

1. COUNTRY

Republic of South Africa

2. DATE OF COMPILATION

December 1984?

3. REFERENCE NUMBER 1 ZA $\phi\phi\phi$

4. COMPILER

4.1 Name

Mr CJ Burgers

4.2 Address

Jonkershoek Nature Conservation Station
Private Bag 5014
Stellenbosch
7600
South Africa

5. NAME OF WETLAND

Verlorenvlei

6. DATE OF RAMSAR DESIGNATION

02 July 1991

7. GEOGRAPHICAL CO-ORDINATES

SOUTH: $32^{\circ} 19'$ to $32^{\circ} 29'$

EAST: $18^{\circ} 20'$ to $18^{\circ} 32'$

8. GENERAL LOCATION
(Nearest large town)

Lambert's Bay - 25km North
Between the villages of Eland's Bay and Redelinghuys.

9. AREA (ha)

ca 1 500 ha.

10. WETLAND TYPE

Type 19 (Fresh oligotrophic lake).
Type 26 (Marshland and reedswamp).

11. ALTITUDE
(Average; or maximum and minimum)

Min: 1m
Max: 5m

12. OVERVIEW OF SITE
(Thumbnail sketch in 2-3 sentences)

Velorenvlei is one of the largest natural wetlands along the West Coast of South Africa and one of the few coastal fresh water lakes in the country. A small estuary connects the lake to the sea and marshlands are present along the main river which enters the lake. The vlei is an important feeding area for the rare white pelican (*Peleanus onocrotalus*).

13. PHYSICAL FEATURES

13.1 Geology and geomorphology

The first mapping of the area was carried out by Rogers (1904), whilst engaged on a survey of parts of the divisions of Piketberg, Clanwilliam and Vanrhynsdorp.

Malmesbury Group

The Malmesbury Group (Proterozoic) has been subdivided on purely lithological grounds into three groups, calcareous, quartzose and phyllite with greywacke. The calcareous group comprises pure limestone, dolomitic limestone and dolomite. Carbonaceous patches and calcareous rocks grade into quartz-rich varieties.

Klipheuwel Formation

Sediments showing a high degree of lithological similarity to the Klipheuwel beds of the type area are found in small occurrences along Verlorenvlei. No angular unconformity is visible between them and the Table Mountain Group but their regional relationships clearly show the presence of an unconformity. Rogers (1904) named these rocks Ibigua Beds, which implies a correlation with the Nama System, for which there is no proof available yet.

The Klipheuwel Formation (Proterozoic) comprises the following: purple to red-dish brown sandy micaceous shale which is mostly poorly-bedded and grades into mudstone; alternating beds of sandstone, shaly sandstone and sandy shale with colours ranging from buff to purple and red; white and brightly coloured sandstone and grit with minor conglomerate and shale layers. The arenaceous strata are commonly cross-bedded, quite often feldspathic, and much

softer than the Table Mountain Group sandstone. The maximum thickness exposed on the eastern boundary of this area amounts to about 375m.

Table Mountain Group.

The lower portion of the Table Mountain Group (Upper Silurian-Lower Devonian) is found throughout the area. The maximum thickness of strata is estimated at 750mm to 900mm. The major constituent of the group is medium to coarse-grained, white to reddish brown sandstone, which is thickly bedded, and commonly cross-bedded. Fine grained shaly sandstone is confined to the lower shale band.

Tertiary to Recent Deposits

White to slightly-reddish sandy soil found over large areas was formed at more than one period and at different altitudes. It originated mainly from the underlying unconsolidated to partly-consolidated sand and clay, and to a lesser extent from the Table Mountain Group, the coastal dunes, and fluvial deposits of past and present drainage systems.

The stratigraphy is: Elandsfontyn Formation beneath, being peaty clay and sand; the controversial Saldanha Formation; the Varswater Formation, being conglomeratic phosphorite; and on top, the Bredasdorp Formation, with three aeolianite phases, the third being unconsolidated (Hendey 1983; Rogers 1982).

Rubble and debris are found in numerous places at the foot of cliffs and along small streams that flow down hillsides after heavy downpours. The river is flanked by strips of alluvium, part of it being black and rich in plant material. Several patches of driftsand and bare dunes away from the coast originated mostly from mismanagement of the veld. A large dune field occurs to the north of the river mouth and the town of Elandsbaai.

'Heuweltjies' or Hummocks

The phenomenon of 'heuweltjies' occurs on the Verlorenvlei area, and is easily detectable both on the ground and in aerial photographs. Different theories have been propounded as to their origins. They include calcareous layers and a higher clay content in the soil deriving from old termitaria. The activity of mole rats may also contribute to the formation of 'heuweltjies'.

Extensive low-lying sand flats (Tertiary to Recent) occur to the north and east of the lake, sloping gently up to a series of low hills of the Table Mountain Group (Piekenierskloof Formation), which form the catchment boundary in this area.

On the southern side the lake lies against the base of a continuous range of low hills of sandstones of the Table Mountain Group, averaging some 120m above sea-level, with Muishoekberg (300m) forming the only prominent peak. A fairly level plateau of Tertiary to Recent sands lies behind these hills. Outcrops of shales of the Klipheuwel Formation occur at a few places at the base of the hills on the southern side of the lake.

The vlei, the hills on its south bank, and the 'krantzline' all lie in the NW/SE plane. These features follow the direction of geological faults running through the area. The Table Mountain Group lies horizontally over large areas, but is also folded into broad open anticlines and synclines with axes striking north or northwest. Only along the Verlorenvlei two minor folds were formed along axes striking northeast.

13.2 Origins

Natural.

13.3 Hydrology

The entire channel is very shallow (about 0,5m deep), tending to inhibit free water circulation. A natural obstruction at the mouth is a rocky sill topped by a sand bar, above the normal reach of high tides. The sand-topping is formed by a south going longshore current, in combination with frequent onshore winds.

The two types of wave-induced inshore currents, one north going and the other southward, appear to keep a hydraulic and sedimentological near-equilibrium at the beach. Consequently, provided the balance (including source of sand) is not disturbed, a sufficient sand supply from the beach will always tend to cover the rocky barrier at the mouth, to such an extent that the mouth has little chance to remain open for any appreciable length of time after breaching.

In order to upgrade the estuary and enhance the estuarine water circulation, it is clear that the four artificial obstructions in the channel must be removed, or replaced by longspan bridges.

13.4 Soil type and chemistry

Von Harmse, in his Schematic Soil Map of Southern Africa (1978), classifies the Verlorenvlei area as a zone of littoral sands which are arenosols, or of aeolian origin. He points out that the salient feature of such soils is their low reserve of weatherable minerals, and the low

silt/clay ratio. Taylor (1987) describes these coastal lowlands as consisting of sands and conglomerates of Tertiary to Recent origins. He comments on their low water-retaining capacity, being either acid and relatively infertile or, nearer the coast, alkaline with a distinct horizon of lime accumulation. The 'heuweltjies' or hillocks have a higher clay content than the surrounding soils.

A soil classification project was carried out in the Western Cape of the Department of Agricultural Technical Services. A map of soil associations was produced. This map shows the general Verlorenvlei area as being characterized by type B2 soil, a fine sand soil, in which the dominant types are Fernwood and Mkambathi; the sub-dominant Hopefield; and the rare Langebaan, Sandveld and Sonneblom. On the southern bank, extending from Elandsbaai to Redelinghuys, are isolated sections classified as R, being rock and undifferentiated lithosols.

13.5 Water quality

pH - The pH ranges from 6,7 to 9,6 with most values on the alkaline side (Robertson 1980). The pH is lower near Redelinghuys than in the vlei itself. This suggests either a higher contribution of alkalinity from ground water seepage into the vlei than from river input, or the concentration of alkaline salts in the vlei through evaporation (Robertson 1980). The former results because ground-water flow is much slower than surface flow, allowing a longer time for solution to occur. Nearer the sea, the effect of sea water intrusion and the buffering capacity brings the pH to near 8.

Temperature - Mean temperatures at the various stations range from 15,2° C at the mouth to 20,4° C at Redelinghuys at Robertson's Station 11 on the north shore approximately 10km from the mouth.

Transparency - water transparency measurements (Secchi disc method) vary from 17 to 114 cm, with a mean value of 36,6 cm (University of Cape Town 1978).

Nutrients - Measurements carried out by postgraduate students of the former school of Environment Studies at the University of Cape Town in 1978 indicate that Verlorenvlei is an oligotrophic system. The nutrient status of the vlei, however, will vary with the water level. As the water recedes during the summer the lake will become mesotrophic, and possibly even eutrophic. Nitrate levels exceeded those of nitrites, although both nutrients were absent at the mouth during the drought period of 1978, having been high during 1976.

Salinity - Salinity measured at five stations along the vlei shows a decline in salinity with increasing distance from the sea. The cation ratios for sodium, magnesium, calcium and potassium, of the Verlorenvlei samples deviate significantly from those of sea or average river water. The order of abundance of the four cations is as listed above. The Malmesbury rocks which underly about 50% of the catchment contain high concentrations of mineral salts, mostly in the form of sodium chloride. The enrichment of sodium in the vlei water is derived from this source. Limestone deposits are a characteristic of the area and result in enrichment of calcium. In contrast, tertiary to recent sands are low in salts. This is reflected by the lower concentration of calcium and sodium in water that seeped from the northern bank of Verlorenvlei into an irrigation pit, which was also sampled (Sinclair *et al.* 1986).

Dissolved oxygen - the vlei water is generally well-oxygenated, both on the surface and below. Where the mud is thick, and the water shallow and slow-flowing, oxygen concentrations are reduced to as low as 3,6 mg/l (Robertson 1980).

Pollution and public health aspects - Local residents warn against swimming in the vlei in the vicinity of the road bridge to Elandsbaai, and one case of illness (vomiting and dysentery) has been reported after swimming in the vlei water. Low levels of dissolved oxygen, and a high nitrate level, suggesting organic pollution, were recorded along the south shore east of the Verlorenvlei settlement during the drought year of 1978 (University of Cape Town 1978).

13.6 Depth, fluctuations and permanence

Average depth of open water area of the lake is between 2 and 3 metres with maximum depth of 5 metres.

13.7 Tidal variations

In Elands Bay, a north-going longshore current is induced by the oblique incidence of the predominant southerly and south-westerly deep-sea waves. Even after diffraction around Baboon Point, and partial alignment parallel to the beach by refraction, these waves mostly retain a southerly angle of approach to the coast which provides sufficient energy to move the surf-zone water to the north.

An opposing southward component of the longshore current seems to be alternately generated by differential wave setup caused by diffraction of the southerly and south-westerly waves around Baboon Point. At Baboon Point, the southward flow is deflected out to sea.

When calm conditions prevail in summer and cold upwelling is limited, red water sometimes occurs in Elands Bay. This is caused by the accumulation of planktonic dinoflagellates, one of which (*Gonyaulax catenella*) is toxic, and causes mussels to become dangerously poisonous (Grindley & Sapeika 1969).

13.8 Catchment area

The catchment is about 87km long in a north-west/south-east direction and up to 43km wide. Its surface area is estimated by Noble and Hemens (1987) to be 1 890km², or 198 000 ha. Three of the rivers fall within the area controlled by the Swartland Divisional Council, while one falls within the Cedarberg Divisional Council area.

The catchment is bounded by the Swartberg and Olifantsrivierberge in the east and by the Piketberg in the south, and includes the Eendekuil basin, a low-lying area lying between the Olifantsrivierberge and the Piketsberg. The Verlorenvlei River and its tributaries drain the entire Eendekuil basin, the Table Mountain Group mountains around Paleisheuwel, the northern outliers of Piketberg, the extensive flats of Tertiary to Recent sands between Het Kruis and Redelinghuys and the 5km strip of low Table Mountain Group hills and sand flats on either side of the lake which contribute seepage.

13.9 Downstream area

13.10 Climate

The area has a Mediterranean climate with an average annual rainfall of 275mm of which an average of 70% falls in the winter half-year (April to September). Evaporation potential is high.

14. ECOLOGICAL FEATURES (Main habitats and vegetation types)

The different vegetation types are:

- i. Strandveld
 - Seaward dune strandveld
 - Shrubby strandveld
 - Restoid strandveld
- ii. Saltpan vegetation
- iii. Lowland fynbos.
- iv. Dry mountain fynbos
- v. Mountain fynbos
- vi. Karroid scrubland
- ii. Marsh vegetation.

15. LAND TENURE
(Ownership of site and surrounding areas)

The entire vlei is in State ownership
Surrounding land is in private ownership.

16. CONSERVATION MEASURES TAKEN

16.1 Legal status

Verlorenvlei is one of the most important Cape estuarine systems. It is rated as a conservation priority, both in the Cape and nationally. The conservation motivations have been well substantiated by the research which has been carried out in the area since 1967. Motivations for the conservation of Verlorenvlei have continued for a decade. It was designated as a Category B coastal/marine reserve by Grindley *et al.* (1976). Formal reserve status was proposed, with no exploitaton to be allowed. Public entry was to be controlled so that the recreational carrying capacity would not be exceeded.

At a National Committee for Nature Conservation (NAKOR) workshop meeting in 1982, when various national priorities were being rated, it became apparent that Verlorenvlei is unique amongst all other priority areas in that it possesses a multiplicity of conservation assets, not only ecologically, but also in terms of its social, historical, cultural, architectural and archaeological assets.

In 1985, a meeting of the South African National Committee for Oceanographic Research (SANCOR) assessed the condition of the Verlorenvlei estuary as "fair", and assigned it to Category 2. The category includes estuaries where limited development has already taken palce, but which are considered to be in a good enough state to be conserved, with further development to be strictly controlled at a low intensity compatible with conservation criteria.

As of 1986, the committee for Coastal and Marine Systems of the Council for the Environment compiled a document entitled: "A plan for the protection of special natural features and systems in the South African coastal zone".

Despite the efforts of concerned individuals in their private and officil capacities, and despite innumerable submissions to various authorities, no officil conservation action has resulted since 1980. The formal conservation status of Verlorenvlei has not yet been secured, nor have ecological and conservation management principles been formally incorporated into land-use policies or practices.

16.2 Management category

16.3 Management practices

Cutting of reeds (*Phragmites australis*) takes place for driftsand reclamation work (± 3 ha/year). Marshland along the edges of the lake and along the Verlorenvlei River is used for cattle grazing (when reeds have been cut) and *Mynophyllum spicatum* in the vlei are also grazed by cattle.

Water is pumped out of the vlei at several places for irrigation purposes.

Motor boats are not allowed on the lake but sailing and angling is permitted.

The construction of causeways across the estuary has interfered with the movement of fish into the lake from the sea.

17. CONSERVATION MEASURES PROPOSED

Future management of Verlorenvlei requires co-ordination if it is to be successful. A single authority should now be assigned overall responsibility for the area.

This authority should examine all research based recommendations; formulate a regional management plan that reconciles development objectives with the conservation of the natural and cultural assets; and direct all the recommendations consistent with this plan to the relevant authorities for attention and implementation.

In the interim, because of the sensitivity of this ecosystem, and its conservation and research importance, all local, provincial and national authorities should consult with the Chief Directorate Nature and Environmental Conservation. Consultation should take place before the authorization of any actions likely to affect land or water use in the area, including the estuary, coastal lake and catchment.

In addition, all future development applications (including agricultural), should incorporate environmental impact assessment by qualified professionals in the planning phase, and should be formulated within the context of the regional management plan.

Specific recommendations arising from this report are:

i. Artificial obstructions (obstructions 1, 2, & 4. See map 8) and illegal structures at the mouth of the estuary should receive urgent attention. Unnecessary obstructions should be removed altogether, while necessary crossing points should be redesigned and reconstructed, in consultation with the Department of Environment Affairs, and the Estuarine and Coastal Research Unit of the National Research Institute for Oceanology.

ii. The extent of use of mobile irrigation systems in the area should be determined. All impacts associated with such systems should be investigated, including those deriving from the use of vlei water for irrigation, excavation of irrigation pits in wetlands, withdrawal of groundwater, installation of pumphouses and pipelines, salinization of soil and water, and total clearing of natural vegetation for fields. Steps should be taken to control the use of these irrigation systems and their impacts.

iii. The exact numbers and species of domestic stock using the natural grazing in the area should be determined. Stock carrying capacity of the natural grazing area bordering the coastal lake should be calculated, in relation to present veld and climatic conditions and to conservation objectives. Adjustments to stock numbers should be made, monitored and updated continuously with landowners.

iv. Steps should be taken to plan for, and to manage the pressures caused by the temporary influx of weekend and holiday visitors. The maintenance of environmental, and consequently of recreational carrying capacities for the area; the planned provision of temporary facilities with minimal impact and disturbance; and the control of influx patterns and concentrations of use. It may prove necessary, in all coastal areas, to introduce charges for recreational activities that are related to the cost of providing and maintaining the facilities and environmental quality required.

v. Recreational use of the coastal lake itself has been, up to now, virtually non-existent. Because of the lake's unique qualities, this situation should be retained and reinforced, particularly if water quality, the aquatic macrophyte and fringing vegetation, and bird habitats are to be maintained. For example, use of the lake surface for boating would immediately lead to demands for the removal of the indigenous *Myriophyllum*. Re-evaluation of existing legislative control, the introduction of new conservation measures, and more stringent enforcement should be undertaken.

vi. Active efforts must be made to involve the Verlorenvlei landowners directly in management and conservation efforts, and to develop an awareness of the conservation values of their property. Such efforts could include encouragement of landowner participation in the Natural Heritage and National Monuments programmes. The local agricultural extension service should also be expanded to encourage the integration of ecological and conservation principles into environmental management and land-use practices.

vii. Eradication of alien vegetation should be undertaken, particularly in source areas, before this problem assumes unmanageable proportions through exponential growth. Timely action could obviate considerable expenditure and loss in the future.

In management terms, water is a critical limiting factor. Future research must examine inputs in the form of rainfall and fog; processes such as evaporation, stream flow, run-off, infiltration, percolation, aquifer recharge, and physio-chemical fluctuations in the coastal lake and its catchment; and the effects of human actions on these processes, on water availability and quality, and consequently on the biotic components of the system (section 4). Such information is a prerequisite for future estuarine and terrestrial management recommendations.

18. LAND USE

(Human population, principle human activities and main forms of land use)

The surrounding area is privately owned and farm boundaries extend to the 50 year flood line. Fields have been established along part of the lake margins and extend below high water marks in places. Extensive ploughing has occurred in the surrounding area particularly on the hills south of Verlorenvlei, but the greater part of the area is used as natural veld grazing for sheep and cattle.

A small village, Eland's Bay, lies along the coast near the mouth of the estuary. Important fishing grounds are found along the coast and four small fish processing factories have been built along the coast at Baboon Point. These factories are mostly concerned with the crayfish industry although a small amount of fish processing does occur.

The catchment of the lake (about 1 890 km² in extent: Noble and Hemens 1978) is also privately owned farmland of which the greater portion has been ploughed for establishment of wheat fields and pastures.

The lake itself is owned by the State.

19. POSSIBLE CHANGES IN LAND USE AND PROPOSED DEVELOPMENT PROJECTS

Intensification of agriculture and applications for the development of recreation facilities are likely to increase in the near future.

20. DISTURBANCES AND THREATS

Development pressure in the Verlorenvlei area has been concentrated along the coastline, in the vicinity of Elands Bay. The pressure is beginning to increase in the form of applications for township extensions (Heinecken & Badenhorst 1985). The coastal environs attract weekend and holiday visitors, particularly in the summer, causing short term, seasonal increases in the demand for facilities.

The land and its vegetation cover have been degraded, mainly due to grazing and clearing of land for agriculture and rural settlement. Despite the long history of human use of the area for grazing and cultivation, the level of degradation is presently low enough to allow for natural rehabilitation, but the rate of degradation is escalating. For example, agricultural activities have led to interference with the natural function of the estuarine channel. The culverts in the causeway near the mouth have been blocked in order to dam fresh water for irrigation of recently cleared land.

Likely sources of threats in the future include:

- existing and additional obstructions which interfere with natural estuarine and coastal lake dynamics;
- increases in domestic live stock, particularly goats;
- the clearing of natural vegetation for the extension of agriculture;
- increased extraction of underground water for irrigation.

21. HYDROLOGICAL AND BIOPHYSICAL VALUES

22. SOCIAL AND CULTURAL VALUES

23. NOTEWORTHY FAUNA

Zooplankton:- The zooplankton of the vlei includes estuarine and freshwater elements (Grindley 1979 and Robertson 1980). The most abundant organisms were Copepoda, of which the

estuarine species (*Pseudodiaptomus hessei*) and the freshwater species (*Diaptomus purcellii*) were dominant. Various harpacticoid species and the syslopoids (*Mesocyclops* sp.), (*Leptocyclops sublaevis*) and (*Hemicyclops* sp.) were less abundant. Large numbers of nauplius larvae and copepodite stages of Capepoda were also present.

The freshwater cladoceran (*Leydigia propinqua*) was absent at the mouth, but occurred throughout the vlei. Four species of freshwater Ostracoda were present. *Zonocypris tuberosa* and *Gypridopsis gregaria* occurred at the mouth as well as throughout the vlei, while *Eucypirs purcellii*, *Isopris priomena* and *Paracypretta rubra* were only recorded in the vlei.

Zoea and mysis larvae of Decapoda were present in the vlei. The amphipod *Afrochiltonia subtenuis* was present at the mouth, Small numbers of Chelicerata, fish larvae and fish eggs (Diameter 0,25mm) were also present. Detritus was present in all samples and some diatoms were recorded.

Invertebrates:

Insects:- A variety of insect larvae were obtained in the plankton samples, including Chironmidae and other Dipters, Ephemeroptera, Coleoptera and Hemiptera.

The following insects and larvae were recorded by Robertson (1980) as common at Verlorenvlei during 1979 to 1980:

<i>Sigara contortuplicata</i>	<i>Mesogomphus cognatus</i>
<i>Tendipes</i>	Egg jelly
<i>Tachnura senegalensis</i>	Chironomid (adult)
<i>Anisops gracilis</i>	Dutiscid (bettle larvae)
<i>Micronecta scutellaris</i>	Water spider
Hudrophyllida	<i>Nychia limpida</i>
Chironomid pupae	

Other invertebrates:

Specimens of the mollusc *Trigonephrus globulus* (Mull) were collected by CJ Hannocks on the northern bank of Verlorenvlei during 1986, and indentified by Dr WF Sirgel, Department of Zoology, University of Stellenbosch. Found along the Cape west coast, up to the Orange River, this species digs down into the sand during the dry summer, and emerges onto the surface when rain falls.

The crab *Potamonautes periatius* was found along the southern shore of the coastal lake during the ECRU survey in September 1985.

Fish:- In the past estuarine fish could enter Verlorenvlei viz. *Lithognathus lithognanthus* (white steenbras), *Liza richardsonii* (Haarder) and *Mugil cephalus* (mullet). Another estuarine species, *Gilchristella aestuarius* (white bait), breeds in the lake.

The only indigenous freshwater species are *Galaxias zebratus* (Cape galaxia) and the rare *Barbus burgii* which occurs in the Verlorenvlei River (Skelton 1977).

In recent years the lake has been colonized by the introduced exotic (to the vlei) species *Cyprinus carpio* (carp), *Oreochromis mossambica* (tilapia), *Tinca tinca* (tench) and *Tilapia sparrmannii* (Sparrmann's kurper) (Grindley et al. 1980).

Birds:- In two surveys carried out by the Western Cape Wader Study Group during January and February 1976, 934 and 1 371 waders respectively were recorded in the lower reaches of Verlorenvlei (Summers et al. 1977). In an analysis of resident and migrant waders from the same survey data, migrants constituted 95% of the wader population. In a survey of the whole Verlorenvlei area in December 1980 by Underhill and Cooper (1983), 3 655 waders were reported, of which 2 928 were migrants and 727 residents. This same survey yielded a total of 6 829 birds of 60 species in the environs of Verlorenvlei.

Verlorenvlei's importance as a bird habitat is not restricted to waders. The vlei provides feeding, nesting and roosting sites for many bird species. There are around 200 species of birds in the surrounding area.

It is an important moulting area for Egyptian geese (*Alopochen aegyptiaccus*) and other waterfowl.

Waterbirds seen at Verlorenvlei include herons, egrets, ibises, spoonbills and flamingos. The presence of glossy ibises an African spoonbills is important, since these species are uncommon in the south-western Cape (Cooper 1976). Flamongos appear at Verlorenvlei when other vleis, such as Rocher Pan 35km to the south, and Wadrifsoutpan 13km to the north, dry up. Flamingos are listed in the South African Red Data Book as requiring conservation (Brooke 1984).

Other Red Data Book species include the little bittern and the Caspian tern. The area is possibly also an important moulting ground and summer refuge for ducks, with 600 Cape shoveller and 1 200 yellow-billed duck being observed in May 1979 (Heyl 1985 pers comm). In addition, Verlorenvlei is a type locality for several species of birds, including the white-backed duck (Cooper 1976).

Up to 150 great white pelicans were counted by the Fitz Patrick Institute in 1976, representing 26% of the total south-western Cape population (Cooper 1976). On 23 March 1982, 212 pelicans were counted. The great white pelican is rated as rare in South Africa, and therefore in need of special protection (Brooke 1984).

Mammals:- Little information exists on mammal populations at Verlorenvlei. Archaeological and historical evidence suggest that larger mammals were present in abundance in the past, whereas they are non-existent today.

A survey by Stuart (1981) indicates the presence of the following carnivore in the vicinity:

<i>Otocyon megalotis</i>	bat-eared fox
<i>Vulpes chama</i>	Cape fox
<i>Chanis mesomelae</i>	black-backed jackal
<i>Ictonyx striatus</i>	striped polecat
<i>Genetta genetta</i>	small-spotted genet
<i>Suricata suricatta</i>	suricate (meerkat)
<i>Gynictis penicillata</i>	yellow mongoose
<i>Herpestes pulverulentus</i>	Cape grey mongoose
<i>Atilax paludinosus</i>	water mongoose

<i>Panthera pardus</i>	leopard
<i>Felis lybica</i>	wild cat
<i>Felis caracal</i>	caracal

The following mammals can still be found in the surrounding area:

<i>Papio ursinus</i>	baboon
<i>Hystrix africaeaustralis</i>	porcupine
<i>Aonys capensis</i>	Cape clawless otter
<i>Mellivora capensis</i>	honey badger
<i>Proteles cristatus</i>	aardwolf
<i>Orycteropus afer</i>	antbear
<i>Procavia capensis</i>	rock dassie
<i>Raphicerus campsetris</i>	steenbok
<i>Raphicerus melanotis</i>	grysbok
<i>Sylvicapra grimmia</i>	grey duiker
<i>Pelea capreolus</i>	grey rhebuck

24. NOTEWORTHY FLORA

Phytoplankton/Diatoms:- Although no detailed work on the phytoplankton of Verlorenvlei has been undertaken, Robertson (1980) took some phytoplankton productivity measurements at various times of the year. Results indicate low levels of productivity.

Algae:- Large masses of filamentous green algae, including *Chaetomorpha* and *Cladophora*, are common in the channel, particularly between the railway bridge and the lower causeway, where the water is often stagnant and hypersaline (Robertson 1980).

Aquatic vegetation:- Extensive beds of emergent aquatic macrophytes occur along the margins of the lake with *Phragmites australis*, *Typha latifolia* and sedges as dominants. Downstream of Redelinghuys there are fairly wide and open wetlands with patches of mixed sedges and reed communities along the course of the Verlorenvlei River over a distance of 11km. Dense reedbeds are present in the upper part of the lake. *Myriophyllum spicatum*, a submerged macrophyte, dominates large areas of the lake where the water is about 2m deep. *Nymphaea capensis* (waterlily), a species which is becoming rare in South Africa due to destruction of wetlands, occurs in small numbers.

Terrestrial vegetation:- Many researchers have noted the botanical importance of the vlei and its environs, because of its position at the transition between the karroid and fynbos vegetation types. The region therefore, has a high diversity typical of an ecotone area.

The different vegetation types that have been mapped are:

1. Strandveld
 - i. Seaward dune strandveld
 - ii. Shrubby strandveld
 - iii. Restioid strandveld
2. Saltpan vegetation
3. Lowland fynbos
4. Dry mountain fynbos
5. mountain fynbos
6. Karroid shrubland
7. Marsh vegetation

Rare plant species which have been recorded from this area include *Ferraria foliosa*, *F. densepunctulata*, *Cercium venom* (presumed extinct) and *Cullumia floccosa*.

25. SCIENTIFIC RESEARCH AND FACILITIES

Studies of the ecology of Verlorenvlei have been undertaken by the School for Environmental Studies, University of Cape Town since 1975. Preliminary results are reported by Grindley *et al.* (1980). These studies are being continued.

Sinclair (1980) has studied the origin of the historic Verlorenvlei settlement and has also reported on the history of settlement in the area as a whole.

Archaeological studies has received much attention particularly by the Department of Archaeology, University of Cape Town since 1976 and this work will be greatly extended (cf. Parkington 1980)/

26. CONSERVATION EDUCATION

The rich bird life, archaeological sites and other features of the area provide enormous opportunities for environmental education programmes. The area also provides opportunities to illustrate the detrimental consequences of ill-considered land-use practices, and when proposed conservation measures are implemented, the beneficial results of such measures and sustained land-use practices.

27. RECREATION AND TOURISM

The roads in the area are poor and relatively low visitor numbers are experienced at present. Visitor pressure is very seasonal.

Boating:- Motor boats above 5 horsepower are not permitted on the lake. The deeper, *Myriophyllum* free areas, are suitable for sailing, although these areas are very small. The varying depth of the vlei throughout the year also places a large restriction on sailing.

Fishing:- Fishing is permitted provided an Inland Water Fishing License is obtained. Only riparian landowners have permits for catching fish with nets.

Swimming:- Swimming, although not prohibited, due to the thick layer of silt and its unhygienic conditions, is discouraged.

Bird-watching:- The vlei and its environs lends itself to ideal bird-watching conditions.

Hiking:- The area is suitable for hiking trails and possible routes for such trails are along the waters edge as well as to places of historical interest and archaeological sites. They may also follow a route through the different vegetation types.

Picnicking:- Picnicking can become popular if the necessary sites were provided.

28. MANAGEMENT AUTHORITY

Chief Director
Nature and Environmental Conservation

Private Bag X9086
Cape Town
8000
Republic of South Africa

29. JURISDICTION

Verlorenvlei has a regional jurisdiction. It occurs in the Piketberg district, Cape Province. It falls under the jurisdiction of the Chief Directorate: Nature and Environmental Conservation of the Cape Provincial Administration.

30. REFERENCES

Burgers, C. 1978. A preliminary assessment of the conservation and recreational potential of Verlorenvlei. Unpublished memorandum. Cape Department of Nature and Environmental Conservation.

Burgers, CJ. 1980. Bewaring van Verlorenvlei en omgewing. Unpublished memorandum. Cape Department of Nature and Environmental Conservation.

Burgers, CJ. 1984. Ramsar directory of wetlands of international importance: Verlorenvlei. Unpublished memorandum. Cape Department of Nature and Environmental Conservation

Cooper, J. 1976. The ornithological importance of Verlorenvlei and its value as a nature reserve. Unpublished memorandum. University of Cape Town, Percy Fitz-Patrick Institute of African Ornithology.

Cooper, J., Summers, RW. and Pringle, JS. 1976. Conservation of coastal habitats of waders in the south-western Cape, South Africa. *Biological Conservation* 10:239-247.

Fromme, GW. 1985. The dynamics of the mouth channel of Verlorenvlei: Western Cape. Stellenbosch, CSIR report T/SEA 8517. 18pp.

Grindley, JR. 1979. The ecology of Verlorenvlei. Fourth national oceanographic symposium. Cape Town, South Africa.

Grindley, JR. *pers comm*. Verlorenvlei. In: Estuaries of the Cape. Part II: Synopsis of available information on individual systems. SCIR report, Stellenbosch, South Africa.

- Grindley, JR., Lane, SB. and Robertson, HN. 1980. The environment and ecology of Verlorenvlei. In: Verlorenvlei: A challenge to conservation. School of Environmental Studies, University of Cape Town.
- Heineken, TJE. and Badenhorst, P. 1985. Elandsbaai extensions 2 and 3. Unpublished report. Stellenbosch, National Research Institute for Oceanology, CSIR.
- Holtrop, VP. 1981a. The operation and construction of the horsemill at Verlorenvlei. Cape Town, unpublished report.
- Holtrop, VP. 1981b. Factors leading to the decay of Verlorenvlei settlement buildings. Cape Town, unpublished report.
- Lane, SB. 1980. Interpretation of digital Landsat-1 imagery from Verlorenvlei, south-western Cape. 159p. M.Sc. Thesis, University of Cape Town.
- Manhire, AH. Rock art of the Strandveld. University of Cape Town. Honours thesis.
- Noble, RG. and Hemens, J. 1978. Inland water ecosystems in South Africa - a review of research needs. SCIR, Pretoria, South Africa.
- Parkington, JE. 1976a. Conservation of Verlorenvlei: archaeological implications. Unpublished memorandum. University of Cape Town.
- Parkington, JE. 1976b. Coastal settlement between the mouths of the Berg and Olifants Rivers, Cape Province. S. Afr. Archaeology. Bull. 31:127-140.
- Parkington, JE. 1980. Report on archaeological research in the Verlorenvlei 1976 - 9. In: Verlorenvlei - a challenge to conservation. School of Environmental Studies, University of Cape Town.
- Robertson, HN. 1980. An assessment of the utility of Verlorenvlei water. University of Cape Town.
- Rogers, J. 1980. First report on the Cenozoic sediments between Cape Town and Elands Bay. Pretoria Rep. Geol. Surv. S. Afr. 165:1-64.
- Sinclair, SA. 1980a. The rural settlement of Verlorenvlei in historical perspective. University of Cape Town.
- Sinclair, SA. 1980b. Recent settlement at Verlorenvlei. In: Verlorenvlei - a challenge to conservation. School of Environmental Studies, University of Cape Town.

Sinclair, SA. 1986a. A synthesis of available research information on the Verlorenvlei from 1979 to 1985. University of Stellenbosch. Unpublished report.

Sinclair, SA. 1986b. Historical review of the fauna and vegetation of Verlorenvlei. University of Stellenbosch.

Sinclair, SA. 1986b. Historical review of the fauna and vegetation of Verlorenvlei. University of Stellenbosch.

Sinclair, SA. 1986c. Interpretation of an archival map sequence for Verlorenvlei. University of Stellenbosch.

Sinclair, SA. 1986d. Conservation development plan for the Eland's Bay coastal region. Unpublished report.

Sinclair, SA., Lane, SB., and Grindley, JR. 1986. Estuaries of the Cape: Part II: Synopses of available information on individual systems. Rep No.32 Verlorenvlei (CW 13). CSIR Research report 431.

Summers, RW., Pringle, JS., and Cooper, J 1976. The status of coastal waders in the south-western Cape, South Africa. Western Cape Study Group. 162p.

Summers, RW., Pringle, JS. and Cooper, J. 1977. Distribution and numbers of coastal waders (Charadrii) in the south-western Cape, South Africa. Ostrich 48:85-97.

University of Cape Town. 1978. Nutrient analysis - Verlorenvlei. Unpublished masters project. University of Cape Town.

University of Cape Town. 1980. Verlorenvlei recorded. Unpublished group project. University of Cape Town.

Visser, HM. and Toerien, DK. 1971. Die geologie van die gebied tussen Vredendal en Elandsbaai. Toeligting van blaaie 321BC Doringbaaien 3218A Lambertsbaai. Pretoria, Department of Mines, Geological survey No.62831-1.

Yates, RJ., Miller, DE., Halket, DJ., Manhire, AH. and Parkington, JE. 1986. A late mid-holocene high sea-level: a preliminary report on geoarchaeology at Elands Bay Western Cape Province, South Africa. S. Afr. J. Sci. 82:164-165.

31. REASONS FOR INCLUSION
(Reference to criteria)

1. Verlorenvlei is one of the largest natural wetlands along the West Coast of South Africa and one of the few coastal fresh water lakes in this country. A variety of habitats are represented including a central open water area, dense beds of the submerged macrophytic plants as well as exposed areas

along the edge of the lake. A small estuary connects the lake to the sea and marshlands are present along the main river which enters the lake.

2. Verlorenvlei is of particular importance as a feeding area for the white pelican. Approximately 200 pelicans, representing more than 25% of the south-western Cape population may assemble on the vlei. The white pelican is a rare species in South Africa since it breeds at only two sites viz. on Dassenberg along the West Coast (175 breeding pairs) and Lake St Lucia along the East Coast (ca 1000 breeding pairs) (Siegfried et al. 1976).

Other threatened birds include the African fish eagle (*Haliaeetus vocifer*), greater flamingo (*Phoenicopterus ruber*), lesser flamingo (*Phoeniconaias minor*), Caspian tern (*Hydroprogne caspia*), little bittern (*Ixobrychus minutus*) and the great crested grebe (*Podiceps crestatus*) (Grindley et al. 1976). Spoonbills (*Platalea alba*) and glossy ibises (*Plegadis falcinellus*), which are uncommon in the south-western Cape, may also be found in the area (Cooper 1976). The rare minnow (*Barbus burgi*) has been recorded in the Verlorenvlei River (Skelton 1977).

3. Verlorenvlei is one of the ten most important wetlands for wading birds in the south-western Cape Province, supporting over a thousand waders of more than eleven different species, mainly migrants from the northern hemisphere (Cooper & Summers 1976).

This wetland system provides feeding, nesting and resting facilities to a large variety of birds (75 different species have been recorded) (Grindley et al. 1980). It is an important moulting area for Egyptian geese (*Alopochen aegyptianus*) (Currie pers comm).

4. The Verlorenvlei area provides outstanding opportunities for research and detailed research has been undertaken on the ecology of the wetland and surrounding area by the School for Environmental Studies, University of Cape Town (Grindley et al. 1980). Studies of the historic settlements in the area (Sinclair 1980) and archaeological studies (Parkington 1980) have also been undertaken. This work is being continued.

5. Verlorenvlei has a particularly scenic location on the northern side of a mountain with high kranzes near the sea at Baboon Point. Due to its relative remoteness (180km) from the Cape Town metropolitan area and restricted access to the lake, visitor pressure has, as yet, been moderate. However, as road networks are improved, the area is likely to be a focus for increased visitation.

VERLORENVLEI

Location

32°19' - 32°29' S; 18°20' - 18°32' E. 3 km East of Elands Bay and 25 km south of Lambert's Bay on the west coast of the Cape Province.

Area

Ca 1 500 ha.

Degree of Protection

At present Verlorenvlei does not have any formal protection status. The area has a recreational potential and there are certain characteristics placed on fishing and boating.

Site Description

Verlorenvlei is one of the largest natural wetlands along the west coast of South Africa and one of the few coastal fresh water lakes in the country. The lake is in a scenic location on the northern side of a mountain with high kranzes near the sea. Verlorenvlei is a coastal lake and reedswamp system which is connected to the sea by a small 2,5 km long estuary. The main body of the lake is approximately 13,5 km long and 1,4 km wide. During the wet season the maximum depth is about 4,6 m but normally it is around 3,0 m. The lake is regarded as oligotrophic and phytoplankton productivity appears to be low. The rainfall of the area is low and the soils sandy with the salinity of the main body of the lake being fairly constant around 2 ‰. Verlorenvlei forms part of a "chain" of wetlands along the West Coast and is a permanent wetland.

International and National Importance

Verlorenvlei is an important wetland supporting over a thousand waders of more than eleven different species. The wetland provides further feeding, nesting and resting facilities to a large variety of birds (over 75 species have been recorded). Approximately 200 of the rare white pelican *Pelecanus onocrotalus* assemble on the lake, representing 26 % of South Africa's population. Other threatened birds include the African Fish Eagle *Haliaeetus vocifer*, Greater Flamingo *Phoenicopterus ruber*, Lesser Flamingo *Phoenicopterus minor*, Little Bittern *Ixobrychus minutus* and Caspian Tern *Hydroprogne caspia* besides others. The lake is a type locality for several species of birds, including the White-backed Duck *Thalassornis leuconotis*. Verlorenvlei occurs at the transition between the karroid and fynbos vegetation types and the region therefore has a high diversity typical of an ecotone area. Rare plants which have been recorded from this area include *Ferraria foliosa*, *F. densepunctulata*, *Cerycium venoum*

(presumed extinct) and *Cullumia floccosa*. The only indigenous freshwater fish species occurring in the lake are Cape galaxia *Galaxias zebratus* and the rare *Barus burgi*. In recent years the lake has been colonized by the introduction of exotic species such as carp *Cyprinus carpio* and Sparrmann's kurper *Tilapia sparrmannii*. Certain rare and threatened mammals such as the aardwolf *Proteles cristatus* and Cape clawless otter *Aonyx capensis* have been recorded in this area.