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International Commission on Irrigation and Drainage (ICID)



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Periodic Assessment of Sedimentation in Existing Reservoirs

2nd Indo Global Irrigation Summit
24-25 June 2026, New Delhi India

PERIODIC ASSESSMENT OF SEDIMENTATION IN EXISTING RESERVOIRS

A.K. GOYAL, MD, EHYTE INDIA PRIVATE LIMITED

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Importance of Periodic Assessment of Sedimentation in Existing Reservoirs

- Sedimentation is the main governing factor for deciding the life and performance of a reservoir, particularly in case of storage reservoirs.
- Storage reservoirs are the backbone of irrigation sector in India as runoff is mainly monsoon driven.
- At the time of planning and design of reservoirs, certain sedimentation rate is considered and various levels mainly MDDL is fixed based on the same.
- Large storage structures particularly concrete dams can last for centuries but the sedimentation may become a limiting factor.
- Sedimentation takes place in live storage also.

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Factors Governing the Sedimentation in Reservoirs

Sedimentation flowing in the reservoir storage is mainly dependent upon following characteristics of the catchment

- Amount and intensity of precipitation
- Land use and land cover
- Soil type and geological strata
- Gradient/slope

Sedimentation rate in the reservoir storage are mainly dependent upon following characteristics of the reservoir

- Size and shape of the reservoir
- Spillway arrangement
- Sluicing arrangement
- Presence of large storage reservoirs upstream.

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Sedimentation Study



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Main Equipment Used:

- Boat mounted RTK DGPS
- Boat mounted echo-sounder
- Total Station /DGPS/LIDAR drones



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Reservoir Survey and Data Processing Activities



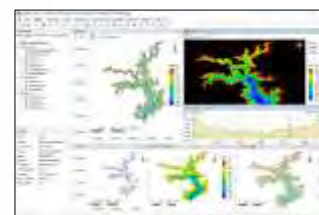
Equipment Setup



Static DGPS Survey In Progress



Hydrographic Survey



Data Processing in Hypack



Data Processing in AutoCAD



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SEDIMENTATION STUDIES FOR SARDAR SAROVAR RESERVOIR

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SALIENT FEATURES	
State	Gujarat
River Basin	Narmada
Catchment Area	88,000 Sq.km. (Total) 21,329 Sq.km. (Free)
Area of Reservoir at FRL	370.30 Sq.km.
Year of Impoundment	1995 for a level of 80 m
Minimum Draw Down Level (MDDL)	110.64 m
Full Reservoir Level (FRL)	138.68 m
Maximum Reservoir Level (MWL)	140.21 m
Design Spillway Discharge	86,944 Cumecs

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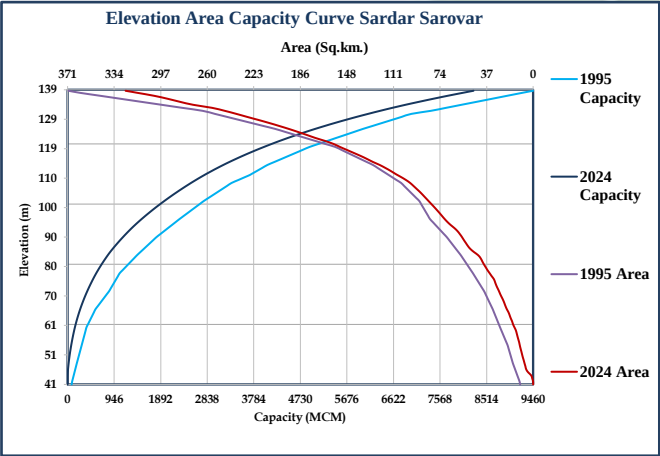
The map displays the Narmada River basin, which covers a significant portion of central India. The river originates in the Western Ghats of Madhya Pradesh and flows westward into the Arabian Sea. The Sardar Sarovar Dam is located on the Narmada River in Gujarat. The map includes state boundaries for Madhya Pradesh, Gujarat, and Chhattisgarh. An inset map in the top left corner shows the location of the Narmada basin within the Indian subcontinent. A legend in the bottom left corner provides details about the symbols used on the map, including cities, towns, and various types of land use. A pie chart in the bottom right corner illustrates the distribution of water resources within the basin.



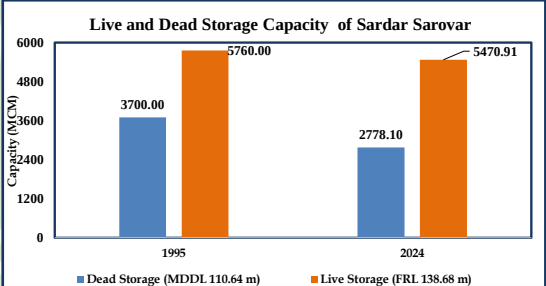
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COMPARATIVE ELEVATION-AREA-CAPACITY CURVES FOR SARDAR SAROVAR FOR YEARS 1995 AND 2024



Storage Capacities	Base year (1995)	HS 2024
Gross storage capacity (MCM) at FRL 138.68 m	9460	8249.01
Live storage capacity (MCM) at FRL 138.68 m	5760	5470.91
Dead Storage capacity (MCM) at MDDL 110.64 m	3700	2778.10



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Rate of siltation up to 2024		
No. of Years since impoundment (1995)	29	Years
Annual Rate of Siltation of Sardar Sarovar reservoir	41.76	MCM/Yr.
Effective Annual Rate of Siltation by the free Catchment of Sardar Sarovar reservoir (21329 Sq.km.)	0.475	mm/yr.
Reservoir Sedimentation Problem Category	Significant	

Zone of Storage	Annual Percentage loss up to 2024	
Dead Storage (MDDL 110.64 m)	0.86	%
Live Storage (FRL 138.68 m)	0.17	%
Gross Storage (FRL 138.68 m)	0.44	%

NZE BY 2124 (m)	MDDL (m)
79.19	110.64

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SOIL EROSION POTENTIAL OF SUB CATCHMENTS OF SARDAR SAROVAR

Sl. No.	Sub Catchment Code	Area (Sq.km.)	Erosion Category
1	MWS01	1864.48	Priority 3
2	MWS02	1462.04	Priority 3
3	MWS03	1960.06	Priority 5
4	MWS04	1734.35	Priority 5
5	MWS05	2251.73	Priority 3
6	MWS06	2300.62	Priority 1
7	MWS07	2916.24	Priority 3
8	MWS08	1763.18	Priority 3
9	MWS09	2575.26	Priority 1
10	MWS10	2432.15	Priority 1



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SEDIMENTATION STUDIES FOR KOTA BARRAGE RESERVOIR

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SALIENT FEATURES			
Year of first impoundment (Year/Level)	1960	Sill level of Scouring Sluice	235.36m
River	Chambal	Spillway Crest level	247.50m
Type of Dam	Gravity / Earthen Dam	Catchment Area (Free)	2005 Sq.km.
Height of the Dam above Lowest Foundation	37.35 m	Year of Hydrographic Survey	2021
Purpose	Irrigation, Drinking water Supply & Power	Gross Storage Capacity (MCM)	112.06MCM (Original)
Area of Submergence at FRL	5.82 Sq.km. (Original)	Live Storage (MCM)	29.92MCM (Original)
Lowest Riverbed Level	227.38m	Dead Storage Capacity (MCM)	82.14MCM (Original)
Sill level of irrigation Sluice	254.80m (RMC)/256.03m (LMC)		

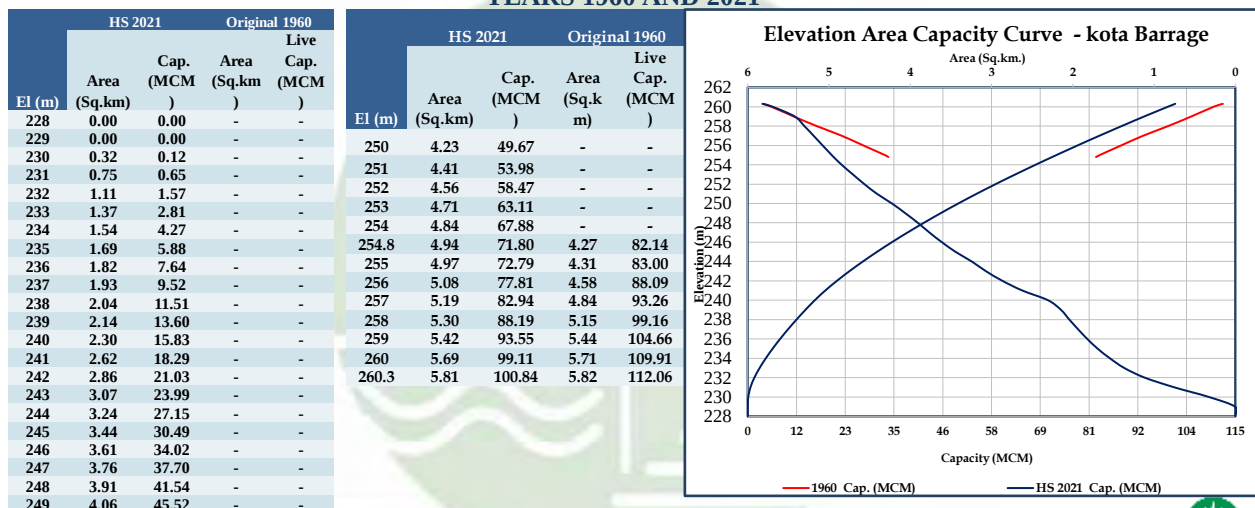
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LOCATION OF KOTA BARRAGE



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COMPARATIVE ELEVATION-AREA-CAPACITY CURVES FOR KOTA BARRAGE FOR YEARS 1960 AND 2021



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CUMULATIVE CAPACITY LOSS IN RPS RESERVOIR UP TO 2021

Rate of siltation at Kota Barrage up to 2021

Rate of siltation up to 2021		
No. of Years since impoundment	61	Years
Annual Rate of Siltation of Kota Barrage Reservoir	0.18	MCM/Yr
Effective Annual Rate of Siltation by the free Catchment of Kota Barrage reservoir (2005 Sq. Km.)	0.092	Th. Cum/Sq.km. /Yr
Effective Annual Rate of Siltation by the free Catchment of Kota Barrage reservoir (2005 Sq. Km.)	0.092	mm /Yr
Effective Annual Rate of Siltation by the free Catchment of Kota Barrage reservoir (2005 Sq. Km.)	0.918	Ha-m/ 100 Sq. km./Yr

Annual Percentage Loss in Different Zones of the Kota Barrage

Zone of Storage	Up to 2021	
Dead Storage (254.80 m)	0.21	%
Live Storage (FRL 260.30 m)	0.05	%
Gross Storage (FRL 260.30 m)	0.16	%

Capacity Loss in Diff. Zones of Kota Barrage

<i>Zone of Storage</i>	<i>Original Capacity (MCM)</i>	<i>2021 Capacity (MCM)</i>	<i>Loss up to 2021 (MCM)</i>
<i>Dead Storage (254.8 m)</i>	82.14	71.80	10.34
<i>Live Storage (FRL 260.3 m)</i>	29.92	29.04	0.88
<i>Gross Storage (FRL 260.3 m)</i>	112.06	100.84	11.22

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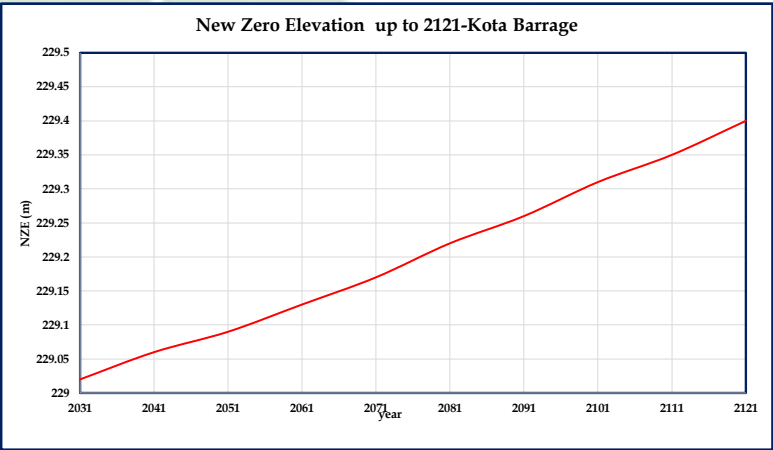


RESULTS

- Major storage structures like Gandhi Sagar and Rana Pratap Sagar upstream of the Kota Barrage -Trap almost all the sediment coming from upstream of these reservoirs.
- Loss in live storage is less than 1 MCM in 61 years which is negligible. As the project is essentially a barrage project having capacity inflow ratio (C/I) very less of the order of even 0.02, there is very little chance of accumulating sedimentation in live storage of the project. The MDDL of the project is same as crest level of spillway and reservoir area is 5.81 Sq.km. Hence, the sediment above this level gets flushed frequently and there is a very little chance of significant loss of live capacity above MDDL.
- It is to emphasize that this is the rate of accumulation of sediment the behind the structure, which essentially behaves as a barrage and not the rate of sediment contributed by the catchment, as most of the incoming sediment in the barrage gets flushed during floods.
- Scouring sluices with sill level of 235.36 m are not functional.

NEW ZERO ELEVATION FOR 100 YEARS

Year	NZE (m)
2031	229.02
2041	229.06
2051	229.09
2061	229.13
2071	229.17
2081	229.22
2091	229.26
2101	229.31
2111	229.35
2121	229.4



SOIL EROSION POTENTIAL OF SUB CATCHMENTS OF KOTA BARRAGE

Sl. No.	Sub Catchment Code	Area (Sq.km.)	Erosion Category
1	MWS01	167	High
2	MWS02	170	Moderate
3	MWS03	115	Moderate
4	MWS04	80	Slight
5	MWS05	93	Moderate
6	MWS06	161	Very High
7	MWS07	179	High
8	MWS08	124	Moderate
9	MWS09	128	Moderate
10	MWS10	134	Moderate
11	MWS11	217	High
12	MWS12	335	Severe
13	MWS13	102	Moderate



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- Design and Drawings
- Stability Analysis
- BoQ and Cost Estimation
- Power Potential Studies
- Irrigation Planning
- Reservoir simulation studies
- Economic Evaluation



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