

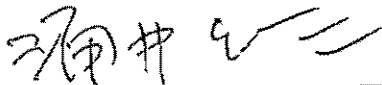
**Minutes of Discussions**  
on  
**the Preparatory Survey for the Project for the Establishment of**  
**Rural Water Supply System in Kambia Town**  
**in the Republic of Sierra Leone**  
**(Explanation on Draft Report)**

In April 2010, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched a Preparatory Survey Team on the Project for the Establishment of Rural Water Supply System in Kambia Town (hereinafter referred to as "the Project") to the Republic of Sierra Leone (hereinafter referred to as "Sierra Leone") and through discussion, field survey, and technical examination of the results in Japan, JICA prepared a draft report of the study.

In order to explain and to consult the Sierra Leonean authorities concerned on the components of the draft report, JICA dispatched to Sierra Leone the Draft Report Explanation Team (hereinafter referred to as "the Team"), which was headed by Mr. Junji Wakui, Director of Water Resources Management Division 2, Global Environment Department, JICA, from October 18<sup>th</sup>, 2010.


As a result of discussions, both parties confirmed the main items described on the attached sheets.

Freetown, 21<sup>st</sup> October 2010



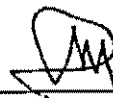
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Mr. Junji Wakui  
Team Leader  
Preparatory Survey Team  
Japan International Cooperation Agency



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Hon. Prof. Ogunlade R. Davidson  
Minister  
Ministry of Energy and Water Resources  
Government of Sierra Leone



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Mr. S. S. A. Sankoh  
Chairman  
Kambia District Council

## ATTACHMENT

### 1. Components of the Draft Report

The Sierra Leonean side agreed and accepted in principle the components of the draft outline design explained by the Team.

### 2. Japan's Grant Aid scheme

The Sierra Leonean side understood the scheme of Japan's Grant Aid and would take the necessary measures and allocate necessary budget properly for smooth implementation of the Project, as a condition for the Japanese Grant Aid to be implemented. The Grant Aid Scheme and necessary measures were described in the Annex 4, 5 and 6 of the Minutes of Discussions signed by both sides on 29<sup>th</sup> April, 2010 (hereinafter referred to as "the previous minute").

### 3. Responsible and Implementing Agency

Both sides reconfirmed the responsible and implementing agencies as follows:

- The responsible agency: the Ministry of Energy and Water Resources (hereinafter referred to as "ME&WR")
- The implementing agency: Water Supply Division of ME&WR (hereinafter referred to as "WSD")

### 4. Schedule of the Study

JICA will complete the final report in accordance with the confirmed item and send it to the Government of Sierra Leone by the end of January, 2011.

### 5. Other Relevant Issues

#### (1) Project Cost Estimate and Budgetary Arrangement

The Team explained to the Sierra Leonean side the estimated project cost as attached in Annex 1. Both sides confirmed that this estimated cost was provisional and would be examined further by the Government of Japan for its final approval. Furthermore, both sides confirmed that this project cost estimate is confidential, and should never be duplicated in any forms or released to any other parties until the relevant contracts are awarded by ME&WR, in order to secure fairness of tender procedure.

#### (2) Budget arrangement for operation and maintenance of the water supply facilities

The Team explained the estimated cost for management, operation, and maintenance of water supply facilities as described in Annex 2, and the Sierra Leonean side promised to allocate necessary budget.

#### (3) Service Area of the Project

Both sides reconfirmed the service areas, the locations of principal facilities, and the route of distribution network as shown in Annex-3.

#### (4) Preparation for establishment of KWSSB

Both sides have agreed the detailed necessary procedures to follow for the establishment

of the Kambia Water Supply and Sanitation Board (KWSSB), which is responsible for water supply in Kambia Town, in the Annex-8 of the previous minutes (the Roadmap). Regarding the preparation for the establishment of KWSSB, both sides confirmed the progress as followings;

- The Working Group for the establishment of KWSSB has been officially established with the official appointment of thirteen (13) members. The member list is attached in Annex-4.
- The Working Group completed to prepare a draft bye-law for the establishment of KWSSB as shown in Annex-5, through member meetings.
- Kambia District Council will review the draft and officially approve it, by May 15<sup>th</sup>, 2011.
- The Team proposed a tentative organization chart, indicating number of staff necessary to be assigned for appropriate operation of KWSSB, in Annex-6. The Kambia District Council understood and expressed its will to recruit staffs by following the chart.
- It is the Kambia District Council that has responsibility for the establishment of KWSSB, and it will make the best effort. However, WSD will monitor the progress and provide technical and financial assistance to the District when necessary. Especially, WSD shall dispatch its technical staff who are familiar with operation of water supply facilities to KWSSB for technical transfer and consultation.
- The Team explained estimated monthly cost for the operation of KWSSB, including operation and maintenance of the facilities to be constructed by the Project, administrative cost, etc, as shown in Annex-2. The Sierra Leonean side understood it and confirmed that WSD is responsible for securing budget necessary for first three (3) months for operation at least as initial capital before KWSSB is able to collect sufficient water charge for proper operation and maintenance from its customers.

**(5) Other undertakings of the Sierra Leonean side**

The Team explained to the Sierra Leonean side its undertakings as listed in Annex-7, and the Sierra Leonean side understood and promised to execute them. The following items are to be emphasized:

**1) Exemption of financial duties**

Both sides reconfirmed ME&WR shall take necessary measures to facilitate project implementation, such as exemption of Value Added Tax, Goods and Service Tax (GST), custom duties, and any other taxes and fiscal levy charges in Sierra Leone arisen from the Project activities, collaborating with the Ministry of Finance and Ministry of Foreign Affairs.

**2) Site clearance at the proposed construction site**

The Team requested the Sierra Leonean side to remove existing buildings on the proposed construction sites for the water treatment plant and elevated tank by September 30<sup>th</sup>, 2011, at own cost. The Sierra Leonean side understood and promised to carry it out by the above mentioned deadline.

**3) Provision of stock yard**

The Team explained that the huge amount of construction materials for the Project such as

pipng materials might be delivered to Kambia Town and they must be properly stored during the construction, and therefore requested the Sierra Leonean side to provide land for stock yard in Kambia Town before the Project commences. The Sierra Leonean side understood and promised that Kambia District Council will propose location of the stock yard to JICA Sierra Leone Field Office by November 30<sup>th</sup>, 2010 in writing, through consultation with WSD. The Team requested that the yard should be flat for easy access of construction vehicles, and the Sierra Leonean side took note.

**(6) Environmental and social consideration**

The Sierra Leonean side explained that, in response to the application to environmental impact assessment submitted by WSD, the Sierra Leone Environment Protection Agency (SLEPA) would categorized the Project as "class C", which is not expected to generate negative impact on environment. Japanese side requested WSD to submit a copy of the environmental certificate to JICA Sierra Leone Field Office by November 30<sup>th</sup>, 2010, to verify the official decision of the SLEPA.

**(7) Land use permission**

Both sides confirmed that the Sierra Leonean side already made agreement with the Paramount Chief on the land use for the Project, but the agreement has not included the exact location of the facilities to be constructed yet. The Team showed the proposed location of the public taps and pipeline route as a result of the survey as shown in Annex-8, and requested the Sierra Leonean side to make complementary agreement with the Paramount Chief on land use on the proposed locations. The Sierra Leonean side agreed and promised to submit a copy of the agreement to JICA Sierra Leone Field Office by November 30<sup>th</sup>, 2010.

**(8) Tentative Schedule**

Japanese side explained the tentative schedule as shown in the following table;

The Government of Japan has cabinet meeting for final approval.	December, 2010
(In the case the Project is formally approved by the Government of Japan)	
- Both Governments sign Exchange of Note. - The Sierra Leonean authorities and JICA sign Grant Agreement.	January, 2011
The Government of Sierra Leone makes contract with Japanese consulting firm for the project implementation, referring to the recommendation from the Government of Japan.	February, 2011
Tender for the construction is carried out.	June, 2011
Actual construction work commences.	August, 2011
Construction work is completed.	November, 2012

End

Confidential

Annex 1

Components of the Project

This Page is closed due to the confidentiality.

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Table 1-B: Cost borne by the Government of Sierra Leone

Items	Cost (Million SLL)	Cost (Million JPY)
Clearing Construction Sites		
- Site clearance at the existing waterworks	504.52	12.61
- Site clearance at the existing elevated tank	131.64	3.29
Initial O&M Cost for KWSSB	39.51	0.99
Total	675.67	16.89

Note:

- The costs in Table 1-B are estimated based on prices and exchange rate (1.0 US dollar = 92.13 Japanese Yen, 1.0 Leone = 0.0250 Japanese Yen) as of June, 2010.
- Management cost including payment of banking commission for the Authorization to Pay (A/P) and payment to a Japanese bank based upon the Banking Arrangement (B/A), as mentioned in 10) of Annex-7 in this Minute of Discussions, is also to be borne by the Sierra Leonean side. The total amount will be depend on the total project cost, and it might be approximately 0.1% of the project cost (0.8million JPY =32 million SLL).

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**Monthly operation and maintenance cost in 2013**

Items	Cost (Thousand SLL)	Cost (Thousand JPY)	Remarks
1. Fuel cost	7,910	198	
2. Maintenance Cost	396	10	5% of 1
3. Personnel Cost - Technical Staff - Administrative Staff - Water rate collector - Part-time labourer	4,150	104	
4. Office cost	415	10	10% of 3
5. Sitting Fee (Board Member))	300	8	
<b>Total</b>	<b>13,171</b>	<b>330</b>	

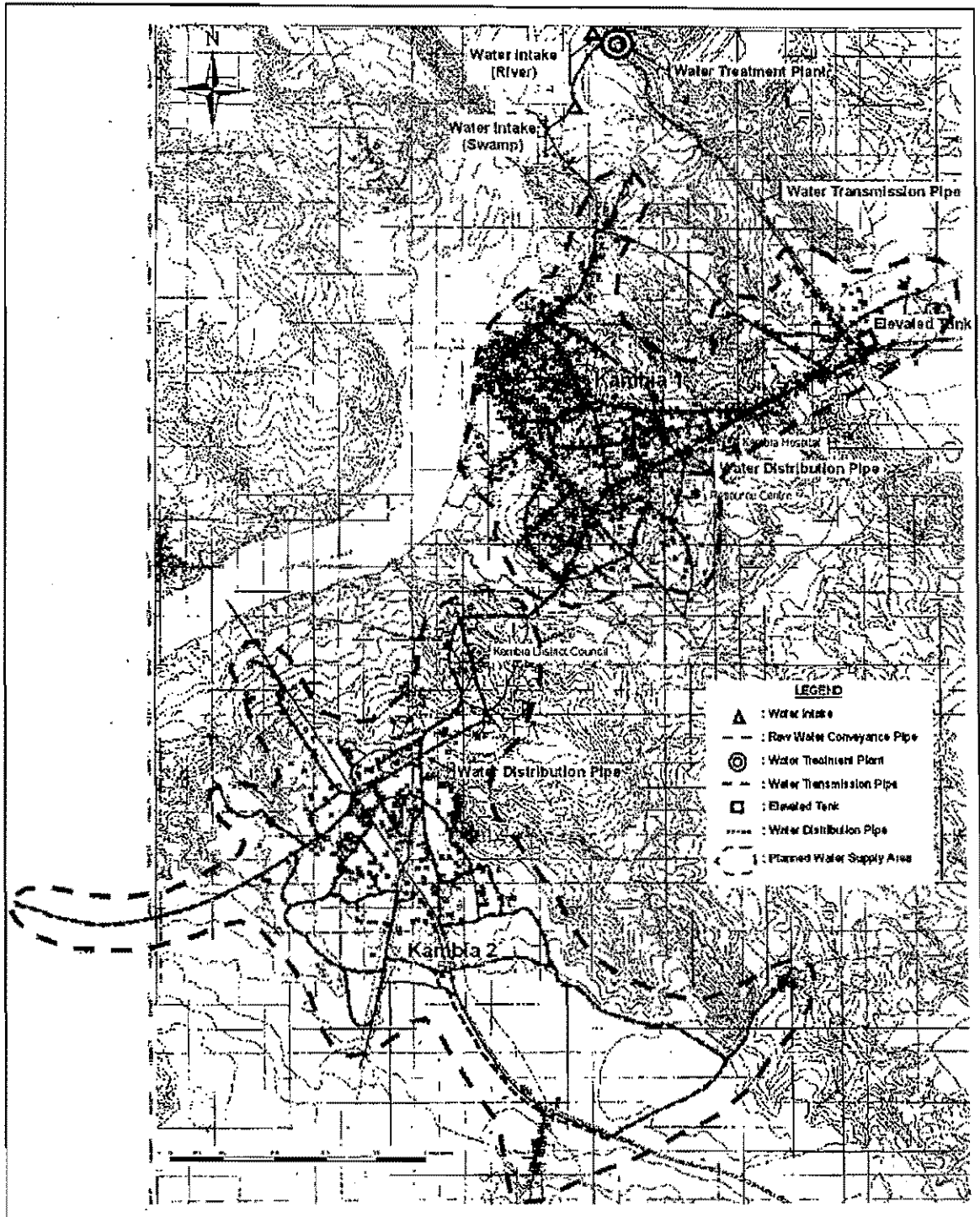
**Monthly operation and maintenance cost in the Target Year (2016)**

Items	Cost (Thousand SLL)	Cost (Thousand JPY)	Remarks
1. Fuel cost	20,196	505	
2. Maintenance Cost	1,010	25	5% of 1
3. Personnel Cost - Technical Staff - Administrative Staff - Water rate collector - Part-time labourer	7,800	195	
4. Office cost	780	19	10% of 3
5. Sitting Fee (Board Member))	300	8	
<b>Total</b>	<b>30,086</b>	<b>752</b>	

Note:

The costs are estimated based on prices and exchange rate (1.0 US dollar = 92.13 Japanese Yen, 1.0 Leone = 0.0250 Japanese Yen) as of June, 2010.

Service area and layout map



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**Member list of the working group for establishment of KWSSB  
(as of October, 2010)**

- |  |  |
|--|--|
| 1. Kambia 1                                | Madam Hawa Kamura  |
| 2. Kambia 2                                | Madam Umu Turay  |
| 3. Kambia 3                                | Madam Ya Alimamy Sally Smith                                     |
| 4. Paramount Chief                         | P.C. Bai Farama Tass Bubu Angbak III                             |
| 5. District Medical Officer                | Dr. Chernor Jalloh (Kambia Govt. Hospital)                       |
| 6. NGO Representative                      | Mr. Alimamy Kamara (ABC Development)                             |
| 7. Youth Group                             | Mr. Anito Kamara   |
| 8. Women's Group                           | Madam Isatu Serengbeh  |
| 9. Teachers' Union                         | Mr. Osman S. Conteh  |
| 10. MDA's Representative                   | Mr. Abdul Nassar Fofanah (SLRA Engineer)                         |
| 11. Kambia District Council Representative | Mr. Francis Kamara (MEWR WSD)                                    |
| 12. Ward -122 Representative-              | Coouncilor Aminata Conteh (Mrs.)                                 |
| 13. Works Committee Representative         | Councilor N'Sorie Yansaneh, Chairman<br>Councils' Work Committee |

The above is as approved by Kambia District Council on August 15<sup>th</sup>, 2010

**Draft Bye-Laws for establishment of KWSSB**



**KAMBIA DISTRICT COUNCIL  
KAMBIA**


Sierra Leone District Council 2010/11

1<sup>st</sup> October, 2010

Representative of JICA  
Sierra Leone

**APPROVAL OF DRAFT BYE-LAWS**

Having gone through the Draft Bye-laws prepared by the Working Group, for the operation of the Kambia Water Supply, I hereby approve these Bye-laws for the effective running of the water Supply, when completed.

  
.....  
Samuel S. A. Sankoh  
Chairman  
Kambia District Council

**Copy:**

The Chief Administrator – Kambia District Council

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## BYE LAWS FOR KAMBIA WATER SUPPLY AND SANITATION BOARD

By virtue of the powers vested in the Kambia District Council these Bye-laws are hereby made this 1<sup>st</sup> day of October 2010.

### 1.0 NAME

This is hereby established for each area or community listed in the Kambia Water Supply Schedule to a body which shall be called the Kambia Water and Sanitation Development Board hereinafter referred to as "The Board" whose functions shall be applicable in the Kambia community and such others as may from times be added by amendment of these bye-laws.

### 2.0 COMPOSITION

The Board shall comprise not less than 5 and not more than 13 members. This number may be exceeded if the system serves several areas or communities.

### 2.1 BOARD MEMBERSHIP

Members of the Board shall be appointed or elected as follows:-

- (a) Representative from various sections of the Kambia Community
- (b) In the event (a) result in gender imbalance, or does not make up the required number the following shall be considered:-
  - (1) At least two representatives, who shall be women, representing women's organization and water user groups
  - (2) Recognized community organizations that carry out activities directly related to water, sanitation and community development. The Board shall keep a list of eligible community organizations to be revised each year adding new and active groups, and removing those, which have become inactive from which members may be drawn, the list of community organization eligible to elect members onto the Board must include women's organizations as well.
- (c) Additionally, the following may be considered as Ex-officio members:
  - (1) Representatives of leaders of the community that have the authority to represent their areas in community affairs inclusive of women and or religious authorities.
  - (2) The Councillor representing Kambia Community in the Kambia District Council. In the event these are more than one, at least one member of the Kambia District Council representing the community.

### 2.2 DURATION OF MEMBERSHIP

Each person elected or appointed to the Board shall serve a two-year term. Members of the Board shall be eligible for re-election or re-appointment.

Members of the first elected Board shall have an initial term commensurate with the duration of the project cycle till commissioning of the water supply system, and thereafter, another term of two years. During this period, the Board cannot be changed.

### 3.0 DELEGATION OF RESPONSIBILITIES

The Board shall delegate responsibility for its various management functions among its members by appointing 1- 2 members:

- a. administrations
- b. financial management and
- c. technical management
- d. water utilisation, education, community mobilization and training

### 4.0 MANDATE OF THE BOARD

The Board shall be responsible for the management of the operation and maintenance of all water supply systems in the service area KAMBIA within the jurisdiction of the Kambia District Council.

This mandate shall include the following specific aspects:

- a. The preparation of plans for the establishment, rehabilitation, expansion and replacement of existing well as new water systems in any community specified in the schedule to these bye-laws.
- b. Proposing an appropriate tariff to cover the cost of operation and maintaining the community water system, including capital depreciation; such tariff to be approved by the Kambia District Council.
- c. Recruiting and supervision of qualified persons within the community to work as operators and managers of the community water system.
- d. Contracting an outside agency where appropriate to carry out operations and maintenance or maintenance alone.
- e. Recommending necessary byelaws (to be enacted by the Kambia District Council) that would regulate water use enforce tariff and other financial obligations and promote appropriate sanitation practices within the community.
- f. Undertaking public education and community training to promote tariff obligations and sound sanitation and hygienic behaviors within the community.
- g. Setting procedures and charges for services connection, disconnection, penalties for default and damages to the water supply system, subject to the approval of the Kambia District Council,

### 5.0 OBLIGATIONS OF THE BOARD

The Board has an obligation to establish a mechanism for consultation with the community in arriving at decisions on all matters including:

- a) Preparation of plans for water system rehabilitation and expansion; and
- b) Major expenditure on the water system
- c) Mobilization of the community for education on its objectives and necessary steps for implementing same
- d) Fixing of sanctions by way of monetary fines not exceeding.....Leones Le.....for a first breach of its rules, the provisions of this sub-section to be applicable to only able-bodied persons of rate-paying age.

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- e) The WSSB will ensure that Water is kept running for the period of time each day planned for.
- f) The WSSB will ensure that the quantity of water to be provided each day allows for a minimum of 15 l/c/d.
- g) Water losses will be kept to a maximum of 10% (New Systems) and 15% (Rehabilitated Systems). These will be determined by meters of which records of readings shall be kept and aggregated monthly to be made available for inspection by the designated representative of the district should an inspection be carried out.
- h) The WSSDB shall ensure that the quality of the Water is regularly monitored in accordance with guidelines to be issued by the Sierra Leone National Water Quality lab.
- i) While the WSSB may not itself carry out the monitoring, it will have the responsibility to ensure that the monitoring is carried out with the specified regularity.
- j) Breakdowns shall be kept to a minimum

In the case of breakdowns lasting for 1 – 3 days, the WSSB shall ensure that communities always store at least one day Water Supply for emergency use and that this Water is changed every 48 hours

In the case of major breakdown lasting more than 3 days appropriate measures shall be put in place to ensure an emergency supply of potable Water

Arrangement of the provision of such Water in emergency shall be in place by the time of commissioning of the work

The WSSB will have the obligation to inform the community of planned shut downs before these shut downs are made

In the case of planned shut downs, the obligations governing emergency supply of Water can still be applied

## 6.0 JURISDICTION AND AUTHORITY

- 6.1 The Board derives its legal authority in accordance with the byelaws of the Kambia District Council. The Council shall approve and adopt all resolutions and sanction all byelaws proposed by the Board, after the necessary deliberations on the appropriateness and legality for such resolutions and byelaws.
- 6.2 In turn, the Council shall vest the Board with all authority and jurisdiction over the development, operation and maintenance of all Water Systems specified in the schedule and such others as may from time to time be added thereto.
- 6.3 The Kambia District Water and Sanitation Team and from the National level, the MDA responsible for backstopping the Local Councils in Water Supply and Sanitation service delivery shall facilitate the work of the WSSB and shall, from time to time provide technical advice to guide the work of the WSSB and assist the Kambia District Council to exercise its jurisdiction and authority.

## 7.0 FINANCE AND OPERATING BUDGET

### 7.1 FINANCE

- (1) The Board shall raise its own finance directly from Water supply tariff to the operation and maintenance of the water system, in a manner determined by the Board and approved by the Assembly. The Kambia District Council may allocate funds through its regular budgetary allocation to

support major rehabilitation and expansion of the community water supply system, where necessary.

## **7.2 Financial Management**

For the purpose of managing these finances, the Board shall establish its own bank accounts. At least two of these accounts shall be operational designated as "Operational Account" and "Reserve Account" Other accounts may be designated for particular activities including the running of the Board. The Board shall establish a book-keeping system appropriate for the management of funds relating to the nature of its business, and provide quarterly financial reports to the Kambia District Council and the Kambia Community.

## **8.0 MEETING AND REPORTING**

### **8.1 Regular Meeting**

The Board shall meet as many times as required but at any rate no less than once a month to effectively develop, operate and maintain the community water supply system

### **8.2 Quorum and Voting**

At least half of the Board members shall form a quorum for Board meetings. Voting at the Board shall be based on a simple majority.

### **8.3 Records of Decisions**

The Secretary of the Board shall keep a correct record of decision made at each meeting. This record of decisions shall be posted at the community Notice Board for public view

### **8.4 Community Notice Board**

The Board shall establish a Community Board, accessible to all Community members at all times. The notice Board shall be used to publicise all records of decision of Board meetings, monthly financial reports, information and announcement about the water system.

### **8.5 Sitting Allowance**

The Board members shall be paid sitting allowances to be agreed with the Community. Allowances payable shall be subject to periodic review by the Community.

### **8.6 Presentation to the Kambia District Council**

Each time the Kambia District Council is in session the Chairperson of the Board (or his/her representative) shall make a presentation to the Kambia District Council on the status of the community water system, upon request. At least, one presentation shall be made in a year.

### 8.7 Annual Community Forum

Once every year, the entire community shall be given the opportunity to participate in the review of the Board's work through a community forum. The forum would also be used to educate the community on their obligations to support the water system, and to promote appropriate sanitation and hygienic behavior.

### 9.0 Financial Statement and Regular Audit

- i. The Board shall produce month, quarterly and annual financial statement/reports. These shall be posted on Community Notice Board for public review. A copy of each of the quarterly and annual financial reports shall also be given to the Kambia District Council.
- ii. The finances of the Board shall be audited once a year, via the regular District Administration audit mechanism. The Board shall arrange for quarterly internal audit on retainer basis. The audit reports shall be approved by the Kambia District Council and posted on the Kambia Water Supply System community Notice Board.

### 10.0 Amendment of Bye-Laws

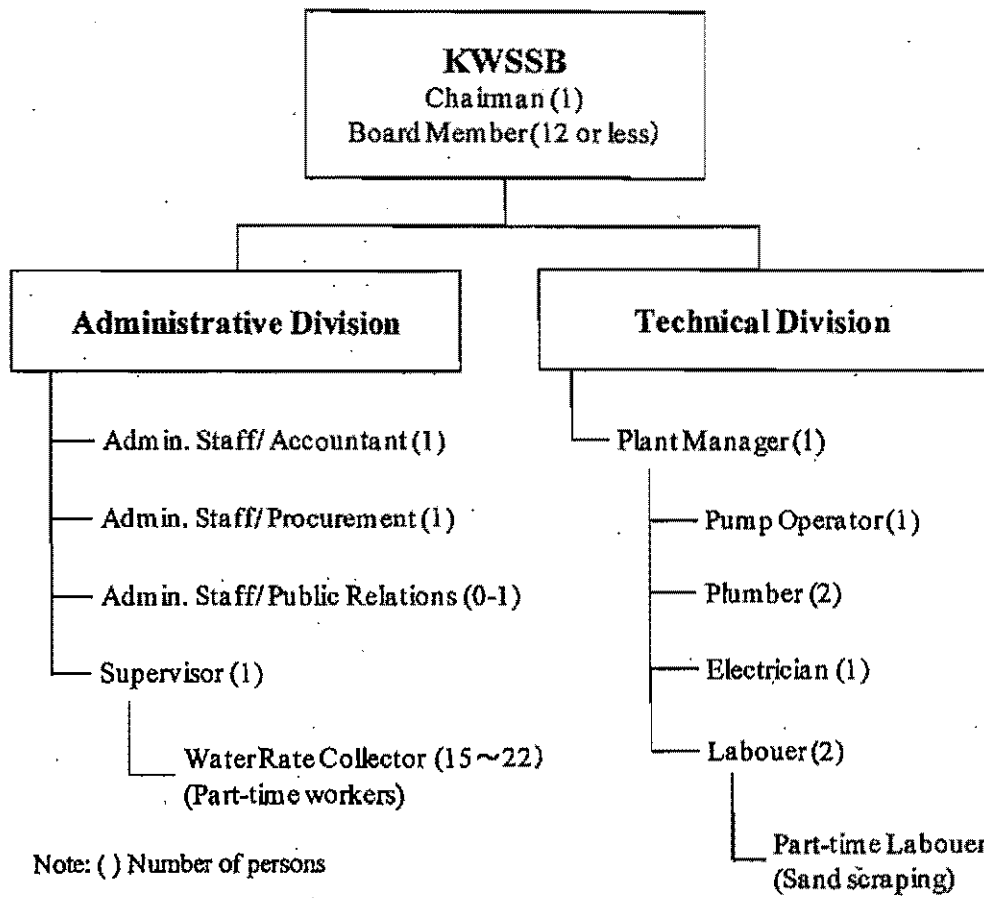
- i. These byelaws may be amended at any time deemed necessary for the achievement of the objectives of the Board.
- ii. Such amendment can only be effected upon agreement by no less than two thirds of all members of the Board that have been established by this instrument, and in the presence and active participation and consent of the Assembly members designated for said communities.
- iii. The Schedule hereto may be amended by addition of such other communities or areas as is deemed appropriate for the application of these byelaws by a Resolution of the Kambia District Council.

### 11.0 Schedule

<u>Community Name</u>	<u>Date</u>	<u>Signature of Board Chairman</u>
Kambla One	1st OCT 2010	Gibril Conteh
Kambla Two		
Kambla Three		



Tentative organization chart of KWSSB



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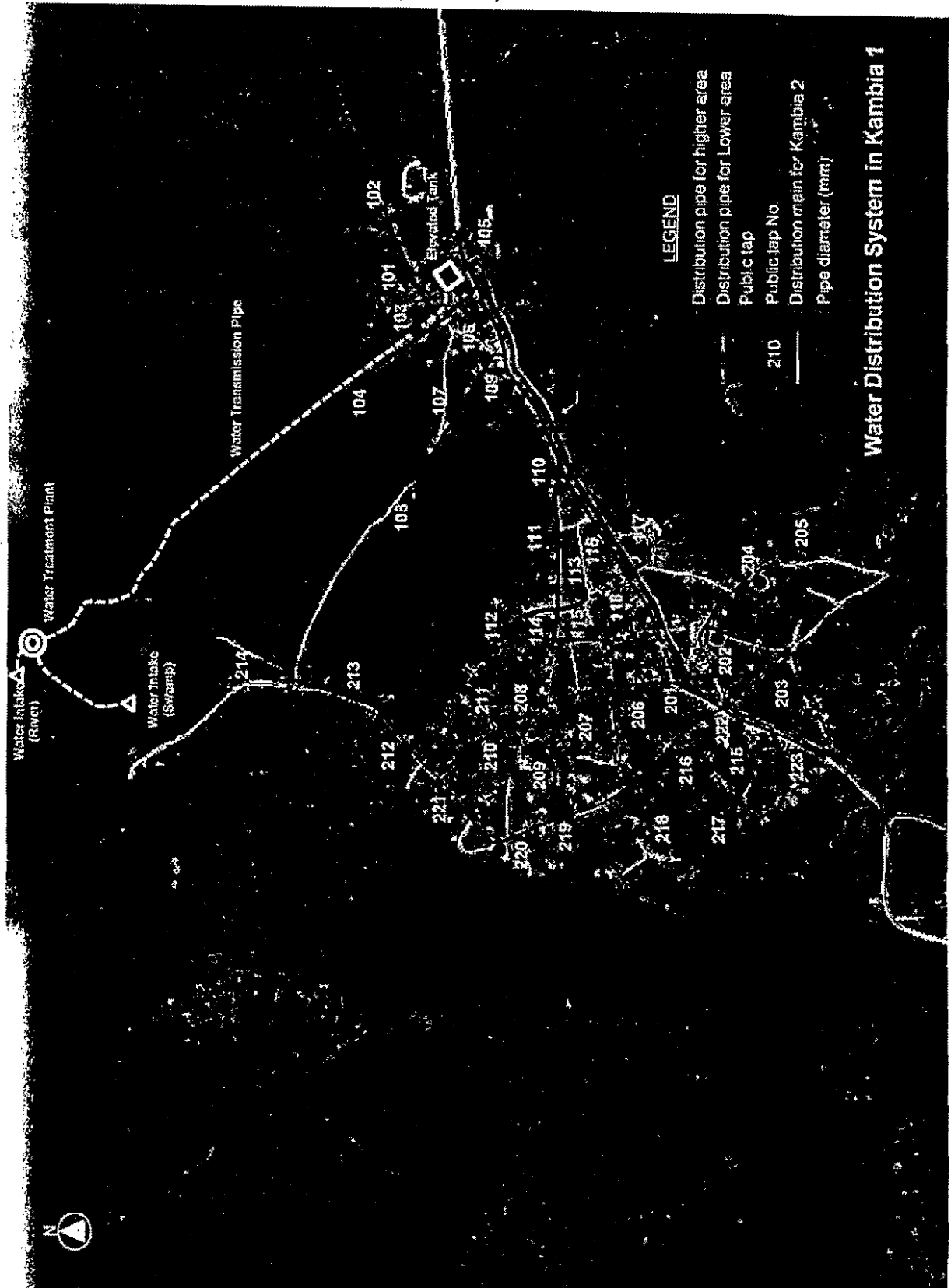
### Undertakings of the Sierra Leonean side

In the implementation of the Project, the Sierra Leonean side will be responsible for the following:

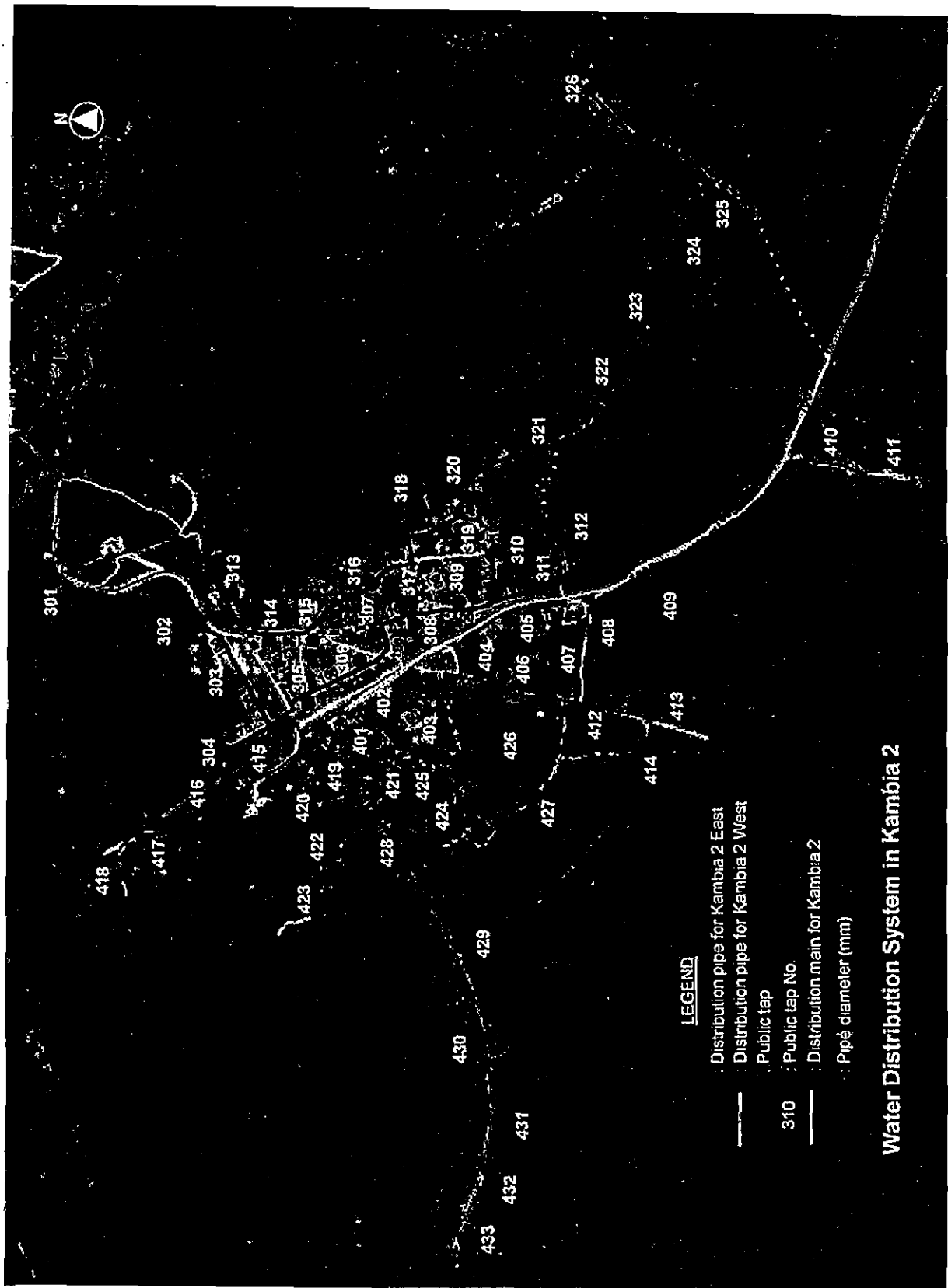
- 1) Provision of stock yard (approx. 5,000m<sup>2</sup>) of the construction materials and equipment
- 2) Acquisition of land at the sites for the construction of the following facilities:
  - (a) Water Intake
 

- Kolentén River	100m <sup>2</sup>	Public lands
- Swamp	100m <sup>2</sup>	Public lands
  - (b) Water Treatment Plant      10,000m<sup>2</sup>      Public lands
  - (c) Elevated Tank                      500m<sup>2</sup>      Public lands
  - (d) Public Taps                      5m<sup>2</sup>×100 places      Public and private lands
- 3) Site clearance at the construction site of the water treatment plant (removal of the existing water treatment facilities and buildings).
- 4) Site clearance at the construction site of the elevated tank (removal of steel shaft and tank of the existing elevated tank).
- 5) Prompt customs clearance and tax exemption of the equipment and materials required in the implementation of the Project at the port of landing and support for smooth delivery of the equipment and materials.
- 6) Payment of all the expenses not including in Japan's Grant Aid scheme but necessary for the implementation of the project:
  - (a) Management cost of the Ministry of Energy and Water Resources related to the Project
  - (b) Management cost of the Kambia District Council related to the Project
  - (c) Initial working capital for the operation and maintenance of KWSSB
- 7) Exemption of the equipment and materials brought into Sierra Leone and services provided by the Japanese nationals in accordance with the contracts, from customs duty, internal taxes and other levies, including GST.
- 8) Granting of relevant visas and permits of stay in Sierra Leone towards the Japanese nationals involved in the Project in accordance with the contracts.
- 9) Proper maintenance and use of the facilities and equipment provided with in the Japan's Grant Aid scheme.
- 10) Payment of banking commission for the Authorization to Pay (A/P) and payment to a Japanese bank based upon the Banking Arrangement (B/A).

Proposed location of public taps to be constructed in the Project  
(Kambia 1)



Proposed location of public taps to be constructed in the Project  
(Kambia 2)



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## **Appendix 5**

Environmental Permit of the Project



**SIERRA LEONE GOVERNMENT**

**Sierra Leone Environment Protection Agency  
3<sup>rd</sup> Floor, Youyi Building, Freetown**

Ref: SLEPA/EIA/25

1<sup>st</sup> November, 2010

Mr. Wosum A. Koroma  
Chief Engineer  
Water Supply Division  
Ministry of Energy & Water Resources  
Tower Hill  
Freetown.

Dear Sir,

**ISSUANCE OF ENVIRONMENTAL PERMIT FOR THE ESTABLISHMENT OF  
RURAL WATER SUPPLY SYSTEM IN KAMBIA TOWN**

I wish to refer to the above subject matter and to inform you that the Sierra Leone Environment Protection Agency (SLEPA) has carefully reviewed the project proposal for the establishment of rural water supply system in Kambia Town and the environmental assessment report submitted by the Ministry of Energy and Water Resources. According to the review and inspection report on the project site, the proposed project would not have any adverse impact to the environment and categorized under "C". The project therefore does not require any environmental impact assessment.

In the light of the foregoing, the Agency is issuing this letter as environmental permit for a "No Objection" to the proposed project to enable the Ministry of Energy and Water Resources to replace the existing and dilapidated facilities in order to provide treated water through distribution pipes and public taps for inhabitants in Kambia Town.

  
Haddijatou Jallow (Mrs.)

**Executive Chairperson, SLEPA**

Cc: The Secretary to the President

## **Appendix 6**

Natural Conditions Survey Result

## Natural Conditions Survey Result

During the field survey, surveys on the natural conditions in the project site mentioned in Table-1 below were conducted entrusting the surveys to local consultants. JICA survey team also conducted quality analysis on the water sources, the Kolenten River and swamp, and the existing wells in Kambia town. Further, the team conducted a flow measurement at the Kolenten River in order to know the river discharge in the dry season. Locations of the above-mentioned surveys are shown in Fig.-1.

Table-1 Natural Condition Survey

Items	Contents	Method and Specifications
1. Topographic survey	(1) Plain table survey	<ul style="list-style-type: none"> <li>- Water intake site Kolenten river (30m×30m=900m<sup>2</sup>)</li> <li>Swamp (30m×30m=900m<sup>2</sup>)</li> <li>- Water treatment plant site Existing site (100m×100m=10,000m<sup>2</sup>)</li> <li>- Elevated tank site Existing site (50m×50m=2,500m<sup>2</sup>)</li> <li>Proposed site (50m×50m=2,500m<sup>2</sup>)</li> <li>Total 16,800m<sup>2</sup></li> </ul>
	(2) Route survey	<ul style="list-style-type: none"> <li>- Kolenten river to Water treatment plant (0.2km)</li> <li>- Swamp to Water treatment plant (0.5km)</li> <li>- Water treatment plant to Elevated tank (2.0km)</li> <li>- Kambia town (35km)</li> <li>Total 37.7km</li> </ul>
2. Geo-technical survey	(1) Boring survey, SPT	<ul style="list-style-type: none"> <li>- Water treatment plant site (1 place×20m)</li> <li>- Existing elevated tank site(1 place×20m)</li> <li>- Proposed elevated tank site (1 place×20m)</li> <li>Total 3 places×60m</li> </ul>
	(2) Plate bearing test	<ul style="list-style-type: none"> <li>- Water treatment plant site (1 place)</li> </ul>
	(3) Test pit survey	<ul style="list-style-type: none"> <li>Excavation of test pit</li> <li>- Kambia town (30 places×1m×1m×1m)</li> <li>- Water treatment plant site (10 places×1m×1m×2m)</li> <li>Total 40 places</li> </ul>

### (1) Topographic Survey

In the topographic survey, which includes plain table survey and route survey, features of the proposed construction sites that are plan, longitudinal section and elevations were surveyed. Elevations of the proposed public tap sites (100 places) in Kambia town were also surveyed during the route survey.

## (2) Geo-technical Survey

Boring survey including standard penetration test (SPT) was conducted at the proposed construction sites of the water treatment plant and the elevated tanks. Plate bearing test was also conducted at the site of the water treatment plant. Result of the boring survey and the plate bearing test is shown in Table-2 and Table-3, respectively.

Test pit survey was conducted at places along the proposed pipeline routes in Kambia town and at the site of the water treatment plant in order to know the difficulty for the excavation work and to examine the construction plan and cost estimation of the Project. Result of the survey is shown in Fig.-2.

As a result of the test pit survey, of the route of the transmission pipe, rock is appeared at some places (Test pit No.2 and No.3), and at approx. 1km of the route of the distribution pipes in the new town it was found that there is laterites rock at 30 to 60cm below the ground level. Trench excavation at these places will therefore be carried out using appropriate construction machines. On the other hand, it was confirmed that there is no disturbance of the excavation work in the site of the water treatment plant because there is no rock up to 2.0m below the ground level.

## (3) Quality Analysis

Water samples were taken from the water sources of the Project, the Kolenten River and swamp, and the existing wells in Kambia town and quality analysis was conducted by the laboratory of WSD in Freetown. Result of the analysis is shown in Table-4.

## (4) Flow Measurement

In order to know the discharge of the Kolenten River in the end of the dry season that is usually the smallest through the year, flow measurement of the river was conducted on May 15, 2010. As a result of the survey, the river discharge is estimated to be  $2.40\text{m}^3/\text{sec}$ .



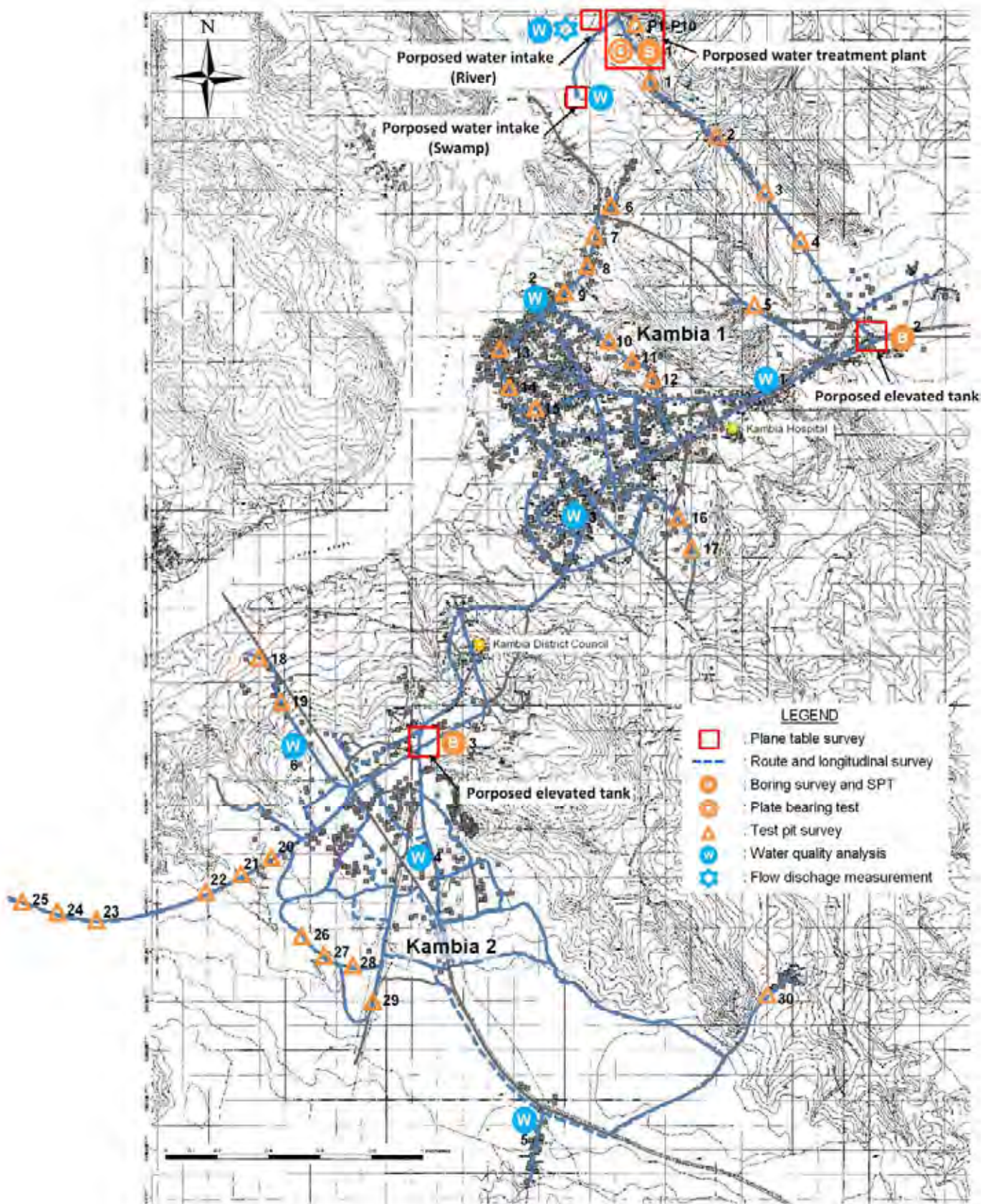


Fig.-1 Locations of National Conditions Survey

Table-2 Boring Survey Result

SPT LITHOLOGIC DRILL LOG											
DATE: 02/06/2010								FOREMAN: J. Aina			
AREA: Kambis Town I		LINE: Existing Elevated Tank				SITE: 1		GEOLOGIST: M. Bawoh			
COLLAR ELEV.: 67.752m		BEDROCK ELEV.: 59.242m				WATER ELEV.: Nil		DRILL TYPE: B53 auger drill rig			
From (m)	To (m)	Drive Interval (m)	Recovery (%)	Test Drive Hammer Blows	Colour	Over Size (%)	Slimes (%)	Characteristic	Modifier	Rock	Other Observations
0.00	0.46	0.46	75	6	Dark Brown	70	20	Coarse Sized	Lateritic	Gravel	Roots and root hairs, pebble-cobble sized lateritic nodules
1.46	1.92	0.46	90	147	Dark Reddish Brown	70	10	Coarse Sized	Iron Stained	Laterite	Iron stained, compacted indurated magnetite nodules with lateritic matrix in the interstices.
2.92	3.38	0.46	100	78	Reddish Brown	70	25	Coarse Sized	Iron Stained	Laterite	Highly weathered micaceous lateritic matrix with many magnetite nodules embedded
4.38	4.84	0.46	100	12	Reddish Brown	90	30	Highly Weathered	Iron Stained	Laterite	Highly weathered micaceous lateritic matrix with fewer magnetite nodules embedded
5.84	6.30	0.46	70	13	Reddish Brown	10	70	Highly Weathered	Lateritic	Clay	Very few compacted magnetite nodules embedded in lateritic clayey matrix
7.30	7.76	0.46	85	42	Orange Brown	40	30	Partly Weathered	Indurated	Saprolite	Partly weathered and fresh rock material embedded in weathered matrix showing honey-comb texture, and relics of gneiss texture
7.76	8.57	0.81	Fresh Country Rock: No Penetration by motorised auger drive								

SPT LITHOLOGIC DRILL LOG											
DATE: 03/06/2010								SUPERVISOR: J. Aina			
AREA: Kambis Town I		LINE: Proposed Water Treatment Facility				SITE: 1		GEOLOGIST: M. Bawoh			
COLLAR ELEV.: 29.561m		BEDROCK ELEV.: 16.341m				WATER ELEV.: Nil		DRILL TYPE: B53 auger drill rig			
From (m)	To (m)	Drive Interval (m)	Recovery (%)	Test Drive Hammer Blows	Colour	Over Size (%)	Slimes (%)	Characteristic	Modifier	Rock	Other Observations
0.00	0.46	0.46	70	13	Dark Brown	10	30	Coarse Sized	Lateritic	Gravel	Roots and root hairs, clay matrix in interstices of iron-stained compacted lateritic nodules
1.46	1.92	0.46	75	112	Reddish Brown	70	10	Coarse Sized	Iron Stained	Laterite	Iron stained, compacted indurated magnetite nodules with lateritic matrix in their interstices
2.92	3.38	0.46	90	71	Reddish Brown	50	30	Coarse Sized	Iron Stained	Laterite	Iron stained, matrix with compacted indurated magnetite nodules embedded
4.38	4.84	0.46	80	28	Reddish Brown	20	50	Highly Weathered	Lateritic	Clay	Highly weathered lateritic clay with few lateritic pebbles
5.84	6.30	0.46	80	20	Orange Brown	5	80	Highly Weathered	Lateritic	Clay	Highly weathered lateritic clay with fewer lateritic pebbles
7.30	7.76	0.46	75	15	Dark Brown	5	80	Highly Weathered	Lateritic	Clay	Highly weathered lateritic clay with lesser lateritic pebbles
8.76	9.22	0.46	100	10	Mottled brown	5	20	Partly Weathered	Indurated	Saprolite	Saprolite material mixed with fresh and partly weathered country rock
10.22	-	-	After more than 25 blows, no penetration for seating drive (fresh country rock encountered).								

SPT LITHOLOGIC DRILL LOG											
DATE: 04/06/2010								SUPERVISOR: J. Aina			
AREA: Kambis Town II		LINE: Proposed Elevated Tank				SITE: 1		GEOLOGIST: M. Bawoh			
COLLAR ELEV.: 55.217m		BEDROCK ELEV.: 41.617m				WATER ELEV.: Nil		DRILL TYPE: B53 auger drill rig			
From (m)	To (m)	Drive Interval (m)	Recovery (%)	Test Drive Hammer Blows	Colour	Over Size (%)	Slimes (%)	Characteristic	Modifier	Rock	Other Observations
0.00	0.46	0.46	80	10	Dark Brown	50	20	Coarse Sized	Lateritic	Gravel	Roots and root hairs, iron stained lateritic pebbles and clay matrix
1.46	1.92	0.46	70	20	Reddish Brown	40	10	Partly Weathered	Iron Stained	Laterite	Iron stained, density packed coarse-gravel sized particles
2.92	3.38	0.46	85	17	Reddish Brown	20	30	Highly Weathered	Iron Stained	Laterite	Fine-medium grain size quartz particles embedded in weathered laterite
4.38	4.84	0.46	80	22	Reddish Brown	25	30	Highly Weathered	Iron Stained	Laterite	Fine-medium grain size quartz particles with very few magnetite nodules embedded in weathered laterite
5.84	6.30	0.46	70	20	Reddish Brown	10	55	Highly Weathered	Lateritic	Clay	Fewer magnetite nodules embedded in dominant clay matrix
7.30	7.76	0.46	70	7	Reddish Brown	5	60	Highly Weathered	Lateritic	Clay	Very very few magnetite nodules embedded in dominant clay matrix
8.76	9.22	0.46	65	14	Orange Brown	-	50	Partly Weathered	Indurated	Saprolite	Saprolite material containing partly weathered country rock
10.22	10.68	0.46	90	21	Orange Brown	-	50	Partly Weathered	Indurated	Saprolite	Saprolite material containing partly weathered country rock
11.68	12.14	0.46	85	10	Orange Brown	20	40	Partly Weathered	Indurated	Saprolite	Saprolite material containing partly weathered country rock
13.14	13.60	0.46	100	45	Orange Brown	10	50	Partly Weathered	Indurated	Saprolite	Saprolite material containing partly weathered country rock
14.60	-	-	After more than 25 blows, no penetration for seating drive (fresh country rock encountered).								

Recovery (%): Total length of core recovered expressed as a percentage of the drive length.  
 Blows: The number of times a 63.5kg hammer is dropped from a height of 0.76m for the split sampler tube to penetrate the ground for 0.30m  
 Oversize: Size fraction greater than 75µm  
 Slimes: Size fraction smaller than 63µm

Table-3 Plate Bearing Test Result

REPUBLIC OF SIERRA LEONE CONSULTANT JICA CONTROL LABORATORY		ESTABLISHMENT OF RURAL WATER SUPPLY SYSTEM IN KAMBIA TOWN						CONTRACTOR MINISTRY OF WATER AND ENERGY		
<b>DETERMINATION OF THE PLATE-BEARING VALUE</b>										
CHAINAGE:			LOCATION:			KAMBIA		DATE: 23/05/2010		
LAYER:					Operator: A KAMARA and I KOROMA					
DESCRIPTION: CLAYEY SAND										
Manometer reading		Deflexion reading in 0.01 mm = 10 <sup>-3</sup> m					Soil Pressure		ΔP/ΔS	Bearing Plate D = 60 [cm]
Pm		Gauge 1	Gauge 2	Gauge 3	Gauge 4	Sum x 10 <sup>-5</sup>	Average x 10 <sup>-5</sup>	P=C · Pm		
[Kg/cm <sup>2</sup> ]	[MN/m <sup>2</sup> ]	0.01mm	0.01mm	0.01mm	0.01mm	[m]	[m]	[MN/m <sup>2</sup> ]	[MN/m <sup>3</sup> ]	
0,0	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,000	Bearing Piston d = 6 [cm]	
0,5	0,05	112,00	119,00	104,00	119,00	454,00	113,50	0,050		
1,0	0,10	198,00	196,00	180,00	201,00	775,00	193,75	0,100		
1,5	0,15	245,00	250,00	238,00	272,00	1005,00	251,25	0,150		
2,0	0,20	289,00	299,00	297,00	313,00	1198,00	299,50	0,200		
2,5	0,25	320,00	346,00	361,00	367,00	1394,00	348,50	0,250	C = d <sup>2</sup> / D <sup>2</sup>	
3,0	0,30	365,00	398,00	410,00	450,00	1623,00	405,75	0,300	ΔP= 0,150 x 10 <sup>-1</sup> [MN/m <sup>2</sup> ] ΔS= 154,75 x 10 <sup>-1</sup> [m]	
1,5	0,15	300,00	335,00	378,00	433,00	1446,00	361,50	0,150	Ev = 0.75 · D · ΔP / ΔS	
0,0	0,00	255,00	278,00	295,00	359,00	1187,00	296,75	0,000		
0,5	0,05	258,00	296,00	298,00	363,00	1215,00	303,75	0,050		
1,0	0,10	272,00	309,00	300,00	358,00	1239,00	309,75	0,100	E <sub>v1</sub> = 0,2 [MN/m <sup>2</sup> ]	
1,5	0,15	284,00	319,00	316,00	410,00	1329,00	332,25	0,150	ΔP= 0,150 x 10 <sup>-1</sup> [MN/m <sup>2</sup> ] ΔS= 44,75 x 10 <sup>-1</sup> [m]	
2,0	0,20	290,00	324,00	331,00	425,00	1370,00	342,50	0,200		
2,5	0,25	298,00	334,00	349,00	437,00	1418,00	354,50	0,250		
0,0	0,00	158,00	272,00	270,00	357,00	1057,00	264,25	0,000		
0,5	0,05	164,00	300,00	286,00	371,00	1121,00	280,25	0,050	E <sub>v2</sub> = 0,8 [MN/m <sup>2</sup> ]	
2,5	0,25	201,00	338,00	350,00	442,00	1331,00	332,75	0,250	E <sub>v2</sub> /E <sub>v1</sub> = 3,46 (>2.2)	
Remarks:										

Test Pit in Kambia Town



Fig-2 (1/2) Test Pit Survey Result



Test pit No.25



Test pit No.26



Test pit No.27



Test pit No.28



Test pit No.29



Test pit No.30

Test Pit in Existing Water Treatment Plant



Test pit No.P1



Test pit No.P2



Test pit No.P3



Test pit No.P4



Test pit No.P5



Test pit No.P6



Test pit No.P7



Test pit No.P8



Test pit No.P9



Test pit No.P10

Fig.-2 (2/2) Test Pit Survey Result

Table-4 Quality Analysis Result

Parameters	Measured Values										WHO recommended Permissible Limits
	Kolenten	Swamp	Well No.1	Well No.2	Well No.3	Well No.4	Well No.5	Well No.6	Well No.6	Well No.6	
1 PH	5.8	6.1	5.7	6	6.1	5.7	6.2	6.2	6.2	6.2	6.5 – 8.5
2 Turbidity (NTU)	1.5	2.2	2.4	1.3	0.5	4.5	0.4	11.4	11.4	11.4	<5.0
3 Conductivity (µS/cm)	39.9	40.1	129.8	237	107	37.5	93.2	51.4	51.4	51.4	<450
4 TDS (mg/l)	19.3	20	64.2	118.1	53.1	18.4	46.1	25.6	25.6	25.6	<248
5 Ammonia (mg/l)	0	0	0	0	0	0	0	0	0	0	No. Value
6 Total Hardness CaCO <sub>3</sub> (mg/l)	14	11	0	0	0	8	4	11	11	11	<500
7 Copper (mg/l)	0.04	0	0.06	0	0.03	0.03	0	0.12	0.12	0.12	<2.0
8 Fluoride (mg/l)	0.44	0.04	0.2	0.9	0.7	0.65	0.4	1.46	1.46	1.46	<1.5
9 Iron (mg/l)	0	0.06	0.09	0.03	0.02	0.03	0	0.04	0.04	0.04	<0.3
10 Magnesium (mg/l)	0	0	8.5	14.5	11	9.5	4	0	0	0	<200
11 Manganese (mg/l)	0.02	0.003	0.035	0.018	0.014	0.015	0	0.002	0.002	0.002	<0.4
12 Nitrite (mg/l)	0.027	0.012	0.004	0.006	0.001	0.004	0.017	0.025	0.025	0.025	3
13 Nitrate – Nitrogen (mg/l)/HR	1.38	0.58	9.4	27.6	24	10.8	0.66	2.2	2.2	2.2	<10
14 Sulphate (mg/l)	0	0	8	3	3	5	0	4	4	4	<400
15 Sulphide (mg/l)	0.14	0.15	0.1	0.09	0.07	0.1	0.16	0.18	0.18	0.18	<0.5
16 Chloride (mg/l)	-	-	-	-	-	-	-	-	-	-	<250
17 Arsenic – (p)	0	0	0	0	0	0	0	0	0	0	0.01
18 Zinc (mg/l)	0.02	0	3.5	0.74	0.08	0.02	0.03	0.06	0.06	0.06	<5.0
19 E. Coli	0	0	0	0	0	0	0	0	0	0	Zero
20 Faecal Coliforms	80	160	135	175	85	120	55	145	145	145	Zero

Note: Date of water sampling: May 19, 2010

## **Appendix 7**

Socio-Economic Survey Result

## Socio-Economic Survey Result

The objectives of the socio-economic survey and analysis are to understand:

- (1) the general living conditions and economy,
- (2) the actual conditions of water usage,
- (3) the sanitation and health conditions,
- (4) willingness to maintain a water supply system of the households,
- (5) expectations to connect the private connections to their houses, and
- (6) total number of houses and population in the planned water supply area of the Kambia water supply system.

To undertake this exercise, a sample size of 385 households consisting of 200 from Kambia 2 (New settlement area) and 185 from Kambia 1 (Old town) was used. A summary of the result of the survey are as follows:

### [Ethnic group]

- Temne	71%
- Limba	13%
- Susu	9%
- Others	6%

### [Education and literacy]

- Primary school	29%
- Secondary school	14%
- Tertiary	2%
- Literacy ratio	47%

### [Health conditions in the past year]

- Illness during the past 1 year	62%	have had illness
- Diarrhea	10%	
- Typhoid	18%	

### [Sanitation facility]

- Private pit	21%
- Common pit	70%
- Flush	1%

### [Present water sources]

- Traditional well	44%
--------------------	-----



- Water well with hand-pump 16%
- Stream or river 37%

[Required time for fetching water]

- Less than 10 min. 34%
- 10 to 25 min. 33%
- More than 25 min. 30%

[Distance of water point from house]

- Less than 50m 44%
- 60 to 100m 54%
- More than 100m 1%

[Major sources of income]

- Salaried worker 24%
- Petty trader 21%
- Retiree 2%
- Remittance 3%
- Self-employed 33%
- Others 13%

[Monthly income]

- Less than Le. 100,000 43%
- Le. 100,000 to 200,000 27%
- Le. 200,000 to 350,000 13%
- Le. 350,000 to 500,000 7%
- Le. 500,000 to 750,000 2%

[Saving]

- Yes 25%
- No 65%

[Willingness to support the Project]

- Yes 87%
- No 11%
- Not sure 2%

[Type of fetching water]

- Public taps 16%
- Yard connection 43%

- House connection 37%
- Not sure 3%

[Willingness to pay for water services]

- Yes 80%
- No 10%
- Don't know yet 10%

[Willingness to pay for public taps]

- Less than Le. 5,000 55%
- Le. 5,000 23%
- Le. 5,000 to 7,500 3%

[Willingness to pay for yard connection]

- Less than Le. 5,000 9%
- Le. 5,000 11%
- Le. 5,000 to 7,500 16%
- Le. 7,500 to 10,000 46%

[Willingness to pay for house connection]

- Le. 15,000 to 20,000 35%
- Le. 20,000 to 30,000 11%
- More than Le. 30,000 1%

Present number of houses and population in the planned water supply area of the Project are as follows:

	No. of houses	Population
- Old town (Kambia 1)	1,231	9,892
- New town (Kambia 2)	1,962	10,876
Total	3,193	20,768

## **Appendix 8**

Hydraulic Calculation on Water Pressure at Public Taps

## Hydraulic Calculation on Water Pressure at Public Taps in Kambia 1

### Water Head at Junctions in Kambia 1

Junction	C	D (mm)	Q (m <sup>3</sup> /min)	L (m)	V (m/sec)	Hf (m)	Σ Hf (m)	El. Tank (EL-m)	Water Head	Discharge (m <sup>3</sup> /day)	Hourly Coefficient
1A	130	150	1.367	20	1.290	0.25	0.25	77.90	77.65	492	4.0
	130	150	0.767	400	0.723	1.69					
1B	130	100	0.767	790	1.628	24.09	26.03	77.90	51.87	276	
	130	100	0.767	790	1.628	24.09					
1C	130	100	0.300	140	0.637	0.75	26.78	77.90	51.12	108	

### Kambia 1 - Higher Area 1

Tap No.	C	D (mm)	Q (m <sup>3</sup> /min)	L (m)	V (m/sec)	Hf (m)	Σ Hf (m)	Elevation (EL-m)	Pressure (m)	Discharge (m <sup>3</sup> /day)
103	130	75	0.133	100	0.503	0.49	0.71	65.99	10.95	48
	130	75	0.067	160	0.252	0.22				
101	130	75	0.033	200	0.126	0.07	0.78	66.10	10.77	12
102	130	75	0.067	80	0.252	0.11	0.60	63.54	13.51	24
103	130	75	0.033	220	0.126	0.08	0.68	60.92	16.05	12
104	130	75	0.033	220	0.126	0.08	0.68	60.92	16.05	12

### Kambia 1 - Higher Area 2

Tap No.	C	D (mm)	Q (m <sup>3</sup> /min)	L (m)	V (m/sec)	Hf (m)	Σ Hf (m)	Elevation (EL-m)	Pressure (m)	Discharge (m <sup>3</sup> /day)
105	130	150	0.467	30	0.440	0.05	0.90	63.38	13.37	168
	130	100	0.433	80	0.920	0.85				
106	130	100	0.400	120	0.849	1.10	2.46	56.43	18.76	144
	130	100	0.333	70	0.708	0.46				
107	130	100	0.300	250	0.637	1.34	3.95	45.87	27.83	108
108	130	100	0.100	210	0.212	0.15	4.00	40.77	32.88	36
	130	100	0.067	130	0.142	0.04				
109	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
110	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
111	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
112	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
113	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
114	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
115	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
116	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
117	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
118	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
119	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
120	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
121	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
122	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
123	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
124	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
125	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
126	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
127	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
128	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
129	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
130	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
131	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
132	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
133	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
134	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
135	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
136	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
137	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
138	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
139	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
140	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
141	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
142	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
143	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
144	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
145	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
146	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
147	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
148	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
149	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
150	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
151	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
152	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
153	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
154	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
155	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
156	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
157	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
158	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
159	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
160	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
161	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
162	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
163	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
164	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
165	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
166	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
167	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
168	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
169	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
170	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
171	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
172	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
173	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
174	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
175	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
176	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
177	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
178	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
179	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
180	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
181	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
182	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
183	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
184	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
185	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
186	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
187	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
188	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
189	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
190	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
191	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
192	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	12
193	130	100	0.033	120	0.071	0.01	4.06	40.77	32.88	

Kambia 1 - Lower Area 1

Tap No.	C	D (mm)	Q (m3/min)	L (m)	V (m/sec)	Hf (m)	ΣHf (m)	Elevation (EL-m)	Pressure (m)	Discharge (m3/day)
1B	130	100	0.167	10	0.354	0.02				60
202	201	130	0.133	220	0.283	0.26	0.02	37.64	14.21	48
		130	0.067	180	0.252	0.24				24
	204	130	0.033	200	0.126	0.07	0.52	34.70	16.65	12
	205						0.59	29.24	22.04	
		130	0.067	20	0.142	0.01				24
	202						0.29	37.06	14.52	
		130	0.033	290	0.071	0.03				12
	203						0.32	29.44	22.11	

Kambia 1 - Lower Area 2

Tap No.	C	D (mm)	Q (m3/min)	L (m)	V (m/sec)	Hf (m)	ΣHf (m)	Elevation (EL-m)	Pressure (m)	Discharge (m3/day)
1B	130	100	0.300	160	0.637	0.86				108
207	206	130	0.267	190	0.566	0.82	0.86	34.37	16.64	96
		130	0.233	10	0.495	0.03				84
	208						1.71	33.00	17.16	
209		130	0.200	10	0.425	0.03				72
		130	0.167	220	0.354	0.40				60
	210						2.14	21.12	28.61	
211		130	0.133	170	0.283	0.20				48
		130	0.100	50	0.377	0.14				36
		130	0.067	270	0.252	0.36	2.48	18.08	31.31	24
	213						2.84	18.92	30.11	
		130	0.033	220	0.126	0.08				12
	214						2.92	25.69	23.26	
		130	0.033	140	0.071	0.01				12
	207						1.69	31.31	18.87	
		130	0.033	140	0.071	0.01				12
	209						1.75	28.81	21.31	
		130	0.033	180	0.071	0.02				12
	211						2.36	24.55	24.96	

Kambia 1 - Lower Area 3

Tap No.	C	D (mm)	Q (m3/min)	L (m)	V (m/sec)	Hf (m)	ΣHf (m)	Elevation (EL-m)	Pressure (m)	Discharge (m3/day)
215	1C	130	0.233	110	0.495	0.37				84
		130	0.200	90	0.425	0.23				72
	216						0.60	28.54	21.98	
217		130	0.167	50	0.354	0.09				60
218		130	0.133	130	0.283	0.16				48
		130	0.100	110	0.212	0.08				36
	219						0.93	18.94	31.25	
		130	0.067	180	0.142	0.06				24
	220						0.99	16.41	33.72	
		130	0.033	170	0.071	0.02				12
	221						1.01	16.64	33.47	
		130	0.033	120	0.071	0.01				12
	215						0.38	30.40	20.34	
		130	0.033	220	0.071	0.02				12
	217						0.71	26.63	23.78	
		130	0.033	120	0.126	0.04				12
	218						0.89	17.34	32.89	

Kambia 1 - Lower Area 4

Tap No.	C	D (mm)	Q (m <sup>3</sup> /min)	L (m)	V (m/sec)	Hf (m)	ΣHf (m)	Elevation (EL-m)	Pressure (m)	Discharge (m <sup>3</sup> /day)
1C	130	100	0.067	80	0.142	0.03				24
222							0.03	33.14	17.95	
	130	100	0.033	220	0.071	0.02				12
223							0.05	18.03	33.04	

## Hydraulic Calculation on Water Pressure at Public Taps in Kambia 2

### Water Head at Junctions in Kambia 2

Junction	C	D (mm)	Q (m <sup>3</sup> /min)	L (m)	V (m/sec)	Hf (m)	Σ Hf (m)	El. Tank (EL-m)	Water Head	Discharge (m <sup>3</sup> /day)	Hourly Coefficient
2A	130	250	1.967	2150	0.668	4.32	4.32	77.90	73.58	708	4.0
	130	200	1.100	940	0.584	1.91					
2B							6.23	77.90	71.67		

### Kambia 2 East 1

Tap No.	C	D (mm)	Q (m <sup>3</sup> /min)	L (m)	V (m/sec)	Hf (m)	Σ Hf (m)	Elevation (EL-m)	Pressure (m)	Discharge (m <sup>3</sup> /day)
2A	130	100	0.400	20	0.849	0.18	0.18	33.60	39.80	144
301	130	100	0.367	480	0.778	3.74				
302	130	100	0.333	220	0.708	1.44	3.92	49.22	20.44	132
303	130	100	0.300	120	0.637	0.64	5.36	55.47	12.75	120
304	130	100	0.267	150	0.566	0.65				
305	130	100	0.233	180	0.495	0.61	6.65	55.76	11.17	84
306	130	100	0.200	120	0.425	0.30	7.26	55.57	10.75	72
307	130	100	0.167	100	0.354	0.18	7.56	55.27	10.75	60
308	130	100	0.133	140	0.283	0.17	7.74	55.13	10.71	48
309	130	100	0.100	110	0.212	0.08	7.91	54.85	10.82	36
310	130	100	0.067	80	0.142	0.03				
311	130	100	0.033	240	0.071	0.02	8.02	54.93	10.63	24
312	130	100	0.033	240	0.071	0.02	8.04	53.36	12.18	12
304	130	75	0.033	120	0.126	0.04	6.04	55.35	12.19	12
310	130	100	0.033	150	0.071	0.01	8.00	53.26	12.32	12

### Kambia 2 East 2

Tap No.	C	D (mm)	Q (m <sup>3</sup> /min)	L (m)	V (m/sec)	Hf (m)	Σ Hf (m)	Elevation (EL-m)	Pressure (m)	Discharge (m <sup>3</sup> /day)
2A	130	150	0.467	580	0.440	0.98	0.98	55.04	17.56	168
313	130	150	0.433	190	0.409	0.28				
314	130	150	0.400	110	0.377	0.14	1.26	55.43	16.89	156
315	130	150	0.367	240	0.346	0.26	1.40	55.40	16.78	144
316	130	150	0.333	110	0.315	0.10	1.66	54.32	17.60	132
317	130	150	0.300	150	0.283	0.11	1.76	53.70	18.12	120
318	130	100	0.267	10	0.566	0.04				
319	130	100	0.233	260	0.495	0.88	1.91	53.42	18.25	84
320	130	100	0.200	200	0.425	0.51	2.79	50.46	20.33	72
321	130	100	0.167	260	0.354	0.47	3.30	52.54	17.74	60
322	130	100	0.133	220	0.283	0.26	3.77	55.07	14.74	48
323	130	100	0.100	200	0.212	0.14	4.03	56.21	13.34	36
324	130	100	0.067	200	0.142	0.07	4.17	57.91	11.50	24
325	130	100	0.067	200	0.142	0.07	4.24	58.68	10.66	

326	130	75	0.033	400	0.126	0.15				12
							4.39	41.82	27.37	

318	130	75	0.033	120	0.126	0.04				12
							1.91	50.49	21.18	

Kambia 2 West 1

Tap No.	C	D (mm)	Q (m3/min)	L (m)	V (m/sec)	Hf (m)	Σ Hf (m)	Elevation (EL-m)	Pressure (m)	Discharge (m3/day)
2B	130	150	0.467	220	0.440	0.37				168
401							0.37	54.83	16.47	
402	130	150	0.433	120	0.409	0.18				156
403							0.55	55.32	15.80	
404	130	150	0.400	100	0.377	0.13				144
404	130	100	0.367	140	0.778	1.09				132
404	130	100	0.300	100	0.637	0.54				108
406							2.31	54.98	14.38	
413	130	100	0.267	130	0.566	0.56				96
413	130	100	0.167	130	0.354	0.24				60
407							3.11	55.53	13.03	
408	130	100	0.133	170	0.283	0.20				48
408							3.31	55.55	12.81	
409	130	100	0.100	180	0.212	0.13				36
409							3.44	57.09	11.14	
410	130	100	0.067	480	0.142	0.16				24
410							3.60	57.28	10.79	
411	130	75	0.033	170	0.126	0.06				12
411							3.66	55.40	12.61	
404	130	100	0.067	60	0.142	0.02				24
404							1.79	55.24	14.64	
405	130	100	0.033	180	0.071	0.02				12
405							1.81	55.10	14.76	
412	130	100	0.100	60	0.212	0.04				36
412	130	100	0.067	220	0.142	0.07				24
413							2.98	53.91	14.78	
414	130	100	0.033	130	0.071	0.01				12
414							2.99	52.54	16.14	
412	130	100	0.033	80	0.071	0.01				12
412							2.92	53.15	15.60	

Kambia 2 West 2

Tap No.	C	D (mm)	Q (m3/min)	L (m)	V (m/sec)	Hf (m)	Σ Hf (m)	Elevation (EL-m)	Pressure (m)	Discharge (m3/day)
2B	130	100	0.133	140	0.283	0.17				48
415							0.17	55.66	15.84	
416	130	75	0.100	150	0.377	0.43				36
416							0.60	53.52	17.55	
417	130	75	0.067	180	0.252	0.24				24
417							0.84	37.65	33.18	
418	130	75	0.033	240	0.126	0.09				12
418							0.93	24.33	46.41	

Kambia 2 West 3

Tap No.	C	D (mm)	Q (m3/min)	L (m)	V (m/sec)	Hf (m)	Σ Hf (m)	Elevation (EL-m)	Pressure (m)	Discharge (m3/day)
2B	130	100	0.500	110	1.062	1.52				180
419							1.52	55.41	14.74	
420	130	100	0.467	120	0.991	1.46				168
420	130	100	0.433	10	0.920	0.11				156
421							3.09	53.22	15.36	
422	130	100	0.400	60	0.849	0.55				144
424	130	100	0.333	50	0.708	0.33				120
424	130	75	0.200	30	0.755	0.31				72
428							4.28	50.27	17.12	
429	130	75	0.167	380	0.629	2.79				60
429							7.07	49.22	15.38	
429	130	75	0.133	240	0.503	1.17				48



430							8.24	50.66	12.77	
	130	75	0.100	220	0.377	0.63				36
431							8.87	49.34	13.46	
	130	75	0.067	210	0.252	0.28				24
432							9.15	37.17	25.35	
	130	75	0.033	140	0.126	0.05				12
433							9.20	30.74	31.73	
	130	100	0.033	100	0.071	0.01				12
420							2.99	53.57	15.11	
	130	75	0.067	160	0.252	0.22				24
422							3.86	48.35	19.46	
	130	75	0.033	200	0.126	0.07				12
423							3.93	44.49	23.25	
<u>427</u>	130	100	0.133	220	0.283	0.26				48
424							4.23	48.18	19.26	
	130	100	0.067	220	0.142	0.07				24
425							4.30	52.72	14.65	
	130	100	0.033	200	0.071	0.02				12
426							4.32	53.20	14.15	
	130	100	0.033	240	0.071	0.02				12
427							4.25	50.03	17.39	

