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 18th, 2010.

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

Freetown, 21st October 2010

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

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

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 29th 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 15th, 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 30th, 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

piping 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 30th, 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 30th, 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 30th, 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

Table 1-A: Cost borne by the Government of Japan

Unit: Million JPY

Items	Cost
Water Supply Facilities - Water intake facilities - Plain sedimentation basin - Slow sand filter - Clear water reservoir - Sand wash and dry - Sludge and drainage basin - Piping work in the plant - Exterior work in the plant - Electrical work - Elevated tank - Public taps - Private connections - Building works Piping Works - Water conveyance pipe - Water Transmission pipe - Water Distribution pipe - Equipment and materials	637
Detailed Design & Construction Supervision	99
Contingency (12%)	82
Total	818

Note:

Both sides understood that contingency must be used on unforeseen items and cannot be realigned for other purposes such as purchase of additional materials and equipment.

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 - Site clearance at the existing elevated tank	 504.52 131.64	 12.61 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).

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 labouer	4,150	104	
4. Office cost	415	10	10% of 3
5. Sitting Fee (Board Member))	300	8	
Total	13,171	330	

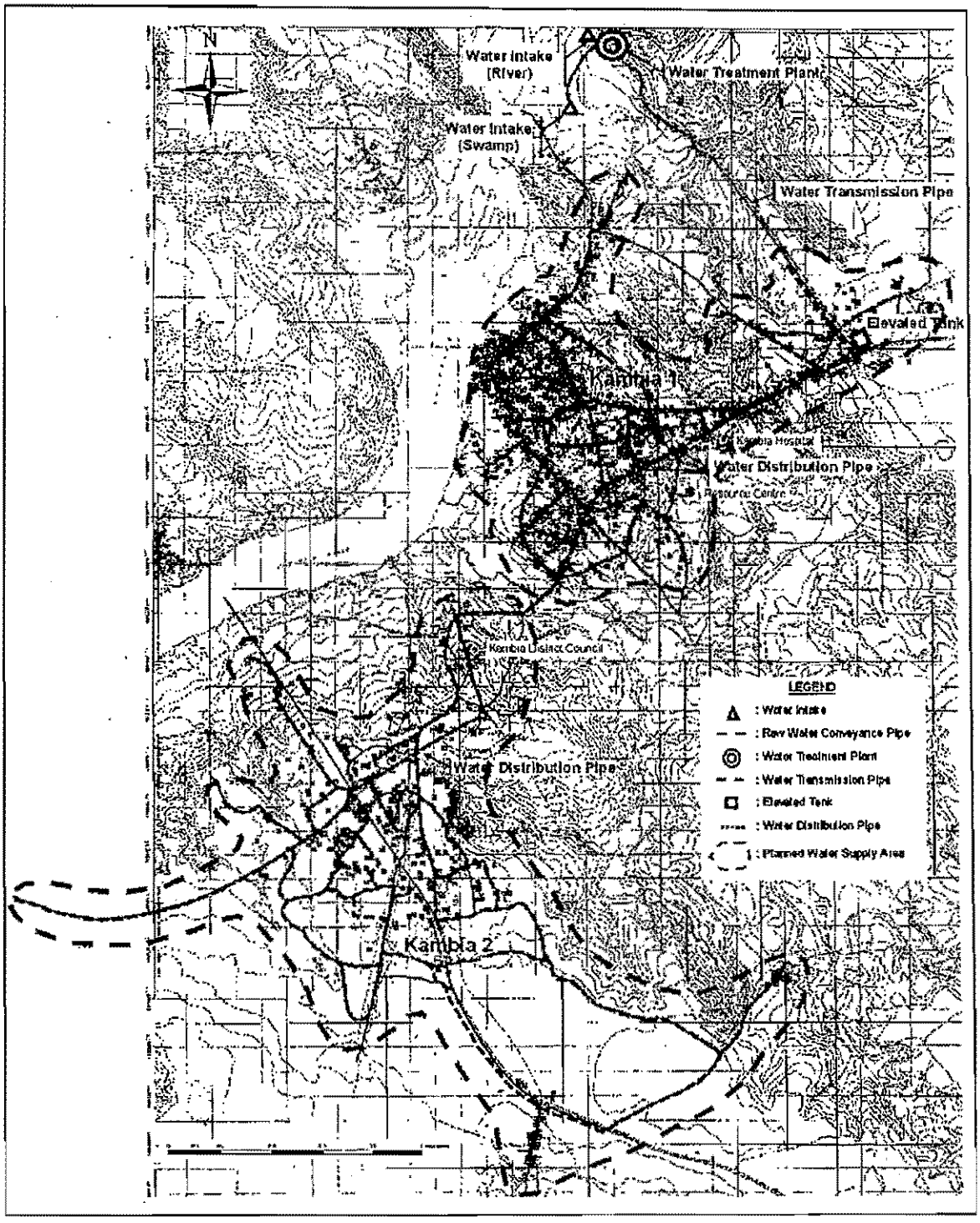
Monthly operation and maintenance cost in the Target Year (2016)

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 labouer	7,800	195	
4. Office cost	780	19	10% of 3
5. Sitting Fee (Board Member))	300	8	
Total	30,086	752	

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



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 Councils' Work Committee

The above is as approved by Kambia District Council on August 15th, 2010

Draft Bye-Laws for establishment of KWSSB

KAMBIA DISTRICT COUNCIL
KAMBIA

1st 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

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 ....1st....day of ..October.....201.0.....

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.

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 id changed every 48 hours

In the case of major breakdown lasting more that 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 accpunts. At least two of these accounts shall be operational designated as "Operational Account" and "Resaeve 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 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 though 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.

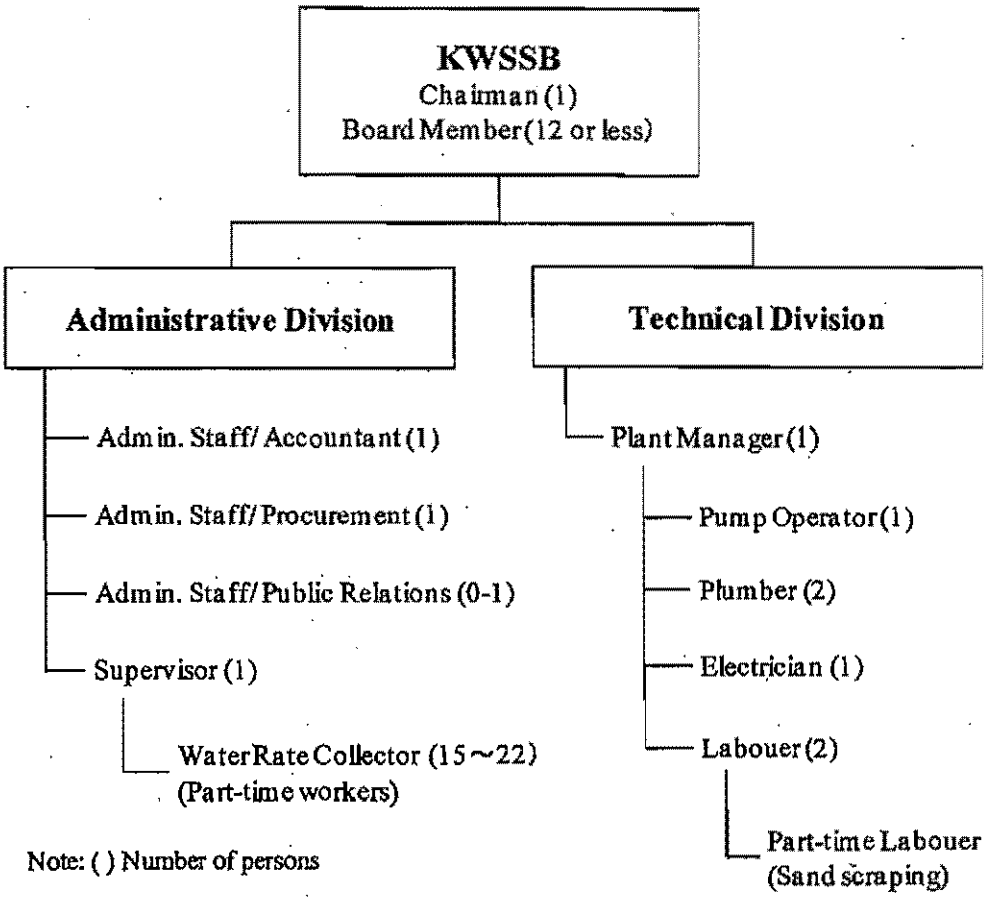
ii. Such amendment can only be effected upon agreement by no less than two thirds of all members of the Board that have been established by this instrument, and in the presence and active participation and consent of the Assembly members designated for said communities.

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

Community Name	Date	Signature of Board Chairman
Kambia One	1st Oct 2010	Gibril Conteh
Kambia Two		
Kambia Three		

Tentative organization chart of KWSSB



Note: ( ) Number of persons

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^2) of the construction materials and equipment

2) Acquisition of land at the sites for the construction of the following facilities:

(a)	Water Intake		
	- Kolenten River	100m^2	Public lands
	- Swamp	100m^2	Public lands
(b)	Water Treatment Plant	10,000m^2	Public lands
(c)	Elevated Tank	500m^2	Public lands
(d)	Public Taps	5m^2×100 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.

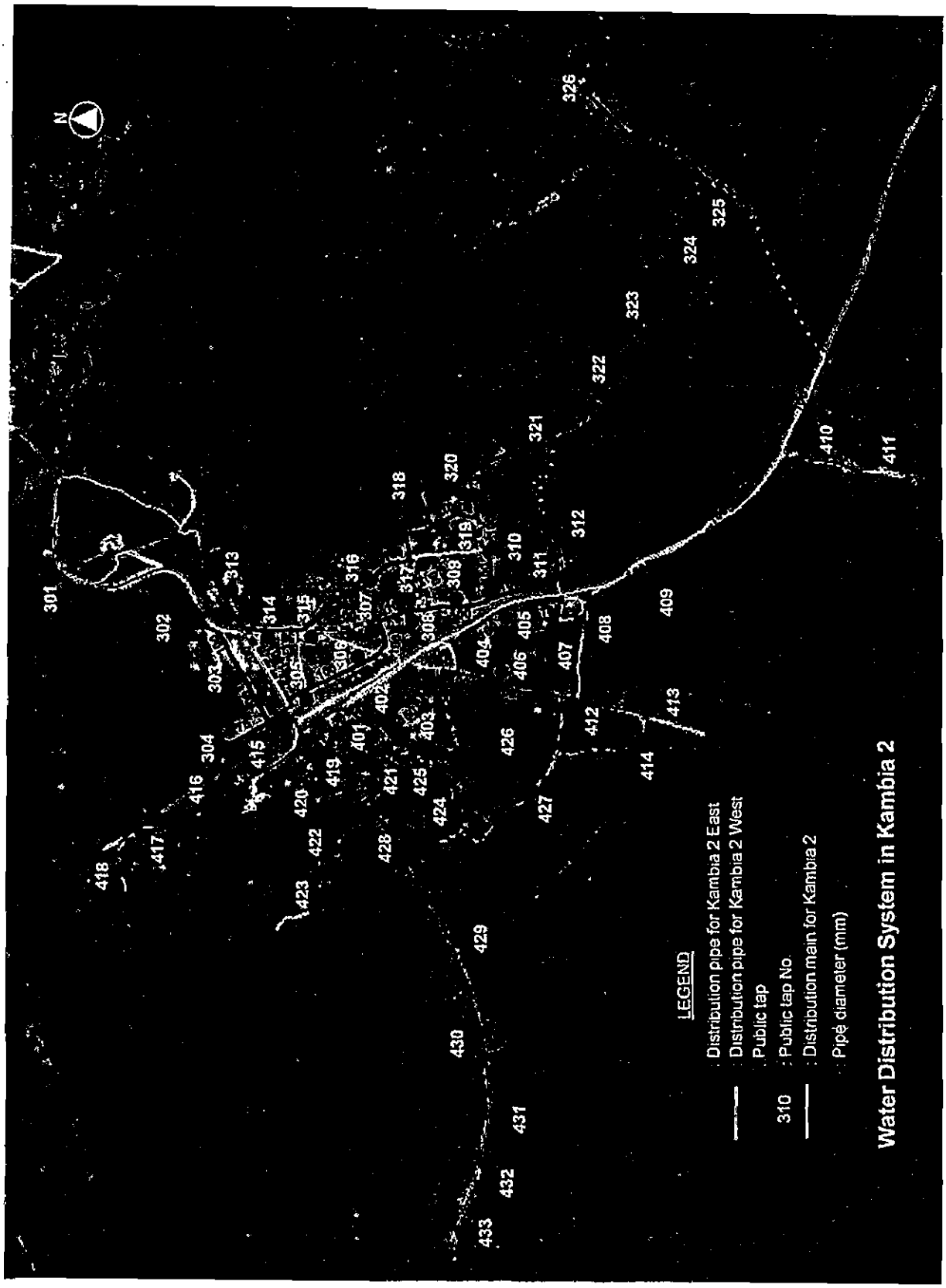
9) Proper maintenance and use of the facilities and equipment provided with in the Japan's Grant Aid scheme.

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).

Annex 8

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)



資 料 ５

本プロジェクトの環境許可証

資料５ 本プロジェクトの環境許可証

SIERRA LEONE GOVERNMENT

Sierra Leone Environment Protection Agency
3rd Floor, Youyi Building, Freetown

Ref: SLEPA/EIA/25

1st 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 nor 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

資 料 6

自然条件調査結果

資料６ 自然条件調査結果

現地調査では表-1に示す自然条件に係る調査を現地再委託業務で実施した。また、本プロジェクトの水源（コレンテン川、スワンプ）及びカンビア・タウン内の井戸から採水して水質状況を確認した。さらに、コレンテン川の流量観測を行い、乾期の流量を調査した。各調査の実施地点を図-1に示す。

表-1 自然条件調査（現地再委託業務）

調査項目	調査内容	調査方法及び仕様
1. 地形測量	(1) 平面測量	・取水施設予定地 コレンテン川（30m×30m＝900㎡） スワンプ（30m×30m＝900㎡） ・浄水施設予定地 既存施設（100m×100m＝10,000㎡） ・高架水槽予定地 既存施設（50m×50m＝2,500㎡） 新設予定地（50m×50m＝2,500㎡） 合計16,800㎡
	(2) 路線測量	・コレンテン川～浄水場間（0.2km） ・スワンプ～浄水場間（0.5km） ・浄水場～既存高架水槽(2.0km) ・カンビア市街地（35km） 合計37.7km
2. 地盤・土質調査	(1) ボーリング調査及び標準貫入試験	・浄水場予定地（1個所×20m） ・既存高架水槽（1個所×20m） ・新設高架水槽（1個所×20m） 合計3個所60m
	(2) 平板載荷試験	・浄水施設予定地（1個所）
	(3) 埋設構造物確認調査	試掘調査 ・カンビア市街地（30個所×1m×1m×1m） ・浄水施設（10個所×1m×1m×2m） 合計40個所

（1）地形測量

地形測量では、計画施設の建設予定地の平面測量と配管ルートの路線測量（平面及び縦断）を実施し、計画地点の平面・縦断形及び標高を調査した。なお、路線測量ではカンビア・タウン内の公共水栓の建設予定地（100ヶ所）の地点及び標高についても合わせて調査した。

（2）地盤･土質調査

地盤・土質調査では、浄水場及び高架水槽建設予定地点でのボーリング調査（標準貫入試験含む）、浄水場建設予定地（既存浄水場内）での平板載荷試験を実施した。ボーリング調査の結果を表-2、平板載荷試験の結果を表-3に示す。

また、地盤・土質調査では、施工計画や工事費の積算に反映させるため、カンビア・タウン内の配管ルート及び浄水場建設予定地で試掘を実施し、土質や転石等の有無を確認した。試掘調査の結果を図-2に示す。

配管ルートの内、浄水場～高架水槽間の送水管ルートの一部（Test Pit No.2及び No.3地点）、カンビア・タウンの新市街地の西地区の一部（Test Pit No.26～No.28、No.22地点）には地表から30～60cm の深さに岩が確認され、同地点を含む約1km の区間は配管工事で岩掘削が必要となる。一方、浄水場内の試掘調査では浄水施設の建設予定地点10箇所で深さ2m まで掘削を行い、転石等による掘削工事への障害はないことを確認した。

（3）水質調査

現地調査では、本プロジェクトの水源となるコレンテン川及びスワンプから採水して水質分析を行い、原水の水質の性状について確認を行った。また、カンビア・タウン内の伝統井戸及びハンドポンプ付井戸から採水して、住民が利用している給水源の水質についても調査を行った。これら水質分析の結果を表-4に示す。なお、水質分析は WSD の水質分析室に依頼した。

（4）河川流量観測

本プロジェクトの水源となるコレンテン川の河川流量（特に、乾期の終わりの最も流量の少ない時期の流量）に対する取水の影響を把握する目的で同河川の流量観測を行った。河川流量は、河川の流速を流速計により測定し、河川の流積（流下断面積）との積によって算定した。この結果、コレンテン川の流量は2.40m^3/秒（2010年5月15日観測）であった。

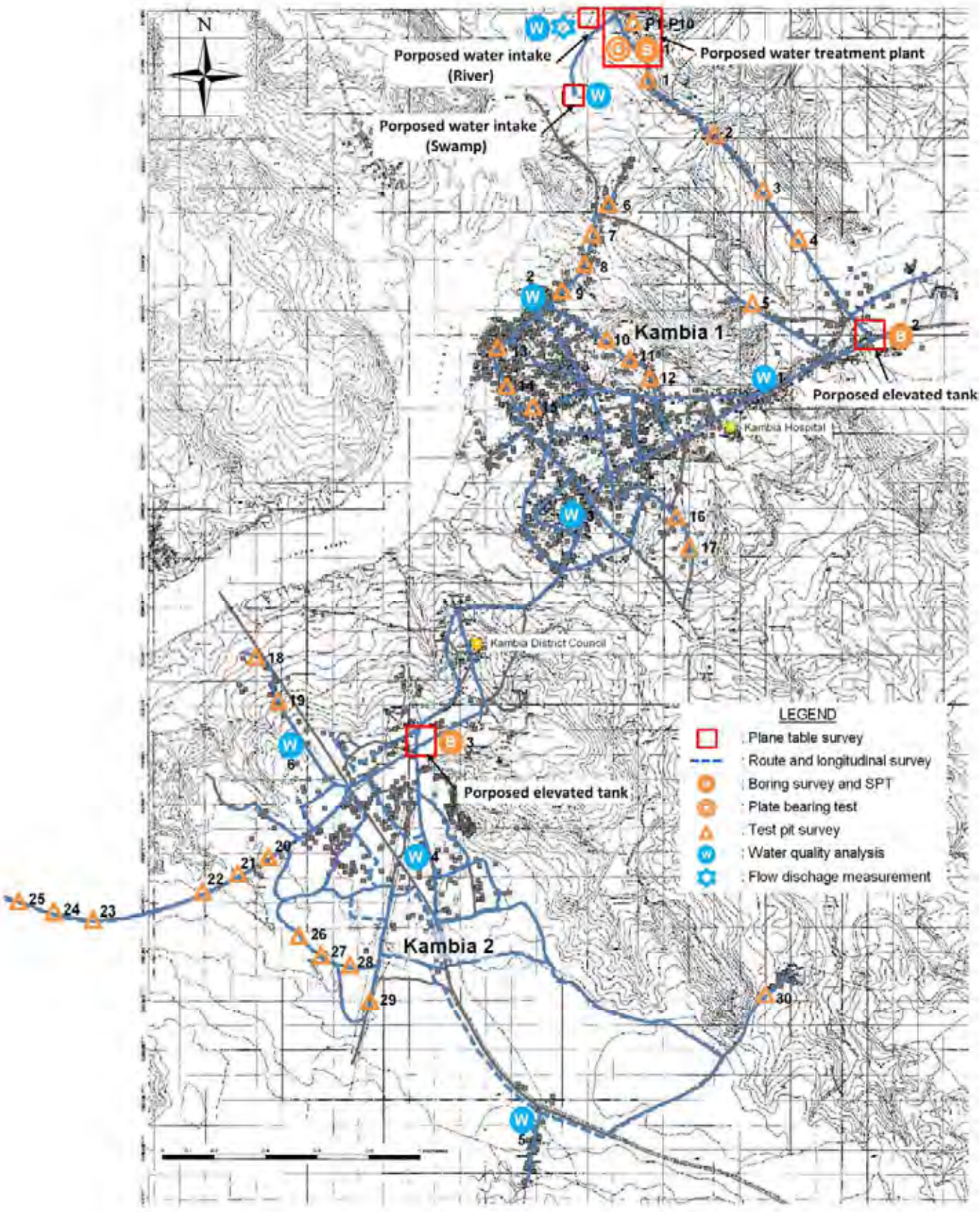


図-1 自然条件調査位置図

表-2 ボーリング調査結果

SPT LITHOLOGIC DRILL LOG

DATE: 02/06/2010 | FOREMAN: J. Allie

AREA: Kambia 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	8	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	50	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 gneissic 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. Allie

AREA: Kambia Town I | LINE : Proposed Water Treatment Facility | SITE: 1 | GEOLOGIST: M. Bawoh

COLLAR ELEV.: 28.561m | BEDROCK ELEV.: 18.341m | 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 embeded
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	10	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	Saprolitic 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. Allie

AREA: Kambia 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, densely 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	Saprolitic material containing partly weathered country rock
10.22	10.68	0.46	90	21	Orange Brown	-	50	Partly Weathered	Indurated	Saprolite	Saprolitic material containing partly weathered country rock
11.68	12.14	0.46	85	10	Orange Brown	20	40	Partly Weathered	Indurated	Saprolite	Saprolitic material containing partly weathered country rock
13.14	13.60	0.46	100	45	Orange Brown	10	50	Partly Weathered	Indurated	Saprolite	Saprolitic 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 1mm
Slimes: Size fraction smaller that -63µm

表-3 平板載荷試験結果

REPUBLIC OF SIERRA LEONE CONSULTANT JICA CONTROL LABORATORY	ESTABLISHMENT OF RURAL WATER SUPPLY SYSTEM IN KAMBIA TOWN	CONTRACTOR MINISTRY OF WATER AND ENERGY

DETERMINATION OF THE PLATE-BEARING VALUE

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^{-3} m						Soil Pressure	ΔP/ΔS
Pm		Gauge 1	Gauge 2	Gauge 3	Gauge 4	Sum x 10^{-5}	Average x 10^{-5}	P=C · Pm x 10^{-2}	
[Kg/cm^2]	[MN/m^2]	0.01mm	0.01mm	0.01mm	0.01mm	[m]	[m]	[MN/m^2]	[MN/m^3]
0,0	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,000	
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	
3,0	0,30	365,00	398,00	410,00	450,00	1623,00	405,75	0,300	0,001
1,5	0,15	300,00	335,00	378,00	433,00	1446,00	361,50	0,150	
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	
1,5	0,15	284,00	319,00	316,00	410,00	1329,00	332,25	0,150	
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	0,003
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	
2,5	0,25	201,00	338,00	350,00	442,00	1331,00	332,75	0,250	

Bearing Plate D = 60 [cm]

Bearing Piston d = 6 [cm]

$C = d^2 / D^2$

ΔP= 0,150 x10^{-1}[MN/m^2]

ΔS= 154,75 x 10^{-5} [m]

Ev = 0.75·D·ΔP/ΔS

E_v1 = 0,2 [MN/m^2]

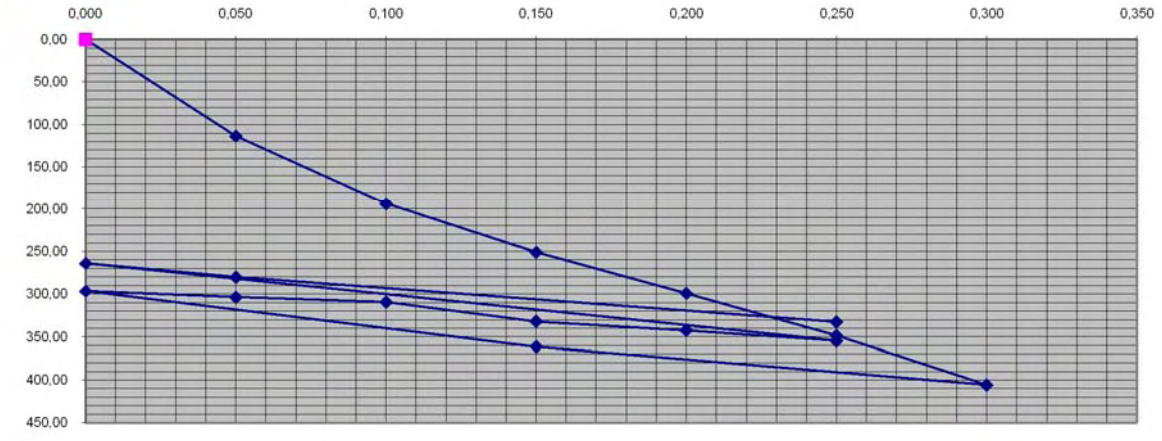
ΔP= 0,150 x10^{-1}[MN/m^2]

ΔS= 44,75 x 10^{-5} [m]

E_v2 = 0,8 [MN/m^2]

E_v2/E_v1 = 3,46 (>2.2)

Remarks:



Test Pit in Kambia Town

Test pit No.1 Test pit No.2 Test pit No.3 Test pit No.4

Test pit No.5 Test pit No.6 Test pit No.7 Test pit No.8

Test pit No.9 Test pit No.10 Test pit No.11 Test pit No.12

Test pit No.13 Test pit No.14 Test pit No.15 Test pit No.16

Test pit No.17 Test pit No.18 Test pit No.19 Test pit No.20

Test pit No.21 Test pit No.22 Test pit No.23 Test pit No.24

図-2 (1/2) 試掘調査写真

Test pit No25

Test pit No26

Test pit No27

Test pit No28

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

図-2 (2/2) 試掘調査写真

表-4 水質分析結果

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	
1	PH	5.8	6.1	5.7	6	6.1	5.7	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	<5.0
3	Conductivity (µS/cm)	39.9	40.1	129.8	237	107	37.5	93.2	51.4	<450
4	TDS (mg/l)	19.3	20	64.2	118.1	53.1	18.4	46.1	25.6	<248
5	Ammonia (mg/l)	0	0	0	0	0	0	0	0	No. Value
6	Total Hardness $CaCO_3$ (mg/l)	14	11	0	0	0	8	4	11	<500
7	Copper (mg/l)	0.04	0	0.06	0	0.03	0.03	0	0.12	<2.0
8	Fluoride (mg/l)	0.44	0.04	0.2	0.9	0.7	0.65	0.4	1.46	<1.5
9	Iron (mg/l)	0	0.06	0.09	0.03	0.02	0.03	0	0.04	<0.3
10	Magnesium (mg/l)	0	0	8.5	14.5	11	9.5	4	0	<200
11	Manganese (mg/l)	0.02	0.003	0.035	0.018	0.014	0.015	0	0.002	<0.4
12	Nitrite (mg/l)	0.027	0.012	0.004	0.006	0.001	0.004	0.017	0.025	3
13	Nitrate – Nitrogen (mg/l)*HR*	1.38	0.58	9.4	27.6	24	10.8	0.66	2.2	<10
14	Sulphate (mg/l)	0	0	8	3	3	5	0	4	<400
15	Sulphide (mg/l)	0.14	0.15	0.1	0.09	0.07	0.1	0.16	0.18	<0.5
16	Chloride (mg/l)	-	-	-	-	-	-	-	-	<250
17	Arsenic – (p)	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	<5.0
19	E. Coli	0	0	0	0	0	0	0	0	Zero
20	Faecal Coliforms	80	160	135	175	85	120	55	145	Zero

Note: Date of water sampling: May 19, 2010

資 料 7

社会条件調査結果

資料７ 社会条件調査結果

現地調査では、カンビア・タウンの一般的な社会経済状況の把握、水利用実態、衛生状況、本プロジェクトが実施後の給水の利用に係る意思、各戸給水栓の接続に係る希望等に係るアンケート調査を実施した、また、給水区域内の戸数と人口を把握するためのカウント（全数調査）を実施した。

上記アンケート調査のサンプル数は旧市街地185、新市街地200の合計385サンプルを対象に行った。アンケート調査の結果の概要は以下のとおりである。

【民族】

・ティムニ：	71%
・リンバ：	13%
・スス：	9%
・その他	6%

【識字率/最終学歴】

・小学校	29%
・中学校	14%
・高等学校	2%
・識字率	47%

【健康状態】

・過去 1 年間に病気を経験	62%
・内、下痢	10%
・内、腸チフス	18%

【衛生施設】

・個人トイレ	21%
・共同トイレ	70%
・水洗トイレ	1%

【給水源】

・伝統井戸	44%
・ハンドポンプ付井戸	16%
・河川・小川	37%

【水汲みに要する時間】

・10 分以内	34%
・10～20 分	33%
・25 分以上	30%

【水源までの距離】

・50m 以内　44%
・60～100m　54%
・100m 以上　1%

【主な収入源】

・給与所得　24%
・貿易業（Trader）　21%
・年金　2%
・送金　3%
・自営　33%
・その他　13%

【月収】

・10 万レオネ以下　43%
・10～20 万レオネ　27%
・20～35 万レオネ　13%
・35～50 万レオネ　7%
・50～75 万レオネ　2%

【貯蓄】

・貯金あり　25%
・貯金なし　65%

【本プロジェクトへの協力】

・協力する　87%
・協力しない　11%
・分からない　2%

【希望する給水形態】

・公共水栓　16%
・各戸給水栓（Yard connection）　43%
・各戸給水栓（House connection）　37%
・分からない　3%

【水道料金の支払い】

・意志あり　80%
・意思なし　10%
・分からない　10%

【支払い意思額/公共水栓】

・5,000 レオネ以下　55%
・5,000 レオネ　23%
・5,000～7,500　3%

【支払い意思額/Yard Connection】

・5,000 レオネ以下　9%
・5,000 レオネ　11%
・5,000～7,500 レオネ　16%
・7,500～10,000 レオネ　46%

【支払い意思額/House Connection】

・15,000～20,000 レオネ　35%
・20,000～30,000 レオネ　11%
・30,000 レオネ以上　1%

本プロジェクトの計画給水区域内の戸数と人口は以下のとおりである。

	戸数（戸）	人口（人）
・旧市街地（Kambia 1）	1,231	9,892
・新市街地（Kambia 2）	1,962	10,876
合 計	3,193	20,768

資 料 8

配水管水理計算書

資料８ 配水管水理計算書

Hydraulic Calculation on Water Pressure at Public Taps in Kambia 1

Water Head at Junctions in Kambia 1

Junction	C	D (mm)	Q (m3/min)	L (m)	V (m/sec)	Hf (m)	ΣHf (m)	El. Tank (EL-m)	Water Head	Discharge (m3/day)	Hourly Coefficient
	130	150	1.367	20	1.290	0.25				492	4.0
1A							0.25	77.90	77.65		
	130	150	0.767	400	0.723	1.69				276	
	130	100	0.767	790	1.628	24.09				276	
1B							26.03	77.90	51.87		
	130	100	0.300	140	0.637	0.75				108	
1C							26.78	77.90	51.12		

Kambia 1 - Higher 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)
103	1A	130	75	0.133	100	0.503	0.49				48
		130	75	0.067	160	0.252	0.22				24
	101							0.71	65.99	10.95	
		130	75	0.033	200	0.126	0.07				12
	102							0.78	66.10	10.77	
		130	75	0.067	80	0.252	0.11				24
	103							0.60	63.54	13.51	
		130	75	0.033	220	0.126	0.08				12
	104							0.68	60.92	16.05	

Kambia 1 - Higher 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)
105	1A	130	150	0.467	30	0.440	0.05				168
		130	100	0.433	80	0.920	0.85				156
	106							0.90	63.38	13.37	
107		130	100	0.400	120	0.849	1.10				144
		130	100	0.333	70	0.708	0.46				120
	109							2.46	56.43	18.76	
110		130	100	0.300	250	0.637	1.34				108
		130	100	0.100	210	0.212	0.15				36
	116							3.95	45.87	27.83	
117		130	100	0.067	130	0.142	0.04				24
		130	100	0.033	120	0.071	0.01				12
	118							4.00	40.77	32.88	
		130	100	0.033	120	0.071	0.01				12
	105							0.06	67.51	10.08	
		130	75	0.067	180	0.252	0.24				24
	107							2.24	58.39	17.02	
		130	75	0.033	280	0.126	0.10				12
	108							2.34	51.08	24.23	
		130	100	0.200	10	0.425	0.03				72
	110							3.83	50.30	23.52	
		130	100	0.167	200	0.354	0.36				60
112	111							4.19	47.20	26.26	
113		130	100	0.133	160	0.283	0.19				48
		130	100	0.067	60	0.142	0.02				24
	114							4.40	40.51	32.74	
		130	100	0.033	140	0.071	0.01				12
	115							4.41	40.98	32.26	
		130	100	0.033	160	0.071	0.01				12
	112							4.39	42.33	30.93	
		130	100	0.033	90	0.071	0.01				12
	113							4.39	43.83	29.43	
		130	75	0.033	80	0.126	0.03				12
	117							4.02	43.00	30.63	

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
	201							0.02	37.64	14.21	
202		130	100	0.133	220	0.283	0.26				48
		130	75	0.067	180	0.252	0.24				24
	204							0.52	34.70	16.65	
		130	75	0.033	200	0.126	0.07				12
	205							0.59	29.24	22.04	
		130	100	0.067	20	0.142	0.01				24
	202							0.29	37.06	14.52	
		130	100	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
	206							0.86	34.37	16.64	
207		130	100	0.267	190	0.566	0.82				96
		130	100	0.233	10	0.495	0.03				84
	208							1.71	33.00	17.16	
209		130	100	0.200	10	0.425	0.03				72
		130	100	0.167	220	0.354	0.40				60
	210							2.14	21.12	28.61	
211		130	100	0.133	170	0.283	0.20				48
		130	75	0.100	50	0.377	0.14				36
	212							2.48	18.08	31.31	
		130	75	0.067	270	0.252	0.36				24
	213							2.84	18.92	30.11	
		130	75	0.033	220	0.126	0.08				12
	214							2.92	25.69	23.26	
		130	100	0.033	140	0.071	0.01				12
	207							1.69	31.31	18.87	
		130	100	0.033	140	0.071	0.01				12
	209							1.75	28.81	21.31	
		130	100	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	100	0.233	110	0.495	0.37				84
		130	100	0.200	90	0.425	0.23				72
	216							0.60	28.54	21.98	
217		130	100	0.167	50	0.354	0.09				60
218		130	100	0.133	130	0.283	0.16				48
		130	100	0.100	110	0.212	0.08				36
	219							0.93	18.94	31.25	
		130	100	0.067	180	0.142	0.06				24
	220							0.99	16.41	33.72	
		130	100	0.033	170	0.071	0.02				12
	221							1.01	16.64	33.47	
		130	100	0.033	120	0.071	0.01				12
	215							0.38	30.40	20.34	
		130	100	0.033	220	0.071	0.02				12
	217							0.71	26.63	23.78	
		130	75	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 (m3/min)	L (m)	V (m/sec)	Hf (m)	ΣHf (m)	Elevation (EL-m)	Pressure (m)	Discharge (m3/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 (m3/min)	L (m)	V (m/sec)	Hf (m)	ΣHf (m)	El. Tank (EL-m)	Water Head	Discharge (m3/day)	Hourly Coefficient
	130	250	1.967	2150	0.668	4.32				708	4.0
2A							4.32	77.90	73.58		
	130	200	1.100	940	0.584	1.91				396	
2B							6.23	77.90	71.67		

Kambia 2 East 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)
2A	130	100	0.400	20	0.849	0.18				144
301							0.18	33.60	39.80	
	130	100	0.367	480	0.778	3.74				132
302							3.92	49.22	20.44	
	130	100	0.333	220	0.708	1.44				120
303							5.36	55.47	12.75	
304	130	100	0.300	120	0.637	0.64				108
	130	100	0.267	150	0.566	0.65				96
305							6.65	55.76	11.17	
	130	100	0.233	180	0.495	0.61				84
306							7.26	55.57	10.75	
	130	100	0.200	120	0.425	0.30				72
307							7.56	55.27	10.75	
	130	100	0.167	100	0.354	0.18				60
308							7.74	55.13	10.71	
	130	100	0.133	140	0.283	0.17				48
309							7.91	54.85	10.82	
310	130	100	0.100	110	0.212	0.08				36
	130	100	0.067	80	0.142	0.03				24
311							8.02	54.93	10.63	
	130	100	0.033	240	0.071	0.02				12
312							8.04	53.36	12.18	
	130	75	0.033	120	0.126	0.04				12
304							6.04	55.35	12.19	
	130	100	0.033	150	0.071	0.01				12
310							8.00	53.26	12.32	

Kambia 2 East 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)
2A	130	150	0.467	580	0.440	0.98				168
313							0.98	55.04	17.56	
	130	150	0.433	190	0.409	0.28				156
314							1.26	55.43	16.89	
	130	150	0.400	110	0.377	0.14				144
315							1.40	55.40	16.78	
	130	150	0.367	240	0.346	0.26				132
316							1.66	54.32	17.60	
	130	150	0.333	110	0.315	0.10				120
317							1.76	53.70	18.12	
318	130	150	0.300	150	0.283	0.11				108
	130	100	0.267	10	0.566	0.04				96
319							1.91	53.42	18.25	
	130	100	0.233	260	0.495	0.88				84
320							2.79	50.46	20.33	
	130	100	0.200	200	0.425	0.51				72
321							3.30	52.54	17.74	
	130	100	0.167	260	0.354	0.47				60
322							3.77	55.07	14.74	
	130	100	0.133	220	0.283	0.26				48
323							4.03	56.21	13.34	
	130	100	0.100	200	0.212	0.14				36
324							4.17	57.91	11.50	
	130	100	0.067	200	0.142	0.07				24
325							4.24	58.68	10.66	

	130	75	0.033	400	0.126	0.15					12
326							4.39	41.82	27.37		
	130	75	0.033	120	0.126	0.04					12
318							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)	ΣHf (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	
		130	150	0.433	120	0.409	0.18				156
	402							0.55	55.32	15.80	
		130	150	0.400	100	0.377	0.13				144
	403							0.68	55.63	15.36	
404		130	100	0.367	140	0.778	1.09				132
		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
		130	100	0.167	130	0.354	0.24				60
	407							3.11	55.53	13.03	
		130	100	0.133	170	0.283	0.20				48
	408							3.31	55.55	12.81	
		130	100	0.100	180	0.212	0.13				36
	409							3.44	57.09	11.14	
		130	100	0.067	480	0.142	0.16				24
	410							3.60	57.28	10.79	
		130	75	0.033	170	0.126	0.06				12
	411							3.66	55.40	12.61	
		130	100	0.067	60	0.142	0.02				24
	404							1.79	55.24	14.64	
		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
		130	100	0.067	220	0.142	0.07				24
	413							2.98	53.91	14.78	
		130	100	0.033	130	0.071	0.01				12
	414							2.99	52.54	16.14	
		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)	ΣHf (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	
		130	75	0.100	150	0.377	0.43				36
	416							0.60	53.52	17.55	
		130	75	0.067	180	0.252	0.24				24
	417							0.84	37.65	33.18	
		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)	ΣHf (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
		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
		130	75	0.200	30	0.755	0.31				72
	428							4.28	50.27	17.12	
		130	75	0.167	380	0.629	2.79				60
	429							7.07	49.22	15.38	
		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	
427		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	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