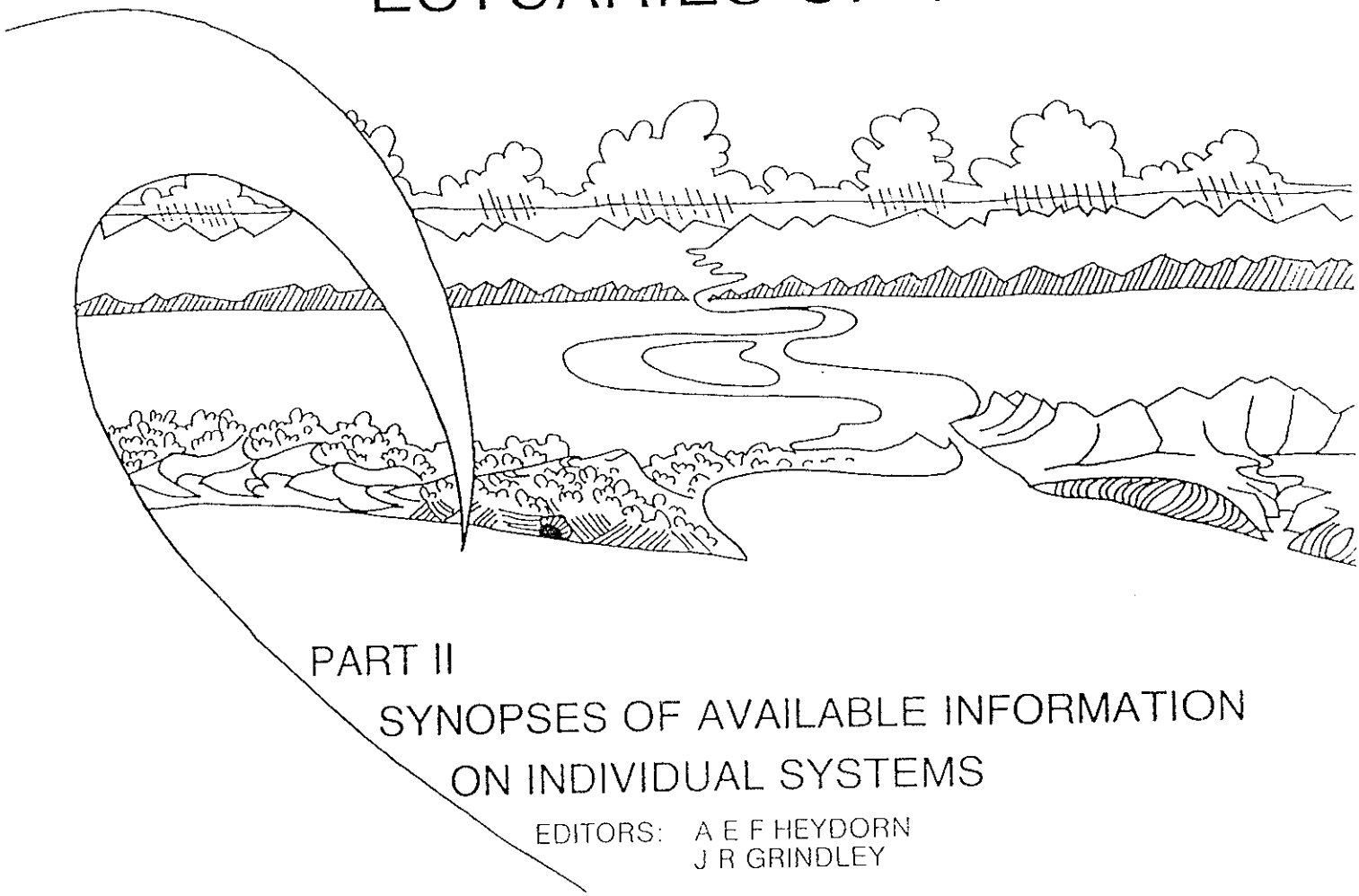
COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH
NATIONAL RESEARCH INSTITUTE FOR OCEANOLOGY
ESTUARINE AND COASTAL RESEARCH UNIT – ECRU

ESTUARIES OF THE CAPE



PART II
SYNOPSES OF AVAILABLE INFORMATION ON INDIVIDUAL SYSTEMS

EDITORS: A E F HEYDORN
J R GRINDLEY

REPORT NO. 13

SILVERMINE (CSW 3)

CSIR RESEARCH REPORT 412

Stellenbosch, South Africa
September 1982

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PART II: SYNOPSES OF AVAILABLE INFORMATION ON INDIVIDUAL SYSTEMS

REPORT NO. 13: SILVERMINE (CSW 3)

(CSW 3 — CSIR Estuary Index Number)

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PREFACE

The Estuarine and Coastal Research Unit (ECRU) was established by the National Research Institute for Oceanology (NRIO) 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, to conduct research to fill these and to stimulate Universities, Museums and other institutions to become involved in this kind of work;

- to contribute to *ad hoc* investigations carried out by NRIO on the impacts of proposed developments in the coastal environment, and especially in estuaries.

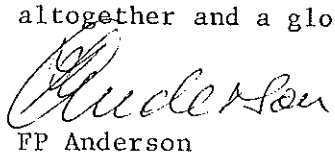
The Unit was established at the request of the Government, and the Department of Environment Affairs contributes substantially to the running costs.

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 JR 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 on 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, the attempt has been made to write the Part II reports in language understandable to the layman. However it has been impossible to avoid technical terms altogether and a glossary explaining these is therefore included in each report.



FP Anderson
DIRECTOR

National Research Institute for Oceanology
CSIR

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SILVERMINE

1. HISTORICAL BACKGROUND

Various charts and title deeds give the name of the river as the Zilvermyn Rivier, Silver Mijn Stream or Silvermynrivier. The name Silvermine apparently originates from attempts in the 1680s to mine silver in the valley through which this river flows. The old silver-mine workings consisting of the mine, a tunnel near the mine and a shaft are all that remain of this venture (Burman, 1962).

In his books "Safe to the sea" and "The False Bay story", Jose Burman gives a full account of the fascinating history of the river and of the adjoining town of Fish Hoek.

Many details regarding the early history of Fish Hoek and the Silvermine River are contained in a book presently being published by Mr M Cobern of Fish Hoek (Cobern, 1983, in press).

In the course of its expansion the low-lying north-eastern part of the town has spread out over the entire area previously occupied by a series of shallow seasonal pans and vleis which periodically formed behind a low barrier dune just above high water mark (Figure 1a). Old charts and early photographs of the area indicate that at times when the mouth of the river was blocked by sand it would break through the coastal barrier dune as far south as opposite the present day railway station.

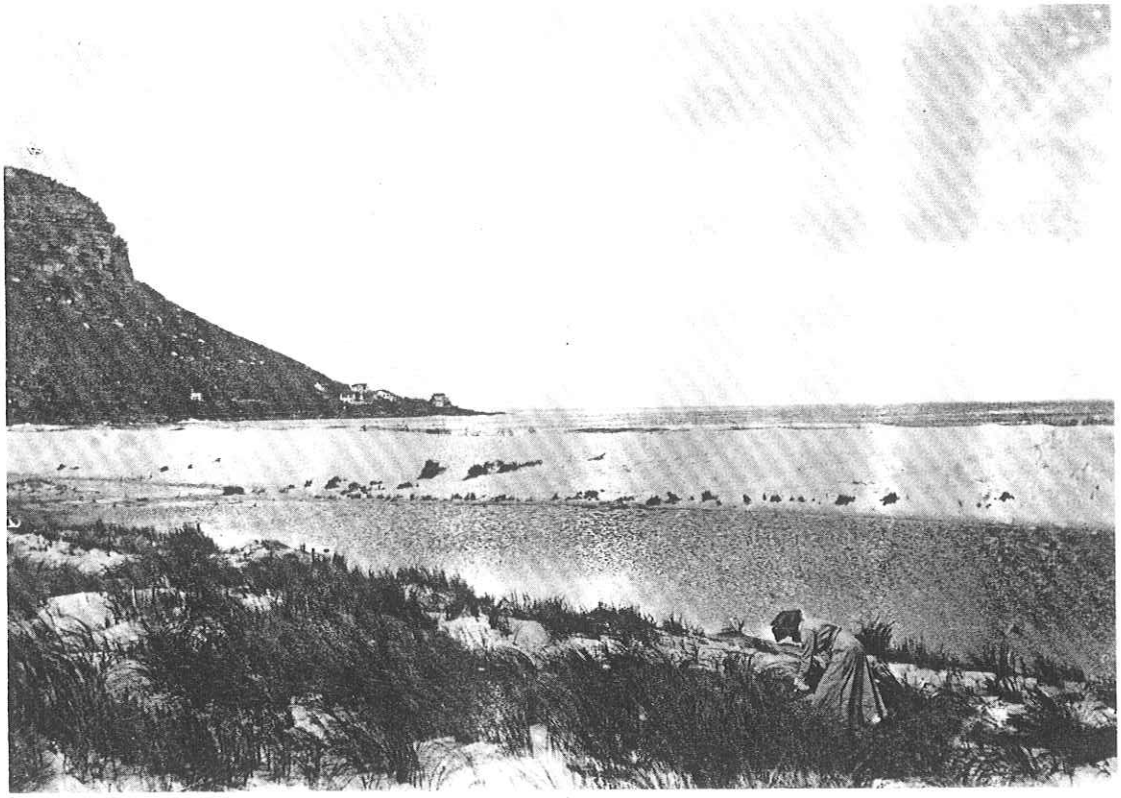


FIG. 1a: Part of the Silvermine Estuary in the early 1900s. The photograph is taken looking east from approximately the end of the present day parking area on the beach front. (reproduced by courtesy of Mr M Cobern)

When the first road and rail bridges were built across the Silvermine River in 1876 and 1890 respectively (Burman, 1977) the lower part of the river flowed through an area of bare sand flats (Figure 1b). In about 1900 the South African Railways were forced to build a retaining embankment along the southern banks of the river in an attempt to stop it from flooding towards Fish Hoek (see Figure 2). Soon after the building of the railway line the problem of blocking of the line by windblown sand resulted in the Railways initiating a programme of stabilization of the driftsand by planting Marram grass (*Ammophila arenaria*) along the low coastal dune (see Figure 1b). This was only partially successful and was followed in 1928 by the levelling of all the coastal dunes and the subsequent covering of the levelled surface with crushed stone. (Fish Hoek Town Engineer, pers. comm.).

FIG. 1b: The lower part of the Silvermine River valley in 1910. The photograph is taken looking westwards from approximately the centre of the present day shopping area (reproduced by courtesy of Mr M Cobern).

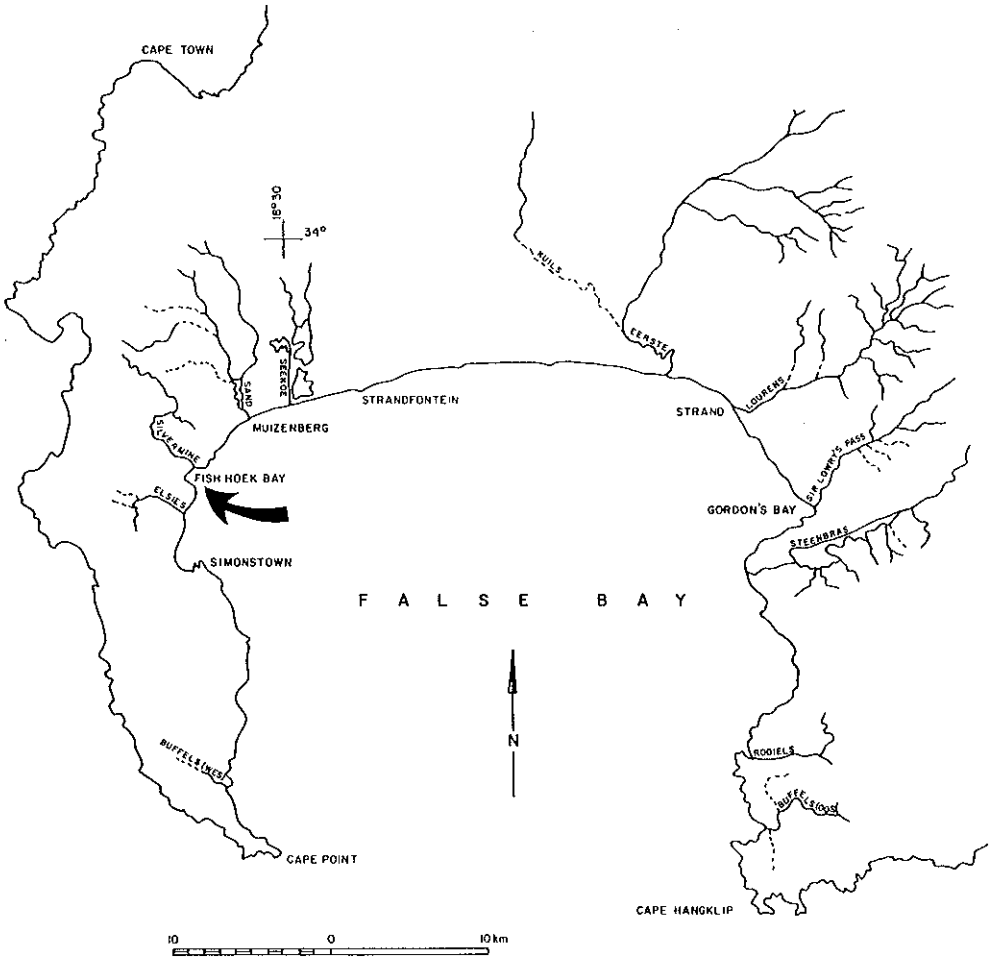
A further historical event which would have had a pronounced effect on the lower part of the Silvermine River was the building of the Silvermine reservoir with a capacity of 82 x 10^3 m^3 in the upper catchment in 1898 (Silvermine Nature Reserve, undated).

The discovery of the skeleton of the famous "Fish Hoek Man" by Mr B Peers in 1927 at the Skildersgatkop archaeological site is a notable event in the historical background of the Silvermine River valley (Volman, 1981). This cave, now known as "Peers Cave", also yielded a number of other important archaeological finds and is protected under the Act on War Graves and National

Monuments No 28 of 1969 (National Monuments Council, pers. comm.).

2. LOCATION

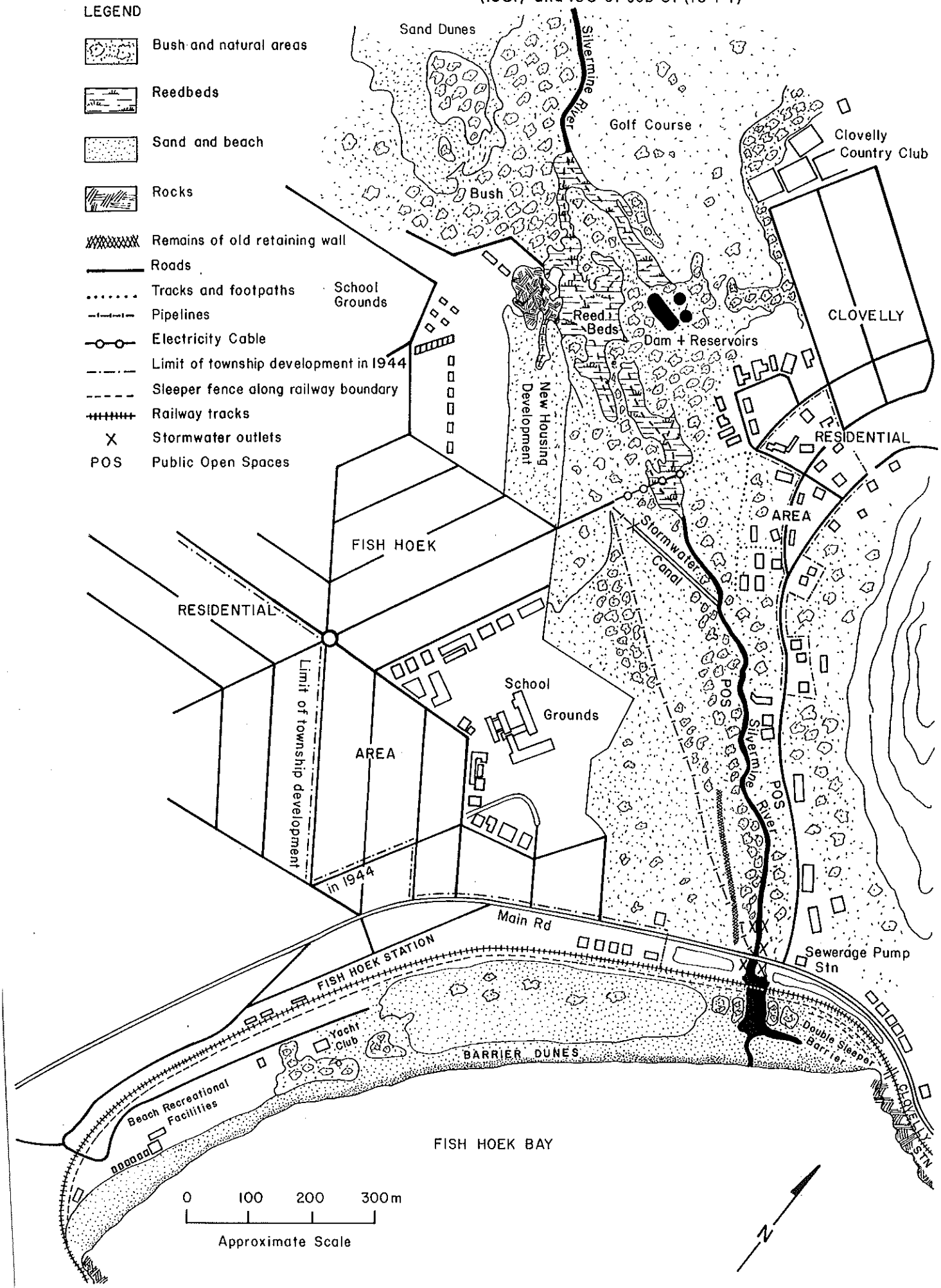
The mouth of the Silvermine River is located at 34°07'S, 18°27'E. This is in the north-eastern corner of Fish Hoek Bay, an embayment in the north-western corner of False Bay (1 : 50 000 Sheet 3418 AB and AD).



2.1 Accessibility

The main tarred road and a double railway track from Cape Town to Simonstown cross the river at its mouth (Figure 2). The Clovelly railway station is situated a few hundred metres from the rivermouth and the Cape Town City Council has provided a small parking area at the river, alongside the main road. Access to the beach and rivermouth are via an overhead pedestrian crossing at Clovelly Station and a pedestrian level crossing on the Fish Hoek side of the rivermouth. A tarred road serving the residential area of Clovelly and the Clovelly Country Club runs towards the upper part of the catchment parallel to the river on its northern side.

FIG 2: The Silvermine Rivermouth and surrounding areas in 1981, also indicating limits of township development in 1944. Drawn from Aerial photographs 274/4 of Job 391 (1981) and 193 of Job 61 (1944)



2.2 Local Authorities

The Silvermine River and its catchment fall within the jurisdiction of four authorities, namely, the Cape Town City Council, the Fish Hoek Municipality, the Cape Divisional Council and the South African Railways and Harbours. Details of landownership will be given under the Sections 3.1.2 River Catchment - Land Ownership/Uses and 3.2.3 Estuary - Land Ownership/Uses which are to follow.

3. ABIOTIC CHARACTERISTICS

3.1 River Catchment

3.1.1 Catchment characteristics

The total area of the Silvermine catchment has been calculated to be 2 106 ha (Cape Town City Engineer, pers. comm.). The river which is 12,3 km long, has its source in the Steenberg mountains on the western side of the Cape peninsula at an altitude of 640 m. From here it flows in a south-easterly direction across the Steenberg Plateau which forms part of the " 1 000 Foot Surface" formed during a period of faulting and uplift in the early Tertiary, some 30 million years ago (Mabbutt, 1952). From the Steenberg Plateau it cuts southwards through a fairly deeply incised valley picking up a number of small seasonal streams which drain the surrounding mountains. Once the river reaches the coastal plain, formed by the "Fish Hoek-Noordhoek Gap" which is cut along a line of faulting separating the north and south Peninsula (Haughton, 1933) it flows in a south-easterly direction along the base of the mountains entering the sea at Clovelly (see Figure 3). The lower course of the river which meanders through the unconsolidated sediments of the coastal plain is narrow (2 - 3 m wide) and its lateral movement is somewhat restricted by well-vegetated banks and man-made barriers, particularly near the mouth (see Section 1).

Geology

The geology of the Silvermine system in the upper catchment consists predominantly of quartzitic sandstones of the Table Mountain Series which overlie shales of the Malmesbury Series. The soils are largely thin whitish sandy lithosols typical of the rugged topography and the parent rock (Cape Town City Engineer, pers. comm.). The coastal plain (Fish Hoek-Noordhoek Gap) is made up of Tertiary to Recent windblown sands and shelly material which overlie weathered Cape Granite in the west (Smith-Baillie *et al.*, 1976 and Cape Town City Engineer, pers. comm.).

Rainfall and run-off

An average annual rainfall of 1 294 mm has been recorded over a period of 52 years from 1908 to 1960 for the Silvermine recording station situated at the Silvermine Reservoir in the upper catchment (Cape Town City Engineer, pers. comm.). Records from the Fish Hoek Municipality taken from 1969 to 1981 (13 years) at the Fish Hoek municipal yard give an average annual rainfall at this site, of 633 mm (Fish Hoek Town Engineer, pers. comm.).

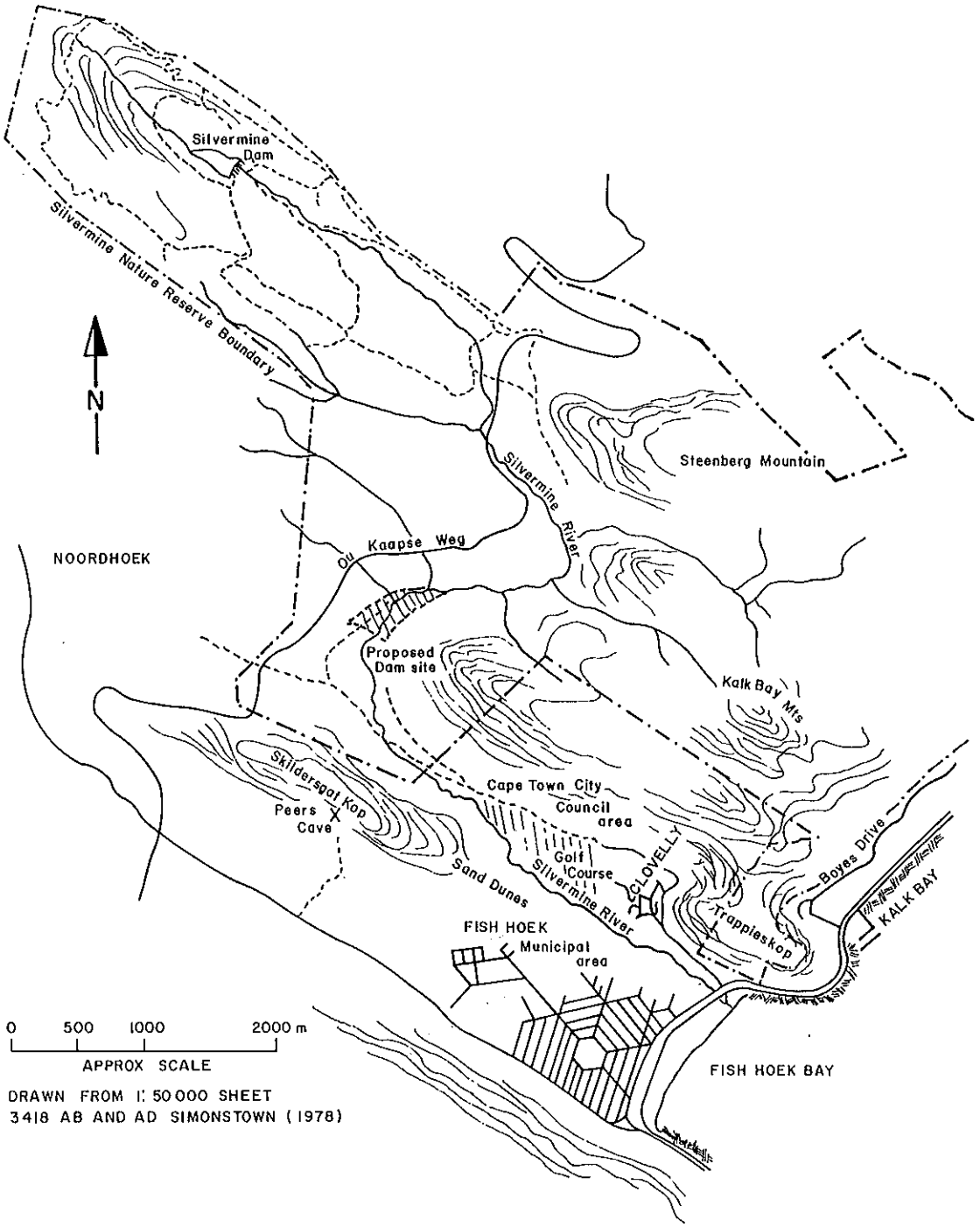


FIG. 3 : THE SILVERMINE RIVER FROM ITS SOURCE TO ITS MOUTH SHOWING MAJOR FEATURES OF THE SYSTEM

Rainfall occurs mainly during the winter months of June, July and August with February being the driest month of the year (Smith-Baillie *et al.*, 1976).

An average annual run-off of $4,5 \times 10^6$ m^3 has been given for the upper catchment (Cape Town City Engineer, pers. comm.).

It can be expected that during the winter months the river will flow strongly due to the higher rainfall experienced at that time of the year. This has been confirmed by Bourgeois (1948), and

the Fish Hoek Town Engineer (pers. comm.).

3.1.2 Land Ownership/Uses

The entire upper catchment of the river falls within the Silvermine Nature Reserve (see Figure 3). This is a Provincially subsidized reserve of approximately 2 140 ha established in 1965 and administered by the Cape Town City Council (CPA Dept. of Nat. Cons., 1965). It is managed primarily for outdoor recreation and the conservation of indigenous flora. The Silvermine Reservoir (see Section 1) in the upper catchment, was originally built to supply water to Kalk Bay and Muizenberg. It now supplies water only for the Westlake golf course and the public amenities in the Reserve. One of the major policies of the Nature Reserve is eradication of alien vegetation and its replacement with indigenous flora which is propagated on a large scale by the Silvermine nursery (Cape Town City Engineer, pers. comm.). The Silvermine valley below the Steenberg plateau was previously a private farm, having being granted to W Kirsten in 1813; it was probably one of the earliest private properties in the area (Burman, 1962). It is now included in the Silvermine Nature Reserve. According to the Cape Provincial Administration, Coastal Survey (1973) the Silvermine Valley-Ou Kaapse Weg area is important for recreation and sightseeing while the Nature Trails in the mountains and reserve are used extensively.

Below the Reserve, in its middle reaches, (see Figure 3) the centre of the river forms the boundary between the Fish Hoek Municipality and the Cape Town City Council (Prov. Proc. No. 170 of 1940). As the river tends to meander in the unconsolidated sediments of this part of its course, this boundary alters frequently and has been the subject of discussion between the two local authorities for many years. The river has in fact cut through the lower part of one property situated close to its banks on the northern side.

In the upper part of the above-mentioned area the Clovelly Country Club and golf course are situated on the northern edge of the river while on the southern side the sandstone ridge and bare dunes of Skildersgatkop are found (see Figure 3). Below this, the river flows in a narrow channel between the residential area of Clovelly and the Fish Hoek township, which has spread out over the former floodplain of the river.

There are two strips of public open space situated between the river and the privately owned erven of the residential areas (see Figure 2).

The boundary of the Table Mountain and Southern Peninsula Mountain Chain Reserve includes the entire Silvermine Nature Reserve as well as Skildersgatkop and the sand dunes (Hey, 1978 and J Malan of the Dept. of Envir. Affairs, pers. comm.). The Cape Divisional Council controls a small portion of approximately 160 ha in the upper north-western part of the catchment above the golf course (Cape Town City Engineer, pers. comm.).

3.1.3 Obstructions

The Silvermine Reservoir (see Section 1) forms a major obstruction in the upper catchment, in that it probably retains most of the upper catchment run-off of the river, particularly during the summer and drought periods. A number of small weirs and low bridges cross the river within the Silvermine Nature Reserve, but none of these appears to impede the flow of the river to any great extent. (Burman, 1962 and the Cape Town City Engineer, 1979).

Proposals have been put forward for the construction of a second reservoir on the Silvermine River, possibly in 1984/85. The dam is to be sited below the confluence of the majority of tributaries (see Figure 3). It will probably have a capacity of $1,42 \times 10^6$ m^3 and a yield of about $11,35 \times 10^3$ m^3. It is intended that the water from this dam will be used to augment domestic water supplies to the Fish Hoek/Sun Valley Noordhoek developments and for limited amenity/recreation purposes (Cape Town City Engineer, pers. comm.).

The riverbed, from just below the Silvermine Nature Reserve to the lower end of the golf course is choked with alien vegetation, particularly *Acacia* spp. The section of river which flows alongside the southern edge of the golf course has some minor weirs across the stream-bed, but these do not stop the normal river flow. At the lower end of the golf course there is an off-channel dam and two 20 m deep wells which draw water from underground sources and not the river as such. The water from these wells and the dam is used to irrigate the golf course (Mr P Bottome, Clovelly Golf Club official, pers. comm.). Below the golf course, the river dissipates into a fairly extensive area of *Phragmites* reed-swamp (see Plate I).

The main electricity supply cable from Cape Town to Fish Hoek and beyond, crosses the river in a reinforced steel structure just below the reed-swamp. This structure causes an occasional obstruction to river flow, especially after heavy rains when it becomes blocked with debris (Fish Hoek Town Engineer, pers. comm.). An agreement exists between the Cape Town City Council and Fish Hoek Municipality for keeping the lower part of the river channel clear of vegetation which would obstruct flood flows (Cape Town City Engineer, pers. comm.).

Two sewerage pipes cast into low concrete walls and a wooden foot- bridge cross the river below the electric cable structure (ECRU survey, 17 May 1982), but these do not appear to impede the normal flow of the river.

3.1.4 Siltation

The soil type and activities in the upper catchment result in very little silt being washed downstream by the river.

Township development and the resultant increased stormwater run-off has resulted in windblown sand and a small amount of fine clay sediment being washed into the river by stormwater from Fish Hoek (Fish Hoek Town Engineer, pers. comm. and ECRU survey

17 May 1982). The dense growth of *Acacia* spp found on and alongside a large proportion of the river banks can lead to increased erosion and collapse of these banks. The root systems of these trees do not have the same soil-binding properties as the indigenous riverine vegetation.

3.1.5 Abnormal flow patterns

In the past, during the wet winter seasons the Silvermine River would spread out and flood large areas in the dune-slacks and low-lying sandflats near the mouth (see Section 1). Today this no longer occurs as the majority of the area has been built up, the bare sands are covered with vegetation and the river is restricted to a narrow straight channel.

Due to the topography and porous substratum, there is a high water table throughout the lower part of the river and adjoining low-lying developed areas of Fish Hoek.

All the stormwater from Clovelly and the greater part of Fish Hoek is channelled into the Silvermine River (see Figure 2). Drainage problems in the low-lying parts of Fish Hoek have arisen due to the low gradient of the stormwater drains and lower section of the river. This problem is aggravated during successive years of high rainfall when the low-lying ground becomes saturated (Fish Hoek Town Engineer, pers. comm.). For this reason it is essential that the river course is not obstructed and that the mouth is open to the sea during the winter months.

According to the Fish Hoek Town Engineer, the river does not flow strongly for extended periods and he can recall only two noteworthy floods within the past seven years.

3.2 Estuary

(This section is contributed by Dr G A W Fromme of the Sediment Dynamics Division (SDD) of NRIO).

For the purposes of this report the estuary is considered to be that portion of the river and land immediately adjacent to it, from approximately 100 m upstream of the road bridge down to the sea.

3.2.1 Estuary characteristics

The Silvermine River emerges onto the northern end of Fish Hoek beach after running through an artificial channel underneath the road and railway bridges. Here a small seasonal lagoon is usually formed in the sandy substrate of the beach during low flow periods, behind a flat beach bar (see Frontispiece). At the time of the ECRU survey on 25 May 1982 this lagoon was 60 m long, 15 m wide and approximately 2 m deep at its deepest point.

Historical evidence and aerial photographs. Historical maps and photographs in the possession of Mr M Cobern, an archivist from Fish Hoek, show that the lower Fish Hoek valley has undergone

significant changes since the time prior to the development of the township (see Figure 2). According to a map dated 1785, the Silvermine River did not flow straight out to sea at the northern end of the beach where its mouth is at present (M Cobern, pers. comm.). This map shows the upper course of the river as it is today. However, the lower part was diverted southwards by a belt of low barrier dunes approximately 0,5 km upstream of the present mouth. It was then joined by the old "Fish Hoek River" approximately in the area between today's centre of the town and the bathing beach. The mouth of the combined Fish Hoek and Silvermine Rivers used to be situated at the Fish Hoek beach, approximately 0,8 km south of the present mouth. The Fish Hoek River has since been incorporated into the town's stormwater drainage system and emerges as a drain outlet at the Fish Hoek beach, while the Silvermine River has been restricted to the northern side of Fish Hoek valley (see Section 1 "Historical Background").

A series of aerial photographs from 1944 to 1981 show various extents of the lagoon at the mouth of the Silvermine River. Since the fixing of the course of the river under the road and railway bridges the position of this lagoon has stabilized, but the dimensions vary seasonally with the waterlevels. When the levels rise to such an extent that back-flooding of the lower Fish Hoek stormwater drainage system is likely to occur, the mouth is usually breached artificially.

3.2.2 Mouth Dynamics

The general setting of the Fish Hoek beach can be described as a large (1,3 km wide) embayment, sheltered at both sides by steep rocky shores.

The attempts in the early 1900s to confine the beach to a predominantly wet-beach zone by planting with grass and the subsequent covering with crushed stone (see Section 1 "Historical Background"), have, together with the presently vegetated barrier dunes, partially alleviated the driftsand problem.

An interesting phenomenon at the mouth of the river is the occasional occurrence of quicksand opposite the Silvermine lagoon. This is mentioned in historical reports when a rider was reported to have lost his horse in these quicksands (Burman, 1962). A possible explanation for this phenomenon is that seepage from the lagoon on the back-shore, causes an internal uplift of the sand deposits below the lagoon, resulting in the formation of unstable patches which would give in under load.

Observations - ECRU survey 25 May 1982. At the time of the survey the banks of a previous straight breach through the beach-bar were still visible; the breach was, however, closed by sand washed up from the sea.

The beach face at the mouth was steep ($5^{o}30'$ slope), but the back-shore was flat. At the northern end, against the sea wall of the Clovelly railway station (see Figure 2), the beach was very steep ($9^{o}40'$ slope). The central section of the beach flattened gradually to about a 3^{o} slope, and at the southern end

(bathing beach) it was very flat ($1^{o}20'$ slope). The sand grain size decreased from a medium/coarse sand at the estuary mouth to a fine sand at the bathing beach.

Inshore oceanography. From Swart and Serdyn (1982) and Valsbaai Strandverbeteringe (1980) it was calculated that the average energy wave height+ for Fish Hoek Bay was 0,95 m which is representative of a medium-energy beach.

The erosional conditions at the northern end of the beach and the blocking of the river mouth as observed during the ECRU survey, indicate that there might be a local concentration of higher wave energy at this end of the beach. This could also be increased by spring tide conditions.

The southern end of the beach does not appear to be subject to serious erosion, which is borne out by the decreasing beach slopes and finer sand grain sizes. This is further supported by the fact that a vertical railway sleeper pallisade, virtually at high water mark, lasted from 1929 to 1980 with little variation of the width of the beach in front of it.

The whole Fish Hoek beach as such appears to be in a state of sedimentary equilibrium, i.e. not losing or gaining excessive amounts of sand. No obvious signs of a longshore sand movement in or out of Fish Hoek Bay could be detected during the ECRU survey. This would tend to classify it as a "closed sedimentary cell", with mainly on- and off-shore patterns of sand movement, i.e. off-shore movement of sand towards an off-shore breaker bar during conditions of beach erosion and back to the beach during conditions of accretion.

A weak longshore current from north to south, observed during the ECRU survey, removes the fine sand fraction from the northern end of the beach and transports it towards the southern part of the beach.

The incidence of high wave energy at the northern end of the beach during the frequent south-easterly winds and deep-sea wave conditions in the False Bay area, cause a wave "set-up" i.e. higher surf-zone water levels at the northern end of the beach. This results in a south-going longshore current and sediment displacement. At the southern end of the bay the south-going longshore current is deflected in an off-shore direction by either rip currents or undertow. The suspended sediment carried by these currents may then be transported back to the northern end of the beach by a north-going deeper water current, usually prevailing along this coast during south-easterly wind conditions.

A general onshore sediment movement from the shallow bottom of False Bay compensates for the loss of sand blown inland by the wind.

+average energy wave height: a parameter which reflects the distribution of average incident wave energy at inshore sites along the coast presented as a wave height.

Mouth behaviour. After natural or artificial breaching of the mouth, the Silvermine River tends to meander under the influence of the prevailing inshore oceanographic conditions (see Plate II and Figure 4).

The driftsand problems and dynamic rivermouth conditions must be borne in mind when any future developments on the Fish Hoek beach are planned.

3.2.3 Land Ownership/Uses

As in the lower part of the catchment the middle of the river forms the boundary between the Cape Town City Council and Fish Hoek Municipality. At the mouth this is complicated by the fact that the railway lines and railway bridge cross the estuary in a strip of land approximately 36 m wide which belongs to the South African Railways and Harbours (SAR Chart CT-107-C-44-C3, 1968).

From the time the railway line was constructed (see Section 1) problems have been experienced with windblown sand covering the tracks. Numerous attempts have been made to arrest this problem, the most recent being the construction of a double sleeper wall at the "Clovelly Corner" (Mr A G S Loubser of S A Transport Services, pers. comm.), (see Figure 4).

The small portion of beach to the north of the estuary falls under the jurisdiction of the Cape Town City Council. This beach and estuary, when it contains water, is used extensively over weekends and public holidays by the non-white population group.

The entire foreshore area of Fish Hoek Beach between the railway property, High Water Mark and up to the Silvermine Estuary is controlled by the Fish Hoek Municipality. By municipal regulation the beach on the southern side of the estuary is reserved specifically "for use by *bona fide* non-white employees of Fish Hoek residents" (ECRU survey 25 May 1982).

The Fish Hoek foreshore, the portion of sea-shore and the sea adjoining the area of jurisdiction of the Fish Hoek Municipality are governed by a set of Municipal regulations made under section 10 of the Seashore Act (Provincial Notice No. 539/1948 and the Seashore Act No. 21 of 1935 as amended).

Plans for the development of this area for camping, caravanning and general beach recreation have been drawn up and put before the ratepayers of Fish Hoek for comment. The proposed plans have been favourably received (Fish Hoek Town Engineer, pers. comm.).

The land on either side of the estuary just above the main road bridge is demarcated as public open space under the jurisdiction of Fish Hoek Municipality to the south and Cape Town City Council to the north (see also Section 3.1.2).

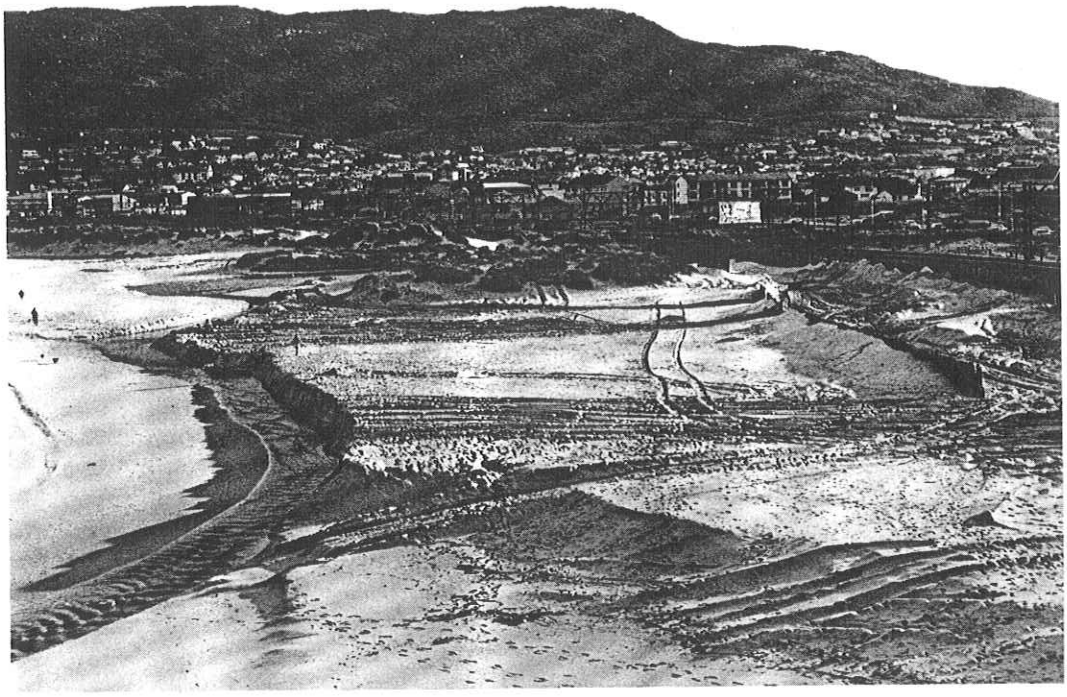


FIG. 4: Railway sleeper barriers erected to arrest driftsand problems at the Silvermine rivermouth.

3.2.4 Obstructions

Major obstructions in the estuarine section of the river consist of:

(a) The Main Road bridge situated approximately 150 m from the mouth. This bridge has 3 spans of 4 m each and on 17 September 1980 it had a clearance under the bridge, of only 1 m.

(b) An embankment of rubble-filled, square watertanks just below the road bridge, which was built in approximately 1928. This embankment which is about 1 m above the general level of the main water body of the estuary, prevents any retrogressive scouring of the stream-bed and also prevents any saltwater exchange with the upper section of the river. (see Figure 5).

(c) The railway bridge which is 30 m below the road bridge. This has 8 spans of 2,5 m each and carries two tracks. At the time of the ECRU survey on 17 May 1982, three spans on the northern side of this bridge were completely sanded up.

On the seaward side of the railway bridge an attempt has been made to prevent south-eastward migration of the estuary by placing concrete-filled oil drums along the southern banks.

In places, undercutting of this barrier has taken place and the drums have slumped into the estuary (see Figure 6).

Although not an obstruction at present, one of the planned transportation routes for the Southern Cape Peninsula consists of an extension of Boyes Drive via a tunnel through "Trappieskop" (see Figure 3). Together with this, a major freeway inter-change is planned in the lower floodplain of the Silvermine River.

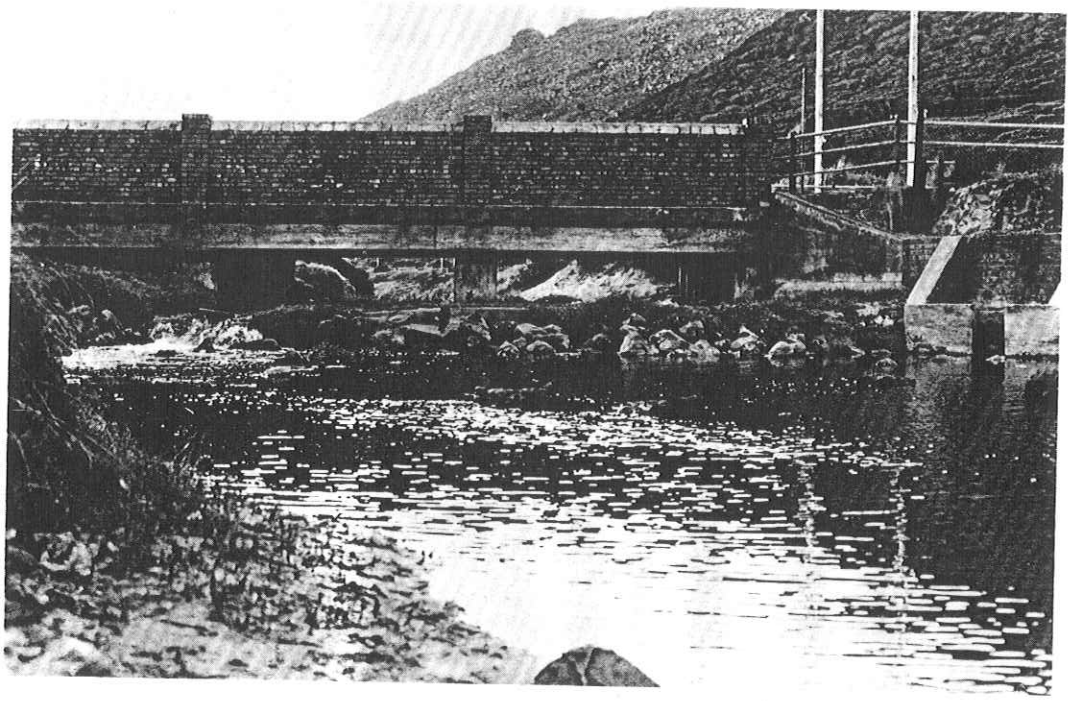


FIG. 5: Part of the seasonal lagoon formed at the Silvermine rivermouth between the road and the railbridge.

If this scheme materializes, it will constitute the most dramatic change to the character and nature of the estuary and the Silvermine valley, particularly as the proposals also call for the canalization of the lower section of the river (Van Niekerk, Kleyn & Edwards, 1973). An alternative scheme, "the Silvermine Route," has been put forward which appears to be environmentally, less damaging than the "Boyes Drive Route" in that it would consist of a tunnel for much of its length (Mallows, Louw, Hoffe & partners, 1974). This route would be situated in the upper part of the Silvermine catchment and would cross the river above the Clovelly Golf Course.

3.2.5 Physico-chemical Characteristics

(This section incorporates unpublished reports on the chemistry of the Silvermine Estuary by the Marine Chemistry and Biology Division (MCBD) of NRIO.)

Salinity. The Silvermine Estuary is fully tidal only on rare occasions and it appears to be slightly above normal sea level which results in an almost constant flow or seepage of fresh water from its catchment and the Fish Hoek aquifer. All salinities recorded over a period of one year by Bourgeois (1948) at 5 stations situated from between the road and rail bridges and the sea, ranged from 0,1 to 19,3 parts per thousand during the winter and summer months, respectively. Salinity readings taken by the MCBD on 27 April 1982 with the mouth closed but with evidence of overtopping of the bar at high tide ranged from 11 parts per thousand at the seaward end of the estuary to 0 parts per thousand in the river channel above the road bridge.

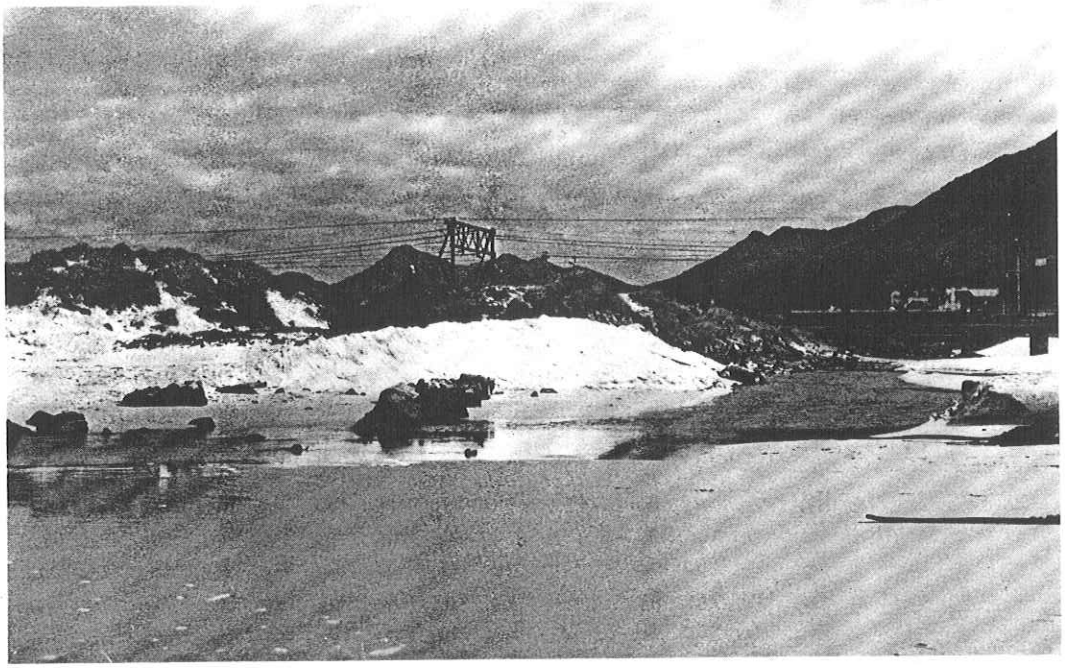


FIG. 6: A barrier of concrete filled oil drums at the Silvermine Estuary.

Temperatures recorded by Bourgeois (1948) ranged from 11,9°C in winter to 25,8°C in shallow water during summer. The MCBD recorded surface temperatures of 16,9 to 17,2°C throughout the system on 27 April 1982.

pH and transparency. At the mouth a typical marine pH value of 8 was recorded while just upstream of the bridge a value of 7 was recorded (MCBD, 27 April 1982). McVeigh (1979, unpublished) gives a pH of 4,9 for the Silvermine Reservoir in the upper catchment.

Dissolved Oxygen. On 27 April 1982 oxygen levels in the small lagoon seaward of the railway bridge were 90 percent of saturation but they dropped substantially to 26 percent at a sampling station above the road bridge (MCBD survey).

Nutrients. According to the samples taken by the MCBD on 27 April 1982 all nutrients, particularly nitrate and ammonia, increased from the mouth of the estuary to the last station above the road bridge. A comparatively high ammonia value (364 µmol/dm^3 or 5,1 mg/ℓ) was recorded at this last station, which indicates an input from some organic source. Stormwater drains enter the river in this vicinity.

The dissolved organic carbon values also followed the above-mentioned pattern. The value of 13 mg/ℓ at the upper station is approximately twice that of a typical value for an unpolluted Cape river (MCBD, 27 April 1982).

3.2.6 Pollution

At present there does not appear to be any major pollution input into the Silvermine River. However, a potential source of pollution is the stormwater run-off from Fish Hoek, Clovelly and

the main road crossing the estuary. At least five stormwater drains discharge into the river and estuary (see Figures 2 and 5).

A sewerage pump station handling raw sewage from Clovelly is situated at the junction of the Clovelly and the Main roads. An emergency overflow in case of pump failure, runs from this pump station into the estuary (see Figure 5). When this occurs (approximately once every 5 - 10 years) the estuary is treated with a commercial chlorine compound (Cape Town City Engineer, pers. comm.). A similar situation exists at Fish Hoek where, in emergencies, the sewage is discharged via the lower stormwater drain into the estuary, in which case the entire affected section of stormwater piping and the estuary are treated.

Two "scour valves" for clearing out settled sediment from the watermains discharge into the river just above the road bridge (Fish Hoek Town Engineer, pers. comm.).

The chemical analysis of water samples taken on 27 April 1982 suggested the presence of localized organic pollution (see Section 3.2.5).

It can be expected that a certain amount of enrichment of the river water takes place from the stormwater input and run-off from the golf course which is regularly fertilized (Mr P Bottome, pers. comm.). The reed swamp mentioned in Section 3.1.3 and the vegetation lining the river banks would absorb some nutrients and pollutants entering the river.

A large amount of litter and some faecal pollution occurs at the estuary, and between and under the road and rail bridges (Plate III). The large "billboard" sited on the South African Railways property next to the estuary and at the entrance to Fish Hoek is offensive in a scenically attractive environment (see Figure 4).

3.2.7 Public Health Aspects

According to the local authorities no bacterial sampling is carried out on the water from the river or estuary. The practice of emergency sewage release into the estuary and the present litter and faecal pollution mentioned in Section 3.2.6 may constitute public health hazards.

4. BIOTIC CHARACTERISTICS

(This section is contributed by M O'Callaghan of the Botanical Research Unit, Stellenbosch.)

4.1 Flora

4.1.1 Phytoplankton/Diatoms

No data available.

4.1.2 Algae

Marine algae are washed into the lower part of the river and/or

deposited on the beach. These are mainly the kelps *Ecklonia maxima* with smaller amounts of *Laminaria pallida* and *Macrocystis angustifolia*.

The common filamentous green algae *Enteromorpha, Chaetomorpha* and *Cladophora* were found attached to the stones and litter below the road bridge during May 1982.

4.1.3 Aquatic Vegetation

No aquatic angiosperms were found.

4.1.4 Semi-Aquatic Vegetation

Some of the vegetation adjacent to this river become inundated during winter and might thus be regarded as being semi-aquatic.

4.1.5 Terrestrial Vegetation

Nine vegetation mapping units were identified during May 1982. The spatial distribution of these is depicted in Figure 7 while Appendix I shows some of the species and physical features of each unit.

(a) The hummock dunes on the seaward side of the road are covered mainly with marram grass *(Ammophila arenaria)* with other dune shrubs such as klappiesbrak *(Tetragonia decumbens)* and sea pumpkin *(Arctotheca populifolia)*. *Acacia cyclops* (rooikrans) is found in some areas as a low shrub. It is advisable that this alien be systematically removed (and replaced with suitable indigenous species) before it dominates the area.

(b) Fringe Vegetation: Below the road bridge, the river is fringed with kikuyu *(Pennisetum clandestinum)*, Bermuda quick grass *(Cynodon dactylon)*, *Paspalum vaginatum* and numerous shrubs. This area becomes flooded after heavy rains.

The roads and river above the road bridge are fringed with kikuyu and Bermuda quick grass. This vegetation is important in stabilizing the sand, especially along the river banks, thus preventing siltation and keeping the river course relatively open.

(c) *Ehrharta villosa/Tetragonia decumbens* Low Dune Shrubland: Most of the area north-east of the river is covered by this vegetation type. It contains numerous typical dune plants such as pypgras *(Ehrharta villosa)*, *Pelargonium capitatum*, *Nylandtia spinosa* and numerous others. *Acacia saligna* seedlings are still uncommon in this area and the lower part of this unit is bushcut regularly.

(d) *Acacia saligna/Chrysanthemoides monolifera* Woodland: This unit is totally dominated by Port Jackson willow *(Acacia saligna)* and is rapidly becoming a monoculture of this alien plant. However, numerous indigenous herbs and shrubs such as bietou *(Chrysanthemoides monolifera)*, taaibos *(Rhus*

glauca), blombos *(Metalasia muricata)*, kinkelbossie *(Tetragonia fruticosa)*, etc. are still to be found in this area.

(e) *Metalasia muricata/Acacia cyclops* Dune Shrubland: This vegetation unit is less dense than the above and the predominant invader is *Acacia cyclops*. However, most of the shrubs found here are also contained in the above unit.

(f) Large areas near the golf course, which become inundated during winter, are covered with *Phragmites australis*. Not only do these reed beds prevent erosion, but they also utilize excess nutrients entering this area in storm water run-off.

(g) *Cynodon dactylon/Chondropetalum tectorum* Wetland: Although this area is very damp, it does not become inundated. It contains numerous restioids and sedges such as dekriet *(Chondopetalum tectorum)*, *Juncus dreganus*, vleibiesie *(Scirpus nodosus)* and some grasses and shrubs such as *Cynodon dactylon*, *Plecostachys serpyllifolia* and others.

(h) *Rhus glauca/Chironia baccifera* Rocky Outcrop Vegetation: This vegetation type occurs on restricted rocky outcrops near the road and new housing developments. Although some *A. cyclops* is present, this vegetation unit includes numerous natural herbs and shrubs and should be protected.

As can be seen, practically all the vegetation adjacent to the Silvermine River is endangered by encroaching alien plants (see Frontispiece and Plate I). However, as many indigenous herbs and shrubs are still to be found in most of the vegetation types, a well planned eradication programme could rid the area of these undesirable plants and the natural dune shrublands could be re-established. Not only will this offer more protection to the soils, but it will be aesthetically more appealing and reduce the risk of vagrancy in the area.

4.2 Fauna

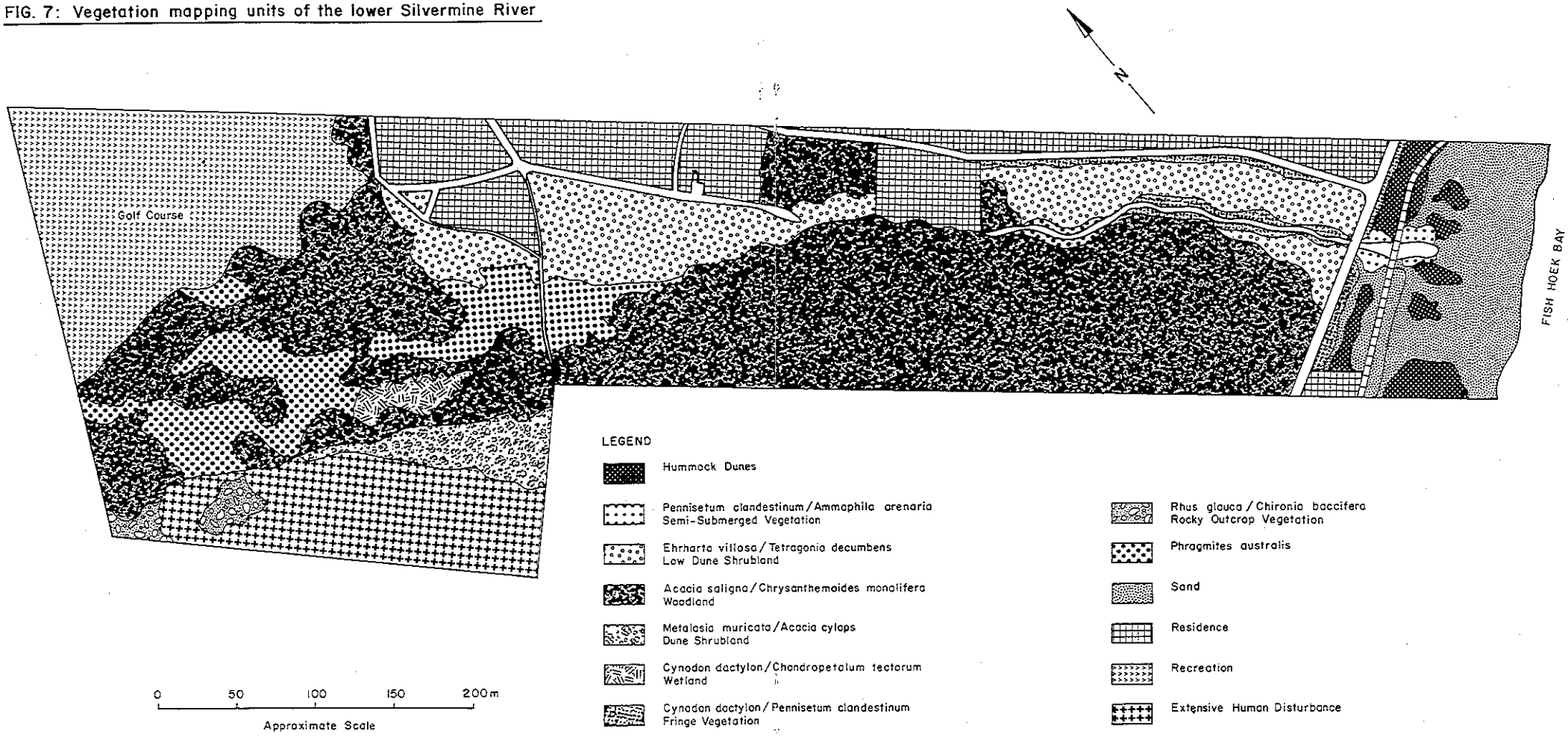
4.2.1 Zooplankton

Some unidentified Ostracoda and Copepoda were recorded by Bourgeois (1948).

4.2.2 Aquatic Invertebrates

According to Bourgeois (1948) the Silvermine Estuary was very poor in aquatic fauna, with fresh water insects and larvae forming the majority of what was present. The area of the estuary, between the road and rail bridges was constantly populated as the grass and algae found here provided food and shelter for these animals. Marine and estuarine species occurred mainly when the estuary was connected to the sea. The sea-lice *Pontogeloides latipes* was the only estuarine form truly established in the estuary while the fresh water crab *Potamonautes perlatus* was and still is common in the upper part of the estuary (Bourgeois, 1948 and ECRU survey 17 May 1982).

FIG. 7: Vegetation mapping units of the lower Silvermine River



The estuarine crab *Hymenosoma orbiculare* was recorded by Bourgeois in 1948 and by ECRU in May 1982. The only other invertebrate recorded during the ECRU survey was the amphipod, *Talorchestia* sp.

4.2.3 Insects

Bourgeois (1948) found that fresh water aquatic insects formed the greater part of the fauna of the estuary with 16 species having been identified.

4.2.4 Other Invertebrates

No published data were traced.

4.2.5 Fish

During two "D-net" hauls through the lower part of the estuary (seaward of the railway bridge) on 17 May 1982 five juvenile Southern mullet *(Liza richardsoni)* and nine Gobies *(Psammagobius knysnaensis)* were caught (ECRU survey).

On 19 July 1982 numerous juvenile mullet (2 - 12 cm) were present in the upper part of the estuary i.e. between the road and rail bridges (C Gaigher, pers. comm.).

B Bennet of the University of Cape Town has recorded 22 species of fish, during monthly sampling in the surf-zone of Fish Hoek Bay using a fine mesh seine net (see Appendix II). Of these, at least 11 species are known to utilize estuaries at some stage in their life-cycle. Marked seasonal trends were noted in the species which were most abundant.

4.2.6 Reptiles and Amphibians

The reptiles and amphibians as recorded from 1955 to 1975 by G Palmer, a naturalist and former resident at Clovelly are given in Appendix III. He records 7 species of amphibians, 9 species of lizard, 14 species of snake and 5 species of Chelonia (tortoise or turtle) as occurring at the estuary and in the Silvermine River valley. Many of the amphibians are threatened due to habitat changes such as the disappearance of temporary pans in the dune slacks where these species breed (G Palmer, pers. comm.).

Although not recorded by Palmer, Rau (1978) records that the type locality of the Cape Platanna *(Xenopus gilli)* is the "Silvermine Stream near Clovelly". This species is listed in the Red Data Book for rare and endangered species and appears to be both habitat specific and have a localised distribution (McLachlan, 1978).

The Loggerhead turtle *(Caretta caretta)* which Palmer and others have recorded, are juveniles which wash up on the beach opposite the Silvermine Estuary. This usually occurs after prolonged periods of strong south-easterly winds. These turtle hatchlings are carried southwards from the Tongaland coast of Natal in the

Agulhas current. According to Branch (1980) and Dr E Schumann of NRIO (pers. comm.) the summer south-easters can bring "cells" of Agulhas water which have separated from the main current, into False Bay.

4.2.7 Birds

The Silvermine valley, the estuary and in particular the riverine areas are rich in birdlife. Two naturalists, Mr G Palmer and Mr E Barnes have recorded 137 species in the abovementioned localities (see Appendix IV), (G Palmer and E Barnes, pers. comm.). Of these the Jackass Penguin and Bank Cormorant are listed in the Red Data Book for rare and endangered birds (Siegfried *et al.*, 1976). Many of the species listed in Appendix IV as "remains on the beach" are oceanic species which died at sea. This could be a further indicator of the currents entering Fish Hoek Bay (see also Section 4.2.6).

4.2.8 Mammals

A list of 21 species of mammals, (see Appendix V), have been recorded from the Silvermine River valley between 1955 and 1975 (G Palmer, pers. comm.). Due to development around the estuary, it can be expected that only the smaller, secretive mammals are likely to occur at the estuary. Spoor and signs of grysbuck *(Raphicerus melanotis)* and small carnivores are still fairly prevalent in the riverine areas above the estuary and the dunes of Skildersgatkop (ECRU survey).

Southern Right Whales *(Eubalaena australis)* are often seen close inshore in the shelter of Fish Hoek Bay, usually in the deeper water opposite the Silvermine Estuary.

5.. SYNTHESIS

Some of the more important points made in this report can be drawn together as follows:

The Silvermine Estuary is connected with the sea only for very limited periods during strong river flow and it closes up as soon as the flow rate of the river drops. Some estuarine fauna occur in the small seasonal lagoon which forms at the mouth.

The Silvermine River valley, Skildersgatkop dunes and the little lagoon often formed at the mouth of the river are, however, integral parts of the attractive residential areas of Fish Hoek and Clovelly. The character of the valley depends on the surrounding natural mountain slopes, the unspoilt beach and the undeveloped "green belt" on either side of the river which links these features (see Frontispiece).

In the face of increasing population growth and the general rate of urbanization of the Cape Peninsula these unspoilt natural features have become extremely important.

Hey (1978) in his report on the future control and management of Table Mountain and the Southern Peninsula Mountain Chain, points out that the present Table Mountain Reserve and the Silvermine

Nature Reserve (see Section 3.1.2) are already too small to meet even the present recreational needs of Cape Town and its tourists. He also states that "wherever possible the concept of maintaining an environmental continuum from shoreline to mountain top should be adopted". This concept could be partially fulfilled in the Silvermine River valley, where the areas of public open space situated on either side of the river, extend from the Clovelly Golf Course right down to the rivermouth. By conserving these open spaces in their natural state it will be possible to link the Silvermine Nature Reserve with the proposed Fish Hoek Beach recreational developments. This would also effectively conserve an entire river system from its source to its mouth.

The Skildersgatkop sand-dunes which form an integral part of the aesthetic character of the area and also constitute an important habitat for various plants and animals (see Sections 4.1 and 4.2), should be preserved and included with the conserved riverine areas. It has been proposed that these dunes and the "Peers Cave" archaeological site be included in the Southern Peninsula Mountain Chain Reserve.

Some of the stormwater drainage and windblown sand problems presently being experienced by the Fish Hoek Municipality and the South African Railways, can be related to the siting of these developments in an area that was formerly a series of seasonal vleis and dunes (see Section 1).

The extension of the Fish Hoek township over the former flat floodplain of the river and the discharge of stormwater into the river has made it essential that the mouth of the estuary remains open during the wet periods of the year. Further encroachment on the floodplain by township development would increase and compound the drainage problems, by reducing the area of open ground which acts as a buffer for absorbing flood and stormwaters. The construction of buildings and roads will also affect the natural ground-water flow patterns in this high water-table area.

The problem of windblown sand on the railway line and road is one which can be expected to continue, particularly at the northern end of the beach, where the incidence of higher wave energy causes a continuous supply of sand from the shallow seabed of False Bay. A possible solution to this problem would be to create a continuous, steep, well vegetated barrier-dune along the beach right up to the "Clovelly Corner". All human presence would have to be totally excluded from this dune.

The migration of the dynamic rivermouth during times of flood can be expected to cause erosion of any structures or barriers situated on the beach and adjacent to the rivermouth.

At present there do not appear to be any major pollution problems in the Silvermine River, despite the fact that a major portion of Fish Hoek's stormwater and all the stormwater from Clovelly is discharged into the river. The reason for this is probably that the majority of nutrients and other pollutants from these sources, as well as run-off from the heavily fertilized golf course, are absorbed by the vegetation lining the river banks and

the dense reedbeds situated below the golf course.

The reedbeds and the indigenous vegetation of the riverine area also provide the habitat which results in the Silvermine valley being so rich in birdlife (see Section 4.2.7).

The value and importance of the natural features of the Silvermine River valley have been discussed above. Many of these features are, however, threatend by proposed developments which will affect the hydrological regime and the entire aesthetic value of the area. These developments include:

(a) The proposed Boyes Drive Tunnel and Clovelly interchange, which, if built, will be sited just above the present road bridge, taking up most of the public open space alongside the lower part of the Silvermine River. An alternative route, which would be more expensive would pass through the upper Silvermine Valley. It would, however, be environmentally less damaging and aesthetically more acceptable as it would be a tunnel for much of its length, although it too, would cause a lot of damage. In their report to the Fish Hoek Municipality on the transportation and planning of the South Peninsula, Mallows, Louw, Hoffe & Partners (1974) recommend that, "serious consideration should be given to costs other than the purely financial ones" when considering alternative schemes.

(b) A proposed dam in the Silvermine Valley (see Section 3.1.2) which, if it is to be a viable proposition, will probably cut off all flow downstream of the dam-wall, except during years of very high rainfall. The side-effects of this would be a change in the ground-water regime of the lower Silvermine Valley with a consequent change in the vegetation patterns. The present self-purifying capabilities of the river receiving stormwater drainage from Fish Hoek and Clovelly, would also be reduced. The question should be asked: "Is the increased price of water from the existing sources and the amenity value of the dam, worth the costs to the environment and existing developments downstream of the dam?"

(c) Future township expansion of Fish Hoek onto the already drastically reduced, low-lying floodplain of the Silvermine River and into the reedswamps below the golf course and the fringes of the Skildersgatkop sand dune. The encroachment into these areas, particularly the seemingly "useless" reedswamps, not only destroys the natural functioning of these systems but reduces the future options for utilization of these areas.

The following recommendations, based on the information contained in this report and the management recommendations given in Heydorn and Tinley (1980) are put forward for consideration.

Beach recreational facilities: The protection of the primary dune, along the entire length of the beach, is of paramount importance. This dune which acts as a buffer against the wind and waves and is a source of sediment during periods of erosion

should be stabilized with a variety of indigenous dune vegetation. No human access should be allowed to this dune-ridge. Access to the beach should be given in a number of spots via raised wooden "board-walks" placed at an angle to the wind direction, in naturally occurring breaks along the dune-ridge.

Erosion is likely to occur at the dynamic rivermouth, when this is open to the sea (see Figure 6 and Plate II). Provision should be made for this and a certain degree of regular maintenance which will be required in this area.

The visual impact and aesthetic appeal of this beach development is extremely important; care should be taken not to impede views of the sea with tall buildings. The parking and camping areas should look as natural as possible and full use should be made of indigenous dune shrubs and trees which are adapted to grow in this environment with the minimum of attention.

Public open spaces: These could be considered for development as open parkland with paths and picnic sites. They could provide a graded "link" between the high-intensity recreational developments along the beach and the primitive areas of Skildersgatkop and the Silvermine Nature Reserve (see Frontispiece). Safe subway access under the road and rail bridges should be provided between these developments.

The possiblity of improved flow and drainage of the river by removal of the embankment below the road bridge should be investigated.

It is very important that the natural purifying and filtering functions of the river be retained by the conservation of the vegetation lining its banks. If at all possible the reed swamps below the golf course should not be disturbed or reduced in area.

The gradual systematic removal of alien vegetation, particularly all the *Acacia* spp., along the entire river course should be carried out as soon as possible.

The large, unsightly billboard at the entrance to Fish Hoek should be removed and regular clearing up of litter at the bridges and along the river should be carried out.

The provision of ablution facilities in the vicinity of the estuary would hopefully reduce the incidence of faecal pollution in the area.

Detailed environmental impact assessments of the proposed transportation routes through the Silvermine River valley should be carried out before either of these projects are considered.

The proposed "Riverside Drive" should be sited as far from the river as possible.

Proposed Silvermine Dam: The possible effects of an additional dam on the Silvermine River have already been discussed. It is strongly recommended that all the effects of this dam be thoroughly investigated before it is constructed.

A great responsibility rests upon the Cape Town City Council and the Fish Hoek Municipality to ensure that the Silvermine River valley and its surroundings remain an asset to the present and future residents of Fish Hoek, Clovelly and Cape Town.

6. ACKNOWLEDGEMENTS

Besides forming part of the Cape Estuaries Part II report series, this document is also a contribution to an overall pollution report on False Bay. For this reason much reliance was placed on information received from the local authorities who control the areas through which the Silvermine River flows. Special thanks are due to Mr PM Hedderwick, the Town Engineer of Fish Hoek Municipality and Mr G Boddington of the Cape Town City Engineer's Department. Other officials of the above-mentioned authorities, as well as Mr P King of the Cape Divisional Council and Mr AGS Loubser of the South African Transport Services are thanked for the data they supplied.

Mr M Cobern of Fish Hoek is thanked for all the interesting historical information and photographs he made available, while Messrs G Palmer and E Barnes of Clovelly are thanked for the valuable data on birds and other fauna of the area.

As the collection of data and preparation of the report are essentially a team effort, the assistance of all contributors and members of ECRU is acknowledged.

The survey was carried out at the request of the Department of Environment Affairs. The encouragement of this Department, the NRIO Steering Committee for Estuarine and Coastal Research and of the SA National Committee for Oceanographic Research is gratefully acknowledged.

7. 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 plants and/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 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 recemented by silicon. Quartzite is hard, resistant and impermeable.

riparian: adjacent to or living on the banks of rivers, streams or lakes.

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°/$_{oo}$.

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 cartilaginous 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.

8. REFERENCES

Literature cited

BOURGEOIS, M. (1948). A study of two estuaries of the Cape Peninsula. M. Sc. Thesis. University of Cape Town. 33 pp.

BRANCH, G. (1980). Aquatic flora and fauna. In: The future management of False Bay. Proceedings of a seminar held on 11 June 1980 in Cape Town. B. Gasson (ed.): 68 - 75.

BURMAN, J. (1977). The False Bay story. Cape Town. Human and Rousseau: 139-144.

BURMAN, J. (1962). Safe to the sea. Cape Town. Human and Rousseau: 125 - 135.

CAPE OF GOOD HOPE. PROVINCIAL ADMINISTRATION. Dept of Nature Conservation (1965). Report no 22: 32 - 33.

CAPE OF GOOD HOPE PROVINCIAL NOTICE 539 of 1948. Regulations relating to Municipal gardens, parks, plantations and recreational grounds. Cape Town. C.P.A. 4 November 1948: 1 - 3.

CAPE OF GOOD HOPE PROVINCIAL PROCLAMATION 170 of 1940. Description of the boundaries of the Municipality of Fish Hoek: Cape Division. Cape Town. C.P.A. 23 October 1940.

CAPE PROVINCIAL ADMINISTRATION (1973). Cape coastal survey. Report no 2. Sections B, C and marginal regions. Gouritz river to Elandsbaai. 125 pp.

COBERN, M. (1983). Story of the Fish Hoek Valley. Fish Hoek. Cobern. (in press).

HAUGHTON, S.H. (1933). The geology of Cape Town and adjoining country. An explanation of Sheet No 247 (Cape Town). Geological Survey. Pretoria. 84 pp.

HEY, D. (Commissioner) (1978). Report on the future control and management of Table Mountain and the Southern Peninsula Mountain Chain. Pretoria. Government Printer. 113 pp.

HEYDORN, A.E.F. and TINLEY, K.L. (1980). Estuaries of the Cape, Part I. Synopsis of the Cape Coast. Natural Features, Dynamics and Utilization. CSIR Research Report 380. 97 pp.

MABBUTT, J.A. (1952). The Cape Peninsula. Cape Town. Maskew Miller: 22 - 23.

MALLOWS, LOUW, HOFFE AND PARTNERS. (1974). Report to Fish Hoek Municipality on the transportation and planning of the South Peninsula. 73/873. May 1974. 21 pp.

McLACHLAN, G.R. (1978). South African red data book - Reptiles and Amphibians. S. Afr. Natl. Sci. Programmes Rep. 23. 53 pp.

Mc VEIGH, S.J. (1979). A preliminary report on the waters of the Western Cape (unpublished).

RAU, R.E. (1978). The development of *Xenopus gilli* Rose and Hewitt (Anura, Ripidae). Ann. S. Afr. Mus. 76: 247-263.

ROBERTS, A. (1978). Roberts birds of South Africa. 4th edition. Revised by G.R. McLachlan and Liversidge. Cape Town. The Trustees of the John Voelcker Bird Book fund. 660 pp.

SIEGFRIED, W.R. *et al.* (1976). South African red data book - Aves. S. Afr. Natl. Sci. Programmes Rep. 7. 108 pp.

SILVERMINE NATURE RESERVE: Maps, walks, picnic sites and caves: A brief guide to the reserve (no date). Cape Town. City Engineers Dept. Land Survey Branch and Parks and Forest Branch. 3 pp.

SMITH-BAILLIE, A.L. *et al.* (1976). Soil survey of the Cape Peninsula. 1 : 20 000. Soil and Irrigation Research Institute. Pretoria. 65 pp.

SOUTH AFRICA (Republic). Seashore Act No 21 of 1935.

SWART, D.H. AND SERDYN, J. de V. (1982). Statistical analysis of visually observed wave data from voluntary observing ships (VOS) for the South African coast. NRIO Report (to be published).

VALSBAAI STRANDVERBETERINGE VOORLOPIGE STUDIE VOLUME II : BYLAE. (1980). Voorgelê aan O'Connell Manthé en Vennote. WNNR Verslag C/SEA 8046/2.

VAN NIEKERK, KLEYN AND EDWARDS (1973). Fish Hoek central area development. Ref. 73/873. December 1973. 76 pp.

VOLMAN, T.P. (1981). The middle stone age in the Southern Cape. Ph. D. Thesis. University of Chicago: 166 - 174.

Maps

SOUTH AFRICA 1 : 50 000 Sheet 3418 AB and AD Simonstad/Simonstown. 3rd edition. Pretoria. Government Printer 1978.

SOUTH AFRICAN RAILWAYS. Cape Western System. (1968). Clovelly. Station yard layout. CT-107-C.44-C.3. 1" = 40'.

Aerial Photographs

{SILVERMINE RIVERMOUTH/LAGOON}. Bl. & Wh. Job No. 61. Photo No. 193. Trig. Surv. Mowbray, 1 : 18 000, 1944.

{SILVERMINE RIVERMOUTH/LAGOON}. Bl. & Wh. Job No. 424. Photo No. 7010. Trig. Surv. Mowbray, 1 : 30 000, 1958.

{SILVERMINE RIVERMOUTH/LAGOON}. Bl. & Wh. Job. No. 620. Photo No. 502. Trig Surv. Mowbray, 1 : 20 000, 1968.

{SILVERMINE RIVERMOUTH/LAGOON}. Colour. Job No. 326. Photo No. 369/3. Dept. Land Surveying, Univ. of Natal, 1 : 10 000, 1979.

{SILVERMINE RIVERMOUTH/LAGOON}. Colour. Job No. 391. Photo No. 274/4. Dept. Land Surveying, Univ. of Natal, 1 : 20 000, 1981.

APPENDIX I: Species composition and physical features of the vegetation mapping units of the area studied at the Silvermine River.

Mapping Unit	+Area (ha)	% of area studied	Cover (%)	Average height (m)
Hummock Dunes	0,65	2,24	30	0,4
Pennisetum clandestinum/ Ammophila arenaria Semi-Submerged Fringe Vegetation	0,09	0,32	70	0,1
Cynodon dactylon/ Pennisetum clandestinum Fringe Vegetation	0,47	1,62	100	0,1
Ehrharta villosa/ Tetragonia decumbens Low Dune Shrubland	2,92	10,03	70	0,2
Acacia saligna/ Chrysanthemoides monolifera Woodland	10,83	37,19	65	2,0
Metalasia muricata/ Acacia cyclops Dune Shrubland	0,56	1,93	50	0,75
Phragmites australis Reed Swamps	2,02	6,94	90	1,8
Cynodon dactylon/ Chondropetalum tectorum Wetland	0,19	0,65	90	0,5
Rhus glauca/Chironia baccifera Rocky Outcrop Vegetation	0,22	0,77	40	1,0
Water	0,09	0,32		
Sand	1,65	5,66		
Residential	2,82	9,69		
Recreation	3,45	11,85		
Extensive Human Disturbance	2,01	7,07		
Roads, Railway tracks and Paths	1,11	3,79		
Total	29,13			

(+Estimated values)

Metalasia muricata/Acacia cyclops Dune Shrubland

Acacia cyclops (1); *A. saligna* (+); *Ammophilla arenaria* (+); *Carpobrotus edulis* (+); *Chrysanthemoides monolifera* (+); *Cynodon dactylon* (+); *Ehrharta villosa* (+); *Helichrysum metalasioides* (+); *Metalasia muricata* (1); *Nylandtia spinosa* (+); *Pelargonium capitatum* (+); *Pennisetum clandestinum* (+); *Senecio elegans* (+); *Sonchus oleraceus* (+); *Stoebe plumosa* (r); *Tetragonia fruticosa* (+); *Trachyandra divaricata* (+).

Phragmites australis Reed Swamps

Phragmites australis (5).

Cynodon dactylon/Chondropetalum tectorum Wetland

Chondropetalum tectorum (3); *Chasmanthe aethiopica* (+); *Cynodon dactylon* (4); *Cyperus* cf *longus* (+); *Juncus dregaenus* (1); *Metalasia muricata* (+); *Myrica cordifolia* (+); *Plecostachys serpyllifolia* (1); *Rhus glauca* (+); *Scirpus nodosus* (1).

Rhus glauca/Chironia baccifera Rocky Outcrop Vegetation

Acacia cyclops (1); *Carpobrotus aciniformis* (r); *C. edulis* (+); *Chironia baccifera* (2); *Chrysanthemoides monolifera* (+); *Lagurus ovatis* (+); *Myrica cordifolia* (1); *Nylandtia spinosa* (+); *Pelargonium capitatum* (+); *Plecostachys serpyllifolia* (+); *Rhus glauca* (1).

Hummock Dune Vegetation

Acacia cyclops (1); *Agropyron distichum* (r); *Ammophila arenaria* (3); *Arctotheca populifolia* (r); *Carpobrotus edulis* (r); *Chrysanthemoides monolifera* (r); *Pelargonium capitatum* (r); *Tetragonia decumbens* (r); *Trachyandra divaricata* (+).

Pennisetum clandestinum/Paspalum vaginatum Semi-Submerged Fringe Vegetation

Acacia saligna (+); *Chenopodium ambrosioides* (+); *Cynodon dactylon* (2); *Lobelia anceps* (+); *Mariscus congestus* (r); *Oxalis pes-caprae* (+); *Paspalum vaginatum* (1); *Pennisetum clandestinum* (3); *Sonchus oleraceus* (+); *S. asper* (+).

Cynodon dactylon/Pennisetum clandestinum Fringe Vegetation

Pennisetum clandestinum (2); *Cynodon dactylon* (3).

Ehrharta villosa/Tetragonia decumbens Low Dune Shrubland

Acacia saligna (r); *Ammophila arenaria* (1); *Carpobrotus edulis* (+); *Chrysanthemoides monolifera* (+); *Ehrharta villosa* (1); *Myoporum serratum* (r); *Nylandtia spinosa* (+); *Oxalis pes-caprae* (+); *Pelargonium capitatum* (1); *Plecostachys serpyllifolia* (+); *Scirpus nodosus* (+); *Stenotaphrum secundatum* (1); *Tetragonia decumbens* (1); *Trachyandra divaricata* (+).

Acacia saligna/Chrysanthemoides monolifera Woodland

Acacia cyclops (+); *A. saligna* (3); *Ammophila arenaria* (1); *Avena sativa* (r); *Briza maxima* (1); *Bromus diandrus* (r); *Carpobrotus aciniformis* (+); *C. edulis* (1); *Chrysanthemoides monolifera* (2); *Cineraria geifolia* (+); *Colpoon compressum* (r); *Dimorphotheca pluvialis* (+); *Ehrharta villosa* (1); *Geranium incanum* (1); *Helichrysum metalasioides* (+); *Lagurus ovatis* (+); *Lolium multiflorum* (+); *Metalasia muricata* (1); *Mylandtia spinosa* (+); *Oxalis pes-caprae* (1); *Pelargonium capitatum* (1); *Plecostachys serpyllifolia* (+); *Pennisetum clandestinum* (1); *Raphanus raphanistrum* (+); *Rhus glauca* (r); *Ruschia geminiflora* (+); *Senecio elegans* (1); *S. laxus* (+); *Sonchus oleraceus* (1); *Sporobolus virginicus* (1); *Tetragonia fructicosa* (1); *T. decumbens* (+); *Trachyandra divaricata* (+); *Typha capensis* (1).

The symbols in brackets following each species name represent Braun-Blanquet Cover Classes as follows :

r	1 - few individuals, cover less than 0,1% of area
+	occasional plants, cover less than 1% of area
1	abundant, cover 1 - 5% of area
2	any number, cover 6 - 25% of area
3	any number, cover 26 - 50% of area
4	any number, cover 51 - 75% of area
5	any number, cover 76 - 100% of area

APPENDIX II: Fish sampled by fine mesh seine netting in the surf-zone of Fish Hoek Bay, May 1980 - May 1981 (B Bennet, pers. comm.)

Total Number Caught	Common Name	Species	Period of Occurrence (most abundant species only)
11 610	*Hepsetia breviceps*	Cape silverside	Strong summer peak
4 648	*Lithognathus mormyrus*	Sandsteenbras	Spring peak
2 264	*Liza richardsoni*	Southern mullet	Scattered with a winter peak
524	*Rhabdosargus globiceps*	White stumpnose	Summer peak
261	*Pomadasys olivaceum*	Piggy	Winter peak
237	*Diplodus sargus*	Blacktail	Scattered
105	*Pomatomus saltatrix*	Elf	Summer peak
39	*Trigloporus africanus*	African gurnard	Winter peak
35	*Amblyrhynchotes hypselogenion*	Harlequin blaasop	Summer peak
18	*Gilchristella aestuarius*	Estuarine round-herring	
12	*Trachurus capensis*	Maasbanker	
6	*Heteromycteris capensis*	Cape sole	
6	*Lichia amia*	Leervis	
4	*Sarpa salpa*	Strepie	
2	*Umbrina capensis*	Baardman	
2	*Clinus latipennis*	False Bay klipvis	
1	*Solea bleekeri*	Blackhand sole	
1	*Lithognathus lithognathus*	White steenbras	
1	*Rhabdosargus holubi*	Cape stumpnose	
1	*Mugil cephalus*	Flathead mullet	
1	*Sphyrina japonica*	Barracuda ?	
1	*Terapon jarbua*	Thornfish	

APPENDIX III: Reptiles and Amphibians recorded from the Silvermine River Valley (G Palmer, pers. comm.)

Amphibians (Frogs and toads)

Common name	Generic name	Remarks
Common platanna	*Xenopus laevis*	Breeds in large numbers in temporary pans in dune slacks
Clicking stream frog	*Rana grayii*	Abundant, widely spread
Cape river frog	*Rana fuscigula*	Common, mainly at permanent waters
Cape chirping frog	*Arthroleptella lightfooti*	Beside stream - upper catchment
Cape sand frog	*Tomopterna delalandii*	Uncommon, restricted to sand dunes, breeds in temporary pans
Leopard toad	*Bufo pardalis*	Common, breeds in temporary pans in sand dunes
Sand toad	*Bufo augusticeps*	Uncommon, found only in sand dunes where it breeds in temporary pans

Reptiles (Snakes)

Common water snake	*Lycodonomorphus rufulus*	Common
Black house snake	*Lamprophis inornatus*	Common
Aurora house snake	*Lamprophis aurora*	Present
Common mole snake	*Pseudaspis cana*	Common
Common slug-eater	*Duberria lutrix*	Common
Common egg-eater	*Dasypeltis scabra*	Present
Spotted skaapsteker	*Psammophylax rhombeatus*	Common
Herald snake	*Crotaphopeltis hotamboeia*	Common
Boomslang	*Dispholidus typus*	Common
Cross-marked grass snake	*Psammophis crucifer*	Common
Cape cobra	*Naja nivea*	Common
Spotted dwarf garter snake	*Elaps lacteus*	Present
Common sea snake	*Pelamis platurus*	Present (on beach)
Common puff-adder	*Bitis arietans*	Common

Reptiles (Chelonia)

Duineskilpad	*Chersina angulata*	Fairly common in flat areas
Padlopertjie	*Homopus aerolatus*	Restricted to fynbos and mountain
Mountain tortoise	*Geochelone pardalis*	Translocated "escapees"
Loggerhead turtle	*Caretta caretta*	Juveniles washed up on the beach

APPENDIX IV: Birds of the Silvermine valley and Estuary (G Palmer (1955 - 1975) and E Barnes (1982), pers. comm.)

Roberts Number	Species	Habitat	Status
2	Jackass Penguin	Beach	Occasional
6	Dabchick	River	Common
7	Wandering Albatross	Oceanic	Remains on Beach
8	Black-browed Albatross	Oceanic	Remains on Beach
10	Yellow-nosed Albatross	Oceanic	Remains on Beach
13	Giant Petrel	Oceanic and Inshore	Remains on Beach
14	Cape Pigeon	Oceanic	Remains on Beach
15	Silver-grey Fulmer	Oceanic	Remains on Beach
21	Broad-billed Prion	Oceanic	Remains on Beach
22	Dove Prion	Oceanic	Remains on Beach
23	White-chinned Prion	Oceanic	Remains on Beach
24	Great Grey Shearwater	Oceanic	Remains on Beach
29	Sooty Shearwater	Oceanic and Inshore	Remains on Beach
30	Storm Petrel	Oceanic and Inshore	Remains on Beach
44	Cape Gannet	Oceanic and Inshore	Remains on Beach
47	White-breasted Cormorant	Beach	Common
48	Cape Cormorant	Beach	Common
49	Bank Cormorant	Beach	Occasional
50	Reed Cormorant	Estuary and River	Common
52	Darter	River	Common
54	Grey Heron	Estuary and River	Common
55	Black-headed Heron	Estuary and River	Common
57	Purple Heron	River	Seldom
59	Little Egret	Estuary and River	Common
61	Cattle Egret	River	Common
69	Night Heron	River	Common
72	Hamerkop	Estuary and River	Occasional
79	Black Stork	River	Vagrant
81	Sacred Ibis	River	Seldom
85	African Spoonbill	River	Seldom
86	Greater Flamingo	River	Seldom/Vagrant
87	Lesser Flamingo	River	Seldom/Vagrant
88	Spur-winged Goose	River	Occasional
89	Egyptian Goose	River	Occasional
94	Cape Shoveler	River	Common
95	Black Duck	River	Rare
96	Yellow-billed Duck	River	Common/Breeding
97	Red-billed Teal	River	Uncommon
98	Cape Teal	River	Uncommon
113	Peregrine	River/Hunting	Resident in Mountain
123	Rock Kestrel	Estuary and River	Breeding, Resident
130	Black-shouldered Kite	Estuary and River	Breeding, Resident
152	Jackal Buzzard	River	Uncommon
154	Buzzard	River/Hunting	Common, Summer, Migrant
167	African Marsh Harrier	River	Rare

APPENDIX IV: (Cont.)

Roberts Number	Species	Habitat	Status
176	Grey-wing Francolin	-	Uncommon
181	Cape Francolin	River	Common, Breeding, Resident
192	Crowned Guineafowl	River	Common, Breeding, Resident
203	Black Crake	River	Common, Breeding, Resident
208	Purple Gallinule	River	Uncommon
208X	American Purple Gallinule	River	Vagrant
210	Moorhen	River	Common, Breeding, Resident
212	Red-knobbed Coot	River	Common, Breeding
235	White-fronted Sandplover	Beach	Seldom
238	Three-banded Sandplover	Beach	Uncommon
242	Crowned Plover	River	Common, Breeding, Resident
245	Blacksmith Plover	River	Common, Breeding, Resident
250	Ethiopian Snipe	River	Uncommon
251	Curlew Sandpiper	Estuary and Beach	Summer, Migrant
258	Common Sandpiper	Estuary	Seldom
263	Greenshank	Estuary	Summer, Migrant
269	Avocet	Estuary and Dune Slacks	Uncommon
270	Stilt	Estuary and Dune Slacks	Common, Breeding, Resident
271	Grey Phalarope	Oceanic	Vagrant, 1 Obs. During Storm on Beach
274	Water Dikkop	River	Uncommon
275	Dikkop	River	Breeding, Resident
287	Southern Black-backed Gull	Beach/Estuary/River	Common
288	Grey-headed Gull	Beach	Occasional
289	Silver Gull	Beach/Estuary/River	Common
289X	Sabine's Gull	Oceanic	Remains on Beach
291	Common Tern	Beach	Occasional, (Summer)
296	Sandwich Tern	Beach	Occasional, (Summer)
298	Swift Tern	Beach	Occasional
311	Rock Pigeon	River	Breeding, Resident
312	Rameron Pigeon	River	Occasional
314	Red-eyed Turtle Dove	River	Breeding, Resident
316	Cape Turtle Dove	River	Breeding, Resident
317	Laughing Dove	River	Common, Breeding, Resident
322	Cinnamon Dove	River	Breeding, Resident
343	Red-chested Cuckoo	River	Occasional, (Summer)
351	Klaas's Cuckoo	River	Occasional
352	Diederik Cuckoo	River	Uncommon, Migrant
356	White-browed Coucal	River	Common, Breeding, Resident
368	Spotted Eagle Owl	River	Common, Breeding, Resident
373	Fiery-necked Nightjar	River	Common
380	Black Swift	Estuary, River (Air Space)	Common, Migrant
383	White-rumped Swift	Estuary, River (Air Space)	Regular Visitor
385	Little Swift	River (Air Space)	Occasional
386	Alpine Swift	Estuary, River (Air Space)	Regular Visitor

APPENDIX IV: (Cont.)

Roberts Number	Species	Habitat	Status
390	Speckled Mousebird	River	Common, Breeding, Resident
391	White-backed Mousebird	River	Resident
392	Red-faced Mousebird	River	Occasional
394	Pied Kingfisher	Estuary, River	Common
395	Giant Kingfisher	Estuary, River	Common
397	Malachite Kingfisher	River	Uncommon
418	African Hoopoe	River	Common, Breeding, Resident
432	Pied Barbet	River	Common, Breeding, Resident (First Appeared in 1970-71)
445	Ground Woodpecker	-	Uncommon
493	European Swallow	Estuary, River	Common, Summer Migrant
495	White-throated Swallow	River	Occasional
502	Greater Striped Swallow	River	Breeding, Summer Migrant
506	Rock Martin	River, Estuary	Breeding, Resident
509	African Sand Martin	River, Estuary	Breeding, Resident
511	Black Saw-wing Martin	River	Occasional
524	White-necked Raven	Beach/Estuary/River	Breeding, Resident (in Mountains)
543	Cape Bulbul	River	Common, Breeding, Resident
551	Sombre Bulbul	River	Common, Breeding, Resident
553	Olive Thrush	River	Common, Breeding, Resident
559	Cape Rock-thrush	River	Uncommon, Breeding, Resident
570	Familiar Chat	River	Common, Breeding, Resident
581	Cape Robin	River	Common, Breeding, Resident
604	Cape Reed Warbler	River	Common, Breeding, Resident
609	African Sedge Warbler	River	Occasional
618	Grassbird	River	Common, Breeding, Resident
646	Le Vaillant's Cisticola	River, Estuary	Common, Breeding, Resident
651	Karoo Prinia	River, Estuary	Common, Breeding, Resident
655	Dusky Flycatcher	River	Uncommon, Breeding, Resident
665	Fiscal Flycatcher	River	Occasional
672	Cape Batis	River	Uncommon, Breeding, Resident
682	Paradise Flycatcher	River	Uncommon, Breeding, Resident
686	Cape Wagtail	Beach/Estuary/River	Common, Breeding, Resident
703	Orange-throated Longclaw	River	Uncommon
707	Fiscal Shrike	Estuary, River	Common, Breeding, Resident
709	Boubou Shrike	River	Common, Breedomg. Resident
722	Bokmakierie	River	Common, Breeding, Resident
733	European Starling	Estuary, River	Common, Breeding, Resident
745	Red-winged Starling	Estuary, River	Common, Breeding, Resident
749	Cape Sugarbird	River	Common, Breeding, Resident
751	Malachite Sunbird	River	Common, Breeding, Resident
753	Orange-breasted Sunbird	River	Common, Breeding, Resident
760	Lesser Double-collared Sunbird	River	Common, Breeding, Resident

APPENDIX IV: (Cont.)

Roberts Number	Species	Habitat	Status
775	Cape White-eye	River	Common, Breeding, Resident
784	House Sparrow	River	Common, Breeding, Resident (First Appeared About 1970)
786	Cape Sparrow	River	Common, Breeding, Resident
799	Cape Weaver	River	Common, Breeding, Resident
810	Cape Widow	River	Uncommon, Breeding
843	Common Waxbill	River	Common, Breeding, Resident
846	Pin-tailed Whydah	River	Uncommon, Breeding
855	Cape Siskin	-	Uncommon, Breeding, Resident
857	Cape Canary	Estuary, River	Common, Breeding, Resident
862	Blackhead Canary	River	Common, Breeding, Resident
863	Bully Seed-eater	River	Common, Breeding, Resident
873	Cape Bunting	River	Uncommon, Breeding, Resident

Footnote:
Beach = On the beach
Estuary = Approximately 100 m above the road bridge in the vicinity of the river
River = From Estuary to approximately 1,5 km from the mouth.

APPENDIX V : Mammals recorded from the Silvermine valley 1955 - 1975 (G Palmer, pers. comm.)

Common name	Generic name	Status
Forest shrew	*Myoserex varius*	Common
Red musk shrew	*Crocidura flavescens*	Common
Cape golden mole	*Chrysochloris asiatica*	Common
Bat	*Rhinolaphus clivosus*	Present
Bat	*Miniopterus schreibersi*	Present
Chacma baboon	*Papio ursinus*	Present
Large-spotted Genet	*Genetta tigrina*	Present
Cape grey mongoose	*Herpestes pulverulentus*	Common
Marsh mongoose	*Atilax paludinosus*	Common
Rock dassie	*Procavia capensis*	Common
Cape grysbok	*Raphicerus melanotis*	Common
Vaal rhebuck	*Pelea capreolus*	Last seen in 1969
Cape dune molerat	*Bathyergus suillus*	Present
Cape molerat	*Georychus capensis*	Common
Cape porcupine	*Hystrix africaeaustralis*	Present
Striped mouse	*Rhabdomys pumilio*	Abundant
Pygmy mouse	*Mus minutoides*	Common
Cape spiny mouse	*Acomys subspinosus*	Present
Chestnut climbing mouse	*Dendromus mesomelas*	Present
Vlei rat	*Otomys irroratus*	Common
Cape fur-seal	*Arctocepholus pusillus*	Common (on beach)

APPENDIX VI: Summary of available information

ESTUARY / RIVERMOUTH / LAGOON: SILVERMINE (Rivermouth/Lagoon)

Summary of available information

		Sources of Information	Bourgeois	Branch	Burman	Burman	Cape of Good Hope, Prov. Admin., Nat. Cons.	Cape of Good Hope, Prov. Notice	Cape of Good Hope, Prov. Proclamation	Cape Provincial Administration	Cobern	Haughton	Heydorn and Tinley	Hey	Mabbutt	Mallows, Louw, Hoffe and Partners	McLachlan	Mc Veigh	Roberts	Siegfried
		YEAR (DATE OF INFORMATION)	1948	1980	1977	1962	1965	1948	1940	1973	1983	1933	1980	1978	1952	1974	1978	1979	1978	1976
BIOTIC		Food Webs																		
BIOTIC	Fauna	Mammals																		
BIOTIC	Fauna	Birds																	*	*
BIOTIC	Fauna	Reptiles & Amphibians															*			
BIOTIC	Fauna	Fish																		
BIOTIC	Fauna	Fauna on soft substrates	*																	
BIOTIC	Fauna	Fauna on hard substrates																		
BIOTIC	Fauna	Insects	*																	
BIOTIC	Fauna	Other invertebrates	*																	
BIOTIC	Fauna	Zooplankton	*																	
BIOTIC	Flora	Terrestrial																		
BIOTIC	Flora	Phytoplankton	*																	
BIOTIC	Flora	Halophytes	*																	
ABIOTIC	Other	Historical			*	*			*		*									
ABIOTIC	Other	Utilization						*		*	*		*	*		*				
ABIOTIC	Other	Conservation					*			*			*	*						
ABIOTIC	Other	Modelling																		
ABIOTIC	Other	Aquaculture																		
ABIOTIC	Other	Management					*		*				*	*		*				
ABIOTIC		Bacteriology																		
ABIOTIC	Chemistry	Pesticide residues																		
ABIOTIC	Chemistry	Metal residues																		
ABIOTIC	Chemistry	Eutrophication																		
ABIOTIC	Chemistry	General chemistry																*		
ABIOTIC	Geomorphology	Sediment transport & deposition									*									
ABIOTIC	Geomorphology	Paleoenviroment									*									
ABIOTIC	Geomorphology	Geology									*	*			*					
ABIOTIC	Physics	Circulation & mixing		*																
ABIOTIC	Physics	Density variations																		
ABIOTIC	Physics	Hydrology																		
ABIOTIC	Physiography	Morphology									*									
ABIOTIC	Physiography	Catchment characteristics									*									

ESTUARY / RIVERMOUTH / LAGOON	YEAR (DATE OF INFORMATION)	ABIOTIC																			BIOTIC										
		Physiography		Physics			Geomorphology			Chemistry					Bacteriology	Other					Flora		Fauna								
SILVERMINE (Rivermouth/Lagoon)		Catchment characteristics	Morphology	Hydrology	Density variations	Circulation & mixing	Geology	Paleoenvironment	Sediment transport & deposition	General chemistry	Eutrophication	Metal residues	Pesticide residues	Bacteriology	Management	Aquaculture	Modelling	Conservation	Utilization	Historical	Halophytes	Phytoplankton	Terrestrial	Zooplankton	Other invertebrates	Insects	Fauna on hard substrates	Fauna on soft substrates	Fish	Reptiles & Amphibians	Birds	Mammals	Food Webs
Sources of Information		Summary of available information																													
Silvermine Nature Reserve	-														*			*	*	*			*								*	
Smith-Baillie	1976						*																									
South Africa (Rep.) Seashore Act	1935																		*													
Swart and Serdyn	1982					*			*																							
Valsbaai: Strandverbeteringe WNNR Verslag	1980					*			*																							
Van Niekerk, Kleyn and Edwards	1973														*				*													
Volman	1981																			*												
E. Barnes (pers. comm.)	1982																													*		
B. Bennet (pers. comm.)	1982																											*				
P. Bottome (pers. comm.)	1982			*											*																	
Cape Town City Engineer (pers. comm.)	1982	*	*	*			*								*			*	*	*			*									
M. Cobern (pers. comm.)	1982																			*												
Fish Hoek Town Engineer (pers. comm.)	1982	*	*	*		*			*				*	*	*			*	*	*												
C. Gaigher (pers. comm.)	1982																											*	*			
A. Loubser (pers. comm.)	1982														*				*	*												
J. Malan (pers. comm.)	1982																	*														
National Monuments Council (pers. comm.)	1982																			*												

ESTUARY / RIVERMOUTH / LAGOON	YEAR (DATE OF INFORMATION)	ABIOTIC																				BIOTIC											
		Physiography		Physics			Geomorphology			Chemistry					Bacteriology	Other						Flora			Fauna								
SILVERMINE (Rivermouth/Lagoon)		Catchment characteristics	Morphology	Hydrology	Density variations	Circulation & mixing	Geology	Paleoenvironment	Sediment transport & deposition	General chemistry	Eutrophication	Metal residues	Pesticide residues		Management	Aquaculture	Modelling	Conservation	Utilization	Historical	Halophytes	Phytoplankton	Terrestrial	Zooplankton	Other invertebrates	Insects	Fauna on hard substrates	Fauna on soft substrates	Fish	Reptiles & Amphibians	Birds	Mammals	Food Webs
Sources of Information		Summary of available information																															
G. Palmer (pers. comm.)	1982																												*	*	*	
E. Schumann (pers. comm.)	1982					*																										
ECRU Surveys	1982	*	*	*	*	*	*		*	*					*				*	*	*		*			*	*	*			*	
MAPS																																
S.A. 1:50 000 Sheet 3418 AB and AD	1978	*	*																*													
S.A. Railways Chart CT - 107 - C.44 - C.3	1968																		*													
AERIAL PHOTOGRAPHY																																
Univ. of Natal: Land Surv. Dept.																																
Job No. 326	1979								*						*				*				*									
Job No. 391	1981		*						*						*				*				*									
Trig. Survey:																																
Job No. 61	1944		*						*										*	*												
Job No. 424	1958		*						*										*	*												
Job No. 620	1968		*						*										*	*												

PLATE I: Fish Hoek, Clovelly and the Silvermine River valley showing the *Phragmites* reedbeds below the Clovelly Golf Course. Clearing for new township development on the lowlying flood plain and into the reed-beds can be seen (centre left), as well as encroachment of alien vegetation onto the Skildersgatkop sand dunes (ECRU, 82-07-24).

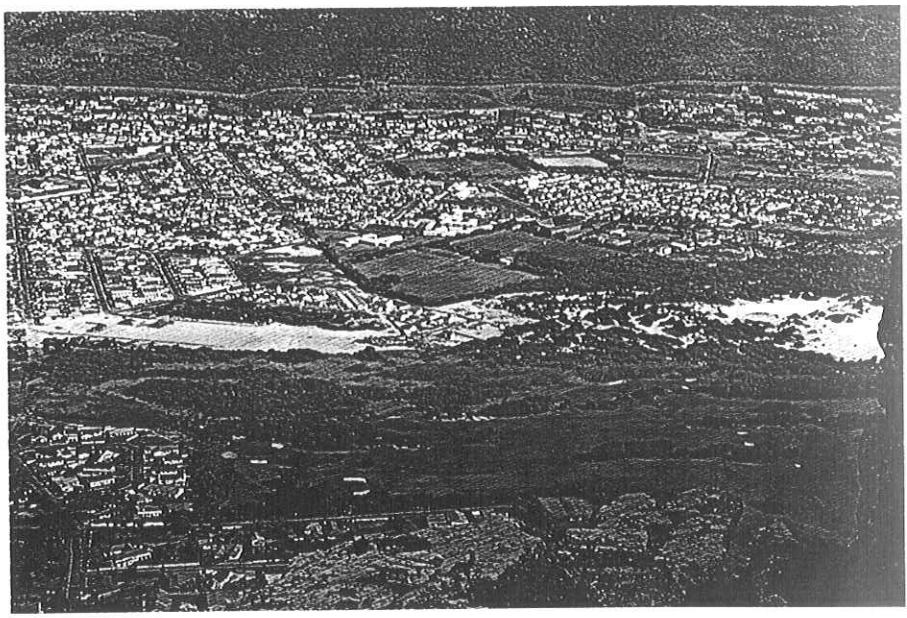


PLATE II: Northward migration of the Silvermine rivermouth can be seen as well as the steep, higher energy section of the northern part of Fish Hoek beach.
(E Barnes, Oct 1981).

PLATE III: Part of the seasonal lagoon between the road and rail bridges at the Silvermine rivermouth. A stormwater drain outlet can be seen in the centre of the photograph as well as a large amount of litter often found in the area.
(ECRU, 82-04-27).