Environmental Assessment/Analysis Reports

Sierra Leone - Urban Water Supply Project
EA Category B

2 of 2
Environmental Assessment
February 1994

This report has been prepared by the Borrower or its Consultant
Guma Valley Water Company.

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Date 24 February 1994

The World Bank
1818 H Street NW
Washington DC 20433

ATTENTION: Mr. Nguyen Tin, Principal Operation Officer
Infrastructure Operation Division, Western Africa Dept.

WATER MASTER PLAN AND FEASIBILITY STUDY
ENVIRONMENTAL IMPACT ASSESSMENT REPORT

We have received the above draft Report - 15th January 1994 and the final Report 15 February 1994 which reviewed and included the points raised by the World Bank.

The final report has been made available for public inspection by affected groups and NGOs as per the attached Daily Mail publication of February 15 and 17, 1994.

We submit for your further action please.

With best regards.

Sincerely,

C.A.H. WILLIAMS
GENERAL MANAGER/ENGINEER-IN-CHIEF

Enc.

Copy: Mr. K. Nhango
Principal Water Engineer
African Development Bank
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<th>No. 0100</th>
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**INVOICE**

**DR TO SIERRA LEONE DAILY MAIL**

P. O. BOX 53—FREETOWN

**DATE:** 15th February 1939

<table>
<thead>
<tr>
<th>M. GUMA VALLEY WATER COMPANY</th>
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**ADVERTISE IN THE DAILY MAIL**

- **Public Notice**
- **Action by C. Mapeko**

1. **To cost of A 1½ × H. Advert: £2. 100,000**
2. **1 1 1 13½ × H. 17½ × H. 100,000**

**16/SEP/1939**

**ACTION BY C. Mapeko**

C. Mapeko

**PROOF**

1. **£200,000**
   2. **£200,000**
PUBLIC NOTICE

WATER MASTER PLAN AND FEASIBILITY STUDY - ENVIRONMENTAL ASSESSMENT

A water Master Plan and Feasibility Study for Gurna Valley Water company was undertaken as part of the Freetown Infrastructure Rehabilitation Project financed under a loan to the Government of Sierra Leone from the World Bank. The study recommended immediate works to rehabilitate and expand the water supply facilities. The sub-components of the physical works are as follows:

1. rehabilitation and repairs to Guma Dam and ancillary works;
2. raising of spillway level by about 1.5 metres to increase impounding capacity;
3. diversion of wet season flows from three small subsidiary catchments into the Guma reservoir to increase raw water storage capacity and improve reliability;
4. rehabilitation of Guma water treatment plant including replacement of obsolete equipment, refurbishment of filters and modifications to increase capacity to match the capacity of the Guma reservoir and transmission pipelines to Freetown;
5. trunk distribution pipe lines from Congo Cross to Dam Street (700mm dia) and Alcanus Road to Wellington (600mm dia);
6. secondary distribution repairs, replacement and limited extension;
7. roofing and repairs to distribution reservoirs in the high level zones.

A separate Environmental Assessment Report was prepared by our consultants Howard Humphreys and Engcon Ltd. Before this project is presented, by end February 1994, to financiers for project review and appraisal, the report is made available from February 15, 1994 in the public for inspection at the following places:

1. British Council Library
   Development Information Unit
   Tower Hill
   Freetown

2. Sierra Leone Library Board
   Reference Department
   Rokel Street
   Freetown

3. Guma Valley Water Company
   Guma Building, Cash Office, Groundfloor
   Lamina Sankoh Street
   Freetown
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INTRODUCTION

At present Howard Humphreys and Partners of UK, together with ENGON of Freetown, are finalising a Water Master Plan and Feasibility Study for Guma Valley Water Company. The draft report for this study is due towards the end of February 1994 when the World Bank hope to identify a fundable immediate works programme. In particular the works are to be such that they fully utilise existing resources and facilities with a view to improving supply to the water stressed areas in the east of Freetown. An outline of the major elements of the existing system are shown on Figure 1.1.

In order that the World Bank could plan for possible funding the Consultants were required to submit an additional report in December 1993 to give an indication of the likely immediate works to meet the above objectives.

At present GVWC relies almost entirely on the Guma dam source which was developed in the early 1960's. The treatment works capacity has been augmented twice since then. With the growing population and consequential increase in water demand this source will soon be inadequate and the next major source development would be by impounding the Orugu River to the east of the town. Development of the Orugu will entail very high capital expenditure, possibly in excess of U.S. $50 million for a first stage development. Such expenditure can be delayed by rehabilitation of the existing system to reduce leakage and thus make more water available to the consumer. In addition, more water can be obtained from the existing Guma source by diverting the flow from small adjacent catchments into the lake formed by Guma dam and by raising the top water level of the reservoir. Trunk distribution pipelines will have to be augmented to ensure that additional water can be conveyed to the east. These will be of large diameter and will have to traverse built up areas.
These possibilities were the subject of discussion between the World Bank and GVWC during the appraisal mission in December 1993. At a meeting on 14th December 1993 the Consultants were asked to submit this environmental impact assessment report by mid January 1994 in order to highlight any likely problem areas within a first stage project.

The items covered by this report are:

- Raising of Guma Dam spillway level

- Diversion of waters from the Little Guma and Upper Sussex catchments into the Guma Dam reservoir

- Trunk distribution mains from Congo Cross to Dan Street reservoir and from Africanus Road reservoir to Wellington reservoir.
EXISTING TRANSMISSION SYSTEM
SOURCE, TRANSMISSION, TRUNK DISTRIBUTION
AND MAJOR STORAGE

Figure 1
2. WORKS TO IMPROVE THE YIELD OF GUMA DAM

2.1 Introduction

The construction of dams, and weirs and the diversion of flows from one catchment to another may produce environmental implications to both local eco systems and to those relying on the water for their daily needs.

Guma dam was constructed in the early 1960's and is situated within the Forest Reserve of the Western Area of Sierra Leone approximately 13 km due south of Freetown. It impounds the Guma River which is one of the rivers forming the upper reaches of No. 2 River (See Figure 2.1). About 90% of the annual average inflow to the reservoir occurs in the four months July to October.

The dam is of earth and rockfill construction and is about 70m high. The catchment area is 866 ha and the lake area at a top water level of 261m a.s.l (spillway crest level) is 93 ha. The dam impounds approximately 21 million cubic metres. During construction the forest area upstream of the dam was cleared of vegetation to the 872 ft (266m) contour, which is the same level as the top of the dam.

The side channel spillway has been designed for a flood of 210 m$^3$/s. The present spillway could be raised by up to 1.5m and still accommodate the flood without any other work having to be carried out to the dam. Any increase above 1.5m would require increased rip rap protection to the upstream face and the construction of a wave wall.

The yield of Guma dam can be improved by diverting flows from the adjacent catchments of the Little Guma, Stoney and Water Chute rivers, which form part of the lower Guma/No. 2 River catchment. The Upper Sussex catchment of the Sussex river could also be diverted into the Guma reservoir (See Figure 2.1). In addition the yield and reliability of Guma can be improved by increasing the storage capacity by raising the
spillway level of Guma dam. It may not be prudent to divert all the catchments as the extent to which the yield is augmented will be governed by existing treatment and transmission capacities. However raising the dam spillway is a cheap way of improving yield and security of supply and is likely to form part of any immediate works programme.

The lay-out of the Upper Sussex diversion would comprise a 3m high concrete diversion weir at approximately 350m elevation and a trapezoidal unlined channel which would intercept run-off from the various subsidiary catchments. The channel would have a capacity of about 5m³/s which is three times greater than the estimated peak monthly flow in the period 1947 - 1992 of 1.65m³/s. Only a negligible quantity of water will be lost in spills.

A typical channel section is shown in Figure 2.2. The channel will be excavated in laterite and weathered rock and little blasting is expected to be required. The channel will have a similar section and profile to natural streams and like them will be lined with boulders. The extent of losses from the channels is expected to be low, but will be estimated during the design stage. The channels will pose no greater threat to wildlife than the existing stream courses.

As with Upper Sussex, it is proposed that diversions from Little Guma should be effected by means of an open channel. The catchment considered comprise three sub catchments, with approximate areas as follows:

<table>
<thead>
<tr>
<th>Catchment</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Little Guma</td>
<td>139 ha</td>
</tr>
<tr>
<td>Storey river</td>
<td>47 ha</td>
</tr>
<tr>
<td>Water chute</td>
<td>42 ha</td>
</tr>
</tbody>
</table>

Subject to a check on elevations, one single weir could divert the flows of Stoney river and Water Chute into the Little Guma by means of a contour channel. A second weir would be required, at the location of
Figure 2.1

GUMA DAM AND CATCHMENTS

KEY
- Catchment boundary
- Main road
- Site road
- Proposed track
- Proposed track and channel
- Weir

1000 0 1000 2000 3000m
LITTLE GUMA, WATER CHUTE AND STONEY RIVERS DIVERSION

TYPICAL SECTION

Figure 2.2
the flow measuring weir on the Little Guma, to divert the combined flow into the reservoir via a channel which would pass through the old borrow area for Guma dam.

Environmental aspects relating to the proposed yield improvements are given in the following sections.

2.2 General

The Guma catchment area has been identified as a distinct environment and one meriting protection status. It is a small catchment area of 2140 acres (866 ha) or 0.012% of the total land area of the Western Area which has a complex physical and demographic environment.

Climate

Average annual rainfall in the Dam area is 250 inches or 6350 mm/year with an average annual temperature of 27.5 degrees centigrade.

The area also has the distinction of long duration and high intensity rainfall. In August 1992 21 in. or 533 mm of rainfall was recorded within 24 hours.

Topography and Geology

The general topography in the area is hilly and mountainous with hills ranging from 230 to 460 metres above mean sea level. The soils compose of lateritic layers on the basement complex rock. Consisting mainly of basic and ultra basic igneous rocks, mainly gabbro.

The area is well drained by the Guma, Little Guma, Stoney and Water Chute rivers which are perennial and converge into the No. 2 River which flows into the coastal area and enters the Atlantic Ocean.
Human Settlement

Any populated areas are approximately 5 km down stream of the Guma dam. No. 2 River Forest compound is the only settlement which is directly located on the hill top along the No. 2 River down stream of the Guma dam.

Urban agriculture in the form of home/compound gardens (fruits and vegetables), vegetable plots and upland cultivation is practised in the coastal settlement downstream. Small ruminants, poultry and piggeries are also present.

Land tenure is freehold or privately owned.

Vegetation and Land Use

The vegetation in the Guma catchment area is typically a tropical rain forest, numerically rich in a wide spectrum of an intimate mixture of species (Flora & Fauna).

Land use in the area is limited to the dam, treatment plant and appurtenant roads and infrastructure.

Economic Activities

The sparse population in the areas downstream of the dam are involved in various economic activities such as urban agriculture, boat building, fishing, hunting, tourism, firewood and charcoal production.

Study Methodology

The environmental impact study involved field survey, interviews and discussions with Water Company personnel and local inhabitants by the multidisciplinary team. The dam site and sites for the construction of
weirs, access roads and channels were visited and water samples collected. An analysis of the major issues was made taking cognisance of the factors important to environmental management and resource use.

2.3 Findings and Observations

Land Loss and Land Degradation

The catchment areas of the Guma dam, Little Guma, Stoney, Water Chute and Upper Sussex rivers all form part of the Guma Protected Area. The existing catchment for Guma Dam occupies an area of 866 hectares whereas the total area of the four additional sub-catchments is 420 hectares (i.e. Little Guma 139 ha, Upper Sussex 192 ha, Water Chute 42 ha and Stoney 47 ha).

The catchments areas are hilly and mountainous and generally unsuitable for agriculture. There is no agricultural or economic activity taking place at present either in the catchments or in the areas proposed for the diversion weirs, channels and access roads.

The top water level of the Guma lake is 857 ft (261m) a.s.l and floods an area of 93 ha. Raising the top water level by 1.5m will increase the dam capacity to about 23 million cubic meters and the flooded area will be increased to 100 ha.

At present the area immediately above top water level is almost free of any significant vegetation. This area constitutes a freeboard area of 4.5m in depth. Any increase in storage will be accommodated within this area with no need for further vegetation clearing.

No significant exposure of land clearing that could facilitate land slip, landslide, serious erosion hazards or land degradation was observed within the catchment areas or in the areas proposed for the diversion weirs, channels or access road. The proposed development areas are
devoid of any form of settlement or any form of economic activity. The only major land use is the development works done by Guma Valley Water Company during the construction of the dam and allied components.

River Flows

The reservoir direct catchment, together with the proposed indirect catchment of Little Guma, Stoney and Water Chute form part of the upper catchment of the No. 2 River. Their catchment areas are as follows:

<table>
<thead>
<tr>
<th>Catchment Area</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guma dam direct</td>
<td>866 ha</td>
</tr>
<tr>
<td>Guma dam indirect</td>
<td>228 ha</td>
</tr>
<tr>
<td>Other catchment</td>
<td>2050 ha</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>3144 ha</td>
</tr>
</tbody>
</table>

Because of the dam, the reservoir direct catchment only contributes to the flow at No. 2 River during times of spillage, which is limited to isolated occasions during the three months of the wet season. Of the total area that at present contributes directly to the flow of No. 2 River, where the only settlement depending on Guma water exists, the area of the indirect catchment forms 10%. Thus, the contribution of this area, when diverted into the reservoir will be lost to the settlement, but this loss will only be small in proportion to the total flow.

Similarly the catchment area of the Upper Sussex is estimated to be only 18% of the total Sussex catchment and its diversion into the reservoir would have a negligible effect on the total flow in the lower Sussex River.

It is not expected that either the frequency of spilling of the Guma dam or the volume of water spilled will be affected by the proposed changes.
Fish, Aquatic Life and Water Weeds

The lake and rivers are almost free of any algae or water lilies. Mud fish and catch fish were observed in the rivers and the Guma lake. Tilapia which has been introduced into the Guma lake were also observed. There was a complete absence of blackflies and snails along the rivers or the lake.

Flora and Fauna

The catchment areas are well protected as they lie within the declared Government Forest Reserve. The forest reserve falls under the category of Tropical Moist Evergreen Forest formed on mountains and hill slopes. Presently the reserves consists of closed high forest, secondary forests and forest regrowth, with relatively high humidity and high annual average rainfall of about 250 inches (6350mm) with 3-4 months of dry season.

The reserve is numerically rich in a wide spectrum of an intimate mixture of species therefore offering a large diversity of plant and animal population. It is characterised by tall, moist, evergreen trees with a closed canopy over 30m tall and occasional emergent trees with a tendency to gregariousness in some species, with a dense undergrowth. The forests serve a wide range of ecological functions including the protection and enrichment of the soils and the natural local regulation of the hydrologic cycle especially the flows of surface and groundwater.

Common Tree Species found in the area are:

Terminalia ivorensis, Funtimia africana, Funtimia elastica, Parinari excelsia, Laphira alatz, Haritiera utilis, Nuclea diderrichu, etc. Also present in smaller quantities are: Anthonotha fragrans, Oldfieldia africana, Cynometra leoneasis. The lower storey consists of an array of species some of which are Calpacylx brevibracteatus,
Protomegararia stapfiana, Diospyros spp; Lianes, woody and herbaceous epiphytes are also common with selaginella and ferns also present.

Animal species found in these forests are: Jonticks Duicker, Diana Monkey, Red Colobus, White-necked Picathartes, Chimpanzee, and a colourful array of insects, bush fowls, reptiles, etc.

The forests provide a very rich and wide habitat for these animals. The diversion of the Little Guma and Upper Sussex rivers would have a minimal effect on plant and animal life as less than 1% of forest reserve will be affected and also these animals are not sedentary, but roam widely in search of food and shelter. Thus the diversion weirs, channel and access road which will have a width of less than 16m will not limit the free movement of animals nor affect much of the vegetation which is made of forest regrowth, shrub and bush. The clearing will therefore not adversely affect the closed high forest as the species are not endangered along the entire channel/access road route which follows approximately the 350m contour. In addition the very high annual rainfall and average yearly temperature would encourage forest emergence to clothe any of the lands which had been cleared during construction.

Deforestation

Even though there is serious encroachment within the Peninsula Forest Reserve by illegal woodcutters, coal burners, hunters, etc. surprisingly there was little evidence of these in the Guma protected area. Fortunately the catchments under study have not been adversely affected. This can be attributed to conscientious patrolling and restriction of entry by both Forestry and Water Company personnel. The very low population in the area and absence of settlements in the upper and middle catchment areas could also be a reason.
Health

Observations along the shoreline of the Guma lake and the rivers showed no evidence of snails and blackflies which are intermediate hosts for the transmission of schistomiasis and Onchocerciasis. From interviews it was established that few mosquitoes are present. Guma Valley Water Company workers and inhabitants reported not to have suffered from schists or Oncho, but only from malaria. It is quite likely that the few small ponds in the vicinity of the Guma compound close to the coastal area serves as breeding grounds for mosquitoes.

Water Quality

Analysis of the water sample collected from Little Guma river on 29th December 1993 gave the following results:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6.7</td>
</tr>
<tr>
<td>Electrical conductivity</td>
<td>20 mMhos</td>
</tr>
<tr>
<td>Total dissolved solids</td>
<td>13.0 mg/l</td>
</tr>
<tr>
<td>Iron</td>
<td>0.64 mg/l</td>
</tr>
<tr>
<td>Manganese</td>
<td>0.06 mg/l</td>
</tr>
<tr>
<td>Turbidity</td>
<td>0.84 NTU</td>
</tr>
</tbody>
</table>

Turbidity analysis of raw water from the Guma Lake on the 29th December 1993 was 0.5 NTU.

Analyses of samples of Guma raw water entering the treatment works in November 1993 gave the following results for the same determinands.

<p>| | |</p>
<table>
<thead>
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<tbody>
<tr>
<td>pH</td>
<td>6.8</td>
</tr>
<tr>
<td>Electrical conductivity</td>
<td>&lt; 36 mMhos</td>
</tr>
<tr>
<td>Total dissolved solids</td>
<td>&lt; 10 ppm</td>
</tr>
<tr>
<td>Iron</td>
<td>0.03 ppm</td>
</tr>
</tbody>
</table>
Manganese | 0.01 ppm
Turbidity | 0.45 NTU

Due to restricted access to the Stoney and Water Chute Rivers, it was not possible to collect water samples from these rivers for chemical analyses. However, the water quality of these rivers is expected to be of similar quality to the Little Guma river because of similar drainage characteristics of the catchment areas.

The water quality of the Little Guma river as shown by the parameters measured, apart from the iron concentration, complies with standards stipulated by international organisations.

The World Health Organisation (WHO) international drinking water standard for iron is 0.3 mg/l. The higher iron concentration measured in the Little River is probably from leaching of iron deposits within the catchment area. The presence of excessive iron in drinking water although objectionable on aesthetic grounds has no known adverse effects on health. The other parameters: pH, electrical conductivity, total dissolved solids, manganese and turbidity are all within acceptable ranges for drinking water supply.

Based on the above water quality data and relevant international standards, it can be concluded that the water quality of the rivers to be diverted to the Guma Reservoir will not in any way impair the existing water quality of the Guma Reservoir.

Tourism

The Guma dam and reservoir is a minor tourist attraction with tours advertised by local travel agencies. A picnic and viewing platform was provided at the time of construction as a facility for visitors. It is not known how many tourists visit the dam, but it is thought that it is very few.
The proposed diversions from the Upper Sussex and the Little Guma catchments will however add to the attractions for the visitor, as an access track will be constructed to follow the channels for their entire length. These tracks, cut at a gentle incline should provide a pleasant forest walk for visitors.

2.4 Socio Economic and Socio-Cultural Factors

Interviews carried out with a cross section of the local populace downstream of the dam area with a view of investigating the effect/impact of the construction on the local community revealed that:

i) The immediate community have been availed with the supply of pipe-borne water supply of good quality and of electricity sometime ago.

ii) The communities downstream have not experienced any serious shortage of their normal water supply needs in areas where pipe borne water is not available.

iii) Flooding has never been reported. Never has there been any loss of life or property due to any hazard.

iv) No serious erosion, land slides or any form of land degradation has been reported.

v) No water-borne disease or serious health hazard have been reported as a result of the dam.

vi) Agricultural or economic activities are absent in the Guma Reserve.

vii) Degradation is minimal in the immediate environs of the reserve.
viii) There is limited land use and no settlement in the upper and middle catchment areas of the study area.

ix) There is effective restriction entry and regular patrolling of the Guma Reserve.

2.5 Conclusions and Recommendations

The construction of access road and channel to conduct flows from Little Guma and Upper Sussex catchments to Guma lake will have minimal effect on the land, forest and animal resources of the whole of No. 2 river catchment area as less than 1% of the catchment area will be disturbed.

By increasing the top water level from 261m to 262.5m a.m.s.l. about 7 ha of additional land surrounding the lake surface will be flooded. This will not entail additional forest clearing as these areas presently form part of the cleared free board of the lake.

The chemical composition of the rivers to be diverted into the Guma lake are very similar to the lake water composition. It is therefore expected that these rivers will not affect the aquatic life of the Guma lake for both fish and plant species.

No inland fishing is carried out in the Guma lake or along the river banks of No. 2 River. Fishing is done only along the coastal creek of the river.

There are more major tributaries of No. 2 River downstream of Guma dam. These contribute water to maintain a reasonable flow in the dry season for domestic use and the dilution of water in the mangrove ecology along the coast.
The Upper Sussex river is not part of the No. 2 River catchment in which the Guma Lake is situated. Diverting water from the Upper Sussex catchment into the Guma lake will not increase the risk of flooding downstream.

Very large flood flows would not be diverted into the Guma. Flow in excess of the carrying capacity of the catchwater channel would continue down the Sussex river.
3. TRUNK DISTRIBUTION EXTENSIONS

3.1 Introduction

The present trunk distribution mains within Freetown are of inadequate size to deliver water to the east of the town or even to enable water to be fed into some of the service reservoirs. Works are in hand to reduce the leakage within the system and if the trunk distribution is not strengthened then it will not be possible to distribute the extra water to where it is urgently needed. It is proposed therefore that the trunk mains be reinforced. This will entail the laying of relatively large diameter pipes (500mm to 700mm diameter) through built up areas of the city. Basically there are two sections.

The first would be from the termination of an existing DN 700 main on Congo Town Main Road to Dan Street reservoir (see Figure 3.1). The length of this main is about 5 km and it will pass through the low cost housing and densely populated area of Kroo Bay as well as the busy commercial section of the city. Engineering considerations preclude any alternative route.

The second main, also about 5 km long, would convey water from Africanus Road reservoir to Wellington reservoir. This DN 600 main would be laid in or alongside the Kissy By-pass road as shown in Figure 3.2.

3.2 Observations

Neither of the two pipelines will have any significant long term environmental impact. Following construction and reinstatement of all surfaces, the only visible evidence of the pipelines existence will be valve chambers and short sections of exposed pipe where crossing the deeply incised river valleys. Care should be taken when siting pipe fittings to ensure, as far as possible, unobtrusive locations for any chambers, the
covers of which should be flush with the road surface or slightly proud on verges. Exposed pipes should be protected against corrosion using bitumen based paints with colours selected to be unobtrusive and to blend with the surrounds.

Major impacts will occur during the construction stage where the route through Freetown's relatively narrow, congested streets will inevitably result in increased noise and traffic disruption. Local traffic control regulations should be enforced and every effort made to minimise disruption by co-operating with the requirements of the local authorities and the traffic police. Access to properties affected by the works should be maintained as far as possible by:

i) limiting the amount of trench permitted to be open at any time.

ii) limiting contractor's stringing operations to avoid long lengths of unlaid pipes strung by the roadside.

iii) providing financial incentives within the contract for prompt temporary reinstatement of trenches.

iv) restricting the dumping of trench spoil in unsuitable or inconvenient locations.

v) ensuring the provision of adequate road plates to enable trench crossing.

Dust and noise could become a nuisance but strict control of contractor's activities should minimise these effects. However, the anticipated large quantity of rock to be encountered will mean that jack hammers, rock breakers and possibly even blasting may be required. If so elaborate measures will need to be taken to safeguard people and property.
ROUTE OF MAIN BETWEEN
AFRICANIUS ROAD AND WELLINGTON RESERVOIRS

Figure 3
Traffic control will be a major concern. In the central business district sufficient alternative routes exist to minimise congestion however, in the areas of Congo Town, Ascension Town Road, Goderich Road and Kissy Street significant disruption to traffic must be expected. Well marked alternative routes are required.

The following two sections describe in more detail each of the pipeline routes and their possible environmental impacts. Section 3.3 deals with the pipeline from Congo Town Main Road to Dan Street reservoir and Section 3.4 the pipeline from Africanus Road reservoir to Wellington reservoir.
<table>
<thead>
<tr>
<th>SECTION</th>
<th>LENGTH</th>
<th>DESCRIPTION</th>
<th>EFFECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONGO TOWN MAIN ROAD</td>
<td>Approx 900m</td>
<td>Residential area with some street trading. Occasional high traffic flow to city.</td>
<td>Initial sections of the road are narrow and construction work will prevent traffic from using the road as a through route. Access for residents will be from either end.</td>
</tr>
<tr>
<td>ASCENSION TOWN ROAD</td>
<td>Approx 525m</td>
<td>Residential area and continuation of Congo Town Road, light traffic volume. The Northern edge of the Road has an embankment at the foot of which there are some houses. This road also serves as one of the accesses to the Ascension Town Cemetery. Street trading in this area is scanty.</td>
<td>The most significant impact will be the disruption to funeral processions and of risk excavated materials falling on to houses where the road is on an embankment. This could however be averted if proper site management is observed during construction.</td>
</tr>
<tr>
<td>LOWER SYKE ST. KINGDOM</td>
<td>Approx 110m</td>
<td>Low income group Residential area. Temporary structures around the vicinity. This unpaved leg of lower Syke St. was acquired in the early nineteen seventies for the proposed coastal route highway.</td>
<td>No significant impact temporary structures are not threatened and therefore no disruption to life and commerce. Traffic control required at junction with Ascension Town Road.</td>
</tr>
<tr>
<td>GENET LANE</td>
<td>Approx 200m</td>
<td>Partly residential. This is a swamp area which has been reclaimed with refuse dumped over decades and which has now consolidated to permit the construction of a road for further reclamation work.</td>
<td>No significant disruption anticipated. Pipe buried in this area may be endangered by aggressive sub-surface conditions. Little traffic uses this road.</td>
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<tr>
<td>HENNESSY ST.</td>
<td>Approx 50m</td>
<td>This is a Residential/Commercial/Industrial area adjacent to the 7-UP factory. It is the only road leading to Kingtom Power House which supplies Freetown with electricity. There is also the Cemetery, Police Barracks, and two important Schools - St Edwards and Prince of Wales.</td>
<td>Some disruption to traffic will be caused into and out of Kingtom during the road works. Proper traffic control arrangements should minimise disruption. The construction period is not anticipated to last for more than one week.</td>
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<tr>
<td>BYRNE LAND DOWN TO KROOBAY AND LOWER WALLACE JOHNSON ST.</td>
<td>Approx 500m</td>
<td>Mixed activity area mostly occupied by the low income group. Between Byrne Street and the Alligator River, the route goes through some private land. Within Kroobay the pipe line follows an existing access road which is to be widened under the Kroobay upgrading program. Marketing is prevalent at Kroobay and many zinc structures could be close to the vicinity of construction.</td>
<td>The major impact of displacing some owners of zinc structures at Kroobay has been absorbed by the road Project. Further minor disruption to a few properties may be necessary along the pipe alignment which does not initially follow an established road. After joining the new road there will be some disruption to street trading. Care must be taken not to leave trenches open for long periods because many children in this income level are outdoor most of the time. Excavation, laying of pipe and backfilling is advised to be handled one pipe at a time. The crossing of the Alligator river will be by undercrossing to minimise long term effects. The river course will be reinstated to its former condition.</td>
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<tr>
<td>LIGHTFOOT BOSTON ST. TO EAST ST.</td>
<td>Approx 1200m</td>
<td>Central Business District area Connought Hospital, King Jimmy Market, Churches, Mosques. Office building and shops are along this route. The route could carry four cars although it is currently used as a dual carriageway.</td>
<td>No significant adverse Impact is anticipated. Measures may however be necessary to minimise noise levels at vicinity of Connought Hospital. Whilst trenching across Percival Street it is important to maintain access to Connought Hospital's Emergency Section. Minor disruption will be caused to the street parking.</td>
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<td>EAST STREET, UPPER EAST AND LUMLEY STREET, GODERICH STREET UNTO CLOCK TOWER</td>
<td>Approx 1100m</td>
<td>This area is the most congested within the Central Business District (CBD). East Street has mainly building material stores; Upper East Street has the Kissy Road market, and street hawkers, Provision Stores and all types of traders sprawl along Lumley Street. Most of the structures are concrete and have three floors on average. Although the traffic volume is not high but most part of the Street is occupied by parked cars owned by the shop owners or shoppers who go to Malama Thomas Street and other narrow no-parking streets.</td>
<td>Construction in this area will cause disruption to the normal commercial activities for the period of the works. Access will be restricted and street parking curtailed. Access for pedestrians must be maintained. Traffic flow could be affected at Kissy Street crossing. Kissy Road is a major route linking the CBD and the East. It is a dual carriageway and most goods containers for the Port use this route. Goderich Street by the bridge unto Clock Tower is another area likely to cause problem to traffic flow because of its narrowness, the closeness of buildings the bridge crossing and the several trenching deflections all of which are not conducive to speedy construction. It is advisable that this particular area must be addressed in the tender document and co-ordination with relevant authorities on traffic and roads would be essential and that Kissy Road must be controlled to enhance its capacity to handle additional traffic volume which may be diverted from Goderick Street. Sensitive crossings of main roads can be carried out at night.</td>
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<td>FROM CLOCK TOWER, ALONG KISSY ROAD TO DAN STREET</td>
<td>Approx 1100m</td>
<td>Kissy Road goes through the heart of Freetown East. This area has the highest population density and the houses along Kissy Road are closely knitted. Majority of the houses are multi-storey and almost all have stores or shops on the ground floor. Many also have drive ways into their property. Kissy Road is the route used by many buses, taxis, and is shortest route to the industrial area at Wellington. There are churches and schools. Traffic flow is in two directions. It also has buried water pipes, electric and telephone cables buried.</td>
<td>The impact in this area will be significant particularly on vehicular traffic. During construct access to shops and premises will be on foot with parking in the side streets. The presence of rock will increase the duration of construction. Main access to the CBD from the east will be along Fourbay Road. Some restrictions on street trading will be necessary if the flow of traffic is to be maintained. The high population density increases the chances of accidents to pedestrians. Care must be taken to protect pedestrians by provision of adequate barriers and trench bridges. Danger also exist of disruption to essential services which may be accidentally damaged. It is advisable the preconstruction activities include an investigation on actual location of these facilities.</td>
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<td>KISSY BY-PASS</td>
<td>Approx 4800m</td>
<td>Old main route out of Freetown to the east. Single carriage road with run-off areas. Small commercial premise fronting the road and some residential properties. Light traffic usage due to presence of adjacent dual carriageway</td>
<td>Disruption should be minimal. Traffic volumes can be handled using diversions or traffic control passed working area. Several large culverts and small bridges will require overcrossings adjacent to existing services. These should be carried out unobtrusively.</td>
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<tr>
<td>MAXWELL ROAD</td>
<td>Approx 500m</td>
<td>Narrow improved road to reservoir site. A small number of residential properties and a construction camp. Minimal traffic.</td>
<td>Alternative routes exist via linked parallel roads so disruption should be minimal.</td>
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