

NRIO when updating - there is now available a photo copy
of a Nov. 1850 map from the Natal Archive

(ii) Hydro data (simulated) now available.

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(iii) Additional notes on floods from G. Schmidt, Bosch & Ass. (Hydro Conf. Paper)

HYDROLOGICAL / HYDRAULIC STUDY
OF NATAL ESTUARIES

DOCUMENTATION CENTRE
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DATA REPORT No. 8

TONGATI NN 4

ESTUARINE DYNAMICS (CESD)
NRIO / CSIR
STELLENBOSCH

June 1982

NN 4

Confidential

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OF NATAL ESTUARIES

DATA REPORT No. 8

TONGATI NN 4

ESTUARINE DYNAMICS (CESD)
NRIO / CSIR
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Details of the classification of the lower reaches of the Tongati river for 1937, 1953, 1959, 1968 and 1977 are given in Tables NN4/I - V. Details of river widths and lateral stability appear in Tables NN4/VI and VII and an abstract of results in Table NN4/VIII. Thalweg displacement and open water areas are shown in Figures NN4/1 and 2. Photograph NN4/1 shows the 1937 river course superimposed on a 1977 photograph from the orthophoto series and Photographs NN4/2 - 6 show the river courses for the five years used for classification purposes.

The Tongati river course is diverted near the mouth by a southerly-extending sand-spit and discharges into the ocean over a rocky sill. The building of the National Road (NR) bridge near the mouth apparently does not inhibit the natural behaviour of the river mouth; its span covering the peak flow width at that point. The highest recorded flood level near the mouth is ± 3 m to MSL (Orme 1974). Major floods were experienced in January 1953, February 1958 and March 1976. The 1953 flood was estimated to discharge 934 cumecs (Begg 1978) and the 1958 and 1976 floods were of a similar magnitude. The causeway/low-level bridge built at the head of the reach in the 1960s allows for two river courses and is probably submerged during floods.

Sugar-cane cultivation (in some areas down to the river's edge) has been a marked feature of the flood plain and valley sides for the whole period under review. Eroding cane fields are one local source of silt and there is a silt supply from upstream. The effects of siltation are quantified by the reduced river widths and open water areas since 1937. The especially narrow river widths of 1968 are largely the result of a long dry cycle.

The Tongati estuary is silting up and is unstable. The instability is indicated by an average lateral displacement of 29,7 m with a coefficient of variation of 34,8% - both of which are high for a river of this size.

LIST OF TABLES

NN4/I	Classification of the lower reaches of the Tongati:	1937
NN4/II	" " " " " " " "	: 1953
NN4/III	" " " " " " " "	: 1959
NN4/IV	" " " " " " " "	: 1968
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NN4/2	30-4-37
NN4/3	July/August 1953
NN4/4	6-6-59
NN4/5	2-8-68
NN4/6	23-6-77 (Orthophoto)

REFERENCES

BEGG G.W.	1978	The estuaries of Natal
ORME A.R.	1974	Estuarine sedimentation along the Natal coast, South Africa. Technical Report No. 5, Office of Naval Research.

ABBREVIATIONS/SYMBOLS USED IN THE TABLES

M.A.R.	Mean annual run-off
L.B.	Left bank
R.B.	Right bank
P	Perimeter
\bar{x}	Arithmetic mean
s	Standard deviation
V	Coefficient of variation $\frac{s}{\bar{x}}$
MSL	Mean sea level
R	River
d/s	Downstream
—	Maximum value
.....	Minimum value
N.R.	No record

RIVER TONGATI, 47 % ESTUARINE, REACH from ^{1960's} causeway to Mouth, 2.4 km from mouth. REF. DEA 1302a
 AERIAL PHOTO DATE 30-4-37 SCALE 1:10 000 CATCHMENT AREA 4.12 km², M.A.R. 88.7 m³x10⁶, No. of DAMS 2

NRIO NN 4
 REF. DEA 1302a

RIVER VALLEY AND RIVER MOUTH FEATURES

General Description of the Terrain above the Valley

Valley Sides (Not Well-defined)

Terrain	Vegetation	Land-Use	Slumping	Vegetation and Land-Use	Left	Right
mountainous	almost none	none	none	none		
hilly	grass	scattered cultivation	occasional	grass, scrub		16 %
undulating	sparsely forested (0-25%)	partly cultivated	frequent	trees	22	34 %
plains	moderately forested (25-75%)	mainly cultivated		cultivated	78	50 %
	heavily forested (75-100%)	scattered settlement		built-up		
	swamp/bog	partly built-up				
		urbanised				

Comments _____

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>1945</u> m	none	not applicable	not applicable (no valley or free)	bedrock
bottom width (av.) <u>420</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 _____ m to MSL	continuous	entrenched	entrenched	aeolian
		aggrading		sand covered <u>NIL</u> % area

Comments _____

River Mouth

Characteristics	Measurements
open/closed	right bank breakwater length _____ m
natural/artificial	left bank breakwater length _____ m
canalized	rock sill level _____ m to MSL
sandy	cliffs on right bank: height _____ m to MSL
rocks on right bank	cliffs on left bank: height _____ m to MSL
rocks on left bank	spit/bar: direction of growth <u>205</u> °
outer bar	length of spit/bar <u>261</u> m
silt plume (fluvial)	length stabilized <u>NIL</u> m
suspended sediment (marine)	width <u>88</u> m

Comments _____

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>420</u> m	grass	riverine:	cultivated <u>56</u> % area
fragmentary	maximum width <u>650</u> m	reed swamp <u>8</u> % area	main channel	crop/s <u>SUGAR</u>
continuous	aerial length <u>1852</u> m	sparsely forested	tributaries	partly built-up
	area <u>93,0</u> ha	moderately forested	coastal dune/evergreen	mainly built-up
		heavily forested	mangroves	

Comments _____

Channel Description H.B. Estimate of flow stage: LOW/NEAR LONG-TERM MEAN/LOW

Pattern	Measurements	Islands/ Shoals	Type of Flow	Bar Type
straight	thalweg <u>2380</u> m	none	stagnant/still	none
sinuous	*sinuosity <u>1,29</u>	occasional	uniform water surface	channel side bars
irregular	*open water area <u>16,5</u> ha	frequent	uniform with rapid in reach	point bars
regular meanders	perimeter <u>5758</u> m	split/braided	irregular	channel junction bars
irregular meanders	lake/lagoon area _____ ha		pool & riffle sequence	mid-channel bars
tortuous meanders	river X-sections available			diamond bars
bifurcated	channel slope _____			diagonal bars
lake/s	channel width x _____ m			sand waves/large dunes
lagoon	river slope _____			
	river width x <u>61,2</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		
logs	minor	rail bridge/s		
boulders	major	causeway		
vegetation		weir/dam		
		fish traps		
		embankment/s		
		groynes		
		canals		
		drainage furrows		
		others		

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>4</u> %	
irregular lateral activity		right bank <u>40</u> %	
avulsion			

Comments _____

RIVER TONGATI, 47 % ESTUARINE, REACH from ^{1960's} causeway to Mouth, 2.4 km from mouth. REF. DEA U 302 a
 AERIAL PHOTO DATE July/Aug '53 SCALE 1:10 000 CATCHMENT AREA 412 km², M.A.R. 88.7 m³x10⁶, No. of DAMS 2

RIVER VALLEY AND RIVER MOUTH FEATURES

General Description of the Terrain above the Valley

Valley Sides (Not Well-defined)

Terrain	Vegetation	Land-Use	Slumping	Vegetation and Land-Use	Left	Right
mountainous	almost none	none	none	none		
hilly	grass	scattered cultivation	occasional	grass/scrub		16 %
undulating	sparsely forested (0-25%)	partly cultivated	frequent	trees	22	34 %
plains	moderately forested (25-75%)	mainly cultivated		cultivated	78	50 %
	heavily forested (75-100%)	scattered settlement		built-up		
	swamp/bog	partly built-up				
		urbanised				

Comments _____

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>1945</u> m	none	not applicable	not applicable (no valley or free)	bedrock
bottom width (av.) <u>420</u> m	indefinite	not obviously degrading	occasionally confined	lacustrine deposits
valley slope	fragmentary	partly entrenched	frequently confined	fluvial deposits
(straight-line)	continuous	entrenched	entrenched	aeolian
height at head of reach _____ m to MSL		grading		sand covered <u>1</u> % area

Comments _____

River Mouth

Characteristics	Measurements
open/closed	right bank breakwater length _____ m
natural/modified	left bank breakwater length _____ m
canalised	rock sill level _____ m to MSL
sandy	cliffs on right bank: height _____ m to MSL
rocks on right bank	cliffs on left bank: height _____ m to MSL
rocks on left bank	spit/bar: direction of growth <u>204</u> °
outer bar	length of spit/bar <u>221</u> m
silt plume (fluvial)	length stabilized <u>60</u> m
suspended sediment (marine)	width <u>62</u> m

Comments _____

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>420</u> m	grass	riverine:	cultivated <u>52</u> % area
fragmentary	maximum width <u>650</u> m	reed swamp <u>10</u> % area	main channel	crop/s <u>sugar</u>
continuous	aerial length <u>1826</u> m	sparsely forested	tributaries	partly built-up
	area <u>93,0</u> ha	moderately forested	coastal dune/evergreen	mainly built-up
		heavily forested	mangroves	

Comments _____

very little

Channel Description N.B. Estimate of flow stage: NOW/NEAR LONG-TERM MEAN/NEVER

Pattern	Measurements	Islands/Shoals	Type of Flow	Bar Type
straight	thalweg <u>2350</u> m	none	stagnant/still	none
sinuous	*sinuosity <u>1,29</u>	occasional	uniform water surface	channel side bars
irregular	*open water area <u>9,1</u> ha	frequent	uniform with rapid in reach	point bars
regular meanders	perimeter <u>5400</u> m	split	irregular	channel junction bars
irregular meanders	lake/lagoon area _____ ha	braided	pool & riffle sequence	mid-channel bars
tortuous meanders	river X-sections available			diamond bars
bifurcated	channel slope _____			diagonal bars
lake/s	channel width \bar{x} _____ m			sand waves/large dunes
lagoon	river slope _____			
	river width \bar{x} <u>35,1</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 _____		
logs	minor	rail bridge/s _____		
boulders	major	causeway _____		
vegetation		weir/dam _____		
		fish traps _____		
		embankment/s _____		
		groynes _____		
		canals _____		
		drainage furrows _____		
		others _____		

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/stabilised	very strong	highly unstable
entrenched loop development	cultivation to channel edge	left bank <u>2</u> %	
irregular lateral activity		right bank <u>12</u> %	
avulsion			

Comments _____

RIVER TONGATI, 47 % ESTUARINE, REACH from ^{1960's} causeway to Mouth, 2.4 km from mouth. REF. DEA 4302a
 AERIAL PHOTO DATE 6-6-59 SCALE 1:10 000 CATCHMENT AREA 412 km², M.A.R. 88.7 m³x10⁶, No. of DAMS 2

NRIO NN 4
4302a

RIVER VALLEY AND RIVER MOUTH FEATURES

General Description of the Terrain above the Valley

Valley Sides (Not Well-defined)

Terrain	Vegetation	Land-Use	Sloping	Vegetation and Land-Use	Left	Right
mountainous	almost none	none	none	none		
hilly	grass	scattered cultivation	occasional	grass/scrub		16
undulating	✓ sparsely forested (0-25%)	partly cultivated	✓ frequent	trees	22	34
plains	moderately forested (25-75%)	✓ mainly cultivated		cultivated	78	50
	heavily forested (75-100%)	✓ scattered settlement		built-up		
	swamp/bog	partly built-up				
		urbanised				

Comments

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>1945</u> m	none	not applicable	not applicable (no valley or free)	bedrock
bottom width (av.) <u>420</u> m	indefinite	not obviously degrading	✓ occasionally confined	lacustrine deposits
valley slope	✓ fragmentary	partly entrenched	✓ frequently confined	✓ fluvial deposits
(straight-line)	continuous	entrenched	entrenched	aeolian
height at head of reach _____ m to MSL		✓ aggrading		sand covered <u>NIL</u> % area

Comments

River Mouth

Characteristics	Measurements
✓ open/obscured	right bank breakwater length _____ m
✓ natural/structural	left bank breakwater length _____ m
canalized	✓ rock sill level _____ m to MSL
sandy	cliffs on right bank: height _____ m to MSL
✓ rocks on right bank	cliffs on left bank: height _____ m to MSL
rocks on left bank	spit/bar: direction of growth <u>213</u> °
outer bar	length of spit/bar <u>201</u> m
silt plume (fluvial)	length stabilized <u>60</u> m
✓ suspended sediment (marine)	width <u>52</u> m

Comments

FLOOD PLAIN AND CHANNEL FEATURES

Description of Flood Plain	Presence	Extent	Vegetation	Forest Type	Land-Use
none	none	average width <u>420</u> m	almost none	not known/applicable	✓ non-cultivated, not built-up
indefinite		maximum width <u>650</u> m	grass	riverine:	✓ cultivated <u>56</u> % area
fragmentary		aerial length <u>1778</u> m	reed swamp <u>8</u> % area	✓ main channel	✓ crop/sugar
✓ continuous		area <u>93,0</u> ha	sparsely forested	tributaries	partly built-up
			moderately forested	✓ coastal dune/evergreen	mainly built-up
			heavily forested	mangroves	

Comments

Channel Description N.B. Estimate of flow stage: LOW/NEAR LONG-TERM MEAN/LOW

Pattern	Measurements	Islands/Shoals	Type of Flow	Bar Type
straight	thalweg <u>2410</u> m	none	stagnant/still	none
✓ sinuous	*sinuosity <u>1,35</u>	✓ occasional	✓ uniform water surface	✓ channel side bars
irregular	*open water area <u>6,1</u> ha	frequent	uniform with rapid in reach	✓ point bars
regular meanders	perimeter <u>5050</u> m	split	irregular	✓ channel junction bars
irregular meanders	lake/lagoon area _____ ha	braided	pool & riffle sequence	mid-channel bars
tortuous meanders	river X-sections available			✓ diamond bars
bifurcated	channel slope _____			diagonal bars
lake/s	channel width x _____ m			✓ sand waves/large dunes
lagoon	river slope _____			
	river width x <u>30,8</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 _____		
logs	minor	rail bridge/s _____		
boulders	major	causeway _____		
vegetation		weir/dam _____		
		fish traps _____		
		embankment/s _____		
		groynes _____		
		canals _____		
		drainage furrows _____		
		others _____		

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>5</u> %	
irregular lateral activity		right bank <u>12</u> %	
avulsion			

Comments

RIVER TONGATI, 47 % ESTUARINE, REACH from ^{1960's} causeway to Mouth, 2.4 km from mouth. REF. DEA U 302 a
 AERIAL PHOTO DATE 2-8-68 SCALE 1:10 000 CATCHMENT AREA 4.2 km², M.A.R. 88.7 m²x10⁶, No. of DAMS 2

NRIO NN 4
U 302 a

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		2
✓ undulating	✓ sparsely forested (0-25%)	partly cultivated	✓ frequent	trees	22	34
plains	moderately forested (25-75%)	✓ mainly cultivated		cultivated	78	66
	heavily forested (75-100%)	✓ scattered settlement		built-up		2
	swamp/bog	partly built-up				2
		urbanised				

Comments _____

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>19.45</u> m	none	not applicable	not applicable (no valley or free)	bedrock
bottom width (av.) <u>4.20</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 _____ m to MSL	continuous	entrenched	entrenched	aeolian sand covered <u>NIL</u> % area

Comments _____

River Mouth

Characteristics	Measurements
✓ open/abandoned	right bank breakwater length _____ m
✓ natural/artificial	left bank breakwater length _____ m
canalized	✓ rock sill level _____ m to MSL
sandy	cliffs on right bank: height _____ m to MSL
✓ rocks on right bank	cliffs on left bank: height _____ m to MSL
rocks on left bank	spit/bar: direction of growth <u>202</u> °
outer bar	length of spit/bar <u>262</u> m
silt plume (fluvial)	length stabilized <u>50</u> m
✓ suspended sediment (marine)	width <u>42</u> m

Comments _____

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>4.20</u> m	grass	riverine:	✓ cultivated <u>62</u> % area
fragmentary	maximum width <u>6.50</u> m	reed swamp <u>8</u> % area	✓ main channel*	✓ crops <u>sugar</u>
✓ continuous	serial length <u>18.8</u> m	sparsely forested	tributaries	partly built-up
	area <u>93.0</u> ha	moderately forested	✓ coastal duna/evergreen mangroves	mainly built-up

Comments _____

Channel Description N.B. Estimate of flow stage: LOW

Pattern	Measurements	Islands/Shoals	Type of Flow	Bar Type
straight	thalweg <u>24.20</u> m	none	stagnant/still	none
✓ sinuous	*sinuosity <u>1.33</u>	✓ occasional	uniform water surface	✓ channel side bars
irregular	*open water area <u>5.7</u> ha	frequent	uniform with rapid in reach	✓ point bars
regular meanders	perimeter <u>5070</u> m	split	✓ irregular	channel junction bars
irregular meanders	lake/lagoon area <u>available</u>	braided	pool & riffle sequence	mid-channel bars
tortuous meanders	river X-sections _____			diamond bars
bifurcated	channel slope _____			diagonal bars
lake/s	channel width x _____ m s = _____			sand waves/large dunes
lagoon	river slope _____			
	river width x <u>22.0</u> m s = <u>33.6</u> m			

Comments *whole reach

Obstructions/Constrictions

Natural	Degree	Man-made	Degree of Obstruction/Constriction for Each	Position (from head of reach)
none	none	✓ road bridge/s	<u>1</u>	<u>apparently none</u>
logs	✓ minor	✓ rail bridge/s	<u>1</u>	<u>2.4 km (at mouth)</u>
boulders	major	✓ causeway	<u>1</u>	<u>? not obvious; marked as causeway 0 (at head)</u>
✓ vegetation*		weir/dam		<u>on 1:50 000 map but maybe low level bridge</u>
		fish-traps		<u>allowing two possible R. courses.</u>
		embankment/s		
		groynes		
		canals		
		drainage furrows		
		others		

Comments ? water hyacinth covering upper 2/3 reach

Lateral Channel Activity

Lateral Activity	Nature of Banks	Bank Vegetation	Lateral Stability
not detectable	✓ alluvium (silt/sand)	none	stable
downstream progression	natural ledges	✓ 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>5</u> %	
irregular lateral activity		right bank <u>11</u> %	
avulsion			

Comments _____

RIVER TONGATI, 47 % ESTUARINE, REACH from ^{1960's} causeway to Mouth, 2.4 km from mouth. REF. DEA U 302a
 AERIAL PHOTO DATE 23-6-77 SCALE 1:10 000 CATCHMENT AREA 412 km², M.A.R. 88.7 m³x10⁶, No. of DAMS 2
 (orthophoto)

RIVER VALLEY AND RIVER MOUTH FEATURES

General Description of the Terrain above the Valley

Valley Sides (Not Well-defined)

Terrain	Vegetation	Land-Use	Slumping	Vegetation and Land-Use	Left	Right
mountainous	almost none	none	none	none		
hilly	grass	scattered cultivation	occasional	grass		
✓ undulating	✓ sparsely forested (0-25%)	partly cultivated	✓ frequent	trees	<u>22</u>	<u>34</u>
plains	moderately forested (25-75%)	✓ mainly cultivated		cultivated	<u>78</u>	<u>66</u>
	heavily forested (75-100%)	✓ scattered settlement		built-up		
	swamp/bog	partly built-up				
		urbanised				

Comments _____

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>1945</u> m	none	not applicable	not applicable (no valley or free)	bedrock
bottom width (av.) <u>420</u> m	indefinite	not obviously degrading	✓ occasionally confined	lacustrine deposits
valley slope <u>1:648</u>	✓ fragmentary	partly entrenched	frequently confined	✓ fluvial deposits
(straight-line)	continuous	entrenched	entrenched	aeolian
height at head of reach <u>+3</u> m to MSL approx.		✓ aggrading		sand covered <u>NIL</u> % area

Comments _____

River Mouth

Characteristics	Measurements
✓ open/closed	right bank breakwater length _____ m
✓ natural/artificial	left bank breakwater length _____ m
canalized	✓ rock sill level _____ m to MSL
sandy	cliffs on right bank: height _____ m to MSL
✓ rocks on right bank	cliffs on left bank: height _____ m to MSL
rocks on left bank	spit/bar: direction of growth <u>206</u> °
outer bar	length of spit/bar <u>265</u> m
silt plume (fluvial)	length stabilized <u>25</u> m
✓ suspended sediment (marine)	width <u>52</u> m

Comments _____

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>420</u> m	grass	riverine:	✓ cultivated <u>62</u> % area
fragmentary	maximum width <u>650</u> m	reed swamp <u>7</u> % area	✓ main channel*	✓ crop/s sugar + orchards
✓ continuous	serial length <u>1833</u> m	sparsely forested	tributaries	partly built-up
	area <u>93,0</u> ha	moderately forested	✓ coastal dune/evergreen mangroves	mainly built-up
		heavily forested		

Comments _____

Channel Description N.B. Estimate of flow stage: LOW/NEAR LONG-TERM MEAN/WATER

Pattern	Measurements	Islands/Shoals	Type of Flow	Bar Type
straight	thalweg <u>2430</u> m	none	stagnant/still	none
✓ sinuous	*sinuosity <u>1.33</u>	✓ occasional	✓ uniform water surface	✓ channel side bars
irregular	*open water area <u>9.7</u> ha	frequent	uniform with rapid in reach	✓ point bars
regular meanders	perimeter <u>5233</u> m	split	irregular	channel junction bars
irregular meanders	lake/lagoon area _____ ha	braided	pool & riffle sequence	mid-channel bars
ortugous meanders	river X-sections <u>available</u>			diamond bars
bifurcated	channel slope _____			diagonal bars
lake/s	channel width <u>_____</u> m			sand waves/large dunes
lagoon	river slope _____			
	river width <u>_____</u> m			
			Comments <u>*whole reach</u>	

Obstructions/Constructions

Natural	Degree	Man-made	Degree of Obstruction/Constriction for Each	Position (from head of reach)
✓ none	✓ none	✓ road bridge/s	<u>1</u> <u>apparently none</u>	<u>2.4 km (= at mouth)</u>
logs	minor	✓ rail bridge/s		
boulders	major	✓ causeway	<u>R. confused by two possible courses; marked as causeway on 1:50 000 map but probably in a low level bridge - with two spans for R.</u>	<u>0. (at head)</u>
vegetation		water/dam		
		silt/crump		
		embankment/s		
		groynes		
		canals		
		drainage furrows		
		others		

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>8</u> %	
irregular lateral activity		right bank <u>27</u> %	
avulsion			Comments _____

TABLE NN4/VI

RIVER WIDTHS

TONGATI NN 4

Station	Approx distance along 1977 R. course from 1960's causeway (m)	River widths (m)					\bar{x}	s	V%
		Date							
		30-4-37	Ju1/Aug. '53	6-6-59	2-8-68	23-6-77			
1	0	28	22	15	5	8	15,6	9,6	61,3
2	260	34	20	12	5	10	16,2	11,3	69,9
3	520	25	8	12	5	10	12,0	7,7	64,3
4	780	46	18	20	5	12	20,2	15,6	77,0
5	1 040	52	10	21	10	25	23,6	17,2	72,9
6	1 300	70	30	17	15	38	34,0	22,2	65,4
7	1 560	102	50	30	12	28	44,4	34,9	78,6
8	1 820	110	69	55	48	55	67,4	25,0	37,1
9	2 080	140	112	108	110	85 (70+15)	111,0	19,5	17,6
10	2 340	5	12	18	5	5	9,0	5,9	65,3
\bar{x}		61,2	35,1	30,8	22,0	27,6	35,3		
s		43,4	33,2	29,9	33,6	25,6			
V%		70,9	94,5	97,2	152,7	92,9			

LATERAL STABILITY

TABLE NN4/VII

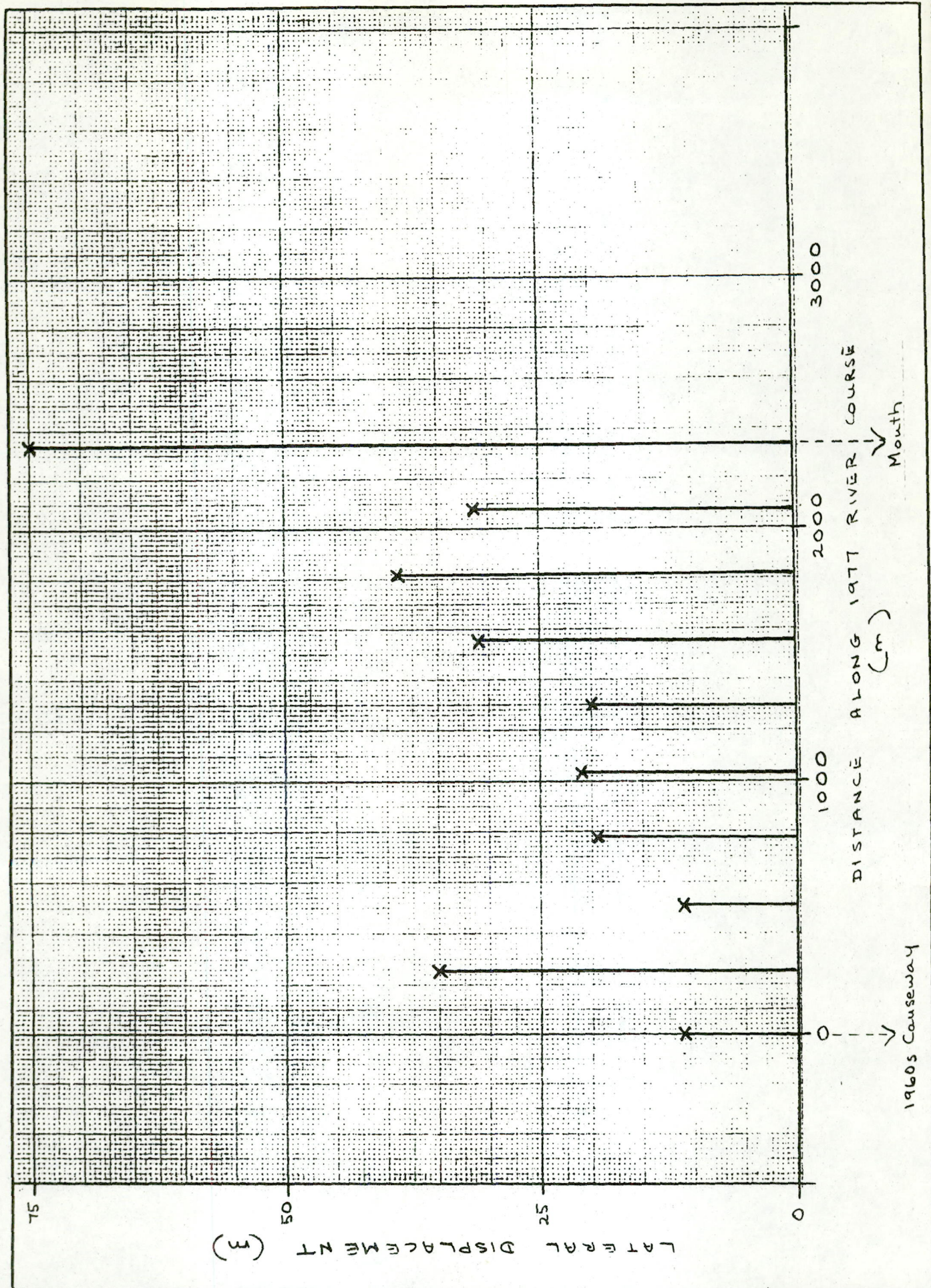
Station	Approx distance along 1977 R. course from 1960's causeway (m)	Distance from maximum observed L.B. position to mid-river (m)							Max-Min	\bar{x}	s	V%
		Date										
		30-4-37	Jul/Aug. '53	6-6-59	2-8-68	25-6-77						
1	0	14,0	18,0	7,5	15,0	10,0		10,5	12,9	4,2	32,2	
2	260	40,0	35,0	40,0	40,0	5,0		35,0	32,0	15,2	47,6	
3	520	12,5	18,0	6,0	10,0	8,0		12,0	10,9	4,6	42,6	
4	780	23,0	29,0	18,0	28,0	10,0		19,0	21,6	7,8	36,2	
5	1 040	26,0	40,0	27,0	18,0	25,0		22,0	27,2	8,0	29,3	
6	1 300	35,0	35,0	15,0	22,0	19,0		20,0	25,2	9,3	36,8	
7	1 560	57,0	42,0	25,0	32,0	43,0		32,0	39,8	12,2	30,5	
8	1 820	55,0	44,0	35,0	45,0	73,0		38,0	50,4	14,5	28,7	
9	2 080	70,0	103,0	91,0	102,0	82,7		33,0	89,7	13,8	15,4	
10	2 340	60,0	52,0	15,0	78,0	90,0		75,0	59,0	28,8	48,7	
\bar{x}		39,3	41,6	28,0	39,0	36,5		29,7	36,9		34,8	
s		20,4	24,1	24,8	29,5	33,3		18,6			10,0	
V%		52,0	58,0	88,6	75,7	91,1		62,7			28,6	

Average lateral displacement 1937 - 77 = 29,7 m
 Average coefficient of variation 1937 - 1977 = 34,8%

TABLE NN4/VIII

ABSTRACT

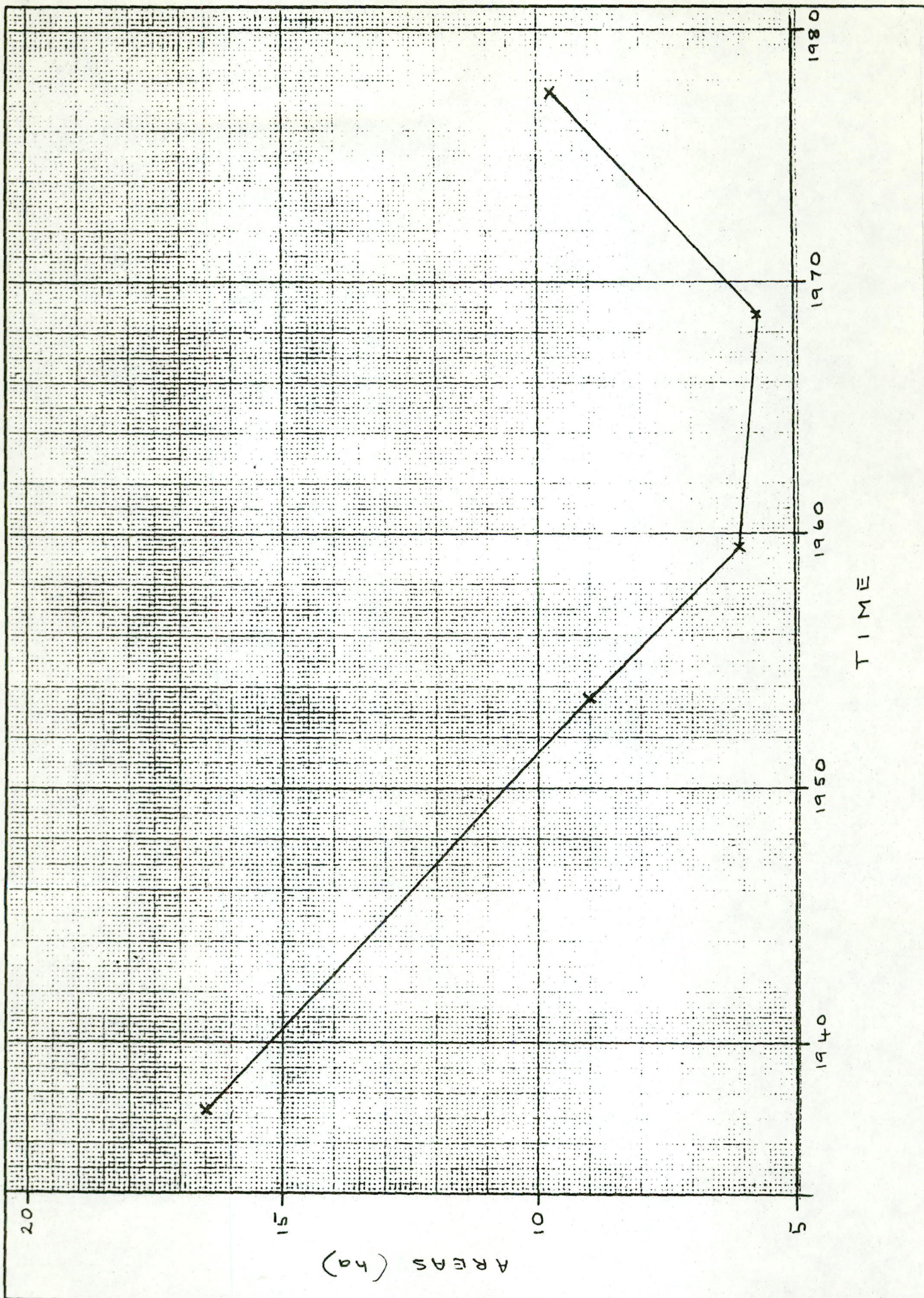
TONGATI (NN 4)		1937 - 1977
1. Sinuosity	Range	1,29 - 1,35
2. River width	\bar{x} Range	22,0 m - 61,2 m
3. Lateral displacement	\bar{x}	29,7 m
	\bar{v}	34,8%
4. Thalweg	Range	2 350 m - 2 430 m
5. Open water area	Range	5,7 ha - 16,5 ha
6. Reed swamp area	Range	7% - 10%
7. Cultivation		
Valley sides L.B.		78%
R.B.	Range	50% - 66%
Flood plain	Range	56% - 62%
8. <u>Human influence</u>		
(a)	Valley sides mostly under sugar cane: also more than half the flood plain area.	
(b)	Cultivation to the river's edge or reed swamp edge.	
(c)	National road bridge near mouth built in 1960s; spanning peak flow width.	
(d)	Upstream of reach, cultivation malpractices and construction works for La Mercy airport have generated silt (Begg 1978)	



TRACED
 CHECKED
 DATE:
 REF.

NATAL ESTUARIES: TONGATI
 THALWEG DISPLACEMENT: 1937-77

FIGURE
 NN 4 / 1



TRACED
 CHECKED
 DATE
 REF

NATAL ESTUARIES: TONGATI

OPEN WATER AREAS: 1937-77

FIGURE
 NN 4 / 2



SCALE: 1:10 000 approx

TRACED: J6AN
CHECKED:
DATE:
REF.:

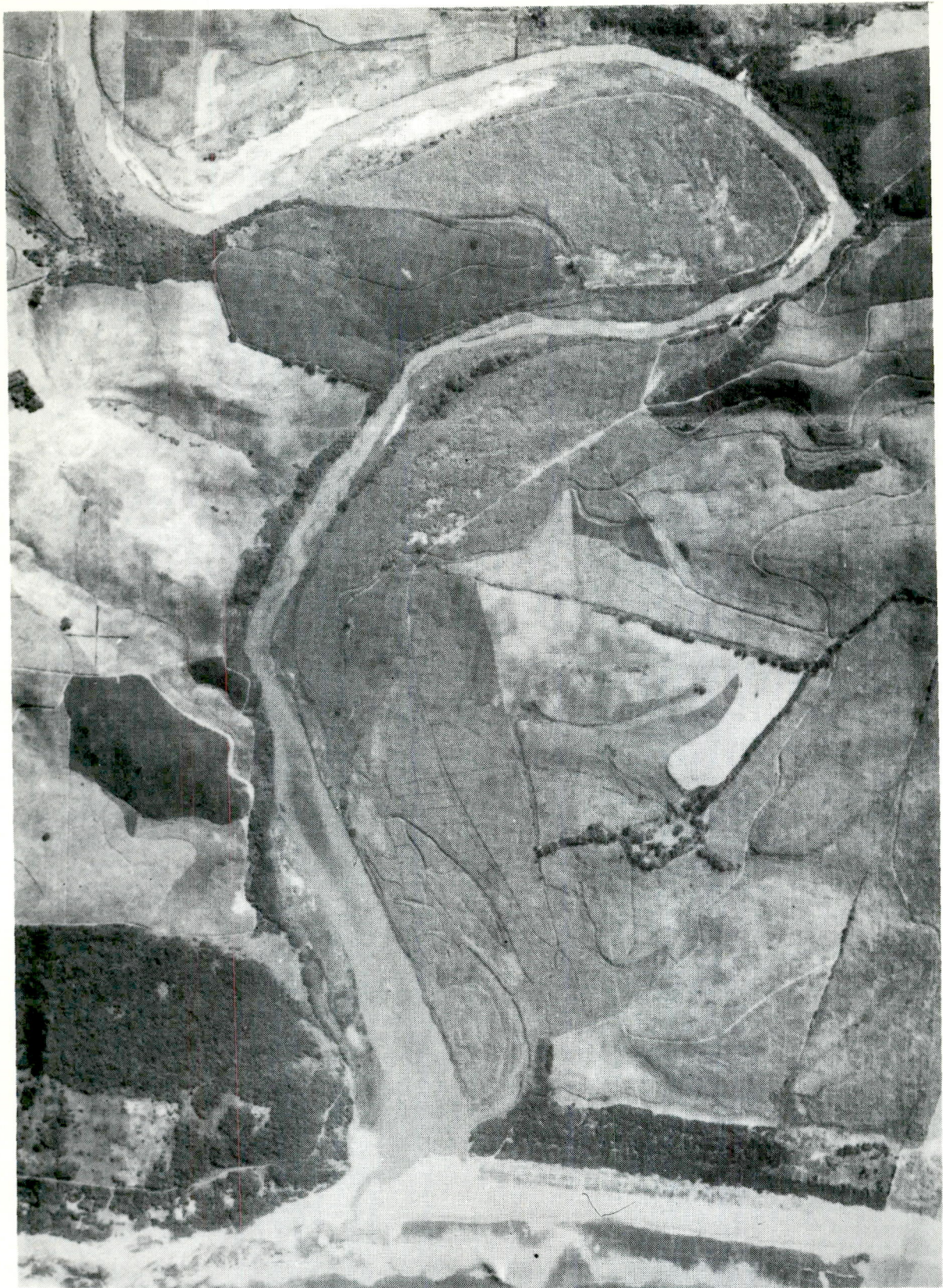
NATAL ESTUARIES: TONGATI

23-6-77 (30-4-37 RIVER COURSE SUPERIMPOSED)

PHOTOGRAPH

NN 4 / 1

NATIONAL RESEARCH INSTITUTE FOR OCEANOLOGY



SCALE: 1 : 10 000 approx.

TRACED JGAN
CHECKED
DATE
REF

NATAL ESTUARIES : TONGATI

30 - 4 - 37

PHOTOGRAPH

NN 4 / 2

NATIONAL RESEARCH INSTITUTE FOR OCEANOLOGY



SCALE: 1:10 000 approx

TRACED JGAN
CHECKED
DATE
REF

NATAL ESTUARIES: TONGATI

JULY / AUGUST 1953

PHOTOGRAPH

NN 4 / 3

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SCALE 1 : 10 000 approx.

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DATE
REF

NATAL ESTUARIES : TONGATI

6 - 6 - 59

PHOTOGRAPH

NN 4/4

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DATE
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NATAL ESTUARIES: TONGATI

2 - 8 - 68

PHOTOGRAPH

NN 4 / 5

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SCALE: 1:10 000 approx

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DATE
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NATAL ESTUARIES: TONGATI

23-6-77 (ORTHOPHOTO)

PHOTOGRAPH

NN 4/6

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