



KALESHWARAM PROJECT

Engineer-in-Chief(General)
I&CAD Department

Contents

1. Background

2. Overview of Kaleshwaram Project

3. Dr. B. R. Ambedkar Pranahita-Chevella Sujala Sravanthi (Dr.B.R.A. PCSS) Project -

Justification for changing from earlier PCSS to present KP-Challenges -Re-Engineering of the Project-Power requirements & Financial Details of Kaleshwaram Project.

4. Comparison Dr.B.R.A. PCSS & Kaleshwaram Projects

- Cost
- Ayacut envisaged New / stabilization ayacut
- Source/ cost of finance
- Power requirements

5. Problems & solutions in Medigadda, Sundilla and Annaram barrages



1. Background

Background

- Every year, nearly **3000 TMC of Godavari** water goes into the ocean.
- Utilizing waters going waste to the ocean will **serve multiple needs of the state.**
- Multi-purpose projects on River Godavari can help utilize the water for **Irrigation, Drinking water & Industrial use in Telangana for its prosperity**

Godavari: A beautiful bounty of nature

The Godavari river, also known as Dakshin Ganga, is the second longest river of India. Born at Trimbakeshwar, near Nashik in Maharashtra, the river travels 1,465 kms through Maharashtra, Telangana, Chhattisgarh, Madhya Pradesh, Odisha, Karnataka and Andhra Pradesh before merging into the Bay of Bengal.



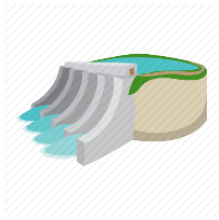
Background

Allocation of Godavari Water

Total allocation of water to the erstwhile state of AP	= 1486 TMC
Total allocation of water to Telangana	= 968 TMC
Water allocation to approved projects	= 806 TMC
Hydrology clearance approved for	= 140 TMC

Background

Need for major irrigation schemes in Telangana



Unfavorable Topography

Godavari river flows at an altitude **below 200 meters** whereas Telangana is at a much higher altitude making it difficult to divert water through gravity



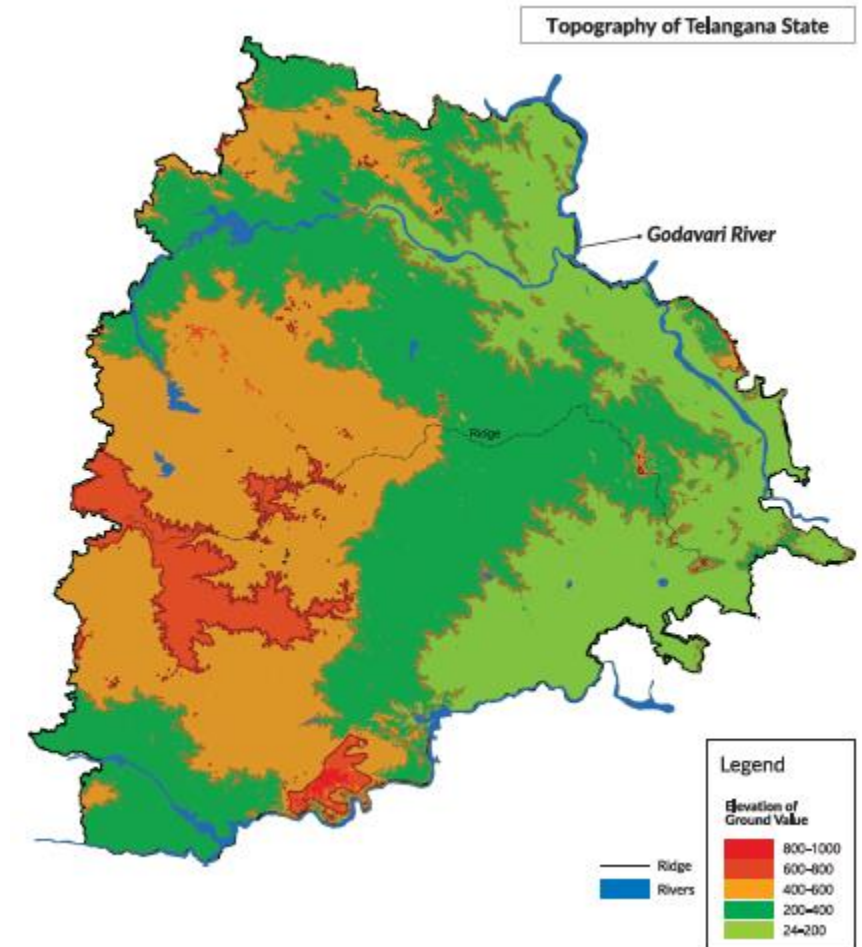
Overexploitation at Upstream of Rivers

Construction of Dams and reservoirs upstream of the Krishna and Godavari river in Maharashtra has led to overexploitation



High Demand for Drinking Water

Increasing urbanization, growing population and **shortage of rainfall** has led to depletion of ground water causing high demand for drinking water

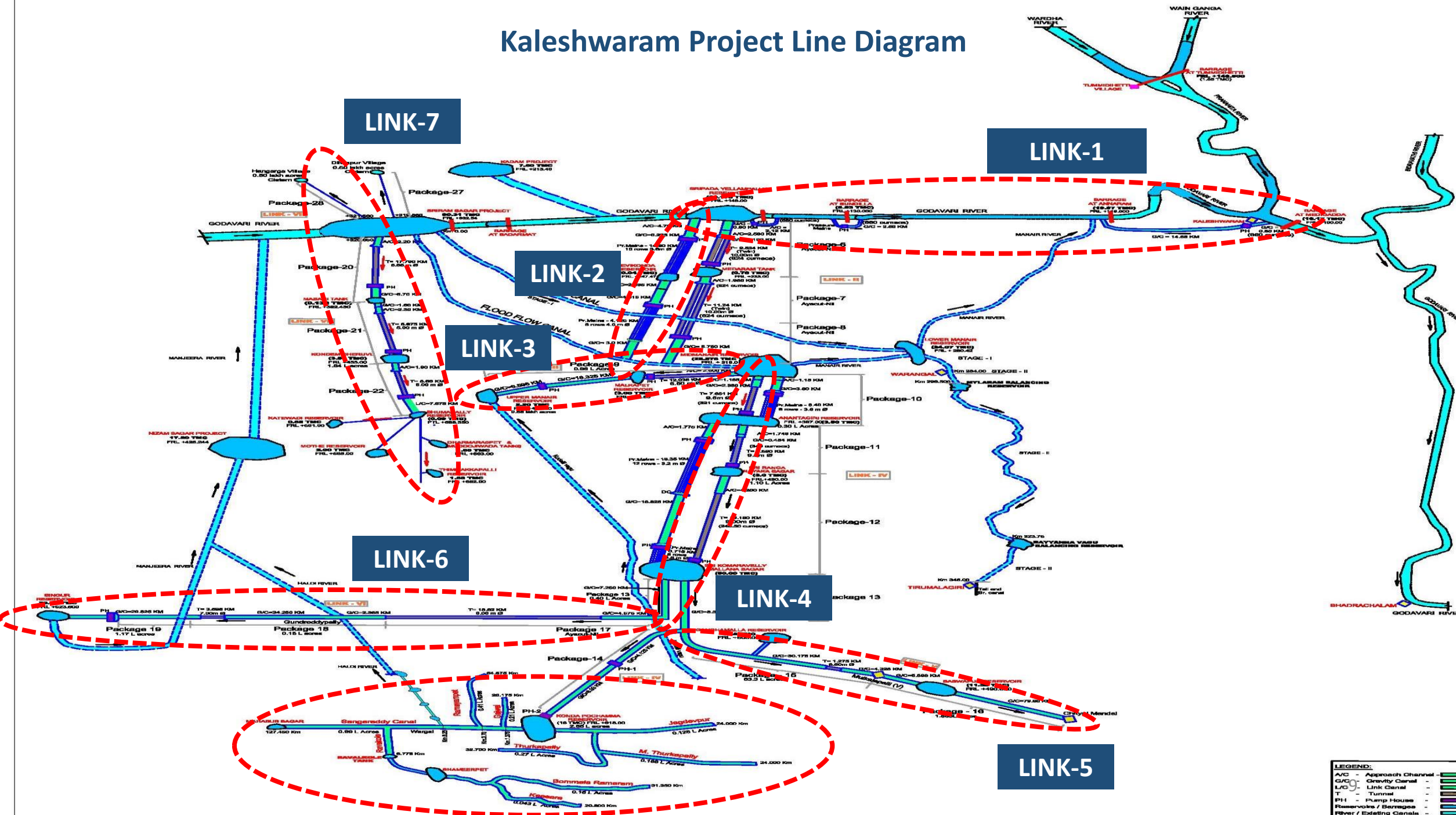


Topographical Map of Telangana



2. Overview of Kaleshwaram Project

Kaleshwaram Project Line Diagram



LEGEND:

A/C	- Approach Channel	-
G/C	- Gravity Canal	-
L/C	- Link Canal	-
T	- Tunnel	-
PH	- Pump House	-
R	- Reservoirs / Barrages	-
R	- River / Existing Canals	-

Kaleshwaram Project Link wise details

Link No.	Particulars	Command Area
		Acres
Link-I	From Lakshmi Barrage (Medigadda) on Godavari River to Sripada Yellampally Project	1,500
Link-II	From Sripada Yellampally Project to Mid Manair Reservoir (Package 6, 7 & 8)	0
Link-III	From Mid Manair Reservoir to Upper Manair Reservoir (Package 9)	96,150
Link-IV	From Mid Manair Reservoir to Konda Pochamma Reservoir (Package 10, 11, 12, 13 & 14)	5,98,482
Link-V	From Sri Komaravelli Mallanna Sagar Reservoir to Baswapur Reservoir (Package 15 & 16)	2,51,800
Link-VI	From Sri Komaravelli Mallanna Sagar to Singur Reservoir (Package 17, 18 & 19)	5,16,000
Link-VII	From SRSP Foreshore to Nizam Sagar Canals (Package 20, 21 and 22) and to Dilwapur (Package 27) and Hangarga (Package 28) village for Nirmal and Mudhole Constituency	4,99,428
	TOTAL	19,63,360*

** Includes additional contemplated Ayacut from Sangameshwara and Basaweshwara project*

Kaleshwaram project consists of 7 links and 28 packages.

Link 1

Lifts water from Godavari River to Sripada Yellampalli Reservoir

Link 2

Conveys water from Sripada Yellampalli Reservoir to Mid Manair Reservoir

Link 3

Conveys water from Mid Manair Reservoir to Upper Manair Reservoir

Link 4

Conveys water from Mid Manair Reservoir to Kondapochamma Sagar

Link 5

Conveys water from end of gravity canal of Package 13 via Gandhamalla and Baswapur Reservoirs to Chityala Mandal

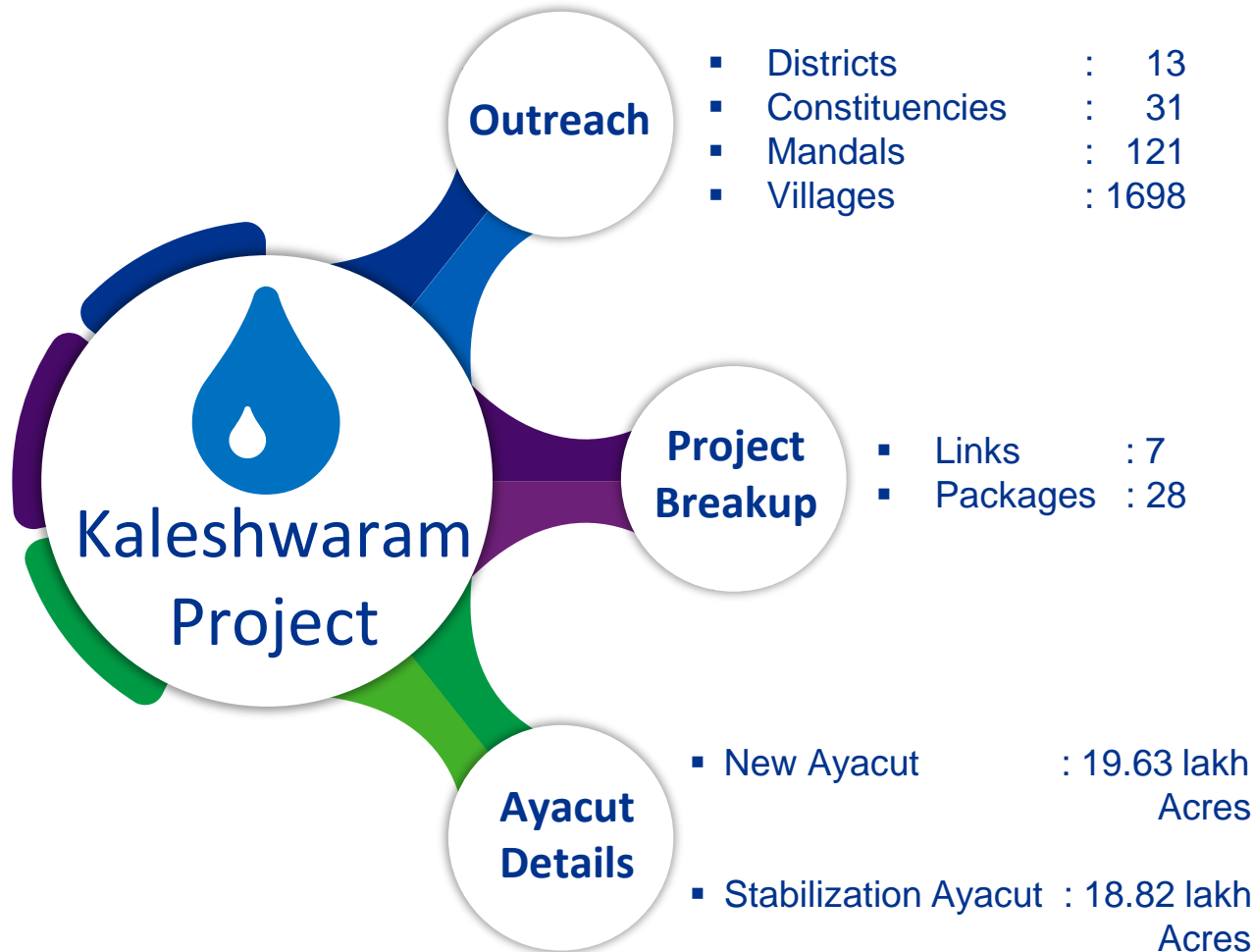
Link 6

Conveys water from Sri Komaravelli Mallana Sagar to Singur Reservoir

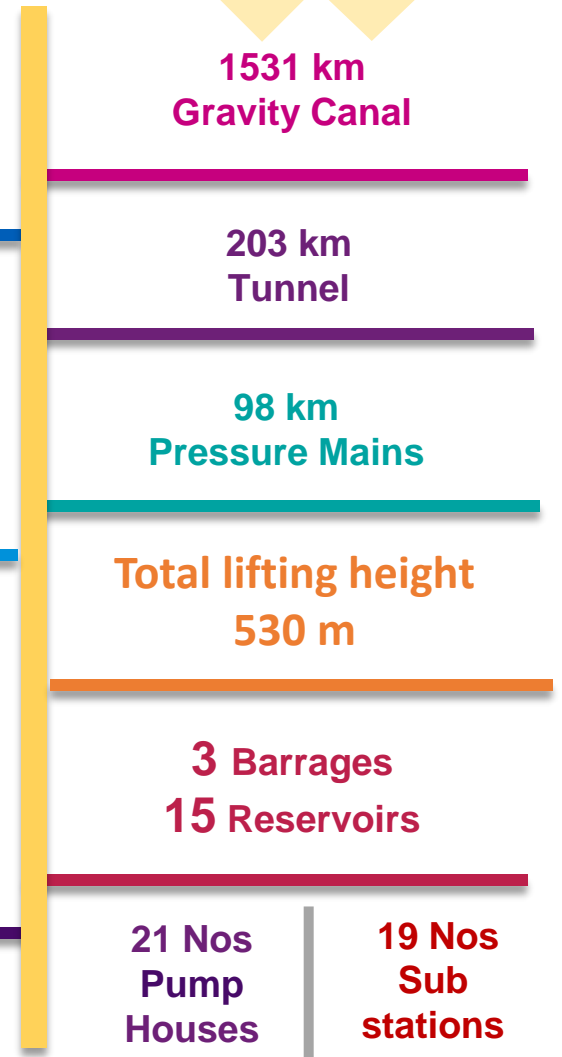
Link 7

Conveys water from foreshore of SRSP to Kondem cheruvu , Dilwapur, Hangarga villages, Nirmal and Mudhole Constituencies

Salient Features of Kaleshwaram Project



141 TMC	
Total Storage Capacity	
Diversion from Godavari river incl SYP	215 TMC
Ground Water	25 TMC
Total Water	240 TMC
Drinking Water to Twin Cities	30 TMC
Water to enroute villages	10 TMC
Water for industrial use	16 TMC
4959 MW	
Power Demand	



* Actual Power consumption = 80% i.e. 3967 MW



Capacities of Reservoirs

Reservoir/Barrage	Capacity (TMC)
Medigadda Barrage	16.17
Annaram Barrage	10.87
Sundilla Barrage	8.83
Medaram Reservoir	0.78
Malkapet Reservoir	3
Anantagiri Reservoir	3.5
Ranganayaksagar Reservoir	3
SKMS reservoir	50
Kondapochamma Sagar	15
Baswapur Reservoir	11.39
Gandhamalla reservoir	9.87
Kondamcheruvu	3.5
Bhumpally	0.09
Mothe Reservoir	2.0
Dharmaraopet	0.5
Katewadi	0.5
Muddojiwadi	0.5
Timmakkapally	1.5
Grand total of capacities	141 TMC

Kaleshwaram Project Jurisdiction details

Sl. No	Link	Package Nos	Name & Designation of ENC/CE	Headquarters
1	Link-1	Medigadda (Laxmi) barrage,	Sri N. Venkateshwarlu Engineer-in-Chief (Irrigation), Ramagundam	Ramagundam
		Medigadda (Laxmi) LIS(2 TMC + 1 TMC)		
		Annaram (Saraswathi) Barrage,		
		Annaram (Saraswathi) LIS(2 TMC + 1 TMC)		
		Sundilla (Parvathi) Barrage,		
		Sundilla (Parvathi) LIS(2 TMC + 1 TMC)		
	Link-2	Package-6 (Nandi Pump House)		
		Package-7		
		Medaram Reservoir		
		Package-8 (Gayatri Pump House)		
		3 rd TMC - Package-1		
		3 rd TMC - Package-2		
		3 rd TMC - Package-3		
	3 rd TMC - Package-4			
	Link-3	Package-9		
Malakpet reservoir				
Package-9 Mini lift				

Kaleshwaram Project Jurisdiction details

Sl. No	Link	Package Nos	Name & Designation of ENC/CE	Headquarters
2	Link-4	Package-10,	Sri B. Hariram Engineer-in-Chief (Irrigation), Gajwel	Gajwel
		Annapurna Reservoir,		
		Package-11,		
		Sri Ranganayaka Sagar,		
		Package-12,		
		2 nd TMC - Package-1		
		2 nd TMC - Package-2		
		2 nd TMC - Package-3		
		2 nd TMC - Package-4		
		Sri Komuravelli Mallanna Sagar,		
	Package-13,			
	Package-14,(Akkaram & Markook Pump House)			
	Kondapochamma Sagar,			
	Kondapochamma Canals			
	Link-5	Package-15,		
Gandhamalla reservoir,				
Package-16,				
Baswapur (Nrusimha Sagar) Reservoir				

Kaleshwaram Project Jurisdiction details

Sl. No	Link	Package Nos	Name & Designation of ENC/CE	Headquarters
3	Link-6	Package-17,	Sri V. Ajay Kumar Chief Engineer (Irrigation), Sangareddy	Sangareddy
		Package-18,		
		Package-19		
		Sangareddy canal Reach-3		
		Sangameshwara LIS		
		Basaweshwara LIS		
		Package-23 (Deleted)		
		Package-24(Deleted)		
		Package-25 (Deleted)		
		Package-26 (Deleted)		
4	Link-7	Package-20,	Sri R. Madhusudan Rao Chief Engineer (Irrigation), Nizamabad	Nizamabad
		Package-21		
		Package-21A		
5	Link-7	Package-22,	Sri T. Srinivas Chief Engineer (Irrigation), Kamareddy	Kamareddy
6	Link-7	Package-27	Sri T. Srinivas Chief Engineer (Irrigation), Adilabad	Adilabad
		Package-28		

Kaleshwaram Project CE Jurisdiction wise Contemplated Ayacut Details

SI No	Jurisdiction	Name of ENC/CE	Ayacut under jurisdiction (Acres)
1	Engineer-in-Chief(Irrigation), Ramagundam	Sri N Venkateswarlu	97,650
2	Engineer-in-Chief(Irrigation), Gajwel	Sri B. Hariram	8,02,597
3	Chief Engineer (Irrigation), Sangareddy	Sri V. Ajay Kumar	5,63,686
4	Chief Engineer (Irrigation), Nizamabad	Sri R. Madhusudan Rao	1,99,428
5	Chief Engineer (Irrigation), Kamareddy	Sri T. Srinivas	2,00,000
6	Chief Engineer (Irrigation), Adilabad	Sri T. Srinivas	1,00,000
	Total		19,63,630

Ayacut Created Details

- ❑ **Total ayacut of 98,570 acres** irrigated through Kaleshwaram project
- ❑ **456 MI tanks filled through Kaleshwaram project Canals**
- ❑ **Ayacut covered about 39,146 Acres**
- ❑ **2,143 Nos. of MI tanks** were filled with Kaleshwaram project through other projects canals of SRSP – I&II, Nizam Sagar and **ayacut covered about 1,67,050 acres**
- ❑ Existing ayacut was stabilized under SRSP stage-I below LMD, SRSP Stage-II and Nizamsagar projects in form of crucial wettings at crucial period in the crop cycle, thereby stabilizing the ayacut of **17,08,230 Acres (Khariff & Rabi – Proposed) in 2023-24**
- ❑ From 2020-21 Rabi to 2023-24 Kharif, water was released to **Kudelli Vagu and Haldi Vagu to 66 check dams for an ayacut of 20,576 acres**

Kaleshwaram Project – Action Plan for Balance Ayacut Creation

Ayacut Details

<input type="checkbox"/> Contemplated Ayacut	=	19,63,360 Acres
<input type="checkbox"/> Ayacut Created	=	98,570 Acres
<input type="checkbox"/> Balance Ayacut to be created	=	18,64,970 Acres

Action Plan for Balance ayacut creation

<input type="checkbox"/> 2024-25	=	2,83,404 Acres
<input type="checkbox"/> 2025-26	=	5,13,054 Acres
<input type="checkbox"/> 2026-27	=	2,91,867 Acres
<input type="checkbox"/> 2027-28	=	3,35,300 Acres
<input type="checkbox"/> 2028-29	=	4,41,165 Acres



Power Details

Power Requirement Details - Summary

Sl.No.	Location of the Lift	No. of pumps	Total Power (MW)
1	Total for 2 TMC	91	4958.74
2	Mentrazpally(V), Dichpally (M), Nizamabad – Pkg 21A (i)	10	25.00
3	Manchippa(V), Mugpal(M), Nizamabad. – Pkg 21A (ii)	8	16.00
	Sub-Total	18	41.00
4	Total for 3rd TMC	38	3451.00
	GRAND TOTAL	147	8450.74

Year wise water lifted & Energy Consumed

Year Wise Water Lifted & Energy Consumed

Sl.No.	Name of the Pump House	Description	Year (1st June to 31st May)					Total Water lifted (TMC)	Energy Consumption (MU)
			2019-20	2020-21	2021-22	2022-23	2023-24		
1	Medigadda (Laxmi) Pump House	Water lifted (TMC)	61.666	31.828	33.971	25.971	8.932	162.368	
		Energy Consumption (MU)	216.693	111.432	119.068	90.766	31.264		569.223
2	Annaram (Saraswathi) Pump House	Water lifted (TMC)	56.978	43.329	36.327	27.521	8.711	172.866	
		Energy Consumption (MU)	131.026	101.066	85.082	63.44	20.2		400.814
3	Sundilla (Parvathi) Pump House	Water lifted (TMC)	53.771	48.733	38.261	28.835	7.529	177.129	
		Energy Consumption (MU)	179.628	176.03	137.046	100.7	32.71		626.114
4	Nandi Pump House (Package-6)	Water lifted (TMC)	68.95	38.41	35.8	31.04	10.48	184.68	
		Energy Consumption (MU)	687.02	382.75	356.71	309.27	104.47		1840.22
5	Gayathri Pump House (Package-8)	Water lifted (TMC)	66.44	37.56	35.18	31.3	10.34	180.82	
		Energy Consumption (MU)	732.41	414.03	403.95	345.07	113.93		2009.39
6	Package-9	Water lifted (TMC)	-	-	-	-	0.8191	0.8191	
		Energy Consumption (MU)	-	-	-	-	9.7		9.7

Year wise water lifted & Energy Consumed

Sl. No	Name of PH	Description	Year					Total Water Lifted (TMC)	Energy Consumption (MU)
			2019-20	2020-21	2021-22	2022-23	2023-24		
7	Pkg-10	Water lifted (TMC)	6.61	13.59	18.04	7.53	4.54	50.31	
		Energy consumption (MU)	55.95	118.8	171.21	76.15	69.396	491.506	
8	Pkg-11	Water lifted (TMC)	3.26	12.56	17.62	7.95	4.81	46.2	
		Energy consumption (MU)	33.398	125.32	188.254	85.199	54.629	486.8	
9	Pkg-12	Water lifted (TMC)	0.47	11	18.14	7.45	4.29	41.35	
		Energy consumption (MU)	0.415	74.18	154.206	37.294	21.162	287.257	
10	Akkaram PH	Water lifted (TMC)	0.205	8.954	2.469	7.136	0.044	18.808	
		Energy consumption (MU)	0.128	43.256	13.011	33.202	0.393	89.99	
11	Markook PH	Water lifted (TMC)	0.14	8.808	2.38	7.188	0.114	18.63	
		Energy consumption (MU)	0.033	52.498	15.102	38.546	1.113	107.292	
TOTAL		Water lifted (TMC)	318.49	254.772	238.188	181.921	60.609		
		Energy consumption (MU)	2036.701	1599.362	1643.639	1179.492	458.967		6918.306 MU



Financial Details



Summary of Project Cost & Expenditure

Description	Project Cost	Expenditure		TOTAL Exp
		From Loans (KIPCL)	From Government	
1	2	3	4	5= (3+4)
TOTAL OF 2 TMC	94413.27	44614.06	28885.93	73499.99
TOTAL OF 3 rd TMC	33459.01	17051.14	3320.93	20372.07
GRAND TOTAL OF Kaleshwaram project	127872.28	61665.20	32206.87	93872.07

Present Status of Loans of Kaleshwaram Project

* Rs in Crore

SI No	Bank/FI	Amount Sanctioned		Amount Disbursed		Balance Loan Available		Principal paid	Balance principal to be paid
		Incl IDC	Excl IDC	Incl IDC	Excl IDC	Incl IDC	Excl IDC		
1	2	3	4	5	6	7 = (3) - (5)	8 = (4) - (6)	9	10 = (5) - (9)
1	Union Bank of India Consortium	7400	6000	7342.32	6000	57.68*	0	675.22	6667.1
2	PNB Consortium	11400	9790.3	11273.12	9745.75	126.88*	44.55*	1074.73	10198.39
3	Bank of Baroda	2150	1939.33	2150	1939.33	0	0	193.5	1956.5
4	PFC Ltd	27737.11	21578.18	26212.12	20404.83	1524.99	1173.35	2138.89	24073.2
5	NABARD	8225.97	8225.97	6528.94	6528.93	1697.03	1697.04	575.6	5953.33
TOTAL of 2 TMC		56913.08	47533.78	53506.5	44618.84	3222.02	2870.39	4657.94	48848.52
6	REC Ltd (3rd TMC)	30536.08	27184.65	18059.19	16670.19	12476.89	10514.46	38.39	18020.3
GRAND TOTAL		87449.16	74718.43	71565.69	61289.03	15698.91	13384.85	4696.33	66868.82

NOTE*: *The amounts were not disbursed by one of the consortium banks (P&SB), due to reduction of their exposure limit

Present Status of Loans of PRLIS Project

❖ The Government vide G.O.Ms.No.10, I&CAD (Projects-II) Department, Dt:20.04.2019 have issued orders stating to include the Palamuru Rangareddy Lift Irrigation Scheme (PRLIS) as an additional mandate of Kaleshwaram Irrigation Project Corporation Limited (KIPCL)

❖ **The present Status of loans of PRLIS.**

** Rs in Crore*

Sl No	Bank/FI	Amount Sanctioned		Amount Disbursed		Balance Loan Available		Principal paid	Balance principal to be paid
		Incl IDC	Excl IDC	Incl IDC	Excl IDC	Incl IDC	Excl IDC		
1	2	3	4	5	6	7 = (3) - (5)	8 = (4) - (6)	9	10 = (5) - (9)
1	PFC Ltd for PRLIS	10000	7725.91	7721.51	7140.77	2278.49	585.14	**	7721.51

** Principal Repayment starts from October 2024 (Tenure is 15 years)

Abstract of Interest and Principal paid

KIPCL - ABSTRACT OF INTEREST AND PRINCIPAL PAID FOR KALESHWARAM PROJECT

							*Amt in crores
Sl No	Description	2019-20	2020-21	2021-22	2022-23	2023-24	Grand Total
1	Interest	334.01	1640.07	4349.73	5815.71	4062.42	16201.94
2	Principal	0	0	79.27	2567.13	2309.53	4955.93
Total		334.01	1640.07	4429	8382.84	6371.95	21157.87

KIPCL - ABSTRACT OF INTEREST AND PRINCIPAL PAID FOR PRLIS

							*Amt in crores
Sl No	Description	2019-20	2020-21	2021-22	2022-23	2023-24	Grand Total
1	Interest	IDC adjusted during this period		187.7	826.22	508.88	1522.8
2	Principal	Principal Repayment starts from October 2024					0
Total		0	0	187.7	826.22	508.88	1522.8

Summary of LA , IP Creation & Funds Requirement

Land Acquisition

- Total Land Required : 97,417 Acres
- Total Land acquired : 66,190 Acres
- Balance to be acquired: 31,227 Acres
- Funds required for balance LA: Rs 5,438 Crores

IP Creation

- Total Ayacut contemplated : 19, 63,360 Acres
- Ayacut created: 98,570 Acres
- Balance Ayacut to be created: 18,64,790

Funds Requirement for creation of balance contemplated Ayacut

Project Cost	Rs 94,413.27 Cr
Expenditure	Rs. 73,500 Cr
Balance	Rs 20,913.27 Cr
Less O&M	Rs 2,124.67 Cr
Less Loan Available	Rs. 2,870.39 Cr
Funds required for works	Rs. 15,918.21 Cr
Funds for LA	Rs 5,438.30 Cr

Summary of Pending Bills (Rs. in Crore)

Work bills		LA	R&R	Sub-stations	KPMG	NPDCL	TOTAL
Govt	KIPCL						
576.577	1915.885	466.589	229.154	2.430	1.180	0.265	3192.08

3. Dr. B. R. Ambedkar Pranahita-Chevella Sujala Sravanthi (PCSS) Project.

- Justification for changing from earlier Pranahita- Chevella project to present Kaleshwaram project
- Challenges with implementation of Dr.B.R.A. PCSS
- Re-Engineering of the Project

Origin of the Dr.B.R.A.PCSS Project

Permission for DPR

The Government of erstwhile AP, vide **GO Rt No 623, Dt:15.07.2005** has provided permission to prepare Detailed Project Report for :

- Diverting 160 TMC of water from Pranahita to Sripada Sagar Project Reservoir (Yellampally) keeping future requirements in view
- Creating an additional ayacut of about 12 lakh acres in erstwhile Adilabad, Karimnagar, Medak, Nalgonda, Nizamabad and RR district including drinking water and industrial requirements of Hyderabad
- Supplement the shortage of water, if any, to the existing and developing commands in the Telangana region

Administrative sanction for the Pranahita Chevella Lift Irrigation Scheme




Further the Government of erstwhile AP, vide **GO Ms No 124, Dt:16.05.2007** has provided Administrative sanction for **Rs. 17,875 Crore** to take up the works of Pranahita Chevella Lift Irrigation Scheme for diversion of **160 TMC** of water from Pranahitha river to Sripada Sagar project (Yellampally), serving multiple purposes of **12 lakh acres** of irrigation, drinking and industrial water.

The water availability and utilization potential were as envisaged in the interim report submitted by WAPCOS

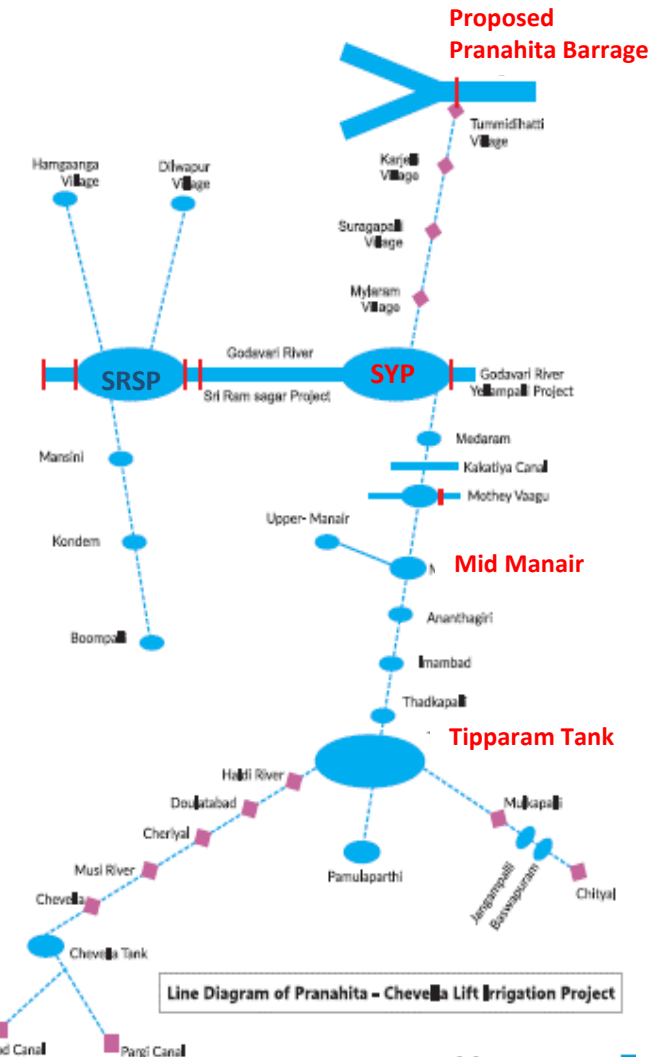
Revised Administrative Sanction vide **GO MS No. 238, dt: 17.12.2008** was accorded for an amount of **Rs. 38,500 Crores**, for an ayacut of **16.4 lakh acres**. The project works were taken up as part of **Jalayagnam** and entire project was divided into **28 packages** and the agreements were concluded during **2007-08 and 2008-09 under EPC**.

Features of the Dr.B.R.A.PCSS Project

Dr.B.R.Ambedkar Pranahita-Chevella Sujala Sravanthi (PCSS) project was originally envisaged for **diversion of 160 TMC** of water by **constructing a barrage across River Pranahita** near the confluence of rivers Wardha and Wainganga at **Tummidihetti (V), Koutala(M), Adilabad District** of Telangana with **FRL +152.00 m**. It further utilizes **20 TMC of water** from Godavari at **Sripada Yellampally Project**.

	Utilization Potential 160 TMC
	Reservoir capacities 16.4 TMC
	Ayacut 16.4 Lakh Acres in 7 Districts

10 TMC of Drinking Water to the villages en route
30 TMC of Drinking Water to twin Cities of Hyderabad & Secunderabad
16 TMC of Industrial Water



Details of Dr.B.R.A.PCSS Project

Financial Details

Agreement Value	Rs 36,257.83 Cr
Expenditure up to 2014	Rs 6,156.92 Cr
Expenditure from 2014 to 2016 (Before Re-engg)	Rs 5,522.79Cr
Total expenditure upto 2016	Rs 11,679.71 Cr (32%)

7 Districts (erstwhile AP) – 16.4 Lakh Acres

Adilabad	Medak
Karimnagar	Nalgonda
Nizamabad	Warangal
Ranga Reddy	

* No stabilization envisaged

Power requirement

3466 MW (8701 MU) in 16 packages for **94** pumps

- Feasibility report submitted to CWC in 04/2009.**
- In-principle clearance is obtained from CWC in 04/2010
- DPR submitted to CWC in 10/2010 for Rs.40,300 Crores.**

Status of Statutory Clearances obtained

- Central Soil Research and Material Station (CSMRS)
- Construction Machinery Consultancy (CMC)
- Ministry of Agriculture
- Central Ground Water Board
- Terms Of Reference for Environmental Clearance received from MOEF&CC

Challenge

- Public hearings were conducted in all the 7 districts of erstwhile Andhra Pradesh
- Public hearings could not be conducted in Maharashtra State due to strong objection on submergence area is about 3786 Acres in their territory.



Challenges in Dr.B.R.A.PCSS Project

Challenges in Dr.B.R.A.PCSS Project

- **The barrage was proposed at Tummidihetti (V), Koutala(M), Adilabad District in Telangana with FRL @ + 152 m with capacity + 5.09 TMC by the erstwhile state of AP**
- **Due to location of its head works**, and other side of river flowing in Maharashtra, this project became an **Inter-state Project** between Maharashtra and erstwhile Andhra Pradesh.
- Maharashtra Government expressed **serious concerns** over fixing of the proposed **FRL of +152.00** and strongly **objected** the construction of **barrage near Tummidihetti due to submergence** to an extent of **3,786 Acres** of land in their territory and requested to **reduce the FRL to +148.00 m** and minimize submergence in their territory.
- An agreement for **constitution of Inter State Board** for PCSS was entered into by the then Hon'ble C.Ms of Maharashtra & AP on 05/05/2012, to resolve the issues in the project over a period of time.

Challenges in Dr.B.R.A.PCSS Project

- ❑ As per the Interstate agreement, a **3-tier committee** was formed to finalize the FRL of barrage with mutual consensus and resolve any other issues relating to construction of barrage.
- ❑ The **co-ordinating committee** meeting was held at **Hyderabad on 21-01-2013** where-in the Chief Engineer, Maharashtra expressed that there is **strong opposition of farmers in Maharashtra** due to submergence of their lands at the proposed FRL of +152.00 m and requested to lower the FRL to +148.00 m.
- ❑ Further, technical meeting was also held between the Chief Engineers of both the states in Nagpur on 24-03-2014.
- ❑ But **no consensus** could be reached in finalizing the FRL of barrage at Tummidihetti.

Challenges in Dr.B.R.A.PCSS Project

- ❑ After formation of **Telangana state**, a **Joint meeting** was convened at Mumbai between the then **Hon'ble Ministers for Irrigation/WRD** of the both the States on **23/7/2014** wherein, the Hon'ble Minister for Irrigation, Mining & Geology, Marketing and Legislature Affairs, Telangana State has requested the Maharashtra Government to **expedite the finalization of the control level of the Barrage** which is essential pre-requisite to proceed with for completion of the public hearing meetings in the districts of **Gadchiroli** and **Chandrapur** in the Maharashtra so as to complete the process and to obtain the Environmental Clearance for the project.
- ❑ The Government of Maharashtra **requested to lower the FRL** and **minimize the submergence** in their territory, as a prerequisite for their concurrence.
- ❑ The **barrage** was proposed with **FRL +152.00 m** and a capacity of **+5.09 TMC**.
- ❑ Detailed **Joint surveys by both the States** were conducted and the **actual submergence** extent of Maharashtra territory was assessed as **3786 acres** with barrage at **FRL +152.00 m** and **285 acres** with **FRL of +148.00m**.
- ❑ The capacity was assessed as **+1.85 TMC** with **FRL +148.00 m** and as per the hydraulic studies done by I&CAD department, a tentative diversion of **only 44 TMC** is possible at **FRL +148.00m** instead of 160 TMC envisaged at FRL +152.00m

Challenges in Dr.B.R.A.PCSS Project

- ❑ In continuation of the Joint meeting of the Hon'ble Irrigation/WRD Ministers of both the States, **Technical meetings** were held on 16-08-2014, 04-02-2015, 26-10-2015 at Hyderabad **to resolve the technical issues** with officials of Maharashtra regarding the design of the barrage, submergence etc., in order to finalize the FRL.
- ❑ During the meeting, the Government of Maharashtra has **requested to lower the FRL from +152.00 m to +148.00 m** and minimize the extent of submergence in their territory.
- ❑ Further, based on the request of Maharashtra State, **backwater studies** were carried out at **different levels** i.e, +151.00, +150, +148.00 and +149.00 and furnished.
- ❑ In all the above meetings and even after all the efforts made by Government of Telangana, **mutual consensus could not be attained on the FRL** of barrage at Tummidihetti and the Government of Maharashtra has **repeatedly requested** Government of Telangana **to lower the FRL from +152.00 m to +148.00 m** and **minimize the extent of submergence**.

Challenges in Dr.B.R.A.PCSS Project

- All efforts were made by the Government of Telangana to convince the Government of Maharashtra **to accept for** the construction of barrage **at Tummidihetti with FRL +152m**
- **Maharashtra state objected** due to the submergence of about **3,786 acres at +152m** and requested to construct the barrage at **+148 m** to reduce submergence in their State
- If the barrage is constructed at Tummidihetti with FRL +148.0m, the submergence in Maharashtra will be **285 acres**, and the storage capacity will be **1.85 TMC**.
- This quantum of water would be **insufficient** for the diversion of **2 TMC per day to meet the planned utilization** of the project



Inter-state Meeting

- A meeting was held on **17th February 2015** in Mumbai between the then **Hon'ble Chief Ministers of Telangana and Maharashtra** along with the concerned Ministers and officers of Telangana and Maharashtra.
- The then on'ble Chief Minister of Maharashtra expressed that considering the public unrest, it is necessary to **lower down the barrage level at Tummidihetti to (+) 148m** and **minimize the submergence area**. However, **there is no objection from Maharashtra** for diversion of allocated water to Telangana **from Pranahita or Godavari rivers**. The then Hon'ble Chief Minister of Telangana agreed to **conduct alternate studies** for construction of the barrage with **minimum submergence in Maharashtra state**.

Challenges in Dr.B.R.A.PCSS Project

Central Water Commission (CWC) commented on the availability of water at Tummidihetti

As assessed by the Central Water Commission, the net water availability at the barrage location (Tummidihetti) was about 165.38 TMC **at 75% dependability** which includes **perceived surpluses of 63 TMC** from the share of u/s states.

The project authorities were advised to **review** the **quantum of divertible flows** from Pranhita barrage site considering the overall availability at the location, requirement of environmental flows, capacity of pumping, storage of barrage, en-route and command area storages etc. The CWC stated that availability of surpluses of **63 TMC from upstream states** as estimated at the barrage site **may not be reliably available in future**.

Challenges in Dr.B.R.A.PCSS Project

Central Water Commission (CWC) had suggested increase in reservoir capacities to match the demand and supply of water vide letter dated 22-07-2008

- The Central Water Commission, suggested to re-look into the **integrated Storage Planning aspects** of the project to **match the demand and supply**
- The proposed **capacities of storage reservoirs** is **insufficient** for success of the project. As such, there is **requirement of artificial reservoirs** within and around the project area either by increasing the capacity of existing reservoirs or creating additional new reservoirs.

PRANAHITA-CHEVELLA SUJALA SRAVANTHI

Originally proposed Reservoir Capacities

Reservoir	Capacity (TMC)
1. Barrage at Thummidihetti	5.0
2. Medaram Reservoir	0.58
3. Malkapet Reservoir	0.35
4. Anantagiri Reservoir	1.7
5. Imamabad Reservoir	1.5
6. Komarelli Mallanna Sagar (Tadkapally)	1.5
7. Thipparam Reservoir	1.0
8. Kondapochamma Sagar Reservoir (Pamulaparthi)	1.0
9. Baswapur Reservoir	0.8
10. Chevella Reservoir	3.0
Grand total	16.43

Efforts for finding alternate location

The work of investigation for Alternate location of barrage was entrusted to **M/s WAPCOS Ltd, Gurgaon.**

WAPCOS conducted LiDAR (Light Detection and Ranging) Survey and identified Medigadda as location for construction of barrage and also proposed two more barrages at Annaram and Sundilla.

The **water availability** at Medigadda was assessed as **282.3 TMC**



Agreement on Alternate Location

An **Interstate Board** between Telangana and Maharashtra States was constituted to resolve the issues between both the states on **08th March, 2016**. The board consisted of **3-tier committee** i.e., Co-ordinating committee, Standing Committee and Interstate Board.

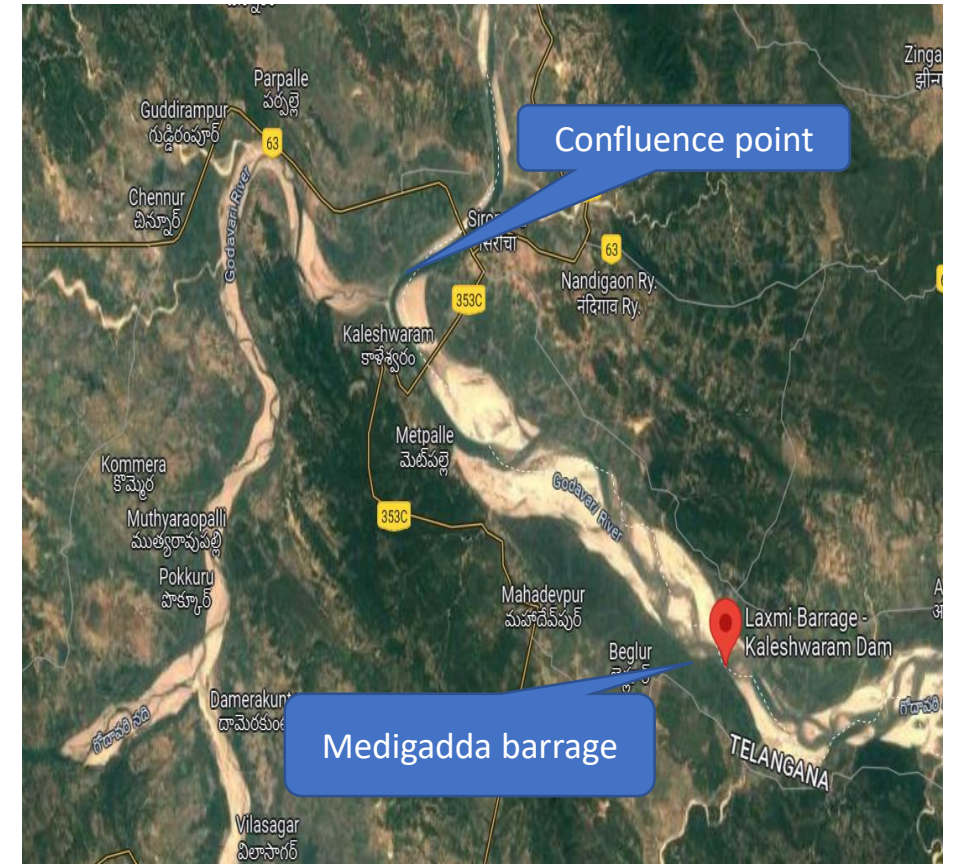
On **19th March 2016**, **meetings** of coordination committee (Chief Engineers) and standing committee (Secretaries) of interstate board were held at Hyderabad and after detailed discussions, the officials of both states **concluded** that the FRL of the **barrage at Tummidihetti** shall be proposed at **+148 m**.

The proposal of **barrage at Tummidihetti with FRL +148m** and **barrage at Medigadda with FRL +100.00 m** was discussed and **accepted** by the **interstate board**.

Agreement on Alternate Location

Finally, during the Interstate Board Meeting on 23rd August 2016 at Mumbai between the then **Hon'ble Chief Ministers of Telangana and Maharashtra**, the FRL of the barrage at **Tummidihetti** was agreed as **+148.00 m** and **the FRL of the barrage at Medigadda** was agreed as **+100.00 m**. Thus, resolving the interstate and water availability aspects.

~ 22Km downstream point of confluence of River Pranahitha with River Godavari





Need for Re-engineering of the Project

Need for Re-engineering of the project

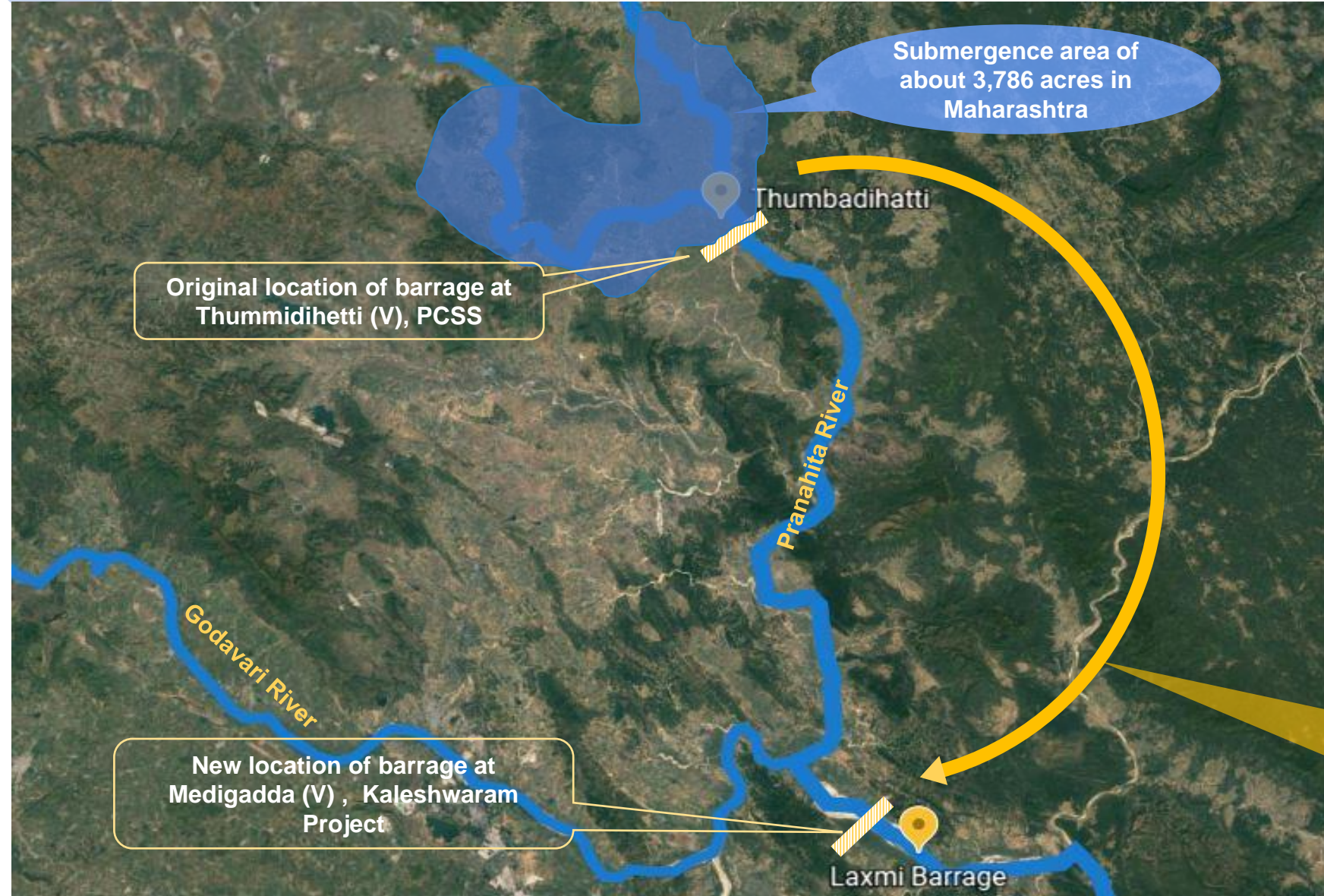
- 1** Reduction of **submergence** area as per the insistence of the state of Maharashtra
- 2** Identifying the alternate source for construction of barrage at **maximum water availability**
- 3** Construction of barrages and reservoirs duly **enhancing the storage capacities**

Key Enablers for Re-engineering the Project

Technology

Innovative Approaches

Technology for Shifting of Source Point



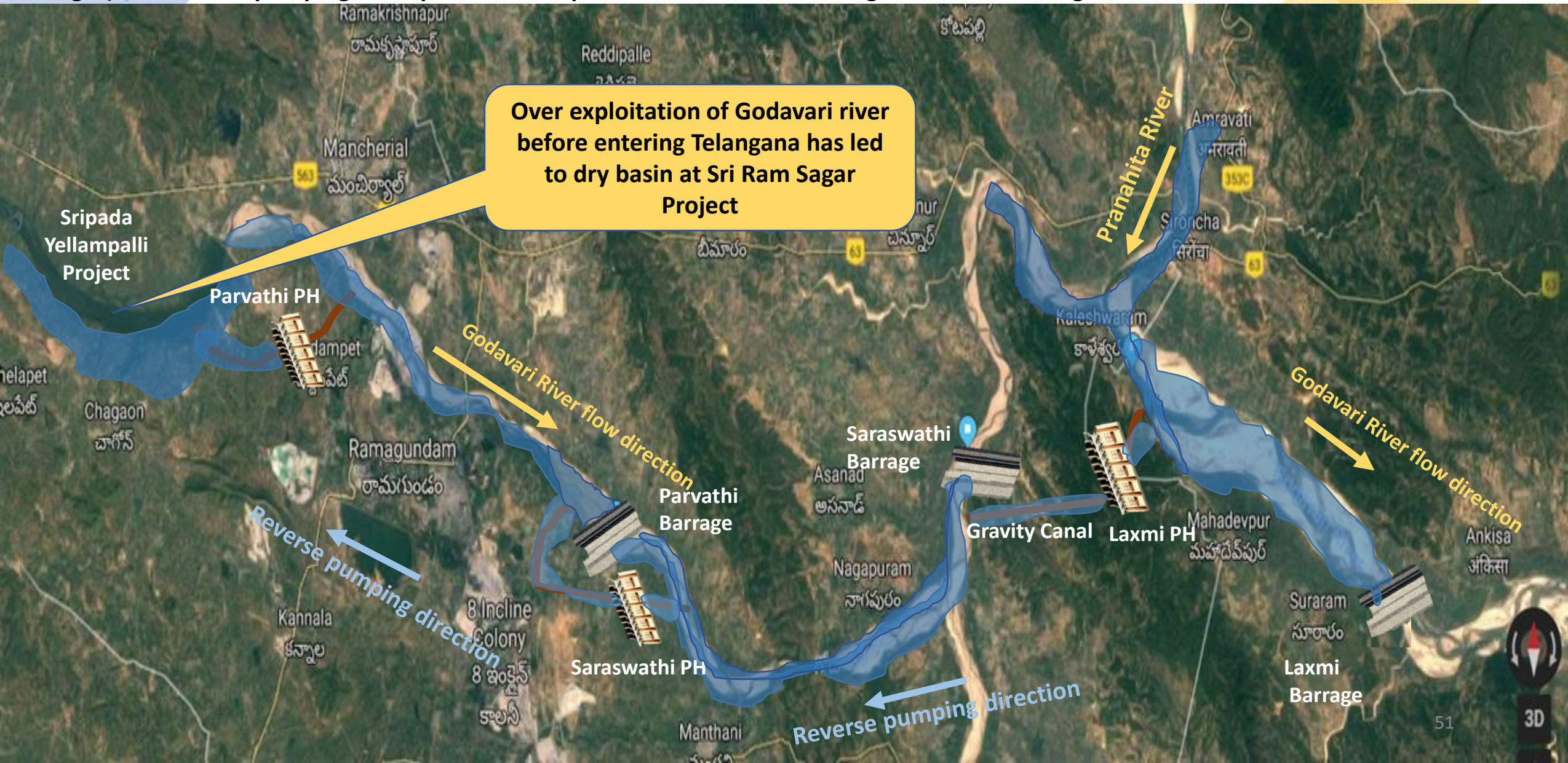
LiDAR (Light Detection and Ranging) Survey was conducted to ascertain alternate source

Source Point shifted to Medigadda (V) due to the following reasons.

- Reduction of submergence area to 285 acres.
- More water availability at Medigadda (V).

New approach: Reverse Pumping

(A Barrage was proposed at Medigadda (V) to store water within the flanks of the Godavari River to an extent of 16.17 TMC (35.87 TMC in all 3 Barrages) and reverse pumping concept was developed with minimum submergence in all 3 Barrages)



Re-engineering of the Project

Dr. B. R. Ambedkar Pranahita
Chevella Sujala Sravanthi Project

Dr. B. R. Ambedkar
Pranahita Project

- Construction of barrage across Pranahita river to draw 20 TMC of water
- Irrigation facility in 2,00,000 Acres in erstwhile Adilabad district.

Kaleshwaram Project

- Construction of 3 Barrages across river Godavari at Medigadda, Annaram & Sundilla
- Lift systems, Tunnels, Reservoirs, Canals and distributary network
- Irrigating an ayacut of 18,25,700 acres (with 134.5 TMC) and stabilizing 18,82,970 acres of existing ayacut (with 34.5 TMC) in 13 districts
- Besides irrigation -
 - 10 TMC of drinking water to enroute villages
 - 30 TMC of drinking water to twin cities
 - 16 TMC of water to industries.

DPR of Kaleshwaram Project

- The **Detailed Project Report of Kaleshwaram Project** was submitted to the Central Water Commission(CWC), New Delhi in **February 2017**.
- All the requisite clearances were obtained from the various directorates of CWC and ministries of GOI.
- The **Technical Advisory Committee (TAC)** has accepted the Kaleshwaram project in its 136th meeting held on **06.06.2018**.

Statutory Clearances for Kaleshwaram Project

S.No	NAME OF DIRECTORATE/ MINISTRY/ BOARD	STATUS
1	Hydrology (S)	Clearance received from CWC vide Lr.F.No.6/231/ 2017-PA (S)/1327-28, dt:30-10-2017.
2	Inter State Matters (ISM)	Clearance received from CWC vide Lr.No. U.No. 4/2/TEL./ISM-I/2017/927-928,Dt: 03-11-2017 & Lr.No. U.No. 4/2/TEL./ISM-I/2017/974, Dt: 30-11-2017
3	Construction Machinery Consultancy (CMC)	Clearance received from CWC vide U.O.No.21/Telangana/02/2017 -CMC/432,dt:24-11-2017.
4	Irrigation Planning (S)	Clearance received CWC ID No.2/1481/IP (S)/2013/272 Dt: 13-04-2018 and B.C. Ratio finalized vide ewe ID No.2/1481/ IP(S)/2013/320 Dt: 11-05-2018.
5	Ministry of Agriculture & Farmers Welfare (MoA &FW)	
6	Cost Appraisal (I)	Finalized Cost received from CWC vide ID No.1 O-A/27/2017/CA(I)-2/77, dt:01-05-2018.
7	Central Soil & Materials Research Station (CSMRS)	Clearance received from CSMRS vide U.O. No.29/36/Kaleshwaram/RM-I/CSMRS/2017 /308,dt:21-05-2018.
8	Ministry of Environment, Forest and Climate Change (MoEF & CC)	1) Environmental Clearance: MoEF vide Lr. No.J-12011 /1/2017 -IA-I(R) Dt: 22-12-2017
		2) Forest Clearance: Stage-I: F.No.8-31/2017-FC, Dt:24.10.17. Stage-II F.No 8-31/2017-FC Dt: 24-11-2017
9	Central Ground Water Board (CGWB)	Clearance received vide Lr No: 4-1/CWC-PA/SML-CGWB/2017-1945 Dt: 21-11-2017
10	Technical Advisory Committee of MoWR	Clearance received vide Lr No.16/27/2018-PA(N)/939/70 Dt:14.06.2018.
11	Ministry of Tribal Affairs (MoTA)	Clearance received vide Lr No: 21011/02/2022 –FRA, Dt: 30-01-2022

4. Dr.B.R.Ambedkar Pranahitha Chevella Sujala Sravanthi Project & Kaleshwaram Project- Comparison of

- Cost
- Ayacut envisaged New / stabilisation ayacut
- Source/ cost of finance
- Power requirements

Name of Project	Original Cost (Rs. In Crores)	Revised Cost (Rs. In Crores)	Expenditure Made (Rs. In Crores)			Original Ayacut Envisaged (In Lakh Acres)	Stabilization Ayacut Proposed (In Lakh Acres)	Power Required	Electricity Required to Run the Project
			State	Loan	Total				
Dr.B.R. Ambedkar Pranahita-chevella Sujala Sravanthi	17,875	38,500	11,679	-	11,679	16.40	-	3,466 MW	8,701 MU
Kaleshwaram Project (Incl. 3 rd TMC)	80,190.46	1,27,872	32,207	61,665	93,872	19.63	18.85	4959 MW (2 TMC) 8450 MW (3 TMC)	13,702 MU



5. Problems & solutions in Medigadda, Sundilla and Annaram barrages



**Sripada
Yellampalli
Project**

Ramakrishnapur
రామకృష్ణాపూర్

Reddipalle
రెడ్డిపల్లె

కోటపల్లి

Amravati
అమరావతి

Mancherial
మంచెరియ్యల్

Beemaram
బీమారం

Chinnur
చిన్నూర్

Sironcha
సిరొచా

**Sundilla
Barrage**

**Annaram
Barrage**

**Medigadda
Barrage**

Peddampet
పెద్దంపేట్

Ramagundam
రామగుండం

Asanad
అసనాడ్

Mahadevpur
మహాదేవ్‌పూర్

Ankisa
అంకిసా

Kannala
కన్నాల

8 Incline
Colony
8 ఇంక్లైన్
కాలనీ

Nagapuram
నాగపూర్

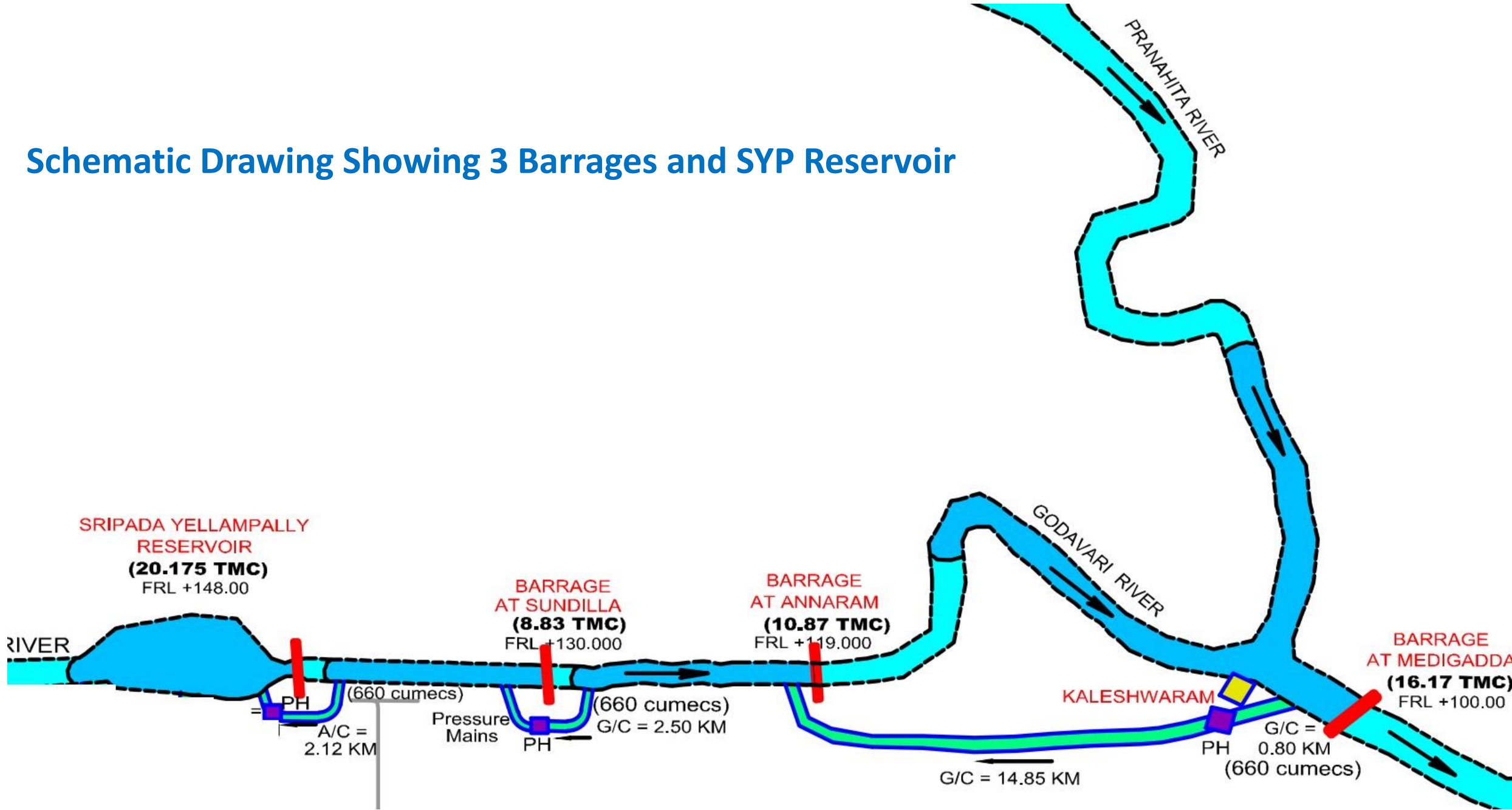
Suraram
సూరారం

Manthani
మంథాని



3D

Schematic Drawing Showing 3 Barrages and SYP Reservoir



Expenditure incurred for three barrages

Sl No	Barrage	Amount (in Cr)
1	Medigadda Barrage	3625.82
2	Annaram Barrage	2228.43
3	Sundilla Barage	1662.06
	Total	7516.31

All the main components of Barrages are completed and the barrages are being utilized by the department since 2019-20

Medigadda Barrage



Medigadda Barrage

Salient Features

Major Components

Barrage with Raft

energy dissipation arrangements

Abutments with fish pass

Piers, Flank walls and Returns

Road Bridge with clear carriage way of 7.50 m

Guide Bunds/Flood Banks on both banks on U/s and D/s

Diversion Channel either side of banks

Radial Gates with Rope Drum Hoist

Structural features

FRL	EL(+) 100.00m
Barrage crest	EL(+) 88.00 m for under sluice bays.
	EL(+) 89.00 m for other bays
TBL of U/s Earth Bund	(+) 105.700M
TBL of D/s Earth Bund	(+) 105.100 M
Capacity	16.17 TMC
Length of Barrage	1.632 KM
Width of Barrage	110.00 M
No. of Gates	$85 (15.0\text{ M X }12.0\text{M})$
MFD	$80,000\text{ Cumecs/}$ $28,25,120\text{ Cusecs}$
Length of Flood Banks	17.26 KM

Medigadda Barrage Incident

Chronology of Events

21.10.2023

- Field engineers of Irrigation Department heard a loud sound on Barrage at about 6.20 PM on 21.10.2023 and noticed damage at Pier No.19,20 & 21 of Block No.7 on Left Bank. The Pier No's 20 and adjacent piers 18,19 & 21 of Block-7 of Medigadda Barrage have sunken and the slabs & parapet wall resting on Pier No.20 have also sunken affecting the adjacent Piers 19 & 21.
- The E-in-C Ramagundam along with SE reached site around 11 PM and to avoid further damage, water stored in the barrage was depleted

22.10.2023

- Mr. Suresh Kumar, General Manager, Head- Hydrel & Tanners L&T agency and three members inspected the site and held a press conference along with I&CAD department officials to carry out the barrage restoration works by L&T construction company itself. They said that, they will complete all the restoration works on their own and will hand over to the department
- The Chief Engineer, CDO along with his technical team inspected the Medigadda barrage to asses the ground reality

Medigadda Barrage Incident

Chronology of Events

23.10.2023
to
25.10.2023

- A six-member Committee led by Member (Disaster & Resilience), National Dam Safety Authority visited the site on 24th Oct and examined the reasons for the incident. The NDSA Committee held discussions (General), I& CAD Dept. on 23rd at Hyderabad, carried out an inspection of the Medigadda Barrage on 24th and held the final round of discussions with various stakeholders viz. I & CAD Dept., L&T Infra Ltd., SDSO, etc., on the 25th of October at Hyderabad.
- The sinking is stabilized by 24.10.2023 and the final settlement is 1.256 M

28.10.2023

- Sri Ashwin B.Pandya, Chairan Dam Safety Review Panel & former Chairman, Central Water Commission along with his team of engineers visited the site and gave the inspection report

UP STREAM

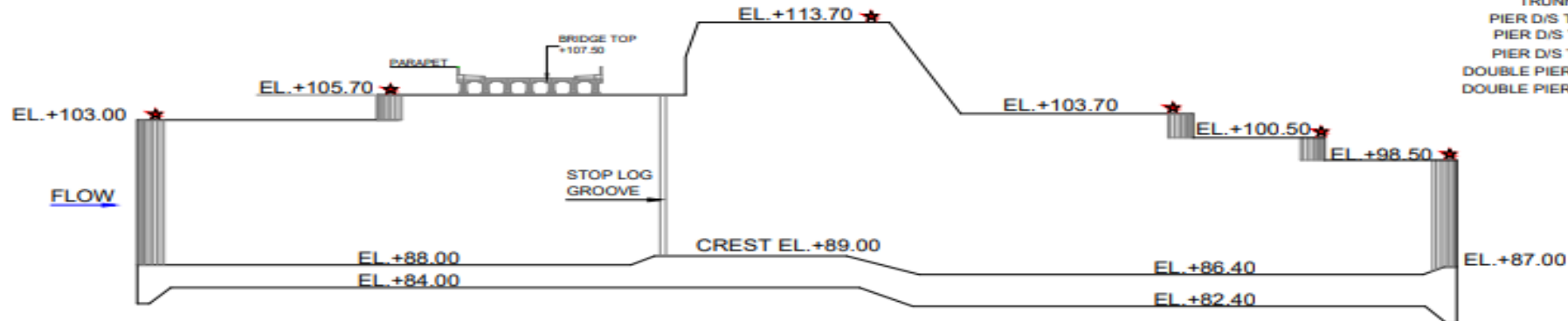
DATE : 26-OCT-2023 TIME : 7.00AM

RIGHT BANK

LEFT BANK

	P22 [DP]	P-21	P-20	P-19	P-18	P-17	P-16	P-15	P-14	P-13	P-12	P11 [DP-1]
PIER U/S TOP 1ST STEP	105.700	102.860 (-140)	101.742 (-1258)	102.156 (-844)	102.790 (-210)	103.000	103.000	103.000	103.000	103.000	103.000	105.700
PIER U/S TOP 2ND STEP	105.700	105.575 (-125)	104.848 (-852)	105.080 (-620)	105.421 (-279)	105.700	105.700	105.700	105.700	105.700	105.700	105.700
TRUNNION LVL TOP	113.700	113.627 (-73)	113.510 (-190)	113.350 (-350)	113.416 (-284)	113.633 (-67)	113.700	113.700	113.700	113.700	113.700	113.700
PIER D/S TOP 3RD STEP	105.100	103.700	103.702 (2)	103.652 (-48)	103.498 (-202)	103.647 (-53)	103.700	103.700	103.700	103.700	103.700	105.100
PIER D/S TOP 2ND STEP	-	100.500	100.530 (30)	100.550 (50)	100.330 (-170)	100.356 (-144)	100.500	100.500	100.500	100.500	100.500	-
PIER D/S TOP 1ST STEP	105.100	98.500	98.550 (50)	98.554 (54)	98.360 (-140)	98.340 (-160)	98.500	98.500	98.500	98.500	98.500	105.100

DOWN STREAM



- PIER U/S TOP 1ST STEP : +103.00
- PIER U/S TOP 2ND STEP : +105.70
- TRUNNION LVL. TOP : +113.70
- PIER D/S TOP 3RD STEP : +103.70
- PIER D/S TOP 2ND STEP : +100.50
- PIER D/S TOP 1ST STEP : + 98.50
- DOUBLE PIER U/S TOP [P22] : +105.70
- DOUBLE PIER D/S TOP [P22] : +105.10

LONGITUDINAL SECTION OF BLOCK - 07

A photograph showing a close-up of a concrete pier. A large, jagged crack runs diagonally across the concrete surface. To the right, a metal railing is visible, suggesting a walkway or staircase. The concrete has a weathered appearance with some discoloration and shadows cast across it.

Pier-20

Shot on OnePlus
By NEeRaj

10/26/23
10:26

NDSA Report

The NDSA Committee has communicated its report to Special Chief Secretary to Government on 01.11.2023 and made the following observations

Observations of the Committee

- Sought a list of 20 data/inputs to examine the matter
- Piers had sunk due to a combination of issues involving planning design, quality control and Operation and Maintainance
- Primary Reason for the failure is the settlement of the raft which could be due to various reasons including failure of u/s secant piles due to barrage load
- Construction deficieny due to lack of stringent quality control

Replies submitted by the I & CAD Department

- All data/inputs sought were shared with the committee
- The Correct causes can be determined only after proper inspection of the foundation. A coffer dam is under construction to divert the water and facilitate thorough inspection
- U/S and D/S secant piles are provided with a flexible joint with the main raft eliminating the possibility of barrage loads directly impinging on the piles . The prototype was developed by CWC and used in the Tapovan project in Uttarakhand
- Stringent quality control checks have been conducted during the execution of secant piles and plinth connection between raft and cut off

Observations of the Committee

- The Barrage has been designed as a floating structure but constructed as a rigid structure. Taking D/S cut off upto impermeable strata alters the uplift pressure due to blocking of subsurface flow
- The dam owners have not maintained the cement concrete blocks or launching aprons
- Non Compliance of Dam Safety Act 2021 in pre & post monsoon inspections to check for unusual behaviour

Replies submitted by the I & CAD Department

- The Barrage has been designed as RCC raft duly following the IS Code 6966 – Part – 1 (1989) and CBIP Manual. Pressure Relieve Valves are also provided as a drainage arrangement to relieve the uplift pressure
- The need for revision of the apron design is already in the notice of SDSO. Detailed model studies have been done jointly with IIT Hyd. Due to continuous rains in the basin and flows in the barrage, an opportunity to implement the modification was not available for the last 3 years
- DSA was effective from 13.12.2021, the regulations made thereupon did not provide clarity regarding the height and other details of specified structures. The SDSO, Telangana has sought for several clarifications in this matter and as per clarifications given Barrages were included to the list only on 12-07-2023

- The Special Chief Secretary to Government, Telangana has responded with a reply to NDSA report on 04.11.2023 and in turn the NDSA has asked Telangana State to undertake a detailed investigation to determine the failure causes, which were listed out in the committee's report such as planning, design, quality control and operation and maintenance (O&M) and keep NDSA informed of the outcome of such an investigation and the proposed rehabilitation process.
- Meanwhile the department has initiated the investigation work by carrying out required works such as an approach road for raft inspection by the L&T agency and contacting, finalizing agencies for geo-physical & geo-technical inspections

CE, CDO Report

Observations:

- The road bridge panels and parapet wall from Pier number 21 to Pier number 16 are sunken due to settlement of Pier number 20. Visible cracks over surface of road bridge and parapet wall are noticed.
- The DLRB slab maximum settlement at Pier number 20 is reported as 600mm.
- A major crack appeared in Pier number 20 along the radial gate wall plate alignment i.e., at a distance of about 45m from u/s face of the Pier. The crack width is varying from 150mm to 250mm. The origin of the crack was not visible as it is under water and extended above about 5m from the water level.

CE, CDO Report

Observations:

- Pier number 19 and 21 are noticed with hair line crack extending from top of Pier to almost up to water level.
- A slow whirling action of water is noticed on upstream of Pier number 20.
- Two Sand boils are noticed on DS side of block number 7 in bays between Pier numbers 16, 17 and between Pier numbers 17 and 18.
- Gantry girder and gantry rail alignment is distorted in horizontal direction between Pier numbers 19 to 21. Welding joints between two gantry girders over Pier are distorted.
- A reverberate sound was heard from stop log elements resting on Pier numbers 20 and 21.

CE, CDO Report

Conclusions:

The CE, CDO has concluded that based on design philosophy and observations made during preliminary inspection:

- The problem of settlement appears not due to any structural failures
- The differential settlement leading to visible cracks in Pier may be due to sand undermining below the raft.
- The cut offs seepage length provided is also sufficient for safe exit gradient as per design
- There might be possible mud/ bentonite pockets while laying cut offs which may later open up gradually during course of time and or deviation from vertical inclination of piling may lead to gaps between plain and RCC cut offs leading to sand migration channels

Report by Sri A B Pandya, Chariman (Dam Safety Review Panel) and Team

A visit was made on 28-10-2023 by a team of Engineers led by Sri Ashwin B.Pandya, chairman of the Dam Safety Review Panel for the state of Telangana & former Chairman, Central Water Commission and submitted the inspection report

Observations

- The settlement of the blocks is visible to the naked eye at the top road way level and Such visible settlement indicates significant structural and seepage failure of the barrage block in question.
- The maximum settlement observed is at the upstream end of Pier 20 of the order of 1256 mm.
- Pier number 20 exhibits a serious structural crack extending from top of the Pier to the junction of the Pier and raft.
- The Pier raft has sagged between Piers 17 and 22 with the deepest sag at Pier 20 and the twisting and torsion were also observed.

Report by Sri A B Pandya and Team

Observations

- The settlement and consequent twisting of the Piers necessitate examination of all the gates as to their clearances and safe operation
- The rail girder of the stop log gantry cranes indicates the same twisting and settlement across the joints between the girders
- It will not be advisable to fill the reservoir by installing stop logs in the distressed blocks as it may lead to further distress.
- Since the arrangements remain the same for the entire barrage, there is a need to examine the competency of the seepage cutoffs for the entire barrage.

Report by Sri A B Pandya and Team

Discussion on Secant piles

- While examining the drawings, it was observed that, the seepage cutoffs in the form of secant piles, have been provided as a separate structure which is not integrated with the raft for u/s as well as d/s cutoffs. There are possibilities of the cutoffs being bypassed by the pressurized water. Consequently, the extensive piping and erosion noticed in the foundations below the block 7.
- It appears that the Secant Pile cut-offs were rested on sand stone at higher levels in the flanks. The structural and hydraulics of this arrangement needs review.

Explanation

- The secant piles are provided with a flexible joint with the main raft. In line with approved drawings of CWC for Tapovan project in Uttarakhand. This would eliminate the possibility of barrage loads directly impinging on the piles
- Due to Geological condition of the site, the cutoffs have been provided with secant piles with a PCC overlapping between the adjacent piles.
- It will be necessary to review the designs considering the above Geological condition and consider provision of additional alternative cutoff in form of sheet piles or continuous diaphragm as a permanent remedial measure to the phenomenon noticed.

Recommendations by Sri A B Pandya and Team

- Precision surveys with millimeter level accuracy for the barrage floor and Piers to assess the horizontal and vertical deformations observed. Bay wise deformed shape drawings may be prepared.
- Exposing the downstream raft and river channel by diverting the flows and assessing the state of CC block and launching apron.
- Taking up planning of u/s and d/s cofferdams as suggested in the previous paragraphs.
- Assessing the clearances of the gates and recording them for the full opening of the gates.

Recommendations by Sri A B Pandya and Team

- Taking undisturbed samples of the foundation materials and testing them for the permeability as well as particle size distribution.
- Collecting and compiling the foundation investigation results as carried out during the planning and construction of the barrage.
- The efficacy of the existing pile cutoffs to withstand the scours, and their ability to control the flows below the barrage needs to be established. It also necessary to establish the structural competence of each component and their assemblage into a barrage unit, needs to be verified with reference to the various operational conditions.

NDSA Way Forward

- The project designs and drawings (as designed and built) need to be examined along with the results of geotechnical and geological investigations.
- Considering the commonalities, the likelihood of the piping failure of other blocks resulting in a similar failure is very much possible. Therefore, all piers and rafts of the Barrage must be surveyed, especially in block seven and blocks 6 and 8 (adjoining blocks), immediately to see if there is any piping/settlement. The observations should be made continuously to observe whether it is continuing.
- Inspection of apron/plinth connection downstream and upstream should be inspected urgently to know the gravity of the damage and plan for subsequent repair / remedial measures. Cracks should be monitored through standard methods (e.g., affixing glass strips with making across cracks, etc.)

NDSA Way Forward

- Before the remedial measures can be formulated, the extent of settlement and damage to the raft needs to be ascertained by project authorities and balance input/data provided to the committee.
- The distress condition developed in one block of the Medigadda barrage is adversely affecting the functionality of the barrage. To avoid further aggravation of the situation until it is fully rehabilitated, the following measures should be taken:
 - a. Hydraulic head should not be created by ponding as it may worsen piping.
 - b. Gantry crane should not be operated.
 - c. Gates in block number 7 should not be operated.
- After obtaining the results from the various investigations and on opinion of the expert committee the restoration of the Block 7 of Medigadda Barrage will be taken up and the Barrage will be under operation.

Annaram Barrage



Annaram Barrage

Salient Features

Major Components

Barrage with Raft

energy dissipation arrangements

Abutments with fish pass

Piers, Flank walls and Returns

Road Bridge with clear carriage way of 7.50 m

Guide Bunds/Flood Banks on both banks on U/s and D/s

Diversion Channel either side of banks

Radial Gates with Rope Drum Hoist

Structural features

FRL	EL(+)119.000 m
Barrage crest	EL(+) 106.000 m for under sluice bays.
	EL(+)107.000 m for other bays
TBL of U/s Earth Bund	(+) 123.000 M
TBL of D/s Earth Bund	(+) 123.000 M
Capacity	10.87 TMC
Length of Barrage	1270 KM
Width of Barrage	100.00 M
No. of Gates	66 (15.0 M X 12.30M)
MFD	65000 Cumecs/ 22,95,453 Cusecs
Length of Flood Banks	25.55 KM

- The visible seepage has been observed in monsoon period -2020 at downstream of the Annaram barrage in between the vent-33&34 and in the vent-44.
 - Poly Urethane (PU) grouting was done for the above seepage locations during the period June-2020 to arrest the seepage as a part of O&M of barrage.

- II) The visible seepage has been observed in monsoon period June-2023 at downstream of the Saraswathi barrage in the vent-28 and in the vent-38.
 - Temporary measures were taken like forming a ring bund with sand bags around the seepage location and dumped the metal and boulders to reduce the seepage as a part of O&M of barrage.

 - The Poly Urethane (PU) grouting is to be done for the above seepage locations to arrest the seepage.

- Almost all through the length of the barrage, the C.C blocks got dislocated and are washed downstream from the end sill and also the launching apron. The inverted filter below the CC blocks got washed away.

Model Studies have been conducted by TSERL, Hyd for Annaram Barrage & Sundilla Barrage Near the Sundilla Barrage on energy dissipation arrangements and CFD analysis has been conducted by IIT, Hyd to avoid impact of Hydraulic Jump on d/s Apron and further sectional model studies on Energy dissipation arrangements for Saraswathi barrage was carried out by at Infra plan Hydro Laboratory, Pune, Maharashtra state under the guidance and supervision of Mr. Deolalikari, Ex.Jt.Director, CWPRS Pune

Conclusions:

- Shooting velocities are observed from 16m/s to 16.5 m/s at the end of stilling basins
- Three alternatives are given to reduce the velocities and shooting flow
Submitted the three alternative proposals to the CE, CDO, Hyd for designing and according the approval for execution. Awaiting for approval



Visual-3: Visible seepage is observed in vent No-28 at downstream of Saraswathi Barrage



Visual-4: Visible seepage is observed in vent No-38 at downstream of Saraswathi Barrage



Visible seepage is arrested in between vent No.33&34 and in the vent No.44 by PU grouting during the period June-2020.

NDSA Report (Annaram)

A visit was made on 02-11-2023 by NDSA and CWC team to Annaram Barrage. On the day of visit, the water level is + 116.200 M with corresponding storage of 5.16 TMC (FRL= +119.00 M with corresponding storage of 10.87 TMC and Bed Level/ End sill level = +104.50 M).

Suggestions

- There is need to immediately arrest the concentrated leaks in Bay- 28 and 38 by adopting the method(s) adopted earlier. But it should be kept in mind that it is temporary measure and does not address the cause of the problem
- Techniques such as ground penetrating radars (GPRs) or any other suitable method may be used to diagnose the problem areas i.e. cracks in the cut off and/or at the junction of the cut off and raft. And also pockets of foundation piping formed, if any.

Way Forward

- The temporary remedial measures were taken at leaks in Bay-28 and 38 by forming a ring bund with sand bags to increase the head of the water to reduce/avoid migration of sand if any. There are no observations of coming out of sand before or after remedial measures
- The Agency has addressed to the investing agency to take up rectification work on permanent basis duly conducting the proper investigation. Accordingly the investigation agency M/s Parsan Overseas Pvt Ltd visited the leakages location and opined to carryout further investigation after depletion of water

Suggestions

- Remedial measures may be taken at the earliest to seal the cracks, if any and drill and fill the foundation piping pockets
- Till remedial measures are adopted to address root cause of the problem, the upstream water level may be kept at minimum possible level

Way Forward

- After investigation work, the suitable measures will be taken up to seal the cracks, if any
- As per the suggestions made by NDSA and CWC, the upstream water level is reduced from +116.200 M to +112.200 M to facilitate to know the root cause of the problem

Sundilla Barrage



Sundilla Barrage

Salient Features

Major Components

Barrage with Raft

energy dissipation arrangements

Abutments with fish pass

Piers, Flank walls and Returns

Road Bridge with clear carriage way of 7.50 m

Guide Bunds/Flood Banks on both banks on U/s and D/s

Diversion Channel either side of banks

Radial Gates with Rope Drum Hoist

Structural features

FRL	EL(+)130.000 m
Barrage crest	EL(+) 118.500 m for under sluice bays.
	EL(+)119.500 m for other bays
TBL of U/s Earth Bund	(+) 133.930 M
TBL of D/s Earth Bund	(+) 133.930 M
Capacity	8.83 TMC
Length of Barrage	1452 KM
Width of Barrage	89.00 M
No. of Gates	74 (15.0 M X 11.50M)
MFD	57000 Cumecs/ 20,12,936 Cusecs
Length of Flood Banks	16.7 KM

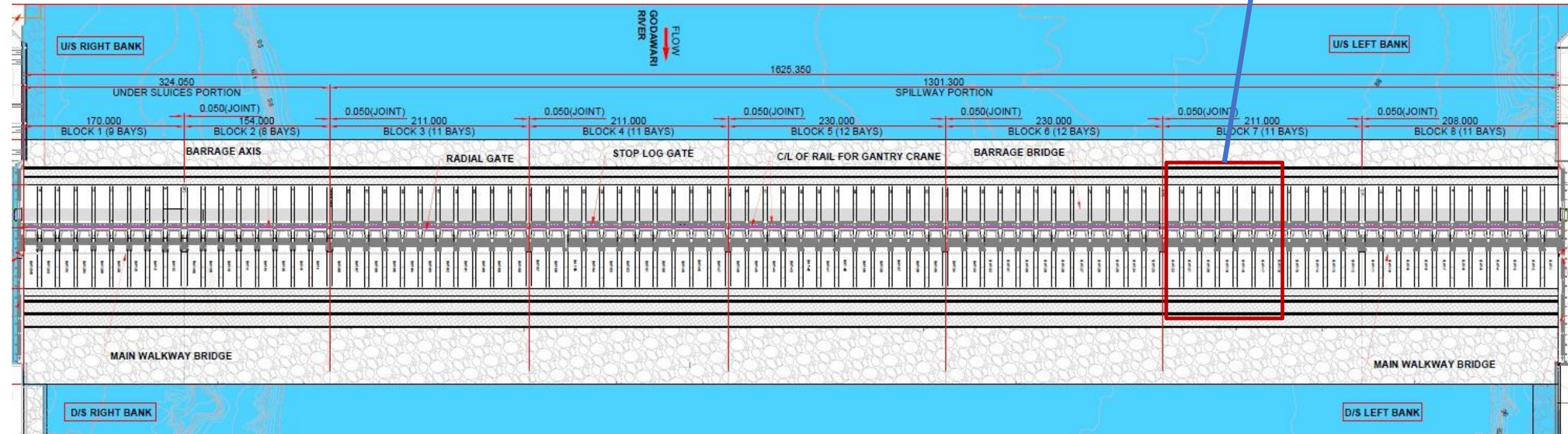
Observations at Sundilla Barrage

- Leaks of considerable discharge are observed in the year(s) 2020/21 at the middle of the bay no. 46 and bay no. 52 just downstream of the end sill. Treated by PU Grouting which effectively ended the leaks
- Similar leaks occurred recently in middle of the bay no. 50 & bay no. 33. Bay no. 50 is treated adopting similar remedial measures and leakages are arrested. Work at bay no. 33 is also in progress in the same way
- As per the suggestions made by NDSA, the upstream water level is reduced from +129.000 M to +123.800 M to facilitate to know the root cause of the problem

**Medigadda Barrage
Way Forward by Department for
Restoration**

Affected Area

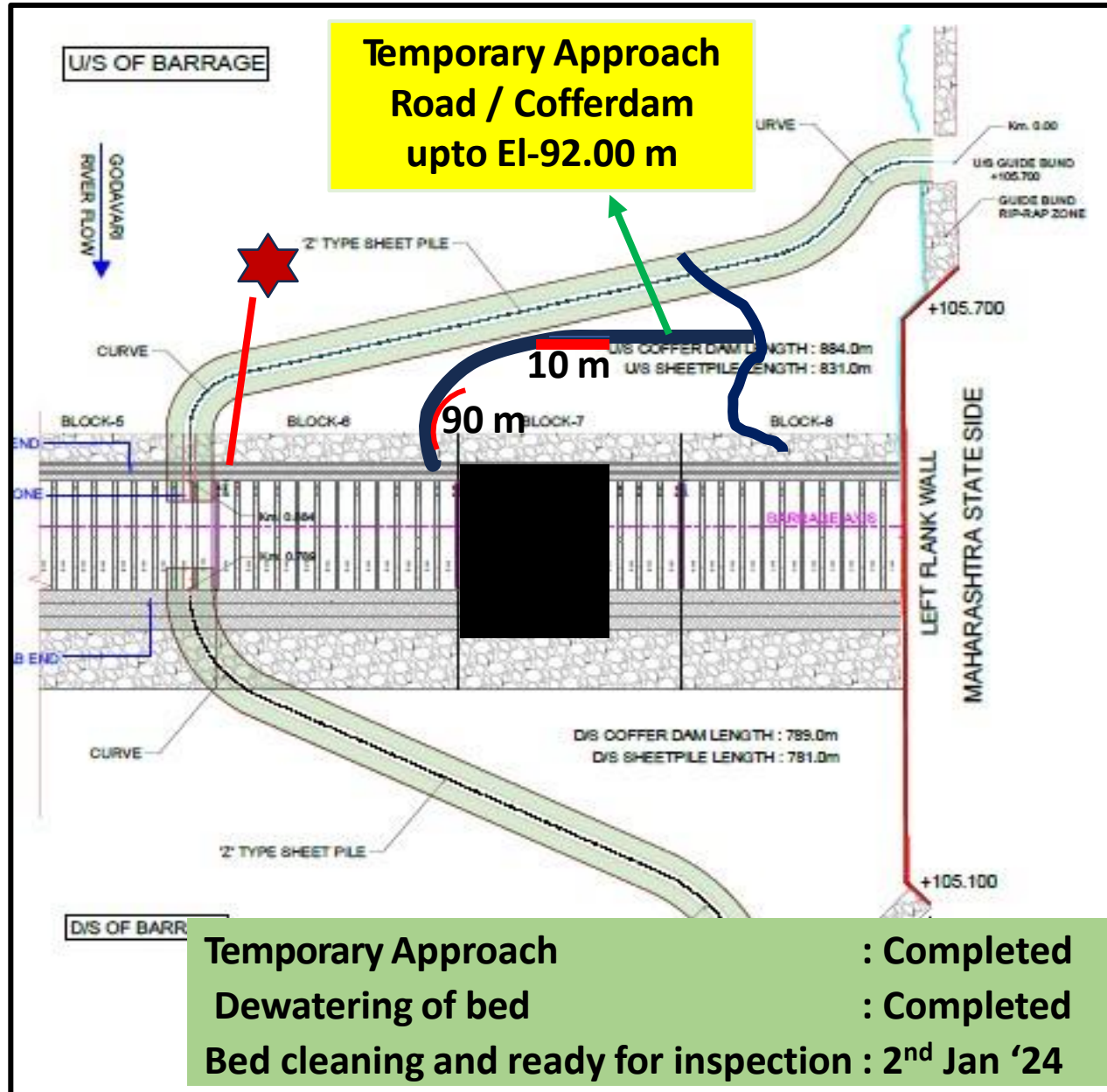
**Affected Area
Pier-21,20,19,18,17,16**



Block-1 9 Bays (Under Sluice Bays)	Block-2 8 Bays (Under Sluice Bays)	Block-3 11 Bays	Block-4 11 Bays	Block-5 12 Bays	Block-6 12 Bays	Block-7 11 Bays	Block-8 11 Bays
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Incidence Date & Time : 21-10-2023 at 6:30 pm , Location Block-7

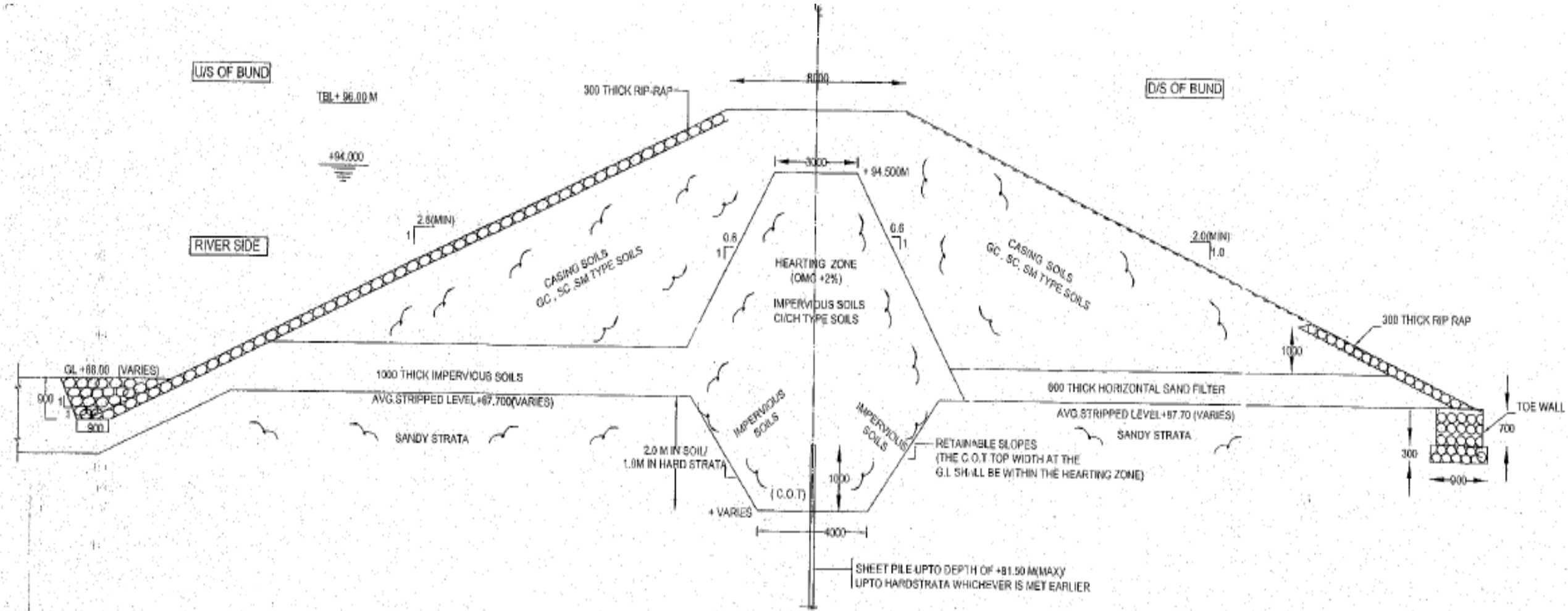
Temporary Approach Road / Cofferdam to Reach Location



Total Length : 350 m
Completed : 260 m
Balance : 100 m



Proposed Cofferdam Section



Approved Drawing Sheet
Pile COT-Bottom

- 1) Following Equipments mobilized on 29th Oct-23**
 - **2 Excavator, 6 Dumpers, 1 Dozer , 1 Loader, 1 Roller, 25 Workmen...**
 - **Approach Road / Temp Cofferdam work commenced on 7th Nov-23**
- 2) 260 m out of 350 m Approach Road completed till 15th Dec-23**
- 3) 2 Nos 60 HP Dewatering pumps mobilized at site**
- 4) Continuous monitoring of All affected piers NO SETTLEMENT OBSERVED**
- 5) Glass Tell-tale monitoring of Cracks, continuously- NO SETTLEMENT OBSERVED**
- 6) Sandbag placement to arrest Seepage appx 18450 Nos in U/S & D/S**
- 7) Water Dye Test : Block-7**

Sand Bag Placement in US and DS of block-7



Sandbag placement to arrest Seepage

Upstream near Pier-20 : 10290 Nos

Downstream Bay-15-16 & Bay-17-18 : 8160 Nos

Total : 18450 Nos

Agencies for Geo-Physical and Geo-technical investigations.....

1) Dynasoure Concrete Treatment Pvt Ltd : Visited Site (Referred by ENC RGM)

2) LTi Mindtree : Under discussion by L&T HQ team

INVESTIGATIONS PLANNED – LTi Mindtree

1. **GPR (Ground Penetrating Radar) Survey** - is a geophysical method that uses radar pulses to image the subsurface. This non-destructive method uses electromagnetic radiation in the microwave band (UHF/VHF frequencies) of the radio spectrum and detects the reflected signals from subsurface structures providing a better vision to the subsurface.

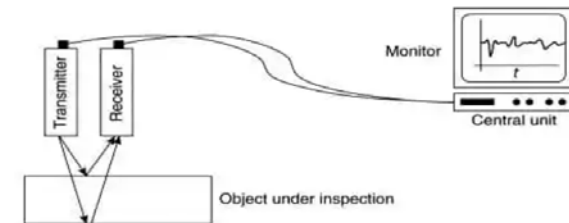
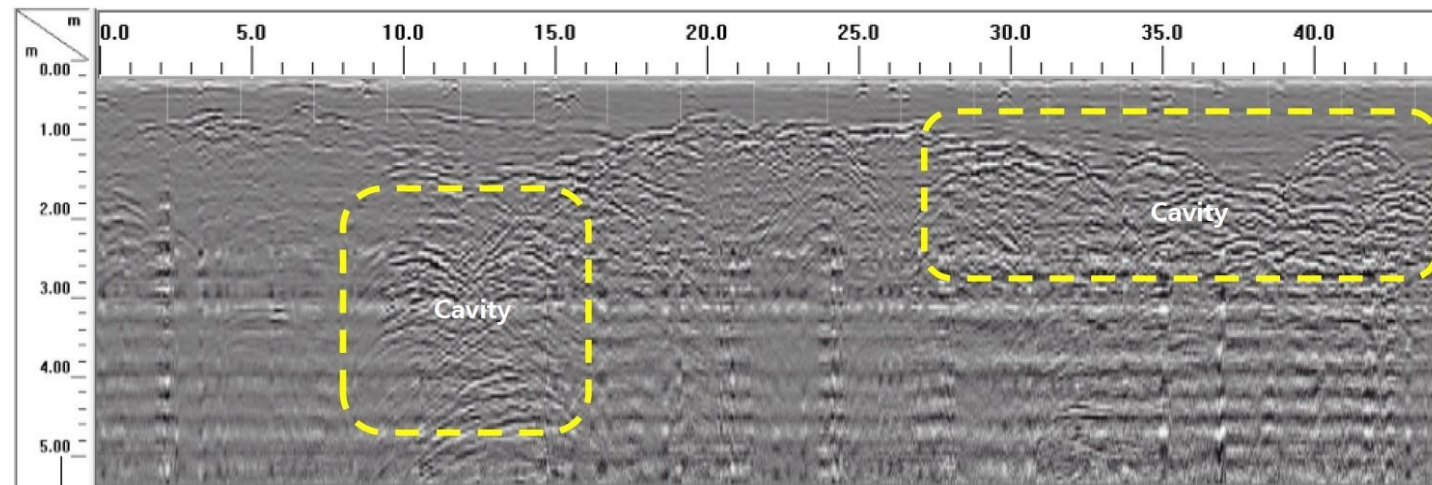


Fig.1: Typical GPR instrument and Its component

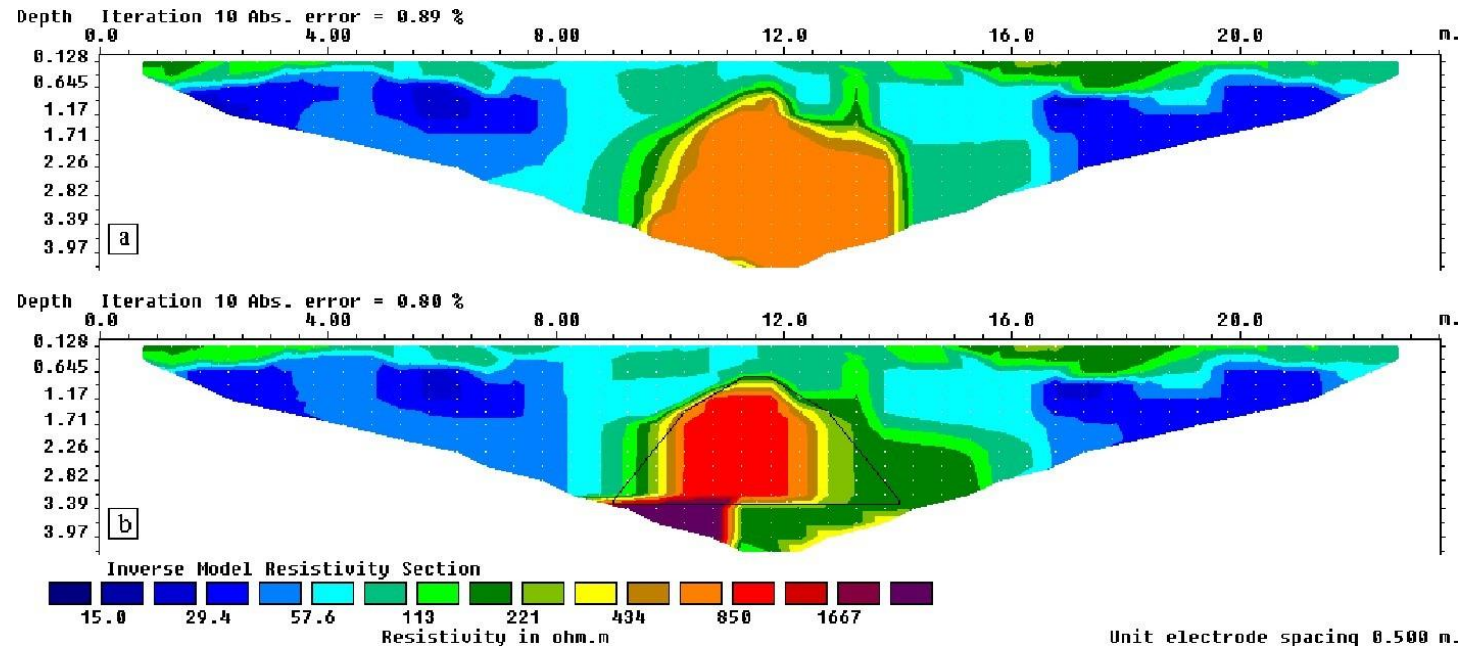
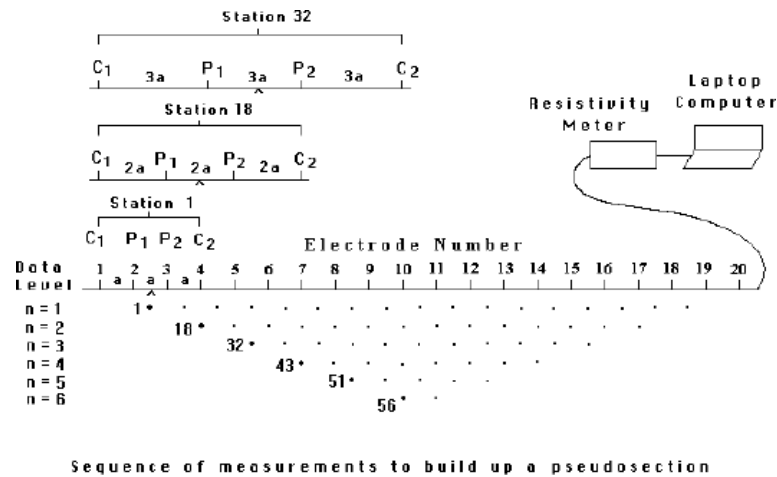
Fig 2: GPR Working Principle

Fig 3: Sample GPR data



INVESTIGATIONS PLANNED – LTi Mindtree

1. **ELECTRICAL RESISTIVITY TEST** : 2D Resistivity Image Profiling is to be conducted in the mountainous area/alignment of the proposed highway tunnel. Based on the Resistivity sections obtained from profiling the subsurface strata will be classified in different categories: Overburden strata, fresh rock strata, relatively fresh rock strata that includes many joints, weathered or altered rock and fractured zone with clayey material.



Cavity detection by ERT

Comparison of Demolition Methods

Diamond Wire Saw

Drill & Blast

Drill & Onetime Blast

Pros

- Safest Method
- No vibrations
- No sound pollution

- Blasting at localized area
- No vibrations since blasting done in zone wise
- Faster than diamond wire saw technique

- Fastest Method
- Entire demolition (both pier & base) at one go

Cons

- More Time consuming
- Secondary demolition is required
- Most expensive method

- Time consuming
- Special permits required

- Special permits required
- Vibration limits of structure is required
- Monitoring of adjacent blocks

Pier

- Intermediate Piers – P11 to P21 - **10 nos.**
- 4m thick; 110m length; max 25m height.
- **M25 Grade** Concrete with 20mm aggregate.
- Main Bar **36mm/32mm @ 140mm C/C**
- Transverse bar **25mm @ 250mm C/C**
- Volume of 1 Pier – App. **7950 cum**
(for 10 Piers – **79500 cum**)
- Double Piers – DP1/P11 and DP2/P22 – 2 nos. - **6m thick.**
- **(2 Double Pier 11,900 cum)**
- **91,400 Cum**

215064 cum

Base Slab

- Bay 12 to Bay 22 - **11 nos. of Bay**
- 4m to 4.7m thick; 110m width; Length 211m.
- **M25 Grade** Concrete with 40mm aggregate.
- Main Bar **32mm @ 125mm C/C;**
- Transverse bar **20mm/16mm @ 125mm C/C**
- Volume of 1 Bay (19m width) – App. **8680 cum**
(for 11 Bays – **95500 cum**)
- HPC Concrete : 5926 cum
 - **Raft Total : 101426 cum**
 - **DLRB & Aprons : 22238 cum**

Dismantling of structural items



Winch

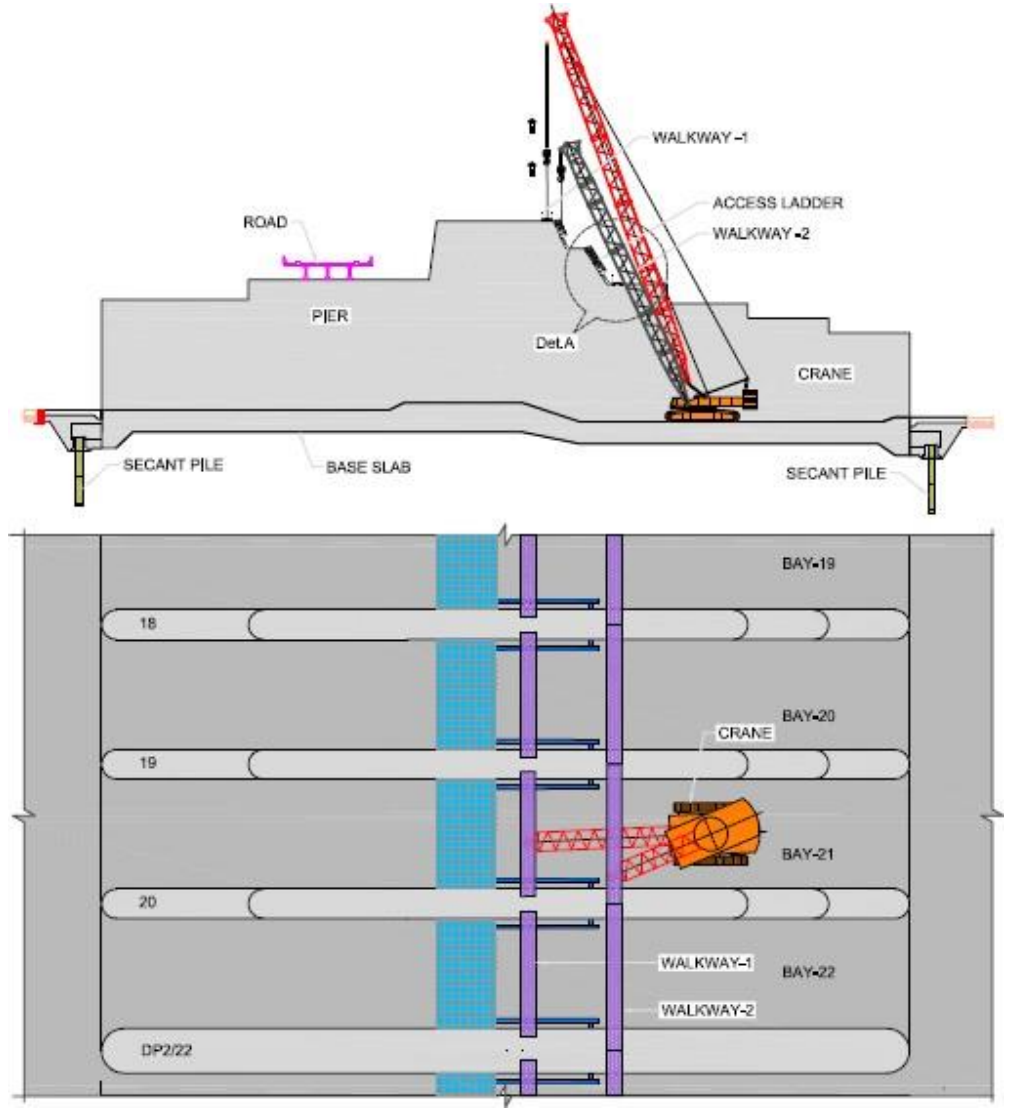
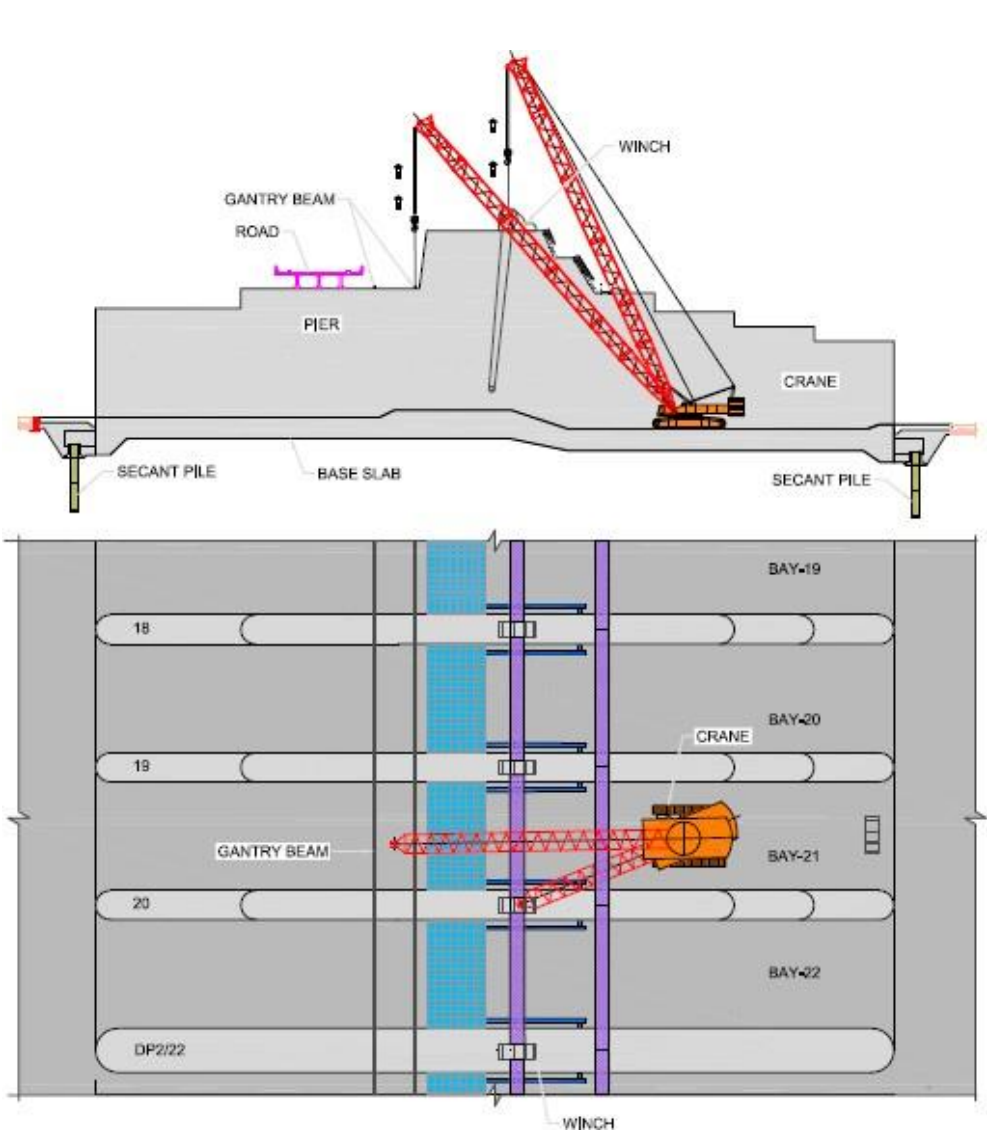
Walkway - 1

Access Ladder

Walkway - 2

**Gantry Track
Girder**

Dismantling of structural items



- Dismantle structural components – Road, Winch, Gantry beam, Walkway 1&2 and Access ladder.
- Structural components shall be dismantled and loaded in trailer

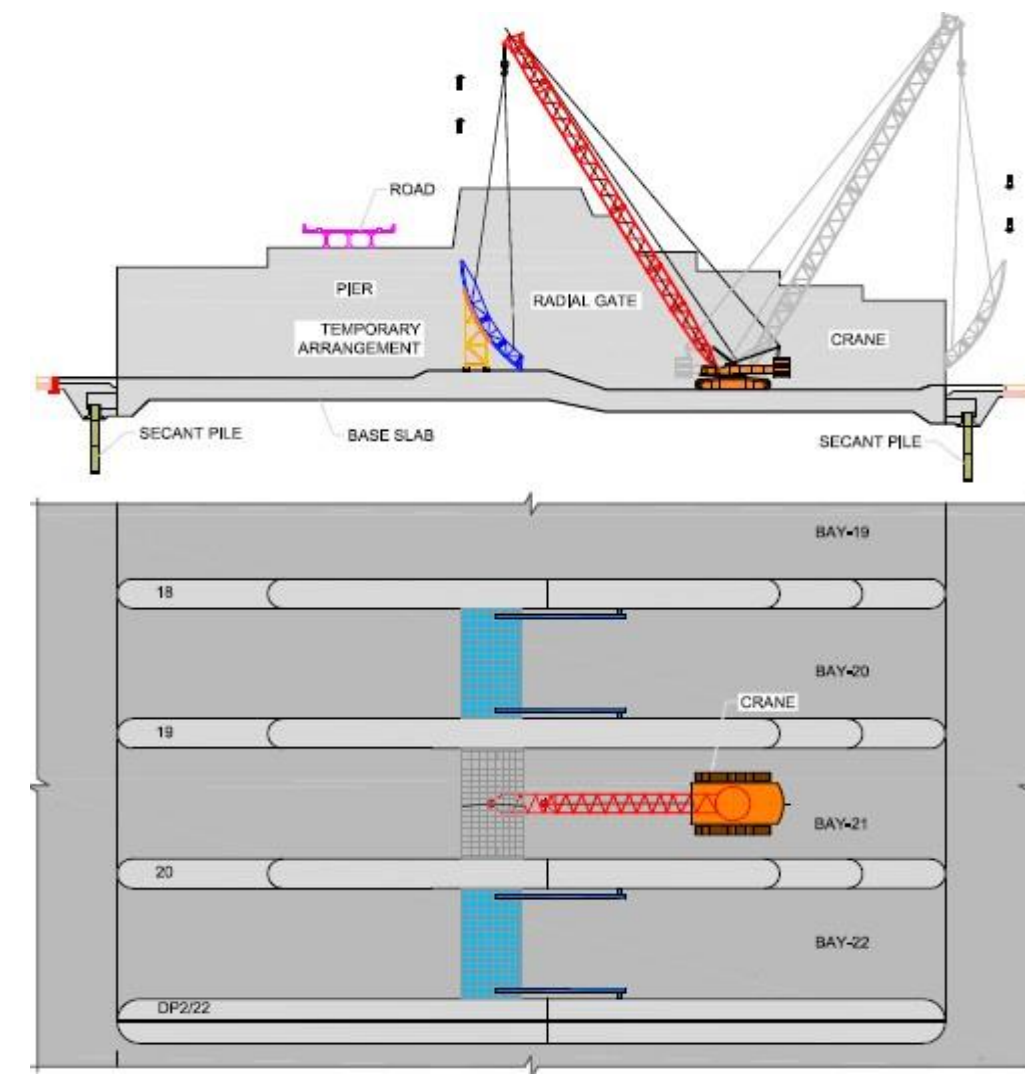
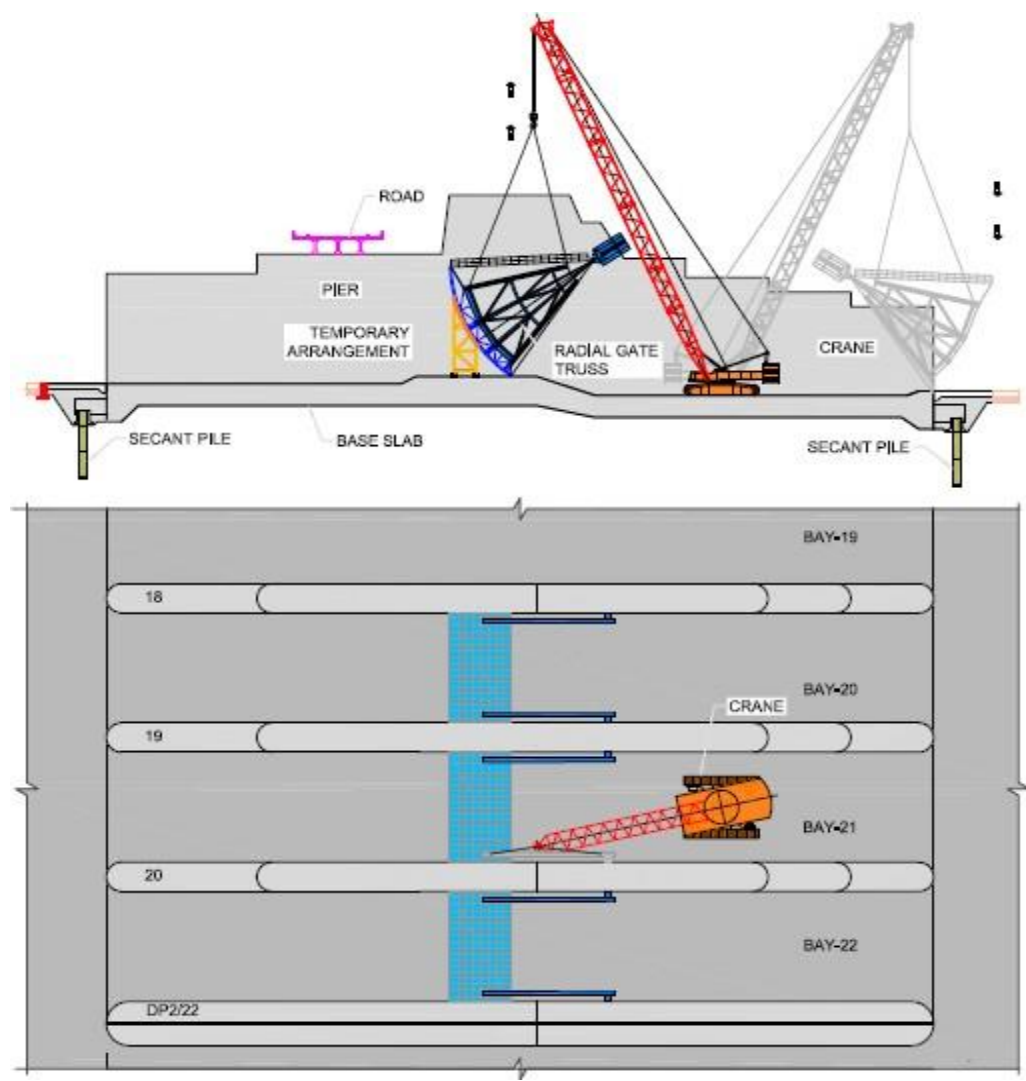
Dismantling of Radial Gate



Radial Gate

Truss holding Radial gate

Dismantling of Radial Gate



➤ Dismantle radial gate supporting truss and radial gate

Diamond Wire Saw Technique

- Diamond wire cutting (DWC) is the process of using wire of various diameters and lengths, impregnated with diamond dust of various sizes to cut through materials.
- Using this technique, a **diamond-infused wire** is fed through a sequence of **guide pulleys** and passed through or around the section of concrete that needs cutting and thus forming a loop. The wire loop is pulled continuously through the concrete until the cut is accomplished.



Concrete Cut Section

Guide Pulleys

Diamond Wire Saw

Way Forward

- After obtaining the results from the various investigations and on opinion of the expert committee, the restoration of Medigadda Barrage will be taken up.



THANK YOU