IIC TECHNOLOGIES™

Final Feasibility Report National Waterway-13, Region VI - AVM Canal Poovar to Erayumanthurai (11.30km)

SURVEY PERIOD: 20 DEC 2015 TO 18 FEB 2016

Volume - I

Prepared for:

Inland Waterways Authority of India
(Ministry of Shipping, Govt. of India)
A-13, Sector – 1, NOIDA
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Uttar Pradesh – 201 301

ACKNOWLEDGEMENT

IIC Technologies Ltd. expresses its sincere gratitude to IWAI for awarding the work of carrying out detailed hydrographic surveys in the New National Waterways in NW-13 in Region VI – AVM Canal from Poovar to Erayumanthurai.

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

IIC Technologies Ltd. wishes to express their gratitude to **Capt. Ashish Arya, Hydrographic Chief, IWAI, Cdr. P.K. Srivastava, ex-Hydrographic Chief and Shri SVK Reddy, Chief Engineer-I** for their guidance and inspiration for this project. IIC Technologies Ltd, would also like to thank **Sh. Rajiv Singhal, A.H.S., IWAI** for his invaluable support and suggestions provided throughout the survey period. IIC Technologies Ltd, is pleased to place on records its sincere thanks to other staff and officers of IWAI for their excellent support and cooperation throughout the survey period.

CONTENTS

List of Abbreviations

AVM	Anantha Victoria Marthandam Canal
CD	Chart Datum
DGPS	Differential Global Positioning Systems
ETS	Electronic Total Station
GPS	Global Positioning Systems
LBM	Local Bench Mark
MSL	Mean Sea Level
RL	Reference Level
SD	Sounding Datum
SBAS	Satellite-Based Augmentation System
TBC	Trimble Business Center
FRP	Fiber Reinforced Plastic
PIA	Project Influence Area
NH	National Highway
SH	State Highway

SALIENT FEATURES AT A GLANCE

<table>
<tr><th>#</th><th>Particulars</th><th>Details</th></tr>
<tr><td>1.</td><td>Name of Consultant</td><td>IIC Technologies Limited, Hyderabad</td></tr>
<tr><td>2.</td><td>Region number & State(s)</td><td>Region – VI , Kerala and Tamilnadu States</td></tr>
<tr><td>3.</td><td>Waterway stretch, NW #
(from…. to; total length)</td><td>National Waterway No – 13
Poovar to Erayumanthurai (11.30km)</td></tr>
<tr><td>4.</td><td><u>Navigability Status</u></td><td>At present partially navigable</td></tr>
<tr><td>a)</td><td>Tidal & non tidal portions
(from… to, length, average tidal variation)</td><td>
<table>
<tr><th>Ch. From</th><th>Ch. To</th><th>Tidal Variation</th></tr>
<tr><td>0</td><td>2.10</td><td>0.2 m</td></tr>
<tr><td>2.10</td><td>9.5</td><td>Non Tidal area</td></tr>
<tr><td>9.5</td><td>11.30</td><td>0.3 m</td></tr>
</table>
</td></tr>
<tr><td>b)</td><td>LAD status (w.r.t. CD)
i) Survey period (.. to ..)
ii) < 1.2 m (km)
iii) 1.2 m to 1.4 m (km)
iv) 1.5 m to 1.7 m (km)
v) 1.8 m to 2.0 m (km)
vi) > 2.0 m (km)</td><td>
<table>
<tr><th>LAD (m)</th><th>0-3.5 km</th><th>3.5-9.5 km</th><th>9.5-11.30 km</th><th>Total</th></tr>
<tr><td>< 1.2</td><td>2.80</td><td>5.00</td><td>2.80</td><td>10.60</td></tr>
<tr><td>1.2 - 1.4</td><td>0.10</td><td>0.00</td><td>0.00</td><td>0.10</td></tr>
<tr><td>1.5 - 1.7</td><td>0.25</td><td>0.00</td><td>0.00</td><td>0.25</td></tr>
<tr><td>1.8 - 2.0</td><td>0.20</td><td>0.00</td><td>0.00</td><td>0.20</td></tr>
<tr><td>> 2</td><td>0.15</td><td>0.00</td><td>0.00</td><td>0.15</td></tr>
<tr><td>Total</td><td>3.50</td><td>5.00</td><td>2.80</td><td>11.30</td></tr>
</table>
</td></tr>
<tr><td>c)</td><td>Cross structures
i) Dams, weirs, barrages etc (total number; with navigation locks or not)
ii) Bridges, Power cables etc [total number; range of horizontal and vertical clearances]</td><td>Cross structures
(i) Dams, weirs, barrages - Nil
(ii) Bridges – 26 Nos
Horizontal Clearance range 1.1m to 21.8m
Vertical Clearance range 0.5m to 3.6m from MHWS
(iii) Power Cables - Nil</td></tr>
<tr><td>d)</td><td>Avg. discharge & no. of days</td><td>Discharge data not available from authorities</td></tr>
<tr><td>e)</td><td>Slope (1 in ….)</td><td>
<table>
<tr><th colspan="2">Chainage (km)</th><th rowspan="2">Slope (A/B)</th></tr>
<tr><th>From</th><th>To</th></tr>
<tr><td>0</td><td>3.5</td><td>1 : 0.651</td></tr>
<tr><td>3.5</td><td>9.5</td><td>1 : 0.077</td></tr>
<tr><td>9.5</td><td>11.3</td><td>1 : 0.842</td></tr>
</table>
Average Slope 1: 0.109
</td></tr>
<tr><td>5.</td><td>Traffic potential</td><td>Non Navigable at present condition</td></tr>
</table>

#	Particulars	Details
a)	Present IWT operations, ferry services, tourism, cargo, if any	No IWT operations had been found. Local Ferry Service by small boats and operation of tourism boats.
b)	Important industries within 50 km	No major industries. Found small scale Coconut Husk Processing industries near to canal.
c)	Distance of Rail & Road from Industry	SH179 and SH91 are passing parallel through the AVM canal.
6.	Consultant's recommendation for going ahead with TEF / DPR preparation	1. The canal can be developed for navigation with 30 m bottom width and 1.8 m depth below datum with a side slope of 1:3. 2. Dredging to the tune of 7.42 lakh cu.m is to be carried out to achieve this target. Waterway may be developed as a Class II waterway. 3. No cargo movement or passenger movement is envisaged through this canal. Considering the navigation feasibility of the AVM canal recommended to go ahead with TEF/DPR.
7.	Any other information/ comment	Nil

(Signature)

Date: Name of Consultant

1 Introduction

1.1 Background

The AVM canal is a man-made canal excavated in 1860 during the reign of Marthanda Varma Maharaja of Travancore state. It was a scheme for connecting Thiruvananthapuram with Kanyakumari and thus extending the water connectivity to the extreme South of the country. All the coastal villages numbering more than 20, including, Pozhiyoor, Kollengode, Marthandanthurai, Chinnathurai, Thengapattnam, Colachel, and Mondaicadu, all depended on upon this resource for most of their needs, including day to day transportation of men and materials. Since vast network of road exist in the region, today the AVM canal is not being used for transportation purpose. To assess the feasibility of water transportation over this stretch of river a bathymetric survey and topographic survey was carried out by IIC Technologies Ltd. on behalf of IWAI.

Figure 1 - Locations around the Survey Stretch

The weather was sunny throughout the period during survey operations. The weather was very favorable for boat operations and various topographic surveys, which includes a lot of man efforts. The weather condition remains same for the entire duration of the survey.

1.2 Tributaries of AVM Canal

No tributaries found for AVM Canal

1.3 State/District through which Canal passes

The AVM canal originates from Poovar Lake on Trivandrum district of Kerala and passes through Kanyakumari district of Tamilnadu State.

State Name	Chainage (km)		Length (km)
	From	To	
Kerala	0.00	2.80	2.80
Tamilnadu	2.80	11.30	8.50

Table 1 - State wise waterway

1.4 Maps

1.4.1 Full course of the waterway

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

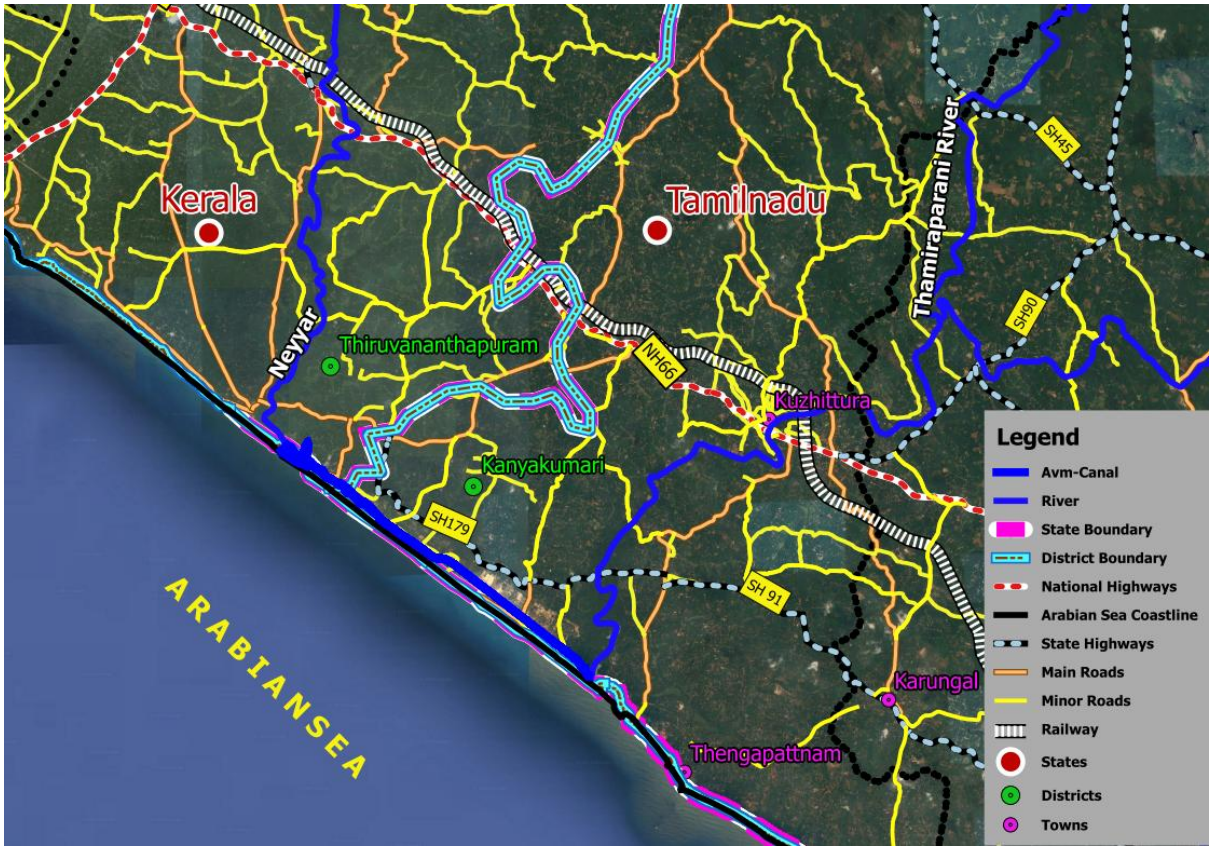


Figure 2 - Full course of AVM Canal

1.4.2 Course of the waterway under study

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

Figure 3- Map of AVM Canal

1.5 Scope of Work

IIC Technologies Ltd. conducted a hydrographic and topographic survey of AVM Canal from Poovar Beach at Lat 8°18'29.73"N, Long 77°4'45.20"E to Erayumanthurai Bus Stop at Lat 8°14'54.16"N, Long 77° 9'33.50"E.

The scope of the work for the conduct of survey of AVM canal includes:

- Undertake bathymetric and topographic survey of proposed waterway.
- Establishing horizontal and vertical control stations.
- Construction of benchmark pillars and establishing its reduced level w.r.to Mean Sea Level.
- Setting up and deployment of water level gauges
- Current velocity and discharge measurements.
- Collection and analysis of water and bottom samples.
- A collection of topographic features including existing cross structures.

- Preparation of inventory of industries in the project influence area (PIA)
- Analysis of survey data, including assessment of water availability for navigation.
- Preparation of survey charts and feasibility report.

2 Methodology Adopted to Undertake Study

2.1 Recce

Advance recce of the survey stretch was conducted on 16th Dec 2015. Recce started from Poovar beach (Pozhiyoor) by hiring a small boat on 16th Dec 2015. The canal takes off from South Poovar beach in Kerala and flows almost parallel to the Arabian Sea, at a distance of about 500 m to 1.5 km from the sea shore. It merges with Thamirabarani River in Tamil Nadu before its outfalls into the Arabian sea. The approximate length of the canal is 11.30 km.

Thick vegetation exists at many locations on either bank makes it difficult for taking spot leveling (as we have to study for minimum 100 m wide corridor if the width of the water body is less than 100 m).

2.2 Survey Resources and Methodology

The survey was commenced on 20th Dec 2015 and completed on 18 Feb 2016. The survey was undertaken on a scale of 1:1000, with sounding line spacing, kept at 50 m and plotted on UTM Projection at Zone 43N as directed in the contract specifications.

2.2.1 Survey Equipment

Following equipment were employed for the bathymetric and topographic survey

Equipment	Make	Eqpt. Serial No.	Qty. Employed
Echosounder	ELAC Hydrostar Digital Echosounder	308	1
Current Meter	Valeport801	-	1
Tide Gauge	Manual (Pole type)	-	3
Grab Sampler	Vanveen	-	1
Water sampler	Niskin Water Sampler	-	1
DGPS	Hemisphere Differential DGPS	18260616	1
DGPS Sets	Trimble R3/R4	-	06
Auto Level	Sokkia Auto level & Accessories	120775, 120595	02
ETS	Trimble M3	-	01

E/S Calibration	Bar Check	-	1
Software	HYPACK Survey	Version 15	1
Software	AUTOCAD	2012	1
Software	Microsoft Office	2013	1
Software	Trimble Business Center	Version-2	1

Table 2- Survey Equipment Used

2.2.2 Bathymetric Survey and Survey Launch

The bathymetric survey was conducted by hiring shallow draft boat (small FRP boat fitted with OBM) namely 'Vadekkevettil Boat No. 01' for the river stretch near to Poovar Lake. The maximum possible stretch of the canal was covered during the maximum flood water available within the canal due to the closing of sea opening (Pozhi). Another Low draft fishing boat was also hired for Erayumanthurai Side.

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

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

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

Figure 4 - Spot Sounding on AVM canal

2.2.3 Topographic Survey

The topographic survey was conducted to collect the following data:-

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

The spot levels along the river were obtained by using GPS leveling technique. Local terrain and limitation of the line of sight visibility prohibited the use of optical techniques to a large extent. The data was post processed using Trimble Business Center to get the correct position and height values of the rover locations visited during the day. These spot level heights were further compared and corrected in reference to the values obtained by Auto level and incorporated into the final map. The details of all spot levels are provided in the respective sheets being presented alongwith this report. Additionally, a soft copy of the same in XYZ format is being handed over as deliverable data.

Figure 5- Spot leveling by DGPS in progress

2.2.4 Calibration

The equipment used for the survey was calibrated by the equipment supplier. The equipment calibration certificates are placed at Annexure - 15 to this report.

2.3 Description of Benchmarks (BM) and Reference Level

The Details of Thengapattnam LBM was recovered from the layout of proposed Thengapattnam Fishing harbor, supplied by the State Fisheries Department, Tamilnadu. The details of Thengapattnam LBM are as follows:-

Sl. No.	Station	Latitude	Longitude
01	Thengapattnam LBM	8°14'25.41185"N	77°10'07.44564"E
The Reference level Value w.r.t Thengapattnam LBM			
(a)	M.H.W.S	5.140	Meters Below Thengapattnam LBM
(b)	M.H.W.N	5.380	
(c)	M.L.W.N	5.500	
(d)	M.L.W.S	5.750	
(e)	M.S.L	5.440	
(f)	CD	5.930	

Table 3-Reference Level Value of Thengapattnam LBM

The stations AVM-01 and AVM-02 are established near to the starting and end points of the stretch under study by baseline processing from Thengapattnam LBM. These stations are chosen for setting up as a reference station for daily Topographic survey operations. The raw data was logged on the DGPS receiver and the same was retrieved on daily basis. The raw data was post-processed on daily basis by using Trimble Business Center. The Auto Level was used for daily comparison and reduction of DGPS heights to accurate MSL heights throughout the period of Topographic survey. The final accepted WGS 84 coordinates of the various stations used for Horizontal and vertical control are as follows:

Sl. No.	Station	Latitude	Longitude	Ht. (in meters above MSL)	Chainage (km)	Source/ Type
01	Thengapattnam LBM	8°14'25.41185"N	77°10'07.44564"E	5.440	1.4km Downstream of Survey stretch	Online processing
02	AVM-01	8°18'14.97990"N	77°05'01.15664"E	2.364	0.71	Baseline processing
03	AVM-02	8° 14' 51.9770"N	77°09'34.33606"E	4.019	11.364	Baseline processing

Table 4 - Accepted Station Coordinates (WGS-84)

The details of horizontal and vertical control established and methodology followed for the conduct of survey is placed at Annexure 8.

Figure 6- LBM at Thengapattnam

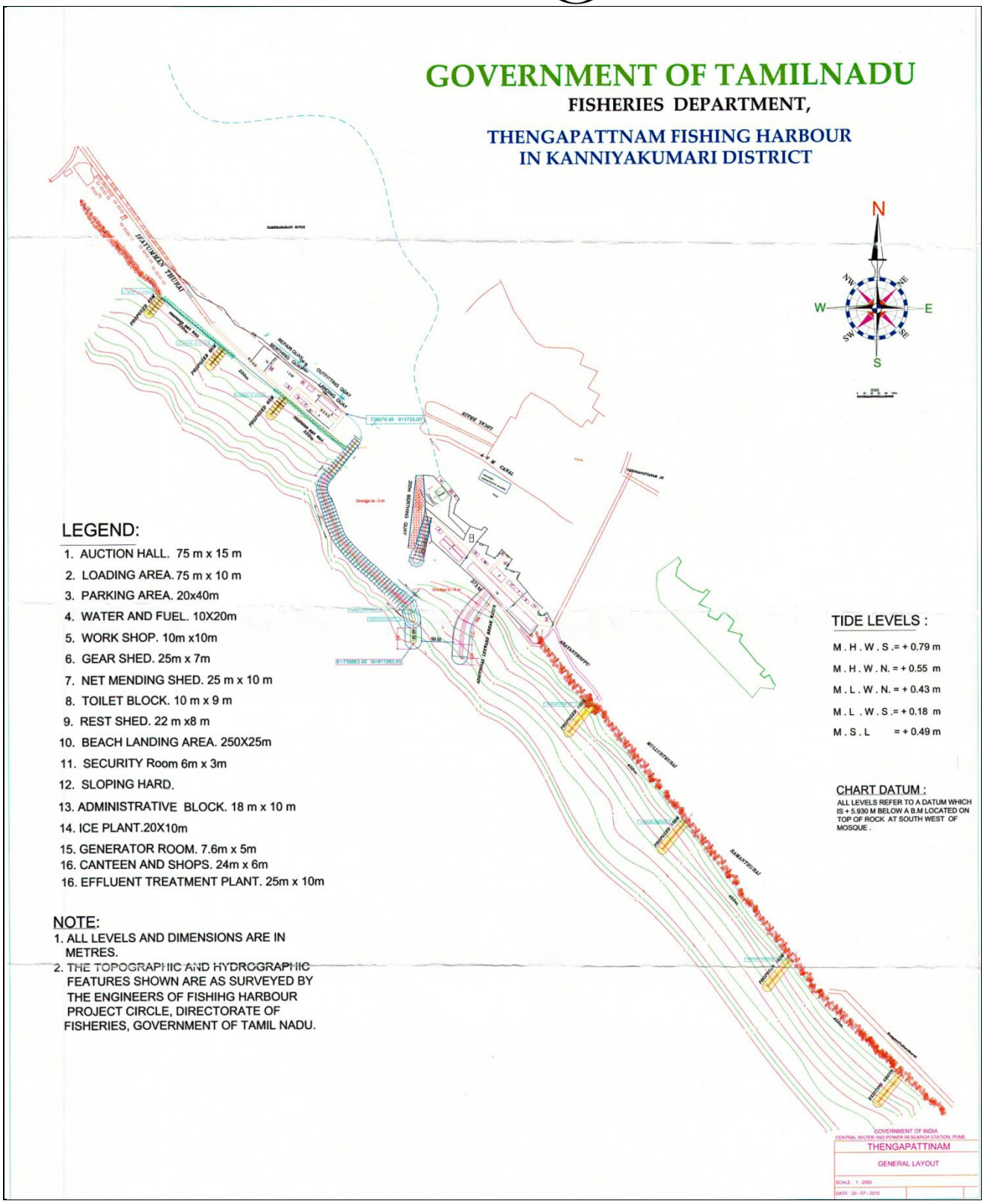


Figure 7-Layout of Proposed Fishing Harbour–Thengapattnam

2.4 Tidal influence Zone and Tidal Variation

The AVM canal is tidal canal and is connected to sea on both ends

Northern Side Poovar: The canal is connected to the Arabian Sea through the opening of Poovar Lake at Poovar Beach Pozhi. The Sea opening is generally closed due to the sand deposition from the sea waves to the beach. This results in the increase of water level in the AVM Canal and the adjoining area. On reaching flood level in the AVM canal the Pozhi will be opened by the local people and the water will be discharged through the Pozhi.

Figure 8- View of Pozhi from Poovar Lake to Open Sea

It is found that the excess water is not discharged fully through the AVM canal to Erayumanthurai or any major difference in the flow was observed during the survey period, however, the steady increase in the water level was observed throughout the canal. This phenomenon is likely due to the non-availability of adequate width for the canal, siltation of the canal bed and also on account of the slope of the canal.

Southern Side Erayumanthurai: The construction of the proposed fishing harbor is in progress at Thengapattnam. The Canal is always opened to the Sea in all state and a tidal variation is observed throughout the period of the survey. The datum value of Thengapattnam matches to the datum at Erayumanthurai. The area under Tidal Effect for the AVM canal is identified as follows:-

Sl. No.	Chainage (km)		Tidal Variation	Remarks
	From	To		
01	0	2.10	0.2 m	Small Variation in canal gradient.
02	2.10	9.5	Non Tidal area	Small Variation in canal gradient.
03	9.5	11.30	0.3 m	Large Variation in canal gradient

Table 5- Tidal variation - AVM Canal

2.5 Methodology to fix Chart Datum / Sounding Datums

2.5.1 Slope Calculation

The slope of AVM canal was calculated by doing simultaneous water level observations at 05 locations. The result is as follows:

Date:	05 Feb 2016	Time:	12:30 on All Tide Poles	
Tide Pole	**River Chainage**	**TP_Reading**	**Zero of TP w.r.t MSL**	**Water Level w.r.t MSL**
TP_AVM01	00.700	1.180	-0.068	1.112
TP_KLL2	02.600	1.187	-0.043	1.144
TP_THAT	06.115	0.945	0.189	1.134
TP_CHN3	08.630	0.205	0.819	1.024
TP_AVM 02	11.350	1.055	-0.827	0.228

Table 6 - Slope calculation AVM Canal

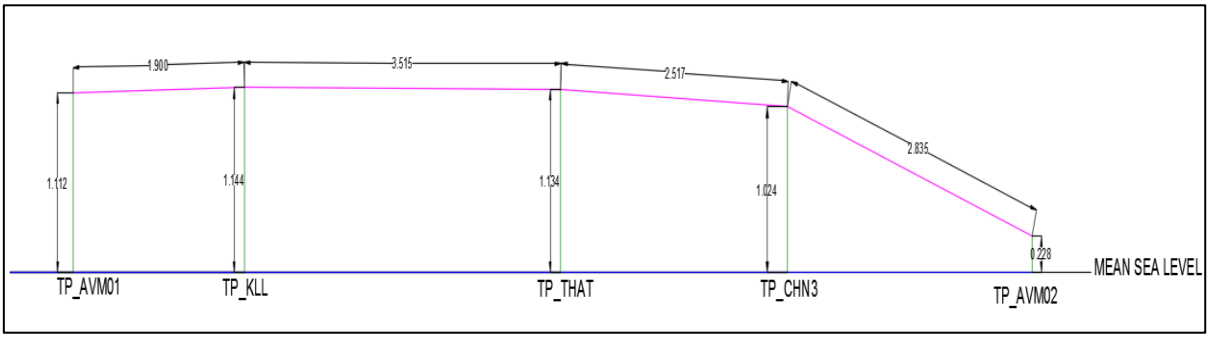


Figure 9 - Slope Calculation

2.5.2 Sounding Datum

The AVM canal lowest water level value is not available with CWC, IWAI Regional Office, PWD/ Irrigation Department. However, a Chart of the proposed fishing harbor was obtained from the State Fisheries Department, Thengapattnam in Tamil Nadu. The chart datum value of Thengapattnam LBM was transferred to AVM-02 by optical leveling method using Auto Levels (Sokia).

This chart datum was further attempted to transfer from AVM-02 to AVM 01 by auto leveling, however, the datum obtained by level transfer is not agreeing with on field tide behavior. The Transfer of sounding datum method as per admiralty was further attempted to obtain the new sounding datum value at AVM-01.

2.6 Yearly Minimum and Maximum Water Level

The AVM canal has tidal behaviors on starting and end chainages and with non-tidal behavior on the middle chainage. There are no established tide gauges of CWC/State Government and details of water level observations are also not available for this canal.

2.7 Transfer of Sounding Datum

The sounding datum was transferred from AVM02 to AVM01 while the Pozhi was opened. The final result of transfer of sounding datum from AVM-02 at Eraiammanthurai to AVM-01 at Poovar is as tabulated below:

Transfer of Sounding Datum – TP_AVM 02 To TP_AVM01			
S No	**Established Gauge**	**Value Of Sounding Datum w.r.t Zero Of TP**	
01	TP_AVM 02	TP_AVM01	The sounding Datum is 0.06m Below Zero Of TP_AVM01

Table 7- Transfer of Sounding Datum – TP_AVM02 to TP_AVM-01

TRANSFER OF SOUNDING DATUM **IH.533**

(FOR SEMI-DIURNAL TIDES)

Date and Time of 1st LW Observation at Established Gauge 01 Feb 2016, 12:00 hrs.

	Position of Established Gauge		**Lat / Lon** / **Name:**	**08°14′52.0″N, 77°09′34.4″E** / **AVM02 (E-THURAI)**		**Position of New Gauge**		**Lat / Lon** / **Name:**	**08°18′19.39″N, 77°05′2.08″E** / **AVM01 (POOVAR)**	
	AT ESTABLISHED GAUGE					AT NEW GAUGE				
Sl. No.	Height Above Cd			Contribution For		Height Above Zero Of Gauge			Contribution For	
	H.W	L.W	Factor	H.Ws	L.Ws	H.W	L.W	Factor	H.Ws	L.Ws
a	-	0.54	1	-	0.54	-	0.30	1	-	0.30
b	0.96	-	1	0.96	-	0.57	-	1	0.57	-
c	-	0.81	3	-	2.44	-	0.47	3	-	1.40
d	0.95	-	2	1.91	-	0.58	-	2	1.15	-
e	-	0.52	3	-	1.57	-	0.32	3	-	0.96
f	0.94	-	1	0.94	-	0.59	-	1	0.59	-
g	-	0.83	1	-	0.83	-	0.48	1	-	0.48
	Sum of Contribution			3.80	5.38	Sum of Contribution			2.31	3.14
	Observed MHW			0.95	-	Observed MHW			0.58	-
	Observed MLW			-	0.67	Observed MLW			-	0.39

Note: Observed MHW = Sum of Contributions of HW/4

Observed MLW = Sum of Contributions of LW/8

Observed Mean Range (R) =	0.28	Observed Mean Range (r) =	0.19
Observed Mean Level (M') =	0.81	Observed Mean Level (m') =	0.48

Note:Observed Mean Range = Observed MHW - Observed MLW

Observed Mean Level = (Observed MHW + Observed MLW)/2

CALCUALTION OF SOUNDING DATUM (d) AT NEW GAUGE

(A) Where 'True Spring M.L (M)' at Established gauge is known

From A.T.T (Table V of Part II)

MHWS =	
MLWS =	
True Spring M.L (M) =	0.00

Note:True Spring M.L (M) = (MHWS + MLWS)/2

SD = m'-(M'-M)-M*(r/R)

SD = 0.00 Mtrs above Zero of Gauge

(B) Where 'True Spring M.L (M)' at Established gauge is not known

SD = m'-((M*r)/R)

SD = 0.065 Mtrs below Zero of Gauge

Figure 10- Transfer of Sounding Datum – TP_AVM02 to TP_AVM-01

2.7.1 Sounding Datum adopted for Dredging Calculation

The obtained Sounding Datum value is in general agreement with the depths in the near vicinity area. The requirement of the survey is to maintain an even depth of 1.8 m

throughout the channel by dredging and to ascertain the dredge quantity. The details are as follows:

Sl. No.	Location	Chainage (km)	SD value from MSL (in m)
01	TP_AVM-01	0 to 2.1	0.128 Below MSL
02	TP_KLN	2.1 to 3.1	0.128 Below MSL
03	TP_THAT	3.1 to 7.9	0.128 Below MSL
04	TP_CHN	7.9 to 9.5	0.128 Below MSL
05	TP_AVM-02 (CD)	9.5 to 11.30	0.49 Below MSL (CD Value)

Table 8- Sounding Datum for Dredge Volume Calculation

The Sounding Datum value adopted for each Local Benchmarks and Tide Pole is as follows:-

Tide Gauge No.	Location	Chainage (km)	Easting/ Northing	Zero of Tide Gauge w.r.t. MSL (m)	Period of Observation
TP_AVM-01	Poovar	0.7	729519.964 918662.137	-0.068	23, 24, 25, 29, 30 Jan to 1st Feb 2016
TP_KLN-01	Kollemcode	2.6	731059.738 917579.873	0.235	25 Jan, 2, 3, 5 Feb 2016
TP_KLN-02	Kollemcode	2.6	731059.738 917579.873	-0.043	
TP_THAT	Thattur	6.1	733905.936 915670.750	0.189	3 Feb 2016
TP_CHN01	Chinnathurai	8.6	735889.950 914161.013	0.917	27, 30 Jan 2016
TP_CHN02	Chinnathurai	8.6	735889.950 914161.013	0.468	23 Jan 2016
TP_AVM-02	Eraiyumanthurai	11.35	737889.744 912333.595	-0.827	23, 24, 25, 27, 30 Jan to 1, 2, 3, 4, 5 Feb 2016

Table 9 - Value of Tide Pole w.r.t MSL

The acceptance of this value will give negative sounding on the central areas but considering the requirement of the survey is for making a navigable channel of 1.8mtrs depth, these areas need to be dredged for the smooth flow and availability of water throughout the area thereby clearing the impound central area.

As per the contractual agreement, Tidal observations needs to be recorded at 10 km (approx.) interval, However, Tide Gauges were erected at intermediate points to find the actual behavior/ variation of the tide and water level for the entire stretch of the AVM Canal for the duration of sounding operations. The calculation details of Sounding Datum, Leveling and Tides are placed at Annexure –3 and 11 to this report, respectively.

The tide gauges remained vertical for the complete duration of the survey and no shift (vertical/ horizontal) was observed in the gauges during the observation period. The

gauges were leveled to Local Bench Marks/ Bench Marks set up in the respective stretches. MSL heights of the BM/ LBMs were used to obtain the value of Zero of gauge w.r.t MSL.

2.8 Table indicating Tidal Variation at Different Observation Points

Sl. No	Tide Pole	Chainage (km)	Tidal Variation	Remarks
01	TP_AVM-01	0.7	0.2 m	Found during simultaneous observation on corresponding Tide Poles
02	TP_KLN	2.6	Non Tidal area	
03	TP_THAT	6.1	Non Tidal area	
04	TP_CHN	8.6	Non Tidal area	
05	TP_AVM-02	11.35	0.3 m	

Table 10 - Tidal variation at Different Observation Points

2.9 Salient features of Dam, Barrages etc.

There are no Dam, Barrages, Weirs, Anicut, Locks, and Aqueducts on the survey stretch of the AVM Canal.

2.10 Erected IWAI Benchmark Pillars

New bench Mark Pillars (IWAI BM Pillars) were constructed (02 no's) as per specification and erected at the starting and end chainage of the river. The value of these benchmarks w.r.t. MSL was obtained by leveling them to the Local bench marks established earlier. The final accepted co-ordinates and reduced level (R.L) values of these Bench Marks and other station established for setting up of reference DGPS base stations are as below:

BM. No.	Location	Chainage (km)	Latitude (N)	Longitude (E)	Easting	Northing	BM Height above MSL (m)	BM Height above SD (m)
BM-01	Pozhiyoor	0.71	N8°18'14.95844"	E77°05'01.20206"	729493.844	918525.816	2.553	2.681
BM-02	Erayumanthurai	11.364	N8°14'51.9975"	E77°09'34.2885"	737886.331	912333.500	3.662	4.152

Table 11 - Erected BM Pillars

2.11 Chart Datum / Sounding Datum and Reductions Details

Sl. No.	Bench Mark / Tide Gauges	Chainage (km)	Stretch for corrected soundings and topo levels (km)	Established Sounding Datum w.r.t. MSL (m) at col. A.	Sounding Datum of Tide Gauge wrt MSL (m)	Correction in WL data for Bathymetric survey (m)	Topo level data to be converted as depth for volume calculation wrt SD (m)
	A	B	C (50% stretch is to be selected on both side of tide gauge)	D +ve indicates above MSL -ve indicates below MSL	E	F = (E- WL data in MSL)	G = ((E- topo levels in MSL)
1	TP_AVM-01	0.7	0-2.1	-0.128	-0.128	Details placed at Annexure-4	Reduced_Topo _Dredging.xyz
2	TP_KLN	2.6	2.1-3.1	-0.128	-0.128		
3	TP_THAT	6.1	3.1-7.9	-0.128	-0.128		
4	TP_CHN	8.6	7.9-9.5	-0.128	-0.128		
5	TP_AVM 02	11.35	9.5-11.30	-0.490	-0.490		

Table 12 - CD /SD and Reductions

Station description of all IWAI Benchmark Pillars is placed at Annexure - 10 to this report.

2.12 HFL/MHWS values of Bridges/Cross Structures

There are no CWC gauges or state government gauges established in the survey stretch for computing the HFL value. The observed FSL caused due to the closing of Pozhi at Poovar Lake is accepted for starting chainage and the MHWS values of Thengapattnam LBM as obtained from the layout of proposed Thengapattnam Fishing harbor is accepted as the MHWS value at 11.3 km chainage of AVM Canal. The details of established and computed HFL values for the entire stretch are as follows:-

Sl. No.	Location and Description of Tide Gauge	Cross-Structure Details	Chainage (km)	Established HFL / MHWS / FSL / MWL / FRL w.r.t. MSL (m)	Computed MHWS/FSL at Cross-Structures w.r.t. MSL (m)
	A	B	B	D	E
01	TP_AVM01	-	0.7	-	1.8 (Observed)
02	-	Vellamanipalam	1.078	-	1.8
03	-	Poothurai	1.078	-	1.8
04	-	Poziyoor	1.831	-	1.8
05	-	Pallipalam	2.529	-	1.8
06	TP_KLL2	-	2.6	-	1.8
07	-	Neerody	3.409	-	1.8
08	-	Marthandamturai	3.409	-	1.8
09	-	Pozihyoor South	3.827	-	1.8
10	-	Wooden Bridge	4.323	-	1.8
11	-	Marthandamturai	4.324	-	1.8
12	-	Marthandamturai	4.636	-	1.7
13	-	Vallivalli	4.958	-	1.7
14	-	Vallivallikurusadi	4.966	-	1.7

Sl. No.	Location and Description of Tide Gauge	Cross-Structure Details	Chainage (km)	Established HFL / MHWS / FSL / MWL / FRL w.r.t. MSL (m)	Computed MHWS/FSL at Cross-Structures w.r.t. MSL (m)
	A	B	B	D	E
15	-	Tsunami colony	5.911	-	1.7
16	TP_THAT	-	6.1	-	1.7
17	-	Tadipuram	6.137	-	1.7
18	-	Wooden Bridge	7.903	-	1.6
19	-	Old Bridge	8.35	-	1.6
20	-	Under construction Bridge	8.351	-	1.6
21	-	New Bridge	8.59	-	1.6
22	-	Chinnaturai	8.59	-	1.6
23	TP_CHN	-	8.6	-	1.6
24	-	New Bridge	8.767	-	1.6
25	--	Old Bridge	8.768	-	1.6
26	-	Old Bridge	8.768	-	1.6
27	-	New Bridge	9.038	-	1.6
28	-	Thoorthoor	9.564	-	0.3
29	-	Thoorthoor	10.144	-	0.3
30	TP_AVM 02	-	11.35	0.3	-

Table 13 - HFL/MHWS values of Bridges/Cross Structures

2.13 Graph: Sounding Datum and HFL vs Chainage

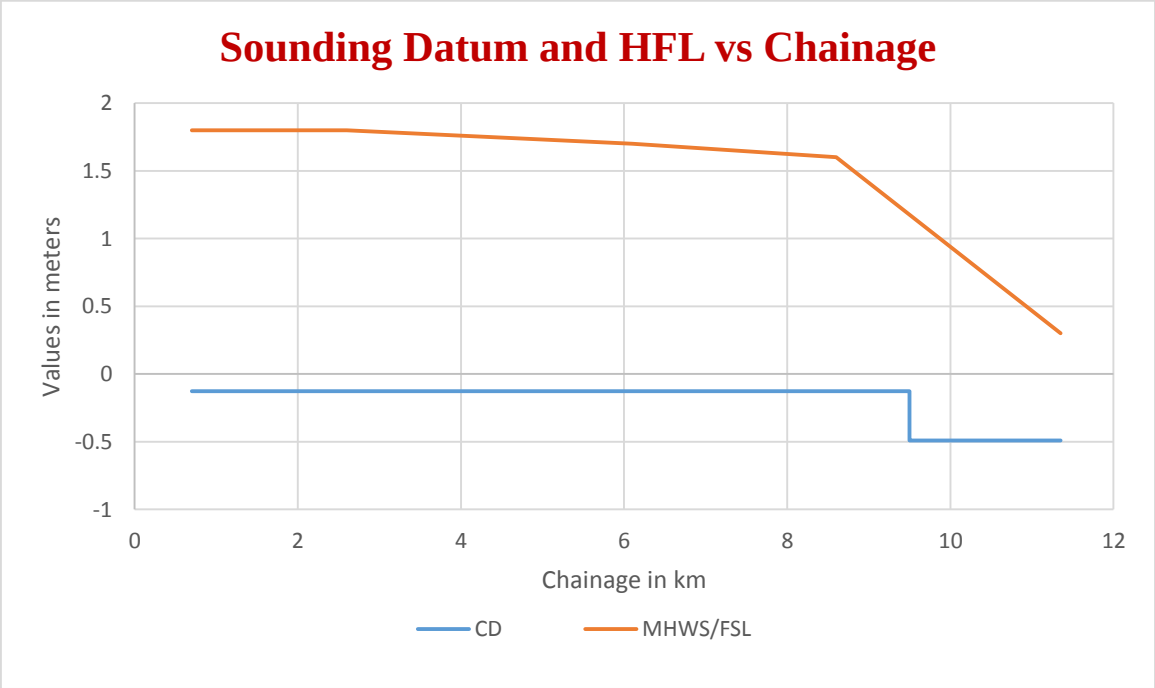


Figure 11 - SD and HFL vs Chainage

2.14 Average Bed Slope

The average bed slope for the AVM Canal is as follows:

Reach and River-bed Level (RBL)		River-bed Level Change (m) (A)	Distance (km) (B)	Slope (A/B)
From	To			
Ch. 0 - RBL_-2.308	Ch. 3.5 - RBL_-0.028	2.28	3.5	1 : 0.651
Ch. 3.5 - RBL_-0.028	Ch. 9.5 - RBL_0.435	0.463	6	1 : 0.077
Ch. 9.5 - RBL_0.435	Ch. 11.3 - RBL_-1.08	1.515	1.8	1 : 0.842

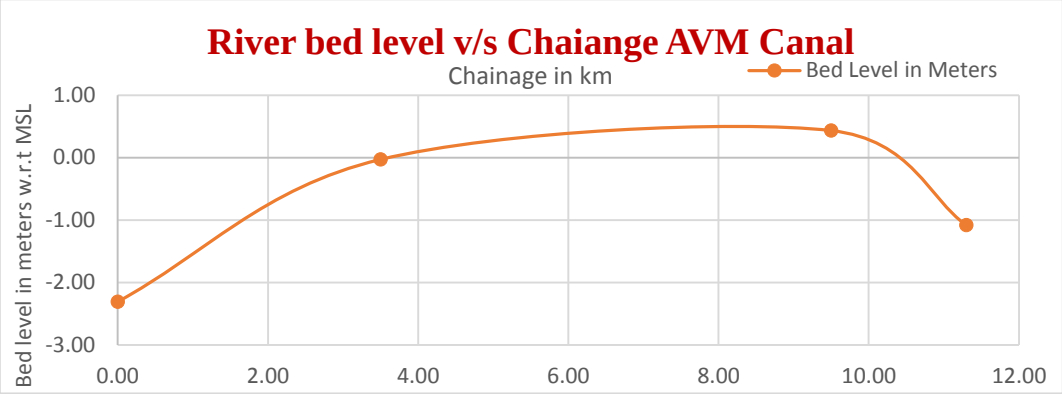


Table 14 - Average Bed Slope

2.15 Details of Dam, Barrages, Weirs, Anicut, etc

There are no Dams, Barrages, Weirs, Anicut etc.

2.16 Details of Locks

There are no Locks present in the survey stretch of the AVM canal.

2.17 Details of Aqueducts

There are no Aqueducts present in the survey stretch of the AVM canal.

2.18 Details of Bridges and Crossings over Waterway

There exist 26 bridges of permanent nature on the 11.30 km stretch of the AVM Canal. It is observed that the Bridges across the canal is notably low height. Considering the water level increase for the duration of Pozhi being closed, the overhead clearance on the tidal area near Poovar lakes are also derived from the High flood line instead of MHWS level. There are no High Tension lines crossing through the AVM Canal.

Sl. No.	Structure Name and for road / rail	Ch. (km)	Type of Structur	Location	Position (Lat Long) Left Bank/ Right Bank	Position (Lat Long) Left Bank/ Right Bank	Length (m)	Width (m)	No. of Piers	Horizontal clear	Vertical clearan	Remarks (complete / under - constructio

			e (RCC/Iron Wooden)							ance (clear distance Between piers) (m)	ce w.r.t. MHWS/FSL (m)	n), in use or not, condition
1	Vellamanipalam Bridge	1.078	RCC	Vellamanipalam	**Left Bank:** 8°18'11.2356"N 77°05'14.5140"E **Right Bank:** 8°18'9.9828"N 77°05'13.6608"E	**Left Bank:** 729901.8894 918413.5601 **Right Bank:** 729875.9777 918374.9255	47.28	2.6	10	4.95	1.1	Completed
2	Poziyoor Bridge	1.831	RCC	Poziyoor	**Left Bank:** 8°18'3.3048"N 77°05'25.2564"E **Right Bank:** 8°18'0.6660"N 77°05'23.9712"E	**Left Bank:** 730231.97146 918171.58682 **Right Bank:** 730193.06169 918090.29203	31.3	5.5	4	16.5	3	Completed
3	Pallipalam Bridge	2.529	RCC	Pallipalam	**Left Bank:** 8°17'56.6556"N 77°05'33.8388"E **Right Bank:** 8°17'56.0652"N 77°05'33.5148"E	**Left Bank:** 730495.73672 917968.64867 **Right Bank:** 730485.91546 917950.45397	15.7	2	4	7	2.2	Completed
4	Pozihyoor South Bridge	3.827	RCC	Pozihyoor South	**Left Bank:** 8°17'43.4652"N 77°05'51.8820"E **Right Bank:** 8°17'42.6408"N 77°05'51.1656"E	**Left Bank:** 731050.14381 917566.23617 **Right Bank:** 731028.34994 917540.78724	29.6	2.79	4	10.08	2.8	Completed
5	Neerody Bridge	3.409	RCC	Neerody	**Left Bank:** 8°17'25.6164"N 77°06'13.1724"E **Right Bank:** 8°17'25.0044"N 77°06'12.5820"E	**Left Bank:** 731704.71250 917021.20579 **Right Bank:** 731686.74071 917002.30382	26.48	4.1	4	7.25	2.3	Completed
6	Marthandamturai (Epline crossing)	3.827	RCC	Marthandamturai	**Left Bank:** 8°17'17.1852"N 77°06'23.9112"E **Right Bank:** 8°17'15.6732"N 77°06'22.7772"E	**Left Bank:** 732034.78787 916763.86363 **Right Bank:** 732000.32363 916717.21700	24.64	11.76	3	15.7	2.9	Completed
7	Marthandamturai Bridge	3.409	RCC	Marthandamturai	**Left Bank:** 8°17'11.3784"N 77°06'30.8268"E **Right Bank:** 8°17'10.6152"N 77°06'30.2616"E	**Left Bank:** 732247.41435 916586.54785 **Right Bank:** 732230.23851 916563.00347	26.35	3.59	4	6.1	1.6	Completed
8	Marthandamturai Bridge	4.324	RCC	Marthandamturai	**Left Bank:** 8°17'6.8640"N 77°06'36.5112"E **Right Bank:** 8°17'6.2376"N 77°06'36.1944"E	**Left Bank:** 732422.14561 916448.74711 **Right Bank:** 732412.55079 916429.44679	22.87	3.45	4	6.5	0.5	Completed
9	Marthandamturai Bridge	4.636	RCC	Marthandamturai	**Left Bank:** 8°17'01.5"N 77°06'44.9"E **Right Bank:** 8°17'1.0752"N 77°06'44.5752"E	**Left Bank:** 732679.79683 916285.27902 **Right Bank:** 732669.92426 916272.17236	14.1	3.6	4	4.4	1.6	Completed
10	Vallivalli Bridge	4.958	RCC	Vallivalli	**Left Bank:** 8°16'55.5960"N	**Left Bank:** 732950.05167	20.85	8.98	2	21.8	3	Completed

Sl. No.	Structure Name and for road / rail	Ch. (km)	Type of Structure (RCC/Iron Wooden)	Location	Position (Lat Long) Left Bank/ Right Bank	Position (Lat Long) Left Bank/ Right Bank	Length (m)	Width (m)	No. of Piers	Horizontal clearance (clear distance Between piers) (m)	Vertical clearance w.r.t. MHWS/ FSL (m)	Remarks (complete / under - construction), in use or not, condition
					77°06’53.6976”E **Right Bank:** 8°16’54.7000”N 77°06’53.1000”E	916105.28467 **Right Bank:** 732931.90583 916077.65384						
11	Vallivallikurusadi Bridge	4.966	RCC	Vallivalikurusadi	**Left Bank:** 8°16’48.1512”N 77°07’3.4716”E **Right Bank:** 8°16’47.6000”N 77°07’3.1000”E	**Left Bank:** 733250.44848 915878.10267 **Right Bank:** 733239.16407 915861.10404	11.13	1.88	4	5.9	0.8	Completed
12	Tsunami colony Bridge	5.911	RCC	Tsunami colony	**Left Bank:** 8°16’42.8844”N 77°07’20.8380”E **Right Bank:** 8°16’42.4000”N 77°07’20.500”E	**Left Bank:** 733782.89513 915719.09035 **Right Bank:** 733772.62838 915704.14976	13.46	4.13	3	5.5	1.5	Completed
13	Tadipuram Bridge	6.137	RCC	Tadipuram	**Left Bank:** 8°16’38.69”N 77°7’26.77”E **Right Bank:** 08°16’38.3”N 77°07’26.5”E	**Left Bank:** 733965.16210 915591.16762 **Right Bank:** 733956.96136 915579.13897	14.93	3.37	3	5.4	1.8	Completed
14	Wooden BridgeBridge	7.903	Wooden	Eraviputhenthurai West	**Left Bank:** 8°16’8.73”N 77°8’5.81”E **Right Bank:** 8°16’08”N 77°08’05.3”E	**Left Bank:** 735165.12443 914676.90136 **Right Bank:** 735149.63310 914654.38494	27.3	1.79	6	3.1	1	Completed
15	Old Bridge	8.35	RCC	Eraviputhenthurai West	**Left Bank:** 8°16’3.91”N 77°8’12.18”E **Right Bank:** 8°16’03.6”N 77°08’11.9”E	**Left Bank:** 735360.91125 914529.82969 **Right Bank:** 735352.39125 914520.25747	12.31	3	3	4.8	1.1	Completed
16	New Bridge	8.59	RCC	Eraviputhenthurai West	**Left Bank:** 8°16’4.16”N 77°8’12.13”E **Right Bank:** 8°16’03.8”N 77°08’11.8”E	**Left Bank:** 735359.33948 914537.50392 **Right Bank:** 735349.29716 914526.38700	21.24	6.76	3	6.8	1.8	Under construction
17	Old Bridge	8.768	Wooden	Eraviputhenthurai	**Left Bank:** 8°15’58.60”N 77°8’19.06”E **Right Bank:** 8°15’58.3”N 77°08’18.8”E	**Left Bank:** 735572.39207 914367.78477 **Right Bank:** 735564.48264 914358.52309	10.27	2.29	8	1.1	0.8	Completed
18	New Bridge	9.038	RCC	Eraviputhenthurai	**Left Bank:** 8°15’58.77”N 77°8’18.83”E **Right Bank:** 8°15’58.4”N 77°08’18.5”E	**Left Bank:** 735565.32343 914372.97104 **Right Bank:** 735555.28276 914361.54677	15.12	3.08	2	15.5	2.4	Completed

Sl. No.	Structure Name and for road / rail	Ch. (km)	Type of Structure (RCC/Iron Wooden)	Location	Position (Lat Long) Left Bank/ Right Bank	Position (Lat Long) Left Bank/ Right Bank	Length (m)	Width (m)	No. of Piers	Horizontal clearance (clear distance Between piers) (m)	Vertical clearance w.r.t. MHWS/ FSL (m)	Remarks (complete / under - construction), in use or not, condition
19	Under construction Bridge	8.351	RCC	Eraviputhenthurai	**Left Bank:** 8°15'56.14"N 77°8'22.19"E **Right Bank:** 8°15'55.75"N 77°8'21.90"E	**Left Bank:** 735668.61141 914292.70390 **Right Bank:** 735659.79848 914280.67159	12.55	2.46	3	5.8	1.1	Completed
20	Chinnaturai Bridge	8.59	RCC	Chinnaturai	**Left Bank:** 8°15'50.50"N 77°8'29.74"E **Right Bank:** 8°15'49.89"N 77°8'29.25"E	**Left Bank:** 735900.65887 914120.62927 **Right Bank:** 735885.75998 914101.80343	23.4	7.52	2	14.5	3.3	Completed
21	Old Bridge	8.768	RCC	Chinnaturai	**Left Bank:** 8°15'46.83"N 77°8'34.26"E **Right Bank:** 8°15'46.55"N 77°8'34.07"E	**Left Bank:** 736039.62943 914008.59447 **Right Bank:** 736033.85949 913999.95882	14.29	4.46	2	7.9	3.2	Completed
22	New Bridge	8.767	RCC	Chinnaturai	**Left Bank:** 8°15'46.83"N 77°8'34.26"E **Right Bank:** 8°15'46.55"N 77°8'34.07"E	**Left Bank:** 736039.62943 914008.59447 **Right Bank:** 736033.85949 913999.95882	14.29	4.46	4	3	1.4	Completed
23	Thoorthoor Bridge	9.564	RCC	Thoorthoor	**Left Bank:** 8°15'41.56"N 77°8'41.03"E **Right Bank:** 8°15'41.4"N 77°08'40.9"E	**Left Bank:** 736247.74169 913847.76265 **Right Bank:** 736243.78862 913842.82445	7.4	3.15	2	9.1	2.9	Completed
24	Thoorthoor Bridge	10.144	Wooden	Thoorthoor	**Left Bank:** 8°15'36.18"N 77°8'47.97"E **Right Bank:** 8°15'35.95"N 77°8'47.82"E	**Left Bank:** 736461.07781 913683.57917 **Right Bank:** 736456.52409 913676.48654	8.38	1	4	2	0.7	Completed
25	Wooden Bridge	4.323	RCC	Thoorthoor	**Left Bank:** 8°15'31.26"N 77°8'54.57"E **Right Bank:** 8°15'30.9"N 77°08'54.4"E	**Left Bank:** 736663.93 913533.48 **Right Bank:** 736658.79 913522.39	12.34	1.74	3	5.5	2.8	Under construction
26	Poothurai Bridge	1.078	RCC	Poothurai	**Left Bank:** 8°15'19.96"N 77°9'9.34"E **Right Bank:** 8°15'19.07"N 77°9'8.98"E	**Left Bank:** 737117.95 913188.66 **Right Bank:** 737107.07 913161.26	29.92	8.14	2	14.2	3.6	Completed

Table 15 - Details of existing Bridges and Crossings over Waterway

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

There are no other Cross structures, pipe-lines and underwater cables in the survey stretch of AVM canal.

2.20 Details of High Tension Lines / Electric lines / Tele-communication lines

There are no High Tension Line/Electric lines crossing the canal.

2.21 Current Meter and Discharge details

Valeport801 Velocity meter was used to log the flow rates of the river. The observations were undertaken on upstream and downstream of the AVM Canal. The locations of current meter deployment are as follows:

Sample No.	Chainage (km)	Position		Observed Depth (m) (D)	Velocity (m/sec.) 0.5 D	Average Velocity (m/sec.)	X-Sectional area (sq. m.)	Discharge (Cu.m)
		Latitude/ Longitude	Easting (m)/ Northing(m)					
1	2.02	08°18′04.3″N7 7°05′21.90″E	730129.079 918201.627	2.2	0.048	0.018	40.200	0.724
2	11.02	08°14′55.6″N7 7°09′32.24″E	737823.022 912443.867	1.3	0.089	0.031	22.681	0.703

Table 16 - Current Meter and Discharge Details

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

2.22 (a) Soil Sample Locations

Sample No.	Chainage (km)	Latitude	Longitude	Easting (m)	Northing (m)	Depth (m)
1	1.45	08°18′04.3″N	77°05′21.90″E	730129.079	918201.627	2.2
2	11.24	08°14′55.6″N	77°09′32.24″E	737823.022	912443.867	1.3

Table 17 - Soil Sample Locations

2.23 (b) Water Sample Locations

Sample No.	Chainage (km)	Latitude	Longitude	Easting (m)	Northing (m)	Total Depth (d) (m)	Mid-Depth (0.5d) (m)
1	1.45	08°18′04.3″N	77°05′21.90″E	730129.079	918201.627	2.2	1.0
2	11.24	08°14′55.6″N	77°09′32.24″E	737823.022	912443.867	1.3	0.7

Table 18 -Water Sample Locations

Canal bed soil and water sampling was undertaken using Vanveen Grab and by deploying Niskin Samplers at respective locations. The samples were sent for analysis purpose for soil lab.

Figure 12- Soil &Water Sampling of AVM canal

2.24 Analysis

The collected samples were analyzed for following properties:-

a) **Soil Samples**
   - Grain size
   - Specific Gravity
   - PH Value
   - Cu, Cc
   - Clay Silt percentage

b) **Water Samples**
   - Sediment Concentration

A detailed report on sample analysis is placed in Annexure–12 and 13 to this report.

3 Description of Waterway

The waterway of AVM canal coming within survey limits can be broadly divided into three stretches in accordance with the characteristics. The details are as follows:-

3.1 Sub-Stretch-1: From Poovar beach to Kollemcode (Ch. 0km to 3.5km)

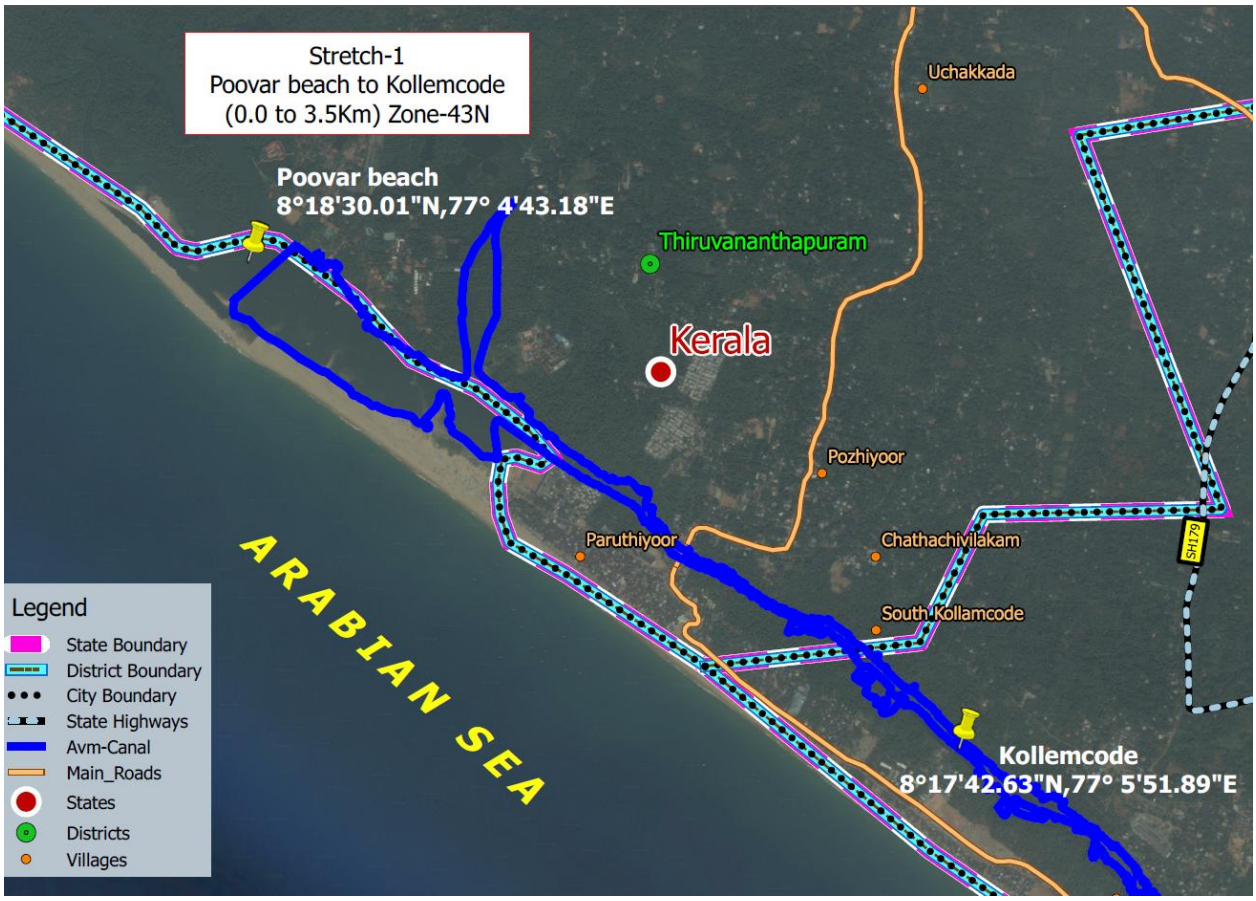


Figure 13- Poovar beach to Kollemcode– Stretch-01 (view near to Holy Marry Statue)

- **Bathymetry Survey**
  a) 3.5 km from 0.0 to 3.5 km chainage is covered by bathymetric survey for river bed area.
- **Topographic Survey**
  b) 3.5 km from 0.0 to 3.5 km chainage is covered by topographic survey for the river banks.

This stretch is covered by bathymetric survey for the canal bed and the topographic survey was conducted for the area beyond the river banks. There is no check dam/Barrage in this stretch; however, various overhead crossovers are present on this stretch. The right banks sides of the canal are protected in nature with various steps build for accessing the water for domestic purpose. The Left bank side of the canal in this stretch is non-protected in nature with coconut plantations on the river banks. Due to protected nature of the canal banks the encroachment to the waterways in not found in this stretch.

There are no railway station or railway lines running near to this stretch. The presence of various tourist spots (Poovar Beach, Floating Restaurant and resorts, Holy Mary Matha statue and Kollemcode Church) and frequent operation of Tourists boats make this area more prominent in the AVM Canal.

This stretch of AVM canal experiences the tidal effect with the observed mean range of 0.2m. The Pozhi (opening of Poovar Lake to the Arabian Sea) situated on Poovar beach is observed to be obstructed intermediately due to tidal activities. During these times the water level in Poovar Lake will be charged due to the inflow from Neyyar River. The rise in water level due to this charging is observed to be raised upto1.5m from the normal water level. The Right Bank side of the AVM Canal is not affected by the increase in water level due to protected in nature and high elevation. This increase in water level will flood the plantation and nearby areas. The Right bank Side is densely populated with several housing colonies near to the river banks. Waste dumping is also observed on various places from 2.1 to 3.1 km chainage on these densely populated canal banks.

Figure 14-Waste dumping on AVM Canal (1.2 km Chainage)

Class	Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.
I	0	2.1	-	-	-	-	-	-0.52	2.95	950	35,052.59	35,052.59
	2.1	3.5	1.23	3.27	900	6,802.10	0.00	-0.51	1.16	1500	56,508.83	91,561.42
II	0	2.1	-	-	-	-	-	-0.51	2.52	1200	73,151.35	73,151.35
	2.1	3.5	1.1	3.23	900	29,724.86	29,724.86	-0.51	1.16	1500	100,530.70	173,682.05
III	0	2.1	-	-	-	-	-	-0.52	2.92	1330	137,128.35	137,128.35
	2.1	3.5	1.1	3.23	900	77,302.29	77,302.29	-0.51	1.16	1500	163,338.55	300,466.90
IV	0	2.1	-	-	-	-	-	-0.52	2.92	1530	210,329.30	210,329.30
	2.1	3.5	1.1	3.23	1000	132,565.32	132,565.32	-0.53	1.16	1500	229,962.30	440,291.60

Table 19 - Stretch 1 Dredging Quantity

3.1.1 Observed and Reduced River-bed Profile

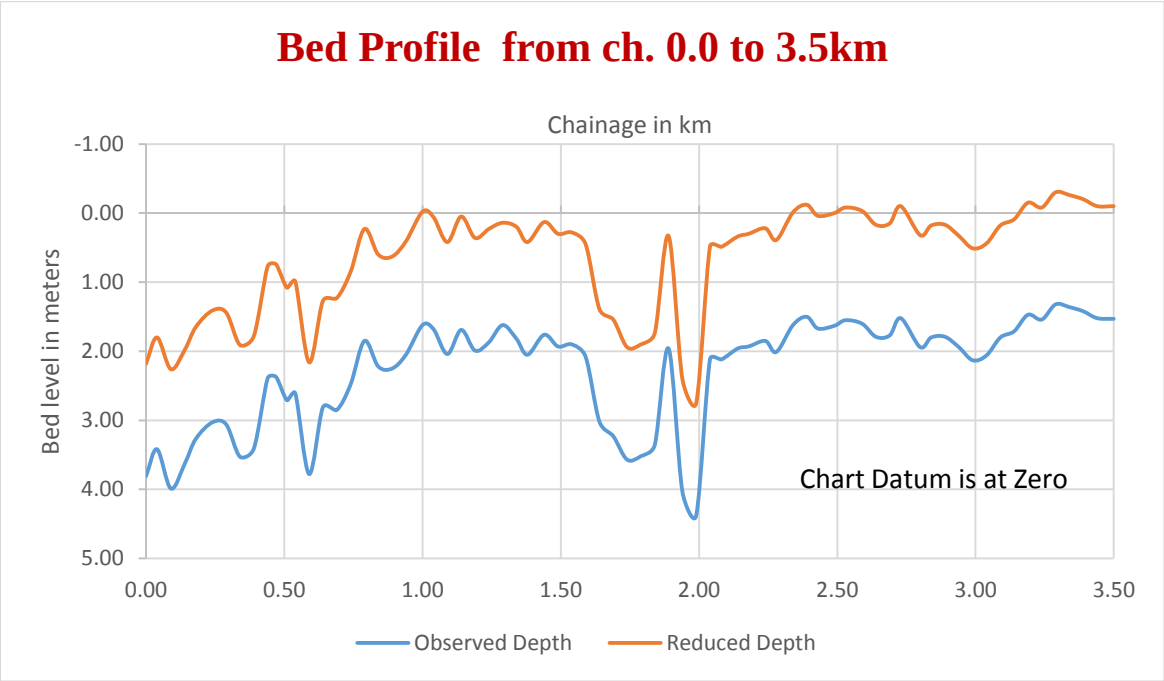


Figure 15 - Stretch 1 River-bed Profile

3.2 Sub-Stretch-2: From Kollemcode to Chinnathurai (Ch.3.5km to 9.5km)

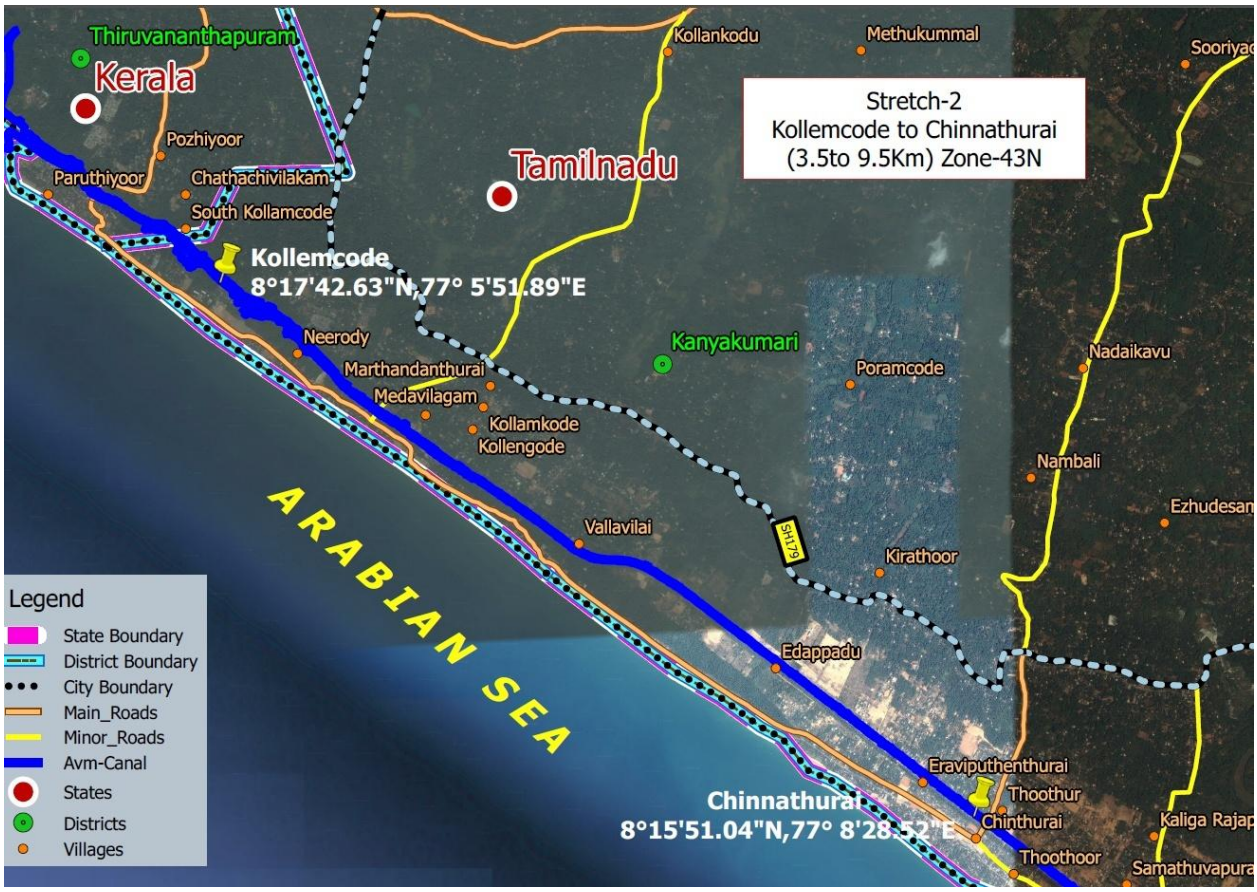


Figure 16- Kollemcode to Chinnathurai – Stretch-02 (Middle Portion)

- **Bathymetry Survey**
  a) 860 m from 3.5 to 4.36 km chainage is covered by bathymetric survey for river bed area.
- **Topographic Survey**
  b) 6.0 km from 3.5 to 9.5 km chainage is covered by topographic survey for this stretch.

This stretch is covered by topographic survey and the bathymetric survey could not be conducted due to non-availability of sufficient water level. There is no check dam/Barrage in this stretch; however, various overhead crossovers are present on this stretch. The right banks sides of the canal are protected in nature with various steps build for accessing the water for domestic purpose. The left bank side of the canal in this stretch is non-protected in nature with coconut plantations on the river banks.

This is the non-tidal Stretch of 06 km with very shallow depths and dry heights in the middle portions, a gradual increase in water level is observed while the pozhi at Poovar beach is closed. The prominent areas nearby are fishing villages and no tourist activities are observed in this area. Isolated Husk operations on the sides of the canal

were observed in this area. The right bank side is densely populated with several housing colonies near to the river banks.

Figure 17- View of AVM canal Middle stretches

Class	Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.
I	3.5	9.5	0.1	2.25	5800	196,473.74	203,275.84	-0.53	0.52	6000	269,148.61	360,710.03
II	3.5	9.5	0.1	2.16	5900	352,271.80	381,996.66	-0.53	0.52	6000	450,375.63	624,057.68
III	3.5	9.5	0.1	2.16	6000	580,424.62	657,726.91	-0.53	0.52	6000	702,964.38	1,003,431.28
IV	3.5	9.5	0.1	2.16	6000	824,690.10	957,255.42	-0.53	0.1	6000	968,946.07	1,409,237.67

Table 20 - Stretch 2 Dredging Quantity

3.2.1 Observed and Reduced River-bed Profile

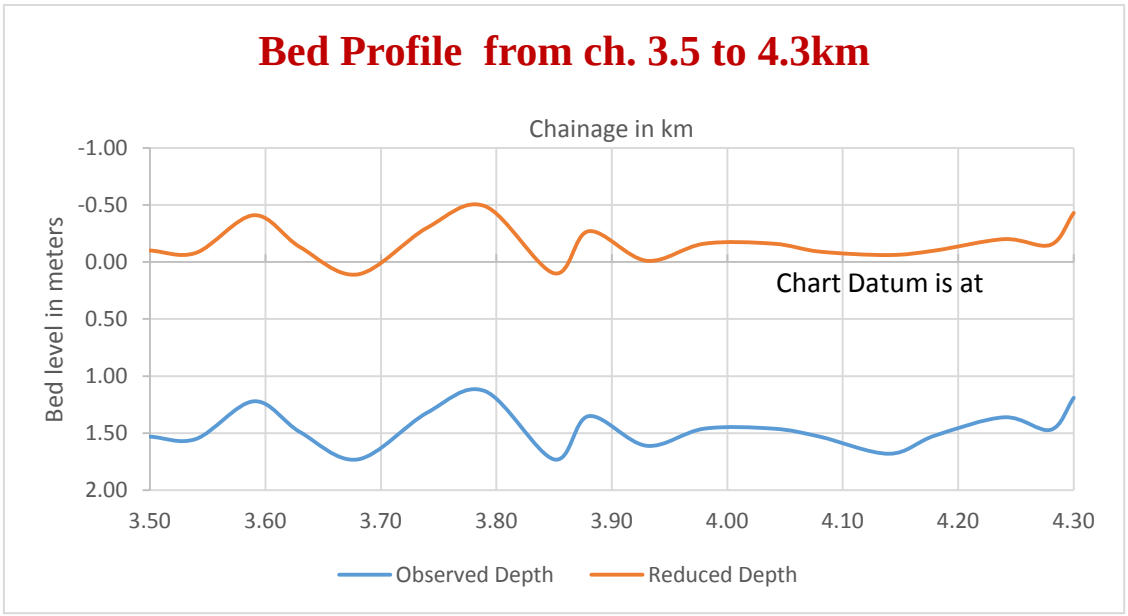


Figure 18 - Stretch 2 River-bed Profile for Soundings

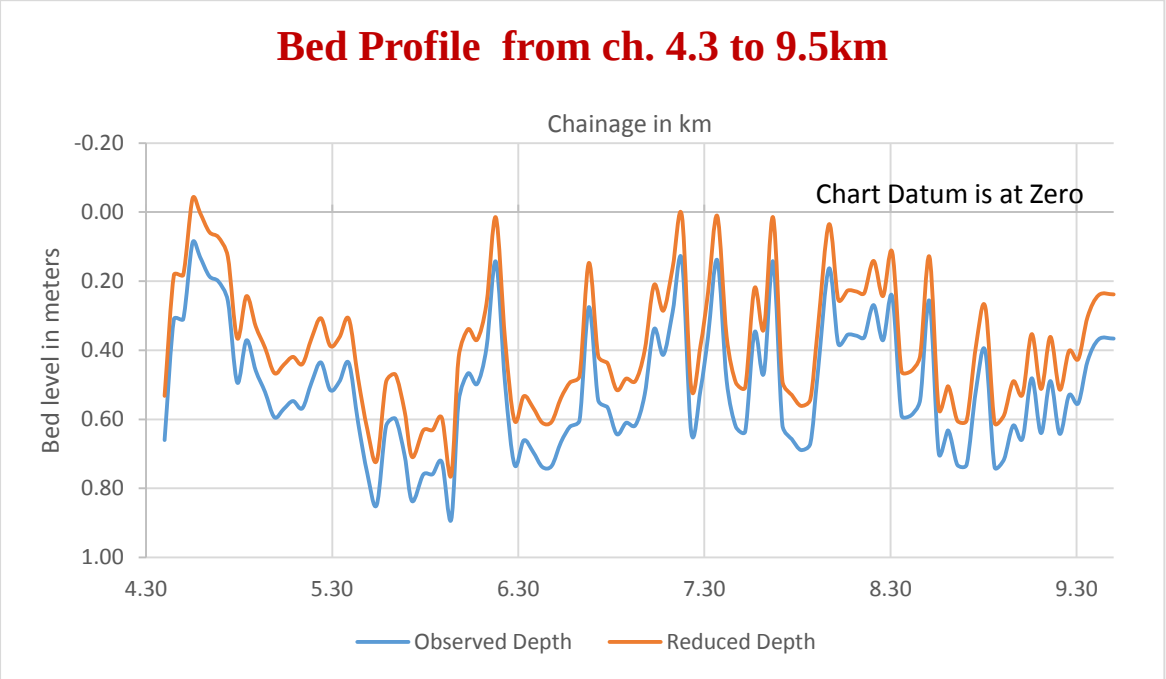


Figure 19 - Stretch 2 River-bed Profile for Elevations

3.3 Sub-Stretch-3: Chinnathurai to Erayumanthurai (9.5km to 11.30km)

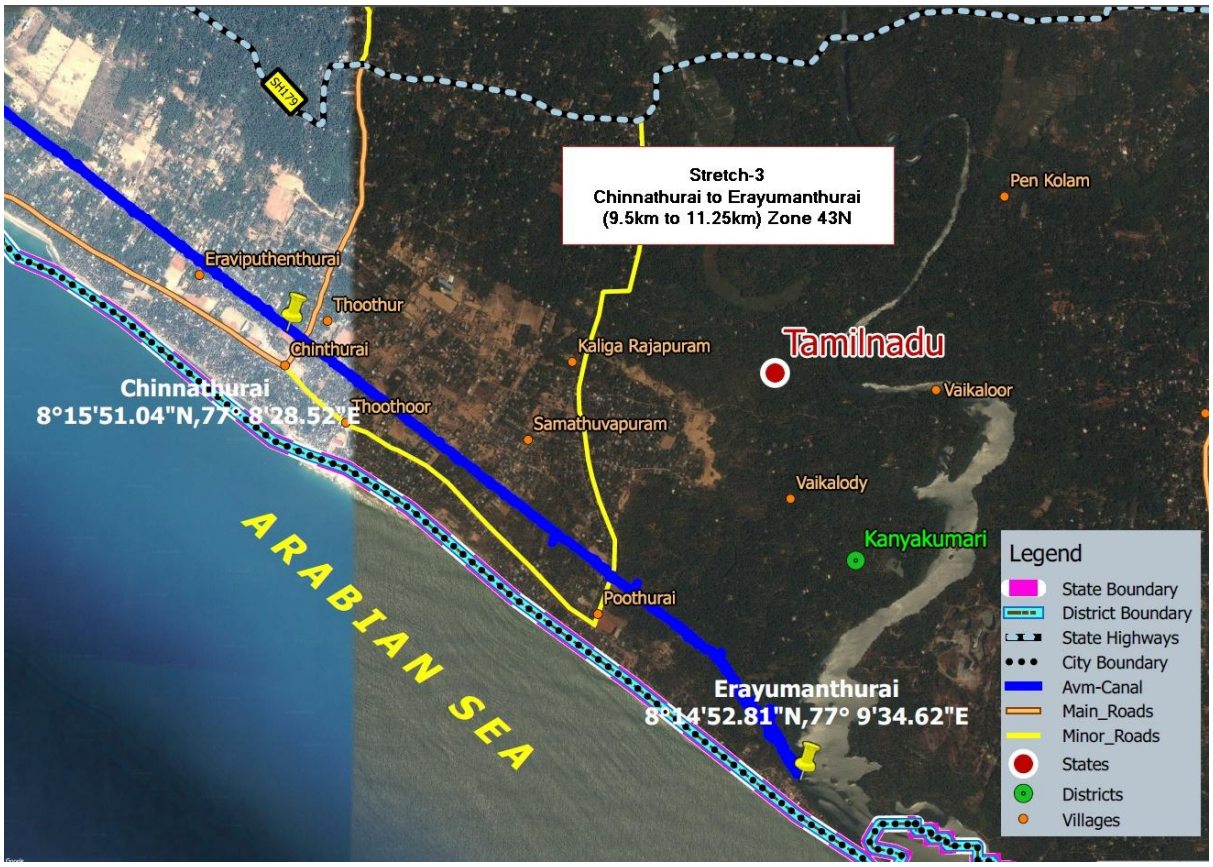


Figure 20- View of AVM Canal – Stretch-03 (Erayumanthurai)

- **Bathymetry Survey**
  a) 845 m from 10.455 to 11.3 km chainage is covered by bathymetric survey for river bed area.
- **Topographic Survey**
  b) 6.0 km from 9.5 to 11.3 km chainage is covered by topographic survey for the both river banks.

This stretch is covered by bathymetric survey for the canal bed and the topographic survey was conducted for the area beyond the river banks. There is no check dam/Barrage in this stretch; however, various overhead crossovers are present on this stretch. The right banks sides of the canal are densely populated and the river banks are protected in nature with various steps build for accessing the water for domestic purpose. The left bank side of the canal in this stretch is non-protected in nature with coconut plantations on the river banks. Due to protected nature of the canal banks the encroachment to the waterways in not found in this stretch.

This is a tidal Stretch of 1.8km with moderate depth on the area conjoining with Thamarapharani River. This portion of AVM canal experience tidal effect of 0.3 m throughout as the chances of the closing of Pozhi near Thengapattnam is very less due to ongoing fishing and construction activities. The proposed site for the fishing harbor at Thengapattnam is very close by and construction works are going on in this area. There exist small boats which are used for ferry services from Erayumanthurai to

Thengapattnam. This area has potential scope for development of tourism activities. Isolated husk operations were also found on the sides of the canal with some small scale production.

Class	Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.
I	9.5	11.3	-	-	-	-	-	-0.3	1.21	1800	67,052.80	427,762.83
II	9.5	11.3	-	-	-	-	-	-0.3	1.21	1800	117,726.88	741,784.56
III	9.5	11.3	-	-	-	-	-	-0.3	1.21	1800	190,249.44	1,193,680.72
IV	9.5	11.3	-	-	-	-	-	-0.3	1.21	1800	267,294.13	1,676,531.80

Table 21 - Stretch 3 Dredging Quantity

3.3.1 Observed and Reduced River-bed Profile

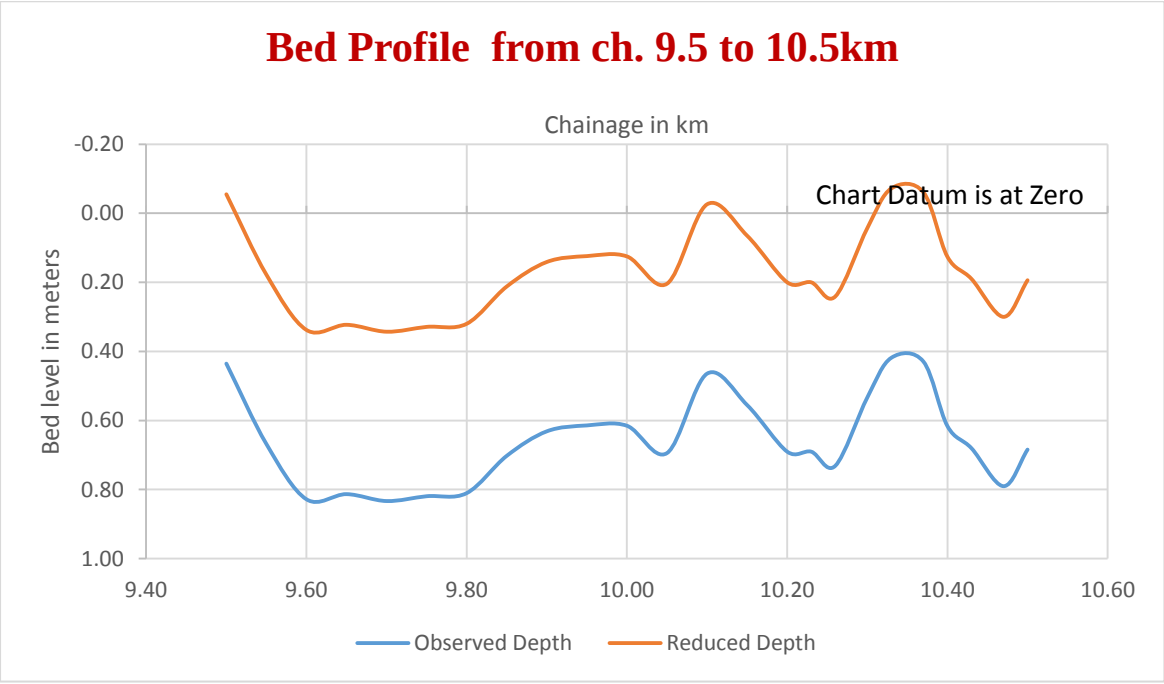


Figure 21 - Stretch 3 River-bed Profile for Elevations

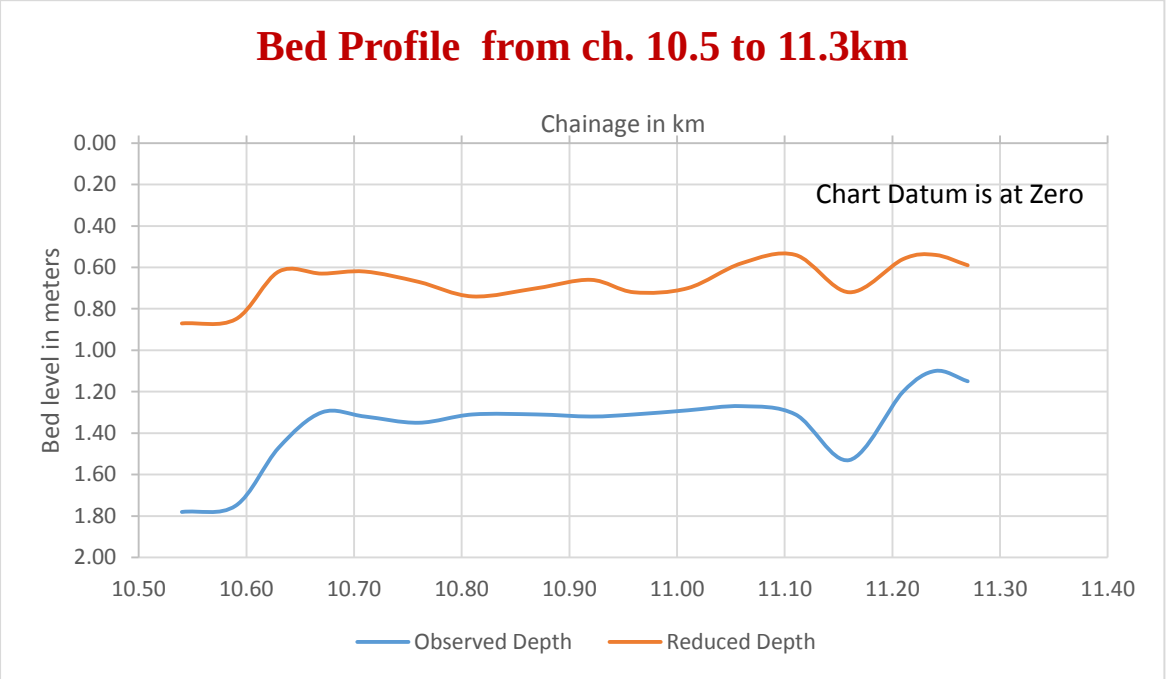


Figure 22 - Stretch 3 River-bed Profile for Soundings

3.4 Other Aspects of Waterway

3.4.1 Fishing

The AVM canal is located as parallel to the coastline and most of the population depends upon fishing activities. There exists no fishing jetty near to the AVM canal. The construction work of the proposed fishing harbor is in progress near Thengapattnam. The boats used for the fishing are conventional small boats with less endurance at sea.

3.4.2 Industries

No Large scale industries exist near to the survey area. The presence of Husk industry (Very Small Scale) near to Erayumanthurai depends on the AVM Canal for processing of Coconut Husk.

3.4.3 Crops

The river banks are plenty spread with coconut trees on the entire stretch of the river. No other seasonal crops are available in the area.

Figure 23 - Thick Coconut trees on riverbank of AVM canal

3.4.4 Settlements

The Right bank (western side) of the canal is densely populated in comparison with the left bank (eastern side). The work of proposed Road from Vizhinjam harbor to Kanyakumari is in progress on the right bank (seaward side). Tsunami relief colonies are also situated near to the river bank of AVM Canal.

3.4.5 Irrigation/Drinking water

The AVM canal is not utilized for any irrigation projects for other cultivation. There is no other Drinking water pumping facility found throughout the canal.

3.4.6 Important cities/towns

The Major town situated near to AVM canal is Poovar on the starting chainage and Marthandam at the End chainage. No Major cities are located nearby; however, the area adjoining is moderately developed at various locations. These are capable of sustaining for all day to day needs of the population nearby. The areas are well connected by Road and public transport system. Local taxis and Autos are also available along the entire canal stretch.

3.4.7 Transportation

SH179 and SH91 are passing parallel through the AVM canal in Kanyakumari district. As per local information, the present beach road is proposed to be developed to Vizinjam- Kanyakumari road as a part of the development program for newly constructed Vizhinjam harbor.

Figure 24 - Road Network

3.4.8 Land Use

The Right bank Side of AVM Canal is densely populated in nature and the beach road is running parallel to the canal in this area. The Left bank side of the AVM canal is utilized for coconut plantation and some isolated houses are present in this area.

3.4.9 Construction Material

The constructions of Hollow bricks are very prominent near Erayumanthurai area. The river banks are having a good road network and hence any types of construction material are available at ease. The houses and buildings well-ordered to the survey area are concrete constructed.

3.4.10 Cargo Movement

There are no major industries present near AVM canal, hence no cargo movement or passenger movement is envisaged through this canal. However, if adequate depth and width is maintained with bank protection measures, the canal is having high potential for tourism activities, particularly for boat operation between the two beaches of Poovar and Thengapattnam.

3.4.11 Passenger Ferry Services

Small passenger ferry system is available at Erayumanthurai at on-demand basis. The small country boats are being used for the transit of man and materials from

Erayumanthurai to Thengapattnam. On Poovar side, the tourist boats are operated frequently on the Poovar Lake.

3.4.12 Historic Importance

The AVM canal was formed in July 1860 during the reign of Marthanda Varma Maharaja of Travancore state. It was a scheme for connecting Thiruvananthapuram with Kanyakumari and thus extending the water communications to the extreme south of the country.

3.4.13 Tourism

The canal starts from the Poovar Lake. Poovar Beach separates the River Neyyar from the sea. Poovar is basically a fishing village known for its pristine beauty. The estuary there is one among the natural wonders where the Lake, River, Sea and Beach meet the land, and is situated adjacent to the Poovar Island. Large scale beach activities and water sports are not fully developed, but the tourism activity is limited to small boat operations (FRP boats fitted with OBM in Neyyar River between Uchakada and Poovar beach). Floating Accommodation and Floating Restaurant at Poovar Lake are main tourist attraction. These facilities are being used suitably by the tourist who visits the area.

Figure 25- View of Poovar lake with Floating accommodation on Background (0.5 km chainage)

There exist many Agents operating Tourist Boats in the area. These boats operate in Poovar Lake and the small creeks through the Neyyar River. On discussion with the boat operators, they expressed their willingness to operate in the AVM canal provided adequate depth is maintained in the canal up to Erayumanthurai.

Figure 26 - Tourist boats operating near Poovar Lake (0.7 km chainage)

3.4.14 Proposed Fishing Harbour

The Proposed fishing harbor at Thengapattnam also contributes a good scope for the improvement of the AVM canal near Erayumanthurai. The Fishing Jetty is likely to be extended up to the Erayumanthurai Bus stand. There exists a small boat for ferrying men and material from Erayumanthurai to Thengapattnam. The detail of Proposed Fishing Harbour is as follows:-

Location	Lat	Long	Remarks
Proposed Fishing Harbour – Thengapattnam	8°14'20.62"N	77°10'5.89"E	Construction phase is in progress

Table 22 - Proposed fishing harbor at Thengapattnam

Figure 27-Site for proposed fishing harbor at Thengapattnam (1.3 km from Erayumanthurai)

3.4.15 Irrigation Canals and Outlets

No irrigational canals and outlets are present in the AVM Canal throughout the stretch. The Water discharge from Neyyar River to Poovar Lake is the major source of water for the AVM canal at the starting stretch. The Thamirabarani River is the main source of water for the end stretch of AVM Canal. Besides, the tidal effect also

contributes to the water when the pozhi is open. The water from AVM canal is not used directly for any drinking purpose and there is no pump house located in the AVM canal. The photos of important events and features are placed at Annexure -16 to this report.

Figure 28 – Riverside Features

4 Terminals

There are no existing jetties and terminals in the survey stretch of the AVM canal. The protected river banks and steps near Erayumanthurai are being used locally for fasting the small boats. This area is also being used as the boarding point for the transfer of men and material from Erayumanthurai to Thengapattnam. The small protected boundary line wall near Holy Marymatha Shrine is also used by the tourist boat as the boarding point for tourist passengers. The details of the location used as local terminals are as follows:

Sl. No.	Location	Chainage	Lat	Long	Remarks
01	Poovar	0.7 km	8°18'16.60"N	77° 5'0.88"E	Used by Tourist Boats
02	Erayumanthurai	11.3 km	8°14'53.14"N	77° 9'33.79"E	Used by Country boats

Table 23-Location of local Terminal on AVM Canal

4.1 Proposed Locations for Construction of New Terminals

The AVM Canal is only 11.30 km stretch and most of the Right bank sides is protected in nature with several steps build up. If having sufficient depth these places, these areas can be used as Terminals for small boats. The AVM canal is connected with Poovar Lake, on maintaining sufficient depth throughout the canal; this has got a potential tourism value. However, the Low overhead clearance will be a challenge for this canal to enable Inland Water Transportation (IWT). It would be better to construct jetties at important locations (i.e. starting, ending and mid portion) for boat operations. The details of the proposed locations for the terminal construction are as tabulated below:

Sl. No.	Location	Lat	Long	Land Use	Owner
01	Poovar	8°18'16.60"N	77° 5' 0.88"E	Used by Tourist Boat	Govt. Land
	The proposed location is 3.0 Km from Poovar-Parasala Road and is 7.0 Km from Poovar Town. The area is well connected with road network and is very near to the place of interest for tourism activities like Poovar beach. The Depth in the area need to be improved for the berthing of boats throughout the period. There are no industries situated near to the proposed location thus scope of development in cargo movement aspect is very less.				
Sl. No.	**Location**	**Lat**	**Long**	**Land Use**	**Owner**
02	Chinnathurai	8°15'50.16"N	77° 8'29.31"E	Bathing Place	Govt. Land

Sl. No.	Location	Lat	Long	Land Use	Owner
	The proposed location is 10 Km from Poovar-Marthandam Road and is 20 Km from Marthandam Town, TN. The area is well connected with road network and the area is one of the prominent places between Kollemcode and Erayumanthurai. The Depth in the channel is needed to be improved for the berthing of boats throughout the period. There are no industries situated near to the proposed location thus scope of development in cargo movement aspect is very less.				
03	Erayumanthurai	8°14'53.14"N	77° 9'33.79"E	Local Boarding Point	Govt. Land
	The proposed location is 14 Km fromPoovar-Marthandam Road and is 24 Km from Marthandam Town, TN. The proposed Thengapatanam fishing Harbour is situated 1.5 Km South from this proposed location. The area is well connected with road network and the area is the end point for the public transportation. This can be developed as the terminal for the ferry system for transportation of Men and material from Erayumanthurai to Thengapatanam fishing harbour. The Depth in the channel is needed to be improved for the berthing of boats throughout the period.				

Table 24-Proposed Locations for Terminal Construction

5 Fairway Development

5.1 Design channel of the waterway

The AVM canal is situated parallel to the seashore and is almost straight with no major curves in the run. The canal is designed as best suitable for the purpose of navigation. No major alteration in design is required to make this channel navigable.

5.2 Fairway Dimensions

As per the specification of the survey, dredging quantity was required to be estimated for different channel classifications along the deepest route. Class-II canal with dimension 30m width, 1.8m depth and side slop of 1:3 is shown below.

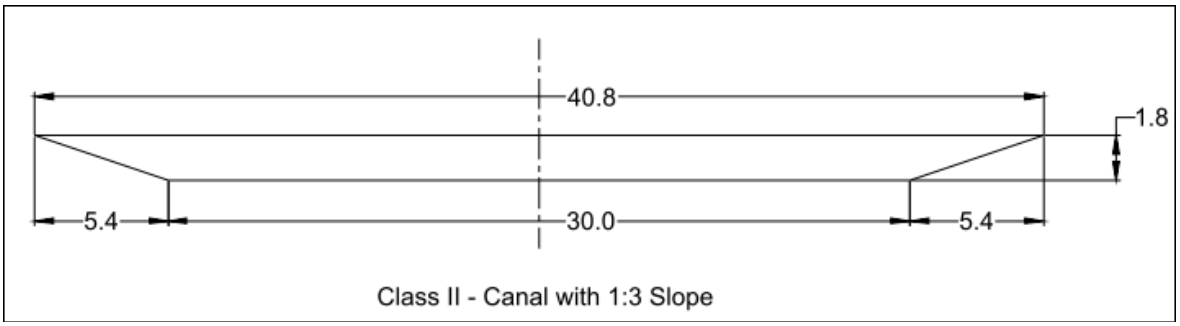
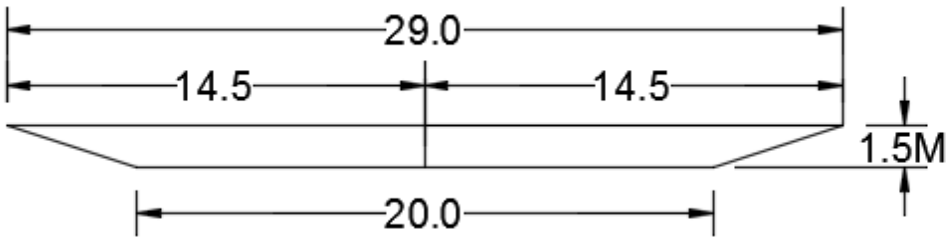


Figure 29- Fairway Channel Dimensions

5.3 Calculation of Dredging Quantity

The dredge volume calculations were accomplished using the HYPACK dredge volume computation utility. The channel template was created as per the different classification and kilo meter wise dredging calculation was carried out. (Enclosed at Annexure 2). The Hypack Standard volume algorithm was used to calculate the dredge volume in each segment. The stretch wise dredge volume for different class of fairway is as follows:-

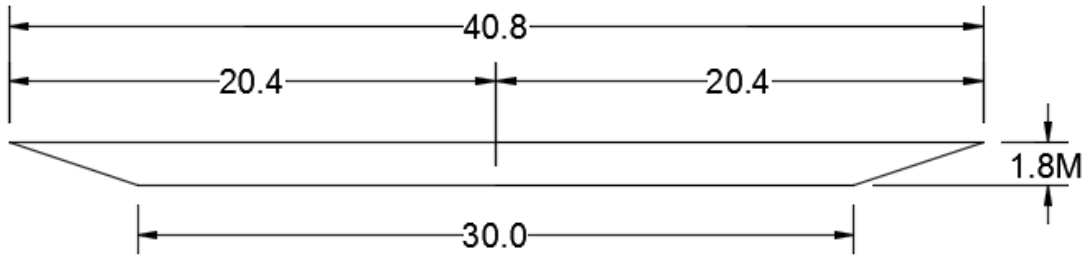
Class I



Class I													
Location		Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
From	To	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.
Poovar Beach	Kollemcode	0	2.1	-	-	-	-	-	-0.52	2.95	950	35,052.59	35,052.59
Kollemcode	Kollemcode	2.1	3.5	1.23	3.27	900	6,802.10	0.00	-0.51	1.16	1500	56,508.83	91,561.42
Kollemcode	Chinnathurai	3.5	9.5	0.1	2.25	5800	196,473.74	203,275.84	-0.53	0.52	6000	269,148.61	360,710.03
Chinnathurai	Erayumanthurai	9.5	11.3	-	-	-	-	-	-0.3	1.21	1800	67,052.80	427,762.83
			Total			**6700**	**203,275.84**	**203,275.84**		**Total**		**10250**	**427,762.83**	**427,762.83**

Table 25 - Dredge Volumes Class-I

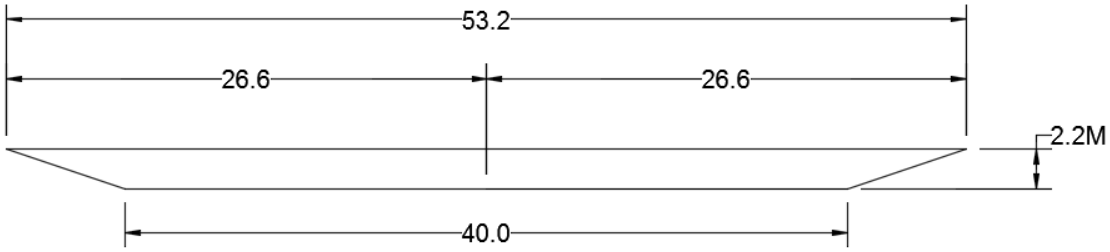
Class II



Class II													
Location		Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
From	To	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.
Poovar Beach	Kollemcode	0	2.1	-	-	-	-	-	-0.51	2.52	1200	73,151.35	73,151.35
Kollemcode	Kollemcode	2.1	3.5	1.1	3.23	900	29,724.86	29,724.86	-0.51	1.16	1500	100,530.70	173,682.05
Kollemcode	Chinnathurai	3.5	9.5	0.1	2.16	5900	352,271.80	381,996.66	-0.53	0.52	6000	450,375.63	624,057.68
Chinnathurai	Erayumanthurai	9.5	11.3	-	-	-	-	-	-0.3	1.21	1800	117,726.88	741,784.56
			Total			**6800**	**381,996.66**	**381,996.66**		**Total**		**10500**	**741,784.56**	**741,784.56**

Table 26 - Dredge Volumes Class-II

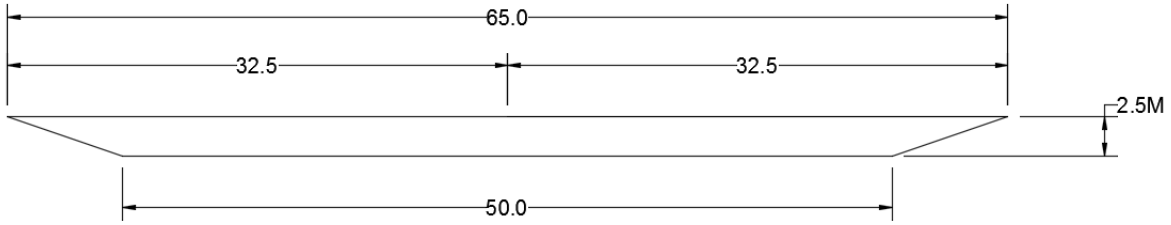
Class III



Class III													
Location		Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
From	To	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.
Poovar Beach	Kollemcode	0	2.1	-	-	-	-	-	-0.52	2.92	1330	137,128.35	137,128.35
Kollemcode	Kollemcode	2.1	3.5	1.1	3.23	900	77,302.29	77,302.29	-0.51	1.16	1500	163,338.55	300,466.90
Kollemcode	Chinnathurai	3.5	9.5	0.1	2.16	6000	580,424.62	657,726.91	-0.53	0.52	6000	702,964.38	1,003,431.28
Chinnathurai	Erayumanthurai	9.5	11.3	-	-	-	-	-	-0.3	1.21	1800	190,249.44	1,193,680.72
			Total			**6900**	**657,726.91**	**657,726.91**		**Total**	**10630**	**1,193,680.72**	**1,193,680.72**

Table 27 -Dredge Volumes Class-III

Class IV



Class IV													
Location		Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
From	To	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.
Poovar Beach	Kollemcode	0	2.1	-	-	-	-	-	-0.52	2.92	1530	210,329.30	210,329.30
Kollemcode	Kollemcode	2.1	3.5	1.1	3.23	1000	132,565.32	132,565.32	-0.53	1.16	1500	229,962.30	440,291.60
Kollemcode	Chinnathurai	3.5	9.5	0.1	2.16	6000	824,690.10	957,255.42	-0.53	0.1	6000	968,946.07	1,409,237.67
Chinnathurai	Erayumanthurai	9.5	11.3	-	-	-	-	-	-0.3	1.21	1800	267,294.13	1,676,531.80
			Total			**7000**	**957,255.42**	**957,255.42**		**Total**	**10830**	**1,676,531.80**	**1,676,531.80**

Table 28 -Dredge Volumes Class-IV

6 Conclusion

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

6.1 Description of Waterways

The surveyed stretch of AVM canal is 11.30 Km in length. This whole stretch was used for navigation in earlier days. This canal interlinks Kerala with Tamilnadu. If developed, AVM Canal can enhance the tourism activities and boat services in Poovar- Erayumanthurai area. A total 4 km of the survey stretch of AVM canal is tidal in nature with the north side of the AVM canal connected to the Arabian Sea through the opening of Poovar Lake at Poovar Beach Pozhi and southern side confluence with Tamarabarani River.

There are 26 bridges of permanent nature are present in the survey stretch of AVM canal with minimum clearance of 0.5 mtr vertical and 1.1 mtr horizontal clearances. The Poovar and Marthandam are the major towns situated near the survey stretch. There are no Dam, barrages weirs, anicut, locks and Aqueducts present in the survey stretch of AVM Canal. The stretch wise minimum and maximum width range, average width and average slope of the waterway are as below:-

Sl. No.	Location		Chaiange (km)		Width Range of the waterway		Average Width	Average slope (in m/km)
	From	To	From	To	Min	Max		
1	Poovar Beach	Kollemcode	0.0	3.5	11.540	292.690	81.553	1 : 0.651
2	Kollemcode	Chinnathurai	3.5	9.5	9.581	23.045	12.811	1 : 0.077
3	Chinnathurai	Erayumanthurai	9.5	11.30	12.282	66.124	15.862	1 : 0.358

Table 29 - Stretch wise Average width and slope of waterway

6.2 Condition of Canal bed

The canal bed at the middle stretch is mainly sandy in nature. The coconut husk operations were very prominent in the canal during olden times but presently these operations are sparsely located. In South Kollengode, Neerody and South of Thoothoor, the coconut husk operation takes place in the canal itself. These are located on the starting and end stretches of the canal.

As per the information gathered from the local people, the decrease in depth in the canal is mainly due to the husk operation (coconut retting) which leads to non-navigable condition Presently Husk operations are very less being a non-profitable occupation. Still, some small scale operations exist in the area. The RBS i.e. seaward side is densely populated than the LBS eastern bank.

These husks deposits also cause a gradual barrier and accumulation of silt in the AVM canal gradually resulted into an increase in the canal bed level w.r.t. its original bed level. Due to such accumulation of husk/ waste over a period of time, this becomes a semi-artificial river bed thereby decreasing the available depth in the canal. These areas can be easily identified from the nature of bed material. This also causes hindrance for smooth water flow from both sides resulting in the central portion as an elevated non-tidal area where water weeds and water hyacinth exist in plenty. During the survey, it was observed that the central portion of the canal gets dry during normal time with no water available for sounding operations.

6.3 Methods for Making Waterway Feasible

The canal can be developed for navigation with 32 m bottom width and 1.8 m depth below lowest low water with a side slope of 1:5. Dredging to the tune of 17.8 lakh cu.m is to be carried out to achieve this target. Waterway may be developed as a Class II waterway. Frequent dredging is required at both sea openings to maintain the required depth and also to avoid inside flooding. The class-wise details of reduced dredging quantities of the waterways are as tabulated below:-

Reduced w.r.t. CD Dredging Values				
Class	**0-3.5 (km)**	**3.5-9.5 (km)**	**9.5-11.30 (km)**	**Total**
I	91,561.42	269,148.61	67,052.80	**427,762.83**
II	173,682.05	450,375.63	117,726.88	**741,784.56**
III	300,466.90	702,964.38	190,249.44	**1,193,680.72**
IV	440,291.60	968,946.07	267,294.13	**1,676,531.80**

Table 30 - Class-wise Reduced Dredging quantity

Due to a sudden drop in the canal gradient at the last 2.75 km stretch (near Erayumanthurai) construction of barrage/navigational lock is required to maintain the minimum depth required for navigation and regulate the water level inside the canal (preferably 1 km inside the canal). Similarly navigational lock is also proposed at Poovar side to maintain the water level during non-monsoon period. Suitable bank protection measures are to be provided almost throughout the eastern bank and at the eroded locations in the western bank.

All the low lying structures are to be re-constructed to provide the requisite horizontal and vertical clearance for the vessel movement. Boat jetties may be constructed at Poovar, Chinnathurai and Erayumanthurai for embarking/ disembarking of tourists. The class-wise details of reduced depth at different stretches of the waterways are as tabulated below:-

Sl. No.	Chaiange (km)		< 1.2		1.2 - 1.4		1.5 - 1.7		1.8 - 2.0		> 2.0	
	From	To	Availability of Depth (km)	of availability	Availability of Depth (km)	% of availability	vailability of Depth (km)	% of availability	Availability of Depth (km)	% of availability	Availability of Depth (km)	of availability

Sl. No.	Chaiange (km)		< 1.2		1.2 - 1.4		1.5 - 1.7		1.8 - 2.0		> 2.0	
	From	To	Availability of Depth (km)	of availability	Availability of Depth (km)	% of availability	vailability of Depth (km)	% of availability	Availability of Depth (km)	% of availability	Availability of Depth (km)	of availability
1	0	3.5	2.8	**80%**	0.10	2.9 %	0.25	7.1 %	0.20	5.7 %	0.15	4.3 %
2	3.5	9.5	6.0	**100%**	0	0 %	0	0 %	0	0 %	0	0 %
3	9.5	11.3	1.8	**100%**	0	0 %	0	0 %	0	0 %	0	0 %
Total			**10.6**	**93.8%**	**0.10**	**0.9 %**	**0.25**	**2.2 %**	**0.2**	**1.8 %**	**0.15**	**1.3 %**

Table 30 – Class-wise availability of reduced depth of the waterway

6.4 Modifications/ improvement measures

Improvement measures for overhead clearance and depth improvement are required on the first phase of the development. The AVM canal is running near to the Fishing villages and tsunami colonies. The waste deposition and sewage disposal to the canal is to be controlled. Most of the Right Bank of AVM canal is protected in nature, hence the chances of encroachment are not as much on the right bank side. However, the Left bank side consists of mostly non-protected river banks. The construction of protective wall will further prevent encroachment and erosion of river banks. The class-wise modification details of cross structure and high tension line clearance are as tabulated below.

Bridges Clearances less than Class			High Tension lines Clearances less than Class	
Class	**Horizontal**	**Vertical**	**Horizontal**	**Vertical**
I	25	26	0	0
II	26	26		
III	26	26		
IV	26	26		

Table 31 - Bridges and HTL Clearances less than Class no.

6.5 Recommendation

No cargo movement or passenger movement is envisaged through this canal. However, if adequate depth and width is maintained with bank protection measures, the canal is having high potential for tourism activities, particularly for boat operation between the two beaches of Poovar and Thengapattnam. There are no major industries existed in the nearby area. The riverbanks are well connected with roads and other infrastructures.

The purpose of the survey was for assessing the canal stretch from Poovar beach to Erayumanthurai, for development of water transport facilities in the new National Waterway (NW-13). All conspicuous objects within and in the vicinity of the survey area have been fixed. The deliverable sheets contain mean sea level values of elevation information, important landmarks with the state of the river banks. The survey is considered complete in all respects.

7 Details of Annexures