4.	General Cargo Loading Area (**Figure 8.15** & **Figure 8.16**)
Zone 5.	Existing Wagon Tippler & Yard (**Figure 8.17**)
Zone 6.	Loading Area for Multi-purpose berth at Southern Dock (**Figure 8.18**)
Zone 7.	Outer Harbour MGR (**Figure 8.20**)
Zone 8.	Outer Harbour Exchange Yard (**Figure 8.21**)

Rail Traffic for zones 2 till 6 are calculated for all traffic projection years separately.

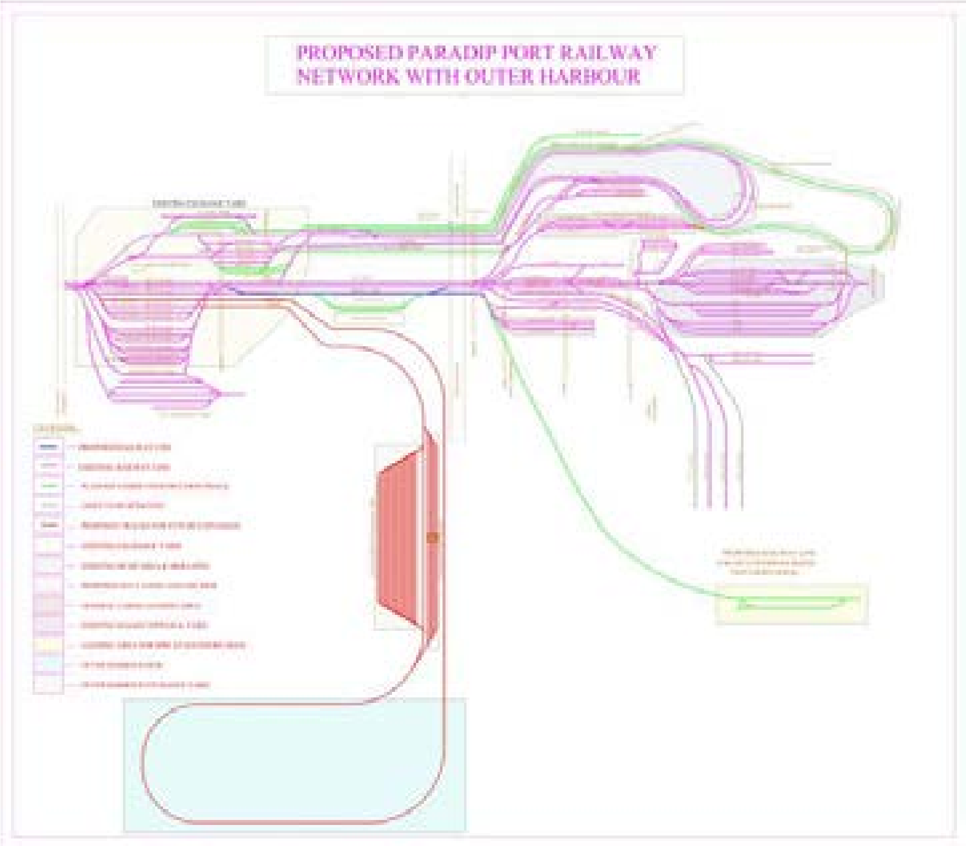


Figure 8.12 Overall Schematic Port Rail Network

8.3.2 Observations from the Calculations

8.3.2.1 Existing MCHP & MGR Lines

Presently the complete circuit from the exchange yard till MCHP area is operated with auto-signalling. The total turnaround time estimated is about 3 hr/rake. Total number of locomotive required is 3 as shown in **Table 8.6**. However, with additional locomotive, more number of rakes can be handled in peak hours.

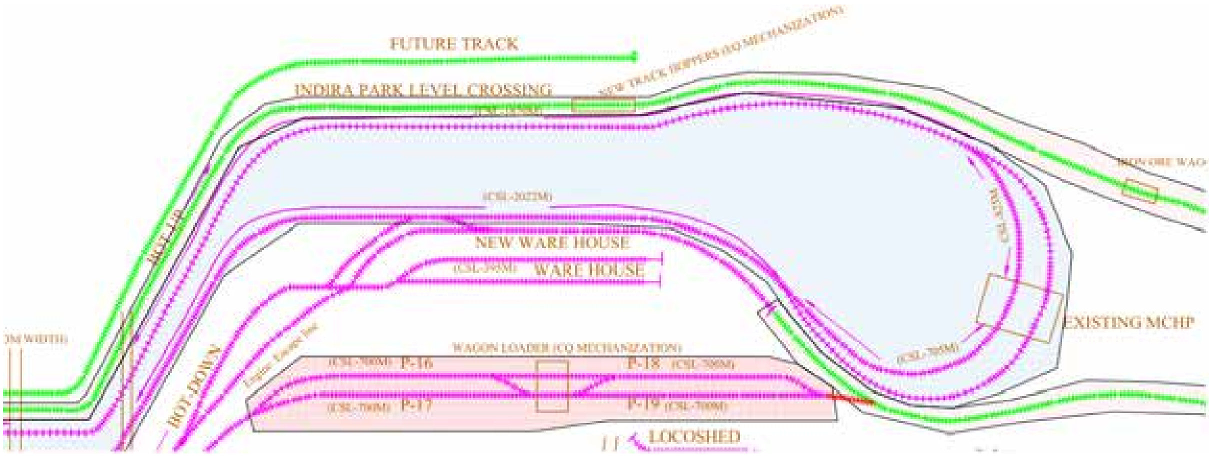


Figure 8.13 Existing MCHP Area & MGR Lines

Table 8.6 Traffic Estimate for Existing MCHP Area

Distance from Receiving yard till Track Hoppers	5.5	km	
Average Driving speed of train in this area	20	km/h	
Engine Exchange time at receiving yard	0.5	hr.	
Time required for traversing receiving yard to hopper	0.28	hr.	
Unloading time at Track Hopper	1.5	hr.	
Time required for traversing hopper to receiving yard	0.28	hr.	
Engine Exchange time at receiving yard	0.5	hr.	
Total turnaround time	3.05	hr/rake	
Number of Locos required	3		
Nr. Sidings required for bunching/peaking	3.13		
Total sidings required at Receiving Yard	3.13	i.e.	4 No.

Presently non-mechanized loading of coal is done on track numbers RRS-3 & RRS-4 (Line No. C18 & C13). Once the BOT Track construction is done, these would become a part of the new MGR tracks. Hence, the non-mechanized loading, if still be required, could be shifted to sidings P-6 & P-7.

8.3.2.2 Proposed BOT Tracks & 2nd MGR Area

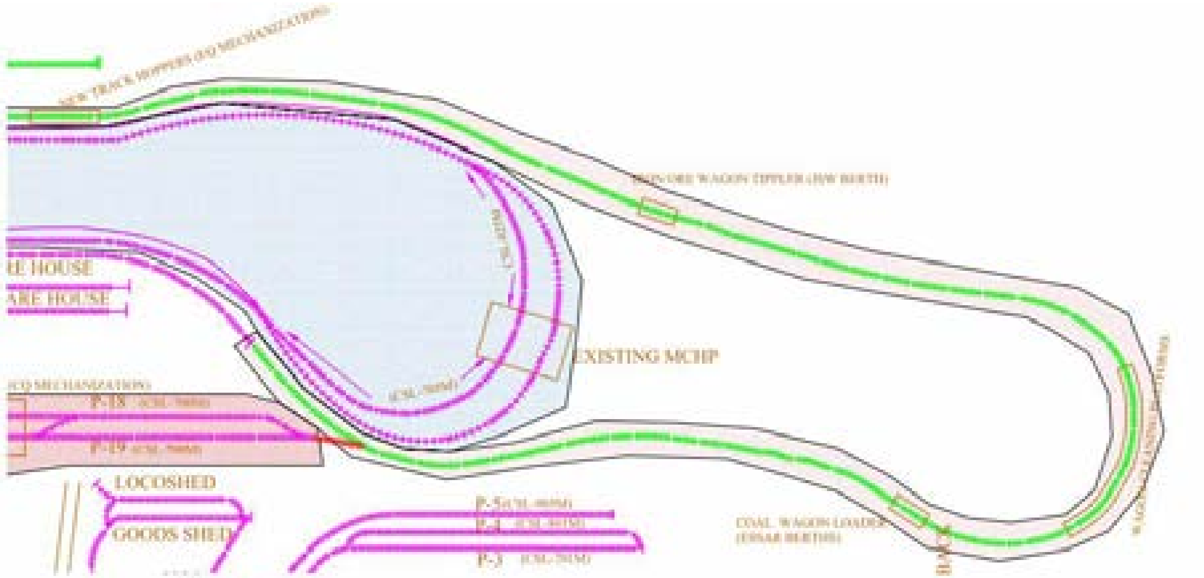


Figure 8.14 Proposed BOT Lines and 2nd MGR

Proposed new tracks are being constructed along with the facilities for new Track Hoppers, Wagon Tipplers, Cleaning Platforms & In-motion Wagon Loaders. All of these facilities shall have one by-pass track.

Upon detailed check it is found that the time required for inspection & cleaning of rake shall be a constraint here. As per the present proposal, 2 platforms shall be built. However, for traffic expected in 2020 an additional platform may be required. Of course, this can be offset by reducing the time required for inspection & cleaning, for which more human resources may have to be deployed.

As per the DPR for this development, BOT operators may not use any captive locomotives for rake movement and shall use the IR Locos for the purpose. However, for emergency locos may be required from PPT. Hence only 2 numbers of locos has been added in the total requirements.

From the detailed calculations presented in **Table 8.7**, it may be seen that the coal unloading facilities are expected to reach their working limits by the year 2025. This would mean more traffic shall be diverted to outer harbour.

Table 8.7 Traffic Estimate for BOT Tracks along with CQ Mechanization

Capacity of the new Track Hoppers	=	24 rakes/day			
	~	20.9 rakes/day (avg.)	Demand	19.1 rakes/day (avg.)	Ok
Capacity of Wagon Tipplers	=	8 rakes/day			
	~	7.0 rakes/day (avg.)	Demand	2.2 rakes/day (avg.)	Ok
Capacity of Wagon Loader	=	8 rakes/day			
	~	7.0 rakes/day (avg.)	Demand	17.0 rakes/day (avg.)	Ok
Capacity of Proposed Wagon Loader for CQ	=	16 rakes/day			
	~	13.9 rakes/day (avg.)			
Capacity of proposed cleaning area	=	22.2 rakes/day			
3 tracks	~	19.3 rakes/day (avg.)	Demand	17.0 rakes/day (avg.)	Ok

	Scenario 1 (Coal unloading, no back loading)	Scenario 2 (Coal unloading, cleaning, coal back loading)	Scenario 3 (Iron Ore unloading, cleaning, coal back loading)	Scenario 4 (Iron Ore unloading, no back loading)
Engine Exchange time at receiving yard	0 hr	0 hr	0 hr	0 hr
Distance from Receiving yard till Track Hoppers/Tippler	4 km	4 km	9 km	9 km
Average Driving speed of train in this area	20 km/h	20 km/h	20 km/h	20 km/h
Time required for traversing receiving yard to hopper/Tippler	0.2 hr	0.2 hr	0.45 hr	0.45 hr
Placing Time for Rake	hr	hr	0.5 hr	0.5 hr
Unloading time at Track Hopper/Tippler	1.5 hr	1.5 hr	2 hr	2 hr
Distance from Track Hopper/Tippler to Cleaning Area		2.5 km	1.5 km	km
Time required for traversing hopper/tippler to Cleaning		0.125 hr	0.075 hr	hr
Cleaning Time for Rake (effective)		0.67 hr	0.67 hr	hr
Distance from Cleaning to Backloading Area		0.5 km	0.5 km	km
Time required for traversing Cleaning to Backloading Area		0.03 hr	0.03 hr	hr
Loading Time for Rake		1.5 hr	1.5 hr	hr
Distance from Last stop to receiving yard	9 km	9.5 km	9.5 km	11.5 km
Time required for traversing last stop to receiving yard	0.45 hr	0.475 hr	0.475 hr	0.575 hr
Engine Exchange time at receiving yard	0 hr	0 hr	0 hr	0 hr
Total turnaround time =	2.15 hr/rake	4.5 hr/rake	5.7 hr/rake	3.5 hr/rake
Average ratio of rakes for Scenario1/2 and 3/4	0.77	0.23	0.0	1.0
Average Turnaround Time =	2.69		3.53	
Number of Locos required =	3		2	
Total Number of Locos required =	5			

Total number of rakes handled (up & down) in an hour (average) =	3.20
Add peaking factor of 30%=	1.0
Total amount of rakes to be handled in 0.25 day peak =	5.76
Hence, sidings required at exchange yard =	6

8.3.2.3 Location & Tracks for Wagon Loader for CQ Mechanization in Future

The project for CQ Mechanization is on hold at this moment. However, it will be executed in near future to provide additional capacity of Coal Imports.

The present BOT Lines are not planned with this facility. Within the area of the existing and planned MGR Tracks, there is not much space where the Coal Loading facility can be added. It is identified that the present sidings P-16 to P-19 are suitable for providing coal wagon loader with adequate track length. However, these tracks are dead-ended presently. To convert them to a wagon loader facility tracks, they need to be connected to a loop line. So, it is proposed to have connectivity from the 2nd MGR Tracks to these sidings.

The sidings P-16 to P-19 are being used for GCB cargo loading at present. This operation may be shifted to P-14, P-15.

Alternatively, additional 2 tracks parallel to P-16 to P-19 may be built with wagon loader facility.

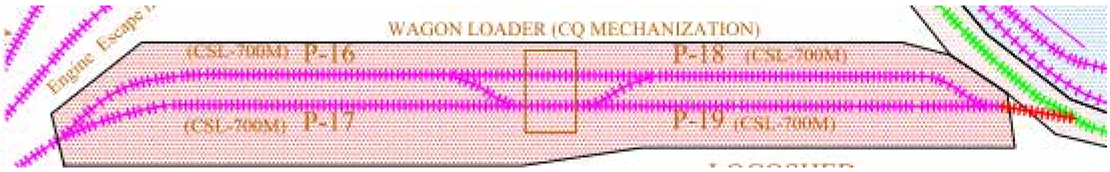


Figure 8.15 General Cargo Loading Area (Existing)

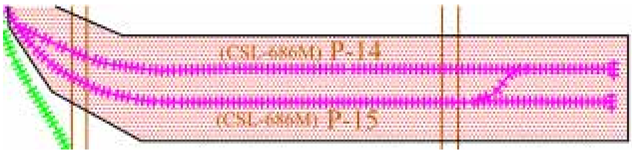


Figure 8.16 General Cargo Loading Area (Proposed)

Table 8.8 Traffic Estimate for GCB Loading Area

GCB Loading-unloading area

Traffic for JMB-MPB at Southern Dock =	5.00 MTPA	
Traffic for GCB =	6.30 MTPA	
Rail Share =	25%	
Rail Traffic Expected =	1.26 rakes/day	
Distance from Receiving yard till GCB Loading/Unloading Area	5.00 km	
Average Driving speed of train in this area	20.00 km/h	
Engine Exchange time at receiving yard	0.50 hr	
Time required for traversing receiving yard to hopper	0.25 hr	
Unloading & Loading time at Yard (non-mechanised)	8.00 hr	
Placing Time for Rake	0.50 hr	
Time required for traversing GCB till receiving yard	0.25 hr	
Engine Exchange time at receiving yard	0.50 hr	
Total turnaround time =	10.00 hr/rake	
Nr. of rakes possible to be handled =	2.00 /day	
Nr. of Sidings Required =	0.63	
Number of Tracks in the GCB Yard =	2.00	Ok
Presently the GCB cargo is handled on track P-16 to P-19. However, after CQ Mechanization, the same shall become the tracks for Wagon Loader for CQ. The GCB Cargo Loading is proposed to be shifted to P-14, P-15.		
Number of Locos required =	1	
Siding Tracks needed in the exchange yard =	1	
Nr. Sidings required for bunching/peaking =	0.189	
Total sidings required at Receiving Yard =	1.189 i.e.	2 Nrs.

8.3.2.4 Existing Wagon Tippler Facility & Yard for it

Existing wagon tippler facility (T-149 & T-150) along with Yard Siding Tracks (T-1 to 7 & T-10 to 12) was originally constructed for Iron Ore unloading. Presently these are being used for Coal Unloading. These tracks are so located that they cannot be connected to the proposed MGR Tracks. Moreover, the dead end of the facility is constructed with "Kick-back" system for pushing back the empty wagons to collection yard. Hence, this facility shall remain "stand-alone".

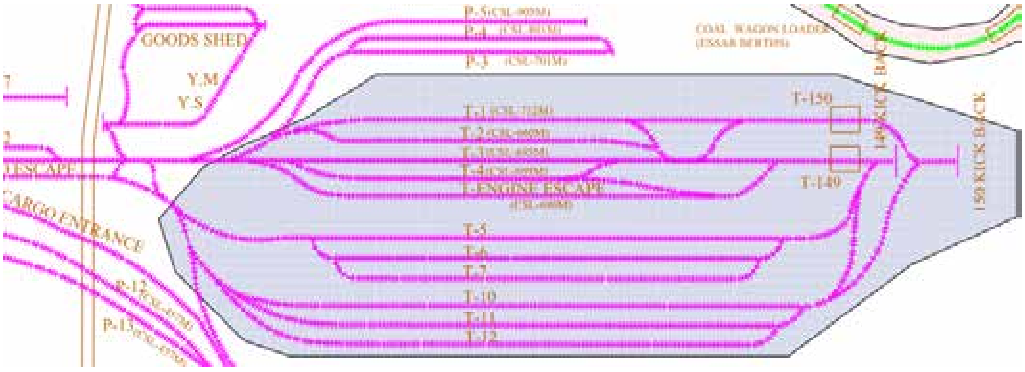


Figure 8.17 Existing Wagon Tippler & Yard

Table 8.9 Traffic Estimate for Existing Wagon Tippler

Capacity of the wagon Tippler (2 No.)		5-6 rakes/day (rated)
Average Rakes that can be handled		8.7 rakes/day (avg.)
Demand	12.0 rakes/day (avg.)	Larger than Capacity

The above shows that the present facility of unloading BOXN Coal Wagons are not enough. However, the ratio of BOXN to BOBRN wagons received are based on present day ratio which is expected to change with introduction of more track hoppers. Hence the traffic expected with BOXN shall be lesser and may be limited to the capacity of the present facility only.

Distance from Receiving yard till Tippler Yard	5 km	
Average Driving speed of train in this area	20 km/h	
Engine Exchange time at receiving yard	0.5 hr	
Time required for traversing receiving yard to hopper	0.25 hr	
Unloading time at Yard	2.5 hr	
Placing Time for Rake	0.5 hr	
Collecting Time for rake	0.5 hr	
Time required for traversing Tippler till receiving yard	0.25 hr	
Engine Exchange time at receiving yard	0.5 hr	
Total turnaround time =	5 hr/rake	
No. of Tippler	2	
No. of rakes can be handled =	9.6 rakes/day	
Nr. of tracks needed =	1.25	
Nr. of existing tracks at the Tippler Yard =	4	
Nr. Sidings required for bunching/peaking =	1.44	
Total sidings required at Receiving Yard =	1 i.e.	1 No.
Number of Locos required =	0	

8.3.3 Tracks between EQ & CQ Area

Between the Quay face of existing EQ & CQ there are 4 tracks at present. After both EQ & CQ Mechanization, 2 tracks shall have to be removed. Also the remaining yard here shall be serving only SQ, with non-mechanized loading.

8.3.4 Tracks to Multi-purpose Berths in Southern Dock

BOT Operator (JMB) is in the process of construction of the Multi-purpose berths in Southern Dock along with the yard and rail tracks. The proposed track connecting the main up & down tracks to the Yard of MPB, runs parallel to the existing road (NH-5A) just inside the port boundary. This track shall cross the access road to existing harbour in front of Gate 3 & 4 where level crossings are planned.

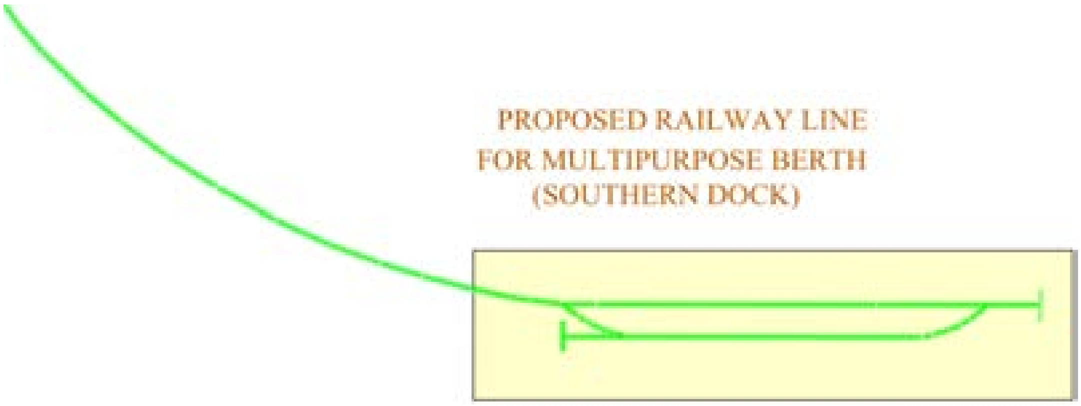


Figure 8.18 Loading Area for MPB

Table 8.10 Traffic Estimate for MPB in Southern Dock

	Containers	Other Cargo
Traffic Projected (as per Tender Documents/DPR)	0.43 MTEU	2.18 MTPA
Rail share	30 %	50 %
Rail Traffic	0.129 MTEU	1.09 MTPA
Daily rail traffic (average)	4.1 rakes/day	0.9 rakes/day
Total number of rakes =	5.0 rakes/day	
Turnaround time for rakes (as per IR Rules)	6 hrs	
Number of Loading Tracks required	2	

Number of loading tracks planned within MPB Yard	3	
Distance from exchange yard till MPB Area	6 km	
Rakes can be accomodated enroute to MPB	2	
Nr. Sidings required for bunching/peaking =	0.75	
Total sidings required at Receiving Yard =	1 i.e.	1 No.
Number of Locos required =	2	

8.3.4.1 Existing Exchange Yard along with All Planned Projects

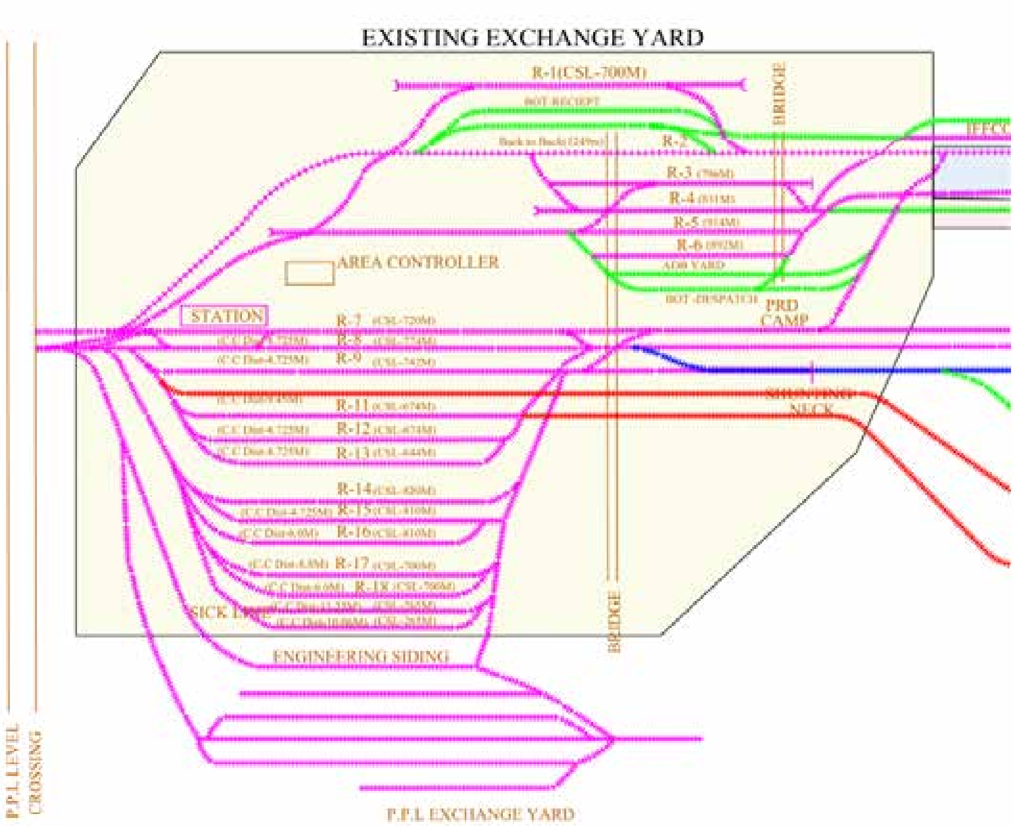


Figure 8.19 Exchange Yard for Existing Harbour

From all the traffic estimates for separate facilities, it is seen that the total number of sidings in the exchange yard required are less than already available space. Of course, this also depends on the efficiency of the external rail network on incoming and outgoing traffic.

8.3.5 New Tracks and Rail Network for Outer Harbour

The rail network for the proposed outer harbour is planned to be able to work independently of the existing rail network. Since this is a complete new development, all facilities can be planned as per the traffic demands within the limits of the harbour.

In the Master Plan, for unloading of the coal rakes track hoppers are proposed and for loading of imported coal, In-motion wagon loader is proposed. Capacities of these facilities shall match the projected demand.

The main rail network to outer harbour shall consist of a Loop line on which the track hoppers and cleaning platforms shall be located. The wagon loader shall load near the import coal stacking location planned in the Western Dock area.

It is proposed to have a dedicated parallel set of up & down tracks from existing Paradip station exchange yard till the new exchange yard for the outer harbour located at the existing golf club area.

The proposed tracks shall take a turn just before the flyover at Atharbanki and then continue parallel to NH5A to the outer harbour area.

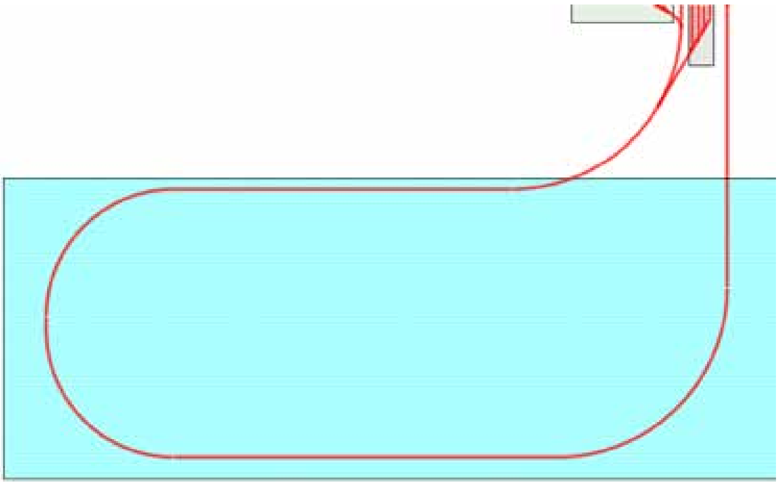


Figure 8.20 Outer Harbour MGR

Figure 8.21 Exchange Yard for Outer Harbour

Table 8.11 Traffic Estimate for Outer Harbour Area for 2020

Capacity of Track Hoppers		24 rakes/day (rated)			
	~	20.9 rakes/day (avg.)	Demand	20.0 rakes/day (avg.)	Ok
Capacity of Proposed Wagon Loader for OH		10 rakes/day (rated)			
	~	8.7 rakes/day (avg.)	Demand	0.0 rakes/day (avg.)	Ok
Capacity of proposed cleaning area		7.4 rakes/day			
1 tracks	~	6.4 rakes/day (avg.)	Demand	0.0 rakes/day (avg.)	Ok

	Scenario 1 (Coal unloading, no back loading)	Scenario 2 (Coal unloading, cleaning, coal back loading)
Engine Exchange time at receiving yard	0 hr	0 hr
Distance from Receiving yard till Track Hoppers/Tippler	4 km	4 km
Average Driving speed of train in this area	20 km/h	20 km/h
Time required for traversing receiving yard to hopper/Tippler	0.2 hr	0.2 hr
Placing Time for Rake	hr	hr
Unloading time at Track Hopper/Tippler	1.5 hr	1.5 hr
Distance from Track Hopper/Tippler to Cleaning Area		1.5 km
Time required for traversing hopper/tippler to Cleaning		0.075 hr
Cleaning Time for Rake		2 hr
Distance from Cleaning to Backloading Area		2.5 km
Time required for traversing Cleaning to Backloading Area		0.125 hr
Loading Time for Rake		1.5 hr
Distance from Last stop to receiving yeard	4 km	0 km
Time required for traversing last stop to receiving yard	0.2 hr	0 hr
Engine Exchange time at receiving yard	0 hr	0 hr
Total turnaround time =	1.9 hr/rake	5.4 hr/rake
Average ratio of rakes for Scenario1/2	1	0
Average Turnaround Time =	1.9	
Number of Locos required =	2	

Total number of rakes handled (up & down) in an hour (average) =	1.67
Add peaking factor of 30%=	0.5
Total amount of rakes to be handled in 0.25 day peak =	3.00
Hence, sidings required at exchange yard =	3

Since the Wagon Loader is co-located with the exchange yard, additional 2 tracks would be required for the same.

Hence total tracks required at the exchange yard 5 No.

Based on similar calculations total 15 tracks are required for traffic projected for year 2035 in the exchange yard.

8.3.6 No. of Mainlines Entry / Exit to Port

Indian Rail Network reaching to Paradip Port is being converted to auto-signalling to increase the network capacity. Taking the track capacity as 50 rakes/day average on conservative side, the requirement of the number of tracks estimated for traffic till 2025 are presented in **Table 8.4** & **Table 8.5** above. As can be seen total 2 up & 2 down tracks should be sufficient to cater to the projected traffic in the port till year 2025. This would mean additional up & down tracks to be laid in the main line to cater to increased traffic demands.

It has been observed that basis the similar calculations for year 2035 would result in 4 up and 4 down lines which may not be practically provided. However it is expected that by that time better technology like heavy haul rail might be in place, which using the same line space could handle much higher throughput.

8.4 Recommendations for Improvement in Road Access

The following recommendations are made with reference to improvement in road access to and from the existing harbour:

- After completion of EQ & CQ mechanisation along with other planned projects as mentioned earlier, the vehicular traffic exchange is expected to significantly reduce. Hence, the requirements of vehicle access gates shall reduce too. In light of this and the development of BOT Tracks, the gate 2 is proposed to be closed. Minor road traffic shall use gates 1 & 3 for accessing the harbour.
- Existing NH-5A from Athrabanki Flyover till outer harbour shall be bound by rail tracks on either side of it; on eastern side tracks to southern dock and on western side the tracks to outer harbour. With all access from port township cut-off this portion of the NH shall become a dedicated corridor for Port traffic only.
- For accessing the harbour from the Township, two flyovers for personal & light commercial vehicles are proposed as mentioned below:
  - **Flyover near Gate 3**: In the Smart-city planning being developed under separate contract, a flyover is proposed parallel to existing Athrabanki Flyover for access to township from Main NH-5A. It is proposed to have a ramp out of the same to cross over the NH-5A & Rail Tracks parallel to it and land directly in the harbour area nearby Gate 3. Proposed flyover is shown in **Figure 8.22**.

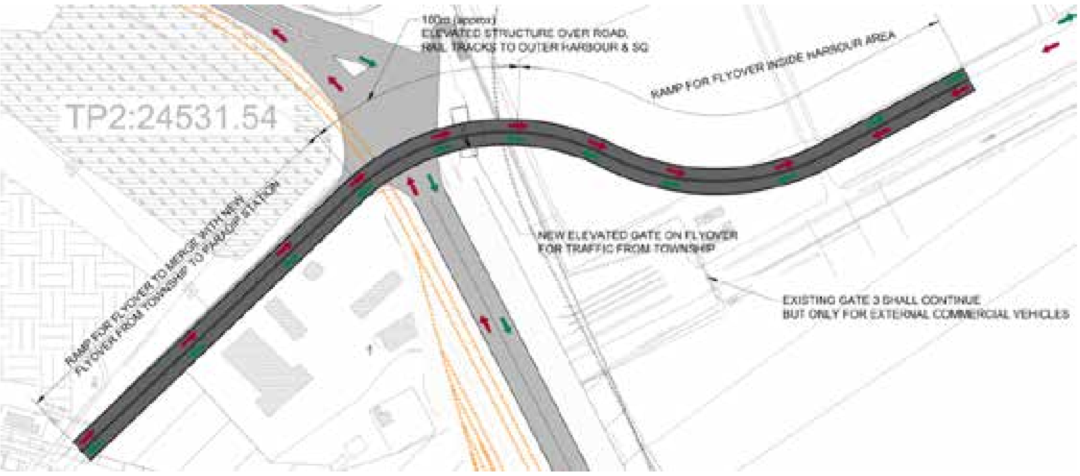


Figure 8.22 Proposed Flyover at Gate 3

– Similar to Gate 3, a separate flyover for Gate 4 is proposed (**Figure 8.23**). It shall start in front of Port Trust Hospital, cross over the rail tracks & NH5A below and would end inside the harbour on other side. This flyover is proposed to have stairs and footpaths on either sides of the main deck for ease of pedestrian movement.

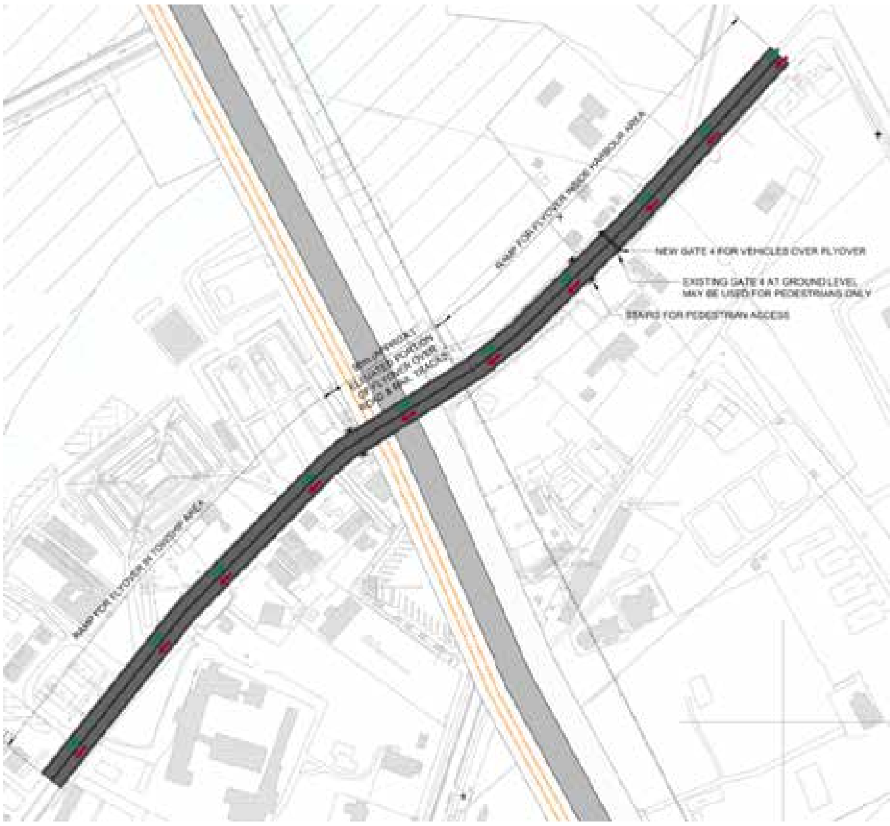


Figure 8.23 Proposed Flyover at Gate 4

It may however be noted that the above proposals may be refined keeping in view of the recommendations of the report on Smart City, which is in progress currently.

9.0 SCOPE FOR FUTURE CAPACITY EXPANSION

9.1 Development Possible within the Existing Harbour

9.1.1 Mechanization of CQ1 to CQ2

The port also proposes to mechanize berths CQ1 and CQ2 to enable import of cargo like coking and thermal coal, limestone, gypsum etc.

Mechanization of these berths will involve the following:

§ Strengthening these berths to receive 2 coal unloaders on each berth.

§ Bulk Stackyard south of the incoming rail track, adjacent to the bulb having storage capacity of about 0.83 MT of coal. The port also proposes to allocate an additional stacking area just south of the proposed stackyard to add additional capacity of 0.44 MT.

§ Mechanization of the stackyard with stacker cum reclaimers and connected conveyor system.

§ Two rapid loading systems with 4,000 T capacity silos each.

The location plan of berths and stackyard is shown in **Figure 9.1**.

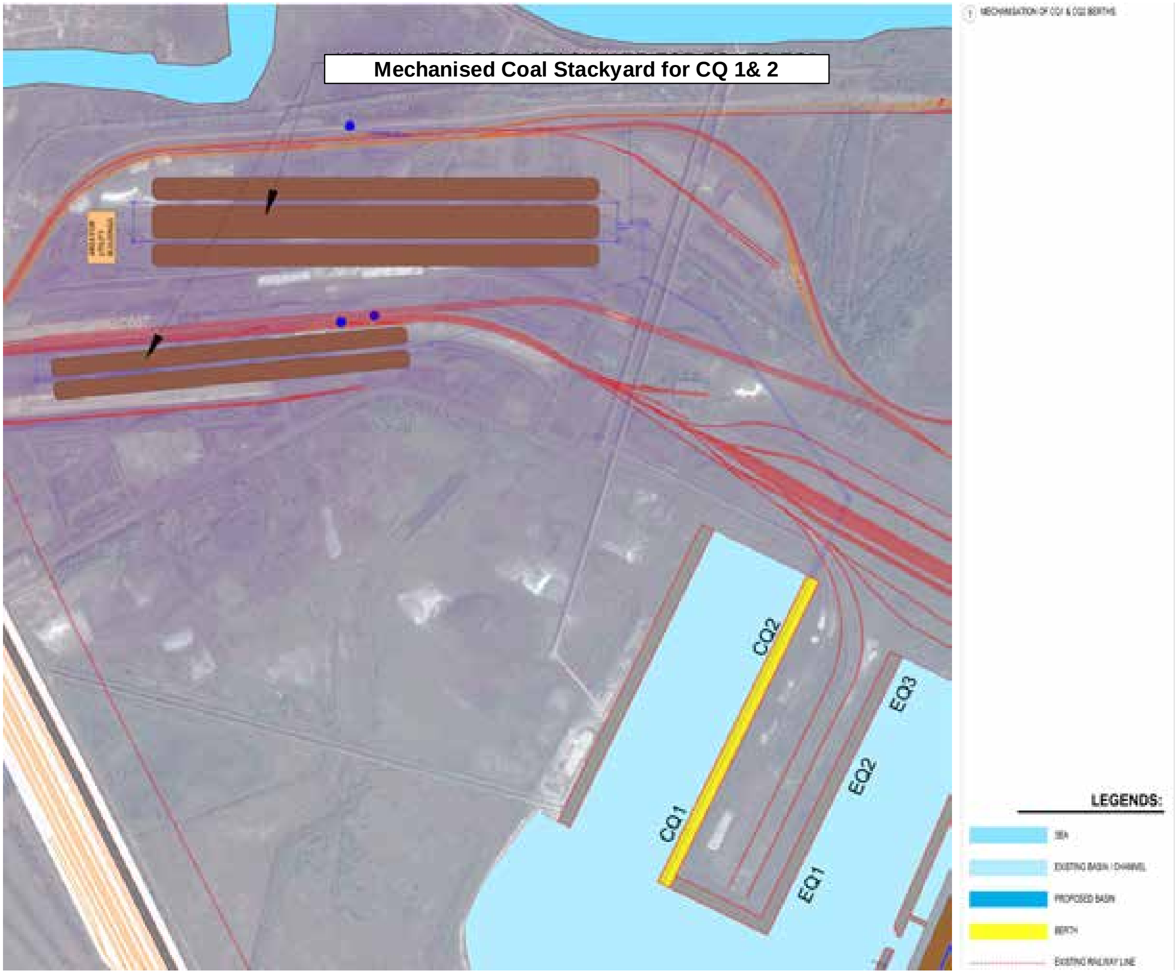


Figure 9.1 Mechanization of CQ1 & CQ2 Berths

It was assessed that even after allocation of additional stackyard the total storage capacity of coking coal (which is the main commodity to be handled at the proposed terminal) would only be limited to about 1.3 MT only. Considering the average dwell about 30 days, the proposed stackyards can only support the terminal capacity of about 11.0 MTPA only. Significant efforts would be needed to evacuate the cargo faster so that the dwell time could be reduced to match the stacking capacity.

This project could be initiated once the projects for mechanisation of EQ1-3 and deep draft coal import berth are in advanced stage of completion.

9.1.2 Capacity Augmentation of MCHP

The utilization of the equipment at MCHP is very high, which is likely to impact the maintenance schedule requirement. The port is therefore considering various options for the capacity augmentation of the MCHP whereby increasing the rated capacity of the equipment by way of replacing the motors, gears etc.

It is also suggested that the augmentation of stacking area could also be carried out in the following manner:

§ Addition of one row of stockpile towards north of existing stackyard

§ Add one stream of conveyor and Stacker cum Reclaimer

The proposed arrangement is shown in **Figure 9.2**.

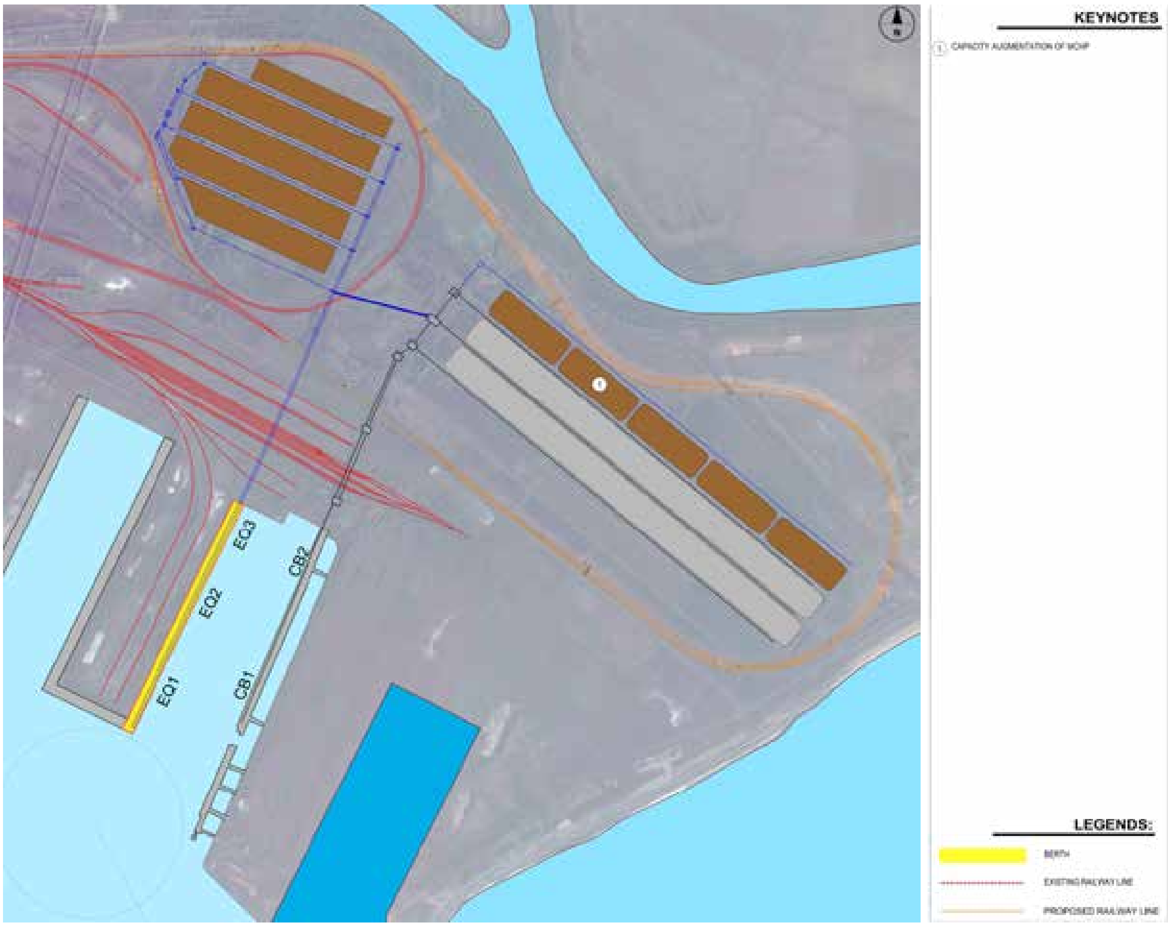


Figure 9.2 Proposed Arrangement for Capacity Augmentation of MCHP

The capacity of the stackyard would go up from existing 0.97 MT to 1.45 MT and would have the following advantages:

- The yard would be able to support additional berth capacity of MCHP.
- This would reduce the overutilization of existing stackyard equipment so that adequate time of scheduled maintenance would be available.

The additional yard can also support the upcoming EQ1, 2 and 3 berths. This could be accomplished by providing a conveyor system connecting the additional yard with the proposed stackyard of EQ1 to EQ3. The modalities of development of the additional stackyard and sharing with MCHP and EQ berths need to be worked out.

9.1.3 IWT Terminal

Another possible development within the existing inner harbour is the IWT terminal, which needs to be developed as part of NW5 development for movement of coal from Talcher mines to Paradip and Dhamra port. This has a potential to ease the congested rail lines in the region. The indicative locations for the IWT terminal are shown in **Figure 9.3**.

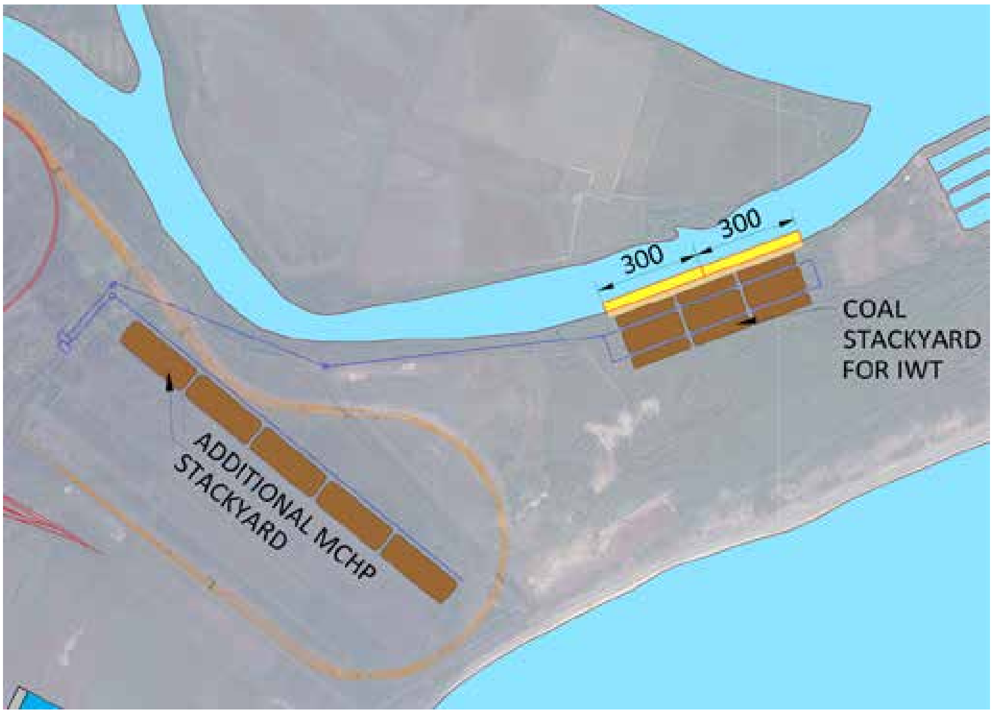


Figure 9.3 Proposed Location for the IWT Terminal

As part of the proposed development, the barge unloading jetties along with associated infrastructure like barge unloaders, connected conveyor system and transit stackyard shall be built. The coal from the transit stackyard would thereafter be transferred to the main coal yard of MCHP or EQ 1 to 3 berths for onward loading to ships.

The project should be initiated once the overall development of National Waterway NW5 is undertaken. Meanwhile the IWT traffic could be handled at NQ1 & NQ2 with deployment of suitable cranes.

9.1.4 Conversion of Iron Ore Berth to Handle Coal

In the past few years there was decline in iron ore traffic through IOHP, and therefore it was proposed to handle Thermal coal at IOB in addition to Iron ore. The proposal envisages unloading thermal coal rakes in BOXN wagons at Wagon Tippler and loading through IOHP. In fact coal loading was already carried out in the past and there is nothing new in handling coal.

The mechanised IOHP has a capacity to handle Iron ore at a designed rate of 3,000 TPH. Due to lower projection of iron ore traffic to be handled at this berth, it is proposed that this berth be used for coal exports as well apart from the little iron ore traffic that may come in future. However, considering bulk density of coal being about a third of iron ore the capacity of this berth for loading coal would be limited to about 1,000 TPD, which is quite low and does not meet the objective.

It is therefore suggested that the handling system is upgraded to enable coal loading at 2,000 TPH. It is proposed to provide additional conveyor streams parallel to conveyors IV and VI and an additional ship loader having capacity of 2,000 TPH for loading coal as shown in **Figure 9.4**.

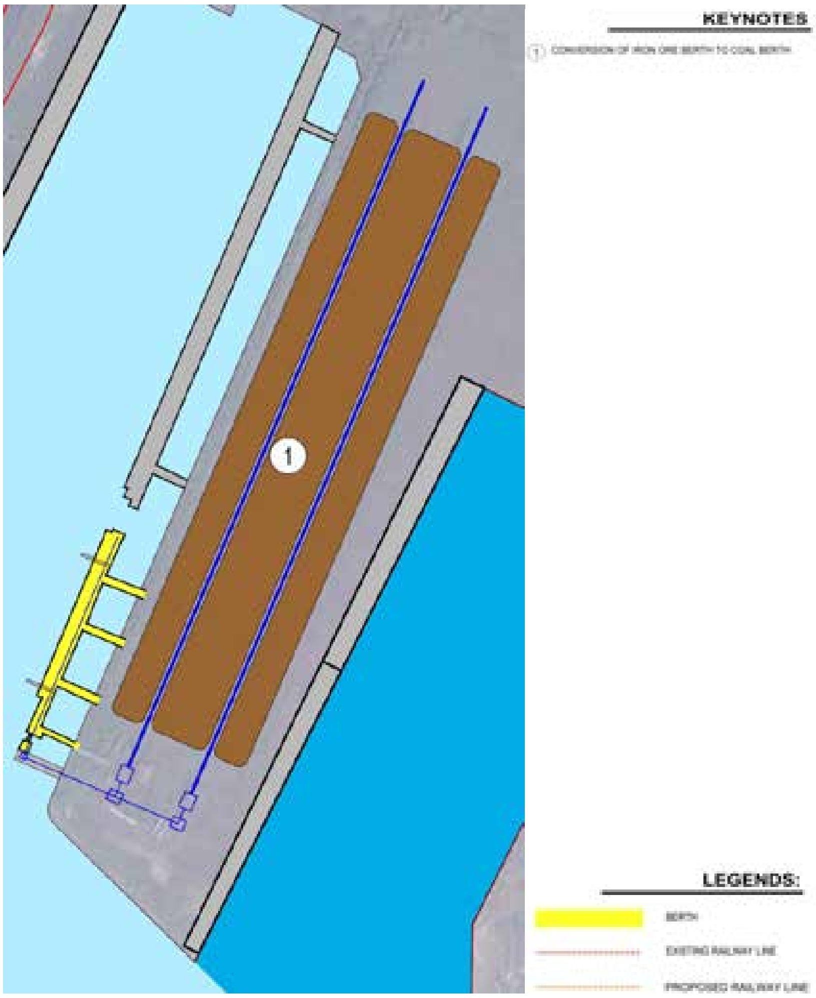


Figure 9.4 Conversion of IOHP to Handle Coal

Port has reported recent spurt in the traffic of iron ore and pallets and thus it is advisable to keep a close watch on this trend and the above conversion is not required to be initiated immediately. In future if there is again a substantial decline in iron ore traffic due to policy change etc. this project may be undertaken.

9.2 Development of Potential Outer Harbour

9.2.1 Alternative Locations

The possible alternative locations for development of outer harbour are shown in **Figure 9.5**.

Figure 9.5 Location of Project Sites

9.2.2 Qualitative Evaluation of the Alternative Sites

Based on the site visits and discussions with the port personnel the following observations are made:

- Technically, it is possible to locate the outer harbour in any of the three alternative sites.
- The access to Location 1 would be through the existing port facilities and thus is likely to constraint the existing port infrastructure.
- Location 3 is close to the fishing village. Further the rail and road access to this site would need to be through PPL establishments involving R&R issues.
- Location 2 seems to be best suited for the development of the outer harbour with rail and road access without any R&R issues.

9.2.3 Planning of the Outer Harbour

To cater to the proposed traffic in the year 2020, it is estimated that initial two coal export berths and one coal import berth would be needed along with the associated handling system and storage at outer harbour.

For an outer harbour development following technical requirements need to be addressed:

- Adequate Channel width to handle 200,000 DWT cape size ships
- Adequate stopping distance for vessels entering the harbour
- Adequate water depths in the channel and harbour for the cape size ships
- Acceptable tranquillity in the harbour basin and berths
- Optimisation of dredging and reclamation

Considering the above aspects various alternative layouts were prepared as part of a separate TEFR prepared for the project. The shortlisted layout of the proposed development is shown in **Figure 9.6**. The salient features of the development are given below:

- North breakwater of length 1,140 m and south breakwater of length 4,150 m shall be provided. The breakwaters are proposed to be rubble mound type with ACCROPODES provided as artificial armour units on sea side to absorb the wave forces.
- The dredged depths in the channel and harbour basin shall be provided to handle capesize vessels.
- The layout has been planned such the requirement of borrowed fill for reclamation purposes could be minimised.
- The fully mechanised system shall be provided for import and export of bulk cargo.
- The proposed Phase 1 layout can be suitably developed out of the proposed layout based on the immediate augmentation requirement i.e. two berths for coal export and one berth for coal import.

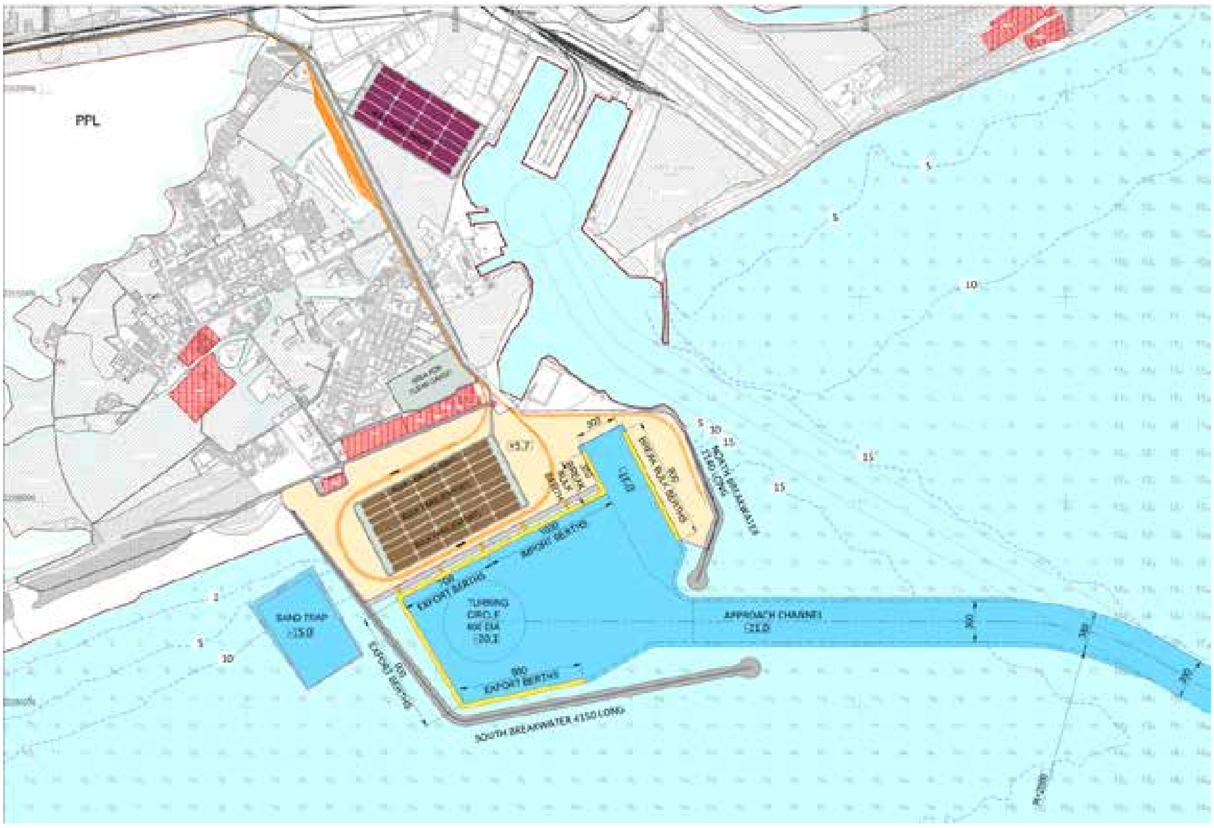


Figure 9.6 Master Plan Layout for Proposed Outer Harbour

9.3 Land Use Plan

The estate department of the port has already prepared the land use plan, which would need to be updated in view of the updated master plan of the port. In this connection our recommendations are follows:

§ Adequate area needs to be reserved for the storage and operations for the proposed outer harbour. The land area behind 1.8 km from the waterfront of outer harbour can be reserved for this purpose. The land owned by state government can be excluded.

§ Land towards the south west of proposed port land till the Atharabanki creek could be utilised for setting up Smart city.

§ Land towards northwest can be developed for the commercial purposed and leased out for hotel, offices etc.

The broad suggestions are indicated in **Figure 9.7**.

Figure 9.7 Port Land Use Plan

It may however be noted that the above proposals may be refined keeping in view of the recommendations of the report on Smart City, which is in progress currently.

10.0 SHELF OF NEW PROJECTS AND PHASING

10.1 General

As part of Paradip Port Master Plan several projects have been identified which need to be taken up in phased manner with the built up in traffic. The proposed phasing, capacity addition and the likely investments are discussed in paragraphs below.

It may be noted that apart from these projects there could be several other projects which port would be implementing as part of the routine operations and maintenance of the port facilities. Further the phasing proposed is not cast in stone but could be reviewed periodically and revised based on the economic scenario and demand for port at that particular point of time.

10.2 Ongoing Projects

The details of the projects which have already been awarded and development is ongoing are given below in **Table 10.1**.

Table 10.1 Ongoing Projects

S. No.	Project Name	Investment required (INR in Crores)	Capacity Addition (MTPA)	Mode of Implementation
1.	Deep Draft Coal Import Berth	479	10.0	PPP
2.	Deep Draft Iron Ore Export Berth	430	10.0	PPP
3.	Development of Clean Cargo Berth	430	5.0	PPP
4.	Development of Rail Connectivity for BOT berths	128	-	Port's funds
5.	Mechanisation of EQ1 -3 Berths	1,437	30.0	PPP
6.	Capital Dredging of BOT basin	173	-	Port's funds

The port layout after completion of ongoing projects shall be as shown in **Figure 10.1**.

Figure 10.1 Port Layout along with Ongoing Developments

10.3 Projects to be completed by Year 2020

The details of the projects which are envisaged to be completed by year 2020 are given below in **Table 10.2**.

Table 10.2 Projects to be Completed by Year 2020

S. No.	Project Name	Investment required (INR in Crores)	Capacity Addition (MTPA)	Mode of Implementation
1.	Development of IWT Terminal at Paradip Port	200	2.5	PPP
2.	LPG Terminal at South jetty	690	0.75	PPP
3.	Development of Outer Harbour - Phase 1	4,179	39	PPP

The port layout after completion of projects mentioned above shall be as shown in **Figure 10.2**.

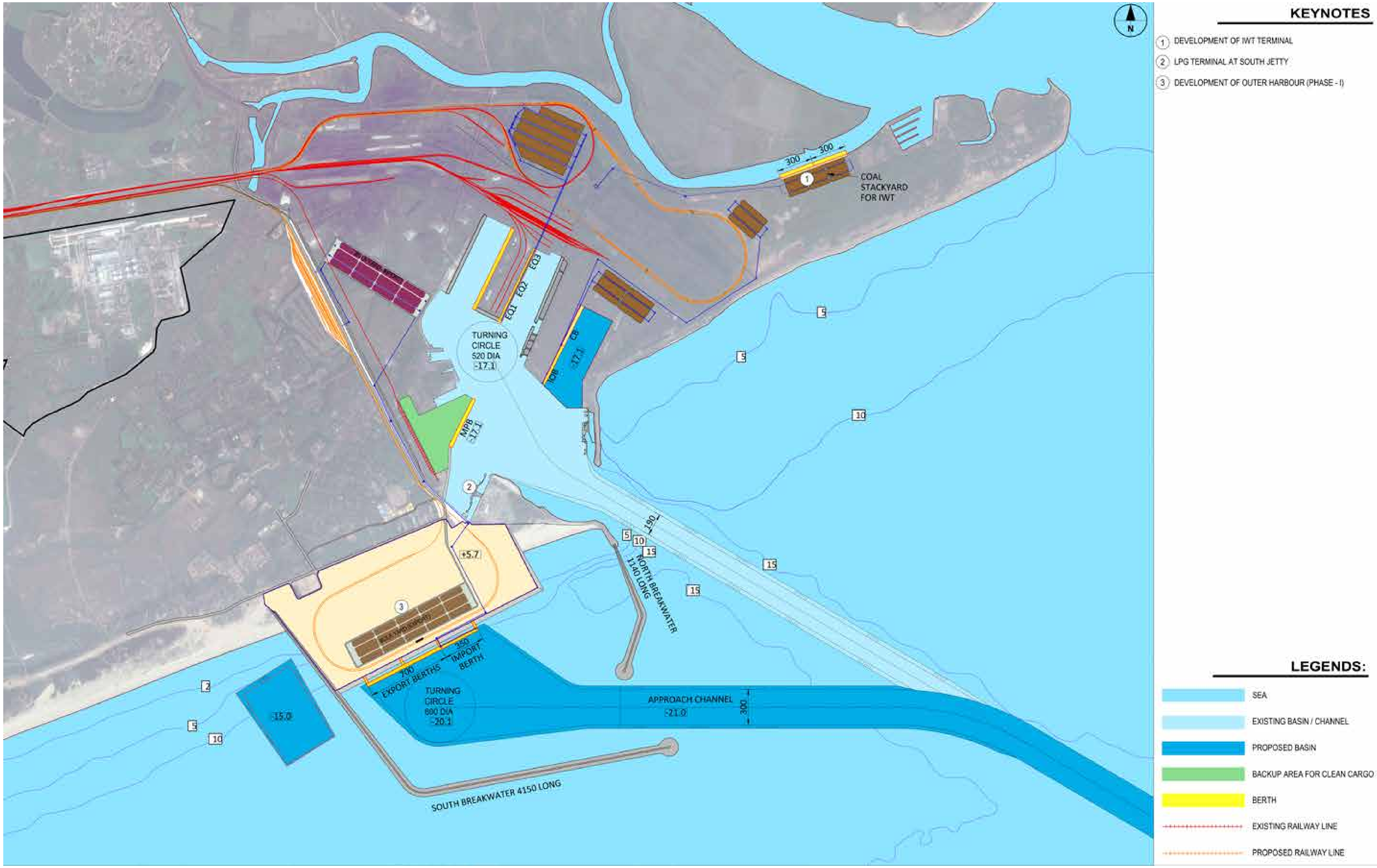


Figure 10.2 Layout Plan 2020

10.4 Projects to be completed by Year 2025

The details of the projects which are envisaged to be completed by year 2025 are given below in **Table 10.3**.

Table 10.3 Projects to be Completed by Year 2025

S. No.	Project Name	Investment required (INR in Crores)	Capacity Addition (MTPA)	Mode of Implementation
1.	Mechanisation of CQ1 -2 Berths	1,357	20	PPP
2.	Development of Outer Harbour - Phase 2	1,103	32	PPP
3.	Conversion of Iron Ore Berth to Coal Berth*	100	5.0	Port's Fund
4.	Expansion of the MCHP stackyard for additional coal storage#	150	6.0	PPP

* The project to be initiated only if berth is available due to insufficient iron ore traffic.

The project to be initiated only if additional stackyard capacity is envisaged.

The port layout after completion of projects mentioned above shall be as shown in **Figure 10.3**.

Figure 10.3 Layout Plan 2025

10.5 Projects to be completed by Year 2035

The details of the projects which are envisaged to be completed by year 2035 are given below in **Table 10.4**.

Table 10.4 Projects to be Completed by Year 2035

S. No.	Project Name	Investment required (INR in Crores)	Capacity Addition (MTPA)	Mode of Implementation
1.	Development of Outer Harbour – Ultimate Phase	3,485	75+	PPP

The port layout after completion of mentioned above shall be as shown in **Figure 10.4**.

Figure 10.4 Layout Plan 2035

Appendix-1: **BCG Benchmarking Study for Paradip Port**

Master Plan for V.O. Chidambaranar Port - Final

Prepared for

Ministry of Shipping/ Indian Ports Association

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Covering Letter/ Transmittal Ref. No:	Date of Issue: **11 August 2016**

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B.	Master Plan for V.O. Chidambaranar Port - Final	PM 20.05.2016	JES 31.05.2016	SG 01.06.2016
A.	Master Plan for V.O. Chidambaranar Port - Final	PM 22.01.2016	JES 22.01.2016	SG 22.01.2016
Revision	Description	Prepared by/ date	Reviewed by/ date	Approved by/ date

Document Revision Register

Issue no.	Date of issue	Section	Revision Details	Revision By Name & Position
1.	01.06.2016		Incorporating Comments on Draft Master Plan Report	Marshal Praveen (Engineer II)
2.	11.08.2016		Incorporating Comments on Final Master Plan Report	Marshal Praveen (Engineer II)

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1.0 INTRODUCTION

1.1 Background

The Sagarmala initiative is one of the most important and strategic imperatives to realize India's economic aspirations. The overall objective of the project is to evolve a model of port-led development, whereby Indian ports become a major contributor to the country's GDP.

As shown in **Figure 1.1**, the Sagarmala project envisages transforming existing ports into modern world-class ports, and developing new top notch ports based on the requirement. It also aspires to efficiently integrate ports with industrial clusters, the hinterland and the evacuation systems, through road, rail, inland and coastal waterways. This would enable ports to drive economic activity in coastal areas. Further, Sagarmala aims to develop coastal and inland shipping as a major mode of transport for carriage of goods along the coastal and riverine economic centres.

As an outcome, it would offer efficient and seamless evacuation of cargo for both the EXIM and domestic sectors, thereby reducing logistics costs with ports becoming larger drivers of economy.

Sagarmala aims to optimize the Logistics route for Port and Increase focus on Port led development for the country

	Details	Description
Why is Sagarmala needed?	1 Dual institutional structure at ports	▪ Due to segregation of major and minor ports, ports of India have grown as due unconnected entities and not benefitting from co-location or economics of scale
	2 Weak infrastructure at ports and beyond	▪ Weak modes of evacuation from both major and minor ports leading to sub – optimal modal mix presently ▪ Limited hinterland linkages that increases cost of transportation
	3 Limited economic benefit of location & to community	▪ Limited conscious skill development and leverage to peripheral trades (fisheries, tourism etc.) ▪ Limited development of centres of manufacturing near ports
What does Sagarmala want to achieve?	1 Ports led development	▪ Undertake development of coastal economic zones with projects like – port based industrialization, coastal tourism, Logistics parks, warehousing, fisheries etc.
	2 Port infrastructure enhancement	▪ Action points on transforming existing ports into world class ports be developing deep drafts, mechanization of existing berths, creation of new capacity and greenfield ports
	3 Efficient evacuation	▪ Expansion of rail / road network connected to ports and identification of congested routes ▪ Find optimized transport solution for bulk and container cargo

Figure 1.1 Aim of Sagarmala Development

In order to meet the objectives, Indian Port Association (IPA) appointed the consortium of McKinsey and AECOM as Consultant to prepare the National Perspective Plan as part of the Sagarmala Programme.

1.2 Scope of Work

Based on the experience in port-led development, the major engagement challenge to develop a set of governing principles for our approach is shown in **Figure 1.2**.

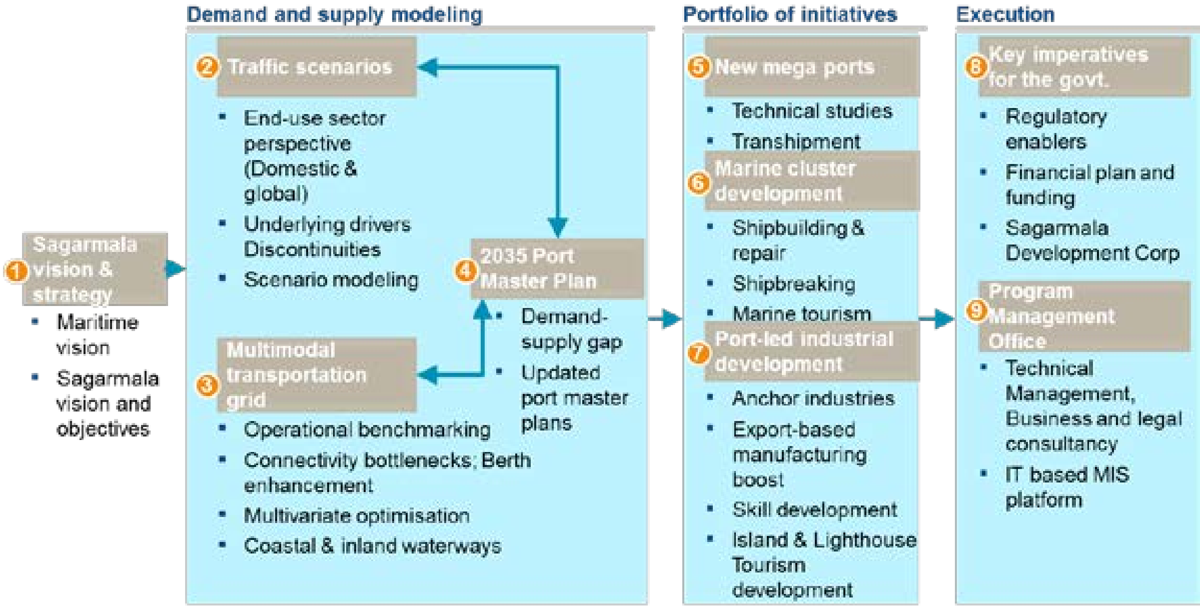


Figure 1.2 Governing Principles of Approach

As indicated above, the origin-destination of key cargo (accounting for greater than 85% of the total traffic) in Indian ports shall be mapped to develop traffic scenarios for a period of next 20 years. The forces and developments that will drive change in the cargo flows shall also be identified. This would lead to the identification of regions along the coastline where the potential for expansion of existing port exists. The various activities involved in the port led developments are charted in **Figure 1.3**.

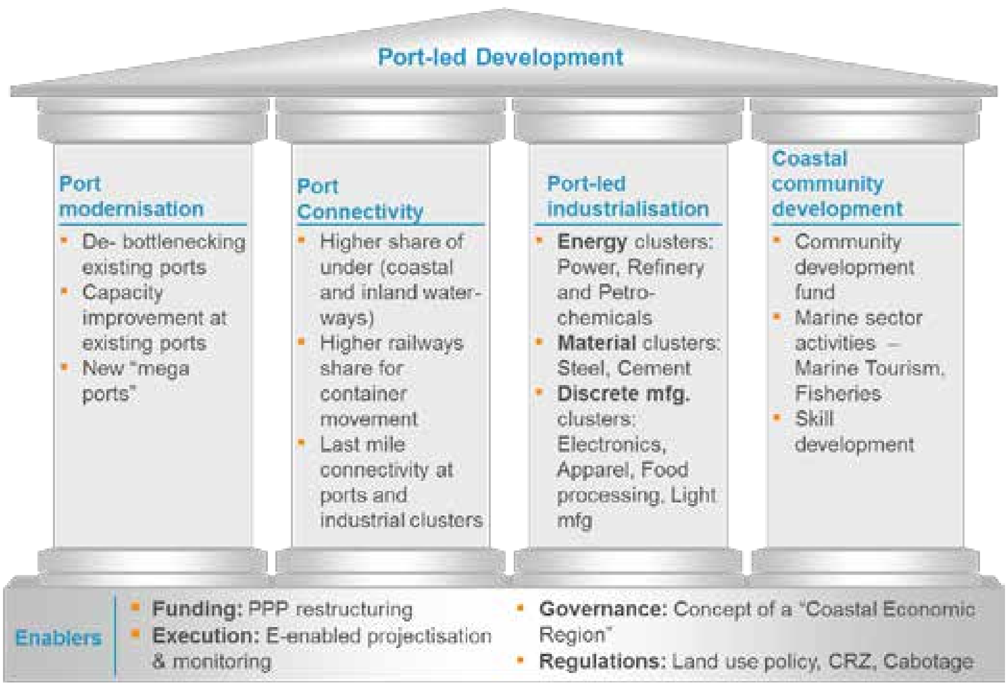


Figure 1.3 Port Led Developments

As part of the assignment, it is also expected to coordinate with the team working on “Benchmarking Operational Improvement Roadmap for Major Ports in India” study (which is being carried out simultaneously along with this assignment) and identify current and future logistic constraints (at the Major Ports) for the top 85% cargo categories based on analysis of current port capacity, productivity levels in comparison to international benchmark and evacuation bottlenecks in the logistics chain. This understanding should be an input in defining the 2035 Master Plan for each port.

Accordingly, this Master Plan report has been prepared taking into consideration the inputs provided on the future traffic and the benchmarking and operational improvements suggested for this port.

1.3 Present Submission

The present submission is the Final report for Development of Master Plan for V. O. Chidambaranar Port as part of SAGARMALA assignment. This report is organised in the following sections:

Section 1.0 : Introduction
Section 2.0 : The Port and Site Conditions
Section 3.0 : Details of Existing Facilities
Section 4.0 : Performance, Options for Debottlenecking & Capacity Assessment
Section 5.0 : Details of Ongoing Developments
Section 6.0 : Traffic Projections
Section 7.0 : Capacity Augmentation Requirements
Section 8.0 : Rail and Road Connectivity
Section 9.0 : Scope for Future Capacity Expansion
Section 10.0 : Shelf of New Projects and Phasing

2.0 THE PORT AND SITE CONDITIONS

2.1 Tuticorin Port as at Present

Tuticorin Port (08° 45‘N and 78° 13‘E) is one of the 12 major ports in India. It is an artificial, deep-water port on the East coast of India in Tuticorin district of Tamil Nadu. It is situated alongside of Palk Strait and inside Gulf of Mannar. It is situated approximately 160km North from Kanyakumari and 129 Nautical miles from Western region connecting international sea route. The location plan is shown in **Figure 2.1**.

Figure 2.1 Location Plan

VOC Port has, at present 14 berths and the port handled a total traffic of about 32 MT during 2014 – 15. The major commodities are coal (≈ 14 MT) followed by containers (≈ 11 MT); Fertilisers (≈ 1.5 MT); Copper concentrate (≈ 1.2 MT); others (≈4 MT)

The layout of port with existing berths as seen from the latest satellite picture is furnished in **Figure 2.2**.

Figure 2.2 VOCPT Port Layout Satellite Image

There are three coal berths exclusively handling thermal coal for captive power plants and one oil berth for handling POL products, LPG and chemicals. There are two exclusive container terminals each with one berth operated by two different BOT operators. The other eight berths handle all other cargo including thermal coal meant for other power plants, industrial coal, copper concentrate, fertilisers and general cargo.

While liquid cargo and containers are handled in exclusive berths with dedicated facilities, thermal coal meant for captive use of nearby power plants of TNEB & NTPL is handled in exclusive berths and conveyed through mechanized methods. However identical/similar cargoes like thermal coal meant for private power plants, industrial coal, and pet coke meant for multiple users are handled in multi-cargo berths through semi-mechanized methods for unloading, stacking and evacuation. Similarly bulk cargoes like lime stone, copper concentrate whose quantity is considerable are handled and conveyed by semi-mechanized methods. All these are bulk import cargoes having potential to cause pollution while being handled the side of food grains, fertilizers and other general cargoes in multipurpose berths.

2.2 Road Connectivity

V.O. Chidambaranar Port is connected with major National Highways connecting through three major cities/ urban centres in Tamil Nadu like Tirunelveli, Madurai and Kanyakumari.

§ NH-45 beyond Tirunelveli road intersection meeting Tuticorin – Madurai (NH-45B)

§ Tuticorin – Tiruchendur (NH7A) road cutover NH7 connecting to Kanyakumari

All-important destinations in India from North or East could be accessed through NH7 to travel south as shown **Figure 2.3** in below.

Figure 2.3 Road Connectivity to Tuticorin

2.3 Rail Connectivity

Presently a Broad Gauge single line connects the Port area originating from Milavattan Railway station. The total length of this railway line is 17.60 km as shown in **Figure 2.4**.

The distance from Milavattan Railway station to VOC wharf is 14.0 km and VOC wharf to Marshalling yard is the balance length near coal yard with a loop line with 5 no. lines available in the Marshalling yard.

Figure 2.4 Rail Connectivity to VOC Port

2.4 Site Conditions

2.4.1 Meteorology

The weather of Tuticorin constitutes extended summer and tender winter influenced by tropical hot climate. The temperature in summer varies from 25° C to 40° C. The hottest months are found to be May and June. The monsoon season commences around August and lasts till October. The mean atmospheric pressure reduced to MSL is 1010.70 mb. The monthly maximum observed mean sea level pressure is 1014.00 mb.

2.4.1.1 Winds

The governing wind direction in India is NE and SW influenced by monsoon. Monsoonal winds occur from WNW – WSW during May to August and N – ENE during November to February in this region. Prevailing winds was high during 1966 i.e. 47 days with wind speed of 40 kmph.

Annual Wind distribution percentage at Tuticorin is presented for a period of 1961-90 in **Table 2.1**.

Table 2.1 Annual Wind Distribution at Tuticorin (%)

MONTH		WIND												
		No. OF DAYS WITH WIND SPEED (KMPH)				PERCENTAGE No. OF DAYS WIND FROM								
		0	1 - 19	20 - 61	62 or more	N	NE	E	SE	S	SW	W	NW	CALM
JAN	I	0	24	7	0	66	16	1	0	0	0	0	17	0
	II	0	6	25	0	5	43	49	2	1	0	0	0	0
FEB	I	0	25	3	0	58	16	1	1	1	2	1	20	0
	II	0	8	20	0	1	25	61	10	3	0	0	0	0
MAR	I	0	29	2	0	39	20	5	2	3	7	6	17	1
	II	0	13	18	0	1	11	47	26	13	1	1	0	0
APR	I	1	28	1	0	17	13	6	5	9	13	16	18	3
	II	0	14	16	0	1	2	15	37	40	2	2	1	0
MAY	I	1	26	4	0	7	4	2	3	10	25	34	13	2
	II	0	13	18	0	0	0	2	19	44	11	22	2	0
JUN	I	0	19	11	0	1	0	0	2	10	30	51	6	0
	II	0	7	23	0	0	0	0	6	11	15	64	4	0
JUL	I	0	20	11	0	2	1	1	1	5	18	60	11	1
	II	0	9	22	0	0	0	2	10	10	10	64	4	0
AUG	I	0	20	11	0	4	3	1	1	2	13	62	14	0
	II	0	11	20	0	0	0	2	13	14	7	60	4	0
SEP	I	0	24	6	0	9	7	3	1	5	18	42	14	1
	II	0	14	16	0	1	1	2	13	28	11	40	4	0
OCT	I	0	29	2	0	19	12	3	4	4	14	23	20	1
	II	0	23	8	0	3	8	11	18	31	10	14	4	1
NOV	I	0	24	6	0	45	19	2	1	2	6	8	16	1
	II	0	19	11	0	8	32	26	14	11	3	3	2	1
DEC	I	0	23	8	0	60	22	1	0	1	2	1	13	0
	II	0	13	18	0	12	52	27	4	3	1	0	1	0

MONTH		WIND												
		No. OF DAYS WITH WIND SPEED (KMPH)				PERCENTAGE No. OF DAYS WIND FROM								
		0	1 - 19	20 - 61	62 or more	N	NE	E	SE	S	SW	W	NW	CALM
ANNUAL TOTAL OR MEAN	I	2	291	72	0	27	11	2	2	4	12	25	15	1
	II	0	150	215	0	3	15	20	14	17	6	23	2	0
NUMBER OF YEARS	I	31				31								
	II	31				31								

2.4.1.2 Rainfall

More than 70% of rainfall occurs during the month of October to December. Annual Average monthly rain distribution percentage at Tuticorin is presented for the period 1961-90 in **Table 2.2** below.

Table 2.2 Average Monthly Distribution of Rainfall

Month	RAIN FALL						
	Monthly Total	No. of Rainy Days	Total in Wettest Month with Year	Total in Driest Month with Year	Heaviest Fall in 24 Hours	Date and Year	Mean Wind Speed
	mm		mm	mm	mm		kmph
JAN	14.9	1	155.8 1961	0	90	11, 1961	19
FEB	17.6	1.1	99.2 1959	0	51.8	28, 1974	17.9
MAR	36.5	1.9	164.4 1971	0	71	7, 1971	15.2
APR	56.6	3	162.1 1970	0	126	2, 1961	12.6
MAY	20.9	1	163.1 1972	0	94.4	9, 1977	13.4
JUN	3.1	0.3	21.0 1970	0	21	4, 1970	16.7
JUL	10.8	0.7	142.1 1964	0	66.1	28, 1964	17.1
AUG	7.3	0.7	37.1 1971	0	30.2	12, 1972	16.8
SEP	17.7	1.2	101.7 1979	0	58.3	6, 1979	14.6
OCT	157.1	7.3	485.4 1972	23	167.4	28, 1957	11.7
NOV	206	8.3	441.1 1961	34.8	163.2	25, 1978	13.2
DEC	92.2	5	301.9 1955	14.6	188.2	3 1955	16.7

2.4.1.3 *Air Temperature*

The mean daily maximum and minimum temperature were observed to be 35.8° C and 21.30° C respectively. The maximum temperature at Tuticorin ranges between 41.1° and 33.3° C, while minimum temperature varies between 21.3° to 15.3° C. Month wise Maximum and Minimum Temperature at the port vicinity is presented in **Table 2.3** below.

Table 2.3 Maximum and Minimum Temperature - Monthwise

Month	MEAN						EXTREMES			
	Dry Bulb	Wet Bulb	Daily Max	Daily Min	Highest in the Month	Lowest in the Month	Highest	Date and Year	Lowest	Date and Year
	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
JAN	24.4	21.9	28.6	21.3	29.9	18.8	33.3	12	15.3	15
	27.2	23.9						1955		1990
FEB	25.6	23	29.5	22.3	31.5	19.6	35.8	9	17.2	4
	28.1	24.6						1965		1989
MAR	27.9	24.9	31.2	24.2	33.4	21.2	34.8	28	15.6	2
	29.6	25.8						1961		1989
APR	29.9	26.2	32.9	25.6	35.3	23	39.1	29	19.9	12
	30.9	26.9						1973		1984
MAY	30.7	25.9	34.9	26.5	38.4	23.8	41.1	14	21.1	26
	32.2	27						1956		1986
JUN	30.3	25	35.8	26.1	38.3	23.8	39.8	8	21.3	4
	32.5	25.3						1987		1970
JUL	29.8	24.4	35.2	25.8	37.8	23	39.4	11	20.4	15
	31.8	24.9						1987		1986
AUG	29.8	24.3	35	25.8	37.6	23.3	39.3	19	20.7	24
	31.5	24.9						1990		1969
SEP	29.6	24.4	34.1	25.3	37.5	23	38.7	5	20.7	30
	30.9	25.3						1980		1987
OCT	28.1	24.7	32.1	24.2	35.8	21.5	38.6	7	17.7	19
	29.3	25.4						1990		1984
NOV	26.4	23.9	30	23.2	32.4	20.8	34.9	9	17.8	17
	28.1	24.9						1969		1986
DEC	25.1	22.8	29	22.1	30.8	19.6	33.3	7	15.6	14
	27.4	24.4						1972		1984

2.4.1.4 *Visibility*

Generally, the visibility is comprehensible; visibility in the monsoon normally deteriorates during rains and occasional squalls. Visibility data are recorded at Tuticorin daily and observation records are available since 1961-1990. Analysis of the average visibility ratio for every month is carried out based on I.M.D. maintained data for a period of 30 years. Around the year more than 84% of the days the visibility is explicit even over 20 km. On an average only one day over the years is visible up to 4 km and around 5 days up to 10 km.

2.4.1.5 Relative Humidity

The average humidity ranges from nearly 79% in December to about 59% in June.

2.4.2 Oceanography

2.4.2.1 Tides

The tide range at Tuticorin relative to the Chart Datum (CD) is as follows:

§ Lowest Low Water Level	(LLWL)	+ 0.11 m
§ Mean Lower Low Water Springs	(MLLWS)	+ 0.25 m
§ Mean Low Water Springs	(MLWS)	+ 0.29 m
§ Mean Low Water Neaps	(MLWN)	+ 0.55 m
§ Mean Sea Level	(MSL)	+ 0.64 m
§ Mean High Water Neaps	(MHWN)	+ 0.71 m
§ Mean High Water Springs	(MHWS)	+ 0.99 m
§ Highest High Water Level	(HHWL)	+ 1.26 m

The above levels are with respect to chart datum, which is approximately the level of Lowest Astronomical Tide.

2.4.2.2 Currents

North/ South current are created at the approach channel of range 0.5 – 1.0 Knots due to seasonal wind. The current direction is southwards during Dec – Mar, East – North East during May – Sep. During monsoon predominant direction is SSE (South South East) to SSW (South South West) for NE monsoon. The current magnitude ranges around 0.5 – 1.0 Knot most of the time during NE monsoon. During SW monsoon the directions are wider with magnitude of 0.5 Knots and less for most of the period.

2.4.2.3 Cyclone

Cyclone might occur during NE monsoon at Tuticorin. Tuticorin is not a frequent cyclone prone area. Even then on Nov 13th, 1992 at 1610 IST the port was hit directly by a cyclone with 113Kmph from ESE direction. In Dec 2000 port experienced shadow effects of the cyclone that passed nearby Tuticorin. NIOT managed to record a maximum wave height of 3 m off Tuticorin during this cyclone.

2.4.3 Geotechnical Data

Borehole data collected at Tuticorin Port trust as reported in the report of I-Maritime, 2013 for DPR of Outer Harbour indicates that the seabed profile for BH 12 at 11.1m CD generally comprises of hard limestone between11.10m – 12.51 m CD and soft limestone at 12.5m – 12.89 m CD. Whereas BH 27 profile at 6.85 m CD comprises of clayey sand between 6.85 m – 7.85 m CD, Silty sand between 13.85m – 21.05 m CD and Calcareous Sandstone between 7.85 m – 13.85 m; 21.05 m – 25.10 m CD.

3.0 DETAILS OF EXISTING FACILITIES

3.1 General

Tuticorin Port presently handles commodities such as thermal coal, coking coal, limestone, iron ore, fertilizers and other break bulk cargo. The port also handles substantial quantities of POL at a dedicated jetty through pipelines. The total land area of the port is 2597.70 acres; Water spread area is 960 acres and is located south of Old Tuticorin Harbour.

The V. O. Chidambaranar port has an artificial harbour protected by two rubble mound breakwaters and is connected to deep water by a dredged channel.

The locations of the berths are shown in the following **Figure 3.1.**

Figure 3.1 Existing Facilities

The features of the existing harbour are as shown in below **Table 3.1**.

Table 3.1 Details of Breakwater and Channel

Breakwater	
§ North Breakwater	4086 m
§ South Breakwater	3876 m
Approach Channel	
§ Length	3800 m
§ Width	230 m
§ Depth	14.7 m below CD
Entrance Channel	
§ Length	300
§ Width	153 m
§ Depth	14.7 m below CD
Turning Basin	
§ Diameter	488 m
§ Depths	14.1 m below CD

3.2 Existing Jetties and Quays

The present berthing infrastructure at Tuticorin port can be divided into two categories (**Figure 3.1**) viz., coal & oil berths/jetties along the lee of North breakwater and container, multipurpose & shallow draft berths along the lee of South breakwater. There are 4 general cargo berths within a dock like basin at the North West side of Southern breakwater kink and 2 others parallel to it. Two privatised container terminals and a deeper draft quay are reclaimed next to general cargo berths. On the northwest side of the reclaimed quay shallow berths are assigned for construction materials. A small finger jetty exists adjacent to shallow berths. One deeper coal berth, two coal jetties and one oil jetty are being operated alongside the North breakwater. **Table 3.2** provides details of all the berths at V.O. Chidambaranar Port.

Table 3.2 Details of Berthing Infrastructure

S. No.	Berth Description	Length (m)	Draft (m)	Cargo Handled
1.	Berth No I	168.0	9.30	General Cargo
2.	Berth No II	168.0	9.30	General Cargo
3.	Berth No III	192.0	10.70	General Cargo
4.	Berth No IV	192.0	10.80	General Cargo
5.	Berth No V	168.0	8.60	General Cargo
6.	Berth No VI	168.0	9.30	General Cargo
7.	Berth No VII	370.0	10.90	Container
8.	Berth No VIII	345.0	12.80	Container
9.	Berth No IX	334.5	12.80	General Cargo
10.	Oil Jetty	228.0	12.80	POL
11.	Coal Jetty I	185.0	12.80	Thermal Coal For TNEB
12.	Coal Jetty II	210.0	12.80	Thermal Coal For TNEB
13.	SDB (Shallow Draft Berths)	140.0	5.85	Coast Guard Utility
14.	NCB I (North Cargo Berth I)	306.0	12.80	Thermal Coal for NTPL
15.	Finger Jetty	121.0	4.50	Port Craft Utility

3.2.1 Berth I – IV

It has a quay length of 732 m with four berths viz. Berth I, Berth II, Berth III and Berth IV. Berth I can handle 25,000 DWT, Berth II can handle 40,000 DWT, Berth III can handle 50,000 DWT and Berth IV can handle 50,000 DWT size vessels. All these are multi-purpose berths are handling industrial coal, cement, fertilizers, and other bulk cargos.

3.2.2 Berth V – VI

This quay has two berths (Berth V & VI) with a length of 168 m each and draft of 8.6 m and 9.3 m respectively. These berths are multipurpose berths and can accommodate vessel sizes of 40,000 - 45000 DWT handling logs, construction materials, stones/rocks and other general cargoes.

3.2.3 Berth VII

This quay is a single berth having 10.9 m draft and 370 m of quay length facing perpendicular to Berth V–VI. It is a container berth operated by M/S PSA SICAL on BOT basis since July 1998. This berth is capable of accommodating container vessel sizes up to 50,000 DWT.

3.2.4 Berth VIII

This berth has a draft of 12.8 m and 345.50 m of quay length. It is also a container berth and operated by M/s. Dakshin Bharat Gateway Terminals on BOT basis. This berth is capable of accommodating container vessel sizes up to 60,000 DWT.

3.2.5 Berth IX

Berth IX is one of the deeper berths at VOCPT and is located next to Berth VIII. It has a draft of 12.8 m and the length of 334.5 m. Similar to berths VII and VIII this berth has a reclaimed backup area of approximately 6 Ha behind it and is used as container stack yard.

3.2.6 Coal Jetties (CJ-I & CJ-II)

The Port has two coal jetties at the northern end of north breakwater lee operated by TNEB (Tamil Nadu Electricity Board). Each jetty has a draft of 12.8 m. The main jetty length of CJ I & II are 185 m and 210 m respectively. The lengths of the jetties from dolphin to dolphin facilities are 340 m each. It can accommodate vessel sizes up to 50,000 to 60,000 DWT. These berths are equipped with shore reception hopper facilities for unloading of coal and are connected to conveying system leading to the power plant stack yard.

3.2.7 Oil Jetty (POL)

VOCPT has an oil jetty with a draft of 12.8 m with jetty head of 30.3 m with dolphins of size 15 m X 15 m at each side of berth at 11.35 m from jetty head located in the lieu of north breakwater. This berth handles petroleum, oil and lubes (POL) LPG and Liquid Ammonia. This berth can handle tankers up to 65,000 dwt with Length Overall (LOA) up to 229 m.

3.2.8 NCB-I (North Cargo Berth)

North cargo berth has commenced operations recently is located along the lee of Northern breakwater. This berth being a deep a draft berth of 14.1 m depth can handle Panamax vessels up to a draft of 12.8 m. This is a captive berth for unloading thermal coal meant for NTPL power plant.

3.3 Cargo Handling System

3.3.1 Coal Handling System

Coal handling through Tuticorin Port is basically imports of thermal coal for Power Plants located in the vicinity of Port. Presently there are two main power plants as below.

§ Tuticorin Thermal Power station (TTPS) of TANGEDCO Located in Port Estate - 1050 MW consisting of five units of 210 MW each.

§ NTPL Power plant near TANGEDCO power plant – 1000 MW Power plant consisting of 2 units of 500 MW

In addition to the above there are a few small/mini thermal power plants in and around Tuticorin all owned by private industries some of which are meant for captive use of the specific industries.

Further coal is also imported by private traders for use of various industries like cement plants, sugar plants, paper industry etc., in the hinterland.

The coal jetties CJ1 and CJ2 handle coal meant for TANGEDCO power plant through a two mechanical coal handling conveyor system is available from the respective berths of Tuticorin Port to the power plant’s stack yard direct with any transit stacking with annual throughput of around 6 MT. The berths CJ1 and CJ2 were constructed by the port authority the top side facilities like Hoppers for receiving coal from the ship’s cranes and the conveyor system are owned, operated and maintained by Tangedco.

The salient features of the conveyor system from CJ-I are given in **Table 3.3**:

Table 3.3 Coal Handling System at CJ-I

S. No	Conveyor No.	Length	Power		Belt Used	Belt Width	Speed	Capacity
		(m)	(KW)	(KV)	(Material)	(mm)	(m/s)	(TPH)
1.	13	252.00	150.0	415.0	Nylon	1400	3.300	2000
2.	13A	255.00	150.0	415.0	Nylon	1400	3.300	2000
3.	14	300.00	150.0	415.0	Nylon	1400	3.300	2000
4.	15	837.60	336.0	6.6	Nylon	1400	3.300	2000
5.	16	847.00	336.0	6.6	Nylon	1400	3.300	2000
6.	17	1,240.00	485.0	6.6	Nylon	1400	3.300	2000
7.	19	265.00	300.0	6.6	Nylon	1400	3.300	2000
8.	BFD-8	26.40	45.0	415.0	Nylon	1800	2.500	2000
9.	RBFD-11	9.35	30.0	415.0	Nylon	2000	1.000	2000
10.	45	101.20	300.0	6.6	Nylon	1800	2.450	2000
11.	46	76.45	115.0	6.6	Nylon	1800	2.500	2000
12.	43	107.92	240.0	6.6	Nylon	1800	2.500	2000
13.	47	101.53	300.0	6.6	Nylon	1800	2.450	2000
14.	62	174.94	115.0	415.0	Nylon	1800	1.250	900

The salient features of the conveyor system from CJ-II are given in **Table 3.4.**

Table 3.4 Coal Handling System at CJ-II

S. No	Conveyor No.	Length (m)	Power (KW)	Power (KV)	Belt Used (Material)	Belt Width (mm)	Speed (m/s)	Capacity (TPH)
1.	65	284.00	255.0	6.6	Nylon	1800	2.500	2000
2.	66	167.75	160.0	6.6	Nylon	1800	2.500	2000
3.	67	996.19	485.0	6.6	Nylon	1800	2.500	2000
4.	68	127.70	160.0	6.6	Nylon	2000	2.000	2000
5.	69	669.90	416.0	6.6	Nylon	1800	2.500	2000
6.	70	711.30	436.0	6.6	Nylon	1800	2.500	2000
7.	71	549.96	365.0	6.6	Nylon	1800	2.500	2000
8.	72	885.33	604.0	6.6	Nylon	1800	2.500	2000
9.	73	97.63	188.0	6.6	Nylon	1800	2.500	2000
10.	48A	192.45	209.0	6.6	Nylon	1800	1.300	1100
11.	48B	194.68	209.0	6.6	Nylon	1800	1.300	1100
12.	48A1	252.23	175.0	6.6	Nylon	1400	2.417	1100
13.	48B1	262.23	175.0	6.6	Nylon	1400	2.417	1100
14.	61	157.30	236.0	6.6	Nylon	1800	2.500	2000
15.	64	49.722	118.0	6.6	Nylon	1800	2.500	2000

The locations and plan of the conveyor system from jetty to the plant stack yard is shown in detail in **Figure 3.2** & **Figure 3.3** for CJ-I & CJ-II.

Figure 3.2 Converyor Plan from Coal Jetty CJ2 upto the Port Limit

Figure 3.3 Converyor Plan from Coal Jetty CJ2 to the Port Limit and to their Yard

Similarly the coal meant for NTPL power plant is handled exclusively from their captive berth NCB1 through a fully mechanized handing system consisting of gantry grab unloaders and conveyor system leading to their power plant direct without any intermediate stack yard inside the port. The berth NCB1 and the entire handling system is installed and operated by NTPL on BOT basis

3.3.2 Container Handling System

The port does not own any container handling systems as the container berths are privatised on BOT basis. Each container berth has their own equipment based on their requirement.

Terminal VII (PSA SICAL) has a capacity of 4,50,000 TEU and terminal VIII (DBGT) has a capacity of 6,00,000 TEU. The equipment deployed at the terminals as of now are listed in **Table 3.5**

Table 3.5 Major Container Handling Equipment Deployed by BOT Operators as of Now

BOT Operator Description	Quantity (No.)	Rated Capacity (T)
Equipment Deployed by M/S PSA SICAL		
§ Rail Mounted Quay Crane	3	40
§ Rubber Tyre Gantry Crane	8	40
§ Tractor Trailers	12	55
Equipment Deployed by M/S DBGT		
§ Reach Stackers	2	45
§ Prime movers & Trailers	8	50
§ Harbour Mobile Crane	1	200
§ Harbour Mobile Crane	2	100

3.3.3 Other Equipment

Apart from the mechanized Coal and Container handling terminals, the port has some own and other equipment deployed on BOT basis for efficient loading/unloading operations. The details are outlined in **Table 3.6**

Table 3.6 Other Loading/ Unloading Equipment in VOCPT

Equipment Description	Quantity (No.)	Rated Capacity (T)
Equipment Deployed by VOCPT		
§ Wharf Crane	2	6
§ Wharf Crane	2	10
§ Wharf Crane (Grab)	3	20
§ Floating Crane	1	4
Equipment Deployed by BOT Operator		
§ Harbour Mobile Cranes	2	124
§ Floating Crane	1	35
§ Self-Propelled Barge	3	2000

It is pertinent to note that besides these, certain other private equipment is permitted from time to time as necessary.

3.4 Storage Facilities

The logistic operations are supported by storage arrangements by V.O. Chidambaranar Port Trust. In addition to the open stack yard, there are transit Sheds, warehouses and other storage facilities inside and outside the Port area as presented in **Table 3.7** below.

Table 3.7 Details of Storage Facilities

Description	Quantity	Location	Capacity		Commodity
			Dry	Liquid	
OWNED BY PORT					
§ Warehouses	3	Inside	14,940.00 m^2		
§ Transit sheds	2	Inside	10,800.00 m^2		
§ Dangerous Cargo Sheds	1	Inside	733.00 m^2		
§ Fumatorium	1	Inside	739.00 m^2		
§ Open area	1	Inside	5,53,000.00 m^2		
OWNED BY PRIVATE PARTIES (In Port's Leased Land)					
§ Warehouses	14	Outside	4,23,000.00 m^2		
§ Warehouses	2	Outside	36,000.00 m^2		
§ Tank	3	Inside		15,000.00 m^3	Phosphoric acid
§ Tank	1	Outside		13,700.00 KL	Naphtha
§ Tank	1	Outside		13,800.00 KL	Naphtha
§ Tank	1	Outside		14,100.00 KL	Naphtha
§ Tank	3	Outside		25,500.00 KL	Furnace oil
§ Tank	1	Outside		750.00 KL	LSFO
§ Tank	1	Outside		540.00 KL	LSHFHSD
§ Tank	3	Outside		7,800.00 KL	Petrol
§ Tank	2	Outside		15,000.00 KL	HSD
§ Tank	2	Outside		10,830.00 KL	Kerosene
§ Tank	2	Outside		7,790.00 KL	EDC
§ Tank	1	Outside		15,000.00 KL	LPG
§ Tank		Outside		2,000.00 m^3	VCM
§ Tank	1	Outside		5,000.00 m^3	VCM
§ Tank	1	Outside		10,000.00 m^3	Ammonia

3.5 Pilotage and Towage Facilities

Pilotage is compulsory for all vessels having capacity of more than 200 MT Gross Tonnage. The port has tugs, launches and mooring boats for pilotage and towage operations as listed in **Table 3.8**.

Table 3.8 Floating Crafts

Description	Quantity	Capacity	Owned/ Hired/ Lease
Tugs	1	32T BP	Own
Tugs	1	45T BP	Own
Tugs	1	50T BP	Hired
Tugs	1	50T BP	Hired
Launches	1	20 knots	Hired
Launches	1	48 GRT	Own
Launches	1	48 GRT	Own
Launches	1	2x640 BHP	Own
Launches	1	20 Knots	Hired
Mooring Boats	2	1x54 BHP	Own

4.0 PERFORMANCE, OPTIONS FOR DEBOTTLENECKING & CAPACITY ASSESSMENT

4.1 General

The total cargo handled through the existing facilities, during the past 5 years ending March 2015, is presented in the following **Table 4.1**.

Table 4.1 Cargo Handled During Last 5 Years

S. No.	COMMODITY	2010-11	2011-12	2012-13	2013-14	2014-15
	IMPORT (MTPA)					
1.	Liquid cargoes	1.15	1.29	1.21	0.94	1.11
2.	Fertilizer	1.16	1.11	0.49	0.39	0.42
3.	F.R. Materials	0.73	0.89	0.56	0.79	1.05
4.	Coal	8.19	9.28	10.62	12.15	13.80
5.	Pet coke	0.07	0.11	0.07	0.20	0.21
6.	General Cargo	2.49	2.56	2.88	2.06	2.76
7.	Other General Cargo	1.36	1.22	0.55	0.56	0.25
8.	**Total Imports**	**15.16**	**16.46**	**16.37**	**17.09**	**19.60**
	EXPORT (MTPA)					
1.	Dry Cargoes	0.72	0.43	0.46	0.48	0.30
2.	Liquid Cargoes	0.54	0.47	0.70	0.55	0.40
3.	Food Grains	0.04	0.30	0.13	0.05	0.06
4.	General Cargo	1.05	1.06	0.95	0.34	0.96
5.	Other General Cargo	0.06	0.15	0.27	0.01	0.06
6.	**Total Export**	**2.40**	**2.42**	**2.52**	**1.42**	**1.78**
	LIGTHERAGE AT (MTPA)					
1.	Old Harbour	0.78	0.68	0.04	0.12	0.13
2.	V.O.Chidambaranar Port Trust	0.21	0.26	0.30	0.07	0.26
3.	**Total Lighterage**	**0.99**	**0.94**	**0.33**	**0.19**	**0.40**
	CONTAINER TRAFFIC					
1.	Import (Mil TEUs)	0.23	0.23	0.23	0.25	0.29
2.	Export (Mil TEUs)	0.24	0.25	0.24	0.26	0.27
3.	**Total Traffic (Mil TEUs)**	**0.47**	**0.48**	**0.48**	**0.51**	**0.56**
4.	**Total Traffic (MTPA)**	**8.17**	**9.23**	**9.37**	**10.13**	**11.03**
	TOTAL TRAFFIC (MTPA)					
1.	Old Harbour	0.78	0.68	0.04	0.12	0.13
2.	V.O. Chidambaranar Port Trust	**25.94**	**28.36**	**28.56**	**28.71**	**32.68**
	Total	**26.71**	**29.05**	**28.59**	**28.83**	**32.81**

4.2 BCG Benchmarking Study

BCG, as part of their benchmarking study, has looked into the operation of the berths and has suggested various measures for improving the performance. The report of BCG pertaining to V. O. Chidambaranar Port is given in the **Annexure 1**. The key observations are as follows:

According to them VOCPT has Potential to handle additional cargo volume but it is constrained by low productivity and draft constraints. The findings and suggestion for the Tuticorin port are as follows-

4.2.1 Cargo Volume Analysis

The Tuticorin port has handled 32 MT in 2015 which is an increase over 5 year CAGR of 6%. Due to recently commissioned power plants in and nearby Tuticorin port, the coal cargo volume demand has been increasing. Both coal and container has shown traffic growth consistently for the past 5 years. The percentage of occupancy of the coal berths as calculated are found to be very high, mainly due to the increase in volume for newly operating power plants and this is expected to grow much more in the coming years. Once the new power plants are installed as planned operate to their full capacity, the demand for coal is expected to increase by 43% by 2017-19.

4.2.2 Berth Occupancy

The berths approximately have occupancy of 75% presently. The highest occupied berth is IX and the other general cargo berths have occupancy of around 65%. (Refer to **Figure 4.1** for detailed occupancy berth-wise).

4.2.2.1 Coal Berths

The Tuticorin port handles coal for TNEB in CJ-I and CJII. Coal meant for other than TNEB is handled at berth IX, which is the only deep draft multi-purpose berth (12.8 m draft). The port actually faces certain constraints for handling coal since fully loaded Panamax vessels cannot be brought into port unless unloaded partially at anchorage. The partially unloaded Panamax vessels are again partially unloaded at berth IX due to draft constraints before taken to other multi-purpose berths.

Productivity at the anchorage is significantly lower than at berths due to rough weather, higher handling cost etc. Comparison on cost of offloading Panamax vessel at nearest deeper port (Karaikal) shows anchorage offloading is cheaper. To the present floating crane and 3 barges an additional floating crane by a third party invited by the port is suggested.

4.2.2.2 Container Berths

The Tuticorin port handles container at two berths namely VII & VIII. Occupancy of berth VII is optimal due to consolidated cargo i.e. occupancy is nearly maximal and there is limited scope of traffic growth. Limitation in berth strength to take higher capacity cranes on quay is a drawback. PSA owned berth VII works on royalty based model with VOCPT. Productivity is higher than TAMP norms and profit margin is reduced every year due to high royalty.

Occupancy of berth VIII is less for now due to absence of handling equipment despite of 12.8 m draft. Due to this it could not get the needed attention form international shipping lines. However this terminal is expected to be equipped with container quay cranes by 2016-17.

4.2.2.3 Fertilizer Berths

The Tuticorin port handles fertilizer at multi-purpose berths namely II, III, IV VI and IX. The scope of traffic growth for fertilizers is dependent on increase in agricultural activities. Approximate traffic of 1.7 MT is handled at VOPCT in all the above mentioned berths in total. The low productivity at berths II, III, IV and VI is due to vessels lightened at berth IX. The other reason influencing low productivity is limitation in the capacity of cranes available for ship to shore operations.

4.2.3 Key Findings & Recommendations

4.2.3.1 Coal Handling Productivity

- Panamax vessels with over 12.8 m draft cannot enter the port.
- All Panamax vessels with a loaded draft of more than 12.8 m have to resort to lighterage operations at anchorage till they attain the permissible draft.
- Coal handling capacity needs to be improved on productivity to create additional capacity.
- Average productivity at anchorage is approx. 8000 T/day against 20,000 T/day at berth.
- At present Cape size vessels cannot enter the port due to channel width constraints, however suggested to handle the entire cargo at anchorage (approx. 0.11 MT)
- Increase in cost of offshore coal handlings are high due to tariff of floating crane, high stevedoring cost and additional vessel chartering cost due to low handling rate.
- Old Tuticorin port cannot be an alternative unloading point due to draft constraints, port locality and distance from the anchorage.
- Berth IX (12.8 m draft) is highly in demand being the only option for partially loaded Panamax vessel resulting in increasing pre-berthing delay
- After MHC's installed at coal handling berths, the expected productivity will be 17,000 T/day (11,000 T/day currently).
- 2 Nos. of 125T MHC at berth IX can result in increased utilisation to produce 28,000 T/day, if shallow draft coal berths are equipped as required (19,000 T/day currently).
- By limiting maximum of 3 shifts of stay at Berth IX with fully utilised MHC achieving vessel draft reduced to 10.4 m (required) shall unlock up to 1.4 MT of productivity.

4.2.3.2 Mechanisation of Berths III & IV

- Low capacity equipment and high reliance on vessels gear are the reasons for low productivity at the berths
- Incapable of shifting gearless vessels and absence of required crane capacity also a reason for the low productivity of the berths
- Due to high occupancy at berth IX the potential of these shallow draft coal berths are not revealed
- VOCPT to invite a third party for an additional MHC at each of these berths are suggested

- Additional MHC will result in increase of 50% productivity (17,000 T/day) leading to unlock additional berth capacity of 1.6 MT

4.2.3.3 Mechanisation of Berths IX

- Vessel handling is convenient since both discharge rate of vessel and evacuation rate at the berth is 17,000 T/day
- Present discharge rate at berth is 18,000 T/day
- In case of gearless vessels the discharge rate is 23,000 T/day resulting in berth cluttered upon departure
- Piling of coal at berth is undesirable due to cluttered berth hindering MHC and reduces its productivity up to 20% and it creates difficulty to heap the next vessel's cargo
- With capital cost of approx. 60 Cr INR conveyors from berth to storage yard shall be planned with IRR of 48%
- On deploying conveyors the MHC shall be used to discharge into hoppers

4.2.3.4 Additional Capacity by Traffic Relocation

- TNEB's demand constraints and lack of infrastructure leads to CJ-I and CJ-II limitation of productivity to 11,000 T/day.
- With present condition it can achieve 15,000 T/day and can increase to 25,000 T/day by the following:
  - Widening and strengthening the berth
  - Installation of shore cranes
  - Conveyor overhauling
- The additional capacity unlocked can be used to handle non TNEB coal and can be stacked in different location by an additional diversified conveyor branch from the existing.
- This also benefits TNEB by logistic cost by gearless vessels and productivity increase.
- Three phase possibility to unlock 3-7 MT is also suggested:
  - Incentivise TNEB to improve productivity with no overhaul
  - Take over and refurbish one berth
  - Take over one berth and refurbish both

4.2.3.5 Dedicated Berth for Copper Concentrate (Berth VIII)

- Berth VIII was planned for container berth but resulted in low occupancy (approx. 55%) due to absence of quay cranes.
- This berth can be a short term alternative for lack of deeper draft berths to handle dry bulk
- Clean the commodity to prevent dust accumulation on berth and equipment.
- To be planned for bulk handling along with existing container handling.
- Release of approx. 0.3 MT Copper concentrate from berth IX impacts in additional handling of coal (approx. 1.5 MT/year).

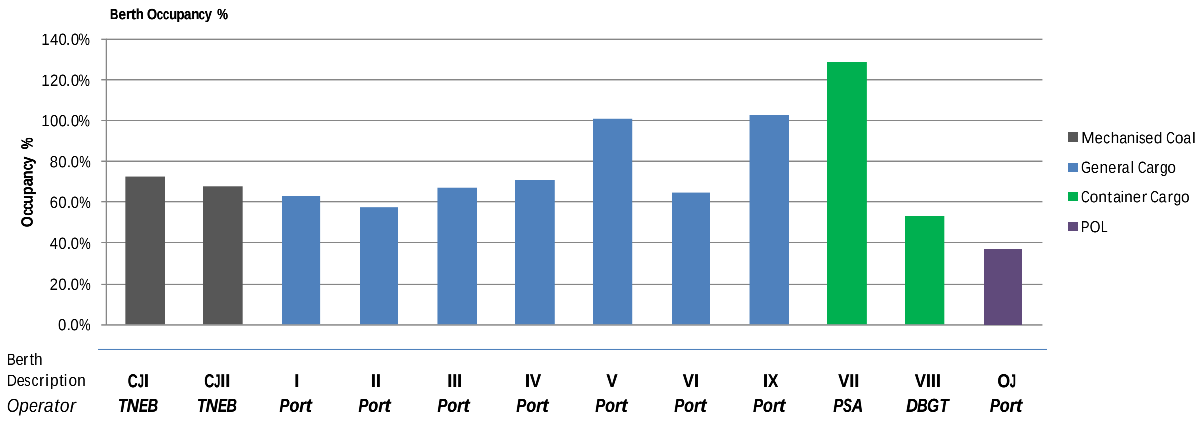


Figure 4.1 Berth Occupancy %

4.2.3.6 Coal Handling at Anchorage

The port is presently carrying out lighterage operations for coal due to current limitations of drafts and navigation as below:

§ The present harbour entrance which has a width of 153 m cannot allow navigation of vessels with a beam wider than 32.2 m.

§ The depth of channel and the coal handling berths is 14.7 m which means Panamax vessels with loaded draft of 12.8m only can be handled.

§ Any further deepening of the berthing area beyond (-) 14.7 m will infringe on the toe line of the existing coal handling berths CJ1, CJ2 and berth IX which are all constructed on piles thus endangering on their stability.

Since it make considerable economic sense to bring bulk coal panamax vessels to their full load draft up to 14.5 m, the importers bring them fully loaded.

In order to handle fully loaded Panamax vessel the port does partial offshore transhipment until the vessel is lightened to the permissible draft. Anchorage handling is not cost effective as compared to handling at the berths. Apart from multiple handling the lack tranquil conditions at anchorage leads to significantly low productivity.

At present the lightening operation is executed with one floating crane and three barges. Average productivity at anchorage is approx. 8000 T per day as compared to productivity up to 20,000 TPD possible at the berth. The cargo wise tonnage at the anchorage for the FY 2014-15 is shown in **Table 4.2.** This causes increase in turnaround time leading to additional cost of charter. The handling cost at anchorage is high due to the following:

§ High cost of floating crane used for lighterage operations.

§ High stevedoring cost

§ Additional vessel charter cost due to low productivity

Table 4.2 Cargo Handled in Anchorage for FY 2014-15

Cargo	Qty (T)	Avg. Output (T)
Cu. Concentrate	445	445
Iron Ore	9,329	3,165
Lime Stones	8,833	4,417
Peas (Yellow)	1,000	1,000
Steaming(Non-Coking)Coal (I.Coal)	91,906	2998
T. Coal	23,104	1679
Total	**1,34,617**	

Also the lighterage operations during the year were limited to just 21 vessels. Thus the impact of lighterage operations in the overall traffic was limited during the year. The significant reason for this appears to be that imported coal from foreign countries is the main commodity that is brought in fully loaded Panamax vessels. It is further found that this happens when the importer buys the cargo on high seas and when the importer charters the vessel from load port itself with a planned intent to bring cargo to Tuticorin this does not happen much.

4.3 Performance of Existing Facilities

4.3.1 General

The cargo handling capacity of port facilities is based on many factors like the vessel size, fleet mix, equipment provided and the possible handling rates, time required for peripheral activities, capacity of stack yard, number of users, grades, capacity of evacuation system etc.

The capacity of existing berths is assessed assuming the mix of cargo being currently handled at these berths and the corresponding parcel sizes.

Another factor that is important in arriving at the berth capacity is the allowable Berth occupancy, which is expressed as the ratio of the total number of days per year that a berth is occupied by a vessel (including the time spent in peripheral activities) to the number of port operational days in a year. High levels of berth occupancy will result in bunching of ships resulting in undesirable pre-berthing detention. For limited number of berths and with random arrival of ships, the berth occupancy levels have to be kept low to reduce this detention. The norms generally followed for planning the number of berths in modern port to minimise the pre-berthing detention are given in **Table 4.3**.

Table 4.3 Recommended Berth Occupency

No. of Berths	Recommended Berth Occupancy Factor
1	60 %
2	65 %
3 & above	70 %

The performance of the berths are analysed and presented in the sections below.

4.3.2 Performance of Coal Handling Berths

The performance of coal berths CJ1 and CJ2 exclusively handling coal meant for TANGEDCO is provided in **Table 4.4**. Other coal is widely handled in various other berths like II, III, IV, V, VI and IX. A small quantity was also handled at the eastern arm during the non-availability of shallow berths. The performance of dedicated coal handling berths of TNEB during 2014-15 is shown in **Table 4.4**.

Table 4.4 Performance of Coal Handling Berths

S. No.	Berth Description	Total Cargo Handled (MT)	Total No. of Ships	Avg Parcel Size (T)	Standard Berth Days	Berthing/ De-Berthing Days	Total Berth Days	Berth Occupancy (%)
1.	CJI	3.10	74.00	41,915.34	252.46	12.33	264.79	**72.5%**
2.	CJII	3.18	68.00	46,730.01	236.76	11.33	248.09	**68.0%**

4.3.3 Performance of Container Berths

Berth VII operated by PSA has a high occupancy level where as berth VIII operated by DGBT has low occupancy for now as it is not yet equipped with container quay cranes. Their performance is outline in brief in **Table 4.5**.

Table 4.5 Performance of Container Berths

S. No.	Berth Description	Total Cargo Handled (MT)	Total No. of Ships	Avg Parcel Size (T)	Standard Berth Days	Berthing/ De-Berthing Days	Total Berth Days	Berth Occupancy (%)
1.	VII	7.54	781.00	9,648.19	339.16	130.17	469.33	**128.6%**
2.	VIII	1.34	235.00	5,701.12	155.94	39.17	195.10	**53.5%**

4.3.4 Performance of Oil Jetty

OJ operated by IOCL for their POL has a low occupancy despite having water depth of 14.1 m. Performance is studied in brief as shown in **Table 4.6**. The berth has two unloading arms for handling POL leading to the IOCL tank farms as also unloading arms for handling LPG and Liquid Ammonia.

Table 4.6 Performance of Oil Jetty

S. No.	Berth Description	Total Cargo Handled (MT)	Total No. of Ships	Avg Parcel Size (T)	Standard Berth Days	Berthing/ De-Berthing Days	Total Berth Days	Berth Occupancy (%)
1.	OJ	0.64	83.00	7,686.76	120.89	13.83	134.73	**36.9%**

4.3.5 Performance of Multipurpose Berths

Berth I, II, III, IV, V & VI are operated by VOCPT and have a fair occupancy but the shallow draft has a low occupancy. Berth wise Performance for the multipurpose berths is as shown in **Table 4.7.**

Table 4.7 Performance of Multipurpose Berths

S. No.	Berth Description	Total Cargo Handled (MT)	Total No. of Ships	Avg Parcel Size (T)	Standard Berth Days	Berthing/ De-Berthing Days	Total Berth Days	Berth Occupancy (%)
1.	I	0.48	131.00	3,634.80	207.35	21.83	229.19	**62.8%**
2.	II	0.73	119.00	6,140.26	190.13	19.83	209.96	**57.5%**
3.	III	2.30	108.00	21,303.15	226.14	18.00	244.14	**66.9%**
4.	IV	2.52	116.00	21,681.89	238.53	19.33	257.86	**70.6%**
5.	V	0.71	250.00	2,837.62	327.73	41.67	369.40	**101.2%**
6.	VI	0.98	138.00	7,117.60	212.52	23.00	235.52	**64.5%**

4.4 Capacity Assessment of Existing Facilities

The capacity of any existing port facilities depends on a combination of number of factors like the type of cargo handled, the DWT of the vessel, the vessel parcel size, the permissible berth occupancy, the type of handling facilities, the productivity of human resources both handling and managerial, the traditions and practices obtained etc., This being a complex matrix, the overall capacity of the existing port facilities is assessed as about 43 to 45 Million tonnes for the current cargo mix and infrastructure.

5.0 DETAILS OF ONGOING DEVELOPMENTS

5.1 General

VOC Port Trust has planned for various developmental projects which are in various stages of implementation to meet the port's traffic forecast from time to time. The locations of these projects in the layout of the existing harbour are indicated in **Figure 5.1**

Figure 5.1 Location of On Going Projects in VOCPT – As Per Current Plans

5.1.1 Development of North Cargo Berth II for Coal: 7.2 MTPA

The Concession Agreement with M/s. Tuticorin Coal Terminal Limited which is an SPV of ABG – LDA Bulk Handling Private limited entered on 11.09.2010 with revenue share of 52.17 %. The civil works for NCB II was commenced on 01.03.2012 with about 90% progress as on date. The three nos Gantry grab unloaders of 1800 TPH are in place. The conveyor system from berth to stack yard is to be installed. The installation of yard stacking and reclaiming equipment is taking place. It is understood that the concessionaire has sought time till end of July 2016 to complete construction phase. The terminal is expected to be commissioned during 2016-17..

5.1.2 Development of North Cargo Berth III for Coal: 9.15 MTPA

Concession Agreement was signed with M/s. Transstroy North Cargo Berth Pvt Ltd on 08.10.2013 with revenue share of 30%. Environmental clearance for the berth was received on 02.01.2015 with conditions. However, the agreement has since been cancelled and the port authority has already invited EOI, which is going to be followed by a tender to finalise a concessionaire.

5.1.3 Development of North Cargo Berth IV for Coal: 9.15 MTPA

Concession Agreement was signed with M/s. Transstroy North Cargo Berth India Pvt Ltd on 30.01.2013 with revenue share of 30%. Environmental clearance for the berth was received on 02.01.2015 with conditions. However the agreement has since been cancelled.

Port is planning to develop this berth as a container terminal for which EOI has already been invited.

5.1.4 Mechanization of Berth I-IV & IX: 8.72 MTPA (Addition)

Agreement was signed between the port and M/s IMC – PSTS Ltd on 25.03.2012 with revenue share of 26.55%. Also a concession agreement was signed with M/s CREW for mechanizing the unloading and conveying of coal and limestone in bulk from berth no. IX to the present multi-user coal stack yard (with a revenue share of 28%) and this is expected to be commissioned in 2016-17.

5.1.5 Development of Shallow Berth for Multipurpose Cargo : 2.67 MTPA

Concession Agreement was signed with M/s. Transstroy North Cargo Berth India Pvt Ltd on 17.04.2013 with revenue share of 22% for developing it as cement berth. Environmental clearance for the berth was received on 31.03.2014 with conditions. However the agreement has been cancelled and the project is expected to go through a process of retender for developing it as Multipurpose berth.

5.1.6 Development of Shallow Berth for Construction Materials: 2.0 MTPA

This project was tendered but not yet awarded. Presently the project is under litigation.

5.1.7 Rail Connectivity Projects

5.1.7.1 Port Marshalling Yard to Hare Island

For the evacuations of the bulk cargoes from the North Cargo Berths II, III and IV estimated around 25.3 MTPA stack yards are identified on Hare Island. Connectivity from Hare Island to Port Marshalling Yard is proposed and M/s. RITES Ltd was awarded for PMC on 17.08.2015.

5.1.7.2 Renovation of Existing Rail between Marshalling Yard to V.O.C Wharf

All the 5 tracks within the marshalling yard and near the berths I, II, III and IV upgradation was commenced on 20.04.2015. This upgradation also includes the siding into the stack yard near the green gate.

Apart from the above the port has upgraded the main connectivity road in the port into a four lane road recently

5.1.8 Road Connectivity Related Projects

5.1.8.1 Proposed Truck Parking Yard Adjacent to NH 7A

Outside the port limits adjacent to NH 7A opposite to Fisheries College a truck parking yard has been planned by the port trust. It is planned with 4.2 Ha for minimum of 200 trucks at a time as shown in **Figure 5.2**. It also comprises facilities like insurance agents, lorry booking offices, truck operator office, branches of corporate buildings etc. The land allotted for the parking is a low lying area approx. 3m down from adjoining road level with a 10m wide canal in between NH and the land. Since it is away from port limits the area is prone to encroachments. It has the advantage of being on the national highway. The basic development cost is studied by a third party consultant by the port to be 8.3 Cr INR and planned to develop on PPP mode. The total construction cost shall be about 24 Cr INR which includes RCC retaining wall, sand filling and consolidation, compound wall and fencing, 2 RCC bridge over canal and shifting of HT wire.

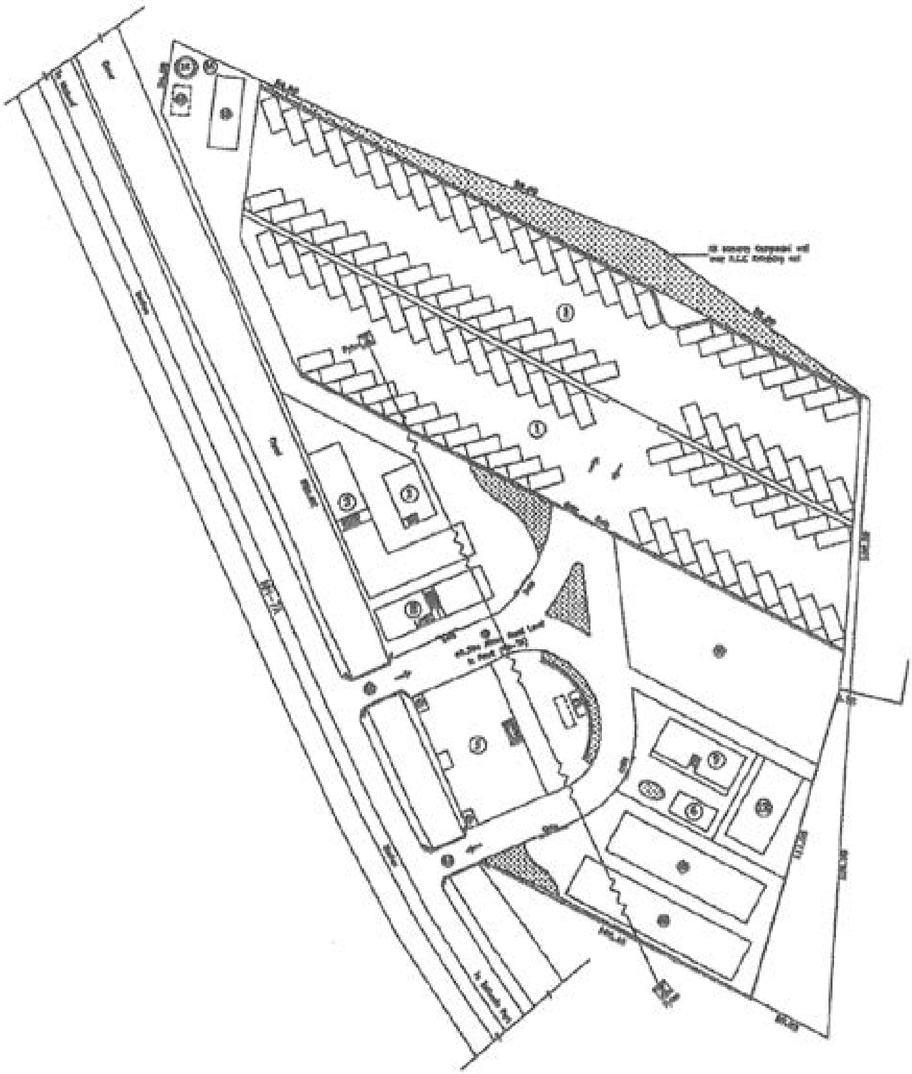


Figure 5.2 Proposed Truck Parking Yard Layout

5.1.8.2 Proposed Truck Parking Yard Adjacent to NH 7A

Within the port limits adjacent to VOC park lorry parking area is been proposed. The advantage of the location is it's near the intersection of harbour highway extension and VOC road. The total area allocated for parking yard is 23,750 m^2. The project has been awarded to M/s HPCL who will develop the yard with retail outlet as shown in **Figure 5.3**.

Figure 5.3 Proposed Parking Yard Near VOC Park

6.0 TRAFFIC PROJECTIONS

6.1 General

Tuticorin port is located in the southern part of Tamil Nadu and is the second biggest port in the state after Chennai. The port mainly handles containers, catering to the industrial regions in Central and Southern Tamil Nadu, and thermal coal for the power plants in the hinterland.

Tuticorin handled 32.5 MTPA of cargo traffic during year 2014-2015. Key commodities include thermal coal and containers. Thermal coal contributes ~42% to the total traffic while containers contribute another ~34%. Going forward, the total cargo is expected to increase to ~54 MTPA by 2020 and 75-83 MTPA by 2025.

The materialisation of projected traffic will however depend upon many factors such as growth of economy as assumed and certain specific events like installation of some of the power plants which are on the anvil. It can be seen that thermal coal and industrial coal imports constitute bulk of the cargoes. The trend in historical traffic at Tuticorin and the traffic forecast is shown below.

The origin-destination of key cargo (accounting for greater than 85% of the total traffic) for all Indian ports and development of traffic scenarios for a period of next 20 years has been carried out by **McKinsey & Co.** as mandated for this project. Accordingly, based on a macro-level analysis the future traffic for Tuticorin up to 2035 has be derived as presented in this section.

The trend in historical traffic at Tuticorin can be seen in **Figure 6.1** and the traffic forecast for VOCPT is shown in **Figure 6.2**.

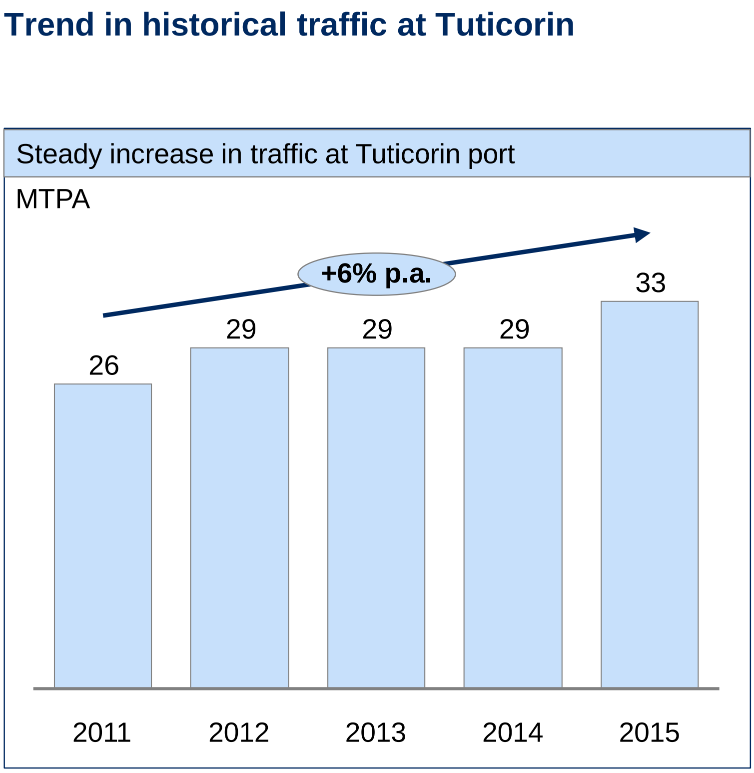


Figure 6.1 Historical Traffic Trend - Tuticorin

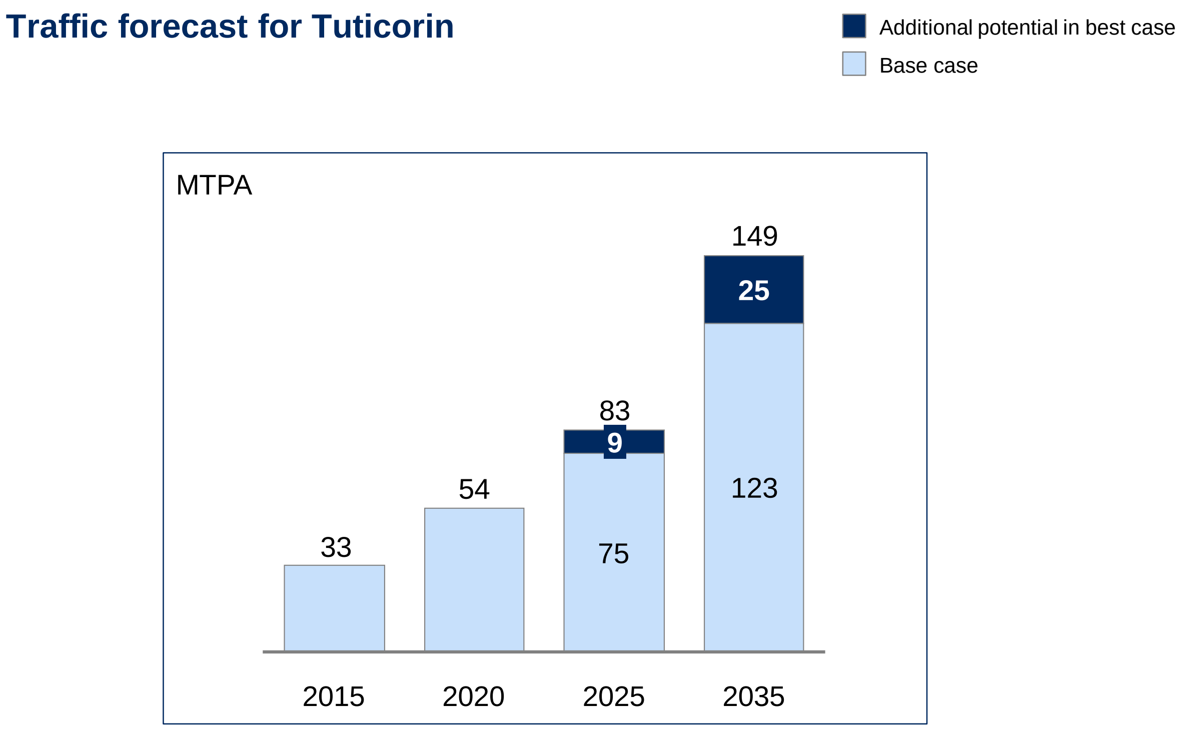


Figure 6.2 Traffic Forecast – VOCPT

6.1.1 Major Commodities and their Projections

Although there are a number of bulk cargoes that are handled through the port, the majority of those bulk cargoes as listed below are identified for handling through mechanized methods. They are also the most enduring part of the cargoes of port. All of them are import cargoes and has potential to generate dust during handling hence, prone to cause pollution when handled through semi-mechanized methods.

They consist of –

- Thermal Coal
- Industrial coal
- Copper Concentrate
- Pet Coke
- Limestone

Coal of all types is classified as one cargo and copper concentrate is included in other ores.

6.2 Bulk Cargoes - Handled by Fully Mechanized Systems

6.2.1 Thermal Coal

Thermal coal imports through VOC Port can be classified as –

§ Thermal coal meant for captive users

§ Thermal coal meant for others

The thermal coal meant for captive users form the major quantity which consists of coal meant for TNEB Power plant and NTPL power plant both of which are handled through captive jetties and though conveyors.

In addition thermal coal meant for M/s. Coastal Energen (whose plant is located at about 30 km from port) whose first of the two units each of 600 MW was commissioned in 2014-15 and coal meant for 160 MW power plant of M/s Sterlite Industries which are handled by semi-mechanised methods through multipurpose berths can also called as captive thermal coal for the port.

Further M/s SEPC is putting up a 525 MW power plant close to the port in the Harbour estate itself and this is expected to go to operation near future. The thermal coal import on account of this will also be captive coal for the port.

The above account most of the total thermal coal imports through the port.

Currently, the port imports 13.8 MTPA of thermal coal primarily for the consumption of power plants. Out of this, 4.4 MTPA is coastally shipped coal for Tuticorin thermal power plant. 9.3 MTPA is imported coal catering to Tuticorin thermal power plant, Coastal Energen, Ind Bharath power plant, DCW, Sterlite, NTPL and other non-power customers. With the power sector growing resulting in higher PLFs, and the new capacity expected to come up around Tuticorin, along with import substitution on the back of rising domestic coal production, thermal coal imports can reach ~27 MTPA by 2020 and 38-42 MTPA by 2025. The plant wise projected thermal coal traffic through Tuticorin is as shown in **Figure 6.3**.

Thermal coal volumes

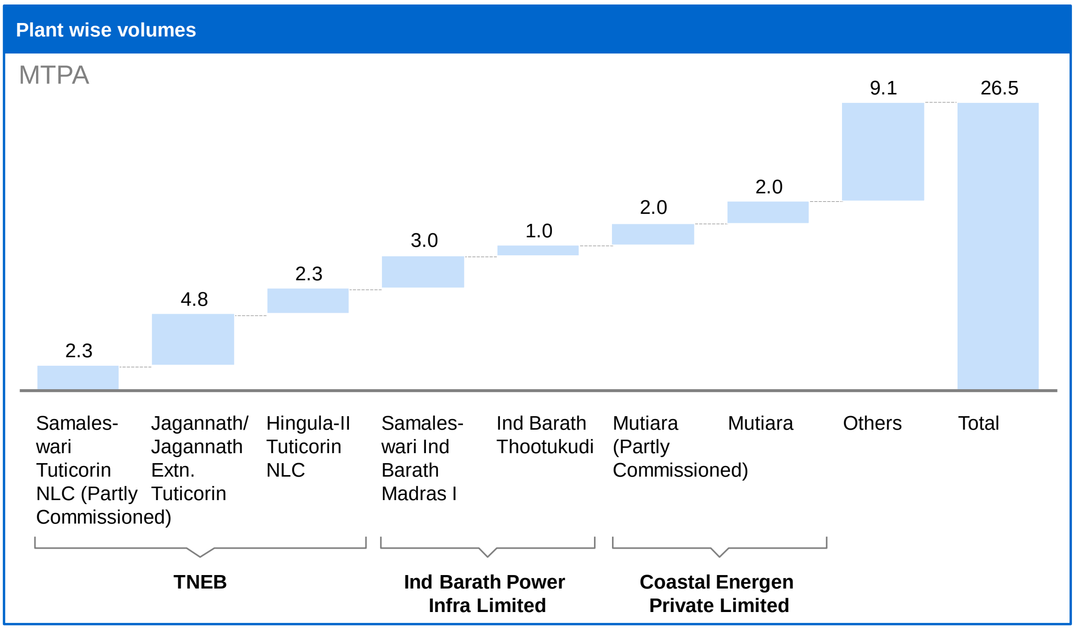


Figure 6.3 Plant Wise Project Thermal Coal Traffic for VOC Port

6.2.2 Copper Concentrate

It is a captive cargo of the port as it is imported as raw material for the use of nearby Sterlite copper. The annual throughput requirement of Copper concentrate is 1.2 MTPA and is nearly a fixed quantity for now as it is dependent of the capacity of this particular industry.

6.2.3 Industrial Coal

VOC Port has emerged as preferred port in the region for import of industrial coal meant for cement plants, paper industry, Foundries etc. with increasing throughputs over the years.

6.2.4 Pet Coke

Petroleum coke mainly used by Aluminium and anode making industries is imported through the port. Though its quantity is not very large has reasonable volume.

6.2.5 Lime Stone

Lime stone has of late emerged as a sizeable bulk cargo basically imported by cement industry.

The projections for commodities like iron-ore, limestone and other ores in the base case scenario has been arrived at by taking a GDP multiplier of 1.14 and an estimated growth rate of 5.88%. In the optimistic scenario, same GDP multiplier and an estimated GDP growth rate of 7% has been assumed.

6.2.6 Traffic Pattern of Coal of Different types

The traffic pattern of Coal of different types coal and Pet coke for the last 3 years is as below in **Table 6.1**.

Table 6.1 Traffic Pattern of Coal Traffic for Last 3 Years

S. No.	Cargo	2012-13	2013-14	2014-15
1.	Thermal Coal	66,60,692	66,43,688	86,12,589
2.	Industrial Coal	39,57,099	55,03,190	51,91,288
3.	Pet Coke	68,299	2,02,387	2,12,482
	Total	**1,06,86,090**	**1,23,49,265**	**1,40,16,359**

In addition Limestone is emerging as a major bulk over the years. The traffic projections for coal for the Master plan period are consistently increasing and large as can be seen in **Table 6.2**. The traffic for 2015-16 is based on port's estimates, while the projections for 2020, 2025 and 2035 are as per origin and destination study for ocean bound traffic of all the major ports as part of this master plan by M/s Mckinsey.

Table 6.2 Traffic Projection of Major Bulk Cargoes Over Master Plan Period (in MT)

S. No.	Cargo	2015-16	2020-21	2025-26		2035-36	
				Base Scenario	Optimistic Scenario	Base Scenario	Optimistic Scenario
1.	Coal of All Types	17.1	26.6	38.3	42.3	63.4	75.8
2.	Limestone	1.1	1.1	1.5	1.6	2.7	3.1
3.	Copper Concentrate	1.2	1.2	1.2	1.2	1.2	1.2
	Total	**18.4**	**28.9**	**41.0**	**45.1**	**67.3**	**80.1**

6.3 Containers

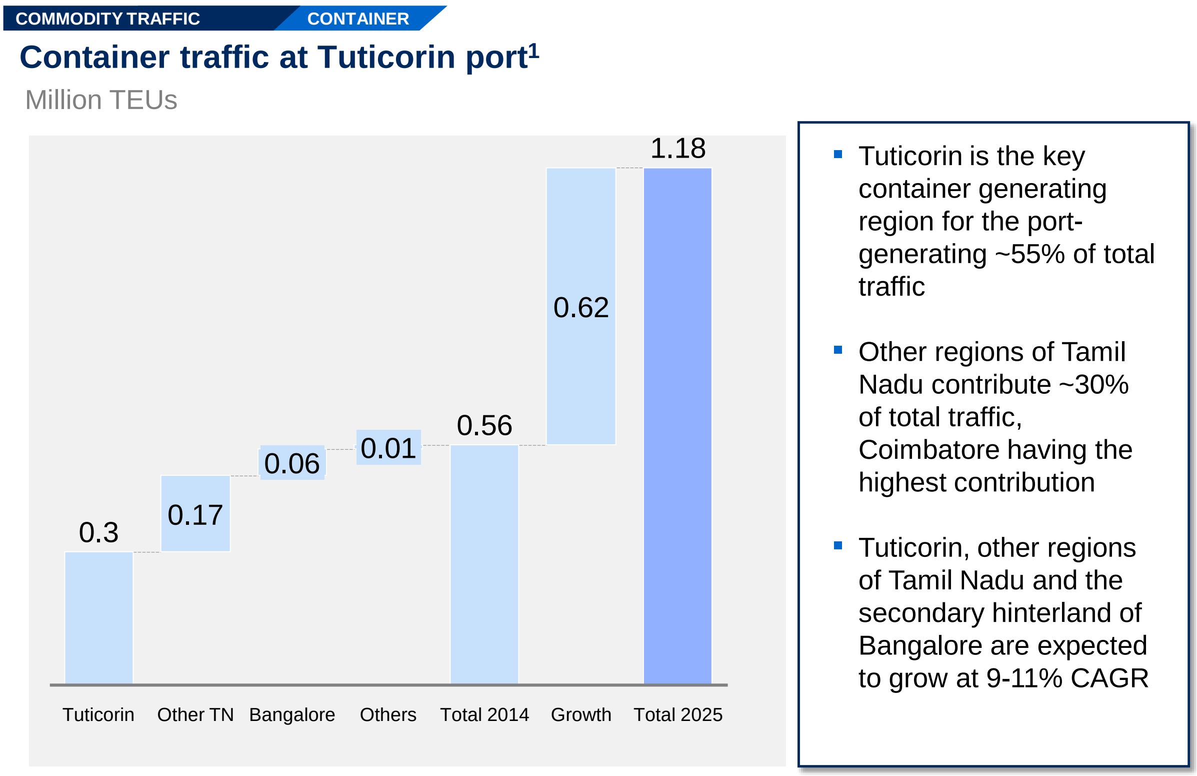
The port primarily caters to industrial districts of Southern and Central Tamil Nadu – Salem, Mettur, Namakkal, Karur, Coimbatore, Tuticorin, and also some parts of Karnataka. Currently the port handles 0.56 Mn TEUs of containers. Tuticorin generates ~55% of the container cargo for the port. Tuticorin, other regions of Tamil Nadu and the secondary hinterland of Bangalore are expected to grow at 9-11% GDP CAGR. Industrial activity is expected to increase at a healthy rate in Tamil Nadu, and the container volumes is expected to touch 0.99 Mn TEUs and 1.18-1.45 Mn TEUs by 2020 & 2025 respectively. For the projections till 2025, it is estimated that the GDP of above mentioned hinterland are expected to grow at 9% CAGR in the base case and 11% CAGR in the optimistic case. Post 2025 till 2035, growth rate of 5% in projected volume has been assumed in the base case and 6% in the optimistic case.

Tuticorin port is a feeder port and the containers are transhipped at international locations like Colombo and Singapore. If a transhipment port comes up at the southern tip of India, it can severely impact of the container volumes at Tuticorin as part of the cargo would directly go to the transhipment port via road. The evolution of container traffic through the port for the last five years is presented in **Table 6.3**.

Table 6.3 Container Traffic in VOCPT During the Last Five Years

Description	2010-11	2011-12	2012-13	2013-14	2014-15
No. of Vessels Handled	NA	365	351	399	491
Import TEUS.	2,26,230	2,31,457	2,34,098	2,51,038	2,88,503
Export TEUS.	2,41,522	2,45,639	2,41,501	2,56,697	2,71,224
Total TEUs	**4,67,752**	**4,77,096**	**4,75,599**	**5,07,735**	**5,59,727**

It can be seen that the increasing trend in container traffic through the port has been consistent and robust. **Figure 6.4, Figure 6.5** & **Figure 6.6** exhibits show the split of cargo from the different hinterlands and the projected traffic growth.



1 Due to the development of transshipment hub at Enayam, part of the traffic from Coimbatore, Namakkal, Madurai will directly go to Enayam via road hence diverting traffic away from VOC port

SOURCE: APMT; India Port Statistics, Expert interviews

Figure 6.4 Container Traffic – VOC Port

COMMODITY TRAFFIC | CONTAINER

Tamil Nadu is the primary hinterland of Tuticorin port with small traffic from Bangalore

Primary hinterland of port

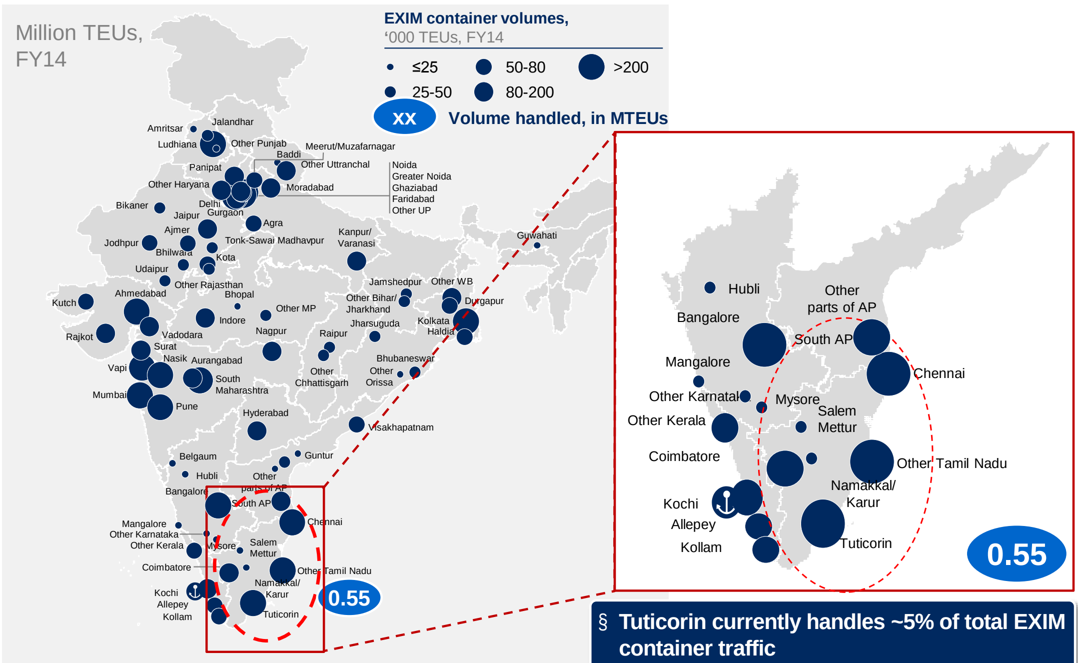
EXIM container volumes, '000 TEUs, FY14	JNPT	Mundra	Chennai	Pipavav	Tuticorin	Haldia	Cochin	Visakhapatnam	Mangalore
NCR+Punjab	936	1,264	0	329	0	0	0	0	0
Maharashtra	2,121	54	0	0	0	0	0	0	0
Tamil Nadu	0	0	1,240	0	484	0	0	0	0
Gujarat	552	262	0	169	0	0	0	0	0
Uttar Pradesh	228	274	0	107	0	0	0	0	0
West Bengal	0	0	0	0	0	458	0	0	0
Rajasthan	43	448	0	60	0	0	0	0	0
Karnataka	94	0	163	0	66	0	0	0	50
Kerala	0	0	0	0	0	0	351	0	0
Andhra Pradesh	75	0	65	0	0	0	0	110	0
Madhya Pradesh	43	70	0	14	0	0	0	29	0
Bihar/Jharkhand	0	0	0	0	0	85	0	8	0
Uttaranchal	95	0	0	0	0	0	0	0	0
Orissa	0	0	0	0	0	12	0	69	0
Chhatisgarh	15	18	0	14	0	0	0	15	0
North East	0	0	0	0	0	7	0	0	0
Port total	4,202	2,390	1,468	693	551	562	351	263	50

SOURCE: APMT; Expert interviews

Figure 6.5 VOC Port Hinterland

COMMODITY TRAFFIC | CONTAINER

EXIM container generating hinterlands for Tuticorin port



- Tuticorin currently handles ~5% of total EXIM container traffic
- Almost all of the traffic gets transshipped

SOURCE: APMT; IPA statistics; Stakeholder interviews

Figure 6.6 EXIM Container Hinterland – VOC Port

6.4 Break Bulk Cargo

The traffic data pertaining to General/Break Bulk Cargo for the last 5 years is furnished in **Table 6.4**.

Table 6.4 General Cargo - Imports & Exports - During Last Five Years

S. No	COMMODITY	2010-11	2011-12	2012-13	2013-14	2014-15
IMPORT (MTPA)						
1.	Fertilizer	1.16	1.11	0.49	0.39	0.42
2.	F.R. Materials	0.73	0.89	0.56	0.79	1.05
3.	General Cargo	2.49	2.56	2.88	2.06	2.76
4.	Other General Cargo	1.36	1.22	0.55	0.56	0.25
	Total Imports	**5.74**	**5.78**	**4.48**	**3.8**	**4.48**
EXPORT (MTPA)						
1.	Dry Cargoes	0.72	0.43	0.46	0.48	0.3
2.	Liquid Cargoes	0.54	0.47	0.7	0.55	0.4
3.	Food Grains	0.04	0.3	0.13	0.05	0.06
4.	General Cargo	1.05	1.06	0.95	0.34	0.96
5.	Other General Cargo	0.06	0.15	0.27	0.01	0.06
	Total Export	**2.41**	**2.41**	**2.51**	**1.43**	**1.78**
Breakbulk Cargo – Total Import & Export		**8.15**	**8.19**	**6.99**	**5.23**	**6.26**

6.4.1 Imports

The import of fertilizer is mainly import of Urea, MOP and DAP. The fertilizer raw materials imports mainly are sulphur and rock phosphate. The general cargo under imports includes copper concentrate whose volume is about 1.2 MTPA during 2014-15. Import under the head general cargo and other general cargo includes the following.

- Limestone
- Gypsum
- Cashew nuts
- Timber
- Iron and steel materials
- Palm Oil
- Caustic soda lye.
- Vinyl Chloride monomer (VCM)
- Others

Limestone imports alone constitute about 0.8 MT during 2014-15. Palm oil imports during the same period is about 0.3 MT. Timber in log form constitutes about 0.5 MT. VCM, Caustic soda Lye and peas (yellow) have a quantity of about 0.1 Million each. The rest are highly fragmented. VCM is handled through Shallow berth I as the pipe line for this cargo is located in that berth.

6.4.2 Exports

The general cargoes and other general cargoes under exports include

- Construction materials for Maldives
- Cement mainly for Maldives
- Granite
- Stone dust
- Oil cake and Copra
- others

The exports of construction materials and cement to Maldives have a quantity of about 0.4 MT which are handled through shallow berths. The rest are highly fragmented.

6.4.3 General Cargo – Traffic Projections

The traffic projection by M/s McKinsey in respect of General cargo is presented in Table 6.6. They include some dry cargoes in bulk like fertilizers, Copper concentrate in the figures for 2014-15.

Table 6.5 Dry and Break Bulk Cargo (To be Handled in Multipurpose Berths)

Commodity	Current 2014-15	2020-21	2025-26		2035-36	
			Base	Optimistic	Base	Optimistic
Iron Ore	0.05	0.06	0.08	0.09	0.14	0.17
Other Ore	Nil	1.7	2.2	2.3	3.7	4.2
Fertilizers	1.5	1.6	2	2.1	3.1	3.4
Others	3.5	4.4	5.9	6.2	9.7	11.1
Total (MTPA)	**5.05**	**7.76**	**10.18**	**10.69**	**16.64**	**18.87**

This **Figure 6.7** summarizes the traffic potential for key commodities for Tuticorin port.

Units: MMTPA (except Containers)

Tuticorin Port - Traffic Projections

xx Base Scenario | xx Optimistic Scenario

Commodity	2014-15	2020	2025 (Base)	2025 (Optimistic)	2035 (Base)	2035 (Optimistic)	Remarks
Liquid Cargo							
POL	0.6	0.8	1.3	1.8	2.0	2.5	
Dry and Break Bulk Cargo							
Thermal Coal (Loading)	0.0	0.0	0.0	0.0	0.0	0.0	
Thermal Coal (Unloading)	13.8	26.5	38.3	42.3	63.4	75.8	▪ Increase in coastal shipping
Coking Coal	0.0	0.0	0.0	0.0	0.0	0.0	
Iron Ore	0.05	0.06	0.08	0.09	0.14	0.17	▪ Mostly imports
Limestone	0.8	1.1	1.5	1.6	2.7	3.1	
Other Ore	1.2	1.7	2.2	2.3	3.7	4.2	
Fertilizers	1.5	1.6	2.0	2.1	3.1	3.4	
Containers and other Cargo							
Containers (MnTEU)*	0.56	0.99	1.18	1.45	1.95	2.44	▪ Traffic projections for the port may reduce post development of transshipment hub in Enayam
Others	3.5	4.4	5.9	6.2	9.7	11.1	▪ Highly fragmented, no particular commodity with significant volume
Total (MMTPA)	**32.5**	**55.7**	**74.5**	**85.0**	**123.2**	**148.6**	

* Due to the development of transshipment hub at Enayam, part of the traffic from Coimbatore, Namakkal, Madurai will directly go to Enayam via road hence diverting traffic away from VOC port

Conversion Factor Used for Containers Projections: 1 TEU = 19.7 Tons

Figure 6.7 VOC Port Traffic Projection

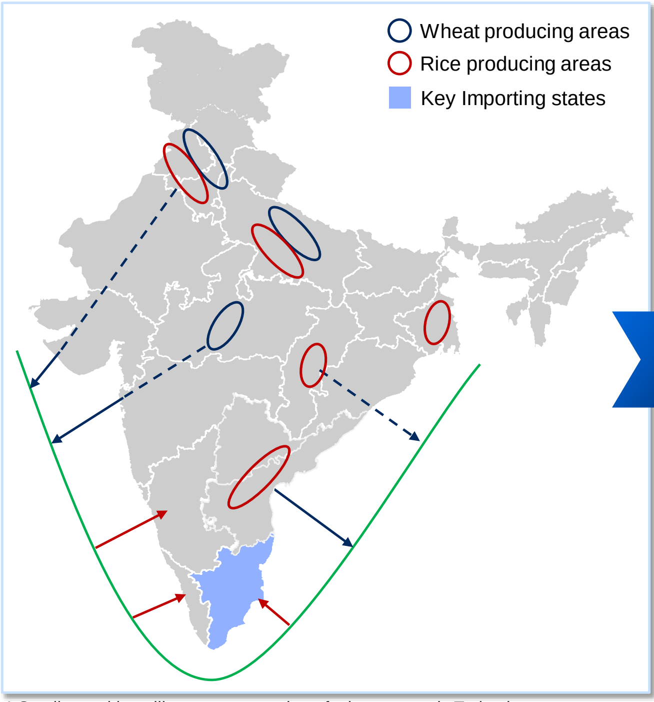
6.4.3.1 Coastal Shipping Potential

Apart from the above mentioned traffic, there is additional opportunity of coastal shipping that can be potentially tapped. Food grains provide a significant opportunity with small volumes possible for other commodities as well.

Food grains: ~1-2 MTPA of food grains can be coastally shipped to Tuticorin port by 2025 from Andhra Pradesh, Madhya Pradesh, Punjab and Haryana as shown in **Figure 6.8**.

COASTAL SHIPPING FOODGRAINS

~1-2 MTPA of food grains can be coastally shipped to Tuticorin Port by 2025



1 Small quantities will move on a number of other routes via Tuticorin port

Key ODs with coastal shipping potential to Tuticorin Port

Route[1]	Volume, '000 TPA
Andhra Pradesh to Tamil Nadu	536
Madhya Pradesh to Tamil Nadu	343
Punjab to Tamil Nadu	190
Haryana to Tamil Nadu	171

Figure 6.8 Coastal Traffic Hinterland – VOC Port

Figure 6.9 summarizes the potential of coastal movement for key commodities.

Tuticorin Port – New Opportunities Possible via Coastal Shipping

Units: MM TPA (except Containers)

Commodity	2020	2025	2035
Steel (Loading)	-	-	-
Steel (Unloading)	0.40	0.54	0.96
Cement (Loading)	-	-	-
Cement (Unloading)	0.44	0.59	1.06
Fertilizer (Loading)	0.57	0.70	1.03
Fertilizer (Unloading)	0.02	0.03	0.04
Food Grains (Loading)	0.01	0.01	0.02
Food Grains (Unloading)	1.27	1.54	2.28

Figure 6.9 Coastal Traffic Possibilities – VOC Port

7.0 CAPACITY AUGMENTATION REQUIRMENTS

7.1 General

The capacity augmentation requirement shall be based on the difference between the project traffic for the particular commodity and the capacity of the port available (after debottlenecking and physical improvements) for handling that particular commodity. The capacity assessment of the existing / planned for various cargos like coal, containers and breakbulk has been carried out as below:

7.2 Coal Handling Facilities

7.2.1 Type of Present Facilities for Coal handling

For the purpose of the present analysis, coal may be broadly segregated as thermal coal meant for power plants of TNEB & NTPL which is handled through conveyors and remaining coal.

7.2.1.1 Thermal Coal for TNEB & NTPL Power Plants

This thermal coal is unloaded in bulk and conveyed direct to the power plants in the vicinity through conveyor systems without any transit stack yard.

The thermal coal under this head is entirely for the Power plants of TNEB and NTPL. For handling this traffic there are three dedicated jetties. Of them Coal jetty 1 and Coal jetty 2 together handle about 6.3 MTPA feeding to the 1050 MW Power plant of TNEB. The jetty NCB 1 handles coal meant for NTPL power plant of 1000 MW Capacity. Of these two power plants, while the TNEB power plant has been in operation for a long time, the NTPL power plant commissioned during 2014-15, is new one and is yet to work to its full capacity.

7.2.1.2 Coal – Others

This consists of thermal coal meant for private power plants, industrial coal for cement plants, paper industry etc., This coal is handled in multi-cargo berths located on the south side. It is unloaded by ship gear/shore electric cranes /Harbour mobile cranes and transported by dumpers to stack yards and is stacked by semi-mechanised methods. It is similarly loaded out of stackyards and evacuated through dumper Lorries.

7.2.2 Rationalisation of Berths Handling Coal for TNEB Power Plant

The thermal coal for TNEB power plant is handled through two captive coal jetties CJ1 & CJ2 with each handling about 3 to 3.3 MTPA. The coal jetties CJ1 & CJ2 commissioned during 1983 and 1995 respectively were originally designed to handle handy/handymax vessels. Subsequently they have been deepened to a dredged depth of 14.1 m, adequate to handle Panamax vessels with a loaded draft of 12.8 m. But the two jetties have no onshore equipment to handle gearless vessels.

In both jetties the unloading of coal is done by ship bound cranes with grabs discharging into hoppers on the jetty from where the coal is conveyed by belt conveyors. The two jetties CJ1 & CJ2 are equipped with two independent conveyor systems each leading to the same power plant and both the conveyor systems have a designed capacity of 2000 TPH.

While the conveyor systems have a designed capacity of 2000 TPH, the average and maximum unloading rate per jetty was about 12,300 TPD and 17,500 TPD respectively. The berth occupancy was about 73% in 2014-15, which was the best over the years.

During 2014-15, the jetties CJ1 & CJ2 have handled a total quantity of 6.69 MT the highest so far with an average parcel size of 47,250 T. While each coal jetty is equipped with conveyors to transfer coal with a capacity of 2000 TPH, they actually handle an average of 12,300 TPD which roughly means about 500 TPH plus. This is due to the fact that the jetties handle mostly handy/ handymax vessels and few Panamax vessels and have no on-shore unloading equipment and unloading is done by ship's cranes which have limited capacity.

7.2.3 Upgradation of CJ2 Initially

While the captive coal jetties CJ1 & CJ2 were constructed by the port authority, the top side facilities consisting of shore hoppers and conveyor system are installed and operated by the captive user viz. TNEB. The thermal coal imported through these two jetties is meant for their "Tuticorin Thermal Power Plant" (TTPS) which has a capacity of 1050 MW.

It is envisaged that the coal now being imported through two jetties CJ1 & CJ2 may be imported by using just one jetty viz. CJ2. This would involve the following.

§ Upgrading of coal jetty CJ2 to handle Panamax vessels with construction of a new coal jetty of about 25 m width and about 300 m length for which purpose enough space is available.

§ Equipping the new jetty with two shore unloaders each of 2000 TPH capacity.

§ Modifying the existing conveyor system to upgrade its capacity from the present 2000 TPH capacity to 4000 TPH capacity. This will involve changing of drives and conveyor belt with the rest of the conveyor system intact. This is technically feasible as the existing Coal conveyor with a width of 1800 mm running at a speed of 2.5 m/s needs to be modified to run at 4.2 m/s. This would also require change of conveyor belt to take care of the increased starting and running tensions consequent to increased capacity.

It may be noted that this jetty area already has adequate dredged depth of (-)14.1 m and hence no further expenditure on dredging is involved.

7.2.3.1 Benefits

To the Port:

- The port will be able to handle entire 6.2 to 6.5 MT of thermal coal required for TNEB power plant with just one jetty and the second jetty will be available for other developments.
- The port will be able to make full use of the existing depth of 14.1 m and handle gearless Panamax vessels with a draft of 12.8 m.
- The number of vessel movements will get reduced.

To the TNEB:

- There will be a saving of about Rs 75/- per T or even more on ocean freight for TNEB due to handling fully loaded Panamax vessels (subject to further deepening of harbour).
- Only one conveyor needs to be operated and maintained instead of two now, saving in operation and maintenance cost and effort.
- The modifications to be made for conveyors are simple and not very expensive.

Common Benefit to Both Port and TNEB:

The requirement of TNEB power plant may be of the order of 6.5 MT per annum (depending on grade of coal and number of power plant utilisation days). But the actual capacity of this jetty after the proposed construction will be 8 to 8.5 MT. As such there will be a spare capacity of about 1.5 to 2 MT which can be used by port for other users. This would however require an arrangement between port and TNEB and a take-off conveyor from the TNEB conveyor junction house to a stackyard in Hare Island. This will enable additional revenue for both.

7.2.4 Constructing New Coal Berth at CJ1

With modifications proposed to CJ2 by way of constructing a new berth in front of existing jetty and equipping it with two unloaders each of 2000 TPH, then that single jetty will be adequate to handle the entire coal requirement of TNEB for the present plant. If the port authority can take up construction of similar new jetty at CJ1 for handling fully loaded Panamax vessels, then it will have a similar capacity of 8 to 8.5 MT. This would however require mutual understanding between Port authority and TNEB.

7.2.5 Limitations of Proposals

The above proposals viz., construction of new berthing structures in front of the existing CJ1 and CJ2 and equipping them with on shore unloaders have the following implications.

- Construction of new berthing structures in front of the existing CJ1 and CJ2 will have a cost implication of Rs 100 Crores each. The length of berthing structure may be limited to about 200 m sufficient to cater to the span of hatches of a Panamax vessel which is of the order of 165 m. The possibility of using the existing mooring structures while handling a fully loaded panamax vessel need to be examined.

- The TNEB has to be persuaded and convinced of the benefits that will accrue to them by way of savings in ocean freight and operating and maintaining only one conveyor instead of two as at present. The TNEB has to come forward to make a capital investment towards the cost of two Gantry grab unloaders, providing HT power supply required for operation of gantry grab unloaders and modifications to increase the speed of the conveyors which will all cost about Rs 120 Crores. They may also have to invest on certain other replacements like crushers and stacking equipment at the power plant end.

- During the intervening period of when such modifications and construction of new berth structure are taken up, the TNEB has to have a contingency plan by way of handling their coal requirement through the second jetty and the remaining from NCB1 with provision of an interconnecting conveyor system between NTPL and TNEB conveyors.

7.2.6 NCB 1 – Utilisation of its Full Capacity

The 1000 MW capacity NTPL power plant consists of two units each of 500 MW. Of them the first unit was commissioned in June 2015 and the second unit in august 2015. The estimated coal requirement for NTPL is about 6 MT and this will be exclusively handled in NCB 1 which is a captive berth for NPTL. This is a new berth constructed by NTPL in which coal meant for their 1000 MW power plant is directly led through an exclusive conveyor from berth to power plant.

Presently the berth has a depth of 14.1 m and is capable of handling panamax vessels with a draft of 12.8 m.

The berth is equipped with two gantry grab unloaders each of 2000 TPH capacity. Technically this berth has a capacity of 8 to 8.5 MT. Against this the actual requirement of NTPL is only 6 MT, thus leaving a spare capacity of 2 to 2.5 MT. The port and NTPL may jointly evolve a strategy to utilise the spare capacity of this berth by way of putting up a take-off conveyor from the transfer tower near the port boundary. This may bring additional revenue to both Port and NTPL.

7.2.7 NCB II under Construction

The port is developing NCB 2 under DBFOT basis for handling coal and other bulk cargoes for which it has entered into a concession agreement with Tuticorin Coal terminals Pvt Ltd(TCTPL) a subsidiary of ABG Infralogistics group (with a revenue share of 52.17 per cent). This work awarded in 2010 is in an advanced stage of construction. It consists of a berth of 306 m length and 22.9 m width, is located adjacent to NCB I and designed to handle fully loaded Panamax vessels. The berth is being equipped with 3 no of gantry grab unloaders each having a capacity of 1800 TPH and mounted on 18 m gauge rails. The two conveyors from berth to stack yard have a belt width of 1600 mm each. The stackyard equipped with stackers is located in the Hare Island. The port's assessed capacity of this terminal is 7 MTPA. This terminal is likely to be commissioned in 2016.

7.2.8 Construction of North Cargo Berths III

The port has plans to award NCB3 berth on DBFOT basis to a concessionaire. The berth is planned to handle about 9 MTPA of coal.

7.2.9 Capacity Assessment of Bulk Cargo Handling

7.2.9.1 Scenario 1

This is an optimistic scenario with berths NCB III and NCB IV as planned earlier, with reconstruction of CJ1 and CJ2 as now proposed and on an assumption that TNEB and NTPL will be agreeing to operate these berths to their full capacity and share with port. The detailed scenario is presented below in **Table 7.1**.

Table 7.1 Existing Harbour- Capacity of Bulk Cargo Berths When Fully Developed

S. No.	Berth	Capacity (MT)	Remarks
1.	CJ1	8	These two jetties were constructed by port and are for captive use of TNEB. They now have a combined capacity of 6.5 MTPA. The jetties were constructed by port. The actual requirement of TNEB is limited to 6.5 MT per annum totally. The capacity indicated is after their reconstruction and with provision of unloaders.
2.	CJ2	8	
3.	NCB1	8	The actual capacity requirement of NTPL (for whom this a captive berth) is 6.0 MTPA. Hence there will be a surplus capacity. The guaranteed throughput for this berth is 4.00 MTPA.
4.	NCB2	7	This is a BOT berth under construction meant for multiple users. The guaranteed through put for this berth is 4.00 MTPA
5.	NCB3	9	This is expected to be a BOT berth meant for multiple users. The guaranteed throughput for this berth is expected to be fixed as 4.00 MTPA
6.	Berth 9	6	With mechanization of this berth with Harbour Mobile cranes and conveyors for which BOT agreement was already entered into and expected to be completed in 2016-17
	Total	**46**	

The projected traffic for 2025 for bulk cargoes consisting of Coal of all types, copper concentrate, Limestone and also Rock Phosphate is 42 MTPA and 46 MTPA for base and optimistic scenarios respectively. The facilities proposed in the Master plan as above therefore adequately takes care of the projected traffic up to 2025 beyond which the port has to expand to outer harbour.

7.2.9.2 Scenario 2

This is a scenario which envisages that the projected traffic will materialise and is another type of optimistic scenario, but with the following riders.

§ That TNEB will not come forward to upgrade their handling facilities to handle their entire cargo requirement from one jetty and instead would like to continue with the present arrangement of two jetties CJ1 & CJ2. Hence their combined capacity will be limited to 6.5 MTPA which is the requirement of TNEB.

§ NCB1 being a captive berth of NTPL will operate only to their requirement. Hence its capacity will be limited to 6 MTPA.

§ That the NCB 2 will operate to its full capacity and there will be enough cargo generated and that the bulk and dusty import cargoes from existing multipurpose berths will be shifted to this berth.

§ That the mechanization of berth 9 now on way will be completed and will operate to its capacity.

In this scenario the capacity of bulk cargo handling berths in the existing harbour will be as given in **Table 7.2**.

Table 7.2 Existing Harbour - Capacity of Bulk Cargo Berths When Fully Developed-Scenario 2

S. No.	Berth	Capacity (MT)	Remarks
1.	CJ1	6.5	It is assumed that TNEB will continue with the present system and there will be no reconstruction of CJ1 & CJ2
2.	CJ2		
3.	NCB1	6	NTPL will operate this captive berth to its capacity which is their plant's requirement as well
4.	NCB2	7	The berth will operate to its capacity for multiple users and traffic will materialise.
5.	NCB3	9	This is expected to be a BOT berth meant for multiple users.
7.	Berth 9	6	With mechanization of unloading, conveying and stacking now taken up on BOT basis
	Total	**34.5**	

7.2.9.3 Preferred Scenario for Planning

The preferred scenario for this master planning is scenario 2. Based on this the traffic projections of bulk cargoes up to 2025-26 can be handled in inner harbour. This includes coal of all types, Limestone and copper concentrate.

Beyond this, the facilities for handling of bulk cargoes, more particularly coal will have to be created in the outer harbour. As such construction of outer harbour beyond 2025-26 is imperative. This also envisages development of bulk cargo berths on the northern side of outer harbour and the berths will be developed to handle mini cape size vessels (draft of 16 m). Initially two bulk cargo berths mainly for handling coal of all types will be developed and each berth will have a capacity of 10 MTPA. There will be two closed conveyors each of a capacity of 5000 TPH and will be fed by two unloaders each having a capacity of 2500 TPH. In the second stage of outer harbour development for bulk cargoes, two more berths will be added.

The coal will be received and stockpiled in the Hare Island for NCB III and evacuated through railway system proposed for connecting the Hare Island. For handling the projected traffic of 2035, more bulk coal unloading berths in the outer harbour have to be developed with similar connectivity closed conveyor system. The stackyard area at this stage will be located at the reclaimed area of Hare Island.

7.3 Container Handling

7.3.1 Berth VII

This berth was given on BOT basis to M/s Tuticorin Container Terminals Pvt Ltd., jointly promoted by PSA international and SICAL. The berth has a length of 370 m and a depth of 11.9 m with a backup area of 10 acres. The berth is equipped with 3 container Quay cranes and the capacity of the terminal is about 0.45 Million TEU.

7.3.2 Berth VIII

This berth was given to Dakshin Bharat Gateway Terminal (DBGT) a subsidiary of ABG Container Handling Private Limited. The berth though formally started operations during May 2014 is not yet equipped fully. The terminal is expected to shortly receive its 64 T capacity container quay cranes with 47 m outreach, and when fully developed will have a capacity of 0.6 Million TEUs.

7.4 Break Bulk Cargo

7.4.1 Based on Present Handling

During the year 2014-15, of the total port traffic of 31.3 MT, 11.03 MT is the share of container and 6.24 MT is thermal coal handled in the captive jetties on the north. The remaining 13.4 MT of cargo is handled in the multipurpose berths on the south side of harbour basin viz., in berth no 1 to 6, the shallow berths, the E Arm and berth IX. A small part of this was also handled in container berth no VIII whenever it was free. Also a small quantity is handled through lighterage operations.

Of this 13.4 MT, the Industrial coal, pet coke and thermal coal for private power plants account for 5.24 MT, copper concentrate another 1.13 MT, Limestone a quantity of 0.8 MT all these totalling to 7.17 MT.

Table 7.3 further illustrates the quantity handled by multipurpose berths I to VI and their berth occupancy during 2014-15. It can be seen that the quantity handled is 7.72 MT. Therefore it can be taken that the berth IX, the E arm and the shallow berth and lighterage operations have together handled 5.68 Million tons.

Table 7.3 Multipurpose Berths I – VI Performance

S. No.	Berth	Total Cargo Handled (MT)	Total No. of Ships	Avg Parcel Size (T)	Standard Berth Days	Berthing/ De-Berthing Days	Total Berth Days	Berth Occupancy (%)
1.	I	0.48	131.00	3,634.80	207.35	21.83	229.19	**62.8%**
2.	II	0.73	119.00	6,140.26	190.13	19.83	209.96	**57.5%**
3.	III	2.30	108.00	21,303.15	226.14	18.00	244.14	**66.9%**
4.	IV	2.52	116.00	21,681.89	238.53	19.33	257.86	**70.6%**
5.	V	0.71	250.00	2,837.62	327.73	41.67	369.40	**101.2%**
6.	VI	0.98	138.00	7,117.60	212.52	23.00	235.52	**64.5%**

The quantity of 7.78 MT handled includes copper concentrate, lime stone and industrial coal whose total quantity is assessed as about 4 Millions. This master plan envisages handling of all copper concentrate, limestone, thermal coal for private users, all industrial coal, pet coke through the mechanized bulk berths on the north and berth IX. The E arm and shallow berth will handle construction materials, cement and VCM; the quantity of remaining general cargoes handled by these six berths is found to be about 3.68 MT.

The capacity of any multipurpose berth depends upon the type of cargo handled, the vessel parcel size, the mode of handling, the capacity of equipment deployed, the speed of evacuation and so on. Taking all this into consideration and assuming that handling remaining bulk cargoes and more particularly fertilizer and fertilizer raw material will all be done using high capacity electrical level luffing wharf cranes and mobile harbour cranes, the combined capacity of the existing 6 multipurpose berths is assessed to as 9 MT.

7.4.2 Capacity based on Average Parcels Size and Average Handling Rate

As indicated earlier, the capacity of a berth depends on parcel size and speed of handling. On this basis certain assumptions have been made in respect of these two variables to arrive at the capacity a multipurpose berth as provided in **Table 7.4**.

Table 7.4 Capacity of a Typical Multipurpose Berth

S. No.	Particulars	Units	With MHCr		With Ship Gear/High Capacity Shore Electric Cranes	
			Bulk	**Break-Bulk**	**Bulk**	**Break-Bulk**
1.	Average Parcel size	T	45,000	15,000	45,000	15,000
2.	Average handling rate	TPD	20,000	8,000	12,000	6,000
3.	Handling time	Days	2.25	1.88	3.75	2.50
4.	Berthing, Deberthing and Miscellaneous time	Days	0.25	0.25	0.25	0.25
5.	Total time per ship	Days	2.5	2.13	4	2.75
6.	Total berth days available per annum	Days	350	350	350	350
7.	Maximum allowable berth occupancy	Percent	70	70	70	70
8.	Optimum berth occupancy days	Days	245	245	245	245
9.	Capacity of berth (2x8)	MT	4.9	1.96	2.94	1.47
10.	Percentage weightage	Percent	10	90	10	90
11.	Capacity for each range	MTPA	0.49	1.756	0.294	1.33
	Capacity	**MTPA**	**2.246**		**1.624**	
	Assumed Capacity	**MTPA**	**2**		**1.5**	

In line with the above it can be deduced that the combined capacity of the present multipurpose berth group consisting of 6 berths alone without the shallow draft berths and E arm may be taken as 9.0 MTPA. The capacity of each berth is taken as 1.5 MT and not 2 MT is on the understanding, that once all the major bulks except fertilisers and FR are shifted they have to contend with highly fragmented cargoes.

7.5 Liquid Cargo

The port has an exclusive liquid cargo jetty called OJ for handling POL products and LPG. During the last financial year i.e. 2014-15 a quantity of 0.637 MT was handled at this jetty. During this period it had an occupancy of 132 days which means occupancy of 37.7%. The jetty has depth of 14.1 m below CD which means it is capable of handling POL tankers drawing a draft of 12.8 m.

The jetty is presently handling Naphtha, LPG, Liquid ammonia, Furnace oil and diesel. Furnace oil is however handled in some of the multipurpose berths also (like berth V, VI etc.). Of them only Naphtha has average parcels size of about 15,000 tons plus. All other remaining cargoes have low parcel size of 6,000 T and less.

Even with the present cargo mix and parcel sizes this jetty alone is capable of handling POL cargoes of 1.25 MT. And by increasing the size of pipe lines and higher parcel sizes which can be expected when the throughput increases, this jetty can handle about 2 MTPA of POL products. As is already noted the furnace oil is already handled at other multipurpose berths. In fact even diesel can be handled in a multipurpose berth like berth 6 with certain precautions.

As such for the traffic projection by 2025 viz., of 2 to 2.1 MTPA of Liquid cargoes no additional berthing infrastructure is necessary.

In this connection it is pertinent to note that liquid cargoes like Palm oil are handled in multipurpose berths and VCM is handled in shallow berth. Beyond 2025 when POL liquid cargo projections increase to 3 to 3.3 MT as projected for 2035, then some of the POL products like furnace oil can he handled in multipurpose berths.

7.6 Requirement for Capacity Expansion

The requirement for future expansion of facilities for various phases of development has been worked out as in **Table 7.5**.

Table 7.5 Capacity Augmentation Requirements

Commodity	Current Capacity (MTPA)	2020		2025		2035	
		Forecast Traffic (MTPA)	Capacity Augmentation required over current (MTPA)	Forecast Traffic (MTPA)	Capacity Augmentation required over current (MTPA)	Forecast Traffic (MTPA)	Capacity Augmentation required over current (MTPA)
Dry Bulk	**14.2**	26.5	12.3	38.3	24.1	63.4	49.2
Break Bulk	**13.7**	8.9	0.0	11.7	0.0	19.3	5.6
Containers (TEUs)	**1.1**	1.0	0.0	1.2	0.1	2.0	0.9
Liquid Bulk	**2.0**	0.8	0.0	1.3	0.0	2.0	0.0
Total	**50.6**	**55.7**	**12.3**	**74.5**	**26.6**	**123.2**	**72.5**

1 TEU = 19.7 T

The projected traffic for VOCPT for the year 2020 is estimated to be 55.7 MTPA. The increase in traffic is majorly due to dry bulk cargo demand. The total growth is expected to raise high up to 74.5 MTPA by 2025 and 123.2 MTPA by 2035. The required additional capacity of 72.5 MT would be needed by 2035.

Various options for achieving the capacity augmentation like inner harbour development and outer harbour development are discussed in subsequent sections.

8.0 RAIL AND ROAD CONNECTIVITY

8.1 Road Connectivity

8.1.1 Present Scenario

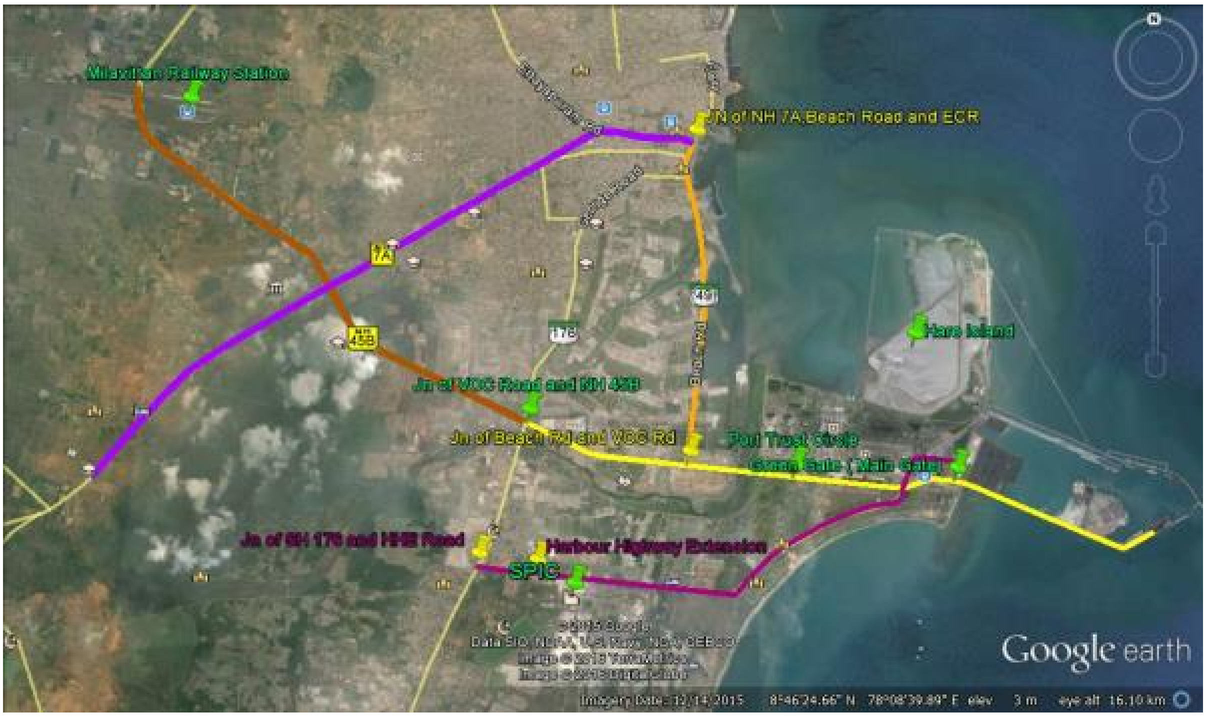


Figure 8.1 Road Connectivity VOCPT

The two important National Highways NH 7A and NH 45 B pass near the port as shown in **Figure 8.1**. These two cater to the major port bound traffic movement from the Hinterland. From the junction presently all traffic moves through the VOC road and passes through the Green Gate.

8.1.1.1 VOC Road (SH 200)

This road is the major arterial road for present port bound traffic movement. Presently the road is having the 4 lane divided carriageway with paved shoulder as shown in **Figure 8.2**. Truck queuing is observed on the road along with the uncontrolled cross overs thro median opening near the Green gate. Presently one major bridge is there on the road.

Figure 8.2 VOC Road (SH 200)

8.1.1.2 State Highway 49

State Highway 49 originating from the VOC road (known as Beach Road) meets with NH 7A after traversing a length of about 5 km as shown in **Figure 8.3**. Presently, this is a two lane road and passes through congested built up section. Connectivity from Tuticorin railway station is also from Beach Road.

Figure 8.3 State Highway 49

8.1.1.3 State Highway 176

State Highway 176 crosses NH 45B and further it meets with the Beach Road. It is a 2 lane road.

8.1.1.4 Harbour Extension Road

This road originates from SH 176 and traverse towards South direction. It crosses VOC Road; moves further east and come to Green Gate as shown in **Figure 8.4**. This road is having 2 lane configurations and presently not much traffic is observed. A pipeline is observed at the left side of the road

Figure 8.4 Harbour Extension Road

8.1.1.5 Proposed Vehicle Evacuation by the Port Authority

1. Gate Details

There are 4 existing gates for the port.

a) **Green Gate:** It takes care of the Entry / Exit for most of the present port bound traffic. It is on the VOC road which is having the 4 lane configuration.
b) **Red Gate**: It takes care of the cargo that passes through the Conveyor.
c) **Yellow Gate:** It takes care of the evacuation of the coal yard traffic. The vehicle from proposed NCB 1 -4 will use the road for evacuation purpose and also the officials' vehicle will use the gate
d) **Blue Gate:** Presently the gate is closed. Will be used for any kind of emergency in future

2. **Ongoing / Recently Completed Road Project**

a) 4 lane road from Hare Island to Red gate

b) Red gate to TTPS circle 4 lane road (Rigid pavement)

8.1.2 Consultant' Proposal for Future Road Connectivity

For the better connectivity in future following new road connectivity has been proposed.

§ New 4 lane road connectivity in between Harbour Extension Road and National Highway 7A as shown in **Figure 8.5**.

Figure 8.5 Proposed Connectivity to NH7A

§ The Harbour Highway Extension road in between node A and B will have divided 4 lane configurations (about 5 km length) as shown in **Figure 8.6**.

Figure 8.6 Proposed Widening of Harbour Highway Extension Road

§ From node A to VOC road junction of the HHE road will be used by the traffic who wants to get into the port through green gate only as shown in **Figure 8.7**. Once the VOC road as well as new road connecting HHE road and NH 7A is operational SH 176 has to be carried out.

Figure 8.7 Proposed Road for Traffic through Green Gate

§ It is proposed to provide divided 8 lane configuration of VOC road in between port trust circle and the junction with NH 45 B as shown in **Figure 8.8**.

§ New bridge over the creek (parallel to the existing bridge) on VOC road to match with the VOC road configuration.

Figure 8.8 Proposed Widening of VOC Road (8 Lane)

§ It is proposed to widen the existing NH 7A as shown in **Figure 8.9**.

Figure 8.9 Proposed Widening of NH 7A

§ Presently Green gate is handling both the Entry as well as Exit of the vehicles. Long queue of the traffic on VOC road is observed which leads to the major congestion. After the proposed road from Hare Island will become functional, the traffic movement will be worsening further on VOC road. To remove the bottleneck near the Green gate following measurement is proposed

- Staggered Entry and Exit gate location to provide the exclusive entry and Exit to reduce the waiting period at Gate.
- Elevated Road on VOC Road (About 2 km) for the traffic coming out of the port.
- The traffic from Hare Island will have the up ramp (2 lane configuration) to meet with the elevated road on VOC.
- Elevated road on VOC will be 2 lane road configurations from the exit gate and after the merger of the ramp from Hare Island it will have 4 lane configurations as shown in **Figure 8.10**.
- The elevated road will have down ramp (2 lanes) for the vehicles intended to go for Harbour Highway Road.
- The elevated road will continue further and meet with the VOC road after crossing the port trust circle.
- Harbour Highway Road will further meet with VOC road. Traffic comes from NH 7A and intend to go to Hare island will only follow this route as shown in **Figure 8.11**.

Figure 8.10 Proposed Elevated Road Above VOC Road

Figure 8.11 Connecting Road Between VOC and Hare Island

8.1.3 Trucking Parking Facilities

Based on the land use plan studied and proposed by RITES India Ltd for VOC Port, out of the total existing land available with the port 32.85 ha is allocated only for truck parking facility. Four different locations have been identified for truck parking facility within the port limit as listed below and shown in **Figure 8.12**:

§ Area I – Near the intersection of harbour highway extension and VOC road (allotted 3.9 Ha)
§ Area II – Near the junction of beach road and VOC road, next to the existing rail line (allotted 1.3 Ha)
§ Area III – Near the junction of beach road and VOC road, next to the existing rail line (allotted 1.3 Ha)
§ Area IV – At the south west area of the Hare Island to be developed (allotted 20.75 Ha).

Figure 8.12 Planned Locations for Truck Parking Facilities

8.2 Railway Connectivity

8.2.1 Present Scenario

Figure 8.13 Railway Connectivity VOCPT

Presently one single Broad Gauge line comes to Port area after originating from Milavattan Railway station. The total length of the railway line is 17.60 km as shown in **Figure 8.13**.

From Milavattan Railway station to VOC wharf is 14.0 km and VOC wharf to Marshalling yard is having the balance length near coal yard a loop line is there and 5 nos. lines are available in the Marshalling yard.

8.2.2 Proposed Railway Option by the Port Authority

- It is proposed to have railway line from Hare Island to Marshalling Yard (Approximate length 5.9 km) – The detailed plan submitted to the Railways for approval
- New railway line is also proposed from Marshalling Yard to Red Gate (2 lines Approximate length 1.8 km)

8.2.3 Consultants Proposal on Railway Option

The Madurai – Dindigul double line is under progress and the doubling of Madurai – Tuticorin section is proposed. To have better access with the hinterland it is proposed to have electrification and doubling of the existing Milavattan Railway station to Marshalling yard line. The same is also proposed for existing Line from Milavattan railway station to Tuticorin section.

9.0 SCOPE FOR FUTURE CAPACITY EXPANSION

9.1 Development Possible within the Existing Harbour

9.1.1 Existing Harbour – Limitations and Planned Developments

The port has a dredged depth of 14.1m below CD in the inner channel, coal jetties CJ1, CJ2, Coal berth NCB1, NCB2 which are all on the north side of harbour. On the south side similar depth of 14.1 m is available in container berth 8 and berth 9. All these berths can handle Panamax vessels with a loaded draft up to 12.8 m, leaving an under keel clearance of about 1.3 m. As regards the remaining existing berths it is not feasible to deepen further due to their design limitations.

The currently planned layout of the inner harbour is shown in **Figure 9.1**.

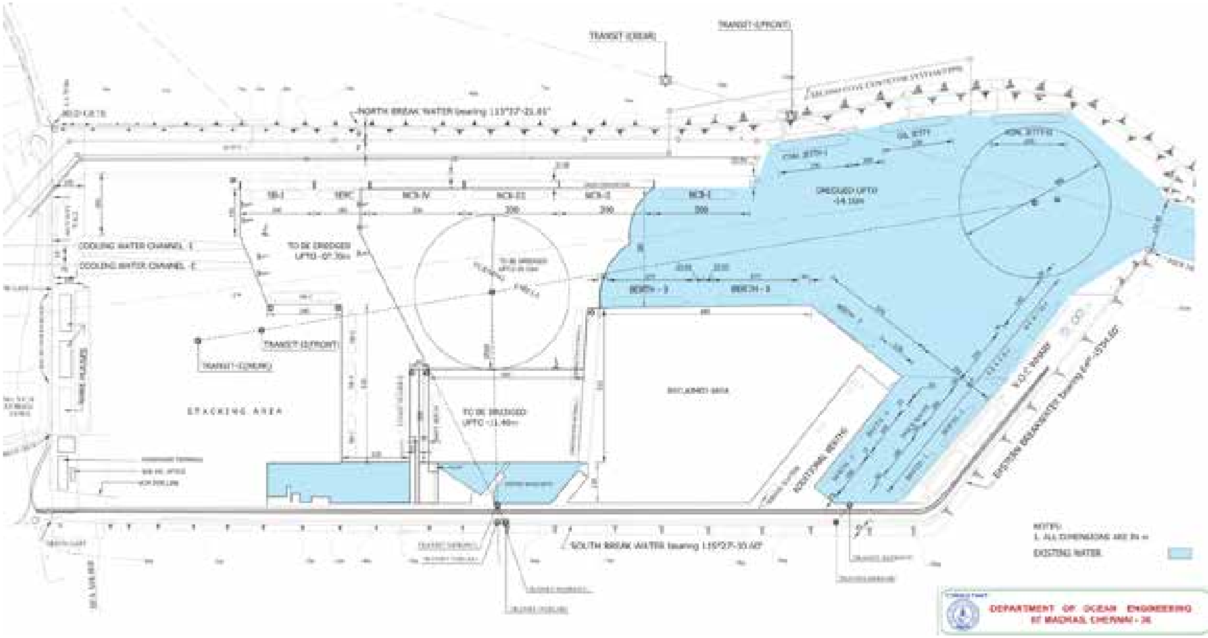


Figure 9.1 Planned Layout of VOC Port Inner Harbour

9.1.2 Options for Development of Existing harbour

9.1.2.1 General

In order to develop the suitable alternative layouts for the inner harbour development of VOC port, following facts are to be duly taken into account:

§ The concessions for NCB3, NCB4 and cement berths have been cancelled and port would be calling for fresh tenders.

§ The planned shallow water berth perpendicular to berth 9 is under litigation and if the tender process is cancelled, the same shall be available for development for handling required commodities.

§ The port has firmed up plans for development of coastal berth and also a finger jetty perpendicular to the south breakwater has been allocated to Navy and coast guard as shown in **Figure 9.2**.

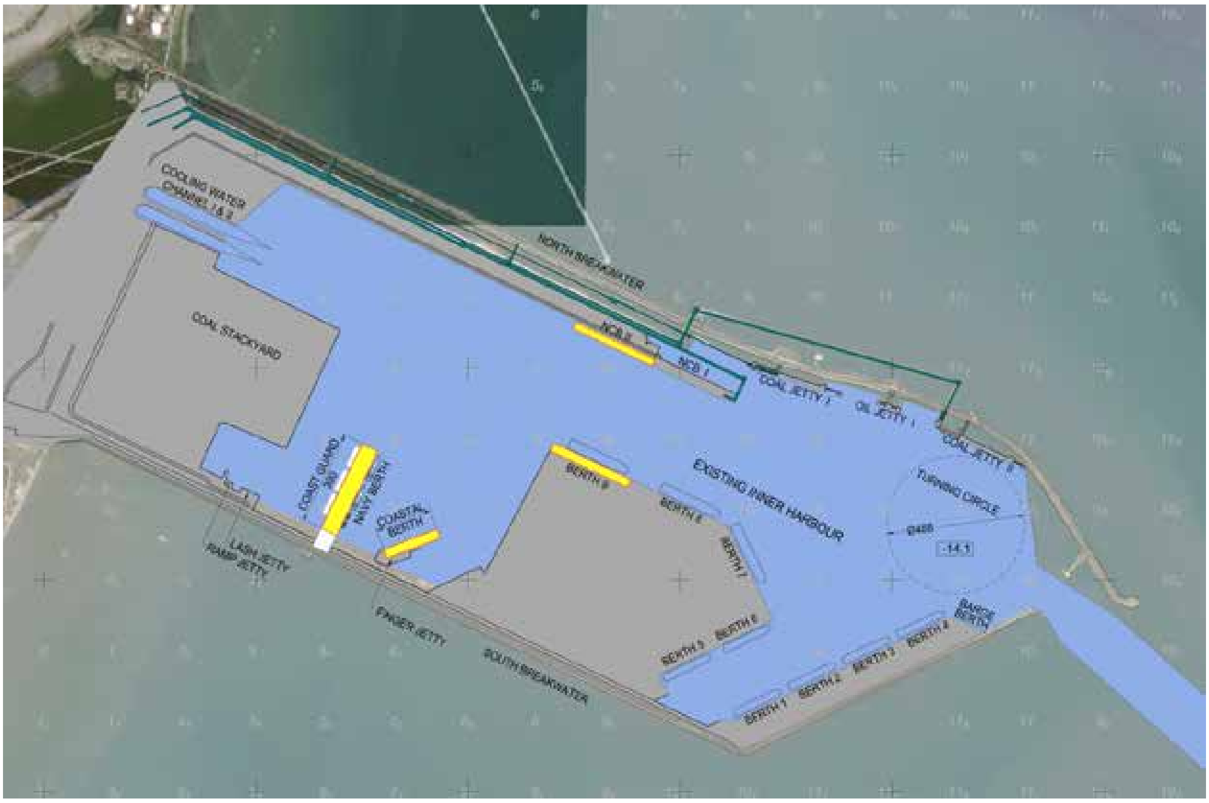


Figure 9.2 Layout Showing Current Inner Harbour and Confirmed Plans of Additional Berths

§ As regards berth 9, the contract for O&M for handling and transferring bulk cargo to bulk stackyard through conveyor system has already been awarded. Therefore the location of berth for handling bulk cargo through conveyor etc. as already envisaged cannot be changed.

- Though the location of berth 9 is not ideal for handling of dry bulk cargo due to presence of container berths nearby, this is the only deep water berth available at present for handling the bulk cargo other than coal. At the time of renewal of O&M contract now under implementation and once the same expires, after 10 years the handling operations now being installed could be shifted to other berth, if needed.
- The coastal berths being developed by port does not allow a “Green Channel” i.e. the entry/exit to this berth still has to pass through the custom bound area and thus do not meet the objective fully.

9.1.2.2 *Alternative 1*

This alternative is basically similar to the plans of the port currently being pursued has regarding berths located along the north breakwater in which NCB 3, NCB 4 and SPEC berths which shall be built along the north breakwater.

Currently dredging has already been carried out by port for the shallow water berth and in the next phase the deepening would take place for the turning circle and berthing areas for NCB 3 and 4 berths. As the deeper water (i.e. -14.1 m CD) would be available at turning circle, with little extra dredging it would be possible to create deeper draft at the location of currently proposed shallow water berth so that the same could be instead used as a deep water berth for handling containers or bulk cargo.

On the opposite side of the container berth, taking the advantage of deeper water available due to dredging in the turning circle, another berth for handling coal could be developed with minimal quantity of dredging. The reclaimed area on the western end could be extended to create more space for stacking of coal.

It is also proposed that the coastal berth could be further extended parallel to proposed Navy berth so as to provide berthing facility to handle two barges simultaneously. This would optimally utilise the harbour area.

Similar to alternatives 1 and 3 the east side of bulk stackyard shall be developed a deep water bulk berth, which would meet the requirement of port to handle other dry bulk apart from coal. This berth is optimally located as the stackyard is adjacent to this berth. This alternative layout is shown in **Figure 9.3**.

Figure 9.3 Options for Development of Existing Harbour – Alternative 1

With the provision of two additional coal berths and one dry bulk berth within the inner harbour, the berth 9 could later be released developing the container berth, after the expiry of the current concession of the O&M contract (now under implementation). Apart from that a berth perpendicular to berth 9 could also be built for handling containers. This berth 9a can utilise the same yard as for berth 9 and with proper circulation plan could add additional container handling capacity. Also this perpendicular berth can be either a container or a bulk berth.

This layout has the following benefits:

§ Utilises the deeper water depths proposed to be created for only two berths (NCB 3 and NCB 4) to enable two more deep draft berths with minimal additional dredging.

§ Consolidates the container handling at berths 7, 8, 9 and 9a berths with adequate backup area.

§ Allows separation of clean cargo and dirty cargo area. This has large impact on the user perception about a port particularly for containers.

The only issue could be that the berth 9 would only be available after 10 years after the expiry of current O&M contract for dry bulk cargo handling.

9.1.2.3 Alternative 2

In alternative 2, it is proposed that a quay length of 900 m could be created parallel to NCB I and II, as shown in **Figure 9.4**.

This would enable providing one coal berth and two container berths, towards west of NCB 2. The existing reclaimed area near the root of north breakwater could be extended to allow space for container yard. The quay perpendicular to berth 9 shall also be used as a deep draft bulk berth due to availability of deeper depths

Figure 9.4 Options for Development of Existing harbour – Alternative 2

SEPC berths (for barges of draft limited to 7 m) and a deep draft coal berth are proposed in the existing stackyard area towards west of harbour basin.

Only issue in layout is likely to be the limited space available for the proposed two berth container terminal along the north breakwater. Therefore the proposed container terminal as part of this alternative is analysed further to assess its suitability.

Based on the area available a tentative layout of the container terminal has been developed as shown in **Figure 9.5**. It is assessed that about 1700 ground slots for stacking of containers would be possible for using RTGs. Considering the dwell time of 3 days this translates to a terminal capacity of 550,000 TEUs only. Hence the limited yard area can support only one full-fledged container berth rather than two.

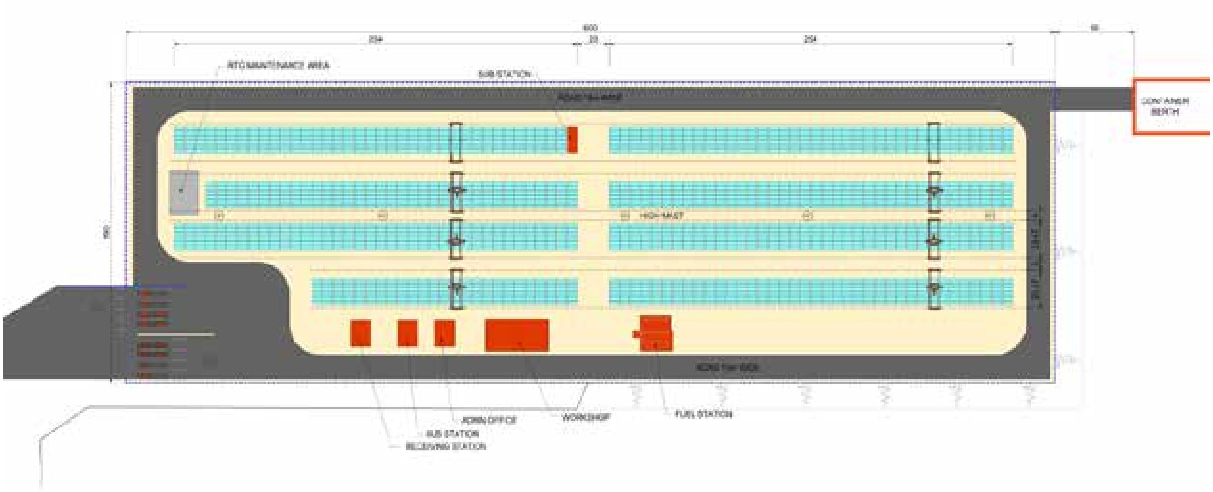


Figure 9.5 Layout of Container Yard along North Breakwater

As per the traffic projections the need for additional coal berths is likely to be earlier than the need for container berths and therefore reduction of 1 bulk berth in this alternative is not suitable. This also has an issue that the container handling facilities and coal handling facilities are spread all over without proper segregation. Only advantage in this case is that in and out movement to the proposed container yard is through a separate access.

9.1.2.4 Alternative 3

The proposed layout is similar to the alternative layout 2 with the exception that only one container berth is provided along the north breakwater (NCB 4). The reason of considering NCB 4 as container berth instead of the berth on its north side is that additional dredging will not be needed in the initial stage of container berth development. The following options would exist for developing the berth north to NCB4:

- To develop this as a container berth to complement NCB 4. This would be possible only if it is later found that the existing yard can service two container berths due to lower dwell time.
- To develop this as a container berth as a replacement to NCB 4, which shall be later converted to a coal berth, if the demand of coal picks up. To pursue this option it would be preferable that the container cranes provided at NCB 4 are of 20 m rail gauge which is also the rail gauge for the coal unloaders.
- To develop this berth as a clean cargo berth

A suitable decision in this regard could be taken at a later stage depending on the traffic growth scenario.

Further it is suggested that the additional deep water berths i.e. NCB 3, NCB 4, berth 9, bulk berth, new container berth and existing berth NCB 2 are all deepened to handle fully loaded panamax vessel with draft of 14.5 m as shown in **Figure 9.6**.

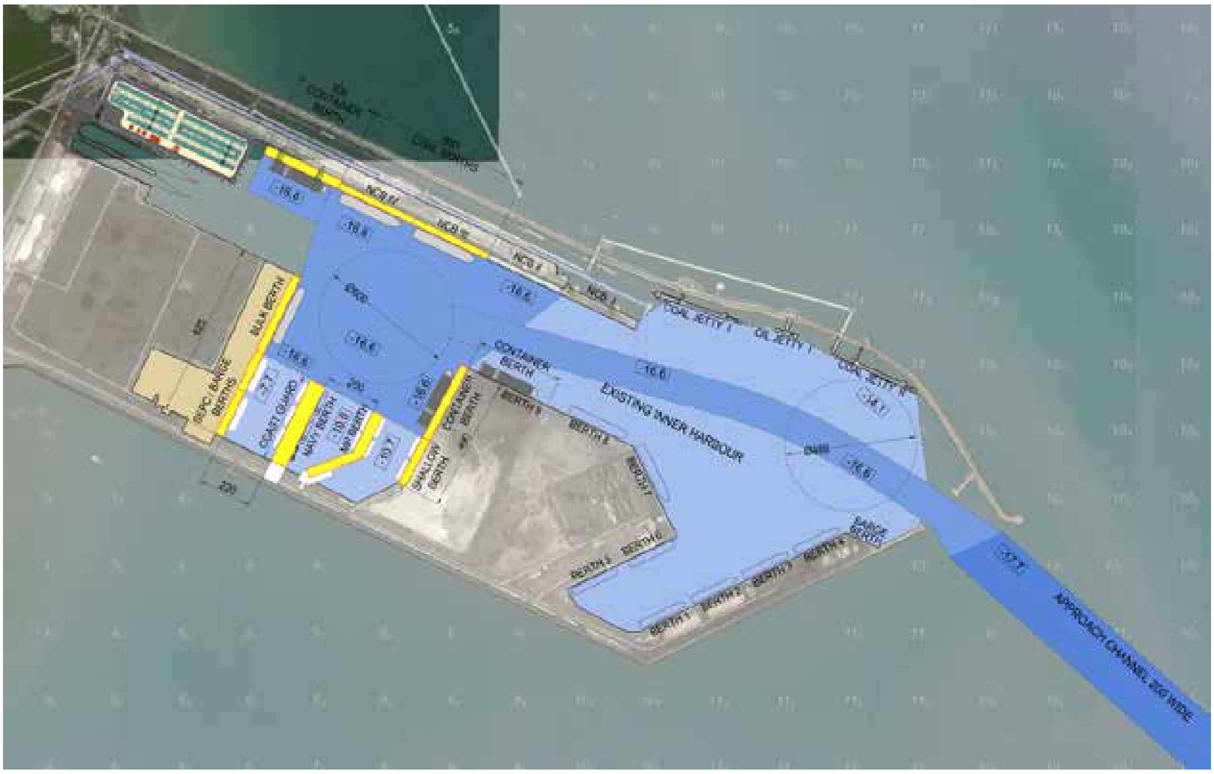


Figure 9.6 Options for Development of Existing Harbour – Alternative 3

This would significantly reduce the logistics cost of handling coal as fully loaded panamax size ships with draft of 14.5 m would be able to directly able to call at the port. Currently, they have to incur significant waiting time and cost at anchorage operations to light load the ship up to allowable harbour draft of 12.8 m.

However, this option involves significant cost of capital dredging in rock, though much less than the outer harbour development. Therefore the phasing for deepening could be decided duly evaluating the financial viability.

Earlier also the possibility of dredging to deepen the existing harbour up to 16.1 m depth to cater to fully loaded Panamax vessels was examined and in our opinion possible due to following reasons:

§ As regards to the impact on the existing berths due to deepening, it could be seen from **Figure 9.6** that the proposed area of deepening is away from the existing berths and therefore does not endanger their stability.

§ The deepening is proposed so that fully loaded panamax ships could be brought to the port. Even currently panamax vessels are brought to the port using the same entrance width and therefore entrance width cannot be considered as a constraint for about 1.7 m deepening.

- However in case the ports feel that the current entrance width is tight even for panamax vessel, which are currently visiting the port, then appropriate measures are technically possible to increase the entrance width.
- Due to the relatively benign wave conditions at site, as compared to other ports along east and west coast, the current entrance width of 153 m is very narrow from the wave tranquillity point of view and it is felt that the same could be widened to about 200 m without affecting the tranquillity at the berths.

Considering the benefits that the harbour deepening offers to the port, it is recommended that port should seriously pursue the option of further deepening of harbour to handle fully loaded panamax ships at the significantly large proportion of berths.

9.1.3 Recommended Plan for Development of Inner Harbour

Based on the currently executed projects particularly the mechanisation of berth 9, it is assessed that alternative 3 is more appropriate. This would however require wider harbour entrance. The recommended layout is as shown in **Figure 9.7**

Figure 9.7 Recommended Layout of Inner Harbour

From the above discussions, it can be seen that the thrust of recommended layout of Inner harbour envisages the following.

§ The inner harbour shall be developed to its full and optimal potential.
§ The inner harbour to be developed to handle fully loaded panamax vessels.
§ The entrance of inner harbour be widened
§ The consequent dredging of Approach Channel outside the present harbour entrance will eventually be useful for outer harbour dredging whenever such outer harbour materialises.
§ It will cater to the natural growth of exim container and import coal traffic that may be expected by the time Outer harbour becomes operational.
§ In alignment with the policy of government of India to reduce dependence on foreign coal imports, the coal import through Tuticorin port will be mostly through coastal movement of coal for which fully fully-loaded panamax vessels will be the optimal vessels size. The development of inner harbour as proposed will perfectly align with this objective. Further the length and cost of conveyors for coal berths developed in the optimised layout of inner harbour will be more economical.

9.2 Outer Harbour

With the above scheme of inner harbour development the projected traffic forecast up to year 2025 could be handled. As per current projections beyond this there would be a need for development of outer harbour as far as cargo handling capacity is concerned. Also as per the recommended scheme, it would be possible to handle fully loaded panamax bulk carriers within inner harbour with adequate number of container and bulk berths in inner harbour. Therefore any advancement of outer harbour development would be only be needed if the large container vessels having draft of 16 m or bulk cape carriers of draft 18.3 m are required to be catered to achieve the overall logistics advantage.

9.2.1 Basis for Port's Outer Harbour Development Proposal

The port has developed the master plan proposals and layout on the basis of traffic forecast as per DPR (by I-maritime) and refined by IPA. However, a recent national level Origin-Destination study of the cargo being handled at ports across the country carried out as part of Sagarmala (by McKinsey) has projected different traffic figures. The broad comparison of two studies is mentioned in **Table 9.1** below.

Table 9.1 Coal - Traffic Forecast as per VOCP (Validated by IPA)

Commodity	Unit	Year 2019/2020		Year 2024/2025		Year 2035/2036	
		I-Maritime	McKinsey	I-Maritime	McKinsey	I-Maritime	McKinsey
Coal	(MT)	26.9	26.6	42.1	38.3	75.3	63.4
Containers	(MTEU)	1.2	0.9	1.7	1.2	3.1	2.0

It could be clearly seen from Table 9.1 that as far as coal is concerned, it is established that Tuticorin port offers great potential for handling of coal brought to the port using coastal movement and in this regard the projected traffic numbers are more or less similar in both the studies. The numbers for hinterland containers projected by McKinsey are slightly lesser as compared to those projected by I-Maritime. But the projections by McKinsey duly consider the current scenario in which the proposed container port at Vizhinjam is under construction and that at Enayam has already been approved by Government and DPR is under preparation. These two ports apart from handling transshipment containers would definitely have their share of hinterland containers also eating away the share of Tuticorin and Cochin.

The major difference is in the traffic for the transshipment containers. It may not be out of place to mention that as part of Sagarmala assignment, a separate report on the suitable location of transshipment terminal has been prepared and basis which site at Enayam has been selected. As the construction of Vizhinjam has started and DPR for Enayam underway by VOC port itself, it would be very unreasonable to assume significant transshipment traffic at VOC port requiring very large outer harbour development. Even the IPA report mentions the following:

"The Team strongly recommends that serious and due consideration may be given by the port to the concept of Satellite port as the first expansion alternative of the port and take an informed decision before considering Outer harbour option."

The layout of Port's Master Plan for Outer harbour is shown in **Figure 9.8.**

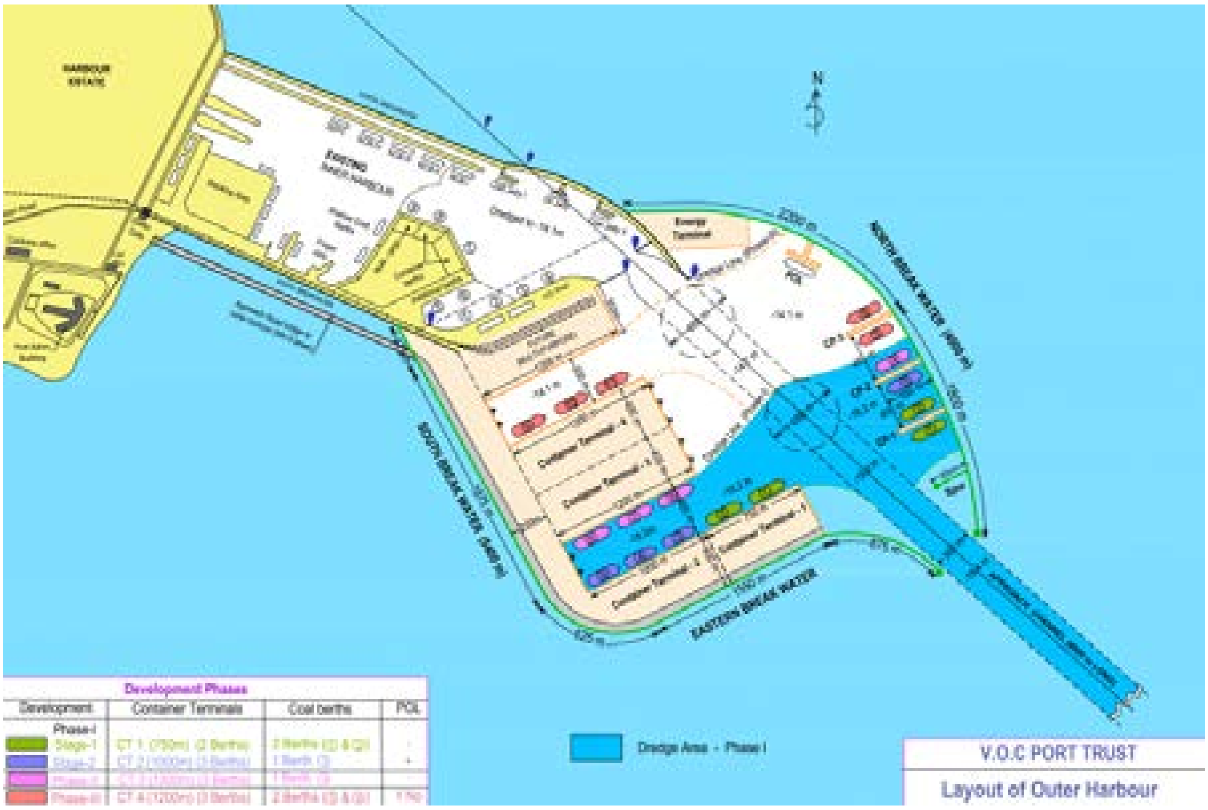


Figure 9.8 Layout of Port's Master Plan for Outer Harbour

As could be seen the layout proposed by the port envisages development of 14 container berths, which are basically necessitated on account of projected 7.4 MTEUs of transhipment container traffic.

9.2.2 Master Plan Layout based on the Current Traffic Forecast

9.2.2.1 Facility Requirements

For Coal Handling

As already indicated earlier that the preferred option is to develop coal handling capabilities within the inner harbour to the maximum extent and only after exhausting the same the development of bulk berths in the outer harbour may be taken up. This is due to the fact that as per government policy of sourcing of coal for power plants shall be 70% indigenous which means handling of Panamax vessels will be adequate.

When the inner harbour saturates for bulk handling, creating facilities in the outer harbour for bulk handling more particularly for coal is imperative.

For Container Handling

The current capacity of two container berths 7 and 8 together for container handling is of the order of 1.0 MTEUs and even if the additional container handling projects within the inner harbour do not materialise, the required container handling capacity for outer harbour would be only 1.0 to 2.1 MTEUs requiring maximum 3 to 4 berths.

9.2.2.2 AECOM's Proposed Master Plan Layout

In line with the above requirements an alternative master plan layout has been developed by AECOM as presented below in **Figure 9.9**. This layout is basically a downsized version of the layout by port.

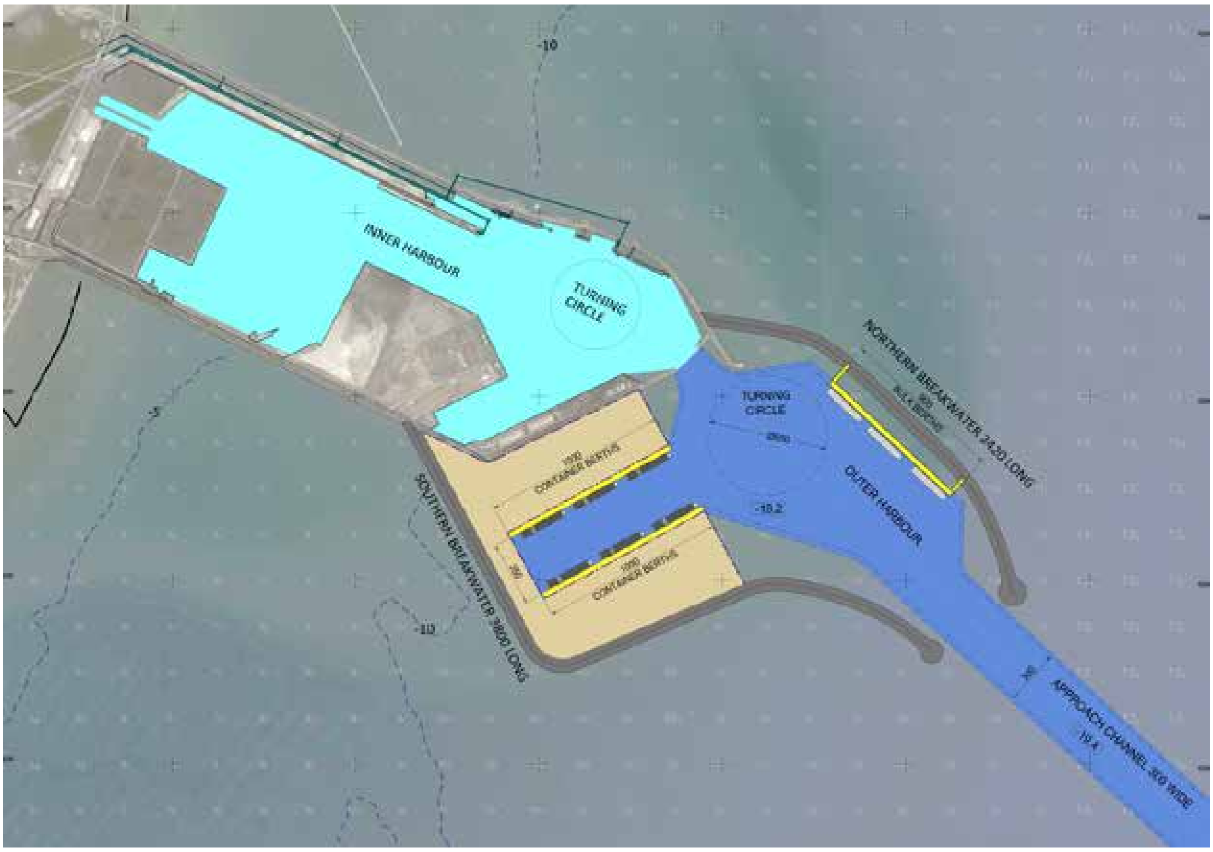


Figure 9.9 AECOM's Modified Master Plan Layout

The proposed master plan layout can provide additional container handling capacity of about 3.6 MTEU and about 30 MTPA capacities for bulk import. The approach channel and harbour would be dredged for 16 m draft ships eventually and could be planned to cater to 14.5 m draft ships initially.

9.2.3 Comparison between Port's and AECOM's Layout

9.2.3.1 Facilities in Phase 1 Development

The traffic forecast made over a time horizon of 20 years up to 2035-36 will actually develop over a period of many years depending upon the GDP growth, and industrialisation of the hinterland etc. In view of this, it is necessary to plan for the layout of outer harbour taking the ultimate traffic by 2035 and the berthing facilities as per incremental increase in traffic that can be excepted in five, ten and fifteen years in a phased manner.

It is therefore proposed to develop the outer harbour in phases with breakwater for ultimate layout in the beginning itself but the berthing structures, dredging and reclamation can happen in phases. In line with this, the layout and berthing facilities in the first phase are proposed as per the following layout.

The proposed Phase 1 layout comprises of 2 container berths and 2 coal berths. It is proposed that while the berthing structures may be designed for the 16 m or even 18 m draft ships, the dredged depths in the channel and harbour basin are to be increased in a phased manner. Initially the dredging could be carried out for 14.5 m draft ships to cater to fully loaded Panamax ships of all sizes. Subsequently, it can be increased to 16.0 m as per market demand.

9.2.3.2 Phase 1 Layout of Outer Harbour

The proposed Phase 1 layout of the outer harbour development as per the Port's Layout and that as per AECOM's Layouts are shown in **Figure 9.10** and **Figure 9.11** respectively.

Figure 9.10 Proposed Phase 1 Development of Layout by VOC Port

Figure 9.11 Proposed Phase 1 Development of Layout by AECOM

9.2.3.3 Comparison of Layouts

Considering the shorter breakwater lengths, it is estimated that about 60% of the rock quantity would be needed in the modified layout as compared to the base layout proposed by the port. Therefore Phase 1 facilities could be commissioned about 2 years earlier in the layout proposed by AECOM.

A cost comparison between the two layouts reveal that the cost of basic infrastructure in terms of breakwater, dredging and reclamation in the Phase 1 layout proposed by AECOM would be lower by about INR 500 crores i.e. about 6%.

As regards the master plan layout, the downsized version of Port's layout (even after keeping the breakwater configuration same but reducing the number of container berths) would be as shown in **Figure 9.12** below.

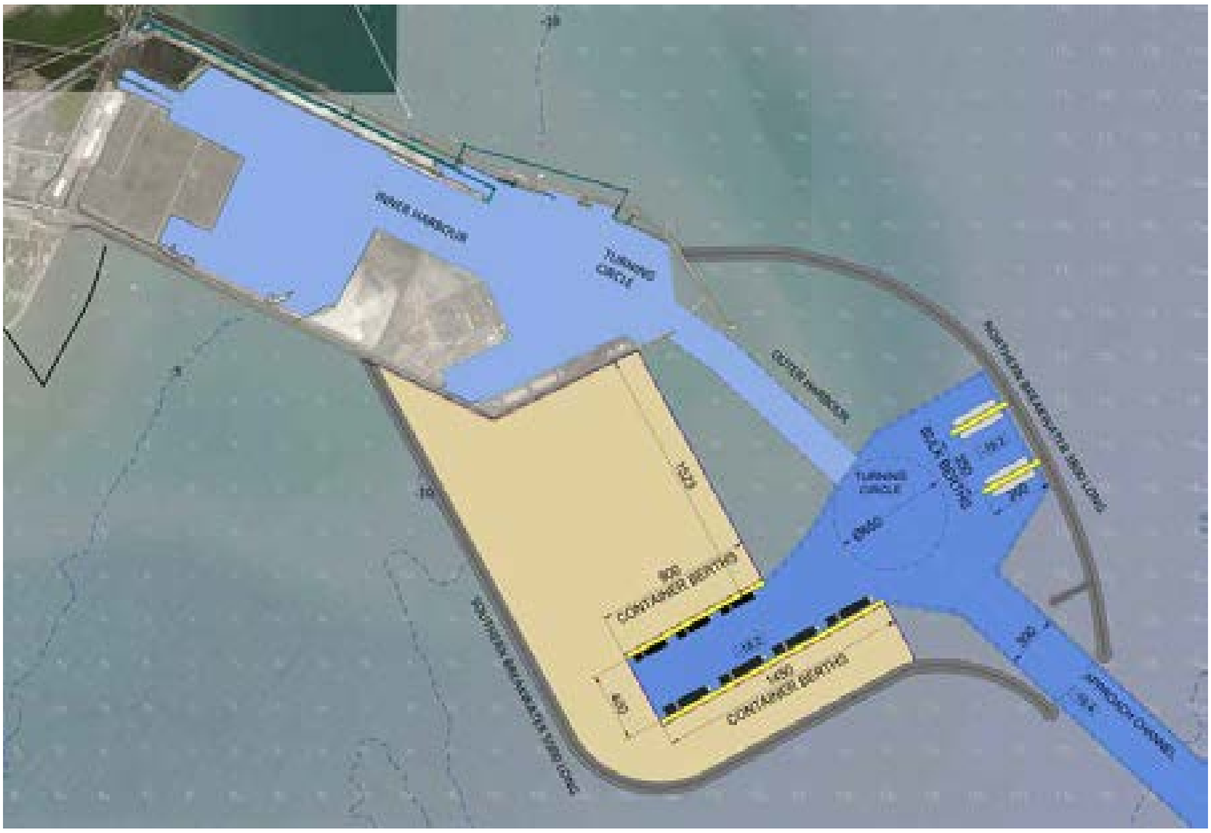


Figure 9.12 Downsized Master Plan Layout of the Outer Harbour

The additional harbour area obtained in this layout due to long breakwaters could be utilised for creating huge backup area of about 140 Ha, (beyond what is required for berthing facilities developed in outer harbour), which at present is scarce within the harbour. This area could be utilised for storage of cargo and port operations. While part of the reclaimed area could be developed by utilising the dredged material, borrowed fill would be needed to create the balance area.

9.2.4 Recommendations for Outer Harbour

The pros and cons of long breakwaters and the consequent time of construction and cost have to be duly weighed with respect to additional reclaimed area obtained while finalising the appropriate layout of the outer harbour. This could ideally be decided while arranging financing for the Phase 1 development of the outer harbour based on the firm requirements of the facilities to be created.

10.0 SHELF OF NEW PROJECTS AND PHASING

10.1 General

As part of V. O. Chidambaranar Port Master Plan several projects have been identified which need to be taken up in phased manner with the built up in traffic. The proposed phasing, capacity addition and the likely investments are discussed in paragraphs below.

It may be noted that apart from these projects there could be several other projects which port would be implementing as part of the routine operations and maintenance of the port facilities. Further the phasing proposed is not cast in stone but could be reviewed periodically and revised based on the economic scenario and demand for port at that particular point of time.

10.2 Ongoing Projects

The details of the projects which have already been awarded and development is ongoing are given below in **Table 10.1**.

Table 10.1 Ongoing Projects

S. No.	Project Name	Investment required (In Crores)	Capacity Addition (MTPA)	Mode of Implementation
1.	Construction of North Cargo berth-II for handling bulk cargoes on DBFOT basis - Tuticorin	335	7	PPP
2.	Conversion of 8th berth as container terminal on BOT basis for a period of 30 years - Tuticorin	315	7	BOT
3.	Mechanization of Berth IX	50	6	PPP

The port layout after completion of ongoing projects shall be as shown in **Figure 10.1**.

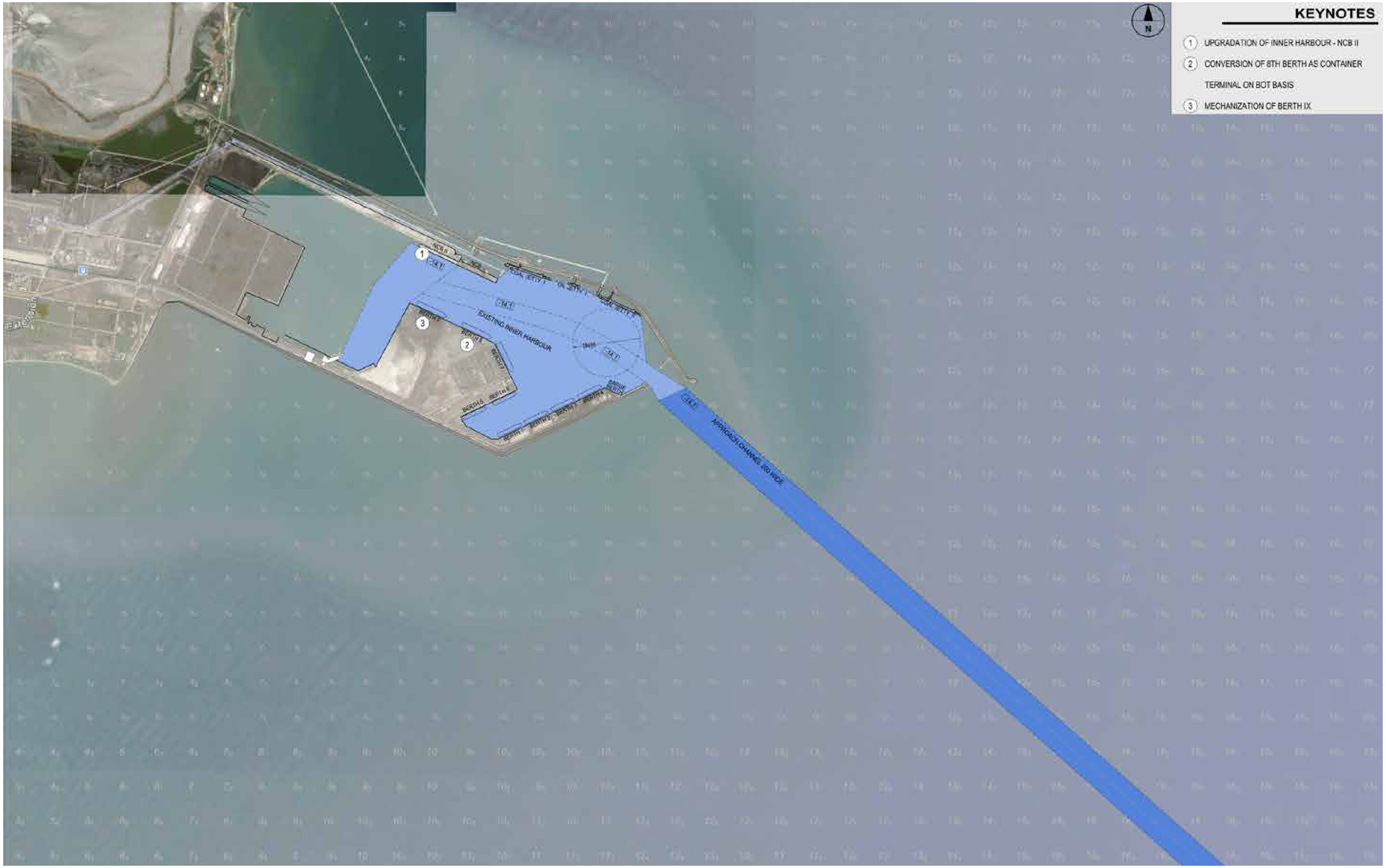


Figure 10.1 Port Layout along with Ongoing Developments

10.3 Projects to be completed by Year 2020

The details of the projects which are envisaged to be completed by the year 2020 are given below in **Table 10.2**

Table 10.2 Projects to be completed by Year 2020

S.No.	Project Name	Investment required (in croes)	Capacity	Mode of implementation
1.	Upgradation of existing coal jetty (CJ2)	250	6	Port's fund
2.	Upgradation of inner harbour NCB III	587	18	PPP
3.	Upgradation of inner harbour NCB IV – Container / clean cargo	515	0.6M TEU	PPP
4.	Upgradation of inner harbour – SEPC berth	200	4	PPP
5.	Upgradation of inner harbour – Shallow berth	126	2.6	PPP
6.	Construction of new ROB parallel to existing between TTPS to Check Post	0.3	-	Port's fund
7.	Providing Railway Track between Marshalling Yard and Hare Island	70	-	Port's fund
8.	NCB I – utilization of its full capacity at Tuticorin	-	2.5	PPP
9.	Deepening of NCB III and IV	900	-	Port's fund

The port layout after completion of planned projects till 2020 shall be as shown in **Figure 10.2**.

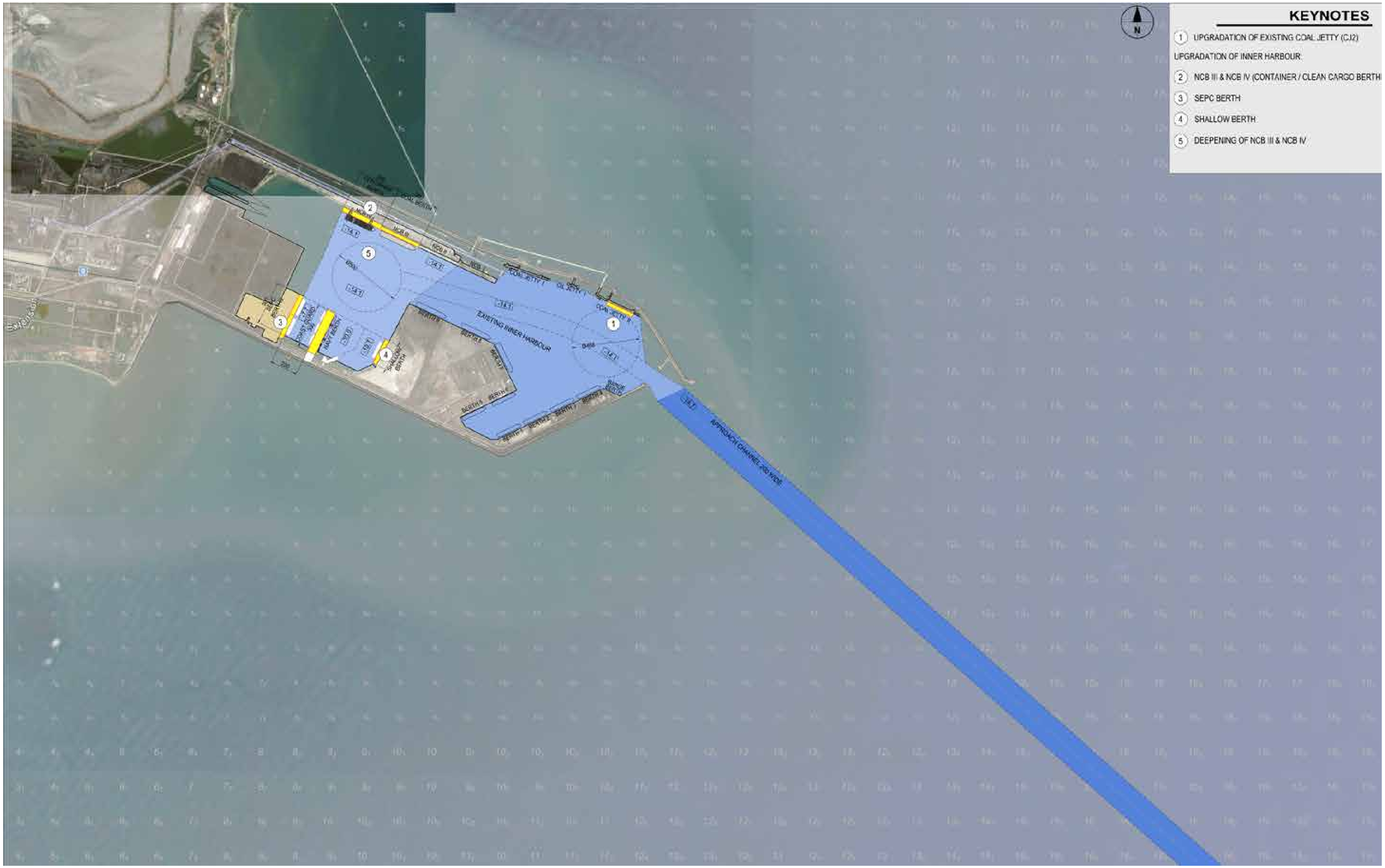


Figure 10.2 Port Layout 2020

10.4 Projects to be completed by Year 2025

The details of the projects which are envisaged to be completed by the year 2025 are given below in **Table 10.3**

Table 10.3 Projects to be completed by Year 2025

S. No.	Project Name	Investment required (In Crores)	Capacity Addition (MTPA)	Mode of Implementation
1.	Upgradation of Inner Harbour - Deep Draft Bulk Berth	330	9	PPP
2.	Upgradation of Inner Harbour – Multi-Purpose Barge Berths	100	2	PPP
3.	Upgradation of Inner Harbour - Channel and Basin Deepening for Fully Loaded Panamax Ships	1600	6	Port's funds
4.	Development of Outer Harbour- Dredging and Breakwaters	7000	0	Port's funds
5.	Development of Outer Harbour - Phase 1 (2 coal and 2 container)	1600	38	PPP
6.	New 4 lane road connectivity in between Harbour Extension Road and National Highway 7A	36	-	Port's funds
7.	Widening of harbour highway extension road (HHE Road) into 4 lane configuration (a section of about 5 km length)	30	-	Port's funds
8.	Widening of VOC road into 8 lane configuration from Port Trust Circle to NH 45B junction	16	-	Port's funds
9.	Elevated road above VOC road to take Traffic of Hare Island (about 2km)	43	-	Port's funds
10.	New railway line from Marshalling Yard to Red gate	18	-	Port's funds

The port layout after completion of planned projects till 2025 shall be as shown in **Figure 10.3**.

Figure 10.3 Layout Plan 2025

10.5 Projects to be completed by Year 2035

The details of the projects which are envisaged to be completed by the year 2035 are given below in **Table 10.4**.

Table 10.4 Projects to be completed by Year 2035

S. No.	Project Name	Investment required (In Crores)	Capacity Addition (MTPA)	Mode of Implementation
1.	Multi-Purpose Berth	330	9	PPP
2.	Future Berth	-	-	-
3.	Development of Outer Harbour - Phase 2 (2 coal and 5 container berths)	1600	58.25	PPP
4.	Electrification and doubling from Milavittan railway station to Marshalling yard and Milavittan station to Tuticorin station	150	-	Port's funds

The port layout after completion of planned projects shall be as shown in **Figure 10.4**.

Figure 10.4 Port Layout 2035

Appendix 1 - **BCG Benchmarking Study for V. O. Chidambaranar Port**

Master Plan for V.O. Chidambaranar Port - Final

Prepared for

Ministry of Shipping/ Indian Ports Association

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Document Revision Register

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2.	11.08.2016		Incorporating Comments on Final Master Plan Report	Marshal Praveen (Engineer II)

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1.0 INTRODUCTION

1.1 Background

The Sagarmala initiative is one of the most important and strategic imperatives to realize India's economic aspirations. The overall objective of the project is to evolve a model of port-led development, whereby Indian ports become a major contributor to the country's GDP.

As shown in **Figure 1.1**, the Sagarmala project envisages transforming existing ports into modern world-class ports, and developing new top notch ports based on the requirement. It also aspires to efficiently integrate ports with industrial clusters, the hinterland and the evacuation systems, through road, rail, inland and coastal waterways. This would enable ports to drive economic activity in coastal areas. Further, Sagarmala aims to develop coastal and inland shipping as a major mode of transport for carriage of goods along the coastal and riverine economic centres.

As an outcome, it would offer efficient and seamless evacuation of cargo for both the EXIM and domestic sectors, thereby reducing logistics costs with ports becoming larger drivers of economy.

Sagarmala aims to optimize the Logistics route for Port and Increase focus on Port led development for the country

	Details	Description
Why is Sagarmala needed?	1 Dual institutional structure at ports	▪ Due to segregation of major and minor ports, ports of India have grown as due unconnected entities and not benefitting from co-location or economics of scale
	2 Weak infrastructure at ports and beyond	▪ Weak modes of evacuation from both major and minor ports leading to sub – optimal modal mix presently ▪ Limited hinterland linkages that increases cost of transportation
	3 Limited economic benefit of location & to community	▪ Limited conscious skill development and leverage to peripheral trades (fisheries, tourism etc.) ▪ Limited development of centres of manufacturing near ports
What does Sagarmala want to achieve?	1 Ports led development	▪ Undertake development of coastal economic zones with projects like – port based industrialization, coastal tourism, Logistics parks, warehousing, fisheries etc.
	2 Port infrastructure enhancement	▪ Action points on transforming existing ports into world class ports be developing deep drafts, mechanization of existing berths, creation of new capacity and greenfield ports
	3 Efficient evacuation	▪ Expansion of rail / road network connected to ports and identification of congested routes ▪ Find optimized transport solution for bulk and container cargo

Figure 1.1 Aim of Sagarmala Development

In order to meet the objectives, Indian Port Association (IPA) appointed the consortium of McKinsey and AECOM as Consultant to prepare the National Perspective Plan as part of the Sagarmala Programme.

1.2 Scope of Work

Based on the experience in port-led development, the major engagement challenge to develop a set of governing principles for our approach is shown in **Figure 1.2**.

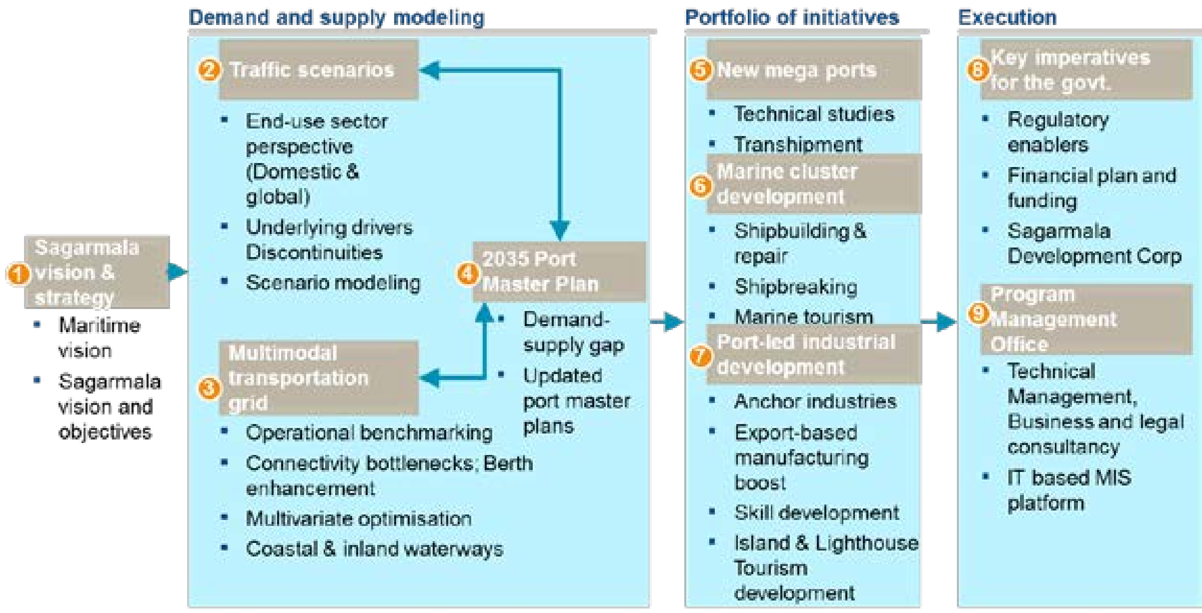


Figure 1.2 Governing Principles of Approach

As indicated above, the origin-destination of key cargo (accounting for greater than 85% of the total traffic) in Indian ports shall be mapped to develop traffic scenarios for a period of next 20 years. The forces and developments that will drive change in the cargo flows shall also be identified. This would lead to the identification of regions along the coastline where the potential for expansion of existing port exists. The various activities involved in the port led developments are charted in **Figure 1.3**.

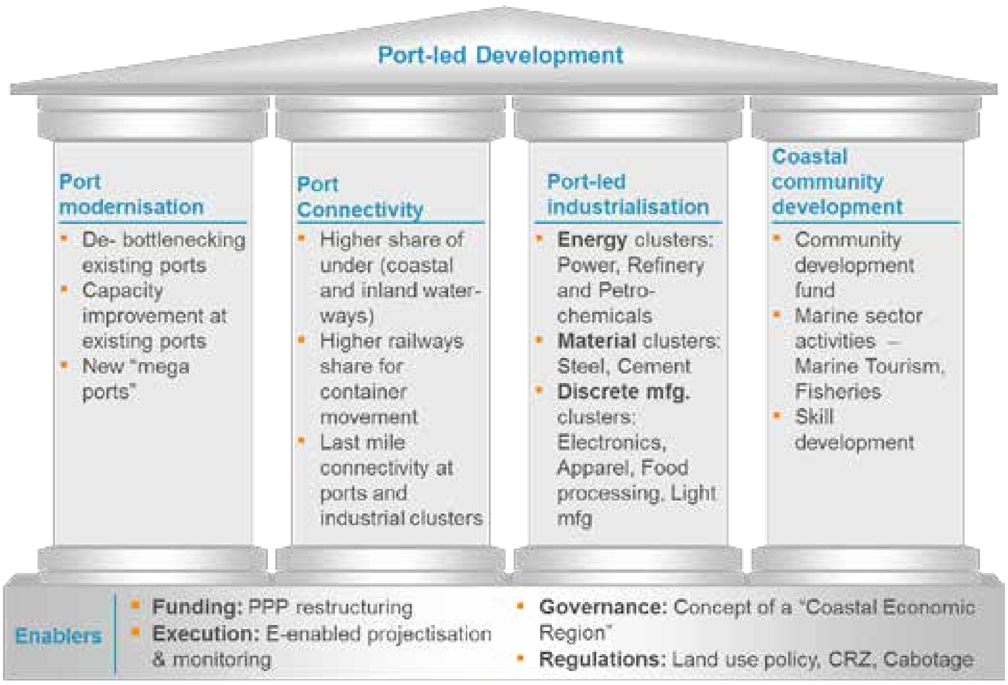


Figure 1.3 Port Led Developments

As part of the assignment, it is also expected to coordinate with the team working on "Benchmarking Operational Improvement Roadmap for Major Ports in India" study (which is being carried out simultaneously along with this assignment) and identify current and future logistic constraints (at the Major Ports) for the top 85% cargo categories based on analysis of current port capacity, productivity levels in comparison to international benchmark and evacuation bottlenecks in the logistics chain. This understanding should be an input in defining the 2035 Master Plan for each port.

Accordingly, this Master Plan report has been prepared taking into consideration the inputs provided on the future traffic and the benchmarking and operational improvements suggested for this port.

1.3 Present Submission

The present submission is the Final report for Development of Master Plan for V. O. Chidambaranar Port as part of SAGARMALA assignment. This report is organised in the following sections:

Section 1.0 : Introduction
Section 2.0 : The Port and Site Conditions
Section 3.0 : Details of Existing Facilities
Section 4.0 : Performance, Options for Debottlenecking & Capacity Assessment
Section 5.0 : Details of Ongoing Developments
Section 6.0 : Traffic Projections
Section 7.0 : Capacity Augmentation Requirements
Section 8.0 : Rail and Road Connectivity
Section 9.0 : Scope for Future Capacity Expansion
Section 10.0 : Shelf of New Projects and Phasing

2.0 THE PORT AND SITE CONDITIONS

2.1 Tuticorin Port as at Present

Tuticorin Port (08° 45‘N and 78° 13‘E) is one of the 12 major ports in India. It is an artificial, deep-water port on the East coast of India in Tuticorin district of Tamil Nadu. It is situated alongside of Palk Strait and inside Gulf of Mannar. It is situated approximately 160km North from Kanyakumari and 129 Nautical miles from Western region connecting international sea route. The location plan is shown in **Figure 2.1**.

Figure 2.1 Location Plan

VOC Port has, at present 14 berths and the port handled a total traffic of about 32 MT during 2014 – 15. The major commodities are coal (≈ 14 MT) followed by containers (≈ 11 MT); Fertilisers (≈ 1.5 MT); Copper concentrate (≈ 1.2 MT); others (≈4 MT)

The layout of port with existing berths as seen from the latest satellite picture is furnished in **Figure 2.2**.

Figure 2.2 VOCPT Port Layout Satellite Image

There are three coal berths exclusively handling thermal coal for captive power plants and one oil berth for handling POL products, LPG and chemicals. There are two exclusive container terminals each with one berth operated by two different BOT operators. The other eight berths handle all other cargo including thermal coal meant for other power plants, industrial coal, copper concentrate, fertilisers and general cargo.

While liquid cargo and containers are handled in exclusive berths with dedicated facilities, thermal coal meant for captive use of nearby power plants of TNEB & NTPL is handled in exclusive berths and conveyed through mechanized methods. However identical/similar cargoes like thermal coal meant for private power plants, industrial coal, and pet coke meant for multiple users are handled in multi-cargo berths through semi-mechanized methods for unloading, stacking and evacuation. Similarly bulk cargoes like lime stone, copper concentrate whose quantity is considerable are handled and conveyed by semi-mechanized methods. All these are bulk import cargoes having potential to cause pollution while being handled the side of food grains, fertilizers and other general cargoes in multipurpose berths.

2.2 Road Connectivity

V.O. Chidambaranar Port is connected with major National Highways connecting through three major cities/ urban centres in Tamil Nadu like Tirunelveli, Madurai and Kanyakumari.

§ NH-45 beyond Tirunelveli road intersection meeting Tuticorin – Madurai (NH-45B)

§ Tuticorin – Tiruchendur (NH7A) road cutover NH7 connecting to Kanyakumari

All-important destinations in India from North or East could be accessed through NH7 to travel south as shown **Figure 2.3** in below.

Figure 2.3 Road Connectivity to Tuticorin

2.3 Rail Connectivity

Presently a Broad Gauge single line connects the Port area originating from Milavattan Railway station. The total length of this railway line is 17.60 km as shown in **Figure 2.4**.

The distance from Milavattan Railway station to VOC wharf is 14.0 km and VOC wharf to Marshalling yard is the balance length near coal yard with a loop line with 5 no. lines available in the Marshalling yard.

Figure 2.4 Rail Connectivity to VOC Port

2.4 Site Conditions

2.4.1 Meteorology

The weather of Tuticorin constitutes extended summer and tender winter influenced by tropical hot climate. The temperature in summer varies from 25° C to 40° C. The hottest months are found to be May and June. The monsoon season commences around August and lasts till October. The mean atmospheric pressure reduced to MSL is 1010.70 mb. The monthly maximum observed mean sea level pressure is 1014.00 mb.

2.4.1.1 Winds

The governing wind direction in India is NE and SW influenced by monsoon. Monsoonal winds occur from WNW – WSW during May to August and N – ENE during November to February in this region. Prevailing winds was high during 1966 i.e. 47 days with wind speed of 40 kmph.

Annual Wind distribution percentage at Tuticorin is presented for a period of 1961-90 in **Table 2.1**.

Table 2.1 Annual Wind Distribution at Tuticorin (%)

MONTH		WIND												
		No. OF DAYS WITH WIND SPEED (KMPH)				PERCENTAGE No. OF DAYS WIND FROM								
		0	1 - 19	20 - 61	62 or more	N	NE	E	SE	S	SW	W	NW	CALM
JAN	I	0	24	7	0	66	16	1	0	0	0	0	17	0
	II	0	6	25	0	5	43	49	2	1	0	0	0	0
FEB	I	0	25	3	0	58	16	1	1	1	2	1	20	0
	II	0	8	20	0	1	25	61	10	3	0	0	0	0
MAR	I	0	29	2	0	39	20	5	2	3	7	6	17	1
	II	0	13	18	0	1	11	47	26	13	1	1	0	0
APR	I	1	28	1	0	17	13	6	5	9	13	16	18	3
	II	0	14	16	0	1	2	15	37	40	2	2	1	0
MAY	I	1	26	4	0	7	4	2	3	10	25	34	13	2
	II	0	13	18	0	0	0	2	19	44	11	22	2	0
JUN	I	0	19	11	0	1	0	0	2	10	30	51	6	0
	II	0	7	23	0	0	0	0	6	11	15	64	4	0
JUL	I	0	20	11	0	2	1	1	1	5	18	60	11	1
	II	0	9	22	0	0	0	2	10	10	10	64	4	0
AUG	I	0	20	11	0	4	3	1	1	2	13	62	14	0
	II	0	11	20	0	0	0	2	13	14	7	60	4	0
SEP	I	0	24	6	0	9	7	3	1	5	18	42	14	1
	II	0	14	16	0	1	1	2	13	28	11	40	4	0
OCT	I	0	29	2	0	19	12	3	4	4	14	23	20	1
	II	0	23	8	0	3	8	11	18	31	10	14	4	1
NOV	I	0	24	6	0	45	19	2	1	2	6	8	16	1
	II	0	19	11	0	8	32	26	14	11	3	3	2	1
DEC	I	0	23	8	0	60	22	1	0	1	2	1	13	0
	II	0	13	18	0	12	52	27	4	3	1	0	1	0

MONTH		WIND												
		No. OF DAYS WITH WIND SPEED (KMPH)				PERCENTAGE No. OF DAYS WIND FROM								
		0	1 - 19	20 - 61	62 or more	N	NE	E	SE	S	SW	W	NW	CALM
ANNUAL TOTAL OR MEAN	I	2	291	72	0	27	11	2	2	4	12	25	15	1
	II	0	150	215	0	3	15	20	14	17	6	23	2	0
NUMBER OF YEARS	I	31				31								
	II	31				31								

2.4.1.2 *Rainfall*

More than 70% of rainfall occurs during the month of October to December. Annual Average monthly rain distribution percentage at Tuticorin is presented for the period 1961-90 in **Table 2.2** below.

Table 2.2 Average Monthly Distribution of Rainfall

Month	RAIN FALL						
	Monthly Total	No. of Rainy Days	Total in Wettest Month with Year	Total in Driest Month with Year	Heaviest Fall in 24 Hours	Date and Year	Mean Wind Speed
	mm		mm	mm	mm		kmph
JAN	14.9	1	155.8 1961	0	90	11, 1961	19
FEB	17.6	1.1	99.2 1959	0	51.8	28, 1974	17.9
MAR	36.5	1.9	164.4 1971	0	71	7, 1971	15.2
APR	56.6	3	162.1 1970	0	126	2, 1961	12.6
MAY	20.9	1	163.1 1972	0	94.4	9, 1977	13.4
JUN	3.1	0.3	21.0 1970	0	21	4, 1970	16.7
JUL	10.8	0.7	142.1 1964	0	66.1	28, 1964	17.1
AUG	7.3	0.7	37.1 1971	0	30.2	12, 1972	16.8
SEP	17.7	1.2	101.7 1979	0	58.3	6, 1979	14.6
OCT	157.1	7.3	485.4 1972	23	167.4	28, 1957	11.7
NOV	206	8.3	441.1 1961	34.8	163.2	25, 1978	13.2
DEC	92.2	5	301.9 1955	14.6	188.2	3 1955	16.7

2.4.1.3 Air Temperature

The mean daily maximum and minimum temperature were observed to be 35.8° C and 21.30° C respectively. The maximum temperature at Tuticorin ranges between 41.1° and 33.3° C, while minimum temperature varies between 21.3° to 15.3° C. Month wise Maximum and Minimum Temperature at the port vicinity is presented in **Table 2.3** below.

Table 2.3 Maximum and Minimum Temperature - Monthwise

Month	MEAN						EXTREMES			
	Dry Bulb	Wet Bulb	Daily Max	Daily Min	Highest in the Month	Lowest in the Month	Highest	Date and Year	Lowest	Date and Year
	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
JAN	24.4	21.9	28.6	21.3	29.9	18.8	33.3	12	15.3	15
	27.2	23.9						1955		1990
FEB	25.6	23	29.5	22.3	31.5	19.6	35.8	9	17.2	4
	28.1	24.6						1965		1989
MAR	27.9	24.9	31.2	24.2	33.4	21.2	34.8	28	15.6	2
	29.6	25.8						1961		1989
APR	29.9	26.2	32.9	25.6	35.3	23	39.1	29	19.9	12
	30.9	26.9						1973		1984
MAY	30.7	25.9	34.9	26.5	38.4	23.8	41.1	14	21.1	26
	32.2	27						1956		1986
JUN	30.3	25	35.8	26.1	38.3	23.8	39.8	8	21.3	4
	32.5	25.3						1987		1970
JUL	29.8	24.4	35.2	25.8	37.8	23	39.4	11	20.4	15
	31.8	24.9						1987		1986
AUG	29.8	24.3	35	25.8	37.6	23.3	39.3	19	20.7	24
	31.5	24.9						1990		1969
SEP	29.6	24.4	34.1	25.3	37.5	23	38.7	5	20.7	30
	30.9	25.3						1980		1987
OCT	28.1	24.7	32.1	24.2	35.8	21.5	38.6	7	17.7	19
	29.3	25.4						1990		1984
NOV	26.4	23.9	30	23.2	32.4	20.8	34.9	9	17.8	17
	28.1	24.9						1969		1986
DEC	25.1	22.8	29	22.1	30.8	19.6	33.3	7	15.6	14
	27.4	24.4						1972		1984

2.4.1.4 Visibility

Generally, the visibility is comprehensible; visibility in the monsoon normally deteriorates during rains and occasional squalls. Visibility data are recorded at Tuticorin daily and observation records are available since 1961-1990. Analysis of the average visibility ratio for every month is carried out based on I.M.D. maintained data for a period of 30 years. Around the year more than 84% of the days the visibility is explicit even over 20 km. On an average only one day over the years is visible up to 4 km and around 5 days up to 10 km.

2.4.1.5 Relative Humidity

The average humidity ranges from nearly 79% in December to about 59% in June.

2.4.2 Oceanography

2.4.2.1 Tides

The tide range at Tuticorin relative to the Chart Datum (CD) is as follows:

§	Lowest Low Water Level	(LLWL)	+ 0.11 m
§	Mean Lower Low Water Springs	(MLLWS)	+ 0.25 m
§	Mean Low Water Springs	(MLWS)	+ 0.29 m
§	Mean Low Water Neaps	(MLWN)	+ 0.55 m
§	Mean Sea Level	(MSL)	+ 0.64 m
§	Mean High Water Neaps	(MHWN)	+ 0.71 m
§	Mean High Water Springs	(MHWS)	+ 0.99 m
§	Highest High Water Level	(HHWL)	+ 1.26 m

The above levels are with respect to chart datum, which is approximately the level of Lowest Astronomical Tide.

2.4.2.2 Currents

North/ South current are created at the approach channel of range 0.5 – 1.0 Knots due to seasonal wind. The current direction is southwards during Dec – Mar, East – North East during May – Sep. During monsoon predominant direction is SSE (South South East) to SSW (South South West) for NE monsoon. The current magnitude ranges around 0.5 – 1.0 Knot most of the time during NE monsoon. During SW monsoon the directions are wider with magnitude of 0.5 Knots and less for most of the period.

2.4.2.3 Cyclone

Cyclone might occur during NE monsoon at Tuticorin. Tuticorin is not a frequent cyclone prone area. Even then on Nov 13th, 1992 at 1610 IST the port was hit directly by a cyclone with 113Kmph from ESE direction. In Dec 2000 port experienced shadow effects of the cyclone that passed nearby Tuticorin. NIOT managed to record a maximum wave height of 3 m off Tuticorin during this cyclone.

2.4.3 Geotechnical Data

Borehole data collected at Tuticorin Port trust as reported in the report of I-Maritime, 2013 for DPR of Outer Harbour indicates that the seabed profile for BH 12 at 11.1m CD generally comprises of hard limestone between11.10m – 12.51 m CD and soft limestone at 12.5m – 12.89 m CD. Whereas BH 27 profile at 6.85 m CD comprises of clayey sand between 6.85 m – 7.85 m CD, Silty sand between 13.85m – 21.05 m CD and Calcareous Sandstone between 7.85 m – 13.85 m; 21.05 m – 25.10 m CD.

3.0 DETAILS OF EXISTING FACILITIES

3.1 General

Tuticorin Port presently handles commodities such as thermal coal, coking coal, limestone, iron ore, fertilizers and other break bulk cargo. The port also handles substantial quantities of POL at a dedicated jetty through pipelines. The total land area of the port is 2597.70 acres; Water spread area is 960 acres and is located south of Old Tuticorin Harbour.

The V. O. Chidambaranar port has an artificial harbour protected by two rubble mound breakwaters and is connected to deep water by a dredged channel.

The locations of the berths are shown in the following **Figure 3.1.**

Figure 3.1 Existing Facilities

The features of the existing harbour are as shown in below **Table 3.1**.

Table 3.1 Details of Breakwater and Channel

Breakwater	
§ North Breakwater	4086 m
§ South Breakwater	3876 m
Approach Channel	
§ Length	3800 m
§ Width	230 m
§ Depth	14.7 m below CD
Entrance Channel	
§ Length	300
§ Width	153 m
§ Depth	14.7 m below CD
Turning Basin	
§ Diameter	488 m
§ Depths	14.1 m below CD

3.2 Existing Jetties and Quays

The present berthing infrastructure at Tuticorin port can be divided into two categories (**Figure 3.1**) viz., coal & oil berths/jetties along the lee of North breakwater and container, multipurpose & shallow draft berths along the lee of South breakwater. There are 4 general cargo berths within a dock like basin at the North West side of Southern breakwater kink and 2 others parallel to it. Two privatised container terminals and a deeper draft quay are reclaimed next to general cargo berths. On the northwest side of the reclaimed quay shallow berths are assigned for construction materials. A small finger jetty exists adjacent to shallow berths. One deeper coal berth, two coal jetties and one oil jetty are being operated alongside the North breakwater. **Table 3.2** provides details of all the berths at V.O. Chidambaranar Port.

Table 3.2 Details of Berthing Infrastructure

S. No.	Berth Description	Length (m)	Draft (m)	Cargo Handled
1.	Berth No I	168.0	9.30	General Cargo
2.	Berth No II	168.0	9.30	General Cargo
3.	Berth No III	192.0	10.70	General Cargo
4.	Berth No IV	192.0	10.80	General Cargo
5.	Berth No V	168.0	8.60	General Cargo
6.	Berth No VI	168.0	9.30	General Cargo
7.	Berth No VII	370.0	10.90	Container
8.	Berth No VIII	345.0	12.80	Container
9.	Berth No IX	334.5	12.80	General Cargo
10.	Oil Jetty	228.0	12.80	POL
11.	Coal Jetty I	185.0	12.80	Thermal Coal For TNEB
12.	Coal Jetty II	210.0	12.80	Thermal Coal For TNEB
13.	SDB (Shallow Draft Berths)	140.0	5.85	Coast Guard Utility
14.	NCB I (North Cargo Berth I)	306.0	12.80	Thermal Coal for NTPL
15.	Finger Jetty	121.0	4.50	Port Craft Utility

3.2.1 Berth I – IV

It has a quay length of 732 m with four berths viz. Berth I, Berth II, Berth III and Berth IV. Berth I can handle 25,000 DWT, Berth II can handle 40,000 DWT, Berth III can handle 50,000 DWT and Berth IV can handle 50,000 DWT size vessels. All these are multi-purpose berths are handling industrial coal, cement, fertilizers, and other bulk cargos.

3.2.2 Berth V – VI

This quay has two berths (Berth V & VI) with a length of 168 m each and draft of 8.6 m and 9.3 m respectively. These berths are multipurpose berths and can accommodate vessel sizes of 40,000 - 45000 DWT handling logs, construction materials, stones/rocks and other general cargoes.

3.2.3 Berth VII

This quay is a single berth having 10.9 m draft and 370 m of quay length facing perpendicular to Berth V–VI. It is a container berth operated by M/S PSA SICAL on BOT basis since July 1998. This berth is capable of accommodating container vessel sizes up to 50,000 DWT.

3.2.4 Berth VIII

This berth has a draft of 12.8 m and 345.50 m of quay length. It is also a container berth and operated by M/s. Dakshin Bharat Gateway Terminals on BOT basis. This berth is capable of accommodating container vessel sizes up to 60,000 DWT.

3.2.5 Berth IX

Berth IX is one of the deeper berths at VOCPT and is located next to Berth VIII. It has a draft of 12.8 m and the length of 334.5 m. Similar to berths VII and VIII this berth has a reclaimed backup area of approximately 6 Ha behind it and is used as container stack yard.

3.2.6 Coal Jetties (CJ-I & CJ-II)

The Port has two coal jetties at the northern end of north breakwater lee operated by TNEB (Tamil Nadu Electricity Board). Each jetty has a draft of 12.8 m. The main jetty length of CJ I & II are 185 m and 210 m respectively. The lengths of the jetties from dolphin to dolphin facilities are 340 m each. It can accommodate vessel sizes up to 50,000 to 60,000 DWT. These berths are equipped with shore reception hopper facilities for unloading of coal and are connected to conveying system leading to the power plant stack yard.

3.2.7 Oil Jetty (POL)

VOCPT has an oil jetty with a draft of 12.8 m with jetty head of 30.3 m with dolphins of size 15 m X 15 m at each side of berth at 11.35 m from jetty head located in the lieu of north breakwater. This berth handles petroleum, oil and lubes (POL) LPG and Liquid Ammonia. This berth can handle tankers up to 65,000 dwt with Length Overall (LOA) up to 229 m.

3.2.8 NCB-I (North Cargo Berth)

North cargo berth has commenced operations recently is located along the lee of Northern breakwater. This berth being a deep a draft berth of 14.1 m depth can handle Panamax vessels up to a draft of 12.8 m. This is a captive berth for unloading thermal coal meant for NTPL power plant.

3.3 Cargo Handling System

3.3.1 Coal Handling System

Coal handling through Tuticorin Port is basically imports of thermal coal for Power Plants located in the vicinity of Port. Presently there are two main power plants as below.

§ Tuticorin Thermal Power station (TTPS) of TANGEDCO Located in Port Estate - 1050 MW consisting of five units of 210 MW each.

§ NTPL Power plant near TANGEDCO power plant – 1000 MW Power plant consisting of 2 units of 500 MW

In addition to the above there are a few small/mini thermal power plants in and around Tuticorin all owned by private industries some of which are meant for captive use of the specific industries.

Further coal is also imported by private traders for use of various industries like cement plants, sugar plants, paper industry etc., in the hinterland.

The coal jetties CJ1 and CJ2 handle coal meant for TANGEDCO power plant through a two mechanical coal handling conveyor system is available from the respective berths of Tuticorin Port to the power plant's stack yard direct with any transit stacking with annual throughput of around 6 MT. The berths CJ1 and CJ2 were constructed by the port authority the top side facilities like Hoppers for receiving coal from the ship's cranes and the conveyor system are owned, operated and maintained by Tangedco.

The salient features of the conveyor system from CJ-I are given in **Table 3.3**:

Table 3.3 Coal Handling System at CJ-I

S. No	Conveyor No.	Length	Power		Belt Used	Belt Width	Speed	Capacity
		(m)	(KW)	(KV)	(Material)	(mm)	(m/s)	(TPH)
1.	13	252.00	150.0	415.0	Nylon	1400	3.300	2000
2.	13A	255.00	150.0	415.0	Nylon	1400	3.300	2000
3.	14	300.00	150.0	415.0	Nylon	1400	3.300	2000
4.	15	837.60	336.0	6.6	Nylon	1400	3.300	2000
5.	16	847.00	336.0	6.6	Nylon	1400	3.300	2000
6.	17	1,240.00	485.0	6.6	Nylon	1400	3.300	2000
7.	19	265.00	300.0	6.6	Nylon	1400	3.300	2000
8.	BFD-8	26.40	45.0	415.0	Nylon	1800	2.500	2000
9.	RBFD-11	9.35	30.0	415.0	Nylon	2000	1.000	2000
10.	45	101.20	300.0	6.6	Nylon	1800	2.450	2000
11.	46	76.45	115.0	6.6	Nylon	1800	2.500	2000
12.	43	107.92	240.0	6.6	Nylon	1800	2.500	2000
13.	47	101.53	300.0	6.6	Nylon	1800	2.450	2000
14.	62	174.94	115.0	415.0	Nylon	1800	1.250	900

The salient features of the conveyor system from CJ-II are given in **Table 3.4.**

Table 3.4 Coal Handling System at CJ-II

S. No	Conveyor No.	Length	Power		Belt Used	Belt Width	Speed	Capacity
		(m)	(KW)	(KV)	(Material)	(mm)	(m/s)	(TPH)
1.	65	284.00	255.0	6.6	Nylon	1800	2.500	2000
2.	66	167.75	160.0	6.6	Nylon	1800	2.500	2000
3.	67	996.19	485.0	6.6	Nylon	1800	2.500	2000
4.	68	127.70	160.0	6.6	Nylon	2000	2.000	2000
5.	69	669.90	416.0	6.6	Nylon	1800	2.500	2000
6.	70	711.30	436.0	6.6	Nylon	1800	2.500	2000
7.	71	549.96	365.0	6.6	Nylon	1800	2.500	2000
8.	72	885.33	604.0	6.6	Nylon	1800	2.500	2000
9.	73	97.63	188.0	6.6	Nylon	1800	2.500	2000
10.	48A	192.45	209.0	6.6	Nylon	1800	1.300	1100
11.	48B	194.68	209.0	6.6	Nylon	1800	1.300	1100
12.	48A1	252.23	175.0	6.6	Nylon	1400	2.417	1100
13.	48B1	262.23	175.0	6.6	Nylon	1400	2.417	1100
14.	61	157.30	236.0	6.6	Nylon	1800	2.500	2000
15.	64	49.722	118.0	6.6	Nylon	1800	2.500	2000

The locations and plan of the conveyor system from jetty to the plant stack yard is shown in detail in **Figure 3.2** & **Figure 3.3** for CJ-I & CJ-II.

Figure 3.2 Converyor Plan from Coal Jetty CJ2 upto the Port Limit

Figure 3.3 Converyor Plan from Coal Jetty CJ2 to the Port Limit and to their Yard

Similarly the coal meant for NTPL power plant is handled exclusively from their captive berth NCB1 through a fully mechanized handing system consisting of gantry grab unloaders and conveyor system leading to their power plant direct without any intermediate stack yard inside the port. The berth NCB1 and the entire handling system is installed and operated by NTPL on BOT basis

3.3.2 Container Handling System

The port does not own any container handling systems as the container berths are privatised on BOT basis. Each container berth has their own equipment based on their requirement.

Terminal VII (PSA SICAL) has a capacity of 4,50,000 TEU and terminal VIII (DBGT) has a capacity of 6,00,000 TEU. The equipment deployed at the terminals as of now are listed in **Table 3.5**

Table 3.5 Major Container Handling Equipment Deployed by BOT Operators as of Now

BOT Operator Description	Quantity (No.)	Rated Capacity (T)
Equipment Deployed by M/S PSA SICAL		
§ Rail Mounted Quay Crane	3	40
§ Rubber Tyre Gantry Crane	8	40
§ Tractor Trailers	12	55
Equipment Deployed by M/S DBGT		
§ Reach Stackers	2	45
§ Prime movers & Trailers	8	50
§ Harbour Mobile Crane	1	200
§ Harbour Mobile Crane	2	100

3.3.3 Other Equipment

Apart from the mechanized Coal and Container handling terminals, the port has some own and other equipment deployed on BOT basis for efficient loading/unloading operations. The details are outlined in **Table 3.6**

Table 3.6 Other Loading/ Unloading Equipment in VOCPT

Equipment Description	Quantity (No.)	Rated Capacity (T)
Equipment Deployed by VOCPT		
§ Wharf Crane	2	6
§ Wharf Crane	2	10
§ Wharf Crane (Grab)	3	20
§ Floating Crane	1	4
Equipment Deployed by BOT Operator		
§ Harbour Mobile Cranes	2	124
§ Floating Crane	1	35
§ Self-Propelled Barge	3	2000

It is pertinent to note that besides these, certain other private equipment is permitted from time to time as necessary.

3.4 Storage Facilities

The logistic operations are supported by storage arrangements by V.O. Chidambaranar Port Trust. In addition to the open stack yard, there are transit Sheds, warehouses and other storage facilities inside and outside the Port area as presented in **Table 3.7** below.

Table 3.7 Details of Storage Facilities

Description	Quantity	Location	Capacity		Commodity
			Dry	Liquid	
OWNED BY PORT					
§ Warehouses	3	Inside	14,940.00 m^2		
§ Transit sheds	2	Inside	10,800.00 m^2		
§ Dangerous Cargo Sheds	1	Inside	733.00 m^2		
§ Fumatorium	1	Inside	739.00 m^2		
§ Open area	1	Inside	5,53,000.00 m^2		
OWNED BY PRIVATE PARTIES (In Port's Leased Land)					
§ Warehouses	14	Outside	4,23,000.00 m^2		
§ Warehouses	2	Outside	36,000.00 m^2		
§ Tank	3	Inside		15,000.00 m^3	Phosphoric acid
§ Tank	1	Outside		13,700.00 KL	Naphtha
§ Tank	1	Outside		13,800.00 KL	Naphtha
§ Tank	1	Outside		14,100.00 KL	Naphtha
§ Tank	3	Outside		25,500.00 KL	Furnace oil
§ Tank	1	Outside		750.00 KL	LSFO
§ Tank	1	Outside		540.00 KL	LSHFHSD
§ Tank	3	Outside		7,800.00 KL	Petrol
§ Tank	2	Outside		15,000.00 KL	HSD
§ Tank	2	Outside		10,830.00 KL	Kerosene
§ Tank	2	Outside		7,790.00 KL	EDC
§ Tank	1	Outside		15,000.00 KL	LPG
§ Tank		Outside		2,000.00 m^3	VCM
§ Tank	1	Outside		5,000.00 m^3	VCM
§ Tank	1	Outside		10,000.00 m^3	Ammonia

3.5 Pilotage and Towage Facilities

Pilotage is compulsory for all vessels having capacity of more than 200 MT Gross Tonnage. The port has tugs, launches and mooring boats for pilotage and towage operations as listed in **Table 3.8**.

Table 3.8 Floating Crafts

Description	Quantity	Capacity	Owned/ Hired/ Lease
Tugs	1	32T BP	Own
Tugs	1	45T BP	Own
Tugs	1	50T BP	Hired
Tugs	1	50T BP	Hired
Launches	1	20 knots	Hired
Launches	1	48 GRT	Own
Launches	1	48 GRT	Own
Launches	1	2x640 BHP	Own
Launches	1	20 Knots	Hired
Mooring Boats	2	1x54 BHP	Own

4.0 PERFORMANCE, OPTIONS FOR DEBOTTLENECKING & CAPACITY ASSESSMENT

4.1 General

The total cargo handled through the existing facilities, during the past 5 years ending March 2015, is presented in the following **Table 4.1**.

Table 4.1 Cargo Handled During Last 5 Years

S. No.	COMMODITY	2010-11	2011-12	2012-13	2013-14	2014-15
IMPORT (MTPA)						
1.	Liquid cargoes	1.15	1.29	1.21	0.94	1.11
2.	Fertilizer	1.16	1.11	0.49	0.39	0.42
3.	F.R. Materials	0.73	0.89	0.56	0.79	1.05
4.	Coal	8.19	9.28	10.62	12.15	13.80
5.	Pet coke	0.07	0.11	0.07	0.20	0.21
6.	General Cargo	2.49	2.56	2.88	2.06	2.76
7.	Other General Cargo	1.36	1.22	0.55	0.56	0.25
8.	**Total Imports**	**15.16**	**16.46**	**16.37**	**17.09**	**19.60**
EXPORT (MTPA)						
1.	Dry Cargoes	0.72	0.43	0.46	0.48	0.30
2.	Liquid Cargoes	0.54	0.47	0.70	0.55	0.40
3.	Food Grains	0.04	0.30	0.13	0.05	0.06
4.	General Cargo	1.05	1.06	0.95	0.34	0.96
5.	Other General Cargo	0.06	0.15	0.27	0.01	0.06
6.	**Total Export**	**2.40**	**2.42**	**2.52**	**1.42**	**1.78**
LIGTHERAGE AT (MTPA)						
1.	Old Harbour	0.78	0.68	0.04	0.12	0.13
2.	V.O.Chidambaranar Port Trust	0.21	0.26	0.30	0.07	0.26
3.	**Total Lighterage**	**0.99**	**0.94**	**0.33**	**0.19**	**0.40**
CONTAINER TRAFFIC						
1.	Import (Mil TEUs)	0.23	0.23	0.23	0.25	0.29
2.	Export (Mil TEUs)	0.24	0.25	0.24	0.26	0.27
3.	**Total Traffic (Mil TEUs)**	**0.47**	**0.48**	**0.48**	**0.51**	**0.56**
4.	**Total Traffic (MTPA)**	**8.17**	**9.23**	**9.37**	**10.13**	**11.03**
TOTAL TRAFFIC (MTPA)						
1.	Old Harbour	0.78	0.68	0.04	0.12	0.13
2.	V.O. Chidambaranar Port Trust	**25.94**	**28.36**	**28.56**	**28.71**	**32.68**
	Total	**26.71**	**29.05**	**28.59**	**28.83**	**32.81**

4.2 BCG Benchmarking Study

BCG, as part of their benchmarking study, has looked into the operation of the berths and has suggested various measures for improving the performance. The report of BCG pertaining to V. O. Chidambaranar Port is given in the **Annexure 1**. The key observations are as follows:

According to them VOCPT has Potential to handle additional cargo volume but it is constrained by low productivity and draft constraints. The findings and suggestion for the Tuticorin port are as follows-

4.2.1 Cargo Volume Analysis

The Tuticorin port has handled 32 MT in 2015 which is an increase over 5 year CAGR of 6%. Due to recently commissioned power plants in and nearby Tuticorin port, the coal cargo volume demand has been increasing. Both coal and container has shown traffic growth consistently for the past 5 years. The percentage of occupancy of the coal berths as calculated are found to be very high, mainly due to the increase in volume for newly operating power plants and this is expected to grow much more in the coming years. Once the new power plants are installed as planned operate to their full capacity, the demand for coal is expected to increase by 43% by 2017-19.

4.2.2 Berth Occupancy

The berths approximately have occupancy of 75% presently. The highest occupied berth is IX and the other general cargo berths have occupancy of around 65%. (Refer to **Figure 4.1** for detailed occupancy berth-wise).

4.2.2.1 Coal Berths

The Tuticorin port handles coal for TNEB in CJ-I and CJII. Coal meant for other than TNEB is handled at berth IX, which is the only deep draft multi-purpose berth (12.8 m draft). The port actually faces certain constraints for handling coal since fully loaded Panamax vessels cannot be brought into port unless unloaded partially at anchorage. The partially unloaded Panamax vessels are again partially unloaded at berth IX due to draft constraints before taken to other multi-purpose berths.

Productivity at the anchorage is significantly lower than at berths due to rough weather, higher handling cost etc. Comparison on cost of offloading Panamax vessel at nearest deeper port (Karaikal) shows anchorage offloading is cheaper. To the present floating crane and 3 barges an additional floating crane by a third party invited by the port is suggested.

4.2.2.2 Container Berths

The Tuticorin port handles container at two berths namely VII & VIII. Occupancy of berth VII is optimal due to consolidated cargo i.e. occupancy is nearly maximal and there is limited scope of traffic growth. Limitation in berth strength to take higher capacity cranes on quay is a drawback. PSA owned berth VII works on royalty based model with VOCPT. Productivity is higher than TAMP norms and profit margin is reduced every year due to high royalty.

Occupancy of berth VIII is less for now due to absence of handling equipment despite of 12.8 m draft. Due to this it could not get the needed attention form international shipping lines. However this terminal is expected to be equipped with container quay cranes by 2016-17.

4.2.2.3 Fertilizer Berths

The Tuticorin port handles fertilizer at multi-purpose berths namely II, III, IV VI and IX. The scope of traffic growth for fertilizers is dependent on increase in agricultural activities. Approximate traffic of 1.7 MT is handled at VOPCT in all the above mentioned berths in total. The low productivity at berths II, III, IV and VI is due to vessels lightened at berth IX. The other reason influencing low productivity is limitation in the capacity of cranes available for ship to shore operations.

4.2.3 Key Findings & Recommendations

4.2.3.1 Coal Handling Productivity

- Panamax vessels with over 12.8 m draft cannot enter the port.
- All Panamax vessels with a loaded draft of more than 12.8 m have to resort to lighterage operations at anchorage till they attain the permissible draft.
- Coal handling capacity needs to be improved on productivity to create additional capacity.
- Average productivity at anchorage is approx. 8000 T/day against 20,000 T/day at berth.
- At present Cape size vessels cannot enter the port due to channel width constraints, however suggested to handle the entire cargo at anchorage (approx. 0.11 MT)
- Increase in cost of offshore coal handlings are high due to tariff of floating crane, high stevedoring cost and additional vessel chartering cost due to low handling rate.
- Old Tuticorin port cannot be an alternative unloading point due to draft constraints, port locality and distance from the anchorage.
- Berth IX (12.8 m draft) is highly in demand being the only option for partially loaded Panamax vessel resulting in increasing pre-berthing delay
- After MHC’s installed at coal handling berths, the expected productivity will be 17,000 T/day (11,000 T/day currently).
- 2 Nos. of 125T MHC at berth IX can result in increased utilisation to produce 28,000 T/day, if shallow draft coal berths are equipped as required (19,000 T/day currently).
- By limiting maximum of 3 shifts of stay at Berth IX with fully utilised MHC achieving vessel draft reduced to 10.4 m (required) shall unlock up to 1.4 MT of productivity.

4.2.3.2 Mechanisation of Berths III & IV

- Low capacity equipment and high reliance on vessels gear are the reasons for low productivity at the berths
- Incapable of shifting gearless vessels and absence of required crane capacity also a reason for the low productivity of the berths
- Due to high occupancy at berth IX the potential of these shallow draft coal berths are not revealed
- VOCPT to invite a third party for an additional MHC at each of these berths are suggested

- Additional MHC will result in increase of 50% productivity (17,000 T/day) leading to unlock additional berth capacity of 1.6 MT

4.2.3.3 Mechanisation of Berths IX

- Vessel handling is convenient since both discharge rate of vessel and evacuation rate at the berth is 17,000 T/day
- Present discharge rate at berth is 18,000 T/day
- In case of gearless vessels the discharge rate is 23,000 T/day resulting in berth cluttered upon departure
- Piling of coal at berth is undesirable due to cluttered berth hindering MHC and reduces its productivity up to 20% and it creates difficulty to heap the next vessel's cargo
- With capital cost of approx. 60 Cr INR conveyors from berth to storage yard shall be planned with IRR of 48%
- On deploying conveyors the MHC shall be used to discharge into hoppers

4.2.3.4 Additional Capacity by Traffic Relocation

- TNEB's demand constraints and lack of infrastructure leads to CJ-I and CJ-II limitation of productivity to 11,000 T/day.
- With present condition it can achieve 15,000 T/day and can increase to 25,000 T/day by the following:
  - Widening and strengthening the berth
  - Installation of shore cranes
  - Conveyor overhauling
- The additional capacity unlocked can be used to handle non TNEB coal and can be stacked in different location by an additional diversified conveyor branch from the existing.
- This also benefits TNEB by logistic cost by gearless vessels and productivity increase.
- Three phase possibility to unlock 3-7 MT is also suggested:
  - Incentivise TNEB to improve productivity with no overhaul
  - Take over and refurbish one berth
  - Take over one berth and refurbish both

4.2.3.5 Dedicated Berth for Copper Concentrate (Berth VIII)

- Berth VIII was planned for container berth but resulted in low occupancy (approx. 55%) due to absence of quay cranes.
- This berth can be a short term alternative for lack of deeper draft berths to handle dry bulk
- Clean the commodity to prevent dust accumulation on berth and equipment.
- To be planned for bulk handling along with existing container handling.
- Release of approx. 0.3 MT Copper concentrate from berth IX impacts in additional handling of coal (approx. 1.5 MT/year).

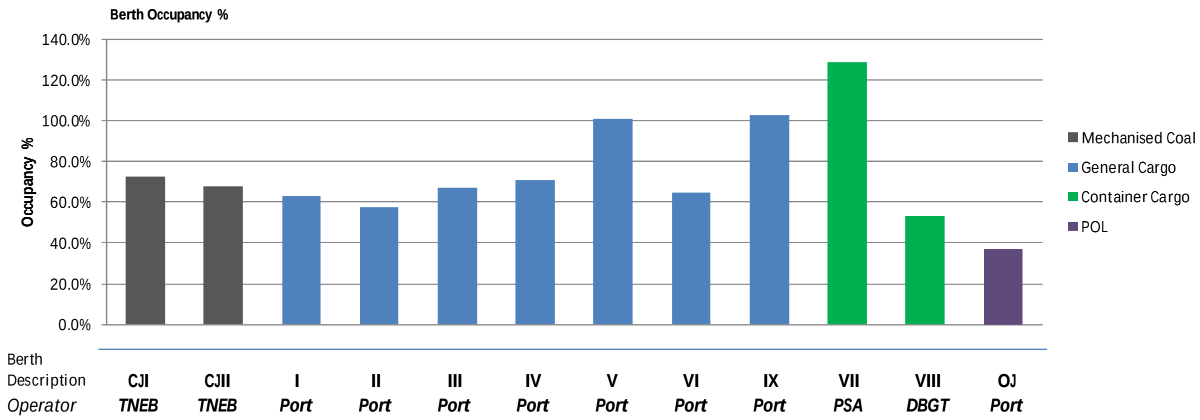


**Figure 4.1	Berth Occupancy %**

#### ***4.2.3.6	Coal Handling at Anchorage***

The port is presently carrying out lighterage operations for coal due to current limitations of drafts and navigation as below:

§ The present harbour entrance which has a width of 153 m cannot allow navigation of vessels with a beam wider than 32.2 m.
§ The depth of channel and the coal handling berths is 14.7 m which means Panamax vessels with loaded draft of 12.8m only can be handled.
§ Any further deepening of the berthing area beyond (-) 14.7 m will infringe on the toe line of the existing coal handling berths CJ1, CJ2 and berth IX which are all constructed on piles thus endangering on their stability.

Since it make considerable economic sense to bring bulk coal panamax vessels to their full load draft up to 14.5 m, the importers bring them fully loaded.

In order to handle fully loaded Panamax vessel the port does partial offshore transhipment until the vessel is lightened to the permissible draft. Anchorage handling is not cost effective as compared to handling at the berths. Apart from multiple handling the lack tranquil conditions at anchorage leads to significantly low productivity.

At present the lightening operation is executed with one floating crane and three barges. Average productivity at anchorage is approx. 8000 T per day as compared to productivity up to 20,000 TPD possible at the berth. The cargo wise tonnage at the anchorage for the FY 2014-15 is shown in **Table 4.2.** This causes increase in turnaround time leading to additional cost of charter. The handling cost at anchorage is high due to the following:

§ High cost of floating crane used for lighterage operations.
§ High stevedoring cost
§ Additional vessel charter cost due to low productivity

Table 4.2 Cargo Handled in Anchorage for FY 2014-15

Cargo	Qty (T)	Avg. Output (T)
Cu. Concentrate	445	445
Iron Ore	9,329	3,165
Lime Stones	8,833	4,417
Peas (Yellow)	1,000	1,000
Steaming(Non-Coking)Coal (I.Coal)	91,906	2998
T. Coal	23,104	1679
Total	**1,34,617**	

Also the lighterage operations during the year were limited to just 21 vessels. Thus the impact of lighterage operations in the overall traffic was limited during the year. The significant reason for this appears to be that imported coal from foreign countries is the main commodity that is brought in fully loaded Panamax vessels. It is further found that this happens when the importer buys the cargo on high seas and when the importer charters the vessel from load port itself with a planned intent to bring cargo to Tuticorin this does not happen much.

4.3 Performance of Existing Facilities

4.3.1 General

The cargo handling capacity of port facilities is based on many factors like the vessel size, fleet mix, equipment provided and the possible handling rates, time required for peripheral activities, capacity of stack yard, number of users, grades, capacity of evacuation system etc.

The capacity of existing berths is assessed assuming the mix of cargo being currently handled at these berths and the corresponding parcel sizes.

Another factor that is important in arriving at the berth capacity is the allowable Berth occupancy, which is expressed as the ratio of the total number of days per year that a berth is occupied by a vessel (including the time spent in peripheral activities) to the number of port operational days in a year. High levels of berth occupancy will result in bunching of ships resulting in undesirable pre-berthing detention. For limited number of berths and with random arrival of ships, the berth occupancy levels have to be kept low to reduce this detention. The norms generally followed for planning the number of berths in modern port to minimise the pre-berthing detention are given in **Table 4.3**.

Table 4.3 Recommended Berth Occupency

No. of Berths	Recommended Berth Occupancy Factor
1	60 %
2	65 %
3 & above	70 %

The performance of the berths are analysed and presented in the sections below.

4.3.2 Performance of Coal Handling Berths

The performance of coal berths CJ1 and CJ2 exclusively handling coal meant for TANGEDCO is provided in **Table 4.4**. Other coal is widely handled in various other berths like II, III, IV, V, VI and IX. A small quantity was also handled at the eastern arm during the non-availability of shallow berths. The performance of dedicated coal handling berths of TNEB during 2014-15 is shown in **Table 4.4**.

Table 4.4 Performance of Coal Handling Berths

S. No.	Berth Description	Total Cargo Handled (MT)	Total No. of Ships	Avg Parcel Size (T)	Standard Berth Days	Berthing/ De-Berthing Days	Total Berth Days	Berth Occupancy (%)
1.	CJI	3.10	74.00	41,915.34	252.46	12.33	264.79	**72.5%**
2.	CJII	3.18	68.00	46,730.01	236.76	11.33	248.09	**68.0%**

4.3.3 Performance of Container Berths

Berth VII operated by PSA has a high occupancy level where as berth VIII operated by DGBT has low occupancy for now as it is not yet equipped with container quay cranes. Their performance is outline in brief in **Table 4.5**.

Table 4.5 Performance of Container Berths

S. No.	Berth Description	Total Cargo Handled (MT)	Total No. of Ships	Avg Parcel Size (T)	Standard Berth Days	Berthing/ De-Berthing Days	Total Berth Days	Berth Occupancy (%)
1.	VII	7.54	781.00	9,648.19	339.16	130.17	469.33	**128.6%**
2.	VIII	1.34	235.00	5,701.12	155.94	39.17	195.10	**53.5%**

4.3.4 Performance of Oil Jetty

OJ operated by IOCL for their POL has a low occupancy despite having water depth of 14.1 m. Performance is studied in brief as shown in **Table 4.6**. The berth has two unloading arms for handling POL leading to the IOCL tank farms as also unloading arms for handling LPG and Liquid Ammonia.

Table 4.6 Performance of Oil Jetty

S. No.	Berth Description	Total Cargo Handled (MT)	Total No. of Ships	Avg Parcel Size (T)	Standard Berth Days	Berthing/ De-Berthing Days	Total Berth Days	Berth Occupancy (%)
1.	OJ	0.64	83.00	7,686.76	120.89	13.83	134.73	**36.9%**

4.3.5 Performance of Multipurpose Berths

Berth I, II, III, IV, V & VI are operated by VOCPT and have a fair occupancy but the shallow draft has a low occupancy. Berth wise Performance for the multipurpose berths is as shown in **Table 4.7.**

Table 4.7 Performance of Multipurpose Berths

S. No.	Berth Description	Total Cargo Handled (MT)	Total No. of Ships	Avg Parcel Size (T)	Standard Berth Days	Berthing/ De-Berthing Days	Total Berth Days	Berth Occupancy (%)
1.	I	0.48	131.00	3,634.80	207.35	21.83	229.19	**62.8%**
2.	II	0.73	119.00	6,140.26	190.13	19.83	209.96	**57.5%**
3.	III	2.30	108.00	21,303.15	226.14	18.00	244.14	**66.9%**
4.	IV	2.52	116.00	21,681.89	238.53	19.33	257.86	**70.6%**
5.	V	0.71	250.00	2,837.62	327.73	41.67	369.40	**101.2%**
6.	VI	0.98	138.00	7,117.60	212.52	23.00	235.52	**64.5%**

4.4 Capacity Assessment of Existing Facilities

The capacity of any existing port facilities depends on a combination of number of factors like the type of cargo handled, the DWT of the vessel, the vessel parcel size, the permissible berth occupancy, the type of handling facilities, the productivity of human resources both handling and managerial, the traditions and practices obtained etc., This being a complex matrix, the overall capacity of the existing port facilities is assessed as about 43 to 45 Million tonnes for the current cargo mix and infrastructure.

5.0 DETAILS OF ONGOING DEVELOPMENTS

5.1 General

VOC Port Trust has planned for various developmental projects which are in various stages of implementation to meet the port's traffic forecast from time to time. The locations of these projects in the layout of the existing harbour are indicated in **Figure 5.1**

Figure 5.1 Location of On Going Projects in VOCPT – As Per Current Plans

5.1.1 Development of North Cargo Berth II for Coal: 7.2 MTPA

The Concession Agreement with M/s. Tuticorin Coal Terminal Limited which is an SPV of ABG – LDA Bulk Handling Private limited entered on 11.09.2010 with revenue share of 52.17 %. The civil works for NCB II was commenced on 01.03.2012 with about 90% progress as on date. The three nos Gantry grab unloaders of 1800 TPH are in place. The conveyor system from berth to stack yard is to be installed. The installation of yard stacking and reclaiming equipment is taking place. It is understood that the concessionaire has sought time till end of July 2016 to complete construction phase. The terminal is expected to be commissioned during 2016-17..

5.1.2 Development of North Cargo Berth III for Coal: 9.15 MTPA

Concession Agreement was signed with M/s. Transstroy North Cargo Berth Pvt Ltd on 08.10.2013 with revenue share of 30%. Environmental clearance for the berth was received on 02.01.2015 with conditions. However, the agreement has since been cancelled and the port authority has already invited EOI, which is going to be followed by a tender to finalise a concessionaire.

5.1.3 Development of North Cargo Berth IV for Coal: 9.15 MTPA

Concession Agreement was signed with M/s. Transstroy North Cargo Berth India Pvt Ltd on 30.01.2013 with revenue share of 30%. Environmental clearance for the berth was received on 02.01.2015 with conditions. However the agreement has since been cancelled.

Port is planning to develop this berth as a container terminal for which EOI has already been invited.

5.1.4 Mechanization of Berth I-IV & IX: 8.72 MTPA (Addition)

Agreement was signed between the port and M/s IMC – PSTS Ltd on 25.03.2012 with revenue share of 26.55%. Also a concession agreement was signed with M/s CREW for mechanizing the unloading and conveying of coal and limestone in bulk from berth no. IX to the present multi-user coal stack yard (with a revenue share of 28%) and this is expected to be commissioned in 2016-17.

5.1.5 Development of Shallow Berth for Multipurpose Cargo : 2.67 MTPA

Concession Agreement was signed with M/s. Transstroy North Cargo Berth India Pvt Ltd on 17.04.2013 with revenue share of 22% for developing it as cement berth. Environmental clearance for the berth was received on 31.03.2014 with conditions. However the agreement has been cancelled and the project is expected to go through a process of retender for developing it as Multipurpose berth.

5.1.6 Development of Shallow Berth for Construction Materials: 2.0 MTPA

This project was tendered but not yet awarded. Presently the project is under litigation.

5.1.7 Rail Connectivity Projects

5.1.7.1 Port Marshalling Yard to Hare Island

For the evacuations of the bulk cargoes from the North Cargo Berths II, III and IV estimated around 25.3 MTPA stack yards are identified on Hare Island. Connectivity from Hare Island to Port Marshalling Yard is proposed and M/s. RITES Ltd was awarded for PMC on 17.08.2015.

5.1.7.2 Renovation of Existing Rail between Marshalling Yard to V.O.C Wharf

All the 5 tracks within the marshalling yard and near the berths I, II, III and IV upgradation was commenced on 20.04.2015. This upgradation also includes the siding into the stack yard near the green gate.

Apart from the above the port has upgraded the main connectivity road in the port into a four lane road recently

5.1.8 Road Connectivity Related Projects

5.1.8.1 Proposed Truck Parking Yard Adjacent to NH 7A

Outside the port limits adjacent to NH 7A opposite to Fisheries College a truck parking yard has been planned by the port trust. It is planned with 4.2 Ha for minimum of 200 trucks at a time as shown in **Figure 5.2**. It also comprises facilities like insurance agents, lorry booking offices, truck operator office, branches of corporate buildings etc. The land allotted for the parking is a low lying area approx. 3m down from adjoining road level with a 10m wide canal in between NH and the land. Since it is away from port limits the area is prone to encroachments. It has the advantage of being on the national highway. The basic development cost is studied by a third party consultant by the port to be 8.3 Cr INR and planned to develop on PPP mode. The total construction cost shall be about 24 Cr INR which includes RCC retaining wall, sand filling and consolidation, compound wall and fencing, 2 RCC bridge over canal and shifting of HT wire.

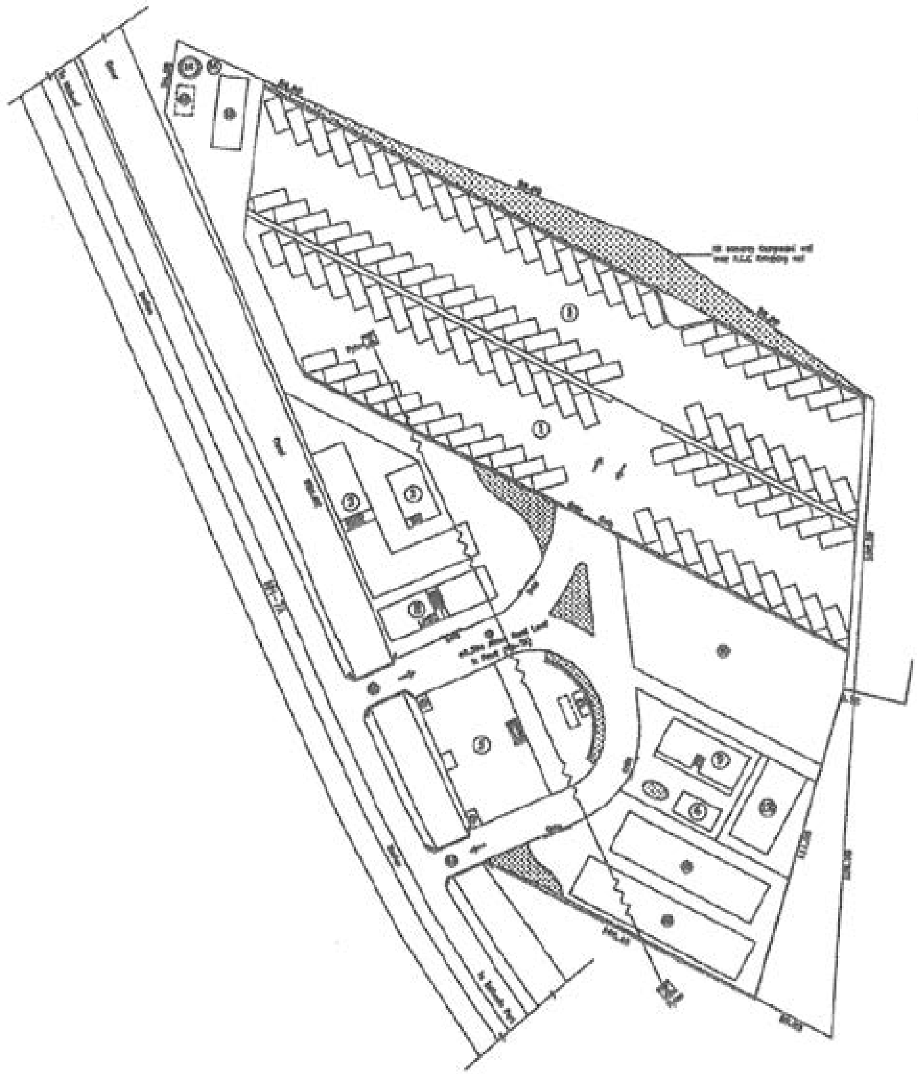


Figure 5.2 Proposed Truck Parking Yard Layout

5.1.8.2 Proposed Truck Parking Yard Adjacent to NH 7A

Within the port limits adjacent to VOC park lorry parking area is been proposed. The advantage of the location is it's near the intersection of harbour highway extension and VOC road. The total area allocated for parking yard is 23,750 m^2. The project has been awarded to M/s HPCL who will develop the yard with retail outlet as shown in **Figure 5.3**.

Figure 5.3 Proposed Parking Yard Near VOC Park

6.0 TRAFFIC PROJECTIONS

6.1 General

Tuticorin port is located in the southern part of Tamil Nadu and is the second biggest port in the state after Chennai. The port mainly handles containers, catering to the industrial regions in Central and Southern Tamil Nadu, and thermal coal for the power plants in the hinterland.

Tuticorin handled 32.5 MTPA of cargo traffic during year 2014-2015. Key commodities include thermal coal and containers. Thermal coal contributes ~42% to the total traffic while containers contribute another ~34%. Going forward, the total cargo is expected to increase to ~54 MTPA by 2020 and 75-83 MTPA by 2025.

The materialisation of projected traffic will however depend upon many factors such as growth of economy as assumed and certain specific events like installation of some of the power plants which are on the anvil. It can be seen that thermal coal and industrial coal imports constitute bulk of the cargoes. The trend in historical traffic at Tuticorin and the traffic forecast is shown below.

The origin-destination of key cargo (accounting for greater than 85% of the total traffic) for all Indian ports and development of traffic scenarios for a period of next 20 years has been carried out by **McKinsey & Co.** as mandated for this project. Accordingly, based on a macro-level analysis the future traffic for Tuticorin up to 2035 has be derived as presented in this section.

The trend in historical traffic at Tuticorin can be seen in **Figure 6.1** and the traffic forecast for VOCPT is shown in **Figure 6.2**.

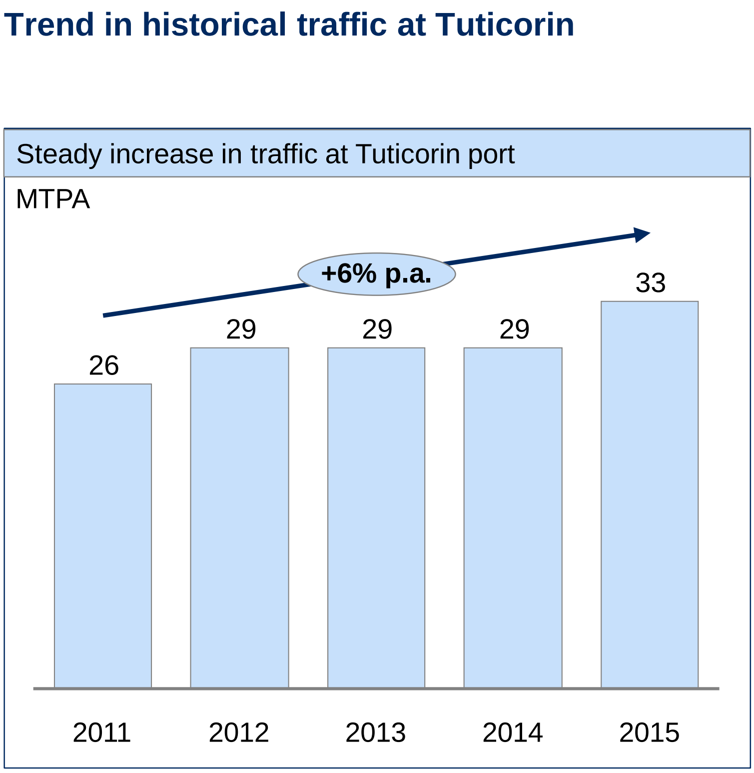


Figure 6.1 Historical Traffic Trend - Tuticorin

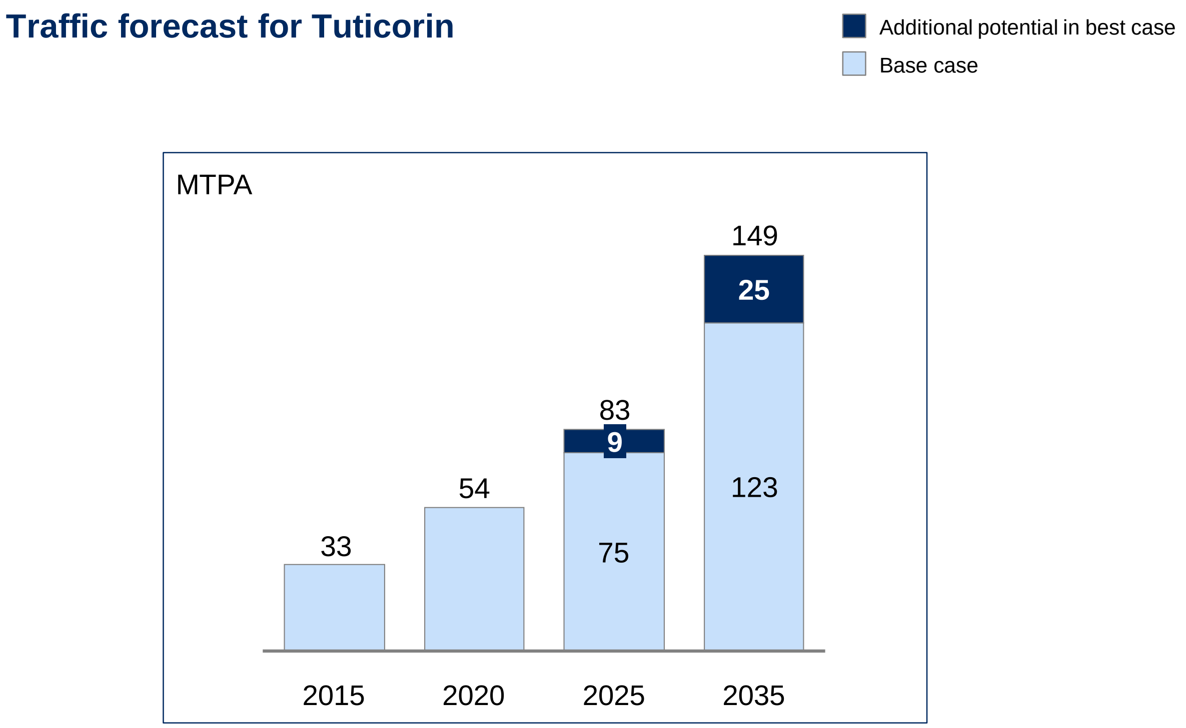


Figure 6.2 Traffic Forecast – VOCPT

6.1.1 Major Commodities and their Projections

Although there are a number of bulk cargoes that are handled through the port, the majority of those bulk cargoes as listed below are identified for handling through mechanized methods. They are also the most enduring part of the cargoes of port. All of them are import cargoes and has potential to generate dust during handling hence, prone to cause pollution when handled through semi-mechanized methods.

They consist of –

§ Thermal Coal

§ Industrial coal

§ Copper Concentrate

§ Pet Coke

§ Limestone

Coal of all types is classified as one cargo and copper concentrate is included in other ores.

6.2 Bulk Cargoes - Handled by Fully Mechanized Systems

6.2.1 Thermal Coal

Thermal coal imports through VOC Port can be classified as –

§ Thermal coal meant for captive users

§ Thermal coal meant for others

The thermal coal meant for captive users form the major quantity which consists of coal meant for TNEB Power plant and NTPL power plant both of which are handled through captive jetties and though conveyors.

In addition thermal coal meant for M/s. Coastal Energen (whose plant is located at about 30 km from port) whose first of the two units each of 600 MW was commissioned in 2014-15 and coal meant for 160 MW power plant of M/s Sterlite Industries which are handled by semi-mechanised methods through multipurpose berths can also called as captive thermal coal for the port.

Further M/s SEPC is putting up a 525 MW power plant close to the port in the Harbour estate itself and this is expected to go to operation near future. The thermal coal import on account of this will also be captive coal for the port.

The above account most of the total thermal coal imports through the port.

Currently, the port imports 13.8 MTPA of thermal coal primarily for the consumption of power plants. Out of this, 4.4 MTPA is coastally shipped coal for Tuticorin thermal power plant. 9.3 MTPA is imported coal catering to Tuticorin thermal power plant, Coastal Energen, Ind Bharath power plant, DCW, Sterlite, NTPL and other non-power customers. With the power sector growing resulting in higher PLFs, and the new capacity expected to come up around Tuticorin, along with import substitution on the back of rising domestic coal production, thermal coal imports can reach ~27 MTPA by 2020 and 38-42 MTPA by 2025. The plant wise projected thermal coal traffic through Tuticorin is as shown in **Figure 6.3**.

Thermal coal volumes

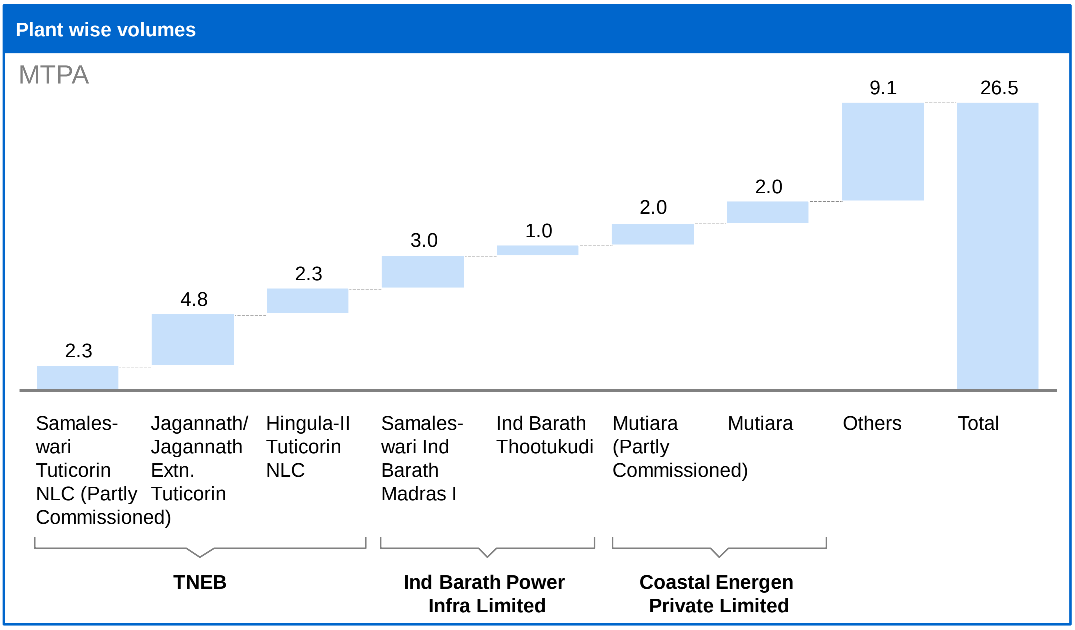


Figure 6.3 Plant Wise Project Thermal Coal Traffic for VOC Port

6.2.2 Copper Concentrate

It is a captive cargo of the port as it is imported as raw material for the use of nearby Sterlite copper. The annual throughput requirement of Copper concentrate is 1.2 MTPA and is nearly a fixed quantity for now as it is dependent of the capacity of this particular industry.

6.2.3 Industrial Coal

VOC Port has emerged as preferred port in the region for import of industrial coal meant for cement plants, paper industry, Foundries etc. with increasing throughputs over the years.

6.2.4 Pet Coke

Petroleum coke mainly used by Aluminium and anode making industries is imported through the port. Though its quantity is not very large has reasonable volume.

6.2.5 Lime Stone

Lime stone has of late emerged as a sizeable bulk cargo basically imported by cement industry.

The projections for commodities like iron-ore, limestone and other ores in the base case scenario has been arrived at by taking a GDP multiplier of 1.14 and an estimated growth rate of 5.88%. In the optimistic scenario, same GDP multiplier and an estimated GDP growth rate of 7% has been assumed.

6.2.6 Traffic Pattern of Coal of Different types

The traffic pattern of Coal of different types coal and Pet coke for the last 3 years is as below in **Table 6.1**.

Table 6.1 Traffic Pattern of Coal Traffic for Last 3 Years

S. No.	Cargo	2012-13	2013-14	2014-15
1.	Thermal Coal	66,60,692	66,43,688	86,12,589
2.	Industrial Coal	39,57,099	55,03,190	51,91,288
3.	Pet Coke	68,299	2,02,387	2,12,482
	Total	**1,06,86,090**	**1,23,49,265**	**1,40,16,359**

In addition Limestone is emerging as a major bulk over the years. The traffic projections for coal for the Master plan period are consistently increasing and large as can be seen in **Table 6.2**. The traffic for 2015-16 is based on port's estimates, while the projections for 2020, 2025 and 2035 are as per origin and destination study for ocean bound traffic of all the major ports as part of this master plan by M/s Mckinsey.

Table 6.2 Traffic Projection of Major Bulk Cargoes Over Master Plan Period (in MT)

S. No.	Cargo	2015-16	2020-21	2025-26		2035-36	
				Base Scenario	Optimistic Scenario	Base Scenario	Optimistic Scenario
1.	Coal of All Types	17.1	26.6	38.3	42.3	63.4	75.8
2.	Limestone	1.1	1.1	1.5	1.6	2.7	3.1
3.	Copper Concentrate	1.2	1.2	1.2	1.2	1.2	1.2
	Total	**18.4**	**28.9**	**41.0**	**45.1**	**67.3**	**80.1**

6.3 Containers

The port primarily caters to industrial districts of Southern and Central Tamil Nadu – Salem, Mettur, Namakkal, Karur, Coimbatore, Tuticorin, and also some parts of Karnataka. Currently the port handles 0.56 Mn TEUs of containers. Tuticorin generates ~55% of the container cargo for the port. Tuticorin, other regions of Tamil Nadu and the secondary hinterland of Bangalore are expected to grow at 9-11% GDP CAGR. Industrial activity is expected to increase at a healthy rate in Tamil Nadu, and the container volumes is expected to touch 0.99 Mn TEUs and 1.18-1.45 Mn TEUs by 2020 & 2025 respectively. For the projections till 2025, it is estimated that the GDP of above mentioned hinterland are expected to grow at 9% CAGR in the base case and 11% CAGR in the optimistic case. Post 2025 till 2035, growth rate of 5% in projected volume has been assumed in the base case and 6% in the optimistic case.

Tuticorin port is a feeder port and the containers are transhipped at international locations like Colombo and Singapore. If a transhipment port comes up at the southern tip of India, it can severely impact of the container volumes at Tuticorin as part of the cargo would directly go to the transhipment port via road. The evolution of container traffic through the port for the last five years is presented in **Table 6.3**.

Table 6.3 Container Traffic in VOCPT During the Last Five Years

Description	2010-11	2011-12	2012-13	2013-14	2014-15
No. of Vessels Handled	NA	365	351	399	491
Import TEUS.	2,26,230	2,31,457	2,34,098	2,51,038	2,88,503
Export TEUS.	2,41,522	2,45,639	2,41,501	2,56,697	2,71,224
Total TEUs	**4,67,752**	**4,77,096**	**4,75,599**	**5,07,735**	**5,59,727**

It can be seen that the increasing trend in container traffic through the port has been consistent and robust. **Figure 6.4, Figure 6.5** & **Figure 6.6** exhibits show the split of cargo from the different hinterlands and the projected traffic growth.

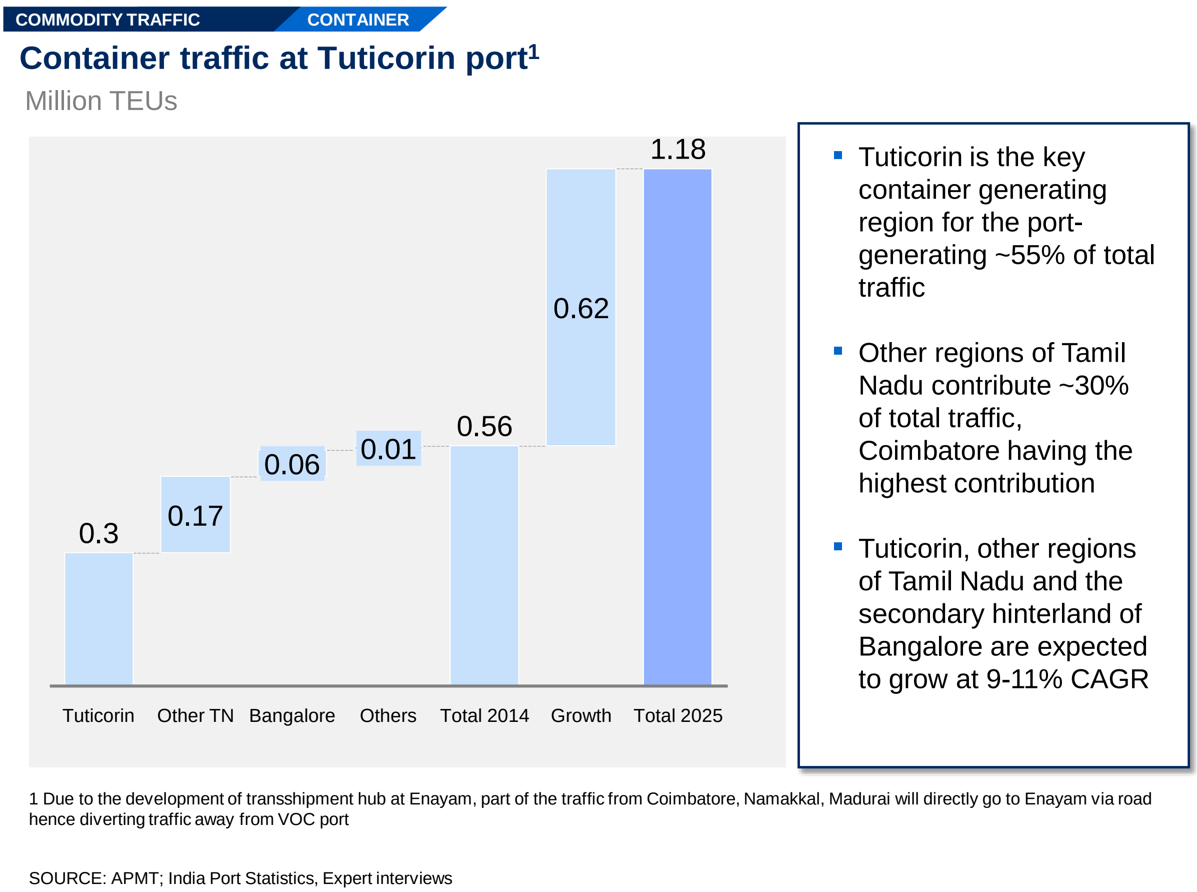


Figure 6.4 Container Traffic – VOC Port

COMMODITY TRAFFIC | CONTAINER

Tamil Nadu is the primary hinterland of Tuticorin port with small traffic from Bangalore

Primary hinterland of port

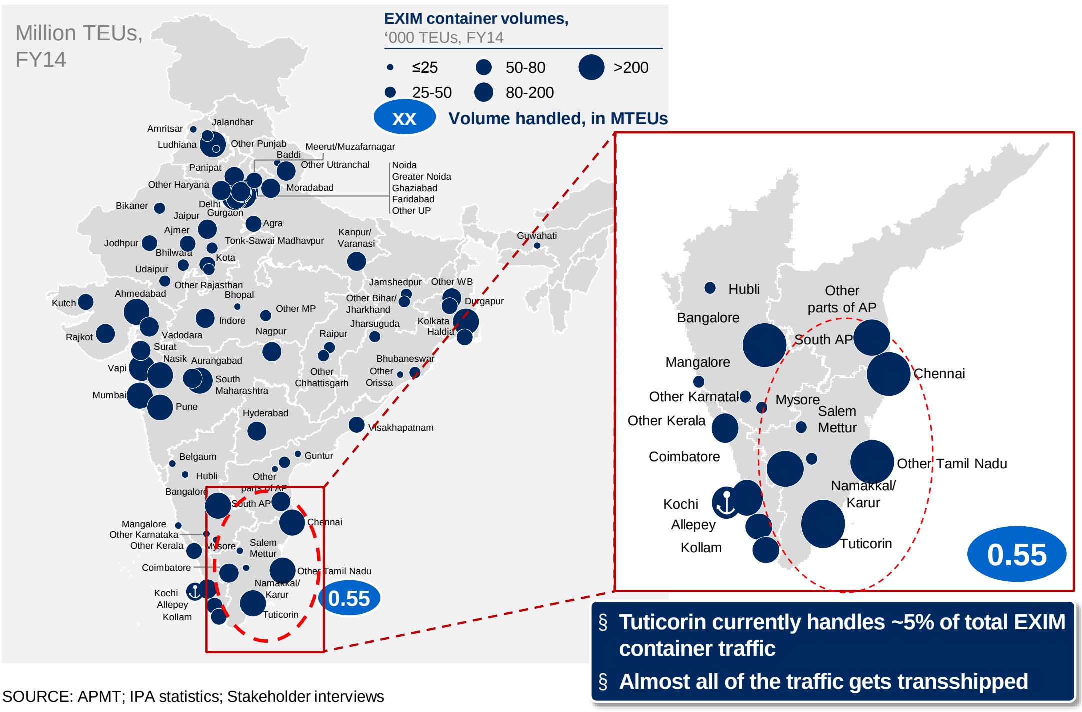
EXIM container volumes, '000 TEUs, FY14	JNPT	Mundra	Chennai	Pipavav	Tuticorin	Haldia	Cochin	Visakha-patnam	Mangalore
NCR+Punjab	936	1,264	0	329	0	0	0	0	0
Maharashtra	2,121	54	0	0	0	0	0	0	0
Tamil Nadu	0	0	1,240	0	484	0	0	0	0
Gujarat	552	262	0	169	0	0	0	0	0
Uttar Pradesh	228	274	0	107	0	0	0	0	0
West Bengal	0	0	0	0	0	458	0	0	0
Rajasthan	43	448	0	60	0	0	0	0	0
Karnataka	94	0	163	0	66	0	0	0	50
Kerala	0	0	0	0	0	0	351	0	0
Andhra Pradesh	75	0	65	0	0	0	0	110	0
Madhya Pradesh	43	70	0	14	0	0	0	29	0
Bihar/Jharkhand	0	0	0	0	0	85	0	8	0
Uttaranchal	95	0	0	0	0	0	0	0	0
Orissa	0	0	0	0	0	12	0	69	0
Chhatisgarh	15	18	0	14	0	0	0	15	0
North East	0	0	0	0	0	7	0	0	0
Port total	4,202	2,390	1,468	693	551	562	351	263	50

SOURCE: APMT; Expert interviews

Figure 6.5 VOC Port Hinterland

COMMODITY TRAFFIC | CONTAINER

EXIM container generating hinterlands for Tuticorin port



SOURCE: APMT; IPA statistics; Stakeholder interviews

Figure 6.6 EXIM Container Hinterland – VOC Port

6.4 Break Bulk Cargo

The traffic data pertaining to General/Break Bulk Cargo for the last 5 years is furnished in **Table 6.4**.

Table 6.4 General Cargo - Imports & Exports - During Last Five Years

S. No	COMMODITY	2010-11	2011-12	2012-13	2013-14	2014-15
IMPORT (MTPA)						
1.	Fertilizer	1.16	1.11	0.49	0.39	0.42
2.	F.R. Materials	0.73	0.89	0.56	0.79	1.05
3.	General Cargo	2.49	2.56	2.88	2.06	2.76
4.	Other General Cargo	1.36	1.22	0.55	0.56	0.25
	Total Imports	**5.74**	**5.78**	**4.48**	**3.8**	**4.48**
EXPORT (MTPA)						
1.	Dry Cargoes	0.72	0.43	0.46	0.48	0.3
2.	Liquid Cargoes	0.54	0.47	0.7	0.55	0.4
3.	Food Grains	0.04	0.3	0.13	0.05	0.06
4.	General Cargo	1.05	1.06	0.95	0.34	0.96
5.	Other General Cargo	0.06	0.15	0.27	0.01	0.06
	Total Export	**2.41**	**2.41**	**2.51**	**1.43**	**1.78**
Breakbulk Cargo – Total Import & Export		**8.15**	**8.19**	**6.99**	**5.23**	**6.26**

6.4.1 Imports

The import of fertilizer is mainly import of Urea, MOP and DAP. The fertilizer raw materials imports mainly are sulphur and rock phosphate. The general cargo under imports includes copper concentrate whose volume is about 1.2 MTPA during 2014-15. Import under the head general cargo and other general cargo includes the following.

§ Limestone
§ Gypsum
§ Cashew nuts
§ Timber
§ Iron and steel materials
§ Palm Oil
§ Caustic soda lye.
§ Vinyl Chloride monomer (VCM)
§ Others

Limestone imports alone constitute about 0.8 MT during 2014-15. Palm oil imports during the same period is about 0.3 MT. Timber in log form constitutes about 0.5 MT. VCM, Caustic soda Lye and peas (yellow) have a quantity of about 0.1 Million each. The rest are highly fragmented. VCM is handled through Shallow berth I as the pipe line for this cargo is located in that berth.

6.4.2 Exports

The general cargoes and other general cargoes under exports include

- Construction materials for Maldives
- Cement mainly for Maldives
- Granite
- Stone dust
- Oil cake and Copra
- others

The exports of construction materials and cement to Maldives have a quantity of about 0.4 MT which are handled through shallow berths. The rest are highly fragmented.

6.4.3 General Cargo – Traffic Projections

The traffic projection by M/s McKinsey in respect of General cargo is presented in Table 6.6. They include some dry cargoes in bulk like fertilizers, Copper concentrate in the figures for 2014-15.

Table 6.5 Dry and Break Bulk Cargo (To be Handled in Multipurpose Berths)

Commodity	Current 2014-15	2020-21	2025-26		2035-36	
			Base	Optimistic	Base	Optimistic
Iron Ore	0.05	0.06	0.08	0.09	0.14	0.17
Other Ore	Nil	1.7	2.2	2.3	3.7	4.2
Fertilizers	1.5	1.6	2	2.1	3.1	3.4
Others	3.5	4.4	5.9	6.2	9.7	11.1
Total (MTPA)	**5.05**	**7.76**	**10.18**	**10.69**	**16.64**	**18.87**

This **Figure 6.7** summarizes the traffic potential for key commodities for Tuticorin port.

Units: MMTPA (except Containers)

Tuticorin Port - Traffic Projections

xx Base Scenario | xx Optimistic Scenario

Commodity	2014-15	2020	2025 (Base)	2025 (Optimistic)	2035 (Base)	2035 (Optimistic)	Remarks
Liquid Cargo							
POL	0.6	0.8	1.3	1.8	2.0	2.5	
Dry and Break Bulk Cargo							
Thermal Coal (Loading)	0.0	0.0	0.0	0.0	0.0	0.0	
Thermal Coal (Unloading)	13.8	26.5	38.3	42.3	63.4	75.8	▪ Increase in coastal shipping
Coking Coal	0.0	0.0	0.0	0.0	0.0	0.0	
Iron Ore	0.05	0.06	0.08	0.09	0.14	0.17	▪ Mostly imports
Limestone	0.8	1.1	1.5	1.6	2.7	3.1	
Other Ore	1.2	1.7	2.2	2.3	3.7	4.2	
Fertilizers	1.5	1.6	2.0	2.1	3.1	3.4	
Containers and other Cargo							
Containers (MnTEU)*	0.56	0.99	1.18	1.45	1.95	2.44	▪ Traffic projections for the port may reduce post development of transshipment hub in Enayam
Others	3.5	4.4	5.9	6.2	9.7	11.1	▪ Highly fragmented, no particular commodity with significant volume
Total (MMTPA)	**32.5**	**55.7**	**74.5**	**85.0**	**123.2**	**148.6**	

* Due to the development of transshipment hub at Enayam, part of the traffic from Coimbatore, Namakkal, Madurai will directly go to Enayam via road hence diverting traffic away from VOC port

Conversion Factor Used for Containers Projections: 1 TEU = 19.7 Tons

Figure 6.7 VOC Port Traffic Projection

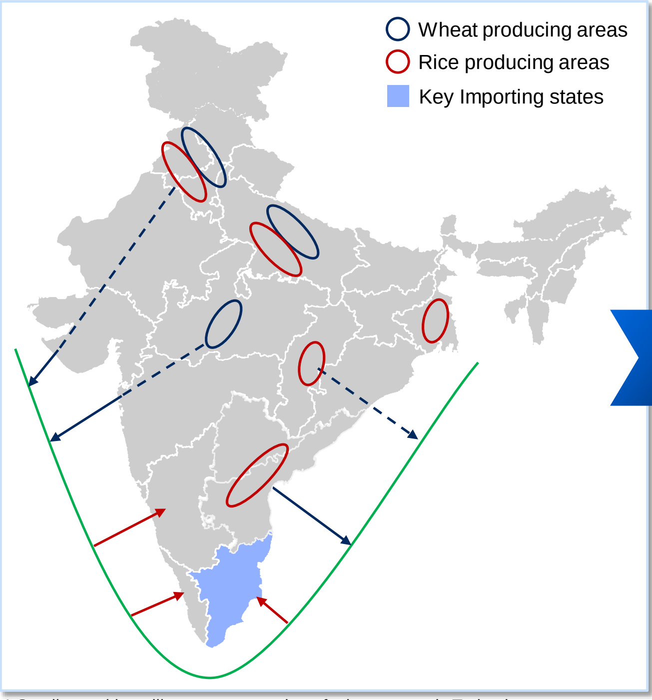
6.4.3.1 Coastal Shipping Potential

Apart from the above mentioned traffic, there is additional opportunity of coastal shipping that can be potentially tapped. Food grains provide a significant opportunity with small volumes possible for other commodities as well.

Food grains: ~1-2 MTPA of food grains can be coastally shipped to Tuticorin port by 2025 from Andhra Pradesh, Madhya Pradesh, Punjab and Haryana as shown in **Figure 6.8**.

COASTAL SHIPPING FOODGRAINS

~1-2 MTPA of food grains can be coastally shipped to Tuticorin Port by 2025



1 Small quantities will move on a number of other routes via Tuticorin port

Key ODs with coastal shipping potential to Tuticorin Port

Route[1]	Volume, '000 TPA
Andhra Pradesh to Tamil Nadu	536
Madhya Pradesh to Tamil Nadu	343
Punjab to Tamil Nadu	190
Haryana to Tamil Nadu	171

Figure 6.8 Coastal Traffic Hinterland – VOC Port

Figure 6.9 summarizes the potential of coastal movement for key commodities.

Tuticorin Port – New Opportunities Possible via Coastal Shipping

Units: MMTPA (except Containers)

Commodity	2020	2025	2035
Steel (Loading)	-	-	-
Steel (Unloading)	0.40	0.54	0.96
Cement (Loading)	-	-	-
Cement (Unloading)	0.44	0.59	1.06
Fertilizer (Loading)	0.57	0.70	1.03
Fertilizer (Unloading)	0.02	0.03	0.04
Food Grains (Loading)	0.01	0.01	0.02
Food Grains (Unloading)	1.27	1.54	2.28

Figure 6.9 Coastal Traffic Possibilities – VOC Port

7.0 CAPACITY AUGMENTATION REQUIRMENTS

7.1 General

The capacity augmentation requirement shall be based on the difference between the project traffic for the particular commodity and the capacity of the port available (after debottlenecking and physical improvements) for handling that particular commodity. The capacity assessment of the existing / planned for various cargos like coal, containers and breakbulk has been carried out as below:

7.2 Coal Handling Facilities

7.2.1 Type of Present Facilities for Coal handling

For the purpose of the present analysis, coal may be broadly segregated as thermal coal meant for power plants of TNEB & NTPL which is handled through conveyors and remaining coal.

7.2.1.1 Thermal Coal for TNEB & NTPL Power Plants

This thermal coal is unloaded in bulk and conveyed direct to the power plants in the vicinity through conveyor systems without any transit stack yard.

The thermal coal under this head is entirely for the Power plants of TNEB and NTPL. For handling this traffic there are three dedicated jetties. Of them Coal jetty 1 and Coal jetty 2 together handle about 6.3 MTPA feeding to the 1050 MW Power plant of TNEB. The jetty NCB 1 handles coal meant for NTPL power plant of 1000 MW Capacity. Of these two power plants, while the TNEB power plant has been in operation for a long time, the NTPL power plant commissioned during 2014-15, is new one and is yet to work to its full capacity.

7.2.1.2 Coal – Others

This consists of thermal coal meant for private power plants, industrial coal for cement plants, paper industry etc., This coal is handled in multi-cargo berths located on the south side. It is unloaded by ship gear/shore electric cranes /Harbour mobile cranes and transported by dumpers to stack yards and is stacked by semi-mechanised methods. It is similarly loaded out of stackyards and evacuated through dumper Lorries.

7.2.2 Rationalisation of Berths Handling Coal for TNEB Power Plant

The thermal coal for TNEB power plant is handled through two captive coal jetties CJ1 & CJ2 with each handling about 3 to 3.3 MTPA. The coal jetties CJ1 & CJ2 commissioned during 1983 and 1995 respectively were originally designed to handle handy/handymax vessels. Subsequently they have been deepened to a dredged depth of 14.1 m, adequate to handle Panamax vessels with a loaded draft of 12.8 m. But the two jetties have no onshore equipment to handle gearless vessels.

In both jetties the unloading of coal is done by ship bound cranes with grabs discharging into hoppers on the jetty from where the coal is conveyed by belt conveyors. The two jetties CJ1 & CJ2 are equipped with two independent conveyor systems each leading to the same power plant and both the conveyor systems have a designed capacity of 2000 TPH.

While the conveyor systems have a designed capacity of 2000 TPH, the average and maximum unloading rate per jetty was about 12,300 TPD and 17,500 TPD respectively. The berth occupancy was about 73% in 2014-15, which was the best over the years.

During 2014-15, the jetties CJ1 & CJ2 have handled a total quantity of 6.69 MT the highest so far with an average parcel size of 47,250 T. While each coal jetty is equipped with conveyors to transfer coal with a capacity of 2000 TPH, they actually handle an average of 12,300 TPD which roughly means about 500 TPH plus. This is due to the fact that the jetties handle mostly handy/ handymax vessels and few Panamax vessels and have no on-shore unloading equipment and unloading is done by ship's cranes which have limited capacity.

7.2.3 Upgradation of CJ2 Initially

While the captive coal jetties CJ1 & CJ2 were constructed by the port authority, the top side facilities consisting of shore hoppers and conveyor system are installed and operated by the captive user viz. TNEB. The thermal coal imported through these two jetties is meant for their "Tuticorin Thermal Power Plant" (TTPS) which has a capacity of 1050 MW.

It is envisaged that the coal now being imported through two jetties CJ1 & CJ2 may be imported by using just one jetty viz. CJ2. This would involve the following.

§ Upgrading of coal jetty CJ2 to handle Panamax vessels with construction of a new coal jetty of about 25 m width and about 300 m length for which purpose enough space is available.

§ Equipping the new jetty with two shore unloaders each of 2000 TPH capacity.

§ Modifying the existing conveyor system to upgrade its capacity from the present 2000 TPH capacity to 4000 TPH capacity. This will involve changing of drives and conveyor belt with the rest of the conveyor system intact. This is technically feasible as the existing Coal conveyor with a width of 1800 mm running at a speed of 2.5 m/s needs to be modified to run at 4.2 m/s. This would also require change of conveyor belt to take care of the increased starting and running tensions consequent to increased capacity.

It may be noted that this jetty area already has adequate dredged depth of (-)14.1 m and hence no further expenditure on dredging is involved.

7.2.3.1 ***Benefits***

To the Port:

§ The port will be able to handle entire 6.2 to 6.5 MT of thermal coal required for TNEB power plant with just one jetty and the second jetty will be available for other developments.

§ The port will be able to make full use of the existing depth of 14.1 m and handle gearless Panamax vessels with a draft of 12.8 m.

§ The number of vessel movements will get reduced.

To the TNEB:

§ There will be a saving of about Rs 75/- per T or even more on ocean freight for TNEB due to handling fully loaded Panamax vessels (subject to further deepening of harbour).

§ Only one conveyor needs to be operated and maintained instead of two now, saving in operation and maintenance cost and effort.

§ The modifications to be made for conveyors are simple and not very expensive.

Common Benefit to Both Port and TNEB:

The requirement of TNEB power plant may be of the order of 6.5 MT per annum (depending on grade of coal and number of power plant utilisation days). But the actual capacity of this jetty after the proposed construction will be 8 to 8.5 MT. As such there will be a spare capacity of about 1.5 to 2 MT which can be used by port for other users. This would however require an arrangement between port and TNEB and a take-off conveyor from the TNEB conveyor junction house to a stackyard in Hare Island. This will enable additional revenue for both.

7.2.4 Constructing New Coal Berth at CJ1

With modifications proposed to CJ2 by way of constructing a new berth in front of existing jetty and equipping it with two unloaders each of 2000 TPH, then that single jetty will be adequate to handle the entire coal requirement of TNEB for the present plant. If the port authority can take up construction of similar new jetty at CJ1 for handling fully loaded Panamax vessels, then it will have a similar capacity of 8 to 8.5 MT. This would however require mutual understanding between Port authority and TNEB.

7.2.5 Limitations of Proposals

The above proposals viz., construction of new berthing structures in front of the existing CJ1 and CJ2 and equipping them with on shore unloaders have the following implications.

§ Construction of new berthing structures in front of the existing CJ1 and CJ2 will have a cost implication of Rs 100 Crores each. The length of berthing structure may be limited to about 200 m sufficient to cater to the span of hatches of a Panamax vessel which is of the order of 165 m. The possibility of using the existing mooring structures while handling a fully loaded panamax vessel need to be examined.

- The TNEB has to be persuaded and convinced of the benefits that will accrue to them by way of savings in ocean freight and operating and maintaining only one conveyor instead of two as at present. The TNEB has to come forward to make a capital investment towards the cost of two Gantry grab unloaders, providing HT power supply required for operation of gantry grab unloaders and modifications to increase the speed of the conveyors which will all cost about Rs 120 Crores. They may also have to invest on certain other replacements like crushers and stacking equipment at the power plant end.
- During the intervening period of when such modifications and construction of new berth structure are taken up, the TNEB has to have a contingency plan by way of handling their coal requirement through the second jetty and the remaining from NCB1 with provision of an interconnecting conveyor system between NTPL and TNEB conveyors.

7.2.6 NCB 1 – Utilisation of its Full Capacity

The 1000 MW capacity NTPL power plant consists of two units each of 500 MW. Of them the first unit was commissioned in June 2015 and the second unit in august 2015. The estimated coal requirement for NTPL is about 6 MT and this will be exclusively handled in NCB 1 which is a captive berth for NPTL. This is a new berth constructed by NTPL in which coal meant for their 1000 MW power plant is directly led through an exclusive conveyor from berth to power plant.

Presently the berth has a depth of 14.1 m and is capable of handling panamax vessels with a draft of 12.8 m.

The berth is equipped with two gantry grab unloaders each of 2000 TPH capacity. Technically this berth has a capacity of 8 to 8.5 MT. Against this the actual requirement of NTPL is only 6 MT, thus leaving a spare capacity of 2 to 2.5 MT. The port and NTPL may jointly evolve a strategy to utilise the spare capacity of this berth by way of putting up a take-off conveyor from the transfer tower near the port boundary. This may bring additional revenue to both Port and NTPL.

7.2.7 NCB II under Construction

The port is developing NCB 2 under DBFOT basis for handling coal and other bulk cargoes for which it has entered into a concession agreement with Tuticorin Coal terminals Pvt Ltd(TCTPL) a subsidiary of ABG Infralogistics group (with a revenue share of 52.17 per cent). This work awarded in 2010 is in an advanced stage of construction. It consists of a berth of 306 m length and 22.9 m width, is located adjacent to NCB I and designed to handle fully loaded Panamax vessels. The berth is being equipped with 3 no of gantry grab unloaders each having a capacity of 1800 TPH and mounted on 18 m gauge rails. The two conveyors from berth to stack yard have a belt width of 1600 mm each. The stackyard equipped with stackers is located in the Hare Island. The port's assessed capacity of this terminal is 7 MTPA. This terminal is likely to be commissioned in 2016.

7.2.8 Construction of North Cargo Berths III

The port has plans to award NCB3 berth on DBFOT basis to a concessionaire. The berth is planned to handle about 9 MTPA of coal.

7.2.9 Capacity Assessment of Bulk Cargo Handling

7.2.9.1 Scenario 1

This is an optimistic scenario with berths NCB III and NCB IV as planned earlier, with reconstruction of CJ1 and CJ2 as now proposed and on an assumption that TNEB and NTPL will be agreeing to operate these berths to their full capacity and share with port. The detailed scenario is presented below in **Table 7.1**.

Table 7.1 Existing Harbour- Capacity of Bulk Cargo Berths When Fully Developed

S. No.	Berth	Capacity (MT)	Remarks
1.	CJ1	8	These two jetties were constructed by port and are for captive use of TNEB. They now have a combined capacity of 6.5 MTPA. The jetties were constructed by port. The actual requirement of TNEB is limited to 6.5 MT per annum totally. The capacity indicated is after their reconstruction and with provision of unloaders.
2.	CJ2	8	
3.	NCB1	8	The actual capacity requirement of NTPL (for whom this a captive berth) is 6.0 MTPA. Hence there will be a surplus capacity. The guaranteed throughput for this berth is 4.00 MTPA.
4.	NCB2	7	This is a BOT berth under construction meant for multiple users. The guaranteed through put for this berth is 4.00 MTPA
5.	NCB3	9	This is expected to be a BOT berth meant for multiple users. The guaranteed throughput for this berth is expected to be fixed as 4.00 MTPA
6.	Berth 9	6	With mechanization of this berth with Harbour Mobile cranes and conveyors for which BOT agreement was already entered into and expected to be completed in 2016-17
	Total	**46**	

The projected traffic for 2025 for bulk cargoes consisting of Coal of all types, copper concentrate, Limestone and also Rock Phosphate is 42 MTPA and 46 MTPA for base and optimistic scenarios respectively. The facilities proposed in the Master plan as above therefore adequately takes care of the projected traffic up to 2025 beyond which the port has to expand to outer harbour.

7.2.9.2 Scenario 2

This is a scenario which envisages that the projected traffic will materialise and is another type of optimistic scenario, but with the following riders.

§ That TNEB will not come forward to upgrade their handling facilities to handle their entire cargo requirement from one jetty and instead would like to continue with the present arrangement of two jetties CJ1 & CJ2. Hence their combined capacity will be limited to 6.5 MTPA which is the requirement of TNEB.

§ NCB1 being a captive berth of NTPL will operate only to their requirement. Hence its capacity will be limited to 6 MTPA.

§ That the NCB 2 will operate to its full capacity and there will be enough cargo generated and that the bulk and dusty import cargoes from existing multipurpose berths will be shifted to this berth.

§ That the mechanization of berth 9 now on way will be completed and will operate to its capacity.

In this scenario the capacity of bulk cargo handling berths in the existing harbour will be as given in **Table 7.2**.

Table 7.2 Existing Harbour - Capacity of Bulk Cargo Berths When Fully Developed-Scenario 2

S. No.	Berth	Capacity (MT)	Remarks
1.	CJ1	6.5	It is assumed that TNEB will continue with the present system and there will be no reconstruction of CJ1 & CJ2
2.	CJ2		
3.	NCB1	6	NTPL will operate this captive berth to its capacity which is their plant's requirement as well
4.	NCB2	7	The berth will operate to its capacity for multiple users and traffic will materialise.
5.	NCB3	9	This is expected to be a BOT berth meant for multiple users.
7.	Berth 9	6	With mechanization of unloading, conveying and stacking now taken up on BOT basis
	Total	**34.5**	

7.2.9.3 Preferred Scenario for Planning

The preferred scenario for this master planning is scenario 2. Based on this the traffic projections of bulk cargoes up to 2025-26 can be handled in inner harbour. This includes coal of all types, Limestone and copper concentrate.

Beyond this, the facilities for handling of bulk cargoes, more particularly coal will have to be created in the outer harbour. As such construction of outer harbour beyond 2025-26 is imperative. This also envisages development of bulk cargo berths on the northern side of outer harbour and the berths will be developed to handle mini cape size vessels (draft of 16 m). Initially two bulk cargo berths mainly for handling coal of all types will be developed and each berth will have a capacity of 10 MTPA. There will be two closed conveyors each of a capacity of 5000 TPH and will be fed by two unloaders each having a capacity of 2500 TPH. In the second stage of outer harbour development for bulk cargoes, two more berths will be added.

The coal will be received and stockpiled in the Hare Island for NCB III and evacuated through railway system proposed for connecting the Hare Island. For handling the projected traffic of 2035, more bulk coal unloading berths in the outer harbour have to be developed with similar connectivity closed conveyor system. The stackyard area at this stage will be located at the reclaimed area of Hare Island.

7.3 Container Handling

7.3.1 Berth VII

This berth was given on BOT basis to M/s Tuticorin Container Terminals Pvt Ltd., jointly promoted by PSA international and SICAL. The berth has a length of 370 m and a depth of 11.9 m with a backup area of 10 acres. The berth is equipped with 3 container Quay cranes and the capacity of the terminal is about 0.45 Million TEU.

7.3.2 Berth VIII

This berth was given to Dakshin Bharat Gateway Terminal (DBGT) a subsidiary of ABG Container Handling Private Limited. The berth though formally started operations during May 2014 is not yet equipped fully. The terminal is expected to shortly receive its 64 T capacity container quay cranes with 47 m outreach, and when fully developed will have a capacity of 0.6 Million TEUs.

7.4 Break Bulk Cargo

7.4.1 Based on Present Handling

During the year 2014-15, of the total port traffic of 31.3 MT, 11.03 MT is the share of container and 6.24 MT is thermal coal handled in the captive jetties on the north. The remaining 13.4 MT of cargo is handled in the multipurpose berths on the south side of harbour basin viz., in berth no 1 to 6, the shallow berths, the E Arm and berth IX. A small part of this was also handled in container berth no VIII whenever it was free. Also a small quantity is handled through lighterage operations.

Of this 13.4 MT, the Industrial coal, pet coke and thermal coal for private power plants account for 5.24 MT, copper concentrate another 1.13 MT, Limestone a quantity of 0.8 MT all these totalling to 7.17 MT.

Table 7.3 further illustrates the quantity handled by multipurpose berths I to VI and their berth occupancy during 2014-15. It can be seen that the quantity handled is 7.72 MT. Therefore it can be taken that the berth IX, the E arm and the shallow berth and lighterage operations have together handled 5.68 Million tons.

Table 7.3 Multipurpose Berths I – VI Performance

S. No.	Berth	Total Cargo Handled (MT)	Total No. of Ships	Avg Parcel Size (T)	Standard Berth Days	Berthing/ De-Berthing Days	Total Berth Days	Berth Occupancy (%)
1.	I	0.48	131.00	3,634.80	207.35	21.83	229.19	**62.8%**
2.	II	0.73	119.00	6,140.26	190.13	19.83	209.96	**57.5%**
3.	III	2.30	108.00	21,303.15	226.14	18.00	244.14	**66.9%**
4.	IV	2.52	116.00	21,681.89	238.53	19.33	257.86	**70.6%**
5.	V	0.71	250.00	2,837.62	327.73	41.67	369.40	**101.2%**
6.	VI	0.98	138.00	7,117.60	212.52	23.00	235.52	**64.5%**

The quantity of 7.78 MT handled includes copper concentrate, lime stone and industrial coal whose total quantity is assessed as about 4 Millions. This master plan envisages handling of all copper concentrate, limestone, thermal coal for private users, all industrial coal, pet coke through the mechanized bulk berths on the north and berth IX. The E arm and shallow berth will handle construction materials, cement and VCM; the quantity of remaining general cargoes handled by these six berths is found to be about 3.68 MT.

The capacity of any multipurpose berth depends upon the type of cargo handled, the vessel parcel size, the mode of handling, the capacity of equipment deployed, the speed of evacuation and so on. Taking all this into consideration and assuming that handling remaining bulk cargoes and more particularly fertilizer and fertilizer raw material will all be done using high capacity electrical level luffing wharf cranes and mobile harbour cranes, the combined capacity of the existing 6 multipurpose berths is assessed to as 9 MT.

7.4.2 Capacity based on Average Parcels Size and Average Handling Rate

As indicated earlier, the capacity of a berth depends on parcel size and speed of handling. On this basis certain assumptions have been made in respect of these two variables to arrive at the capacity a multipurpose berth as provided in **Table 7.4**.

Table 7.4 Capacity of a Typical Multipurpose Berth

S. No.	Particulars	Units	With MHCr		With Ship Gear/High Capacity Shore Electric Cranes	
			Bulk	Break-Bulk	Bulk	Break-Bulk
1.	Average Parcel size	T	45,000	15,000	45,000	15,000
2.	Average handling rate	TPD	20,000	8,000	12,000	6,000
3.	Handling time	Days	2.25	1.88	3.75	2.50
4.	Berthing, Deberthing and Miscellaneous time	Days	0.25	0.25	0.25	0.25
5.	Total time per ship	Days	2.5	2.13	4	2.75
6.	Total berth days available per annum	Days	350	350	350	350
7.	Maximum allowable berth occupancy	Percent	70	70	70	70
8.	Optimum berth occupancy days	Days	245	245	245	245
9.	Capacity of berth (2x8)	MT	4.9	1.96	2.94	1.47
10.	Percentage weightage	Percent	10	90	10	90
11.	Capacity for each range	MTPA	0.49	1.756	0.294	1.33
	Capacity	**MTPA**	**2.246**		**1.624**	
	Assumed Capacity	**MTPA**	**2**		**1.5**	

In line with the above it can be deduced that the combined capacity of the present multipurpose berth group consisting of 6 berths alone without the shallow draft berths and E arm may be taken as 9.0 MTPA. The capacity of each berth is taken as 1.5 MT and not 2 MT is on the understanding, that once all the major bulks except fertilisers and FR are shifted they have to contend with highly fragmented cargoes.

7.5 Liquid Cargo

The port has an exclusive liquid cargo jetty called OJ for handling POL products and LPG. During the last financial year i.e. 2014-15 a quantity of 0.637 MT was handled at this jetty. During this period it had an occupancy of 132 days which means occupancy of 37.7%. The jetty has depth of 14.1 m below CD which means it is capable of handling POL tankers drawing a draft of 12.8 m.

The jetty is presently handling Naphtha, LPG, Liquid ammonia, Furnace oil and diesel. Furnace oil is however handled in some of the multipurpose berths also (like berth V, VI etc.). Of them only Naphtha has average parcels size of about 15,000 tons plus. All other remaining cargoes have low parcel size of 6,000 T and less.

Even with the present cargo mix and parcel sizes this jetty alone is capable of handling POL cargoes of 1.25 MT. And by increasing the size of pipe lines and higher parcel sizes which can be expected when the throughput increases, this jetty can handle about 2 MTPA of POL products. As is already noted the furnace oil is already handled at other multipurpose berths. In fact even diesel can be handled in a multipurpose berth like berth 6 with certain precautions.

As such for the traffic projection by 2025 viz., of 2 to 2.1 MTPA of Liquid cargoes no additional berthing infrastructure is necessary.

In this connection it is pertinent to note that liquid cargoes like Palm oil are handled in multipurpose berths and VCM is handled in shallow berth. Beyond 2025 when POL liquid cargo projections increase to 3 to 3.3 MT as projected for 2035, then some of the POL products like furnace oil can he handled in multipurpose berths.

7.6 Requirement for Capacity Expansion

The requirement for future expansion of facilities for various phases of development has been worked out as in **Table 7.5**.

Table 7.5 Capacity Augmentation Requirements

Commodity	Current Capacity (MTPA)	2020		2025		2035	
		Forecast Traffic (MTPA)	Capacity Augmentation required over current (MTPA)	Forecast Traffic (MTPA)	Capacity Augmentation required over current (MTPA)	Forecast Traffic (MTPA)	Capacity Augmentation required over current (MTPA)
Dry Bulk	**14.2**	26.5	12.3	38.3	24.1	63.4	49.2
Break Bulk	**13.7**	8.9	0.0	11.7	0.0	19.3	5.6
Containers (TEUs)	**1.1**	1.0	0.0	1.2	0.1	2.0	0.9
Liquid Bulk	**2.0**	0.8	0.0	1.3	0.0	2.0	0.0
Total	**50.6**	**55.7**	**12.3**	**74.5**	**26.6**	**123.2**	**72.5**

1 TEU = 19.7 T

The projected traffic for VOCPT for the year 2020 is estimated to be 55.7 MTPA. The increase in traffic is majorly due to dry bulk cargo demand. The total growth is expected to raise high up to 74.5 MTPA by 2025 and 123.2 MTPA by 2035. The required additional capacity of 72.5 MT would be needed by 2035.

Various options for achieving the capacity augmentation like inner harbour development and outer harbour development are discussed in subsequent sections.

8.0 RAIL AND ROAD CONNECTIVITY

8.1 Road Connectivity

8.1.1 Present Scenario

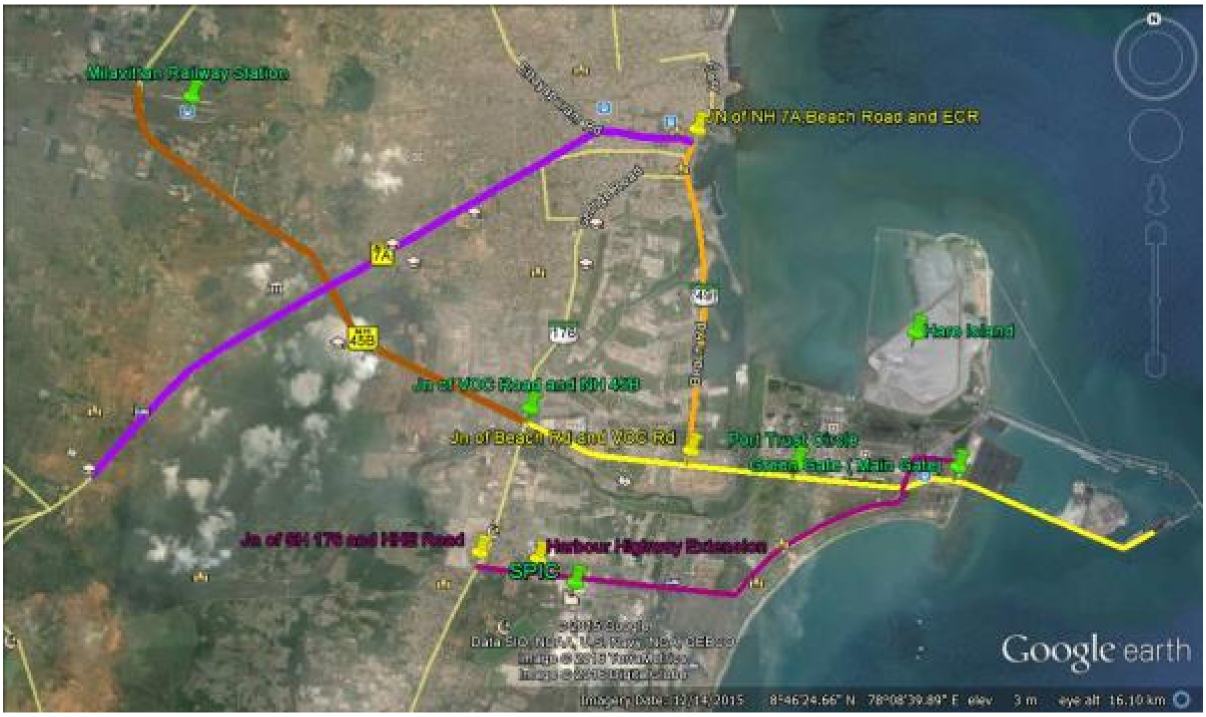


Figure 8.1 Road Connectivity VOCPT

The two important National Highways NH 7A and NH 45 B pass near the port as shown in **Figure 8.1**. These two cater to the major port bound traffic movement from the Hinterland. From the junction presently all traffic moves through the VOC road and passes through the Green Gate.

8.1.1.1 VOC Road (SH 200)

This road is the major arterial road for present port bound traffic movement. Presently the road is having the 4 lane divided carriageway with paved shoulder as shown in **Figure 8.2**. Truck queuing is observed on the road along with the uncontrolled cross overs thro median opening near the Green gate. Presently one major bridge is there on the road.

Figure 8.2 VOC Road (SH 200)

8.1.1.2 State Highway 49

State Highway 49 originating from the VOC road (known as Beach Road) meets with NH 7A after traversing a length of about 5 km as shown in **Figure 8.3**. Presently, this is a two lane road and passes through congested built up section. Connectivity from Tuticorin railway station is also from Beach Road.

Figure 8.3 State Highway 49

8.1.1.3 State Highway 176

State Highway 176 crosses NH 45B and further it meets with the Beach Road. It is a 2 lane road.

8.1.1.4 Harbour Extension Road

This road originates from SH 176 and traverse towards South direction. It crosses VOC Road; moves further east and come to Green Gate as shown in **Figure 8.4**. This road is having 2 lane configurations and presently not much traffic is observed. A pipeline is observed at the left side of the road

Figure 8.4 Harbour Extension Road

8.1.1.5 Proposed Vehicle Evacuation by the Port Authority

1. Gate Details

There are 4 existing gates for the port.

a) **Green Gate:** It takes care of the Entry / Exit for most of the present port bound traffic. It is on the VOC road which is having the 4 lane configuration.
b) **Red Gate**: It takes care of the cargo that passes through the Conveyor.
c) **Yellow Gate:** It takes care of the evacuation of the coal yard traffic. The vehicle from proposed NCB 1 -4 will use the road for evacuation purpose and also the officials' vehicle will use the gate
d) **Blue Gate:** Presently the gate is closed. Will be used for any kind of emergency in future

2. Ongoing / Recently Completed Road Project

a) 4 lane road from Hare Island to Red gate

b) Red gate to TTPS circle 4 lane road (Rigid pavement)

8.1.2 Consultant' Proposal for Future Road Connectivity

For the better connectivity in future following new road connectivity has been proposed.

§ New 4 lane road connectivity in between Harbour Extension Road and National Highway 7A as shown in **Figure 8.5**.

Figure 8.5 Proposed Connectivity to NH7A

§ The Harbour Highway Extension road in between node A and B will have divided 4 lane configurations (about 5 km length) as shown in **Figure 8.6**.

Figure 8.6 Proposed Widening of Harbour Highway Extension Road

§ From node A to VOC road junction of the HHE road will be used by the traffic who wants to get into the port through green gate only as shown in **Figure 8.7**. Once the VOC road as well as new road connecting HHE road and NH 7A is operational SH 176 has to be carried out.

Figure 8.7 Proposed Road for Traffic through Green Gate

§ It is proposed to provide divided 8 lane configuration of VOC road in between port trust circle and the junction with NH 45 B as shown in **Figure 8.8**.

§ New bridge over the creek (parallel to the existing bridge) on VOC road to match with the VOC road configuration.

Figure 8.8 **Proposed Widening of VOC Road (8 Lane)**

§ It is proposed to widen the existing NH 7A as shown in **Figure 8.9**.

Figure 8.9 Proposed Widening of NH 7A

§ Presently Green gate is handling both the Entry as well as Exit of the vehicles. Long queue of the traffic on VOC road is observed which leads to the major congestion. After the proposed road from Hare Island will become functional, the traffic movement will be worsening further on VOC road. To remove the bottleneck near the Green gate following measurement is proposed

- Staggered Entry and Exit gate location to provide the exclusive entry and Exit to reduce the waiting period at Gate.
- Elevated Road on VOC Road (About 2 km) for the traffic coming out of the port.
- The traffic from Hare Island will have the up ramp (2 lane configuration) to meet with the elevated road on VOC.
- Elevated road on VOC will be 2 lane road configurations from the exit gate and after the merger of the ramp from Hare Island it will have 4 lane configurations as shown in **Figure 8.10**.
- The elevated road will have down ramp (2 lanes) for the vehicles intended to go for Harbour Highway Road.
- The elevated road will continue further and meet with the VOC road after crossing the port trust circle.
- Harbour Highway Road will further meet with VOC road. Traffic comes from NH 7A and intend to go to Hare island will only follow this route as shown in **Figure 8.11**.

Figure 8.10 Proposed Elevated Road Above VOC Road

Figure 8.11 Connecting Road Between VOC and Hare Island

8.1.3 Trucking Parking Facilities

Based on the land use plan studied and proposed by RITES India Ltd for VOC Port, out of the total existing land available with the port 32.85 ha is allocated only for truck parking facility. Four different locations have been identified for truck parking facility within the port limit as listed below and shown in **Figure 8.12**:

- Area I – Near the intersection of harbour highway extension and VOC road (allotted 3.9 Ha)
- Area II – Near the junction of beach road and VOC road, next to the existing rail line (allotted 1.3 Ha)
- Area III – Near the junction of beach road and VOC road, next to the existing rail line (allotted 1.3 Ha)
- Area IV – At the south west area of the Hare Island to be developed (allotted 20.75 Ha).

Figure 8.12 Planned Locations for Truck Parking Facilities

8.2 Railway Connectivity

8.2.1 Present Scenario

Figure 8.13 Railway Connectivity VOCPT

Presently one single Broad Gauge line comes to Port area after originating from Milavattan Railway station. The total length of the railway line is 17.60 km as shown in **Figure 8.13**.

From Milavattan Railway station to VOC wharf is 14.0 km and VOC wharf to Marshalling yard is having the balance length near coal yard a loop line is there and 5 nos. lines are available in the Marshalling yard.

8.2.2 Proposed Railway Option by the Port Authority

- It is proposed to have railway line from Hare Island to Marshalling Yard (Approximate length 5.9 km) – The detailed plan submitted to the Railways for approval
- New railway line is also proposed from Marshalling Yard to Red Gate (2 lines Approximate length 1.8 km)

8.2.3 Consultants Proposal on Railway Option

The Madurai – Dindigul double line is under progress and the doubling of Madurai – Tuticorin section is proposed. To have better access with the hinterland it is proposed to have electrification and doubling of the existing Milavattan Railway station to Marshalling yard line. The same is also proposed for existing Line from Milavattan railway station to Tuticorin section.

9.0 SCOPE FOR FUTURE CAPACITY EXPANSION

9.1 Development Possible within the Existing Harbour

9.1.1 Existing Harbour – Limitations and Planned Developments

The port has a dredged depth of 14.1m below CD in the inner channel, coal jetties CJ1, CJ2, Coal berth NCB1, NCB2 which are all on the north side of harbour. On the south side similar depth of 14.1 m is available in container berth 8 and berth 9. All these berths can handle Panamax vessels with a loaded draft up to 12.8 m, leaving an under keel clearance of about 1.3 m. As regards the remaining existing berths it is not feasible to deepen further due to their design limitations.

The currently planned layout of the inner harbour is shown in **Figure 9.1**.

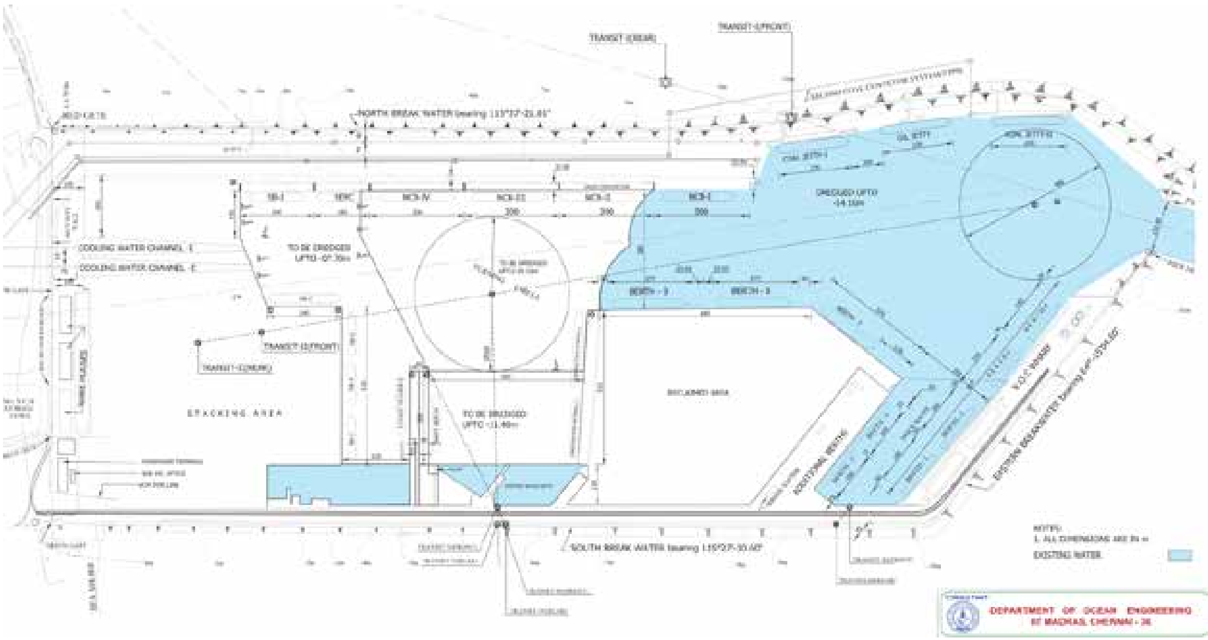


Figure 9.1 Planned Layout of VOC Port Inner Harbour

9.1.2 Options for Development of Existing harbour

9.1.2.1 General

In order to develop the suitable alternative layouts for the inner harbour development of VOC port, following facts are to be duly taken into account:

§ The concessions for NCB3, NCB4 and cement berths have been cancelled and port would be calling for fresh tenders.

§ The planned shallow water berth perpendicular to berth 9 is under litigation and if the tender process is cancelled, the same shall be available for development for handling required commodities.

§ The port has firmed up plans for development of coastal berth and also a finger jetty perpendicular to the south breakwater has been allocated to Navy and coast guard as shown in **Figure 9.2**.

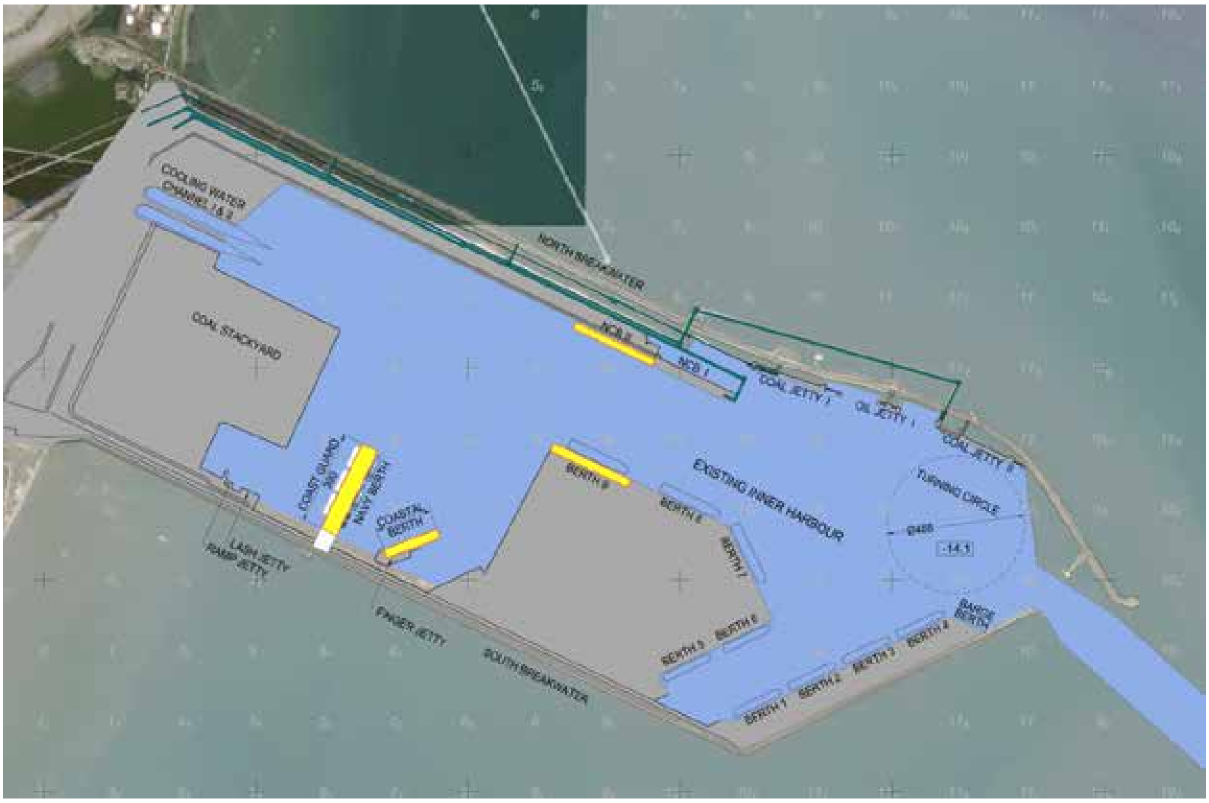


Figure 9.2 Layout Showing Current Inner Harbour and Confirmed Plans of Additional Berths

§ As regards berth 9, the contract for O&M for handling and transferring bulk cargo to bulk stackyard through conveyor system has already been awarded. Therefore the location of berth for handling bulk cargo through conveyor etc. as already envisaged cannot be changed.

- Though the location of berth 9 is not ideal for handling of dry bulk cargo due to presence of container berths nearby, this is the only deep water berth available at present for handling the bulk cargo other than coal. At the time of renewal of O&M contract now under implementation and once the same expires, after 10 years the handling operations now being installed could be shifted to other berth, if needed.
- The coastal berths being developed by port does not allow a "Green Channel" i.e. the entry/exit to this berth still has to pass through the custom bound area and thus do not meet the objective fully.

9.1.2.2 *Alternative 1*

This alternative is basically similar to the plans of the port currently being pursued has regarding berths located along the north breakwater in which NCB 3, NCB 4 and SPEC berths which shall be built along the north breakwater.

Currently dredging has already been carried out by port for the shallow water berth and in the next phase the deepening would take place for the turning circle and berthing areas for NCB 3 and 4 berths. As the deeper water (i.e. -14.1 m CD) would be available at turning circle, with little extra dredging it would be possible to create deeper draft at the location of currently proposed shallow water berth so that the same could be instead used as a deep water berth for handling containers or bulk cargo.

On the opposite side of the container berth, taking the advantage of deeper water available due to dredging in the turning circle, another berth for handling coal could be developed with minimal quantity of dredging. The reclaimed area on the western end could be extended to create more space for stacking of coal.

It is also proposed that the coastal berth could be further extended parallel to proposed Navy berth so as to provide berthing facility to handle two barges simultaneously. This would optimally utilise the harbour area.

Similar to alternatives 1 and 3 the east side of bulk stackyard shall be developed a deep water bulk berth, which would meet the requirement of port to handle other dry bulk apart from coal. This berth is optimally located as the stackyard is adjacent to this berth. This alternative layout is shown in **Figure 9.3**.

Figure 9.3 Options for Development of Existing Harbour – Alternative 1

With the provision of two additional coal berths and one dry bulk berth within the inner harbour, the berth 9 could later be released developing the container berth, after the expiry of the current concession of the O&M contract (now under implementation). Apart from that a berth perpendicular to berth 9 could also be built for handling containers. This berth 9a can utilise the same yard as for berth 9 and with proper circulation plan could add additional container handling capacity. Also this perpendicular berth can be either a container or a bulk berth.

This layout has the following benefits:

§ Utilises the deeper water depths proposed to be created for only two berths (NCB 3 and NCB 4) to enable two more deep draft berths with minimal additional dredging.

§ Consolidates the container handling at berths 7, 8, 9 and 9a berths with adequate backup area.

§ Allows separation of clean cargo and dirty cargo area. This has large impact on the user perception about a port particularly for containers.

The only issue could be that the berth 9 would only be available after 10 years after the expiry of current O&M contract for dry bulk cargo handling.

9.1.2.3 *Alternative 2*

In alternative 2, it is proposed that a quay length of 900 m could be created parallel to NCB I and II, as shown in **Figure 9.4**.

This would enable providing one coal berth and two container berths, towards west of NCB 2. The existing reclaimed area near the root of north breakwater could be extended to allow space for container yard. The quay perpendicular to berth 9 shall also be used as a deep draft bulk berth due to availability of deeper depths

Figure 9.4 Options for Development of Existing harbour – Alternative 2

SEPC berths (for barges of draft limited to 7 m) and a deep draft coal berth are proposed in the existing stackyard area towards west of harbour basin.

Only issue in layout is likely to be the limited space available for the proposed two berth container terminal along the north breakwater. Therefore the proposed container terminal as part of this alternative is analysed further to assess its suitability.

Based on the area available a tentative layout of the container terminal has been developed as shown in **Figure 9.5**. It is assessed that about 1700 ground slots for stacking of containers would be possible for using RTGs. Considering the dwell time of 3 days this translates to a terminal capacity of 550,000 TEUs only. Hence the limited yard area can support only one full-fledged container berth rather than two.

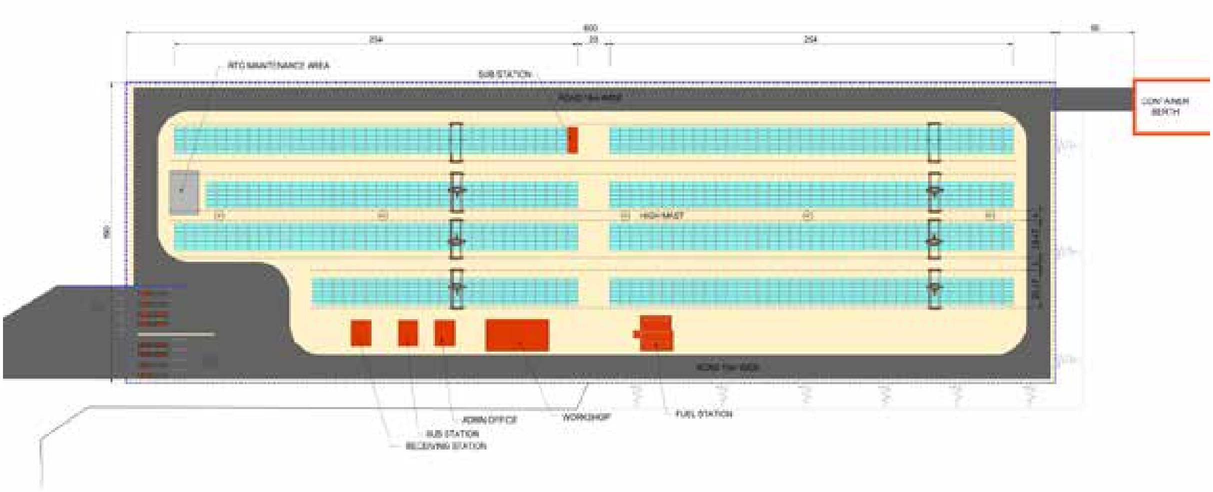


Figure 9.5 **Layout of Container Yard along North Breakwater**

As per the traffic projections the need for additional coal berths is likely to be earlier than the need for container berths and therefore reduction of 1 bulk berth in this alternative is not suitable. This also has an issue that the container handling facilities and coal handling facilities are spread all over without proper segregation. Only advantage in this case is that in and out movement to the proposed container yard is through a separate access.

9.1.2.4 Alternative 3

The proposed layout is similar to the alternative layout 2 with the exception that only one container berth is provided along the north breakwater (NCB 4). The reason of considering NCB 4 as container berth instead of the berth on its north side is that additional dredging will not be needed in the initial stage of container berth development. The following options would exist for developing the berth north to NCB4:

§ To develop this as a container berth to complement NCB 4. This would be possible only if it is later found that the existing yard can service two container berths due to lower dwell time.

§ To develop this as a container berth as a replacement to NCB 4, which shall be later converted to a coal berth, if the demand of coal picks up. To pursue this option it would be preferable that the container cranes provided at NCB 4 are of 20 m rail gauge which is also the rail gauge for the coal unloaders.

§ To develop this berth as a clean cargo berth

A suitable decision in this regard could be taken at a later stage depending on the traffic growth scenario.

Further it is suggested that the additional deep water berths i.e. NCB 3, NCB 4, berth 9, bulk berth, new container berth and existing berth NCB 2 are all deepened to handle fully loaded panamax vessel with draft of 14.5 m as shown in **Figure 9.6**.

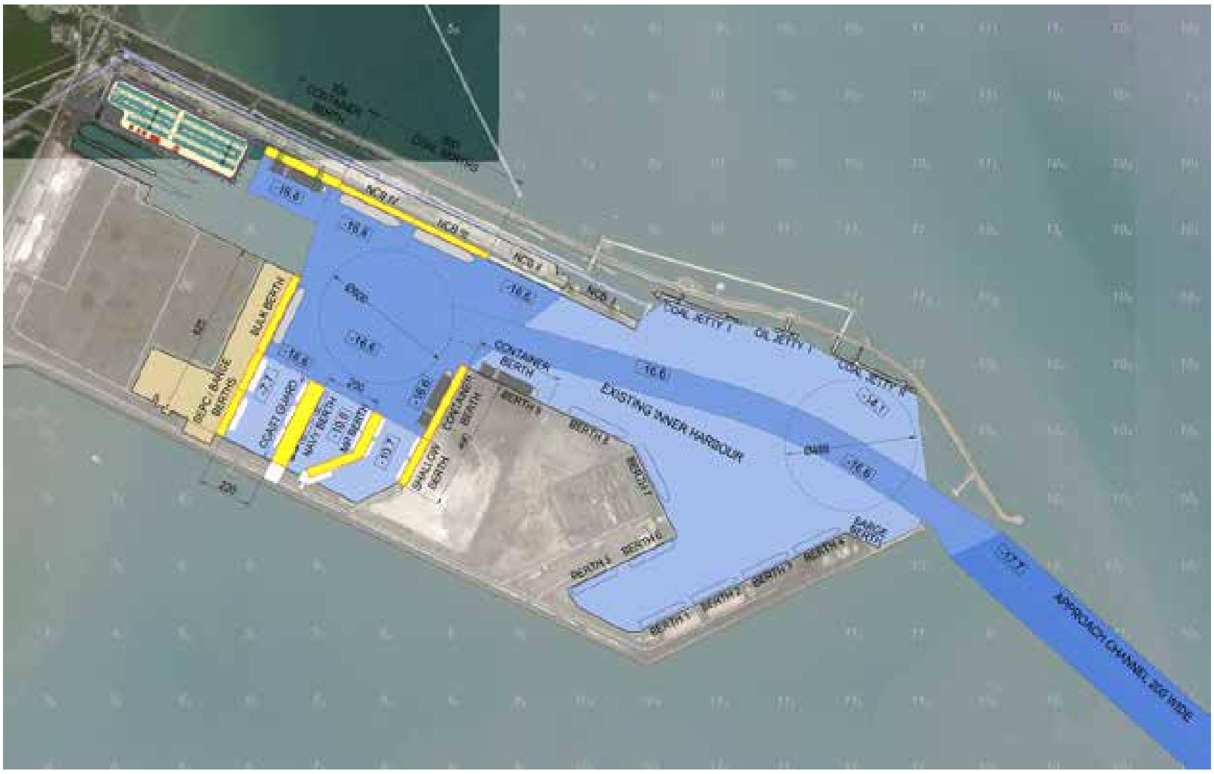


Figure 9.6 Options for Development of Existing Harbour – Alternative 3

This would significantly reduce the logistics cost of handling coal as fully loaded panamax size ships with draft of 14.5 m would be able to directly able to call at the port. Currently, they have to incur significant waiting time and cost at anchorage operations to light load the ship up to allowable harbour draft of 12.8 m.

However, this option involves significant cost of capital dredging in rock, though much less than the outer harbour development. Therefore the phasing for deepening could be decided duly evaluating the financial viability.

Earlier also the possibility of dredging to deepen the existing harbour up to 16.1 m depth to cater to fully loaded Panamax vessels was examined and in our opinion possible due to following reasons:

§ As regards to the impact on the existing berths due to deepening, it could be seen from **Figure 9.6** that the proposed area of deepening is away from the existing berths and therefore does not endanger their stability.

§ The deepening is proposed so that fully loaded panamax ships could be brought to the port. Even currently panamax vessels are brought to the port using the same entrance width and therefore entrance width cannot be considered as a constraint for about 1.7 m deepening.

§ However in case the ports feel that the current entrance width is tight even for panamax vessel, which are currently visiting the port, then appropriate measures are technically possible to increase the entrance width.

§ Due to the relatively benign wave conditions at site, as compared to other ports along east and west coast, the current entrance width of 153 m is very narrow from the wave tranquillity point of view and it is felt that the same could be widened to about 200 m without affecting the tranquillity at the berths.

Considering the benefits that the harbour deepening offers to the port, it is recommended that port should seriously pursue the option of further deepening of harbour to handle fully loaded panamax ships at the significantly large proportion of berths.

9.1.3 Recommended Plan for Development of Inner Harbour

Based on the currently executed projects particularly the mechanisation of berth 9, it is assessed that alternative 3 is more appropriate. This would however require wider harbour entrance. The recommended layout is as shown in **Figure 9.7**

Figure 9.7 Recommended Layout of Inner Harbour

From the above discussions, it can be seen that the thrust of recommended layout of Inner harbour envisages the following.

§ The inner harbour shall be developed to its full and optimal potential.
§ The inner harbour to be developed to handle fully loaded panamax vessels.
§ The entrance of inner harbour be widened
§ The consequent dredging of Approach Channel outside the present harbour entrance will eventually be useful for outer harbour dredging whenever such outer harbour materialises.
§ It will cater to the natural growth of exim container and import coal traffic that may be expected by the time Outer harbour becomes operational.
§ In alignment with the policy of government of India to reduce dependence on foreign coal imports, the coal import through Tuticorin port will be mostly through coastal movement of coal for which fully fully-loaded panamax vessels will be the optimal vessels size. The development of inner harbour as proposed will perfectly align with this objective. Further the length and cost of conveyors for coal berths developed in the optimised layout of inner harbour will be more economical.

9.2 Outer Harbour

With the above scheme of inner harbour development the projected traffic forecast up to year 2025 could be handled. As per current projections beyond this there would be a need for development of outer harbour as far as cargo handling capacity is concerned. Also as per the recommended scheme, it would be possible to handle fully loaded panamax bulk carriers within inner harbour with adequate number of container and bulk berths in inner harbour. Therefore any advancement of outer harbour development would be only be needed if the large container vessels having draft of 16 m or bulk cape carriers of draft 18.3 m are required to be catered to achieve the overall logistics advantage.

9.2.1 Basis for Port's Outer Harbour Development Proposal

The port has developed the master plan proposals and layout on the basis of traffic forecast as per DPR (by I-maritime) and refined by IPA. However, a recent national level Origin-Destination study of the cargo being handled at ports across the country carried out as part of Sagarmala (by McKinsey) has projected different traffic figures. The broad comparison of two studies is mentioned in **Table 9.1** below.

Table 9.1 Coal - Traffic Forecast as per VOCP (Validated by IPA)

Commodity	Unit	Year 2019/2020		Year 2024/2025		Year 2035/2036	
		I-Maritime	McKinsey	I-Maritime	McKinsey	I-Maritime	McKinsey
Coal	(MT)	26.9	26.6	42.1	38.3	75.3	63.4
Containers	(MTEU)	1.2	0.9	1.7	1.2	3.1	2.0

It could be clearly seen from Table 9.1 that as far as coal is concerned, it is established that Tuticorin port offers great potential for handling of coal brought to the port using coastal movement and in this regard the projected traffic numbers are more or less similar in both the studies. The numbers for hinterland containers projected by McKinsey are slightly lesser as compared to those projected by I-Maritime. But the projections by McKinsey duly consider the current scenario in which the proposed container port at Vizhinjam is under construction and that at Enayam has already been approved by Government and DPR is under preparation. These two ports apart from handling transshipment containers would definitely have their share of hinterland containers also eating away the share of Tuticorin and Cochin.

The major difference is in the traffic for the transshipment containers. It may not be out of place to mention that as part of Sagarmala assignment, a separate report on the suitable location of transshipment terminal has been prepared and basis which site at Enayam has been selected. As the construction of Vizhinjam has started and DPR for Enayam underway by VOC port itself, it would be very unreasonable to assume significant transshipment traffic at VOC port requiring very large outer harbour development. Even the IPA report mentions the following:

"The Team strongly recommends that serious and due consideration may be given by the port to the concept of Satellite port as the first expansion alternative of the port and take an informed decision before considering Outer harbour option."

The layout of Port's Master Plan for Outer harbour is shown in **Figure 9.8.**

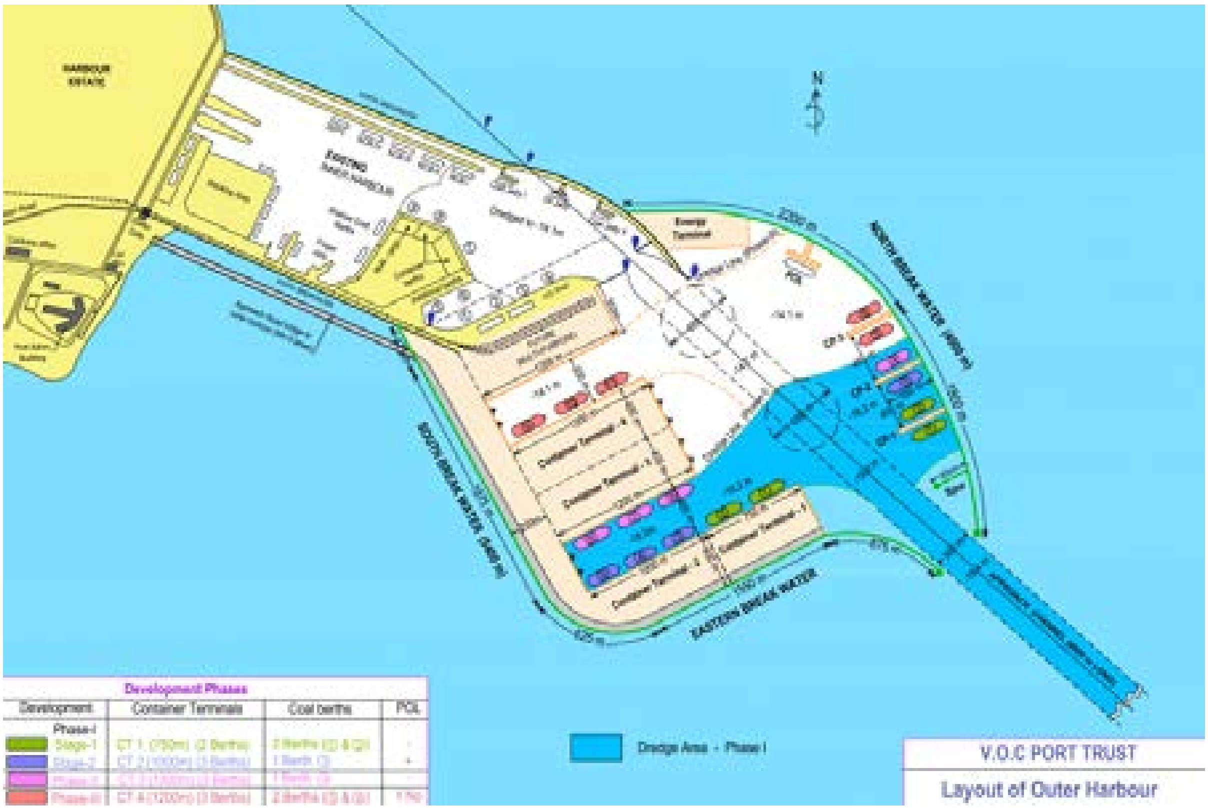


Figure 9.8 Layout of Port's Master Plan for Outer Harbour

As could be seen the layout proposed by the port envisages development of 14 container berths, which are basically necessitated on account of projected 7.4 MTEUs of transhipment container traffic.

9.2.2 Master Plan Layout based on the Current Traffic Forecast

9.2.2.1 Facility Requirements

For Coal Handling

As already indicated earlier that the preferred option is to develop coal handling capabilities within the inner harbour to the maximum extent and only after exhausting the same the development of bulk berths in the outer harbour may be taken up. This is due to the fact that as per government policy of sourcing of coal for power plants shall be 70% indigenous which means handling of Panamax vessels will be adequate.

When the inner harbour saturates for bulk handling, creating facilities in the outer harbour for bulk handling more particularly for coal is imperative.

For Container Handling

The current capacity of two container berths 7 and 8 together for container handling is of the order of 1.0 MTEUs and even if the additional container handling projects within the inner harbour do not materialise, the required container handling capacity for outer harbour would be only 1.0 to 2.1 MTEUs requiring maximum 3 to 4 berths.

9.2.2.2 AECOM's Proposed Master Plan Layout

In line with the above requirements an alternative master plan layout has been developed by AECOM as presented below in **Figure 9.9**. This layout is basically a downsized version of the layout by port.

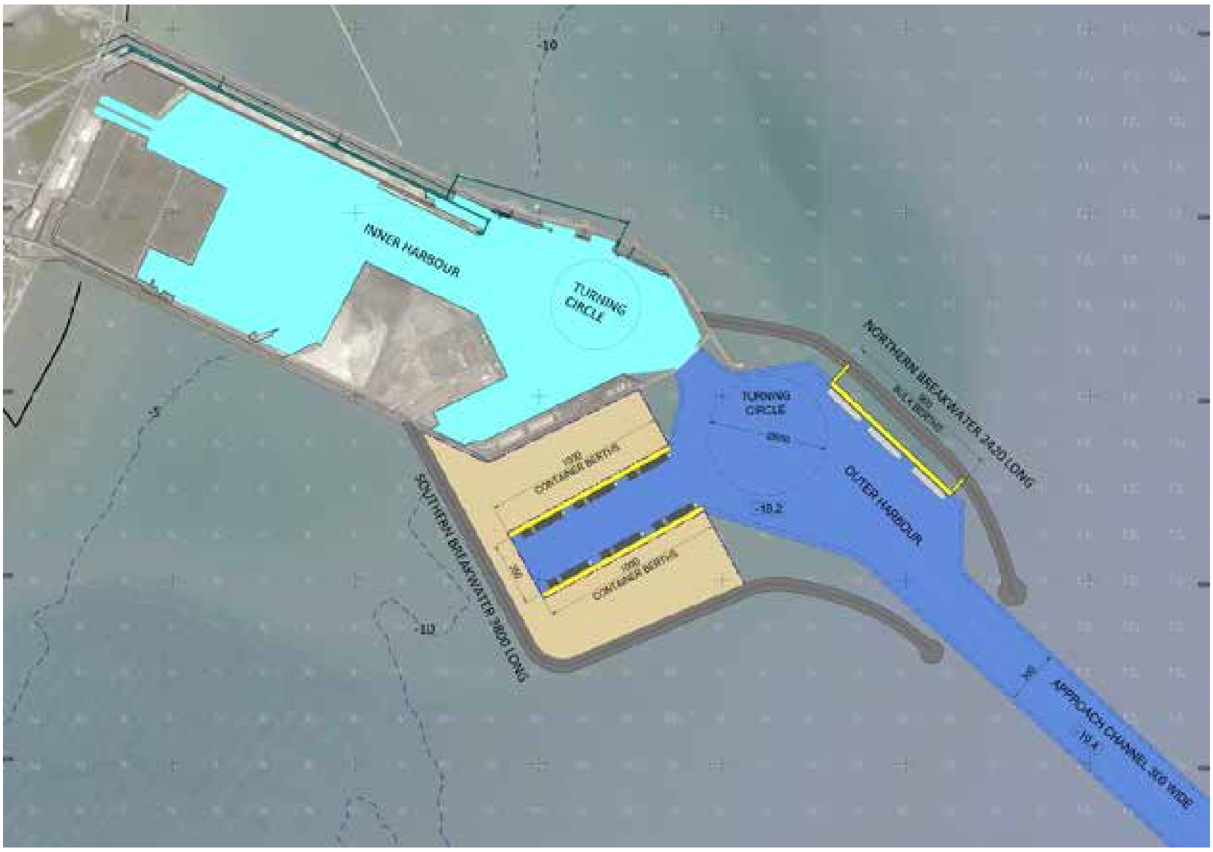


Figure 9.9 AECOM's Modified Master Plan Layout

The proposed master plan layout can provide additional container handling capacity of about 3.6 MTEU and about 30 MTPA capacities for bulk import. The approach channel and harbour would be dredged for 16 m draft ships eventually and could be planned to cater to 14.5 m draft ships initially.

9.2.3 Comparison between Port's and AECOM's Layout

9.2.3.1 Facilities in Phase 1 Development

The traffic forecast made over a time horizon of 20 years up to 2035-36 will actually develop over a period of many years depending upon the GDP growth, and industrialisation of the hinterland etc. In view of this, it is necessary to plan for the layout of outer harbour taking the ultimate traffic by 2035 and the berthing facilities as per incremental increase in traffic that can be excepted in five, ten and fifteen years in a phased manner.

It is therefore proposed to develop the outer harbour in phases with breakwater for ultimate layout in the beginning itself but the berthing structures, dredging and reclamation can happen in phases. In line with this, the layout and berthing facilities in the first phase are proposed as per the following layout.

The proposed Phase 1 layout comprises of 2 container berths and 2 coal berths. It is proposed that while the berthing structures may be designed for the 16 m or even 18 m draft ships, the dredged depths in the channel and harbour basin are to be increased in a phased manner. Initially the dredging could be carried out for 14.5 m draft ships to cater to fully loaded Panamax ships of all sizes. Subsequently, it can be increased to 16.0 m as per market demand.

9.2.3.2 Phase 1 Layout of Outer Harbour

The proposed Phase 1 layout of the outer harbour development as per the Port's Layout and that as per AECOM's Layouts are shown in **Figure 9.10** and **Figure 9.11** respectively.

Figure 9.10 Proposed Phase 1 Development of Layout by VOC Port

Figure 9.11 Proposed Phase 1 Development of Layout by AECOM

9.2.3.3 Comparison of Layouts

Considering the shorter breakwater lengths, it is estimated that about 60% of the rock quantity would be needed in the modified layout as compared to the base layout proposed by the port. Therefore Phase 1 facilities could be commissioned about 2 years earlier in the layout proposed by AECOM.

A cost comparison between the two layouts reveal that the cost of basic infrastructure in terms of breakwater, dredging and reclamation in the Phase 1 layout proposed by AECOM would be lower by about INR 500 crores i.e. about 6%.

As regards the master plan layout, the downsized version of Port's layout (even after keeping the breakwater configuration same but reducing the number of container berths) would be as shown in **Figure 9.12** below.

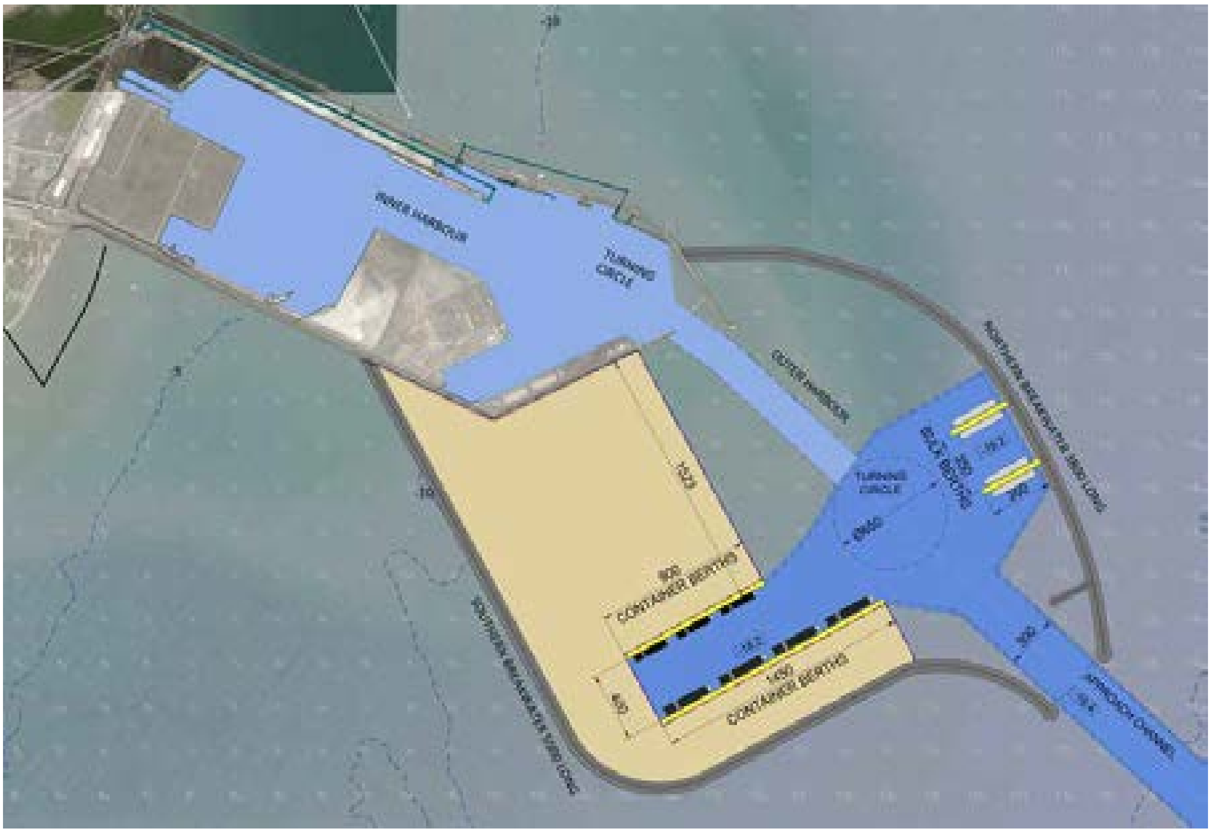


Figure 9.12 Downsized Master Plan Layout of the Outer Harbour

The additional harbour area obtained in this layout due to long breakwaters could be utilised for creating huge backup area of about 140 Ha, (beyond what is required for berthing facilities developed in outer harbour), which at present is scarce within the harbour. This area could be utilised for storage of cargo and port operations. While part of the reclaimed area could be developed by utilising the dredged material, borrowed fill would be needed to create the balance area.

9.2.4 Recommendations for Outer Harbour

The pros and cons of long breakwaters and the consequent time of construction and cost have to be duly weighed with respect to additional reclaimed area obtained while finalising the appropriate layout of the outer harbour. This could ideally be decided while arranging financing for the Phase 1 development of the outer harbour based on the firm requirements of the facilities to be created.

10.0 SHELF OF NEW PROJECTS AND PHASING

10.1 General

As part of V. O. Chidambaranar Port Master Plan several projects have been identified which need to be taken up in phased manner with the built up in traffic. The proposed phasing, capacity addition and the likely investments are discussed in paragraphs below.

It may be noted that apart from these projects there could be several other projects which port would be implementing as part of the routine operations and maintenance of the port facilities. Further the phasing proposed is not cast in stone but could be reviewed periodically and revised based on the economic scenario and demand for port at that particular point of time.

10.2 Ongoing Projects

The details of the projects which have already been awarded and development is ongoing are given below in **Table 10.1**.

Table 10.1 Ongoing Projects

S. No.	Project Name	Investment required (In Crores)	Capacity Addition (MTPA)	Mode of Implementation
1.	Construction of North Cargo berth-II for handling bulk cargoes on DBFOT basis - Tuticorin	335	7	PPP
2.	Conversion of 8th berth as container terminal on BOT basis for a period of 30 years - Tuticorin	315	7	BOT
3.	Mechanization of Berth IX	50	6	PPP

The port layout after completion of ongoing projects shall be as shown in **Figure 10.1**.

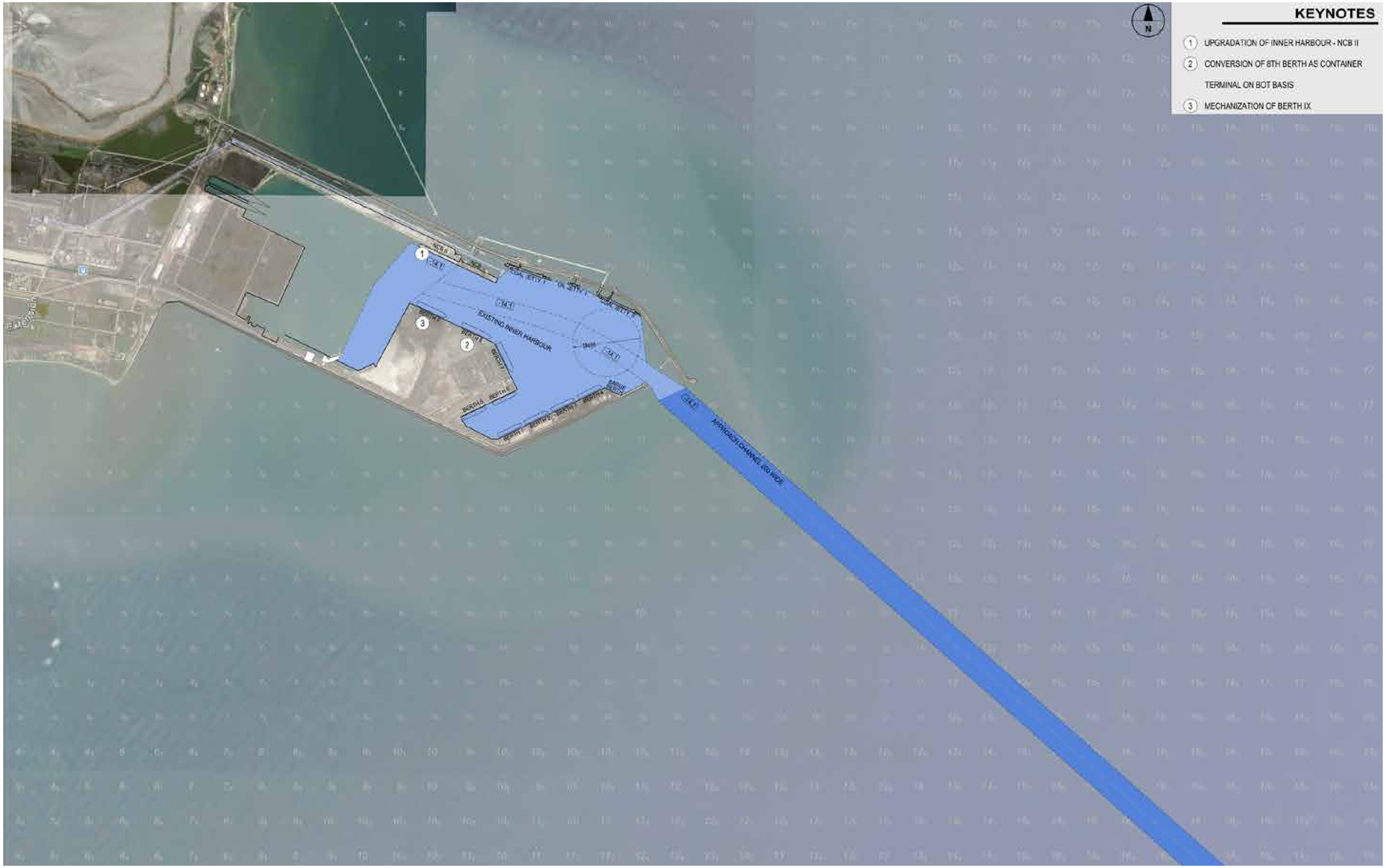


Figure 10.1 Port Layout along with Ongoing Developments

10.3 Projects to be completed by Year 2020

The details of the projects which are envisaged to be completed by the year 2020 are given below in **Table 10.2**

Table 10.2 Projects to be completed by Year 2020

S.No.	Project Name	Investment required (in croes)	Capacity	Mode of implementation
1.	Upgradation of existing coal jetty (CJ2)	250	6	Port's fund
2.	Upgradation of inner harbour NCB III	587	18	PPP
3.	Upgradation of inner harbour NCB IV – Container / clean cargo	515	0.6M TEU	PPP
4.	Upgradation of inner harbour – SEPC berth	200	4	PPP
5.	Upgradation of inner harbour – Shallow berth	126	2.6	PPP
6.	Construction of new ROB parallel to existing between TTPS to Check Post	0.3	-	Port's fund
7.	Providing Railway Track between Marshalling Yard and Hare Island	70	-	Port's fund
8.	NCB I – utilization of its full capacity at Tuticorin	-	2.5	PPP
9.	Deepening of NCB III and IV	900	-	Port's fund

The port layout after completion of planned projects till 2020 shall be as shown in **Figure 10.2**.

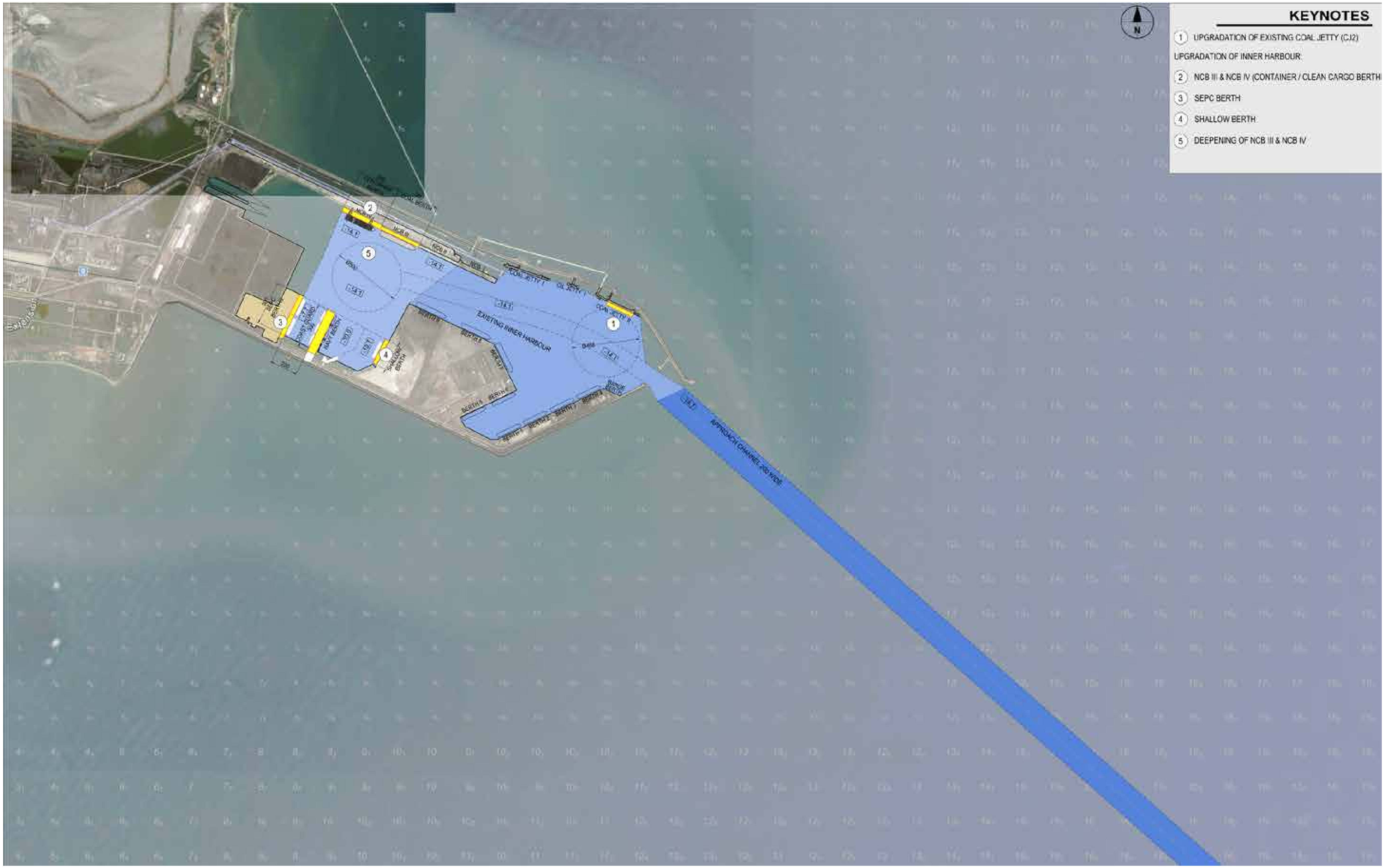


Figure 10.2 Port Layout 2020

10.4 Projects to be completed by Year 2025

The details of the projects which are envisaged to be completed by the year 2025 are given below in **Table 10.3**

Table 10.3 Projects to be completed by Year 2025

S. No.	Project Name	Investment required (In Crores)	Capacity Addition (MTPA)	Mode of Implementation
1.	Upgradation of Inner Harbour - Deep Draft Bulk Berth	330	9	PPP
2.	Upgradation of Inner Harbour – Multi-Purpose Barge Berths	100	2	PPP
3.	Upgradation of Inner Harbour - Channel and Basin Deepening for Fully Loaded Panamax Ships	1600	6	Port's funds
4.	Development of Outer Harbour-Dredging and Breakwaters	7000	0	Port's funds
5.	Development of Outer Harbour - Phase 1 (2 coal and 2 container)	1600	38	PPP
6.	New 4 lane road connectivity in between Harbour Extension Road and National Highway 7A	36	-	Port's funds
7.	Widening of harbour highway extension road (HHE Road) into 4 lane configuration (a section of about 5 km length)	30	-	Port's funds
8.	Widening of VOC road into 8 lane configuration from Port Trust Circle to NH 45B junction	16	-	Port's funds
9.	Elevated road above VOC road to take Traffic of Hare Island (about 2km)	43	-	Port's funds
10.	New railway line from Marshalling Yard to Red gate	18	-	Port's funds

The port layout after completion of planned projects till 2025 shall be as shown in **Figure 10.3**.

Figure 10.3 Layout Plan 2025

10.5 Projects to be completed by Year 2035

The details of the projects which are envisaged to be completed by the year 2035 are given below in **Table 10.4**.

Table 10.4 Projects to be completed by Year 2035

S. No.	Project Name	Investment required (In Crores)	Capacity Addition (MTPA)	Mode of Implementation
1.	Multi-Purpose Berth	330	9	PPP
2.	Future Berth	-	-	-
3.	Development of Outer Harbour - Phase 2 (2 coal and 5 container berths)	1600	58.25	PPP
4.	Electrification and doubling from Milavittan railway station to Marshalling yard and Milavittan station to Tuticorin station	150	-	Port's funds

The port layout after completion of planned projects shall be as shown in **Figure 10.4**.

Figure 10.4 Port Layout 2035

Appendix 1 - **BCG Benchmarking Study for V. O. Chidambaranar Port**

Master Plan for Visakhapatnam Port

Prepared for

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Government of India

Ministry of Shipping/ Indian Ports Association

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Revision	Description	Prepared by/ date	Reviewed by/ date	Approved by/ date

Document Revision Register

Issue no.	Date of issue	Section	Revision Details	Revision By Name & Position
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2	27.07.2016		Comments on Final Master Plan Report	Ritu Paliwal (Senior Consultant)

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1.0 INTRODUCTION

1.1 Background

The Sagarmala initiative is one of the most important strategic imperatives to realize India's economic aspirations. The overall objective of the project is to evolve a model of port-led development, whereby Indian ports become a major contributor to the country's GDP.

As shown in **Figure 1.1**, the Sagarmala project envisages transforming existing ports into modern world-class ports, and developing new top notch ports based on the requirement. It also aspires to efficiently integrate ports with industrial clusters, the hinterland and the evacuation systems, through road, rail, inland and coastal waterways. This would enable ports to drive economic activity in coastal areas. Further, Sagarmala aims to develop coastal and inland shipping as a major mode of transport for the carriage of goods along the coastal and riverine economic centres.

As an outcome, it would offer efficient and seamless evacuation of cargo for both the EXIM and domestic sectors, thereby reducing logistics costs with ports becoming a larger economy.

Sagarmala aims to optimize the Logistics route for Port and Increase focus on Port led development for the country

		Details	Description
Why is Sagarmala needed?	1	Dual institutional structure at ports	▪ Due to segregation of major and minor ports, ports of India have grown as due unconnected entities and not benefitting from co-location or economics of scale
	2	Weak infrastructure at ports and beyond	▪ Weak modes of evacuation from both major and minor ports leading to sub – optimal modal mix presently ▪ Limited hinterland linkages that increases cost of transportation
	3	Limited economic benefit of location & to community	▪ Limited conscious skill development and leverage to peripheral trades (fisheries, tourism etc.) ▪ Limited development of centres of manufacturing near ports
What does Sagarmala want to achieve?	1	Ports led development	▪ Undertake development of coastal economic zones with projects like – port based industrialization, coastal tourism, Logistics parks, warehousing, fisheries etc.
	2	Port infrastructure enhancement	▪ Action points on transforming existing ports into world class ports be developing deep drafts, mechanization of existing berths, creation of new capacity and greenfield ports
	3	Efficient evacuation	▪ Expansion of rail / road network connected to ports and identification of congested routes ▪ Find optimized transport solution for bulk and container cargo

Figure 1.1 Aim of Sagarmala Development

In order to meet the objectives, Indian Port Association (IPA) appointed the consortium of McKinsey and AECOM as Consultant to prepare the National Perspective Plan as part of the Sagarmala Programme.

1.2 Scope of Work

The team of McKinsey and AECOM distilled learnings from experience in port-led development, the major engagement challenge to develop a set of governing principles of approach is shown in **Figure 1.2**.

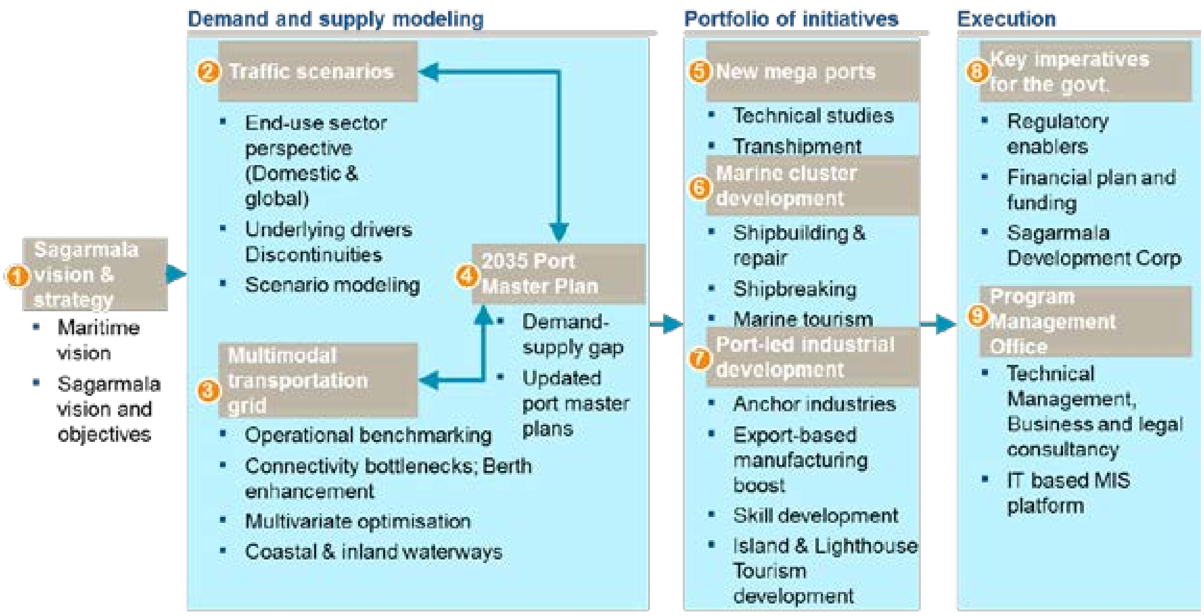


Figure 1.2 Governing Principles of Our Approach

As indicated above, the origin-destination of key cargo (accounting for greater than 85% of the total traffic) in Indian ports have been mapped to develop traffic scenarios for a period of next 20 years. The forces and developments that will drive change in the cargo flows are also identified. This would lead to the identification of regions along the coastline where the potential for the expansion of existing port exists. The various activities involved in the port led developments are charted in **Figure 1.3**.

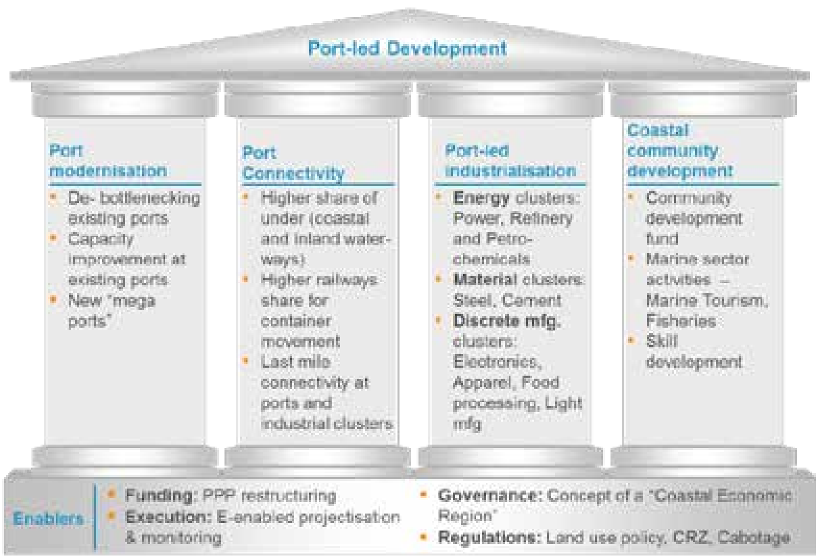


Figure 1.3 Port Led Developments

As part of the assignment, we are also expected to coordinate with the team working on "Benchmarking Operational Improvement Roadmap for Major Ports in India" study (which is being carried out simultaneously along with this assignment) and identify current and future logistic constraints (at the Major Ports) for the top 85% cargo categories based on analysis of current port capacity, productivity levels in comparison to international benchmark and evacuation bottlenecks in the logistics chain. This understanding would be an input in defining the 2035 Master Plan for each port.

Accordingly, this Master Plan report has been prepared taking into consideration the inputs provided on the future traffic and the benchmarking and operational improvements suggested for this port.

1.3 Present Submission

The present submission is the Final report for Development of Master Plan for Visakhapatnam Port as part of SAGARMALA assignment. This report is organised in the following sections:

Section 1 : Introduction

Section 2 : The Port and Site Conditions

Section 3 : Details of Existing Facilities

Section 4 : Details of Ongoing & Planned Developments

Section 5 : Performance, Options for Debottlenecking & Capacity Assessment

Section 6 : Traffic Projections

Section 7 : Capacity Augmentation Requirements

Section 8 : Rail and Road - Internal Network and External Connectivity

Section 9 : Scope for Future Capacity Expansion

Section 10 : Shelf of New Projects and Phasing

2.0 THE PORT AND SITE CONDITIONS

2.1 Visakhapatnam Port as at Present

2.1.1 Location Plan and Harbour Details

The location of the port is shown in the **Figure 2.1**.

Figure 2.1 Location of Visakhaptnam Port

Port of Visakhapatnam is one of the leading major ports of India and is located on the east coast midway between Kolkata and Chennai. The Port is located at Latitude 17° 41’ N and Longitude 83° 18’ E. The time zone is GMT +5:30 hr.

The Port has two components viz., Inner harbour and an Outer harbour. The Outer Harbour is accessed through an approach channel which is 3.1km long; 200m wide and 20m deep. This is up to the Dolphin’s nose light house. This leads to a turning circle of 610m diameter. The Inner Harbour is accessed through an extension of this approach channel which is 1.1km long (from Dolphin’s nose light house); the width varies from a minimum of 111m to 168m and is 16.1m deep. This leads to a turning circle of 440 m diameter.

The Inner Harbour is a natural harbour with a turning basin and three navigable arms – northern, western and north-western. The total water spread is about 100 hectares. It accommodates 18 berths. It can accommodate fully loaded Panamax vessels of 230m LOA; 32.5m beam and 14.5m draft.

The Outer Harbour is an artificial harbour with a total water spread area of 200 hectares. Its basin is protected by two breakwaters: 1070m long eastern breakwater and 1540m long southern breakwater. It accommodates 6 berths. It can accommodate fully loaded cape size vessels of 320 m LOA; 50 m beam and 18.0m draft.

The port has a vast hinterland and is surrounded by many major industries such as M/s RINL, SAIL, NALCO, NMDC, MMTC, Hindustan Shipyard, Coromandel Fertilizers, Hindustan Zinc Ltd., RCL, HPCL, etc. within the vicinity of port. The Headquarters of Eastern Naval Command also exists adjacent to Visakhapatnam port. The inner harbour channel is shared by the Port and Eastern Naval Command for movement of vessels.

The relative locations of VPT inner harbour, VPT outer harbour, Eastern Naval Command and Hindustan Shipyard are shown in the satellite picture hereunder in **Figure 2.2**.

Figure 2.2 Relative Locations of VPT Inner Harbour, VPT Outer Harbour, Eastern Naval Command and Hindustan Shipyard

2.1.2 Road Network and Connectivity

The total road network within the Port limits is about 85 km out which 23.5 km is available within the operational area connecting the entire stacking areas for free movement of vehicles. A 12.47 km port connectivity road was implemented jointly by the Port and NHAI through a SPV “Visakhapatnam Port Road Limited”. This flyover cum road project facilitates smooth movement of cargo traffic between Port and National Highway-5.

The port is well connected by a 4 lane road to NH-5 (Chennai-Kolkata) with access to Tamil Nadu and Odisha/West Bengal. The distance to Chennai is 790 km, while that to Bhubaneswar is 442 km.

2.1.3 Rail Network and Connectivity

The port is having an internal rail network connecting the berths handling bulk and container cargo. This railway network operated by the port is the largest amongst Indian Ports with over 200km rail length and over 30 Sidings. The Port is equipped with 15 WDS-6 locos of 1400 HP and 3 WDG-3 locos of 3100 HP capacity for carrying out marshalling operations.

The Port is also well connected with the Indian railways network directly through the Waltair Railway Marshalling Yard to Chennai-Howrah Main line of East Coast. This line branches off at Kothavlasa leading to Bailadilla Iron Ore mines in Chhattisgarh. This main line goes further up North passing through coastal Orissa, West Bengal up to Assam facilitating movement of imported fertilizers petroleum products etc. to various stations.

2.2 Site Conditions

2.2.1 Meteorological Conditions

2.2.1.1 Climate

The Climate of this region is governed by its location in the tropics and the monsoons. The climate of the South East coast of Bay of Bengal is characterized by the recurring seasonal monsoons, which divide the year into four seasons as follows:

§ The pre-monsoon period is from March to May, usually the beginning of the hottest period of the year, when the winds shift towards south-westerly direction.

§ South-west monsoon period is from the middle of May up to the middle of October with predominantly south-Westerly winds, cloudy weather and frequent rains.

§ The post-monsoon period is from the middle of October to the end of November with variable weather and witnesses cyclones with relatively greater frequency.

§ The North-east monsoon period is from the end of November to the end of February with predominantly north-easterly winds. Cyclones are frequent during November.

§ The climatic division is, of course, not absolute and there is some overlap between seasons.

2.2.1.2 Temperature

There is a seasonal variation in temperature. May and June are hotter months whereas December and January are colder months.

The annual mean maximum temperature is 30°C and the annual mean minimum temperature is 24.3°C.

The highest temperature so far recorded was 44.4° C in the month of June in 1923 and the lowest temperature was 12.8° C in the month of January in 1958.

2.2.1.3 Relative Humidity

The humidity is comparatively high and fairly uniform throughout the year. The mean daily relative humidity over a year is about 76% at 0800 hrs and 72% at 1700 hrs. The highest recorded value is 81% and lowest recorded value is 64%.

2.2.1.4 Rainfall

The rainy season persists mainly during the south-west monsoon and also during north-east monsoon. September and October are the wettest months of the year with an average rainfall of 167.3 mm and 259.3 mm respectively. The average annual rainfall is about 973.6 mm. The average number of rainy days per year is 50.

2.2.1.5 Visibility

Visibility is good throughout the year as fog is infrequent at sea in all seasons. Reduction in visibility is mostly due to heavy rainfall during the south-west monsoon. The highest monthly average duration recorded of fog is 0.1 day in some months from December to May.

2.2.1.6 Wind

The predominant direction of wind is south-west or north-east depending on the monsoon season. The south-west monsoon winds are relatively stronger than the north-east winds. The maximum wind speed recorded is 110 KMPH in May 1950 from east-north-east. It is, however, known that wind speed as high as 150 KMPH may be experienced occasionally during cyclones in the Bay of Bengal.

The wind rose indicating the wind climate for the four quarters of the year (viz. January-March; April-June; July-September & October-December.) is presented hereunder.

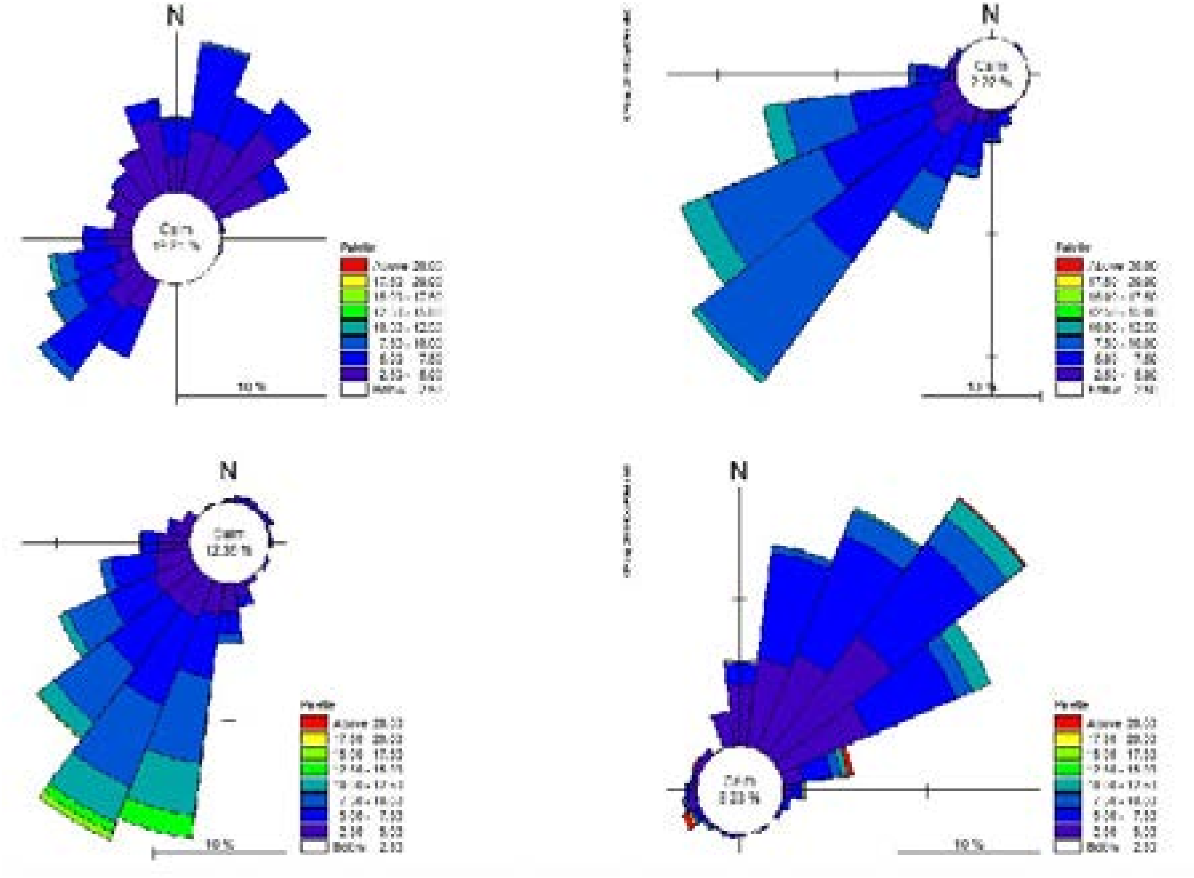


Figure 2.3 Wind Rose Diagram

2.2.1.7 Cyclones

Cyclones are common to occur in the Bay of Bengal.

Average number of cyclones occurring at Visakhapatnam is 3 to 4 per year. Cyclonic storms and depressions occur with greatest frequency is August, October and November generally.

2.2.2 Oceanographic Data

2.2.2.1 Tidal Data

The tides at Visakhapatnam are semi-diurnal with tidal levels, relative to the Chart Datum (CD), as follows:

Highest high water recorded (Nov. 2007)	: +2.38 m
Mean high water level spring	: +2.06 m
Mean high water level neap	: +1.50 m
Mean sea level	: +0.80 m
Mean low water level spring	: +0.16 m
Mean low water level neap	: +0.50 m
Chart datum (CD)	: 0.00 m
Lowest low water recorded (March 2007)	: (-) 0.39 m

During the ‘tsunami’ occurred in December 2004 the max. & min. levels of sea water have varied between a maximum of +3.0 m to a minimum of –1.0 m CD.

2.2.2.2 Waves

The wave rose indicating the wave direction and period for the four quarters of the year (viz. January-March; April-June; July-September & October-December.) is presented hereunder. From this data, it is observed that the external waves of H_s = 0 to 1 m occur for about 150 days and H_s > 2 m occur for about 15 days in a year. From the wave rose diagram it is seen that the predominant wave direction will be form SSE to SE during south-west monsoon period from May to August. This will change to ESE direction during September and October. During the months of November to January, the predominant wave direction would be from ESE quadrant. The months of December to April are relatively calm except for occurrence of occasional cyclones.

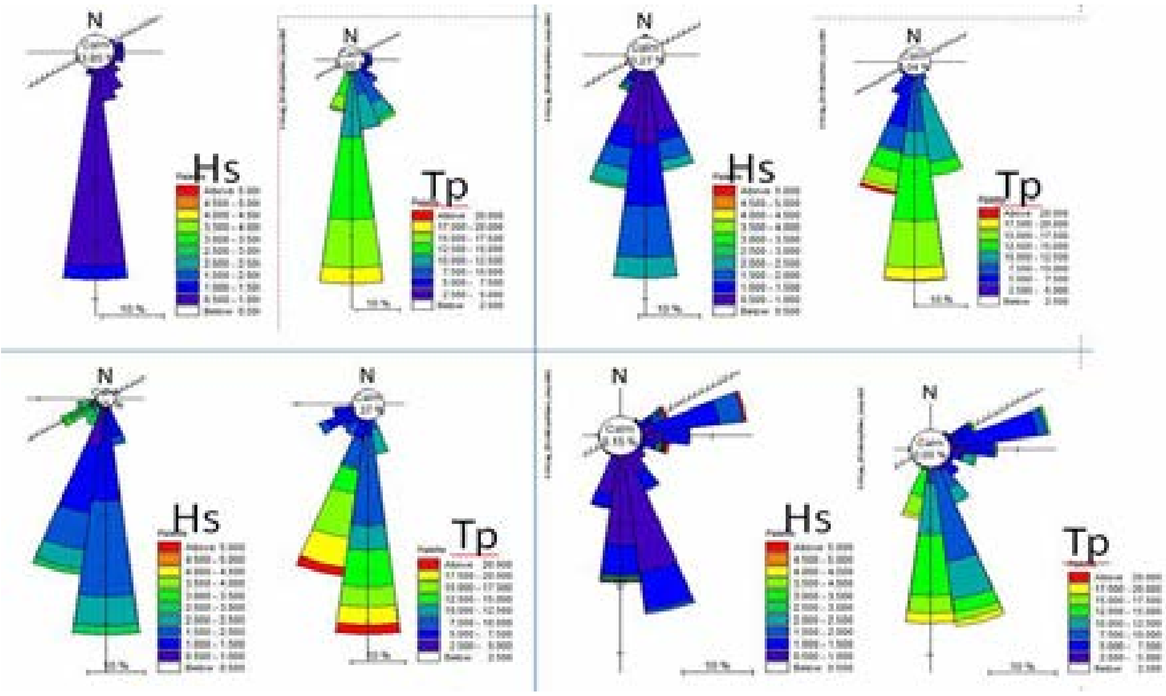


Figure 2.4 Wave Rose Indicating the Wave Direction and Period for the Four Quarters of the Year

2.2.2.3 Currents

Currents in the Bay of Bengal are seasonal and are mainly due to south-west and north-east monsoons. From February to June offshore currents flow towards the north-east and from August to December towards south-west at velocities ranging from 0.5 to 1 knot. In the vicinity of Visakhapatnam coast currents are neither related to wind nor to tides in any appreciable way. Towards north, the coast bears about 50° to the east. Hence if a wave orthogonal bearing 130° to the east the wave crest will be parallel to the coast and there will be no steady longshore current. This concludes that the determining factor for the direction of current is the direction of the predominant wave.

2.2.2.4 ***Littoral Drift***

Visakhapatnam is situated on the east coast and is subject to intense littoral drift moving from south to north. Interception of the littoral drift by any artificial barrier causes up-coast accretion and shoaling and compensating erosion along the down-coast because of mass discontinuity of the natural littoral drift. There is a strong littoral drift of sand northwards from March to September. Maximum amount of drift takes place from May to August when the waves are the highest. It is believed that the drift is largely confined to a zone within 200 m of the shore and is within the 6 m contour. The quantum of annual maintenance dredging carried out in 2009-2010 was 4.46 lakh cubic meters.

3.0 DETAILS OF EXISTING FACILITIES

The VPT Port has three distinct basins:

§ Inner Harbour has a water spread of 100 ha and it comprises of an entrance channel of 1.62 km in length and 14.5 m draft, a turning basin and three navigable arms – northern, western and north-western accommodating a total of 18 berths.

§ Outer Harbour is a protected tranquil basin of 200 ha encompassed by set of three breakwaters. It has 6 berths and draft of 18.0 m.

§ Within outer harbour an area of 24 ha is designated as Fisheries harbour.

3.1 Inner Harbour

In the Inner Harbour, the northern arm is the main commercial arm of the Port and accommodates 15 multi-commodity berths (including BOT berths). The north-western arm is fully utilized by the Eastern Naval Command. A part of the western arm is used by the Hindustan Shipyard Limited and part by the Port where three captive berths (two oil berths and one fertilizer berth) are located. Thus, the total number of berths in Inner Harbour is 18 including BOT berths.

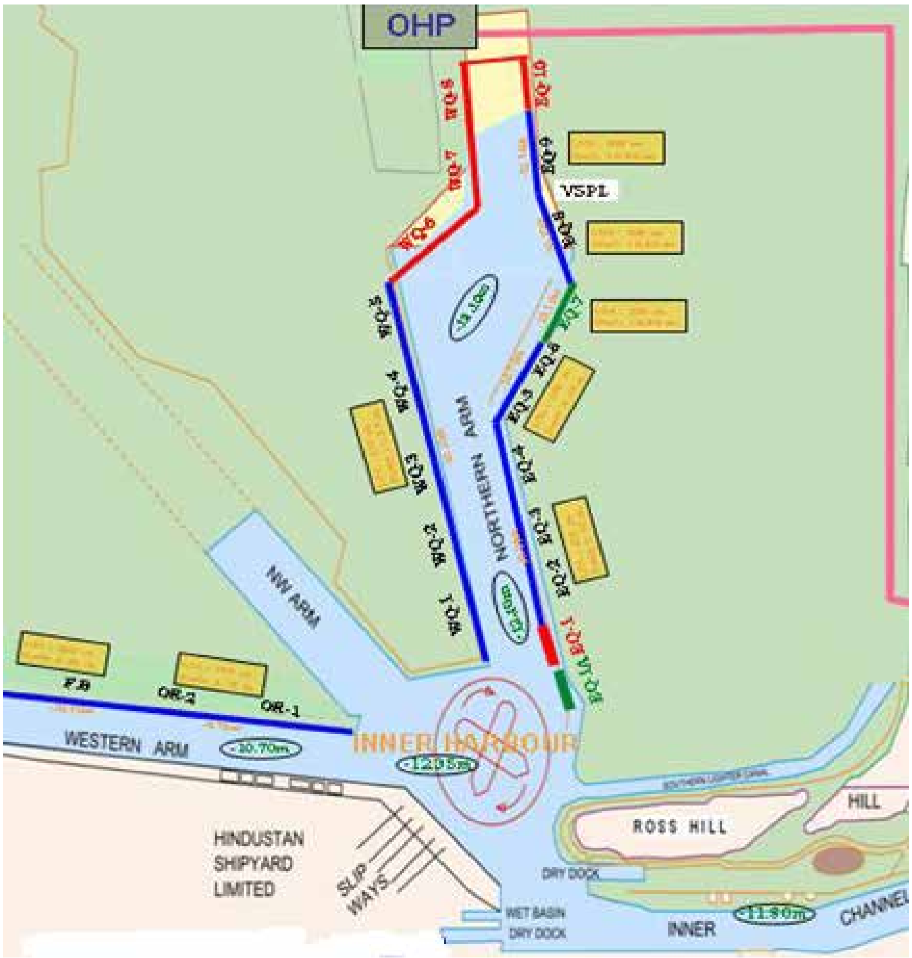


Figure 3.1 Inner Harbour

3.1.1 East Quay

There are 10 berths on the east quay viz. EQ 1 to EQ 10. These are designed to handle partially loaded Panamax vessels. The brief details of the berths are provided in **Table 3.1**.

Table 3.1 Berths Details of East Quay

Berth No.	Cargo Handled	Length (m)	Design Draft (m)
EQ-1	Steam Coal	280	14.0
EQ-2	PET coke, other dry bulk including Iron ore, food grains, containers, steel products etc.	100	10.6
EQ-3		167	10.6
EQ-4		231	10.6
EQ-5		167	11.0
EQ-6	Anthracite coal, BF slag's, steel, Thermal coal, fertilizers, Phosphoric Acid, fertilizers raw materials	183	11.0
EQ-7	Finished Fertilizers including Muriate of Potash	255	12.5
EQ-8	Urea, Magnetite, fertilizers raw materials	255	14.5
EQ-9	Steel, Gen. Cargo, steam coal, lam coke, feldspar and granite	255	14.5
EQ-10	Caustic Soda, Bio diesel, edible oils & chemicals	-189	14.0

In recent times, to meet the demands of trade, the port has taken action for phase wise deepening of Inner Harbour berths to cater to fully laden Panamax vessels and also refurbishing the berthing facilities to handle such vessels.

In line with this, the Port has awarded a concession to M/s Adani Vizag Coal Terminal Ltd. (a SPV formed by the consortium of Mundra Port & SEZ Ltd and Adani Enterprises) for developing EQ 1 berth to handle fully loaded Panamax vessels up to 80,000 dwt. The project involved dismantling the old EQ1 berth of 167 m and part of EQ 2 berth and constructing a new EQ 1 berth of 280 m long and 16.10 m deep. This will handle steam coal through a complete mechanised system with 2x100 T Harbour Mobile Cranes; 1 stacker; 1 reclaimer; 1 stacker-cum-reclaimer; 1 wagon loader and an interconnecting conveyor system. This new berth is provided with a stockyard of 101,200 m2 area. This is expected to handle a minimum 6.41 MTPA. The concession agreement was signed in August, .2012 and the project was completed in September, 2014. The commercial operations commenced during October, 2014.

The remaining portions of EQ 2, EQ 3 and EQ4 remain as old monolithic type construction with a draft of 10.06 m.

EQ 5 & EQ 6 also remains as the old berth.

EQ 7 has been given on license to M/s ABG and the project is presently on hold. The details are covered in a subsequent section.

EQ 8 & EQ 9 berths have been given on license to M/s Vizag Seaport Pvt. Ltd. for handling coal, fertilisers, limestone, other dry bulk, breakbulk and non-hazardous liquid cargo. They have reconstructed the berths with diaphragm wall and a system of vertical and raker piles. The berths have been designed for a length of 255 m each and with 14.5 m water depth. They have been assigned a combined stockyard of 90,000 m^2 area. These berths are mechanised with grab unloaders, conveyor system, stacker and reclaimer and rail loading facility.

3.1.2 Development of New Berth EQ -10

The Port has taken up the development of Eastern Quay-10 (EQ-10) berth in the Northern arm for handling Liquid Cargo (excluding POL products) with a throughput of 1.85 MTPA on Design, Build, Finance, Operate, and Transfer (DBFOT) basis.

The License to develop EQ-10 was awarded to a consortium of M/s IMC Limited who formed a SPV named M/s AVR Infra Pvt Ltd (AVRIPL) for this purpose. The concession agreement for a thirty-year concession period was signed during August 2010.

The berth will have a length of 180.9 m and will be able to cater to vessels up to 14 m draft. 60 m of berth length was already constructed by M/s. Vizag Sea Port Ltd., as shore protection to their berth EQ-9 and this will become part EQ-10 berth. The concessionaire will be building additional 120.9 m of berth length and another 50 m of return end to retain the earth. In addition an area of about 30,000 m^2 of land at North of S-4 conveyor for development of receipt, storage and dispatch facilities and about 3,200 m^2 of land for laying pipelines are leased to the Concessionaire.

For storing the products, 6 numbers of MS vertical cylindrical storage tanks each of 14 m diameter and 20 m height are constructed. These are connected to the berth by 1x12”+2x10” dock lines. The ship-shore transfer will be effected through 8” or 6” SS flexible hoses with a discharge rate of 300 TPH.

In addition a 2” fresh water line and a 1.5” nitrogen purging line are provided. Pig launchers & Pig receivers are also provided for clearing purposes.

The location of the berth with the backup area is shown in the satellite picture in **Figure 3.2**.

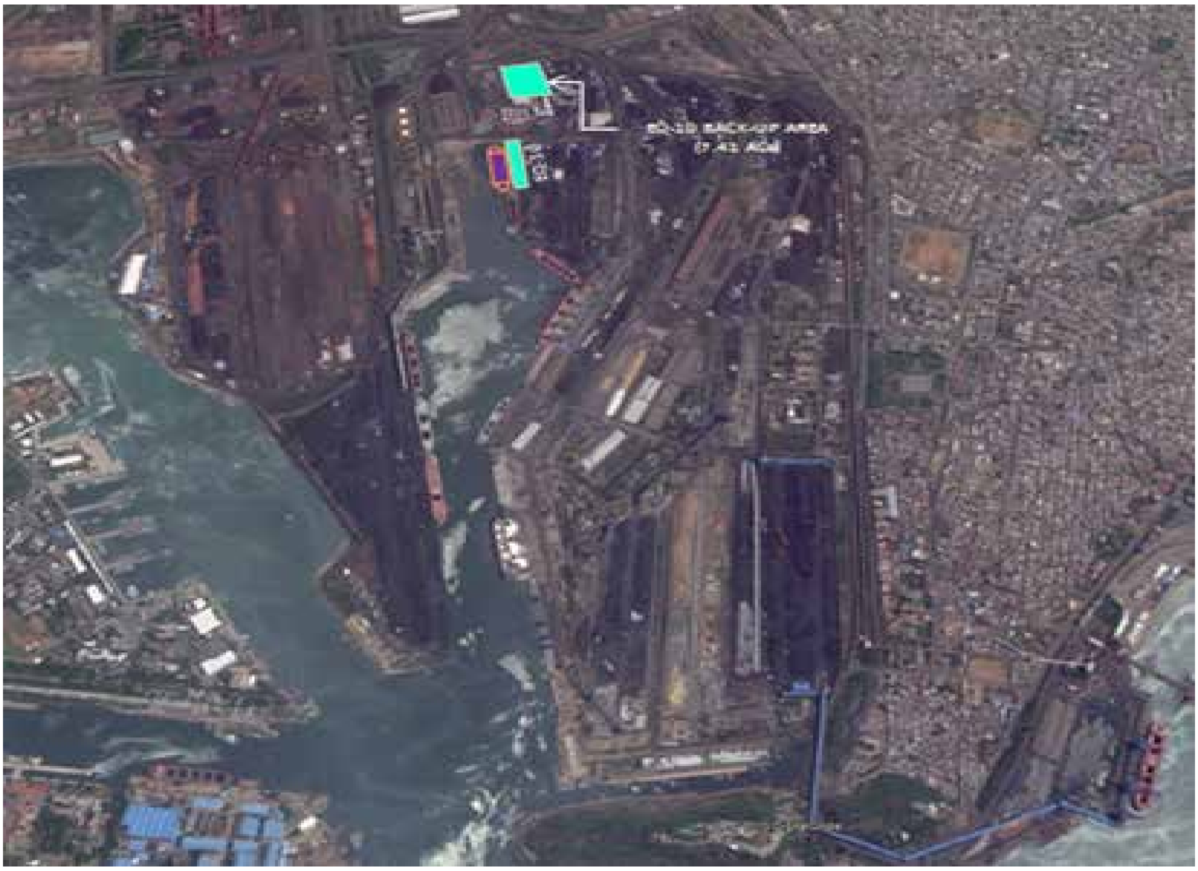


Figure 3.2 Berth with the Backup Area

3.1.3 West Quay

There are 6 berths on the west quay viz. WQ 1 to WQ 6. These were designed to handle partially loaded Panamax vessels (**Table 3.2**).

Table 3.2 Berths Details of West Quay

Berth No.	Cargo Handled	Length (m)	Design Draft (m)
WQ -1	Iron Ore	212.0	13.0
WQ -2	Coking Coal & iron Ore, Granite & Thermal coal	226.7	13.0
WQ -3	Coking coal, steel, thermal coal, soya, PET coke & iron ore	201.12	13.0
WQ -4	Iron ore, Iron ore pellets, steam coal, limestone & steel	243.0	11.0
WQ -5	Alumina, Iron ore, granite & Caustic soda	241.7	11.0
WQ -6	CP coke , LAM coke, steel and granite	255.0	14.0

WQ1, WQ 2 & WQ 3 berths were strengthened to cater to 12.5 m draft vessels. WQ 4 and WQ 5 berths are old.

WQ 6 berth has been given on license to a consortium of M/s. ABG Infralogistics Limited on DBFOT basis who formed a SPV named M/s West Quay Multiport Pvt. Ltd. (WQMPL) for this purpose. This berth will handle LAM coke, CP coke, steel and granite blocks with capacity of 2.08 MTPA. They have reconstructed the berths with diaphragm wall and a system of vertical and raker piles. The berths have been designed for a length of 255 m and with 16 m water depth. They have been assigned a combined stockyard of 14.67 acres area with 2.47 acres behind the berth and 12.2 acres north of VPT flyover. This berth is semi-mechanised with 2 no. 60 T cranes and front end loaders.

3.1.4 Western Arm

The western arm accommodates on the northern side a captive berth of M/s. Coromandal Fertilisers for handling fertilisers and two liquid bulk berths OR 1 & OR 2. These two berths are connected to the refinery and marketing terminals of oil companies. The details of these berths are given in **Table 3.3**.

Table 3.3 Berths Details of Western Arm

Berth No.	Cargo Handled	Length (m)	Design Draft (m)
FB	Fertilizers	173.13	10.06
OR-1	POL	183	10.06
OR-2	POL	183	10.06

3.2 Outer Harbour

In the Outer Harbour, there are two finger type Ore Jetties, OB-1 and OB-2, one Off-shore Oil Tanker Terminal (OSTT), Vizag General cum Bulk Cargo Berth (VGCB), coal terminal operated by Vedanta, an exclusive Jetty for LPG, one Container Terminal operated by M/s Visakha Container Terminal Private Limited. **Table 3.4** provides details of these berths.

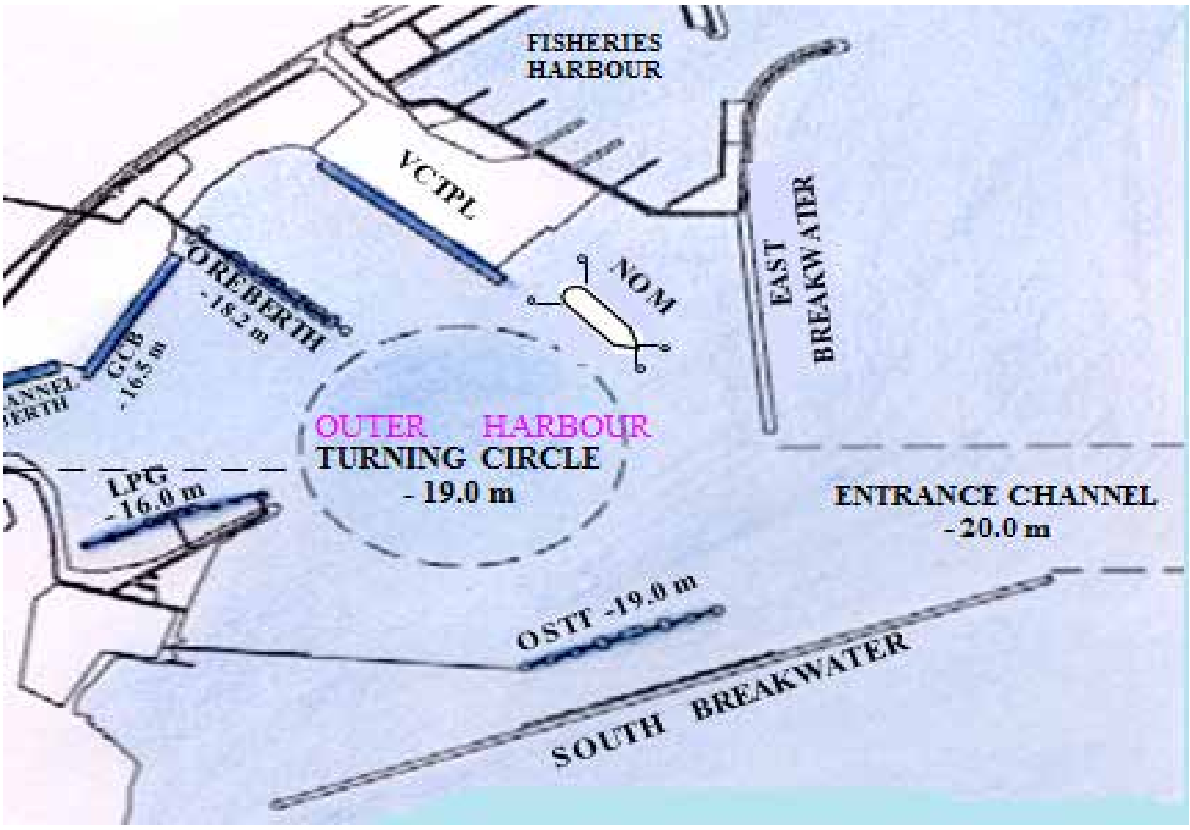


Figure 3.3 Outer Harbour

Table 3.4 Berths Details of Outer Harbour

Berth No.	Cargo Handled	Length (m)	Design Draft (m)
VCTPL	Container	451.0	14.5
LPG Jetty	LPG	370.9	14.0
OSTT	Oil	408.0	17.0
OB1	Iron Ore	270.0	16.5
OB2	Iron Ore	270.0	16.5
SPM	Crude Oil	---	---
VGCB	Coking Coal & Steam Coal	356.0	18.1

The satellite picture of Container berth, Ore berth and the GC berth is presented as **Figure 3.4**.

Figure 3.4 Container Berth, Ore Berth and the GC Berth

3.2.1 Container Berth

The container terminal is being operated by M/s. Visakha Container Terminal Pvt. Ltd.; the licensee has been awarded this project through BOT Basis. This terminal has a total berth length of 451 m with a depth of 16.5 m and capable of accommodating up to 100,000 dwt vessels. The terminal is equipped with 4 Post Panamax RMQCS, 6 Rubber-tyred Gantry cranes and 6 Reach stackers. The terminal has 2,500 TEU ground slots and can handle up to 4.13 lakh TEUs per annum. There are two on dock railway sidings for evacuating containers through rail.

3.2.2 Ore Berth

The ore berth is located on the southern side of the container terminal (**Figure 3.5**). It has been designed as a finger jetty capable of accommodating initially 150,000 dwt and ultimately 200,000 DWT ore carriers. Two carriers can be berthed one on each side .Presently the jetty has a water depth of 17.50 m. The overall length of the berth between centre lines of extreme mooring dolphins is 371 m with permissible vessel length of 270m. The berth is supported by a fully mechanised system backed up by a stockyard located north of inner harbour dock arms. The berth is served by a single 8000 TPH capacity ship loader. The stockyard has a capacity of 120,000 T and is equipped with 3 wagon tipplers (2×100 T +1×120 T); 2 stackers each of 2700 TPH; 3 reclaimers each of 4000 TPH and a closed conveyor system linking the yard to the berth.

Figure 3.5 Satellite Picture of the Stockyard

3.2.3 Vizag General Cargo Berth

The old general cargo berth, capable of handling 100,000 DWT vessels, was given on license to M/s. Vizag General Cargo Berth (VGCB) Pvt Ltd. on PPP mode during 2010 for upgrading it to handle 200,000 dwt coal carriers (**Figure 3.6**). It was proposed to handle coking coal and steam coal imports through this berth. The upgradation included strengthening the berth to take the loads of a 200,000 dwt vessel. The old 22.2 m wide deck was further extended by 21 m with crane rails. The structural integrity of the old berth was also critically examined as part of this upgradation. The licensee was allotted a space of 129,930 m^2 in the eastern yard for locating the stockyard. The material handling system included 3 ship unloaders each of 5000 TPH capacity; 1 stacker of 3000 TPH capacity; 1 reclaimer of 3500 TPH capacity; 1 wagon loader of 3500 TPH capacity and interconnecting conveyor system. The upgraded berth was commissioned in April 2013.

Figure 3.6 Satellite Image of the entire VGCB

3.2.4 Offshore Tanker Terminal

The offshore tanker terminal is located parallel to the south breakwater (**Figure 3.7**). It is made up of concrete caissons for mooring/berthing dolphins and for service platform. The overall length is 408 m and is designed to handle Suezmax tankers up to 150,000 DWT. This terminal is connected to the HPCL refinery through a 36” diameter pipeline. This pipeline is partially submarine and partially on-land over a trestle. This terminal was originally provided to handle the crude oil imports and later facilities were supplemented to handle POL products also. However, this berth is out of commission as it suffered considerable damage due to the Hudhud cyclone which hit Visakhapatnam during October, 2014.

Figure 3.7 The Offshore Tanker Terminal and the Pipeline Trestle

3.2.5 LPG Berth

The LPG berth is located parallel to breakwater. This berth is designed to handle Panamax vessels up to 80,000 dwt. The layout is of isolated berthing and dolphins with a central service platform. This berth handles POL products also along with LPG. The berth is connected to the adjacent LPG cavern of M/s South Asia LPG Pvt Ltd. (a joint venture of HPCL & Total) and also to the tankage of IOC and Eastern India Petroleum Ltd., a private company (**Figure 3.8**).

Figure 3.8 LPG Berth and the Terminal of South Asia LPG Pvt. Ltd.

3.3 Offshore Single Buoy Mooring

HPCL have set up a single buoy mooring at about 4.5 km offshore for handling Very Large Crude Carriers up to 330,000 DWT for handling the crude oil imports for their refinery. This has been constructed with an understanding and cooperation of the port. This is connected to first to the strategic crude oil storage cavern near Lova Garden and from there linked to their refinery. The submarine pipeline is of 48” diameter.

This has been constructed with an understanding and cooperation of the port. The port will provide the pullback tugs whenever a tanker is discharging at the SBM. A satellite picture of the SBM along with a tanker is shown in the **Figure 3.9** and the turret buoy with floating hoses is shown in the **Figure 3.10** hereunder.

Figure 3.9 Relative Location of VPT Eastern Breakwater and the SBM

Figure 3.10 Turret Buoy with Floating Hoses

4.0 DETAILS OF ONGOING & PLANNED DEVELOPMENTS

4.1 General

In recent times, to meet the growing traffic demands, Visakhapatnam Port Trust has initiated action for creating additional terminal facilities. The expansion projects, which are awarded and are currently ongoing consists of development of three new berths, i.e., EQ-1A, EQ-10 and extension of existing container terminal. All the three berths are developed under PPP mode. The other ongoing projects under PPP mode are the Mechanization of existing EQ-7 berth to handle finished fertilizers and the Mechanization of existing OHC and Ore-berths OB-1 & OB-2 to handle Iron-ore. Another project that is planned with Internal Resources of the VPT to handle Manganese Ore, Bauxite, Gypsum, limestone, etc. This project involves development of two Berths WQ-7 and WQ-8 (renamed as WQ-North), with 280 m length each.

The expansion proposals in the pipeline are conversion of the existing Berths EQ-2, EQ-3, EQ-4 and part of EQ-5 into two Berths of 280 m length each under PPP mode.

Projects Awarded and Currently Ongoing are detailed hereunder.

4.1.1 Development of New Berth EQ-1A

The Port Authority has decided to develop Eastern Quay-1A (EQ-1A) berth on south side of EQ-1 berth for handling thermal coal and steam coal in the inner harbour on Design, Build, Finance, Operate, and Transfer (DBFOT) basis.

The License was awarded to a consortium of M/s SEW Infrastructure Ltd. who formed a SPV named "M/s SEW Vizag Coal Terminal Pvt Ltd" (SVCTPL) for this purpose. The Concession Agreement for a thirty-year concession period was signed during February 2012.

The berth has been designed for handling fully loaded Panamax vessels of 80,000 DWT with a draft of 14.0 m with a dredge depth of (-) 16.1 m. The total length of the berth is 280 m and the berth is divided into two portions based on the type of construction i.e. land based and marine based.

The berth will be fully mechanised with the following material handling system:

- 2 ship loaders each of 1500 TPH capacity
- 1 stacker of 1500 TPH capacity
- 1 reclaimer of 1500 TPH capacity
- 1 stacker cum reclaimer of 1500 TPH capacity
- 1 twin wagon tippler of 27 tips/hr capacity
- Interconnecting conveyor system of 3000 TPH capacity
- 2 each of pay loaders and dozers

An area of 1,01,200 m^2 has been allotted for stacking the coal at the east dumps from where the cargo will be handled through rakes.

The berth is planned to have a capacity of about 7.36 MTPA.

The location of the berth with the backup stackyard area is shown in the satellite picture in **Figure 4.1** hereunder.

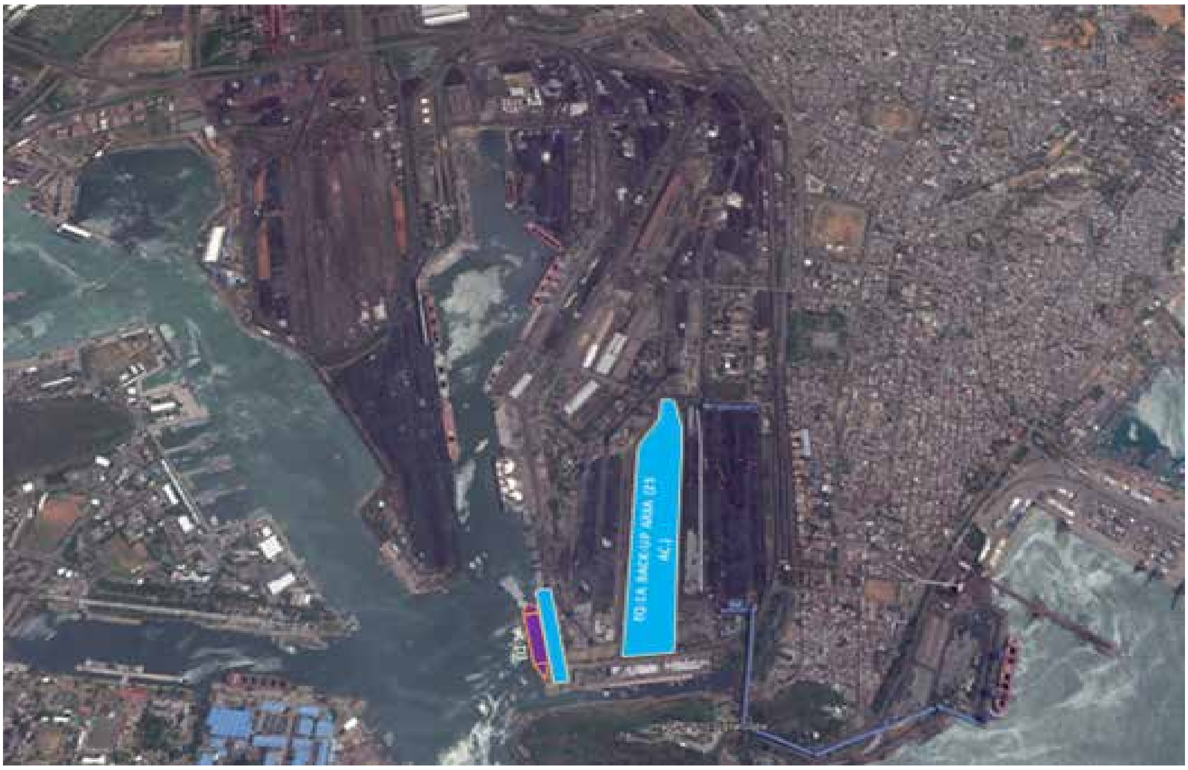


Figure 4.1 Berth with the Backup Stackyard Area

4.1.2 Mechanization of Existing Berth EQ - 7 to Handle Finished Fertilizers

At present finished fertilizers are handled at EQ berths with the help of wharf cranes. Keeping in view the increased demand for fertilizers and the need to enhance efficiency, the Port has decided to undertake mechanisation of Eastern Quay-7 (EQ-7) berth in the Northern arm for handling finished fertilizers with a throughput of 5.21 MTPA on Design, Build, Finance, Operate, and Transfer (DBFOT) basis.

The License to develop EQ-7 was awarded to a consortium of M/s ABG Infra logistics Limited, who formed a SPV named “M/s Vizag Agri Port Pvt. Ltd” for this purpose. The concession agreement for a thirty-year concession period was signed during May 2012.

The length of EQ – 7 berth is 255 m which can accommodate Panamax vessels of 233 m long and 12.5 m draft finished fertilizer, Murate of Phosphate (MOP) and general cargo are expected to be handled.

The concessionaire has been allotted a land measuring 225,267 m^2 for silos, storage sheds, railway loading facility and truck parking area.

The material handling system includes:

- Ship – shore transfer through gantry type ship unloaders with 35 T capacity and with a discharge rate of 800 TPH
- Conveyor system for 3.08 km length with 1200 mm wide belts
- 2 no. scraper reclaimers
- 8 no. front end loaders
- 12,000 T capacity silos with automatic bagging plant of 8,400 TPD capacity
- 28,000T storage shed with railway loading platform for loading two rakes simultaneously.
- Truck parking area.

The location of the berth with the backup area is shown in the satellite picture in **Figure 4.2** hereunder.

Figure 4.2 Location of the Berth with the Backup Area

4.1.3 New Container Terminal Adjacent to the Existing Container Terminal

Keeping in view the anticipated increase in container traffic and also to maintain additional potential, the Port has decided to undertake development of a new berth as an extension to the existing container berth to handle container cargo on Design, Build, Finance, Operate, and Transfer (DBFOT) basis. The new terminal is expected to have a capacity of 0.54 MTEU.

The License to develop the Container terminal extension was awarded to the existing Operator M/s. Visakha Container Terminal Pvt Ltd. (VCTPL). The concession agreement for a thirty-year concession period was signed during Dec 2014.

The new berth will be 395m long and 34m wide, and will be designed for 19 m water depth to accommodate vessels up to 150,000 DWT. However, initially the dredging will be done up to (-) 16.5 m only. The concessionaire has also been allotted 141,000 m^2 area to be reclaimed immediately behind the berth and another 24,570 m^2 behind GCB. For retaining the filling in the backup area, rock bund will be constructed. Heavy duty pavements will be laid for the RTG operating area and loaded container stacking area and light duty pavements for road ways and empty container stacking area. This is expected to accommodate about 2370 TEU ground slots.

The following container handling equipment will be provided:

§ 3 no. quayside gantry cranes

§ 9 no. Rubber Tyres Gantry cranes

§ 5 no. reach stackers

§ 1 no. top lift truck

§ 24 tractor-trailer units

The location of the berth with the backup area is shown in the satellite picture in **Figure 4.3** hereunder.

Figure 4.3 Location of the Container Terminal

4.1.4 Upgradation of Existing Facility and Creation of New Facility to Handle Iron-Ore

To cater to the future growing traffic needs, the Port has decided to up-gradate the existing facility and to create a new facility for iron ore handling on Design, Build, Finance, Operate and Transfer (DBFOT) basis. With these, the capacity is expected to be enhanced to 23 MTPA.

The License for these was awarded to M/s. ESSAR Ports Ltd. The concession agreement for a thirty-year concession period was signed during May 2013.

The original ore handling complex was developed in 1966 to cater to iron ore loading into vessels of size 35,000 DWT and was upgraded in 1976 for a capacity of 8 MTPA with mechanized handling facilities to handle vessels of 100,000 DWT. Since then the OHC is being constantly upgraded in line with changing requirements of the trade.

Some of the major upgradations are:

- Addition of 3rd wagon tippler in 1989;
- Replacement of old 2000 TPH reclaimer by 4000 TPH reclaimer in 1991;
- Replacement of 4000 TPH reclaimer of 1976 in 1996;
- Replacement of twin wagon tippler in the year 1992;
- Replacement 2700 TPH capacity stacker in the year 2003;
- Addition of 4000 TPH bucket wheel reclaimer in the year 2000;
- Up-gradation of berth to handle 1,50,000 DWT Vessels.

The present project includes the upgradation of the following existing facilities

- § Construction of a mooring dolphin and extension of the ore berth by about 50 meters to accommodate 200,000 DWT vessels
- § Dredging at the berth to a depth of 21 meters to cater to 200,000 DWT vessels
- § Strengthening the existing two stockpiles (east & middle) at OHC with a view to increase the stacking capacity
- § Develop the backup area, water supply area, illumination, firefighting, railway, and road facilities
- § Replacement of existing equipment as listed below:
  - – Ship loader 1 × 8000 TPH
  - – Reclaimer 2 × 4000 TPH
  - – Stackers 2 × 2700 TPH
  - – Twin tippler 1 × 1500 TPH
  - – Rotary tippler 1 × 1500 TPH
  - – Mobile crane 1 × 45 T
- § Strengthening a part of the existing conveyor system, surge bin and procurement of belts, up-gradation of dust suppression equipment

The creation of new facility at West Quay-1 (WQ-1) berth in Inner harbour includes:

- § Develop stacking area in continuation to the proposed berth to be made available on long-term lease for the concession period of 30 years
- § Provision of mechanical equipment for unloading iron ore from railway wagons, stacking in the stack yard, and reclaiming the ore with handling equipment comprising 1 x. twin wagon tipplers, side arm charger (handling full rake) with suitable railway tracks, 1 x stacker of 2700 TPH, 1 × reclaimer of 3000 TPH, belt conveyor x 3000 TPH (2.98 Km long),
- § Provision of one ship loader of 3000 TPH for loading the iron ore into the ships at the berth and other ancillary equipment
- § Develop back up area, water supply, area illumination, firefighting, railway and road facilities required including development of the land
- § Develop utilities and services such as communication, office accommodation, etc. required for operation of the berth.

The location of the berth with the backup area is shown in the satellite picture in **Figure 4.4** hereunder.

Figure 4.4 Location of the Berth with the Backup Area

4.1.5 Development of Two Numbers of Berths WQ-7 and WQ-8 (Renamed as WQ-North)

To meet the anticipated demand of dry bulk cargo, a proposal to develop two berths in West Quay North has been taken up. The cargo profile includes Manganese Ore (IMP), bauxite, gypsum, BF Slag, Ilmenite sand, Limestone and other bulk cargo. An extent of 1.01 lakh sq. meters has been allotted as storage area. The assessed capacity is 6.39 MT. The port is developing these berths from internal resources. Work was awarded to ITD Cementation India Ltd. during October, 2015.

The location of the project is at the extended northern arm. The proposal is to club the existing WQ 7 berth and the proposed WQ 8 berth to be developed in continuation as a single quay length of 560 m to accommodate two Panamax vessels. The berth shall be designed for an initial dredged depth of 13.5 m below CD and an ultimate depth of 16.1 m below CD. Development of back up area, water supply, area illumination, and fire-fighting, railway and road connectivity are also part of the project. Since the backup area is not sufficient to store cargo, this has to be developed in the process involving demolishing existing structures, filling up the area and ground improvement measures.

The location of the berths with the backup area is shown in the satellite picture in **Figure 4.5** hereunder.

Figure 4.5 Location of the Berth with the Backup Area

4.2 Conversion of Existing Berths EQ-2, EQ-3, EQ-4 and Part of EQ-5 in to Two Numbers of Berths

The Port has undertaken "Development of Multipurpose Terminal by revamping of EQ 2 to EQ 5 berths to cater to 14.0 m draft vessels in Inner Harbour" on Design, Build, Finance, Operate and Transfer (DBFOT) basis. These berths will have throughput increased to 6.0 MTPA.

The existing EQ 2 to EQ 5 berths are of monolithic construction with a draft of 10.06 m are to be replaced by a single multipurpose terminal of 560 m length to cater to fully laden Panamax vessels of 14 m draft. A berth length of 280 m is required for the safe mooring and operation of the design vessel with 230 m length. The remaining length of EQ 2 together with EQ 3 and EQ 4 berths and a portion of EQ 5 berth (about 89m) are proposed to be merged for developing a multipurpose terminal to cater two vessels each of 230m.

Harbour Mobile cranes (HMC) are proposed for ship to shore handling with grab attachments to handle bulk cargo viz. Pet Coke, Other bulk. For handling steel products and containers, the same type of HMC will be adequate to handle these two types of cargos with hook and spreader attachments. For Shore clearance, dumpers and pay loaders are proposed for bulk cargoes, Fork Lift Trucks (FLT) and mobile cranes are proposed for steel cargo and for container handling, Rubber Tyred Gantry (RTG) cranes, tractor trailers and reach stackers are proposed.

The Mechanical Equipment proposed for the terminal are

- 3 no. of 100 T Harbour Mobile cranes
- 5 no. of 25 tons capacity dumpers
- 5 no. of 10 tons capacity pay loaders
- 2 no. of 25 tons FLT v)1 no of 25 tons mobile cranes
- 4 no. of RTGs
- 8 no. of Tractor trailers
- 2 no. of Reach stackers
- Food grain handling Equipment: Ship loaders, conveyor and silos.

The location of the berths and the layout are given in the drawing in **Figure 4.6**.

Figure 4.6 Location of the Berths and the Layout

5.0 PERFORMANCE, OPTIONS FOR DEBOTTLENECKING & CAPACITY ASSESSMENT

5.1 General

The total cargo handled through the existing facilities, during the past 5 years is presented in the following **Table 5.1**.

Table 5.1 Cargo Handled During Last 5 Years (MTPA)

S. No.	Commodity	Berth	2014-15	2013-14	2012-13	2011-12	2010-11
Liquid Bulk							
1.	Crude	OSTT, SPM	8.66	7.89	7.89	8.72	8.13
2.	POL	OR 1, OR 2, LPG	4.33	4.25	4.5	4.37	4.49
3.	LPG	LPG	1.12	1.05	1.1	1.01	1.06
4.	Chemicals	EQ3, EQ5, EQ6, EQ7, FB,OR 1, OR 2, WQ1, WQ2	1.72	1.56	1.26	1.46	1.25
Dry Bulk							
5.	Thermal Coal	EQ5, EQ6, EQ7, WQ1, WQ2, WQ3, WQ5	2.78	2.74	2.95	3.19	3.54
6.	Steam Coal	EQ1, EQ4, EQ5, EQ6, EQ7, EQ8, EQ9, WQ1, WQ2, WQ3, WQ4, WQ5, OB1, OB2, VCTPL, VGCB	9.37	3.4	4.31	4.04	2.61
7.	Coking Coal	EQ3, EQ5, EQ7, EQ8, EQ9, WQ1, WQ2, WQ3, WQ4, WQ5, OB1, OB2, VCTPL, VGCB	6.07	6.93	6.8	6.87	7.92
8.	Iron-ore	EQ1, EQ2, EQ3, EQ4, EQ5, EQ6, EQ7, EQ8, EQ9, WQ1, WQ2, WQ3, WQ4, WQ5, OB1, OB2, VCTPL, VGCB	8.37	13.03	12.57	16.24	19.35
9.	Fertilisers	EQ-1, EQ-3, EQ-4, EQ-5, EQ-6,EQ-7, EQ-9, FB, WQ-1, WQ-2, WQ-3, WQ-4, WQ-5, OB1, OB2, VCTPL	2.37	2.43	1.99	0.002	0.002
10.	Alumina	EQ3, EQ4, EQ5, EQ6, EQ7, WQ5	1.29	1.49	1.23	0.97	0.96
11.	Manganese Ore	EQ1, EQ3, EQ4, EQ5, EQ6, EQ7,EQ8, EQ9, WQ1, WQ2, WQ3, WQ4, WQ5, OB1, VCTPL, VGCB	1.34	0.98	1.09	0.80	0.94
12.	**Containers**	EQ2, EQ3, VCTPL	4.37	4.92	4.55	4.21	2.57
13.	**Break Bulk**	EQ1, EQ2, EQ3, EQ4, EQ5,EQ6, EQ7, EQ8, EQ9,WQ1, WQ2, WQ3, WQ4, WQ5, OB1, OB2, VCTPL	1.68	1.64	1.27	1.39	1.06

5.2 BCG Benchmarking Study

BCG, as part of their benchmarking study, has looked into the operation of the berths and has suggested various measures for improving the performance. The report of BCG pertaining to Visakhapatnam Port is given in the **Appendix 1**. The key observations are as follows:

The 3 main cargos handled at VPT include coal, POL and iron ore. Competition is driving volume pressure across all 3 commodities. Hence, BCG has focused on demand creation and generating additional revenues from existing operations and cargo demand through improving overall port throughput.

They have dwelt mostly on the performance of VGCB berth under privatised operation. According to them, VGCB is operating at below par capacity. As against their stipulated capacity of 10 MTPA, they handled only 7 million tonnes during 2014-15. One of the main reasons for the low performance was the lack of adequate rakes for cargo evacuation. While they needed to evacuate through 7 to 8 rakes per day, they were able to operate only 4 rakes per day. According to them, the lack of adequate rakes is due to the delay in implementation of electrification and doubling of Raipur – Vizianagaram line which is expected to be completed by end 2018. This line connecting to Chhattisgarh, Madhya Pradesh and Western Odisha is popularised by major steel plants in India and remains the key hinterland driving coal cargo volumes through VPT.

The average inventory storage was assumed to be 10 days. However, due to the slow evacuation the actual inventory storage has doubled and in some cases trebled. As a result, instead of operating at a capacity of >80,000 MT/day, the berth is only able to operate at ~30,000 – 35,000 MT/day for full vessel. In order to overcome this problem, they have suggested allotment of additional land to them to improve their performance. They have suggested movement of existing FCI go downs to the periphery of the port and use of the land parcel of ~28–30 acres near the VGCB terminal for coal storage. This will also reduce coal storage on the port periphery and replace coal with clean cargo of FCI.

They have suggested the rationalization of existing storage cost at PPP–BOT terminals. The rationalization of storage cost needs to be worked out with TAMP as there are no existing clauses in the current contract which provide for change in storage cost structure. Lowering of storage charges from their current levels will only serve to make the existing operations more effective and attract additional cargo to high productive, high profitability berths. This will also reduce lighter age operations and hence conventional coal handling operations at VPT.

5.3 Performance of the Berths

AECOM has carried out a detailed analysis of the performance of the berths during 2014 -15 and the results are furnished in the **Table 5.2** to **Table 5.6** hereunder.

Table 5.2 Performance of Liquid Bulk Berths During 2014-15

S.No	Berth	Occupancy	Cargo	Volume	No. of Ships	Ship/ Parcel Size	Maximum	Minimum	Average
1	Single Buoy Mooring	22%	Crude	25,66,661	20	Ship size - VLCC	3,05,871	2,65,539	2,92,352
						Parcel size - VLCC	1,82,204	72,000	1,28,333
				19,71,329	16	Ship size - Suezmax	1,60,791	1,47,468	1,52,606
						Parcel size - Suezma	1,45,038	3,439	1,23,208
				9,72,494	16	Ship size - Others	1,13,918	73,580	83,702
						Parcel size - Others	1,05,816	49,981	60,781
				55,10,484	52				
2	OSTT	Out of commission from November 2014 due to cyclone damage	Crude	22,45,123	20	Ship size - Suezmax	1,59,901	1,47,468	1,52,398
						Parcel size - Suezma	1,42,860	20,467	1,12,256
				11,65,870	26	Ship size - Others	1,05,849	73,531	83,961
						Parcel size - Others	84,940	20,009	44,841
				34,10,993	46				
3	OR 1	79%	POL	15,98,853	175	Ship size	51,673	4,851	31,347
						Parcel size	31,443	949	9,136
			CHEMICALS	1,30,919	58	Ship size	47,878	9,051	17,970
						Parcel size	10,527	200	2,250
				17,29,772	233				
4	OR 2	82%	POL	12,15,121	170	Ship size	51,603	3,851	25,985
						Parcel size	31,059	105	7,148
			CHEMICALS	2,18,124	143	Ship size	32,950	8,804	15,626
						Parcel size	8,483	162	1,525
				14,33,245	313				
5	LPG	70%	LPG	11,12,281	234	Ship size	64,220	23,257	55,145
						Parcel size	17,004	200	4,753
			POL	17,93,842	104	Ship size	76,586	10,314	46,182
						Parcel size	50,549	1,993	17,248
				29,06,123	338				

Table 5.3 Performance of East Quay (VPT) Berths During 2014-15

S. No	Berths	Occupancy	Cargo	Volume	No. of Ships	Parcel Size	Maximum	Minimum	Average
1	EQ3 EQ4 EQ5 EQ6 EQ7	Varies from 70% to 79% Average 72%	Coal/Coke	4,23,979	38	Parcel size	42,744	400	11,157
			Iron/Manganese ore	3,35,767	63	Parcel size	23,740	300	5,330
			Fertilisers	22,05,395	128	Parcel size	53,044	200	17,230
			Caustic Soda	3,47,059	29	Parcel size	18,806	299	11,968
			Foodgrains	2,69,540	47	Parcel size	30,890	280	5,734
			Steel Products	9,51,320	118	Parcel size	42,744	15	8,062
			Chemicals	3,85,610	38	Parcel size	18,806	299	10,147
			Others	10,18,215	388	Parcel size	42,850	3	2,624
				59,36,885	**849**				**6,846**

Table 5.4 Performance of West Quay (VPT) Berths During 2014-15

S. No.	Berths	Occupancy	Cargo	Volume	No. of Ships	Parcel Size	Maximum	Minimum	Average
1	WQ 1 WQ 2 WQ 3 WQ 4 WQ 5 WQ 6	Varies from 68% to 79% Average 74%	Coal/steam; coking, & coke	36,73,700	253	Parcel size	55,634	400	14,521
			Iron/Manganese ore	27,11,028	139	Parcel size	51,000	147	19,504
			Thermal coal	27,45,701	75	Parcel size	49,197	12,212	36,609
			Alumina Powder	11,84,725	39	Parcel size	30,600	29,470	30,378
			Bauxite	6,41,083	18	Parcel size	56,195	4,762	35,616
			Caustic soda	3,21,546	38	Parcel size	15,970	4,028	8,462
			Rock Phosphate; Sulphuric Acid	2,35,799	22	Parcel size	42,171	2,004	10,718
			Others	6,42,777	218	Parcel size	52,399	37	2,949
				1,21,56,359	**802**				**15,197**

Table 5.5 Performance of OB 1 and OB 2 Berths During 2014-15

S. No.	Berth	Occupancy	Cargo	Volume	No. of Ships		Maximum	Minimum	Average
1	OB 1	79%	Iron ore	7,48,991	14	Parcel size	1,46,858	1,200	53,499
			Steam/coking coal, coke	5,21,258	56	Shifting			
			Others	1,87,570	23	Shifting			
				14,57,819	93				
2	OB 2	82%	Iron ore	50,69,666	81	Ship size	1,75,019	15,148	94,338
						Parcel size	1,38,218	4,100	62,588
			Steam/Coking coal	90,190	7	Shifting			
			Others	29,267	3	Shifting			
				51,59,856	88				

Table 5.6 Performance of PPP Berths During 2014-15

S. No.	Berth	Occupancy	Cargo	Volume	No. of Ships		Maximum	Minimum	Average
1	EQ 8 & EQ 9 VSPL	61% & 74%	Coal / Coke	35,85,538	192	Parcel size	54,539	550	18,675
			Manganese ore	8,42,914	152	Parcel size	30,000	800	5,545
			Gypsum	5,15,505	21	Parcel size	43,660	4,000	24,548
			Others	1,80,053	9	Parcel size	55,000	1,502	20,006
				49,43,957	374				
2	VCTPL	57%	Containers 1	30,70,697	340	Ship size	86,583	2,180	36,538
						Parcel size	36,350	9	9,031
			Containers 2	12,17,580	159	Ship size	46,700	9,944	27,277
						Parcel size	20,631	20	7,658
				42,88,277	499				
3	VGCB	78%	Steam Coal	36,24,315	94	Ship size	1,64,303	37,352	83,351
						Parcel size	1,43,629	3,000	38,557
			Coking Coal	33,38,204	108	Ship size	93,316	40,913	78,492
						Parcel size	89,672	8,500	30,009
			Bauxite & Gypsum	1,07,682	8				
				69,62,519	210				
CAPTIVE BERTH									
4	FB	25%	Liquid Ammonia; Rock Phosphate; Molten sulphur;	5,04,357	45	Parcel Size	38,664	488	11,207
				5,04,357	45				

The following observations are made from this analysis:

- Except for SBM, all other liquid bulk berths are having high levels of berth occupancy. This is because POL products are mostly handled for marketing purposes and the parcel size is relatively small. So is the case with chemicals. This situation is likely to continue in the future also. Hence the port should plan additional berth to reduce the high berth occupancy of the existing berths.
- The productivity of the berths depends largely on the parcel size and the mechanisation of handling system.
- The productivity of east quay berths are less as compared to that of west quay berths. This is mainly because of the parcel size.
- The OSTT has been severely damaged during the cyclone of November 2014 and has been out of commission since then. It may take quite some time for it to be refurbished and re-commissioned. However, since it has been handling mostly crude oil, the SBM will be able to take care of its share without any problem.

5.4 Measures for Capacity Enhancement

The Port has already taken a series of measures to enhance its capacity. One of the important actions was to dredge the inner harbour basin and berths to handle fully loaded Panamax vessels.

Secondly, in order to streamline the cargo handling operations, the Port has awarded several PPP projects for specific cargo and with full mechanisation. These projects are as follows:

- EQ I was already awarded to Adani Vizag Coal Terminal Pvt Ltd. for handling thermal coal. Its capacity is 6.5 MTPA
- EQ 1A has been awarded to SEW Vizag Coal Terminal Pvt Ltd. for handling Thermal and Steam coal. Its capacity is expected to be 7.5 MTPA
- EQ 7 has been allotted to Vizag Agri Port Pvt Ltd. of ABG for handling finished fertilisers. Its capacity is expected to be 5.2 MTPA
- EQ 10 has been awarded to AVR Infra Pvt Ltd. of IMC for handling liquid cargo other than POL products. It is expected to handle 1.8 MTPA
- VCTPL has been awarded an extension to handle 0.54 MTEU containers.
- OB 1, OB 2 along with WQ 1 has been allotted to Essar Ports Ltd. to upgrade the existing mechanised system in OB 1 & OB 2 and to install new mechanised system at WQ 1 for handling iron ore. All these berths are expected to handle a consolidated volume of 23 MTPA.
- Proposals to develop two numbers of Berths WQ-7 and WQ-8 with Internal Resources, to handle Manganese Ore, Bauxite, Gypsum, limestone, etc., with a throughput of 6.39 MTPA.

In addition to these capacity adding programmes, the Port should look into the availability and utility of the backup land for stockyards for dry bulk terminals.

6.0 TRAFFIC PROJECTIONS

6.1 General

In terms of volumes, Visakhapatnam is the fifth largest major port in the country handling approximately 58 MTPA of cargo. Visakhapatnam is located on the northern coast of Andhra Pradesh and serves the Central and Eastern hinterlands of the country like Telangana, Chhattisgarh, Madhya Pradesh and Southern Odisha.

Currently the port handles ~12 MTPA of thermal coal and ~14.6 MTPA of POL. Other major commodities include coking coal, containers, fertilizers and iron-ore. Going into the future we expect the total traffic at the port to go to ~80 MTPA by 2020 and 100-110 MTPA by 2025.

The origin-destination of key cargo (accounting for greater than 85% of the total traffic) for all Indian ports and development of traffic scenarios for a period of next 20 years has been carried out by **McKinsey & Co.** as mandated for this project. Accordingly, based on a macro-level analysis the future traffic for Vishakhapatnam up to 2035 has be derived as presented in this section.

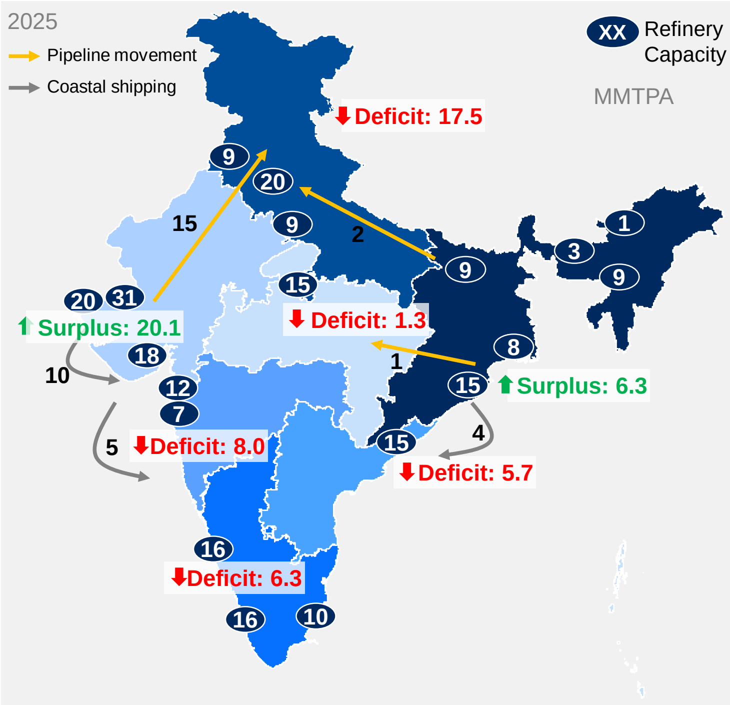
6.2 Major Commodities and their Projections

6.2.1 POL

POL crude and product constitute the biggest portion of traffic handled at the port. Visakhapatnam handles roughly 15 MTPA of POL which comprises approximately 8 MTPA of crude import, 4.6 MTPA of product movement and 1.1 MTPA of LPG imports.

Expansion of HPCL in the future will lead to traffic of roughly 15 MTPA of crude import by 2025. POL coastal traffic is expected to reach 7.5 MTPA by 2025 which includes 4-5 MTPA of coastal shipping potential from Paradip to Vizag port to cater to the demand of Andhra Pradesh and Telangana. (**Figure 6.1**).

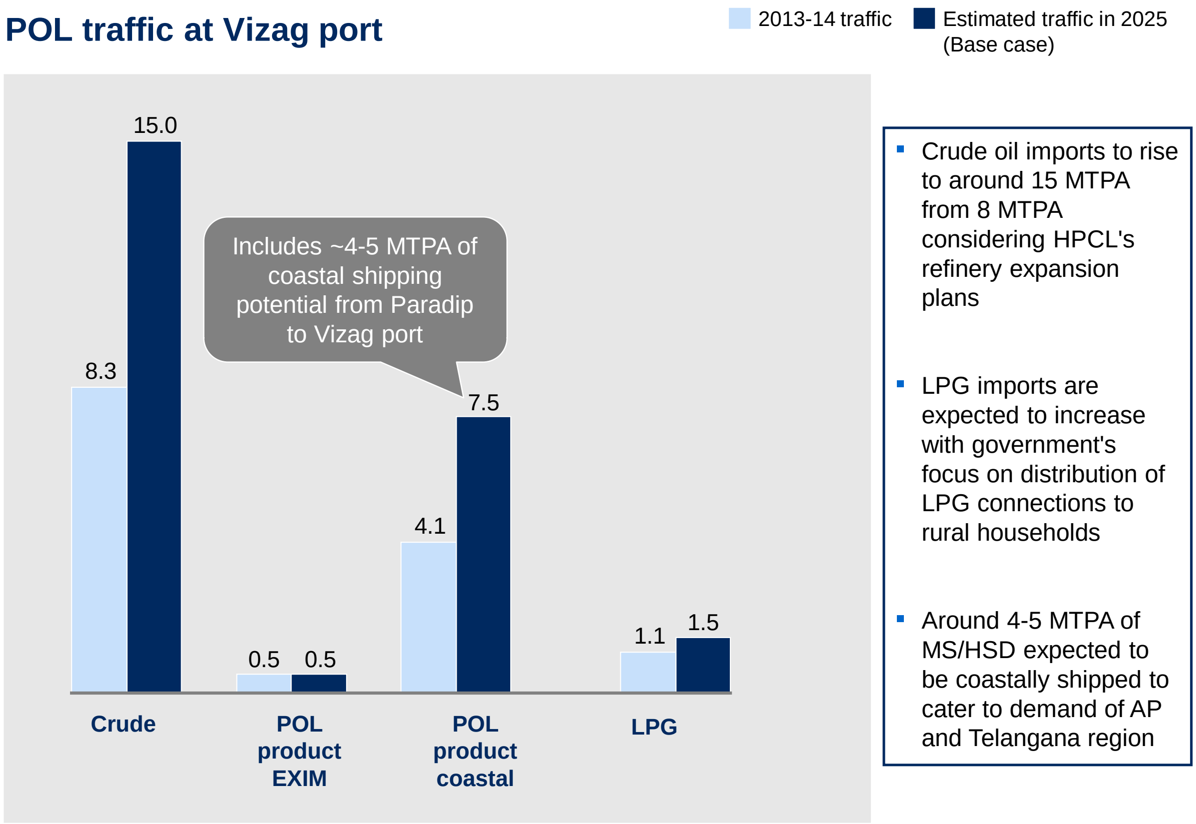
There is a potential for coastal shipping of ~5 MMTPA of MS/HSD from Paradip to Vizag port by 2025



1. Assumes RIL Jamnagar and Essar Oil export nothing while Reliance SEZ exports 100% product

Figure 6.1 Coastal Shipping Potential of MS/HSD from Paradip to Vizag by 2025

LPG imports are expected to increase to 1.5 MTPA by 2025 driven by government's focus on distribution of LPG connections to rural households. The split of the current POL traffic and the estimated traffic in 2025 is as shown in **Figure 6.2**.



SOURCE: Indian Petroleum and Natural Gas Statistics 2013-14; Basic Port Statistics of India 2013-14

Figure 6.2 Split of Current POL Traffic at Vizag Port

6.2.2 Thermal Coal

Currently the port unloads 9.3 MTPA of thermal coal out of which approximately 4 MTPA is for power generation in Adani Power Maharashtra Ltd. in Gondia district. Remaining is primarily for the consumption of non-power plants (>50% of the overall imports). Unloading of thermal coal will be driven by Tiroda plant, demand of captive power plants and import substitution.

The port also handles 2.8 MTPA of outbound coal which is coastal shipped to Tamil Nadu. This figure is projected to grow to ~3.7 MTPA by 2020, ~5 MTPA by 2025 and 5-6 MTPA by 2035.

6.2.3 Coking Coal

The port currently handles 6 MTPA of coking coal which is used for steel production in the steel plants of Rashtriya Ispat Nigam Limited (RINL), SAIL Bhilai, Tata Steel Limited, Jindal Power and Steels Limited. Other consumers of coking coal include Uttam Galva Metallics, Jayswal Neco and Bhushan Power and Steel Limited. We project that going forward the volumes of coking coal handled by the port will increase to 8.6 MTPA by 2020, 11-12 MTPA by 2025 and 14.5-16.5 MTPA by 2035. This increase will be driven primarily by expansion in SAIL Bhilai and Nagarnar plants. The increase of coking coal traffic due to expansion of steel plants in the hinterland would also be shared by the competing non-major port of Gangavaram.

The current traffic of thermal coal and coking coal and the estimated traffic in 2020 is as shown in **Figure 6.3**.

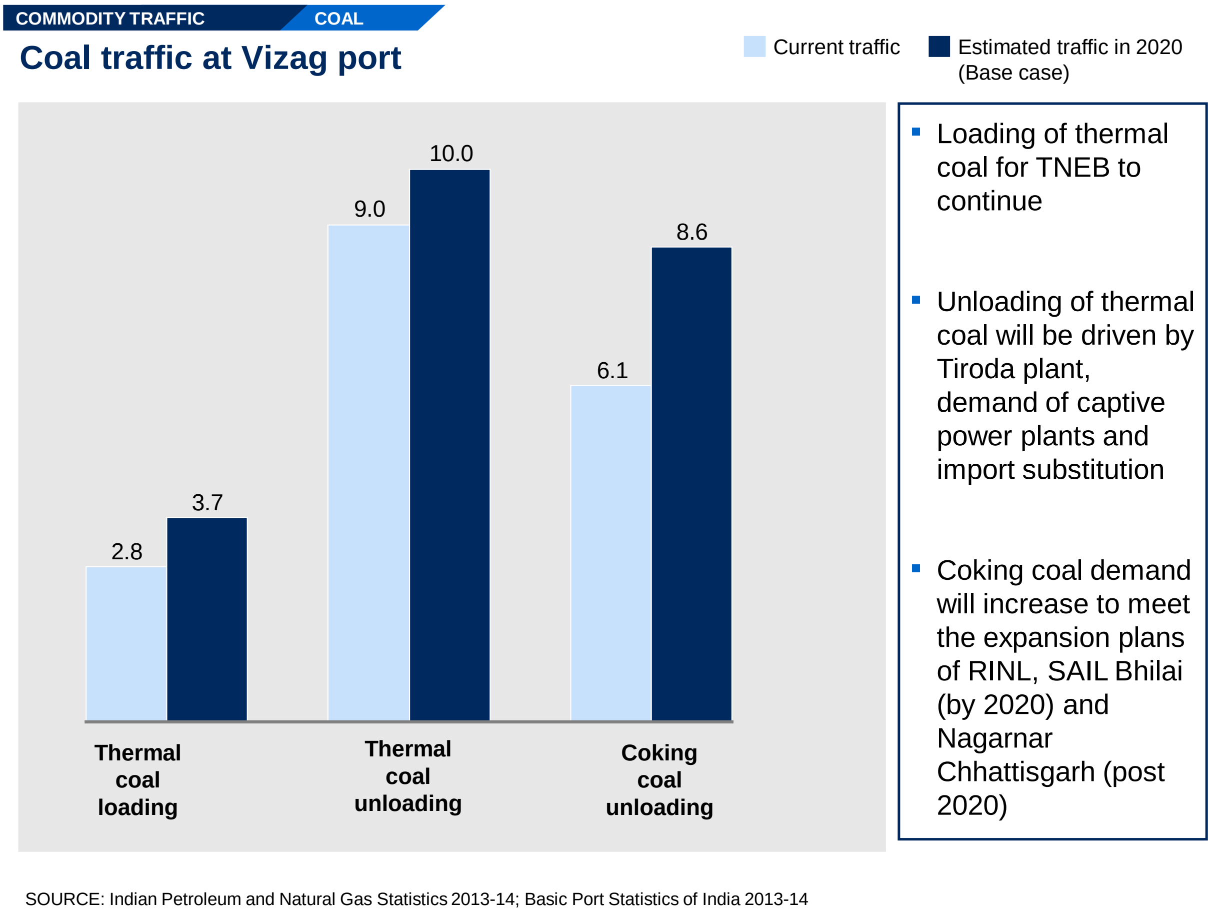


Figure 6.3 Coal Traffic at Vizag Port

6.2.4 Containers

The port, through the Visakha Container Terminal currently handles ~0.25 MTEUs. Andhra Pradesh and Telangana are the key hinterlands for the port. Other hinterlands include Odisha (primarily Bhubaneshwar and Jharsuguda), Madhya Pradesh, Bihar and Chhattisgarh. Visakhapatnam region itself contributes ~20% to the total container traffic at port as shown in **Figure 6.4** and **Figure 6.5**.

COMMODITY TRAFFIC CONTAINER

Andhra Pradesh is the primary hinterland of Visakhapatnam port with small traffic from Odisha and MP

Primary hinterland of port

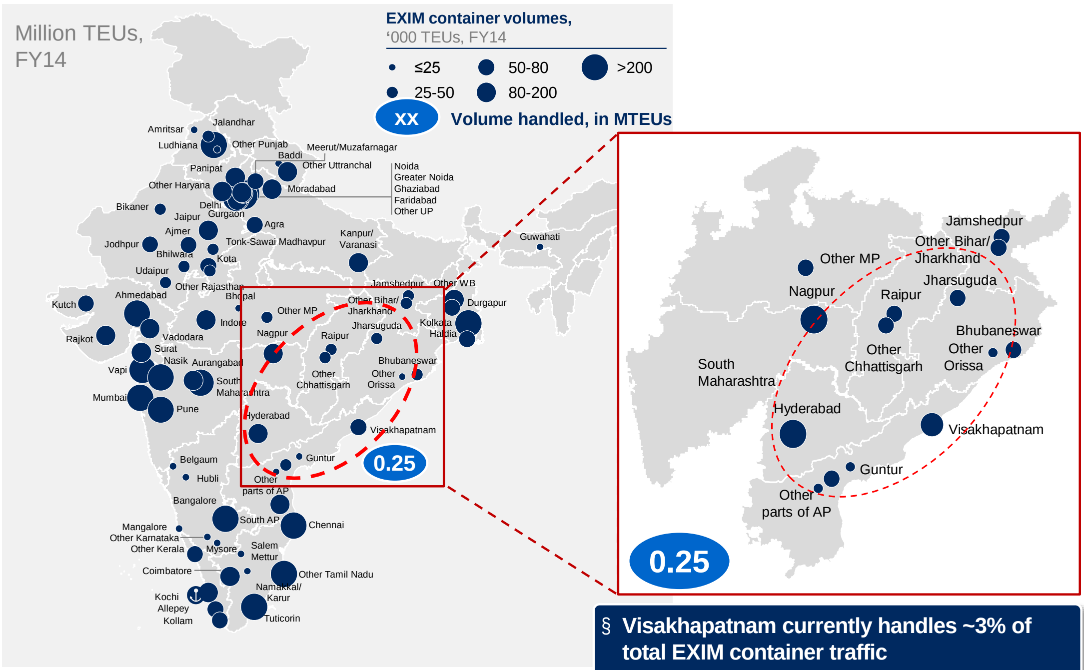
EXIM container volumes, '000 TEUs, FY14	JNPT	Mundra	Chennai	Pipavav	Tuticorin	Haldia	Cochin	Visakha-patnam	Mangalore
NCR+Punjab	936	1,264	0	329	0	0	0	0	0
Maharashtra	2,121	54	0	0	0	0	0	0	0
Tamil Nadu	0	0	1,240	0	484	0	0	0	0
Gujarat	552	262	0	169	0	0	0	0	0
Uttar Pradesh	228	274	0	107	0	0	0	0	0
West Bengal	0	0	0	0	0	458	0	0	0
Rajasthan	43	448	0	60	0	0	0	0	0
Karnataka	94	0	163	0	66	0	0	0	50
Kerala	0	0	0	0	0	0	351	0	0
Andhra Pradesh	75	0	65	0	0	0	0	110	0
Madhya Pradesh	43	70	0	14	0	0	0	29	0
Bihar/Jharkhand	0	0	0	0	0	85	0	8	0
Uttaranchal	95	0	0	0	0	0	0	0	0
Orissa	0	0	0	0	0	12	0	69	0
Chhatisgarh	15	18	0	14	0	0	0	15	0
North East	0	0	0	0	0	7	0	0	0
Port total	4,202	2,390	1,468	693	551	562	351	263	50

SOURCE: APMT; Expert interviews

Figure 6.4 Hinterland to Port Mapping for Containers

COMMODITY TRAFFIC CONTAINER

EXIM container generating hinterlands for Visakhapatnam port



- Visakhapatnam currently handles ~3% of total EXIM container traffic
- Almost all of the traffic gets transshipped

SOURCE: APMT; IPA statistics; Stakeholder interviews

Figure 6.5 Exim Container Generating Hinterlands for Vizag Port

GDP of Andhra Pradesh, Telangana and Odisha are expected to grow at 9-11% CAGR while Madhya Pradesh, Chhattisgarh and Bihar are expected to grow at 6-8% CAGR. Going forward, the container volume at the port is expected to grow to 0.5 MTEUs by 2020 and 0.6-0.7 MTEUs by 2025. However, development of a port in central AP would attract a significant share of this traffic as shown in **Figure 6.6**.

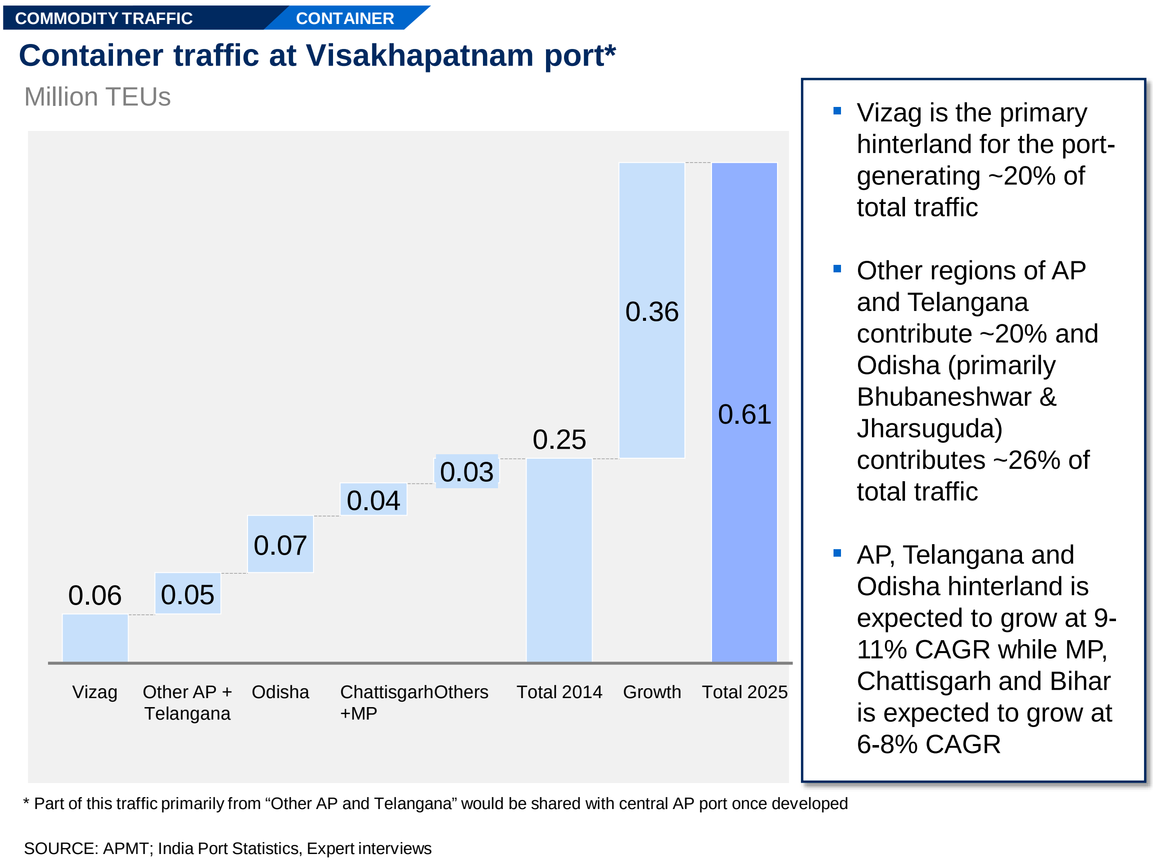


Figure 6.6 Container Traffic at Vizag Port

6.2.5 Iron Ore

The port currently handles ~8 MTPA of iron-ore and pellet exports which is expected to increase to ~12 MTPA by 2020. Depending on how the export volumes pick-up in future, the volume handled by the port will increase to 14-16 MTPA by 2025.

6.2.6 Fertilisers

The port imported 2.6 MTPA of fertilizers and raw materials for fertilizers in FY 15. This comprises of approximately 1.5-1.8 MTPA of finished fertilizer and 1-1.2 MTPA of raw material of fertilizers. The finished fertilizer serves the demand in the hinterlands of Andhra Pradesh, Telangana, Madhya Pradesh and Chhattisgarh. Part of the raw material for fertilizers is utilized in the DAP, NPK, Urea and AS fertilizer plants in Andhra Pradesh itself and a part of it is sent to plants in Uttar Pradesh.

The overall volume of fertilizer and fertilizer raw material is expected to increase to ~4 MTPA by 2020, ~5 MTPA by 2025 and 7-8 MTPA by 2035.

6.2.7 Alumina Powder and Other Ores

Visakhapatnam port also handles alumina power and other ores of approximately 2.6 MTPA currently. This is utilized by customers including NALCO, Sesa Sterlite Ltd., and other metallurgy units. This figure is expected to increase to 2.6 MTPA by 2020 and ~3-4 MTPA by 2025.

6.2.8 Other localized Commodities

Other highly fragmented cargo also makes a sizeable chunk of the total cargo volume handled at Visakhapatnam port. This volume is currently 4.6 MTPA and is expected to increase to ~8 MTPA by 2020 and 10-12 MTPA by 2025.

The overall commodity wise projections for the port are shown in **Table 6.1**.

Table 6.1 Traffic Forecast for Visakhapatnam Port

Units: MMTPA (except Containers)

Vizag Port - Traffic Projections

xx Base Scenario xx Optimistic Scenario

Commodity	2014-15	2020	2025		2035		Remarks
			Base	Optimistic	Base	Optimistic	
Liquid Cargo							
POL	14.6	18.7	24.5	27.1	30.0	35.5	▪ Mainly Crude imports driven by HPCL Vizag expansion and coastal shipping of product from Paradip refinery
Chemicals	1.0	1.3	1.7	1.8	2.9	3.3	
Dry and Break Bulk Cargo							
Thermal Coal (Loading)	2.8	3.7	4.7	5.2	5.0	5.5	
Thermal Coal (Unloading)	9.3	10.0	11.0	11.5	13.3	15.2	
Coking Coal*	6.1	8.6	11.8	12.6	14.5	16.5	▪ Driven by expansion in SAIL Bhilai by 2020 and Nagarnar Chattisgarh post 2020
Iron Ore	8.3	12	14	16	16	16.5	▪ Mostly exports; likely to remain low.
Steel	1.08	1.5	2.1	2.2	3.7	4.2	
Alumina Powder	1.2	1.6	2.1	2.2	3.5	4.0	
Other Ore	1.4	1.0	1.3	1.4	2.2	2.5	
Food Grains	0.8	0.5	0.7	0.7	1.1	1.3	
Fertilizers	2.6	3.4	4.9	5.1	7.3	8.1	
Containers and other Cargo							
Containers (MnTEU)	0.25	0.49	0.61	0.72	1.02	1.29	▪ Some traffic may shift to central AP port once developed
Others	4.6	7.7	9.96	12.33	12.8	13.33	▪ Highly fragmented,
Total (MMTPA)	**58.2**	**78.6**	**99.5**	**110.8**	**130.3**	**148.6**	

Conversion Factor Used for Containers Projections: 1 TEU = 17.6 Tons

* Conversion factor for coking coal consumption per tonner of steel produced is taken as 0.85. Any incremental traffic due to expansion of existing and new plants has been split between Vizag and Gangavaram in 50:50 ratio

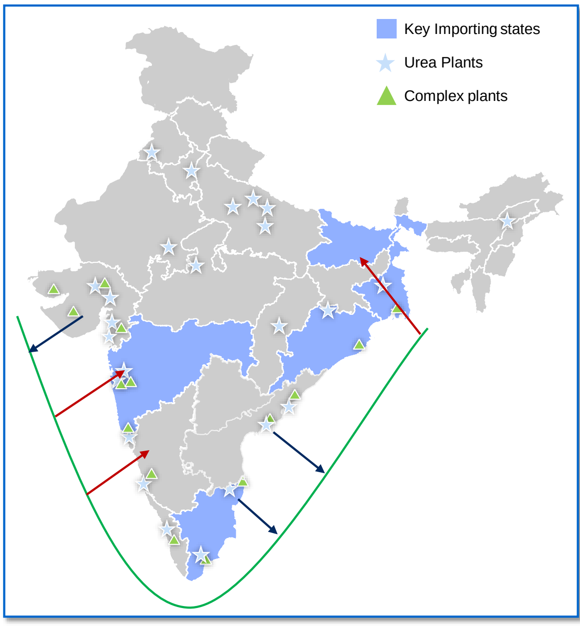
6.2.9 Coastal Shipping Potential

Visakhapatnam is strategically positioned to serve large areas in the hinterland of the country through coastal shipping. Coal, steel and fertilizer can be major commodities to/from Visakhapatnam in case coastal shipping revolution takes place in the country.

§ **Fertilizers:** There is a potential for coastal shipping of ~2 MTPA of fertilizer from Andhra Pradesh to West Bengal, Tamil Nadu and Gujarat via Visakhapatnam port by 2025.

COASTAL SHIPPING | FERTILISERS

~2 MTPA of fertilizer can be coastally shipped from Vizag port by 2025



Key ODs with coastal shipping potential from Visakhapatnam Port

Route[1]	Volume, '000 TPA
Andhra Pradesh to West Bengal	1243
Andhra Pradesh to Tamil Nadu	603
Andhra Pradesh to Gujarat	200

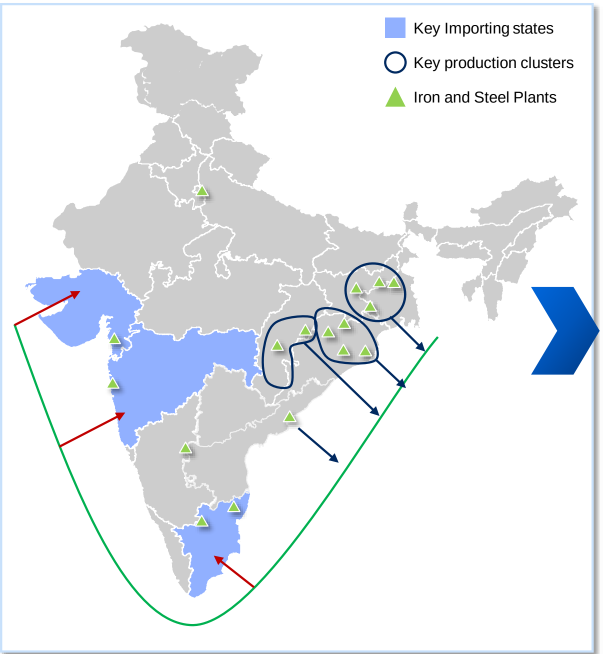
1 Small quantities will move on a number of other routes via Vizag port

Figure 6.7 Coastal Shipping Potential of Fertilizers from Vizag Port

§ **Steel:** ~1.5 MTPA of steel can be coastally shipped from RINL, Visakhapatnam to demand states of Maharashtra, Gujarat and Tamil Nadu by 2025.

COASTAL SHIPPING | IRON AND STEEL

~1.5 MTPA of steel can be coastally shipped from Visakhapatnam to demand states of Maharashtra, Gujarat and TN by 2025



Key plants with coastal shipping potential from Visakhapatnam Port

Plant	Location	Volume Potential to shift to coastal (in MTPA)
RINL	Vizag	1-1.5

SOURCE: DGCIS data 2013-14

Figure 6.8 Coastal Shipping Potential of Iron and Steel from Vizag Port

The table below summarizes the potential of coastal movement for key commodities.

Table 6.2 Opportunities Possible via Coastal Shipping

Vizag Port – New Opportunities Possible via Coastal Shipping

Units: MMTPA (except Containers)

Commodity	2020	2025	2035
Thermal Coal (Unloading)	0	0	0
Steel (Loading)	1.15	1.54	2.75
Steel (Unloading)	0.08	0.11	0.20
Cement (Loading)	0.03	0.04	0.07
Cement (Unloading)	0.01	0.02	0.03
Fertilizer (Loading)	1.68	2.05	3.03
Fertilizer (Unloading)	0.17	0.21	0.31
Food Grains (Loading)	0.57	0.69	1.02
Food Grains (Unloading)	-	-	-

- Additional Coastal shipping Potential if Machilipatnam is not built and Dr. N Tata Rao and Kothegudem plants in AP and Telangana adopt coastal shipping. Vizag would also have to compete with Kakinada

* The coastal opportunity identified is contingent on a number of enablers like last mile connectivity, availability of handling infrastructure at the ports, rationalization of port charges, availability of aggregators for different commodities wherever individual parcel sizes are small. The handling charges and sea freights assumed for the analysis is INR 150 per tonne per handling and INR 0.2 per tonner per km respectively

7.0 CAPACITY AUGMENTATION REQUIRMENTS

7.1 Port Capacity after On-Going Developments

The capacity of the existing berths and the new berths after on-going developments is presented in **Table 7.1**. This is expected to be the situation by the year 2020.

Table 7.1 Capacity of VPT After New Projects

Berth No.	Type of Commodities	Existing Capacity (MT)	Added Capacity (MT)	Total Future Capacity (MT)
INNER HARBOUR				
EQ-1A	Steam coal and back loading of thermal coal	0.00	7.36	7.36
EQ-1	Steam Coal	6.41		6.41
EQ 2-5	Pet-coke, steel products, food grains, containers	4.62	1.38	6.0
EQ-6	Anthracite Coal, BF slag, steel, thermal Coal, fertilizers, Phosphoric acid	1.73		1.73
EQ-7	Fertilizers and fertilizer raw materials	2.52	3.33	5.85
EQ-8	Urea, magnesite, fertilizer raw materials	12.77		12.77
EQ-9	Steel, General cargo, steam coal, lam coke, feldspar and granite			
EQ-10	Caustic soda, bio diesel, edible oils, chemicals	1.84		1.84
	Total East Quay	**29.89**	**12.07**	**41.96**
WQ-1	Iron ore	6.26		6.26
WQ-2	Iron ore, coking coal, granite and thermal coal			
WQ-3	Coking coal, Steel, thermal coal, soya, pet-coke and iron ore	2.52		2.52
WQ-4	Iron ore, iron ore pellets, steam coal, limestone and steel	1.77		1.77
WQ-5	Alumina, iron ore, granite and caustic soda	3.43		3.43
WQ-6	CP Coke, LAM coke, steel and granite	2.08		2.08
WQN	Manganese ore, gypsum, bauxite, limestone, blast furnace slag, ilmenite sand	0.00	6.39	6.39
	Total West Quay	**16.06**	**6.39**	**22.45**
FB	Fertilizers, raw materials, liquid ammonia and molten Sulphur	1.87		1.87
OR-1,2	POL products	3.68		3.68
	TOTAL INNER HARBOUR	**51.50**	**18.46**	**69.96**
OUTER HARBOUR				
OB-1,2	Iron ore and iron pellets, lightening of cargoes such as fertilizers	12.50	3.70	16.20
VGCB	Coking coal and steam coal	10.18		10.18
OSTT	Crude oil	0.00		0.00
LPG	LPG and POL products	4.38		4.38
SBM	Crude oil	15.0		15.0
VCTPL	Container cargo in MT	6.20	8.10	14.30
	Container cargo in MTEUs	0.35	0.46	0.81
	TOTAL OUTER HARBOUR	**48.26**	**17.30**	**60.06**

7.2 Requirement for Capacity Expansion

Based on the projected traffic, the phase-wise capacity augmentation requirements are provided in **Table 7.2**.

Table 7.2 Requirement of Phase-Wise Capacity Augmentation

Cargo Handled	Current Capacity including Ongoing Projects (MTPA)	2020		2025		2035	
		Projected Traffic (MTPA)	Capacity Augmentation Required (MTPA)	Projected Traffic (MTPA)	Capacity Augmentation Required Over Current (MTPA)	Projected Traffic (MTPA)	Capacity Augmentation Required Over Current (MTPA)
Liquid Cargo*	24.9	20.0	0	26.2	1.3	32.9	8.0
Coal (Import)	29.4	18.6	0	22.8	0	27.8	0
Coal (Export)	7.4	3.7	0	4.7	0	5.0	0
Iron Ore	22.5	12.0	0	14.0	0	16.0	0
Breakbulk	23.9	12.3	0	16.2	0	23.3	0
Fertilizers	7.7	3.4	0	4.9	0	7.3	0
Containers	14.3	8.6	0	10.7	0	18.0	3.7
TOTAL	**130.0**	**78.6**	**0.8**	**99.5**	**1.3**	**130.3**	**11.7**

* OSTT is not considered in the current and ongoing capacity but OSTT may be considered to handle POL Products (1.5 MTPA capacity)

From the above table, the following conclusions are made mainly with reference to the traffic projections for year 2025:

§ For handling all types of coal and coke import the total capacity available at dedicated berths will be about 29.4 MTPA. The berths are EQ 1: VGCB and EQ 8/EQ 9.

§ Adequate capacity for coal export is available once EQ1A becomes operational

§ Additional capacity will be distributed among WQ berths. Hence these will be able to take care of the projected traffic up to 2020.

§ For handling iron and manganese ores, the total capacity available at the dedicated berths of OB 1; OB 2 and WQ 1 and WQ 2 will be 22.5 MTPA. As of now, there will be surplus capacity available.

§ For handling fertilisers, Alumina and chemicals sufficient capacity is available through berths EQ 7; WQ 5 and EQ 10.

§ For handling containers, with the license for expansion given to VCTPL capacity will be created more than what future traffic has been projected.

§ The other berths of EQ and WQ, after the streamlining of cargo with the new berths, will have sufficient capacity to handle the other assorted dry bulk and break bulk cargo.

As regards POL traffic, it can be seen that there is a shortfall of capacity. As projected POL products traffic of 7.5 MTPA could not be handled at the existing OR 1 & OR 2.

However during the master plan horizon significant coal import is projected at the port for which there would be shortfall of capacity. Same is the case with Breakbulk cargo wherein it would be required to upgrade the existing breakbulk berths by way of deepening and providing handling equipment.

The indicated capacity of high productivity berths such as VGCB, AVCTPL (EQ 1) and SVCTPL (EQ1A) could be taken as only name- plate capacities as the actual performance is under-par due to the limitations in the available storage space. There is an urgent need to allocate additional area to these agencies for improving their performance standards. These are discussed in detail hereunder.

7.3 Allocation of Land for Additional Stackyard of VGCB

M/s Vizag General Cargo Berth Pvt Ltd. (VGCB) is the licensee to develop the old general cargo berth (located at Visakhapatnam Outer Harbour) by upgrading it to handle 200,000 DWT coal carriers. It is to handle coking coal and steam coal imports. The upgradation included strengthening the berth to take the loads of a 200,000 DWT Ship. The old 22.2 m wide deck was further extended by 21 m with crane rails. The licensee was allotted a limited space of 129,930 m^2 in the eastern yard for locating the stackyard.

The material handling system comprise 3 grab unloaders, each of 2000 TPH capacity; 2 stacker cum Reclaimer units with capacity of 6000 TPH in stacking mode and 3500 TPH in reclaiming mode; 1 wagon loader of 3500 TPH capacity and interconnecting conveyor system. The upgraded berth was commissioned in April 2013. Its capacity was assessed as 10.18 MTPA and it handled 7 MT during 2014 -15.

The overall layout plan of the terminal is shown in **Figure 7.1**.

Figure 7.1 Terminal Layout of VGCB

The existing stackyard has two outer stockpiles of 600 m length and 37 m width and a central stockpile of 600 length and 70 m width. Owing to the stipulation imposed while getting environmental approval, the stockpile height has to be limited to 10 m only. Consequently, the maximum theoretical capacity of the entire stackyard is 500,000 T for stacking of coking coal, assuming it to be homogeneous and for one customer only. However the practical storage that could be achieved at this stackyard is much less due to the following factors:

§ The terminal caters to multiple customers who bring the cargo i.e. coking coal and steam coal, in different grades, requiring separate stockpiles for each customer and for each grade.
§ Sometimes even a single cape size ship brings three different grades of materials which have to be stacked in different stockpiles.
§ Different stockpiles are also needed for the different material so as to avoid the contamination.
§ Due to railway traffic situation and route congestions, railways do not supply rakes to only one location and in same route. Therefore the terminal has to cater to at least 7 to 8 different customers, so that the railways would be able to supply sufficient rakes leaving for diversified destination in different routes

Because of these a number of stockpiles (numbering 16 to 20) are to be provided in the stackyard as against the ideal number of 3 stockpiles: one at the middle and two at the end, used to arrive at the theoretical maximum capacity of the yard.

A broad understanding of the impact of large number of stockpiles in the yard could be had from the **Table 7.3**

Table 7.3 Stockpiles and their Respective Capacities

Scenario No.	Number of Stockpiles	Theoretical Stacking Capacity (T)		
		10 m Height	12 m Height	15 m Height
1.	3; one in the middle and one on either end	5,00,000	5,50,000	6,00,000
2.	6; two in the middle and two on either end	4,70,000	5,20,000	5,60,000
3.	12; Four in the middle and Four on either end	3,60,000	3,90,000	4,10,000

Thus, providing large number of stockpiles results in significant reduction in the capacity of the stackyard. Further, the maximum allowable height of stockpile also has an impact on its capacity. Presently terminal is working at the scenario 3 wherein the maximum allowable storage capacity is only 3,60,000 T and it handled 7 MT last year. Factoring 70% stackyard utilisation, the average dwell time of cargo works out to about 15 days, which is already very tight while considering the dwell time of about 30 days at the similar multi-user terminals at Gangavaram, Dhamra, Karaikal etc.

One of way to increase the storage capacity is to allow higher stacking height of 12 to 15 m. The mitigation measure for environmental impact could be the frequent use of the dust suppression system, covering of the stockpiles and providing wind screens of height 15 m near the periphery of the stackyard. This might increase the stacking capacity approximately by an additional 20%. Another way to manage with the limited storage space is to reduce the dwell time of cargo further by way of faster evacuation. However there are the following constraints for faster evacuation of cargo:

§ The evacuation of the coal from stackyard depends on the availability of the rakes, which currently are in short supply. Apart from rakes the route congestion at that point in time on that particular route is also a governing criterion due to which VGCB tries to send rakes to hinterland in different directions so as to avoid choking of the main railway network.

§ Even if the adequate rakes were available, the evacuation of the coal is governed by the requirement of the customers whose decisions are based on the plant's daily consumption and availability of storage space at the plant end. It's prevalent and established practice in Indian sub-continent that customers would evacuate cargo based on above criteria and port's stack yard is required to meet their storage needs.

§ The wagon loading system provided at the port comprises of two silos of 800 T capacities each. These silos can discharge material into rakes positioned on separate rail tracks. However the feeding to these silos is through one conveyor only and therefore at a given point of time only one silo can be used for rake loading thereby limiting the capacity of wagon loading at an average of 9 rakes per day, which is lower as compared to the average unloading rate at the berth. Therefore adequate space should be available to stack the balance quantity of cargo.

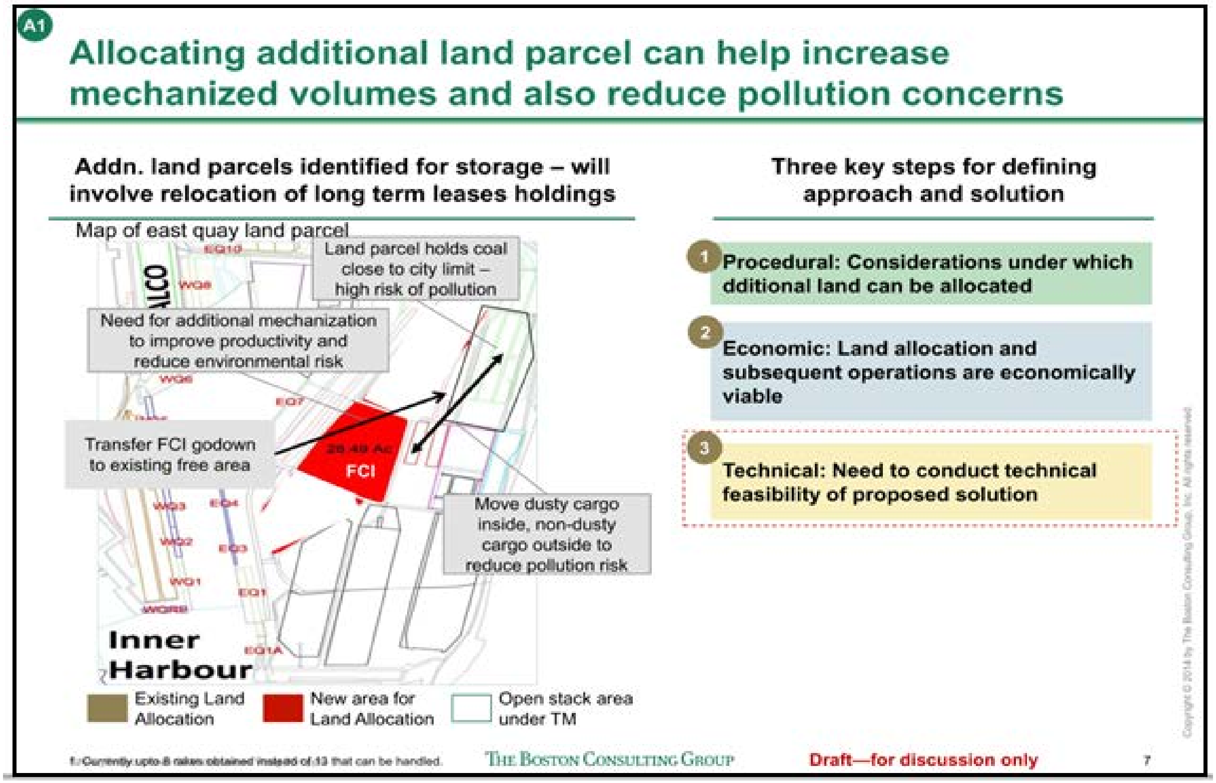
§ The ship arrival is generally random in nature. In case another cape size ship arrives after the unloading of an earlier cape size ship, adequate stacking area is not available at the yard. This results in stoppage of ship unloading operations and thus impacts the berth productivity.

The handling system provided at the berth has a rated capacity of 6,000 TPH with an average throughput of about 60,000 TPD. This translates to the berth capacity of about 13 MTPA. The wagon loading system can cater to a maximum of about 10 rakes per day i.e. about 36,000 TPD. This shows that the current stackyard area and the evacuation infrastructure do not match with the berth capacity, which appears to be the main bottleneck of the project. With this existing bottleneck, the project is likely to underperform, leading to revenue loss to Visakhapatnam Port Trust and PPP Project partner.

In view of the above reasons it is considered necessary that additional stacking area be allocated to VGCB terminal. This would enable the terminal to handle higher volumes to match the assessed capacity of the berth.

The possible area for this additional stackyard is towards the east of berths EQ2 to EQ5, where FCI godowns exist. These godowns can be shifted towards the periphery of the port. This will have a dual advantage in that the dirty cargo storage at the port periphery nearer to the habitation will be replaced by cleaner cargo of FCI and at the same time release the much needed additional area for VGCB.

BCG has also suggested movement of existing FCI go downs to the periphery of the port and use of the land parcel near the VGCB terminal for coal storage.



The land identified for allocation to VGCB measures about 16 ha. The details of the additional stackyard and the associated handling system are given below:

§ It is suggested to take a tap off point from the transfer tower through which a conveyor, following the route of railway line, would be taken to the northern side of the stackyard.

- The stackyard shall be provided with two sets of stacker cum reclaimers, one on each track, of the same rated capacity as in the existing yard.
- The maximum coal storage capacity of the proposed new stackyard is estimated as 3,50,000 T.
- The conveyor system on each track would be reversible i.e. material travelling in N-S direction while in stacking mode and S-N direction while in reclaiming mode.
- The reclaimed material from new stackyard shall be fed to the existing set of silos. This would enable each of the silos to receive the material from either the existing or proposed stackyard, enabling silo to load two rakes simultaneously. This would result in higher rake handling capacity and thus faster evacuation of cargo which would also add capacity to the terminal.

A schematic drawing showing the location of the additional stockyard, its layout and the route of the conveyor are shown in the **Figure 7.2**.

The estimated CAPEX for the development of new yard is about Rs. 150 crores.

Figure 7.2 Additional Stackyard – Location, Layout & Route of Conveyors

7.4 Allocation of Additional Stackyard to AVCTPL

Vishakhapatnam Port Trust has signed a Concession Agreement for Development of steam Coal import Handling Terminal at East Quay – 1 (EQ1) situated at inner harbour of port of Vishakhapatnam on (DBFOT) basis with M/s Adani Vizag Coal Terminal Pvt Ltd.

The material handling system comprise of Rail Mounted, self-propelled boom type luff-able, Slew-able stacker cum bucket wheel reclaimer 2 no. with rated capacity of Stacking Capacity 3200 TPH (Rated) and Reclaiming Capacity 2500 TPH (Rated).

The licensee was allotted an area of 1,01,200 m² for stacking the coal at the east dumps from where the cargo is further loaded in to the rakes through the stacking system.

The overall layout plan of the terminal is shown in **Figure 7.3**.

Figure 7.3 AVCTPL Overall Layout

With the trapezoidal shape of land made available with AVCTPL, two linear stockpile of unequal length can only be provided which does not create the effective cargo storage capacity. Owing to the stipulation imposed while getting environmental approval, the stockpile height has to be limited to 10 m only. With the height limitation in these two stockpiles locations the storage capacity is further limited.

Hence there is a requirement of additional land to create a third Stackyard to increase the targeted terminal capacity. It has been identified that land between EQ-1 berth and AVCTPL back up yard could be utilised for the third Stackyard measuring about 2.53 acres. This area can be effectively utilized by the EQ-1 berth operator increasing the cargo storage capacity thereby increasing the terminal capacity which is constrained by storage capacity. The proposed land is indicated accordingly in **Figure 7.4**.

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Figure 7.4 Proposed Allocation of Additional Stackyard

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7.5 Conversion of Temporary Land to Permanent Land for SVCTPL

Vishakhapatnam Port Trust has signed a Concession Agreement for Development of Eastern Quay – 1A (EQ-1A) berth on south side of EQ-1 berth for handling Thermal coal and Steam coal in the inner harbor of Visakhapatnam Port on Design, Build, Finance, Operate and Transfer (DBFOT) basis" with M/s SEW Vizag Coal Terminal Private Limited (SVCTPL).

The material handling system comprise of 2 no. of Rail Mounted stacker cum bucket wheel reclaimer with Stacking Capacity 3000 TPH (Rated) and Reclaiming Capacity 3000 TPH (Rated).

The coal unloaded from rakes by a suitable twin rail wagon tippler system shall be fed on to receiving conveyors which transport it to the coal Stackyard having an area of about 102,513 sqm.

The overall layout plan of the terminal is shown in **Figure 7.5.**

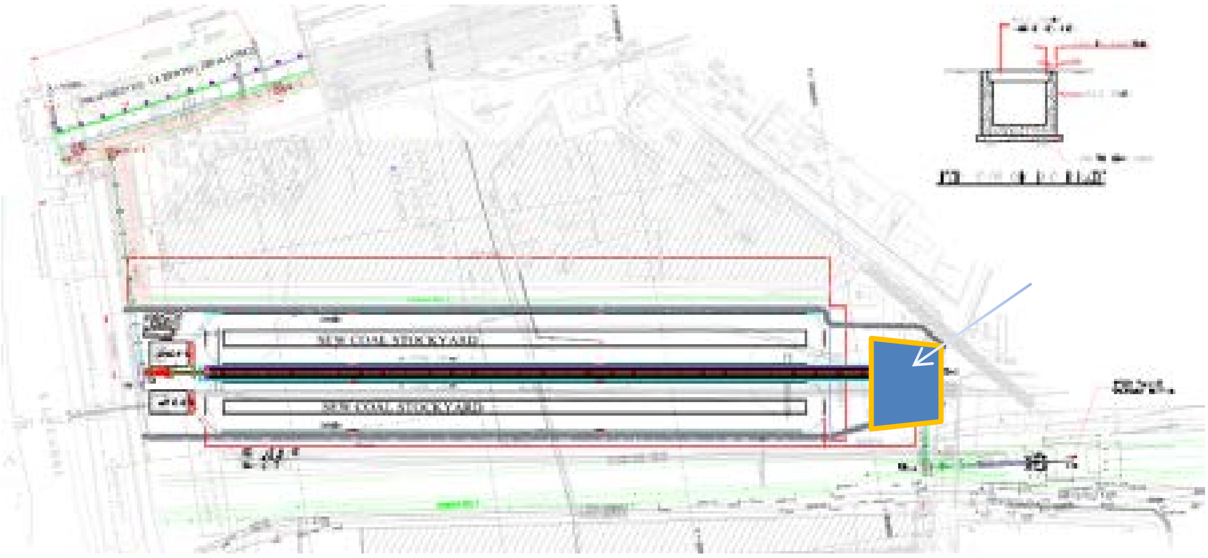


Figure 7.5 SEW Overall Layout

There is a vacant land of 2.82 acres (11,412 sqm) at one end of the stockyard which is outside the area officially handed over to SVCTPL. It is suggested that this Temporary land be converted to Permanent land which can be utilized as the parking for the stacker cum reclaimer cars which in turn would effectively increase the stackyard length and therefore the total stacking capacity of the stackyard.

The proposed conversion of Temporary land to permanent land is indicated in blue colour as in **Figure 7.6**.

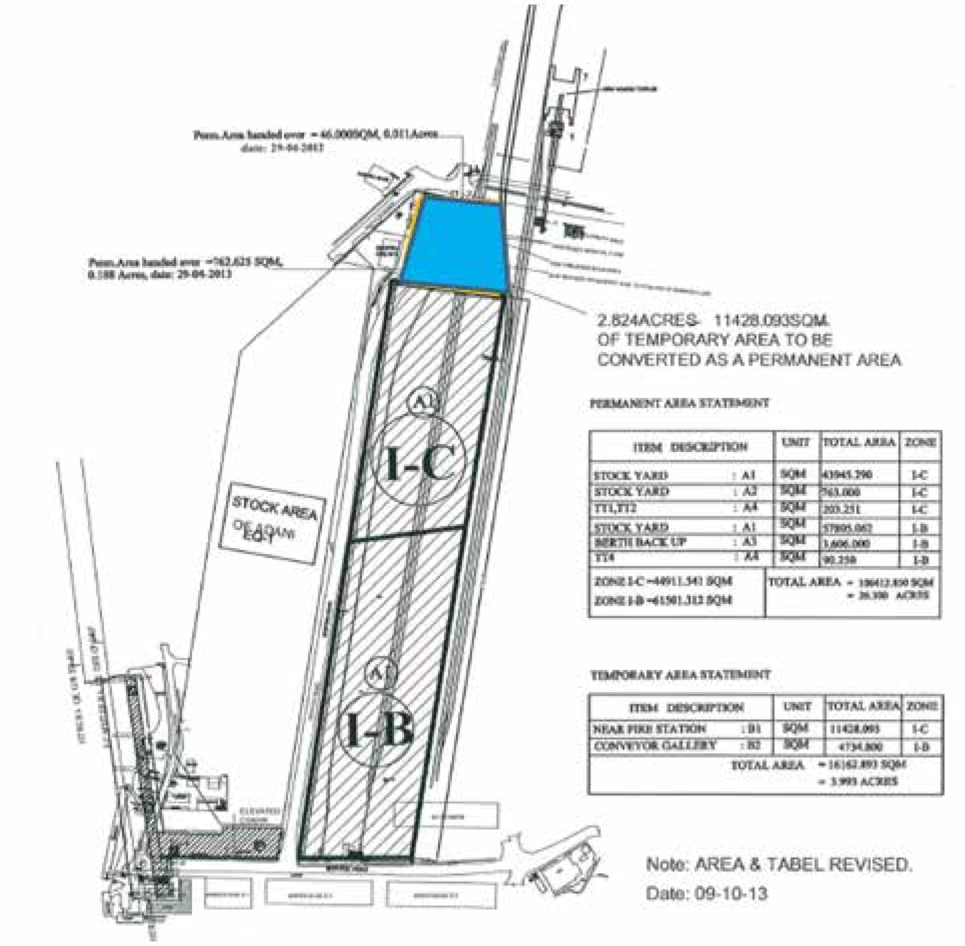


Figure 7.6 Allocation of Temporary Land to Permanent Land

7.6 Stacking Area & Connectivity to Redeveloped EQ 2 – EQ 5 Berths

VPT is upgrading the Inner Harbour so as to handle fully loaded Panamax vessels. The basins are deepened accordingly as well as the berths are being strengthened. Along the East Quay, the port has already commissioned EQ-1 under PPP mode which is capable of handling fully loaded Panamax vessels. For this purpose the old EQ-1 berth along with a portion of EQ-2 berth have been redeveloped into a 280 m long berth. The remaining length of EQ-2 together with EQ-3 and EQ-4 berths and a portion of EQ-5 berth (about 89 m) are proposed to be replaced and realigned to create 2 berths each of 280 m length to cater to fully laden Panamax vessels of 14 m draft. These berths are expected to handle clean cargo such as iron & steel, granite blocks etc.

These berths need appropriate stacking area for transit storage of cargo proposed to be handled. The available stacking area just behind the berths is only 80 m deep and measures around 4.2 Ha (Area 2 as shown in **Figure 7.7**, while about 10 to 12 ha. will be ideally needed for effective operations of these two multipurpose berths. Therefore it is suggested to allocate additional stacking area for these berths. The available area near to the periphery of the Port, near the city, would be preferable to be utilised for storing these clean cargo as compared to using it for any dirty cargo.

The proposed location of stacking area (Area 2) is identified as a plot in between Transit shed of SAIL and the existing rail route of EQ 1 & EQ 1A berths of inner harbour, VGCB & VCTPL of outer harbour. The approximate area of this plot is about 88,000 sqm (8.8 ha.). The location is shown in **Figure 7.7**.

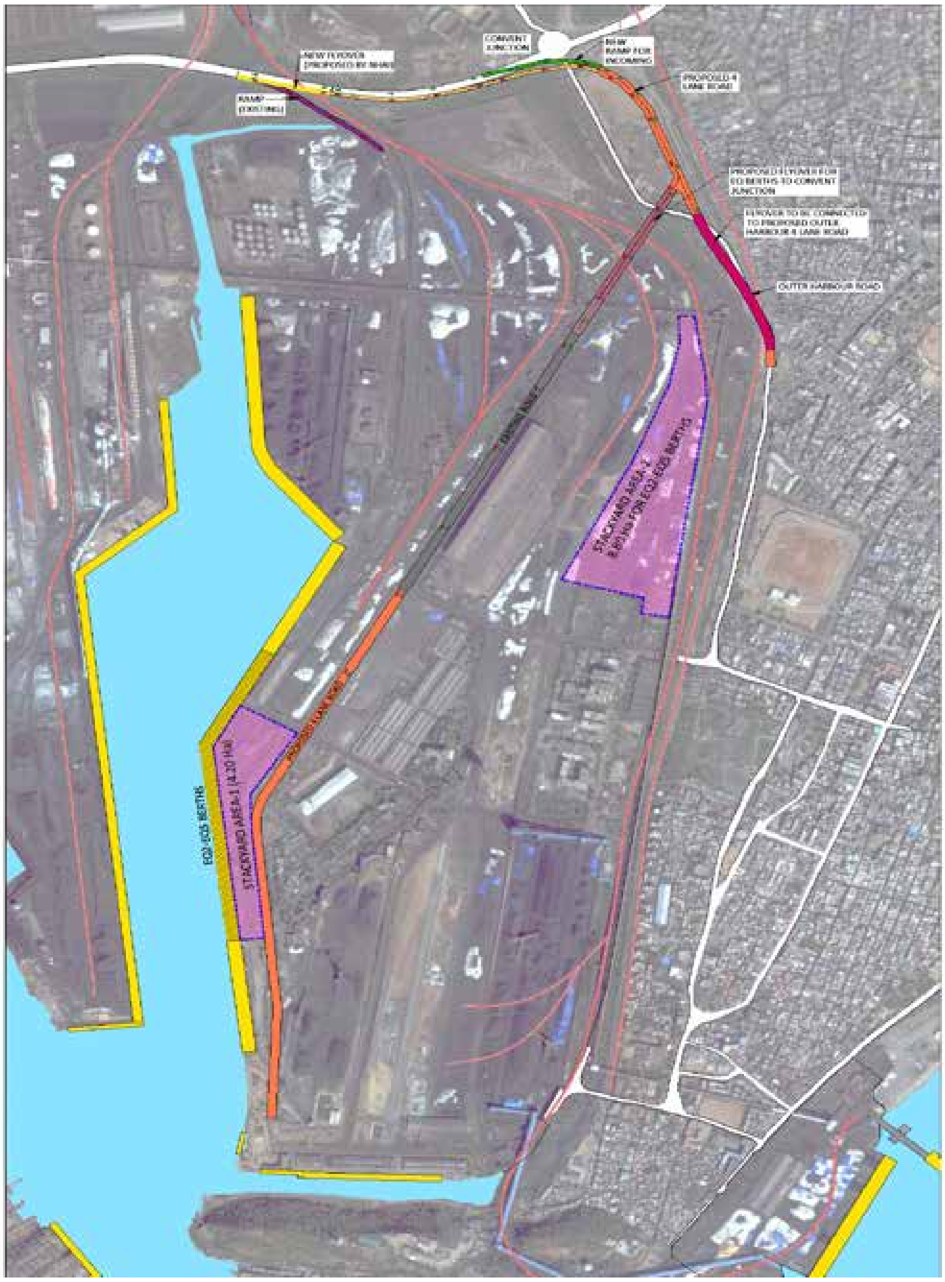


Figure 7.7 Proposed Redeveloped Berths, Stacking Area Location, and Connectivity

The existing and proposed roads and flyovers are also marked in the **Figure 7.7**. The existing 4-lane road adjacent to transit shed is proposed to be extended up to EQ 1A to provide connectivity to the berths EQ 1A and EQ 1 (shown in orange). This proposed road also passes adjacent to the back-up area 1 of the redeveloped berths EQ 2 to EQ 5. Hence the stacking Area 2 is directly connected to berths with the proposed 4–lane road. The stacking area 2 also being adjacent to the existing 4–lane of S4 Road enables expeditious receipt/evacuation of cargo by road.

Regarding rail connectivity, it can be seen that the existing railway lines pass close to stacking area 2 and a siding at the interface could be provided for the rail bound cargo.

7.7 Augmentation of POL Products Handling Facilities

7.7.1 Berthing Facilities

Presently POL products are handled both at the Inner Harbour (IH) as well as at Outer Harbour (OH). At Inner Harbour, they are handled at berths OR I and OR II while at Outer Harbour they are handled at the LPG jetty. The details of these berths are presented in the **Table 7.4**.

Table 7.4 Details of POL Handling Berths

Berth	Cargo Handled	Length (m)	Design Draft (m)
LPG Jetty	LPG & POL	371	14
OR-1	POL	183	10.06
OR-2	POL	183	9.75

7.7.2 Share of Traffic Between IH & OH

The traffic details for the past 4 years were analysed to get the share of IH and OH in handling the total traffic. This information is presented in **Table 7.5**.

Table 7.5 Traffic in POL for the Past 4 Years

Particulars		2014-15	2013-14	2012-13	2011-12
Total Traffic Handled in Million Tonnes		4.54	4.60	5.15	4.99
Total Number of Tankers		341	341	303	331
Traffic Handled at IH	Volume	2.84	2.80	2.67	3.05
	Tankers	253	261	216	235
Traffic Handled at OH	Volume	1.70	1.80	2.48	1.94
	Tankers	88	80	87	96

It could be seen that the OH handles about 40% of the total traffic and the average parcel size is almost twice those handled at IH. This gives an impression that OH handles larger tankers with larger parcel sizes. In order to get the proper perspective, a detailed analysis on the pattern of shipping was carried out.

7.7.3 Traffic Pattern Between IH & OH

A cursory scrutiny of the tanker sizes indicates that on an average about 55% of the tankers are over 45,000 DWT. Hence these groups of tankers were selected for further detailed analysis and the results are presented in **Table 7.6**.

Table 7.6 Performance of Tankers > 45,000 DWT

Traffic	Ship Size		2014-15	2013-14	2012-13	2011-12
Traffic at Outer Harbour	No. of Tankers above 45,000 DWT		53	57	69	68
	Volume handled in million tonnes		1.33	1.54	2.17	1.57
	Ship size in DWT	Maximum	75,013	74,999	76,569	1,15,708
		Minimum	44,970	44,999	44,999	44,995
		Average	53,469	58,495	63,364	56,265
	Parcel size in tonnes	Maximum	50,549	64,035	64,869	41,309
		Minimum	7,176	3,991	12,081	4,000
		Average	25,060	26,934	31,416	23,041
	No. of Tankers with > 30,000 T Parcel		13	14	19	8
Traffic at Inner Harbour	No. of Tankers above 45,000 DWT		58	52	41	47
	Volume handled in million tonnes		1.09	0.85	0.90	1.08
	Ship size in DWT	Maximum	51,763	51,196	52,246	50,076
		Minimum	44,944	44,999	44,999	44,997
		Average	47,351	46,948	47,341	46,592
	Parcel size in tonnes	Maximum	31,443	31,808	33,441	34,604
		Minimum	3,981	1,846	4,004	2,066
		Average	18,852	16,300	22,049	22,935

The following observations are made from **Table 7.6**:

§ During the past 4 years the maximum ship size handled at IH was 50,000 to 52,000 DWT and that at OH was about 75,000 DWT.

§ During the past 3 years, the maximum parcel size at IH has been 31,000 T to 33,000 T. The maximum parcel size at OH has been 50,500 T to 65,000 T.

§ Keeping the bench mark for parcel size as 30,000 T, it is noted that the number of parcels handled at OH greater than 30,000 T has been on an average only 14.

§ Even though OH can handle fully loaded Panamax tankers, the actual number of tankers handled with commensurate parcels are only very limited.

§ It is to be noted that import of POL products is for marketing purposes and the parcel size is always limited depending on the ullage available and the outflow of the products. Similarly the parcel size of export products is also dependent on the ullage available and the market demand.

§ The above table reflects the market situation for these products.

7.7.4 Augmentation of POL Product Handling Facilities

7.7.4.1 Details of the Berths and the Dock Arm

Recently the Port has upgraded the Northern Arm to handle fully loaded Panamax vessels. If such an upgradation has to be carried out at the Western Arm, the efforts and their sequence are examined in this section.

The present layout of the Western Arm, with OR 1 and OR 2 berths is presented in the **Figure 7.8**.

Figure 7.8 Layout of Western Arm

On the northern side are the Fertiliser Berth, OR 1 and OR 2 while on the southern side are the lay-by berths of Hindustan Shipyard. A set of product pipelines run behind OR 1 and OR 2. The existing cross section of OR 1 & OR 2 is presented in **Figure 7.9**.

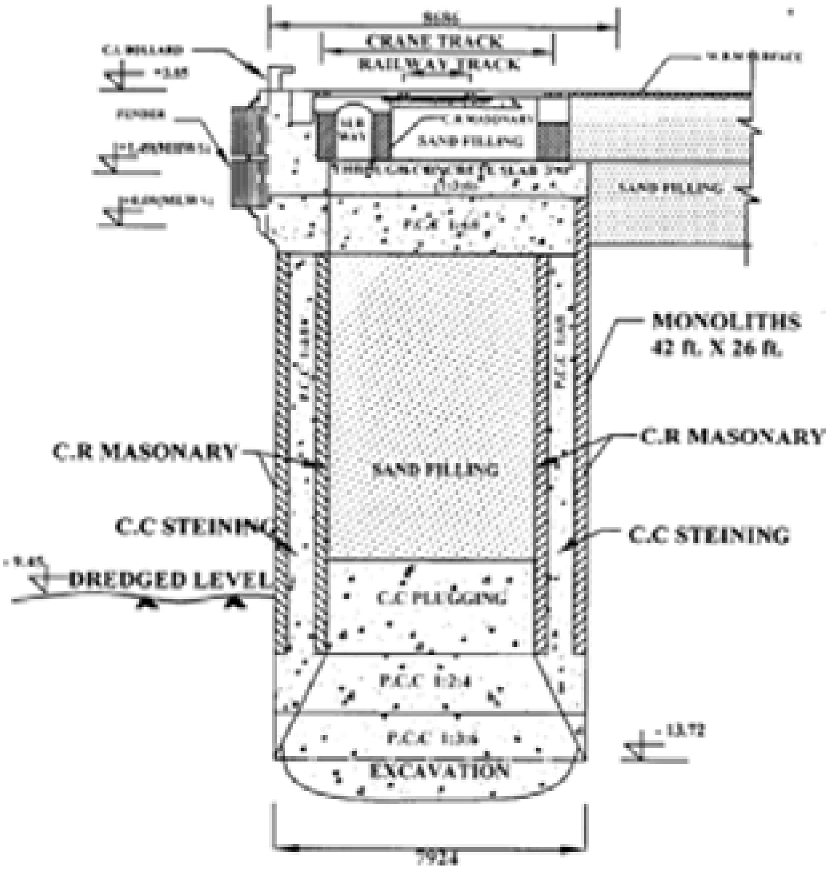


Figure 7.9 Cross Section of OR 1 & OR 2

7.7.5 Possible Options of Augmentation

7.7.5.1 Scheme 1 - Additional Length of OR 1 and OR 2 without Deepening

The suggested option is to extend the existing berths on either side to create additional berthing facilities. It is to be noted that the berthing line of the Fertiliser berth and that of OR 1 & OR 2 are not in the same alignment. The berthing face of OR 1 & OR 2 is set back with reference to the berthing face of Fertiliser berth. Hence it is not possible to make a continuous quay with the fertilizer berth.

OR 1 and OR 2 are each 183 m long. When big tankers call at these berths, it happens that the tankers have to have overhang beyond the berths and the mooring ropes have to be taken ashore at either ends. Hence it is suggested that OR 1 be extended by about 75 m on the eastern side and OR 2 be extended towards fertilizer berth to fill the gap of about 187 m to make the total length of the berths as 553 m. This would enable berthing of two big tankers comfortably within the berth and also enable berthing of 3 MR tankers (about 50,000 DWT) with LOA of about 180 m.

With these measures, the status quo at IH will be maintained without any widening or deepening of the Western Arm, but with a benefit of one additional berth, which would help in significantly reducing the pre-berthing detention. The IH berths will handle most of the POL traffic including the future increase consequent to the refinery expansion.

As indicated earlier, only the limited number of larger parcels could continue to be handled at the OH. This arrangement will release the pressure on the LPG berth which will significantly reduce and make available spare capacity for meeting the future increased traffic in LPG.

The suggested measures are shown in **Figure 7.10**.

Figure 7.10 Suggested Additional Berth Length Adjacent to OR 1 and OR 2

7.7.5.2 Scheme 2 - Additional Length of OR 1 and OR 2 without Deepening

This option is similar to option 1 in terms of getting the additional berth length. However it is proposed in this option that the entire quay length (existing and proposed) shall be upgraded to handle fully loaded panamax ships of draft 14.5 m. Initially the fertilizer berth shall be strengthened and along with newly built berth of 187 m length shall be deepened. Berths OR 1 and OR 2 shall be subsequently dismantled, reconstructed and deepened.

7.7.5.3 Scheme 3 - Deepening of Western Arm and Upgradation of OR 1 and OR 2

The following aspects have to be borne in mind before deciding to upgrade the OR 1 and OR 2 to enable handling of fully loaded Panamax size vessels:

§ At present vessels having beam of 32 m and even above up to 36 m are being handled at these berths and therefore it is envisaged that width of the dock arm is adequate to handle as the required width is governed by the beam and not by the draft of the ships.

§ The existing monoliths are designed for the dredged level of -9.5 m CD and therefore they cannot withstand deepening to -16.0 m CD in the front.

- If these monoliths are to be retained, a new berth in front of these would need to be built resulting in the reduction of the dock basin width.
- The best way would be to remove the superstructure and monoliths and a new berth is built at their location. The berth need not be shore connected but dolphin type to enable cost and time saving.

Therefore in case it is decided to upgrade OR 1 and OR 2 to enable handling of deeper draft ships, the efforts and their sequence are as follows:

- OR 1 has to be decommissioned and the pipeline ends have to be closed with flanges.
- The existing monoliths have to be dismantled and a new berthing structure has to be constructed.
- A new set of pipelines have to be laid behind the new berth and running parallel to the existing set of pipelines till a common tap off point.
- After commissioning the new OR 1, OR 2 has to be decommissioned and reconstructed.
- This reconstruction could be extended to the gap between the Fertiliser berth and OR 2 to get additional berthing length.
- OR 2 have to be connected to the new set of pipelines already laid with OR 1.

In this process, it has to be noted that one berth has to be decommissioned. As explained earlier, the POL traffic is handled by 3 berths – OR 1 & OR 2 and LPG berth. While the IH harbour berths handle, on an average 1.4 MTPA each, LPG berth handles on an average 1.9 MTPA. All the berths are occupied to the optimum extent. If one berth is to be decommissioned, there is no alternate berth to handle its share of traffic. OSTT may not be of much help as the only pipeline connection to it is for handling crude oil. For handling products, a new set of pipelines have to be laid, that too, partly submarine and partly on land. It is difficult to get the ROW for the new set of pipelines from OSTT to the respective tankage terminals far away.

7.7.5.4 Scheme 4 - Upgradation of OR 1 for Handling Deeper Draft Ships with Additional Quay Length

In this option as a first step the gap between the fertilizer berth and OR 2 shall be filled by building a new berth of 187 m length.

Once the additional berth length is commissioned, the reconstruction of berth OR 1 would be taken up. In addition, the OR 1 will also be extended towards east by 75 m to make the total berth length of 258 m, which would be adequate to handle the Panamax size ship. The berthing line of the reconstructed berth OR 1 would be kept at the same location i.e. same as that of OR 2. This would enable a continuous quay length of 628 m for handling of POL products.

In this scheme only one berth would be available for handling of deeper draft ships and remaining one/two berth for handling the smaller parcels as in the present case.

7.7.6 Recommended Scheme of Augmentation

There is definitely a need for additional berthing facilities for handling POL traffic so that the high occupancy of OR 1, OR 2 and LPG berths could be reduced.

Based on the past traffic trend it is observed that the number of larger parcel sizes are very limited. These higher parcels can continue to be handled at the LPG berth in OH. It is therefore suggested that Scheme 1 could be adopted for implementation in which only the additional berth length of 250 m would be added to OR 1 and OR 2. These berths would however continue to handle the smaller parcel sizes as being handled in the present case.

However in case it is still desired that the deeper draft ships with POL products are to be handled at IH, it is recommended to adopt Scheme 3 in which only berth OR 1 shall be upgraded to handle deeper draft ships, which are likely to be in very limited numbers. Apart from that additional quay length of 250 m would be built adjacent to OR 1 and OR 2 berths.

7.7.7 Capacity for Handling Liquid Products After Augmentation

The capacity for handling liquid products after the aforesaid augmentation schemes are executed and commissioned is presented hereunder. This will be the situation by 2020 and will remain the same thereafter.

S. No.	Cargo	Berth	Capacity (MTPA)
1.	Crude oil	SPM	15.00
2.	POL products	OR 1, OR 2, OR 3 & LPG berths (3 x 1.7 + 1.5)	6.50
3.	LPG	LPG berth	1.50
4.	Chemicals	EQ 10	1.85
	Total		**24.85**

It is to be noted that presently OSTT is equipped to handle only crude oil and is in a damaged condition due to Hudhud cyclone. The entire crude traffic will henceforth be handled at the SPM only. As and when OSTT gets restored and as the POL product traffic picks up, the port may examine laying product pipelines from OSTT to shore.

8.0 RAIL AND ROAD - INTERNAL NETWORK AND EXTERNAL CONNECTIVITY

8.1 General

For the efficient performance of a port, the effective internal network of road and rail as well as external connectivity to the national highway and trunk railway routes are essential to ensure faster receipt and evacuation of cargo. Accordingly, the existing situation at Visakhapatnam Port and their proposals are described in the following sub sections.

8.2 Internal Road Network

The total road network within the Port limits is about 85 km of which about 23.5 km is available within the operational area connecting the entire stacking areas for free movement of vehicles.

National Highway No. 5, which is part of the "Golden Quadrilateral" skirts Visakhapatnam Port in an arc with the closest at about 12 km distance. On the southern side it connects to Tamil Nadu, Kerala, Karnataka, East & West Godavari Districts of Andhra Pradesh. On the northern side it connects to Odisha, Madhya Pradesh, Bihar, Uttar Pradesh, Jharkhand and West Bengal. For the northern connectivity, the traffic from/to Visakhapatnam Port has to pass through the Convent Junction and for southern connectivity; the traffic has to pass through the Dockyard Junction. The Convent Junction is connected to NH-5 through (1) Gyanapuram Road as well as (2) Tadchettapalem Road. The Dockyard Junction is connected to NH-5 through (3) Industrial Bypass as well (4) New Gajuwaka Road. These are shown in the following **Figure 8.1** & **Figure 8.2**.

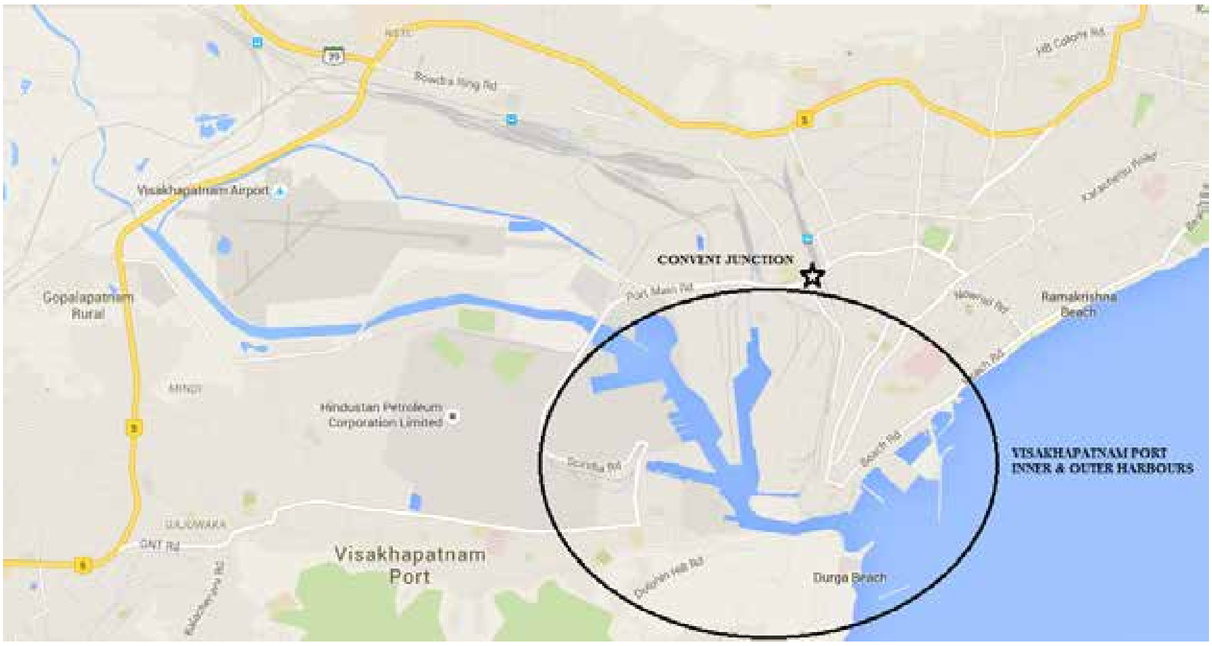


Figure 8.1 Visakhapatnam Port and National Highway No. 5

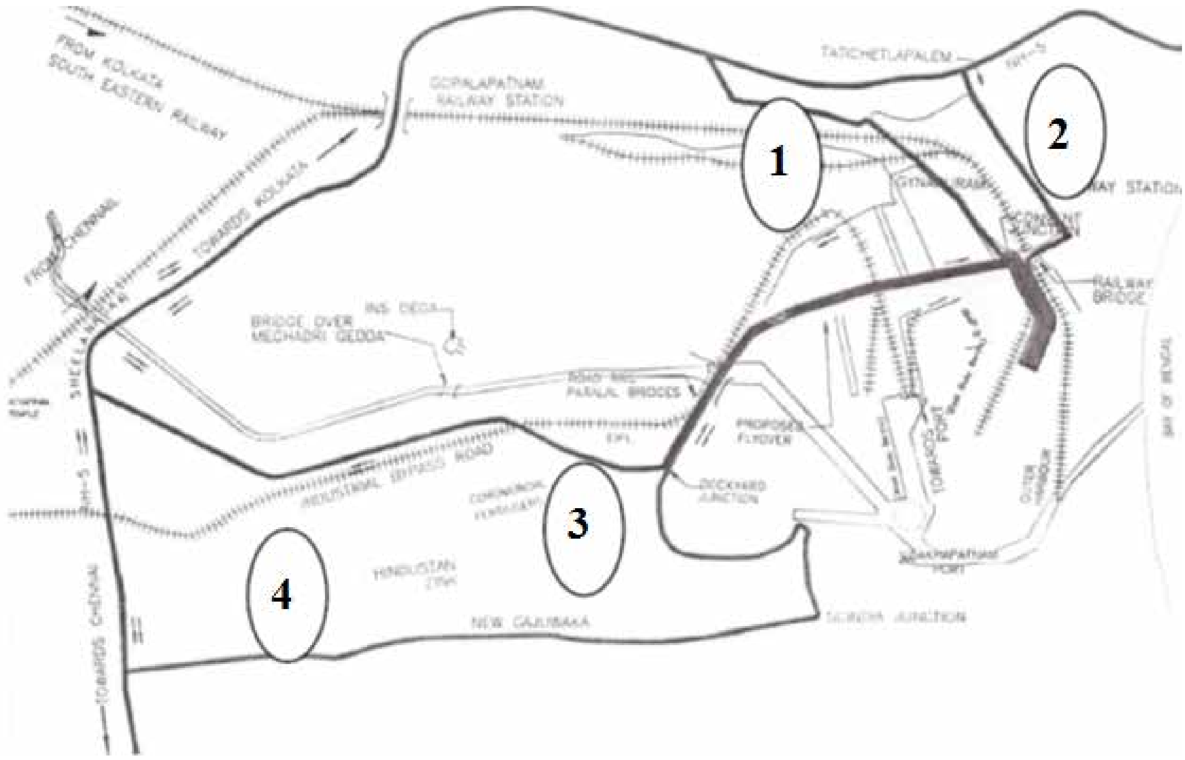


Figure 8.2 Port Connectivity to National Highway No. 5

In the port, all the dry bulk, break bulk, containers and a major portion of liquid bulk are handled at the Northern arm and the Outer Harbour while some POL products are handled at the Western Arm. Hence as could be seen in the **Figure 8.1**, all these dry bulk, break bulk and containers that move through road have to access NH-5 only through the Convent Junction.

In view of this, the road connectivity is looked at from two perspectives – internal connectivity of the port leading to the Convent Junction and the external connectivity from the Convent Junction up to NH-5. The following paragraphs describe the existing situation and the proposals for upgrading the connectivity.

8.3 Internal Connectivity – Present Situation

The total road network within the Port limits is about 85 km of which about 23.5 km is available within the operational area connecting the entire stacking areas for free movement of vehicles.

8.3.1 East Quay Berths

8.3.1.1 EQ 1A to EQ 7 Berths

The present connectivity of these berths is shown in the following **Figure 8.3**.

Figure 8.3 Connectivity of EQ 1A to EQ 7 Berths

EQ 1A and EQ 1 are connected to the Convent Junction through the road just behind the berths, the existing 2 lane service road which travels adjacent to the stackyards of these berths to reach H8 junction. The H8 junction is connected to the Convent Junction through the 3 lane Outer Harbour road which passes through Ambedkar Junction. There is connectivity through the service road which travels in between the stackyards of these berths to touch the north gate. From there it moves via existing 4 lane road located behind SAIL transit shed to reach Port connectivity through Ambedkar junction and Convent junction.

EQ 2 to EQ 7 berths are connected to the Convent junction through the service road behind the berths leading to the North Gate junction and thereafter through the 4 lane EQ 7 road passing through Ambedkar junction.

Before Ambedkar Junction, there is a bottleneck of railway crossing, hampering traffic movement. There is a requirement of development of FOB and an exclusive 4- lane road from Tirupathi Raju Environmental Park up to Convent Junction, within Port boundary.

8.3.1.2 EQ 8 to EQ 10 Berths

EQ 8 to EQ 10 berths are connected to port connectivity road (linking the Convent junction with NH-5) through the 6 lane S4 road and the Ramp B located in front of VSPL main gate as shown in the **Figure 8.4**. If this route is congested, there is an alternative connectivity via the 6 lane S4 road reaching the 4 lane EQ 7 road and thereafter the Convent junction through Ambedkar Junction.

Figure 8.4 Connectivity of EQ 8 to EQ 10 Berths

8.3.2 West Quay Berths

The present situation of WQ berths connectivity is shown in the **Figure 8.5** hereunder.

Figure 8.5 Connectivity of WQ Berths

The WQ berths are connected to Convent Junction by two routes. The first route is through WQ 5 Gate and along the existing 2 lane road in between the OHC yard and NALCO plant with a left turn at Essar junction to join the port connectivity road linking Convent junction with NH-5. The second route is through WQ 5 Gate and along the existing 2 lane road behind the (under constructions) berths WQ 7 & WQ 8, joining the 6 lane S4 road leading to the Ramp B and joining the same port connectivity road. Incidentally the first route serves the OHC yard of Essar also.

8.3.3 Stack Yards at Kancharapalem, on East Side of ESSAR

The stackyards at Kancharapalem, on east side of ESSAR is connected to Port Connectivity road for inward movement of cargo towards STP pond area and for outward movement, the road connectivity is via road on the north side of ESSAR, leading up to Y-junction and from there on connected to Port Connectivity road. These stackyards are adequately connected through road. However, there are constraints for these users to go to eastern dock.

8.3.4 Outer Harbour Berths

The present situation of Outer Harbour berths connectivity is shown in the **Figure 8.6**.

Figure 8.6 Connectivity of Outer Harbour Berths

The connectivity of outer harbour berths VGCB and VCTPL is through the 3 lane Outer Harbour road starting from the Fisheries Harbour and proceeding to the Convent junction through Ambedkar junction. Incidentally this also serves as the connectivity to the Fishing Harbour.

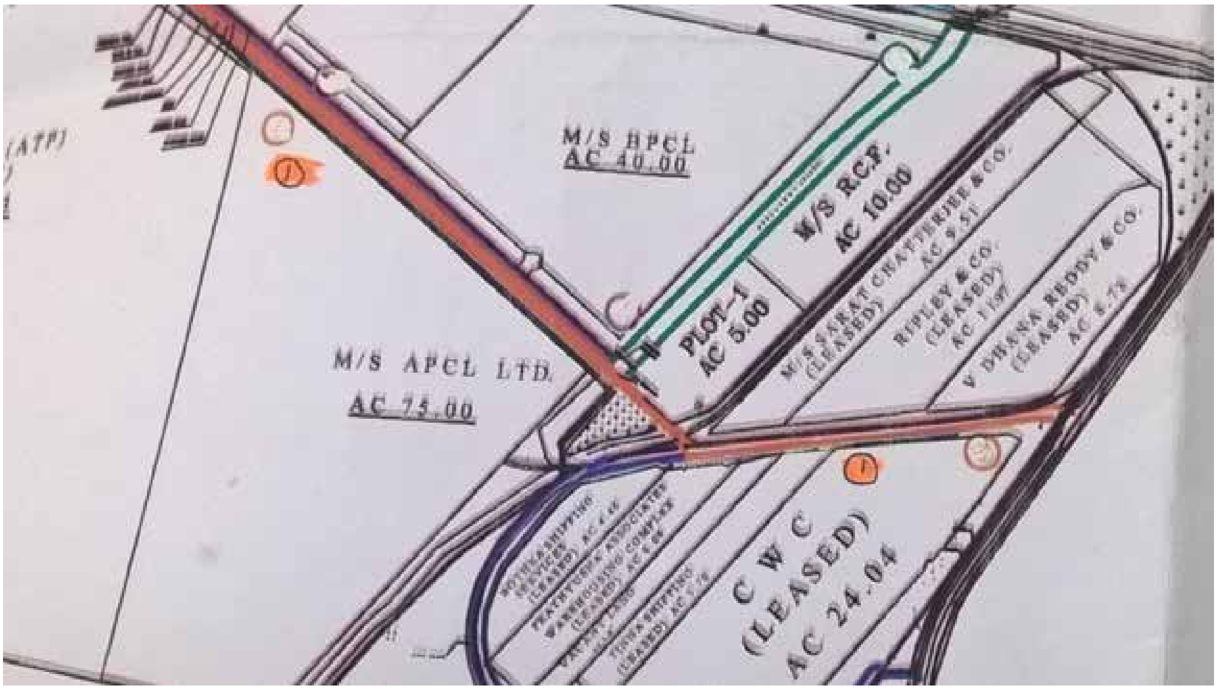
8.4 Internal Connectivity – Works Being Undertaken

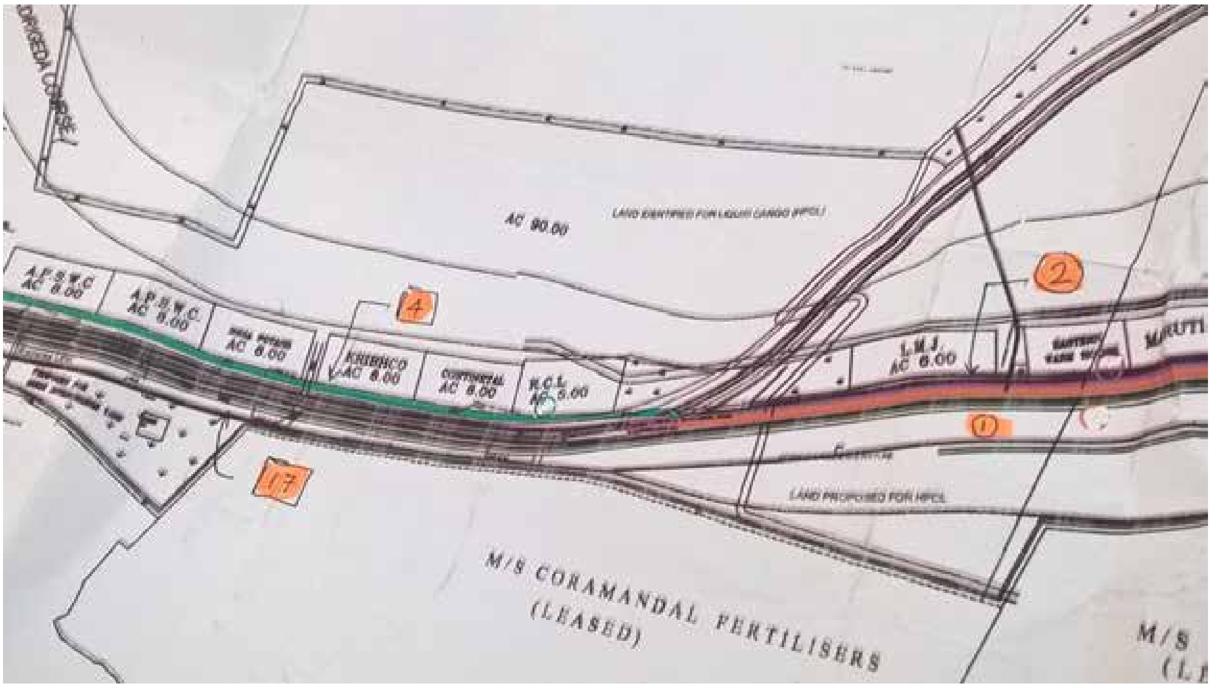
The following road development is proposed and executed by the VPT. It is proposed to be done through output performance of road contract for a period of 5 years:

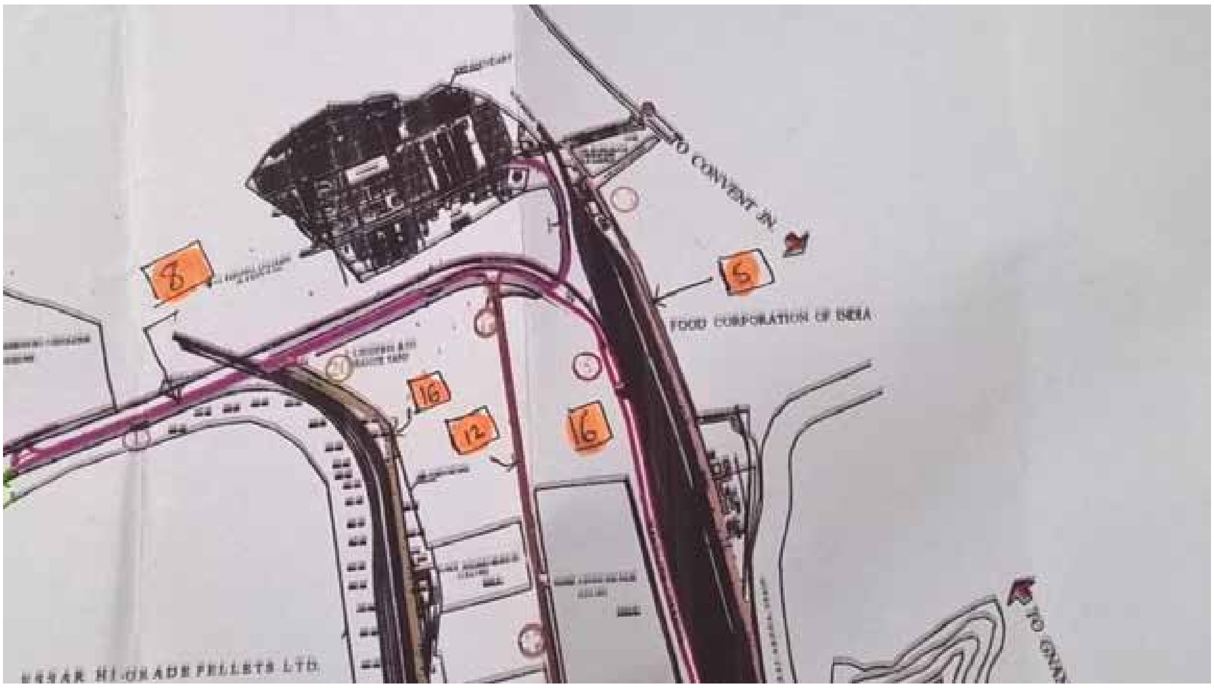
Table 8.1 Details of Proposed Roads by VPT

S. No.	Name of Road	Type of Surface		Length (m)	Breadth (m)
		BT	CC		
Western Sector					
1.	IBP Road from CWC junction to PCR junction (South Side)	BT		500	15
				2550	9
2.	IBP Road from CWC junction to PCR junction(North Side)	BT		2500	7.5
3.	Resurfacing of Road from JP L/C to single span bridge (OPP EIPL)	BT		1350	7.5
4.	Road from PCR Circle to container Yard at Sheela Nagar	BT		2300	7
R&D Yard					
5.	Road from South Gate to North Gate of R&D yard	BT		1150	6
6.	Road along L – 15 Corridor	BT		1100	15
7.	Road from Convent junction to NCFOB approach	BT		500	9
8.	Road from CWC to SS Nagar	BT		1270	7.5
9.	Road from CWC junction to SV Patel Bridge	BT		1300	7.5
OHC Area					
10.	NCFOB	BT		725	7.3
R&D Yard					
11.	NCFOB to South Gate of R&D		CC block	410	7.5
12.	NCFOB to SS Nagar (K R Sons Junction)		CC block	300	10
				1200	16
13.	West of Ambedkar Bridge to Y junction		CC Block	1500	9
OHC Area					
14.	Roads from WOB to ESSAR		CC Block	2300	9.5
15.	Service road and siding along JP-1 and JP-2		CC Block	1500	26
16.	Ambedkar FOB		CC Surface	405	7.5

The locations are given below as per the Sl. No. of the road works.



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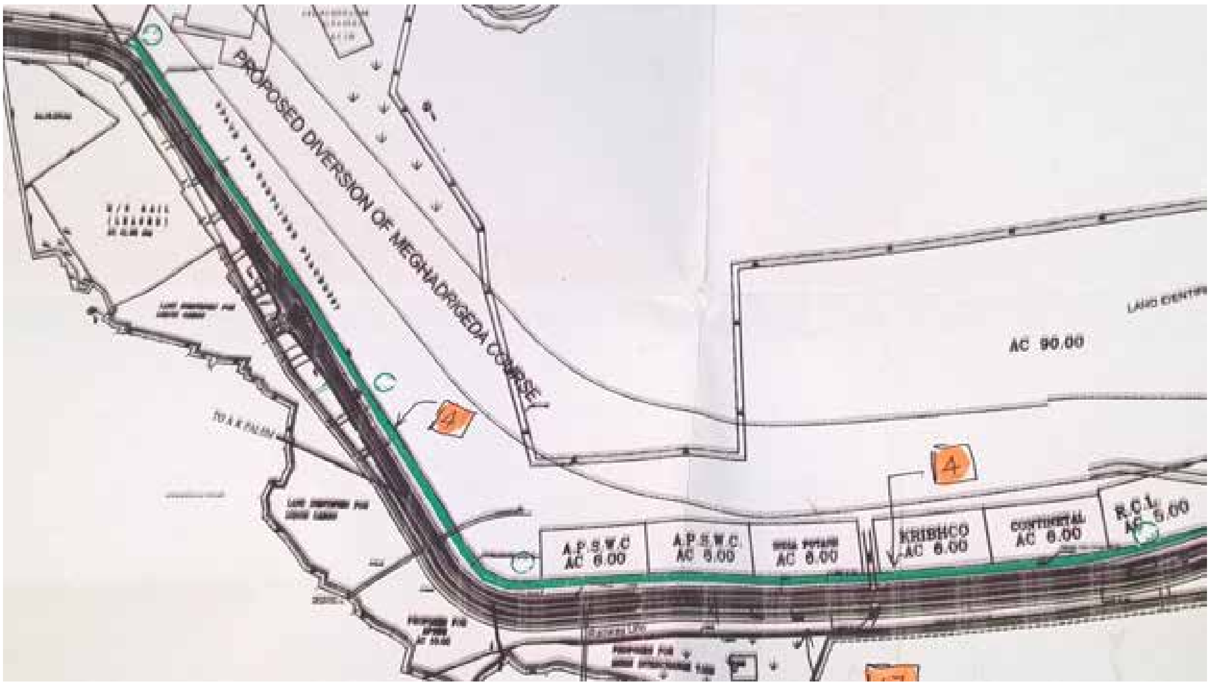
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8.5 Internal Connectivity – AECOM Proposals

During the site visit AECOM identified the following critical junctions which will require immediate attention.

- Ambedkar Junction
- S4 Road Junction
- WQ5 Gate Junction
- Nalco Junction
- K R Sons Junction

8.5.1 Ambedkar Junction

8.5.1.1 Existing Situation

8.5.1.2 AECOM Proposal

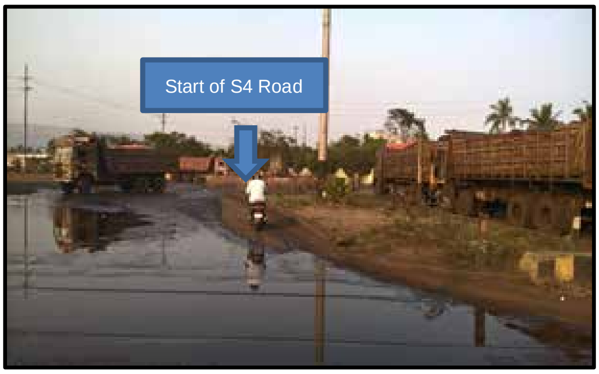
§ The rotary has to be designed properly taking care of all the arms of the same.

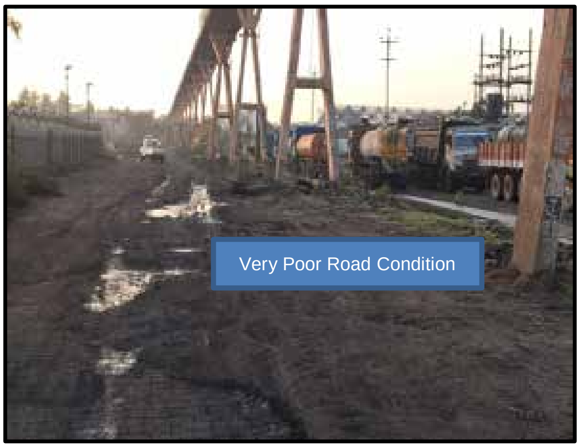
§ Regulations has to be enforced for the errant vehicles

§ The roads around the rotary should have 7.0 m wide road through out with proper channelization

8.5.2 S4 Road

8.5.2.1 Existing Situation





Presently the road is having 4 lane configurations. The foundation of the conveyor belt works as a median. The road is about 3 km in length but it has 3 railway line crossing. The railway lines are active and have frequent wagon movement which in turn results major traffic congestion. The road condition is extremely poor. Presently although the roads have 4 lane configuration, traffic uses the road as individual 2 lane road.

8.5.2.2 AECOM Proposal

§ The road needs to be used as divided 4 lane road with strict traffic regulation.

§ It is proposed to have good quality cement concrete pavement for better traffic movement

§ It is proposed to use traffic light system / uses of the flagman for the traffic comes from the loading / unloading yard to reduce the conflict with the through traffic

8.5.3 WQ5 Junction

8.5.3.1 Existing Situation



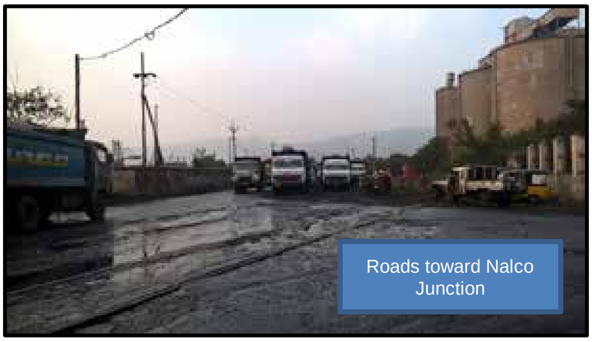

Presently, junction is having 3 legs and the railway line passes thru the junction. The uncontrolled vehicular movement leads to major traffic bottleneck during peak hours

8.5.4 AECOM Proposal

- The junction is proposed to be developed as properly designed roundabout. Blinkers may be installed for the safety of the night traffic movement
- The road in between WQ5 and Nalco junction is proposed to be developed with divided 4 lane configuration

8.5.5 Nalco Junction and K R Sons Junction

8.5.5.1 Existing Situation



8.5.5.2 AECOM Proposal – Option A

It is proposed to have a divided 4 lane road in between Nalco junction and K R Sons Junction.

8.5.5.3 AECOM Proposal – Option B

It is also proposed to have integrated development plan for the three junctions namely WQ5 junction, Nalco junction and K R Sons junction.

It is observed major traffic congestion occurs when the wagon comes at the yard which in turn increases the movement of Truck traffic.

Therefore it is proposed to have a grade separated 2 lane road from WQ5 junction to K R Sons junction (**Figure 8.7**). This arrangement will reduce the traffic congestion as it will reduce the conflict to great extent. It is also proposed to have a dedicated road from the K R Sons Junction to the National Highway which will increase the efficiency of evacuation.

Figure 8.7 Proposed 2 Lane Road from WQ5 Junction to K R Sons Junction

8.5.6 Road Proposal from Fishing Village to Convent Junction

From the fishing village it is proposed to have a 4 lane road. There are some critical issues along this road which were discussed during the site visit of AECOM. It is proposed the maximum using of existing road so that the cost of construction may be minimised.

Existing road from fishing harbour to Convent Junction stretches for about 5.75 km.

The **critical location 1** mentioned may not have the required width. The boundary wall may need to be shifted to accommodate the road configuration

The proposed road passes through another critical area as mentioned in **critical Location 2.** The conveyor belt does not allow the proper 4 lane configuration. There is a hillock at one side. The existing road width will be used for 2 lane and other 2 lane is proposed to be through hillock cutting. The geological property of the rock need to be analysed during detailed design stage. If the hillock cutting made the rock unstable, in that case the road has to be taken through a tunnel. The length of the tunnel will be about 400m. The actual length may be determined during the detailed study.

Another recommendation is to provide a 2 lane elevated corridor along with a 2 lane road at concurrent locations before they connect to the 4 lane road beyond critical locations 2 and 3. Necessary ramp at both ends shall be provided. Also Truck parking for Incoming vehicles need to be allotted to avoid Parking at roadside during peak hours.

Critical location 3 comes on the alignment as given in the photographs. Pipe line passes along the canal makes the location critical for road widening. It is proposed to have the elevated road (2 lane) along the canal and the existing road will be used for the other 2 lane road.

The Critical Location 1, 2 & 3 are shown in **Figure 8.8**.

Figure 8.8 Outer Harbour Road with Critical Locations for Widening (4 Lane Road Proposal)

After the canal, there is no such critical location till it reaches the Convent junction. VPT initiated action for the development of Fly Over Bridge connecting existing road from EQ up-to the road connecting Port Connectivity Junction (Convent Junction).


Fishing Village
Existing Road


Road Widening in
Progress


Critical Location 1


Critical Location 3

Before Ambedkar Junction, there is a bottleneck of Railway crossing, hampering traffic movement, requiring a fly over bridge with necessary diversion and shall be connected to the outer harbour and existing 4-lane road of Eastern sector road with proper ramp below the S-4 conveyor. These shall be connected to the new Fly over proposed by NHAI and from there it shall be connected to the Port connectivity Road.

New ramp exclusively for incoming vehicles shall be provided from Port connectivity road (near Convent junction) to Outer harbour and eastern Sector. The location of Fly over with new Ramp is shown in **Figure 8.9**. Capacity calculation considering projected road traffic is indicated in **Table 8.2**.

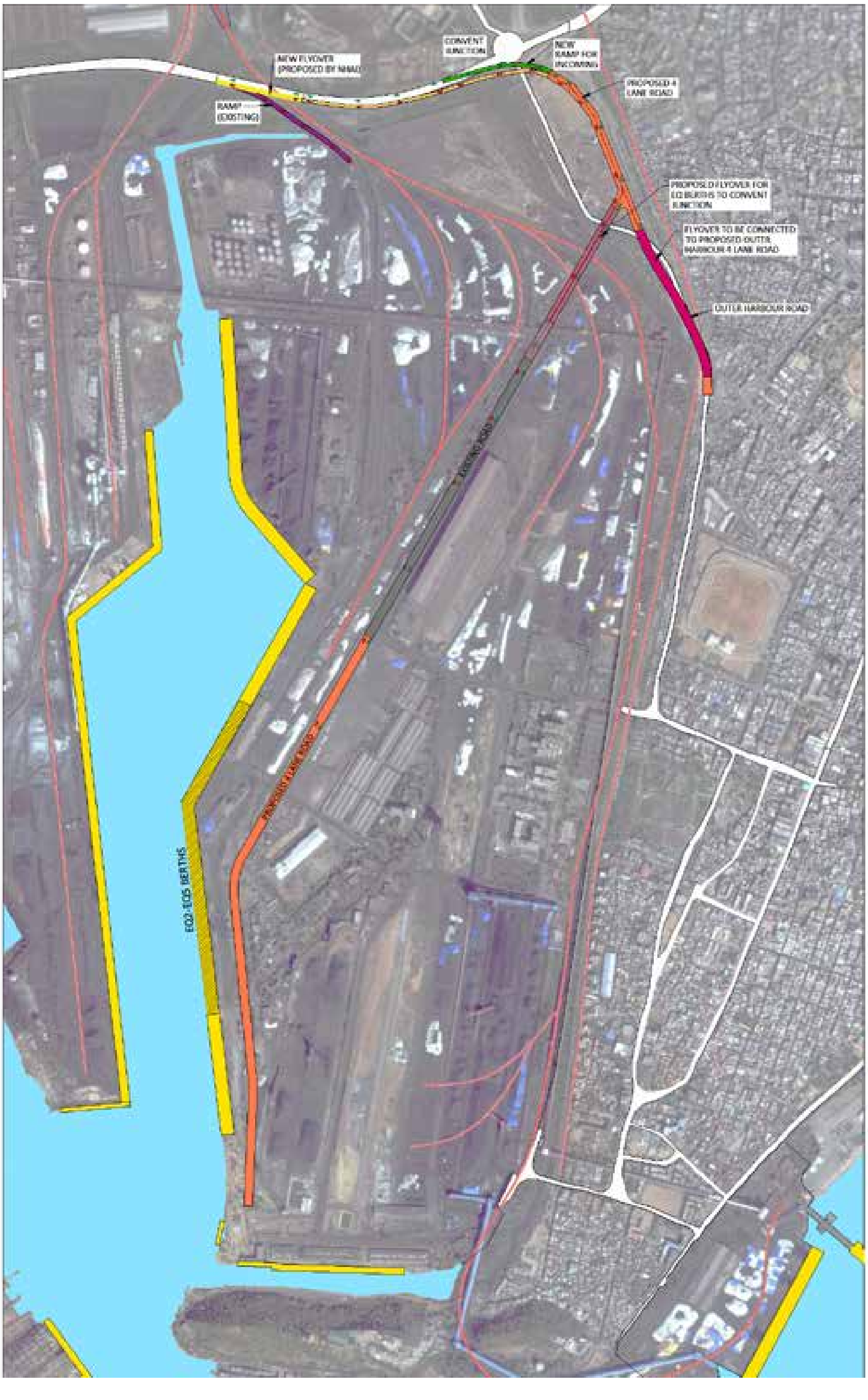


Figure 8.9 Proposed Fly Over Near Ambedkar Junction to Connect Convent Junction

Table 8.2 Capacity Calculation Considering Projected Road Traffic

VISAKHAPATNAM PORT TRUST

Requirements for Road Modifications

S. No.	Road Details	Cargo Originating Center	Cargo Capacity MTPA	Cargo Proportion			Capacity of Truck (T)	Based on Projected Capacity							Proposed Road /Fly over	Recommendation	Remarks
				By Rail (%)	By Road (%)	By Conveyor / Transhipment (%)		No. of Trucks from Terminal (per annum)	Proportion of trucks on the road under consideration	Trucks per hour both ways	Peaking Factor	PCU Factor	PCUs per Hour on the proposed road	Total PCUs per Hour			
1	Existing Capacity																
	From Outer Harbour	VCTPL	8	20%	70%	10%	15	373,333	100%	106.67	50%	4.5	720	851			Presently 3 lane Configuration
		VGCB	10.18	90%	10%	0%	15	67,867	100%	19	50%	4.5	131				
	Projected Capacity																
	From Outer Harbour	VCTPL	20	20%	70%	10%	15	933,333	100%	266.67	50%	4.5	1,800	1,931	4 lane undivided carriageway (Capacity 2400 pcu per hour)	From Outer harbour to Convent Junction upgrade 3 lane to 4 lane road with necessary elevated corridor	Critical locations shown in the Fig 4.2
		VGCB	10.18	90%	10%	0%	15	67,867	100%	19	50%	4.5	131				
2	Existing Capacity																
	I) From Eastern Sector (via Existing EQ7 Road)	EQ1A	7.36	90%	10%	0%	15	49,067	1	14	1	4.5	95	431			Existing 4 lane road upto old Ambedkar Junction
		EQ1	6.4	90%	10%	0%	15	42,667	100%	12	50%	4.5	82				
		EQ2-5	4.14	60%	40%	0%	15	110,400	100%	32	50%	4.5	213				
		EQ6	3.22	90%	10%	0%	15	21,467	100%	6	50%	4.5	41				
		EQ7															
	II) From Eastern Sector	EQ 8	1.88	90%	10%	0%	15	12,533	100%	4	50%	4.5	24	426			Presently Cargo is moving via RAMP B
		EQ9	3.68	60%	40%	0%	15	98,133	100%	28	50%	4.5	189				
		EQ10	1.84	0%	90%	10%	15	110,400	100%	32	50%	4.5	213				
	Projected Capacity																
	I) From Eastern Sector (via Existing EQ7 Road)	EQ1A	7.36	90%	10%	0%	15	49,067	1	14	1	4.5	95	583	4 lane undivided (Capacity 2400 pcu per hour)	From EQ1A to New Proposed 4 lane road back side of EQ1A to EQ 5 Berths. Required Fly over to avoid Railway Crossing near Old Ambedkar Jn to connect the Port Connectivity Road	
		EQ1	6.4	90%	10%	0%	15	42,667	100%	12	50%	4.5	82				
		EQ2-5	6.4	60%	40%	0%	15	170,667	100%	49	50%	4.5	329				
		EQ6	6	90%	10%	0%	15	40,000	100%	11	50%	4.5	77				
		EQ7															
	II) From Eastern Sector	EQ 8	4	90%	10%	0%	15	26,667	100%	8	50%	4.5	51	470			Presently Cargo is moving via RAMP B and during Peak hours via EQ7 to Convent Jn. Need to be rearranged.
		EQ9	4	60%	40%	0%	15	106,667	100%	30	50%	4.5	206				
		EQ10	1.84	0%	90%	10%	15	110,400	100%	32	50%	4.5	213				

The existing 4 lane road shown shall be extended up to EQ 1A to provide connectivity to the berths EQ 1A and EQ 1. This proposed road also passes adjacent to the back-up area redeveloped berths EQ 2 to EQ 5. In this way their stacking area will be directly connected with the proposed 4–lane road. The location of the proposed 4-lane road is shown in **Figure 8.10**

Figure 8.10 Proposed Road Connectivity of Visakhapatnam Port

8.6 External Connectivity – Present Situation

The port is connected to NH-5 through Port Connectivity road, GNT road, Thatichetlapalem road, and Industrial by-pass Road. There has been a significant improvement in the quality of road infrastructure over the last few years. Out of these, the most important is the Port Connectivity Road linking the Convent junction with the NH.

VPT has constructed this road connecting the port with NH-5 which essentially links the port with its hinterland. The project stretch comprises a total distance of 12.47 km connecting the Convent Junction (near port gate) to NH-5 near Ayyappan temple with about 4.85 km of flyovers and ramps. This has been in operation for almost 10 years.

8.7 External Connectivity – New Proposal

8.7.1 Proposed Road Connectivity from Sheela Nagar Junction to Anakapalle-Sabbavaram/Pendurthi-Anandapuram Road Under Phase-III

VPT is initiating action for the development of adequate road connectivity from Visakhapatnam Port – Connectivity from Sheela Nagar Junction to Anakapalle-Sabbavaram/Pendurthi-Anandapuram road under Phase-III i.e., NH-16 (Former NH-5) through SPV between VPT and NHAI.

The Port Cargo travelling via NH-5 from the point of Port Connectivity Junction reaches at Ayyappan Temple Junction at Sheela Nagar, can travel either towards North or South, based on the destination. From the point of Port Connectivity Road meeting NH-5, up-to the point of crossing the Visakhapatnam city, there is congestion due to city traffic interacting with the Cargo movement. Hence NHAI has proposed to upgrade the existing by-pass road between Anakapalle Junction up-to Anandapuram Junction into a National Highway, which bypasses the city traffic, and VPT needs to synchronize its port connectivity with this bypass road of NHAI.

This connectivity from Port Connectivity Junction with NH-5 at Ayyappan Temple Junction at Sheelanagar, up-to the subject bypass road at Sabbavaram Junction, reduces a travel distance of about 25 km on either side of travel, along with reduction of the city congestion enabling free cargo movement, which needs to be taken up on priority. Consultancy services for preparation of detailed project report entrusted to M/s. Aarvee Associates Architects Engineers & Consultants Pvt Ltd by NHAI on 15.01.2016. The location of the proposed road connectivity is shown in **Figure 8.11** and **Figure 8.12** hereunder.

Figure 8.11 Proposed Road Connectivity of Visakhapatnam Port

Figure 8.12 Proposed Road Connectivity of Visakhapatnam Port

8.7.2 Proposed Road Connectivity from RCL to Mindi Yard to NH-16

VPT initiated action for the development of adequate road connectivity from Visakhapatnam Port to NH-16 (former NH-5) i.e. Phase II works - Widening of existing 2-lane Port Connectivity Road to 4-lane. The present road connects NH-16 (former NH-5) at Sheela Nagar to Port connectivity road junction, for inward as well as outward movements of cargo. Presently the existing connectivity from Western Sector starting from IBP Junction up-to RCL Junction is only a two lane. This stretch from Western Sector starting from IBP Junction up-to RCL Junction needs to be converted into a four lane to facilitate safe, efficient and smooth movement of traffic on project road and link roads in the Port area. The scheme proposed to be taken up by the VPT and NHAI on EPC basis. The work already awarded by NHAI on 22.01.2016 to the Contractor and the Cost of Rs. 76.94 Cr and will be commencing soon. The Ministry released Rs. 20.00 Crore under the Sagarmala Project on 09.01.2016. The location of the proposed road connectivity is shown in **Figure 8.13.**

Figure 8.13 Proposed Road Connectivity of Visakhapatnam Port

8.8 Port Internal Rail Network and External Connectivity

8.8.1 Internal Rail Network

8.8.1.1 Overview

The Visakhapatnam Port has a vast railway network consists about 176.678 ETKM approximately including Private sidings. The existing B.G Track in Port 83.718Km and 214Nos Points & Crossings (i.e.21.40ETKM). The total track is being maintained by VPT is 105.118 ETKM and Private sidings of 71.56 ETKM and renders terminal services for the traffic carried by the Indian Railway to and from hinterland. The VPT railway system has two gate ways for carrying cargos i.e., one Marshalling yard to R&D yard for handling various general cargos and other from Ore Exchange Yard to OHC for handling iron ore. VPT Railway network has two Sectors i.e. Eastern Sector and Western Sector, which are under the jurisdiction of four subdivisions for development and maintenances. In the Eastern Sector there are 2 yards i.e. (i) North Holding Yard & East Yard (ii) R & D Yard and in Western Sector there are 2 yards i.e. (i) OHC Yard and (ii) Western Sector Yard. Maximum part of the OHC / lines are owned, maintained and operated by the M/s. ESSAR Vizag Terminal Ltd.

The key-plan of VPT railway layout is shown in **Figure 8.14**.

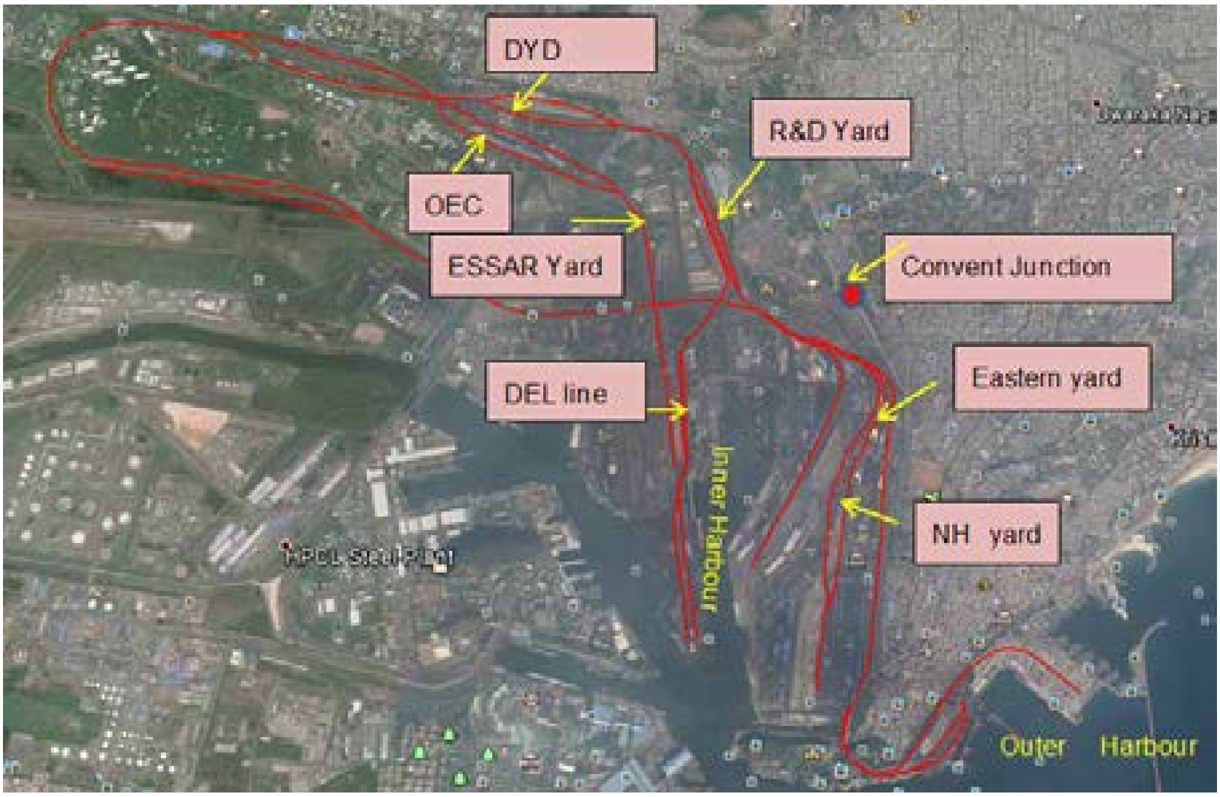


Figure 8.14 Key Plan of VPT Railway Layout

8.8.1.1.1 North Holding Yard (NH Yard) & Eastern Yard

Total track length of East yard and NH yard is 29.591 ETKM there are 31 lines and 53 points and crossings. The railway track structure is modified according to the latest developments in loading / unloading operations and serving lines to various terminals i.e., M/s. VGCBL, M/s. Adani Ltd., M/s. SEW, M/s. VCTPL, M/s. SAIL, M/s. FCI–F siding etc.

8.8.1.1.2 R&D Yard

The Reception & Dispatch yard (R&D yard) and west ore berth lines of Visakhapatnam Ports were commissioned during the year 1969-72. The R & D yard with adjacent Spur lines, DE lines and W.O.B lines are maintained by R & D Sub-division with a total 39.359 ETKM of track length, which consists 82 points & crossings, 21 B.G Railway lines in R & D yard, 2 Spur lines in TNEB complex, 10 lines in W.O.B including DE lines and 1 siding in between R&D yard and OHC. In R&D yard there are 19 lines with signalling and Electrical traction. Remaining lines including DE lines are without Electrical tractions. The trains are being handling to and from R & D Yard to marshalling yard by E. Co. Railways with Railway locos from R & D yard to various sidings by VPT locos.

8.8.1.1.3 Western Sector

Western Sector yard of Visakhapatnam Port has the multiple railway connectivity to various sidings, yards and Ports operational with 28.520 ETKM. It consists of 26 B.G Railway lines & 40Nos of Points & Crossings. Railway tracks in the Western Sector yard were laid for serving the different types of cargo such as fertilizers, food grains, POL products of Central Warehousing Corporation, M/s. H.P.C.L, Oil terminal of Indian Oil Corporation, M/s. Coramandal Fertilizers, M/s. F.C.I, M/s. Zinc, M/s. HZL, M/s. Sarat Chatterjee etc.

8.8.1.1.4 Ore Exchange Yard (OEC)

The iron ore handling system consists of the Ore Exchange Yard operated by the Railways and the Ore Handling Complex, operated by the Port.

The Ore Exchange yard consists of 12 lines of which line nos. 1 to 5 are reception lines and line no. 6 is engine run round line. These are fully wired. Line No. 7 is provided with full wiring and is used as dispatch line only to K.K.line. Line nos. 8 and 12 are dispatch lines provided with top wiring. Line Nos. 9 & 11 are used for conducting P.M.E. (C&W) and these lines have only top wiring. Line no.10 is C&W Material trolley line with top wiring. Additional lines are provided for repairing sick wagons.

In the Ore Handling Complex, there are ten pre-tippler and ten post tippler lines. A train after being brought from the ore Exchange Yard is split into two equal parts and the wagons are uncoupled. They are then brought to the tipplers by VPT Locos for tippling. After tippling, the empty wagons are gathered in the post tippler lines and returned to the Ore Exchange Yard for onward dispatch to the loading points.

In addition, there are three lines for manual unloading of iron ore rakes.

The movements between the Ore Exchange Yard and Ore handling Complex are shunt movements controlled by J. Cabin of the Railways and Dumper cabin of the Port.

8.8.1.2 Present Situation of Railway Lines

8.8.1.2.1 EQ1 & EQ1A Berths

M/s. Adani Railway Lines: The existing Railway lines of M/s. Adani Vizag Coal Terminal Ltd., are used for carrying and handling of Cargo at EQ1 berth of M/s. AVCTL. The existing Railway lines of VPT are used by M/s. AVCTL for the transportation of cargo handling at EQ1.

M/s. SEW Railway lines: The existing Railway line of VPT will be used by M/s. SEW for the transportation of cargo handling at EQ1A and they will lay 2 railway on pre tipper and post tipper.

The rail network connecting from EQ1&EQ1A stacking yard is shown in **Figure 8.15**.

Figure 8.15 Railway Connectivity of EQ1A & EQ1 Berths Stacking Yard

8.8.1.2.2 EQ2 to EQ10 Berths

The Existing Railway lines of NH yard are located behind EQ2 to EQ5 berths and run through crossing the S4 road to connect to R&D Yard. From there it is connected to the DYD yard to connect main Line.

8.8.1.2.3 EQ7 Berth Railway Line

It is located adjacent to the M/s Godavari Fertiliser Chemical Ltd. mainly carrying finished fertilisers. From there it is crossing the S4 road and it connects to main railway line via R&D yard and DYD yard.

8.8.1.2.4 EQ8 & EQ9 Berth Railway Line (M/s. VSPL Railway Lines)

The Railway lines of M/s. VSPL are used for the carrying cargo of M/s. VSPL, handling at EQ8 & EQ9 berths. These lines are directly connected to the R&D yard.

The Rail network connecting from the concern stacking yard is shown in **Figure 8.16**.

Figure 8.16 Railway Connectivity of EQ2 & EQ10 Berths Stacking Yard

8.8.1.2.5 VCTPL Berth (M/s. VCTPL Railway Lines)

The existing Railway lines are used for carrying container cargo of M/s. VCTPL. These lines connect to the R&D yard via NH yard.

8.8.1.2.6 VGCB Berth (M/s. VGCB Railway Lines)

M/s. VGCB connecting of two lines 10 & 11. The existing Railway lines are used for carrying cargo of M/s. VGCB, these lines directly connect to R&D yard via NH Yard and further connect to marshalling yard and then connect to the main line. The Rail network connecting from the concerned stacking yards are shown in **Figure 8.17**.

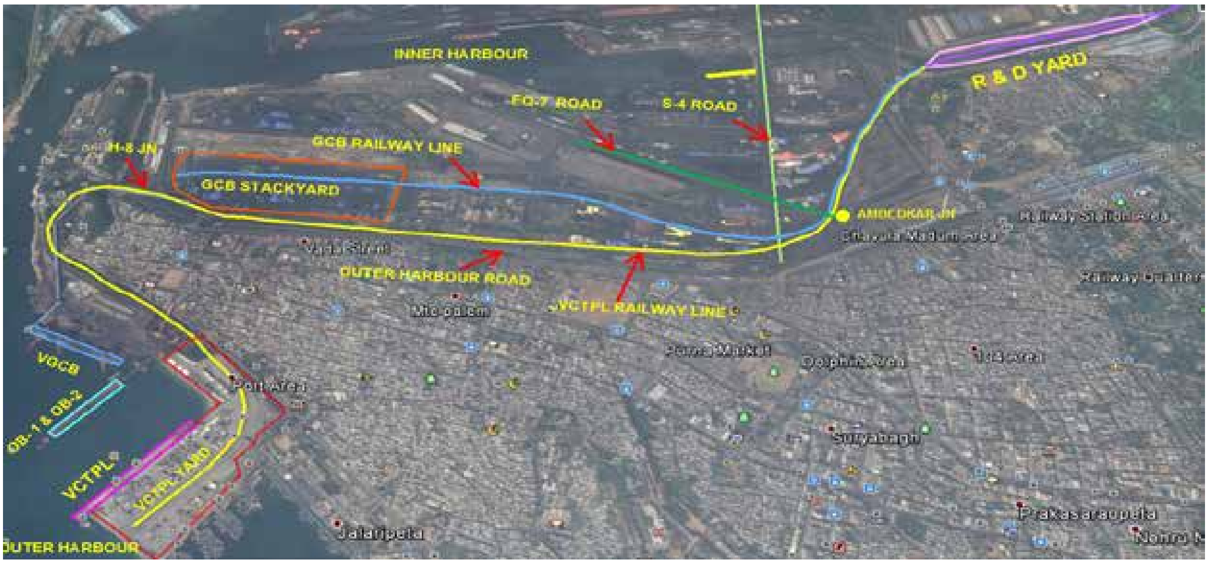


Figure 8.17 Railway Connectivity of VCTPL & VGCB Stacking Yard

8.8.1.2.7 West Ore Berth & DE Line

The existing W.O.B lines are used for the handling of coal cargo at WQ1 to WQ5. 6 lines in W.O.B and 4 lines DEL lines as holding yard. These lines connect to R&D Yard via DE lines.

8.8.1.2.8 M/s. EVTL Railway Lines

Existing Railway lines of M/s. EVTL (formerly OHC of VPT) are used for carrying & tippling of iron ore at tipplers. M/s. EVTL Railway lines operational with 21.650 EQTKM. It consists of 24 B.G Railway lines & 72 no. of Points & Crossings. Railway tracks these lines are directly connected to the Ore Exchange Yard of E. Co. Railways.

The Rail network connecting from the concerned stacking yards are shown in **Figure 8.18**.

Figure 8.18 Railway Connectivity of VCTPL & VGCB Stacking Yard

8.8.1.3 Rationalisation of VPT Rail network

A) Existing track length of VPT &Private siding

S. No.	Description of Yard / Siding	Total Length (m)	Total Length (km)	Gradient
	R&D YARD & WOB			1 IN 400
1.	Line No. 1D	711.39	0.711	
2.	Line No. 1C	754.80	0.755	
3.	Line No. 1B	762.20	0.762	
4.	Line No. 1A	757.63	0.758	
5.	BVR SIDING	100.00	0.100	
6.	Line No.1	744.51	0.745	
7.	Line No.2	827.25	0.827	
8.	Line No.3	887.81	0.888	
9.	Line No.4	886.87	0.887	
10.	Line No.5	960.75	0.961	
11.	Line No.6	960.23	0.960	
12.	Line No.7	882.93	0.883	
13.	Line No.8	757.44	0.757	
14.	Line No.9	756.10	0.756	
15.	Line No.10	708.63	0.709	
16.	Line No.11	720.00	0.720	
17.	Line No.12	715.50	0.716	
18.	Line No.13	668.72	0.669	
19.	Line No.14	583.12	0.583	
20.	Line No.15	548.10	0.548	
21.	Line No.16	695.00	0.695	
22.	Line No.17	697.00	0.697	
23.	Line No.17A	1160.00	1.160	
24.	Link Line	385.05	0.385	
25.	R&D Western Sector Line	700.00	0.700	
	Connecting Lines			
26.	16-17 connecting line at N-W cabin	212.30	0.212	
27.	OEC Line	286.30	0.286	
28.	S/ Neck Line at N-W Cabin	135.60	0.136	
29.	Route X from pt 68 up to girder bridge	180.00	0.180	

S. No.	Description of Yard / Siding	Total Length (m)	Total Length (km)	Gradient
30.	Route Y from IP 50 up to girder bridge	175.00	0.175	
31.	Line No 8 from SHP-1 To SHP-3	145.00	0.145	
32.	Line No 9 from SHP-2 To SHP-3	258.00	0.258	
33.	8&9 Dismantled tracks for loco, BVG siding	180.00	0.180	
34.	Shunting neck line leading diamond crossing	152.00	0.152	
35.	17A to dead end line at Dumper cabin	102.00	0.102	
36.	North Cabin in Between tracks	244.00	0.244	
37.	North West Cabin in Between tracks	278.80	0.279	
38.	South Cabin in Between tracks	319.00	0.319	
39.	South West Cabin in Between tracks	75.00	0.075	
40.	DEL-1	668.72	0.669	1 IN 800
41.	DEL-2	720.00	0.720	
42.	DEL-3	716.00	0.716	
43.	DEL-4	636.00	0.636	
44.	WOB MAIN LINE	1049.00	1.049	
45.	WOB LOOPLINE	994.00	0.994	
46.	AVR NEW MAIN LINE	1040.00	1.040	
47.	AVR NEW LOOPLINE (engine escape line)	1010.00	1.010	
48.	AVR LINE-1	430.00	0.430	
49.	AVR LINE-2	320.00	0.320	
50.	Spur - I	413.00	0.413	
51.	Spur - 2	430.00	0.430	
52.	INBETWEEN TRACKS (WOBON LINE TRACKS)	1112.00	1.112	
		Total	**30.613**	
	Oil loop line			
1.	Oil loop line	3710.00	3.710	1 in 1000
2.	Essar manual unloading line no.1	700.00	0.700	
3.	Essar manual unloading line no.2	700.00	0.700	
		Total	**5.110**	
	NH Yard & East Yard			
1.	CHANNEL LINE	800.00	0.800	1 in 400
2.	SHED LINE	695.00	0.695	
3.	NEW SHED LINE	760.00	0.760	

S. No.	Description of Yard / Siding	Total Length (m)	Total Length (km)	Gradient
4.	VCTPL DIRECT LINE	760.00	0.760	
5.	GCB OLD LINE	1800.00	1.800	
6.	GCB NEW LINE	1800.00	1.800	
7.	R - 9	560.00	0.560	
8.	R - 10	600.00	0.600	
9.	R- 6 MAIN LINE	1500.00	1.500	
10.	R - 6 LOOP LINE	2000.00	2.000	
11.	LINE NO - 7	460.00	0.460	
12.	LINE NO - 8	720.00	0.720	
13.	LINE NO - 9	762.00	0.762	
14.	LINE NO - 10	810.00	0.810	
15.	LINE NO - 15	770.00	0.770	
16.	LINE NO - 16	740.00	0.740	
17.	LINE NO-17	406.00	0.406	
18.	R -12	678.00	0.678	
19.	R-11 MAIN LINE	790.00	0.790	
20.	R-11 LOOP LINE	490.00	0.490	
20.	R-13	600.00	0.600	
21.	R-14	585.00	0.585	
22.	R-15	588.00	0.588	
23.	ROUTE-Z	860.00	0.860	
24.	R-4	700.00	0.700	
25..	N.S.DUMP	510.00	0.510	
26.	ROUTE-X	900.00	0.900	
27.	ROUTE-Y	1100.00	1.100	
28.	SHUNTING NECK	470.00	0.470	
29.	B G LOCO SHED LINE-1	80.00	0.080	
30.	B G LOCO SHED LINE-2	90.00	0.090	
31.	B G LOCO SHED LINE-3	340.00	0.340	
	Connecting Lines			
1.	Between R-6 main line point & R-9& R-10 lines point	57.00	0.057	
2.	Between Shunting neck line point & R-1 lines point	130.00	0.130	
3.	Between Line no.7 point & Route-y lines point	55.00	0.055	

S. No.	Description of Yard / Siding	Total Length (m)	Total Length (km)	Gradient
4.	Between Shunting neck Line point & L/no.15&16 point	115.00	0.115	
		Total	**25.081**	
	Western Sector			
1.	NAD Curve	400.00	0.400	
2.	Western sector Main line NPB	1040.00	1.040	
3.	Western sector Loop line NPB	855.00	0.855	
4.	Parallel bridge	325.00	0.325	
5.	Western sector Main line SPB	1600.00	1.600	
6.	Western sector Loop line SPB	1500.00	1.500	
7.	JP Main line	4850.00	4.850	
8.	Single span bridge	30.00	0.030	
9.	JPL -1	800.00	0.800	
10.	JPL -2	800.00	0.800	
11.	JPL -3	800.00	0.800	
12.	JPL -4	800.00	0.800	
13.	Mindi loop line	720.00	0.720	
14.	Bulb line	1775.00	1.775	1 in 800
15.	Bulb line holding line no.1	487.00	0.487	
16.	Bulb line holding line no.2	900.00	0.900	
17.	New CWC Line	864.00	0.864	
18.	Old CWC Line	600.00	0.600	
19.	Right off way curve	197.00	0.197	
20.	CISF Quarters curve	300.00	0.300	
21.	HPCL holding line no.1	831.00	0.831	
22.	HPCL holding line no.2	784.00	0.784	
23.	HPCL holding line no.3	808.00	0.808	
24.	IOC holding line no. 1	770.00	0.770	
25.	IOC holding line no. 2	732.00	0.732	
26.	Esso Line	517.00	0.517	
27.	Link line	435.00	0.435	
		Total	**24.520**	

B) *Detailed lengths of V.P.T Railway Lines to be dismantled.*

S. No.	Details of dismantling lines	Track (m)	P&C	EQTKM
	R&D / WOB	Nil		
	OHC	Nil		
	NH Yard / East Yard			
1.	R-11 Main line	790	1	0.89
2.	R-11 loop line	470	0	0.47
3.	Line no.10	810	2	1.01
4.	Channel line	800	2	1.00
5.	Shed line	695	1	0.80
6.	R-13	600	1	0.7
7.	R-14	585	1	0.69
	Total	**4750**	**8**	**5.56**
	Western Sector			
1.	Bulb line 1	487	1	0.59
2.	Esso Line	517	1	0.62
		1004	**2**	**1.21**
	Total			**6.77**

C) *Abstract of V.P.T Track Lengths After Dismantling Unused Lines*

S. No.	Description of YARD	Track lengths (km)	Points & Crossings	Equated Track length (km)
1.	R & D Yard	30.613	82 no.	38.813
2.	Oil loop	5.100	11 no.	6.21
3.	NH Yard & East Yard	20.331	42 no.	24.531
4.	Western Sector	23.52	38 no.	27.32
	Total VPT Track	**79.564**	**183 no.**	**97.864**
	Total Pvt Sidings	**58.36**	**197 no.**	**78.059**
	Total Track Lengths	**138**	**380 no.**	**176**

8.8.1.4 Proposal for Extension of Line No. 11 to 15 to Full Length at R&D Yard

To reduce the congestion of movements from NALCO, WQ1 to 4 terminals of Western Yard, VPT has initiated action to Extension of Line no.11 to 15 to full length at R&D Yard. On behalf of VPT, IPRCL has been issued letter of award on 27th Aug 2015 to M/s. RITES Ltd. For providing consultancy services for making DPR for extension of line no. 11 to 15 to full length at R&D yard of VPT and the same is in progress.

The Cost of the Project is Rs. 30.0 Crore. The target date of Completion is December 2017.

The proposed location is shown in **Figure 8.19**.

8.8.1.5 Proposed 3rd Line from Line from R&D Yard to East Yard at AKP Level Crossing

Congestion in Eastern yard & Outer Harbour is due to movements from EQ1, VCTPL, VGCB and to reduce this constraint VPT has initiated action to develop the 3rd line from line from R&D yard to East yard. In Principle Approval given for DPR by Railways Codal Chargeds paid to E.Co Railways. On behalf of VPT M/s IPRCL has been awarded letter of award on 21st August 2015 for Project Management Consultancy for "providing connection of dead end line at north of dead end line at north of R&D yard to Eastern grid (Third line) from E.Co. Railways for VPT and same are in progress. This works includes dead end line at north cabin and IE line of R&D yard.

The Cost of the Project is about Rs. 9.28 cr and the project duration is about 15-24 months. The Project Target date of Completion is December 2016.

The proposed location is shown in **Figure 8.19**.

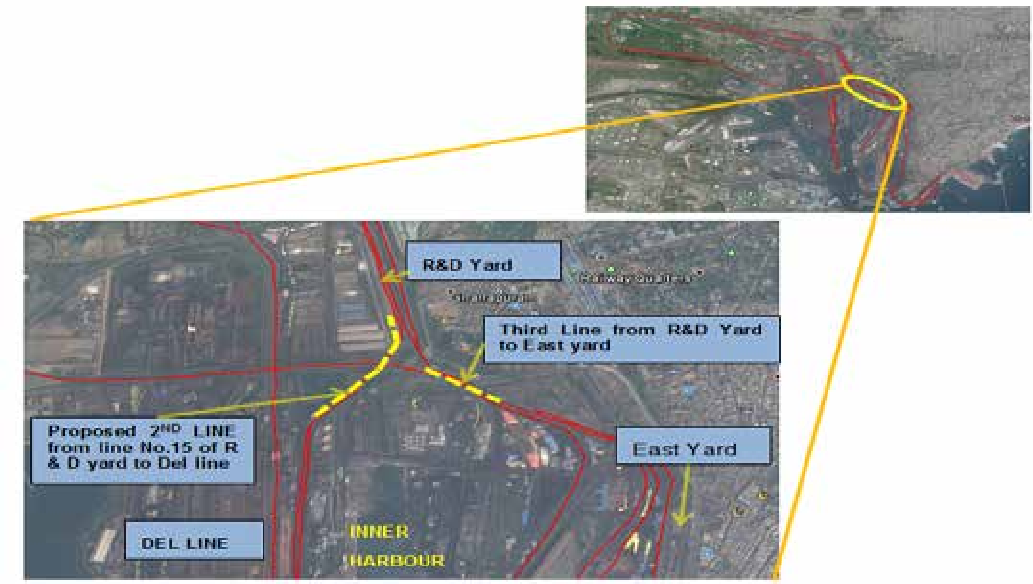


Figure 8.19 Proposed Internal Rail Connectivities

8.8.1.6 Proposed 3rd Line at 14 Lever Goomty of NH Yard

VPT has initiated action to develop the 3rd line at 14 Lever Goomty of NH yard to reduce the congestion in rail network from Eastern Yard, Outer Harbour and NH Yard. This work is to be entrusted to the East Coast Railways. Work Order issued to M/s. RITES Ltd vide Lr.No.PD-24015/56/2015-PD-IV(Pt-II), Dt.27-08-2015 by IPRCL for providing consultancy services for making DPR. Inception report was submitted by M/s RITES on 22.09.2015. The proposed location is shown in **Figure 8.20**.

Figure 8.20 Proposed Internal Rail Connectivities

In addition to the proposed 3rd line at 14 Lever Goomty of NH yard following works are also entrusted to Rites to prepare the DPR for Additional Line No. 1E on the Eastern Side of the R&D Yard. Work order issued for Rs.4,59,85,245/- to M/s JD Constructions, VSKP for Civil and M/s. NCTC, Kolkata for P. Way for Rs.4,62,98,310/- on 31.12.2015 and work is in progress

8.8.1.7 Panel Cabin at Revamped East Yard

Cost estimate for construction of Panel Cabin at Revamped East Yard has already submitted to VPT by M/s. RITES and the same has been forwarded to E.Co. Rlys for examination and remarks.

The Cost of the Project is about Rs. 11.0 Cr .The target date of Completion of the project is December 2016

8.8.1.8 Proposed Electrification Works

VPT has initiated action to develop the electrification works to improve the rail network inside the Port.

A) Electrification of East Yard Revamped Lines. 23.489TKM

Electrification from AKP-East Yard for 4.698TKM and from East Yard for 18.783 amounting to 23.481 TKM is to be taken up as deposit work on urgent basis. Detailed estimates have been furnished to VPT for 11.245 TKM for an amount for Rs.6.84 Cr. For balance length consent has been obtained from PPP operators for Infrastructure cess. Block estimate submitted to E.Co. Railways for

Rs.19,58,84,353/- and informed to deposit 2% charges Rs.39,17,687/-. Work Order issued to M/s. RITES Ltd., vide Lr.No.PD-24015/56/2015-PD-IV(Pt-II), Dt.27.08.2015 by IPRCL providing consultancy services for making DPR.

The total cost of the Project is Rs. 19.58 cr and target date of Completion is December 2016.The amount of Rs 6.80 Cr deposited to Eco. Railway.

The proposed Phase 1 electrification works is shown in **Figure 8.21** hereunder:

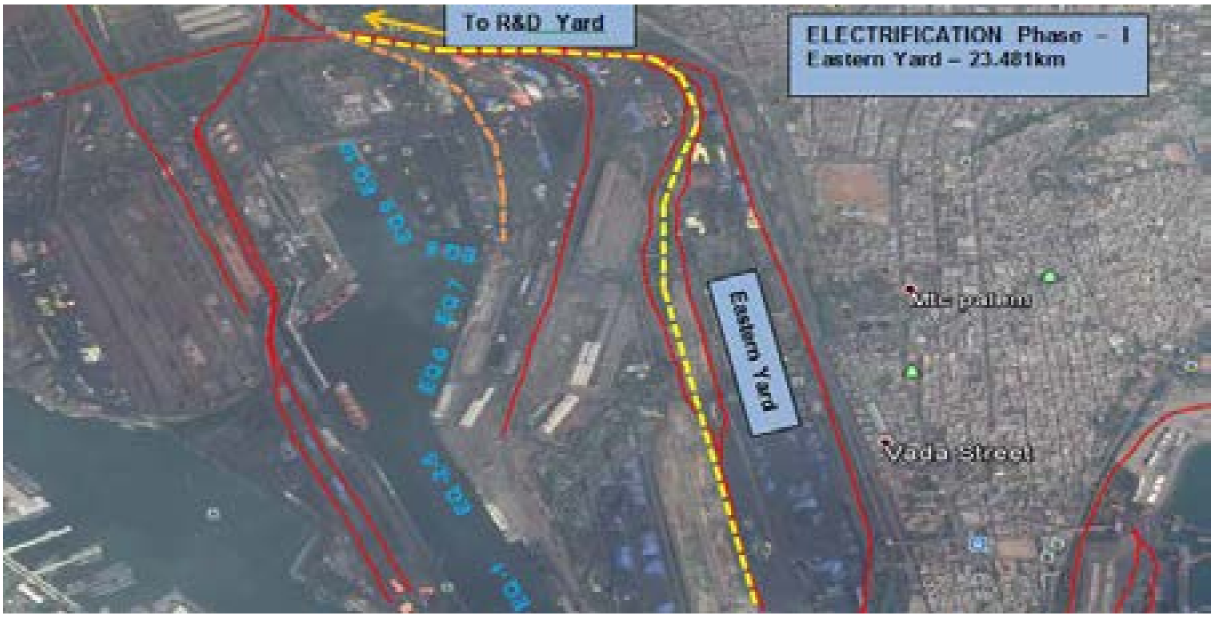


Figure 8.21 Proposed Phase 1 Electrification Works

B) Electrification of VPT Railway Lines 45.143 TKM

Work order issued to M/s. RITES Ltd, Vide Lr.No.PD-24015/56/2015- PD-IV(Pt-II), dt.27-08-2015 for preparation of DPR by Rites and draft DPR was submitted by M/s Rites on 28.10.2015

Providing consultancy services for the above project is given to IPRCL.

The cost of the project is Rs. 30 cr and the date of Completion is December 2017

The remaining Phases of Electrification works is shown in the **Table 8.3**.

Table 8.3 Proposed Electrification Works – Phase-Wise

PHASE NO.	YARD	LENGTH	TOTAL
PHASE-I	I. a) N.H. YARD (AKP TO EAST YARD) b) AKP to connecting point of PPP c) G.C.B. MECH d) EQ-IA SIDING Ph-I e) EQ-1A SIDING Ph-II d) EQ-1 SIDING	2870m 4698m 6547m 6540m 1696m 4000m	7.568TKM 18.783TKM
PHASE-II	a) R&D YARD b) N.H. YARD	4378m 6615m	10.993TKM
PHASE-III	a) D.E. LINES b) OHC LINES	2979m 10753m	13.732TKM
PHASE-IV	WESTERN SECTOR	11390m	11.390TKM
	TOTAL LENGTH:	62466m	62.466TKM

8.8.1.9 S&T Works at R&D Yard, "B" Cabin, 14 Lever Goompty, Dumper Cabin and Service Building

VPT has given IPRCL the order for providing consultancy services for the above work. The Project Cost is about 35.74 Cr. Completion of the Project is by December 2017. DPR submitted by M/s Rites on 30.11.2015.

8.8.1.10 Proposed Signalling Works

VPT has initiated action to develop the signalling works to improve the rail network inside the Port. The works at RRI cabin R&D yard and the Panel Cabin at 14 Lever are under progress by East Coast Railways. The estimate is submitted by RITES for the RRI cabin at East yard and consent obtained from PPP operators for infrastructure cess. The various signalling works in progress are shown in the **Figure 8.22** hereunder:

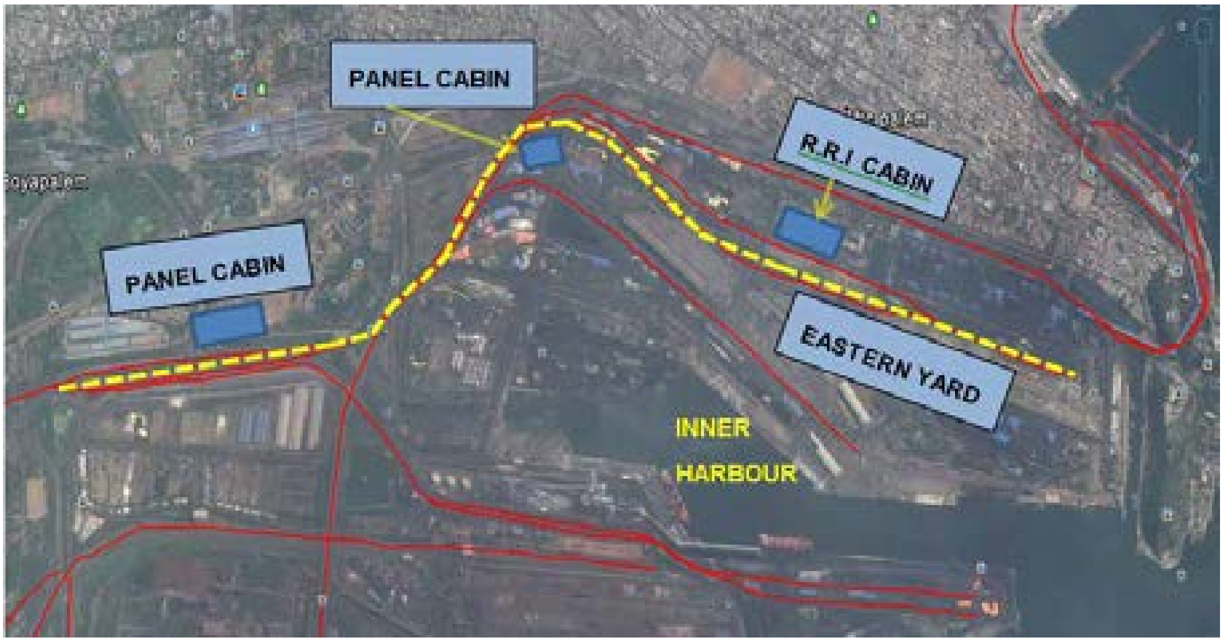


Figure 8.22 Proposed Signalling Works

8.8.1.11 Siding-Wise Rake Loading

The details on number of rakes handled at each of the siding available at VPT are given in **Table 8.4**.

Table 8.4 Table Showing Siding-Wise Rake Loading

Sdg Wise No. of Rakes Loaded & Avg Per Day					
Sl No	Siding	2014-15		2015-16 (upto 22.03.2016)	
		Rakes	Avg. per day	Rakes	Avg. per day
1	Bulb Line	5	0.0	14	0.0
2	Coal Berth	108	0.3	134	0.4
3	Complex I/II	19	0.1	66	0.2
4	East Yard	13	0.0	61	0.2
5	Essar I / II	267	0.7	227	0.6
6	GCB	80	0.2	18	0.1
7	JPL I	59	0.2	35	0.1
8	JPL II	59	0.2	51	0.1
9	JPL III	178	0.5	125	0.4
10	MY	176	0.5	115	0.3
11	NCWC	161	0.4	156	0.4
12	NHY Lines	74	0.2	79	0.2
13	NSD (NHY L 17)	7	0.0	7	0.0
14	OHP 1A,1B	34	0.1	89	0.2
15	R 12-15	178	0.5	146	0.4
16	R 4-10	147	0.4	127	0.4
17	R&D-L 15	6	0.0	23	0.1
18	R&D-L 17	36	0.1	94	0.3
19	R&D-L 17A	9	0.0	13	0.0
20	Route-X	0	0.0	36	0.1
21	FCI	1	0.0	0	0.0
Private Sidings :					
21	CFL	445	1.2	401	1.1
22	HPCL	435	1.2	567	1.6
23	VSPL 9	280	0.8	323	0.9
24	IOCL	269	0.7	292	0.8
25	GFCL	109	0.3	136	0.4
26	NALCO	103	0.3	99	0.3
27	VCTPL	70	0.2	71	0.2
Private Sidings (Mechanical Loading):					
28	VGCB	1630	4.5	1596	4.5
29	VSPL 8	423	1.2	443	1.2
30	AVCTPL	222	0.6	195	0.5
Grand Total		**5603**	**15.4**	**5739**	**16.1**

Considering that each siding served by mechanised means can handled 4 to 5 rakes per day and that using manual labour can also handle about 2 to 3 rakes per day, the utilisation of current rail sidings is very low as most sidings handled less than one rake per day. It is therefore important that a detailed study be carried out to arrive at the sidings that are redundant and should be removed to make way for additional storage and circulation space.

Apart from the above, new rail lines/upgradation to existing lines shall be provided with the following objectives:

- To make sidings full rake length (siding length of about 750 m) so as to reduce time.
- There shall not be any crossover along the track
- Wagon system to be mechanised

8.8.2 External Rail Network

8.8.2.1 Overview

Visakhapatnam Port is connected to trunk line directly through the Walt air Railway Marshalling Yard to the Chennai-Howrah main line of East Coast consisting 1643km of double line rail link. The distance from Visakhapatnam to Chennai is around 761km and from Visakhapatnam to Howrah is around 882km. The rail-borne traffic at Visakhapatnam Port is 32.8 MTPA out of 56.1 MTPA, which was about 58.5% of the total traffic handled at the Port during the year 2013-2014. VPT is well connected to the hinterland through rail network. Apart from coal which is completely moved by rail, fertilisers, limestone and food grains are the other dry bulk commodities being moved by rail. Rail transport is primarily used for low value commodities for which transport costs are an important component of the delivered price. However, apart from coal, most other commodities are beginning to shift to roads owing to the shortage of rail capacity in many sectors. Iron ore exports have experienced a large shift to roads, on account of the rapid increase in exports and the capacity crunch being faced by the railways. Container traffic is also moving away from rail transport. The average interchange between the Port and Railways at Ore Exchange Complex (OEC) is ~12 per day. The average interchange between the Port and Railways at Reception and Dispatch yard (R&D Yard) is ~20 per day. The external rail connectivity of Visakhapatnam Port to rail trunk routes is shown in the **Figure 8.23** hereunder.

Figure 8.23 External Rail Connectivity of Visakhapatnam Port

The main constraints in rail network are:

- Inadequate investment in capacity & proper rail sidings
- Handover time from East Coast Railway to Port Railway authorities
- Poor quality of service and slow response to various segments of growing freight demand
- Lack of availability of wagons
- Container freight response especially from CONCOR who enjoys monopoly in rail container transport
- Rail bottlenecks in hinterland.

The trains handled at the sidings of western sector are traveling an additional distance of 10 km per train with the existing arrangements and the queuing up at the Diamond crossing leads to increase in turn round time and detention of rolling stock by about 3 to 4 hours per rake. It is eminent to develop

- Direct connection from Mindi at western sector to East Coast Railways/ South Central railways
- A direct connection between OEC and Western Sector jointing at NAD Curve from East Coast Railways
- To reduce constraint of twin single lines at R&D yard, third line is proposed by extending the dead end line of East Coast Railways iv) Bulb line from DYD to Western sector and OEC.

The above connectivity's reduce congestion at R&D yard due to many PPP projects in Eastern Sector through which about 40 additional trains are to be handled.

8.8.2.2 Proposed direct connection from Mindi at Western Sector to East Coast Railways/South Central Railways

VPT has initiated action to develop a connection from Mindi at Western sector to the East Coast Railways/South Central railways. The trains handled at the sidings of western sector are traveling an additional distance of 10 km per train with the existing arrangements and the queuing up at the Diamond crossing leads to increase in turn round time and detention of rolling stock by about 3 to 4 hours per rake. The direct connection works from Mindi to East Coast railways and South Central railways will be done in 2 phases. Currently the revised DPR needs to be submitted by M/s. RITES, after approval of methodology by the VPT. The location of the proposed rail connectivity is shown in **Figure 8.24** hereunder.

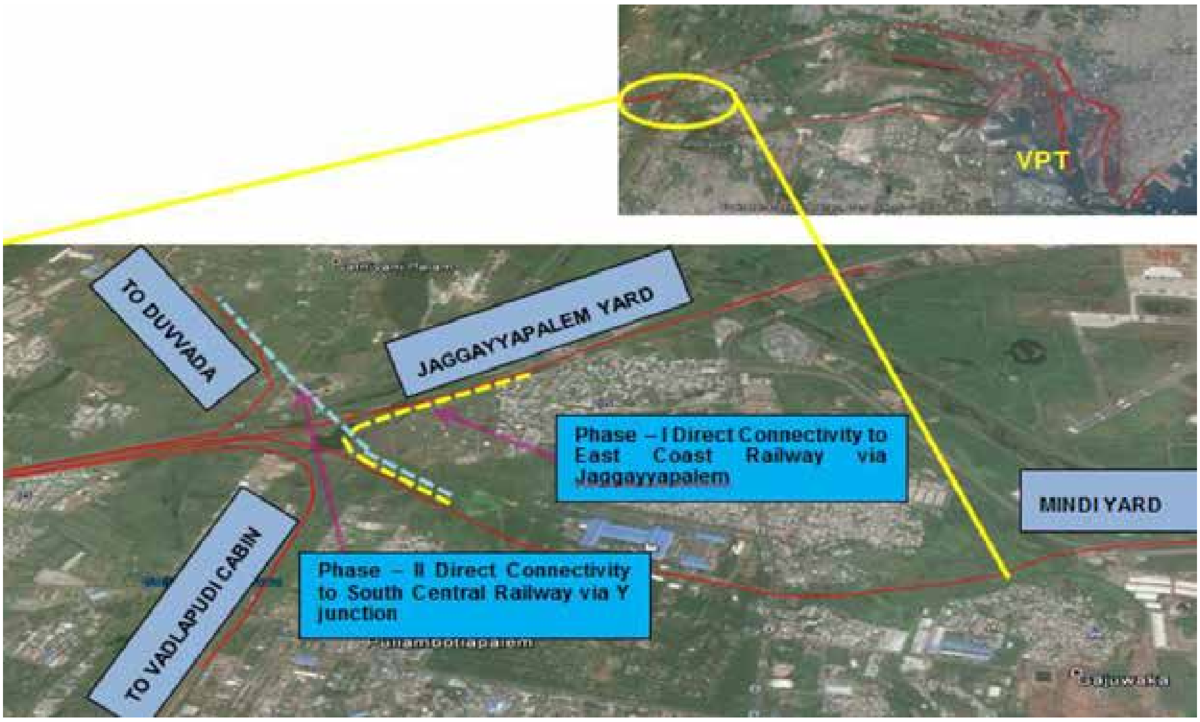


Figure 8.24 Proposed Railway Connection from Mindi to East Coast Railways and South Central Railways

8.8.2.3 Proposed Direct Connection Between OEC and Western Sector Jointing at NAD Curve

VPT has initiated action to develop a connection between OEC and Western Sector jointing at NAD curve. The trains handled at the sidings of western sector are traveling an additional distance of 10 km per train with the existing arrangements and the queuing up at the Diamond crossing leads to increase in turn round time and detention of rolling stock by about 3 to 4 hours per rake. The Revised DPR submitted by Rites to E. Co. Railways. Work has been taken up through IPRCL and it is in progress.

The Cost of the Project is about 16.75 Cr and the duration is about 15-24 months. The target date of completion is December 2016.

Figure 8.25 Proposed Works in Western Sector

8.8.2.4 Bulb Line from DYD to Western Sector and OEC by East Coast Railways

East Coast railway has initiated action to develop bulb line from DYD sector and OEC for engine reversal and this line can also be used for handling western sector without coming to R&D yard .The work has been completed.

8.8.2.5 Proposed Third Line from R&D Yard to DYD Connecting Dead End Line at North of R&D Yard to Eastern Grid

VPT has initiated action to develop third line from R & D yard to DYD connecting dead end line at North of R & D yard to Eastern grid to reduce the constraint of twin single lines at R&D. The rrevised DPR for the project has been submitted by M/s. RITES to East Coast Railway. In principle approval has been given for DPR by Railways. Codal Charges paid to E.Co. Railways. Work Order for PMC issued to M/s. IPRCL Ltd., vide Lr.No.PD-24015/56/2015-PD-IV(Pt-II), Dt.17/21-08-2015 and the work is in progress.

The Cost of the Project is about Rs. 9.28 cr. and the duration is about 15-24 months (will be decided mutually based on volume/ size of works). The target date of completion is by December 2016.

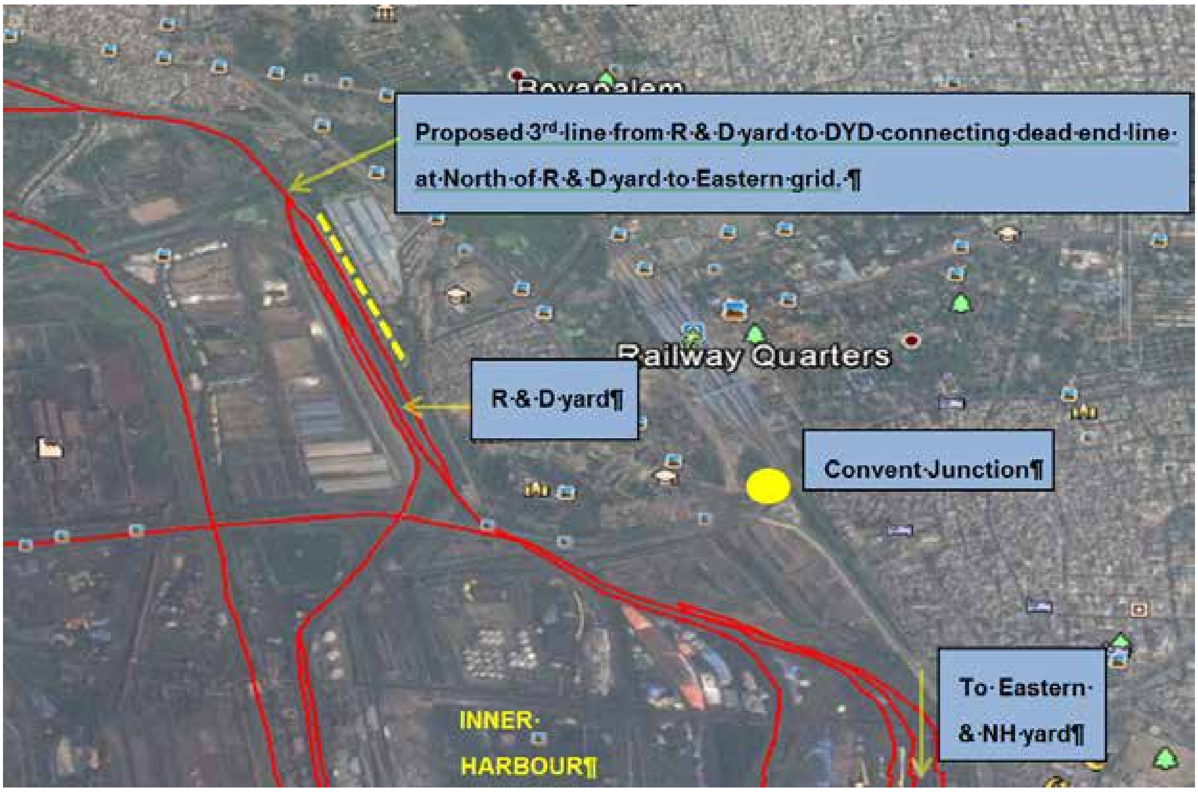


Figure 8.26 Proposed Works in Western Sector

8.8.2.6 Direct Connectivity to Mindi Yard from E.Co. Rlys/SC Rlys

VPT initiated to provide direct rail connectivity to Mindi Yard. This shall reduce travel distance by 10 km and time 3 hr. The total Cost of the Project is about 270.73 Cr. These are divided in 3 Phases. Cost for Phase 1 is about Rs. 19.73 Cr, Phase 2 Rs. 112 cr. and Phase 3 about Rs. 139 cr.

Time period for the entire project shall be 15-24 months (will be decided mutually based on volume/size of works) and date of Completion will be by December 2017.

Revised DPR based on E.Co.Rlys remarks has to be submitted by M/s. RITES. . Work order has been issued to M/s. RITES Ltd., vide Lr.No.PD-24015/56/2015-PD-IV(Pt-II), dt.17/21-08-2015 by IPRCL for PMC.

9.0 SCOPE FOR FUTURE CAPACITY EXPANSION

9.1 Upgradation of WQ 2 to 5 Berths

At present there is not adequate traffic to justify the investment in upgradation of berths WQ 2 to 5 so that fully loaded Panamax ships could be handled. However the future projections for breakbulk cargo beyond year 2025 justify the upgradation of these berths to increase their capacity.

9.2 Proposed Outer Harbour

VPT has plans to develop an outer to outer harbour towards the south side of the south breakwater. The proposed facility is basically to meet the demand of Navy who would like to have deeper berths for its vessels. The layout plan of the current proposal to develop the outer harbour is shown in **Figure 9.1**.

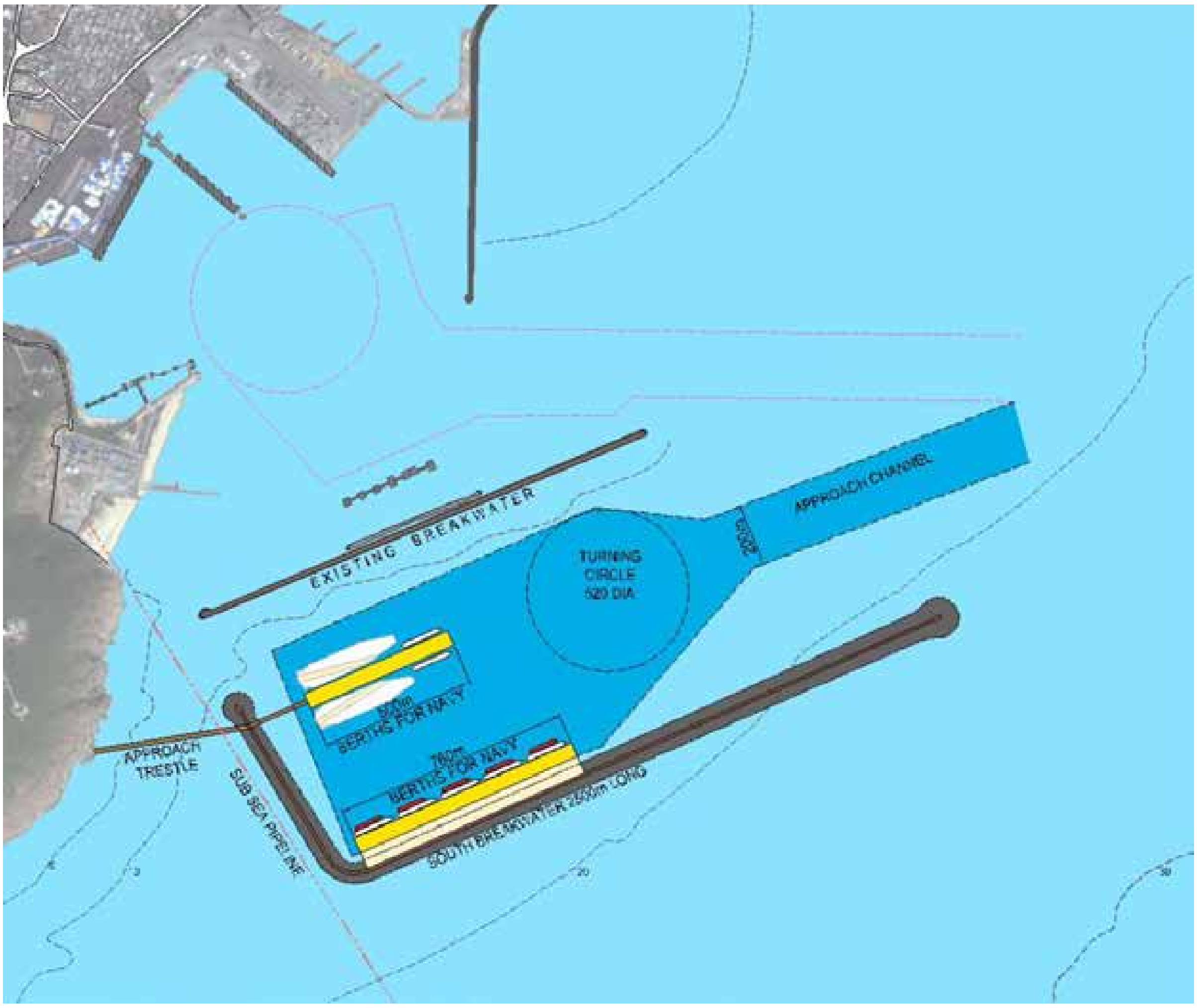


Figure 9.1 Proposed Outer Harbour - Layout Plan Alternative 1

The current proposal of proposed outer harbour comprises of the following:

§ One 2500 m long offshore breakwater south of the south breakwater

§ One 500 m long finger jetty with two sides berthing for navy vessel. This jetty would be connected to shore by mean of an approach trestle.

§ One 760 m long quay on the lee of the proposed breakwater for berthing of small crafts of navy.

It could be seen from **Figure 9.2** that the breakwater has been planned such that it stays clear of the submarine pipeline from SPM.

However it is noticed that the proposed layout is exposed to waves from NE direction and would result in significant downtime during the NE monsoon period. Further this layout does not offer any benefit to VPT. Considering these aspects another alternative layout has been developed as shown in **Figure 9.2**.

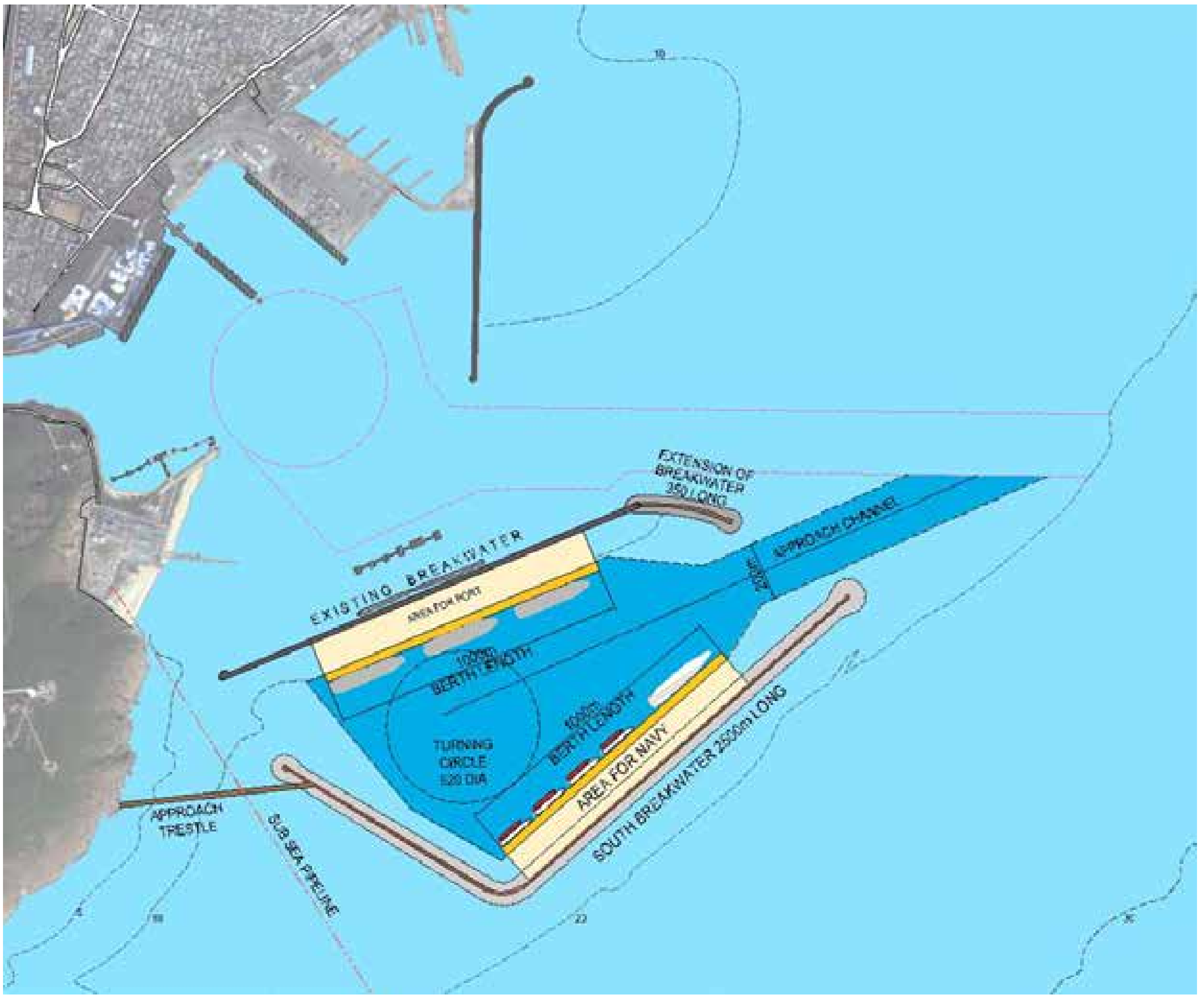


Figure 9.2 Proposed Outer Harbour - Layout Plan Alternative 2

In this layout additional berths for port shall be on the south of the existing south breakwater and that for navy shall be on the lee of the proposed new breakwater. However, considering the fact that there is no backup space for storage of cargo adjacent to the proposed harbour, the berths proposed for the port could be used only for handling the liquid cargo.

The breakwater orientation has been planned such that it would provide a tranquil harbour basin for round the year operations. This layout could be refined further during implementation stage to provide additional berths and backup area for Navy.

9.3 Concept of Satellite Port

It is evident that the available waterfront within the port limits is fully exhausted and there is no further scope for expansion. However as per traffic projections there is significant potential for import of coal in the region. As regards the outer harbour scheme, it could be seen that there will not be any back up area for cargo operations as also the evacuation of cargo will be almost impossible.

Under such circumstances, the port should identify nearby minor ports under the State Port Directorate for adoption and development as a satellite port. Visakhapatnam port can consider a suitable port location along the Andhra coast for this purpose.

10.0 SHELF OF NEW PROJECTS AND PHASING

As part of the Vizag port master plan several projects have been identified which need to be taken up in phased manner with the built up in traffic. The proposed phasing, capacity addition and the likely investments are discussed in paragraphs below.

It may be noted that apart from these projects there could be several other projects which port would be implementing as part of the routine operations and maintenance of the port facilities. Further the phasing proposed is not cast in stone but could be reviewed periodically and revised based on the economic scenario and demand for port at that particular point of time.

10.1 Ongoing Projects

The details of the projects which have already been awarded and development is ongoing are given in **Table 10.1**.

Table 10.1 Ongoing Projects

S. No.	Project Name	Capacity Addition (MTPA)	Investment Required (Crores)	Mode of Implementation
1.	Development of New Berth EQ-1 A Berth	7.64	320	PPP
2.	Conversion of existing berths EQ 2, EQ 3, EQ 4 and part of EQ 5 into two numbers of berths	1.38	600	Port's funds
3.	Mechanization of existing berth EQ 7 to handle finished fertilizers	5.0	217	PPP
4.	New Container Terminal Adjacent to the Existing Container Terminal	8.0	550	PPP
5.	Iron Ore Handling - Phase 1 Upgradation of OB 1 & 2	15.0	800	PPP
6.	Iron Ore Handling - Phase 2 - Mechanisation of WQ 1	8.0	400	PPP
7.	WQ N (WQ-7 and WQ-8)	5.0	250	PPP
8.	Providing a direct connection between OEC and Western Sector jointing at NAD Curve from E.Co. Rlys.	-	16.75	Port's funds
9.	Connection of dead end line at North of R&D yard to Eastern Grid (Third line) from E.Co. Rlys.	-	9.28	Port's funds
10.	a)Additional line No. 1E on the eastern side of the R&D Yard; b)Providing 3rd line near AKP level crossing of R&D Yard; c) Providing 3rd line near 14 Lever Goompty of NH Yard.	-	29.43	Port's funds

S. No.	Project Name	Capacity Addition (MTPA)	Investment Required (Crores)	Mode of Implementation
11.	Electrification of east yard revamped lines. 23.489 TKM	-	19.58	Port's funds
12.	Direct connectivity to Mindi Yard from E.Co. Rlys/SC Rlys (This will reduce the travel distance of 10 km, & saving of 3 hrs time)- In 3 Phases – Ph 1 (Rs. 19.73 cr.), Phase 2 (Rs. 112 cr.), Phase 3 (Rs. 139 cr.)	-	270.73	Port's funds
13.	Extension of lines No.11 to 15 to full length at R&D yard	-	30	Port's funds
14.	Electrification of VPT railway lines 45.143 TKM	-	30	Port's funds
15.	Providing consultancy services for making DPR for S&T works at R&D Yard, "B" Cabin, 14 Lever Goompty, dumper cabin and service building for VPT	-	35.74	Port's funds
16.	Proposed Road Connectivity from Sheela Nagar Junction to Anakapalle-Sabbavaram/ Pendurthi-Anandapuram Road Under Phase 3	-	505.02	Port's funds
17.	Proposed Road Connectivity from RCL to Mindi Yard to NH-16	-	76.95	Port's funds
18.	Development of fly over bridge connecting existing road from EQ up to the road connecting junction (Convent Junction)	-	90.0	Port's funds

The port layout after completion of ongoing projects shall be as shown in **Figure 10.1** and **Figure 10.2**.

Figure 10.1 Layout of Inner Harbour Alongwith Ongoing Developments

Figure 10.2 Layout of Outer Harbour alongwith Ongoing Developments

10.2 Projects to be completed by Year 2020

The details of the projects which are envisaged to be completed by year 2020 are given in **Table 10.2**.

Table 10.2 Projects to be Completed by Year 2020

S. No.	Project Name	Capacity Addition (MTPA)	Investment Required (Crores)	Mode of Implementation
1.	Additional Oil Jetty (OR 3) along with OR 1 and OR 2	1.0	100	Port's funds
2.	Additional Stackyard for VGCB	5.0	150	PPP
3.	Road Connectivity From Outer Harbour To Port Connectivity Junction (B)	-	500	Port's funds

The port layout after completion of projects mentioned above shall be as shown in **Figure 10.3**.

Figure 10.3 Layout Plan of Inner Harbour 2020

10.3 Projects to be completed by Year 2030

The details of the projects which are envisaged to be completed by year 2030 are given in **Table 10.3**.

Table 10.3 Projects to be Completed by Year 2030

S. No.	Project Name	Capacity Addition (MTPA)	Investment Required (Crores)	Mode of Implementation
1.	Upgrading Berth WQ 2-5 to handle fully loaded Panamax ships	2.0	600	PPP

The port layout after completion of mentioned above shall be as shown in **Figure 10.4**.

Figure 10.4 Layout Plan of Inner Harbour 2030

Appendix 1 - **BCG Benchmarking Study for Vishakhapatnam Port**