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International Commission on Irrigation and Drainage (ICID)



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**Analysis of Canal Hydraulic Performance using
Drone Survey And Hydraulic Modeling**

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

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Problem Statement

- The canal is an **unlined canal** constructed during **2014-15** with the primary objective of facilitating **groundwater recharge**.
- Over the years, the canal has experienced significant **morphological changes** due to **erosion of side slopes** and **sediment deposition (siltation)** within the **canal bed**.
- Continuous erosion has resulted in an **increase in canal width**, while sediment deposition has **altered** the **original bed profile** and hydraulic characteristics of the canal.
- These **changes** have **modified** the **original cross-sectional geometry**, potentially **reducing the canal's efficiency** and **discharge-carrying capacity**.
- The canal was originally designed to convey a discharge of **600 cusecs**.
- Due to the **absence** of recent **topographic and hydraulic assessments**, the current **carrying capacity** of the canal **has not been quantified**.



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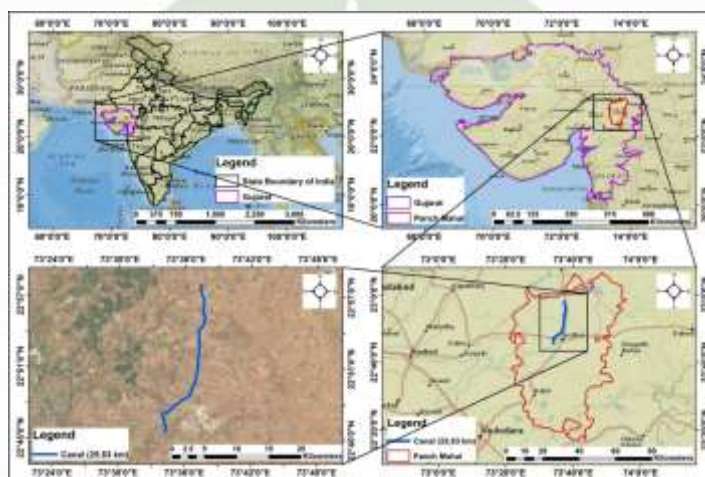
Objectives of the Study

- ❑ The primary objective of this study is to assess the hydraulic performance and structural adequacy of a 26 km stretch of the Left Bank Main Canal (LBMC) of the Panam High Level Canal (PHLC), Godhra Gujarat, India system using high-resolution survey data and hydraulic modeling. The specific objectives are to:
 - Develop an accurate hydraulic model of the canal using DGPS and UAV-derived cross-sectional data.
 - Hydraulic modelling will be carried out to evaluate the existing flow conditions and determine the actual discharge-carrying capacity of the canal.
 - Identify overtopping-prone and hydraulically vulnerable canal sections through Hydraulic Modelling.
 - Assess the hydraulic performance of 13 syphon structures, including discharge adequacy, head losses, and velocity variations.
 - Provide recommendations for canal operation, maintenance prioritization, and infrastructure improvements.

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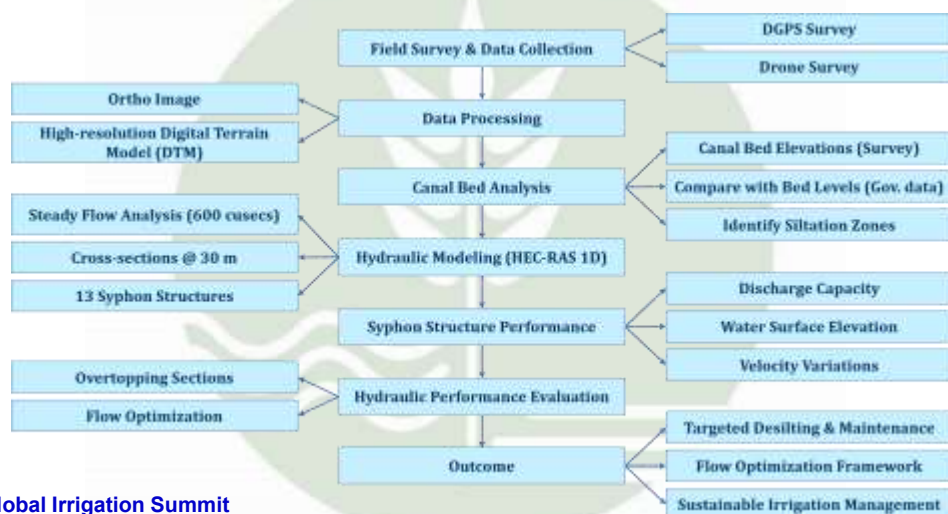
Study Area



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Methodology



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Site Visit Photographs

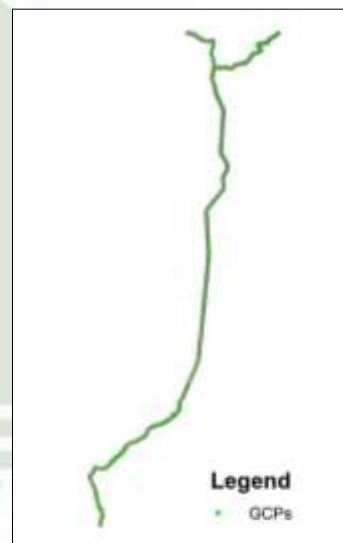


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DGPS Survey

- Ground Control Points (GCPs) and Check Points (CPs) were established across the site using real-time kinematic (RTK) method by Continuously Operating Reference Stations (CORS).
- GCPs were marked with high-contrast targets and coordinated with sub-centimeter accuracy.
- Control data was recorded for georeferencing and accuracy validation of the UAV data.



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Drone Survey

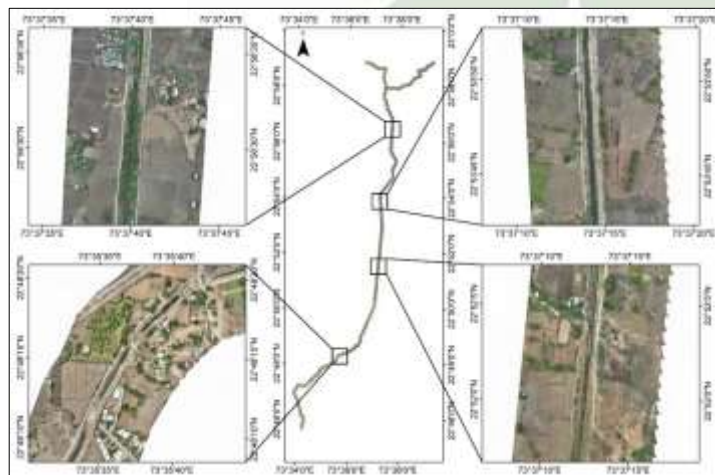
- UAV flights were programmed with 70-75% side and front overlap.
- Flight altitude: 111 m covering 26 km Canal.



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Ortho Image

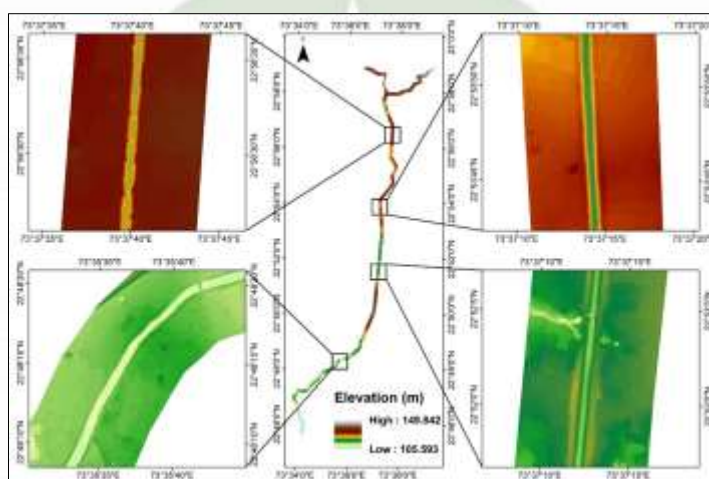


- i.e: Drone captures hundreds or thousands of overlapping photographs.
- Photogrammetry software processes the images.
- Ground Control Points (GCPs) and GPS data improve accuracy.
- Images are stitched (joining) and corrected.
- Final output is an ortho image with real-world coordinates.

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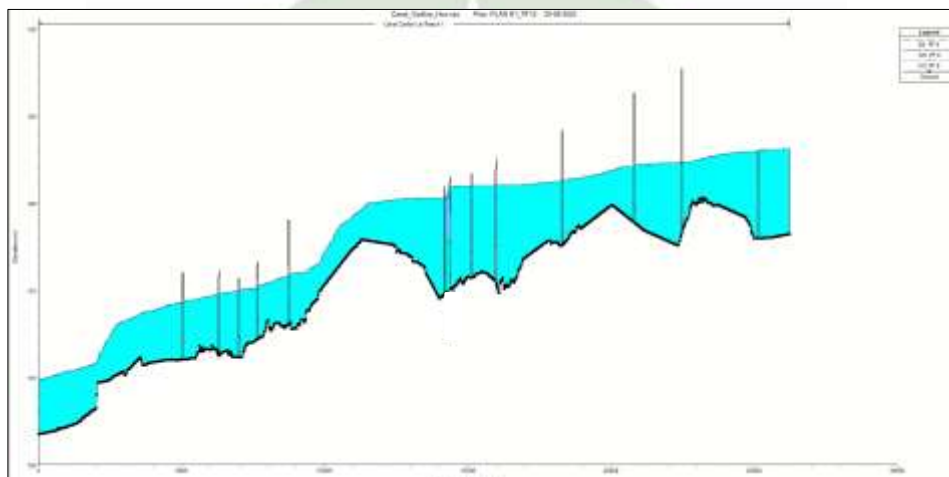
High-Resolution Digital Terrain Model (DTM)



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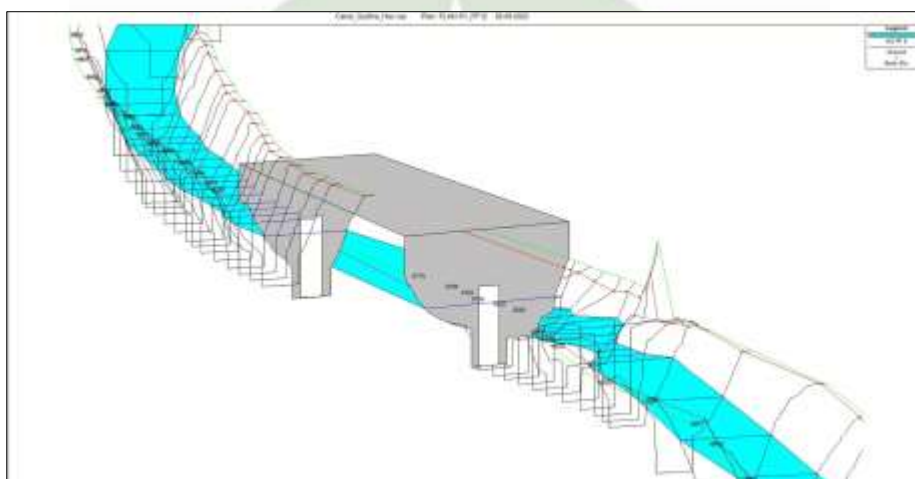
Water Surface Profile



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Water Level in Syphon (at chainage 16.95 km)



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Water Surface Elevation (u/s & d/s of Syphons)

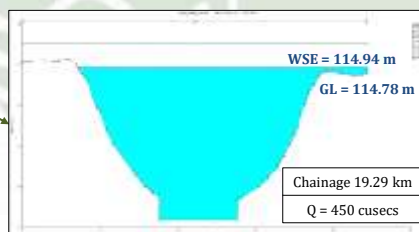
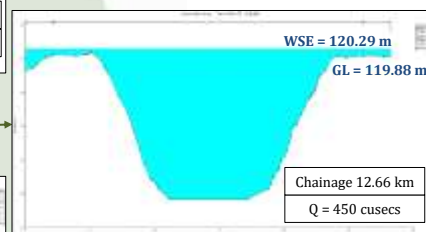
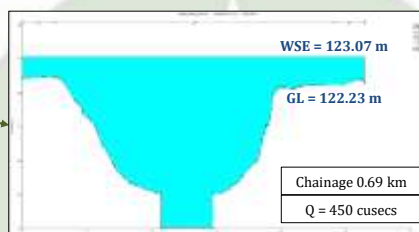
Sr. No.	Syphon Chainage (km)	Water Surface Elevation (u/s)				Water Surface Elevation (d/s)			
		Q=450 cu	Q=500 cu	Q=550 cu	Q=600 cu	Q=450 cu	Q=500 cu	Q=550 cu	Q=600 cu
1	1.02	123.05	123.25	123.45	123.63	122.97	123.18	123.4	123.6
2	3.66	122.35	122.59	122.84	123.05	122.31	122.55	122.79	122.99
3	5.37	122.2	122.43	122.67	122.87	122.1	122.32	122.55	122.72
4	7.89	121.32	121.62	121.94	122.12	121.25	121.54	121.83	121.99
5	10.18	121.03	121.34	121.65	121.8	121	121.3	121.61	121.75
6	11.15	120.99	121.29	121.6	121.74	120.97	121.26	121.56	121.7
7	11.83	120.96	121.25	121.55	121.68	120.39	120.55	120.7	120.86
8	12.01	120.39	120.55	120.7	120.86	120.3	120.44	120.57	120.7
9	16.95	115.91	116.1	116.29	116.48	115.76	115.94	116.11	116.3
10	18.06	115.25	115.47	115.69	115.92	115.13	115.33	115.55	115.76
11	18.69	115.02	115.24	115.46	115.68	114.93	115.12	115.32	115.51
12	19.17	114.82	115.01	115.21	115.41	114.75	114.92	115.09	115.26
13	20.64	114.36	114.54	114.73	114.91	114.29	114.46	114.62	114.77

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Overtopping Cross-sections

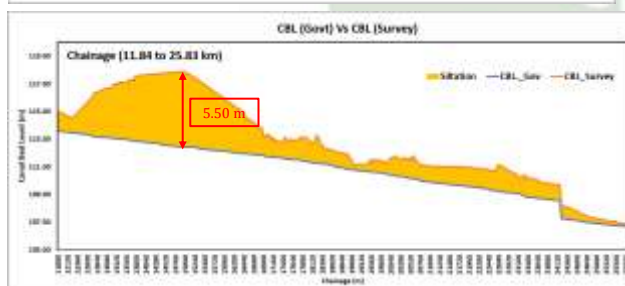
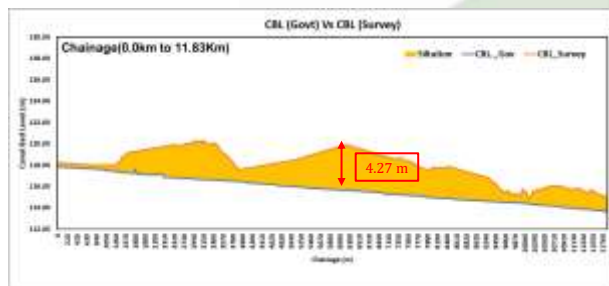
Q = 450 cusecs	
Sr. No.	Chainage (km)
1	0.63 - 1.40
2	1.45
3	1.57
4	3.75
5	4.17
6	4.86
7	5.33 - 5.40
8	9.72 - 12.72
9	17.43 - 17.49
10	18.54 - 18.75
11	19.14 - 19.31
12	21.06
13	25.02 - 25.38



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Comparison of Bed level



Chainage Range (m)	Average Siltation Depth (m)	Remarks
0 to 1260	0.41	Low siltation; no major impact on flow.
1290 to 3900	2.61	High siltation; desilting recommended.
3930 to 7320	2.95	Very high siltation; urgent desilting required.
7350 to 9600	2.62	Significant siltation; maintenance needed.
9630 to 11850	1.46	Moderate siltation; regular monitoring advised.

Chainage Range (m)	Average Siltation Depth (m)	Remarks
11960 to 13500	2.30	Moderate siltation; monitoring and maintenance required.
13530 to 16200	3.80	Very high siltation; urgent desilting recommended.
16230 to 18000	1.89	Moderate siltation; hydraulic assessment recommended
18030 to 22200	1.14	Low to moderate siltation; routine maintenance needed.
22230 to 24600	1.31	Manageable siltation; regular monitoring advised.
24630 to 25830	0.38	Minimal siltation; canal condition is satisfactory.



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Conclusion and Outcomes

- The **drone-based DTM** provided accurate assessment of canal bed changes and siltation patterns, permit targeted desilting and maintenance planning.
- Hydraulic simulations were carried out for discharge scenarios of **450, 500, 550, and 600 cusecs** using the surveyed canal geometry obtained from the Drone Survey and hydraulic model.
- The simulation results indicate that discharges exceeding **450 cusecs** result in inadequate freeboard and overtopping at several canal reaches due to changes in the canal geometry caused by **erosion and siltation**.
- Based on the hydraulic modelling assessment, the existing carrying capacity of the canal is estimated to be approximately **450 cusecs**, which is lower than the original design discharge of **600 cusecs**.
- Overall, the **integration of drone technology and hydraulic modeling** established a **smart irrigation management framework**, enhancing water delivery efficiency, ensuring structural reliability, and supporting **sustainable irrigation practices**.



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Thank You

Special Thanks to S.E , E.E and D.E.E of Panam Project Circle, Godhra
Gujarat, India

Q& A

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