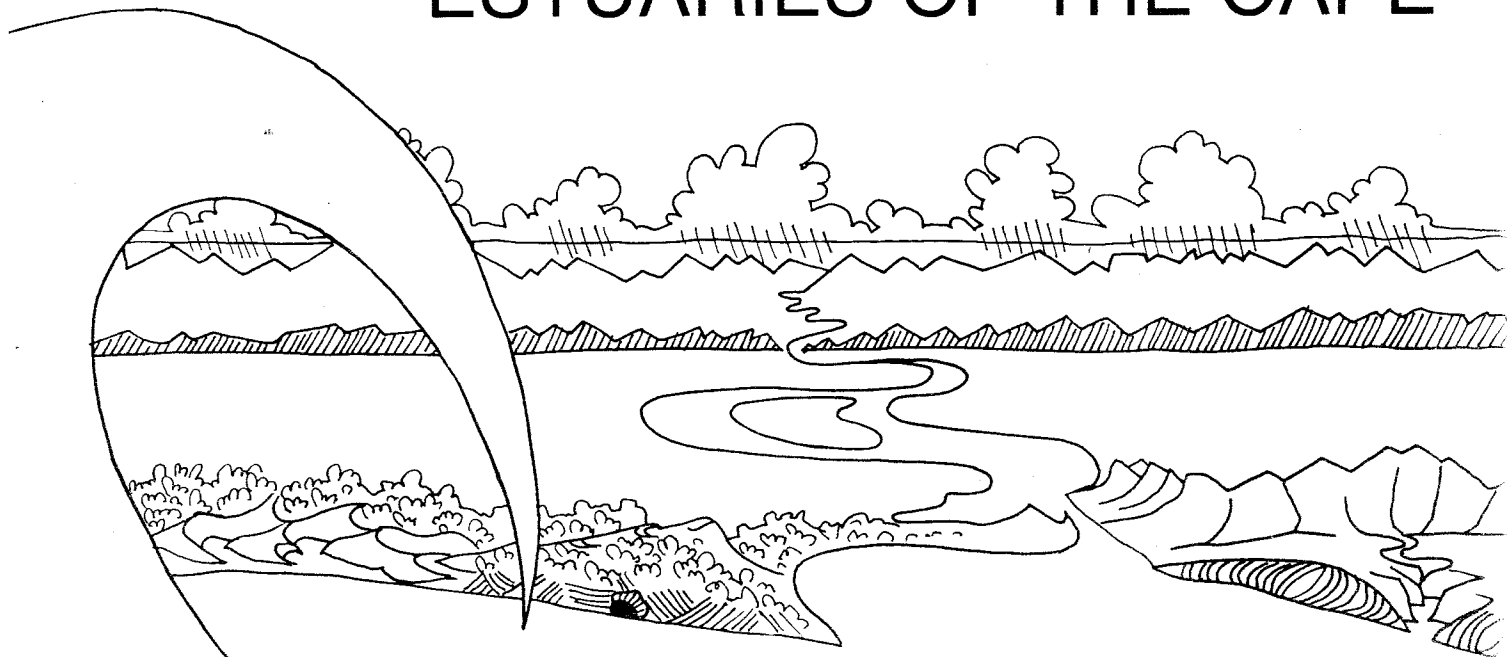


COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH
NATIONAL RESEARCH INSTITUTE FOR OCEANOLOGY
ESTUARINE AND COASTAL RESEARCH UNIT - ECRU



ESTUARIES OF THE CAPE



PART II

SYNOPSES OF AVAILABLE INFORMATION
ON INDIVIDUAL SYSTEMS

EDITORS: A E F HEYDORN
J R GRINDLEY

REPORT NO. 7

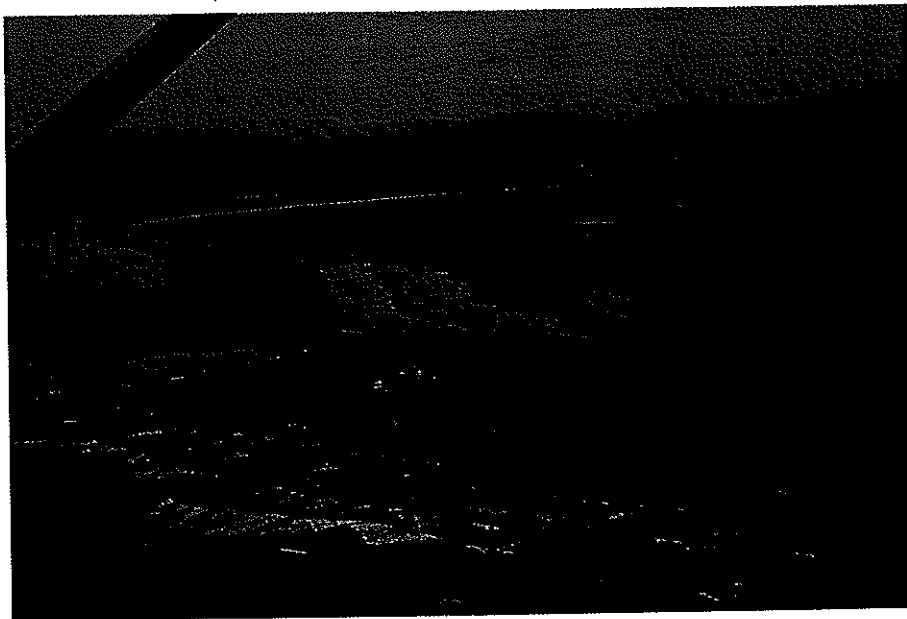
GAMTOOS (CMS48)

ESTUARIES OF THE CAPE

PART II: SYNOPSES OF AVAILABLE
INFORMATION ON INDIVIDUAL SYSTEMS

REPORT NO. 7: GAMTOOS (CMS48)

(CMS48 — CSIR Estuary Index Number)



FRONTISPIECE: GAMTOOS ESTUARY — ALT. 150 m, ECRU 79-10-17

COMPILED BY : T J E HEINECKEN

ECRU SURVEY : 5/6 AUGUST 1980
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ESTUARINE AND COASTAL RESEARCH UNIT — ECRU
NATIONAL RESEARCH INSTITUTE FOR OCEANOLOGY
COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

ISBN 0 7988 1812 3 (Set)
ISBN 0 7988 1813 1 (Part 2)
ISBN 0 7988 1831 X (Rep. No.7)

Published in 1981 by :

National Research Institute for Oceanology
Council for Scientific and Industrial Research
P.O. Box 320, Stellenbosch. 7600

Printed by :

CREDA PRESS, CAPE TOWN

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PREFACE

The Estuarine and Coastal Research Unit (ECRU) was established by the National Research Institute for Oceanology of the CSIR in 1979 with the following aims :

- to contribute information relevant to the development of a cohesive management policy for the South African coastline;
- to compile syntheses of all available knowledge on the 167 estuaries of the Cape between the Kei and the Orange rivers;
- to identify gaps in information and to stimulate research at Universities, Museums and other institutions to fill these.

The Unit was established at the request of the Government, and the Department of Water Affairs, Forestry and Environmental Conservation contributes substantially to the running costs.

In 1980 the Unit published its first report under the title "The Estuaries of the Cape, Part I - Synopsis of the Cape Coast. Natural Features, Dynamics and Utilization" (by Heydorn and Tinley)*. As the name of the report implies, it is an overview of the Cape Coast dealing with aspects such as climate, geology, soils, catchments, run-off, vegetation, oceanography and of course, estuaries. At the specific request of the Government, the report includes preliminary management recommendations.

The present report is one of a series on Cape Estuaries being published under the general title "The Estuaries of the Cape, Part II." In these reports all available information on individual estuaries is summarized and presented in a format similar to that used in a report on Natal estuaries which was published by the Natal Town and Regional Planning Commission in 1978. It was found however, that much information is dated or inadequate and that the compilation of Part II reports is therefore not possible without brief prior surveys by the ECRU. These surveys are usually carried out in collaboration with the Botanical Research Institute and frequently with individual scientists who have special interest in the systems concerned. One of these is Prof J R Grindley of the University of Cape Town who is co-editor of the Part II series.

These surveys are however not adequate to provide complete understanding of the functioning of estuarine systems under the variable conditions prevalent along the South African coastline. The ECRU therefore liaises closely with Universities and other research institutes and encourages them to carry out longer-term research in selected estuarine systems. In this way a far greater range of expertise is involved in the programme and it is hoped that the needs of those responsible for coastal zone management at Local-, Provincial- and Central Government levels can be met within a reasonable period of time.

Finally, it has been attempted to write the Part II reports in language understandable to the layman. However it has been impossible to avoid technical terms altogether. A glossary explaining these is therefore included in each report.



F P Anderson
DIRECTOR

National Research Institute for Oceanology
CSIR

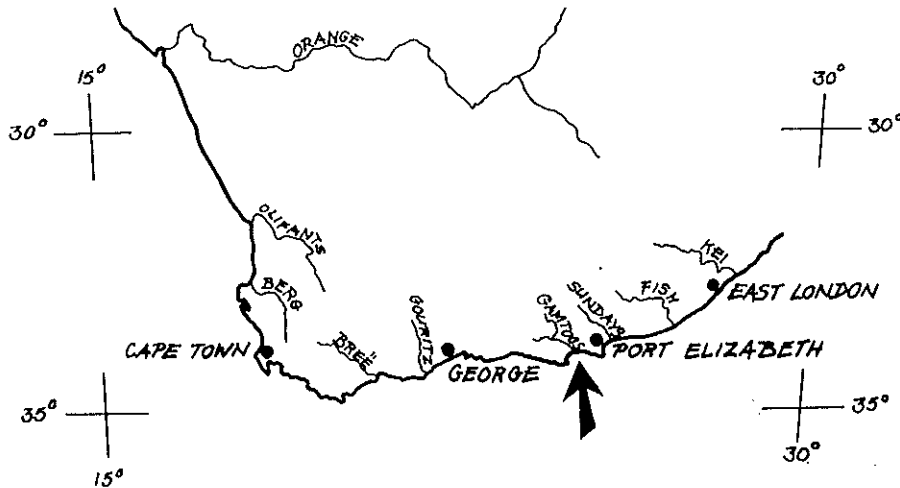
GAMTOOS

1. SYNONYMS AND DERIVATIONS

Gamtoosrivier (1:50 000 Sheet 3325CC)

2. LOCATION

The estuary mouth is located 50 km west of Port Elizabeth at 33° 58' S and 25° 04' E.



2.1 Accessibility :

The river mouth area is accessible via two exits from the main Port Elizabeth - Humansdorp highway. From the Humansdorp direction the road is gravel and follows the course of the river from the old national road bridge approximately 6 km from the mouth (Fig.1). Access from the Port Elizabeth direction is via a tarred road which branches off the national highway at the Hankey/Patensie exit. Following this route the river mouth is 60 km or approx. 45 minutes drive from Port Elizabeth.

3. ABIOTIC CHARACTERISTICS

3.1 Catchment :

Area

The Gamtoos has the fourth largest catchment of all the Cape rivers, with an area of 34 438 km² (Heydorn and Tinley 1980) which extends right up into the Great Karoo. Two large tributaries drain the eastern extremity of the Nuweveld Mountain range and the western slopes of the Onder-Sneeuwberg mountain ranges of the great escarpment above Nelspoort and Murraysburg. Major tributaries also drain parts of the Langkloof,

Baviaanskloof and Klein Winterhoek mountain ranges (1:1 000 000, ICAO. World Aeronautical Chart).

River length

The stretch of river known as the Gamtoos, runs from the confluence of the Kouga and Groot Rivers to the sea and is 75 km long. The distance from the source of the tributary furthest from the sea to the mouth of the system is approximately 450 km (1:1 000 000, ICAO. world Aeronautical Chart).

Tributaries

The two main tributaries draining the Karoo Region are the Kariega and Sout Rivers which join at the Beervlei Dam to form the Groot River. The two tributaries draining the southern slopes of the Baviaanskloof Mountains and the Kouga Mountains are named after these ranges. They join above the Paul Sauer Dam after which the Kouga River joins the Groot River to form the Gamtoos. The Loeriespruit on which the Loerie Dam has been built, joins the Gamtoos River 8,5 km from its mouth (1:500 000 Sheet SE 35/24).

Mean Annual Run-off (MAR)

This is given as $485 \times 10^6 \text{ m}^3$ by Noble and Hemens (1978). In the publication River flow data of the Division of Hydrology the MAR over the seven year period 1962/63 to 1969/70 was calculated to be $184 \times 10^6 \text{ m}^3$ measured at a gauging station on the Gamtoos River at Patensie. This is 50 km upstream from the mouth and above the confluence of the Gamtoos River and the Loeriespruit.

3.2 Flow :

Flow records from the gauging station at Patensie indicate that the Gamtoos River flows continuously throughout the year, but it must be mentioned that flow measurements are frequently not possible during peak or flood flows (River flow data 1978). The general impression of the estuarine portion of the river is one of a large slow flowing, relatively silt laden, tidal river which enters the sea through a dynamic coastal dune-field - See section 3.9. Sandbar characteristics. During the seven year period 1962/63 to 1969/70 the highest total run-off was recorded during the months of April ($226 \times 10^6 \text{ m}^3$) and September ($247 \times 10^6 \text{ m}^3$). However the measuring capacity of the gauging station was exceeded during April and July of 1963, September 1964 and again in September 1968. The lowest total run-off for the same period occurred during the months of January and February ($37 \times 10^6 \text{ m}^3$) (River flow data 1978). The graph in Fig. 1 drawn up using data extracted from River flow data (1978) depicts the average flow rate per month at the Patensie gauging station for the period July 1962 to September 1970.

The fact that the major part of the upper Gamtoos River catchment lies within a bimodal rainfall region (Heydorn and Tinley 1980) would explain the flow peaks in April and September. The tributaries draining the Karoo region probably contribute the bulk of run-off during these months, whereas the Baviaanskloof and Kouga rivers draining the southern mountain ranges to the west would contribute to the higher flow rate in the winter months.

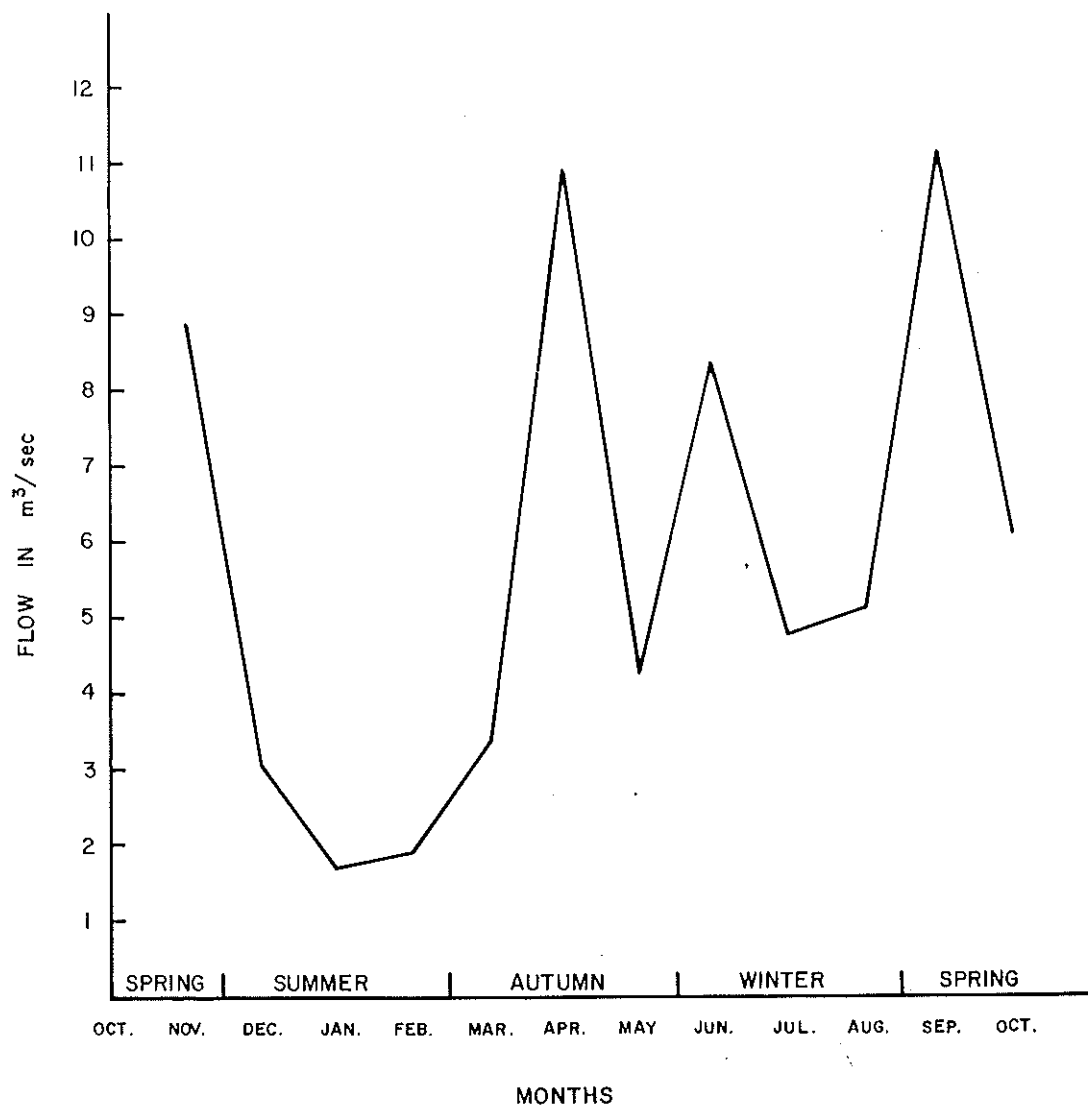


FIG. I The average flow rate of the Gamtoos River at the Patensie gauging station (River flow data 1978).

Flood history and level fluctuations

Alexander (1976), records that the Gamtoos has been subjected to at least 7 major floods since 1847. These floods occurred in October 1847, October 1867, 1905, 1916, December 1931, March 1961 and August 1971. In each case the floods caused considerable damage to agricultural lands, buildings and installations situated in the floodplain which stretches from the confluence of the Kouga River and Groot River down to the mouth. In cases where the flood waters rose rapidly overnight without warning, many people were drowned and in 1971 it was reported that more than 100 persons living on the floodplain lost their lives.

When the Gamtoos River comes down in flood it rises rapidly, usually inundating large areas of the floodplain. In October 1847 the river rose 10 - 14 m overnight and in October 1867 it was reported that the river rose 20 m (Alexander 1976). At present a large proportion of the flood waters are absorbed by three major dams situated on the main tributaries of the Gamtoos. When describing the 1961 flood, Alexander

(1976) wrote "Beervlei Dam on the Groot River upstream of Steytlerville effectively absorbed much of the flood and halved the flood peak, undoubtedly reducing the damage which would otherwise have been caused in the Gamtoos Valley. The flow at Steytlerville was nevertheless the highest recorded since 1929 when measurements commenced and has remained the maximum on record till August 1971". A report by the City of Port Elizabeth's Metropolitan Planning Unit states that the Gamtoos River has an extensive floodplain. It is susceptible to serious flooding and no flood lines have been correctly determined (Metropolitan Planning Unit 1978). The most recent flooding of the Gamtoos River valley occurred during March 1981 just ten years after the major floods of August 1971 (Fig. 2).



FIG. 2 The Gamtoos River in flood, March 1981
(E.P. Herald 81-03-26).

3.3

Obstructions :

(a) In the catchment

Three major impoundments are situated on the main tributaries of the Gamtoos system. Some characteristics of these impoundments are given in Table 1 which was drawn up from information given in Noble and Hemens (1979) and Reservoir inflow records (1978).

Numerous farm dams, bridges, diversion weirs and canals occur in the catchment of the Gamtoos and on the alluvial floodplain of the lower part of the river which is intensively cultivated. The Gamtoos Government Water Scheme (G.W.S.) connects the Paul Sauer Dam with the Loerie Dam via a 72 km canal. The scheme also consists of 4 balancing dams and a number of branch canals leading water off for irrigation purposes as shown on a General Layout sheet of the Gamtoos Water Scheme (Republic of South Africa. Dept. of Water Affairs. G.W.S. General Layout Sheet No. GC 862/78). According to Alexander (1976) "Irrigation has been practised on the alluvial floodplain of the Gamtoos Valley since 1827. The first major irrigation structure built in the Valley was the Hankey Tunnel which was completed in 1844".

(b) Near the mouth

Three major structures cross the lower part of the Gamtoos River. The old national road bridge which is a single lane, steel girder construction spanning the entire water course, crosses the river 6,8 km from the mouth. From this point the river runs alongside a sandstone cliff at the base of which the original gravel road to the mouth was constructed. A water pipeline to Port Elizabeth from the Paul Sauer Dam crosses the river below the old national road bridge, 5,3 km from the mouth. A few hundred metres below this the bridge for the new national coastal freeway has been built. This bridge also spans the entire main water-course of the river but its approach from the west consists of a substantial embankment across the floodplain which, as has previously been mentioned, is subject to inundation when the river comes down in flood (See Fig. 3).

TABLE 1 Major impoundments situated on the main tributaries of the Gamtoos River (Reservoir inflow records 1978 and Noble and Hemens 1979).

River	Dam and date constructed	MAR (10^6 m^3)	Storage capacity (10^6 m^3)	Suspended solids concentration	Total dissolved solids
Groot	Beervlei 1957	65	58,2 up to Sept 56,2 up to Jun. '67 (1962S)* 93,5 from Aug. 1967 (raised)*	Low	200-1000mg ℓ^{-1}
Kouga	Paul Sauer 1961	152	132	Low	200 mg ℓ^{-1}
Loerie	Loerie 1969	21 1 yr's.obs 69/70	3,92	-	-

* By 1962 the dam had trapped so much silt that the wall was raised to increase its storage capacity - See Section 3.4 Siltation.

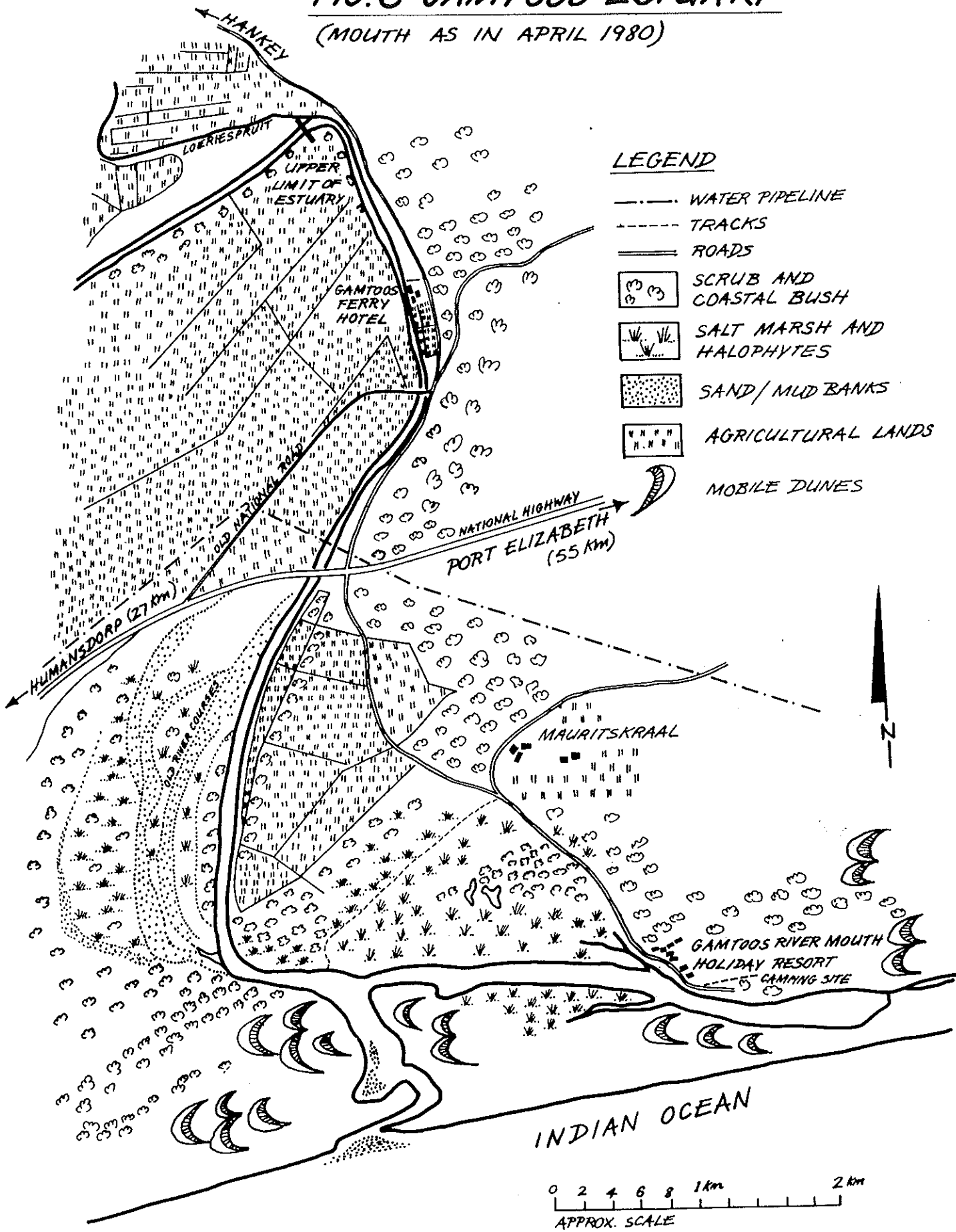
3.4 Siltation :

The silt load of the Gamtoos tributaries from the Karoo is high, particularly when the Karoo receives heavy rainfall. This is illustrated by the fact that the storage capacity of the Beervlei-dam was reduced by $2 \times 10^6 \text{ m}^3$ between the period September 1960 to June 1967 and that it was consequently necessary to raise the dam wall to increase the storage capacity to $93,5 \times 10^6 \text{ m}^3$ - See Table 1.

During the 1971 flood, 24 percent of the areas under irrigation in the Gamtoos Valley were severely damaged by heavy sediment deposition, which in places was more than 3 metres deep (Alexander 1976). According to a Memorandum from the Department of Agricultural Technical Services dated 14-7-75, a considerable amount of silt is washed down the river from the Karoo via the Groot River and this is deposited in the mouth region. The Kouga River, flowing from the mountain catchments of the Kouga and Baviaanskloof mountains which are controlled by the Directorate of Forestry, is relatively silt-free (See Table 1).

FIG. 3 GAMTOOS ESTUARY

(MOUTH AS IN APRIL 1980)



During the ECRU survey in August 1980, undercutting and slumping of the western banks in the stretch of river between the two main road bridges was evident. It can be assumed that this erosional process is continuous along the entire lower river course through the alluvial floodplain. This erosion is no doubt accelerated in places by the clearing and cultivation of land right up to the river banks.

3.5 Land ownership/use :

(a) Catchment

Most of the land in the upper catchment consists of privately owned farms. In the dry Karoo areas, extensive small stock farming is practised with a limited amount of fodder crop production taking place under irrigation in the vicinity of dams on the system.

The catchment areas of the Grootrivier-, Groot Winterhoek-, Elands-, Baviaanskloof- and Kouga mountains, fall under the jurisdiction of the Directorate of Forestry. These areas are managed for maximum watershed yield. Certain areas of privately owned mountain catchment are also managed by the Directorate of Forestry in collaboration with their owners. Privately owned mountain catchment areas are utilized mainly for cattle and goat farming, while within the Baviaanskloof, vegetable seed production takes place.

According to a Memorandum from the Department of Agricultural Technical Services, stock farming is practised in the Groot River catchment while fruit and mixed farming is carried out in the upper reaches of the Langkloof and catchment of the Paul Sauer Dam (South Africa. Dept. Agric. Tech. Services 1975). The Gamtoos River floodplain from Patensie to the mouth, is intensively cultivated with crops such as citrus, tobacco, lucerne and vegetables being grown under irrigation (ECRU survey and Dias Div. Council pers. comm.).



FIG. 4 Intensive agriculture on the Gamtoos River floodplain near Hankey. (ECRU 80-08-05)

(b) Around the estuary

The estuarine stretches of the Gamtoos River run between and through a number of privately owned farms. On the eastern side of the mouth, ownership of a portion of State land previously alienated for drift sand reclamation, has been transferred to the Dias Divisional Council. The Council also has jurisdiction over all land abutting the coast within the boundaries of its Division (Dias Divisional Council pers. comm. and Metropolitan Planning Unit 1978).

The western banks of the estuary consist of privately owned farmland with a portion of State land right at the mouth (Humansdorp Divisional Council pers. comm.).

The Gamtoos River mouth and the 73 km stretch of coastline from Port Elizabeth harbour to the Gamtoos River, excluding an "open area" between Schoenmakerskop and the Willows, has been zoned exclusively for white use (Metropolitan Planning Unit 1978).

On their property at the rivermouth the Dias Divisional Council has laid out a number of grassed camp sites amongst the Port Jackson Willows and Rooikrans trees which were used to fix the driftsands. The only facilities provided for at the camp sites consist of two small ablution blocks, rubbish bins and fresh water taps. During the peak summer season a number of additional pit toilets are erected for use by the campers. The camp sites are utilized mainly during the summer holiday season and over long weekends. It is particularly popular over the Christmas/New Year period and on the 1st of January 1975, 2 500 campers were recorded by A Gibbon (Metropolitan Planning Unit 1978). At such times the existing facilities are heavily overtaxed (Dias Div. Council pers. comm.).

The following facilities are listed as being available at the "Gamtoos Rivermouth Holiday Resort" by the P.E. Metropolitan Planning Unit : a launching ramp, toilets, changing rooms, lifesaving equipment, a parking area, a kiosk/roadhouse, picnic sites and camping sites.

Approximately 33 holiday shacks are situated at the rivermouth, on the farm Mauritskraal, which adjoins the Divisional Council camping area (Fig. 3). These cottages were originally built by relatives and friends of the owners of Mauritskraal which has subsequently been sold to the Gamtoos Mouth Development Co. (Pty.) Ltd. The company had intended developing a holiday township at the mouth but the planned development could not take place due to zoning recommendations by the Town Planning Section of the Provincial Administration. The portion occupied by the cottages and the indigenous bush to the N.E. of the access road to the mouth was zoned as a Natural Environment Area and the beach, driftsands and the salt marshes were zoned as a Primitive Area (Mr C Rushmere pers. comm. and Provincial Administration 1973). At present the existing cottage owners lease the land on which their cottages stand from the Gamtoos Mouth Development (Co.) at a nominal rental (Mr C Rushmere pers. comm.).

Mixed farming and the grazing of cattle and small stock takes place on the floodplain and salt marshes of the lower estuary.

3.6 Local authority :

In its upper catchment, tributaries of the Gamtoos run through the Divisional Council areas of Koup, Kamdeboo and Winterhoek.

The following towns are situated adjacent to the river and its tributaries : Murraysburg on the Kariega River, Willowmore on the Groot River, Klipplaat on the Heuningklip River, Steytlerville on the Groot River, Joubertina on the Kouga River and Hankey on the Gamtoos River (1:1 000 000, ICAO World Aeronautical Chart).

The lower part of the river from just south of Hankey to the mouth, forms the boundary between the Humansdorp Divisional Council on the west and the Dias Divisional Council on the east (Dias Divisional Council pers. comm.).

3.7 Estuary uses :

The estuary itself is very popular and being relatively close to Port Elizabeth is used over weekends and during holiday seasons by large numbers of people for fishing, swimming, waterskiing and bait collection. It is navigable for 8 km upstream but the mouth being shallow and unpredictable cannot be used by boats for putting out to sea (Metropolitan Planning Unit 1978). The use of power-driven boats is limited to motors of 8,9 kw or a speed of 6 km/h by Provincial Proclamation No. 357/72. However under certain circumstances, permits are issued by the Cape Department of Nature and Environmental Conservation for the use of more powerful motors (local resident pers. comm.). Permits for the use of crab nets to catch the large estuarine crab Scylla serrata are issued by the Cape Dept. of Nature and Environmental Conservation on a regular basis. During 1980, 5 of these permits were issued for the Gamtoos River. Sea fishing from the adjacent coast is very popular and extensive use is made of off-road vehicles on the beach, the dunes and salt marsh areas just behind the coastal dunes. Numerous tracks of these vehicles were noted at the time of the ECRU survey which was outside the peak holiday season.

3.8 Morphometry of the Estuary :

Area

The exact head of tidal effect or limit of marine influence has not been established. However the presence of Gobies and of the sandprawn Callinectes in small numbers at the confluence of the Loeriespruit with the Gamtoos indicate that this may be the upper limit of marine influence (C Gaigher pers. comm.), (Fig. 5). The water surface area of the estuary, up to this point, was calculated to be approximately 175 ha. (1:50 000 Sheet 3325 CC.).

Shape (See Fig. 3)

After the confluence of the Groot River and Kouga River, the Gamtoos River meanders through a broad alluvial floodplain for a distance of 90 km. At the upper end of the estuary, i.e. where the Loeriespruit joins the Gamtoos, 8,5 km from the mouth, it is approximately 80 m wide and flows between steep-sided almost parallel banks approximately 2,5 m high. From the new national highway bridge the river broadens gradually towards the mouth and the banks flatten out to form an extensive tidal marsh behind the coastal dunes.

The tidal salt marsh to the north of the former main channel consists of a broad flat area approximately 79 ha in extent covered with halophytic vegetation. On the seaward side of the former main channel, an island of saltmarsh exists, surrounded by numerous tidal pools

which are encroached upon by shifting sand dunes. The substrate of these pools consists of silt brought down during floods and much of the now barren low lying areas between the dunes is being colonized by halophytic vegetation such as Sarcocornia spp.

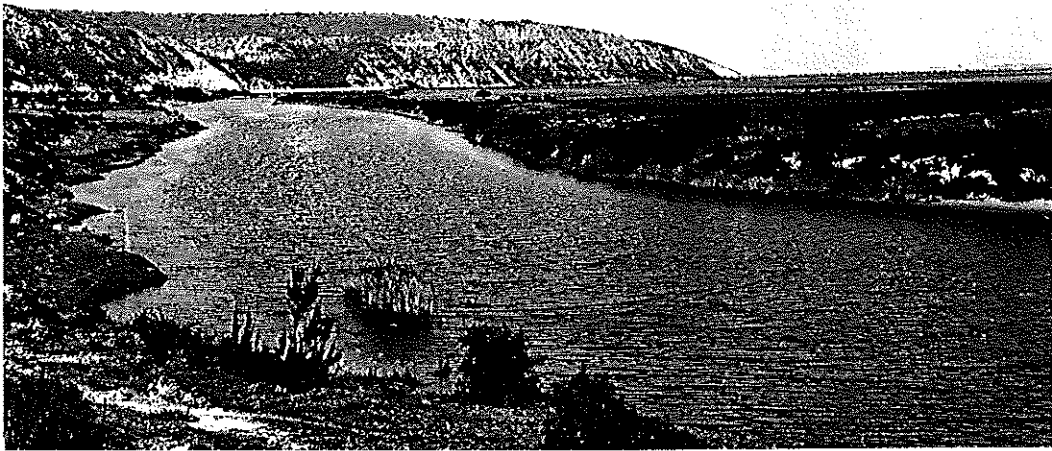


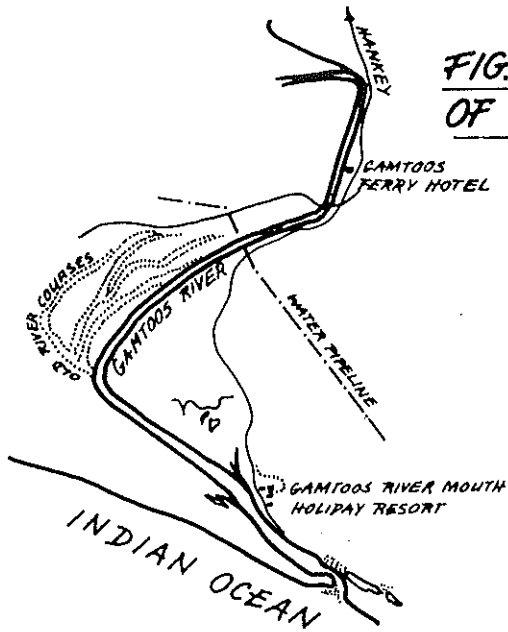
FIG. 5 The Gamtoos River from the confluence of the Gamtoos and Loerie rivers - note the Sandstone cliffs in the background at the base of which the river runs (ECRU 80-08-05).

A study of aerial photographs taken of the mouth region in 1961, 1971 and 1980, reveals the presence of a number of old river courses to the west of the present river (Fig. 6 (a) (b) and (c)). It appears as if the lower course of the river has moved eastwards to its present position where it is now restricted by sandstone cliffs against the eastern bank, i.e. at least in the area between Loeriespruit and the new national highway bridge. When in flood the river chooses the shortest course to the sea and as can be seen from Fig. 6 (b) it cut through the coastal dunes in a number of places after rounding the last bend during the 1971 floods. The western bank at this point i.e. north of the mobile sand dunes, is composed of a conglomerate of rounded boulders in a sandy matrix. After the 1971 floods, the river mouth was re-established approximately 4,2 km west of the previous mouth and the former main channel now consists of a tidal "appendix" together with an additional isolated lagoon to the east. This represents the remains of the main channel when the mouth was situated even further east than in 1961. This lagoon is connected to the main water body by a narrow channel which is shallow (< 1m) even at high tide.

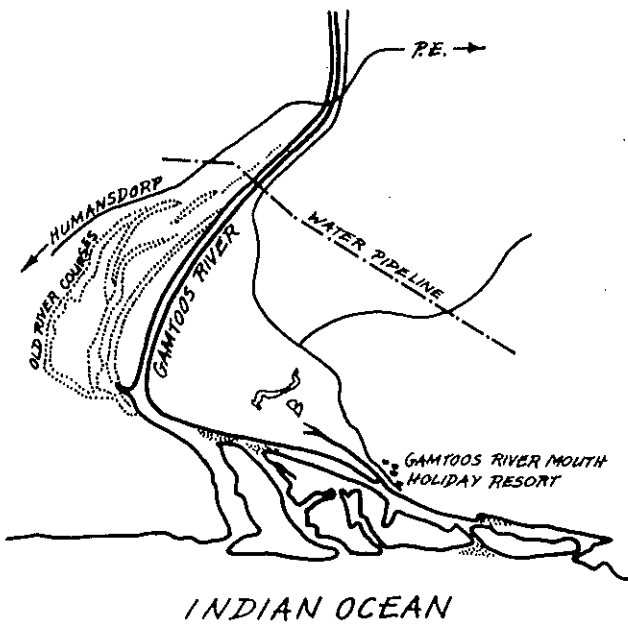
Bathymetry

According to G F van Wyk there were no particularly deep areas in the river below the old national road bridge (Van Wyk 1963). His field notes of a survey done in 1956 record a depth of approximately 1,8 m in

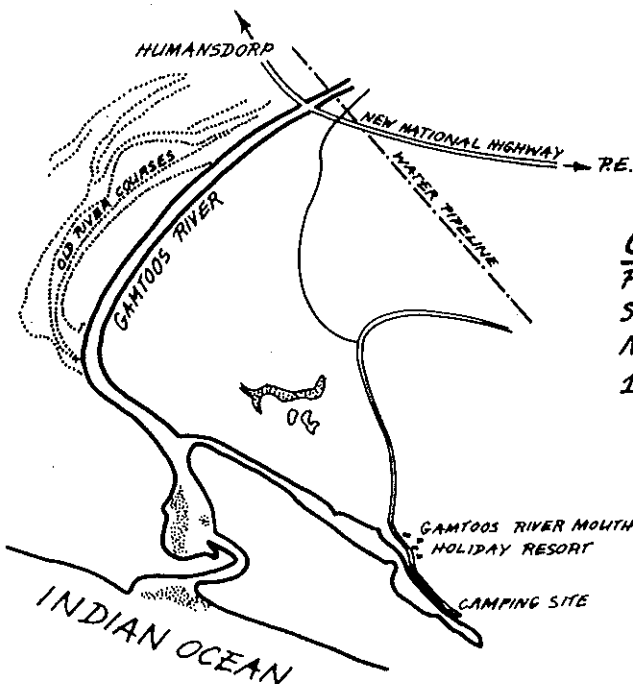
FIG. 6 CHANGES IN CONFIGURATION OF GAMTOOS RIVER MOUTH



(a) 1961 COMPILED FROM AERIAL PHOTOGRAPHS (TRIG. SURVEY) TAKEN IN 1961, JOB No. 459 AT AN APPROX. SCALE OF 1:36 000



(b) 1971 COMPILED FROM AERIAL PHOTOGRAPHS (TRIG. SURVEY) TAKEN IN 1971 (AFTER FLOODS) JOB No. 622 AT AN APPROX. SCALE OF 1:36 000



(c) 1980 COMPILED FROM AERIAL PHOTOGRAPHS (NATAL UNIV. - LAND SURVEY DEPT.) TAKEN IN 1980, JOB No. 348 AT AN APPROX. SCALE OF 1:20 000

mid-stream at low tide opposite the old boat launching site (Fig. 7 Grid Ref. 1915). Depths recorded by ECRU in August 1980 are given in Table 2. The depth of water in the former main channel is very variable and numerous mud banks at a depth of approximately 0,5 m at low tide occur in the stretch of water from the old boat launching site to its confluence with the present main channel. The isolated lagoon at the eastern extremity of the mouth area was described by G F van Wyk in 1958 as having a "deep" basin on the landward side. This was confirmed by C Gaigher in 1980 who estimated the deepest part of this lagoon to be at least 3 m.

3.9

Geomorphology :

Geology

The geology and geomorphological features of the Gamtoos Estuary and adjacent shoreline have been described by the City of Port Elizabeth's Metropolitan Planning Unit in the coastal study undertaken in 1978. According to this publication, shifting windblown dunes cover the fore-shore areas. These are fairly wide at the Gamtoos rivermouth and narrow towards Van Stadens rivermouth in the east. Inland of these modern dunes a wide belt of older vegetated dunes occur which cover arenaceous shelly limestone, overlying pre-Cape phyllites, limestone, quartzites and conglomerates.

The dunes in front of the coastal hills between the Gamtoos and Maitland rivermouths have cut off the drainage of a few rivers flowing down a southward dipping dissected coastal plain. This has resulted in the formation of vleis and pans behind the older dune-fields.

As has already been stated the Gamtoos flows through a broad alluvial floodplain. According to Alexander (1976) the two main tributaries, the Kouga and Groot rivers cut through quartzitic material of the Table Mountain Sandstone series which make up the Kouga and Baviaanskloof mountain ranges. "Downstream of the confluence, these rivers become the Gamtoos river, which follows a 90 km long tortuous course through a flat alluvial plain bounded by soft Enon Conglomerate. In the upstream reaches, the conglomerate consists of a homogeneous mixture of hard, well-rounded boulders, cobbles and gravels derived from the T.M.S. in a weakly cemented sandy matrix. Towards the mouth, the conglomerate is predominantly composed of finer gravels and sands which occur in more defined layers".

A L du Toit (1954) describes the cliffs on the eastern bank of the river upstream of the mouth (See Fig. 5) as "sandstones with reddish marls and grey sandy clays".

The river bank at Grid Ref. 1402 (Fig. 7) is composed of a conglomerate of rounded pebbles in a sandy matrix containing a large amount of shell particularly oyster shells (ECRU survey).

Nature of bottom materials

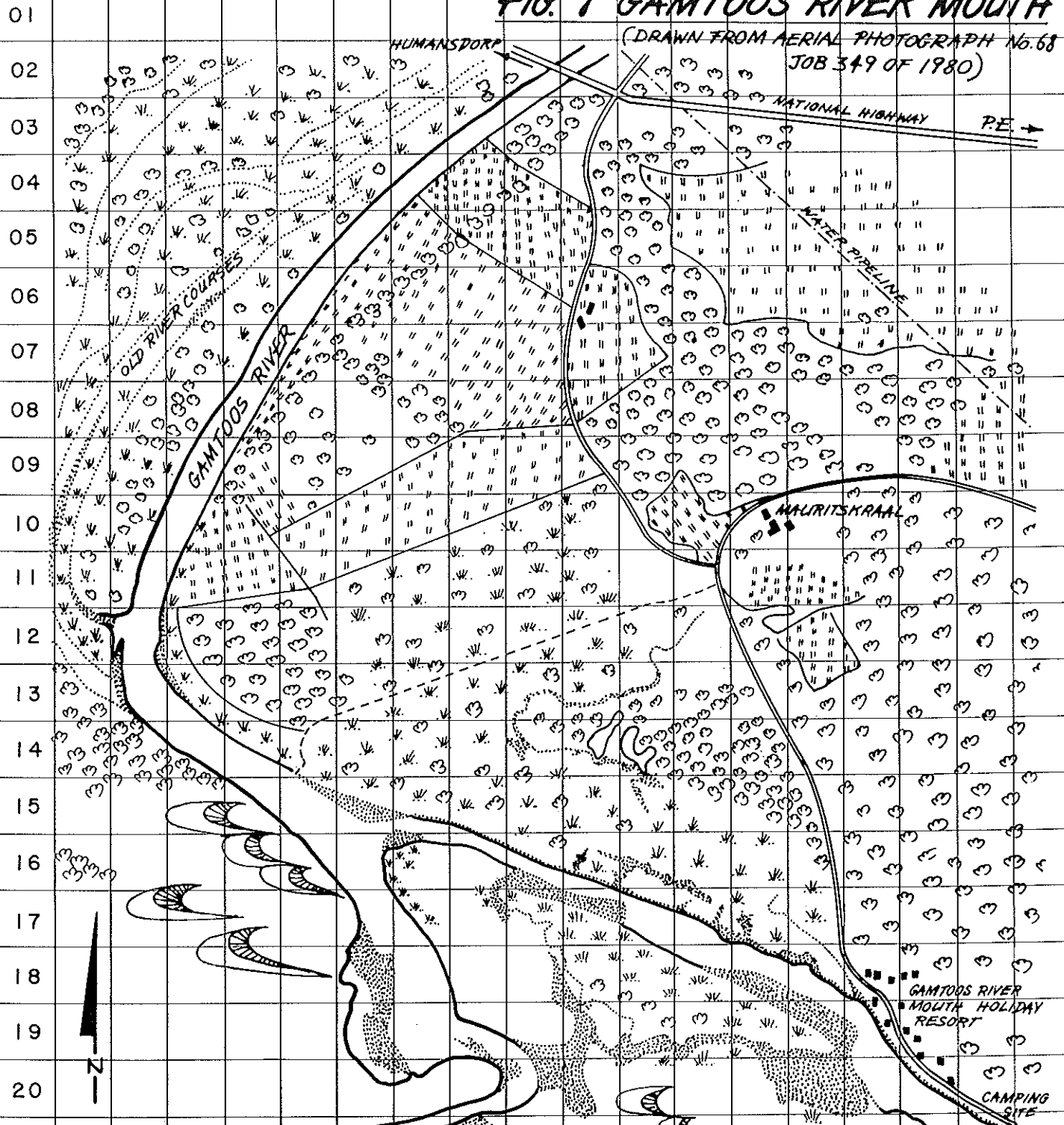
The Gamtoos Valley with evidence of old river courses (Fig. 3) consists of a broad floodplain covered by alluvial deposits which present foundation problems for any fixed structures (Metropolitan Planning Unit 1978).

The substrate of almost the entire lower portion of the estuary consists of fine sandy/silt which is brought down by the river in times of flood. At the mouth and behind the coastal dunes on the seaward side, the sand







00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18

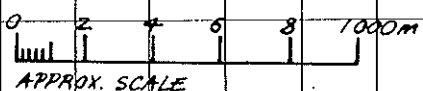
FIG. 7 GAMTOOS RIVER MOUTH

(DRAWN FROM AERIAL PHOTOGRAPH No. 68
JOB 349 OF 1980)



LEGEND

-  ROADS
-  SCRUB AND COASTAL BUSH
-  SALT MARSH AND HALOPHYTES
-  SAND AND MUD BANKS
-  AGRICULTURAL LANDS
-  MOBILE DUNES



APPROX. SCALE

in the slacks behind the dunes and adjacent to the river is also covered with a layer of muddy silt which is being covered with wind-blown sand as the dunes shift according to the prevailing winds. As mentioned previously, in places this fertile silt is colonized by various species of halophytic plants. The nature of bottom materials sampled by ECRU in August 1980 are given in Table 2 under the heading "Substrate".

Sediment core samples taken by R J Watling of CSIR for the determination of metal concentrations are described as follows :

<u>Site*</u>	<u>Core sample</u>
GMT 1 (ECRU Grid Ref.2218)	0 - 13 cm Yellow medium sand with red and brown mottling. 13 - 56 cm Buff to grey medium sand with grey mottling.
GMT 2 (ECRU Grid Ref. 1402)	0 - 19 cm Brown fine sand to silt 19 - 58 cm Brown to grey clay with black mottling.
GMT 3 (ECRU Grid Ref. 0209)	0 - 52 cm Light brown medium sand.
GMT 4 (old national rd. bridge)	0 - 54 cm Brown to grey medium sand with black mottling.
GMT 5 (Loeriespruit confluence with Gamtoos)	0 - 52 cm Brown medium sand with dark grey mottling towards the top.

* GMT - These are the station numbers used by R J Watling for the Gamtoos river system which correspond to the ECRU Grid Ref. Nos. given in brackets below the GMT Nos.

Sandbar characteristics

The mouth of the Gamtoos River is situated in a dynamic environment of bare transverse coastal sand dunes. The mouth is therefore highly susceptible to the combined effects of the predominant wind, wave and longshore current regimes. According to Heydorn and Tinley (1980) the predominant wind direction at Port Elizabeth, 60 km to the east of Gamtoos, is SW and WSW and to a lesser degree E and ESE in January, while in July the wind blows mainly from the west. Furthermore, they state that the dominant wave directions on the south coast are SSW to SSE. Under the influence of all these forces, the mouth of the Gamtoos River tends to move eastwards but at times of flood it breaks through in the west. (See Fig. 6a, b, and c). The rate that the mouth moves eastwards will vary according to the intensity and duration of the combined effects of the wind, waves and longshore currents. Reference to a series of aerial photographs taken from 1971 to 1980 (after the 1971 floods), indicate that initially the mouth moved eastwards and subsequently slightly westwards to its position at the time of the ECRU survey. Throughout the above-mentioned period, the main channel at the mouth has been offset to the west with a flat shallow sandbar on the eastern side of the mouth. A possible reason for the offset tidal inlet is that a delta on the eastern side formed by sediment brought down by the river, refracts the waves to cause a local transport direction from east to west (Dr H Swart pers. comm.).

According to Day (1981), at low tide, sandspits constrict the mouth to a width of 30 m and sandy shoals are revealed which during periods of low river flow unite to close the mouth completely.

Configuration of adjacent shore

The coast on either side of the rivermouth has been described by Heydorn and Tinley (1980) as a Dune and Vlei coastline, defended by plants. Aerial photographs of the estuary show a series of parallel, older, well vegetated longitudinal dunes running WSW to ENE at approximately 20° to the coastline with coastal pans and vleis in the dune slacks. In front of these vegetated dunes a field of mobile transverse barchanoid dunes are found which varies in width from 300 to 1200 m. At the mouth, the river cuts through this dune-field on its way to the sea and the slipfaces of the high transverse dunes on the western side impinge on the river forcing it in an easterly direction as the dunes advance.

3.10 Oceanography :

Major currents

The south-westward flowing Agulhas current which flows south of the -200 m isobath is the major offshore oceanic water movement off the coast opposite the Gamtoos Estuary. However, south of Algoa Bay which lies to the east of the Gamtoos, the Agulhas current swings away from the coast resulting in a zone which is then subjected to mainly tidal, wind and swell driven currents (Dr J Lutjeharms, pers. comm.). Close inshore the predominant swell direction from the S W causes longshore currents which flow in a northeasterly direction. In bays such as St Francis Bay, within which the Gamtoos Estuary is situated, local eddies can cause longshore sediment transport towards the deep curve of the bay i.e. in a westward direction in the case of St Francis Bay (Heydorn and Tinley 1980).

Waves

According to Heydorn and Tinley (1980) the predominant wave direction along the southern coast is SSW to SSE.

Surf zone currents

From aerial photographs taken of the Gamtoos mouth, it appears as if the local sediment transport and hence surf zone currents at the mouth, are predominantly in a westerly direction (See Fig. 7 showing tidal inlet offset towards the west). However, the nett movement of the mouth is in an easterly direction, probably due to the more dominant effect of the wind on the transverse coastal dunes.

Tides

All the levels given in this section are in metres above Chart Datum (S.A. Tide Tables 1980). The tidal predictions for 1980 at Port Elizabeth the closest port to the Gamtoos Estuary are as follows :
MHWS 1,90 m, MLWS 0,29 m. The tidal range is therefore 1,61 m. No figures are available for HAT or LAT at Port Elizabeth. At Knysna which is west of the Gamtoos Estuary, HAT and LAT for 1980 are 2,29 m and 0,11 m respectively. With Mean Level at the Gamtoos being approximately 1,1 m relative to Chart Datum, at the highest predictable tidal levels (HAT) the tide could rise to approximately 1,2 m above Mean Level.

Physico-chemical characteristics :

Water samples taken on 6 October 1981 from the Gamtoos river and the Loerie tributary were analysed by the S.A.B.S. for the Dept. of Water Affairs, Forestry and Environmental Conservation. The results of the analyses are given in Table 3.

pH

See Tables 2 and 3. On 15 June 1956, G F van Wyk recorded a pH of 8,6, 730 m from the mouth (i.e. within the present "appendix" to the main stream).

Temperatures

See Table 2.
On 15 June 1956, G F van Wyk recorded a surface temperature of 15° C, 730 m from the mouth.

Transparency

According to G F van Wyk on 15 June 1956, the water was "limpid" with a transparency of 2' (0,6 m). The colour was light green and he ascribes the cause of discoloration to a suspension of fine mud and algae. Secchi disc readings and transparency descriptions are given in Table 2.

Salinity

Readings in August and May 1980 are given in Table 2 whilst conductivity readings taken by the Directorate of Water Affairs are given in Table 3. G F van Wyk recorded a salinity of 36,7 parts per thousand, 730 m from the mouth on 15 June 1956 (Day 1981).

Dissolved O²

See Table 3.

Nutrients

No data.

Dissolved and Suspended solids

See Tables 1 and 3. No data are available on Nitrogen, Phosphorous, Dissolved Organic Matter (D.O.M.), or Particulate Organic Matter (P.O.M.).

Other Nutrients

Enrichment of the river water via run-off from heavily fertilized agricultural lands can be expected.

Pollution :Sewage

No published data could be traced.

Oil

No data.

TABLE 2

Physico-chemical data collected by UPE and ECRU (See Fig. 7 for Grid References).

Sampling by	ECRU	UPE	ECRU	UPE	ECRU	UPE
Date	80-08-05	80-05-21	80-08-05	80-05-21	80-08-05	80-05-21
Time	11h08	-	12h41	-	10h05	-
State of mouth	OPEN					
State of tide	rising	-	falling	-	rising	-
ECRU Grid Ref.	2218	1504	1402	0704	0209	Above Ferry
Position of Sampling site	mid-stream	-	20 m from west bank	-	against riverbank	-
Depth (m) at Sampling site	2	4	4	3	-	3
*Width (m)	c 100	c 100	c 160	c 70	c 80	c 45
Diss. O ₂ (mg/l)	Top	-	-	-	-	-
	Bottom	-	-	-	-	-
Salinity (‰)	Top	32	23	26	28	20
	Bottom	34	34	36	37	-
Temp. (°C)	Top	17,3	17,2	17,9	18,0	16,5
	Bottom	17,5	18,2	16,1	18,3	-
pH	-	-	-	-	-	-
Secchi disc transparency (m)	0,75	-	0,75	-	0,75	-
Water colour	-	clear	light muddy	-	-	light muddy
Substrate	dark grey mud/sand	-	dark grey mud/silt	-	brown silt	-

*Estuary/River width at sampling site

Metals

R J and H R Watling of CSIR, presently based at the University of Port Elizabeth are engaged in a project titled "Metal Surveys in South African estuaries". This project is divided into a number of separate reports. The report covering the Gamtoos River is scheduled for publication towards the end of 1981.

Pesticides and Herbicides

No published data was traced, however pesticides and herbicides are widely used in intensive agriculture, particularly citrus production in the upper reaches of the Gamtoos floodplain.

Other forms of pollution

No published data was traced. The washing of clothes by local inhabitants

takes place on the river banks and this could be a source of enrichment/pollution which would occur at various points along the course of the river and its tributaries. Enrichment can also be expected from the septic tanks of the holiday resort and camping site in the mouth region.

TABLE 3 Analysis of water samples taken by the Department of Water Affairs, Forestry and Environmental Conservation.

Date	Gamtoos River (below Hankey)		Loerie River below P.E.M. filtration plant	
	6-10-80	29-1-81	6-10-80	29-1-81
pH	8,6	8,8	7,4	7,5
Conductivity in m S/m	209	239	32	44
Dissolved solids at 105°C in mg/ℓ	1455	1490	275	315
Oxygen absorbed from 0,0125 N KMNO ₄ in 4h. as O ₂ in mg/ℓ	1,8	2,8	30	26

3.13 Public health aspects :

Bacteriology

The river water is not sampled on a regular basis by the local authorities but they are prepared to do so on request (Dias Div. Council pers. comm.).

Others

No published data could be traced.

4. BIOTIC CHARACTERISTICS

4.1 Flora :

Phytoplankton/diatoms

No data.

Aquatic vegetation

(a) Estuary

G F van Wyk (1963) records that dense patches of Potamogeton occur above the old national road bridge but that Zostera is entirely absent. No aquatic vegetation was found in the lower part of the estuary during the ECRU survey in August 1980.

(b) Adjacent Shoreline

No aquatic vegetation present as the estuary mouth is situated through a bare sandy beach. (See section 3.9. Configuration of adjacent shore).

Semi-aquatic vegetation

According to Day (1981) "The banks inland of the coastal sand dunes were muddy with salt marshes on the west bank and on an almost isolated lagoon on the east bank. Where the estuary cuts through the bare coastal dunes, the wind-blown sand continually encroaches on the channel so that the banks are clean sand".

The steep banks, particularly on the eastern side upstream of the pipeline crossing the river, (See Fig. 3) are lined with fairly dense patches of Phragmites reeds (ECRU survey). Isolated patches of sparse Phragmites occur in the lower reaches of the estuary, e.g. at ECRU Grid Ref. 1402.

Terrestrial vegetation

The Botanical Research Institute did not participate in the ECRU survey of the Gamtoos Estuary, therefore a description of the terrestrial vegetation is based on,

Acocks (1975), Heydorn and Tinley (1980) and Cowling (1980).

- (a) According to Acocks, the vegetation of the floodplain and slopes of the Gamtoos River valley are classified as Valley Bushveld (Veld Type 23). The Acocks map on Veld types also shows a small pocket of Alexandria Forest (Veld Type 2) occurring on the western bank of the river near the mouth, along the coast behind the coastal dunes and up the Kabeljous River valley.
- (b) Heydorn and Tinley (1980) state that the Gamtoos coastal vegetation includes Dune and Clay thicket. The following plant species were found during the ECRU survey :

Sideroxylon inerme, Euclea racemosa, Rhus glauca
Pterocelastrus tricuspidatus, Tarconanthus camphoratus,
arborescent Euphorbia, Aloes Pappaea capensis, Portulacaria afra,
Maytenus heterophylla, Schotia afra.

- (c) The vegetation in the vicinity of the Gamtoos rivermouth is described by Cowling (1980) as a "Broad leaf sclerophyll scrubland to woodland with a high incidence of spiny plants and succulents".

From the 1:10 000 Colour aerial photographs taken during April 1979 and 1:20 000 Black and White aerial photographs taken in April 1980, four main natural plant formations are evident. These are :

- (1) an area of Alexandria Forest (Acocks Veld Type 2) on the western bank inland of the bare mobile coastal dunes.

- (2) Three areas of Valley Bushveld (Acocks Veld Type 23), situated north and northeast of the saltmarsh above the blind "appendix" to the main river course, a small area on the eastern bank at the first major bend in the river and a third area north of the Mauritskraal homestead (Fig. 3).
- (3) An almost pure stand of Acacia cyclops occurs at the Gamtoos Rivermouth camping site, which was planted for drift-sand reclamation purposes.
- (4) Extensive salt marshes occur inland of the "appendix" to the main river and an island of vegetated sand occurs between the river and the bare mobile coastal dunes.

The remainder of the area up to the new national highway bridge consists of cultivated lands or grazing camps where the composition of the natural vegetation has been radically changed through intensive grazing by stock and the cutting out of unpalatable species.

Above this bridge the entire floodplain is intensively cultivated. In places, a narrow strip of natural vegetation occurs along the river banks and the steep slopes on the eastern bank up to Loeriespruit are covered with typical Valley Bushveld vegetation.

A generalized distribution of the vegetation is given in Fig. 3.

4.2

Fauna :

Zooplankton

No published data. A number of mysids Rhopalophthalmus terranatalis and a shrimp, Palaemon pacificus, were collected at ECRU Grid Ref. 2218 during a 3,5 min. trawl using a small "D"-net with a stretched mesh size of 5 mm. A similar trawl at ECRU Grid Ref. 1402 produced no Zooplankton (ECRU survey).

Fauna on

(a) hard substrates

The barnacle Balanus elizabethae and colonies of polychaete worms, Ficopomatus enigmatica were found growing on the pylons of the new national highway bridge during the ECRU survey in August 1980.

(b) Soft substrates

G F van Wyk (1956 unpublished) recorded that the mud prawn, Upogebia was fairly abundant at the old boat launching site and was also present on the left bank at the campsite as well as on the mudflats of the right banks. According to him numerous sand prawn (Callinassa sp.) holes were found near the mouth and the blind lagoon, but that the prawns were difficult to obtain. His sketch maps of the estuary also show that white mussel (Donax serra) were plentiful along the beach on either side of the mouth. He records that pencil bait (Solen) and giant river crab (Scylla serrata) are present but scarce in the river.

During the ECRU survey Upogebia were found to occur wherever a suitable

muddy substrate existed i.e. along both banks from the boat launching ramp up to the new national highway bridge. Callianassa were present in sandy substrates from the blind lagoon in the east up to the new national highway bridge. Some particularly large specimens of Callianassa were collected at ECRU Grid Ref. 2009.

According to C Gaigher (C.P.A. Dept. of Nature and Environmental Conservation - pers. comm.) who surveyed the Gamtoos river during 1980 for the distribution and relative abundance of benthic organisms, Callianassa and Upogebia are fairly abundant wherever a suitable substrate occurs in the lower part of the estuary. Upogebia disappear above the "Ferry Hotel" while sparse populations of Callianassa occur right up to the confluence of the Loeriespruit with the Gamtoos. Scattered populations of Solen occur in the lower estuary.

The issuing of permits for the use of crab nets in the estuary by the Cape Dept. of Nature and Environmental Conservation would seem to indicate that the giant river crab (Scylla serrata) is relatively abundant (refer to Section 3.7 Estuary uses).

(c) vegetation

No information.

Insects

No data.

Other invertebrates

No published data could be traced.

Fish

G F van Wyk's notes of 15 June 1956 record that Kob (Argyrosomus hololepidotus), Spotted grunter (Pomadasys commersonni), White steenbras (Lithognathus lithognathus), Harders and Springer (fam. Mugilidae) and Sea-barbel (Tachysurus feliceps) occur in the estuary.

The following fish were caught during "D"-net hauls by ECRU on 5 August 1980

ECRU Grid Ref. 2218	ECRU Grid Ref. 1402
(3,5 min. haul)	(5 min. haul)
1 Blackhand sole (<u>Solea bleekeri</u>) 1 Estuarine round-herring (<u>Gilchristella aestuarius</u>)	Banded goby (<u>Gobius caffer</u>)

The following table reflects the fish caught with gill nets on 21 May 1980 by the University of Port Elizabeth at 3 localities in the lower part of the Gamtoos estuary (J F K Marais pers. comm.). The total weight (in gms.) of each species caught at a locality is given in brackets following the total number caught at that locality.

TABLE 4 UPE Gill netting results from the Gamtoos Estuary

Species	Localities			Average Wt. of individual fish (gm)
	ECRU Grid Ref. 1504	ECRU Grid Ref. 0704	Above Gamtoos "Ferry Hotel"	
Sea-barbel (<u>Tachysurus feliceps</u>)	6 (2689)	3 (1244)	4 (1560)	422
Kob (<u>Argyrosomus halolepidotus</u>)	16 (45306)	11 (19548)	12 (18121)	2129
Striped mullet (<u>Liza tricuspidens</u>)	-	2 (2705)	4 (4051)	1126
Southern mullet (<u>Liza richardsonii</u>)	-	-	3 (1163)	388
Flathead Mullet (<u>Mugil cephalus</u>)	-	-	3 (1523)	508
Freshwater mullet (<u>Myxus capensis</u>)	-	-	7 (2536)	362
Leervis (<u>Lichia amia</u>)	1 (1420)	-	-	1420
Spotted grunter (<u>Pomodasys commersonni</u>)	1 (3200)	-	-	3200
Stingray (<u>Dasyatis</u> sp.)	1 (139)	-	-	139
Cape moony (<u>Monodactylus falciformis</u>)	-	-	1 (46)	46

(The common and scientific names of all fish are according to Smith (1975).

Reptiles and Amphibians

No specimens were collected or recorded during the ECRU survey, however, the following species have been recorded from the areas covered by the 1:50 000 Topocadastral sheets of Hankey 3324 DD and Lorie 3325 CC.

Snakes recorded by Fitzsimons (1962) from loci 3324 DD Hankey and 3325 CC Lorie

Brown water snake (<u>Lycodonomorphus refulus</u>)	-	3325 CC
Slug-eater (<u>Duberria lutrix</u>)	-	3324 DD
Boomslang (<u>Dispholidus typus</u>)	-	3325 CC
Cross-marked grass-snake (<u>Psammophis crucifer</u>)	-	3325 CC
Coral snake (<u>Aspidelaps lubricus</u>)	-	3325 CC
Rinkhals (<u>Hemachatus haemachatus</u>)	-	3325 CC
Cape cobra (<u>Naja nivea</u>)	-	3325 CC & 3324 DD
Common sea-snake (<u>Pelamis platurus</u>)	-	3325 CC
Rhombic night-adder (<u>Causus rhombeatus</u>)	-	3325 CC
African puff-adder (<u>Bitis arietans</u>)	-	3324 CC

Amphibians recorded by Poynton (1964) from loci 3324 DD Hankey and 3325 CC Lorie

Painted reed frog (<u>Hyperolius marmoratus verrucosus</u>)	3324 DD
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Tortoises recorded by the Cape Dept. of Nature and Environmental Conservation. (1972 - 1976) from loci 3324 DD Hankey and 3325 CC Lorie

Mountain tortoise (<u>Geochelone pardalis</u>)	3324 DD
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J C Greig and A L de Villiers pers. comm.).

Birds

The birds of the Gamtoos Estuary were recorded by Capt. E L Shewell in 1950, M Schramm in 1977 (unpublished) and the Western Cape Wader Study Group in the summer of 1978/79 (Underhill et al 1980). Table 5 summarizes the species recorded and counted by the abovementioned groups.

TABLE 5

Waders and other birds of the Gamtoos Estuary

Roberts Number	Species Common Name	Capt. E.L. Shewell* Feb. 49-Jan. 50		M. Schramm 1977 (unpublished)		W.C.W.S.G.**
		Nov.-Jan.	May-July	Summer	Winter (only Waders)	Summer 1978/79 (5 Sites)
231	Black Oystercatcher	18	51	19	34	27
232	Turnstone	2	0	0	0	1
233	Ringed Plover	200	10	0	0	38
235	White-fronted Sandplover	c.100 (throughout year)		26	84	18
237	Kittlitz's Sandplover	c.100	do	1	3	5
238	Three-banded Sandplover	c.3	do	13	1	2
241	Grey Plover	75	22	141	8	152
242	Crowned Plover	0	0	0	0	2
245	Blacksmith Plover	0	0	3	3	0
251	Curlew Sandpiper	400	0	69	0	165
253	Little Stint	400	0	4	0	137
255	Sanderling	400	120	43	29	445
256	Ruff	2	0	0	0	69
257	Terek Sandpiper	0	0	0	0	78
258	Common Sandpiper	3	0	5	3	26
263	Greenshank	25	10	19	10	72
264	Wood Sandpiper	0	0	0	0	2
267	Curlew	64	16	1	4	3
268	Whimbrel	5	1	16	19	37
269	Avocet	0	0	2	4	0
270	Stilt	0	0	10	0	0
274	Water Dikkop	0	0	4	0	0
85	Spoonbill	1	0	0	0	0
86&87	Flamingo	0	2	0	0	0
231 X	European Oystercatcher	1	0	0	0	0
261	Redshank	2	0	0	0	0
262	Marsh Sandpiper	0	1	0	0	0
266	Bar-tailed Godwit	8	1	0	0	0
236	Chestnut-banded Sandplover	0	0	0	1	0
47	White-breasted Cormorant	11	3	46	-	82
48	Cape Cormorant	0	0	0	-	1
50	Reed Cormorant	0	1	10	-	7
52	Darter	0	0	3	-	0
54	Grey Heron	10	21	3	-	11
55	Black-necked Heron	0	0	0	-	13
59	Little Egret	10	6	4	-	12
81	Sacred Ibis	0	0	2	-	0
84	Hadeda	0	0	0	-	5
90	South African Shelduck	10	32	16	-	26
96	Yellow-billed Duck	30	90	2	-	17
97	Red-billed Teal	0	5	1	-	9
98	Cape Teal	0	0	2	-	0
115	Hobby	0	0	0	-	5
112	Fish Eagle	0	0	1	-	1
167	African Marsh Harrier	0	0	1	-	1

TABLE 5 (Cont.)

Roberts Number	Species Common Name	Capt. E L Shewell* Feb. 49-Jan. 50		M. Schramm 1977 (unpublished)		W.C.W.S.G.**
		Nov.-Jan.	May-July	Summer	Winter (only waders)	Summer 1978/79 (5 Sites)
287	Kelp Gull (S.B. Backed)	160	50	43	-	114
290	Caspian Tern	17	17	1	-	0
291/294	Common/Arctic Tern	2000	3	27	-	34
296	Sandwich Tern	300	12	0	-	201
298	Swift Tern	2	42	0	-	5
304	White-winged Black Tern	0	0	0	-	1
394	Pied Kingfisher	0	0	5	-	3
685	African-pied Wagtail	0	0	0	-	1
686	Cape Wagtail	0	0	0	-	20
76	Wood Ibis (Yellow-billed Stork)	75	2	0	-	0
88	Spurwing Goose	0	7	0	-	0
89	Egyptian Goose	2	50	0	-	0
98	Cape Wigeon	0	6	0	-	0
288	Grey-headed Gull	0	1	0	-	0
293	Roseate Tern	10	2	0	-	0
305	Lake (Whiskered) Tern	2	1	0	-	0

* The numbers from Capt. E L Shewell's list represent the largest no. of that species seen together at anytime during any one week, during the periods Nov. 1949 to Jan. 1950, for summer and May 1949 to July 1949 for winter.

** W.C.W.S.G. = Western Cape Wader Study Group (Underhill et al 1980).

Mammals

The only mammals seen during the ECRU survey were a troop of Vervet monkeys (Cercopithecus pygerythrus), however, the following mammals are recorded as being present in the areas covered by the 1:50 000 Topocadastral sheets of Hankey 3324 DD and Loerie 3325 CC which cover the Gamtoos Estuary and lower catchment (Stuart et al 1980).

Schreibers bat	-	<u>Miniopterus schreibersi</u>
Egyptian fruitbat	-	<u>Rousettus aegyptiacus</u>
Hottentot golden mole	-	<u>Amblysonius hottentotus</u>
Chacma baboon	-	<u>Papio ursinus</u>
Aardvark	-	<u>Orycteropus afer</u>
Bushbuck	-	<u>Tragelaphus scriptus</u>
Bush karoo rat	-	<u>Otomys unisulcatus</u>
Vlei rat	-	<u>Otomys irroratus</u>
Striped mouse	-	<u>Rhabdomys pumilio</u>
Namaqua rock rat	-	<u>Aethomys namaquensis</u>
Multimammate rat	-	<u>Praomys natalensis</u>
Black rat	-	<u>Rattus rattus</u>
Forest mouse	-	<u>Thamnomys dolichurus</u>
Cape porcupine	-	<u>Hystrix africaeaustralis</u>
Striped polecat (Zorilla)	-	<u>Ictonyx striatus</u>
Lynx	-	<u>Felis caracal</u>

SYNTHESIS

Because of the size and diversity of the entire system it has not been possible to include details of all the available information on the Gamtoos River.

The river which has a large catchment of 34 438 km², drains extensive parts of the southern Karoo as well as four mountain ranges. It carries a high silt load, so much so that the wall of the Beervlei Dam on the Groot River had to be raised in 1967 due to reduction in its storage capacity caused by siltation. The lower parts of the river are subject to extreme floods after heavy rainfalls in the hinterland and since 1847, at least 8 major floods have been recorded, which have caused extensive damage and loss of life in the Gamtoos River valley.

The entire floodplain from the confluence of the Kouga and Groot Rivers down to the mouth is intensively cultivated, which results in substantial quantities of water being withdrawn from the river for irrigation purposes. It can be expected that both pollution and enrichment of the river water originates from the agricultural lands and crops which are treated with herbicides, pesticides and fertilizers.

In the catchments of the main tributaries situated in the Karoo, extensive sheepfarming occurs, while timber production takes place in the catchments of the Kouga, Baviaanskloof and Loeriespruit Rivers. The normal flow channel of the river is not obstructed in its lower reaches by any man-made structures, but the embankments of the old national road and the new coastal freeway across the western part of the floodplain would act as a barrier to a sheet-flow of flood waters during extreme conditions.

The erosion of riverbanks on the floodplain is due to the normal tendency of rivers to meander. However, according to Alexander (1976) "Clearing of lands close to the river banks and construction of dams within the catchment must have an effect on the river's equilibrium conditions and some control will be necessary to prevent an acceleration of the natural processes of erosion and deposition which are always at work in an alluvial floodplain".

Due to flocculation, the lighter sediment fractions carried by the river are deposited in the lower reaches where the river flow slows down and comes in contact with the tidal water pushing in from the sea. This in turn leads to the creation of an extensive system of salt marshes and mud flats which are very productive and attract large numbers of birds and fish to the estuary (See section 4.2).

In terms of its catchment size, present condition and extent the Gamtoos can be considered as an important estuarine system in the Cape Province. The position of the mouth is very variable due to the occurrence of periodic floods, constant encroachment by mobile dunes and the transport of sediments by longshore currents.

The proximity of the estuary to the major metropolitan area of Port Elizabeth, the good fishing in the river and along the coast, the plentiful supply of bait and various other attractive environmental features such as the large numbers of birds, and unspoilt beach etc. all combine to make the Gamtoos estuary an ideal area for recreational development. However it must be borne in mind that it is exposed to

strong predominantly S W and W S W winds which blow during summer (Heydorn and Tinley 1980) and the saltmarsh vegetation is very fragile and therefore vulnerable to trampling, damage caused by "off-road" vehicles and other forms of human interference. Evidence of this danger was seen on the saltmarsh area south of the blind "appendix" to the main river channel during the ECRU survey and it is clear that control is desirable.

If the equilibrium of the estuary is disrupted through undue disturbance of the natural vegetation, the ecological (and therefore economic) viability of the system can be placed in jeopardy. Careful planning for the future use of the estuary and guarding against over-utilization is therefore essential. Examples of the extreme flooding and subsequent damage caused at the Gouritz River in the Southern Cape during January 1981 and the past flood history of the Gamtoos River should serve as examples of what can happen and therefore dictate the type and location of any future developments or permanent structures at or near the Gamtoos River and its floodplain.

The Central Government, the Cape Provincial Administration and the Metropolitan Planning Unit of the City of Port Elizabeth have all been involved with the compilation of various planning proposals covering the Gamtoos Estuary and adjacent coastline. These include :

- (a) an investigation into the utilization of rivermouths, lagoons and vleis in the Republic of South Africa, Vol. VI (Dept. of Planning 1971).
- (b) a report on Cape coastal townships and resorts, preliminary report No. I (Cape Provincial Administration 1969).
- (c) Cape Coastal Survey, Section E, Great Fish to Tsitsikamma river (Cape Provincial Administration 1973).
- (d) "Coastal Study", a Structure plan for the Metropolitan coastline, Greater Algoa Bay Planning Authority (Metropolitan Planning Unit of the City of Port Elizabeth 1978).

From these, plus other publications it is obvious that by the year 2 000 the existing recreational facilities in the Greater Algoa Area will have to be expanded to accommodate twice the present number of users of all population groups.

In the light of the foregoing discussion, it is important to note that the Gamtoos estuary requires special protection for the major dune areas and sensitive salt marshes. The "Coastal Study" (Metropolitan Planning Unit 1978) proposes that a small area of approximately 144 ha around the Gamtoos rivermouth including the existing cottages, launching ramp and campsite be zoned for general recreation. It also proposes that a larger area around this general recreation zone, approximately 760 ha in extent together with 3,0 km of coastline and 10,5 km of riverbank should be set aside as a "Natural Area". Because of its physical characteristics, this area should not be developed as it is subject to flooding and is made up largely of sensitive salt marshes, unstable driftsands and stands of indigenous vegetation.

These recommendations fit in well with the guidelines for management of the coastal zone as set out in "Estuaries of the Cape" by Heydorn and Tinley (1980).

ACKNOWLEDGEMENTS

The assistance of all ECRU colleagues in compiling this report is gratefully acknowledged as well as that of Mr P Coetzee of the Dias Divisional Council, who not only assisted with the field survey but also obtained additional information from the Department of Water Affairs, Forestry, and Environmental Conservation in Port Elizabeth.

The Dept. of Agriculture and Fisheries, the Divisional Council of Dias, Messrs J C Greig, A L de Villiers and C Gaigher of the Cape Department of Nature and Environmental Conservation are all thanked for the information they supplied. To the girls of the NRIO drawing office thanks are extended for the production of the final drawings. Prof Margaret Smith of the J L B Smith Institute of Ichthyology is thanked for identification of fish specimens. The survey was carried out at the request and with the financial support of the Dept. of Water Affairs, Forestry, and Environmental Conservation. The encouragement of this Department, the Cape Estuaries Steering Committee and the S.A. National Committee for Oceanographic Research are gratefully acknowledged.

GLOSSARY OF TERMS USED IN PART II REPORTS

- abiotic: non-living (characteristics).
- aeolian (deposits): materials transported and laid down on the earth's surface by wind.
- alien: plants or animals introduced from one environment to another, where they had not occurred previously.
- alluvium: unconsolidated fragmental material laid down by a river or stream as a cone or fan, in its bed, on its floodplain and in lakes or estuaries, usually comprised of silt, sand or gravel.
- anaerobic: lacking or devoid of oxygen.
- anoxic: the condition of not having enough oxygen.
- aquatic: growing or living in or upon water.
- arcuate: curved symmetrically like a bow.
- barchanoid (dune): crescent-shaped and moving forward continually, the horns of the crescent pointing downwind.
- bathymetry: measurement of depth of a water body.
- benthic: bottom-living.
- berm: a natural or artificially constructed narrow terrace, shelf or ledge of sediment.
- bimodal: having two peaks.
- biogenic: originating from living organisms.
- biomass: a quantitative estimation of the total weight of living material found in a particular area or volume.
- biome: major ecological regions (life zones) identified by the type of vegetation in a landscape.
- biotic: living (characteristics).
- breaching: making a gap or breaking through (a sandbar).
- calcareous: containing an appreciable proportion of calcium carbonate.
- calcrete: a sedimentary deposit derived from coarse fragments of other rocks cemented by calcium carbonate.
- Chart Datum: This is the datum of soundings on the latest edition of the largest scale navigational chart of the area. It is -0,900 m relative to land levelling datum which is commonly called Mean Sea Level by most land surveyors.
- coliforms: members of a particularly large, widespread group of bacteria normally present in the gastro-intestinal tract.
- community: a well defined assemblage of plant/or animals clearly distinguishable from other such assemblages.
- conglomerate: a rock composed of rounded, waterworn pebbles 'cemented' in a matrix of calcium carbonate, silica or iron oxide.
- cusp: a sand spit or beach ridge usually at right angles to the beach formed by sets of constructive waves.
- "D" net: a small net attached to a "D" shaped frame riding on skids and pulled along the bottom of the estuary, used for sampling animals on or near the bottom.
- detritus: organic debris from decomposing plants and animals.
- diatoms: a class of algae with distinct (brown) pigments and siliceous cell walls. They are important components of phytoplankton.
- dynamic: relating to ongoing and natural change.
- ecology: the study of the structure and functions of ecosystems, particularly the dynamic co-evolutionary relationships of organisms, communities and habitats.
- ecosystem: an interacting and interdependent natural system of organisms, biotic communities and their habitats.
- eddies: a movement of a fluid substance, particularly air or water, within a larger body of that substance.
- endemic: confined to and evolved under the unique conditions of a particular region or site and found nowhere else in the world.
- enon: most striking formation in the Cape. Crammed with pebbles and boulders, phenomenally embedded and massive, yellow or brilliantly red in colour, producing remarkable hills. Curiously carved into crags and hollows.

epifauna: animal life found on the surface of any substrate such as plants, rocks or even other animals.

epiphyte: a plant living on the surface of another plant without deriving water or nourishment from it.

episodic: sporadic and tending to be extreme.

estuary: a partially enclosed coastal body of water which is either permanently or periodically open to the sea and within which there is a measurable variation of salinity due to the mixture of sea water with fresh water derived from land drainage (Day 1981).

eutrophication: the process by which a body of water is greatly enriched by the natural or artificial addition of nutrients. This may result in both beneficial (increased productivity) and adverse effects (smothering by dominant plant types).

flocculation (as used in these reports): the settlement or coagulation of river borne silt particles when they come in contact with sea water.

fluvial (deposits): originating from rivers.

food web: a chain of organisms through which energy is transferred. Each "link" in a chain feeds on and obtains energy from the preceding one.

fynbos: literally fine-leaved heath-shrub. Heathlands of the south and south-western Cape of Africa.

geomorphology: the study of land form or topography.

gill net: a vertically placed net left in the water into which fish swim and become enmeshed, usually behind the gills.

habitat: area or natural environment in which the requirements of a specific animal or plant are met.

halophytes: plants which can tolerate salty conditions.

HAT (Highest Astronomical Tide) and LAT (Lowest Astronomical Tide):
HAT and LAT are the highest and lowest levels respectively, which can be predicted to occur under average meteorological conditions and under any combination of astronomical conditions; these levels will not be reached every year. HAT and LAT are not the extreme levels which can be reached, as storm surges may cause considerably higher and lower levels to occur (South African Tide Tables 1980).

hummock (dune): a low rounded hillock or mound of sand.

hydrography: the description, surveying and charting of oceans, seas and coastlines together with the study of water masses (flow, floods, tides etc.).

hydrology: the study of water, including its physical characteristics, distribution and movement.

indigenous: belonging to the locality; not imported.

intertidal: generally the area which is inundated during high tides and exposed during low tides.

isohyets: lines on maps connecting points having equal amounts of rainfall.

isotherms: lines on maps joining places having the same temperature at a particular instant, or having the same average, extremes or ranges of temperature over a certain period.

lagoon: an expanse of sheltered, tranquil water. (Thus Langebaan lagoon is a sheltered arm of the sea with a normal marine salinity; Knysna lagoon is an expanded part of a normal estuary and Hermanus lagoon is a temporarily closed estuary (Day 1981)).

limpid: clear or transparent.

littoral: applied generally to the seashore. Used more specifically it is the zone between high- and low-water marks.

longshore drift: a drift of material along a beach as a result of waves breaking at an angle.

macrophyte: any large plant as opposed to small ones. Aquatic macrophytes may float at the surface or be submerged and/or rooted on the bottom.

marls: crumbly mixture of clay, sand and limestone, usually with shell fragments.

matrix: medium in which a structure is embedded.

meiofauna: microscopic or semi-microscopic animals that inhabit sediments but live quite independently of the macrofauna, or benthos.

metamorphic: changes brought about in rocks within the earth's crust by the agencies of heat, pressure and chemically active substances.

MHWS (Mean High Water Springs) and MLWS (Mean Low Water Springs): the height of MHWS is the average, throughout a year when the average maximum declination of the moon is 23° , of the height of two successive high waters during those periods of 24 hours (approximately once a fortnight) when the range of the tide is greatest. The height of MLWS is the average height obtained by the two successive low waters during the same periods (South African Tide Tables 1980).

morphometry: physical dimensions such as shape, depth, width, length etc.

osmoregulation: the regulation in animals of the osmotic pressure in the body by controlling the amount of water and/or salts in the body.

pathogenic: disease producing.

photosynthesis: the synthesis of carbohydrates in green plants from carbon dioxide and water, using sunlight energy.

phytoplankton: plant components of plankton.

piscivorous: fish-eating.

plankton: microscopic animals and plants which float or drift passively in the water.

quartzite: rock composed almost entirely of quartz re-cemented by silicon. Quartzite is hard, resistant and impermeable.

riparian: living on the banks of rivers or streams.

rip current: the return flow of water which has been piled up on the shore by waves, especially when they break obliquely across a longshore current.

salinity: the proportion of salts in pure water, in parts per thousand by mass. The mean figure for the sea is 34,5 parts per thousand, written 34,5‰.

secchi disc: a simple instrument used to measure the transparency of water.

sheet flow: water flowing in thin continuous sheets rather than concentrated into individual channels.

slipface: the sheltered leeward side of a sand-dune, steeper than the windward side.

teleost: modern day bony fishes (as distinct from cartilagenous fishes).

trophic level: a division of a food chain defined by the method of obtaining food either as primary producers, or as primary, secondary or tertiary consumers.

trough: a crescent shaped section of beach between two cusps.

wetlands: areas that are inundated or saturated by surface or ground water frequently enough to support vegetation adapted to life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas.

zooplankton: animal components of plankton.

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