# NITI AAYOG

## TECHNO-COMMERCIAL PROPOSAL

# FEASIBILITY STUDIES
# FOR
# RECLAMATION OF LAND
# IN
# LITTLE ANDAMAN AND GREAT NICOBAR ISLANDS

**Submitted by:**


**WAPCOS LIMITED, INDIA**

(International Consultant in Water Resources, Power and Infrastructure Development)

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# *C O N T E N T*

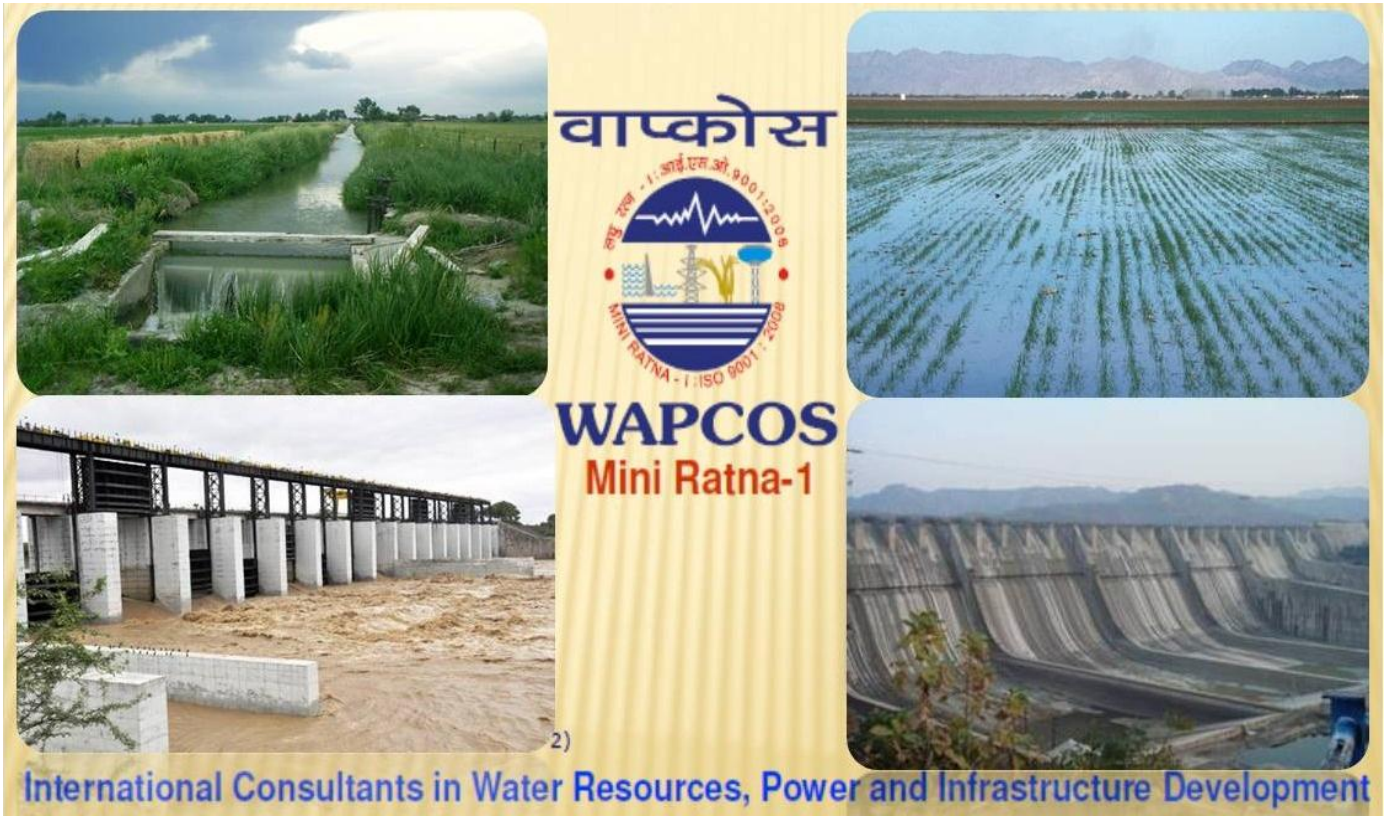
# FEASIBILITY STUDIES FOR RECLAMATION OF LAND IN LITTLE ANDAMAN AND GREAT NICOBAR ISLANDS

## CONTENT

# *Company Profile*

# WAPCOS

**(A GOVERNMENT OF INIDA UNDERTAKING)**
**MINISTRY OF WATER RESOURCES, RIVER DEVELOPMENT & GANGA REJUVENATION**
**MINI RATNA-I**




# COMPANY PROFILE

## WAPCOS BACKGROUND AND ORGANIZATION

### WAPCOS – AN INTRODUCTION

WAPCOS Limited is a "MINI RATNA-I" Public Sector Enterprise under the aegis of the Union Ministry of Water Resources. Incorporated on June 26th, 1969 under the Companies Act, 1956; WAPCOS has been providing consultancy services in all facets of Water Resources, Power and Infrastructure Sectors in India and Abroad. The quality management systems of WAPCOS comply with the Quality Assurance requirements of ISO 9001:2008 for consultancy services in Water Resources, Power and Infrastructure Development Projects.

### VISION

To be a premier consultancy organization recognized as a brand in water, power and infrastructure development for total project solutions in India and abroad.

## MISSION

Sustained Profitable Growth, Excellence in Performance use of State-of-the-art Technical Expertise, Innovativeness, Capacity Building and Meeting Society's Needs

## OBJECTIVES

- To perform the role of a premier agency for offering integrated package of services of the highest scientific, technological and managerial quality with a view to ensure optimal planning and development of water resources and maximizing the efficiency of its utilization.
- To adopt modern technology and systems to build in quality, reliability and accuracy thereby ensuring a high degree of customer satisfaction.
- To continue the pace of growth of domestic and overseas business and to transfer know-how to other developing nations
- To specialize and sustain international standards in surveys, investigations, designs, cost estimates, project planning including environmental studies and project management services for cost-effective and integrated development of Water resources, Power and Infrastructure Development.
- To promote research and development actively through interaction with other national and international agencies.
- To maintain pre-eminence in the field of consultancy through diversification into areas of new challenges and needs in associated fields.
- To secure a fair monetary return to the enterprise as a result of its operations through improved productivity and optimization.
- To play a dynamic role in realizing the potentials by state-of-the-art consultancy in innovative design alternatives.
- To specialize and attain the highest level of International Standards in providing Consultancy Services.
- To attract the best available talent and promote a committed and motivated workforce.
- Increase in business growth and effective business management.
- To gain total client satisfaction
- To promote WAPCOS as a Brand

## RANGE OF SERVICES

Functionally, WAPCOS is broadly categorized into the following groups:

- **Infrastructure Group**
- **Water Resources Group**
- **Power Group**

Each of the groups is headed by a specialist senior level engineer with proven expertise, capability and experience in aspects relevant to that group. The groups have emerged as centres of excellence in their respective fields. Each of these centres has specified disciplines to cater for both the national and international projects. These are briefly as below:

**Infrastructure Disciplines**

- Buildings, Roads and Bridges
- Construction Management
- Drinking Water Supply and Public Health
- Ports and Harbors
- Environmental Studies
- Social Sciences
- Management Information System
- Customized Software Development
- Technology Up gradation

**Water Resources Disciplines**

- Water Resources Development
- Groundwater Development including Recharge
- Irrigation Water Management
- Rain Water Harvesting
- Watershed Management
- Hydrology
- Flood Control and River Training
- Dams and Reservoirs
- Survey & Investigation
- Macro & Micro Canalisation

**Power Disciplines**

- Dam and Reservoir Engineering
- Hydro and Thermal power including transmission
- Civil Designs

Each of these disciplines is headed by officers of the level of Chief Engineers / Additional Chief Engineers who by their specialized qualification and experience are experts in the realm of their individual disciplines. Each of the above wings is staffed with engineers / experts of various levels and relevant fields. The specialized functional core groups as indicated above are supported by over 700 engineers / experts / scientists.

## FIELDS OF SPECIALISATION

### Infrastructure Development

i) Topographical survey
ii) Preliminary and Detailed Survey which include population counts
iii) Design of following component related to the housing separately for 5 bedded and 10-bedded

accommodation (Section, Elevation and floor Plan Design)

- Design of 5-bedded and 10-bedded unit (ground floor plan and all section plan design)
- Layout Plan of roads (12 m & 15 m wide) and Boundary Walls
- Layout Plan of Water supply facilities
- Layout Plan of Sewerage, Storm Water Drainage facilities & Rain Water Harvesting
- Design of Fire Fighting Diagram
- Design of Health Centre Facility
- Design of Training Centre
- Design of Cretch Facility
- Design of community Centre and
- Design of Pumping Station

iv) Design of all the electrical components

v) Construction Supervision, Procurement, Preparation of Tender Document and Management Services

vi) Preparation of bill of quantities and detailed cost estimates for all the components as per the Schedule of Rate (DSR)

vii) Preparation of Draft and Final Detailed Project Report.

## Irrigation Drainage and Water Management

- Hydrological Studies
- Irrigation and Drainage Engineering
- Dams and Reservoir Engineering/Storage works
- Barrages/Headwork's/Diversion Works
- Flood Control and River Training Works
- Major Canalization
- Minor Canalization to serve various systems of irrigation supplies
- Modernization of Existing Projects
- Ground Water Exploration and Development
- Project Management
- Water Management at Institutional and Farm level
- Remote Regulation Control and Tele-transmission system
- Water Resources Planning
- Performance Evaluation & Impact Assessment
- Socio-economic Studies
- EIA & EMP studies

## Water Supply, Sewerage and Storm water Drainage Sanitation

- Feasibility studies
- Preparation of Master Plans/Regional Plans
- Detailed Project Reports
- Detailed engineering, construction supervision, operation and maintenance planning
- Tender documents & specifications

- Monitoring and Evaluation Studies
- Quality Control and Quality Assurance
- Capacity Building Development Studies

## Ports, Harbours & Inland Waterways

Areas of Consultancy:

- Planning Studies
- Traffic analysis and projection
- Hinterland economics and demand
- Project identification and appraisal
- Economic and financial analysis
- Investment analysis of BOOT; BOST; BOLT ports

Investigations

- Topographic surveys
- Hydrographic surveys
- Seismic surveys
- Geo-technical investigations
- Measurements of oceanographic/meteorological parameters, i.e. wind, wave, current, tide, silt charge, salinity etc.
- Forecasting of oceanographic/ meteorological data

Project Reports

- Project planning
- Preparation of techno-economic feasibility
- Cost estimation
- Specifications of works
- Tender engineering
- Detailed project reports

## Roads and Highway Engineering

- Roads and pavements
- Bridges, structures and embankments
- Drainage
- Topographical survey
- Longitudinal and cross section survey
- Construction Supervision
- Quality Control Assessment
- Traffic Management

## Surveys and Mapping

- Topographical Surveys
- Reservoir and Command Area Surveys
- Hydrological, Hydro geological, Hydro Meteorological, Geological and Resources

Survey/ Investigations

- Strip and alignment Surveys
- Hydrographical Surveys
- Geo-technical Investigations and Analysis
- Digitization of Maps

## Rainfed and Irrigated Agriculture

- Irrigated Agriculture
- Agriculture Soil Surveys and Analysis
- Development of Lakes/Water Harvesting/Watershed Management
- Farm Management, Extension Programmes
- Agricultural Mechanization
- Support Services
- Experimental Farms and Pilot Projects
- Land Preparation, Leveling
- Arid Zone Farming
- Land Reclamation
- Command Area Development including On-farm and Off-farm works
- Soil Conservation and Forestry
- Resettlement Plans for Transmigration
- Fisheries processing, Aquaculture engineering, Fishing Harbours and Infrastructural development, Small Scale and Artisanal Fisheries etc.
- Rural and Urban Institution Planning and Development
- Livestock Studies
- Socio-economic and Techno-economic Surveys

## Power Engineering

- Hydropower Planning, Design and Construction Supervision
- Mini-Hydro Power Planning, Design and Construction supervision
- Thermal Power Planning, Design and Construction Supervision
- Transmission
- Rural Electrification
- Operation and Maintenance
- Management Services

## Environmental Engineering

- Impact Assessment
- Water Quality
- Integrated Modeling
- Site Liability Assessment study
- Environment modeling and management
- Waste management
- Aquatic Ecological Studies

- Risk assessment and Consequence Analysis
- Bio Diversity and Wildlife Conservation
- Socio-Economic Studies
- Preparation of guidelines for Sustainable Development
- GIS Data Base and Training
- Catchment Area Treatment

## System Studies and Information Technology

- Monitoring & Evaluation of Impact of various Development Projects
- Hydrological Modeling
- Rainfall Run-off Modeling
- Sedimentation Studies
- Flood Forecasting
- Dam Break Modeling
- Water Balance Studies

## Rural and Urban Development

- Rural water supply
- Rural sanitation
- Rural housing
- Rural electrification
- Rural buildings
- City Development Plan/Master Plan
- Biometric survey
- Housing for Urban poor
- Water supply and sanitation

## Lakes and Wetlands

- Assessment of Land use pattern
- Rejuvenation of Existing Wetlands
- Assessment of contribution of Wetlands into State/Regional Economy
- Developing Biological/Engineering measures for Catchment Area Treatment
- Formulation of Stakeholders Endorshed Water Management Plan

## Dams Safety and Surveillance

- Hydrological Review
- Structural Design Review
- Stability Review
- Spillway Design
- Seismic Design
- Dam Rehabilitation

- Dam Break Modeling
- Flood Routing
- Lake evaporation
- Hydraulic and detailed design of structures, cost estimates

### Natural Resorce Management

- Soil Survey and land capability evaluation
- Land use planning
- Integrated management plan for watershed development
- Roof top rain water harvesting
- Ground water recharge
- Soil moisture conservation
- Site surveys
- Design of structures
- Construction supervision
- Maintenance after construction
- Catchment area treatment plant

### Ground Water Exploration, Development of Wells &Minor Irrigation

- Identification of aquifers
- Yield assessment
- Quality assessment
- Drilling in hard rock, alluvial and river bed, Testing and logging
- Geophysical prospecting Remote Sensing
- Artifical recharge
- Well injection recharge
- Waterlogging
- Salinity control
- Assessment of water resources
- Crop water requirement and other requirements

## INSTITUTIONS BACKING WAPCOS

Besides its own compliment of experienced personnel, WAPCOS has the institutional backing with privilege to draw upon the appropriate in-service expertise from its various reputed constituent units like:

Central Water Commission (CWC)

Survey of India (SOI)

Geological Survey of India (GSI)

Central Ground Water Board (CGWB)

Indian Council of Agricultural Research (ICAR)

Indian Meteorological Department (IMD)

Central Electricity Authority (CEA)

Central Public Health and Environmental Engineering Organisation (CPHEEO)

Central Water and Power Research Station (CWPRS)

अनुसंधान के माध्यम से सेवा
Service Through Research

Central Soil and Material Research Station (CSMRS)

National Remote Sensing Agency (NRSA)

Central Road Research Institute (CRRI)

The engineers, Scientists and other experts of these constituents, have worked in a variety of climatic, topographic and socio-economic environments both in India and abroad in more than 50 countries of Asia and Africa where various types of studies and designs connected resources development projects have been successfully completed. Many of these projects have been funded by International Agencies like the United Nations, the World Bank, the Asian Development Bank, the Kuwait Fund for Arab Economic Development and from local funds of respective countries.

## WAPCOS LINKS – INTERNATIONAL LEVEL

WAPCOS on the international scenario, apart from India, has successfully completed/on-going consultancy assignments abroad in more than 50 countries and is currently engaged in providing consultancy services in Afghanistan, Bangladesh, Bhutan, Burundi, Cambodia, Chad, Central African Republic, Chad, DR Congo, Ethiopia, Ghana, Kenya, Lao PDR, Mozambique, Myanmar, Nepal, Nigeria, Rwanda, Senegal, Sierra Leone, Sri Lanka, Swaziland, Tanzania, Togo, Yemen and Zimbabwe.

African Development Bank

Arab Bank for Economic Development in Africa

Arab Fund for Economic and Social Development, Kuwait

Asian Development Bank

Food and Agriculture Organisation


International Bank for Reconstruction and Development

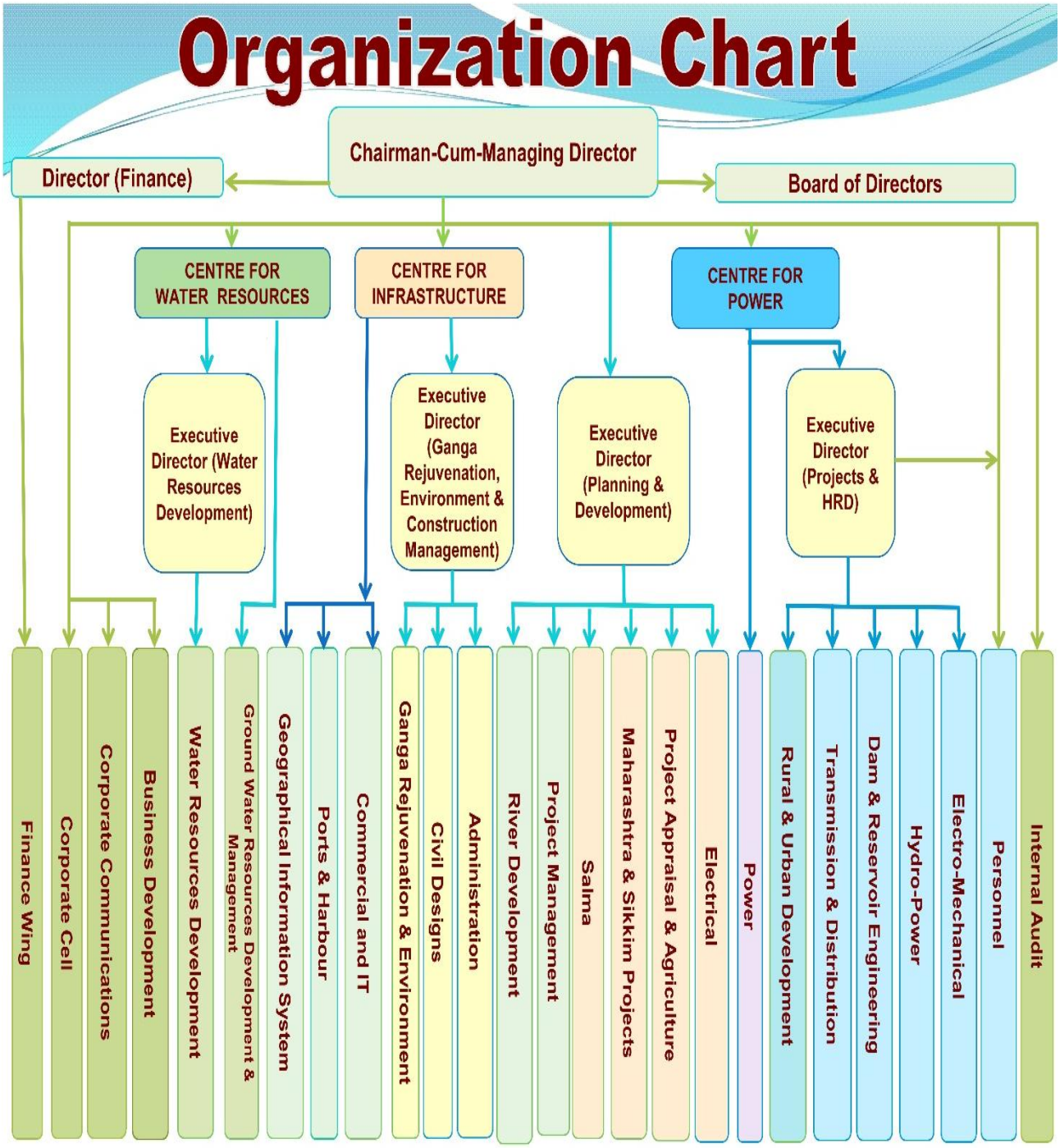

Japan Bank for International Cooperation


United Nations Office for Project Services


World Bank

## WAPCOS ORGANIZATION CHART

WAPCOS derives its strength from its human resources, which form the backbone of the organization. The consultancy services are carried out in 3 main Centers i.e. Water Resources, Power and Infrastructure. WAPCOS has an in-built capability to provide a multidisciplinary team of experts in comprising core professionals.



## AWARDS AND RECOGNITIONS

In recognition of the company's performance and contribution to the society the company has won several awards/appreciation for the quality of its consultancy services.

- WAPCOS conferred with "SCOPE Award for Excellence and Outstanding Contribution to the Public Sector Management – Institutional Category" **April 2017**

- WAPCOS Limited conferred with Water Awards 2016-2017 following Categories on **March 2017**:
  - Best Consultancy Company
  - Made in India – Best Water Company

- WAPCOS gets World Water Leadership Congress Awards – **April 2016** - World CSR Congress – Most Promising Brand (Endorsed by Asian Confederation of Businesses)

- National Export Excellence Award – **2015** – (Instituted by Engineering Export Promotion Council, Ministry of Commerce & Industry, Government of India)

- IPSE Awards – **2014** – India Public Sector Enterprises Awards for Excellence

- PSE Excellence Award – **2013** for company of the year, Human Resources Management and Corporate Governance.

- WAPCOS conferred "SCOPE Meritorious Award - **2011-2012**" for "Corporate Governance" from Hon'ble President of India, Shri Pranab Mukherjee during a Ceremony organised by Department of Public Enterprises, Government of India and Standing Conference of Public Enterprises (SCOPE), at Vigyan Bhawan, New Delhi.

- WAPCOS CONFERRED 43rd National Award for Export Excellence– "Star Performer-Projects Export" from Mr. Milan Hovorka, Hon'ble Minister, Ministry of Industry and Trade, the Czech Republic.

- Water Awards **2010-2011** : Best consultancy company in water sector for outstanding contribution in the field of water in India

- Conferred Mini Ratna-I Status by Hon'ble Minister of Parliamentary Affairs and Water Resources on **6th Dec 2010**

- Hon'ble Prime Minister of India conferred "SCOPE Award for Excellence and Outstanding Contribution to the Public Sector Management-Smaller Public Enterprises" instituted by Standing Conference of Public Enterprise

- EEPC Export Award for the year **2009-10** for outstanding contribution to engineering exports.

- Hon'ble Prime Minister of India conferred "MoU Excellence Award in the Consultancy Sector" instituted by Department of Public Enterprises, Govt. of India.

- "National Award for Excellence in Cost Management" for the year **2009-10** conferred by the Institute of Cost and Works Accountants of India, a premier professional body set up under the Act of Parliament.

- "Excellence Award" during the 27th Indian Achievers' Submit on "Global Business Opportunities" held at New Delhi.
- Millennium National Rajbhasha Shield Samman-**2011** and National Rajbhasha Magazine Shield **Award-2011** conferred by Rashtriya Hindi Akadami, Rupambara
- "Rashtriya Rajbhasha Patrika Shield Samman-**2010**" conferred by Rashtriya Hindi Academy

# WAPCOS Experience in Development of Maritime Infrastructural Projects

The ever increasing quantum of maritime trade arising from the rapid economic growth, following the liberalisation of the economy, has brought into focus the urgent need to upgrade existing major ports and develop new Greenfield sites. With the accent on privatisation there is a growing awareness for upgrading the existing ports, by way of additional berths and equipment, fishing jetties, loading unloading jetties and developmental new sites.

India has 6400 km of coastline with the associated territorial water and exclusive economic zones. The bulk of ocean trade is presently handled through its I 3 major ports.Intermediate, minor and fishing ports, which contribute less than 25% of the total maritime trade, would have to take up a much larger share of the future growth. Total manageable waterways including rivers, canals & backwater extend to 14,500 km. Out of this about 5200 km in Major rivers and 484 km in canal (total 5684 km) is suitable for mechanized crafts.

The Govt. of India has taken initiative to bridge this gap by developing the third mode of transport in the country by way of river navigation. This is to improve transport logistics of the country. The recent trends in India towards speedier development of Ports and Inland Waterways, through private sector participation given impetus to this sector.

Today the company has a leading share of the private sector market in Ports and Harbours Engineering Services. Ports and Harbours unit of WAPCOS with the support of physical and mathematical modelling techniques offers complete range of Engineering Services right from conception to commissioning of the project related to Ports &Harbours, Costal Engineering & Inland Water Transport.

WAPCOS has been involved in Construction Management & Quality Control Services for various prestigious projects in coastal areas of India and Abroad involving **Planning Studies** (Cargo Traffic analysis and projection, Hinterland economics & demand, Project identification & appraisals, Economic & financial analysis, Investment analysis, Logistics/material handling, Container Transshipment terminals, Shore side Logistics of Materials handling), **Land Reclamation Studies** (Site identification, land reclamation planning, finalization of layouts, submergence characteristics and feasibility) **Investigations** (Topographic surveys, Hydrographic surveys, Seismic surveys, Geo-technical investigations, Measurement of oceanographic / meteorological parameters, i.e. wind, wave, current; tide, silt charge, salinity, Assessment of oceanographic /meteorological conditions using forecasting/Hind-casting techniques), **Physical/Mathematical Model Studies** (Tranquility conditions, Optimization of length of breakwaters, Harbour layouts, alignment of Jetties and Berths, Optimization of dimensions & alignment of navigation channels, Ship motions at berth & maneuvering area, Sedimentation, Wave flume studies, Location & alignment of training works and protection works),

**Project Reports** (FRs & DPRs**), Detailed Engineering, Construction Management** (Time scheduling, Cost control, Quality Control, Material management, Site supervision, Construction progress control with PERT/CPM techniques, Training of personnel). WAPCOS have institutional back up of out constituent, the Central Water & Power Research Station (CWPRS), Pune for carrying out physical and mathematical model studies.

WAPCOS has undertaken/is undertaking a large number of projects comprising Master Plan, techno-economic feasibility study, Detailed Project Reports, Tender document and construction drawing, Construction Management & Quality Control Services for the **development of ports & jetting located in Gujarat, Maharashtra, Andhra Pradesh, Orissa and West Bengal, and is well conversant with the developments taking place in the hinterland of the west and east coast ports. WAPCOS have already undertaken large number of studies on behalf of Gujarat Maritime Board and other clients for development of port facilities at Gujarat Coast such as that for development of ports at Umargam, Dahej, Okha, Sikka, Dabhol, Hazira, Positra, Maroli, Sutrapada etc.WAPCOS has also been involved with the port projects for development on the basis of BOST, BOOT, BOT, BOO, etc. such as that for development of ports at Umargam, Rewas-Aware, Gangavaram etc. and a number of captive ports/ terminals in Gujarat and Maharashtra from the client side and for preparation of tender documents for execution of LPG unloading terminal on EPC basis.** WAPCOS have also prepared Master Plans for Jawaharlal Nehru Port. WAPCOS has completed EIA studies for development of port at **Rewas-Aware, Umargam, development of cement handling facilities at Navlakhi Port** for M/s Binani Cement and the LNG facilities for the Dabhol Power Company. Both these projects have been cleared from the environmental committee.

## RANGE OF SERVICES:

### PLANNING STUDIES:

- Cargo Traffic Analysis and Projection
- Hinterland Economics and Demand
- Project Identification and Appraisals
- Economic and Financial Analysis
- Investment Analysis of BOOT, BOST, BOLT Port Projects
- Logistics / Material Handling
- Container Transshipment Terminals
- Shore Side Logistics of Materials handling

### LAND RECLAMATION STUDIES

- Site identification
- Land reclamation planning
- Finalization of layouts
- Bathymetric surveys
- Feasibility studies/Detailed Project Reports

**INVESTIGATIONS**

- Topographic Surveys
- Hydrographic Surveys
- Seismic Surveys
- Geo-technical Investigations
- Measurement of Oceanographic / Meteorological Parameters, i.e. Wind, Wave, Current; Tide, Siltcharge, Salinity ets
- Assessment of Oceanographic / Meteorological Conditions using Forecasting / Hind-Casting Techniques.

**PHYSICAL/MATHEMATICAL MODEL STUDIES**

- Tranquility Conditions
- Optimisation of Length of Breakwaters
- Harbour Layouts, Alignment of Jetties and Berths
- Optimisation of Dimensions And Alignment of Navigation Channels
- Ship Motions at Berth and Maneuvering Area
- Sedimentation in Channel, Basin and Berth Areas
- Wave Flume Studies
- Location &Alignment of Training Works and Other Protection Works

**PROJECT REPORTS (FRs& DPRs)**

- Project Planning
- Techno-Economic Feasibility
- Cost Estimation
- Specifications of Works
- Tender Engineering, Tender Analysis & Selection of Contractors

**DETAILED ENGINEERING**

- Detailed Design
- Construction Drawing
- Construction Management & Site Supervision

**CONSTRUCTION MANAGEMENT**

- Time Scheduling
- Cost Control
- Material Management
- Site Supervision
- Construction Progress Control with PERT/CPM Techniques.
- Training of Personnel

**OTHERS**

- Fishing Harbours
- Dredging and Reclamation
- Coastal Engineering
- Port Related Facilities
- Electrical and Mechanical Services
- Risk Analysis and Management
- SPM & SBM Studies
- Water Intake Systems (Sea & River)
- Area Drainage and Safe Grade Elevation

WAPCOS has a sufficient inventory of application softwares available in today market for their applications in ongoing projects to produce excellent quality of outputs, some of the softwares are mentioned below

## SOFTWARES:

### Model Studies

| | | |
|---|---|---|
| MIKE21 | - | Wave propagation, tidal hydrodynamics & water quality modeling |
| LITPACK | - | Littoral drift distribution and shoreline evolution |
| TELEMAC 2D | - | 2D hydrodynamics and morphology of rivers |
| TIDEWAY 2D | - | Tidal flow simulation |
| SANDFLOW/ MUDFLOW | - | Transport of sand and mud under the action of tides |
| SEAFLOW | - | Tidal hydrodynamics |
| MORMOT | - | Motion of moored ships at berth |
| VERMO | - | Vertical motions of a ship in navigation channel |
| NAVIGA | - | Navigation of a ship in approach channel under the action of wave,wind and current |
| OUTRAY | - | Wavetransformation from deep to shallow coastal waters |
| PORTRAY | - | Wave disturbance in harbours |
| REFDIF | - | Wave propagation in the area of complex bathymetry Includingwave current interaction |
| SOLVIA | - | Dynamic analysis of dams |
| EAGD4 | - | Earthquake analysis of earthen dams |
| EAGD84 | - | Earthquake analysis of gravity dams |
| CHARIMA | - | Unsteady flow in channel and river network |
| NETWORK | - | Unsteady flow in a river network |
| FLOP | - | Flood routing and reservoir operation |
| STRAT | - | 2D Stratified flow |
| WATER HAMMER | - | Analysis of transient flow in hydro-electric power plants |
| IMAGE PROCESSING | - | Developed in-house, for processing and analysis of field images collected using remote sensing satellites |

### AUTOCAD

Preparation of engineering drawings

### STAAD Pro

Structural Analysis

### AUTO CIVIL

Preparation of Topographic Map
Analysis of Survey data to generate Contour Maps
Preparation of L-section, X-section etc.
Digital Terrain Modelling
Calculation of quantities of filling and cutting
Optimisation of alignment of Road
Analysis of pressurised and un-pressurised pipe network

Hydrological Analysis

**PRIMAVERA - Project Management**

**MS-PROJECTS - Project Management**
C - Program - L-section, Cross-section

**HEC-4 -** Stream Flow Generation and Data Gap Filling
Computer Aided Power System Studies

**MIEPOWER**
Load Flow Study
Short Circuit Study
Tangent Stability Study
Relay Co-ordination Study
Dynamic Stability Study
Line & Cable Parameter Calculation

Satellite Image Processing - **ERDAS** - Imagine
Geographic Information System (GIS) - Arc/Info, Arc View, PC-TIN
Auto Cad R 14/2000 with Tracer
Slope Stability Analysis Packages

**LOOP/EPA** – Water Supply Network Analysis
Statistical Package for Social Sciences (SPSS)

**SEWER** – Sewer Network Design Package – In-house Packages for Rising Mains/Treatment Plant/ I-Section

Wind Rose Diagram Preparation
Air Quality Modelling - PAL, FDM, MPTER
Adobe Acrobat Reader
Degadis Model for Risk Analysis
Dam Safety Analysis (In-house developed software)

In addition, for specialised applications WAPCOS utilises the facilities available with its constituents where the best possible software and hardware in India, along with the necessary technical know-how is available to cater to any problem associated with project requirements.

## List of major projects undertaken by WAPCOS in the Field of Development of Ports and Harbor, Coastal Engineering and Inlet Water Transport System

1. Development of Port at Banjarmasin and Balawan (Indonesia), Penang &Klang (Malaysia), Pulupandan (Philippines)

2. Development of Deep Water Machilipatnam Port at Gilakaladinde, Andhra Pradesh, India

3. Development of all-weather Port near Maroli, Gujrat, India

4. Development of Port and Harbor near Kharo/ Jakha/ Creek/Kadoli, Gujarat, India

5. Development of Port at Kakinada (Andhra Pradesh), Kaveri Port (Tamilnadu), , India

6. Development of a Container Cargo Port and Cruise Terminal at Baliharachandhi in Puri District, Orissa, India

7. Detailed Project Report for Development of Fishing Harbor at Sethubhavchatram, Muthupet, Mookiyar, Thondi, Tamilnadu, India

8. Detailed project report of Ro-Ro cum-Multi-purpose Berth and Multi-Level Car Park in Bharathi Dock at Chennai Port, Tamilnadu, India

9. Detailed Project report of Barge Handling Facility at Chennai Port, India

10. Detailed Project report for Development of Rajiv Gandhi Dry port and Multi logistic hub at Chennai Port, India

11. Detailed Project report for Construction of Ship yard in Goa,

12. Detailed Project Report for Construction of Fishing Harbor at Jewana, Maharastra.

## LIST OF MAJOR PORTS & HARBOURS PROJECTS

| Project Name | Client | Project Cost (Rs. in Crores) |
|---|---|---|
| Mathematical Model studies for revalidation of River Regulatory Measures of Kolkata Port Trust | Kolkata Port Trust Kolkata, West Bengal | 9000 |
| Consultancy Services for Conducting Techno-economic Feasibility& Rapid Environmental Impact Assessment Studies for creating transshipment Port at South Bay, Great Nicobar Island of A & N Island | Andaman Lakshadweep Harbour Works Port Blair, A & N Islands | 3500 |
| Development of Port Facilities on the Western Fringe of Sagar Island | Kolkata Port Trust Kolkata, West Bengal | 4000 |
| Development of Port at Kakinada | Kakinada SEZ Pvt. Ltd.Hyderabad, Andhra Pradesh | 4700 |
| Consultancy Services for the providing Detailed Project Report for Development of All Weather Deep Drafted Greenfield Seaport at Haldipur | Mineral Enterprises Limited, Bangalore, Karnataka | 2150 |
| Detailed Project Report & Environment Impact assessment for Development of Port at Maroli | Maroli Port &HarbourLtd.Mumbai, Maharashtra | 1850 |
| Consultancy services for Preparation of Detailed Engineering Report for Development of Kaveri Port, Nagapattinam, Tamilnadu | PEL Power Ltd. Hyderabad, Andhra Pradesh | 810 |
| Preparation of EIA, setting up of jetty, Intake and Outfall for the desalination plant, approaches to jetty with allied material handling equipment and for carrying out any works in river/creek or sea for the proposed 240 MW coal based thermal power plant, 1.5 MTPA cement grinding unit alongwith desalination plant at villages Pappiniassery and Kalliassery, District Kannur, Kerala | Jaiprakash Power Ventures Limited, Noida, U. P. | 100 |

| | | |
|---|---|---|
| Consultancy for demolition and re-construction of North Jetty - Phase I Studies | Flag Officer Commanding-in-Chief, Kochi, Kerala | 550 |
| Development of LPG unloading terminal off Okha, Gujarat | WIMCO Petrogas Ltd., Delhi | 200 |
| Consultancy Services for Detailed Project Report and Detailed Engineering of loading and unloading jetty at Mora Village on the banks of Tapti River, Surat, Gujarat | ABG Cement Ltd. Mumbai, Maharashtra | 1200 |
| Detailed Project report and Siltation Study for Rewas Aware Port | Amma Lines Limited Mumbai, Maharashtra | 3000 |
| Various Oceanographic Studies to be carried out at JN Port | Jawaharlal Nehru Port Trust, Mumbai, Maharashtra | - |
| Contract for carrying out basic detailing to obtain statutory clearance, detailed engineering and supervision services for shallow water berthing facility for proposed steel plant at Salav, in Raigad District, Maharashtra | WelspunMaxsteel Ltd. Mumbai, Maharashtra | 500 |
| Project Report and Environment Impact Assessment Study for Construction of Passenger Jetty at Panje near JNPT & Report and Environment Impact Assessment Study for Construction of Cargo Jetty at Karanja, Maharashtra | Navi Mumbai SEZ Pvt. Ltd. Navi Mumbai, Maharashtra | 63 |
| Project Report and Environment Impact Assessment Study for Construction of Passenger cum Cargo Jetty at BahiramKotak in Amba River & Project Report and Environment Impact Assessment Study for Construction of Jetty for Mumbai Trans Harbour Link Bridge at Nhava Island, Maharashtra | Mumbai Integrated SEZ Ltd. Navi Mumbai, Maharashtra | 63 |
| Mathematical Model Studies for Tidal Hydrodynamics in Salaya | ESSAR Power Ltd. Mumbai, Maharashtra | 800 |
| Techno-economic Feasibility Study & Environmental Impact Assessment for Development of Rewas - Aware Port | Amma Lines Limited Mumbai, Maharashtra | 2077 |

| | | |
|---|---|---|
| Consultancy Services for Mathematical Model Studies for Proposed Development of Multipurpose Terminal at Karanja Creek, Navi Mumbai, Maharashtra | Karanja Terminal Logistics Private Limited, Mumbai, Maharashtra | 1500 |
| Detailed Engineering for Captive Cement Terminal at Vasai Creek, Maharashtra | Gujarat Sidhee Cement Limited | 80 |
| Techno-economic feasibility study and detailed project report for development of Rewas Port | Rewas Ports Limited Navi Mumbai, Maharashtra | 5500 |
| Detailed Project Report for Installation of Single Point Moorings (SPMs) with pipelines in the existing marine facilities at Jamnagar, Gujarat | Reliance Ports & Terminals Limited, Navi Mumbai, Maharashtra | 90 |
| Consultancy Services for Detailed Project Report & EIA for Construction of a Coal Berth at Trombay for Barging of Coal from Mother Ship to TPC Berth, Trombay, Maharashtra | Pallonji& Co. Pvt. Ltd. Mumbai, Maharashtra | 20 |
| Prefeasibility Study for Development of port at Zambezia, Mozambique | M/s Patel Mining Division (PMD), Lda | US$ 660 Millions |
| Techno-economic Feasibility Study for transportation of coal from anchorage point to Shahpur and Captive Jetty in Dharmtar Creek for Maharashtra Energy Generation Limited (MEGL)'s proposed 4000 MW Power Project and other industrial economic infrastructure development at Shahpur, Raigad, Dist. Maharashtra | Maharashtra Energy Generation Limited, Mumbai, Maharashtra | 175 |
| Pre-Techno Economic Feasibility Study for Development of Port at BahudaMuhan in Ganjam District, Odisha | Directorate of Ports & Inland Water Transport, Bhubaneswar, Odisha | 2500 |
| Pre-Techno Economic Feasibility Study for Development of Port at Bahabalpur in Balasore District, Odisha | Directorate of Ports & Inland Water Transport, Bhubaneswar, Odisha | 4000 |
| DPR for GMB Clearance for the proposed Solid jetty And Chemical Jetty in Sikka, Jamnagar | Reliance Ports & Terminals Ltd. Navi Mumbai, Maharashtra | 25 |

| | | |
|---|---|---|
| Rehabilitation of damaged breakwater at Porbandar for M/s Gujarat Maritime Board | Gujarat Maritime Board Gandhi Nagar, Gujarat | 60 |
| Consultancy Services for Extension of Existing PNP Jetty at Dharamtar Creek | PNP Maritime Services Private Limited Mumbai, Maharashtra | 80 |
| Techno-Economic Feasibility study for Permanent Coal Handling Captive Jetty in Savata Creek, Dahanu | BSES Limited Mumbai, Maharashtra | 25 |
| Techno-economic feasibility study for Development of on BOST basis, Andhra Pradesh | Amma Lines Ltd. Mumbai, Maharashtra | 819 |

## LIST OF MAJOR FISHING HARBOUR PROJECTS

| Project Name | Client | Project Cost (Rs. in Crores) |
|---|---|---|
| Consultancy Services for Reconstruction and Modernization of Fishing Harbours at Puducherry and Karaikal for Project Implementation Agency, Government of Puducherry (World Bank Project) | Project Implementation Agency Puducherry | 43.775 |
| Project Management Consultancy for Construction of Fisheries Harbour at Amadalli, Karwar | Project Seabird Karwar, Karnataka | 30.00 |
| Emergency Tsunami Reconstruction Project-Determine and Implement Permanent Solutions for opening of 4 river Bar Mouths at Tamilnadu | Department of Fisheries, Government of Tamilnadu | 100.00 |
| Development of Fisheries Harbours at Harnai and Sakhrinate, Ratnagiri, Maharashtra | Government of Maharashtra | 80.00 |
| Techno-Economic Investigation &Prepararation of Techno - Economic Feasibility Report & Detailed Project Report for construction of Fishing Harbour at Jeewana, Tal Shreevardhan, district Raigad, Maharashtra | Commissionerate of Fisheries, Government of Maharashtra | 60.00 |
| Detailed Project report for the development of Fishing Harbour at Muthupet, Tamil Nadu | Sethusamundram Corporation Limited, Chennai, Tamilnadu | 20.00 |
| Detailed Project report for the development of Fishing Harbour at Mookaiyur, Tamil Nadu | Sethusamundram Corporation Limited | 20.00 |
| Detailed Project report for the development of Fishing Harbour at Sethubhavchatram, Tamil Nadu | Sethusamundram Corporation Limited | 20.00 |
| Detailed Project report for the development of Fishing Harbour at Thondi, Tamil Nadu | Sethusamundram Corporation Limited | 20.00 |
| Detailed Technical Report for Development of Fisheries Harbours at Harnai and Sakhrinate, Ratnagiri, India | Government of Maharashtra | 80.00 |

## LIST OF MAJOR SHIPYARD & DRY DOCK PROJECTS

| Project Name | Client | Project Cost (Rs. in Crores) |
|---|---|---|
| Development of Ship Building Yard at Cuddalore, Tamilnadu | Goodearth Shipbuilding Private Limited, Chennai, Tamilnadu | 1000 |
| Development of Shipyard at Rajapur, Ratnagiri district, Maharashtra | Rajapur Shipyard Private Limited Mumbai, Maharashtra | 2200 |
| Detailed Project Report for Upgradation of Existing Ship Recycling Yards at AlangSosia for undertaking Safe and Environmentally Sound Ship Recycling Operations | Gujarat Maritime Board Gandhinagar, Gujarat | 1200 |
| Techno-Economic Feasibility Study for Proposed Shipyard at Village Turumbad in Rajpuri Creek, Maharashtra | Bombay Marine Engineering Works Private Limited, Mumbai, Maharashtra | 1000 |
| Feasibility Study to set up Ship/Submarine launching System at Alcock, Dockyard Road, Mumbai, Maharashtra | Mazagon Dock Limited Mumbai, Maharashtra | 100 |
| Redesign of Dry dock (Damaged during tsunami) at Andaman & Nicobar Island | Andaman LakshdweepHarbour Works Port Blair, A&N Islands | 50 |

## LIST OF MAJOR IWT PROJECTS

| Project Name | Client | Project Cost (Rs. in Crores) |
|---|---|---|
| Manpower Consultancy for Execution of River Conservancy Works in National Waterway No. – 1 (River Ganga) and National Waterway No – 2 (River Brahamputra) | Inland Waterways Authority of India Noida, U.P. | 50 |
| Study and preparation of DPR for Alternate routes for Navigation to Baratang Island from Port Blair | Director of Shipping Services Andaman & Nicobar Administration | 25 |
| Detail Survey for Development of Inland Waterways in the State of Odisha | Directorate of Ports & Inland Water Transport, Bhubaneswar, Odisha | 1500 |
| Detailed Project Report for Development of Navigation in Kakinada – Pondicherry Canal, Andhra Pradesh, Tamilnadu | Inland Waterways Authority of India Noida, U.P. | 4000 |
| Techno Economic Feasibility Study for Development of Inland Water Transport on National Waterway No.-1 (River Ganga) between Haldia and Allahabad | Prayagraj Power Generation Company Ltd.- Jaypee Group, Noida, U. P. | 8000 |
| Techno-economic feasibility study for Development of navigation on River Narmada from Hoshangabad to the sea (637 km.) including hydrographic surveys | Inland Waterways Authority of India Noida, U.P. | 1500 |
| Inland Waterways Sector Development Program (TA 3974 - IND), an Asian Development Bank (ADB) Technical Assignment - River Ganga Haldia to Allahabad, India, River Brahmaputra from Dhubri to Sadiya, Assam, India, West Coast Canal from Kottapuram to Kollam, Kerala, India | Inland Waterways Authority of India Noida, U.P. | 300 |
| Techno-economic Feasibility Studies for Development of Navigation in River Varuna, Near Varanasi, Uttar Pradesh | Inland Waterways Authority of India Noida, U.P. | 115 |
| Techno Economic Feasibility Study for DamodarVally Corporation Canal (DVC), West Bengal | Inland Waterways Authority of India Noida, U.P. | 1345 |

# *Techno-commercial Offer*

# FEASIBILITY STUDIES FOR RECLAMATION OF LAND IN LITTLE ANDAMAN AND GREAT NICOBAR ISLANDS

## 1. BACKGROUND

### Little Andaman Island

Little Andaman Island (Onge: Gaubolambe) is the fourth largest of the Andaman Islands of India with an area of 731.6 km², lying at the southern end of the archipelago. It belongs to the South Andaman administrative district, part of the Indian union territory of Andaman and Nicobar Islands, the island is lying 88 km (55 mi) south from Port Blair, the capital of Andaman and Nicobar Islands. As per the census of 2011, the population was 18,823 in 4,093 households, spread among 18 villages.


**Index Map – Little Andaman Island**

### Great Nicobar Island

Great Nicobar is the southernmost and largest of the Nicobar Islands of India, north of Sumatra. Sumatra is located 180 km (110 mi) to the south of Great Nicobar. The island covers 1045.1 $km^2$ (356 sq mi) largely being covered by rainforest and known for its diverse wildlife. As per the census of 2011, the population was 8367.

The island has several rivers, including the Alexandra, Amrit Kaur, Dogmar and Galathea. Virtually all rivers flow in a southern or southwesterly direction, which is indicative of the general slope of the terrain across the island. There are undulating hills throughout the island, with the main range running in a north-south orientation.


**Index Map – Great Nicobar Island**

## 2. GENERAL

A properly planned, designed, engineered, and implemented reclamation area can do the country a lot of good if done properly in the right place, at the right time, at the right land-use type and density and correct planning and development.

Land Reclamation has provided an important solution to increasing land areas for a variety of purposes. From commercial perspective, reclamations have been successfully used for expansion of road networks, construction of residential complexes, new Airports, Recreational developments and other commercial utilities etc.

Creating new urban land creates more access roads that connect to or from existing main roads. Reclaimed lands can also act as natural barriers as wave breakers against tsunamis and storm surges.

As per discussions with NITI Aayog officials, WAPCOS limited has prepared the techno-commercial offer for carrying out feasibility studies for reclamation of land in Little Andaman and Great Nicobar Islands. The details are given in subsequent paragraphs.

## 3. SCOPE OF SERVICES

The detailed scope of studies of the present assignment shall be as given below:

1. Collection and review of data / documents related to previous study for the land reclamation of the island.

2. Conducting Field visits and Reconnaissance Survey.
3. Assessing the requirement of the topographical and bathymetric survey of land and ocean area of the island.
4. Identification of land reclamation sites in the island for development of plans for purposes of residential, recreational & various utility services along the waterfront based on the changes in the submergence levels.
5. Assessment of the landfill requirement for developing the Identified land reclamation sites including swamp area.
6. Broad assessment of the requirement of the capacity of dredging equipment required for carrying out the task keeping in the view demand for development of new land.
7. Identification of drains requiring diversion for the development of land reclamation sites and corresponding scope for construction of diversion canal away from the reclamation sites.
8. Preparation of cost estimate as per latest schedule of rates as applicable.
9. Preparation of Feasibility Report for Development of land reclamation area in the Island.
10. Project Implementation Plan in terms of physical and financial aspect.

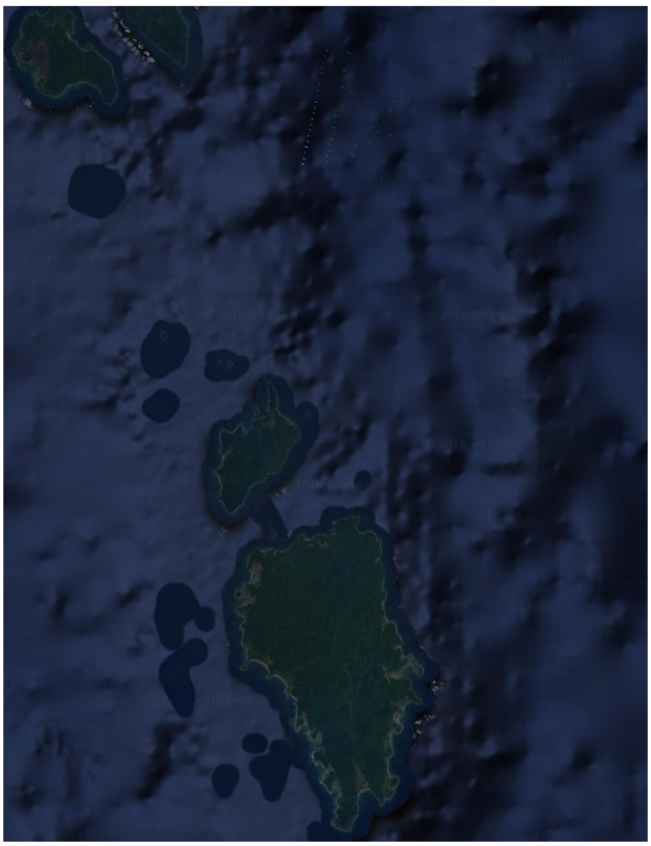
## 4. BRIEF METHODOLOGY FOR THE CONSULTANCY ASSIGNMENT

Feasibility Report (FR) would be prepared for the selected / preferred alternative taking into consideration the site specific conditions. The work would involve quick field studies as may be necessary to substantiate the various options/alternatives identified during the desk studies, which are briefly explained here under:

### 4.1 Surface Water/Submergence Level changes through Satellite Imagery

The Consultant shall study the changes that occurred in the conditions of submergence at the Coastline by analyzing changes in Landsat satellite imagery during the last 30 years. The satellite imagery shall be scanned to detect changes in surface water/submergence levels and discover where water has become land and land has become water. This shall help in identifying suitable sites for carrying out the land reclamation.

**Surface Water/Submergence Level Changes - Little Andaman Island (1985-2016)**



**Surface Water/Submergence Level Changes – Great Nicobar Island (1985-2016)**

Green and blue colors represent areas where surface water/submergence level changes occured during the last 30 years. Green pixels show where surface water has been turned into land (accretion, land reclamation, droughts). Blue pixels show where land has been changed into surface water (floods, erosion, reservoir construction).

The consultant shall carefully study the imageries and submergence patterns over the period of past 30 years and look for areas where the land has changed into surface water. These are the spots which need to be studied extensively as potential sites for land reclamation.

The other areas of the island where surface water has receded and land mass is available, may not be appropriate or conducive for land reclamation unless treated. Such spots/areas would also need attention to study them critically for using as potential land sites for development.

## 4.2 Secondary Data Collection

The Consultant shall carry out the collection and analysis of Secondary data as given below:

- Physical features of the islands:
  - Topographic Features
  - Hydrographic Features
  - Geotechnical/Geological Features (Marine & land)
  - Currents and tidal conditions
  - Water quality / bed sample etc.
- MET-OCEAN Data as available with WAPCOS / CWPRS / IMD
- Satellite imagery of the islands for a period of last 30 years
- Water level characteristics of the near region in due consideration with tides, storm surges etc. and fixing deck/reclamation level
- Sea - land interface behaviour of near shore regions
- Supplementary data obtainable from earlier studies

## 4.3 Site Visits and Reconnaissance Surveys

The site visit to Little Andaman and Great Nicobar islands by the team of experts of WAPCOS will cover the following aspects:

- The experts will have meetings and discussions with all the stakeholders such as Andaman Lakshadweep Harbour Works (ALHW), Port Management Board (PMB), local administration, PWD department, Mining Department, Geologists, Tourism Department, Mechanical Wing of PWD, soil scientists etc.
  - Discuss the potential sites for reclamation identified through satellite imagery
  - Ascertain the nature and extent of secondary data available with the various departments.
  - Understand from them the priorities for the development scenario of the islands for which the reclamation would be needed.
- The experts will subsequently conduct site visits to assess the prevailing conditions at the potential sites for land reclamation.

- The identified sites would be correlated with the MET-Ocean data obtained from CWPRS/IMD and also the water level characteristics of the island with regard to tides, storm surges etc. for fixing reclamation levels.
- During the site visits, the requirement of bathymetric surveys shall be assessed. Secondary data from ALHW and PMB shall be utilized to obtain the quantum of seafill required for carrying out land reclamation at various sites.
- Information of the selected sites for potential land reclamation would be shared with the stakeholders especially Mining Department, Geologist and Mechanical Wing of PWD for finalization of the sites.
- The soil/rock characteristics of the proposed sites shall be ascertained through secondary data and field visits, for determining the suitability of these sites for land reclamation purposes.
- In order to develop any site for land reclamation, it is necessary to identify the drains/streams which are flowing into the site and need diversion. This will be done during site visit by the experts so that they are in a position to prepare a diversion plan accordingly for the construction of diversion canals leading the flow away from the land reclamation site.

## 4.4 Assessment and Prioritization of Potential Sites for Land Reclamation

- The Consultant shall review the satellite imageries of the last 30 years for the islands and surrounding regions on GIS platform.
- Potential sites for land reclamation shall be identified by studying the submergence pattern of shorelines of the Little Andaman and Nicobar Islands and surrounding island groups.
- The identified sites shall be further discussed with the various stakeholders and departments during the visit of Consultant's experts, and additional sites may also be included based on site visits and discussions.
- Based on the analysis of secondary data, the potential sites for reclamation shall be finalized and prioritized considering the level of submergence, ease of reclamation, economic factors, environmental factors etc.
- While identifying the sites for land reclamation, preference will be given to those sites where the land mass of the island has been submerged due to oceanic actions such as Tsunami or changes in the tidal pattern thereby increasing the submergence level, formation of creeks due to soil erosion etc. Such sites are likely to be easy to tackle for reclaiming the land because depth of water will be less and minimum engineering efforts will be required to recoup the area.

## 4.5 Methods of Land Reclamation

The Consultant shall also recommend the suitable methods for carrying out land reclamation studies based on the site conditions, submergence, accessibility, the type of fill material, foundation soil, the topography of the seabed, the availability of equipment, and allowable fine material for reclamation etc. The following methods are generally utilized for carrying out land reclamation in coastal areas and islands:

**i) Dry Method**

The dry method which usually uses a truck or conveyor belt to transport fill material to extend the land towards the sea is suitable for filling material from land sources,

especially rock, hillcut and clay fill. Filling or transporting clay fill material into the sea would create a viscous slurry which would take much longer to become usable land. The dumping process of fill material has to be a continuous operation to avoid loosening of the material with the sea waves.

**ii) Hydraulic Reclamation Method**

This method is implemented when fill material is obtained from an offshore borrow source and is only suitable for granular fill, which has good drainage characteristics.

**iii) Direct Dumping**

A direct dumping method is used when the seabed is deep or the underlying seabed soil is soft and is applicable not only for granular material but also for stiff clay and soft clay. A bottom-opening barge usually carries fill material from the borrow source and either sail with a self-propelled or pushed by the powerful tugboat to the designated location generally controlled by a global positioning system. Sufficient draft and clearance are required for this method. However, bottom dumping alone cannot complete the reclamation because it can only operate up to 2 – 3 meters depth below sea level. The succeeding plane of fill has to be elevated by hydraulic filling or other means.

**iv) Rehandling from a Rehandling Pit**

The rehandling method involves transporting sand by barges and dumping the fill material temporarily in the pit for storage with a storage capacity of a few million cubic meters. Rehandling pit locations are mostly designated at natural hollows on a well-founded seabed or formed by dredging. To create a rehandling pit, one needs to consider the stability of the pit slope. The construction rate of such method is reliant on the stationary cutter suction dredgers and the number of barges utilized for transportation.

**v) Hydraulic Filling**

This method is largely used when filling is carried out from an offshore foundation, either from a rehandling pit or from a trailer suction hopper dredger, appropriate for granular fill and is not desirable when the seabed is too shallow or its soil is too soft. The percentage of fill material to water is accustomed corresponding to the grain size of the fill material. A large ratio of material to water would lead to wearing of the inner walls of the sand transportation pipe. Conversely, a lesser ratio of material to water will lessen the production rate.

**vi) Sand Spreading**

Sand spreading is implemented when a shallow seabed is encountered or when the seabed soil is too soft. Sand deposits using sand spreading method usually results in a loose profile.

## 4.6 Feasibility of Various Alternatives

The data as collected above will be analyzed to evaluate the following:

- Establishment of meteorological/oceanographic design parameters for the coast including that of current and extent/directions of littoral drift

- Conceptualizing various available options and study the likely effects on the proposed alternative locations in terms of technical/logistic and economic considerations.

### 4.7 Conclusion

- The consultant shall carefully study the imageries and submergence patterns over the period of past 30 years and look for areas where the land has changed into surface water. These are the spots which need to be studied extensively as potential sites for land reclamation.
- The other areas of the island where surface water has receded and land mass is available, may not be appropriate or conducive for land reclamation unless treated. Such spots/areas would also need attention to study them critically for using as potential land sites for development.
- The cluster of islands located in the close vicinity of little Andaman and Great Nicobar may provide good answer for land reclamation exercise as by dumping the fill material in the intervening gaps may result in development of a sizeable land-mass for consideration of future development.

## 5. PROPOSED STAFF FOR THE CONSULTANCY ASSIGNMENT

The duration of the study is to be three **(3) months**

The Consultant shall have the following Key Personnel in the Team:

| S. No. | Key Personnel | Major Activities | Estimated Man-Months |
|---|---|---|---|
| 1. | Team Leader – Sr. Coastal Engineer | Overall project management and coordination, discussions with Client, Govt. Authorities and stakeholders, study of secondary data, satellite data and identification and prioritization of potential sites for land reclamation, suggesting suitable methods for land reclamation, feasibility studies for the proposed alternatives, preparation of final report. | 2 |
| 2. | Hydrographer | Study of secondary data related to physical features of oceans, seas and coastal areas, and the prediction of their change over time, assessment of submergence conditions based on secondary data for reclamation sites. | 2 |
| 3. | Coastal Engineering Expert | Study of secondary data, satellite data and identification and prioritization of potential sites for land reclamation, suggesting suitable methods for land reclamation. | 2 |
| 4. | GIS Specialist | Application and use of satellite-imagery and high resolution maps derived information for the studies, study changes in the conditions of submergence at the coastline by analyzing changes in Landsat satellite imagery during the last 30 years, assisting other experts in identification of potential sites for land reclamation. | 2 |
| | | **Total** | **8** |

Based on the scope of the services to be provided, the tentative man-months requirement is 8 man-months which are considered reasonable for completing the

study.

Other than the Key Personnel mentioned key experts, non-key experts and support staff shall be engaged by the Consultant as may be required for carrying out the activities and discharging its duties successfully.

## 5. DELIVERABLES AND TIMELINE

The consultant shall submit to the Client, the following reports/documents:

| S. No. | Report / Documents | Description | Time period (in Days) |
|---|---|---|---|
| 1 | Inception report | Data collection and analysis, review of previous reports, preparation of hydrological database, index maps and drainage lines plotting. | M*+15 days |
| 2 | Draft Feasibility Report | Identification of water resources projects and planning based on hydrological database, remote sensing and satellite data, feasibility studies, discussions with Client and various stakeholders | M*+75 days |
| 3 | Feasibility Report | Final Feasibility studies after incorporation of comments, if any. | M*+90 days |

**** 'M' refers to effective date of commencement of Contract***

All reports, drawings etc shall be provided in hard as well as in soft version. The Consultant shall liaise with the technical staff for producing the scaled drawings in AutoCAD format version. The Consultant shall also provide a comprehensive map indicating all the features and infrastructures related to the land use pattern of the islands.

## 6. TIME PERIOD

The Consultant's services for preparation of Feasibility Report are envisaged for a period of Three (3) calendar months.

## 7. FACILTIES TO BE PROVIDED BY THE EMPLOYER

The Employer shall provide to the Consultant the following:

**a) <u>Data and Information</u>**

(i) All data and information available on the project including the details of existing water sector projects, if any.
(ii) All available reports and documentation.
(iii) Available codes of practice

**b) Decisions**

The Employer shall also give his decisions on matters referred to him by the Consultant in such reasonable time as not to delay or disrupt the performance of the services under this contract.

**c) Facilities**

The Consultant shall make their own arrangements for accommodation, office facilities, office furniture and equipment, consumables, telephone, fax, internet, transport facilities etc. for their personnel to be deployed for the fulfillment of its obligation during this phase. All the costs thereon shall be deemed to be included in the Consultant's fee.

The Employer shall assist the Consultant to look for an appropriate office space and associated facilities if so required.

## 8. CONSULTANCY CHARGES

The Consultancy Charges for "***Feasibility Studies for Reclamation of Land in Little Andaman and Great Nicobar Islands***" will be **Rs 20.2 Lakhs (Rupees Twenty Lakhs Twenty Thousand Only) plus GST at prevailing rate**. This consultancy charges will cover the cost of input of key experts, non-key experts and support staff, communication, travel and transportation, report preparation and WAPCOS fee etc. The breakup of cost is as given below:

| S.No. | Description | | | Cost (Rs. Lakhs) – exclusive of GST |
|---|---|---|---|---|
| i) | Remuneration of Key Experts | Man-months | Man-month Rate (Rs. Lakh) | |
| | Team Leader – Sr. Coastal Engineering Expert | 2 | 2.0 | 4.0 |
| | Hydrographer | 2 | 2.0 | 4.0 |
| | Coastal Engineering Expert | 2 | 2.0 | 4.0 |
| | GIS Specialist | 2 | 1.5 | 3.0 |
| | **Sub-Total (i)** | | | **15.0** |
| ii) | Travel expenses of experts including airfare, accommodation and hiring of vehicles | | | 2.0 |
| iii) | Secondary Data Collection and Reconnaissance Surveys | | | 1.0 |
| v) | Communication charges | | | 0.4 |
| vii) | Printing of reports, stationary and consumables | | | 1.8 |
| | **Total** | | | **20.2** |

The price proposal has been framed on the basis that the entire work has to be completed as per the time frame of total 3 months from the effective date of contract.

It is expected that NITI Aayog would designate a senior officer to act as Liaison officer who shall make available to the consultants all data, reports etc. already available with the Client, liaise with other various departments of the state and facilitate collection of available data from various sources, in accordance with proposed time schedule.

If during the course of this consultancy assignment the consultants are required to perform any additional service, not included in the scope of work, the same would be undertaken by the consultant on payment of additional charges to be agreed upon mutually.

## 9. PAYMENT SCHEDULE

The payment schedule linked to the specified deliverables shall be as given below:

| Description of Deliverable | % of Contract Value |
|---|---|
| Mobilisation advance (non-recoverable on the award of works) | 50% |
| On submission of Draft Feasibility Report | 30% |
| On submission of Final Feasibility Report | 20% |

## 10. STATUTORY LEVIES

Service tax at prevailing rate on consultancy charges and all other professional tax, sales tax and all other statuary levies imposed by the Central/State Govt. from time to time shall be borne by the client over and above the agreed amount of consultancy fee.

## 11. VALIDITY PERIOD

The validity of our proposal will be 90 (ninety) days from the date of submission of this proposal. In case client wants extension of the validity, the time may be mutually agreed.

# *Experience in Similar Assignments*

**1. Project:** Detail Project Report for Establishment of Inland River Port at Ashuganj in Bangladesh.

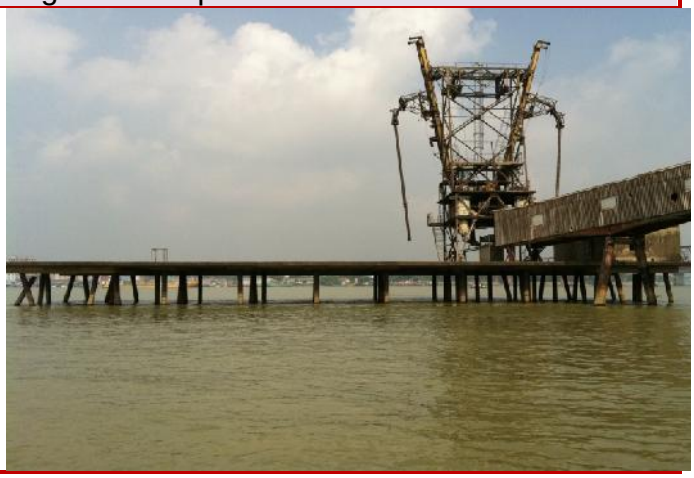
| | |
|---|---|
| **Client:** Ministry of External Affairs, Government of India. | **Project Cost:** Rs. 150 Crores |
| **Start Date:** Dec, 2014<br>**Completion Date:** Oct, 2017 | **Project Location:**Ashuganj, Bangladesh |

**Scope:**

Ashuganj in the district of Brahmanbaria of Bangladesh is a traditional IWT station of Bangladesh. Waterway up to Ashuganj is tidal and river depth is in the range of 4 to 5 meters. **Big inland vessels** therefore ply up to Ashuganjall round the year due to which this has always been an important IWT station of Bangladesh serving the hinterland. Due to its geographical location, the Ashuganj river port could also cater to logistic needs of the cities of Narsingdi, Kishoreganj, Mymensingh, Brahmanbaria, Comilla and Greater Sylhet region of Bangladesh. The growing number of containers handling at the port of Chittagong has necessitated developing better distribution systems of containers throughout Bangladesh. The growth rate of containers handling at the port of Chittagong is persuading the construction of more ICDs in the potential places of Bangladesh. For this reason also, establishment of a river port with container handling facilities at Ashuganj is felt important. Ashuganj is about 50 km from Agartala (Tripura) of India by road, out of which about 35 km road is well developed. Therefore it is evident that establishment of a modern river port at Ashuganj is important both for domestic logistics sector of Bangladesh and for its connectivity with India.

Scope of Services includes:

- Review of previous studies
- Hydrographic survey, Topographic survey, soil investigation and Traffic survey
- **Site Selection, Land Reclamation Studies and Layout Planning**
- Road and Rail Connectivity
- Asses environmental impacts and social impacts
- **Detailed Design with Proof Checking andCost estimate**
- **Financial and Economic Analysis**
- Preparation of Detail Project Report covering above aspects

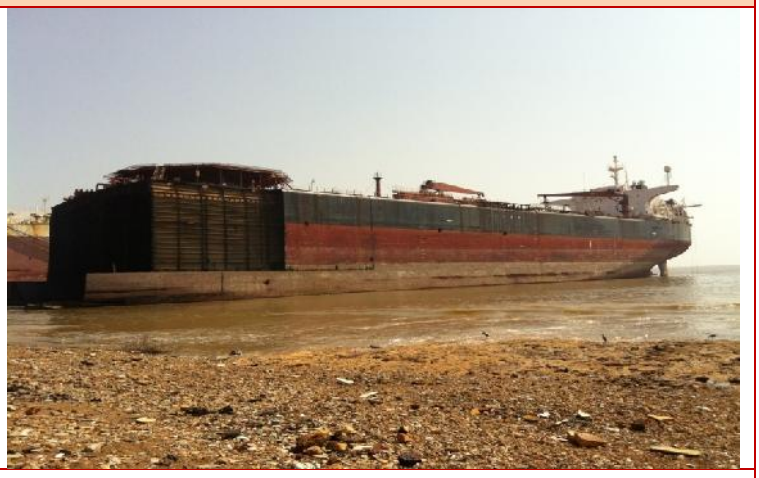


**2.Project:** Pre-feasibility Study for Development of Vansi-Borsi Port.

| | |
|---|---|
| **Client:** Chief Engineer, GMB, Gujarat Maritime Board | **Project Cost:** Rs. 5000.00 Crores |
| **Start Date:** August, 2011<br>**Completion Date:** March, 2012 | **Project Location:**Gujarat |

**Scope:**

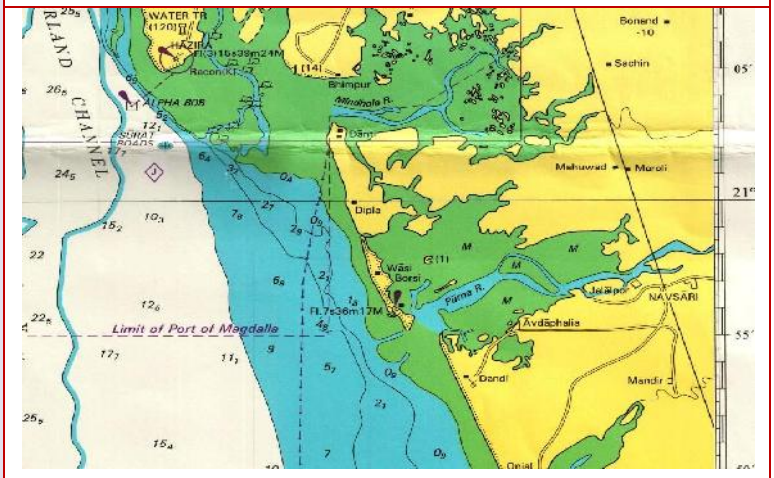
VansiBorsi port has been functioning as minor port and is presently coming into large scale development initiated by the Gujarat Maritime Board (GMB). The Port is located in the Eastern side of Gulf of combat. As characteristic of any Gujarat Port the hinterland coverage is primarily the entire Northern India as well as central India.



GMB had devised a planning with regard to use and development of Gujarat's **Ports** under which Vansi-Borsi comes for private investment. In Pursuance of this GMB now requires a pre-feasibility Report for the Vansi-Borsi**Port.** As cited in the TOR, it is noted that a prefeasibility report was made by STUP consultants. This report covered the need of **POL jetty** and an SPM for crude import. Whereas the current TOR be responded by us calls for multi variety of cargo to be handled and a traffic study is to be prepared.


It is also noted that a pipeline of ONGC is passing along the possible port location precincts and the lay-out of berths and harbor facilitation areas shall be clear of the ONGC pipeline.

In the 1997 CES report, respective layout is observed & will be taken into account.




Scope of Services includes:

- Data Collection and Analysis
- Examine the marine conditions of the waterfront and suggest a best possible site (or a set of alternative sites) for locating the

port

- **Site identification and feasibility of land reclamation.**
- Suggest various conceptual layouts for alternative sites for **development of port** considering the parameter of existing gas pipelines of ONGC.
- Considering the **port sector development** in the region, estimate the type of cargoes that would be handled at the proposed port site.
- Suggest waterfront and on shore facilities to handle the estimated traffic.
- Indicate project estimates of cost for the proposed port facilities.
- Preliminary Environment Impact Assessment
- Traffic (cargo) surveys and demand assessment
- Project Economic Viability

**3. Project:** Providing Detailed Project Report for Development of All Weather Deep Drafted Greenfield Seaport at Haldipur for M/s Mineral Enterprises Limited

**Client:** M/s Mineral Enterprises Ltd., SadashivnagarBangalore,Karnataka

**Project Cost:** Rs. 2150.00 Crores

**Start Date:** Feb,2010
**Completion Date:** Mar, 2011

**Project Location:** Haldipur, Karnataka

**Scope:** M/s Mineral Enterprises Limited (MEL) is Karnataka's premier Mining and Iron ore Exporting Company. With a view to optimising the trade potential of Northern Karnataka's agro and mineral rich hinterland. M/s MEL intends to develop modern deep water all **weather port** in the Honnavar port region under PPP Swiss challenge model.

**Scope of Services includes:**

- Preparation of draft Pre feasibility Report and Preparation of Preliminary layout of harbor and approach channel, detailed land reclamation studies
- Selection of size of channel, turning circle, berth, and basin.
- Preparation of cost estimate of the various alternatives of the project.
- Preparation of final project report
- Mathematical Model Studies
- Geotechnical Investigation (10 Marine Boreholes), Hydrographic Survey (85 $Km^2$), Topographic Survey (6 $Km^2$), Hydraulic Survey, Geophysical Survey (50 Line Kms.) andBeach Profile @ 200m Interval For 10 Kms.
- Review of PFR, Preparation of FR and Preparation of DPR

4. **Project:** Detailed Project Report including Environmental Impact Assessment for Development of Port at Maroli, Gujarat.

| | |
|---|---|
| **Client:** Maroli Port &HarbourLtd | **Project Cost:** Rs. 1850 Crores |
| **Start Date:** Feb,1998<br>**Completion Date:** Dec, 1998 | **Project Location:**Maroli, Gujarat. |

**Scope:** Detailed project report covering, field investigation with regard to topographic survey, bathymetric survey, underwater seismic survey, geotechnical investigation, wave, current and tidal data measurement, collection and analysis of traffic data and projection, model studies with regard to determination tranquillity, dimensioning and alignment of navigational channel, turning circle and water area of the port, determination of the size of optimum vessel size for handling of cargo, cost estimates and methodology of implementation for multi cargo port at Umargam. The study involved handling of various cargos, namely coal, cement, general cargo, containers, LNG and POL. The layout and cargo handling logistics including sizing of the equipment taking into consideration the quarantine distance of LNG was prepared for three different alternatives. The alternatives wereanalyzed from technical, economic and execution point of view culminating in selection of the most optimum layout. Detail cost estimates and detail financial evaluation was carried out for recommending the tariff structure.

**Scope of Services includes:**

- Traffic Survey.
- Study of viable alternatives.
- Hydrographic Survey (Approx. 21 Sq. Km.), Topographic Survey (is now restricted up to only 10m contour to avoid any intrusion into the forest area) (Approx. 9 Sq. Km.) and Hydraulic survey (including Current & Tide Measurement at One location, Water & Sediment samples – 5 each).
- Wave measurement at two locations viz. –20m depth and –35m depth.
- Wind measurement at one location.
- Geotechnical Investigations (6 Nos. Marine Boreholes& 4 Nos. Land Boreholes very near to the shore).
- Layout planning
- Detailed land reclamation studies based on primary data and investigations
- Scheduling basic requirements & procurement program
- Container and other cargo logistics - requirement and scheduling
- Preliminary cost estimate
- Economic & financial analysis

**5. Project:** Development of Port at Bahuda Muhan in Ganjam District- Preparation of Pre-Techno Economic Feasibility Report

| | |
|---|---|
| **Client:** Directorate of **Ports**& Inland Water Transport, Bhubaneswar | **Project Cost:** Rs. 2500 Crores |
| **Start Date:** 25/02/2012<br>**Completion Date:** 31/05/2012 | **Project Location:** Bhubaneswar |

**Scope:**

BahudaMuhan Port in Ganjam district has already been identified by the Government of Odisha has suitable location for development of Minor Port, accordingly Notification of its Port Limit has already been declared by Government in Commerce & Transport (Commerce) Department vide Gazette Notification No. 470 dated 11.04.1997. Now, Government of Odisha through Directorate of Ports& Inland Water Transport (DPIWT) has decided to develop a port. Accordingly Directorate of Ports& Inland Water Transport (DPIWT) wishes to conduct studies for preparation of Pre-Techno-economic Feasibility Report

**Scope of Services includes:**

- Various alternatives and suggestion of the most economic scheme. The drawings, cost estimates and justification of the selected alternative will be indicated.
- In depth study on cargo profile and traffic forecast
- Berth layout orientation
- Alignment of Navigation Channel including its marking
- **Identification of land reclamation requirements and methods, dredging requirement and the prescribed method of dredging, suggestion on type of dredgers to be deployed.**
- Back up facilities for storage or cargo with handling systems.
- Vessel sizes for port operations, pilotage, tugs, pollution control and mitigation.
- Navigational Aids
- Coastal and near shore protections
- Requirement of land for Port operations, customs, Engineering, Immigration, Port Health etc. and user facilities

**6. Project:** Development of Port at Bahabalpur in Balasore District- Preparation of Pre-Techno Economic Feasibility Report

| | |
|---|---|
| **Client:** Directorate of **Ports**& Inland Water Transport, Bhubaneswar | **Project Cost:** Rs. 4000 Crores |
| **Start Date:** 25/02/2012<br>**Completion Date:** 31/05/2012 | **Project Location:**Bhubaneswar |

**Scope:**

Bahabalpur Port in Balasore district has already been identified by the Government of Odisha has suitable location for development of **Minor Port**, accordingly Notification of its Port Limit has already been declared by Government in Commerce & Transport (Commerce) Department vide Gazette Notification No. 446 dated 20.4.1991. Now, Government of Odisha through Directorate of Ports& Inland Water Transport (DPIWT) has decided to develop a **port.**

**Scope of Services includes:**

- Various alternatives and suggestion of the most economic scheme. The drawings, cost estimates and justification of the selected alternative will be indicated.
- In depth study on cargo profile and traffic forecast
- Berth layout orientation
- Alignment of Navigation Channel including its marking
- Assessment of land reclamation requirements and methods to be employed
- Dredging requirement and the prescribed method of dredging, suggestion on type of dredgers to be deployed.
- Back up facilities for storage or cargo with handling systems.
- Vessel sizes for port operations, pilotage, tugs, pollution control and mitigation.
- Navigational Aids
- Coastal and near shore protections
- Requirement of land for Port operations, customs, Engineering, Immigration, Port Health etc. and user facilities.

**7. Project:** Development of Port at Baliharichandi, Orissa- Preparation of Pre-Techno Economic Feasibility Report

| | |
|---|---|
| **Client:** Directorate of **Ports**& Inland Water Transport, Bhubaneswar | **Project Cost:** Rs. 450 Crores |
| **Start Date:** 13/10/11<br>**Completion Date:** 31/12/11 | **Project Location:**Bhubaneswar |

**Scope:**

Odisha, a principal maritime state has a coastline of 480 Kms extending from Bahuda Mouth in Ganjam district to Subarnarekha Mouth in Balasore district. It is endowed with conducive, unique, natural and strategic port locations. Paradeep is the only Major port along the 480 km coastline of Odisha. Apart from Dhamara and Gopalpur**ports**, which are being developed on PPP mode, the other minor **ports** are under initial planning stage though potential sites have already been identified for the phased future development of **minorports**.

**Scope of Services includes:**

- Various alternatives and suggestion of the most economic scheme. The drawings, cost estimates and justification of the selected alternative will be indicated.
- In depth study on cargo profile and traffic forecast
- **Berth** layout orientation
- Alignment of Navigation Channel including its marking
- Land reclamation studies
- Dredging requirement and the prescribed method of dredging, suggestion on type of dredgers to be deployed.
- Back up facilities for storage or cargo with handling systems.
- Vessel sizes for **port operations, pilotage, tugs,** pollution control and mitigation.
- Navigational Aids
- Coastal and near shore protections
- Requirement of land for **Port operations**, customs, Engineering, Immigration, Port Health etc. and user facilities.

**8.Project:** Conducting Techno-Economic Feasibility& Rapid Environmental Impact Assessment Studies for creating transshipment Port at South Bay, Great Nicobar Island of A & N Island

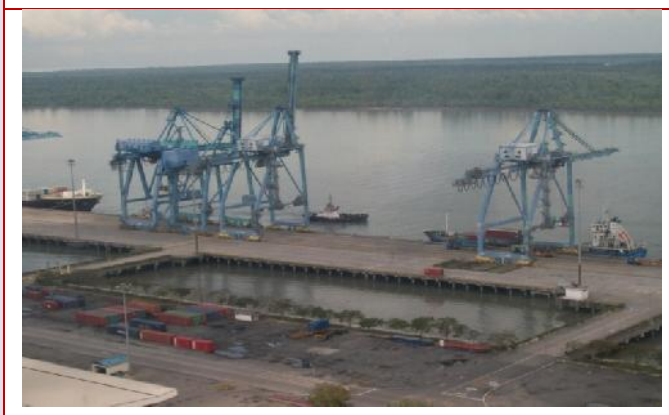
**Client:** Office of Chief Engineer &Administrator, Andaman & Lakshadweep **Harbour** Works

**Project Cost:** Rs. 3500.00 Crores

**Start Date:** Aug,2008
**Completion Date:** March, 2011

**Project Location:** South Bay, Great Nicobar Island of A & N Island

**Scope:**
For the viability of the **shipping traffic** and business prospects in the event of establishing a container transhipment port at Great Nicobar Island, a fully fledged feasibility study is required to be carried out. South Bay at Great Nicobar Island has been chosen by expert committee, set up by the Government of India, for creating a container transhipment port. This will not only boost Indian economy, but also serve other neighbouring international port at Bangladesh, Myanmar, Thailand, Combodia, Vietnam and Philippines too. With a view to examine the feasibility of creating a transhipment port at South Bay, Great Nicobar Island of A & N Islands, Andaman Lakshadweep **Harbour Works** (ALHW) have commissioned WAPCOS Ltd. to conduct **Techno-economic Feasibility and Rapid EIA studies**.



**Scope of Services includes:**

**Phase – I Techno Economic & Commercial Study**

- Traffic Survey.
- Study of viable alternatives.

**Phase – II Investigations & Environmental Studies**

- Hydrographic Survey (Approx. 21 Sq. Km.).
- Topographic Survey (is now restricted up to only 10m contour to avoid any intrusion into the forest area) (Approx. 9 Sq. Km.).
- **Hydraulic survey** (including Current & Tide Measurement at One location, Water & Sediment samples – 5 each).
- Wave measurement at two locations viz. –20m depth and –35m depth.
- **Wind measurement** at one location.
- Geotechnical Investigations (6 Nos. Marine Boreholes& 4 Nos. Land Boreholes very near to the shore).

**Phase – III Planning, Design & Preparation of Project Report**

- Layout planning

- Scheduling basic requirements & procurement program
- Container and other **cargo logistics - requirement** and scheduling
- Preliminary cost estimate
- Economic & financial analysis
- Project implementations programme including finding Scope of private sector/JV participation its time schedule & reporting requirements, Preliminary Project Report.

**9. Project:** Redesign of Dry **dock** (Damaged during tsunami) at Andaman & Nicobar Island, India

| | |
|---|---|
| **Client:** Andaman Lakshdweep **Harbour** Works, Port Blair, A & N Island | **Project Cost:** Rs. 50.00 Crores |
| **Start Date:** Jan**,** 2005<br>**Completion Date:** April, 2005 | **Project Location:** Andaman & Nicobar Island, India |

**Scope:**

During the tsunami of 26 December 2004, various damages took place in the A&N Islands, amongst which was the damage to the two **dry docks**, which jointly served the needs of repair of small vessels used for inter-island traffic. Considering the large number of vessels damaged during the tsunami event, it became a matter of the utmost urgency to bring the **dry docks** in to operation at the earliest, especially the larger **Dry Dock** No. 2, which has a water depth of 4 m below Chart Datum. Subsequently, Andaman Lakshadweep **Harbour Works** entrusted WAPCOS for redesigning of Dry **Dock** No. 2.

**Scope of Services includes:**

- Salvage and tow out the damaged/capsized vessels in the **dry dock**
- Install a temporary tide gauge in the **dry dock** and undertake observations for a semi-lunation, so that **tidal correlations** could be made with other permanent stations
- Carry out an **underwater inspection** of the gate sill to assess the damage thereto, and if considered necessary carry out underwater repairs
- Bring in the spare gate which is apparently undamaged and position it on the sill
- Dewater the **dry dock** gradually
- Epoxy grout all damaged portions
- Checking the design of the existing structure
- Checking the same design in the context of the changed scenario of relative rise in the high water level
- Undertake strengthening measures
- Cost estimate for the proposed strengthening measures
- Drawing up Tender Documents and assistance in evaluation of tenders
- Design, Engineering and Cost Estimates.

**10. Project:** Development of Port Facilities on the Western Fringe of Sagar Island for M/S Kolkata Port Trust.

| | |
|---|---|
| **Client:** Public Entity Kolkata Port trust, Hydraulic Study Department, 20, Garden Research Road, Kolkata – 700 043 | **Project Cost:** Rs. 4000.00 Crores |
| **Start Date:** Nov,2010<br>**Completion Date:** May, 2012 | **Project Location:** Kolkata, West Begal |

**Scope:** Kolkata Port Trust (KoPT) has proposed to set up a Port at Sagar Island (Near Beguakhali and MahishmariMouzas), West Bengal. The Port will handle vessels with a draft not less than 10.5 meters and liquid bulk cargo such as POL, Vegetable oil etc and Dry Bulk cargo such as coking coal , thermal coal, coke, limestone, iron ore etc as also break bulk cargo and containers. The entire cargo will be handled by constructing riverine jetties and there will be no impounded dock. It is proposed that land for this project will be made available through reclamation of riverbed by shore disposal of dredged materials and there will be no acquisition of land at Sagar Island. The proposed terminal will function as a part of the integrated river port system under Kolkata Port Trust, along with the exsisting port facilities at Kolkata, Haldia, Budge Budge and the new port facilities that may come up at Haldia Dock-II (Sulukkhali), Diamond Harbour etc. The project at Sagar Island will be implemented as PPP basis.

Scope of Services includes:

- Analyze the data on traffic including Kolkata **Dock** System (KDS), Haldia**Dock** complex (HDC), **Diamond Harbour**, Haldia**Dock**-II (Salukkhali) and other location
- Collection of additional traffic data and analyze
- Based on the traffic data and analysis, project the traffic for the **ports** in terms of category and volumes for a period of 20 years
- Based on the bathymetry study, prepare feasibility of setting up **of jetties**
- **Layout plan of the port facilities proposed at Sagar Island based on the wave tranquility as per the standard guidelines in the operational areas including detailed assessment of land reclamation works.**

- Assess the cargo possible to be handled at the proposed **jetties** including the total capacity possible
- Carry out Geotechnical Investigations (20 Marine Borholes 30 mts and 3 boreholes - 100mts)
- Carry out initial Environmental Impact Assessment, Study for the commodities likely to be handled at the proposed **jetties**.
- Wave Measurement – at a depth of 6 mts
- Current and bed water samples
- Wind measurement

| 11. **Project:** Development of Port at Kakinada | |
|---|---|
| **Client:** M/s Kakinada SEZ Pvt. Ltd.<br>Banjara Hills, Hyderabad – 500 034 | **Project Cost:** Rs. 4700 Crores |
| **Start Date:** Dec,2009<br>**Completion Date:** March, 2011 | **Project Location:** Kakinada, Hyderabad |

**Scope:**

Kakinada SEZ Ltd. is proposing to develop a multipurpose, all weather, **deep water port** at Kakinada, Andhra Pradesh as an in-zone port. Indicative cargo of the proposed port shall be bulk cargo such as coal, fertilizers, FRM, food grains & other bulk cargo, containers, liquid cargo like crude oil, other POL cargo, bulk chemicals/petrochemicals, edible oils, bitumen, project & engineering cargo, passenger cars, and other diverse cargo, etc. All these indicative cargos shall be handled on eight general cargo and container berths and three liquid cargo berths. The berths designed to handle bulk cargo will be mechanised with conveyor streams and grab/continuous unloaders/loaders, whereas other berths will be equipped with mobile **harbour cranes**. Container berths will have a separate terminal equipped with quay cranes, reach stackers, RTGS, RMGS and other necessary appurtenances to handle containers. A reefer yard for refrigerated containers will also be created. Port backup area will comprise mechanised coal and iron ore stockpiles, high heaping yards, truck and wagon loading areas, head stands, closed godowns, tank farms, necessary amenities and utilities, and other essential port back administration facilities.

Scope of Services includes:

- Mathematical Model Studies for Wave Propagation
- Mathematical Model Studies for Tidal Hydrodynamics and Sedimentation
- Mathematical Model Studies for Estimation of Littoral Drift Distribution and Shoreline Changes due to the Proposed Developments
- Mathematical Model Studies for Ship Maneuvering in the Approach Channel
- Mathematical Model Studies for Moored Ship Behaviour at the **Berth**
- Wave Flume Studies for the Design of **Breakwater**
- Hindcasting for wave heights, period, duration and storm surge for 100 year return period
- Hydrographic surveys (140 Km2) together with tide measurements
- Simultaneous current measurement at 3 locations
- Geotechnical Investigations (19 Marine Boreholes)
- Mathematical Model Studies for Oil dispersion
- Detailed assessment of land reclamation works based on primary data.
- Feasibility Study

**12. Project:** Techno-Economic Feasibility Study for Proposed Shipyard at Village Turumbad in Rajpuri Creek.

| | |
|---|---|
| **Client:** Marine Engineering Works Private, Mumbai**.** | **Project Cost:** Rs. 1000.00 Crores |
| **Start Date:** April, 2007<br>**Completion Date:** June, 2007 | **Project Location:** Mumbai |

**Scope:**

M/s Bombay Marine Engineering Works Private Limited commissioned WAPCOS to carry out Techno-Economic Feasibility Study for their Proposed Shipyard at Village Turumbad in Rajpuri Creek, Maharashtra.

**Scope of Services includes:**

- Source and collate Topographic, Bathymetric surveys and Environment data such as wave, wind, current, tide from available sources.
- Preliminary assessment of various locations and alignment of ship yard at the proposed site from hydraulic and navigability point of view in order to achieve safe entry/exit of vessels with appropriate condition for ship building and repair.
- Site identification and land reclamation studies.
- Selection of vessel size and type to be constructed /repaired depending on the draft availability, geotechnical condition etc.
- Planning and preliminary design of various facilities in the shipyard such as dry dock, slipways, fitting out and repair berths, and workshops, approach channel as per the standard guidelines.
- Planning of the ancillary facilities to provide infrastructure for ship building and ship repair.
- Final recommendation with techno-economic analysis and financial analysis with IRR/ERR for the selected site.
- Preparation of techno-economics feasibility report.

| **13.Project**: Detail design study for Lake Kivu Water Transport Project, Rwanda. | |
|---|---|
| **Client:** Rwanda Transport Development Agency, Rwanda. | **Project Cost:** Rs. 500 Crore |
| **Start Date:** May, 2013<br>**Completion Date:** Ongoing | **Project Location:** Rwanda |

**Scope:**

The need for implementation of a **passenger ferry and waterways cargo system** on Lake Kivu is a renewed initiative of the Government of Rwanda (GOR) to develop accessible infrastructure and tourism in the Western province. The implementation of an optimally structured ferry system operating on Lake Kivu between the main urban areas along the lake is one of the tangible projects to contribute to these set long term strategies

The objective of the inland waterways transportation system on Lake Kivu is to set up a ferry company under a PPP contract which will acquire fast ferries and cargo vessels and which will operate a reliable and frequent ferry schedule between the major urban areas along the lake (Rubavu, Karongi&Rusizi), to be implemented for both passengers and cargo ultimately early 2013. A short haul network to the smaller villages of (Nkora, Mugonero, Kirambo,Nyamirundi and Nkombo island) is also included in this project, for which additional vessels and port facilities will be needed.

Scope of Services includes:

- Detailed design of the requested fast ferries
- Detailed design of the requested cargo vessels
- Detailed design of the construction site of the vessels
- Detailed description of the maintenance of the vessels
- Site identification and detailed land reclamation studies.
- Detailed design for the construction of the port facilities (both the water-side landing structures and the land-side building and other facilities)
- Detailed description of the training packages and facilities for all ferry-related staff.
- Detailed description of one or more options for a PPP for the ferry system.
- Detailed EIA and EMP.
- Detailed report on traffic forecasts for both passengers and cargo transport.
- Preparation of relevant tender documents for the actual execution of parts of the project.


**Proposed Port Locations and Ferry Route for Lake Kivu Water Transport Project, Rwanda**

**14.Project:** Project Management and Consultancy for Demolition and Reconstruction of North Jetty, Naval Base, Kochi for Indian Navy.

| | |
|---|---|
| **Client:** Flag officer Commanding in Chief (For SSO (Projects) Southern naval command Naval base, Kochi. | **Project Cost:** Rs. 450.00 Crores |
| **Start Date:** Sep, 2012<br>**Completion Date:** Ongoing | **Project Location:** North Jetty, Naval Base, Kochi |

**Scope:**

The Southern Naval Command presently has two **jetties** at Kochi for **berthing of ships** of Indian Navy and Coast Guard. The operational ships, ships undergoing workup and visiting ships along with Coast Guard ships are berthed at South Jetty.

The **existing north jetty** is constructed during the period of 1948-1950. The Scope of Work for Demolition and Reconstruction of North Jetty would consist of two phases namely:

i) Phase I Concept Design & DPR
ii) Phase II Project Management

These two tasks cover the demolition methods, dredging, **design of new jetty** and related infrastructure, explanatory drawing, structural scheme, review of documents, calculations, schedule & specification for tender document, assistance in appointing the contractor and arranging site handover, monitoring of work, routine inspection, checking, interaction with MES authorities for site details**.**

| | |
|---|---|
| **15. Project:** Detailed Project Report for Installation of Single Point Moorings (SPMs) with pipelines in the existing marine facilities Jamnagar, Gujarat, India | |
| **Client:** Reliance **Ports**& Terminals Limited, Mumbai | **Project Cost:** Rs. 75 Crores |
| **Start Date:** May, 2015<br>**Completion Date:** May, 2017 | **Project Location:**Banglore |
| **Scope:** Preparation of Detailed Project Report including Technical specifications Detailed Drawings and justifications Design and analysis for installation of SPMs with pipelines in the existing marine facilities Suggestion of Further studies necessary for proper functioning of the **harbour** during construction of the new facilities Discussion with M/s Wallingford on the input data utilized in the navigational studies Preparation of Draft detailed project report and Final detailed project report.<br>Scope of Services includes:<br>• Preparation of Detailed Project Report including Technical specifications and justifications<br>• Preparation of Detailed Drawings<br>• Design and analysis for installation of SPMs with pipelines in the existing marine facilities<br>• Suggestion of Further studies necessary for proper functioning of the **harbour** during construction of the new facilities<br>• Discussion with M/s Wallingford on the input data utilized in the navigational studies<br>• Preparation of Draft detailed project report and Final detailed project report |  <br>  |

**16.Project**: Rehabilitation of damaged breakwater at Porbandar.

**Client:**M/s Gujarat Maritime Board.

**Project Cost:**

**Start Date:** May, 2013
**Completion Date:** Ongoing

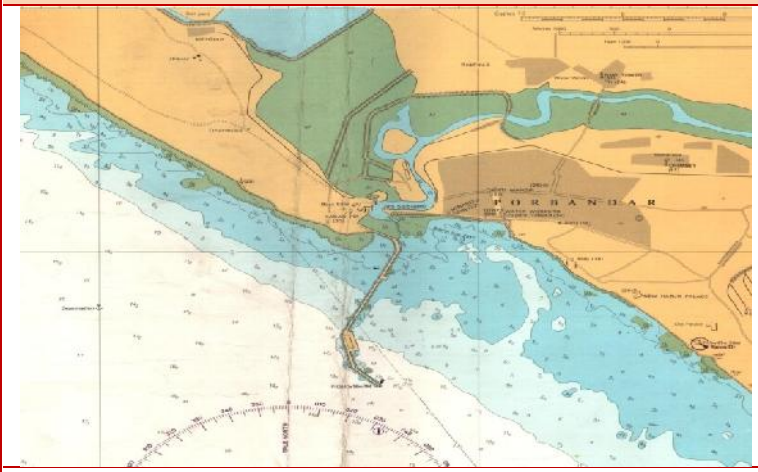
**Project Location:**Porbandar, Gujurat

**Scope:**

The existing breakwater of Porbandar Port which extends from HWL to -12 m C.D. contour got damaged during the cyclone of June 1998. WAPCOS undertook the work of **redesign of breakwater** after re-evaluating design parameters considering tetrapod and corlocarmour units, co-ordination with CWPRS during model studies, preparation of cost estimates and tender documents and periodical supervision during construction.

The Studies included

- Reconnaissance Survey
- Hindcasting of storm
- Estimation of Design Parameters such as Wave, Height, Type of **armour**unit etc.
- Design of Breakwater with coreloc and tetrapod armour units.
- Rate analysis for various items of works
- Cost estimates.
- Preparation of Specifications and tender documents.
- Periodic site supervision.




| | |
|---|---|
| **17. Project:** Detailed Project report for the development of Fishing **Harbour** at Sethubhavchatram, Tamil Nadu | |
| **Client:** M/s Sethusamundram Corporation Limited | **Project Cost:** Rs. 20 Crores |
| **Start Date:** 26/12/2006<br>**Completion Date:** 31/12/2007 | **Project Location:** Tamil Nadu |

**Scope:** M/s Sethusamundram Corporation Limited awarded the work of preparation of DPR of four fishing **harbour**s namely Sethubhavchatram. The DPR studies included site investigations, data analysis, Planning and design of infrastructural facilities, cost estimates & financial analysis etc.

**Scope of Services includes:**

- Detailed fishery traffic forecast for the period upto 2025 indicating the changes required for the fishing vessels, method of handling the catch on board and on shore etc.
- Selection of critical fishing vessels indicating types, sizes and draft and weight of the fishing vessels, unloading methods, area of water front required, depth requirement and repair facilities, etc. in accordance with the National / International standard
- Recommendation of technically feasible alternatives for the layout of **Fish LandingJetties**, other infrastructure, assessment of land reclamation for construction of the ancillary facilities like repair facilities, marketing hall, ice factory and cold storage, requirements, if any, etc.
- Assessment of management of supervisory staff requirement during construction as well as operational period.
- Detailed Cost Estimate for the implementation of the project, recommendations for selection of land and location, detailed drawings and detailed estimates.
- Preparerealistic implementation schedule for the project.

**18. Project:** Consultancy Services for Reconstruction and Modernization of Fishing **Harbour**s at Puducherry and Karaikal for Project Implementation Agency, Government of Puducherry

| | |
|---|---|
| **Client:** Project Implementation Agency, Puducherry | **Project Cost:** 43.775 Crores |
| **Start Date:** 12/02/2009<br>**Completion Date:** 31/03/2007 | **Project Location:**Puducherry |

Scope: Tsunami of December 26, 2004 caused greater devastation along the coastal belt of India. More than one-fourth of the coastline was affected by this massive underwater earthquake that destroyed large expanses of coastal terrain in Tamil Nadu, Kerala, Andhra Pradesh, Puducherry and Andaman & Nicobar Islands. The tsunami affected adversely on the fisheries sector destroying several mechanized/ traditional boats, **fishing harbours/fish landing centres** and other fisheries related infrastructure, thus caused major hampering on capture fisheries industry. Though the natural calamity causes greater impact on the fishing industry and livelihood system of large section of the fishers, in the rehabilitation programme tsunami has been considered as an opportunity to redesign the capture fishery industry in a better and more sustainable way, that includes repair and restoration of infrastructure including developing new one to fill the infrastructure gap, to promote deep sea fishing & aquaculture with an objective to reduce over-exploitation in coastal waters, enhance quality production and exports among the others.

Accordingly, Project Implementation Agency, Puducherry commissioned WAPCOS to carry out Consultancy Services for Reconstruction and Modernization of **FishingHarbour**s at Puducherry and Karaikal.

**Scope of Services includes:**

- Conducting Topographic Survey, Hydrographic Survey and Geotechnical Investigation
- Conducting Fisheries Sectoral Study
- Design of On-Shore Buildings and Effluent Treatment Plant
- Conducting Marine Ecology, HTL/LTL Mapping, land reclamation studies
- Preparation of Implementation Schedule
- Preparation of Bid Document
- Necessary assistance to the client to obtain approvals from government and other statutory bodies and procurement plan for goods and equipments
- Comprehensive supervision of project implementation activities carried out by the contractor to ensure compliance with the drawing, technical specification and various stipulations in the contract documents along with client training and support
- To ensure high standards of quality assurance in the execution of work and completion of work within the stipulated time limit.

**19.Project:** Review and prioritization of River Regulatory Measure of Kolkata Port for KoPT.

| | |
|---|---|
| **Client:** Chief Hydraulic Engineer, Kolkata Port Trust, Hydraulic Study Department, Kolkata. | **Project Cost:** Rs. 1000 Crores |
| **Start Date:** April, 2012<br>**Completion Date:** Nov, 2012 | **Project Location:** Kolkata Port |

**Scope:**

**(A) Dredging Works**

- A comprehensive review of all available data, and thorough appraisal of morphology changes over the long term referring to the historical and present set of Bathymetry and other relevant available data.
- Utilising all such data to generate a conceptual "model" of the estuary to arrive at a sustainable future development scheme.
- Consideration of the possible solutions to the problem. This will include an appraisal of the mathematical modelling completed in 2009 by the Lanka Hydraulic Institute.
- Study, area recommended for dredging including the site specific information like tides, current, water quality, river bed sediment quality, sub strata information etc.
- From the foregoing information to identify a preferred approach to improvement of depth. Then make recommendations on the approach to dredging including selection and availability of plant and options for dredging and disposal. Also provide an assessment of the likely impact on the estuary of both the capital dredging activity and the maintenance works.
- Identify most preferred type and capacity of dredgers which can be deployed considering possibility of simultaneous disposing off dredged spoil into identified shore dumping locations as relevant.
- Identify availability of such dredging units including capacity / size / number etc and organizations which can undertake such works.
- Identify means and methodologies for saving efforts and cost suggest/carry out various modifications including alterations to the declared depth, adopting a different dredging strategy, changes to locations for disposal or placement, changes to the dredging contract, as well as structural changes to the layout etc.
- Identifying and list all additional field specific studies, establishment of specific numerical models if any.
- Sequencing the entire dredging and reclamation process including identifying the necessary preparedness and effects on the ongoing port operations
- Identify suitable consolidation techniques at reclamation area in order of using the land on reclaimed front as early as possible.
- Effects on surrounding areas during and after dredging and RRM work implementation and post work monitoring required.
- Packaging of entire works for taking up work of implementation by execution agencies.
- Navigation specialists to be involved throughout to ensure that any proposed solutions are viable for navigations and that, the implementation of recommendations do not interfere with the other navigation/port operations in vogue.

**(B) Implementation of RRM and Reclamation Bunds**

- Understand the recommendations made in the report for implementation of various **RRM and Reclamation bunds.**
- Recommend best construction procedure and type of structures suitable for the site like Rubble Mound construction/sea walls/Geo Tubes etc. including merits/demerits of the same
- Recommendation on construction materials and sequencing construction duly accounting the dredging process
- Assessing effects on surrounding areas during construction as well as post construction stage and that on dredging process and its effects on dredging / siltation at various stages of construction including remedial measures

**(C) Suggesting Alternative Solutions**

- Maintenance of comfort depth at the shipping channel leading to Haldia, ShalukKhali and **Diamond Harbour** in case of delay/non-execution of RRM

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| 20. **Project:** Preparation of Detailed Engineering Report for Development of Kaveri Port, Nagapattinam, Tamilnadu. | |
| **Client:** Private Entity<br>PEL Power Ltd. 9A Jubilee Hills Hyderabad | **Project Cost:** Rs. 810 Crores |
| **Start Date:**9/12/2010<br>**Completion Date:** 31/05/2011 | **Project Location:**Nagapattinam, Tamilnadu |
| **Scope:**<br>Detailed Engineering for the proposed layout, land reclamation works, Mathematical Model Studies for Tidal Hydrodynamics and Sedimentation, detailed assessment of land reclamation works, Mathematical Model Studies for Estimation of Littoral Drift Distribution and Shoreline Changes due to the Proposed Developments, Mathematical Model Studies for Ship Manoeuvering in the Approach Channel, Desk studies for Ship Motions at Berth, Desk studies for Wave Hindcasting and Storm Surge Analysis, Desk studies and Wave Flume Studies for evolving the Design of Breakwater, Hydraulic Survey including Current Measurement at 3 locations and Collection and Analysis of Bed & Water samples. | |

**21. Project:** Project Report and Environment Impact Assessment Study for Construction of Passenger Jetty at Panje near JNPT & Report and Environment Impact Assessment Study for Construction of Cargo Jetty at Karanja, Near Mumbai, Maharashtra, India

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| **Client:** Navi Mumbai SEZ Pvt. Ltd CBD Belapur, Navi Mumbai. | **Project Cost:** Rs. 63 Crores |
| **Start Date:** April'2006<br>**Completion Date:** Aug.'2006 | **Project Location:** Maharashtra |

**Scope:**

WAPCOS services pertains to development of Passenger Jetty, Preparation of layout with alternatives for design and type of construction, Collection of data, cost estimates and design alternatives, Preliminary design of **jetties**, Environment Impact Studies, Dredging estimation

**Scope of Services includes:**

- Reconnaissance survey for selection of site for jetty (at Karanja and Panje) and field investigation
- Preparation of layout with alternatives for design and type of construction
- Data Collection on Tides, water sample and bed samples
- Cost estimates and design alternatives
- Preliminary design of **jetties**
- Details of wild, domestic and aquatic life within area
- Demography and socio-economic analysis
- Noise level monitoring
- Formulation of mitigation and environment monitoring programs
- Estimation of capital and maintenance dredging for varying drafts (2-4 meters)
- Marine ecology survey
- Optimum dimension of channel along with side slopes
- Preparation of repot on Risk analysis and requirements of statuary safeguards during construction stages

**22. Project:** Techno-economic Feasibility Study for transportation of coal from anchorage point to Shahpur and Captive Jetty in Dharmtar Creek for Maharashtra Energy Generation Limited (MEGL)'s proposed 4000 MW Power Project and other industrial economic infrastructure Near Mumbai, Maharashtra, India.

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| **Client:** Maharashtra Energy Generation Limited | **Project Cost:** Rs. 175 Crores |
| **Start Date:** Feb 2011<br>**Completion Date:** Nov.2011 | **Project Location:**Maharashtra |

**Scope:**

Examination of the effect of deepening on the stability of the existing structures such as road and railway bridges at Dolvi, Govt. of Maharashtra jetty at Dharamtar, Ispat**jetty** at Dharamtar the Govt. jetty at Mandwa, the fisheries jetty at Karanja, the BHP shipyard etc. Determination of the width of channel considering vessels that can be brought up the size of the riverine each phase of development i.e. 4.5, 6.0 and 12.0 m below Chart Datum Examination of the effect of dredging the channel (width and depth) in each phase on the stability on the bank.

**Scope of Services includes:**

- Conducting Topographic Survey, Hydrographic Survey and Geotechnical Investigation
- Conducting Fisheries Sectoral Study
- Design of On-Shore Buildings and Effluent Treatment Plant
- Conducting Marine Ecology, HTL/LTL Mapping
- Preparation of Implementation Schedule
- Preparation of Bid Document
- Necessary assistance to the client to obtain approvals from government and other statutory bodies and procurement plan for goods and equipments
- Comprehensive supervision of project implementation activities carried out by the contractor to ensure compliance with the drawing, technical specification and various stipulations in the contract documents along with client training and support
- To ensure high standards of quality assurance in the execution of work and completion of work within the stipulated time limit.

23. **Project:** Construction for demolition and re-construction of North Jetty-Phase I Studies for Indian Navy.

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| **Client:** Flag officer Commanding in Chief (For SSO (Projects) Southern naval command Naval base, Kochi. | **Project Cost:** |
| **Start Date:** Feb, 2012<br>**Completion Date:** March, 2013 | **Project Location:** North Jetty, Naval Base, Kochi |

**Scope:**

The Southern Naval Command presently has two **jetties** at Kochi for berthing of ships of Indian Navy and Coast Guard. The operational ships, ships undergoing workup and visiting ships along with Coast Guard ships are berthed at South Jetty. The existing north jetty is constructed during the period of 1948-1950.

**Scope of Services includes:**

- Physical Model Studies
- Desk & Mathematical Model studies for Hydrodynamics and Siltation
- Under water Seismic Reflection studies
- Topographic Survey
- Hydraulic Survey
- Consolidated Report