PN-ABY-876

Initial Environmental Examinations (IEEs) of 11 proposed industrial estate sites

INITIAL ENVIRONMENTAL EXAMINATION

of the

PROPOSED INDUSTRIAL ESTATE AT

BATA - ATHA

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by

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The findings and recommendations contained herein represent the best professional judgement of the study team only.

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BATA-ATHA PROPOSED INDUSTRIAL ESTATE
INITIAL ENVIRONMENTAL EXAMINATION

I. GENERAL SITE DESCRIPTION

This site is approximately 43 hectares (107 acres) of land located on the southern coast in the Hambantota District, between Tangalla and Ambalantota, between the main coast road (A2) and the ocean. This area is within the dry zone. The site itself is hilly and in general gently sloping, with surface drainage to the southwest. It is covered with mixed scrub vegetation and contains only a single dwelling unit with a small farm plot. Site access is via a partly tarred road south from the main highway, which becomes an unimproved dirt track before reaching the site. There is a brackish-water lake, the Gurupokuna Saltern, of several hectares in a low-lying area less than 1 km to the southwest; the much larger Kalametiya and Lunama lagoons are within 2 km of the site, to the east. Refer to the maps (Annex A) for the location of this site in relation to these lagoons and other local features.

II. PHYSICAL ENVIRONMENT

A. Weather

The site is situated within the Dry Zone of Sri Lanka. Mean annual rainfall at the Bata-Atha farm (within 1 km of the site) is 1080mm; most rainfall (an average of 615mm) is received during the Northeast Monsoon from October to March, which is the Maha Season; average rainfall from April to September, during Southeast Monsoon or Yala Season, is about 465mm. Average monthly temperature (23-30°C) does not vary greatly during the year. Wind direction is predominantly SW from May to September and NE from December to February. Average wind velocity is about 20 km/hr.

B. Topography, Soils, Ground water

A 1995 survey of the proposed site shows it to be a roughly rectangular tract of 43.464 hectares (see site map in Annex A-II). Its highest elevation, approximately 30m above mean sea level, is along a central east-west ridge, with a slopes of approximately 1%. The site drains to the north and east toward the Kalametiya Lagoon and to the southwest towards the Kunukalli (Gurupokuna) Saltern.

The soil on the site is generally sandy with some clay, and has low to moderate permeability. Detailed analysis of soil samples taken at the site during this study are given below in Annex B. The absence of domestic water wells close to the site could be due to two reasons. First, it may be an indication that ground water is of low quality; local people claim that the ground water is somewhat saline. It may also be because the site is located at a higher elvation relative to the surrounding area; hence the groundwater table may be at a significant depth.

C. Surface Water Hydrology

On-site surface runoff is via small channels towards the lagoons and saltern. Surface areas of the principal water bodies close to the site are as follows:

Kalametiya Lagoon	625 ha
Kahanda Lagoon	80 ha
Gurupokuna (Kunukali) Saltern	20 ha

Surface water inflow to the Kalametiya Lagoon is from the Katchchigal Ara (Oya), which has been augmented over the last 15 years by water diverted from the Walawe Ganga (river). The irrigation drainage is estimated to amount to 28 Cumecs (72.6mcm/month). The Kalametiya Lagoon discharges at the southwestern boundary of the site, discharges to the ocean via a channel that has been artificially stabilized with rip-rap. The Urubokka Oya flows through the Kahanda Lagoon.

The Walawe River flows approximately 10 km from the site; thus the Urubokka Oya and Katchchigal Ara are closer possible water sources for industries at the site (see Part III-A below). One nearby industry, the Lanka Ceramics hydrated lime factory, is already extracting water from the Katchchigal Ara. Downstream from the site, surface water is used by the Kalametiya villagers for domestic purposes; the lagoon is also an important component of a natural system that supports the local fishery resource. From the Walawe Ganga near the Ambalantota bridge the National Water Supply and Drainage Board is extracting water for drinking water supply.

D. Water Quality

In order to assess the current condition of various water bodies in the vicinity, water samples were taken from several locations near the Bata-Atha site as follows:

1. Ground water from well found near the mouth of the Kalametiya Lagoon;
2. Walawe Ganga, at the inlet to the Ambalantota water treatment plant;
3. Katchchigal Ara, at the Hungama bridge on the Tangalla-Ambalantota highway;
4. Urubokka Oya, at the Ranna bridge of the Tangalla-Ambalantota highway;
5. Kalametiya Lagoon, where the lagoon discharges to the ocean.

Water quality data for parameters measured at each of the above locations are summarized in the table in Annex C.

Generally the water quality measurements were found to contain a significant amount of total dissolved solids (TDS), including among others chlorides, fluorides, and sulphates. Most samples also contained a high level of hardness and a low BOD/COD ratio (≤ 0.1), indicating the presence of either refractory or toxic substances in the water sampled.

E. Air Quality and Noise

No site-specific air quality data were available for the proposed site. Ambient air quality is at present quite good, since neither the site nor the surrounding area has yet been developed. The only existing air pollutant emissions come from burning vegetation for agriculture (chena cultivation), small shell burning operations, and a kiln at a hydrated lime factory located within 2 km of the site's border. There are no significant existing sources of noise from human activity.

III. CURRENT AND PLANNED FACILITIES AND SERVICES

A. Water Supply

Since there is no significant on-site source of fresh water, the potential availability of off-site surface water must be considered. Some possible off-site sources are:

1. Walawe Ganga. This river currently provides water to the towns of Hambantota, Ambalantota, Nonagama, and Uda Makale, via the Ambalantota Water Treatment plant. Current demand for treated water at the plant is 3400m^3/day; the treatment plant's capacity is 5600 m^3/day, which is intended to meet the area's anticipated water supply demand in the year 2010. (See the EIA for the Walawe Irrigation Extension Project, JICA, 1992).

2. Katchchigal Ara. The water in this river now comes from the Walawe Right Bank canal as well as from the Chandrika Wewa drainage. Water in this river is used to supply the water requirements (0.07mgd) of the hydrated lime factory owned by Lanka Ceramics Ltd. The National Water Supply and Drainage Board provided water from this river (at an average of approximately 200gpm) to the Ranna-Hungama area until the end of 1993; currently this area gets its water from the Kattakaduwa Wewa (surface tank).

3. Urubokka Oya. The area drained by this river experiences frequent flooding, indicating the periodic presence of excess water. People from the village of Ranna do not use water from this river because they are provided with water (via stand posts) from the Kattakaduwa Wewa.

4. Ground Water. Only four wells were found in the region of the proposed site. Generally the local ground water is not used for domestic purposes in the nearby villages due to its high salinity; this fact suggests that the existing fresh water table is shallow and subject to depletion with resulting salt water intrusion from the nearby ocean.

The following table summarizes available information on surface water availability.

Table 1: Surface water availability at close proximity to Bata-Atha site.

Source	Distance to site (approximate)	Average flow (mcm/month)	Maximum flow (mcm/month)	Minimum flow (mcm/month)	Flow measured during site visit (mcm/month)	Downstream water use
Kachchigal Ara (at A2 road bridge)	2 km	6 1 *	16 0* (Nov)	0 04*(Feb)	0 23 (Jul)	Sea shell industry (0 014 mcm/month), Fishing, fish breeding, Bathing and washing
Waluwe Ganga (at Liyangastota)	10 km	51 44	95 0 (Apr)	12 00 (Sep)	not measured	NWSDB water supply project (0.162 mcm/month) Bathing and washing
Urubokka Oya (at A2 road bridge)	2 km	20 3	30 6 (Nov)	11 4 (Feb and Aug)	not measured	Fishery Bathing and washing

* A drainage flow of 72 6 mcm/month should be added during irrigation releases

Source Feasibility Study on the Rehabilitation of Irrigation and Drainage Systems of Southern Sri Lanka, Interim Report, June 1995

B. Infrastructure

1. Power and Telecommunications. There is a 132kv transmission line along the main road to Hambantota to the north of this site; there are electricity substations in Galle and Matara. Also along this road are telecommunication lines reaching to Hambantota; these lines were upgraded during a service expansion project that was completed in 1994. Cellular phone service is also now available in the area.

2. Transportation and other Public Services. The nearest rail access to this site is approximately 70 km to the west at Matara. The A2 highway carries inter-city buses and commercial lorry traffic past the site. This area is within the Hambantota Health Region. The closest government hospitals to the site are at Ranna (approx. 8 km away) and Ambalantota (6 km away). A proposal to extend the railway line from Matara to Kataragama is under active consideration; this extension, if built, should pass close enough to the Bata-Atha site to be of benefit to industries locating there.

C. Existing Structures and Industrial Activities

As described above, there are no substantial structures on this site or immediately adjacent to it. The ceramics factory, a hydrated lime factory, and a number of private dwellings are near the site to the east; there is also an ancient shrine, the Viharanawaya temple, overlooking the Kalametiya lagoon.

IV. BIOLOGICAL ENVIRONMENT AND NATURAL RESOURCES

A. Significant Flora

The proposed site is situated in the dry and arid lowland floristic region of Sri Lanka (Ashton and Gunatilleke, 1987). The site is completely covered with secondary scrub jungle and has a hilly formation. This land consists of abandoned chenas, now mostly used for grazing purposes.

There are several biologically important wetlands in the vicinity of the proposed site: Kalametiya and Lunama kalapuwa, Kahanda-Modera kalapuwa, Kunukali (Gurupokuna) Saltern, and Thillawatana kalapuwa. The environmental significance of the Kalametiya and Lunama lagoons was first officially recognized in 1938, and again in 1984 when the Department of Wildlife Conservation declared these areas to be Sanctuaries. Kalametiya lagoon still has some extensive, although degraded, mangroves. Small fringes of mangroves, mainly consisting of *Lumnizera racemosa* and *Excoecaria agallocha*, are present along the edge of the lagoon, together with associated species such as *Clerodendrum inerme* and *Phyla nodiflora* (Jayatissa, 1987).

The central, northern, and western parts of Kalametiya and Kahanda Modera lagoons are dominated by fresh water marsh vegetation of *Typha latifolia* together with sedges and floating microphytes. The flood zones of the lagoons are covered with intensively grazed, salt-meadow vegetation types, dominated by several grasses. Two endemic plant species are recorded in this area (Central Environmental Authority, February 1995, Wetland Site Report for Kalametiya and Lunama Kalapuwa), namely *Xylopia championii* and *Veronia zylanica*.

B. Significant Fauna

Most of the available published work on local fauna is focused on the Kalametiya and Lunama lagoons. According to the wetland site report (CEA report, 1995) 41 fish species have been recorded in this area, including one endemic species: the Walking Catfish, *Clarius brachysoma* (magura). There are seven introduced species including the Common Carp, Rohu, Guppy, and Gourami, and two Tilapia species, *Saratherodon mossambicus* and *Oreochromis niloticus*. Fishermen report that several brackish water fish species have disappeared in the last decade after the creation of the Kalametiya lagoon ocean outfall, which led to decreased salinity in the waters of the lagoon.

More than 30 species of reptiles (15 snakes, 23 tetrapods) have been recorded around the Kalametiya lagoon; 10 of them are endemic and 25 are listed as threatened. The globally threatened Estuarine Crocodile is still present in the area as well as four endangered species of sea turtles. The latter are known to nest locally on the beach (CEA report, 1995).

Over 150 species of birds have been identified in this area, according to the annual Asian Waterfowl census (conducted by the International Waterfowl and Wetland Research Bureau in co-operation with the Ceylon Bird Club). Herons, egrets, ibises and spoonbills

are found in considerable numbers, while rails, coots and jacanas can be found in the lush reeds and marsh vegetation. The lagoon's flood zones around the edges, which are frequently trampled by cattle, are major foraging zones for waterfowl, in numbers that frequently exceed 20,000.

The endemic Sri Lanka Jungle Fowl and the Glossy Ibis are two nationally threatened species recorded in the area. Scott (1989) notes that the area is a very important wetland for both resident and migratory waterfowl, with breeding colonies of pelicans, herons, egrets, and open bill storks, and large wintering populations of migratory ducks and shorebirds. Parts of this ecosystem are habitat for the endangered spotted-billed Pelican.

At least two threatened species of mammals have been recorded at the site -- the Bi-colored Spiny Rat, *Coelomys mayori*, and the Mouse Deer, *Tragulus meminna* (IUCN, 1993). The Spiny Rat is endemic to Sri Lanka, as is one other mammal observed by the team to be present, the Toque Monkey, *Macaca sinica*. Resident elephants were recorded in the area until the 1970s. Most of them were driven to nearby protected areas or died due to man-elephant conflicts. But still a few elephants occasionally migrate through the proposed site. The Sambur has also recently disappeared from the area, while Spotted Deer and wild boar are sighted occasionally.

C. Sensitive Habitat

The biological and conservation value of this area was further recognized when the Kalametiya lagoon was included as site number 28 in the Directory of Asian Wetlands (Scott, 1989), giving it the unofficial status of a "wetland of international importance." The Department of Wildlife Conservation in 1992 proposed to declare this lagoon as a RAMSAR site, which would give it official status as an internationally significant wetland ecosystem.

V. SOCIAL AND CULTURAL ENVIRONMENT

A. Human Settlements

The local population of the two Grama Sevaka Divisions encompassing Bata-Atha (North and South) is recorded as 2758. These two divisions are both within the Ambalantota District Secretariat Division. Within Bata-Atha South is the very popular fishing village of Kalametiya with about 150 households. There are three other coastal villages of nearly 800 families in close vicinity to the site, but within the District Secretariat Division of Tangalle: Gurupokuna, Thillawatawana, and Kahanda Modera.

Bata-Atha North has a total of 277 householders in 272 houses of which only 117 are permanent structures, whilst Bata-Atha South has a total of 274 householders in 268 houses of which 141 are considered permanent structures. Most houses of Gurupokuna and Thillawatawana and Kahanda Modera are permanent except those of the fishing community, who are not as successful as their brethren in Kalametiya.

Health facilities are available at the Ranna Government Hospital about 8km away or at Ambalantota Hospital. Educational levels are not high as only primary and secondary education is available at the three village schools, which are attended by about 700 students. Public transport is available to the children to attend schools in Ranna or Ambalantota.

B. Labour Force

The Bata-Atha area has a recorded work force of nearly 1500, mostly of the unskilled category; this exceeds the labour force of the other three villages in the vicinity.

C. Local economic activity

Fishing is a generally a successful activity in the coastal villages as evidenced by the ownership of boats.

Table 2. Number of Fishing Boats in Villages near Bata-Atha

Gurupokuna and Kalametiya	**Total Boats**	**100**
	3-3.5 tonners	30
	17.5' boats	50
	Oru/catamaran	20
Thillawatawana	The village is mainly involved in Madal fishing (beach seining).	
Kahanda Modera	**Total Boats**	**50**
	17.5 feet boats	40
	Oru/Catamaran	10

There is no organised agriculture on the site; paddy farming is possible only north of the main trunk road (A2) in areas fed by Walawe. Lemon Grass/Citronella cultivation, which was once a flourishing local activity, has now ended. There are no forest reserves of importance; the existing forest is about 15 years and parts of it are seasonally cleared.

D. Religious and Cultural Features

Gurupokuna/Kalametiya village has Jayasumanaramaya with Ven Sumangala as the incumbent priest, although administered by Ven Amarawansa from Colombo; Thillawatawana has Vijayaramaya with Ven Vippassi; Kahanda Modera temple has Ven Siriratane as incumbent.

Local historical and archaeologic sites include the Veharanawaya, a nine-stupa temple overlooking the Kalametiya Lagoon 200m from the sea. This is an ancient shrine wherein the hair relics are kept. The existence of stone relics of the past at the entrance to the complex reveal that its construction is earlier than the period of 1875 to 1890. Renovation in 1920s did not do justice to its pristine past.

E. Aesthetic and Recreational Features

This site itself, strictly speaking, lacks significant aesthetic or recreational features. However, the sea beach and large lagoons in the immediate vicinity of the site are natural delights of considerable value and importance, from both environmental and economic perspectives. The natural habitat and biodiversity of the lagoons are of national and international significance, as indicated by their Sanctuary status, by the presence of several endemic and/or threatened species, and by their use in scientific research and field studies. The sea beach is known to be nesting habitat for several sea turtle species that are on the international list of endangered species and for which there are protection programs operating elsewhere in Sri Lanka. These natural features, if properly protected and managed, could become a high-quality aesthetic, scientific, and recreational resource, capable of attracting both domestic and foreign visitors, and thus stimulating the regional economy on a long-term sustainable basis.

F. Local Customs, Aspirations, and Attitudes

Customs are consistent with a Buddhist environment in a rural area. The local people have as yet expressed no reservations regarding the establishment of a nearby industrial estate. They are, however, desirous of maintaining their present environmental equilibrium. Residents of the nearby fishing villages are concerned that the fishery resource on which they are dependent should not be harmed by water pollution or diversion.

VI. MAJOR ENVIRONMENTAL AND REGULATORY ISSUES

A. Sensitivity of the Affected Environment

The area adjacent to this site has the most significant environmental resources of all those included in this study. If this site is developed as an industrial estate, several types of adverse environmental impacts are likely. During the construction phase, soil erosion will result in an increased amount of sediment entering the lagoons and other water bodies. If the site is used to consolidate tannery operations, substantial amounts of pollutants will be generated. Effluent from the tanning process as typically practiced contains a high BOD/COD content, suspended solids, chromium salts, and other toxic chemicals, raising several human health and environmental concerns. Other off-site adverse effects are also likely to result from the influx of workers, both for construction and for operation of whatever industrial facilities are developed here. Some of the most significant potential effects are:

1. <u>Discharge into lagoon or saltern</u>. When chromium is discharged into the aquatic environment it may undergo a variety of reactions depending on the condition of the receiving water body. Heavy metals such as chromium are often found bound to the sediment particles. In slowly moving water bodies such as Kalametiya lagoon these particles have time to settle to the bottom. Therefore it is probable that a significant proportion of any chromium salts reaching the lagoon will remain in the bottom sediment

rather than being flushed out to sea. As this process of sedimentation continues, it will produce high concentrations of chromium in the lagoon bed which in turn will result in chromium entering the aquatic food chain. Since chromium is a toxic metal that accumulates in animal tissues it is obvious that discharge into the lagoon could have disastrous consequences for the entire ecosystem as well as for the human population dependent upon it.

2. Discharge into coastal waters. If liquid effluent from tannery processing is discharged directly into the near- shore region, the high concentrations of pollutants including BOD, suspended solids, and chromium salts may not be diluted sufficiently before being spread by tidal action along the seashore and back into the lagoons, causing a variety of adverse effects on the coastal marine life and on local residents. Even a deep-ocean outfall (discharge at least 2 km from the shore) is likely to have some adverse effects on fish and other marine organisms, especially benthic organisms, in the vicinity of the discharge.

3. Solid waste disposal. Whether a tannery or other industrial use is made of this site, special care will have to be taken to assure that solid waste from industrial processes is not disposed of in ways that could spread toxic substances into the surface or ground water, or otherwise harm local human or wildlife populations. Sludges, flesh or hair residues, or other solid by-products of tanning operations must be placed in a carefully constructed sanitary landfill or other managed disposal area, not discarded into open dump sites.

4. Aesthetic and cultural concerns. Nearby human settlements are also part of the affected environment. The site is relatively large, which allows for the buffering of some adverse effects; nevertheless the development plan should include measures to minimize off-site noise, odors, and negative visual impacts. If hide-tanning operations are permitted at the site, special attention should be paid to local religious concerns regarding animal slaughtering and to proper treatment and disposal of flesh and hide trimmings.

B. Regional Water Resource Limitations

Current information available to the study team indicates that a single source of local surface or ground water resources will be inadequate for a large tannery operation. The possibility of diverting water from the Walawe Ganga exists, but must be evaluated in the context of other existing and anticipated uses. The study team is aware that a major oil refinery, expected to be located within the same district as this site, is currently under review by the government. Whether the region's water resources will be simultaneously adequate to supply this site, the new refinery, and/or other planned municipal or industrial users is a major unresolved issue that will require further detailed, objective analysis before irreversible, and possibly conflicting, commitments are made to allow diversion and/or consumption of water resources for industrial development.

C. Regulatory Issues

Approval of any plans for surface or groundwater use for this estate should be coordinated with the Irrigation Department, the Water Supply and Drainage Board, the C.E.A., and local authorities.

As with other sites evaluated during this study, there is uncertainty as to which level of government and which specific agencies will be responsible for development and management of the site, construction and operation of any common waste treatment and disposal facilities, and the control of activities on lands adjacent to this site (which will almost certainly be subject to residential or commercial development once the site is utilized as an industrial estate). Careful interagency coordination of the planning and approval process for development of this site and adjacent lands is particularly important because of the high environmental value and sensitivity of local land, water, and environmental resources.

VII. GENERAL CONCLUSIONS AND RECOMMENDATIONS

This is the largest site of the 11 potential industrial estates reviewed during this study. The site's size and lack of existing adjacent development make the it suitable for industries needing relatively large tracts of land; the site is also large enough to accommodate a central wastewater treatment plant, a solid waste disposal facility, and other common infrastructure elements. It also, however, presents some unique constraints, particularly for "wet" industries, i.e., those having significant water use requirements and/or wastewater discharges.

The site was rated by the team as currently having medium to low pollution assimilative capacity and medium to low local resource availability. This rating is based primarily on the following limiting factors:

- The site's proximity to important and highly sensitive environmental resources;
- Absence of a suitable local water body for wastewater discharge (other than a deep ocean outfall);
- Uncertainty regarding sufficient surface water availability, given other potential competing regional water demands for the same resources.

The site's limited existing public utilities and community infrastructure were also considered to be potential constraints. These limiting factors can be reduced, and the site's capability for industrial development thereby enhanced, by careful planning and investment in appropriate infrastructure development. At present, the site is best suited for a variety of large-scale, but medium- to low-polluting manufacturing industries that have moderate to low requirements for water, skilled labor, and community infrastructure.

Many of the above-mentioned potential adverse environmental effects can be reduced, but not eliminated, by establishing the following conditions for development of the site: 1) establishing at the outset a specific site development authority and management plan that includes control of adjacent land uses; 2) avoiding any untreated discharges on land or to the lagoons; 3) assuring careful management and containment of hazardous chemicals and solid wastes; and 4) requiring a continuously high level of wastewater treatment that incorporates substantial removal of BOD/COD and nutrients (and, if tanning operations are permitted, maximum recycling and removal of chromium salts). **Ongoing rigorous monitoring and enforcement of standards will be essential to assure that the industrial management and waste treatment processes are accomplishing these objectives.**

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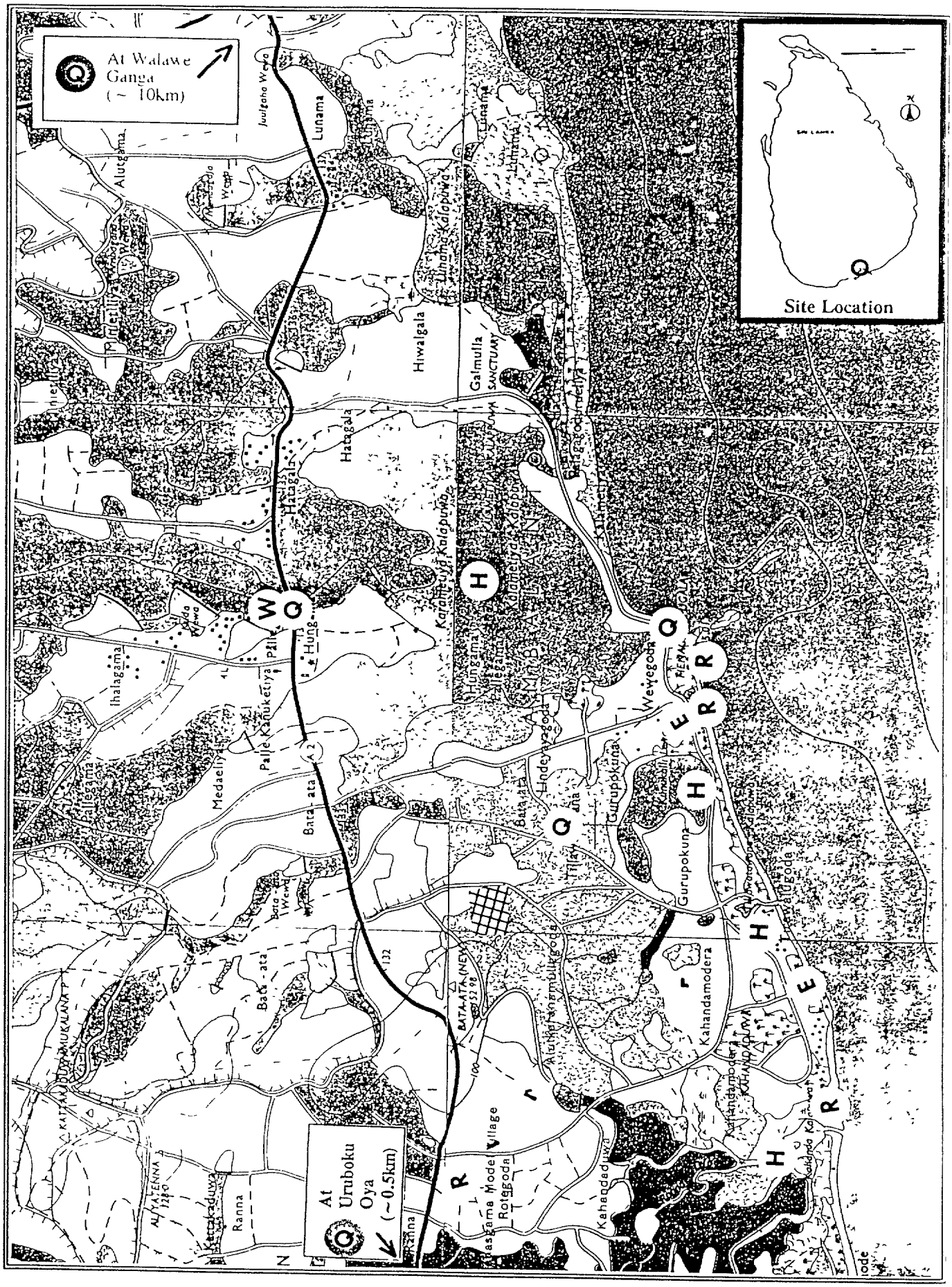
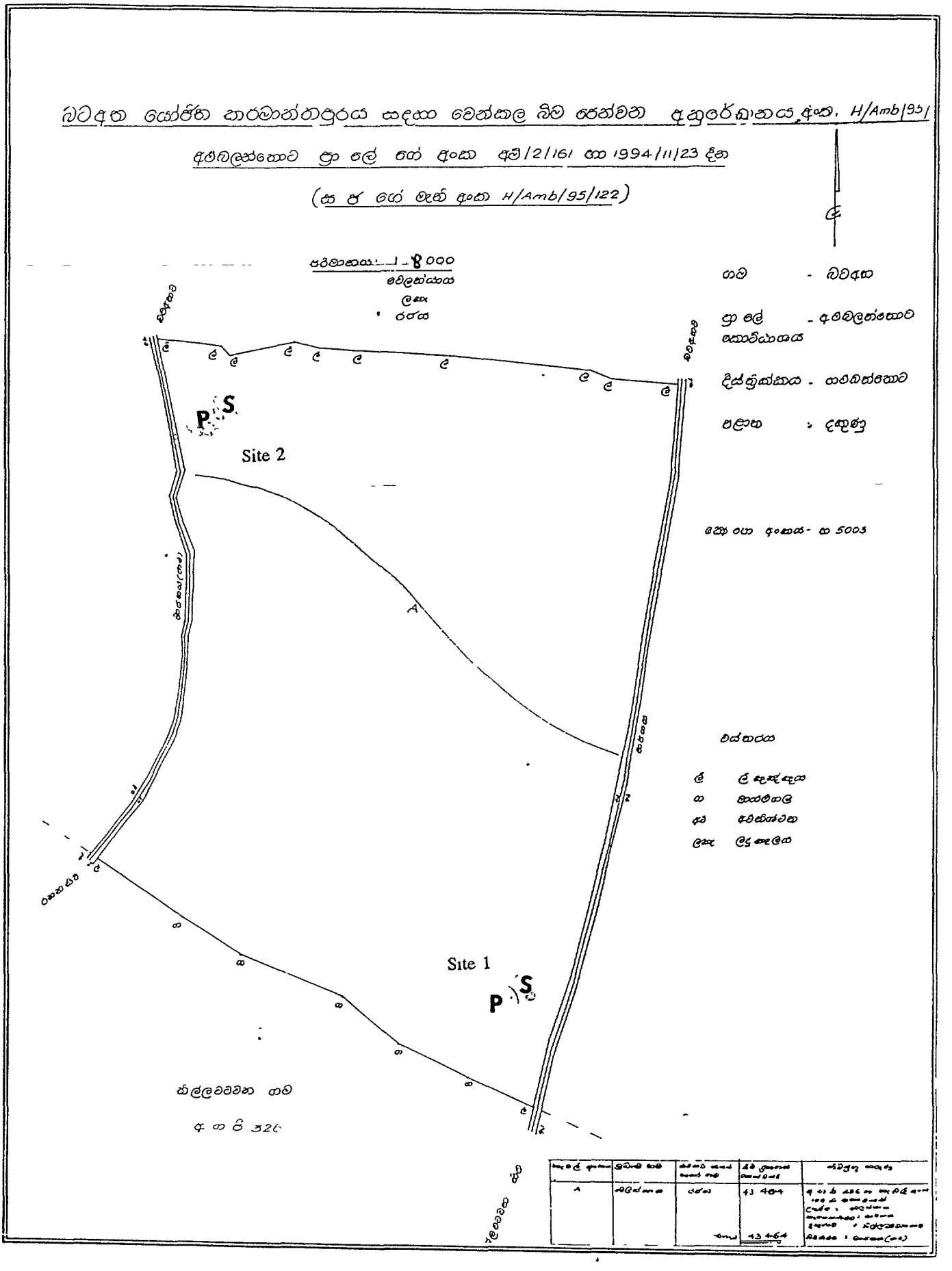


Location Map of Proposed Industrial Estate - Bata-Atha

Scale Produced using 1 50,000 Topographic Map

A - Archeological
E - Schools
H - Important Habitats
I - Industries
M - Medical Facility (Hospital)

P - Percolation Measurement Point
Q - Water Quality Sampling Point
R - Religious(Temple, Church, Kovil/Mosque)
S - Soil Sampling Point
W - Water Quantity Measurement Point

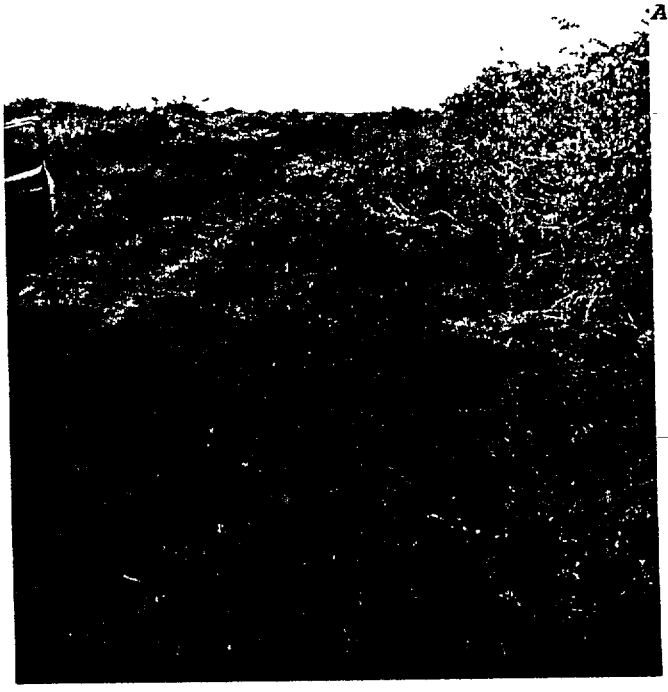


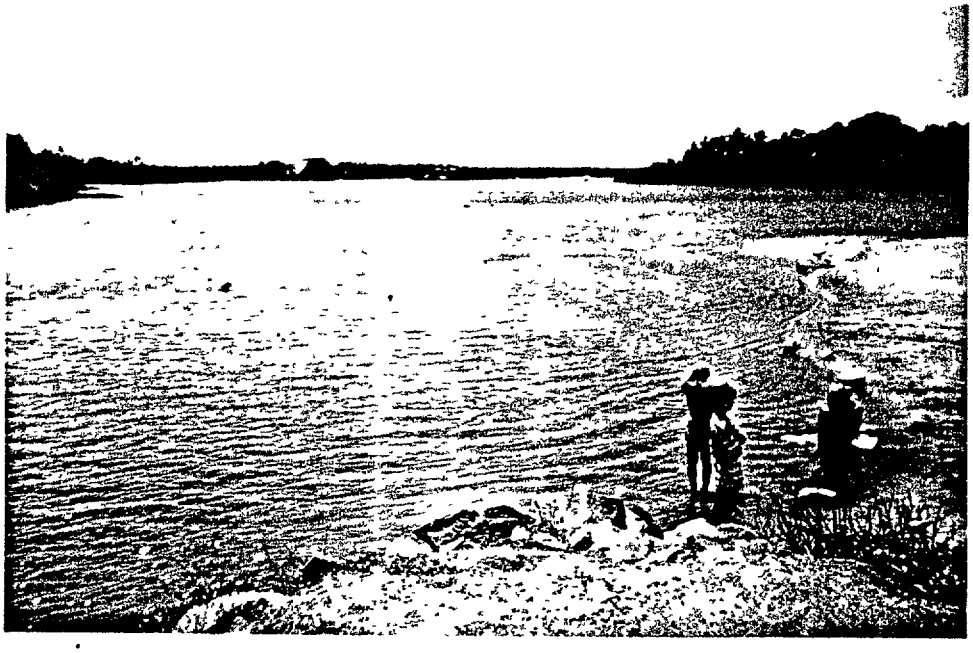
Perimeter Survey Map - Proposed Industrial Estate - Bata-Atha

A - Archeological
E - Schools
H - Important Habitats
I - Industries

P - Percolation Measurement Point
Q - Water Quality Sampling Point
R - Religious(Temple, Church, Kovil/Mosque)
S - Soil Sam ; Point
W

A. Proposed Site for Industrial Estate at Batta - Atha site in Ambalantota.





B. View of the Kalamettiya Kalapuwa as seen from the outlet to the Lagoon.

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C Outlet of the Kelamettiya Lagoon Kalamettiya fishery harbour seen in the background

D Cutting the Built-up sand bar allowing the outflow from the Khandamodera Lagoon fed by Urubokku Oya

ANNEX A-III: SITE PHOTOGRAPHS - BATA ATHA

A. Proposed Site for Industrial Estate at Bata - Atha site in Ambalantota.

B. View of the Kalamettiya Kalapuwa as seen from the outlet to the Lagoon.

C Outlet of the Kelamettiya Lagoon Kalametiya fishery harbour seen in the background

D Cutting the Built-up sand bar allowing the outflow from the Khandamodera Lagoon fed by Urubokku Oya

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ANNEX B: DETAILED SOIL ANALYSIS

SOIL AND SURFACE WATER : METHODS OF COMPUTATION

- Site Elevations in MSL are based on Survey Department Topographic Maps or available contour maps for the respective site.

- Maximum slope values are based on physical measurements during study.

- Reservoir capacity estimates other than from irrigation department are based on the average depths observed during site visits..

- Rainfall values are based on data collected from regional institutions during site visits and the historical data from hydrological annuals and Ceylon Electricity Board Water Resources Data Base (July 1987).

- Maximum, Minimum and Average river flows are based on the historical flow data. In cases where streamflow data were absent, representative runoff ratios from hydrological annuals were used with rainfall in respective regions and watersheds identified using topographic maps.

- Hydraulic Conductivity Data and Sorptivity data are based on Infiltrometer Tests done at each site fitted to infiltration curve by Philip (1957).

- Soil moisture contents and the organic matter contents by Gravimetry.

- Soil quality by liquid (water) extraction and relevant water quality methods.

- Wind and temperature estimates are based on the information in the National Atlas of Sri Lanka.

- Soil classification is according to the unified system.

Soil Data for Proposed Industrial Estate at Bata-Atha

Description	Unit	Site 1	Site 2
Sampling Depth	mm	250	250
Moisture Content	%	2.42	4.12
Organic Matter	%	4.45	6.40
Classification		SW	SW
Chloride Cl^-	mg/gr	0.10	0.10
Nitrates No^-_3 -N	mg/gr	0.00	0.00
Fluoride Fl^-	mg/gr	N/A	N/A
Phospate PO^3_4 - P	mg/gr	N/D	N/D
pH		8.00	7.50
Hydraulic Conductivity (saturated)	cm/hr	1.48	5.31
Sorptivity	cm/(hr 1/2)	15.94	3.46

N/D = Not detected
N/A = Not available

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INDUSTRIAL ESTATES SITING STUDY, 1995

SUMMARY OF ANALYTICAL METHODS

PARAMETER	UNITS	METHOD	DETECTION LEVEL
TSS	mg/l	Gravimetry	-
TDS	mg/l	Gravimetry	-
DO	mg/l	Titrimetry	-
BOD	mg/l	Titrimetry	-
COD	mg/l	Open - Reflux, Titrimetry	-
pH	-log H^+	Selective ion electrode	0.01
Cl^-	mg/l	Titrimetry	-
SO_4^{2}	mg/l	Gravimetry	-
F^-	mg/l	Colorimetry	0.1
NH_4^+ - N	mg/l	Colourization/Spectrophotometer	0.01
NO_3^- - N	mg/l	Colourization/Spectrophotometer	0.01
PO_4^3 - P	mg/l	Colorimetry	2.0
Alkalinity	mg $CaCO_3$/l	Titrimetry	-
Hardness	mg $CaCO_3$/l	Titrimetry	-

WATER QUALITY ANALYSIS :

HAMBANTOTA DISTRICT

PROPOSED SITE AT BATA ATHA

Location	Date of Sample	TSS	TDS	DO	BOD_5	COD	BOD/COD	pH	Temp.	Cl	SO_4^{2-}	F	NH_3-N	NO_3-N	PO_4^{3-} - P	Carb. Alk.	Bicarb. Alk.	Carb. Hard.	Non-Carb. Hard.	Flow rate
Walawe Ganga (Intake)	July 24-27, 1995	8	280	7 4	5 5	54	0 1	7 5	29	18	18 1	2 4	0 07	ND	ND	Nil	170	140	Nil	-
Kachchigal Aru	-do-	81	420	7.0	3 0	36	0 08	8 2	30	50	40	2 6	0 09	ND	ND	Nil	180	180	Nil	5.4 m^3/min
Kalamettiya Kalappuwa Outlet	-do-	33	490	5.6	10	72	0 14	7.5	29	146	50	1 8	0 02	ND	ND	Nil	290	200	Nil	-
Well Water	-do-	84	210	-	-	-	-	7.8	29	19	2.2	1 6	0 02	ND	ND	Nil	80	80	80	-
Urubokku Oya	August 27, 1995	67	220	7.4	3.4	28	0.12	7.5	26	53	50 20	0.4	0 12	0 05	ND	Nil	170	160	Nil	-
Proposed minimum ambient water quality		-	-	3.0	4 0	-	-	5-8 5	-	1200	400	1 5	4 0	5 0	0 7	-	-	600		

ND = Not Detected