

Confidential

HYDROLOGICAL / HYDRAULIC STUDY
OF NATAL ESTUARIES

DATA REPORT No. 6

LOVU NS 47

ESTUARINE DYNAMICS (CESD)
NRIO / CSIR
STELLENBOSCH

February 1982

NS 47

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The estuary is unstable as indicated by a high average lateral displacement of 95,1 m and a high average coefficient of variation of lateral stability (42,2%). The behaviour of the Lovu demonstrates a river trying to adjust to the human influences of bridge building, stabilization of embankments (with part of the sand-spit), sugar-cane farming and canalization.

RIVER LOU, 24 % ESTUARINE, REACH from Sugar Mill Br to Mouth, km from mouth. REF. DEA U700d
 AERIAL PHOTO DATE 26-5-59 SCALE 1:10 000 CATCHMENT AREA 938 km², M.A.R. 115 m³x10⁶, No. of DAMS NIL

RIVER VALLEY AND RIVER MOUTH FEATURES

General Description of the Terrain above the Valley

Terrain	Vegetation	Land-Use	Slumping	Vegetation and Land-Use	Left	Right
mountainous	✓ almost none	none	✓ none	none		
hilly	grass	scattered cultivation	occasional	grass	<u>NIL</u>	<u>NIL</u> %
undulating	sparsely forested (0-25%)	partly cultivated	frequent	trees	<u>11</u>	<u>12</u> %
plains	moderately forested (25-75%)	✓ mainly cultivated		cultivated	<u>89</u>	<u>88</u> %
	heavily forested (75-100%)	scattered settlement		built-up	<u>NIL</u>	<u>NIL</u> %
	swamp/bog	✓ partly built-up* urbanised				

Comments * near coast

Valley Characteristics

Measurements	Terraces	Relation of Channel to Valley Bottom (Vertical)	Relation of Channel to Valley Sides or Resistant Terraces (Lateral)	Surface Geology
valley length <u>3600</u> m	none	not applicable	not applicable (no valley or free)	bedrock
bottom width (av.) <u>880</u> m	indefinite	not obviously degrading	occasionally confined	✓ lacustrine deposits
valley slope (straight-line)	✓ fragmentary	partly entrenched	frequently confined	fluvial deposits
height at head of reach <u> </u> m to MSL	continuous	entrenched	entrenched	aeolian sand covered <u>18</u> % area

Comments

River Mouth

Characteristics	Measurements
open/closed	right bank breakwater length <u> </u> m
natural/artificial	left bank breakwater length <u> </u> m
canalized	rock sill level <u> </u> m to MSL
✓ sandy	cliffs on right bank: height <u> </u> m to MSL
✓ rocks on right bank	cliffs on left bank: height <u> </u> m to MSL
rocks on left bank	spit/bar: direction of growth <u>203</u> °
outer bar	length of spit/bar <u>525</u> m
✓ silt plume (fluvial)	length stabilized <u>405</u> m
suspended sediment (marine)	width <u>107</u> m

Comments

Description of Flood Plain

FLOOD PLAIN AND CHANNEL FEATURES

Presence	Extent	Vegetation	Forest Type	Land-Use
none	none	almost none	not known/applicable	not cultivated , not built-up
indefinite	average width <u>735</u> m	grass	riverine:	cultivated <u>46</u> % area
fragmentary	maximum width <u>1300</u> m	reed swamp <u>9</u> % area	main channel	crop/s <u>sugar</u>
✓ continuous	aerial length <u>3460</u> m	sparsely forested	tributaries	partly built-up
	area <u>246</u> ha	moderately forested	✓ coastal dune/evergreen mangroves	mainly built-up

Comments

Channel Description

N.B. Estimate of flow stage: LOW / HIGH (following 19-5-59 major flood)

Pattern	Measurements	Islands/Shoals	Type of Flow	Bar Type
straight	thalweg <u>3960</u> m	none	stagnant/still	none
sinuous	*sinuosity <u>1.14</u>	✓ occasional	✓ uniform water surface	✓ channel side bars
irregular	*open water area <u>22.2</u> ha	frequent	uniform with rapid in reach	✓ point bars
regular meanders	perimeter <u>8562</u> m	split	irregular	channel junction bars
✓ irregular meanders	lake/lagoon area <u> </u> ha	braided	pool & riffle sequence	✓ mid-channel bars
tortuous meanders	river X-sections <u>available</u>			✓ diamond bars
bifurcated	channel slope <u> </u>			diagonal bars
lake/s	channel width x <u> </u> m			sand waves/large dunes
lagoon	river slope <u> </u>			
	river width x <u>63.8</u> m			

Comments * whole reach

Obstructions/Constructions

Natural	Degree	Man-made	Degree of Obstruction/Constriction for Each	Position (from head of reach)
✓ none	none	✓ road bridge/s	<u>Sugar Mill = NR* brs</u>	<u>R. confined Head = 3 km</u>
logs	minor	✓ rail bridge/s	<u> </u>	<u>R. confined 3.8 km</u>
boulders	major	causeway	<u> </u>	
vegetation		weir/dam	<u> </u>	
		fish traps	<u> </u>	
		✓ embankment/s (2)	<u>for NR 2-way brs.</u>	<u>Across L. flood plain</u>
		groynes	<u> </u>	
		canals	<u> </u>	
		✓ drainage furrows	<u> </u>	<u>widespread = 3 km</u>
		others	<u> </u>	

Lateral Channel Activity

Lateral Activity	Nature of Banks	Bank Vegetation	Lateral Stability
not detectable	✓ alluvium (silt/sand)	none	stable
downstream progression	natural levees	✓ weak	slightly unstable
✓ progression & cut-offs	rock/boulders	good	✓ moderately unstable
mainly cut-offs	protected/stabilized	very strong	highly unstable
entrenched loop development	✓ cultivation to channel edge	left bank <u>7</u> %	
irregular lateral activity		right bank <u>NIL</u> %	
avulsion			

Comments

RIVER LOUVU, 24 % ESTUARINE, REACH from Sugar Mill BR to Mouth, km from mouth. REF. DEA U700d
 AERIAL PHOTO DATE 2-6-73 SCALE 1:10 000 CATCHMENT AREA 938 km², M.A.R. 115 m³x10⁶, No. of DAMS NIL

RIVER VALLEY AND RIVER MOUTH FEATURES

General Description of the Terrain above the Valley

Terrain	Vegetation	Land-Use	Valley Sides (Well-defined)	Slumping	Vegetation and Land-Use	Left	Right
mountainous	✓ almost none	none	✓ none	none			
✓ hilly	grass	none	occasional	grass		<u>NIL</u>	<u>NIL</u> %
undulating	sparsely forested (0-25%)	scattered cultivation	frequent	trees		<u>11</u>	<u>12</u> %
plains	moderately forested (25-75%)	✓ mainly cultivated		cultivated		<u>89</u>	<u>88</u> %
	heavily forested (75-100%)	scattered settlement		built-up		<u>NIL</u>	<u>NIL</u> %
	swamp/bog	✓ partly built-up* urbanised					

Comments * near coast

Valley Characteristics

Measurements	Terraces	Relation of Channel to Valley Bottom (Vertical)	Relation of Channel to Valley Sides or Resistant Terraces (Lateral)	Surface Geology
valley length <u>3600</u> m	none	not applicable	not applicable (non-eroded, or free)	bedrock
bottom width (av.) <u>880</u> m	✓ indefinite	not obviously degrading	occasionally confined	lacustrine deposits
valley slope <u>1:1029</u> (straight-line)	✓ fragmentary	partly entrenched	frequently confined	✓ fluvial deposits
height at head of reach <u>+3.5</u> m to MSL approx.	continuous	entrenched	entrenched	aeolian sand covered <u>NIL</u> % area

Comments

River Mouth

Characteristics	Measurements
open/✓ closed	right bank breakwater length <u> </u> m
natural/✓ artificial	left bank breakwater length <u> </u> m
canalized	rock sill level <u> </u> m to MSL
sandy	cliffs on right bank: height <u> </u> m to MSL
rocks on right bank	cliffs on left bank: height <u> </u> m to MSL
rocks on left bank	spit/✓ bar : direction of growth <u>205</u> °
outer bar	length of spit/✓ bar <u>640</u> m
silt plume (fluvial)	length stabilized <u>510</u> m
✓ suspended sediment (marine)	width <u>110</u> m

Comments

FLOOD PLAIN AND CHANNEL FEATURES

Description of Flood Plain

Presence	Extent	Vegetation	Forest Type	Land-Use
none	none	almost none	not known/applicable	not cultivated, not built-up
indefinite	average width <u>735</u> m	grass	riverine:	cultivated <u>53</u> % area
fragmentary	maximum width <u>1300</u> m	reed swamp <u>19</u> % area	main channel	crop/s <u>swamp</u>
✓ continuous	serial length <u>349</u> m	sparsely forested	tributaries	partly built-up
	area <u>246</u> ha	moderately forested	✓ coastal dune/evergreen mangroves	mainly built-up

Comments

Channel Description N.B. Estimate of flow stage: low/medium-high / HIGH **

Pattern	Measurements	Islands/Shoals	Type of Flow	Bar Type
straight	thalweg <u>3817</u> m	none	stagnant/still	none
sinuous	*sinuosity <u>1.12</u>	✓ occasional	✓ uniform water surface	channel side bars
irregular	*open water area <u>15.7</u> ha	frequent	uniform with rapid in reach	✓ point bars
regular meanders	perimeter <u>9159</u> m	split	irregular	channel junction bars
✓ irregular meanders	lake/lagoon area <u> </u> ha	braided	pool & riffle sequence	mid-channel bars
tortuous meanders	✓ river X-sections available			diamond bars
bifurcated	channel slope <u> </u> m s = <u> </u> m			diagonal bars
lake/s	channel width x <u> </u> m			sand waves/large dunes
lagoon	river slope <u> </u> m s = <u>47.5</u> m			

Comments *whole reach

fairly high (fewer bars)

Obstructions/Constructions

Natural	Degree	Man-made	Degree of Obstruction/Constriction for Each	Position (from head of reach)
✓ none	none	✓ road bridge/s	<u>Sugar Mill = NR bds. R. confined</u>	<u>Head + 3 km</u>
logs	minor	✓ rail bridge/s	<u>R. Confined</u>	<u>3.8 km</u>
boulders	major	✓ causeway	<u>remains of 1959 causeway ? chkb</u>	<u>= 3 km</u>
vegetation		weir/dam		
		fish traps		
		✓ embankment/s	<u>(2) for NR = r/wy bds.</u>	<u>across h. flood plain</u>
		groynes		
		canal		
		drainage furrows	<u>taking whole flow</u>	<u>0-1,2 km</u>
		✓ others	<u>pieces of old r/wy br. little obstr.</u>	<u>wide spread = 3 km</u>

Lateral Channel Activity

Lateral Activity	Nature of Banks	Bank Vegetation	Lateral Stability
not detectable	✓ alluvium (silt/sand)	none	stable
downstream progression	natural levées	✓ weak	slightly unstable
✓ progression & cut-offs	rock/boulders	good	✓ moderately unstable
mainly cut-offs	protected/stabilized	very strong	highly unstable
entrenched loop development	✓ cultivation to channel edge	left bank <u>8</u> %	
irregular lateral activity		right bank <u>NIL</u> %	
avulsion			

Comments

TABLE NS 47/VII

RIVER WIDTHS

LOVU NS 47

Station	Approx. distance along 1973 River course from Sugar Mill Br. (m)	River widths (in metres)										\bar{x}	s	V%
		Date												
		30-4-37	July/Aug. '53	26-5-59	17-6-67	2-6-73	12-6-76	12-6-76	12-6-76	12-6-76	12-6-76			
1	0	15	20 (10+10)	65	20	12	50	30,3	21,8	71,8				
2	290	20	15	15	35 (30+5)	10	15	18,3	8,8	47,8				
3	580	35	15	25	20 (15+5)	15	20	21,7	7,5	34,7				
4	870	23	15	15	25 (20+5)	10	20	18,0	5,7	31,4				
5	1 160	35 (10+25)	18	20	38 (20+18)	10	18	23,2	10,9	47,2				
6	1 450	65 (35+30)	15	58 (40+18)	18	17 (5+12)	20	32,2	22,9	71,1				
7	1 740	65	20	35	18	18	28	30,7	18,1	59,0				
8	2 030	85	50	45	40	12	35	44,5	23,8	53,5				
9	2 320	60 (30+30)	45	70	20	30	25	41,7	20,2	48,4				
10	2 610	60	45	45	60 (45+15)	30 (25+5)	20	43,3	16,0	37,0				
11	2 900	120	85 (10+75)	75	35	85	110	85,0	29,8	35,1				
12	3 190	185	100 (75+25)	105 (25+80)	110 (25+85)	88 (10+78)	90 (10+80)	113,0	36,3	32,1				
13	3 480	160	240	150	165	175	170	176,7	32,2	18,2				
14	3 770	16	30	170	20	12	10	43,0	62,6	145,6				
\bar{x}		67,4	50,9	63,8	44,6	37,4	45,1	51,5						
s		53,6	60,8	48,3	42,5	47,5	46,4							
V%		79,4	119,3	75,7	95,3	127,0	103,0							

LATERAL STABILITY

TABLE NS 47/VIII

Station	Approx distance along 1973 R. course from Sugar Mill Br. (m)	Distance from maximum observed L.B. position to mid-river (m)								Max-Min (m)	\bar{x} (m)	s (m)	V%
		Date											
		30-4-37	Jul/Aug. '53	26-5-59	17-6-67	2-6-73	12-6-76						
1	0	55	55	42	55	30	50	25	47,8	10,1	21,1		
2	290	80	65	52	21	12	95	83	54,2	32,7	60,3		
3	580	128	125	115	38	8	134	126	91,3	54,1	59,3		
4	870	185	188	180	45	10	195	185	133,8	83,2	62,2		
5	1 160	120	180	175	119	65	185	120	140,7	47,6	33,8		
6	1 450	110	165	70	205	151	22	183	120,5	67,0	55,6		
7	1 740	40	10	18	12	15	35	30	21,7	12,7	58,4		
8	2 030	48	25	30	40	35	25	23	33,8	9,1	26,8		
9	2 320	138	100	70	55	55	13	125	71,8	42,9	59,8		
10	2 610	115	85	35	55	50	10	105	58,3	37,1	63,6		
11	2 900	80	98	95	110	95	105	30	97,2	10,3	10,6		
12	3 190	135	154	152	157	170	180	45	158,0	15,6	9,8		
13	3 480	180	120	160	175	170	180	60	164,2	22,9	13,9		
14	3 770	8	140	85	185	175	200	192	132,2	73,4	55,5		
\bar{x}		101,6	107,9	91,4	90,9	74,4	102,1	95,1	94,7		42,2		
s		52,2	55,6	56,2	66,2	65,2	75,6	62,2			21,5		
V%		51,3	51,6	61,5	72,8	87,7	74,1	65,3			50,9		

Average lateral displacement 1937-76 = 95,1 m Average coefficient of variation 1937-76 = 42,2%

TABLE NS 47/IX

ABSTRACT

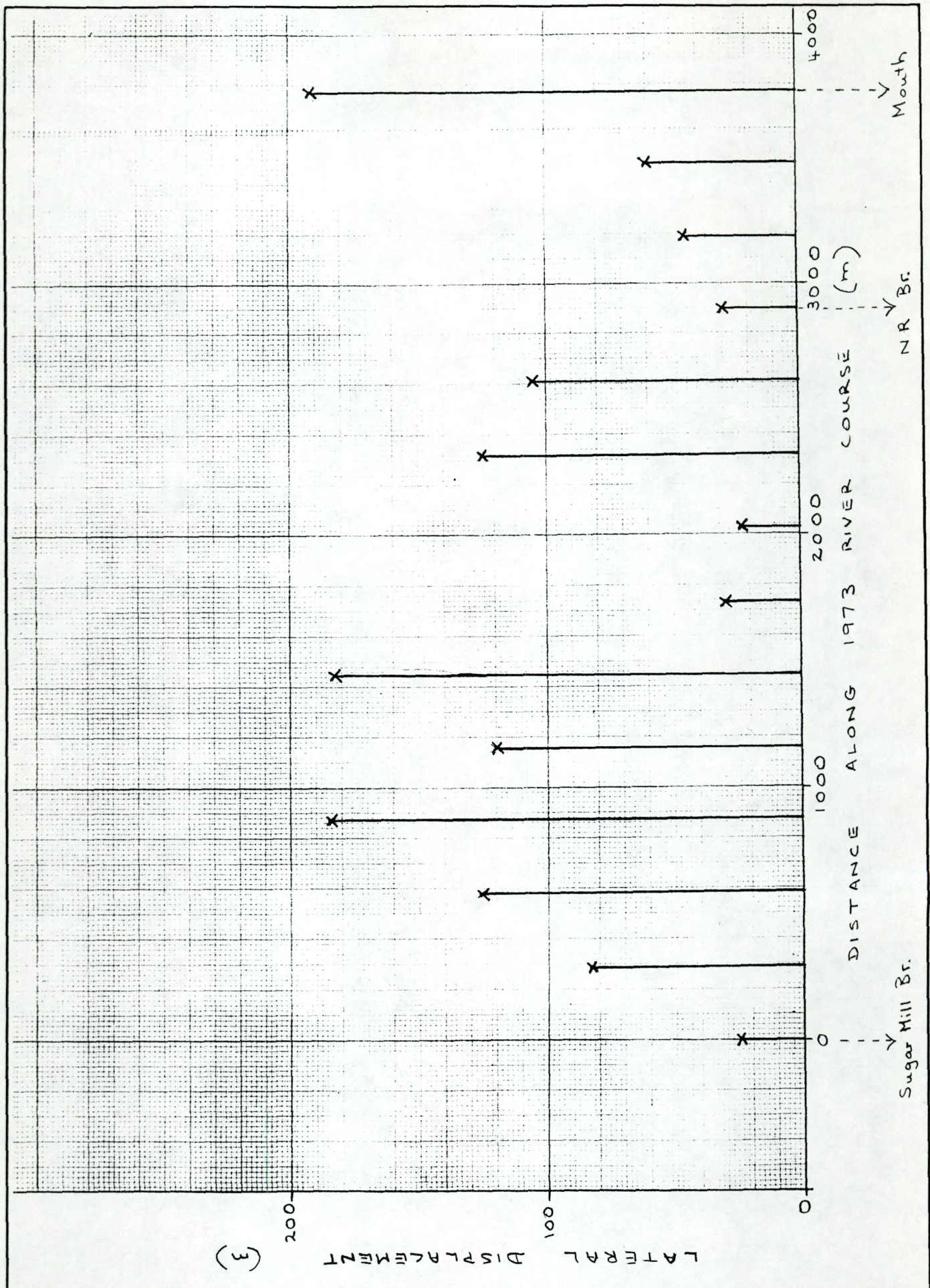
LOVU (NS 47)

1937 - 1976

1	Sinuosity	Range 1,12 - 1,17
2	River width	\bar{x} Range 37,4 m - 67,4 m
3	Lateral displacement	\bar{x} 95,1 m
		\bar{v} 42,2%
4	Thalweg	Range 3 817 m - 4 095 m
5	Open water area	Range 15,7 ha - 27,6 ha
6	Reed swamp area	Range 9% - 19%
7	Cultivation:	
	Valley sides L.B.	89%
	R.B.	Range 85% - 88%
	Flood plain	Range 46% - 60%

8 Human influence

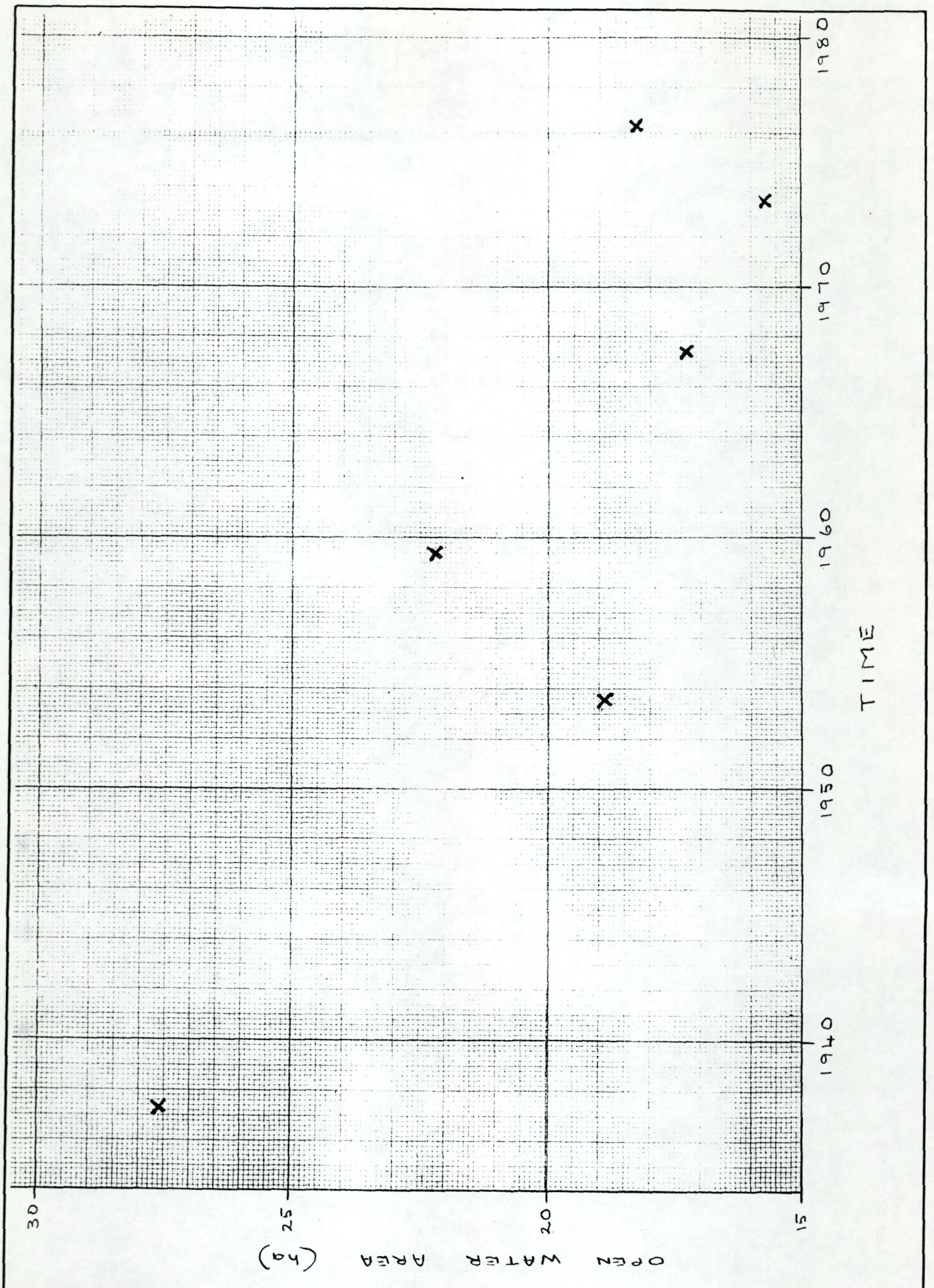
- (a) Valley sides almost entirely under sugar cane: also half the flood plain area.
- (b) Cultivation to the river's edge.
- (c) Railway lines:
 - 1937: old line approximately 550 m inland from sand-spit had little effect on natural river conditions at the mouth but its embankment across the left flood plain increased siltation.
 - 1953+ : new line just inland of sand-spit caused loss of perennial wetland areas, further aggravates siltation and prevents natural functioning of mouth conditions in times of flood.
- (d) Roadways
 - 1953+ : NR bridge and its embankment across left flood plain affects natural downstream progression of meander.
- (e) Remains of 1959 causeway affected scour during major March 1976 flood.
- (f) 1967: canalization over 1,2 km; silted up during March 1976 flood.



TRACED DS
 CHECKED:
 DATE:
 REF.

NATAL ESTUARIES: LOVU
 THALWEG DISPLACEMENT: 1937-76

FIGURE
 NS47/1



TRACED DS CHECKED DATE: REF:	NATAL ESTUARIES: LOVU OPEN WATER AREAS: 1937-76	FIGURE NS47/2
NATIONAL RESEARCH INSTITUTE FOR OCEANOLOGY		



SCALE: 1 : 16 000 approx.

TRACED DS
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NATAL ESTUARIES : LOVU

18-4-74 (ORTHOPHOTO)

PHOTOGRAPH
NS47/1

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SCALE: 1:15 500 approx.

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NATAL ESTUARIES: LOVU

30-4-37

PHOTOGRAPH
NS47/2

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SCALE: 1 : 16 500 approx.

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DATE
REF

NATAL ESTUARIES : LOVU

JULY / AUGUST 1953

PHOTOGRAPH

NS47/3

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SCALE: 1:15 500 approx.

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DATE:
REF:

NATAL ESTUARIES: LOVU

26-5-59

PHOTOGRAPH

NS47/4

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SCALE: 1 : 15 500 approx.

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DATE
REF

NATAL ESTUARIES : LOVU

17-6-67

PHOTOGRAPH

NS47/5

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SCALE: 1 : 15 500 approx.

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DATE:
REF

NATAL ESTUARIES : LOVU

2-6-73

PHOTOGRAPH

NS47/6

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SCALE: 1:16 000 approx.

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DATE:
REF:

NATAL ESTUARIES: LOVU

12-6-76

PHOTOGRAPH

NS47/7

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