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添付資料 1　調査団員・氏名

調査団員・氏名

名前		担当業務	所属
JICA 団員			
1	服部 容子	案件管理	JICA 地球環境部 水資源グループ 水資源第二チーム　課長
2	横田 義昭	団長	JICA 国際協力専門員
3	加治 貴	案件管理	JICA 地球環境部 水資源グループ 水資源第二チーム
4	野田恵莉	案件管理	JICA 地球環境部 水資源グループ 水資源第二チーム
コンサルタント団員			
4	松原 康一	業務主任/上水道計画 1	（株）日水コン
5	間宮 健匡	副業務主任/上水道計画 2	（株）日水コン
6	中田 貴大	送配水管路計画・設計 1	（株）日水コン
7	黒田 將嵩	送配水管路計画・設計 2	（株）日水コン
8	齋藤 周一	配水施設計画・設計/機械電気設備・計装監視	（株）日水コン
9	西田 浩清	施工・調達計画・積算/DX 推進	（株）日水コン
10	新村 宏樹	運営維持管理計画/ソフトコンポーネント計画	八千代エンジニヤリング（株）
11	可児 圭子	環境社会配慮	国際航業（株）
12	玉井 彩香	分野横断課題（ジェンダーや気候変動等）配慮	国際航業（株）
13	浅田 英紀	照査	（株）日水コン

添付資料2　調査行程

第一次現地調査：調査日程

日時	場所	主な内容
(第1陣): 10/16~12/12		
2021年 10月16日(土)		移動
10月17日(日)		移動
10月18日(月)	プロジェクト事務所	・協議のための資料作成
10月19日(火)	WASAC UWSSD	・インセプションレポートの提出 ・執務スペースの確保依頼・確認
10月19日(火)	JICAルワンダ事務所	・インセプションミーティングの段取りの確認 ・業務にあたっての留意事項の確認
10月20日(水)	プロジェクト事務所	・流量計設置現場の確認・再委託打合せ・資料整理
10月21日(木)	Remera Branch	・流量計設置現場の確認、施設使用状況の確認 ・無収水技プロチーム保有機材の確認
10月22日(金)	WASAC UWSSD	・インセプション協議事前説明(Methode局長およびUWSSDマネージャー層5名)
10月25日(月)	WASAC HQ	・インセプション協議
10月26日(火)	現場	・インセプション協議でのMethode局長提案事項(ノトラ・レメラ間送水管に代わる提案)の現場確認
10月27日(水)	プロジェクト事務所	・流量計設置現場の確認・再委託打合せ・資料整理
10月28日(木)	プロジェクト事務所	・流量計設置現場の確認・再委託打合せ・資料整理
10月29日(金)	WASAC UWSSD	・既存流量計の状況について無収水技プロの団員にヒアリング
11月1日(月)	WASAC UWSSD	・ベースライン調査の調査個所、スケジュール、調査方法等を確認した。
11月2日(火)	キガリ市市庁	・Physical Development Planと道路の拡張計画の確認のため、City Engineerと面会した。
11月3日(水)	WASAC UWSSD	・新規送水管布設ルートについて協議した。
11月4日(木)	MINECOFIN	表敬訪問:プロジェクトの内容説明(インセプション協議資料を活用)
11月5日(金)	MININFRA	表敬訪問:プロジェクトの内容説明(インセプション協議資料を活用)
11月8日(月)	現場	・超音波流量計の設置
11月9日(火)	現場	・超音波流量計の設置
11月10日(水)	WASAC UWSSD	・無収水ベースライン調査に係る掘削・機器調達・設置等の進捗報告を行った。 ・機械式流量計を設置する場所での配管切り回し材料・方法の確認や、チャンバーの材質等の再確認を行った。 ・ブロック化の分け方についての考え方と、配水池位置を提案し位置を一か所づつ確認して議論を行った。
11月11日(木)	WASAC HQ	・メータ交換とBilling Section の課題(ソフコン計画)
11月11日(木)	Kanombe Branch	・Kacyiru branch の課題についてヒアリングを行った。(ソフコン計画)
11月11日(木)	Kacyiru Branch	・送水管のバルブ運用についてヒアリングを行った。
11月12日(金)	WASAC中央倉庫	Stock yard management 給水管・漏水資材在庫管理の課題の調査を行った。
11月15日(月)	Kacyiru Branch	・Kacyiru branch の課題(ソフコン計画)についてヒアリングを行った。
11月15日(月)	現場	・既存施設地形、送水管分岐現位置、配水池・高架水槽原位置の確認
11月16日(火)	Remera Branch	Remera branch の課題(ソフコン計画)についてヒアリングを行った。
11月17日(水)	現場	・チャンバー工事監理 ・既存施設の確認
11月18日(木)	現場	・圧力計設置を顧客の給水栓に設置 ・既存施設の確認 ・チャンバー工事監理
11月19日(金)	現場	・超音波流量計の設置 ・送配水管布設ルートの確認 ・試掘調査調整協議 ・チャンバー工事監理
11月22日(月)	WASAC UWSSD	WASAC定例会議。ベースライン調査およびチャンバー工事の進捗報告、配水池・高架水槽の標準図面の共有・水需要予測および配分の共有
11月23日(火)	現場	・超音波流量計の設置 ・400mm送水管の埋設場所調査 ・配水管布設ルートの確認 ・チャンバー工事監理

日時	場所	主な内容
11月24日(水)	現場	・圧力計の撤去 ・試掘場所の現場確認 ・配水管布設ルートの確認 ・チャンバー工事監理
11月25日(木)	現場	・圧力計設置個所の調査 ・試掘場所の現場確認 ・配水管布設ルートの確認 ・チャンバー工事監理
11月26日(金)	現場	・圧力計設置を顧客の給水栓に設置 ・配水管布設ルートの確認 ・チャンバー工事監理
11月29日(月)	現場	・配水池水位データの取得 ・超音波流量計の設置 ・配水管布設ルートの確認 ・チャンバー工事監理
11月30日(火)	現場	WASACディレクターと配水池建設候補地の現場確認を行った。
12月1日(水)	現場	WASACディレクターと配水池建設候補地の現場確認を行った。
12月2日(木)	現場	・圧力計設置を顧客の給水栓に設置 ・配水管布設ルートの確認 ・チャンバー工事監理
12月3日(金)	現場	・試掘調査の現場確認 ・配水管布設ルートの確認 ・チャンバー工事監理
12月6日(月)	現場	・ボーリング位置業者確認 ・チャンバー工事監理
12月7日(火)	現場	・圧力計設置を顧客の給水栓に設置 ・チャンバー工事監理
12月7日(火)	WASAC中央倉庫	・WASACがStock Yardで保有する資機材の確認
12月8日(水)	現場	・コンクリート工場とHDPE工場の確認
12月9日(木)	現場	・WASACマネージャー同行の上、チャンバー工事現場確認
12月10日(金)	プロジェクト事務所	・資料整理
12月11日(土)		移動
12月12日(日)		移動
(第2陣): 1/14~3/6		
1月14日(金)		移動
1月15日(土)		移動
1月17日(月)	プロジェクト事務所	サイト確認・WASAC打合せ
1月18日(火)	現場	土質調査段取りおよびサイト確認・維持管理関連情報収集
1月19日(水)	WASAC UWSSD	WASAC定例会議。ベースライン調査チャンバー工事の進捗報告。設計の進捗報告。WASAC負担事項の確認。ベースライン調査の結果報告。配水池設置場所の共有。
1月20日(木)	WASAC HQ	WASACのCEOに配水池設置、給水管、テクニカルノート等について説明を行った。 WASACのカスタマーサービスの課題について意見を伺った。
1月21日(金)	現場	新配水池用地(Batsinda)確認・Remeraブランチ情報収集
1月24日(月)	プロジェクト事務所	WASAC情報収集・資料整理他
1月25日(火)	WASACカチル支店	カチルブランチ情報収集・新配水池用地確認
1月26日(水)	プロジェクト事務所	コントラクター情報収集、表敬訪問用資料作成
1月27日(木)	WASAC UWSSD	WASAC定例会議。ベースライン調査チャンバー工事の進捗報告。送配水ネット ワークについて説明。JICAルワンダ事務所説明。MINECOFIN情報収集(税金関連)
1月28日(金)	日本大使館	大使館表敬訪問
1月31日(月)	WASAC UWSSD	SCADAのサーバーを確認した。 サーバー管理者へのヒアリングを行った。
2月1日(火)	プロジェクト事務所	・横田長期専門家との打ち合わせを行った。
2月1日(火)	現場	・既存配水池の場内配管の確認
2月2日(水)	WASAC UWSSD	WASAC定例会議。用地取得、モニタリングシステム、ゼロ請求に関する調査結果、管路更新方法の説明を行った。テクニカルノートについて協議を行った。
2月3日(木)	現場	・Nyarutaramaの土質調査個所についてWASAC担当者と現場確認を行った。

日時	場所	主な内容
2月4日(金)	現場	・Nyarutaramaのボーリングを開始した。 ・Gacuriroの土質調査個所についてWASAC担当者と現場確認を行った。
2月7日(月)	現場	・超音波流量計の設置 ・Nyarutaramaのボーリング調査の現場監視
2月8日(火)	プロジェクト事務所	・JICAとテクニカルノートについての打合せを行った。
2月8日(火)	現場	・Gacuriroのボーリングを開始した。
2月9日(水)	WASAC UWSSD	WASAC定例会議。EIAの概要と進捗について説明。送水管ルートについて協議を行った。
2月9日(水)	現場	レメラ新規送水管布設ルートの現場調査
2月10日(木)	WASAC HQ	WASACのCEOにテクニカルノートの内容説明。目標無収水率の整理について議論。レメラ新規送水管布設ルートの説明。
2月10日(木)	現場	EIA再委託先業者と現場踏査
2月11日(金)	現場	測量業者とKaguguの平面測量、レメラ新規送水管布設ルートの路線測量の現場確認を行った。
2月14日(月)	現場	・Gacuriroのボーリング調査の現場監視 ・流量計データの収集
2月15日(火)	WASAC UWSSD	モニタリングシステムと通信方法に関する打合せ

第二次現地調査：調査日程

日時	場所	主な内容
2022年 8月21日(日)	キガリ	キガリ着・団内協議
8月22日(月)	キガリ	WASAC 表敬・DRF説明及びMD協議 団内協議、JICAルワンダ事務所挨拶
8月23日(火)	キガリ	WASAC MD協議 キガリ市副市長 表敬、協議（用地取得・道路横断）
8月24日(水)	キガリ	WASAC MD協議 MININFRA表敬、協議 MINECOFIN表敬、協議
8月25日(木)	キガリ	WASAC MD協議、大使館報告
8月26日(金)	キガリ	WASAC MD協議、MD署名（団長）、JICA事務所報告

添付資料 3　関係者（面会者）リスト

関係者（面会者）リスト

Ministry of Finance (MINECOFIN)

MUGABE Gerald	Director General of External Finance,
BUTERA Tom	External Finance Division Manager

Ministry of Infrastructure (MININFRA)

ABIMANA Fidel	Permanent Secretary
KAYITESI Marcelline	Director General of Water and Sanitation

City of Kigali

MPABWANAMAGURU Merard	Vice Mayor in charge of Urbanization and Infrastructure
ASABA KATABARWA Emmanuel	City Engineer

WASAC

UMUHUMUZA Gisele	Acting CEO
RUTAGUNGIRA Methode	Director, Urban Water and Sanitation Service (UWSS)
MUREKEZI Dominique	Acting Director of Water and Sanitation Services Development
NYIRIGIRA Benoit	Program Manager, Water Program, SPIU
GASHUGI Innocent	Manager Water Operations Services, UWSS
BAHIGE Jean Berchimans	Manager of NRW, UWSS
LOBGA Monia	Water production services Manager
MUSABYEYEZU Jeanne	Head of Kacyiru Branch
RUBAYITA Gilbert	Head of Remera Branch
BUSHAYIJA Yasin	Head of Nzove WTP
HATEGEKIMANA Samson	Manager of Corporate Planning
KANSIIME Alex	Manager of Revenues Collection
UMUHOZA Francine	Water Resources and Environmental Engineer, UWSS
MAZIMPAKA Claudien	Zoning & Mapping Officer, UWSS
HAKIZUWERA Patrick	Water Distribution Officer, Kacyiru Branch
UWITONZE Desire	Ag. Zoning and Mapping Service, UWSS
NSENGIMANA Damascene	Water Distribution Officer / Remera Branch
RWABUNEZA Claudien	Water Distribution Officer / UWSS
MWAMBUTSA Celestin	Head of water distribution services / UWSS
UWUMUREMYI Felicien	Standard and quality control Officer / UWSS
NTAMUTURANO Desire	Head of leak detection and pressure management/UWSS
MUGABO Jean Marie Vianney	Leak Detection and pressure management operator/UWSS
NSHUTI Louis	Water Distribution Officer / Kanombe branch
NYRABEZA Marie Jeanne	Store Officer / Remera Central Store
MUSABYEYEZU Jeanne	Head of Kacyiru Branch
RUBAYITA Gilbert	Head of Remera Branch
UWAMAHORO Peace	Billing Officer / Remera Branch
MUTIMURA Eugene	Lab.Technician / Kimisagara WTP
Valerien NTIRANDEKURA	Water Sector Specialist Department, SPIU

添付資料 4　協議議事録（MD）

Minutes of Discussions
on the Preparatory Survey for the Project for
Improvement of Water Supply Services in North-Central Kigali

Based on the preliminary discussions between the Government of the Republic of Rwanda (hereinafter referred to as "Rwanda") and the Embassy of Japan in Rwanda and the Japan International Cooperation Agency (hereinafter referred to as "JICA") Rwanda Office, JICA dispatched the Preparatory Survey Team for the Outline Design (hereinafter referred to as "the Team") of the Project for Improvement of Water Supply Services in North-Central Kigali (hereinafter referred to as "the Project") to Rwanda. The Team held a series of discussions with the officials of the Government of Rwanda and conducted a field survey. In the course of the discussions, both sides have confirmed the main items described in the attached sheets.

Kigali, 11 November 2021

Mr. YOKOTA Yoshiaki
Leader
Preparatory Survey Team
Japan International Cooperation Agency
Japan

Ms. Gisele Umuhumuza
Acting Chief Executive Officer
Water and Sanitation Corporation
The Republic of Rwanda

1

ATTACHMENT

1. Objective of the Project

The objective of the Project is to contribute to stable water supply through reduction of leakage occurrences and decrease of intermittent water supply by constructing, installing, and replacing water supply facilities in the North-Central Kigali. Thereby it will contribute to improve public health and living conditions of citizens in the North-Central Kigali.

2. Title of the Preparatory Survey

Both sides confirmed the title of the Preparatory Survey as "the Preparatory Survey for the Project for Improvement of Water Supply Services in North-Central Kigali".

3. Project Site

Both sides confirmed that the site of the Project is in Kigali City, as shown in the maps in Annex 1.

4. Responsible Authority for the Project

Both sides confirmed the authorities responsible for the Project are as follows:

4-1. The Water and Sanitation Corporation (WASAC) will be the executing agency for the Project (hereinafter referred to as "the Executing Agency"). The Executing Agency shall coordinate with all the relevant authorities to ensure smooth implementation of the Project and ensure that the undertakings for the Project shall be managed by relevant authorities properly and on time. The organization chart and implementation structure of the Project are shown in Annex 2.

4-2. The line ministry of the Executing Agency is the Ministry of Infrastructure (hereinafter referred to as "MININFRA"). The MININFRA shall be responsible for supervising the Executing Agency on behalf of the Government of Rwanda.

5. Items Requested by the Government of Rwanda

5-1. As a result of discussions, both sides confirmed that the items requested by the Government of Rwanda are as follows:

a. To construct, install, and/or replace water supply facilities such as reservoirs, distribution pipes, house connections, monitoring equipment, etc. in the project intervention area in the water supply area from the Ntora Reservoir;

b. To establish distribution block systems to control pressure of the distribution

networks in the project intervention area in the water supply area from the Ntora Reservoir; and

c. To improve the water transmission capacity from the Ntora Reservoir.

5-2. JICA will assess the feasibility of the above requested items through the survey and will report the findings to the Government of Japan. The final scope of the Project will be decided by the Government of Japan.

5-3. The Government of Rwanda shall submit an official request to the Government of Japan through the diplomatic channel before the appraisal of the Project, which is scheduled no later than August, 2022

6. Points to Note in the Preparatory Survey

6-1. The Project plans to establish the block systems to control the pressure of distribution networks in the water supply area from the Ntora Reservoir. Their establishment is one of the most crucial strategies articulated in the 'Kigali Water Supply Master Plan.' The block systems established by the Project are expected to be a model for the Executing Agency to learn and improve the development of the water supply facilities after the Project. Thus, the Executing Agency will participate in the Preparatory Survey actively to learn designs and concepts of block systems, and the Team will communicate with the Executing Agency closely to promote its understanding about the block systems.

6-2. The water transmission from the Ntora Reservoir is planned to be improved through the Project by the construction or rehabilitation of the transmission pipelines. The increased flow rate after the leakage reduction by the Project must be considered for the planning of transmission pipelines. In addition, the routes and capacity of the pipelines should be planned based on the updated development plans of Kigali City and other related authorities, and relevant projects conducted by the Executing Agency.

6-3. Any works for constructing, installing, and/or replacing water supply facilities in the water supply area from the Remera Golf 8 Reservoir are not planned in the Project at the moment. However, their conditions will be surveyed to identify necessity and possibility that any works should be included in the Project within the project budget, and works which should be done by the Executing Agency.

6-4. The Preparatory Survey Team will conduct the leakage baseline survey to estimate the total amount of water lost through leakages in the project intervention area in the water supply area from the Ntora Reservoir. Installation of meters, arrangement of pipes, closure of valves in transmission/distribution networks, etc.

are necessary for the leakage baseline survey. Thus, the Executing Agency will support and coordinate with the Team closely in the implementation of the leakage baseline survey.

6-5. Regarding the house connections among the requested items by the Rwanda Side, the JICA side currently considers that the Executing Agency should have a full responsibility in installation of service connections including procurement of materials (house connection pipes, fitting materials, and meters) during the Project. However, the both sides understand that quality management of the service connection materials is crucial to reduce the occurrence of leakages. Thus, it should be decided during the Preparatory Survey whether the Project will procure them or not taking into account the Executing Agency' s capacity and magnitude of the installation works.

6-6. The new technical cooperation project titled "the Project for WASAC Utility Turnaround with KAIZEN Approach" plans to start around February, 2022. To enhance capacity for efficient implementation of NRW reduction is one of the most important outputs in it. Thus, close coordination between the Project and the new technical cooperation project is necessary for considering contents of soft-component and its implementation.

6-7. Land acquisition is necessary for the new reservoirs to be constructed by the Project. All the responsibilities including necessary arrangements and the cost for land acquisition shall be borne by the Executing Agency. The Executing Agency will support the Team in selecting the land, arrange the permission to enter and survey the land, and coordinate the procedure for the land acquisition with relevant agencies.

6-8. For the sake of efficient and effective implementation of the Preparatory Survey, close cooperation and coordination between the Executing Agency and the Team is crucial. Thus, the Executing Agency will assign full-time counterparts (staff members who work closely with the Team on a daily basis) from the Directorate of Urban Water and Sanitation Services (DUWSS) during the survey.

7. Procedures and Basic Principles of Japanese Grant

7-1. The Rwanda side agreed that the procedures and basic principles of Japanese Grant (hereinafter referred to as "the Grant") as described in Annex 3 shall be applied to the Project.

As for the monitoring of the implementation of the Project, JICA requires the Rwanda side to submit the Project Monitoring Report, the form of which is

attached as Annex 4.

7-2. Both sides confirmed that Annex 5 described the draft major undertakings to be taken by the Rwanda side for smooth implementation of the Project. The contents of Annex 5 will be elaborated and refined during the Preparatory Survey and be agreed upon in the mission dispatched for explanation of the Draft Preparatory Survey Report.

The contents of Annex 5 will be elaborated and discussed as the Preparatory Survey progresses, and eventually, will be used as an attachment to the Grant Agreement.

8. Schedule of the Survey

8-1. The Team will proceed with further survey in Rwanda until February, 2022 as the first field survey.

8-2. An official request for the Project to the Government of Japan will be submitted no later than August, 2022.

8-3. JICA will prepare a draft Preparatory Survey Report in English and dispatch a mission to Rwanda in order to explain its contents around August, 2022.

8-4. If the contents of the draft Preparatory Survey Report is accepted and the undertakings for the Project are fully agreed by the Rwanda side, JICA will finalize the Preparatory Survey Report and send it to Rwanda around November, 2022.

8-5. The above schedule is tentative and subject to change.

9. Environmental and Social Considerations

9-1. The Rwanda side confirmed to give due attention to the environmental and social considerations before and during implementation, and after completion of the Project, in accordance with the JICA Guidelines for Environmental and Social Considerations (April, 2010).

9-2. The Project is categorized as "B" from the following considerations:

The Project is not located in a sensitive area, nor has sensitive characteristics, nor falls into sensitive sectors under the JICA Guidelines for Environmental and Social Considerations (April, 2010), and its potential adverse impacts on the environment are not likely to be significant.

The Rwanda side confirmed to conduct the necessary procedures concerning the environmental assessment (including stakeholder meetings, Environmental Impact Assessment (EIA)/Initial Environmental Examination (IEE) and information

disclosure, etc.) and make an EIA/IEE report of the Project. The EIA/IEE approval shall be received from the responsible authorities and submitted to JICA by August, 2022.

9-3. For the Project that will result in involuntary resettlement, the Rwanda side confirmed to prepare a Resettlement Action Plan (RAP)/Abbreviated Resettlement Action Plan (ARAP) and make it available to the public. In addition, the Rwanda side confirmed to provide the affected people with sufficient compensation and/or support in accordance with RAP/ARAP, which is consistent with JICA Guidelines for Environmental and Social Considerations (April, 2010), in a timely manner.

10. Other Relevant Issues

10-1. Tax Issues

In the scheme of Japanese Grant, a government of recipient country shall ensure that customs duties, internal taxes, and other fiscal levies which might be imposed in a recipient country with respect to purchase of products and/or services be exempted or be borne by its designated authority without using a grant and its accrued interest, since a grant fund comes from Japanese taxpayers.

Thus, the details of taxes, e.g., names, tax rates, calculation methods, relevant laws/regulations, etc., and processes for exemption and/or for designated authorities to bear them will be confirmed during the Preparatory Survey. The Executing Agency will provide the Team with necessary supports such as provision and access to relevant information, arrangement of meeting with relevant organizations.

10-2. Undertakings by the Rwanda side for the Preparatory Survey

Both sides agreed that the following undertakings shall be done by the Rwanda side.

a. To assign full-time counterparts from DUWSS of the Executing Agency to the Team during the Preparatory Survey who play following roles as a coordinator to the Team:
   - To make appointments and to set up meetings with authorities, departments and all other facilities, and firms whatever the Team intends to visit;
   - To participate in site surveys and any other visiting places with the Team, and to make any convenience on accommodation, working office, adequate transportation, getting permissions if required, etc.; and
   - To assist and advise the Team for the collection of data and information.

b. To provide an office in the WASAC Headquarters or DUWSS for the Team during the Preparatory Survey;
c. To provide the Team with available relevant data, information, materials, and support necessary for the Preparatory Survey;
d. To prepare answers to the questionnaires presented by the Team;
e. To secure permission to photograph, and to enter into private properties and restricted areas for the Team for proper execution of the Preparatory Survey; and
f. To take any measures deemed necessary to secure safety of the Team.

10-3. Mainstreaming of Inclusiveness of Gender and Vulnerable

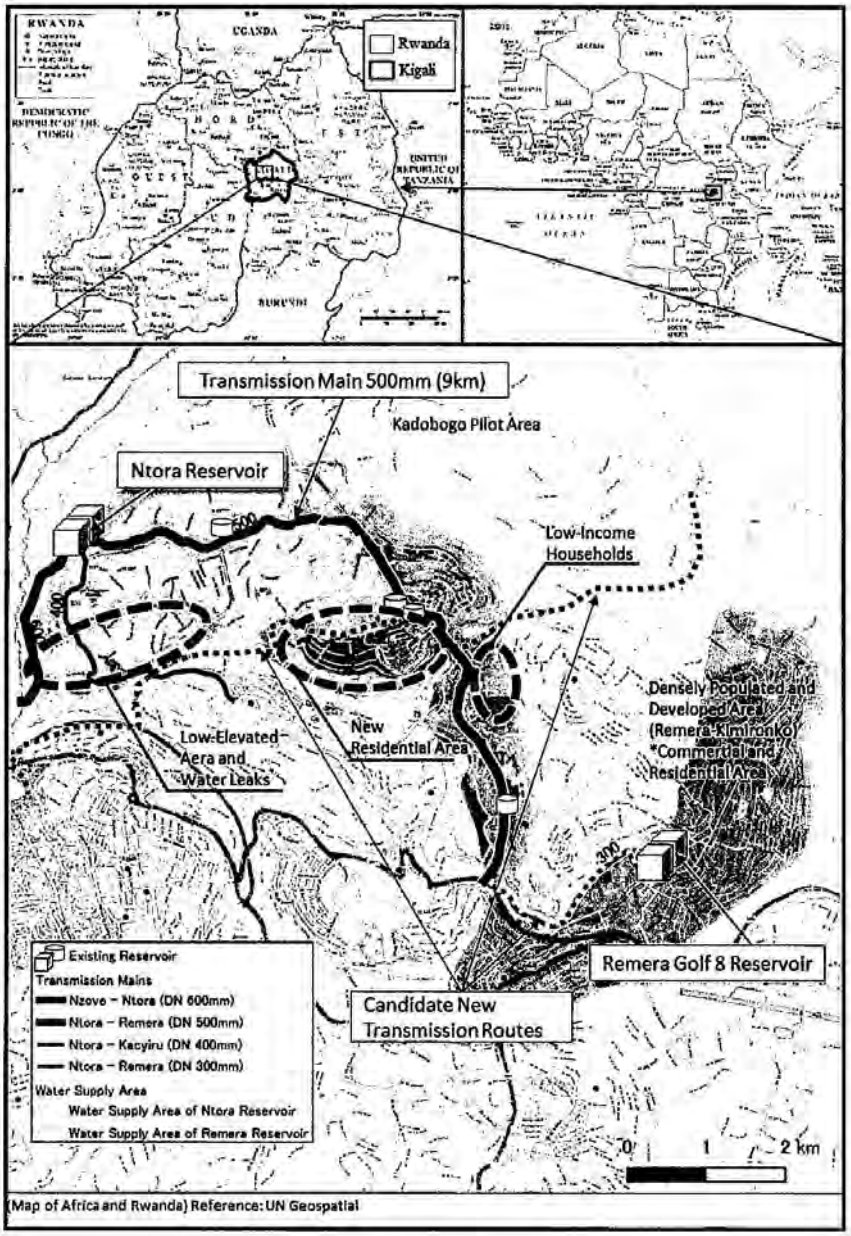
Inclusiveness of gender and the vulnerable is one of the most crucial cross-cutting issues in JICA. In the Preparatory Survey, issues related to gender and the vulnerable will be identified. Some of the major surveyed issues are as follows:

- Methods of access to water from different genders and vulnerable groups;
- Needs for water services from different genders and vulnerable groups; and
- Gender ratio in construction activities for a water sector; etc.

If issues are identified, necessary measures to promote inclusiveness will be incorporated into the facility planning and project implementation such as to set a target gender ratio of workers in the project implementation.

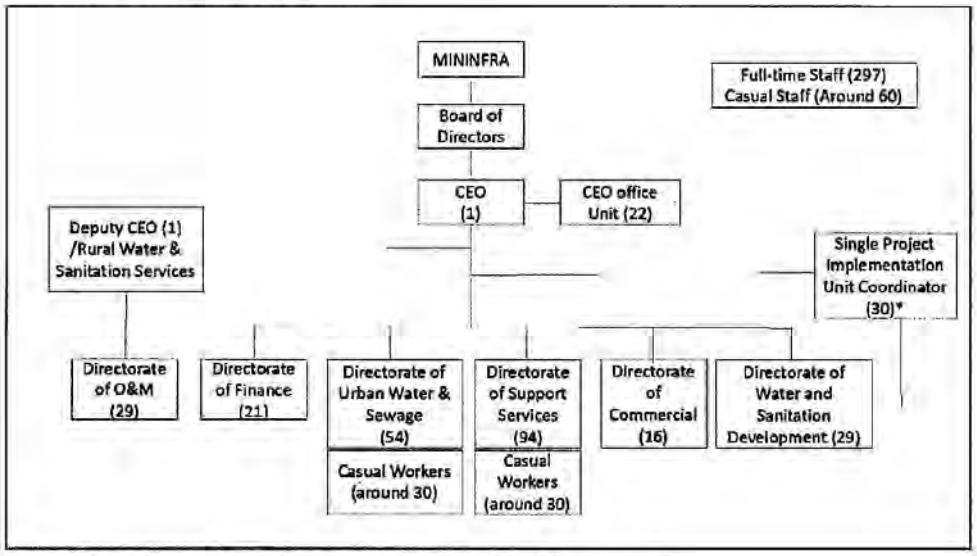
Annex 1 Project Site
Annex 2 Organization Chart and Implementation Structure
Annex 3 Japanese Grant
Annex 4 Project Monitoring Report (template)
Annex 5 Major Undertakings to be taken by the Government of Rwanda

Annex 1


RWANDA
UGANDA
Rwanda
Kigali
BURUNDI
Transmission Main 500mm (9km)
Kadobogo Pilot Area
Ntora Reservoir
Low-Income Households
Densely Populated and Developed Area (Remera-Kimironko) *Commertial and Residential Area
New Residential Area
Low-Elevated Aera and Water Leaks
Remera Golf 8 Reservoir
Candidate New Transmission Routes
Existing Reservoir
Transmission Mains
Nzove – Ntora (DN 600mm)
Ntora – Remera (DN 500mm)
Ntora – Kacyiru (DN 400mm)
Ntora – Remera (DN 300mm)
Water Supply Area
Water Supply Area of Ntora Reservoir
Water Supply Area of Remera Reservoir
0
1
2 km
(Map of Africa and Rwanda) Reference: UN Geospatial

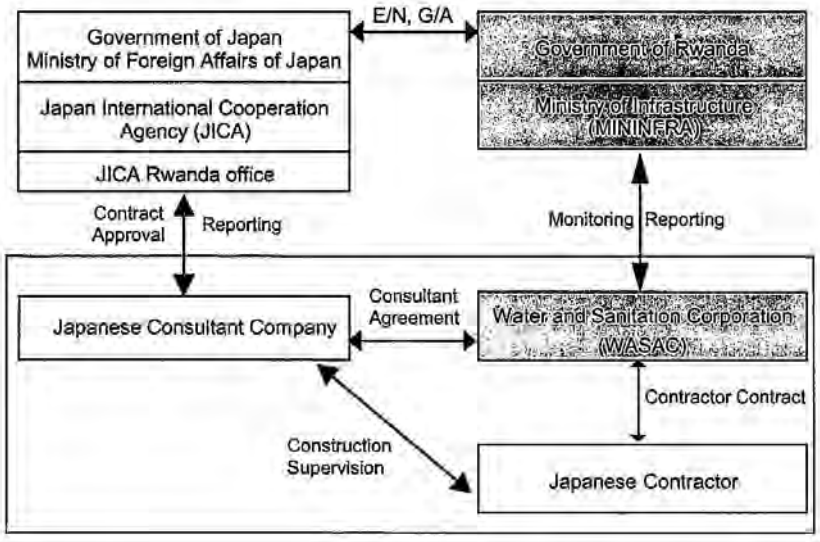
Annex 2 Organization Chart and Implementation Structure

●Organization Chart of WASAC



*Number of SPIU staff is dependent on the scale of on-going projects by development partners.

●Implementation Structure of the Project



Annex 3

JAPANESE GRANT

The Japanese Grant is non-reimbursable fund provided to a recipient country (hereinafter referred to as "the Recipient") to purchase the products and/or services (engineering services and transportation of the products, etc.) for its economic and social development in accordance with the relevant laws and regulations of Japan. Followings are the basic features of the project grants operated by JICA (hereinafter referred to as "Project Grants").

1. Procedures of Project Grants

Project Grants are conducted through following procedures (See "PROCEDURES OF JAPANESE GRANT" for details):

(1) Preparation
- The Preparatory Survey (hereinafter referred to as "the Survey") conducted by JICA

(2) Appraisal
-Appraisal by the government of Japan (hereinafter referred to as "GOJ") and JICA, and Approval by the Japanese Cabinet

(3) Implementation

Exchange of Notes
-The Notes exchanged between the GOJ and the government of the Recipient

Grant Agreement (hereinafter referred to as "the G/A")
-Agreement concluded between JICA and the Recipient

Banking Arrangement (hereinafter referred to as "the B/A")
-Opening of bank account by the Recipient in a bank in Japan (hereinafter referred to as "the Bank") to receive the grant

Construction works/procurement
-Implementation of the project (hereinafter referred to as "the Project") on the basis of the G/A

(4) Ex-post Monitoring and Evaluation
-Monitoring and evaluation at post-implementation stage

2. Preparatory Survey

(1) Contents of the Survey

The aim of the Survey is to provide basic documents necessary for the appraisal of the the Project made by the GOJ and JICA. The contents of the Survey are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of

relevant agencies of the Recipient necessary for the implementation of the Project.

- Evaluation of the feasibility of the Project to be implemented under the Japanese Grant from a technical, financial, social and economic point of view.
- Confirmation of items agreed between both parties concerning the basic concept of the Project.
- Preparation of an outline design of the Project.
- Estimation of costs of the Project.
- Confirmation of Environmental and Social Considerations

The contents of the original request by the Recipient are not necessarily approved in their initial form. The Outline Design of the Project is confirmed based on the guidelines of the Japanese Grant.

JICA requests the Recipient to take measures necessary to achieve its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the executing agency of the Project. Therefore, the contents of the Project are confirmed by all relevant organizations of the Recipient based on the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA contracts with (a) consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

(3) Result of the Survey

JICA reviews the report on the results of the Survey and recommends the GOJ to appraise the implementation of the Project after confirming the feasibility of the Project.

3. Basic Principles of Project Grants

(1) Implementation Stage

1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes (hereinafter referred to as "the E/N") will be singed between the GOJ and the Government of the Recipient to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Recipient to define the necessary articles, in accordance with the E/N, to implement the Project, such as conditions of disbursement, responsibilities of the Recipient, and procurement conditions. The terms and conditions generally applicable to the Japanese Grant are stipulated in the "General Terms and Conditions for Japanese Grant (January 2016)."

2) Banking Arrangements (B/A) (See "Financial Flow of Japanese Grant (A/P Type)" for details)

a) The Recipient shall open an account or shall cause its designated authority to open an account under the name of the Recipient in the Bank, in principle. JICA will disburse the Japanese Grant in Japanese yen for the Recipient to cover the obligations incurred by the Recipient under the verified contracts.

b) The Japanese Grant will be disbursed when payment requests are submitted by the Bank to JICA under an Authorization to Pay (A/P) issued by the Recipient.

3) Procurement Procedure

The products and/or services necessary for the implementation of the Project shall be procured in accordance with JICA's procurement guidelines as stipulated in the G/A.

4) Selection of Consultants

In order to maintain technical consistency, the consulting firm(s) which conducted the Survey will be recommended by JICA to the Recipient to continue to work on the Project's implementation after the E/N and G/A.

5) Eligible source country

In using the Japanese Grant disbursed by JICA for the purchase of products and/or services, the eligible source countries of such products and/or services shall be Japan and/or the Recipient. The Japanese Grant may be used for the purchase of the products and/or services of a third country as eligible, if necessary, taking into account the quality, competitiveness and economic rationality of products and/or services necessary for achieving the objective of the Project. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm, which enter into contracts with the Recipient, are limited to "Japanese nationals", in principle.

6) Contracts and Concurrence by JICA

The Recipient will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be concurred by JICA in order to be verified as eligible for using the Japanese Grant.

7) Monitoring

The Recipient is required to take their initiative to carefully monitor the progress of the Project in order to ensure its smooth implementation as part of their responsibility in the G/A, and to regularly report to JICA about its status by using the Project Monitoring Report (PMR).

8) Safety Measures

The Recipient must ensure that the safety is highly observed during the implementation of the Project.

9) Construction Quality Control Meeting

Construction Quality Control Meeting (hereinafter referred to as the "Meeting") will be held for quality assurance and smooth implementation of the Works at each stage of the Works. The member of the Meeting will be composed by the

Recipient (or executing agency), the Consultant, the Contractor and JICA. The functions of the Meeting are as followings:

a) Sharing information on the objective, concept and conditions of design from the Contractor, before start of construction.

b) Discussing the issues affecting the Works such as modification of the design, test, inspection, safety control and the Client's obligation, during of construction.

(2) Ex-post Monitoring and Evaluation Stage

1) After the project completion, JICA will continue to keep in close contact with the Recipient in order to monitor that the outputs of the Project is used and maintained properly to attain its expected outcomes.

2) In principle, JICA will conduct ex-post evaluation of the Project after three years from the completion. It is required for the Recipient to furnish any necessary information as JICA may reasonably request.

(3) Others

1) Environmental and Social Considerations

The Recipient shall carefully consider environmental and social impacts by the Project and must comply with the environmental regulations of the Recipient and JICA Guidelines for Environmental and Social Considerations (April, 2010).

2) Major undertakings to be taken by the Government of the Recipient

For the smooth and proper implementation of the Project, the Recipient is required to undertake necessary measures including land acquisition, and bear an advising commission of the A/P and payment commissions paid to the Bank as agreed with the GOJ and/or JICA. The Government of the Recipient shall ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the Recipient with respect to the purchase of the Products and/or the Services be exempted or be borne by its designated authority without using the Grant and its accrued interest, since the grant fund comes from the Japanese taxpayers.

3) Proper Use

The Recipient is required to maintain and use properly and effectively the products and/or services under the Project (including the facilities constructed and the equipment purchased), to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Japanese Grant.

4) Export and Re-export

The products purchased under the Japanese Grant should not be exported or re-exported from the Recipient.

PROCEDURES OF JAPANESE GRANT

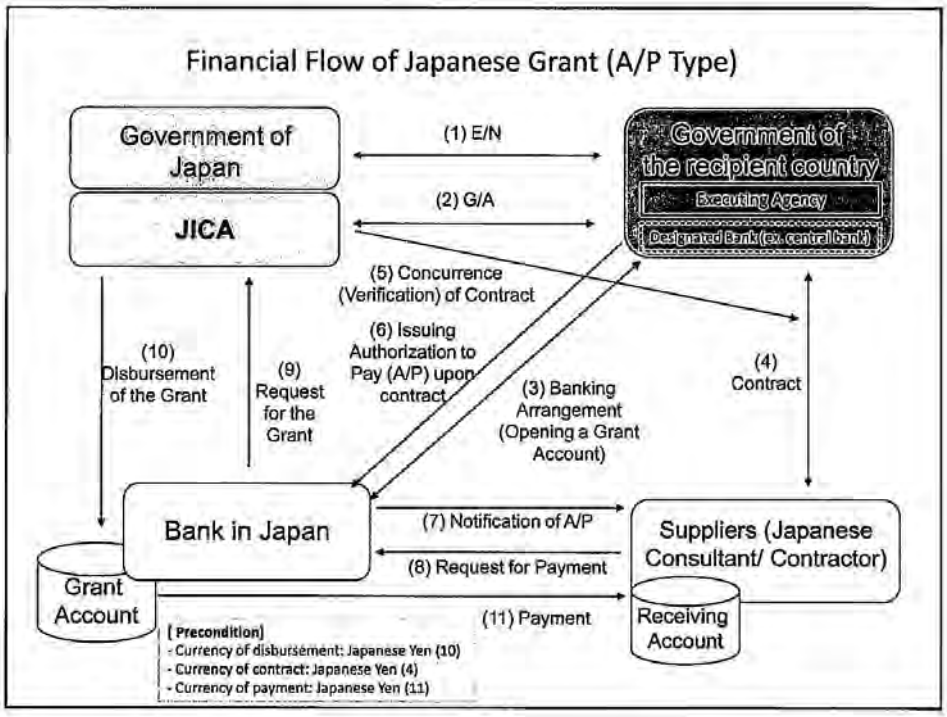
Stage	Procedures	Remarks	Recipient Government	Japanese Government	JICA	Consultants	Contractors	Agent Bank
Official Request	Request for grants through diplomatic channel	Request shall be submitted before appraisal stage.	x	x				
1. Preparation	(1) Preparatory Survey Preparation of outline design and cost estimate		x		x	x		
2. Appraisal	(2)Preparatory Survey Explanation of draft outline design, including cost estimate, undertakings, etc.		x		x	x		
	(3)Agreement on conditions for implementation	Conditions will be explained with the draft notes (E/N) and Grant Agreement (G/A) which will be signed before approval by Japanese government.	x	x (E/N)	x (G/A)			
	(4) Approval by the Japanese cabinet			x				
3. Implementation	(5) Exchange of Notes (E/N)		x	x				
	(6) Signing of Grant Agreement (G/A)		x		x			
	(7) Banking Arrangement (B/A)	Need to be informed to JICA	x					x
	(8) Contracting with consultant and issuance of Authorization to Pay (A/P)	Concurrence by JICA is required	x			x		x
	(9) Detail design (D/D)		x			x		
	(10) Preparation of bidding documents	Concurrence by JICA is required	x			x		
	(11) Bidding	Concurrence by JICA is required	x			x	x	
	(12) Contracting with contractor/supplier and issuance of A/P	Concurrence by JICA is required	x				x	x
	(13) Construction works/procurement	Concurrence by JICA is required for major modification of design and amendment of contracts.	x			x	x	
	(14) Completion certificate		x			x	x	
4. Ex-post monitoring & evaluation	(15) Ex-post monitoring	To be implemented generally after 1, 3, 10 years of completion, subject to change	x		x			
	(16) Ex-post evaluation	To be implemented basically after 3 years of completion	x		x			

notes:

1. Project Monitoring Report and Report for Project Completion shall be submitted to JICA as agreed in the G/A.

2. Concurrence by JICA is required for allocation of grant for remaining amount and/or contingencies as agreed in the G/A.

Annex3-2


Financial Flow of Japanese Grant (A/P Type)
Government of Japan
JICA
(1) E/N
(2) G/A
Government of the recipient country
Executing Agency
Designated Bank (ex. central bank)
(5) Concurrence (Verification) of Contract
(6) Issuing Authorization to Pay (A/P) upon contract
(10) Disbursement of the Grant
(9) Request for the Grant
(3) Banking Arrangement (Opening a Grant Account)
(4) Contract
Bank in Japan
(7) Notification of A/P
(8) Request for Payment
Suppliers (Japanese Consultant/ Contractor)
Grant Account
(11) Payment
Receiving Account
[Precondition]
- Currency of disbursement: Japanese Yen (10)
- Currency of contract: Japanese Yen (4)
- Currency of payment: Japanese Yen (11)

1

Annex 4

G/A NO. XXXXXXX
PMR prepared on DD/MM/YY

Project Monitoring Report
on
Project Name
Grant Agreement No. XXXXXXX
20XX, Month

Organizational Information

Signer of the G/A (Recipient)	Person in Charge	(Designation)
	Contacts	Address: Phone/FAX: Email:
Executing Agency	Person in Charge	(Designation)
	Contacts	Address: Phone/FAX: Email:
Line Ministry	Person in Charge	(Designation)
	Contacts	Address: Phone/FAX: Email:

General Information:

Project Title	
E/N	Signed date: Duration:
G/A	Signed date: Duration:
Source of Finance	Government of Japan: Not exceeding JPY _____ mil. Government of (_____): _____

G/A NO. XXXXXXX
PMR prepared on DD/MM/YY

1: Project Description

1-1 Project Objective

1-2 Project Rationale

- Higher-level objectives to which the project contributes (national/regional/sectoral policies and strategies)
- Situation of the target groups to which the project addresses

1-3 Indicators for measurement of "Effectiveness"

Quantitative indicators to measure the attainment of project objectives		
Indicators	Original (Yr)	Target (Yr)
Qualitative indicators to measure the attainment of project objectives		

2: Details of the Project

2-1 Location

Components	Original *(proposed in the outline design)*	Actual
1.		

2-2 Scope of the work

Components	Original* *(proposed in the outline design)*	Actual*
1.		

Reasons for modification of scope (if any).

(PMR)

G/A NO. XXXXXXX
PMR prepared on DD/MM/YY

2-3 Implementation Schedule

Items	Original		Actual
	(proposed in the outline design)	*(at the time of signing the Grant Agreement)*	

Reasons for any changes of the schedule, and their effects on the project (if any)

2-4 Obligations by the Recipient

2-4-1 Progress of Specific Obligations
See Attachment 2.

2-4-2 Activities
See Attachment 3.

2-4-3 Report on RD
See Attachment 11.

2-5 Project Cost

2-5-1 Cost borne by the Grant(Confidential until the Bidding)

Components			Cost (Million Yen)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			
Total				

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar = Yen

2-5-2 Cost borne by the Recipient

Components			Cost (1,000 Taka)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			

3

G/A NO. XXXXXXX
PMR prepared on DD/MM/YY

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar =

Reasons for the remarkable gaps between the original and actual cost, and the countermeasures (if any)

(PMR)

2-6 Executing Agency

- Organization's role, financial position, capacity, cost recovery etc,
- Organization Chart including the unit in charge of the implementation and number of employees.

Original *(at the time of outline design)* name: role: financial situation: institutional and organizational arrangement (organogram): human resources (number and ability of staff):
Actual *(PMR)*

2-7 Environmental and Social Impacts

- The results of environmental monitoring based on Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- The results of social monitoring based on in Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- Disclosed information related to results of environmental and social monitoring to local stakeholders (whenever applicable).

3: Operation and Maintenance (O&M)

3-1 Physical Arrangement

- Plan for O&M (number and skills of the staff in the responsible division or section, availability of manuals and guidelines, availability of spareparts, etc.)

Original *(at the time of outline design)*
Actual *(PMR)*

3-2 Budgetary Arrangement

- Required O&M cost and actual budget allocation for O&M

Original *(at the time of outline design)*

G/A NO. XXXXXXX
PMR prepared on DD/MM/YY

Actual *(PMR)*

4: Potential Risks and Mitigation Measures

- Potential risks which may affect the project implementation, attainment of objectives, sustainability
- Mitigation measures corresponding to the potential risks

Assessment of Potential Risks *(at the time of outline design)*

Potential Risks	Assessment
1. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
2. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
3. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:

G/A NO. XXXXXXX
PMR prepared on DD/MM/YY

	Contingency Plan (if applicable):
Actual Situation and Countermeasures	
(PMR)	

5: Evaluation and Monitoring Plan (after the work completion)

5-1 Overall evaluation

Please describe your overall evaluation on the project.

5-2 Lessons Learnt and Recommendations

Please raise any lessons learned from the project experience, which might be valuable for the future assistance or similar type of projects, as well as any recommendations, which might be beneficial for better realization of the project effect, impact and assurance of sustainability.

5-3 Monitoring Plan of the Indicators for Post-Evaluation

Please describe monitoring methods, section(s)/department(s) in charge of monitoring, frequency, the term to monitor the indicators stipulated in 1-3.

G/A NO. XXXXXXX
PMR prepared on DD/MM/YY

Attachment

1. Project Location Map
2. Specific obligations of the Recipient which will not be funded with the Grant
3. Monthly Report submitted by the Consultant

Appendix - Photocopy of Contractor's Progress Report (if any)
- Consultant Member List
- Contractor's Main Staff List

4. Check list for the Contract (including Record of Amendment of the Contract/Agreement and Schedule of Payment)
5. Environmental Monitoring Form / Social Monitoring Form
6. Monitoring sheet on price of specified materials (Quarterly)
7. Report on Proportion of Procurement (Recipient Country, Japan and Third Countries) (PMR (final)only)
8. Pictures (by JPEG style by CD-R) (PMR (final)only)
9. Equipment List (PMR (final)only)
10. Drawing (PMR (final)only)
11. Report on RD (After project)

7

Attachment 6

Monitoring sheet on price of specified materials

1. Initial Conditions (Confirmed)

	Items of Specified Materials	Initial Volume A	Initial Unit Price (¥) B	Initial total Price C=A×B	1% of Contract Price D	Condition of payment	
						Price (Decreased) E=C−D	Price (Increased) F=C+D
1	Item 1	●●t	●	●	●	●	●
2	Item 2	●●t	●	●	●		
3	Item 3						
4	Item 4						
5	Item 5						

2. Monitoring of the Unit Price of Specified Materials

(1) Method of Monitoring : ●●

(2) Result of the Monitoring Survey on Unit Price for each specified materials

	Items of Specified Materials	1st ●month, 2015	2nd ●month, 2015	3rd ●month, 2015	4th	5th	6th
1	Item 1						
2	Item 2						
3	Item 3						
4	Item 4						
5	Item 5						

(3) Summary of Discussion with Contractor (if necessary)

-
-
-

Attachment 7

Report on Proportion of Procurement (Recipient Country, Japan and Third Countries)
(Actual Expenditure by Construction and Equipment each)

	Domestic Procurement (Recipient Country) A	Foreign Procurement (Japan) B	Foreign Procurement (Third Countries) C	Total D
Construction Cost	(A/D%)	(B/D%)	(C/D%)	
Direct Construction Cost	(A/D%)	(B/D%)	(C/D%)	
others	(A/D%)	(B/D%)	(C/D%)	
Equipment Cost	(A/D%)	(B/D%)	(C/D%)	
Design and Supervision Cost	(A/D%)	(B/D%)	(C/D%)	
Total	(A/D%)	(B/D%)	(C/D%)	

Annex 5

Major Undertakings to be taken by the Government of Rwanda
(draft)

1. Specific obligations of the Government of Rwanda which will not be funded with the Grant

(1) Before the Tender

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To sign the banking arrangement (B/A) with a bank in Japan (the Agent Bank) to open bank account for the Grant	within 1 month after the signing of the G/A	MINECOFIN/ BNR		
2	To issue A/P to the Agent Bank for the payment to the consultant	within 1 month after the signing of the contract(s)	MINECOFIN		
3	To bear the following commissions to the Agent Bank for the banking services based upon B/A	-	-		
	1) Advising commission of A/P	within 1 month after the signing of the contract(s)	WASAC		
	2) Payment commission for A/P	every payment	WASAC		
4	To approve EIA(Conditions of approval should be fulfilled, if any) and secure the necessary budget for implementation for EMP and EMoP (and fulfilling conditions of approval, if any).	within 1 month after the signing of the G/A	MoE / WASAC		
5	To secure the necessary budget and implement land acquisition and resettlement (including preparation of resettlement sites), and compensation with full replacement cost in accordance with RAP	before notice of the bidding documents	WASAC		
6	To implement social monitoring, and to submit the monitoring results to JICA, by using the monitoring form, on a quarterly basis as a part of Project Monitoring Report	until land acquisition and resettlement complete	WASAC		
7	To secure and clear the following lands 1) 2)	before notice of the bidding documents	WASAC		
8	To obtain the planning, zoning, building permit 1) 2)	before notice of the bidding documents	WASAC		
9	To submit Project Monitoring Report (with the result of Detailed Design)	before preparation of the bidding documents	WASAC		
10					
11					

(MINECOFIN: Ministry of Finance and Economic Planning; BNR: National Bank of Rwanda; MoE: Ministry of Environment; B/A: Banking Arrangement, A/P: Authorization to pay, N/A: Not Applicable)

(2) During the Project Implementation

NO	Items	Deadline	In charge	Estimated Cost	Ref.

1	To issue A/P to the Agent Bank for the payment to the supplier and the contractor	within 1 month after the signing of the contract(s)	WASAC		
2	To bear the following commissions to the Agent Bank for the banking services based upon the B/A	-	-		
	1) Advising commission of A/P	within 1 month after the signing of the contract(s)	WASAC		
	2) Payment commission for A/P	every payment	WASAC		
3	To obtain the necessary permission for construction from the concerned organizations 1) 2)	during the project	WASAC		
4	To ensure prompt customs clearance and to assist the Supplier(s) with internal transportation in the country of the Recipient	during the Project	WASAC		
5	To accord Japanese physical persons and/or physical persons of third countries whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the country of the Recipient and stay therein for the performance of their work	during the Project	WASAC		
6	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the country of the Recipient with respect to the purchase of the products and/or the services be borne by its designated authority without using the Grant	during the Project	MINECOFIN/ WASAC		
7	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project	during the Project	WASAC		
8	To notify JICA promptly of any incident or accident, which has, or is likely to have, a significant adverse effect on the environment, the affected communities, the public or workers.	during the construction	WASAC		
9	To submit Project Monitoring Report	every month	WASAC		
10	To submit Project Monitoring Report (final) (including as-built drawings, equipment list, photographs, etc.)	within 1 month after issuance of Certificate of Completion for the works under the contract(s)	WASAC		
11	To submit a report concerning completion of the Project	within 6 months after completion of the Project	WASAC		
12	To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities necessary for the implementation of the Project outside the site(s)	-	-		
	1) Electricity The distributing line to the site	during the construction	WASAC		
	2) Water Supply The city water distribution main to the site	during the construction	WASAC		
	3) Drainage The city drainage main (for storm, sewer and others) to the site	during the construction	WASAC		
	4)				
13	To implement EMP and EMoP	during the construction	WASAC		
14	To submit results of environmental monitoring to JICA, by using the monitoring form, on a quarterly basis as a part of Project Monitoring Report	during the construction	WASAC		

15	To implement RAP (livelihood restoration program)	for a period based on livelihood restoration program	WASAC		
16	To implement social monitoring, and to submit the monitoring results to JICA, by using the monitoring form, on a quarterly basis as a part of Project Monitoring Report - Period of the monitoring may be extended if affected persons' livelihoods are not sufficiently restored. Extension of the monitoring will be decided based on agreement between WASAC and JICA.	- until the end of livelihood restoration program (In case that livelihood restoration program is provided) *- for 2 years after land acquisition and resettlement complete (In case that livelihood restoration program is not provided)*	WASAC		
17	To assign supervisor during the construction period and counterparts for the soft-component activities	During the project	WASAC		
18	To install house connection equipment	During the project	WASAC		
19					

(3) After the Project

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To implement EMP and EMoP	for a period based on EMP and EMoP	WASAC		
2	To submit results of environmental monitoring to JICA, by using the monitoring form, semiannually - The period of environmental monitoring may be extended if any significant negative impacts on the environment are found. The extension of environmental monitoring will be decided based on the agreement between WASAC and JICA.	for 3 years after the Project	WASAC		
3	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid 1) Allocation of maintenance cost 2) Operation and maintenance 3) Routine check/Periodic inspection	After completion of the construction	WASAC		
4	To install house connection equipment	During the project	WASAC		

2. Other obligations of the Government of Rwanda funded with the Grant

NO	Items	Deadline	Amount (Million Japanese Yen)*
1	To implement detailed design, bidding support and construction supervision		
2	Contingencies		
	Total		

* The Amount is provisional. This is subject to the approval of the Government of Japan.

Minutes of Discussions
on the Preparatory Survey for the Project for
Improvement of Water Supply Services in North-Central Kigali

(Explanation on Draft Preparatory Survey Report)

With reference to the minutes of discussions signed between the Water and Sanitation Corporation (hereinafter referred to as "WASAC") and the Japan International Cooperation Agency (hereinafter referred to as "JICA") on 16th November 2021 and in response to the request from the Government of the Republic of Rwanda (hereinafter referred to as "Rwanda") dated 22nd July 2022, JICA dispatched the Preparatory Survey Team (hereinafter referred to as "the Team") for the explanation of Draft Preparatory Survey Report (hereinafter referred to as "the Draft Report") for the Project for Improvement of Water Supply Services in North-Central Kigali (hereinafter referred to as "the Project").

As a result of the discussions, both sides agreed on the main items described in the attached sheets.

Kigali, 26th August 2022

Mr. YOKOTA Yoshiaki
Leader
Preparatory Survey Team
Japan International Cooperation Agency
Japan

Ms. Gisele UMUHUMUZA
Acting Chief Executive Officer
Water and Sanitation Corporation
The Republic of Rwanda

Mr. Gerald MUGABE
Director General of External Finance
Ministry of Finance and Economic Planning
The Republic of Rwanda

Mr. Fidele ABIMANA
Permanent Secretary
Ministry of Infrastructure
The Republic of Rwanda

ATTACHMENT

1. Objective of the Project

The objective of the Project is to contribute to stable water supply through optimizing water pressures and reduction of leakage occurrences by constructing and replacing water supply facilities in the North-Central Kigali area. Thereby it will contribute to improving the living conditions of residents in the North-Central Kigali area.

2. Project Site

Both sides confirmed that the site of the Project is in Kigali City, which is shown in Annex 1.

3. Responsible Authority for the Project

Both sides confirmed the authorities responsible for the Project are as follows:

3-1 WASAC will be the executing agency for the Project (hereinafter referred to as "the Executing Agency"). The Executing Agency shall coordinate with all the relevant authorities to ensure smooth implementation of the Project and ensure that the undertakings for the Project shall be taken care of by relevant authorities properly and on time. The organization chart and implementation structure are shown in Annex 2.

3-2 The line ministry of the Executing Agency is the Ministry of Infrastructure (hereinafter referred to as "MININFRA"). The MININFRA shall be responsible for supervising the Executing Agency on behalf of the Government of Rwanda.

4. Contents of the Draft Report

After the explanation of the contents of the Draft Report by the Team, the Rwanda side agreed to its contents. JICA will finalize the Preparatory Survey Report based on the confirmed items. The report will be sent to the Rwanda side around the middle of November 2022.

5. Cost Estimate

Both sides confirmed that the cost estimate including the contingency explained by the Team is provisional and will be examined further by the Government of Japan for its approval. The contingency would cover the additional cost against natural disasters, unexpected natural conditions, etc.

6. Confidentiality of the Cost Estimate and Technical Specifications
Both sides confirmed that the cost estimate and technical specifications of the Project should never be disclosed to any third parties until all the contracts under the Project are concluded.

7. Procedures and Basic Principles of Japanese Grant
The Rwanda side agreed that the procedures and basic principles of the Japanese Grant (hereinafter referred to as "the Grant") as described in Annex 3 shall be applied to the Project. In addition, the Rwanda side agreed to take necessary measures according to the procedures.

8. Timeline for the Project Implementation
The Team explained to the Rwanda side that the expected timeline for the project implementation is as attached in Annex 4.

9. Expected Outcomes and Indicators
Both sides agreed that key indicators for expected outcomes are as follows. The Rwanda side will be responsible for the achievement of agreed key indicators targeted in the year 2030 and shall monitor the progress for Ex-Post Evaluation based on those indicators.
[Quantitative indicators]

Output Indicators	Present Values (Actual Values in 2021)	Target Values (2030) [Four (4) years after the project completion]※1
Population who can enjoy stable water supply through optimized water pressures (persons) ※2	0	Around 175,000
Leakage reduction volume by the Project (m^3/d) ※3	0	Around 5,200
Ratio of Non-Revenue Water (NRW) in the project site (%)※4	Around 38%	Less than 24%

※1: Same target year (2030) as one set in the Water Supply Master Plan for the City of Kigali
※2: The 'optimized water pressures' is set as '0.5 bar or more, and 10 bar or less.' Water supply pressures will be measured at one location in each water distribution block to identify whether they meet the optimized water pressures or not. Besides,

interviews with village leaders and residents about water supply conditions will be conducted as supplementary information.

※3: Leakage reduction volume by the Project = Estimated leakage volume in 2030 without the Project (8,130 m^3/d) - Leakage volume in 2030 with the Project (Reference value: new population who can receive water supply with water created by this leakage reduction is assumed to be around 51,000 persons. This population can be calculated by the equation as follows: Leakage reduction volume by the Project / {Water volume used by one service connection in 2030 (m^3/d/connection) + Leakage volume at one service connection in 2030 (m^3/d/connection)}. It is presumed that two (2) households use one service connection, and one household has four (4) persons.)

※4: It is calculated based on the volume of revenue water and supplied water.

[Qualitative indicators]

- Improvement of the living conditions of residents in the project site;
- Improvement of credibility toward water supply service by WASAC; and
- Improvement of financial conditions of WASAC.

10. Ex-Post Evaluation

JICA will conduct an ex-post evaluation after four (4) years from the project completion, in principle, with respect to five evaluation criteria (Relevance, Effectiveness, Efficiency, Impact, and Sustainability). The result of the evaluation will be publicized. The Rwanda side is required to provide the necessary support for the data collection.

11. Technical Assistance ("Soft Component" of the Project)

Considering the sustainable operation and maintenance of the products and services granted through the Project, technical assistance regarding 1) installation and supervision of secondary and tertiary pipes, service connections, and water meters, and 2) operation and maintenance of monitoring system is planned under the Project. The Rwanda side confirmed to deploy a necessary number of counterparts who are appropriate and competent in light of the purpose of the technical assistance as described in the Draft Report.

12. Undertakings of the Project

Both sides confirmed the undertakings of the Project as described in Annex 5. With regard to the exemption of customs duties, internal taxes and other fiscal levies as

stipulated in No. 6 of (2) During the Project Implementation of Annex 5, both sides confirmed that such customs duties, internal taxes and other fiscal levies, which shall be clarified in the bid documents by WASAC during the implementation stage of the Project.

The Rwanda side assured to take the necessary measures and coordination including allocation of the necessary budget for the land acquisition, tax, cost for installation of secondary, tertiary pipelines and service connections etc as described in Annex 5, which are preconditions of implementation of the Project. It is further agreed that the costs are indicative, i.e. at the Outline Design level. More accurate costs will be calculated at the Detailed Design stage.

Both sides also confirmed that Annex 5 will be used as an attachment of G/A.

13. Tax Issues

Both sides confirmed as follows:

- Direct taxes such as corporate tax and personal income tax shall be exempted in the Project;
- Indirect taxes, such as value-added tax (VAT), which may be imposed in Rwanda with respect to the purchase of products and/or services, shall be borne by WASAC without using the Grant; and
- Custom duties related to the Project shall be exempted.

JICA requested WASAC to secure the necessary budget. WASAC confirmed that WASAC would apply the necessary budgets for the required taxes, and conduct appropriate procedures to bear the taxes in a timely manner to avoid any delay of the Project.

14. Monitoring during the Implementation

The Project will be monitored by the Executing Agency and reported to JICA by using the form of Project Monitoring Report (PMR) attached as Annex 6. The timing of submission of the PMR is described in Annex 5.

15. Project Completion

Both sides confirmed that the project completes when all the facilities, including those to be undertaken by the Rwanda side, constructed and equipment procured by the Grant are in operation. The completion of the Project will be reported to JICA promptly by the Executing Agency, but in any event not later than six months after completion of the Project.

16. Items and Measures to be Considered for Smooth Implementation of the Project

Both sides confirmed the items and measures to be considered for the smooth implementation of the Project as described in Annex 7.

17. Environmental and Social Considerations

17-1 General Issues

17-1-1 Environmental Guidelines and Environmental Category

The Team explained that 'JICA Guidelines for Environmental and Social Considerations (April 2010)' (hereinafter referred to as "the Guidelines") is applicable for the Project. The Project is categorized as B because the Project is not located in a sensitive area, nor has sensitive characteristics, nor falls into sensitive sectors under the JICA Guidelines for Environmental and Social Considerations (April, 2010), and its potential adverse impacts on the environment are not likely to be significant.

17-1-2 Environmental Checklist

The environmental and social considerations including major impacts and mitigation measures for the Project are summarized in the Environmental Checklist attached as Annex 8. Both sides confirmed that in case of major modification of the content of the Environmental Checklist, the Rwanda side shall submit the modified version to JICA in a timely manner.

17-2 Environmental Issues

17-2-1 Environmental Impact Assessment (EIA)

Both sides confirmed the EIA report has been approved by the Rwanda Development Board in July 2022. The Rwanda side agreed to JICA's disclosure of provided EIA report on JICA's website.

17-2-2 Environmental Management Plan and Environmental Monitoring Plan

Both sides confirmed the Environmental Management Plan (EMP) and Environmental Monitoring Plan (EMoP) of the Project as Annex 9, respectively. Both sides agreed that environmental mitigation measures and monitoring shall be conducted based on the EMP and EMoP, which may be updated during the detailed design stage.

17-3 Social Issues

17-3-1 Land Acquisition and Resettlement

Both sides confirmed that approximately 0.1 ha of private land would be acquired for the construction of Batsinda Reservoir. One person would be affected due to the implementation of the Project. The land acquisition shall be implemented based on the Abbreviated Resettlement Action Plan (A-RAP) as Annex 10 which was prepared by WASAC in July 2022. WASAC will secure the necessary budget for the land acquisition by January 2023 and will do land valuation, get all required signatures including the land owner's consent on the land valuation, and do payment to the land owner by May 2023.

Regarding the Kagugu Elevated Tank area, approximately 450m^2 of land needs to be acquired. The current owner of the land is the Ministry of Environment. WASAC has submitted the request to the Ministry of Environment for acquiring the land. It will be approved by March 2023.

17-4 Environmental and Social Monitoring

17-4-1 Environmental Monitoring

Both sides agreed that the Rwanda side will submit the results of environmental monitoring to JICA with PMR by using the monitoring form attached as Annex 11. The timing of submission of the monitoring form is described in Annex 5.

17-4-2 Social Monitoring

Both sides confirmed that the Rwanda side will implement the social monitoring proposed in the A-RAP. The Rwanda side and the Team agreed that WASAC will submit the results of social monitoring to JICA with PMR by using the monitoring form attached as Annex 11.

17-4-3 Information Disclosure of Monitoring Results

Both sides confirmed that the WASAC will disclose the results of environmental and social monitoring to local stakeholders through the website.

The Rwanda side agreed that JICA will disclose the results of environmental and social monitoring submitted by the Rwanda side as the monitoring forms attached as Annex 11 on its website.

18. Other Relevant Issues

18-1 Disclosure of Information

Both sides confirmed that the Preparatory Survey Report from which project cost is excluded will be disclosed to the public after completion of the Preparatory Survey. The comprehensive report including the project cost will be disclosed to the public after all the contracts under the Project are concluded.

18-2 Gender Mainstreaming

Both sides confirmed that gender mainstreaming should be duly practiced for the Project implementation as the project is categorized as GIS (Gender Integrated Project). In particular, both sides agreed on the following gender elements to be integrated into the Project.

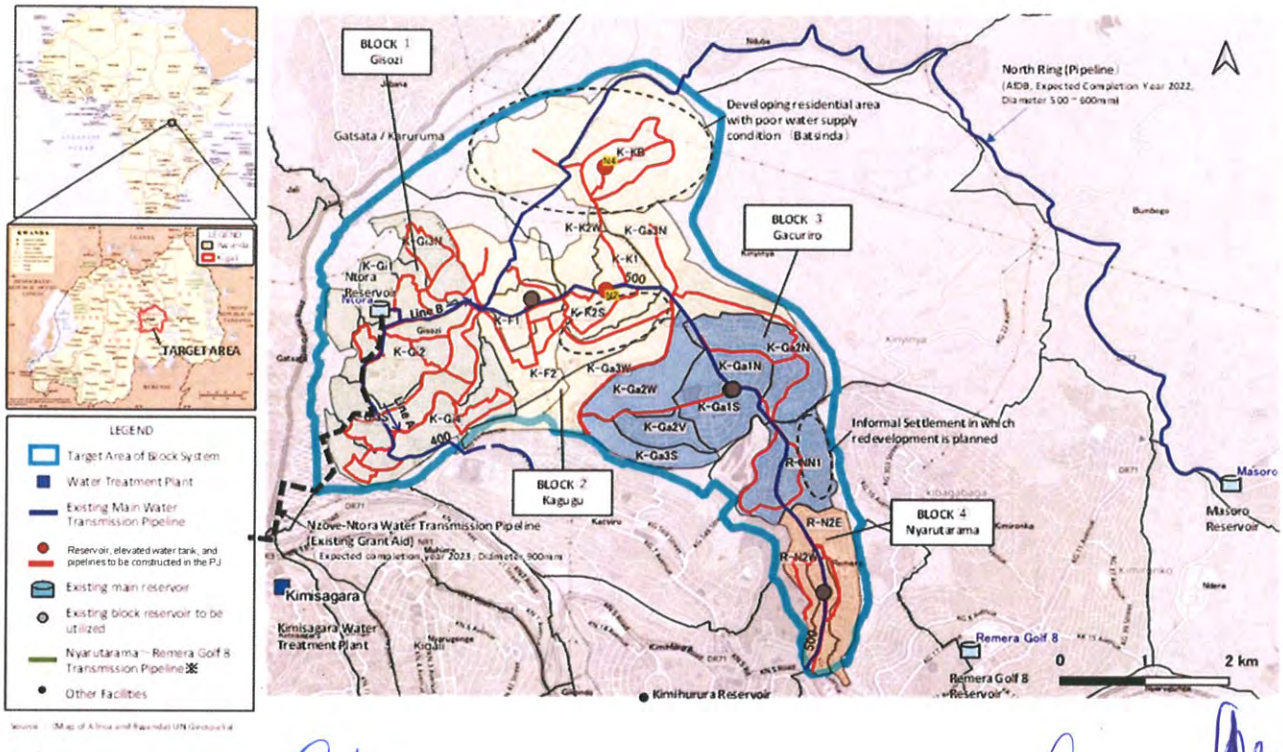
- To be mindful of the gender balance of workers in the construction works contracted under the Project; and
- To continue promoting employment of female staff members in WASAC.

18-3 Adaptation and Mitigation to Climate Change

After the Project, if the operation of the water supply facilities is affected by disasters and/or weather conditions, the monitoring system will be able to help detect, identify and respond to abnormalities. Thereby the Project contributes to adaptation to climate change. In addition, the appropriate management of water pressure and reduction of water leakage by dividing the water distribution areas into blocks contributes to optimizing energy use in the operation of water supply facilities.

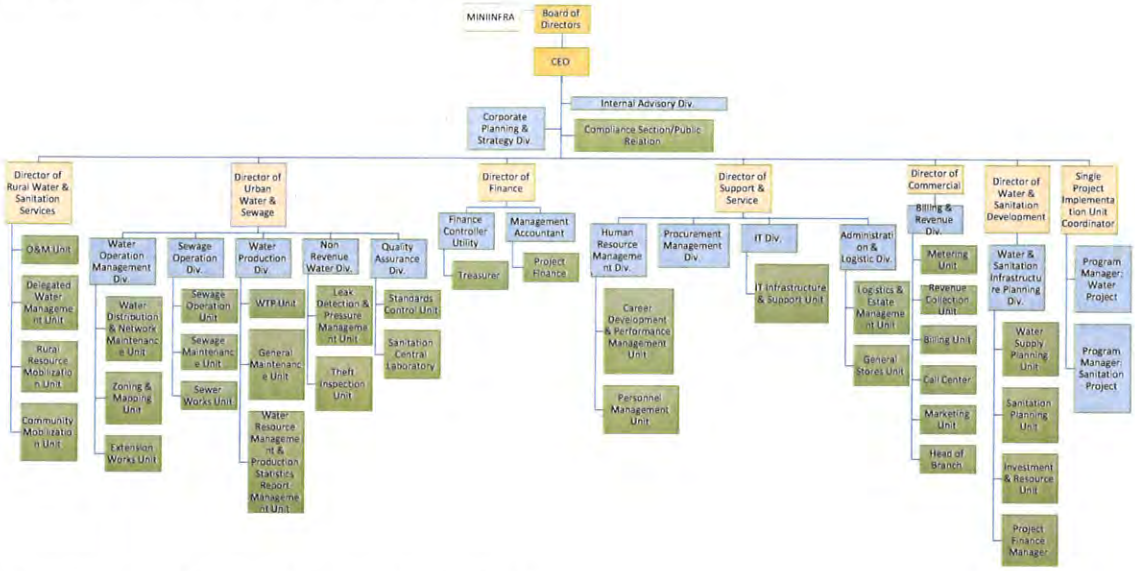
Annex 1 Project Site
Annex 2 Organization Chart and Implementation Structure
Annex 3 Japanese Grant
Annex 4 Project Implementation Schedule
Annex 5 Major Undertakings to be taken by the Government of Rwanda
Annex 6 Project Monitoring Report (template)
Annex 7 Items and Measures to be Considered for Smooth Implementation of the Project
Annex 8 Environmental Check List
Annex 9 Environmental Management Plan/Environmental Monitoring Plan
Annex 10 Abbreviated Resettlement Action Plan
Annex 11 Environmental and Social Monitoring Form

Annex 1 Project Site

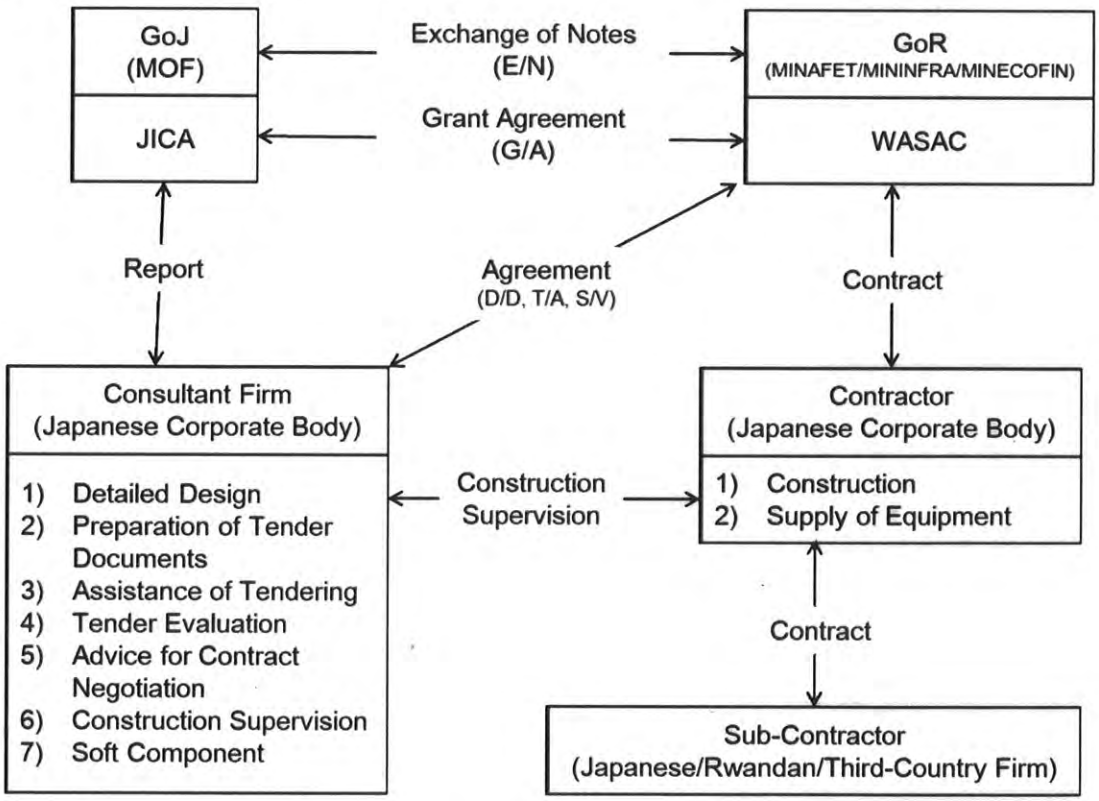


Annex 2 Organization Chart and Implementation Structure

●Organization Chart of WASAC

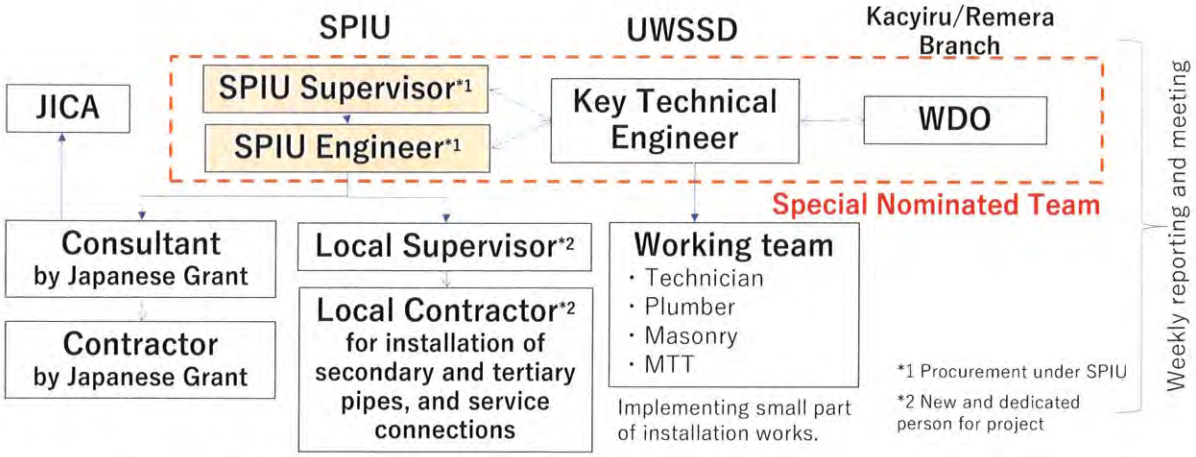


●Implementation Structure of the Project



MINAFET: Ministry of Foreign Affairs and International Cooperation

●Implementation Structure in WASAC



SPIU: Single Project Implementation Unit
UWSSD: Urban Water Supply and Sanitation Department
WDO: Water Distribution Officers
MTT: Manoeuvre tout Travaux (Worker)

Annex 3

JAPANESE GRANT

The Japanese Grant is non-reimbursable fund provided to a recipient country (hereinafter referred to as "the Recipient") to purchase the products and/or services (engineering services and transportation of the products, etc.) for its economic and social development in accordance with the relevant laws and regulations of Japan. Followings are the basic features of the project grants operated by JICA (hereinafter referred to as "Project Grants").

1. Procedures of Project Grants

Project Grants are conducted through following procedures (See "PROCEDURES OF JAPANESE GRANT" for details):

(1) Preparation

- The Preparatory Survey (hereinafter referred to as "the Survey") conducted by JICA

(2) Appraisal

-Appraisal by the government of Japan (hereinafter referred to as "GOJ") and JICA, and Approval by the Japanese Cabinet

(3) Implementation

Exchange of Notes

-The Notes exchanged between the GOJ and the government of the Recipient

Grant Agreement (hereinafter referred to as "the G/A")

-Agreement concluded between JICA and the Recipient

Banking Arrangement (hereinafter referred to as "the B/A")

-Opening of bank account by the Recipient in a bank in Japan (hereinafter referred to as "the Bank") to receive the grant

Construction works/procurement

-Implementation of the project (hereinafter referred to as "the Project") on the basis of the G/A

(4) Ex-post Monitoring and Evaluation

-Monitoring and evaluation at post-implementation stage

2. Preparatory Survey

(1) Contents of the Survey

The aim of the Survey is to provide basic documents necessary for the appraisal of the the Project made by the GOJ and JICA. The contents of the Survey are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of

relevant agencies of the Recipient necessary for the implementation of the Project.

- Evaluation of the feasibility of the Project to be implemented under the Japanese Grant from a technical, financial, social and economic point of view.
- Confirmation of items agreed between both parties concerning the basic concept of the Project.
- Preparation of an outline design of the Project.
- Estimation of costs of the Project.
- Confirmation of Environmental and Social Considerations

The contents of the original request by the Recipient are not necessarily approved in their initial form. The Outline Design of the Project is confirmed based on the guidelines of the Japanese Grant.

JICA requests the Recipient to take measures necessary to achieve its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the executing agency of the Project. Therefore, the contents of the Project are confirmed by all relevant organizations of the Recipient based on the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA contracts with (a) consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

(3) Result of the Survey

JICA reviews the report on the results of the Survey and recommends the GOJ to appraise the implementation of the Project after confirming the feasibility of the Project.

3. Basic Principles of Project Grants

(1) Implementation Stage

1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes (hereinafter referred to as "the E/N") will be signed between the GOJ and the Government of the Recipient to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Recipient to define the necessary articles, in accordance with the E/N, to implement the Project, such as conditions of disbursement, responsibilities of the Recipient, and procurement conditions. The terms and conditions generally applicable to the Japanese Grant are stipulated in the "General Terms and Conditions for Japanese Grant (January 2016)."

2) Banking Arrangements (B/A) (See "Financial Flow of Japanese Grant (A/P Type)" for details)

a) The Recipient shall open an account or shall cause its designated authority to open an account under the name of the Recipient in the Bank, in principle. JICA will disburse the Japanese Grant in Japanese yen for the Recipient to cover the obligations incurred by the Recipient under the verified contracts.

b) The Japanese Grant will be disbursed when payment requests are submitted by the Bank to JICA under an Authorization to Pay (A/P) issued by the Recipient.

3) Procurement Procedure

The products and/or services necessary for the implementation of the Project shall be procured in accordance with JICA's procurement guidelines as stipulated in the G/A.

4) Selection of Consultants

In order to maintain technical consistency, the consulting firm(s) which conducted the Survey will be recommended by JICA to the Recipient to continue to work on the Project's implementation after the E/N and G/A.

5) Eligible source country

In using the Japanese Grant disbursed by JICA for the purchase of products and/or services, the eligible source countries of such products and/or services shall be Japan and/or the Recipient. The Japanese Grant may be used for the purchase of the products and/or services of a third country as eligible, if necessary, taking into account the quality, competitiveness and economic rationality of products and/or services necessary for achieving the objective of the Project. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm, which enter into contracts with the Recipient, are limited to "Japanese nationals", in principle.

6) Contracts and Concurrence by JICA

The Recipient will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be concurred by JICA in order to be verified as eligible for using the Japanese Grant.

7) Monitoring

The Recipient is required to take their initiative to carefully monitor the progress of the Project in order to ensure its smooth implementation as part of their responsibility in the G/A, and to regularly report to JICA about its status by using the Project Monitoring Report (PMR).

8) Safety Measures

The Recipient must ensure that the safety is highly observed during the implementation of the Project.

9) Construction Quality Control Meeting

Construction Quality Control Meeting (hereinafter referred to as the "Meeting") will be held for quality assurance and smooth implementation of the Works at each stage of the Works. The member of the Meeting will be composed by the

Recipient (or executing agency), the Consultant, the Contractor and JICA. The functions of the Meeting are as followings:

a) Sharing information on the objective, concept and conditions of design from the Contractor, before start of construction.

b) Discussing the issues affecting the Works such as modification of the design, test, inspection, safety control and the Client's obligation, during of construction.

(2) Ex-post Monitoring and Evaluation Stage

1) After the project completion, JICA will continue to keep in close contact with the Recipient in order to monitor that the outputs of the Project is used and maintained properly to attain its expected outcomes.

2) In principle, JICA will conduct ex-post evaluation of the Project after three years from the completion. It is required for the Recipient to furnish any necessary information as JICA may reasonably request.

(3) Others

1) Environmental and Social Considerations

The Recipient shall carefully consider environmental and social impacts by the Project and must comply with the environmental regulations of the Recipient and JICA Guidelines for Environmental and Social Considerations (April, 2010).

2) Major undertakings to be taken by the Government of the Recipient

For the smooth and proper implementation of the Project, the Recipient is required to undertake necessary measures including land acquisition, and bear an advising commission of the A/P and payment commissions paid to the Bank as agreed with the GOJ and/or JICA. The Government of the Recipient shall ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the Recipient with respect to the purchase of the Products and/or the Services be exempted or be borne by its designated authority without using the Grant and its accrued interest, since the grant fund comes from the Japanese taxpayers.

3) Measures to ensure more efficient implementation of the Grant

i) In the event that the E/N and the G/A concerning a project cannot be signed by the end of the following Japanese fiscal year of the cabinet decision concerned by the GOJ, the authorities concerned of the two Governments will discuss the cancellation of the project.

ii) In the event that the period, specified in the G/A, during which the grant is available expires before the completion of the disbursement, the authorities concerned of the GO J will thoroughly review the status, situation and perspective of the implementation of the project concerned before extending the said period. The authorities concerned of the two Governments will discuss the termination of the project including a refund, unless there are concrete prospects for its completion.

iii) Regardless of the period mentioned in ii) above, the authorities concerned of the two Governments will, in the event that five years have passed since the cabinet decision concerned by the GOJ before the completion of the disbursement, except as otherwise confirmed between them, discuss the termination of a project including a refund, unless there are concrete prospects for its completion.

4) Proper Use

The Recipient is required to maintain and use properly and effectively the products and/or services under the Project (including the facilities constructed and the equipment purchased), to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Japanese Grant.

5) Export and Re-export

The products purchased under the Japanese Grant should not be exported or re-exported from the Recipient.

Annex 4 Project Implementation Schedule

Item	Year		2023												2024												2025												2026		
	Month	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	Count		*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*	*35*	*36*	*37*	*38*	*39*	*40*
Cabinet Meeting (Japan)	-	▼																																								
Exchange of Note (E/N, GtoG)	-		▼																																							
Grant Agreement (G/A, Exe. Agency)	-		▼																																							
Consultant Appoval and Concurrence by JICA	2M																																									
Detailed Designed (D/D)	4M																																									
Tender Assistant (Bid/Contract/Concurrence)	3M																																									
Construction	24M																																									
Preparation and Procurement	3M																																									
Reservoirs and Elevated Tanks	12M																																									
Transmission and Distribution Pipelines	21M																																									
Electric Work (Flow Meter/Monitoring System)	3+6M																																									
Inspection and Delivery	0.5M																																									
Secondary, Tertiary pipes, Service Connections and meter replacement (Construction by WASAC)	24M										(Procurement)																		(Construction)													
Soft Components(Management Guidance/Training)	6M																																									

Annex 5

Major Undertakings to be taken by the Government of Rwanda

1. Specific obligations of the Government of Rwanda which will not be funded with the Grant

(1) Before the Tender

NO	Items	Deadline	In charge	Estimated Cost (Thousand RWF)	Ref.
1	To sign the banking arrangement (B/A) with a bank in Japan (the Agent Bank) to open bank account for the Grant	Within 1 month after the signing of the G/A	MINECOFIN/ BNR	24,000	
2	To issue A/P to the Agent Bank for the payment to the consultant	Within 1 month after the signing of the contract(s)	MINECOFIN	440	
3	To bear the following commissions to the Agent Bank for the banking services based upon B/A	-	-	N/A	
	1) Advising commission of A/P	Within 1 month after the signing of the contract(s)	WASAC		
	2) Payment commission for A/P	Every payment	WASAC		
4	To secure the necessary budget and implement land acquisition, and compensation with full replacement cost in accordance with Abbreviated RAP	By May 2023	WASAC	69,346	
5	To report the final project componentsto RDB based on the results of Detailed Design	After Detailed Design	WASAC	N/A	
6	To implement social monitoring, and to submit the monitoring results to JICA, by using the monitoring form, on a quarterly basis as a part of Project Monitoring Report	Until land acquisition completes	WASAC	770	
7	To clear, level and secure the lands for a reservoir in Batsinda and elevated tank in Kagugu	Before notice of the bidding documents	WASAC	1,560	
8	To facilitate getting a consensus on the project details with the City of Kigali.	Before notice of the bidding documents	WASAC	N/A	
9	To submit Project Monitoring Report (with the result of Detailed Design)	Before preparation of the bidding documents	WASAC	N/A	

(MINECOFIN: Ministry of Finance and Economic Planning; BNR: National Bank of Rwanda; B/A: Banking Arrangement, A/P: Authorization to pay, N/A: Not Applicable, RDB: Rwanda Development Board) Note: (No.4) The cost will be revised according to the actual price based on the land evaluation.

(2) During the Project Implementation

NO	Items	Deadline	In charge	Estimated Cost (Thousand RWF)	Ref.
1	To issue A/P to the Agent Bank for the payment to the supplier and the contractor	Within 1 month after the signing of the contract(s)	MINECOFIN/ BNR	440	
2	To bear the following commissions to the Agent Bank for the banking services based upon the B/A	-	-	174,000	
	1) Advising commission of A/P	Within 1 month after the signing of the contract(s)	WASAC		
	2) Payment commission for A/P	Every payment	WASAC		
3	To obtain the necessary permission for construction from the concerned organizations 1) Construction permission of pipeline on road by the City of Kigali 2) Construction permission of reservoir and elevated tank by the City of Kigali	During the project	WASAC/ Contractor	N/A	
4	To ensure prompt customs clearance in the country of the Recipient	During the Project	WASAC	N/A	
5	To accord Japanese physical persons and/or physical persons of third countries whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the country of the Recipient and stay therein for the performance of their work	During the Project	WASAC	N/A	
6	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the country of the Recipient with respect to the purchase of the products and/or the services be borne by its designated authority without using the Grant	During the Project	MINECOFIN/ WASAC	1,647,703	
7	To secure stock yards for Japanese contractor.	Before the Project	WASAC	36,000	
8	To bear all the expenses other than those covered by the Grant, necessary for the implementation of the Project.	During the Project	WASAC	N/A	
9	To notify JICA promptly of any incident or accident, which has, or is likely to have, a significant adverse effect on the environment, the affected communities, the public or workers.	During the construction	WASAC	N/A	
10	To submit Project Monitoring Report	Every month (until WASACS's undertakings such as pipe installation finish)	WASAC	N/A	
11	To submit Project Monitoring Report (final) (including as-built drawings, equipment list, photographs, etc.)	Within 1 month after issuance of Certificate of Completion for the works under the contract(s)	WASAC	N/A	
12	To submit a report concerning the completion of the Project	Within 6 months after completion of the Project	WASAC	N/A	
13	To provide facilities for connection to the telecommunication network, distribution of electricity and other incidental facilities necessary for the implementation of the Project	During the construction	WASAC	11,150	
14	To implement EMP and EMoP	During the construction	WASAC/ Contactor	N/A	
15	To submit results of environmental monitoring to JICA, by using the monitoring form, on a quarterly basis as a part of the Project Monitoring Report	During the construction	WASAC	N/A	

NO	Items	Deadline	In charge	Estimated Cost (Thousand RWF)	Ref.
16	To implement Abbreviated RAP (Meetings for grievance redress, PAP's Livelihood assessment)	For a period based on livelihood restoration program	WASAC	68,000	
17	To implement social monitoring, and to submit the monitoring results to JICA, by using the monitoring form, on a quarterly basis as a part of Project Monitoring Report - Period of the monitoring may be extended if affected person's livelihood is not sufficiently restored. The extension of the monitoring will be decided based on an agreement between WASAC and JICA.	- Until the end of livelihood restoration program (In case that livelihood restoration program is provided) *- For 2 years after land acquisition completes (In case that livelihood restoration program is not provided)*	WASAC	Included in No.6 of (1)	
18	To assign a supervisor and an engineerduring the construction period	During the project	WASAC	45,300	
19	To implement construction which WASAC undertakes, e.g. installation of secondary and tertiary pipes, service connections, water meters, and meter boxes - To make contracts with local Rwandan companies to install the pipes and service connections	During the project	WASAC	1,554,000	
20	To assign counterparts for the soft-component activities	During the project	WASAC	N/A	
21	To encourage and continuously implement new service connections	During the project	WASAC	N/A	
22	To ensure the safety of persons engaged in the implementation of the Project	During the Project	WASAC	N/A	

Note: (No.6) The cost will be revised according to the result of the bidding. (No.19) The cost will be revised according to price escalation.

(3) After the Project

NO	Items	Deadline	In charge	Estimated Cost (Thousand RWF)	Ref.
1	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid 1) Allocation of maintenance cost 2) Operation and maintenance 3) Routine check/Periodic inspection	After completion of the construction	WASAC	148,100/y	
2	To encourage and continuously implement new household connections	After the project	WASAC	N/A	
3	To make a maintenance contract with a contractor/supplier for maintenance of software, monitoring equipment, and instrumentation in the monitoring system, including those developed under the Project for Strengthening Non-Revenue Water Control in the City of Kigali Water Network.	During the project	WASAC	11,330/y	

Note: (No.1 and No.3) For at least 4 years after the completion (until 2030).

2. Other obligations of the Government of Rwanda funded with the Grant

NO	Items	Deadline	Amount (Million Japanese Yen)*
1	To construct a reservoir, an elevated tank, and transmission and distribution mains		
2	To implement detailed design, bidding support and construction supervision		
3	Contingencies		
	Total		[redacted]

* The Amount is provisional. This is subject to the approval of the Government of Japan.

Project Monitoring Report
on
Project Name
Grant Agreement No. XXXXXXX

20XX, Month

Organizational Information

Signer of the G/A (Recipient)	Person in Charge	(Designation)
	Contacts	Address: Phone/FAX: Email:
Executing Agency	Person in Charge	(Designation)
	Contacts	Address: Phone/FAX: Email:
Line Ministry	Person in Charge	(Designation)
	Contacts	Address: Phone/FAX: Email:

General Information:

Project Title	
E/N	Signed date: Duration:
G/A	Signed date: Duration:
Source of Finance	Government of Japan: Not exceeding JPY _____ mil. Government of (_____): _____

1: Project Description

1-1 Project Objective

1-2 Project Rationale

- Higher-level objectives to which the project contributes (national/regional/sectoral policies and strategies)
- Situation of the target groups to which the project addresses

1-3 Indicators for measurement of "Effectiveness"

Quantitative indicators to measure the attainment of project objectives		
Indicators	Original (Yr)	Target (Yr)
Qualitative indicators to measure the attainment of project objectives		

2: Details of the Project

2-1 Location

Components	Original *(proposed in the outline design)*	Actual
1.		

2-2 Scope of the work

Components	Original* *(proposed in the outline design)*	Actual*
1.		

Reasons for modification of scope (if any).

(PMR)

2-3 Implementation Schedule

Items	Original		Actual
	(proposed in the outline design)	*(at the time of signing the Grant Agreement)*	

Reasons for any changes of the schedule, and their effects on the project (if any)

2-4 Obligations by the Recipient

2-4-1 Progress of Specific Obligations

See Attachment 2.

2-4-2 Activities

See Attachment 3.

2-4-3 Report on RD

See Attachment 11.

2-5 Project Cost

2-5-1 Cost borne by the Grant(Confidential until the Bidding)

Components			Cost (Million Yen)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			
Total				

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar = Yen

2-5-2 Cost borne by the Recipient

Components			Cost (1,000 Taka)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar =

Reasons for the remarkable gaps between the original and actual cost, and the countermeasures (if any)

(PMR)

2-6 Executing Agency

- Organization's role, financial position, capacity, cost recovery etc,
- Organization Chart including the unit in charge of the implementation and number of employees.

Original *(at the time of outline design)* name: role: financial situation: institutional and organizational arrangement (organogram): human resources (number and ability of staff):
Actual *(PMR)*

2-7 Environmental and Social Impacts

- The results of environmental monitoring based on Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- The results of social monitoring based on in Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- Disclosed information related to results of environmental and social monitoring to local stakeholders (whenever applicable).

3: Operation and Maintenance (O&M)

3-1 Physical Arrangement

- Plan for O&M (number and skills of the staff in the responsible division or section, availability of manuals and guidelines, availability of spareparts, etc.)

Original *(at the time of outline design)*
Actual *(PMR)*

3-2 Budgetary Arrangement

- Required O&M cost and actual budget allocation for O&M

Original *(at the time of outline design)*

Actual *(PMR)*

4: Potential Risks and Mitigation Measures

- Potential risks which may affect the project implementation, attainment of objectives, sustainability
- Mitigation measures corresponding to the potential risks

Assessment of Potential Risks (*at the time of outline design*)

Potential Risks	Assessment
1. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
2. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
3. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:

	Contingency Plan (if applicable):

Actual Situation and Countermeasures
(PMR)

5: Evaluation and Monitoring Plan (after the work completion)

5-1 Overall evaluation

Please describe your overall evaluation on the project.

5-2 Lessons Learnt and Recommendations

Please raise any lessons learned from the project experience, which might be valuable for the future assistance or similar type of projects, as well as any recommendations, which might be beneficial for better realization of the project effect, impact and assurance of sustainability.

5-3 Monitoring Plan of the Indicators for Post-Evaluation

Please describe monitoring methods, section(s)/department(s) in charge of monitoring, frequency, the term to monitor the indicators stipulated in 1-3.

Attachment

1. Project Location Map
2. Specific obligations of the Recipient which will not be funded with the Grant
3. Monthly Report submitted by the Consultant

Appendix - Photocopy of Contractor's Progress Report (if any)
- Consultant Member List
- Contractor's Main Staff List

4. Check list for the Contract (including Record of Amendment of the Contract/ Agreement and Schedule of Payment)
5. Environmental Monitoring Form / Social Monitoring Form
6. Monitoring sheet on price of specified materials (Quarterly)
7. Report on Proportion of Procurement (Recipient Country, Japan and Third Countries) (PMR (final)only)
8. Pictures (by JPEG style by CD-R) (PMR (final)only)
9. Equipment List (PMR (final)only)
10. Drawing (PMR (final)only)
11. Report on RD (After project)

Monitoring sheet on price of specified materials

1. Initial Conditions (Confirmed)

	Items of Specified Materials	Initial Volume A	Initial Unit Price (¥) B	Initial total Price C=A×B	1% of Contract Price D	Condition of payment	
						Price (Decreased) E=C−D	Price (Increased) F=C+D
1	Item 1	●●t	●	●	●	●	●
2	Item 2	●●t	●	●	●		
3	Item 3						
4	Item 4						
5	Item 5						

2. Monitoring of the Unit Price of Specified Materials

(1) Method of Monitoring : ●●

(2) Result of the Monitoring Survey on Unit Price for each specified materials

	Items of Specified Materials	1st ●month, 2015	2nd ●month, 2015	3rd ●month, 2015	4th	5th	6th
1	Item 1						
2	Item 2						
3	Item 3						
4	Item 4						
5	Item 5						

(3) Summary of Discussion with Contractor (if necessary)

-
-
-

yy.

Report on Proportion of Procurement (Recipient Country, Japan and Third Countries)
(Actual Expenditure by Construction and Equipment each)

		Domestic Procurement (Recipient Country) A	Foreign Procurement (Japan) B	Foreign Procurement (Third Countries) C	Total D
Construction Cost		(A/D%)	(B/D%)	(C/D%)	
	Direct Construction Cost	(A/D%)	(B/D%)	(C/D%)	
	others	(A/D%)	(B/D%)	(C/D%)	
Equipment Cost		(A/D%)	(B/D%)	(C/D%)	
Design and Supervision Cost		(A/D%)	(B/D%)	(C/D%)	
Total		(A/D%)	(B/D%)	(C/D%)	

Annex 7 Items and Measures to be Considered for Smooth Implementation of the Project

1. Learnings from the Project and Their Utilization after the Project

The Kigali Water Supply Masterplan proposes that the water distribution system in the City of Kigali be developed and/or rehabilitated referring to the achievements of the Project as a good model. The Project will be a good chance for WASAC to learn the concept of water distribution block, and its planning and construction.

Therefore, both sides confirmed that WASAC would learn them through the Project, and utilize the learnings in the development and/or rehabilitation of the water distribution system in the City of Kigali after the Project.

2. Appropriate Arrangement of Necessary Budgets for the Project

As both sides agreed in Annex 5, WASAC will arrange the necessary budgets for the Project at the appropriate time.

WASAC committed to securing the necessary budget for the land acquisition by January 2023. Regarding the budget for installation of pipes and service connections, etc. for the Rwanda fiscal year 2023/24, WASAC will apply to the Ministry of Finance and Economic Planning (hereinafter referred to as "MINECOFIN") by January 2023.

3. Installation of Secondary Pipes, Tertiary Pipes and Service Connections to be Undertaken by WASAC

The main works to be carried out by WASAC are the installation of secondary and tertiary pipes (approx. 68 km), and service connections (approx. 100 km) except for their installation in the Batsinda Area.

Based on the contents of the draft report 2.4.2, both sides confirmed the procedures for installing secondary and tertiary pipes, and service connections, and points to be noted in coordination between works by a Japanese contractor and those by WASAC.

A Japanese contractor will first install the secondary and tertiary pipes, and service connection in the Batsinda Area. WASAC will have an opportunity to learn the installation techniques and processes. For this purpose, WASAC will organize teams and a person in charge of conducting the installation before the works start in the Batsinda Area.

Based on the learnings about the installation techniques and processes, and the methods of dealing with possible problems during the construction of the works, WASAC will prepare plans for process control and supervision for WASAC's works, and implement them in cooperation with a Japanese consultant.

The progress of preparation of the plans for process control and supervision by WASAC will be reported monthly in the Project Monitoring Sheet. Their final versions will be prepared by WASAC and attached to the PMR before WASAC starts

the works. After the start of construction, the progress of WASAC's works will be reported to JICA through the PMR until their completion.

WASAC will conduct the installation of secondary and tertiary pipes, and service connections mainly by contracting out to local Rwandan companies, while the WASAC will do the work directly by their staff so that WASAC could learn pipe installation skills through the works.

In Rwanda, there are about 15 companies that are eligible to do drinking water supply construction works of similar sizes of the contract. The contractor will be selected after careful evaluation through open competition. WASAC will start its procurement process around July 2023, and the contract will be signed around January 2024.

When the Japanese contractor installs the secondary and tertiary pipes, and service connections in the Batsinda Area, WASAC as well as the contractor will have an opportunity to learn construction techniques and processes. This will be done as a part of the soft component.

4. Replacement of Existing Customer Connections

It is necessary to obtain customers' consents for the renewal of service connections. In particular, in the Batsinda Area where the service connections are to be replaced by the Japanese contractor, WASAC must obtain the consents from households whose service connections need to be replaced prior to the start of the construction so that the Japanese contractor can carry out the replacement smoothly without a delay of the works.

If the customer consent to enter into the customer's premises is not obtained, the service connection is installed up to the rising edge in the customer's premises. If the consent is not obtained, the service connection is installed up to a customer premise's boundary.

5. Replacement of Customer Water Meters

The replacement of water meters in all the project areas will be carried out by WASAC. Water meters whose service lives become over 10 years during the project period will be replaced. Their number is approximately 7,500. The replacement of water meters will start in the Batsinda Area, where the installation of pipes and service connections has been completed. In other areas, WASAC will start to replace corresponding water meters after the installation of pipes and service connections is completed.

6. To Encourage New Service Connections

To realize the appropriate outputs of the Project, WASAC needs to encourage and continuously implement new service connections in the project area. For new connections, households need to make a contract with WASAC and install service

connections at their expense. WASAC has a responsibility to encourage and continuously implement new service connections during and after the Project.

7. Operation and Maintenance of Monitoring System

The project will improve the existing monitoring system that was developed under the Project for Strengthening Non-Revenue Water Control in the City of Kigali Water Network. WASAC will appoint staff members for its operation and maintenance by November 2023.

WASAC will procure and enter into a maintenance contract with a competent contractor/supplier for maintenance of the software (updating), monitoring equipment such as flow meters and instrumentation (replacement of batteries, periodic inspection, and overhaul of flow meters, etc.). This maintenance contract will include not only the equipment to be installed under the Project but also those in the existing monitoring system that was developed under the Project for Strengthening Non-Revenue Water Control in the City of Kigali Water Network.

8. Appropriate Management of Materials for the Project

The Project will procure large quantities of materials, including approximately 168 km of pipes and service connections, and 7,500 water meters, etc. WASAC will secure a large enough material storage area at the site of the Ntora Reservoir and/or at the Remera Golf 8 Reservoir for its storage. To avoid damage from sunshine, rain, etc., materials such as the pipes and service connections are covered by sheets, and equipment such as meters is stored indoors.

9. Securing a Sufficient Number of Staff

WASAC will assign two full-time employees to supervise the construction of the Project. These two employees will continue to work after the completion of the Project. They will also be involved in the operation and maintenance of the water supply facilities.

WASAC has an employment plan to enhance its capacity for operation and mentainance. Following the plan, WASAC continuously hires new employees to improve the water supply services.

10. Close Communication with Customers

Some customers' households will experience lower water supply pressure at times after the Project completion compared to the pressure before the project implementation. In addition, some customers that are currently supplied with high water pressure have installed Pressure Reducing Valves, which may cause unnecessary pressure loss after the completion of the Project. Therefore, it is

necessary for WASAC to properly respond to complaints from customers and announce that this Project will optimize the pressure.

11. Necessary Procedures for the Project Implementation

11.1 Land Acquisition

In the Project for Strengthening of Nzove - Ntora Principal Transmission Pipeline, compensation to the project-affected households for land acquisition was delayed, and then construction works were suspended for a while. WASAC had arranged the necessary budget for the compensation, and this issue was solved.

To mitigate construction delays, both sides confirmed that all the necessary lands for the Project have to be acquired before the notice of bidding documents. In other words, if the lands are not acquired timely, the notice of bidding documents will not be conducted.

11.2 Obtaining Permissions for Construction

In the Project for Strengthening of Nzove - Ntora Principal Transmission Pipeline in Kigali City, the construction schedule is delayed because the permission to use public roads for pipe installation has not been issued on time.

To avoid this kind of delay in the Project, both sides confirmed that WASAC will closely communicate with the City of Kigali to obtain the necessary authorization and permissions for the project infrastructure at an appropriate time.

12. Appropriate Implementation of Relevant Projects

The Project for Strengthening of Nzove-Ntora Principal Transmission Pipeline in Kigali City is being implemented to enhance the transmission capacity of the Nzove-Ntora principal transmission pipeline. After its completion in May 2023, the capacity will increase from 40,000 m^3/d to 62,000 m^3/d.

WASAC is also implementing recovery of water production capacity of the Nzove Water Treatment Plant I (from a production capacity of 17,000 m^3/d to 40,000 m^3/d in 2025/26), and enhancement of transmission capacity of the New Nzove Water Treatment Plant I (from filter and pumping capacity of 40,000 m^3/d to 65,000 m^3/d in 2024/25). Currently, the start of their project implementation has been delayed due to budget constraints. WASAC has submitted the project Feasibility Study for the project for Nzove Water Treatment Plant I to the MINECOFIN for fund mobilization. The MINECOFIN understood the importance of these two projects and agreed to seek funding. WASAC will put the two projects on high priority when they submit budget planning for the next fiscal year in November 2022.

Without completion of the projects above, the planned volume of water by 2030 cannot be transferred to the Ntora Reservoir for the Project to create appropriate outputs. Both sides confirmed that WASAC would provide utmost efforts for smooth

implementation and completion of the projects.

Table. Projected Water Production Capacity and Transmission Capacity of Nzove WTP

Category	Item	2021/2022	2024/2025	2025/2026	2030/2031
Supply Capacity (m^3/d)	Nzove 1	17,000	25,000	40,000	40,000
	Nzove 2	40,000	40,000	40,000	40,000
	New Nzove 1	40,000	65,000	65,000	65,000
	Production Capacity of Nzove WTP	97,000	130,000	145,000	145,000
	Transmission Capacity to Mont-Kigali	40,000	40,000	40,000	40,000
	Transmission Capacity to Kimisagara	3,000	3,000	3,000	3,000
	Transmission Capacity to Ntora	**57,000**	**62,000**	**87,000**	**102,000**

13. Important Actions to be Taken by WASAC in Operation Phase

13.1 Regular Monitoring of Water Pressures in Project Area

To confirm the proper operation of the facilities developed under the Project, WASAC will monitor water supply pressure once a month at each of the 24 blocks after the facilities are put into operation. This data will also be used as a reference in the ex-post evaluation to check whether the indicators of the Project have been achieved or not.

13.2 Regular Maintenance of Existing Secondary and Tertiary Pipes, and Service Connections

Regarding the secondary and tertiary pipes and service connections that were not subject to replacement in the Project, their leakage conditions, etc. will be checked in a timely manner, and if necessary, they will be replaced by WASAC.

13.3 Publicization of the Project

WASAC will publicize the successful cooperation between the Government of Rwanda and the Government of Japan for the Project by displaying a banner, national flags, etc. on the visible facilities and/or on their premises such as the Kagugu Elevated Tank and Batsinda Reservoir.

14. Close Cooperation with the Project for WASAC Utility Turnaround with KAIZEN Approach

In addition to the soft component of the Project, both sides confirmed that the Project for WASAC Utility Turnaround with KAIZEN Approach would cooperate closely with the Project to enhance WASAC's capacities mentioned below:

- Installation of pipes and service connections;
- Updating installation records (including GIS data), and utilization of database;
- Construction planning and supervision; and

- Maintenance of facilities, e.g. Pressure Reducing Valves, Pressure Breaking Chambers, etc.

Lessons learned and best practices acquired from the Project and the Project for WASAC Utility Turnaround with KAIZEN Approach should be reflected in WASAC's daily activities.

Annex 8 Environmental Checklist

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a)Y (b)Y (c)N (d)N	(a) EIA report was prepared and submitted to RDB in July (b) Approved on 29th July, 2022. (c) Conditionally approved. The conditions are the requirement during the implementation and not the presumptions on the approval before starting the works.
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a) Y (b) Y	(a) At the stakeholder meetings, the project contents and its potential impacts were adequately explained, and stakeholders basically agreed with the project. (b) Participants of consultation meetings made comments and questions, but none of them was critical.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) Alternative sets of candidate sites of reservoirs, routes of transmission pipeline, were examined with social and environmental considerations.
2 Pollution Control	(1) Air Quality	(a) Is there a possibility that chlorine from chlorine storage facilities and chlorine injection facilities will cause air pollution? Are any mitigating measures taken? (b) Do chlorine concentrations within the working environments comply with the country's occupational health and safety standards?	(a) N (b) -	(a) Construction/modification of water purification plant is not included in the project components. (b) ditto
	(2) Water Quality	(a) Do pollutants, such as SS, BOD, COD contained in effluents discharged by the facility operations comply with the country's effluent standards?	(a) -	(a) Construction/modification of water purification plant is not included in the project components.
	(3) Wastes	(a) Are wastes, such as sludge generated by the facility operations properly treated and disposed in accordance with the country's regulations?	(a) -	(a) Construction/modification of water purification plant is not included in the project components.
	(4) Noise and Vibration	(a) Do noise and vibrations generated from the facilities, such as pumping stations comply with the country's standards?	(a) -	(a) Construction of pumping stations is not included in the project components.
	(5) Subsidence	(a) In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence?	(a) N	(a) No groundwater will be used.
3 Natural Environment	(1) Protected Areas	(a) Is the project site or discharge area located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a) N	(a) The project site is not located in protected areas and there is no expected impact of the project on the protected areas.
3 Natural Environment	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site or discharge area encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?	(a) N (b) N (c) - (d) N	(a) The project areas are located in the urban areas and no natural forests and ecologically valuable habitats are observed. (b) ditto (c) No serious impact is expected. (d) Construction of new water intake is not included in the project components.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(3) Hydrology	(a) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect surface water and groundwater flows?	(a) N	(a) There are no new water intakes, and no construction works which could affect hydrology of rivers/wetland.
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Is the compensations going to be paid prior to the resettlement? (e) Is the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?	(a) N (b) - (c) - (d) - (e) - (f) - (g) - (h) - (i) - (j) -	(a) There is no involuntary resettlement expected.
4 Social Environment	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (b) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect the existing water uses and water area uses?	(a) N (b) N	(a) One PAP will lose a part of the banana farm, but he has another fam, which is the main income source, and compensations for lost land and crops will be paid. (b) No new water intake will be constructed.
	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N	(a) No such facilities are identified in the project area.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) There will be no serious problems but cutting trees will change the landscape locally. After the construction work, rehabilitation work will be conducted.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a) N (b) N	(a) Ethnic minorities and indigenous people are not confirmed in the Project area. (b) ditto

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(a) Y (b) Y (c) Y (d) Y	(a) Contractors/sub-contractors are requested to take a training provided by Ministry of Public Service and Labour in order to make sure that they would abide by related Rwandan laws and international rules such as OHSAS (b) Measures are taken to oblige workers to wear safety boots and helmets and to manage waste properly, in order to prevent accidents during the construction work (c) The safety and sanitation plan will be planned and regular safety education will be implemented, in consultation with a district work safety inspector (d) Security guards, who are provided with training of health and safety, are assigned and measures are taken such as installation of fence and signboards in order to prevent accidents and troubles involving local residents near the construction site
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts? (d) If the construction activities might cause traffic congestion, are adequate measures considered to reduce such impacts?	(a) Y (b) Y (c) Y (d)Y	(a) Based on the baseline survey, the impact of the project was evaluated, and mitigation measures were planned. (b) ditto (c) ditto (d) A part of the distribution main pipeline are runs along the busy city roads. The installation/replacement work could cause traffic congestion and mitigations measures will be taken.
5 Others	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a) Y (b) Y (c) Y (d) Y	(a) The environmental monitoring plan was prepared for target items of mitigation measures and will be implemented. (b) The feasible monitoring methods and frequency were decided in consultation with the environmental authorities (c) The monitoring system will be established through the EIA survey (d) The reporting system will be established through the EIA survey.
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Dam and River Projects checklist should also be checked.	(a) N	(a) There will be no construction works near the river and wetland.
	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) N	(a) The project does not have possibility of significant adverse impacts on environment, including global warming

Annex 9 Environmental Management Plan/Environmental Monitoring Plan

The Environmental Management and Monitoring Plan (EMMP) is divided into two parts one is the Environmental Management Plan and the other is the Environmental Monitoring Plan. The Environmental Management Plan translates the proposed mitigation measures into actions and provides management measures to be undertaken during the construction and operational phases of the project. The Environmental Monitoring Plan details monitoring activities and measures to be undertaken during construction and operation phases of the project.

WASAC Ltd should designated an environmental officer who will make day to day the follow up of the implementation of the EMMP as well supervise and liaise with project stakeholders. The contractor will also require having an Environmental, Social Health and Safety officer to follow up the implementation of Environmental Management Plan.

1. Environmental Management Plan (EMP)

The table below presents the EMP and provides environmental adverse impacts of the project implementation, the proposed mitigation measures, responsible and the responsible for monitoring.

Table 1: Environmental Management Plan for block system- reservoirs and installation/replacement of distrubution pipes

Environmental /social impacts	Proposed mitigation measures	Responsible	Monitoring	Estimated cost (USD)
Influx of job seekers	- Disclosure the number of available jobs and required personnel for the project disclosure the job application period and deadline before project implementation. - Involve local authorities in local manpower recruitment process; - The employment opportunities to consider both male and female without any segregation. - Residents to be prioritized in the recruitment process.	Contractor	WASAC Ltd/Local authorities	No cost required
Land acquisition	- Fair compensation of land from owners should be done before project activities - Land should be acquired from only landowners with no intermediaries - Secure the required land from competent authorities especially for the land under public domain before project activities. - Involve and work with district/ Sectors authorities to better solve any conflict that may arise connect to right of way	Property valuer WASAC Ltd /District/ local authorities	MINECOFIN WASAC Ltd /District	Under ARAP budget
High expectations of getting great compensation	– Compensation mechanisms should be implemented in all justifiable cases. – Involve PAPs in all steps required for the fair compensation as stipulated in the expropriation laws and regulations. - Establish and make operational conflicts resolutions committees.	Contractor/WASAC Ltd / Local Authorities	WASAC Ltd/ Local authorities/ District	No cost required
Loss of individual owned crops, trees, and other assets	- Valuation of damaged assets to be conducted by independent valuer. - Valuation of damaged properties should be fair and done according to the existing law related to expropriation in public interest. - Fair compensation should be done prior to the project activities - Compensation to be done only at the property's owners without intermediaries	WASAC Ltd/ Independent valuer	WASAC Ltd/ Local authorities/MINECOFIN	Expropriation budget
Disruption of public utilities especially water supply networks, electrical network, and traffic etc	- A well-planned work schedule, including connection between newly installed distribution pipes and existing service pipes, as well as secondary and tertiary distribution pipes, could minimize the water suspension period. - The contractor will avoid as much as possible to affect these infrastructures by properly planning in advance for the project activities and identify those to be affected and use alternatives - The quick rehabilitation of affected infrastructures will be done to avoid greater impacts - Before the excavation works get information from local authorities on the exact location of such utilities when not prior identified - Inform residents ahead of time any expected impact on public utilities (such as power cuts etc) - Where possible and deemed necessary identify new alternatives for water sources and electricity supply when performing project activities	Contractor	WASAC Ltd/ REG-EUCL/ RURA/RTDA/ Local authorities	No cost required

Environmental /social impacts	Proposed mitigation measures	Responsible	Monitoring	Estimated cost (USD)
Incident and accident at excavated trenches	- Demarcate all hazardous trenches with signs posts and warning tapes - Conduct daily morning briefs related to safety measures for all workers - Only authorized personnel to enter the working areas - Provision of Personnel Protective Equipment to all project workers - Sensitization of workers on safety measures - Provide first aid kit on the site - Ensure all employees have health insurance	Contractor/ site workers	WASAC Ltd//Local authorities	5,000
Loss of trees cut during the construction work	- Replant trees which are cut during the construction works	Contractor	REMA/WASAC Ltd	1,800
Soil pollution	- To take necessary measures to prevent oil contamination and spillover of oil/fuels such as using a tray when filling fuels and installing a dyke at the fuel storage place	Contractor	WASAC Ltd/ REMA	Under construction budget
Soil erosion	- Remove and stockpile topsoil, sub-soils and any parent material separately and use it to refill trenches and landscaping - For the excavation work at the steep slope, a heavy vehicle of a suitable size should be used and soil erosion prevention measures such as installation of fences or barrier are taken.	Contractor	WASAC Ltd/ REMA	Under construction budget
Noise pollution	- Construction activities shall be restricted to normal working hours (7h00-17h00) to prevent noise for neighbors at night - The machinery and automobiles to be used on site should have certification of good working conditions from "National Automobile inspection centre" to reduce noise or exhaust fumes emissions. - Ensure routine maintenance, repair of trucks and machines. - Provision of protective equipment to all site workers. - The contractor to inform the general public any activity that shall emit noise prior to execution in order to minimize the impacts (e.g. blasting activities and operation of heavy machinery and construction traffic). - Restrict construction and operation of heavy machines to daylight; - Ensure noise emissions are kept within the Rwanda standards; - Reduce needed truck movements by careful planning of needs of delivery of construction materials.	contractor	WASAC Ltd/ REMA	2,500
Land degradation	- All earthworks for site preparation and levelling shall be carried out in a proper designated way and to be executed by the qualified engineers. - Excavated soil shall be well managed and re-used to backfilling the excavated trenches. - The unused soil and considered as waste shall be deposited in a well designated area to be approved in close collaboration with Gasabo District.	Contractor	WASAC Ltd/ Gasabo district/ REMA/Cok	1,400
Child labour, forced labour and discrimination	- All site workers to be recorded by sex and ages - Protect the workforce from inequality, social exclusion, child labour, and forced labour; - Promote compliance with national legal requirements and provide supplemental due diligence requirements where national laws are silent; - Establish, maintain, and improve the employee–employer relationship	Contractor	WASAC Ltd/ MIFOTRA/ Cok /District/ local authorities	No cost required
Conflicts among workers and local population	- Local population should be prioritized when recutting for project personnel and manpower. - Keeping a good relationship with local communities - Establishment and implementation of set of rules for the workplace	Contractor	WASAC Ltd	No cost required
Fugitive dust generated during excavation works and air pollution	- Spray water when deemed necessary in order to reduce the dust. - Compaction of soil to be minimized by careful stockpiling and separation of top and sub-soils.	Contractor	WASAC Ltd/ REMA	2,000
Pollution of surface and ground water	- Provide onsite adequate sanitary facilities - All unused materials to be properly handled at the construction sites - Work with the accredited companies in waste management and handling activities	Contractor	WASAC Ltd/ REMA/RWB	Under construction budget

Environmental /social impacts	Proposed mitigation measures	Responsible	Monitoring	Estimated cost (USD)
Disturbance of traffic	- Appoint staff in charge of traffic management - Use of appropriate traffic signpost at the working areas - Excavation and backfilling of the affected section during evening hours where there is no heavy traffic	Contractor	WASAC Ltd/ Traffic police/ RTDA	2,000
Vibrations and noise pollution	- To avoid noise and vibrations, construction activities shall be restricted to normal working hours (7h00-17h00) to prevent impacts to neighbors at night. - The machinery and automobiles for the project shall have certification of good working conditions from "National Automobile Inspection centre" to reduce noise or exhaust fumes emissions. - All workers should be equipped with protective equipment including protective masks. - Ensure noise emissions are kept down and meet the existing noise emission standards depending on sites of works.;	Contractor	WASAC Ltd/REMA	2,000
Injuries and accidents during construction works	- All workers shall be equipped with Personnel Protective Equipment - Ensure that all employees have health insurance to afford health facilities - Conduct daily morning briefs related to safety measures for all workers. - The safety and sanitation plan is formulated and safety trainings are provided for workers	Contractor	WASAC Ltd/Local authorities	3,000
Abuse of drugs and use of alcohol	- Avail free of charge potable and safe drinking water for all workers. - Avoid any kind of use of alcohol and other drugs at the project sites.	Contractor/site workers	WASAC Ltd/ local authorities/ RIB	No cost required
Poor solid waste management	- On site adequate sanitary facilities have shall be provided at the project sites - Appropriate waste management mechanisms shall be imposed at the project sites. - All unused materials shall be properly handled - Storage sites shall follow the appropriate regulations related to Waste Management. - No materials storages shall be located nearby water body - Contractor shall regularly monitor water pollution sources at the project sites - Contractor shall maximize efforts to avoid oil spillages at the construction sites	Contractor	WASAC Ltd/ REMA/ RWB	No cost required
Sediment load	- All excavated soil shall be properly handled and managed at the project sites to avoid any incident. - All excavated soil shall be carefully re-used to backfill the excavated trenches - The unused soil shall be dumped at the approved site selected in close collaboration with Gasabo District.	Contractor	WASAC Ltd/ RWB/ REMA	No cost required
Gender based violence and sexual Exploitation and Abuse (GBV/SEA	– Preparation and implementation workers Code of conduct – Conduct GBV/SEA awareness among all workers -	Contractor	WASAC Ltd/ Districts/ Isange One Stop Center	800
General occupational health and Safety (OHS)	- Contractor shall ensure that all employees have health insurance as means of health care affordability; - Contractor shall provide personal protective equipment (PPEs) to all project workers and visitors. - Avail permanent first aid kit at the project sites - Avail an Environmental and safety officer at the site to oversee environmental management, social concerns and the implementation of environmental policies and regulations; - Install safety and warning signage as appropriate - Appoint ESHS Manager to assist with sampling, monitoring and daily environmental compliance; - Provide environmental and health induction talks to all employees.	Contractor	REMA/ WASAC Ltd/Districts	2,000
Total				**23,500**

2. Environmental Monitoring Plan

2.1 General Environmental Monitoring Parameters

The monitoring plan provided in this section is indicating measurements of parameters, responsibility, and cost estimates of outcomes of the proposed mitigation measures. A monitoring plan stands to facilitate and ensure the follow-up of the implementation of the proposed mitigation measures and helps to anticipate possible environmental hazards and/or detect unpredicted impacts over time. However, a general monitoring plan should be implemented on site as it facilitates and ensures the follow-up of the implementation of the proposed mitigation measures. It helps to anticipate possible environmental hazards and/or detect unpredicted impacts over time. Monitoring tools include the:

- Visual observations;
- Selection of environmental parameters/indicators at specific locations;
- Sampling and testing of the selected parameters.

To address all activities that may causes adverse impacts, this environmental monitoring plan should be implemented through the project phases. The implementation of this monitoring plan should be based on direct or indirect indicators of emissions, effluents and resource use and the monitoring frequency should be sufficient to provide representative data for the parameter being monitored.
The following are key parameters to be monitored during this project implementation:

- **Noise and vibration**

It is expected that the project will cause noise and vibrations at the project sites. Therefore, period noise level measurements should be taken at the project sites especially nearby residential areas as well consultation with local Community with the aim to assess the project impacts regarding noise pollution.

- **Soil erosion monitoring**

The project is not likely to have major impact on soil quality as no major activities are anticipated nearby water bodies. However, soil erosion is anticipated at the sites where excavation works shall be carried out at high slops areas. A regular monitoring is then required to avoid any soil erosion that may occur.

- **Soil pollution monitoring**

Though there is no heavy machinery to be used, there might be Oil contamination/ spill over construction areas. Therefore, prevention measures will be monitored.

- **Monitoring ofaccidents/incident**

Most of the project activities will be carried out along different roads within the project areas. WASAC, JICA and any other contractor must make sure that appropriate signs are posted at appropriate locations/positions to minimize/eliminate risk of accidents. In addition, health inspectors should make sure that:

- Measures to create awareness regarding sexually transmitted diseases such as HIV/AIDS, Covid- 19 and other diseases are taken among project workers;

The following parameters could be used as indicators:

- Level of awareness of communities pertaining to dangers/risks associated with the project; and
- Accident and incidents reports: records on actual accidents associated with the project.

- **Monitoring of social impacts**

The monitoring of the social impacts of the project is based on the experience of the communities and households. The following impacts should be monitored with the help of local authorities and households.

- Employment opportunities associated to the project implementation
- Clean water availability within the project area
- Inclusion of women and men when allocating jobs
- Dust and air pollution in the project area

- **Community relationship**:

Conflicts between project workers and local community due to arrival of non-resident workers in the project area. The number of workers should be recorded by their origin, sex, and age. The following table summarizes the parameters to be monitored and the monitoring plan of the project.

2.2 Environmental Monitoring Plan for block system-Reservoirs and pipes

The next table presents Monitoring plan for the construction of reservoirs and installation/replacement of pipes covered under JICA grant.

Table 2: Environmental Monitoring Plan for block system - reservoirs and installation/replacement of distribution pipes

Environmental items	Monitoring item	Parameter/Indicator to be monitored	Location	Frequency	Responsible	Budget
Pre-construction and site mobilization phase						
Land securing and compensation	Compensation for private owned land	Area of land compensated	Project site	Once before construction works	WASAC Ltd	ARAP monitoring report
	Land easement and securing from public land	land for water tank and pipelines secured	Project area	Once before project activities	WASAC/ local Authorities	No cost required
	Complaints related to pipelines locations nearby residential areas	GRM logbook	Project area	Once before project activities	WASAC Ltd/ local authorities	no cost required
Air pollution	Equipment and automobiles in good conditions	certificate of good working condition issued by automobile inspection center	Project sites	As appropriate	Contractor/ traffic police	200
Noise and vibrations	Noise and vibrations	Noise level and vibrations	At reservoirs and water tanks sites	before and during project works	Contractor/ Cok/ wasac	800US$
Construction phase						
Accidents and incidents	Number of accidents and incidents	Incidents and accidents logbook	Project site	When deemed necessary	Contractor WASAC/ traffic police	Operational Cost
Air Pollution	Equipment and automobiles in good shape	Regular inspection and maintenance	at project site	Daily	Contractor	No cost applicable to monitor.
	Records on water spray at the project site	dust at the project site	project sites	regular and when necessary	Contractor	Operational cost
Noise and vibrations	Noise emissions	Noise level Vibration level	Reservoirs, pipelines and water tanks construction sites	During earth works or concrete vibrations.	Contractor/ WASAC / Cok	under implementation cost
Soil pollution	Oil contamination/ spill over prevention measures	Presence of oil contamination/ spill over prevention measures	project areas	daily	Contractor/ WASAC	Operational Cost
Soil erosion	Soil erosion prevention measures	Use of appropriate size of heavy vehicle Presence of prevention measures	project areas	daily	Contractor/ WASAC	Operational Cost
Soil Waste	Proper management of excavated soil and other waste generated from the project	presence of waste management plan	at project site	regular	Contractor/ WASAC	Under Operational Cost
Work conditions	Occupational health and Safety	Availability at site of OHS Plan	Project sites	Permanent through project activities	Contractor/ WASAC Ltd	Operational Cost
	Awareness meeting on social, health and safety	Number of meetings and trainings/ Induction	Project sites	Daily	Contractor/ WASAC Ltd	Operation cost
	Incidents and accidents at the project site	Presence of warning and	Project site	daily	WASAC/ Contractor/	5000 USD

Environmental items	Monitoring item	Parameter/Indicator to be monitored	Location	Frequency	Responsible	Budget
		signposts at the site				
	Personal Protective Equipment (PPEs)	Number of workers with PPEs	project area	daily	Contractor/ JICA/WASAC Project contractor/ project workers	2000 USD
Traffic congestions	Traffic management Plan and traffic signage	Availability of TMP Number of traffic signage	Project area	daily during project works nearby roads	Contractor/ WASAC/ traffic Police	Operational Cost
HIV/ AIDS and other transmitted diseases	Health and sanitation for labor workers	presence of sanitation facilities and diseases preventive measures	Project sites	regular	Contractor/ WASAC Ltd	Operational Cost
Child and forced labour	Minimum working age and working condition	Employment record by age	Construction areas	regular	Contractor /Local authorities/ project workers	no cost required
Disruption of public utilities especially water supply networks, electrical network, and traffic etc	Water, electricity, traffic etc	Duration of Disruption due to construction	Project area	Regular	Contractor/ WASAC Ltd	Operational Cost
Social impacts	Job opportunity, implementation of mitigation measures	Opinions of village leaders based on the observations	Project area	monthly	Contractor/ WASAC Ltd	Operational Cost
Operational Phase						
Water losses	Water leakage	Infrastructures damages	Operation	Regular	WASAC Ltd/ water users	500

3. EMP implementation arrangements

3.1 Overall implementation responsibility

The overall responsibility of implementation of this EMP is under Contractor and Water and Sanitation Corporation (WASAC Ltd). WASAC Ltd will designate a staff in charge of Environmental and Social safeguard who will be responsible for addressing environmental and social issues on a routine basis. The staff will have an oversight of environmental aspects of the construction contracts, including the enforcement of all monitoring provisions, etc. The project Contractor will also have an Environmental Health and Safety Manager to oversee the implementation of project during construction. The main duties of the designated Environmental and social officers will include but not limited to:

- Have an insight on the designs and ensure they adhere to the environmental and social specifications and the requirements of the Environmental and Social Management Plan (EMP).
- Co-ordinate and liaise with government institutions on environmental and social issues and obtaining the necessary clearances from the regulatory authorities.
- Collect and dissemination of relevant environmental documents
- Monitor the environmental and social aspects especially during construction phase to ensure that the environmental requirements of the contract and the mitigation measures proposed in this ESMP are implemented.

3.2 Environmental and social awareness campaigns

The awareness campaigns will cover health and safety, traffic management, measurement techniques in the field, tools for the prediction of pollutants, waste management, etc. various competent authorities may be consulted for such campaigns. The need for additional and specialized campaign shall be examined and appropriate training will be undertaken as required. Training of personnel to be deployed on the proposed project during construction and operation, about environmental requirements should be an integral part of the planning. In addition, all employees will be trained on safety, HIV/AIDS prevention, methods of disaster prevention, action required in case of emergency, fire protection, environmental risk analysis etc.

3.3 Monitoring and reporting procedures

During the project implementation WASAC will designate an EHS officer who will visually assess contractor's practices and if high pollutant levels are suspected instruct the contractor to make corrections. Photographic records will be established to provide useful environmental monitoring tools. A full record will be kept as part of normal contract monitoring. All applicable regulations need to be enforced by the Project Manager and designated EHS manager. The regular monitoring of noise and dust will also be carried out as provided in the environmental monitoring program. It is the mandate for the contractor to use the materials which meet the standards being in civil construction works, the machinery to be used or the pipe to be installed

3.4 Record keeping

Monitoring reports should be documented and recorded. The focus shall be done on issues that are environmental and social harmful and provide feedback for the future stages of the work. Daily project diaries would record environmental problems (spills, dust, noise, etc.) as well as safety incidents and will be retained as part of accepted modern contract management and summarized in monthly and Quarterly Environmental and social safeguard Reports.

3.5 Implementation schedule

The most important aspect of the implementation is the appointment of the Environmental Officer at WASAC level and at Contractor level to oversee the implementation of the environmental mitigation measures incorporated in the design and contract specifications. Most of the planned mitigation measure will be implemented along with project activities and is provided in Environmental Management Plan and Environmental Monitoring Plan.

Annex 10 Abbreviated Resettlement Action Plan

WASAC
Water & Sanitation Corporation

JICA
Japan International CooperationAgency

FINAL REPORT

ABBREVIATED RESETTLEMENT ACTION PLAN FOR PROJECT OF IMPROVEMENT OF WATER SUPPLY SERVICES IN NORTH-CENTRAL KIGALI, REPUBLIC OFRWANDA

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EXECUTIVE SUMMARY

Project background

Water and Sanitation Corporation (WASAC Ltd) with the support from Government of Japan through Japan International Cooperation Agency (JICA) have achieved a series of actions in water supply sector. This includes the formulation of the Kigali Water Supply Master Plan (KWSMP) for efficient and effective facility development from a long-term perspective, the renewal of water transmission pipelines for the purpose of strengthening transmission capacity from the city's largest Nzove WTP to the Ntora Reservoir and technical cooperation for non-revenue water (NRW) reduction, as well as.

One of the projects under KWSMP is the development and renewal of water transmission and distribution facilities in the section between the Ntora Reservoir and the Remera Golf 8 Reservoir. NRW reduction measurement in the entire city of Kigali is planned under a long-term investment plan with 4 phases during the next 10 years and the project contributes to the first phase of NRW reduction and will be implemented in Kigali city, district of Gasabo, Gisozi Sector (Musezero and Ruhango cells); in Kinyinya Sector (Gacuriro and Kagugu Cells) and in Remera Sector (Nyarutarama and Nyabisindu cells.

Objectives of the A-RAP

The objective of the A-RAP is to ensure immediate and fair compensation or other supports to Project Affected Persons (PAPs) for their affected properties at the project sites prior to project implementation. The present report principally describes the proposed project components/activities and associated resettlement impacts. The A-RAP also provides the legal and regulatory framework for assets valuation, eligibility, compensation framework, implementation, and monitoring arrangement.

Approach and methodology of the study

To achieve the objectives, consultant followed procedures stipulated in JICA guidelines for environmental and social consideration and national expropriation and evaluations laws. The study adopted the following approach: (i) preliminary assessment and review of preliminary design of the projects, (ii) review of secondary data on baseline information (iii) review of policies and regulations, (iv) meetings and consultations with stakeholders, (v) field surveys at the project sites including socio-economic baseline data and asset inventory of the affected personnel.

Project location and description

The proposed project will be implemented in Kigali City, Gasabo district, Gisozi sector (Musezero and Ruhango cells); and Kinyinya sector (Gacuriro and Kagugu cells). The project also has a section of Nyarutarama – Golf 8 Reservoir located in Remera Sector (Nyarutarama and Nyabisindu cells). The project consists at construction of grounded water reservoirs (Kagugu and Batsinda sites) and elevated tanks at Nyarutarama and Kibagabaga sites as well as constructions of 5 pressures breaking chambers. It also includes construction of water transmission and distribution pipelines of around 57 km (with dimension varying between ND 160-300); modification of the existing transmission main from Ntora reservoir (ND 400 and ND 500) and the installation of flowmeters, level gauges and monitoring system.

Project Resettlement Impacts

The proposed project is not expected to involve massive land acquisition as new pipeline will be installed in road reserve where existing pipeline are installed. Further, three of four sites targeted for reservoir constructions are either owned by public institutions or WASAC. So far, only one private plot will be affected at Batsinda reservoir. The identified personnel to be affected by project activities is in Gasabo district, Kinyinya Sector, Kagugu Cell, Nyakabungo Village in UPI 1/02/10/03/11112. The land to be affected is currently used as agricultural despite being zoned for residential. The project will be mostly implemented

along the walkways and in the buffer of the existing roads (both tarmac and non-tarmac depending of the area). No access roads shall be constructed and there will be no construction of camp site as most of the project workers will return to their home after work. Project facilities will be constructed at the existing nearby water tanks where land belongs to WASAC, project developer. Where not applicable land lease agreement was discussed and concluded between landowner and WASAC.

A-RAP budget

The proposed project was designed in a way that avoids or minimizes physical and economic resettlement impacts. The water pipelines are located along the walkways and in the buffer of the existing roads (both tarmac and non-tarmac depending on the area) and other project facilities will be constructed at the existing nearby water tanks where the required land is owned by WASAC, project developer. Only one location at Batsinda was identified to be affected. There is no house or other structure within the plot except some crops and different tree species. The affected land will be lost permanently because It will be used for grounded water tank. According to the current market value, the estimated valued cost for compensation of the affected person is 69,346,027Frw equivalent to 67,108 USD this budget includes land value and the estimated cost value of crops and trees and will be born from government of Rwanda funds via WASAC Ltd. The monitoring fees are estimated at 770,000frw.

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ACRONYMS

A-RAP	: Abbreviated Resettlement Action Plan
BESST	: Bureau for Engineering and Environmental Studies
DDP	: District Development Plan
EIA	: **Environmental Impact Assessment**
FRW	: Franc Rwandais/Rwandan Franc
GDP	: Gross Domestic Product
GoR	: Government of Rwanda
JICA	: Japan International Cooperation Agency
M&E	: Monitoring and Evaluation
MoE	: Ministry of Environment
NGO	: Non-Governmental Organization
OP	: Operational Policy
PAPs	: Project Affected Parties/People
REMA	: Rwanda Environment Management Authority
RLMUA	: Rwanda Land management and Use Authority
RPF	: Resettlement Policy Framework
ToRs	: Terms of Reference
UPI	: Unique Personnel Identification
USD	: United States Dollars
WB	: World Bank
WASAC	: Water and Sanitation Corporation

DEFINITIONS OF TERMS

- **Census** is a data collection technique of completing enumeration of Project Affected Householdsand their assets through household questionnaire.
- **Compensation:** means payment in cash or in kind to replace losses of land, housing, income, and other assets caused by a project.
- **Cut-off date:** This refers to the date prior to which the project affected family was in possession ofthe immovable or movable property within the affected zone.
- **Entitlement:** is defined as the right of project affected persons (PAPs) to receive various types of compensation, relocation assistance, and support for income restoration in accordance with the policy provisions.
- **Household** includes a person, his' or her spouse, minor sons, unmarried daughters, minor brothers, unmarried sisters, father, mother and other relatives residing with him or her and dependent on him or her for their livelihood; and includes "nuclear family" consisting of a person, his or her spouse and minor children.
- "**Involuntary Displacement**" means the involuntary taking of land resulting in direct or indirect economic and social impacts caused by:
    - loss of benefits from use of such land;
    - relocation or loss of shelter;
    - loss of assets or access to assets; or
    - loss of income sources or means of livelihood, whether or not the project affectedperson has moved to another location
- **Land acquisition"** means the taking of or alienation of land, buildings or other assets thereon the land,
- **Loss of income**: In this A-RAP, loss of income is defined as the future benefit that was going to begained if the project was not implemented.
- Non-titleholder: Affected persons/families with no legal title to the land, structures and other assets adversely affected by the project. Non-titleholders include encroachers, squatters, etc.
- **Project affected persons (PAPs)** means persons who, for reasons of the involuntary taking or voluntary contribution of their land and other assets under the project, result in direct economic andor social adverse impacts, regardless of whether or not Project affected persons physically relocate.These people may have their:
    - Standard of living adversely affected, whether or not the Project Affected Person must move to another location;
    - Right, title, interest in any house, land (including premises, agricultural and grazing land) or any other fixed or movable asset acquired or possessed, temporarily or permanently, adversely affected;
    - Business, occupation, work or place of residence or habitat adversely affected.
- **Resettlement and Compensation Plan**, also known as a "Resettlement Action Plan (A-RAP)" or "Resettlement Plan" - is a resettlement instrument (document) to be prepared when subproject locations are identified. In such cases, land acquisition leads to physical displacement of persons, and/or loss of shelter, and /or loss of livelihoods and/or loss, denial or restriction of access to economic resources. When the projects affects lees than 200 households or the has low impacts, anAbbreviated Resettlement Action(A-RAP) may be appropriate;
- **Resettlement Assistance** means the measures to ensure that project affected persons who may require to be physically relocated are provided with assistance such as moving allowances, residential housing or rentals whichever is feasible and as required, for ease of resettlement during relocation,
- **Replacement cost/value**: Replacement cost is the cost of purchasing comparable assets elsewhere by the affected person in lieu of the acquired land, buildings, structures, and other immovable assets, etc.

- **Socio-economic survey**: is carried out in order to prepare profile of PAPs and to prepare for Resettlement Action Plan. The survey result is used (i) to assess incomes, identify productive activities, and plan for income restoration, (ii) to develop relocation options where applicable, and (iii) to develop social preparation phase for vulnerable groups.
- **Titleholder**: A PAP who has legal title to land, structures and other assets in the affected zone and theland has a unique personnel Identification;
- "**Vulnerable Groups**" refers to: a. Widows, the disabled, marginalized groups, b. Incapacitated households – those no one fit to work, Child- headed households and street children, old people,

1. INTRODUCTION

1.1. Project background

Government of Rwanda has made sustainable water supply one of the priorities of the National Development Agenda and is establishing supportive policies and legislation. The government also acknowledges that access to safe and clean water plays a vital role in social and economic development, poverty reduction and public health. The main objective of water supply and sanitation policy is to ensure safe, reliable, and affordable water supply services for all 100% by 2024 thereby ensuring universal and equitable access to safe and affordable drinking water for the people while achieving NST-1 along with Sustainable Development Goals (SDGs). In this regards, the Government of Rwanda with the support from Government of Japan through Japan International Cooperation Agency (JICA) have achieved a series of actions in water supply sectors which include the renewal of water transmission pipelines for the purpose of strengthening transmission capacity from the city's largest Nzove WTP to the Ntora Reservoir, technical cooperation for non-revenue water (NRW) reduction, as well as the formulation of the Kigali Water Supply Master Plan (KWSMP) for efficient and effective facility development from a long-term perspective.

One of the priority projects identified under KWSMP selected the development and renewal of water transmission and distribution facilities in the section between the Ntora Reservoir and the Remera Golf 8 Reservoir. NRW reduction measurement in the entire city of Kigali is planned under a long-term investment plan with 4 phases during the next 10 years and the present project contributes to the first phase of NRW reduction and will be implemented in Kigali city, district of Gasabo, Gisozi, Kinyinya and in Remera Sectors. The implementation of the present project will be conducted via accomplishment of a series of activities to be done which include but not limited to the construction of water storages and water transmission and distribution facilities such as water reservoirs and water tanks, water pipelines and equipment required for block systems.

Four (4) water reservoirs are planned to be constructed or extended during this project at (i) Kagugu (Elevated Tank (500 $m^{3)}$ (ii) Batsinda: (Ground Reservoir, 1,000 m^3) (iii) Gacuriro: (Elevated Tank, 500 $m^{3)}$ and at (iv) Nyarutarama: (Elevated Tank, 200 m^3).

1.2. Scope of the A-RAP

The aim of the A-RAP report is to develop an action plan that ensures that the PAP livelihoods and standards of living are improved or at least restored, in real terms, to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher. The scope ofwork undertaken during the RAP preparation included public consultation, PAPs identification, and assets inventory, establishment of legal and regulatory framework for assets valuation and compensation, monitoring, and grievance redress mechanism. The provisional assets inventory and estimated cost was included in the A-RAP but shall be updated by independent valuer upon the completion of final design studies and compensation made prior construction.

1.3. Methodology

The preparation of this A-RAP followed the combination of different steps including desk study, field surveys and involved the consultations with local resident and PAP identification. The desk study involved review of previous study; field surveys and measurement of land and inventory of crops which are likely to be affected. Discussions withPAP and key stakeholders including district administration local authorities were also other tools used along the preparation of this A-RAP.

1.4. Project description

1.4.1. Project Location

Administratively, the proposed project is in Kigali City in Gasabo, Gisozi Sector (Musezero and Ruhango cells) and Kinyinya Sector (Gacuriro and Kagugu Cells). The project also has a section of Nyarutarama – Golf 8 Reservoir located in Remera Sector (Nyarutarama and Nyabisindu cells). The present A-RAP was developed for the site for construction of Batsinda ground water tank located in Gasabo district, Kinyinya Sector, Kagugu Cell, Nyakabungo Village in UPI 1/02/10/03/11112.

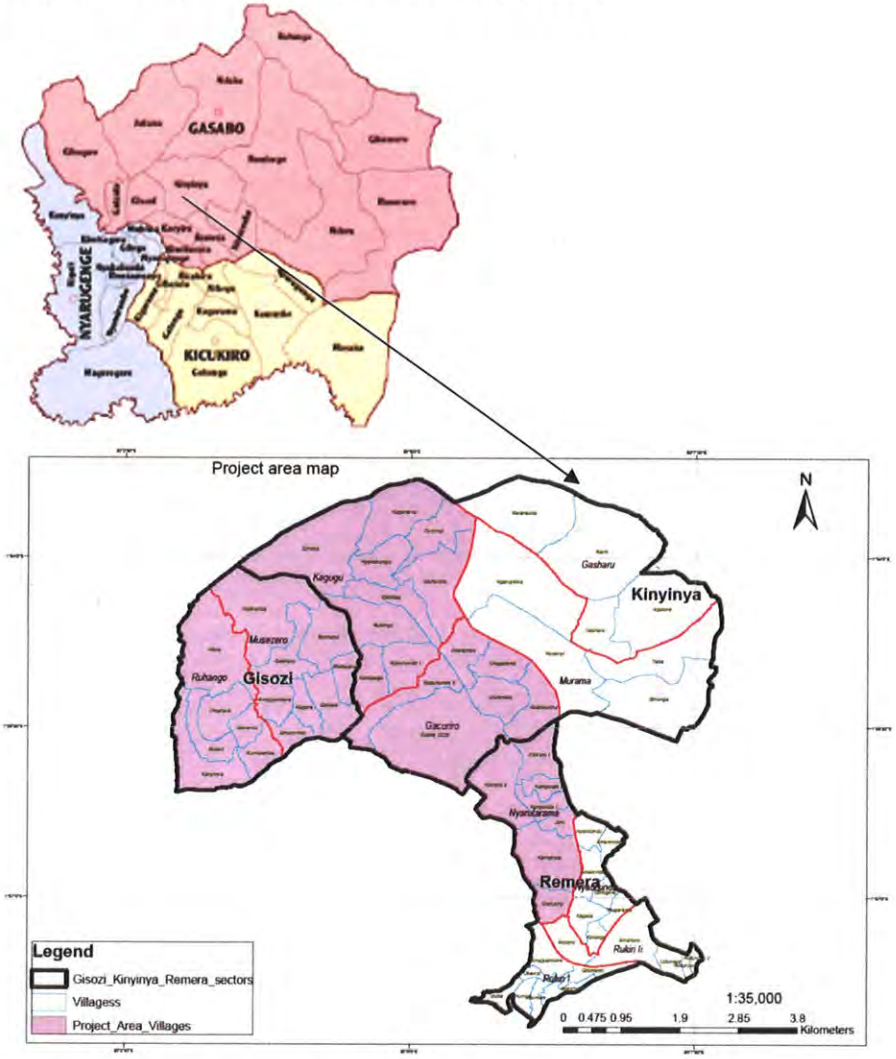


Figure 1: Administrative location of project area
Source: BESST Ltd, 2022

1.4.2. Project description

The proposed project will consist at construction of 5 different water reservoirs and elevated tanks as described in the table below and at the construction of 5 pressures breaking chambers, the construction of water transmission and distribution pipelines of approximately 57 km (dimension varying between ND 160-300); the modification of the existing transmission main from Ntora reservoir (ND 400 and ND 500) and the installation of flow meters, level gauges and monitoring system. There are no access roads that shall be constructed as most efforts have been made to use the buffer zones and walkways for transmission pipes.

Table 1: Summary of the project description

Code	Name	Type and Capacity	Description
N2	Kagugu	Elevated Tank, 500m³	The elevated tank is to supply water to the entire Kagugu hill including the Kadobogo village. The selected land is located along the main road KG14 opposite the church (Catholic Church_ Kagugu Parish).

Code	Name	Type and Capacity	Description
N3	Gacuriro	Elevated Tank, 500m³	The elevated tank is to supply water to the top of Gacuriro hill where the water pressure is not enough by the existing reservoir, and currently supplied water by the by-pass from transmission pipeline.
N4	Batsinda	Ground Reservoir, 1,000m³	The reservoir is to supply water to the new development areas at the Batsinda commercial area and surrounding residential areas with high development (R3). The location is at the top of the village named Muhororo. The land is located near the church (Catholic Church Centrale Batsinda).
N5	Nyarutarama-South	Elevated Tank, 200m³	The elevated tank is to supply water to the top of the southern part of Nyarutarama sector where the water pressure is not enough by the existing reservoir, and currently supplied water by the by-pass from transmission pipeline.

1.4.3. Project activities

Different activities will be done throughout the project implementation and among them include Construction works of elevated water tanks and water reservoirs, replacement of old water transmission and distribution pipes with new pipes and the installation of flow meter as well as the installation of level gauges systems. The construction of new water reservoirs and elevated tanks will be done on some land fully owned by the government of Rwanda and these are Gacuriro and Nyarutarama sites, while others will be done at the land where a full guarantee of land use was concluded between WASAC Ltd/ and landowner (Kagugu sites).

The site for Batsinda is privately owned by MPAGAZEHE Augustin a local resident. The water pipes and other project facilities such as pressure breaking chambers, flow meters and level gauges will be constructed and installed within the walkways of the existing buffer zone of the roads. The total length of the pipes both distribution and transmission to be installed is estimated at 57 km. There are no other planned activities that require land such as construction of access roads, construction of camp site for the project (people will return to their respective resident areas after works) or the necessity of land for storage of construction materials as these will be stored at the identified land at Ntora Reservoirs owned by WASAC Ltd. This Abbreviated Resettlement Action Plan (A-RAP) report was prepared as one of the components of the requirements before project activities as it provides the necessary information on project land requirements and involuntary resettlement implication. It includes socio-economic status the affected PAP, an inventory of assets that are likely to be affected and proposes mitigation and compensation measures. This was only developed at Batsinda plot in Kagugu where a grounded water reservoir of 1,000 m³ will be constructed.

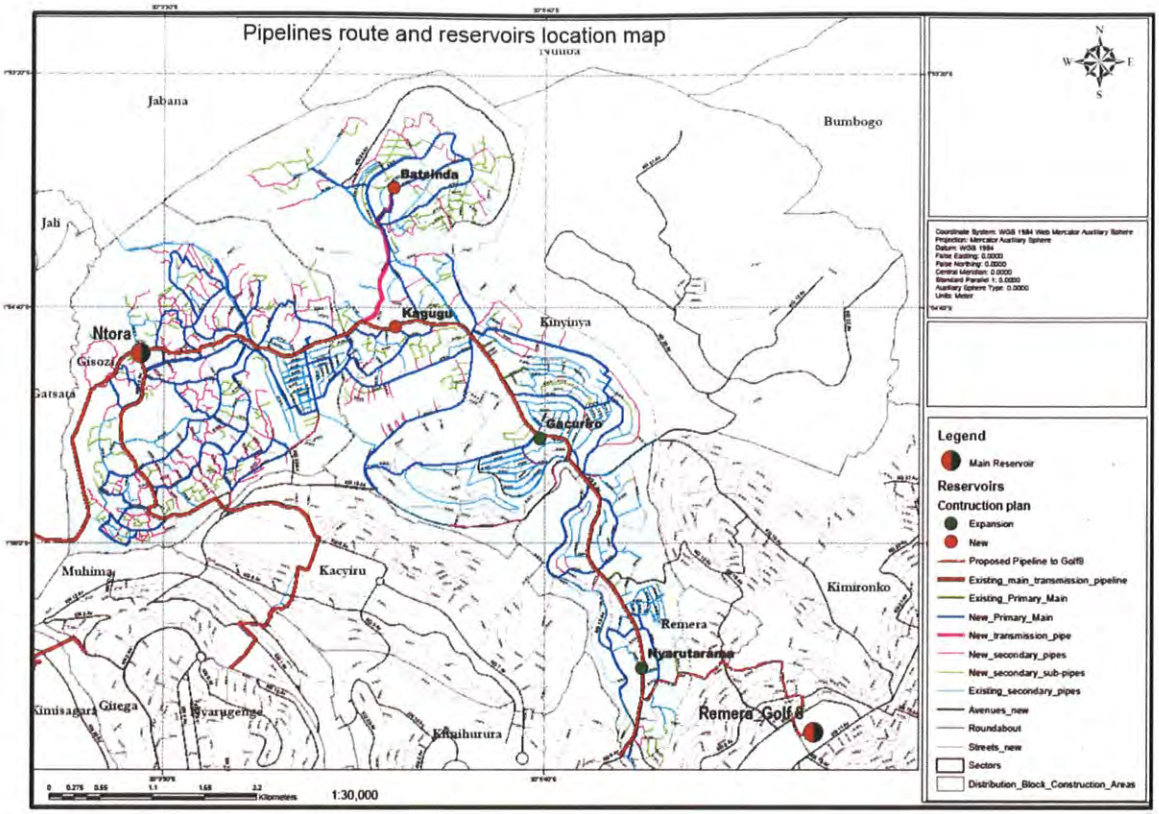


Figure 2: Proposed principal pipeline route and project's reservoir locations
Source: Preliminary design study, 2022

1.4.4. Project land requirement

As described in the previous paragraphs, installation of all principal and secondary water pipes for the project will follow the existing roads both tarmac and earth roads. The pipes will be located under the walkways and in the buffer zones of the roads and hence no land will be permanently used for such pipe installation. The required land not owned by project developer will be used during the project works in form of easement and returns to the owner after project execution. Compensation of land and affected properties will be made at Batsinda where land will be permanently used. The table below summarized the required land for the project

Table 2: Total land to be affected by the proposed project

Sector	Cell	Village	Reservoir/ tank name	Land required (m2)	Ownership
Kinyinya	Kagugu	Nyakabungo	Batsinda	1000	Privately owned by MPAGAZEHE Augustin
	Kagugu	Kabuhunde	Kagugu	450	Owned by RSSB/ Lease agreement available
	Gacuriro	Estate 2020	Gacuriro	750	Fully owned by GoR
Remera	Nyarutarama	Gishushu	Nyarutarama South	750	Fully owned by GoR

Source: Field survey, BESST Ltd, 2022

The following Plate illustrates the sites targeted for reservoirs construction

1.5. Project Schedule

The project schedule includes preliminary works, project approvals and construction work that will be undertaken both in Rwanda and in Japan. The project schedule is provided below:

Table 3: Project construction schedule

Item	Year	2022						2023												2024												2025												2026					
	Month	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6
	Case																																															
Draft Outline Design																																																
Cabinet Meeting (Japan)	-																																															
Exchange of Note (E/N, GtoG)	-																																															
Grant Agreement (G/A, Exe. Agency)	-																																															
Consultant Appoval and Concurrence by JICA	2M																																															
Detailed Designed (D/D)	5M																																															
Tender Assistant (Bid/Contract/Concurrence)	3M																																															
Construction	24M																																															
Preparation and Procurement	3M																																															
Reservoirs and Elevated Tanks	12M																																															
Transmission and Distribution Pipelines	21M																																															
Flow Meter/Monitoring System	3+4M																																															
Replacement of Customer Connections	24M																																															
Soft Components(Management Guidance/Training)	6M																																															

Source: Preliminary design, JST, 2022

2. LEGAL AND INSTITUTIONAL FRAMEWORK

2.1. Introduction

This chapter describes policies, strategies, legal instruments, and institutional framework applicable to the proposed project. This project will not affect structures however; land, crops and trees will be damaged. Much of all trees to be destroyed are owned by the government as are located within road buffers and few are owned by individual. The accessibility to water will enable people to be connected to the water supply system and be able to transform their socio-economic wellbeing. Concerning the ARAP implementation especially inventory and asset valuation, an independent the contractor had the responsibility of conducting inventory and asset valuation and WASAC Ltd via its ordinary budget from MINEFOFIN has the responsibility to compensate the identified PAP.

2.2. National land related regulations

✓ National land policy

The National Land Policy of Rwanda seeks to establish a land tenure system that guarantees tenure security for all Rwandans and give guidance to the necessary land reforms with a view to good management and rational use of national land resources.

The policy seeks to ensure this through the following objectives:

- To promote good allocation of land to enhance rational use of land resources according to their capacity
- To focus on land management towards more viable and sustainable production by choosing reliable and time-tested methods of land development
- To put in place mechanisms which guarantee land tenure security to land users for the promotion of investments in land
- To establish mechanisms which facilitate giving land its productive value to promote the country's socio-economic development
- To develop actions that protects land resources from the various effects of land degradation.
- To promote the involvement and sensitization of the public at all levels to infuse land use practices that are favorable to environmental protection and good land management

✓ Law N° 27/2021 of 10/06/2021 governing land in Rwanda, 2021

The law governing land in Rwanda determines modalities of acquisition, registration, allocation, possession, transfer, management, and use of land in Rwanda. The law defines expropriation as an action based on the powers of the State, public institutions, and decentralized entities with legal personality to remove a person from his or her property due to public interest upon prior payment of fair compensation;

Article 22 related to Consent to transfer land rights says that: "A transfer of land rights, before it is carried out, is consented by all persons registered on the land title. However, the transfer of land rights jointly detained by spouses is approved by both, even if one of the spouses is not registered on the land title. A person who has been deprived of legal capacity by a competent court or a minor are represented in accordance with relevant laws".

Article 31: States that lands in public domain consist of all lands intended to be used by the public or all the lands reserved for organs of State services and national lands reserved for environmental protection. Among the state lands include the national roads and their boundaries that will be used for the project activities.

Article 39 related to the rights to use State lands states that "A public institution or decentralized entities have the right to use the State lands required for accomplishing its mission and responsibilities". Therefore, it is from the land title that it is able to understand category of land use for and also determine who the rightful landowner is, in the process of the asset inventory and compensation.

- ✓ **Organic law n° 32/2015 of 11/06/2015 law relating to expropriation in the public interest**

This law determines the procedures relating to expropriation in the interest of the public. Thelaw stipulates that the government has the authority to carry out expropriation. However the project, atany level, which intends to carry out acts of expropriation in public interest, shall provide funds for inventory of assets of the person to be expropriated. According to the organic law, no person shall hinder the implementation of the program of expropriation on pretext of self-centered justifications and no land owner shall oppose any underground or surface activity carried out on his or her land withan aim of public interest. In case it causes any loss to him or her, he or she shall receive fair compensation for it.

Eligibility for compensation is enshrined under the Rwandan constitution and the expropriation law. The two laws regulate and give entitlement to those affected, whether or not theyhave written customary or formal tenure rights. The person to be expropriated is defined under article2 (8) of the expropriation law to mean any person who is to be removed from his or her private property due to public interest shall be legally entitled to payment of compensation.

Article 3 of the law states that "Only the Government shall order expropriation in the public interest. Expropriation as provided for under this Law shall be carried out only in the public interest and with prior and fair compensation. No person shall hinder the implementation of the program of expropriation in the public interest on pretext of self-centered interests. No person shall oppose any underground or surface activity carried out on his/her land with an aim of public interest. In case it causes any loss to him/her, he/she shall receive fair compensation for it.

Article 4 states that "Every project, at any level, which intends to carry out acts of expropriation in the public interest, shall budget for valuation of the property of the person to be expropriated and for fair compensation".The article 6 states that the price or value of assets affected by the project shall be paid by the initiator of the project before any commencement of activities

Article 35 related to payment of fair compensation states that "Fair compensation can be paid in monetary form in the Rwandan currency or in any other form mutually agreed upon by the expropriator and the person to be expropriated. In order for the expropriation to be authorized, the fair compensation must be paid to the expropriated person before he/she relocates. The article 36 promulgates that approved fair compensation shall be paid within a period not exceeding one hundred and twenty (120) days from the day of its approval by the district.

- ✓ **Law n°.17/2010 of 2010 establishing and organizing the real property valuation profession in Rwanda**

According to the requirement of this law, the valuation of properties and land to be affected shall be done by an approved property valuer and registered by the Rwandan institute for property valuers. IRPV). Article 4 related to the Requirements to exercise the profession says that "Any person wishing to practice as a real property valuer in Rwanda shall have to be a member of the Institute this law".

Article 26 says that "Only registered valuer members of the Institute shall be authorized to exercise the real property valuation profession in Rwanda. However, Government employees fulfilling requirements of the

Council shall also be authorized to conduct valuation when mandated by their government institutions. The attributed prices to the assets shall be fair and compared to the local market as per the article 28 stating that "The proposed price for the real property shall be close or equal to the market value. The valuer shall compare prices by referring to the prices recently assigned to a real property that is similar or comparable to the real property subject to valuation.

2.3.International regulations

2.3.1. JICA Guidelines for Environmental and Social Considerations

The project of improvement of Water Supply Services in North Central Kigali will be funded by Japan Government through Japan International Cooperation Agency (JICA) and it is very important to consider the JICAguidelines for environmental and social consideration in preparation and implementation of the A-RAP.

The key principle of JICA's policy on involuntary resettlement is summarized below:

- Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives.
- When population displacement is unavoidable, effective measures to minimize the impact and to compensate for losses should be taken.
- People who must be resettled involuntarily and people whose means of livelihood will be hinderedor lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels.\
- Compensation must be based on the full replacement cost as much as possible.
- Compensation and other kinds of assistance must be provided prior to displacement.
- For projects that entail large-scale involuntary resettlement, A-RAPs must be prepared and made available to the public. It is desirable that the A-RAP include elements laid out in the WB, OP 4.12Annex A.

2.3.2. World Bank O.P. 4.12 on involuntary resettlement policy

The WB involuntary resettlement related policies are also critical in preparation and implementation of this A-RAP. The main objectives of the WB O.P. 4.12 include: avoiding or minimizing involuntary resettlement where feasible, exploring all viable alternative project design; where it is not feasible to avoid resettlement. Resettlement activities should be conceived and executed as sustainable development programs, providing sufficient investment resources to give the persons displaced by the project the opportunity to share in project benefits.

Displaced persons should be meaningfully consulted and have opportunities to participate in planning and implementing resettlement programs. Those displaced persons should be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them, in real terms, to pre- displacement levels or to levels prevailing prior to beginning of project implementation, whichever is higher. Specifically, the production systems of a community are safeguarded to the extent that guarantees their livelihoods and that their skills base remain relevant regardless of the resettlement site. The policy objectives are also designed to minimize kinship group dislocation that might subject the affected persons to unfair competition when mutual help is diminished or lost. The project consultant met the objective of the WB OP 4.12, by conducting public participation in the project area; evaluating project alternatives to enable minimize involuntary resettlement and developed an entitlement matrix to guide in calculation of resettlement and replacement costs.

Table 4: Gap between Rwandan laws and JICA guidelines for environmental and social considerations

JICA Guidelines	Rwandan regulation	Gaps	Comment
[Avoidance of involuntary resettlement] Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives.	▪ The national laws on environment and EIA guidelines require the developer to examine project alternatives but not mention avoidance or minimization of involuntary resettlement.	The national laws and regulations only require the provision of compensation.	JICA guidelines shall apply
[Mitigation measures for displacement] When population displacement is unavoidable, effective measures to minimize impact and to compensate for losses should be taken.	▪ Resettlement is only acceptable for public interest. Affected persons are fully informed of expropriation issues. ▪ Laws relating to expropriation define valuation of land and assets for the fair compensation, but loss of income is not covered.	Loss of means of livelihoods is not captured in the expropriation law	JICA guidelines shall apply
[Securing livelihood and assistance] People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels.	▪ Laws relating to expropriation define valuation of land and assets for the fair compensation	The laws relating to expropriation do not mention loss of income and compensation for illegal occupants.	Priority for job of construction work will be considered for those who will lose a part of income sources
[Valuation based on replacement cost] Compensation must be based on the full replacement cost as much as possible.	▪ Compensation shall be calculated based on their size, nature and location and the prevailing market rates. ▪ The compensation for disruption caused by expropriation to be paid to the expropriated person shall be equivalent to five percent (5%) of the total value of his/her property expropriated.	The Rwanda Expropriation law does not mention the full replacement cost. The valuation law recognizes replacement cost as valuation methods. what is not covered is full replacement cost (this includes administrative cost, additional cost due to relocation etc)	Compensation based on the market value such as materials and labor cost without depreciation, and disturbance allowances as 5% of market value were used. The proposed price for the real property will be made close or equal to replacement value, referring to the recent data of the transaction in land. Transaction tax and commission fee shall be added as compensation.
[Compensation prior to displacement] Compensation and other kinds of assistance must be provided prior to displacement.	▪ The Article 36 of the Expropriation law (2015) states that approved fair compensation shall be paid within a period not exceeding one hundred and twenty (120) days from the day of its approval.	JICA Guideline does not specify the period of payment and assistance.	Compensation and other kinds of assistance must be provided prior to displacement
Development and disclosure of RAP: For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public.	▪ Article 10 of expropriation law requires the project developer to submit documents, which contain such information as the outline, environmental and socio-economic impact, and concerned people's understanding of the project, along with the application	The Rwandan laws do not stipulate the RAP. Only expropriation report is required. However, donor agencies in general recommend preparing for RAP.	This ARAP was prepared in this regard.
Holding public consultation meetings: In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance.	▪ The Law 48/2018 of 13/08/2018 on environment requires public hearings and consultation during Environmental studies. ▪ The article 11 of the expropriation law requires that the relevant	Both JICA and Rwandan law require consultation with affected people with enough	For the preparation of the EIA report and ARAP, consultation meetings were organized, and sufficient information was provided in the local

JICA Guidelines	Rwandan regulation	Gaps	Comment
Use of local language: When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people.	committee in charge of monitoring projects of expropriation in the public interest shall consider the relevance of the project within a period not exceeding thirty (30) days after receiving the request for expropriation and shall conduct a consultative meeting with the population living where the land is located concerning the relevance of the project of expropriation in the public interest. The committee shall inform them about the date, time and venue of that meeting.	information	language
Promoting public involvement: Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans.	▪ Under the expropriation law, the relevant committee in charge of monitoring projects of expropriation shall conduct a consultative meeting with the affected population.	Under the expropriation law, consultative meeting shall be conducted; however, not promoted in the beginning stage.	Consultation meetings were organized in the planning process for EIA and A-RAP preparation.
Establishing grievance redness mechanism: Appropriate and accessible grievance mechanisms must be established for the affected people and their communities.	▪ The expropriation law provides for rights of persons to be expropriated and stipulates the process for redress of problems with expropriation decision by the affected persons (Article 18, 19, 20 of Section 3) ▪ Article 18 also guarantees the right for appeal and provides for the mechanism for appeal for any person affected by the decision on expropriation in the public interest. Any person to be expropriated who is not satisfied with the assessed land and property value shall indicate in writing grounds for his/her dissatisfaction with the valuation report. (Article 33 and 34)	No gap	For this case no grievance committees are required. Amicable settlement in case of grievance shall eb applied and local authorities shall be mediators for both parties.
[Identifying eligibility] Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advantage of such benefits. (WB OP 4.12 Para. 6)	▪ The Rwandan expropriation law requires the census and asset inventory survey. ▪ The District or City of Kigali administration or the relevant Ministry must inform the persons to be expropriated in the public interest of the expected start date of measurement of land and inventory of property	The social assessment is part of Environmental Impact assessment, but the expropriation law does not require social assessment.	Census survey was done upon identification of the necessity of resettlement and/or land acquisition under the preparatory survey, and to be updated by final valuation stage. Socio-economic survey was also conducted under the preparatory survey, and to be updated by final valuation stage.
[Eligibility requirements] Eligibility of benefits includes the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying. (WB OP	▪ Under the Rwanda Expropriation law compensation is limited only those with land titles and documentary evidence that he/she is the owner of property incorporated on land. He/she shall also provide a civil status certificate and a document evidencing his/her chosen matrimonial regime in case of a	The World Bank OP4.12 policy is much broader and includes both legal and illegal occupants of the land.	There would be no PAPs without formal legal right in this project.

JICA Guidelines	Rwandan regulation	Gaps	Comment
4.12 Para. 15)	married person.		
[Land-to-land Compensation] Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based. (WB OP 4.12 Para. 11)	▪ Under the expropriation law, fair compensation can be paid in monetary form in the Rwandan currency or in any other form mutually agreed upon by the expropriator and the person to be expropriated. (Article 35 of Section 2)	The Rwanda Expropriation law confirms Land for land compensation.	In Kigali, where land is a limited resource, it is very difficult to implement land for land compensation; therefore, compensation will be paid in cash.
[Assistance during transition] Provide support for the transition period (between displacement and livelihood restoration). (WB OP 4. 12, para.6)	▪ There are no explicit support for transition period and livelihood restoration	There are no explicit supports for transition period and livelihood restoration.	No transition period is required as per PAP is not residing at the affected land.

Source: WB OP 4. 12, JICA guidelines and National regulations on expropriation and lands

2.4. Institutional arrangement for A-RAP preparation and implementation

In Rwanda, there is no specific institution governing resettlement activities and social impact are assessed and managed through EIA process and different institutions shares responsibilities in terms of land acquisition and land transfer. In any case the project implementing agency is the responsible institution and should work with other stakeholders and affected people to ensure that land is acquired in compliance with existing regulations. For this project, WASAC Ltd is the lead institution in implementing this ARAP but will be supported by other institutions. WASAC Ltd is the implementing entity for the construction of pipelines but also is responsible for land acquisition. For this reason, WASAC ltd is responsible for the preparation and implementation of this A-RAP and will be responsible for securing funds from Central Government (MINECOFIN) to meet compensation and ensuring that the PAP receives adequate compensation before project implementation. The summary of institutions responsibilities is provided in the table below:

Table 5: Institution arrangement for A-RAP implementation

Organization	Responsibility
WASAC Ltd	✓ Designate a social safeguard specialist who will be the focal point for A-RAPs implementation and will liaise with other stakeholders. ✓ Initiate the expropriation process and compensation requirements; ✓ Preparation and signature of compensation grant agreement with the district; ✓ Ensure funds are allocated appropriately, according to A-RAP; ✓ Prepare the A-RAP closure report and file all documentation related to A-RAP implementation; ✓ Hire independent assets valuer upon the completion of final detailed design study.
Rwanda Land Management and Use Authority	✓ RLMUA through its department of land administration and mapping is the organ responsible for overall management and coordination of all activities related to land administration, land use planning and management in Rwanda. The role of RLMUA role in RAP process is to advise on matters related to land ownership and expropriation. ✓ RLMUA will be also responsible for land transfer and registration after compensation is fairly done and conclude
Gasabo District	✓ Ensure that all procedures related to property valuation and fair compensation have been adhered to and that there is consistency in approach used ✓ Review and approve by signing all documentation related to compensation such as valuation form. ✓ Responsible for monitoring of valuation and fair compensation to the PAP ✓ Monitoring and follow up of the RAP implementation; ✓ Resolution of grievance if any is raised
Local authorities (Village, cell, and Sector)	✓ Review and sign off of all documentation (e.g. completed expropriation form); related to the compensation and that indicates their affected assets for payment ✓ Participation in the different consultation meetings ✓ Participate in the valuation activities for affected assets; ✓ Sign and approve the individual PAPs list;

	✓ Following up and participate in resolving issues that may be raised
Rwanda Institute of Property Valuers	✓ Set up reference prices ✓ Approval of independent valuers ✓ Supervise assets valuation activities
Project Affected Person (PAP)	✓ The primary role of the PAP during the process of property census/measuring land and assessing property thereon is to be physically present and ascertain that indeed the measurements are correct and to his satisfaction. Upon being adequately satisfied with the measurements, his signature will be given as proof of approval. ✓ Be present when the land survey and inventory is being carried out ✓ Provides all required necessary information in regard to compensation activities.

3. SOCIO-ECONOMIC STATUS OF THE AFFECTED PERSON AND CONSULTATION

3.1. Introduction

This section describes the current situation of the PAP to be affected by the project and provides the baseline socio-economic status that will be used to measure the project impact on him. The information presented has been collected through socio-economicsurvey conducted to the person owning the land for the site for construction of Batsinda grounded water reservoirs.

Considering the project nature and extent whereby installation of all principal and secondary water pipes will follow the existing roads both tarmac and earth roads and where the pipes will be located under the walkways and in the buffer zones of the roads, no land for the pipelines will be permanently used for by the project. The affected properties in those buffer zones are also the government trees and these do not require the compensation. However, they will be re-planted after project activities. The required land not owned by project developer will be used during the project works in form of easement and returns to the owner after project execution. Compensation of land and affected properties will be made at Batsinda where land will be permanently used. Hence only one (1) PAP has been identified as project affected person.

3.2. Data collection and analysis

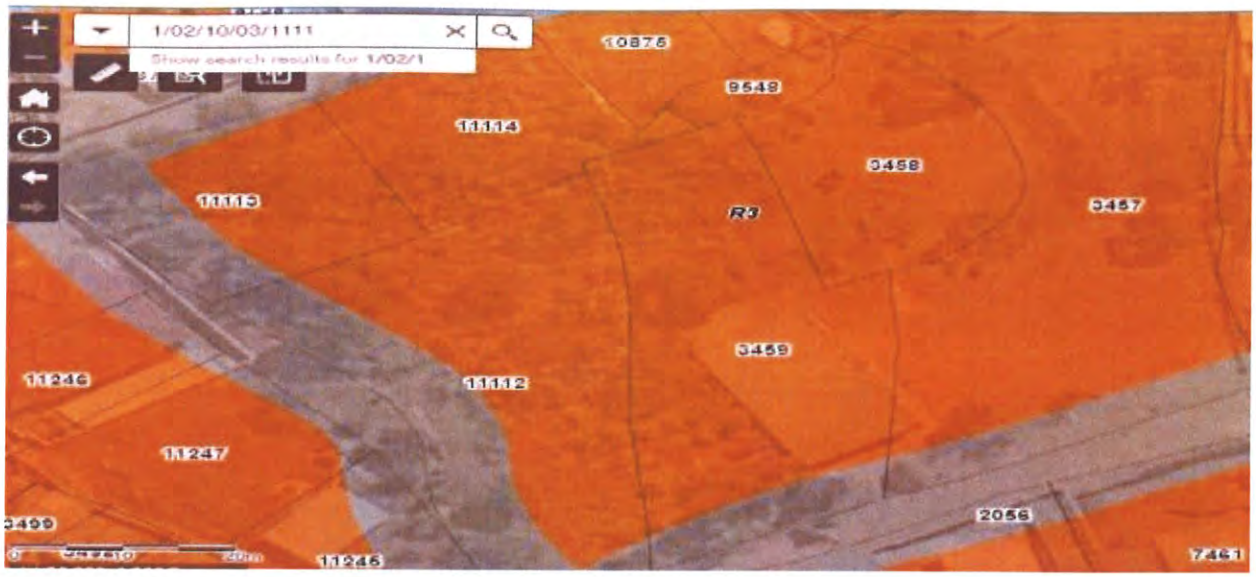
Data collection on the PAP was done using a predefined of questionnaire that was filled at the project site together with the PAP and two of his two (2) sons. Responses obtained from field survey were interpreted and used in this A-RAP.

3.2.1. Characteristics of PAP

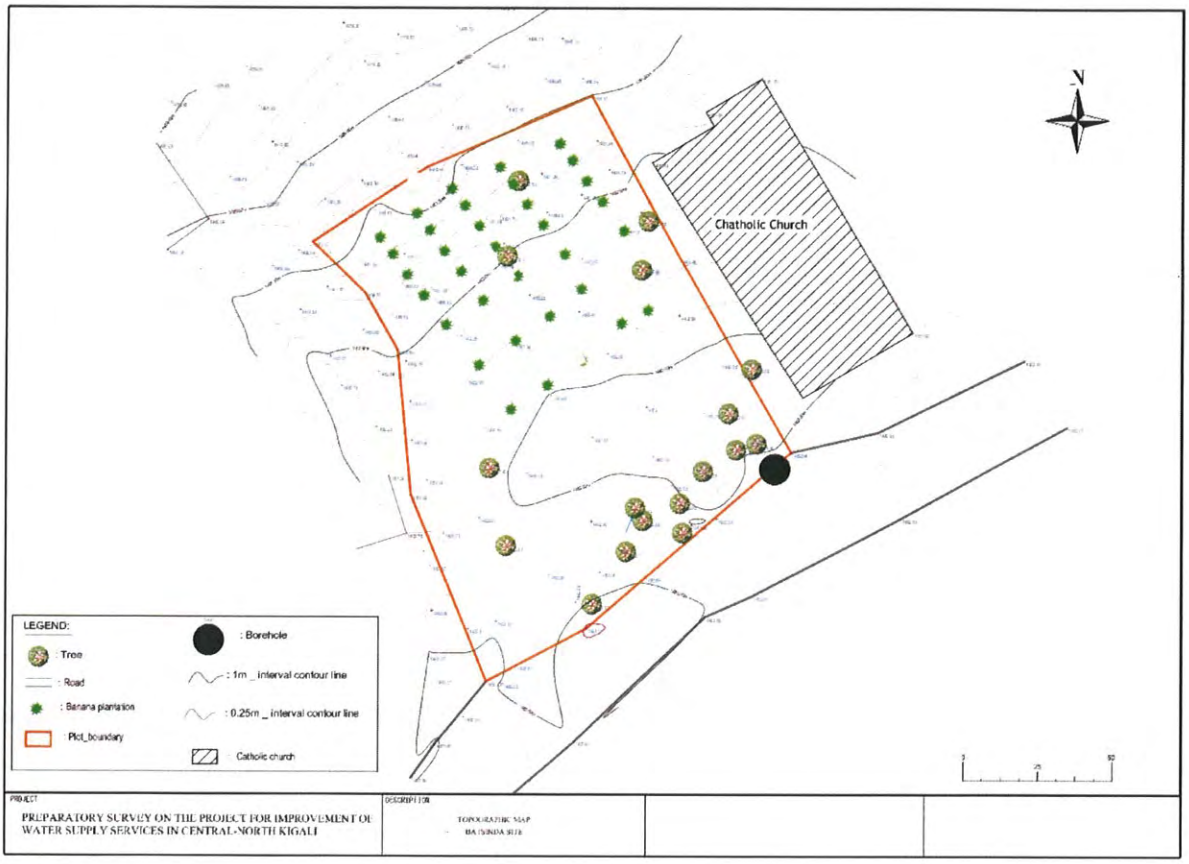
The affected person is MPAGAZEHE Augustin, born in 1950(72 years). He is a widow and head of the family. He resides in Nyakabungo Village, Kagugu Cell, Kinyinya Sector, Gasabo district with ID number 1195080001367182. Due to his his age, Augustin has no temporarily or permanent job. He lives for daily substances form agricultural activities and from support of his children. He has no permanent disability. According to him on monthly basis, he gains almost 50,000 Frw from his agricultural activities outside the project area.

3.2.2. Characteristics of the affected plot

The affected plot is register under UPI: 1/02/10/03/11112 and is in Nyakabungo Village, Kagugu Cell, Kinyinya Sector, Gasabo district. The total area of the plot is 1308 sqm while the required land for the project activities is approximately 1000m2. The land has the land tiles and is designed for residential by Kigali city land use master plan. However, there is not any house within the plot. The expiration date of the freehold title is 8-03-2040. It worth to not that during site visits and review of ownership documents, inconsistencies were observed in terms of plot area as well as the shape of the plot. This has to be well checked during the final valuation. As it can be seen on the following map there a portion of surveyed area which is not part of the plot. According to the owner the error is being rectified and for the moment we considered the area included on the land title with 1308m2. This should be rectified before purchasing the land.



Plot shape



Surveyed area

3.2.3. Affected properties

The affected trees located at the project site as per the date of site survey are summarized in the table below:

The targeted land is planned for residential use but currently is being used for agriculture purposes as it can be seen on these photos.

Key crops properties inventoried are presented in the next table.

Table 6: Affected asset at the project site

No	Names	Local name	Unit	Quantity	Unit price	Estimated cost
1	Land	Ubutaka	sqm	1308	64,246	66,224,777
2	*Persea gratissima*	Avoka	number	46	20,000	920,000
3	*Phaselolus vulgaris*	Ibishyimbo	sqm	1000	150	150,000
4	*Zea mays*	Ibigori	sqm	1000	150	150,000
5	*Colocasia esculenta*	Amateke	number	45	250	11,250
6	*Manihot esculenta*	Imyumbati	sqm	1000	400	400,000
7	*Musa spp.*	Insina	number	102	5,000	510,000
8	*Markhamia lutea*	Umusave	number	41	10,000	410,000
9	*Mangifera indica*	Imyembe	number	3	10,000	30,000
10	*Eucalyptus sp.*	Inturusu	number	33	6,500	214,500
11	*Grevillea robusta*	Gerevelia	number	1	5,500	5,500
12	Euphorbia candelabrum	Umuduha	number	1	10,000	10,000
13	Tetradenia riparia	Imiravumba	number	3	20,000	60,000
14	*Euphorbia tirucalli*	Imiyenzi	number	25	1,000	25,000
TOTAL						**69,121,027**

Source: Field survey, 2022

3.3. Stakeholder engagement and consultation

According to the JICA guidelines for environmental and social consideration and national regulations related to land acquisition, affected persons and host communities are supposed to be meaningfully consulted early in the planning process and encouraged to participate in the planning and implementation of the resettlement program. Hence, the first consultation meeting was held on 26th March 2022 between cells and village authorities to discuss issues related to compensation connected to the project.

3.3.1. Consultation with affected Person

While preparing this A-RAP, another discussion with PAP and his sons was held on site on 16th April 2022. Where present Augustin and his sons Theoneste NGABONZIZA and Vedaste NSANZIMANA. The purpose of the meeting was to inform the affected person were informed about project activities, and requirement and options and rights pertaining to the resettlement. After that, the PAP was fully involved in all the processes of the development of this Abbreviated Resettlement Action plan (ARAP). Compensation requirements were discussed, and provisional assets valuation was conducted to be used

as benchmark for the ARAP budgeting. The real asset valuation shall be conducted by the approved property valuer The bale below summarizes issues raised during the consultation meetings with the PAP along with the responses given.

Table 7: Issues of PAP and responses given

Issues	Responses
The project is good as we don't have enough water in our region. Why the project was designed to be carried out in my plot.	The location of the water reservoir was selected based on different technical alternatives. Among them include the best location to allow easy distribution of the supplied water. Your plot has been found being at the best as being on the highest elevated point in Batsinda and taking into consideration that water from the reservoir will be supplied to the rest of the area by gravity. Therefore, the plot has been found to be the best among other reasons it has been selected.
Will the valuation take into consideration of our land as registered on the land document (crops andtrees)	It is envisaged that the valuation of land will take into consideration only the affected land and required for the project. The remaining part of the land will be your property and your will get the land document according after land transfer.
Will all crops and trees be valued during the valuation?	The valuation of the crops and trees will be done with reference to current compensation rates applied in Rwanda and the compensation package is based on the age and type of the crop or tree.
How will I know the amount of money to be compensated?	It is your full right to know the exact amount of the compensation you will get. The entire package of the expropriation form will be displayed to you before signing. It is your right to accept the amount of money before signing.
How will I receive my money?	All payment will be made directly to your personal bank accounts or Saving and Credit Cooperatives (SACCOs) with no intermediaries.
I used to get around 300 kg of beans from this land and every season. Will this also be catered for during the valuation?	Valuation will consider assets on site. However, 5% of the total amount calculated will be added as disturbance allowance.
After valuation of the crops, will I allow to harvest them even though compensated?	Normally compensation id done to the affected crops. In case the valuation is done after you harvested your crops, they will be no compensation. In case this is done, and the onsite works delayed being implemented yet you have been compensated you will be allowed to harvest your crops.

During consultations done through the conduct of this ARAP, it was indicated that all the residents around the project area and the PAP himself and his relatives had a positive attitude towards the proposed project. All people reached a conclusion that this is a developmental and feasible project, and it must be supported by all parties involved. However, the PAP insisted that fair compensation should be conducted taking into consideration the value of land and local market in project area as well to be done in due time without delays in payment process that are mostly observed in such water supply projects.

After the feasibility study, another consultation was organized with affected households to provide more information on land requirement. The meeting was held on July 26th, 2022, and both owner Augustin and his sons Theoneste NGABONZIZA and Vedaste NSANZIMANA attended the meeting. The affected person was informed that the land required for the project implementation is 1000m2 instead of 750m2 as initially communicated. The PAP was also informed that during the final valuation, it will be agreed whether the entire plot will be taken or only the required land will be compensated. This will depend on whether the remaining portion can be used by the owner. In addition to that, the PAP was informed that during the filed survey, it was found that there are discrepancies on both size and shape of the plot. The size on the ground is different from the one on the land tittle and the one recorded on the Kigali Master Plan. The PAP recognizes these discrepancies and indicates that he has initiated the process for correction.

During this meeting, the affected person reiterated his request about fair compensation, timely payment

of agreed amount and compliance with existing regulations. Minutes of this consultation in local language is provided in Annex 2

3.3.2. Consultation with community

Though only one person will be affected, it is critical to inform the larger communities about the project especially those closer to water reservoirs and pipelines. Consultation with larger communities is conducted in tandem with consultation for environmental studies and are mainly held during community work as agreed with local authorities. During the consultations, the restrictions imposed by COVID-19 were respected. In our context, the community works took place on 26th March 2022 and 3 different study teams attended the in 3 different areas Gisozi, Kagugu and Nyabisindu as detailed in table below. Information and comments collected from the public consultations are all summarized in the table below.

Table 8: Questions /Suggestions and responses provided during public consultations

No	Names	Questions/Suggestions	Responses provided by the consultant
Gisozi, Musezero Cell, Gasharu village Saturday, 26th March, 2022			
1	NIBISHAKA Isaac	-Where will the pipelines pass?	-The pipelines will pass where the existing pipes pass especially in the road reserve from Ntora to Gacuriro
2	MMUKANDORLI Chantal	You said that during the project implementation, some of the pipes will be replaced. Will be water shortages during the period of replacement?	The project is designed in a way that there will be np water shortages during project implementation. In case these happen, people will be informed in advance for them to get prepared.
3	MUKAKABERA Seraphine	We have experienced cases where some of our crops have not been compensated by WASAC. Example is made to my crops affected during the recent constructed Ntora – Gasanze pipe. How can you ensure that this project will be implemented differently while the developer is the same?	Maximum efforts are being done to avoid compensation during the project implementation. In case it happens, compensation will be made before project works. Local people are also required to get all required conditions such and land documents, account numbers etc. to get paid. Details to get paid shall be discussed during the valuation process.
4	BAMPORIKI Jean Baptiste	During the previous projects some of the pipelines that were supplying us water were not re-connected and we are still struggling. Will the project do the same mistakes?	Normally the pipes to be installed are not directly supplying water to locals. These are transmissions pipes while connection is done to distribution pipes. It is expected that this project will not cause such impacts to locals.
5	YANGIRIYENEZA Egide	Will be there any compensation to those who will temporally close their businesses such as MTN kiosk owner during the project implementation	So far it is expected that compensation will be made at only damaged assets. Those having movable properties shall be requested to move them in order to pave the way project activities. However, those owning such business shall be allocated jobs during project implementation and bring back their kiosks after project works.
Remera sector, Nyabisindu cell			
1	UWINGABIRE Marianna	When is the implementation of the project expected to start for us to get prepared?	Different studies related to the project studies are going on and the kick of is expected as soon as the studies are finished and approved and the funds available. It is expected that the project will be start during the next fiscal year and this section to be completed within two years
2	KURADUSENGE David	Will the project give job opportunities to local people or	Considering the project nature, local people will be employed and are priorities when allocating

No	Names	Questions/Suggestions	Responses provided by the consultant
		only engineers will be employed by the project	jobs. Both local and non-locals will be employed during project implementation
3	SEZIBERA Issa	ter the construction works especially where pipes will pass, people are they allowed to continue using their land?	ter construction works and pipes laying, landowners will continue to use their land as usual. However no major structures such as fences will be allowed on the pipelines.
4	NDAYISABA Valens	me have assets on the land where probably the project will pass. Will the project compensate them? ,	affected properties will be compensated according to the existing laws related to the compensation in public interests.
Kinyinya Sector, Kagugu Cell, Nyakabungo Village Saturday, 26th March, 2022			
1.	MUGISHA Jean Claude	We would like to know the exact location of the water tanks in this area. Is only one water tanks or the project will build different tanks in our area?	The water tank in Kagugu will be constructed in the plot located near Batsinda Central Catholic Church. Other tanks will be located nearby the exiting tanks in Gacuriro and Nyarutarama except the other new tank to be constructed opposite Kagugu Catholic Parish
2	NIYONZIMA Jean d'Amour	When the maps of the project will be available, it will be better to be displayed at the villages and at open spaces so that different people can have access to the information related to the line route and other project components?	For sure. Maps of the project location will be published to cell/ villages information will be made public to all.
3	NIYONSENGA Jean Bosco	It should be better that WASAC also take part in the project implementation	For sure. The project will not be implemented only by JICA. WASAC ltd is project developer and will definitively be part of the project implementation.
4	NDABARORA Eliezer	Water is currently expensive and is becoming more expensive. WASAC in charge should look on these issues and act accordingly.	The message is taken into consideration and will be forwarded to WASAC for consideration.
5	NYIRABUHORO M. Aimee	When do you think the project should start?	The project has started with detailed design and onsite works are expected to start next fiscal year that will start in June 2022.
6	MURATABIGWI Fidele	Regarding the work to be available for the project will JICA fully own the payment of manpower? How about the compensation of damaged properties?	Payment of local manpower will be done by the contractor who will be doing the implementation. While compensation of damaged properties will be done through Government budget via WASAC Ltd.
7	MASUMBUKO Oscar	Is it possible for WSAC to think about het prepaid system as this was done for electricity?	Message is taken and will be forwarded to WASAC for consideration

Source: Field survey, BESST Ltd, 2022

3.3.3. Consultation with regulatory agencies and local community

In addition to the Project Affected Person and local community, efforts were made to consult and inform regulatory agencies and local authorities about the project, its implications in terms of land acquisition but also roles and responsibilities in resettlement process. Consultation at central and district level consisted at explaining the proposed project, project environmental concern, legal and regulatory

requirements as well as roles and responsibilities of different stakeholders for the abbreviated Resettlement Action Plan. The consultation at central and district level took place during the period of 6th and 18th January 2022 and consulted institutions at central level are summarized and issues discussed are summarized in next table:

Table 9:Outcome consultation at central and local level

Stakeholder	Summary of discussion	Key outcomes
RLMUA	- Land rights and land use for the buffer zone of the roads - Land transfer ad registration after project implementation especially for Batsinda water tank area - Zoning Plan of the project areas	- Land located within the buffer zone of the road is under public land. Therefore, the project will be implemented in consideration with the existing laws related to land use and rights. - It is mandatory that after compensation the expropriated land be register under government properties via WASAC. All procedures required must be fulfilled in order to get the land register. RLMUA will facilitate in this regard by its staff located at Gasabo District. - This project is not compromising the land use plan of the City of Kigali
REMA	- Project activities and environmental pollution. - Potential source of pollution within project area - Impacts of the project implementation on the surrounding environment. - REMA's responsibilities in the project life span	- REMA will play key role in the EMP during all phases of the project. - Impacts compensation measures of the identified impacts would be clearly developed and implemented. However, efforts must be made to refuse and avoid those identified impacts. - Various impacts connected to this project implementation were discussed and are incorporated in this report. - Monitoring is recommended to be undertaken on regular basis to avoid potential environmental pollution.
WASAC Ltd	- Land requirements and land issues - Compensation and expropriation issues - Project's waste generation and management plan	- This project implementation is a necessity to meet the fixed target and existing policies and programs objectives to supply 100% of clan water to all Rwandans by 2024. - The land for the project will be acquired via the existing laws related to the expropriation/ compensation in public interests. Fair compensation will be made, when necessary, - And independent valuer should be hired to conduct final valuation
MoE	- Environmental concerns related to the project implementation - Laws and regulation related to land acquisition	- Mitigation measure to the identified impacts have to be implemented as well as the regular reporting is required. - Project impacts were discussed and are incorporated in this report.
District, Sector and Cell officials	- Land ownership and land issues. - Land required for the project. - Challenges and impacts associated to the project implementation - Compensation of affected properties	- All households in the project areas should be connected and for the residents to benefit from the project implementation. - Other affected properties that land shall be also fairly compensated as required. - Different project positive and negative impacts were discussed and incorporated in this report. - Mitigation measures for the identified impacts were also discussed.

4. PROJECT RESETTLMENT IMPACT AND COMPENSATION PROCESS

The project of Improvement of Water Supply Services in Kigali City was designed in a way that avoids or minimizes resettlement impacts. Some components of the project such as the installation of pipes and associated infrastructures require land. It is good enough that the required land belongs to the government (road buffer zones) and others belonging to private owners will be temporally used as easement and will return to the owners after project construction works. This section assesses the likely impact to occur to the PAP and propose mitigation measures.

4.1. Asset inventory and valuation

Asset valuation was at the project site for the project land requirement. Final valuation will be conducted by a certifiedvaluer and other parties including local authorities and PAP. Through consultation with PAP and its relatives, it was explained the way the valuation would be done. The following are key activities explained, discussed, and agreed on:

- It was suggested by the PAP to measure by tape measure the size of the plot however, as the land has land title with exact surface area, it was agreed that this provided surface of the plot be considered. Considering that the hall plot will not be affected by project activities, it was agreed that tape measure will be used while conducting final evaluation and determining the required area for the project. .This was done in the presence of the PAP and his two sans who follow-up the asset inventory and valuation.
- Crops valuation was done based on the area of coverage, their type in other cases number of standing crops and age.
- Regarding crops, an agreed estimation was done for annual crops since the seasonal crops shall be harvested by the time of project commencement.
- Trees valuation criteria was based on the number of trees, age and type of tree.

The valuation form shall be well completed and signed off bythe village, Cell and Sector authorities before they are sent to the district land commission forendorsement and for payment processing by WASAC ltd.

4.2. Expected resettlement impacts

The project activities showed that there they will be no loss of shelter (household) during the project implementation. However, some of the public infrastructures will be affected such as road, electrical poles and water pipes. Some of the private land will be temporally used for the project activities and return to the owners on conditional use. There will be also loss of perennial crops and trees.

4.2.1. Loss of private land

The installation of pipeline will involve land clearance and the excavation area has been reduced to 2m to avoid private structures such as wall and fences. The land will be lost temporary or use under conditions where water pipe will be installed and during maintenance works. The remaining land will be taken only during construction.

4.2.2. Loss of government land

Article 31 of the land law **states the lands in public domain as** lands consisting of all lands intended to be used by the public or all the lands reserved for organs of State services and national lands reserved for environmental protection. These lands include the also the national roads and their boundaries. The article 39 states that "A public institution or decentralized entities have the right to use the State lands required for accomplishing its mission and responsibilities" most of the land to be used for pipelines and

associated facilities belongs to the government of Rwanda and hence no local implications or impacts are associated to their use.

4.2.3. Loss of crops and trees

The installation of water pipe Construction works entail clearing of the vegetation inherent in the project site. Some of the trees are within the road boundaries and belongs to the City of Kigali while others may belong to the locals. According to both national regulations and international policies on environmental and social considerations requires the compensation of affected assets including tress and perennial crops. Trees located on the private land at Batsinda site has been counted and included in this report.

4.3. Eligibility for compensation and Entitlement Matrix

4.3.1. Eligibility criteria

In this ARAP, eligibility for compensation was established by comparing what is stipulated inthe Rwandan Constitution (Article 29), the Expropriation Law of Rwanda (N° 32/2015 of 11/06/2015) and the Bank's operational policy, WB OP 4.12. These documents regulate and give entitlement to the affected persons. The WB OP 4.12 goes further and recognizes the affected persons as that one using the land at the time, whether they have written customary or formal tenure rights. However, in the Rwandan Expropriation Law, the personto be expropriated is defined as "any person or a legally accepted association operating in the country that is to have his or her private property transferred due to public interest as well as legally accepted local administrative entities.

JICA guidelines for environmental and social considerations request the recipient country to consider international eligibility criteria including those provided by World Bank Policy OP 4.12 on involuntarily resettlement. The WB OP 4.12 also provides eligibility of benefits including the PAPs who have formal legal rights to land (including customary and traditional land rights recognized underlaw), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets, and the PAPs who have no recognizable legal rights to the land they are occupying. Theeligibility criteria used in this assessment are based on the three criteria given in clause 15 of the World Bank's Operational Policy 4.12: involuntary resettlement:

- ✓ Those who have formal legal rights to land (including customary and traditional rights recognized under the laws of the country);
- ✓ Those who do not have formal legal rights to land at the time the census begins but have a claim to such land or assets – provided that such claims are recognized under the laws of thecountry or become recognized through a process identified in the resettlement plan;

JICA requires recipient country to comply with JICA guidelines on environmental and social consideration and World Bank OP 4.12. Therefore, the eligibility was determined in compliance withthose guidelines together with national expropriation regulations as far as this project is concerned, the Rwandan expropriation law will take precedence.

4.3.2. Entitlement matrix

Entitlement matrix proposes eligibility and payments for the losses triggered by the project such as land, trees, and crops, Therefore, based on the analysis of the impact of the project and the criteria for eligibility, the following entitlement matrix was developed for the affected people found in the project

Table 10: Entitlement Matrix

Type of loss	Entitled Person	Type of Impact	Eligibility criteria	Entitlement
Permanent loss of land	Land title holder	Displacement	Landowner where the water tank will be constructed	Cash compensation plus 5% disturbance allowances as per the expropriation law If the remaining part of the land is too small to be viable or usable, the whole plot will be expropriated.
Temporally loss of private land at the pipeline construction	Landowner	Disturbance	Landowners where the proposed pipeline will be temporarily constructed	People will be notified on time and the shortened
Loss of government land	GoR	Loss of land	Current users of affected land	No compensation required because as in the government land and only small portion will be affected. Affected people should be allowed to use the land outside the pipeline area
Loss of trees on government land	City of Kigali	Loss of trees	Not applicable	No compensation is required.

4.4. Assets inventory and valuation methods

This section describes the methods to be used in valuing assets that will be eligible for compensation consistent with either Rwandan laws or JICA guidelines for environmental and social consideration. Law No.17/2010 of 2010 establishes and organizes the Real Property Valuation Profession in Rwanda. It provides the registration of land valuers in Rwanda and conditions for registration. The law also allows the Government to conduct valuation when mandated by their government institutions. Articles 27, 29, 30 and 31 of the law deal with valuation methods and stipulate that the price for the real property shall be close or equal to the market value. Land values could also be compared country wide. Where comparable prices are not available to determine the value of improved land, the replacement cost approach shall be used to determine the value of improvements to land by taking real property as a reference. The law also allows the use of international methods not covered by the law after approval of the Institute of Valuers.

4.4.1. Valuation methods

The valuation law recognizes different valuation methods and those include:

- **Use of Standard Valuation Tables**

This method is based on reference prices published by Rwanda Institute of valuers every year. Under this method, the compensation rates / valuation tables would be developed using legally acceptable valuation procedures accepted by both the Government of Rwanda and funding agency for purposes of fairness and consistency. The approach considers replacement costs and types and levels of compensation under the Rwanda law. Valuation of lost assets will be made at their replacement cost.

- **Comparison of Land/Property Values Countrywide**

In case there are no compensation rates, the Valuer shall compare prices by referring to the prices recently assigned to a real property that is similar or comparable to the real property subject to valuation. Where comparable prices are not available for land in a particular area, the Valuer may use comparable prices of similarly classified land from other areas of the country

- **Replacement Cost Approach**

The replacement cost approach is based on the premise that the costs of replacing productive assets is based on damages caused by project operations. These costs are taken as a minimum estimate of the value of measures that will reduce the damage or improve on on-site management practices and thereby prevent damage. The approach involves direct replacement of expropriated assets and covers an amount that is sufficient for asset replacement, moving expenses and other transaction costs.

- **Gross Current Replacement Cost**

Gross Current Replacement Cost (GCRC) is defined as the estimated cost of erecting a new building having the same gross external area as that of the existing one, with the same site works and services and on a similar piece of land.

- **Other methods**

Rates from Contractors: When rate schedules do not exist or are out of date, recent quotations by contractors for similar types of construction in the vicinity of the project can be used for calculating replacement costs. In projects offering the options of cash compensation or alternative accommodation, the construction cost estimates for alternative accommodation could be used for calculating cash compensation payable.

It is recommended that the replacement Cost is used as valuation methods. This is because the Replacement cost valuation methods is recommended by funding agency and recognized by valuation law in Rwanda.

4.4.2. Calculation of compensation by assets

The following methods of calculation should be adopted for the preparation of the standardized asset valuation tables and/or the application of specific case by case valuations in the case of projects that have significant impacts.

- **Compensation for Land**

Compensation for land is aimed at providing a farmer whose land is acquired and used for project purposes, with compensation for land labour and crop loss. For this reason, and for transparency, land is defined as an area or homestead (i) in cultivation, (ii) being prepared for cultivation, or (iii) cultivated during the last agricultural season. This definition recognizes the farmer's labour as the biggest investment he/she makes in producing a crop which is higher than all other inputs such as seed and fertilizer. As a result, compensation relating to land will cover the market price of labour invested as well as the market price of the crop lost.

- **Land Measurement**

For purposes of measuring land, the unit of measurement would be that which is used and understood by the affected farmers and if a traditional unit of measure exists in the rural areas, that unit should be used. If a traditional unit of measurement does not exist in a particular area, then it is recommended that land should be measured in meters or any other internationally accepted unit of measurement. However, in such an event, the unit that is being used must be explained to the affected farmers/users and must somehow be related to easily recognizable land features that the communities are familiar with, such as using location of trees, stumps, etc as immovable pegs. The most important concern of this exercise is to ensure that the affected person can verify using his/her own standards/units of measurement, the size of land that is being lost. This will ensure transparency in the system and will thus avoid subsequent

accusations of wrong measurements or miscalculation of areas. A farmer should know how much land he/she is losing, in terms of size and the replacement land must be at least of that same size and comparable value as land lost.

- **Calculation of Crops Compensation Rate**

The current prices for cash crops will be determined and all crops will be valued using a single rate considering the crop at mature age. This rate incorporates the value of crops and the value of the labour invested in preparing new land. Determining compensation using a single rate creates transparency because anyone can measure the area of land for which compensation is due and multiply that by a single rate known to all. This approach also allows assignment of values to previous year's land (land in which a farmer has already invested labour) and land that have been planted but crops have not germinated. Further, it avoids contention over crop density and quality of mixed cropping.

The value of the labour invested in preparing agricultural land will be compensated at the average wage in the community for the same period. The rate used for land compensation should be updated to reflect values at the time compensation is paid. Table below, derives a total value for a one-hectare land from the value of the crops on the land and the value of labour invested in preparing a replacement land.

Table 11: Example of method to be used to determine a monetary compensation rate for land*

Item Compensated	Basis of Value	Rwandese Francs/ha
	Average of the highest 2021 official and market survey land prices per ha of staple food crops (maize, rice etc.), plus cash crops (e.g. sugar cane, corn).	
	Labour costs of preparing a replacement land.	
Total	Replacement value of crops plus labour.	

(Rwandan Francs payments will be revised to reflect crop values and labour rates in effect at the time of compensation). This example assumes a one-hectare land. Crop values will be determined on:

- A combination of staple foods and cash crops. The 80/20 ratio of land that a farmer typically has in food crops and cash crops is used to determine the chances s/he would lose food crop rather than a cash crop income.
- The value of stable crops to be taken as the highest market price (over 3 years) reached during the year, in recognition of the following factors:
- Although most farmers grow staple crops mainly for home consumption, they always have the option of selling these crops to take advantage of the market.
- Farmers most often purchase cereals when they have run out, during drought when prices are high. Compensating at a lower value might put the individual or household at risk.
- On average, the highest price of stable food yields a high per hectare value reimburses for the vegetables and other foods that are commonly inter-cropped with staples but are almost impossible to measure for compensation.
- The labour cost for preparing replacement land is calculated on what it would cost a farmer to create a replacement land. This value is found by adding together the average costs of clearing, ploughing, sowing, weeding twice, and harvesting the crop.

- **Compensation for fruit trees**

Banana and Mango trees are featured here below as two examples of the set of primary fruit trees that are likely to be found in project targeted area and are estimated to account for a significant amount of all fruit bearing trees. They are primarily important as a source of:

- Subsistence food for families

- Cash produce that contributes to the export economy
- Petty market income in some areas, and
- Shade (in the case of mango trees).

For banana trees, they have a relatively much shorter productive life, normally, than mango trees. For species, banana trees will not bear fruit more than once. Therefore, compensation for banana trees would be compensated at the full market rates for bananas harvested in that year and for another year. The second-year payment is for the replacement cost of planting a new tree, looking after it and harvesting it which could all be done in one year. Therefore, the farmer should have restored his pre-project position by the end of the second year. This example of bananas is an example for trees/plants that have a relatively short life.

As defined in this policy, individuals will be compensated for wild trees which are in their land. Wild productive trees belong to the community when they occur in the bush as opposed to fallow land. These trees will be compensated for under the umbrella of the community compensation.

4.4.3. Preparation of asset inventory and PAPs identification

To prepare for compensation and other resettlement benefits, it is imperative that a comprehensive asset and affected persons inventory in the designated areas for the different project components is done. The inventory will specify the different assets, properties affected in each plot of land and their owners. The Land Valuation Bureau which is the entity responsible for undertaking valuation of assets will be responsible for the valuation exercise and will therefore provide independent valuation experts. The valuation document will indicate when the affected person will be notified, and that the inventory will not be official until a second signed copy, verified by project supervisory staff, is returned to the affected person. At this time, a copy of the grievance procedure will also be given to the affected person as stated in the grievance redress mechanism. The valuation experts will work hand in hand with the local leaders of the area. So far, one PAP has been identified and initial assets inventory conducted. Final assets inventory and valuation will be conducted by independent valuer.

4.4.4. Forms of Compensation

Individual and household compensation will be made in cash, in kind, and/or through assistance. The type of compensation will be an individual choice although every effort will be made to instill the importance and preference of accepting in kind compensation if the loss amounts to more than 20% of the total loss of subsistence assets. Compensation payments raises issues regarding inflation, security and timing that must be considered. One purpose of providing in-kind compensation is to reduce inflationary pressure on the cost of goods and services. Local inflation may still occur and thus market prices will be monitored within the time that compensation is being made to allow for adjustments in compensation values. The issue of security, especially for people who will be receiving cash compensation payments should be addressed by the local administration. The ARAP has provided an entitlement matrix that shows type of compensation for each category.

4.4.5. Procedures for delivery of compensation

It is recommended that compensation be made through reputable local banks. This will ensure security of the PAPs money especially for those receiving large sums. Forms acknowledging receipt of the compensation packages shall be signed by each PAP.

4.4.6. Verification and Disclosure of entitlements

PAP will be fully involved in the process of valuation of his land, trees and crops and the property valuation form shall be presented tohim for verification and in return, the form will sign or thumb press in ink as a sign of agreement. The form will be approved by village, Cell and Sector authorities who countersign as a sign of approval and authorization of legal process. Thereafter the form will be forwarded to WASAC for approval and payment process by MINECOFIN.

4.4.7. Cut - off date

Under World Bank OP 4.12, cut-off date is defined as the date of completion of the census and assets inventory of persons affected by the project. Any people occupying the project area after the cut-off date are not eligible for compensation and/or resettlementassistance. The cut-off date in this ARAP refers to the timeframe to be advertised by WASAC in close collaboration by Gasabo District and local authorities beyond which no more claims could be made at which point any assessment of new persons and their property would be undertaken. The establishment of a cut-off date is required to prevent opportunistic invasions/rush migration into the chosen land areas. Persons who encroach on the area after the cut-off date are not entitled to compensation. It should benoted that the cut-off date should be determined before the census is conducted and agreed by all thestakeholders.

The cut of date in our case is not yet fixed and communicated officially. This is planned after all project designs and approvals are in place. WASAC will write officially to all sectors and the communication will be handed to all village leaders of the project area and communicated to local communities during monthly community work.

4.5. A-RAP implementation arrangements

The overall coordination of this A-RAP implementation will be provided Water and Sanitation Corporation (WASAC Ltd). Other stakeholders that will be involved inits implementation are described in detail below. The implementation arrangement builds on responsibilities already in place to ensure that the requirements of this A-RAP are met. At local level, Gasabo district is responsible institution of A-RAP implementation while Kigali City ensures that the proposed project is in line with the city development plans and do not compromise the requirements of the Kigali City Master Plan.

4.5.1. A-RAP implementing Institutions

- ✓ **Ministry of Infrastructures**

Government of Rwanda represented by Ministry of Infrastructure via WASAC Ltd is responsible forland acquisition and hence responsible for A-RAP implementation. The A-RAP implementation will be done through Water and Sanitation Corporation (WASAC Ltd which is the main agency involved in implementation of the project. Ministry of Infrastructure will work together with Ministry of Finance to ensure that compensations funds are secured on time and compensation is made in due time.

- ✓ **Water and Sanitation Corporation Limited**

WASAC Ltd is the technical institution responsible for the project on government side. Therefore, WASAC Ltd will be the leading institution in the implementation of this A-RAP. The role of WASAC Ltd will be but not limited to recruitment of independent assets valuer, responsible for coordination and monitoring activities related to asset valuation, and WASAC will appoint an environmental and social safeguard specialist who hewill be the focal point for A-RAP implementation and will liaise with other stakeholders in this regard. The designated staff will ensure that procedures and requirements of the Rwandan laws and JICA consideration on environment and social consideration are complied with. A key role will be to

implement the A-RAP and other resettlement-related activities and to ensure that all procedures have been adhered to and that there is consistency in approach between sub-projects activities. He/ She will also undertake the main monitoring and evaluation role of resettlement activities during and post implementation.

- ✓ **Rwanda Land Management and Use Authority/ RLMUA**

RLMUA is the organ responsible for overall management and coordination of all activities related to land administration, land use planning and management in Rwanda. The role of RLMUA in A-RAP process will be to advise on matters related to land ownership and expropriation. District land office in close collaboration with project staff will check and approve valuation forms, and after compensation RLMUA will also play a key role in in the process of transferring and registering land titles as appropriate.

- ✓ **Gasabo district**

Gasabo District through its land office will be responsible for ensuring that activities undertaken comply with the national laws and regulations. The district will assess the validity of land tenure rights of affected persons and will be responsible for ensuring that effective grievance mechanisms are in place. Gasabo district will also be used in the implementation of A-RAP as much as possible to reduce the dispute that may occur during the A-RAP implementation Gasabo district will be supported with land office at sector level and community development officer at cell level.

- ✓ **Project Affected Person**

The project affect person will also participate in the A-RAP implementation and is required to be present during finalvaluation and participate in complaints resolutions.

4.5.2. Grievance Redress Mechanism (GRM)

The district is an acknowledged institution for which the PAP has been made aware of as avenue for expressing discontent and disapprovals related to compensation process. Article 26 of the expropriation law N0 18/2015 of 19/04/2015 provides complaints procedures for individuals dissatisfied with the value of their compensation. The law stipulates that dissatisfied person have a period of 30 days after project approval decision has been taken to appeal (Article 19). Grievance procedures are required to ensure that PAPs can lodge complaints or concerns, without cost, and with the assurance of a timely and satisfactory resolution of the issue. Grievances may arise from members of communities who are dissatisfied with eligibility criteria use, community planning and actual implementation or compensation. Considering the number of PAP during this project implementation, the grievance shall be addressed directly to WASAC Ltd and whom will in return receives the complaint and thereafter together with the local leaders from village to district level will ensure the case is amicably solved with satisfaction to both parties during a complains resolution meeting that will include the PAP and his relatives.

4.5.3. A-RAP Monitoring

The objective of the monitoring and evaluation process will be to determine whether PAP has been paid in full and before implementation of the project the affected person is now living a higher standard than before, living at the same standard as before, or is poorer than before. This will be done regarding the income generated before from the project site comparatively to the income generated after the project is implemented. The arrangements for monitoring the compensation activities will fit into the overall monitoring program of the entire project which will fall under the overall responsibility of the JICA and WASAC.

✓ **Monitoring indicators**

Different indicators would be used to determine the status of affected people (land beingused compared to before, , level of living conditions compared to before, health standards and soon). The affected personnel is able to maintainhis pre-project standard of living, and even improve on it; and the local communities remain supportive of the project.

✓ **Monitoring of livelihood restoration**

The affected land is allocated to residential but there is no house constructed on the land. Therefore, there is no loss of income or means of livelihoods. However, WASAC will ensure that the affected person is compensated and monitor the status of affected compensation plans performance.

Table 12: ARAP Implementation Cost

No	Item description	HHs	Unit	Quantity	Total Cost(frw)[1]
1	Permanent loss of land	1	Sqm	1000	66,224,777
2	Loss of trees and crops	1	Pces Sqm	569 4408	2,896,250
3	Final valuation	1	Ls		225,000
	TOTAL				**69,346,027**

Table 13 : Monitoring Cost

Activity	Indicator	Qty	Unit cost (FRW)	Total Cost (FRW)
Follow up valuation and compensation process	Field report	1	70,000	70,000
Meetings for grievance redress	Meetings/grievance resolved	8	70,000	560,000
PAPs Livelihoods assessment	Assessment report	2	70,000	140,000
Total				**770,000**

4.5.4. A-RAP disclosure

JICA and other international policies on environmental and social safeguards require the implementing agency to disclose publicly the A-RAP. Therefore, WASAC will disclose this A-RAP by making copies available at its head office and at District and sector offices. The A-RAP will be disclosed to the WASAC Website, and the Government of Rwanda will also authorize JICA to disclose this A-RAP electronically.

A completion report of the entire compensation process for this project will be prepared andwill include a hand over certificate which will ostensibly provide a verification of when the compensationand assistance were undertaken and to whom these services were provided as well as to indicate that indeed all the compensation has been delivered. This report will be prepared and submitted to JICA after the end of compensation payment by WASAC. The A-RAP implementation report should include (but not be limited to) the following information:

- Background of the A-RAP preparation including a description of the project activities, scope of impacts, number of affected persons, and estimate budget;
- Update of ARAP implementation including compensation paid, issues/complaints raised and solutions provided;
- Early assessment of the impacts of resettlement and compensation on affected categories at the timeof the report production;

[1] 1USD=1035 Rwandan Francs

- Lessons learned from the A-RAP implementation;

ANNEXES

Annex 1:List of consulted people at central and local institutions

No	Names	Contact	Institution	Function
1	ABIMANA Eric	0787812829	Bibare Cell	Community and Economic Development Officer
2	Alain SEZIBERA	0788521930	RDB	EIA Analyst
3	BUGINGO Davis	0788230018	Flood Management and Water Storage Development Division Manager	Rwanda Water Board
4	BYUKUSENGE Jean d'Amour	0788984400	Musezero Cell	Community and Economic Development Officer
5	DUFATANYE Israel	0788481541	REMA	Environmental Inspector
6	DUSABIMANA Annuaritte	0788452328	Gisozi Sector	Health and Sanitation Officer
7	Eng. MUHORAKEYE Jeanne	0788875101	Kimironko sector	Act land management & Notary team leader
8	Enode NIYONSABA	0787958813	Nyabisindu	Executive Secretary
9	GASANA Donatien	0785984429	Gasharu Cell	Community and Economic Development Officer
10	HABINSHUTI Jean Pierre	0788881465	Gasabo District	Water District Engineer
11	HAVUGUZIGA NTABWIKO Charles	0788300397	Kanyinya sector	Executive secretary
12	Jean Pacifique TUYISHIMIRE	0783393820	Murama cell	Community and Economic Development Officer
13	Jeannine MUKARUKUNDO	0783441942	Kibagabaga cell	Community and Economic Development Officer
14	KALISA Hamza Fidel	0788876579	Gisozi Sector	Land manager support Officer
15	KARAMUZI Godfrey	0788861810	Remera sector	Executive secretary
16	KARURANGA Dismas	0788779208	Rwanda Water and Forest Authority	In charge of Water Quality
17	KAYITESI Redempta	0783877212	Gacuriro cell	Executive Secretary
18	MBONAMPEKA Claudine	0788492092	Rukiri II	Executive Secretary
19	MUKAMANA Phoebe	0788583832	Gasabo District	Environmental Officer
20	MUKAMANA Phoebe	0788583832	Gasabo District	District Environmental Officer
21	MUKAMURENZI Antoinette	0788683611	Gisozi Sector	Health and good governance
22	MUKANTWARI Sandrine	0787433065	Gasharu Cell	ES of the cell
23	MUSASANGOHE Providence	0788451827	Gisozi Sector	Executive Secretary
24	NDAMYIMANA Elysée	0788414332	Remera sector	Land bureau
25	NIYONSABA Pascal	0738583283	Rukiri I	Executive Secretary
26	NSENGIMANA Janvier	0788668943	Remera sector	Community Heath and Sanitation Officer
27	RUGAMBIRWA Deo	0788815450	Bumbogo Sector	Executive Secretary
28	RUKUNDO Augustin	0782756565	Gasabo District	District Sanitation Officer
29	RUSINE Alphonse	0788440290	Gasabo District	Land Survey & GIS
30	RUTARINDWA Alphonse	0784902626	Gasabo District	Director of Health and Socio-economic development
31	SHUMBUSHO Faustin	0789198930	Bumbogo Sector	Ngara Cell Executive Secretary
32	TUYISHIMIRE Evelyne	0784388649	Nyagatovu cell	Community and Economic Development Officer
33	UMUHOZA MBATEYE Aimee Francine	0788486203	Water and Sanitation Corporation	In Charge of Planning
34	UMUHOZA RWABUKUMBA	0788304546	Kimironko sector	Executive secretary
35	UMURERWA Josiane	0788627922	Bumbogo Sector	Social affairs
36	UWAMAHORO Chantal	0788946525	Kimironko sector	Community heath and sanitation officer
37	UWAMAHORO Jeanne d'Arc	0788315593	Nyarutarama cell	Community and Economic Development Officer
38	UWAMAHORO Jeanne d'Arc	0788649667	Kimironko sector	Social affairs
39	UWERA Jeanne d'Arc	0787959858	Bumbogo Sector	Customer care

UMURENGE WA GISOZI

AKAGARI KA MUSEZERO

UMUDUGUDU WA GASHARU

ABITABIRIYE UMUGANDA USOZA UKWEZI KWA WERURWE 2022

N	AMAZINA YOMBI	ISIBO ABARIZWAMO	TELEFONE	UMUKONO
1.	Ntibaziyaremye	Umubyizo	0782658096	
2.	Rutabingwa J.D		0787773534	
3	UZAYISENGA Emmanuel	TUZAMURANE	0791240022	
4	MUHAYIMANA J	J.M.V	0785634909	
5	Masiyili Maite			
6	Mogomo Serafini		0785646391	
7.	[illegible]			
8	KAMANA		0788905778	
9			078400089	
10.	NSABIMANA M PASCAL		0788559689	
11.	NDAHIRO Willy Theodo		0788990671	
12	HUKANBIZA Joselyne		078844275	
13.	[illegible]		07887151	
14.	Nyandwi Mathias			
15.	Elvira [illegible]		0791530438	
16	IRAKIZA	Kibuduane	283996067	
17.	Niyomugenga [illegible]		079[illegible]	
18	Yamuremye [illegible]		28371[illegible]	
19.	STEVEN		07841[illegible]	
20.	NYANDWI	DIOLAS	0780516326	
			0784475894	

yy.

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MUDUGUDU WA GASHARU

ABITABIRIYE UMUGANDA USOZA UKWEZI KWA WERURWE 2022

N	AMAZINA YOMBI	ISIBO ABARIZWAMO	TELEFONE	UMUKONO
1.	IRAkoze kevin	Umurava	0791f5028[illegible]	
2.	MAHINGUBA theo		0785660922	
3.	[illegible]		0722554274	
4.	HARINDINTWALI Leopord	UMUTEKANO	0788643825	
5.	UFITYIMANA [illegible]		0785483807	
6.	SABUMORO Ernest		0784573328	
7.	Tuyu [illegible]		0768444241	
8.	Nzamurangimana [illegible]		0780164180	
9.	Nkundabagenzi Venuste		078[illegible]488915	
10.	NSHIMIYIMANA EZECHIEL		078892[illegible]	
11.	Harelimana Alphonse		078826729[illegible]	
12.	Mukeshimana [illegible]	Ubumwe	078[illegible]	
13.	[illegible]	[illegible]		
14.	[illegible]		078149[illegible]	
15.	MPAYIMANA	[illegible]	078883[illegible]	
16.	MUSHABA	Umucyo	078[illegible]	
17.	Bisehura	Umucyo	0787[illegible]	
18.	UWAMAHORO [illegible]		0786[illegible]	
19.	TURIKUMANA	TUZAMURANE	078[illegible]	
20.	KANEZA [illegible]	TUZAMURANE	0798[illegible]457	

yy.

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GUDU WA GASHARU

ABITABIRIYE UMUGANDA USOZA UKWEZI KWA WERURWE 2022

AMAZINA YOMBI	ISIBO ABARIZWAMO	TELEFONE	UMUKONO
NDAYISABA Nepo.	INGENZI	0785395888	
KAYITANA J Damascene	URUMURI 2	0788305379	
NGIRABABYEYI Pierre	INGENZI	0786090708	
NIBISHAKA Isaac	INTWARI	0786020494	
HARIMANA NA	UMA	[illegible]	
KIMONYO J.M.V.	Urumuri 2	0788786468	
NTEZIRYIMANA Pierre Celestin	Intabwe	0788717966	
Habimana Fidele	umutekano	0785277239	
Habimugisha J.D	umutekano		

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ABITABIRIYE UMUGANDA USOZA UKWEZI KWA WERURWE 2022

AMAZINA YOMBI	ISIBO ABARIZWAMO	TELEFONE	UMUKONO
NDAYISABA Nepo.	INGENZI	0785395888	[signature]
KAYITANA J Damascene	URUMURI	0788305379	[signature]
NGIRABABYEYI Pierre	INGENZI	0786090708	[signature]
NIBISHAKA Isaac	INTWARI	078602044	[signature]
HARIMANA	UMA	0780202708	
KIMONYO J.M.V.	Urumuri	0788786468	[signature]
NTEZIRYIMANA Pierre Celestin	Intabwe	0788717966	[signature]
Habimana Fidele	umutekano	0785272739	[signature]
Habumugisha J.D	umutekano		[signature]

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ABITABIRIYE UMUGANDA USOZA UKWEZI KWA WERURWE 2022

N	AMAZINA YOMBI	ISIBO ABARIZWAMO	TELEFONE	UMUKONO
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ABITABIRIYE UMUGANDA USOZA UKWEZI KWA WERURWE 2022

N	AMAZINA YOMBI	ISIBO ABARIZWAMO	TELEFONE	UMUKONO
1.	NGOGA Olivier	Ndashikana	0784651120	[signature]
2.	HAKIZIMANA Dominique	ABADAHEMUKA	0785696602	[signature]
3.	Daniel NDAMUTIGIYE	AMIZERO	0788391432	[signature]
4.	NSIKAHABIMANA Jean	Ingeri	0784300011	[signature]
5.	UKURIMWAMI Jean Wilson	(INGEKI)	0787864253	[signature]
6.				
7.	Nwanabaje Jeanne	Abizerwa	0788350987	[signature]
8.	Mukeshimana Clarisse	Intambwe	0786879445	[signature]
9.	Nyirahumumunti Marie	(17)	0782554155	[signature]
10.	Mukamwezeriyena Christine		0789483576	[signature]
11.	Uwamahoro Pascal	Umucyo	0788256215	[signature]
12.	Nyiransabimana Claudine	Intambwe	0781365548	[signature]
13.	~~Nyirandayambaje~~		~~0781805675~~	[signature]
14.	Nsengiyumva Bea	(7)	0786543145	[signature]
15.	Mukarubera Seraphine	(7)	0788217525	[signature]
16.	Mukanyandwi Grace	Umurava	0780349958	[signature]
17.	NDAYAMBAJE	SIAIAO	0783693549	[signature]
18.	BUGINGO PASIKARI		0787859405	[signature]
19.	Niyonsenga Vincent	Ubumwe	0788439261	[signature]
20.	Niyomfura Emmanuel	Ndashikana	0788261961	[signature]

[signatures]

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ABITABIRIYE UMUGANDA USOZA UKWEZI KWA WERURWE 2022

N	AMAZINA YOMBI	ISIBO ABARIZWAMO	TELEFONE	UMUKONO
1.	NGOGA Olivier	Ndoshibaho	078465118[illegible]	
2.	HAKIZIMANA Dominique	ABADAHIGWA	078569[illegible]	
3.	Daniel NDAMUZEGE	[illegible]	07889[illegible]	
4.	NSIKA HABIMANA [illegible]	[illegible]	078[illegible]	
5.	KARIMUNDA Jean WILSON	(INGAZI)	0781864253	
6.				
7.	Nwambaje [illegible]	Abizera	0783350987	
8.	Mukashumana Claire	Intwari	0786879445	
9.	Nyiramuminta [illegible]	(14)	078255[illegible]	
10.	Mukambabazi[illegible] Christine		0789483576	
11	[illegible] Pascal	Umucyo	07[illegible]	
12	Nyiransabimana Claude	Intambwe	0781365543	
13.	Nyirandayambaje		078[illegible]	
14.	Nsengiyumva Bea	(7)	0786543[illegible]	
15.	Mukarubaya [illegible]	(7)	0788217525	
16.	Mukanyandwi [illegible]	Umucyo	078[illegible]9958	
17.	NTAMUHANDA [illegible]	SIAHO	07836935[illegible]	
18.	BUGINGO PASIKARI		0787859005	
19.	Niyonsenga Vincent	Ubumwe	0728439261	
20.	Niyonsaba Emmanuel	Abadahigwa	0788269961	

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ABITABIRIYE UMUGANDA USOZA UKWEZI KWA WERURWE 2022

N	AMAZINA YOMBI	ISIBO ABARIZWAMO	TELEFONE	UMUKONO
1.	Nyomziima Emmanuel			
2.	KIBASHA Anick	Abahizi 12	078743299[illegible]	[signature]
3.	Bampasire Jean Baptiste	Gasharu	0788356290	[signature]
4.	HAHYUANIMFUZA Jean	Abahizi	0789009710	[signature]
5.	Sebahuvuzi Evariste	[illegible]	0788302288	[signature]
6.	Nikuze Olatiime	Ubumwe	078823006[illegible]	[signature]
7.	Kamikazi Francine	Icyerekezo	0783600510	[signature]
8.	KYAKWITA JENNIFER	ICYEREKEZO	0788[illegible]6669	[signature]
9.	Mukamutesi [illegible]			
10.	Mukamutesi	19 Abadacogora	0784449[illegible]	[signature]
11.	Nyirakoraman Chantal	7	0787455767	[signature]
12.	Mujawamariya [illegible]	8 Ingeli	078846597[illegible]	[signature]
13.	MUTEZIMANA Epiphanie		078348047[illegible]	[signature]
14.	NIYITEZE Rafiki		0788376686	[signature]
15.	NGENDAMBIZI Emmanuel	Amahoro	0788562214	[signature]
16.	Twizerimana Jean d'Amour	7	0788642157	[signature]
17.	AGANZE JONAS	[illegible]	078199[illegible]	[signature]
18.				
19.				

YY. [signatures]

Annex 2: Minutes of additional consultation with affected person, July 26, 2022

Le 26/07/2022

INAMA/IKIGANIRO KUSANYAMAKURU

Uyu munsi taliki ya 26/7/2022 mu mudugudu wa Nyakabungo, Akagari ka Ngoogwe Umurenge wa Kinyinya habereye ikiganiro hagati ya Fabien NSHIMIYIMANA Umukozi wa BESST Ltd na Augustin MPAGAZEHE ku bijyanye n'ubutaka bwe (Augustin) buzubakwaho ikigega cy'amazi na WASAC.

Ibyaganiriweho : - Ingano y'ubutaka buzubakwaho ikigega n'ubuzasigara.
- Uburyo bw'igenagaciro
- Igihe cyo kugena agaciro no kwishyura.
- Imbago z'ubutaka

Imyanzuro yafashwe

- Bitewe n'uko ubutaka buzasigara butavamo cyangwo ngo butererweho ibindi bitewe bitewe n'ingano yabwo (308m²); Augustin yifuje ko ubutaka bwose bwakorerwa igenagaciro bukishyurwa bwose (1308m²).
- Augustin yifuje ko mu gihe cy'igenagaciro byakorwa neza agahabwa ingurane y'amafaranga ikwiye kandi ijyanye n'agaciro k'aho ubutaka buherereye (mu mugi wa Kigali, Ahagenewe imiturire, ku muhanda n'ibindi)
- Hifujwe ko kugena agaciro byakorwa vuba kuko hari benshi bifuza kugura ubutaka bwa Augustin akaba abahakanira kuko yiteze ko WASAC izatubaka ikigega cy'amazi (byibuze mu mezi abiri uhereye ubu).
- Ku bijyanye n'imbago, Augustin avuga ko ubutaka bwe bufatanye n'ubwa centrale kuko nta wundi bahana imbibi. Haramutse hari ikibazo mu makimbirane yagaragara ku cyongombwa cy'ubutaka byagaragazwaho neza bigakosorwa
- Igihe cy'igenagaciro ingano y'atanu ku ijana y'agaciro kose (5%) igomba kuzubahirizwa kandi igihe cyo kwishyurwa bigakorwa vuba amategeko yubahirijwe.

Fabien NSHIMIYIMANA
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HAKIZIMANA Justin [signature] (Fils)
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[signatures]

Annex 3:Crops reference prices 2021 in the project area

INSTITUTE OF REAL PROPERTY VALUERS IN RWANDA

ORDRE DES EVALUATEURS DES BIENS IMMOBILIERS AU RWANDA

CROPS REFERENCE PRICES (IBICIRO NGENDERWAHO BY'IBIHINGWA/IBITI)

IBITI BIBAZWA /BOIS D' OEUVRE

Minimum rate is meant for trees fresh from nursery and Maximum price is for trees ready for production. It is important to note that after optimum age of production, this type of trees may depreciate when they can no longer serve the core purpose because of age.

Commonly known as	Unit	Minimum rate (FRW)	Maximum rate (FRW)
Gereveliya	piece	1000	5,500
Umusave	pces	1000	10,000
Inturusu	pces	1000	6,500
Umuko	pces	1000	8000
Sipure	pces	1000	5300
Pinusi	pces	1000	5500
Sakaranda	pces	1000	6500
Acacia	pces	1000	6500
Lilas	pces	1000	5200
Araucaria	pces	1000	6500
Filawo	pces	1000	4500

CULTURES /IMYAKA

Minimum rate is for crops comparable to nursery level and maximum rate is for pick production stage. Other factors may be the type of seeds, the nature of soil and normal production from it in the area; guidance by an agronomist may be useful if necessary.

Commonly known as	Unit	Minimum rate (FRW)	Maximum rate (FRW)
Ibishyimbo/beans	sqm	80	150
Amashaza/Petit poids	sqm	80	150
Ubunyobwa/Arachides	sqm	100	220
Ingano/Orge	sqm	60	100
Amasaka/Sorgho	sqm	60	100
Mais/Ibigoli	sqm	80	150
Uburo/Eleusine	sqm	300	500
Ibirayi/Pomme de terre	sqm	250	400
Amateke/Colocases	sqm	150	250
Ibikoro/Ignames	sqm	50	100
Ibijumba/Patates douces	sqm	150	250
Imyumbati/Maniocs	sqm	250	400
Isombe/Maniocs-legumes	sqm	800	1.500
Soya/Soja	sqm	100	250
Amashu/ Choux	sqm	500	900
Ibitunguru/Oignons	sqm	250	400

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Inyanya/Tomates	sqm	500	800
Intoryi/Abergines	sqm	600	1,000
Karoti/Carottes	sqm	200	300
Saladi/Salades	sqm	150	250
Sereli/Celery	sqm	200	300
Inzuzi/Courges	sqm	3,000	4,000
Izindi mboga/Autres legumes	sqm	50	300
Ananasi/Ananas	sqm	1,350	2,000
Ipamba/Coton	sqm	720	1,500
Umuceli /Riz paddy	sqm	360	700
Itabi/Tabac	sqm	1,000	1,200
Ibisheke/Canne a sucre	sqm	400	1,000

IBITI BYERA IMBUTO ZIRIBWA N'IBITI BIVAMO IMITI/ PLANTES FRUITIERES ET MEDICINALES/ FRUIT AND MEDICINAL PLANTS

Minimum rate is meant for trees fresh from nursery and Maximum price is for trees ready for production. It is important to note that after optimum age of production, this type of trees may depreciate when they can no longer serve the core purpose because of age. Other factors may be the state of care and appearance and visible level of production for items in that age.

Commonly known as	Unit	Minimum rate (FRW)	Maximum rate (FRW)
Maracouja	pce	1,000	3,000
Ibinyomoro/Prunier du Japon	pce	1,000	3,000
Umutima w'imfizi /Coeur de boeuf	pces	2,000	10,000
Umwembe/Manguier	pces	2,000	10,000
Ipera/Goyavier	pces	2,000	10,000
Ipapayi/Papayer	pces	2,000	10,000
Les Agrumes	pces	3,000	12,000
Macadamia	pces	2,000	30,000
Igiti cy'avoka/Avocatier	pces	3,000	20,000
Vanilla	pces	2,000	10,000
Igiti cya Moringa	pces	3,000	12,000
Ibobere/Murier	pces	1,500	8,000
Ibindi biti byera imbuto ziribwa Bitavuzwe/Autres arbres fruitiers	pces	2,000	10,000
Ibiti bitanga imiti ya Kinyarwanda/Plantes medecinales	pces	5,000	20,000

INSTITUTE OF REAL PROPERTY VALUERS IN RWANDA

ORDRE DES EVALUATEURS DES BIENS IMMOBILIERS AU RWANDA

IBIHINGWA N'IBITI NKONDABUTAKA/ CULTURES PLURIANNUELES ET PERENNES/ MULTI-ANNUAL AND PERENNIAL CROPS

Minimum rate is meant for trees fresh from nursery and Maximum price is for trees ready for production. It is important to note that after optimum age of production, this type of trees may depreciate when they can no longer serve the core purpose because of age. Other factors may be the state of care and appearance and visible level of production for items in that age.

Commonly known as	Unit	Minimum rate (FRW)	Maximum rate (FRW)
Ikawa/Cafeier	pces	1,500	10,000
Ibireti/Pyrethre	pces	50	200
Icyayi/Theiers	pces	500	3,000
Ikinini/Quinquina	pces	300	1,000
Urutoki/Bananeraie	pces	1,500	5,000
Urusenda/Pili pili	pces	200	500
Ikibingo/Pennisetum	sqm	350	2,000
Tiribusakumu/Tripsacum	sqm	350	1,000
Vetiveri/Vetivers	sqm	350	1,000
Setariya/Setaria	sqm	350	1,000
Kikuyu grass	sqm	3,000	8,000
Macyayicyayi/Citronnelle	sqm	350	500
Desmodium	sqm	5,000	12,000
Luzeme	sqm	7,000	15,000
Trefle	sqm	7,000	15,000
Mucuna	sqm	7,000	15,000
Umugwegwe/Sisal	pces	350	1,500
Umugano/Bambou	pces	300	2,000
Imiyenzi/Euphorbes	pces	500	1,000
Urugo rw'imiyenzi	sqm	500	3,000
Imihati	pces	500	1,500
Urugo rw'imihati	sqm	500	2,500
Urugo rw'imbingo cyangwa imiseke	sqm	1,600	3,000
Urugo rwa sipure	sqm	1,500	5,000
Imivumu	pces	6,000	20,000
Umuko	pces	1,000	10,000
Utundi duti tutavuzwe ariko twatewe	pces	600	1,000
Ikinobonobo/Ricin	pces	400	1,000

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Annex 4: Land reference prices 2021 in the project area

INSTITUTE OF REAL PROPERTY VALUERS IN RWANDA

ORDRE DES EVALUATEURS DES BIENS IMMOBILIERS AU RWANDA

Sector	Cell	Village	Land Use	Minimum Value Per Sqm	Weighted Average Value Per Sqm	Maximum Value Per Sqm
			Farm Land (General)	16,782	24,210	65,720
			Low Rise Residential	14,198	22,646	58,797
			Plantation	15,160	21,870	68,614
			Vacant Land	13,961	25,162	29,330
		Kabuhunde ii		11,547	15,340	34,281
			Farm Land (General)	11,547	15,340	34,281
		Kadobogo		13,242	22,635	73,691
			Farm Land (General)	18,515	23,069	73,691
			Health Facilities	15,558	25,305	28,342
			Low Rise Residential	13,242	22,342	44,287
			Vacant Land	17,368	19,824	36,746
		Kagarama		13,759	22,992	98,449
			Existing Forest	18,479	34,128	41,821
			Farm Land (General)	13,759	18,788	98,449
			Low Rise Residential	18,847	19,309	46,932
			Plantation	14,457	19,742	83,752
		Muhororo		9,646	14,386	71,865
			Farm Land (General)	9,887	13,661	71,865
			Low Rise Residential	11,244	16,168	37,571
			Plantation	9,646	13,328	70,398
		Nyakabungo		13,261	23,963	64,246
			Commercial General	19,749	33,883	38,200
			Farm Land (General)	13,261	19,995	64,246
			Low Rise Residential	13,545	23,272	47,110
			Plantation	15,377	23,186	51,192
			Religious Facilities	17,368	21,287	36,746
			Wetland	17,368	22,154	36,746
		Rukingu		11,853	21,349	82,348
			Commercial General	21,729	26,276	60,908

Annex 11 Environmental and Social Monitoring Form

(1) Response/Actions to Comments and Guidance from Government Authorities and the Public

Date:

Venue:

Organizations or Communities:

Monitoring Item	Monitoring Results during Report Period
Number and contents of formal comments made by the public	
Number and contents of responses from Government agencies	

(2) Mitigation Measures

1) Air Quality (smoke and dust control)

Air quality monitoring

Item	Unit	Situations of Dust Based on the observation	Measurement Point	Frequency
Dust	-	1. good 2. Acceptable level 3. bad	Construction site	Daily

Mitigation measures

Frequency: Daily

Date: Mark: "✔" if mitigation measure is done

No	item	Monitoring Site **	Mitigation measure is done or not	Remarks
1	Check the conditions of vehicles (smoke and dust control)			
2	Watering (dust control)			
3	Covering truck load with a sheet (dust control)			

2) Noise and Vibrations

Ambient noise monitoring

Item	Unit	Measured Value (mean)	Measured Value (Max)	Country Standards	Standards for Contract	Referred International Standards	Measurement Point	Frequency
Noise LAeq	dB(A)			60 (residential area) 65 (Industrial area)	60/65	85 (Japan)	Construction site/edge of the construction area (near houses)	During earth works or and compaction
Vibrations	dB(A)			-	-	75 (Japan)	Construction site/edge of the construction area (near houses)	During earth works or and compaction

Ambient noise standards in Rwanda (the East Africa Community, EAC, standards)

No	Area	Time During Day (hours)	Limits, dB(a)
1.	Industrial Noise	07:00-21:00 21:00-07:00	60.0 55.0
2.	Neighborhood Noise	07:00-18:00 18:00-21:00 21:00-07:00	60.0 55.0 50.0

Mitigation measures

Operation hours of construction work

Frequency: daily

No	Date	Construction site	Starting time	Finishing time	Remarks

Operation hours of heavy vehicles and equipment such as generators

Frequency: daily

No	Date	Construction site	Heavy vehicles/ equipment	Starting time	Finishing time	Remarks

3) Waste (Construction Waste)/Soil Management

Frequency: weekly

Date: Item: Waste Management Mark: "✔" if management is done as required

Construction site	Exact location	Kind of waste	Volume of waste (m3)	Final disposal or reuse	Stored at designated place	Waste separation	Remark
	-						
	-						

4) Soil pollution

Frequency: Daily

Date: Mark: "✔" if mitigation measure is done

No	item	Monitoring Site **	Mitigation measure is done or not	Remarks
1	Checking the storage conditions of oil and chemicals			
2	Use of oil pan at the time of fueling			

5) Soil erosion

Frequency: Daily

Date: Mark: "✔" if mitigation measure is done

No	item	Monitoring Site **	Mitigation measure is done or not	Remarks
1	Checking the storage conditions of excavated soil (soil erosion)			
2	Use of appropriate size of an heavy vehicle at the steep slope			
3	Installation of prevention measures such as fence/barrier at the steep slope			
4				

4. Social Environment

1) Land acquisition

Pre-Construction phase

Land expropriation, and compensation for assets and crops (monthly report)

		Planned Total	Actual Total	Date of Completion					Expected completion date	Responsible organization
If the following activities are completed, write the date										
1.Update PAPs list and application for expropriation										
1-1	Identify final PAHs/PAP	1 HH								WASAC
1-2	Prepare and submit application for expropriation									WASAC
1-3	Review and decide the expropriation by Committee									District
1-4	Review and decide the expropriation by District									District
1-5	Announce the decision (cut-off date)									District
2. Official Valuation										
2-1	Select a valuer									WASAC
2-2	Announce valuation to PAP									District
2-3	Conduct valuation and submit the valuation report									Valuer
2-4	Decide about report by WASAC									WASAC
2-5	Agree and sign the report by PAHs									
3. Progress of compensation payment and land acquisition										
3-1	Completion of payment of compensation for land and crops									WASAC
3-2	Completion of land acquisition	1,000 m2								WASAC
		2023.1	**2023.2**	**2023.3**	**2023.4**	**2023.5**				**Responsible organization**
Note the number of complaints and grievance redress cases in each month, if any										
4. Complains and Grievance Redress N/A Cases										
4-1	Solved cases									
4-2	Unsolved cases									

Record of Complain and Grievance Management

No	Date	Complain and Grievance from PAPs	Solution / Result / Any actions to be taken

Consultation meetings

No	Date	Sector	Nos of Participants	Key agenda and result of discussion

During Construction

Socio-economic survey targeting PAH (twice)

2) Livelihood

Before Construction

Item	Monitoring Results during Report Period	Measures to be Taken	Frequency
Priority in Employment			Monthly
Other employment			Monthly

3) Safety Management (Health and Occupational Safety)

Safety and health management plan

Pre-construction phase

Preparation of safety and health management plan

	Safety and health management plan is submitted	Approved by the Consultant	
Date			

Training programs

No	Date	Training Name	Agenda	Participant
1				
2				

During Construction

Date:

No	item	Monitoring Site	Exact Location of pipe installation work (Cell/Village)	Result	Remarks
1	Number of meetings organized since the previous monitoring				
2	Personal protective equipment (PPEs) distribution (%)				
3	Keep records of accidents and injuries properly (Yes/No)				

4	Installation of fences, assignment of guards (Yes/No)				

Record of Accidents

No	Date	Details of accidents	Solution / Result / Any actions to be taken

4) Results of interview with village leaders

Result of observations

Name of village:

Date:

Mark: "✔" if mitigation measure is done

No	item	Exact Location of construction site	Mitigation measure is done or not	Remarks
1	Communities get the information on the construction schedule including water suspension schedule			
2	Communities know get the information of traffic management			
3	Installation of signboard			
4	Assignment of guard			

No	item	Responses
1	Job opportunities in villages (number and ratio of women/men workers employed)	
2	Availability of clean water	
3	Air quality	(if it is worsen or not, comparing before construction)
4	Noise problems	(noise level comparing before construction, if there are complaints from villagers, and so on)

5) Record of community meetings

No	Date	Cell/Village Name	Agenda	Number of participants	Q&A

6) Record of Complains

No	Date	Complains	Solution / Result / Any actions to be taken
1			
2			
3			

添付資料 5　テクニカルノート

TECHNICAL NOTE
ON
THE PREPARATORY SURVEY
FOR
THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SERVICES
IN NORTH-CENTRAL KIGALI
IN THE REPUBLIC OF RWANDA

Based on the Minutes of Discussions (hereinafter referred to as "M/D") between Water and Sanitation Corporation (hereinafter referred to as "WASAC") and Japan International Cooperation Agency (hereinafter referred to as "JICA") signed on 16th November 2021, the consultant members of the JICA Preparatory Survey Team (hereinafter referred to as "JST") had a series of discussions and field surveys with WASAC.

As a result of the discussions and the surveys, both sides confirmed the technical conditions described as per the attached.

It should be noted that this technical note does not mean the commitment of the project scope, project implementation, design, and method to be implemented. The final project scope, project implementation, designs, etc. will be decided by the Government of Japan.

Kigali, June 1st, 2022

Appendix: Technical Consideration

松原康一	
Mr. Matsubara Koichi Consultant Team Leader JICA Preparatory Survey Team	Mr. Methode Ratugungira Director of Urban Water Supply and Sanitation Water and Sanitation Corporation The Republic of Rwanda

1

Appendix. Technical Consideration

Both parties agreed and confirmed the following items.

1. Target Area and Design Conditions

The target area for this project is shown in **Table 1** and **Figure 1**. The target area is the area to improve the water supply system and thus the area for the investment of the facility. The project assumes NRW reduction from 40.3%[1] to 23% by the extensive rehabilitation and expansion of the facilities. The completion of the project is expected to be in the year 2025, its target year for water demand was set as 2030, five years after the completion, in accordance with the benchmark year of the Kigali Water Supply Masterplan.

Table A1. Target Year and NRW

Target Year of Project Completion	2025
Target Year	2030
Target for Non-Revenue Water per connection per	23%[2]

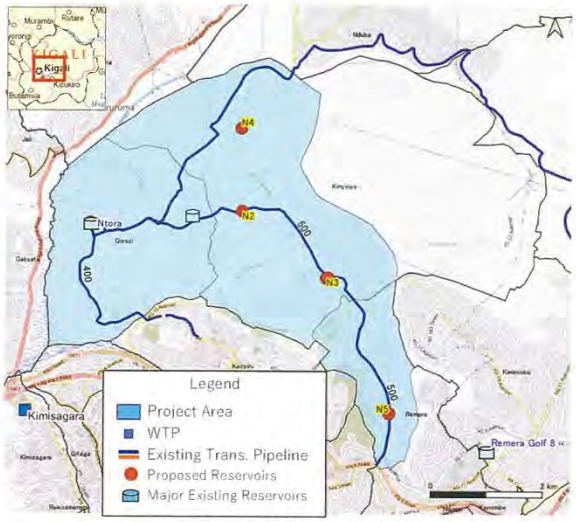


Figure 1 Target Area

2. Discussion on the target area

(1) The project initially assumed expansion of transmission pipeline from Nyarutarama to Remera Golf 8 due to the severe water restriction surrounding the area. However, the water interruption around the area has been already improved by the successful completion of the Kanzenze WTP. JST recommended to focus the facility improvement in the target area (Figure 1).

(2) WASAC advised that the pipeline connecting the ND500mm at Nyarutarama to Remera Golf 8 is still important because the water management will be more flexible by the pipeline. Based on the comment, JST studied the routes and feasibility of the pipeline laying as shown in **Figure 2**. As a result of field reconnaissance JST recommends including the pipeline in the scope of the work of the project and conducted the EIA study.

---

[1] NRW ratio in the area is as of the data in Feb. 2022. The verification will be finalized in March. 2022.

[2] Target leakage amount is 150 liter/connection/day as per the water demand in 2030 (15,400 m3/day on billed amount basis).

(3) As a result of cost estimate, it was found that the transmission pipeline cannot be included in the scope of the work. Therefore, JST will not further propose the pipeline into the scope of the work.

Figure 2 Selection of the Route from Nyarutarama to Golf 8
***OMITTED FROM THE GRANT. EIA HAS BEEN CONDUCTED.**

3. Location of Distribution Reservoirs

- JST proposed the location of distribution reservoirs as shown in **Attachment-A**. WASAC has confirmed the proposed sites by field reconnaissance and agreed to construct the reservoirs and elevated tanks on those sites conceptually.
- WASAC will check the availability of the lands for the four reservoirs listed below, for checking the landowner and the budget for land acquisition.

Table 2 List of Reservoirs/Elevated Tank

Code	Name	Type and Capacity	Description
N2	Kagugu	Elevated Tank, 500m3	The elevated tank is to supply water to the entire Kagugu hill including the Kadobogo village. The selected land is located along the main road KG14 near the church (Catholic Church Centrale Kagugu).
N3	Gacuriro	Elevated Tank, 500m3	The elevated tank is to supply water to the top of Gacuriro hill where the water pressure is not enough by the existing reservoir, and currently supplied water by the by-pass from transmission pipeline.
N4	Batsinda	Ground Reservoir, 1,000m3	The reservoir is to supply water to the new development areas at the Batsinda commercial area and surrounding residential areas with high development (R3). The location is at the top of the village named Muhororo.
N5	Nyarutarama-South	Elevated Tank, 200m3	The elevated tank is to supply water to the top of the southern part of Nyarutarama sector where the water pressure is not enough by the existing reservoir, and currently supplied water by the by-pass from transmission pipeline.

- Design details of the reservoir, elevated tanks, and their capacity will be subject to review by JICA and may be adjusted according to their comment.

4. Distribution Block Zoning and Pipeline Routes

- JST proposed the distribution block zoning and pipeline routes for rehabilitation which are equal to or more than 160 mm shown in **Attachment A**. The pipeline routes were presented to WASAC in December 2021 and were commented by WASAC. The water demand and its allocation, and other considerations for designing the distribution blocks are elaborated in **Attachment B. Design Conditions and Target for the Project**.

5. Draft Scope of Works

- The draft scope of works is proposed in **Attachment C Draft (Proposed) Scope of Works.** The scope of works covers the reservoirs or elevated tanks at the key locations of new Distribution Blocks to be constructed, primary and secondary distribution pipelines, tertiary pipes and fittings, valves necessary for operation and monitoring systems. Water meters are also necessary for reducing the apparent loss (commercial loss) and augment the customer reliability to WASAC.

- Budget constraint is foreseen because of the price hike of raw materials and oils, transportation. In case the budget is in short, a cost reduction measure shall be applied to the scope of works according to EITHER (1) or (2). WASAC advised that replacement of service connection and meters shall be prioritized and kept in the scope of works.

Cost reduction measures:

(1) Nyarutarama elevated tank and the major pipelines in the Nyarutarama may be omitted.
(2) Gacuriro elevated tank and the major pipelines in the Gacuriro may be omitted.

- It should be noted that the major part of the installation of the works for the secondary and tertiary pipes shall be covered by the WASAC to facilitate the implementation of the work. JST and WASAC noted that the components and quantities will be subject to JICA's review and modification.

Table 3. Demarcation of the Work

Item	Dia. (mm)	Procurement	Installation
Primary Main	160-350	Grant	Contractor
Secondary Pipes	63-110	Grant	WASAC*
Tertiary Pipes	20-32	Grant	WASAC*
Customer Water Meter		Grant	WASAC*
Meter Box	-	WASAC*	WASAC*

* Some areas (e.g. Batsinda) will be proposed as the scope of work for the Grant Aid to transfer the construction technique to WASAC's own team/contractor)

6. Draft Undertakings by WASAC

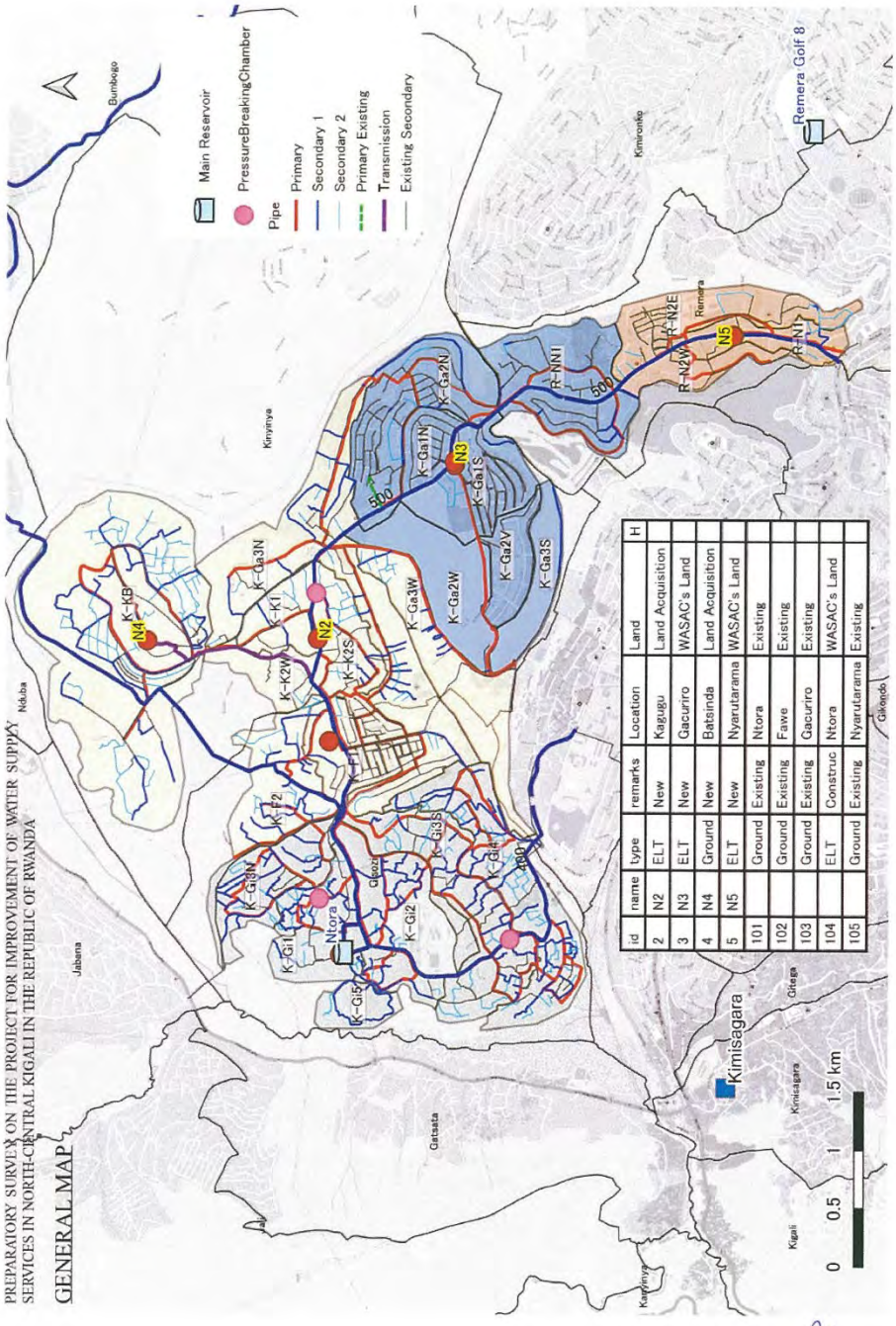
- JST estimated the draft undertakings by the WASAC side as below. The full list of undertakings with their cost will be proposed at the Draft Outline Design (DOD) scheduled in August 2022.

No.	Item	Description
1	Land acquisition	Three locations (Batsinda, Kagugu, ULK).
2	Stockyard and soil disposal site	In or around the Target Area.
3	Labors/Contractors to install distribution sub-mains and customer connection replacement	Approx. 5 construction teams for two years, fully controllable by WASAC Technician/Engineer.
4	Engineer/Technician to supervise and manage the construction works borne by WASAC	Deployment of a dedicated Engineer/Technician at both Kacyiru and Remera branches is strongly recommended.
5	Tax	Import tax (necessary arrangement for deferred payment if applicable), VAT,
6	Electricity and Communication Connection/Tariff	Connection and Subscription fee for Optic/GPRS communication etc.
7	Others	- Long-term contract with electric supplier for maintenance of meters (if applicable).

Attachment A

PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SERVICES IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA

GENERAL MAP



id	name	type	remarks	Location	Land	H
2	N2	ELT	New	Kagugu	Land Acquisition	
3	N3	ELT	New	Gacuriro	WASAC's Land	
4	N4	Ground	New	Batsinda	Land Acquisition	
5	N5	ELT	New	Nyarutarama	WASAC's Land	
101		Ground	Existing	Ntora	Existing	
102		Ground	Existing	Fawe	Existing	
103		Ground	Existing	Gacuriro	Existing	
104		ELT	Construc	Ntora	WASAC's Land	
105		Ground	Existing	Nyarutarama	Existing	

Attachment B. Design Conditions and Target for the Project

(1) Water Demand and Allocation

Table B-1. Water Demand Projection based on Kigali Water Supply Masterplan

m3/day

District	Sector	2021	2030
(1) Yearly average water demand borne by Ntora Reservoir			
Gasabo	Gisozi	2,801	4,562
	Kinyinya	5,864	12,011
	Remera	4,662	7,950
	Kimironko	6,379	11,329
	Jabana	1,906	3,585
	Kacyiru	3,158	5,009
	Kimihurura	2,342	3,669
	Bumbogo	3,539	8,392
	Nduba		2,711
	Ndera※		6,000
total		30,700	65,200
(2) Yearly average water demand of Study Area		11,600	21,300
(3) Planned NRW ratio in Masterplan		30.0%	23.7%
(4) Water Demand as Billed Water Consumption		8,100	16,300

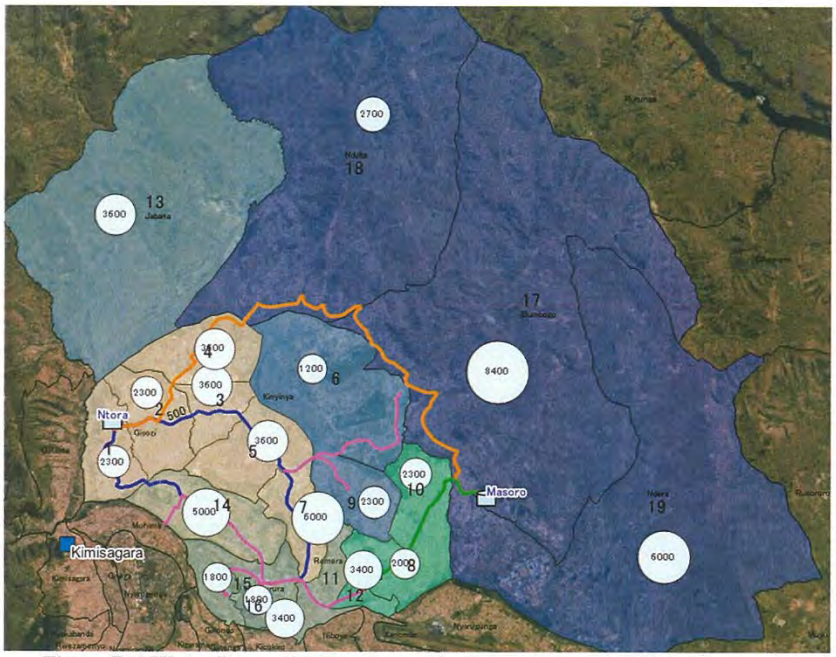


Figure B-1 Water Demand Allocation of the demand borne by Ntora Reservoir (Average water demand in 2030)

Table B-2 Basic conditions of the target area

Item	2021	2030
Non-Revenue Water	43%	20%
Water Distribution Amount (m3/day)	12,910	20,300
Billed Water Consumption (m3/day)	7,380	16,300
Number of Service Connections	15,500	23,200
Number of Households with On-plot Water Supply	31,000	46,400
Served Population	124,000	185,600
Average water consumption per connection (m3/day)	0.48	0.70

(2) Design Principles

Distribution Blocks

- "Distribution blocks" shall be established which are 1) individually district metered at an entry point of water, 2) controlled dynamic pressure within the block with appropriate ranges.
- Maximum static pressure shall not exceed 100 mAq (10 bar).
- Minimum dynamic pressure at the entry point at the peak time shall be not less than 10mAq (1 bar).
- A reservoir, elevated tank, or a Pressure Breaking Chamber (PBC) at an entry point of the Distribution Block. The pressure-reducing valves can be only used for small areas (equal to or less than 100mm in diameter) for it requires frequent maintenance.
- Standard pipe materials for transmission pipes will be DIP and those for distribution pipes shall be HDPE

Distribution Mains and Secondary Pipes

- The diameter for distribution mains shall be 150mm.
- The line valves shall be placed at the branch of the distribution main and the branch.
- Distribution Mains shall have at least one washout.

Block Distribution Reservoirs

- A Block Reservoir should have at least a capacity of three hours of daily maximum water supply amount.
- The inflow control to the reservoir shall be a motorized valve automatically controlled in coordination with the reservoir level.
- The block reservoirs have at least 3 hours of the daily maximum water demand.
- The flow rate at the inlet and levels of the reservoirs shall be monitored at the water management center at the UWSSD. The monitoring screen image shall also be monitored at the customer center at WASAC HQs which is operating business 24 hours.

Attachment C. Proposed Scope of Works

Table. Proposed Scope of Works

Construction	
1. Reservoirs and Elevated Tanks	4 locations Kagugu*1: Elevated Tank, 500 m^3 Batsinda*1: Ground Reservoir, 1,000 m^3 Gacuriro: Elevated Tank, 500 m^3 Nyarutarama: Elevated Tank, 200 m^3
2. Pressure Breaking Chambers	4 locations (Approx. 3m x 4m each)
3. Transmission and Distribution Pipelines	61.8 km* (ND160-350)
4. Secondary and Tertiary Pipe at selected sites	Batsinda Area
5. Modification to Existing Transmission Mains from Ntora Reservoir	Line Valves and Washout on existing pipelines (ND400 and ND500)
6. Flowmeter, Level Gauges and Monitoring Systems	Flowmeter: 25 locations Level Gauges: 12 locations Monitoring System, Display
Equipment	
1. Secondary Pipes	HDPE ND63-110: 88.3 km*
2. Tertiary Pipes, Fittings and Connections before the water meter	HDPE ND25 (3/4"): 150 km* - Water meter: 7,500 - Branch saddle, valves and miscellaneous - Equipment necessary for construction
3. Others	Equipment for Maintenance and Leakage Detection etc.

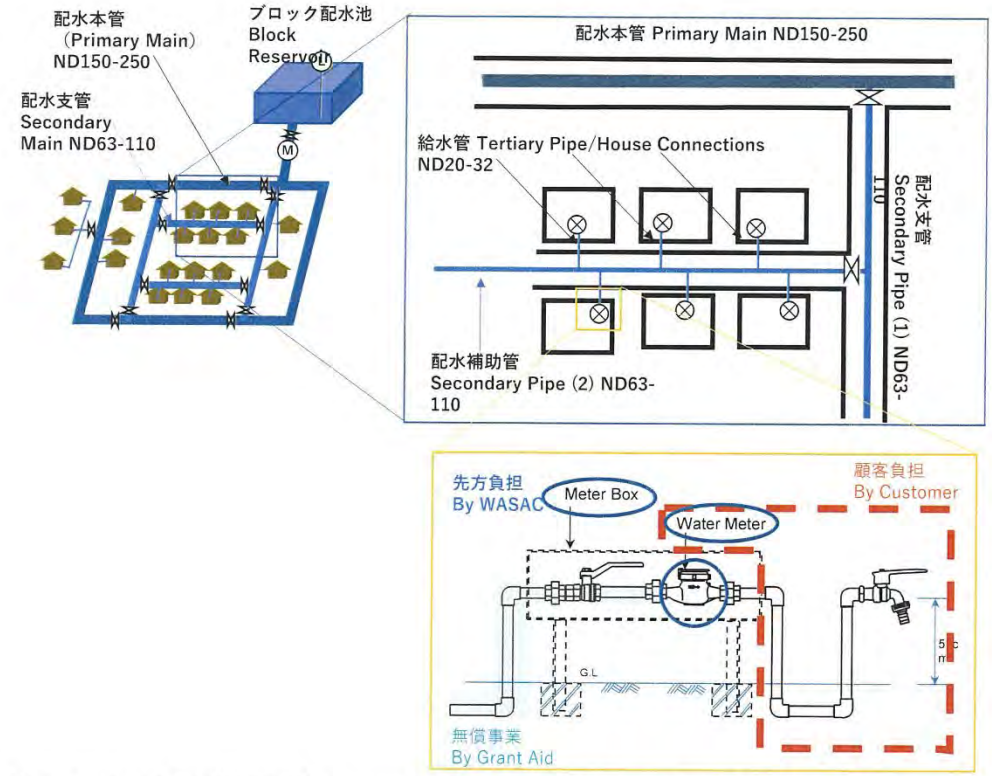
Cost reduction measures in case there is budget constraint:
(1) Nyarutarama elevated tank and the major pipelines in the Nyarutarama may be omitted.
(2) Gacuriro elevated tank and the major pipelines in the Gacuriro may be omitted.

The measure either (1) or (2) shall be applied.

Note: All quantities are a draft proposal by the consultant. The components and quantities will be subject to JICA review and modification.

*1 Land acquisition is necessary
*2 The quantity may be revised during the detailed design
ND: Nominal Diameter

C1



* Some areas (e.g. Batsinda) will be proposed as the scope of work for the Grant Aid to transfer the construction technique to WASAC's team/contractor)

Figure C-1. Work Demarcation

C2

添付資料 6　環境社会配慮報告書（EIA）および簡易住民移転計画（ARAP）

Japan International Cooperation Agency

FINAL REPORT

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) FOR THE PROPOSED PROJECT OF IMPROVEMENT OF WATER SUPPLY SERVICES IN NORTH-CENTRAL KIGALI.

Prepared by:

BUREAU FOR ENVIRONMENTAL AND ENVIRONMENTAL STUDIES/ BESST Ltd
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July 2022

DISCLOSURE OF THE CONSULTANT

I hereby undertake that all requirements included in terms of reference provided by the client and approved by Rwanda Development Board (RDB) for the preparation of Environmental Impact Assessment for Improvement of Water Supply Services in North Central Kigali complied with. I also undertake that the facts given in this ESIA report are factually correct to the best of our knowledge.

Théogène HABAKUBAHO
Managing Director/ BESST LTD
Certified Lead Environmental Practitioner
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Kigali-Rwanda

EXECUTIVE SUMMARY

Project background

Water and Sanitation Corporation (WASAC Ltd) with the support from Government of Japan through Japan International Cooperation Agency (JICA) have achieved a series of actions in water supply sectors. This includes the rehabilitation of water transmission pipelines for strengthening transmission capacity from the city's largest Nzove WTP to the Ntora Reservoir, technical cooperation for non-revenue water (NRW) reduction, as well as the formulation of the Kigali Water Supply Master Plan (KWSMP). The main objective of these interventions for efficient and effective facility development from a long-term perspective. In this regard, another priority project identified under KWSMP is the development and renewal of water transmission and distribution facilities in the section between Ntora Reservoir and Remera Golf 8 Reservoir. In compliance with national environmental regulations and JICA guidelines for environmental and social considerations, such project requires an environmental Impact Assessment Study.

Objective of the Environmental Impact Assessment (EIA)

Some of the proposed activities such as construction and expansion of existing reservoirs and replacement of distribution water pipelines may have environmental and social impacts on receiving environment and surrounding communities. Therefore, the objective of this study is preparing an Environmental Impact Assessment (EIA) including an Environmental Management Plan (EMP) to meet both national environmental regulations and JICA guidelines for environmental and social consideration and other international best practices. This serves to ensure that the project is implemented in an environmental and social sustainable manner and in full compliance with Rwandan and JICA Environmental and Social requirements.

Approach and methodology used for the study

To achieve the study objectives, the consultant followed procedures stipulated in the general guidelines and procedures for conducting EIA studies in Rwanda, JICA guidelines as well as World Bank Safeguards Policies as recognized under JICA guidelines. The study adopted the following approach: (i) preliminary assessment and review of project designs, (ii) review of secondary data on baseline information (iii) review of policies and regulations, (iv) consultations with stakeholders, (v) interviews with key stakeholders, and (vi) field surveys and assessments at the project sites.

Project location and description

The proposed project will be implemented in Kigali City, Gasabo district, Gisozi sector (Musezero and Ruhango cells); and Kinyinya sector (Gacuriro and Kagugu cells). The project also has a section of Nyarutarama – Golf 8 Reservoir located in Remera Sector (Nyarutarama and Nyabisindu cells). The project consists at construction of grounded water reservoirs (Kagugu and Batsinda sites) and elevated tanks at Nyarutarama and Kibagabaga sites as well as constructions of 5 pressures breaking chambers. It also includes construction of water transmission and distribution pipelines of around 57 km (with dimension varying between ND 160-300); modification of the existing transmission main from Ntora reservoir (ND 400 and ND 500) and the installation of flowmeters, level gauges and monitoring system.

Prediction and assessment of potential impacts

The project is expected to have both positive and negative socio-environmental impacts. Positive impacts expected from the project implementation include but not limited to: reduction of water losses, increased accessibility to treated and clean water, improvement of water distribution systems via decreasing of non-revenue water and increasing energy efficiency, improved sanitation, temporary and permanent jobs creation and employment opportunities, income generation to the local population, transfer of knowledge from skilled to non-skilled people who may interact with the project activities; increasing of social welfare, etc.

Anticipated adverse impacts range from physical environment impacts, biological impacts and social impacts and include air and noise pollution, disturbance of normal traffic, possible site injuries and accidents, possible soil erosion at the construction works, water pollution and loss of biodiversity etc. Adverse social impacts include social disturbance, temporally loss of land, permanent loss of land at Batsinda site, possible loss of ornamental trees at the pipeline routes and possible loss of income during construction period.

Mitigation measures for each of adverse impact identified and projected were proposed to an extent that they can be avoided, reduced, limited, or eliminated and therefore manageable. In this context the Environmental Management Plan (EMP) and an Environmental Monitoring Plan indicating the mitigation measures, procedure to be followed,

monitoring indicators, the responsible institutions to implement these measures and estimated cost of implementation were also provided.

Taking into consideration the nature and location of the project, the project works as well as the identified potential impacts, the consultant can conclude that the adverse impacts identified can be avoided, mitigated, and eliminated by the implementation of appropriate mitigation measures. In fact, the project of improvement of water supply services in north-central Kigali is bound to be executed in a sustainable manner and in compliance with national environmental regulations, JICA environmental and social considerations as well as other international environmental and social safeguards policies.

Therefore, to meet the study objectives requires full implementation of proposed mitigation measures and regular monitoring as per the proposed Environmental Management Plan (EMP) and Environmental Monitoring Plan as proposed in this report. The total estimated budget for the implementation and monitoring the EMP is 13,900 USD for the installation and transmission of the pipes, 24,900 USD for the construction of water tanks and reservoirs and replacement of distribution pipes, and 21,800 USD for the implementation of monitoring of the Nyarutarama –Golf 8 reservoir section. These amounts are indicative budget based on similar projects or consultant experience. Hence contractor shall prepare final budget for the implementation of proposed mitigation measures when required.

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ABBREVIATIONS

BESST	: Bureau for Engineering and Environmental Studies
CEDO	: Cell Economic Development Officer
EDPRS	: Economic Development and Poverty Reduction strategy
EIA	: Environmental and Social Impact Assessment
ESIA	: Environmental and Social Impact Assessment
ESMP	: Environmental and Social Management Plan
GIS	: Geographic Information System
GoR	: Government
GPS	: Global Positioning System
IUCN	: International Union for the Conservation of Nature
IWRMP	: Integrated Water Resources Master Plan
JICA	: Japan International Cooperation Agency
JST	: JICA Study Team
Ltd	: Limited
MININFRA	: Ministry of Infrastructure
MoE	: Ministry of Environment
NGO	: Non-Government Organization
NISR	: National Institute of Statistics of Rwanda
NRW	: Non-Revenue Water
OHS	: Occupational, Health and Safety
RDB	: Rwanda Development Board
REG	: Rwanda Energy Group
REMA	: Rwanda Environment Management Authority
RLMUA	: Rwanda Land management and Use Authority
RURA	: Rwanda Utilities Regulatory Agency
ToRs	: Terms of Reference
WASAC	: Water and Sanitation Corporation

1. INTRODUCTION

1.1. Project background

Government of Rwanda has made sustainable water supply one of the priorities of the National Development Agenda and is establishing supportive policies and legislation in this regard. The main objective of water supply and sanitation policy is to ensure safe, reliable, and affordable water supply services for all 100% by 2024 thereby ensuring universal and equitable access to safe and affordable drinking water for the people while achieving NST-1 along with Sustainable Development Goals (SDGs). The Government of Rwanda with the support from Government of Japan through Japan International Cooperation Agency (JICA) have achieved a series of actions in water supply sectors which include the renewal of water transmission pipelines for the purpose of strengthening transmission capacity from the city's largest Nzove WTP to the Ntora Reservoir, technical cooperation for non-revenue water (NRW) reduction, as well as the formulation of the Kigali Water Supply Master Plan (KWSMP) for efficient and effective facility development from a long-term perspective.

Under KWSMP three priority projects were identified including the rehabilitation and extension of Karenge WTP and supply system, the construction of a new water treatment plant in in Masaka, and renewal of water transmission and distribution facilities in the section between Ntora Reservoir and Remera Golf 8 Reservoir. NRW reduction measurement in the entire city of Kigali is planned under a long-term investment plan with 4 phases during the next 10 years and the present project contributes to the first phase and will be implemented in Kigali city, district of Gasabo, (Gisozi, Kinyinya and Remera sectors).

The implementation of the present project will be conducted via accomplishment of a series of activities which include but not limited to the construction of water storages and water transmission and distribution facilities such as water grounded reservoirs and elevated tanks, construction of water pipelines and equipment required for block systems. There are two transmission pipelines (diameter 500 mm and 400 mm) from Ntora Reservoir. The 500 mm diameter pipeline is connected by gravity flow to Remera Golf 8 reservoir, which is the water distribution base for the eastern area of Kigali where there is a rapid increase of new water demand. This pipeline also supplies water to the emerging residential area at the North-Central part of the city. However, almost all the water supply (average of about 35,000 m^3/day) is consumed before reaching Remera Golf 8 Reservoir, which results in the water shortage in supplied area.

The gap between water consumption and water demand in water supply area of Ntora Reservoir is vast (about 13,000 m^3/day). Therefore, strengthening the capacity of this pipeline along the small-diameter section (with a diameter of 300 mm, about 3.5km length) will increase water transmission amount to Remera Golf 8 reservoir.

1.2. Project developer

As per the law Nº 87/03 of 16/08/2014; Water and Sanitation Corporation (WASAC) Ltd is government entity setup to manage water and sanitation services in Rwanda. The Company was created in the on-going government reform intended to deliver water and sanitation utility sufficiently focused to deliver new water infrastructure; efficient and effective service delivery; build a strong people capability; and meet key national milestones. It was created to reverse the status quo that includes inadequate planning and investments; inefficient and wasteful operations; inadequate institutional management focus; improve viability and autonomy; and establish a sustainable and customer-centric utility to deliver an important mandate that touches people of all walks of life. The mission of the company is providing quality, reliable and affordable water and sewerage services through continuous innovations and detailed care to customers' needs.

1.3. Presentation of the consultant

According to the law on environment, Environmental studies are conducted by practitioners licensed under Rwanda Association Professional Environmental Practitioners (RAPEP). This report was prepared by BESST LTD (Bureau for Engineering and Environmental Studies) under JICA study team. BESST Ltd is a Rwandan company Registered with Rwanda Development Board (RDB) and was subcontracted by JICA. The company is licensed by RAPEP with license number RAPEP/EA/O72 (list certified experts available at www.repep.org). BESST Ltd has its headquarters in Kigali City, Gasabo district, KG 182 st, Martin Plaza, second Floor.
The company is specialized in Environmental studies, Resettlement Actions Plans (RAP), climate change risk assessment, socio-economic assessment, baseline surveys, waste management, water and sanitation, advisory

services in sectors ranging from Agriculture, energy development, Infrastructure and housing development, transport, and water supply. For this specific assignment of preparation of EIA, the company used the following team:

Théogène HABAKUBAHO, Team leader He is an authorized EIA Lead expert (RAPEP/EA/024). He holds a Master of Science in environmental science management and development and BSc in physical geography. He has over 14 year's professional experience in the field of environmental assessment and management. He has worked on various projects as team leader of environmental studies. Key projects worked on include irrigation projects, green house agriculture, Water supply mining projects, road, and bridge construction projects, building and house constructions, schools and hospitals, among others.

NSHIMIYIMANA Fabien, Hydrologist: He is an authorized EIA Associate Expert (RAPEP/EA/035). He- holds a Master of Science in Water resources and environmental science and a BSc in Chemistry. He is a Water Resources Engineer with over 10 years' experience in planning, management, design and construction and supervision of water resources infrastructure. Conversant with water resources studies, Environmental and Social Impact Assessment Studies, hydrological, hydrodynamic and groundwater modelling, GIS & remote sensing

NSEKANABANGA Jovine, Statistician: He is an experienced data collector, analysis, and he has a bachelor's degree in applied statistics with over five years of experience in data collection and analysis. He supervised socio-economic data collection, data entry and conducted data analysis.

NZAMURAMBAHO Etienne, surveyor: He is an experience land surveyor with bachelor's degree in land survey and diploma in topography. He coordinated assets inventory and identification of project affected people and he was tasked assignment related to project maps reproduction.

Team of socio-economic surveyors composed by a group of experienced personnel in data collection, data analysis and interpretation with an experience ranging from 5 years to 8 years in socio-economic survey. The team was composed by Mrs Emma BENEMARIYA, KWITONDA Aimable Clément, BYUKUSENGE Gabriel, Jeanne d'Arc UWANYIRIGIRA, NIYITANGA Egide, TUYISINGIZE Jean Paul, NIRAGIRE Aime Pauline and UWASE Djamila.

1.4. Objectives of the study

The overall objective of this study is to prepare an Environmental Impact Assessment (EIA) report and Environmental Management Plan (EMP) for the proposed project. The social and environmental assessment was also done with the aim to:

- Identify and evaluate environmental and social risks and impacts of the project implementation.
- Propose mitigation measures to anticipate and avoid, or where avoidance is not possible, minimize and, where residual impacts remain, compensate for risks and identified impacts to workers, affected and local community and the environment in general.
- Identify key stakeholders and their responsibilities before and during the project implementation.

1.5. Scope of the study

The study covered the impacts of the project from planning phase, construction and operational phases and considered the decommissioning phase of the project with considerations of the project sites and its surroundings. This EIA study was prepared in compliance with national and international environmental regulations and JICA guidelines for environmental and social considerations. To this extent, the scope of the study was to:

- Identify legislation, policies (both local and international) that are likely to influence the implementation of the project;
- Develop an overview of the baseline environment of the project intervention area. i.e. study area description, physical, biological and social- economic-environment etc.;
- Description of the likely significant impacts (both positive and negative) of the proposed project that could be caused by the project implementation on environment and local community;
- Description of the methods used in the analysis, description, and classification of the impacts;
- Description of impacts on human health especially during the construction phase;
- Propose mitigation measures against the predicted adverse impacts; and
- Propose an Environmental Monitoring Plan with measurable indicators and parameters for the mitigation measures to ensure sustainability of the project

1.6. Approach and methodology

To achieve the study's objectives, consultant followed procedures stipulated in General Guidelines and Procedures for Environment Impact Assessment. The methodology used involve several stages from scoping phase and these include preliminary assessment to understand and establish boundaries of the study area; desk review, field visits, stakeholders' consultations, analysis of primary and secondary data, analysis of alternatives, prediction of both positive and negative impacts, as well as the proposal of mitigation measures leading to an Environmental and Social Management and Monitoring plan. These steps were followed as per the requirements of the Organic law N° 48/2018 of 13/08/2018 on Environment determining the modalities of protection, conservation, and promotion of environment in Rwanda, the Ministerial order No 001/2019 of 15/04/2019 establishing the list of projects that must undergo environmental Impact assessment, instructions, requirements, and procedures to conduct environmental impacts assessment and JICA guidelines on Environmental and Social considerations. The followed methodology is detailed as follow:

1.6.1. Preliminary assessment/ scoping study

Scoping study involved the consultation with WASAC Ltd and JICA team. Initially, a field visit was conducted at the proposed project sites including at the location of project infrastructures to understand the project context area and the proposed infrastructures and their receiving environment. The scoping exercise further covered the following:

- To establish clear boundaries of the study and focus on relevant issues concerning the study.
- Preliminary findings of the existing environment; (physical, biological, and socio-cultural environment)
- Preliminary prediction of likely positive and adverse impacts.

1.6.2. Field surveys

Field surveys were conducted in different phases with the aim to assess the baseline physical and biological environmental of the project areas and to identify environmental and socio-economic components that are likely to be significantly affected by this proposed project. During field surveys, basic data and information on the biological and physical resources were collected. The socio-economic data were collected during the socio-economic survey that was also conducted as one standalone component of the project components.

1.6.3. Documents review

Secondary data and legal framework were mainly collected on existing institutional legislation, policies, plans and programs which are likely to influence different parts of the implementation of the present project. Key legal instruments consulted include but are not limited to the:

- The law N° 48/2018 of 13/08/2018 on Environment in Rwanda.
- Ministerial order N° 001/2019 of 15/04/2019 establishing the list of projects that must undergo environmental Impact assessment, instructions, requirements, and procedures to conduct environmental impacts assessment.
- National Water Resources Master Plan;
- National Land Use Development Master Plan;
- Kigali Water Supply Master Plan;
- Water supply and sanitation policy;
- Preliminary project designs

In addition to national policies and regulations influencing this project, international policies, and standards especially JICA guidelines on environmental and social consideration were also considered during the study.

1.6.4. Public Consultation with stakeholders

Information collected from the preliminary desk review, preliminary consultation with JICA study team and WASAC Ltd helped the consultant team to identify the project key stakeholders. Without chronological priority, these stakeholders were identified in three categories. (1) First category of Government officials, (2) Second category of local government officials and (3) Third category of households that are likely to benefit or be affected by the project implementation.

1.6.5. Impacts Assessment

The prediction and analysis of project impacts involved assessment of the entire project cycle in its different phases i.e., project mobilization, construction, operation, and decommissioning phases. Impact assessment applied several tools and techniques to determine the nature (positive or negative), direct or indirect, extent (spatial), occurrence (one-

off, intermitted, or constant), magnitude, whether reversible or irreversible, probability of occurrence and significance with and without mitigation. These tools were used to predict and analyze the project impacts:

- *Geographical Information System (GIS)* - used to show the extent of a particular project activity influence on the area by mapping it out.
- *Checklist*- the analysis of project impacts vis a vis project activity was conducted. The impacts that might affect or enhance the livelihood in the project areas were listed and drawn against environment indicators and occurrence.
- *Impact Matrix*- under the impact matrix, the analysis by these tools of GIS, checklist, CBA, were tested against their significant effect on recipients in the project area of intervention. Impact matrix in tabular format was drawn, in which impacts from project activities were tested against their significant effect on the areas of intervention.

For each adverse impact identified, its level of significance was indicated, mitigation measures proposed, and an Environmental Management Plan (EMP) developed.

1.7. Structure of the report

The structure of this report is as follows:

0. Introduction and general background of the project
1. Project description
2. Policy, legal and institutional framework
3. Environmental and socio-economic baseline data
4. Public consultation and participation
5. Project needs and project alternatives
6. Impacts identification, evaluation, and proposed mitigation measures
7. Environmental Management Plan and Environmental Monitoring Plan
8. Conclusions and recommendations

2. PROJECT LOCATION AND DESCRIPTION

As per the ToRs but also referring to best practices, the EIA consultant is requested to describe the proposed project and its activities. The description of project activities was made based on phases of project life cycle i.e. pre-construction, construction, operation, maintenance, and decommissioning phases. This chapter provides the location of the project, projects component/activities in different phases and projects requirements in terms of material or associated facilities.

2.1. Project location

Administratively, the proposed project is in Kigali City, Gasabo district, Gisozi Sector (Musezero and Ruhango cells) and in Kinyinya Sector (Gacuriro and Kagugu cells). The project also has a section of Nyarutarama – Golf 8 Reservoir located in Remera Sector (Nyarutarama and Nyabisindu cells). The map below illustrates the project area:

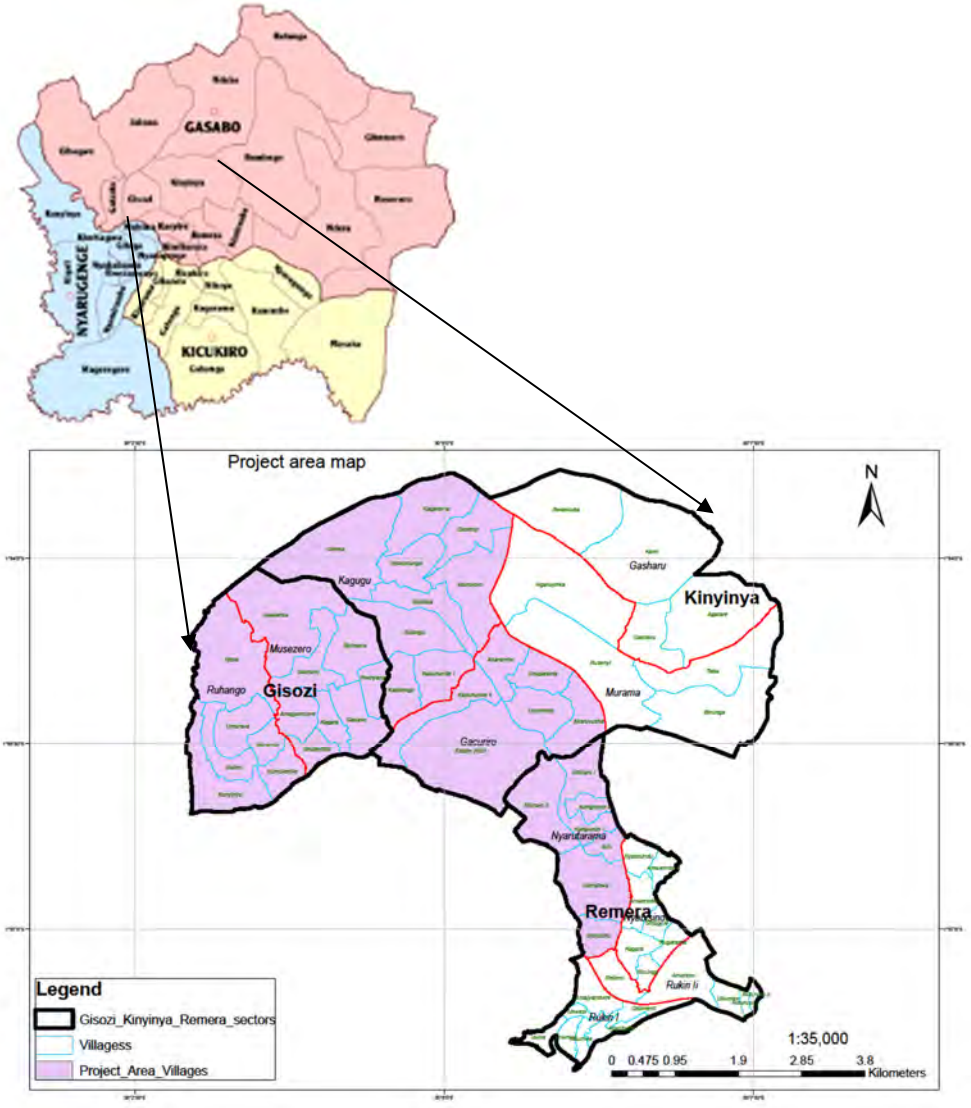


Figure 1: Administrative location of project area
Source: BESST Ltd, 2022

2.2. Project target area

The target area for this project is the area to improve the water supply system and thus the area for the investment of the facilities. The project assumes NRW reduction from 40.3%[1] to 20.9% by the extensive rehabilitation and expansion of the facilities.

The completion of the project is expected to be in the year 2025, its target year for water demand was set as 2030, five years after the completion, in accordance with the benchmark year of the Kigali Water Supply Masterplan.

[1] NRW ratio in the area is as of the data in Feb. 2022. The verification will be finalized in March. 2022.

Table 1: Target year and NRW

Target Year of Project Completion	2025
Target Year	2030
Target for Non-Revenue Water per connection per	20.9 %[1]

Source: JST, 2022

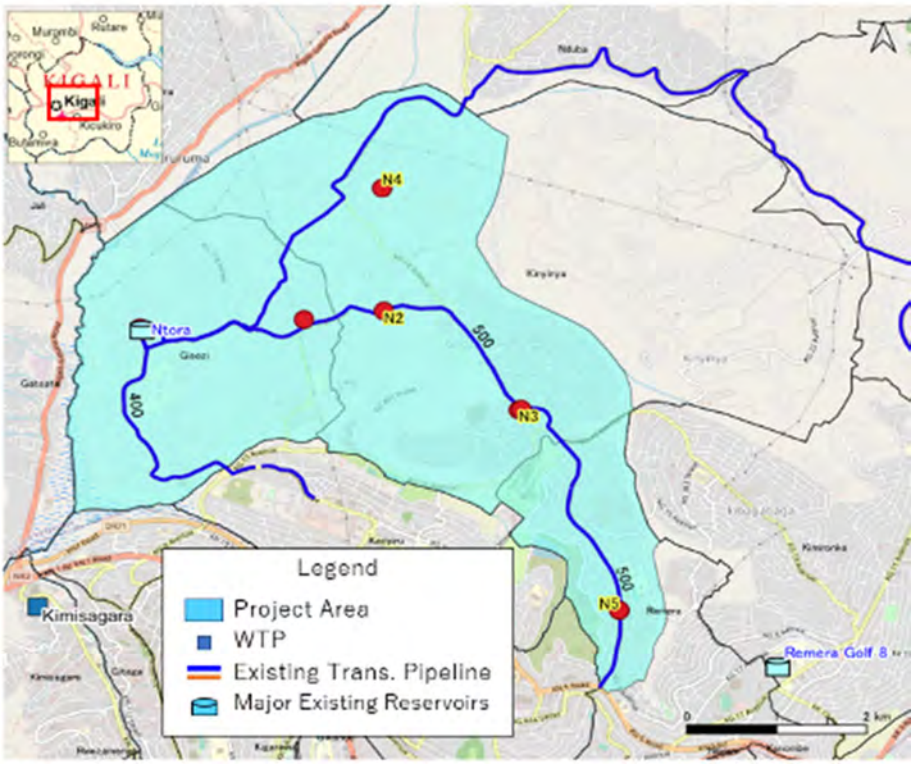


Figure 2: Project target area

Source: Project preliminary Design, JST, 2022

The project initially assumed expansion of transmission pipeline from Nyarutarama to Remera Golf 8 due to the severe water restriction surrounding the area. However, the water interruption around the area has been already improved by the successful completion of the Kanzenze WTP. JST recommended to focus the facility improvement in the target area as shown in fugre2 above. Meanwhile, WASAC advised that the pipeline connection the ND500mm at Nyarutarama to Remera Golf 8 is still important because the water management will be more flexible by the pipeline. Based on the comment, JST studied the routes and feasibility of the pipeline laying as shown in Figure 2. As a result of field reconnaissance JST recommends including the pipeline in the scope of the work of the project. The scope of work will be subject to the review by JICA.

[1] The target NRW ratio may be reviewed before finalization. Target Leakage amount is 150 liter/connection/day.

Figure 3: Selection of the route from Nyarutarama to Golf 8
Source: Project preliminary Design, JST, 2022

In case the transmission pipeline to Golf 8 is not deemed appropriated in light of Grant Aid's mission, JST proposes to increase the scope of works for the additional construction in the target area. JST recommended that the installation of some part of the secondary and tertiary pipes shall be included in the scope of the work.

2.3. Project components

The project is made of different components that include the construction of water grounded reservoirs and water elevated tanks, the construction of water pipelines (primary and secondary lines of around 57 km, the construction of the pressure breaking chambers as summarized in the table below:

Table 2: Project components and main equipment

Project components	
1. Reservoirs and Elevated Tanks	4 locations Kagugu*1: Elevated Tank, 450 m^3 Batsinda*1: Ground Reservoir, 1,000 m^3 Gacuriro: Elevated Tank, 500 m^3 Nyarutarama: Elevated Tank, 200 m^3
2. Pressure Breaking Chambers	5 locations (Approx. 3m x 4m each)
3. Transmission and Distribution Pipelines	Approx. 57 km (ND160-300)
4. Secondary and Tertiary Pipe at selected sites	Batsinda Area
5. Modification to Existing Transmission Mains from Ntora Reservoir	Line Valves and Washout on existing pipelines (ND400 and ND500)
6. Flowmeter, Level Gauges and Monitoring Systems	Flowmeter: 25 locations Level Gauges: 12 locations Monitoring System, Display
Equipment	
1. Secondary Pipes	HDPE ND63-110: 95km
2. Tertiary Pipes, Fittings and Connections before the water meter	HDPE ND25 (3/4"): 85km - Branch saddle, valves and miscellaneous - Equipment necessary for construction
3. Connection Materials for Poor Customer and Meters	HDPE ND25 (3/4"), Branch saddle, water meters, valves and miscellaneous equipment
4. Others	Equipment for Maintenance and Leakage Detection etc.

Note: *1 Land acquisition will be required
ND: Nominal Diameter

The general schematic drawing of the water distribution for the project is given below:

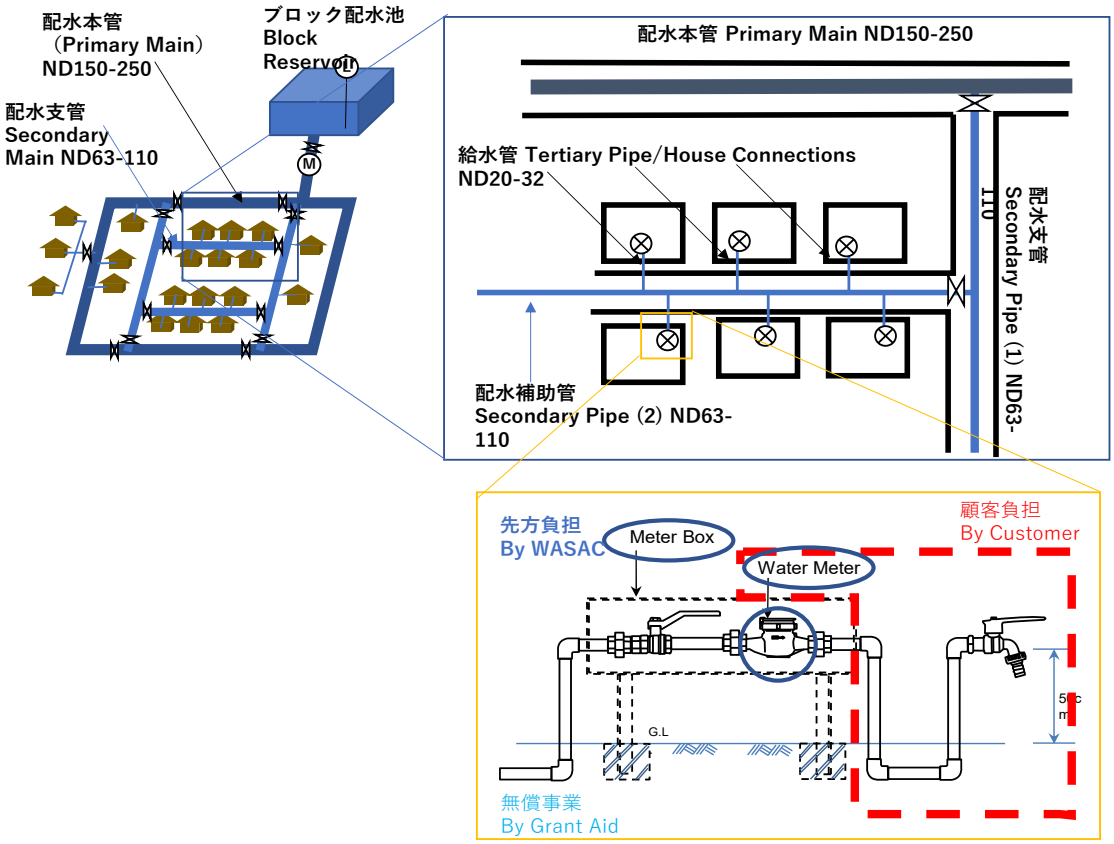


Figure 4: Project Water Distribution Schematic drawing
Source: Project preliminary Design, JST, 2022

2.4. Description of the project

The scope of works covers the reservoirs or elevated tanks at the key locations of new distribution Blocks to be constructed, primary and secondary distribution pipelines, tertiary pipes and fittings, valves necessary for operation and monitoring systems. Water meters are also necessary for reducing the apparent loss (commercial loss) and augment the customer reliability to WASAC. The proposed project will consist at construction of 5 different water grounded reservoirs and elevated tanks as described in the table below (table 2) as well as the construction of 5 pressures breaking chambers, the construction of water transmission and distribution pipelines of approximately 57 km (dimension varying between ND 160-300); the modification of the existing transmission main from Ntora reservoir (ND 400 and ND 500) and the installation of flowmeters, level gauges and monitoring system. As the project will follow the existing pipeline and taking into consideration that mostly project activities will be done around the existing roads, there are no access roads that shall be constructed as most efforts have been made to use the buffer zones and walkways to construct project structures.

Table 3: Summary of the project description

Name	Type and Capacity	Required land (sqm)	Description
Kagugu	Elevated Tank, 500m^3	450	The elevated tank is to supply water to the entire Kagugu hill including the Kadobogo village. The selected land is located along the main road KG14 opposite the church (Catholic Church_ Kagugu Parish).
Gacuriro	Elevated Tank, 500m^3	450	The elevated tank is to supply water to the top of Gacuriro hill where the water pressure is not enough by the existing reservoir, and currently supplied water by the by-pass from transmission pipeline.
Batsinda	Ground Reservoir, 1,000m^3	1,000	The reservoir is to supply water to the new development areas at the Batsinda commercial area and surrounding residential areas with high development (R3). The location is at the top of the village named Muhororo. The land is located near the church (Catholic Church Centrale Batsinda).
Nyarutarama-South	Elevated Tank, 200m^3	450	The elevated tank is to supply water to the top of the southern part of Nyarutarama sector where the water pressure is not enough by the existing reservoir, and currently supplied water by the by-pass from transmission pipeline.

Source: JST, 2022

The water demand and its allocation, and other considerations for designing the distribution blocks are elaborated in the table below:

Table 4: Basic conditions of the target area

Item	2021	2030
Non-Revenue Water	43%	20%
Water Distribution Amount (m3/day)	12,910	20,300
Billed Water Consumption (m3/day)	7,380	16,300
Number of Service Connections	15,500	23,200
Number of Households with On-plot Water Supply	31,000	46,400
Served Population	124,000	185,600
Average water consumption per connection (m3/day)	0.48	0.70

2.5. Project activities

Different activities will be conducted throughout project implementation and among them include Construction works of elevated water tanks and grounded water reservoirs, replacement of old water transmission and distribution pipes with new pipes and the installation of flow meter as well as the installation of level gauges systems. The project will be based on the following main workings:

2.5.1. Project design principles

The project design principles are summarized in the next table below:

Table 5: Project design principles

Component	Design principles
Distribution Blocks	- Distribution blocks shall be established and are 1) individually district metered at an entry point of water, 2) controlled dynamic pressure within the block with appropriate ranges. - Maximum static pressure shall not exceed 100 mAq (10 bar). - Minimum dynamic pressure at the entry point at the peak time shall be not less than 10mAq (1 bar). - A reservoir, elevated tank, or a Pressure Breaking Chamber (PBC) at an entry point of the Distribution Block. The pressure-reducing valves can be only used for small areas (equal to or less than 100mm in diameter) for it requires frequent maintenance. - Standard pipe materials for transmission pipes will be DIP and those for distribution pipes shall be HDPE
Distribution Mains and Secondary Pipes	- The diameter for distribution mains shall be 150mm. - The line valves shall be placed at the branch of the distribution main and the branch. - Distribution mains shall have at least one washout.
Block Distribution Reservoirs	- A block reservoir should have at least a capacity of three hours of daily maximum water supply amount. - The inflow control to the reservoir shall be a motorized valve automatically controlled in coordination with the reservoir level. - The block reservoirs have at least 3 hours of the daily maximum water demand. - The flow rate at the inlet and levels of the reservoirs shall be monitored at the water management center at the UWSSD. The monitoring screen image shall also be monitored at the customer center at WASAC HQs which is operating business 24 hours.

2.5.2. Mobilization or Pre-construction activities

Pre-construction activities consist at preparatory survey to provide the project orientation, project effectiveness, technical and economic validity of the project, preliminary design, and scope of project as well as the outline of project cost and implementation plan. In our case the pre-construction activities will results in three main outputs including:

- Preliminary technical designs: The preliminary technical designs provide information on size and location of project features, mapping of project area that need to be cleared, associated structure/infrastructure estimates of staff and duration, construction materials and their sources and storing, equipment and tools, etc.
- Environmental Impact Assessment (EIA) including household survey: the environmental impact assessment provides baseline information of the projects area both physical and Social, assess the legal

requirement, identify potential impacts associated with the projects, gives their mitigation measures, and proposes an environmental management and monitoring plan.

- Abbreviated Resettlement Action Plan (A-RAP): the abbreviated Resettlement Action Plan provides information on project land requirements and involuntary resettlement implication. It includes socio-economic status of projects affected household, an inventory of assets that are likely to be affected by projects and proposes mitigation and compensation measures. in our context, the A-RAP was developed at Batsinda plot in Kagugu where a grounded water reservoir of 1,000 m^3 will be constructed and only one (1) PAP affected.

Pre-construction works do not have many environmental and social impacts but provide the basis for deep analysis of potential impact during construction, operation, and decommissioning phases of the project.

2.5.3. Construction phase activities

The construction works will consist at construction of new water reservoirs, installation of water pipes and construction of other project structures. It is important to note that maximum efforts have done during the project designs to use the buffer zone of existing roads while avoiding the creation of new access roads. The total length of the pipes both distribution and transmission to be installed is estimated at 57 km and the total number of reservoirs to be constructed is 5 with varying capacities from 200 m^3 (Nyarutarama) to 1000m^3. (Batsinda). For the water pipelines the area that would be cleared and excavated including the working space would not exceed 2 m width and 1 m depth. The summary of key project activities during construction phase is summarized in sub- sections below:

i. Reservoirs construction activities:

Main project activities connected to the construction of the reservoirs are:

- Site clearance and soil excavation,
- Manufacturing and transportation of construction materials,
- Stones masonry with mortar,
- Concrete mixture,
- Civil engineering works,
- Equipment installation etc.

ii. Pipe installation activities

The installation water pipes will necessitate different activities including:

- Site clearance and soil excavation,
- Roads cut and crossing at same sections,
- Reiver crossing for Nyarutarama to Golf 8 reservoir (at Nyabisindu)
- Manufacturing and transportation of pipes from manufacture to the installation site,
- Pipe installation,
- Repair of damaged road sections,
- Concrete mixing and use for pipes protecting etc.

iii. Construction on public roads and in residential areas

Construction activities to be carried out along the public roads and in residential areas special precautions shall be taken into consideration. Among them include that:

- Pipes shall be laid in the road reserves or the walkways.
- All construction in the public road shall be carried out after approvals of the City of Kigali and in coordination with WASAC personnel
- When the activities will be carried out on public road or closer to residential areas, maximum efforts shall be made to avoid dust caused by construction works.
- Watering exercises by a water tanker shall be made in timely manner, especially in the dry season to suppress dust.
- The contractor shall without delay, clean the road surface if any construction material or refusal is spilled on the road during the haulage or construction works.
- The contractor shall take all necessary precautions to avoid causing damage to roads, properties, lands, trees, roots, crops, boundaries and other features, and the apparatus of other utilities such as REG 's properties.
- The contractor shall be responsible for arranging any road and footpath diversions or closures required and for determining and providing any traffic control measures with the relevant authority. Where the temporary diversions

or closures are required by the construction work, the contractor shall provide and maintain an alternative.

- Road structures shall be as the same as the exiting road design and shall get an approval from the competent authority and be tested appropriately.

iv. Road crossing

The number of road crossing shall be minimized so as not to cause the extensive disturbance of public transport. Considering the nature of the work, the damage to the road is limited because the pipe diameters are small.
The typical cross section of the excavation/pipe laying work is as below.

- The pipes shall be constructed by open cut trench. Therefore, the road shall be cut by the road cutter to minimize the areas of the road cutting and the aesthetic value of the road. The contractor shall not directly break the road by backhoe before cut by the road cutter.
- Pipe shall be carefully installed to avoid the future leakages that might cause the caving under the road and repair works that incurs the re-excavation.
- Pipe bed shall be carefully prepared at planned level using the purchased soft sand to avoid the damage of pipes by gravel or concrete wreckage.
- All pipe structures shall be laid at least one meter under the surface of the road.
- Safety measures are strictly taken both in accordance with the regulations in Rwanda and construction restriction by JICA.
- The road reinstatement shall be done by the certified and experienced sub-contractor to implement the quality construction.
- When the depth of the trench may exceed 1.5m, the temporary retaining (sheeting and shoring) shall be applied to the site so as not to cause the collapse of the trench.

Following are typical road cut section and the excavation pipe laying.

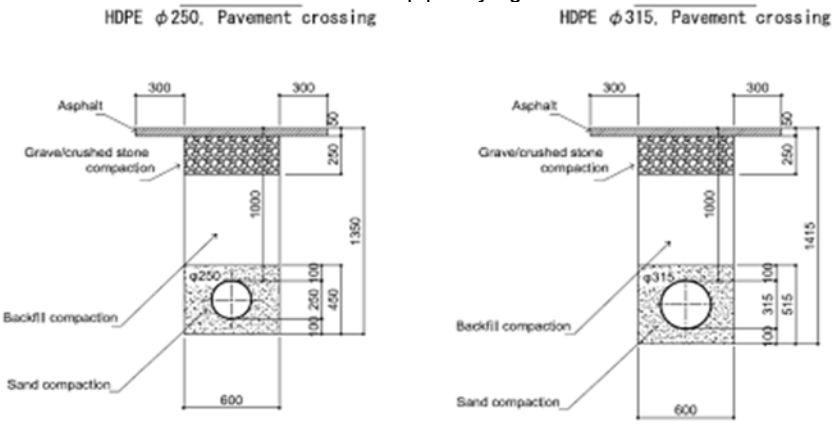


Figure 5: Cross section of the excavation and pipe laying
Source: Project preliminary design, JST, 2022
Figure below presents the project pipeline routes

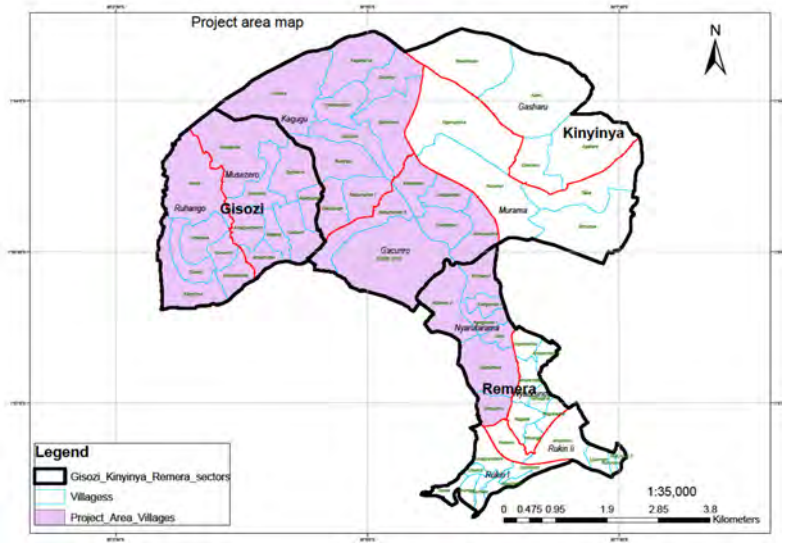


Figure 6: Proposed principal pipeline route and reservoir locations

v. Installation work of water pipes at the steep slope

At steep slope areas, attention will be made to avoid and limit soil erosion. The proposed methods at these areas to limit the soil erosion include:

- The planning of the project activities should be done while taking into consideration to conduct excavation works during the dry season
- Setting safety fence at bottom of the slope made by wooden/steel pile with mesh wire;
- The excavated trenches should be backfilled as soon as the laying of pipes is done
- Properly store and re-use the excavated soil for backfilling
- Setting monorail to carry the dug soil out of the site;
- Manual-excavating and carrying the dug soil;
- Constructing concrete foundation and the stairs to carry the pipes on the foundation.
- Installing pipes and welding joint.
- Fixing pipes by covering with the concrete at some points.

2.5.4. Operation and maintenance activities

After the installation of water pipes as well as the construction of the water reservoirs, no major works are planned during the operation phase. Only monitoring work will be conducted to check any defect or leakage. If any defect or leakage is identified, then rehabilitation works will be undertaken.

2.5.5. Decommissioning activities

Major activities to be considered in this project include movement and demolition of construction facilities such as temporary construction yard, removal of all construction debris and restoration of the project areas. No other major structure that is envisaged to be destructed during the decommissioning phase.

2.6. Construction Nyarutarama to Golf 8 Reservoir section

The section for Nyarutarama to Golf 8 reservoir is considered as potential extension and will be implemented by WASAC if additional funds are secured. Therefore, this section was included in this EIA study to assess potential impacts and possible mitigation measures for any adverse impact occurring at the section. The general schematic drawing of the project transmission system is given in figure below:

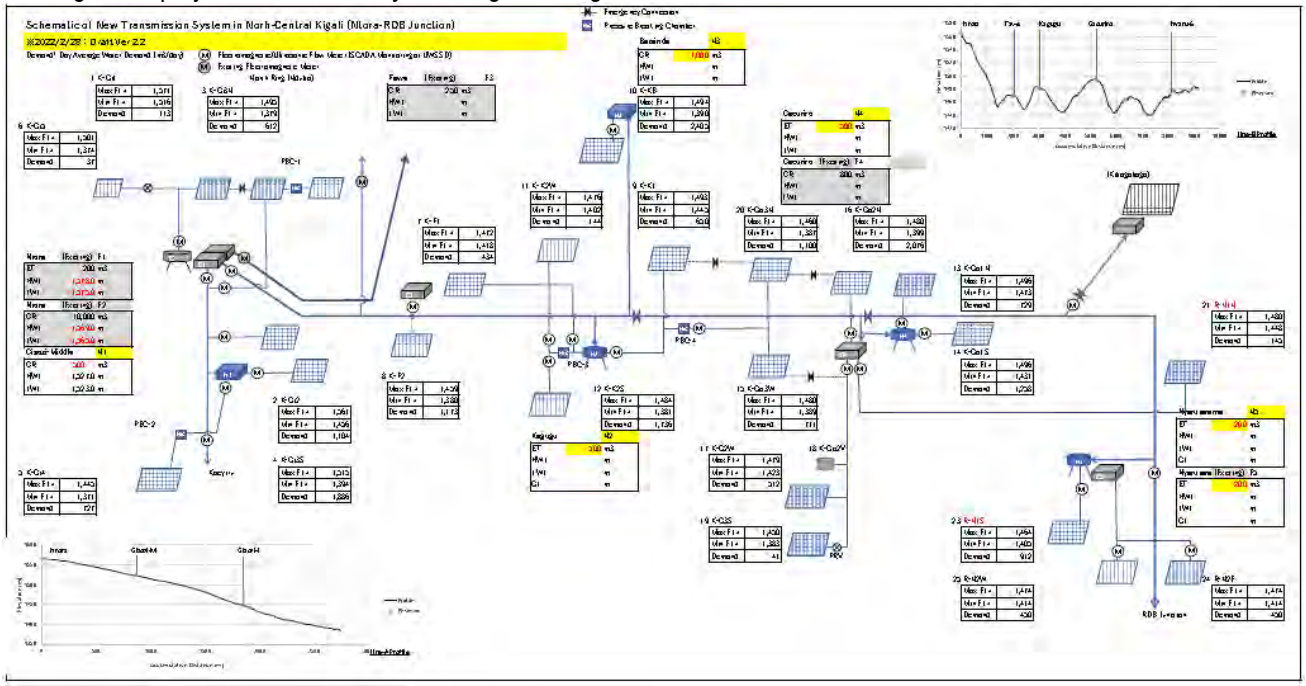


Figure 7: Schematic drawing of the new transmission system in north central Kigali
Source: Preliminary design study, 2022

2.7. Labor camp and storage of construction materials

As per the project design and nature, there would be no labor camp. The project will at maximum employ locals who will be returning at their home after works. Foreigners of the project are also required to return at their residencies after work. This would then attenuate the social and environmental impact connected to labor camp installation. Storage of construction materials such as pipes would be at the existing plot located to the Ntora Reservoir and other site reservoirs such as Gacuriro and Nyarutarama.

2.8. Solid waste from project activities

Different types of solid waste will be generated from project activities and among them include those that are biodegradable and non –biodegradable. Different methods can be used in waste management; however, the best environmental and cost-effective option is recommended while applying waste management hierarchy. To this extent, a temporal dumping site will be allocated at each water tank construction site where solid waste will be separated and collected by an accredited company in waste management. Plastic waste and metals shall be sold to the recycling accredited companies in Rwanda and the excavated soil shall be re-used in backfilling the project sites where possible. The non-re-used and excessive soil shall be dumped at an approved site depending of the site works and to be allocated in advance before project activities in close collaboration with REMA, Gasabo District and the City of Kigali.

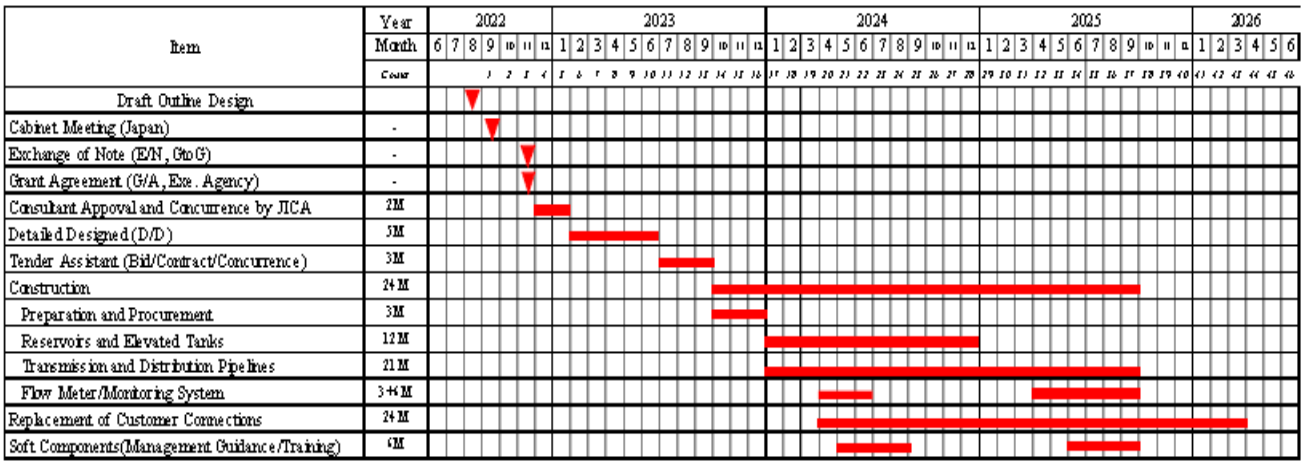
2.9. Project land requirements

The installation of all principal water pipes will follow the existing roads both tarmac and earth roads. Where applicable, pipes will be located under the walkways made to limit the excavation to only 1 m width and 2 m depth to avoid private structures to be damaged. Where not possible compensation will be made to those affected properties such as ornamental trees and other assets. The current design indicates that only one plot of private land will be affected where Batsinda reservoirs will be constructed. Other water reservoirs and tank locations are fully owned by WASAC Ltd (Nyarutarama and Gacuriro). At Kagugu water reservoir site, the land use agreement is available between landowner (RSSB) and WASAC Ltd.

2.10. Project schedule

The project schedule includes preliminary works, project approvals and construction work that will be undertaken both in Rwanda and in Japan. The project schedule is provided in the table below:

Table 6: Project construction schedule



Source: Preliminary design, JST, 2022

3. POLICY LEGAL AND REGULATORY FRAMEWORK

The project of improvement of water supply services in north-central Kigali is owned and will be implemented by WASAC Ltd and is funded by JICA. Taking into consideration the Rwandan environmental policy and regulations as well as the JICA guidelines on environment and social considerations, the project developer is requested to establish an overarching policy defining the environmental and social objectives and principles that guide the project to achieve sound environmental and social performance.

The present chapter of policy, legal and regulatory framework describes policies, laws, regulations, and institutional framework that will oversee the implementation of the project and the implementation of proposed mitigation measures. Both international and national regulations were reviewed to come up with a consolidated legal and regulatory framework to ensure that the project is implemented in compliance with national regulations and international policies and standards.

3.1. National legal, regulatory, and institutional framework

3.1.1. **Summary of legal and regulatory framework**

This project was designed and will be implemented in compliance with existing regulations relevant to environment and social management, water supply, and natural resource management. Key national policies and regulations considered for this project are summarized in the next table below.

Regulations/Policies Standards	**Requirements**
National Legal and regulatory framework	
Environment and climate change policy (2019)	Seeks to integrates environmental aspects into all the development policies, planning and in all activities carried out at the national, provincial and local level, with the full participation of the population, conservation, preserve and restoration of ecosystems and maintenance of ecological and systems functions.
Land policy (2019)	With regard to water supply infrastructure, the implications of this policy relate to resettlement and compensation; assessing the suitability of particular areas for transport infrastructure; and the influence of infrastructure development on the changing value and use of land.
Health Sector Policy (2015)	Priority areas of intervention include strengthening the culture of conducting Occupational Safety and Health related risks assessment and come up with appropriate preventive measures, qualifying Occupational diseases, raising awareness on OSH
National Water Resources Management Policy 2011	The water policy aims at fair and sustainable access to water, improvement of the management of water resources, etc. through reforestation on hillsides and water catchments areas.
Sanitation policies (2016)	Requires enhance storm water management in urban areas to mitigate impacts on properties, infrastructure, human health and the environment and implement integrated solid waste management
National Gender Policy (2010)	Requires Undertaking measure to ensure equal and effective participation of women and men in all environmental protection and natural resources programs and ensure effective dissemination and enforcement of the land law.
National Regulations	
Rwandan Constitution (2003 and amended 2015)	Articulate the rights and responsibilities of all citizens and the role of the state regarding the environment by providing that every citizen is entitled to a healthy and satisfying environment and that every person has the duty to protect, safeguard and promote the environment respectively. Further, stipulates that private ownership of land and other rights related to land are granted by the State.
Law on Environment (2018)	Requires preparing and implement environmental management instruments and get required permits before any construction
Land law in Rwanda (2021)	Determines modalities of allocating, acquisition, transfer, and management of land in Rwanda. It also institutes the principles that are to be respected on land legal rights accepted on any land in the country and all other appendages whether natural or artificial. According to the law, land in Rwanda is categorized into two: individual land and public land. Only one household will be affected, and compensation will be done in accordance with national regulations and JICA guidelines for environmental and social considerations
Ministerial order establishing the list of projects that must undergo an environment impact assessment (2019)	Specify the works, activities and projects that must undertake an environmental impact assessment before being granted permission to commence. Water supply projects fall under projects that should undergo full EIA

Regulations/Policies Standards	Requirements
Law governing biodiversity in Rwanda (2021)	Requires all developers to comply with modalities for management and conservation of biological diversity within Rwanda and provide guidance on biodiversity planning and monitoring, management of ecosystems, endangered and invasive species, and bioprospecting-access and benefit sharing as well as permitting provisions. This project is not expected to have major impacts on biodiversity as only few clearances are expected.
Expropriation Law for Public interest (2015)	Any level, which intends to carry out acts of expropriation in the public interest, shall provide funds for inventory of assets of the person to be expropriated and for just compensation on its budget
Law establishing and organizing the Real Property Valuation Profession in Rwanda	The valuation of land and property incorporated thereon shall be conducted by valuers certified by the Institute of Real Property Valuers in Rwanda
Law on mining and quarry operations (2018)	An EIA Certificate is required for each quarry and borrow pits to be exploited and conditions of approval should be complied with include preparation and implementation of rehabilitation plans.
Law regulating labor in Rwanda (2018)	Requires providing a conducive working environment for the employee and comply with labor and working standards including minimum age, prohibition of child labor, Prohibition of forced labor, Prohibition of sexual harassment, Protection against discrimination at workplace, Right to freedom of opinion and association, employment contracts etc.
Ministerial Order determining conditions for occupational health and safety (2013)	Requires Every employer to ensure the health, safety and welfare at workplace for all persons working in his/her workplace, installation of safety signs, control of air pollution, noise and vibration, Fire-fighting measures, Personnel protective equipment etc.
Ministerial Order determining the list of water pollutants (2013)	Provide the list of water pollutants and requires everyone to avoid any discharge of such pollutant in water bodies.

3.1.2. Instructional framework

In Rwanda there are various institutions involved in environmental management and EIA process and the next table summarizes the role of various institutions connect to this project implementation.

Institution	Roles and responsibilities
Water and Sanitation Corporation Limited (WASAC Ltd)	WASAC Ltd is the entity created by the law Nº 87/03 of 16/08/2014 and to manage water and sanitation services in Rwanda. The entity was created with the aim to deliver water and sanitation utility sufficiently focused to deliver new infrastructure; efficient and effective service delivery; build a strong people capability; and meet key national milestones. It is expected to reverse the status quo that includes inadequate planning and investments; inefficient and wasteful operations; inadequate institutional management; improve viability and autonomy; and establish a sustainable and customer-centric utility to deliver an important mandate that touches people of all walks of life. The mission of the company is providing quality, reliable and affordable water and sewerage services through continuous innovations and detailed care to customers' needs. As implementing agency, WASAC Ltd will play key roles in project implementation but also in the implementation of the Environmental and Management Plan. WASAC Ltd will also be responsible for monitoring of the implementation of mitigation measures and report back to Rwanda Environment Management Authority and JICA.
Ministry of Environment (MoE)	The Ministry of Environment was established to ensure the protection and conservation of the environment and ensure optimal and rational utilization of Water Resources, Lands and Forests for sustainable national development. The ministry has different responsibilities as stipulated in the Prime Minister's Order Nº108/03 of 15/10/2020 determining mission, responsibility's organizational structure, salaries, and fringe benefits for employees of the Ministry of Environment. These responsibilities include: 1. To develop and disseminate the environment and climate change policies, strategies, and programs through the following activities: a. To develop strategies to promote partnership and enhance capacity of private sector to invest in activities of environment and climate change for sustainable economic development. b. To develop laws and regulations to ensure protection of the environment and conservation of natural ecosystems; c. To develop institutional and human resources capacities in environment and climate change. 2. To monitor and evaluate the implementation and mainstreaming of environment and climate change policies, strategies and programs across all sectors, especially productive sectors; 3. To oversee and evaluate institutions under its supervision by providing guidance on the implementation of specific programs to be realized by the institutions under its supervision and local government;

Institution	Roles and responsibilities
	4. To mobilize necessary resources for the development, protection and conservation of the environment for the climate change adaptation and mitigation. The role of the MoE is to monitor and ensure that the project of improvement water supply in North Central Kigali is implemented in a sustainable manner and in line with the existing environmental protection and conservation policies, laws and other legal requirements. In the case that EIA certificate is not issued, project developer may make an appeal to the Ministry of Environment.
Rwanda Environment Management Authority (REMA)	REMA is an institution that was established to implement the environment related policies and laws in Rwanda. Under supervision of the Ministry of environment and from Law N°63/2013 of 27/08/2013 determining the mission, organization and functioning of REMA, it has the legal mandate for national environmental protection, conservation, promotion, and overall management, including advisory to the government on all matters pertinent to the environment and climate change. REMA has different key responsibilities where according to this proposed project, it will: – Closely monitor and assess the project to ensure compliance with the laws on environment; – Participate in the preparation of activities and strategies designed to prevent risks and other phenomena which may cause environmental degradation and propose remedial measures; – Provide, if necessary, advice and technical support in terms of natural resources management and environmental conservation. In this project, REMA will be responsible for overall environmental protection audits and project general overview vis a vis the environmental protection and management compliance. REMA will also play key roles in the implementation of the Environmental Management Plan as key environmental protection regulator.
Rwanda Water Resources Board (RWB)	Rwanda Water Resources Board (RWB) was established by the law N° 71/2019 of 29/01/2020 with the different responsibilities aiming at proper water resources management. Among those responsibilities include: - To implement national policies, laws and strategies related to water resources management; - To advise the Government on matters related to water resources management; - To control and enforce water resources use efficiency; Therefore, RWB will be partner in ensuring a well-managed water resources and advising for water resources efficiency use.
Rwanda Land Management and Use Authority (RLMUA)	RLMUA is an organ responsible for putting in place and operationalizing an efficient system of land administration, use and management that secures land ownership, promotes investment in land for socio-economic development and poverty reduction. Some of the responsibilities of RLMUA include: - Put in place mechanisms which procure security of land tenure for the promotion of investment - Promote proper allocation of land, and proper use of land resources, according to their potential. - Orient land management towards a more profitable and sustainable production, by making good choices among methods of land development. - Develop methods that protect land resources from various types of land degradation. - Establish order and discipline in the allocation of land, as well as in land transactions in order to control the pressure on land, inappropriate development, speculation and trafficking of land. - Involve and sensitize the public at all levels in order to ensure protection of the environment and good management of the land. - Ensure the sustainable use of wetlands. The role of RLMUA in this project is to guarantee the wise use of wetlands located within the project sites (Nyarutarama- Golf8 section) and will play key role in land registration located at the project infrastructures as well as the land transfer process between expropriated land and WASAC Ltd.
Rwanda Development Board (RDB)	RDB was established with the mission of improving the well-being of all Rwandans by fast-tracking development, catalyzing sustainable economic growth, and creating prosperity for all. This a one stop institution bringing together several government bodies in Rwanda focused at promoting investment. RDB is also tasked to review and approve all EIA reports for proposed projects and programs before their implementation. RDB in this project is a key partner as it will be responsible for issuing the EIA ToRs, review the report with aim of approving the study report and ensuing the EIA certificate for the project before implementation.
Rwanda Utility Regulatory Authority (RURA)	Rwanda Utilities Regulatory Authority (RURA) was created with the mandate to regulate: - Telecommunications, information technology, broadcasting and converging electronic technologies including the internet and any other audio-visual information and communication technology. - Postal services; - Renewable and non-renewable energy, industrial gases, pipelines and storage facilities;

Institution	Roles and responsibilities
	- Water supply including tariffs; - Sanitation; - Transport of persons and goods; and - Other public utilities, if deemed necessary. The regulation of water supply activities and other public utilities are among the mandates of RURA which makes it important to this proposed project as it is about the construction of water distribution infrastructures and non-revenue water project.
Gasabo district and Local decentralized entities	Generally, decentralized entities are responsible for the implementation of laws, policies, strategies, objectives, and programs relating to protection, conservation, and promotion of the environment in Rwanda. Article 61 of environmental law state that in the framework of conservation and protection of the environment, decentralized entities are particularly responsible for: - ensuring activities related to better management of land, especially controlling soil erosion and tap rainwater; - Afforestation, protection, and proper management of forests; - efficient management of rivers, lakes, sources of water and underground water; - efficient management and effective use of swamps; - Protection and proper management of reserved areas, historical sites, endangered animal and plant species. Under the General Guidelines and Procedure for EIA Local Governments including Kigali City, and Gasabo district and its respective sectors are tasked to perform the following functions: - Review Project Briefs to advise on Terms of Reference, - Provide information or advice to developers and EIA Experts when consulted during EIA process, - At the request of RDB, review EIA reports and provide comments to RDB, - Assist RDB in organizing public hearings, - Host public hearings, - Host individual consultations, - Gather written comments from public and transmit them to RDB. - Facilitate the land acquisition process through land bureau office; - Plan and complaints resolutions.

3.2. International legislative and policy framework

In addition to national environmental legislations, Rwanda is also party to several regional and international conventions and protocols on environment. To this, the present project will be implemented in compliance with those international policies and regulations particularly the JICA Environmental and Social considerations (project funder) and the World Bank safeguards Policies.

3.2.1. JICA guidelines on environmental and social consideration

The project of improvement of water Supply services in North Central Kigali will be implemented in compliance with the JICA Environmental and Social Considerations guidelines. JICA encourages host country governments including local governments, borrowers, and project proponents, to implement the appropriate measures for environmental and social considerations when engaging in cooperation activities. At the same time, JICA provides support for and examinations of environmental and social considerations in accordance with the guidelines.

The guidelines cover five schemes: (1) Loan aid, (2) Grant aid (excluding projects executed through international organizations), (3) Preliminary studies of grant aid undertaken by MOFA, (4) Technical cooperation for development planning, and (5) Technical cooperation projects.

- Objectives of JICA guidelines

The objectives of JICA guidelines are to encourage project proponents to have appropriate consideration for environmental and social impacts, as well as to ensure that JICA's support for an examination of environmental and social considerations are conducted accordingly. The guidelines outline JICA's responsibilities and procedures, along with its requirements for project proponents to facilitate the achievement the above-mentioned objectives. In doing so, JICA endeavors to ensure transparency, predictability, and accountability in its support for an examination of environmental and social consideration.

- Key principles of JICA guidelines

Some of the principles of JICA guidelines on environmental and social considerations are summarized as follows:

1. Environmental impacts that may be caused by projects must be assessed and examined in the earliest possible planning stage.
2. Alternatives or mitigation measures to avoid or minimize adverse impacts must be examined and incorporated into the project plan.
3. Examinations must be endeavored to include an analysis of environmental and social costs and benefits in the most quantitative terms possible, as well as a qualitative analysis. These must be conducted in close harmony with the economic, financial, institutional, social, and technical analyses of projects.
4. The findings of the examination of environmental and social considerations must include alternatives and mitigation measures and must be recorded as separate documents or as a part of other documents. EIA reports must be produced for projects in which there is a reasonable expectation of particularly large adverse environmental impacts.
5. For projects that have a particularly high potential for adverse impacts or that are highly contentious, a committee of experts may be formed so that JICA may seek their opinions, in order to increase accountability.

- Responsibility of JICA in EIA process

While project proponents take the initiative to deal with the environmental and social considerations of projects, JICA provides support for and examinations of the environmental and social considerations for the project proponents in accordance with Sections 2 and 3 of the guidelines and depending on the nature of cooperation projects. Project proponents are required to incorporate the output of environmental and social considerations studies into project planning and decision-making processes. When JICA provides support for and examinations of environmental and social considerations, JICA examines the requirements that must be met.

- Categorization of projects and JICA guidelines

JICA classifies projects into four categories according to the extent of environmental and social impacts they may cause as well as considering an outline of project, scale, site condition, etc. The four categories are the following:

Category A: Proposed projects are classified as Category A if they are likely to have significant adverse impacts on the environment and society. Projects with complicated or unprecedented impacts that are difficult to assess, or projects with a wide range of impacts or irreversible impacts, are also classified as Category A. These impacts may affect an area broader than the sites or facilities subject to physical construction. Category A, in principle, includes projects in sensitive sectors, projects that have characteristics that are liable to cause adverse environmental impacts, and projects located in or near sensitive areas.

Category B: Proposed projects are classified as category B if their potential adverse impacts on the environment and society are less adverse than those of category A projects. Generally, they are site-specific; few if any are irreversible; and in most cases, normal mitigation measures can be designed more readily. The rehabilitation of irrigation facilities in Rwamagana can be classified as category B projects.

Category C: Proposed projects are classified as Category C if they are likely to have minimal or little adverse impact on the environment and society.

Category FI: Proposed projects are classified as Category FI if they satisfy all of the following requirements: JICA's funding of projects is provided to a financial intermediary or executing agency; the selection and appraisal of the sub-projects is substantially undertaken by such an institution only after JICA's approval of the funding, so that the sub-projects cannot be specified prior to JICA's approval of funding (or project appraisal); and those sub-projects are expected to have a potential impact on the environment.

- Impacts to be assessed

The impacts to be assessed about environmental and social considerations include impacts on human health and safety, as well as on the natural environment, that are transmitted through air, water, soil, waste, accidents, water usage, climate change, ecosystems, fauna, and flora, including trans-boundary or global scale impacts. These also include social impacts, including migration of population and involuntary resettlement, local economy such as employment and livelihood, utilization of land and local resources, social institutions such as social capital and local decision-making institutions, existing social infrastructures and services, vulnerable social groups such as poor and indigenous peoples, equality of benefits and losses and equality in the development process, gender, children's rights, cultural heritage, local conflicts of interest, infectious diseases such as HIV/AIDS, and working conditions including

occupational safety. Items to be addressed in the specific project are narrowed down to the needed ones through the scoping process.
In addition to the direct and immediate impacts of projects, the derivative, secondary, and cumulative impacts as well as impacts associated with indivisible projects will also be assessed about environmental and social considerations, so far as it is rational. The life cycle impact of a project period is also considered.
Various kinds of relevant information are needed to assess impacts on the environment and local communities. There are, however, uncertainties in predicting such impacts caused by the incomplete understanding of impact mechanisms and the limited information available. Therefore, if the scale of uncertainty is large, project proponents etc. provide environmental and social considerations that include preventive measures as much as possible.

3.2.2. Framework convention on climate change

This convention considers the fact that climate change has trans-boundary impacts. The basic objective of this convention is to provide for agreed limits on the release of greenhouse gases into the atmosphere to prevent the occurrence of climate change. It also aims to prepare countries to minimize the impact of climate change, should it occur.

3.2.3. Convention on biological diversity

The convention on biological diversity has three goals. These are:

- Conservation of biodiversity;
- Sustainable use of the components of biodiversity; and
- Fair and equitable sharing of the benefits arising from the use of genetic resources. Rwanda has ratified this convention and all project developers are urged to implement the convention during project implementation.

Based on the above assessment of legal and institutional framework both national and international, it can be concluded that the present project of Improvement of Water supply in North Central Kigali has a comprehensive legal and regulatory framework that can enable the project to be implemented in sustainable manner if complied with. The consultant recommends implementing the proposed project in consideration of national and international laws and policies as well as the associated standards especially the JICA guidelines on environmental and social considerations.

4. ENVIRONMENTAL AND SOCIAL BASELINE DATA

4.1. Introduction

To understand the existing environmental and socio-economic conditions of the project, baseline data have been collected, compiled, and analyzed for the following:

- Socio-economic environment
- Physical environment and
- Biological environment

The information presented has been collected from various sources and most data have been collected from field visits and surveys, as well as from secondary data collected from literature review. Formal and informal discussions were held with the local people, project affected people and local government/non-government that provided useful information for preparation of this report. Information on project facilities, size and magnitude have been taken from the preliminary design documents done by JICA study team. Therefore, the data provided in this chapter shall be used as benchmarks for future project impacts monitoring.

4.2. Socio-economic baseline data

In this section data presented are from the socio-economic survey conducted on 300 households located in the project area of intervention and project impacted zones. Demographic characteristics of households

- Sex of heads of households

In this section, the study results were presented by describing the sex of heads of households.

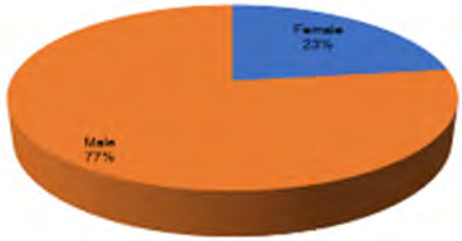


Figure 8: Percentage (%) of sex of heads of household
Source: Household survey 2022

As seen from Figure 9, from 300 sampled households 23% households are headed by females and 77% households headed by males. In terms of sex of respondents, results shows that 64% of respondents were females and 36% males. This shows how females are the one who do the housework and remain at home while main are involved in works outside the home.

- Age of respondents

Ages of respondents were presented in form of intervals from 18 years to more than 65 years.

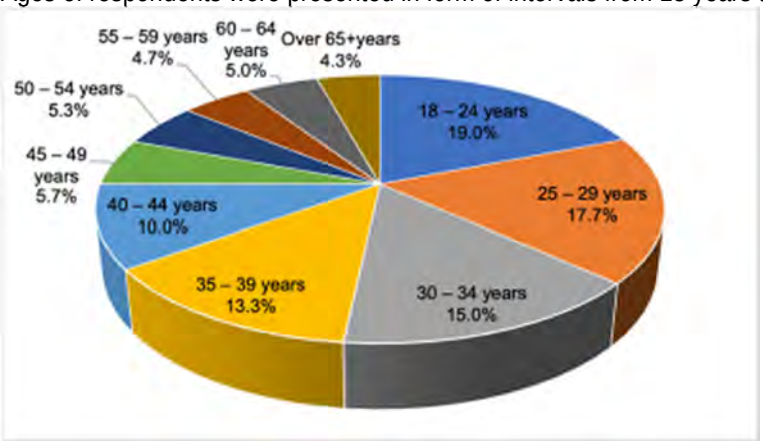


Figure 9: Percentage (%) of respondents by age
Source: Household survey 2022

From the Figure 10 among 300 respondents 19% were aged between 18-24 years old, 17.7% aged between 25-29 years old, 15% aged between 30-34 years old, 13.3% aged between 35-39 years old, 10% aged between 40-44 years old, 5.7% aged between 45-49 years old, 5.3% aged between 50-54 years old, 4.7% aged between 55-59 years old and 5% were aged between 60-64 years old as well as 4.3% were aged 65 years old and above.

- Size of households Composition of households

With its young population and low level of family planning, Rwanda has a relatively high household size which is 4.2. The survey results do not differ a lot to this average though some cells go to six. It is worth to note that in Kigali the size of households is increased by members of family who leave rural area and stay with the relatives in the city. Further, many of households in the city has at least one house helper.

Table 7: Households by average size in the survey area

Sector	Cell	Person per HH (Average)	Count/Sample (Total)
Bumbogo	Ngara	5.4	16
Gisozi	Musezero	5.4	38
	Ruhango	4.7	29
Kimironko	Bibare	5.8	16
	Kibagabaga	5.4	23
	Nyagatovu	5.2	19
Kinyinya	Gacuriro	4.7	14
	Gasharu	5.1	13
	Kagugu	5.2	60
	Murama	5.0	20
Remera	Nyabisindu	5.5	22
	Nyarutarama	6.0	18
	Rukiri I	5.2	7
	Rukiri II	3.3	5
Grand Total		5.2	300

Source: Household survey, 2022

4.2.1. Socio-economic characteristics

- Education level of respondents

The results of EICV6 state that educational attainment refers to the highest level of education that an individual has attained or completed. This is distinct from the level of schooling that an individual is attending. Most Rwandans have attended school, and many have attended primary school.

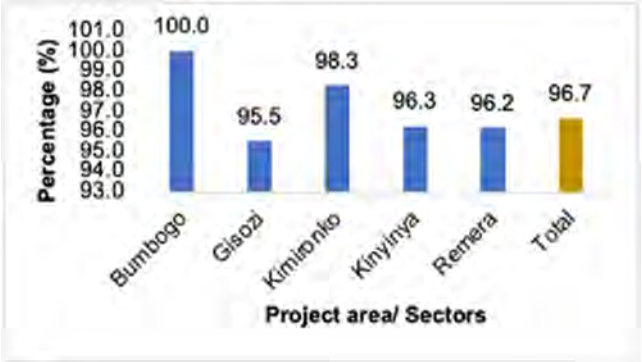


Figure 10: Literacy of respondent (%)
Source: Household survey 2022

As seen from Figure 10, from 300 household's sampled equivalent to 300 respondents, around 96.7% were literate against that 3.3% were not. From the above figure to each cell, the remaining percentage from 100% represent the number of illiterate respondents.

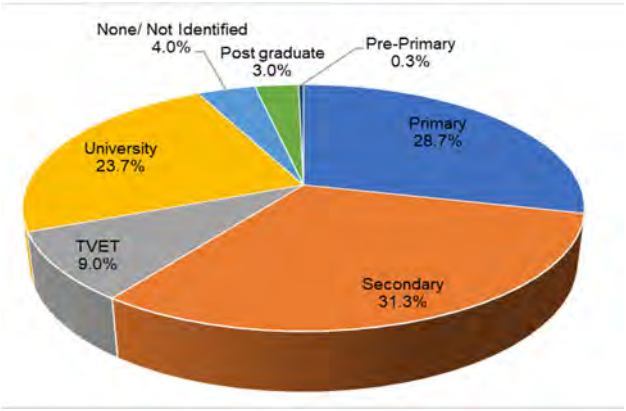


Figure 11: Education level of respondents (%)
Source: Household survey 2022

As seen from Figure 11, among 300 respondents 28.7% attended primary education, 31.3% attended secondary education, 9% attended TVET, 23.7% attended university, 7.1% did not attended any or not identified their education attainment level, 3% attended postgraduate, and 0.3% attended pre-primary education only.

- Occupation of respondents

Occupation in Rwanda has significant meaning as the main source of income or determinant of working status. In this section, the researcher has assessed the occupation status of respondents within the project area and the results are presented below.

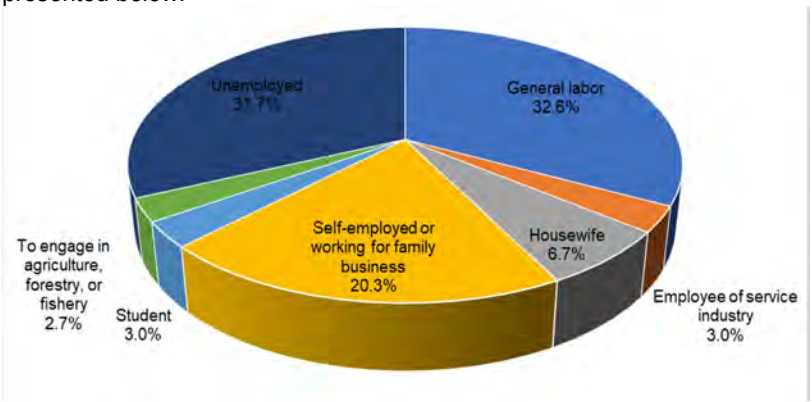


Figure 12: Percentage (%) of Respondents by occupation
Source: Household survey 2022

As seen from Figure 12, from 300 respondents assessed, 32% are general labor occupants, 31.7% are unemployed, 20.3% self-employed or working in family business, 6.7% are housewives, 3% are students, 3% are employees of service industry and 2.7% are engaged in agriculture forestry, or fishery.

- Household monthly income

Household income was estimated to all people in each household working for money (who have share in feeding the household members or in satisfaction their other needs primary or secondary).

Table 8: Percentage (%) of monthly income by households (FRW[3])

Sector	Cell	10,000-50,000	50,000-100,000	100,000-200,000	200,000-500,000	500,000-300,000,000	12,000,000	N/A	Count/Sample	Average (Rwfs/Month)
Bumbogo	Ngara	31.3	25	0	18.8	0	0	25	16	141,250.00
Gisozi	Musezero	5.3	13.2	0	5.3	7.9	0	68.4	38	321,666.70
	Ruhango	0	0	3.4	3.4	0	0	93.1	29	350,000.00
Kimironko	Bibare	12.5	6.3	0	0	0	0	81.3	16	50,000.00
	Kibagabaga	0	4.3	4.3	8.7	8.7	0	73.9	23	358,333.30
	Nyagatovu	0	31.6	15.8	15.8	10.5	0	26.3	19	284,642.90
Kinyinya	Gacuriro	28.6	14.3	7.1	7.1	0	7.1	35.7	14	1,440,555.60
	Gasharu	30.8	46.2	15.4	0	0	0	7.7	13	84,166.70

[3] 1US$ =1030 FRW

Sector	Cell	10,000-50,000	50,000-100,000	100,000-200,000	200,000-500,000	500,000-300,000,000	12,000,000	N/A	Count/Sample	Average (Rwfs/Month)
	Kagugu	23.3	18.3	16.7	6.7	0	0	35	60	117,692.30
	Murama	15	15	25	5	10	0	30	20	392,500.00
Remera	Nyabisindu	4.5	4.5	13.6	27.3	27.3	0	22.7	22	716,117.60
	Nyarutarama	5.6	22.2	11.1	33.3	0	0	27.8	18	220,769.20
	Rukiri I	14.3	0	0	28.6	28.6	0	28.6	7	556,000.00
	Rukiri II	0	0	0	40	20	0	40	5	933,333.30
Grand Total		12.3	14.7	9.3	11	6	0.3	46.3	300	355,428.60

Source: Household survey 2022

As seen from Table 8, from 300 household sampled only a single (0.3%) household is earning 12 million Rwandan francs per month, 6% are earning monthly income ranged between 500,000 to 3,000,000 FRW per month, 11% earn monthly income ranged between 200,000 to 500,000 FRW, 9.3% earn monthly income between 100,000 to 200,000 FRW, 14.7% earn monthly income ranged between 50,000 to 100,000 FRW and 12.3% earn monthly income between 10,000 to 50,000 FRW. Note that, most of respondents (46.3%) did not feel free to announce their monthly income, they keep the number as secret.

- Household expenditure

This sub-section gives distribution of households by ranges of payment on different items which are necessary in living conditions. It gives also average per each category of payment. The main touched are costs of water from WASAC or any other water distributor, costs of electricity, energy for cooking, cost on telephone, and capacity of payment for each household once water is supplied regularly (full day and night).

Table 9: Households by average monthly paid bills for basic needs (FRW/Month)

Sector	Cell	Average of Water tariff paid to WASAC or another distributor	Average cost on Bottled/Jerrycan water including transportation fee	Average of cost on electricity	Average cost on Telephone/Cell phone/ Telephone	Average cost on energy for Cooking
Bumbogo	Ngara	18,285.00	3,662.50	10,562.50	6,756.30	14,968.80
Gisozi	Musezero	12,700.00	4,628.60	9,046.90	6,302.90	18,220.80
	Ruhango	10,808.40	4,644.40	5,657.70	7,064.00	14,875.00
Kimironko	Bibare	14,164.70	7,050.00	17,625.00	5,346.20	21,875.00
	Kibagabaga	20,214.90	3,227.30	20,239.10	13,700.00	29,886.40
	Nyagatovu	17,409.50	1,106.70	14,921.10	17,105.30	19,794.70
Kinyinya	Gacuriro	20,433.40	777.7	11,818.20	13,030.00	16,846.20
	Gasharu	3,576.50	466.2	3,615.40	4,346.20	17,884.60
	Kagugu	6,103.90	1,918.50	5,613.80	3,101.80	14,626.70
	Murama	10,236.80	2,056.40	10,825.00	7,900.00	22,600.00
Remera	Nyabisindu	17,904.80	1,922.10	10,159.10	11,431.80	21,000.00
	Nyarutarama	6,307.80	4,805.00	11,111.10	7,622.20	23,934.70
	Rukiri I	21,542.90	12,740.00	14,428.60	13,285.70	24,900.00
	Rukiri II	13,000.00	24,000.00	14,000.00	8,400.00	18,500.00
Grand Total		12,568.00	3,437.70	10,315.40	7,948.60	19,091.60

Source: Household survey 2022

As seen from Table 9, among 300 assessed households, each pay an estimated average of 12,568 Frw per month on water bill to WASAC or any other water distributor. The lowest payment of this category was found in Gasharu cell of Kinyinya sector (3,576 Frw per month) and the highest average monthly payment of water bill was found in Rukiri I of Remera sector which is estimated to 21,543 Frw. By the average of bottled/ jerrican water including transportation fees, each household was found paying around 3,438 Frw per month where the lowest average was found in Gasharu cell/ Kinyinya sector (466. FRW per month) and the highest bill was found in Rukiri II which is estimated to 24,000 Frw per month.

In terms of electricity fees, survey results indicates that in average a household pays 10,315.4 Frw per month. The lowest monthly average is 3,615 Frw per month obtained in Gasharu cell/ Kinyinya sector and the highest being 20,239.1 Frw per month in Kibagabaga cell/ Kimironko sector. Telephone monthly payment was also among consuming categories to households' members in the project area for communication and other online services accessibility. Each household was attributed to an average telephone bill payment of 7,948 Frw per month. The lowest monthly telephone bill is 3,101.8 Frw found in Kagugu cell/Kinyinya sector and the highest being 17,105 Frw in Nyagatovu cell/ Kimironko sector. For cooking energy households, in average, pays 19,091.6 Frw per month. The

lowest monthly bill for energy for cooking is 14,626 Frw reported in Kagugu cell/ Kinyinya sector and the highest is 24,900 Frw obtained Rukiri I cell/ Remera sector.

- Housing and house ownership

This section presents the type of building tenure status of the housing unit from 300 sampled households in the project area. This is referred to the current building types available in Rwanda and tenure status available in Rwanda from all areas (mainly Kigali City).

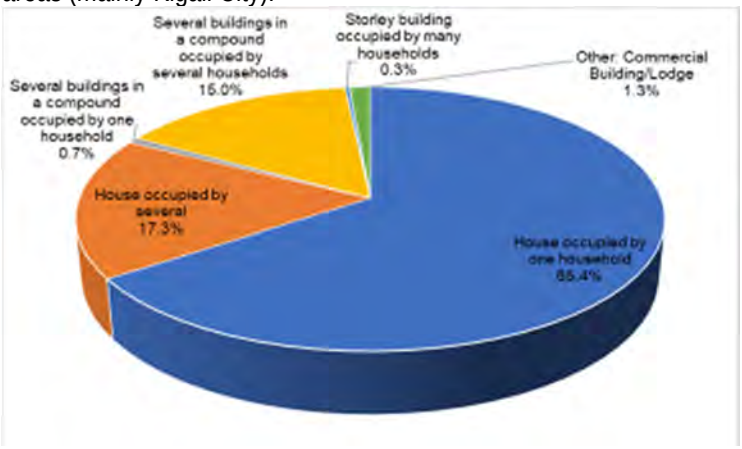


Figure 13:Percentage (%) of Households by type of building
Source: Household survey 2022

As seen from Figure 13, among 300 households sampled, 65.3% are living in a house occupied by one household, 17.3% in house occupied by several households, 15% in several buildings in a compound occupied by several households, 1.3% households are living in other type of building such as commercial building/lodge, 0.7% were in several buildings in a compound occupied by one household and 0.3% households are living in story building occupied by many households. In terms of ownership, among 300 sampled households 54.7% are owner of the house (even when he/she is still paying the bank loan), 44.3% are tenant and 1% is free lodging.

- Source of energy

The main sources of energy described are both electricity (grid electricity and off-grid solutions), and energy for cooking.

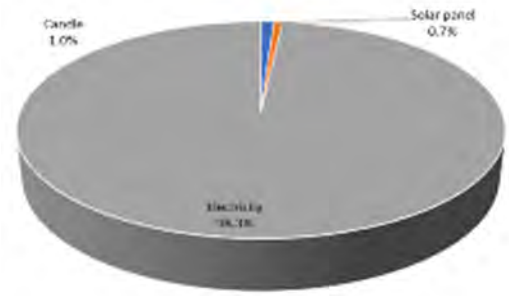


Figure 14:Households (%) by main source of energy for lighting
Source: Household survey 2022

As seen from Figure 14, from 300 sampled households most of them (98.3%) are using grid electricity as main source of energy for lighting, 1% are using candle while 0.7% are using solar panel as main source of energy for lighting. For Cooking, most of households (61%) are using charcoal as main source of energy for cooking, 35.3% are using cooking gas (LPG), 2.7% use firewood, and 1% are using electricity.

- Equipment and amenities owned by households in study area

In this section, the results on the household's equipment were presented. This refers to the average amount of equipment per household in the project area by cells and sectors of location.

Table 10: Distribution of assets in households (average per household per each asset)

Sector	Cell	Car	Motorbike	TV	Video deck	Landline Telephone	Cellular phone	Smart phone	Personal computer	Air conditioner	Refrigerator	Washing machine	Microwaves/Electric Cooker	Iron	Blender	Mixer	Kettle
Bumbogo	Ngara	0.2	0.1	0.8	0.1	0.0	1.9	1.3	0.3	0.0	0.3	0.1	1.0	1.0	1.0	1.0	1.0
Gisozi	Musezero	0.5	0.1	0.8	0.1	0.2	1.9	1.8	0.6	0.1	0.3	0.0	1.0	1.1	1.0	0.0	1.0

Sector	Cell	Car	Motorbike	TV	Video deck	Landline Telephone	Cellular phone	Smart phone	Personal computer	Air conditioner	Refrigerator	Washing machine	Microwaves/Electric Cooker	Iron	Blender	Mixer	Kettle
	Ruhango	0.3	0.1	0.7	0.0	0.1	1.2	2.0	0.4	0.1	0.3	0.0	0.0	1.0	0.0	1.0	0.0
Kimironko	Bibare	0.7	0.0	0.9	0.0	0.0	1.3	2.4	0.5	0.2	0.8	0.8	0.0	1.0	0.0	1.0	0.0
	Kibagabaga	1.0	0.0	1.1	1.0	0.1	2.9	4.1	2.0	0.1	1.0	0.2	1.1	1.0	1.0	0.0	1.5
	Nyagatovu	0.4	0.1	0.9	0.9	0.1	3.5	2.7	1.2	0.0	0.5	0.1	1.0	1.0	0.0	0.0	1.0
Kinyinya	Gacuriro	0.4	0.1	0.6	1.2	1.0	2.1	2.1	1.1	0.1	1.1	1.0	1.0	1.0	0.0	0.0	0.0
	Gasharu	0.5	0.1	0.5	0.6	0.0	2.1	0.9	0.2	0.0	0.1	0.0	1.0	1.0	0.0	0.0	0.0
	Kagugu	0.1	0.1	0.7	0.4	0.1	1.7	1.2	0.2	0.0	0.1	0.0	1.2	1.0	0.0	0.0	1.0
	Murama	0.3	0.1	1.0	0.2	0.1	1.8	2.9	0.9	0.0	0.6	0.3	0.0	0.0	0.0	0.0	0.0
Remera	Nyabisindu	0.9	0.0	0.9	0.0	0.1	1.3	2.5	1.0	0.1	0.7	0.0	0.0	0.0	0.0	0.0	0.0
	Nyarutarama	0.2	0.2	0.7	0.1	0.0	1.7	1.9	0.8	0.1	0.5	0.1	0.0	0.0	0.0	0.0	0.0
	Rukiri I	0.3	0.0	0.7	0.0	0.0	0.9	2.7	0.7	0.0	1.0	0.1	0.0	0.0	0.0	0.0	0.0
	Rukiri II	0.2	0.0	0.8	0.2	0.0	1.4	1.8	0.4	0.0	0.8	0.2	0.0	0.0	0.0	0.0	0.0
Grand Total		0.4	0.1	0.8	0.3	0.1	1.9	2.1	0.7	0.1	0.5	0.2	1.1	1.0	1.0	1.0	1.1

Source: Household survey 2022

As seen from Table 10, among 300 sampled households some of them have one or more equipment. From a list of equipment listed, at least each has a specific household which hold it. And the study results show that, there is no household lacking any among the above list of equipment in the Table 10 The most frequent equipment found is smart phone, whereby the average of each household among 300 sampled has 2.1 smart phones. This may be the results of government program of distributing smartphone to poor family but to the development of ICT in the country where most of the services are offered electronically.

- Socio-economic infrastructures in project area

Different socio-economic infrastructures such as schools, health centers and churches will benefit from the project by getting sufficient and reliable water. Further, the project was designed in a way that is not affecting existing infrastructures such as electrical lines, poles and roads. The next map presents key socio-economic infrastructure.

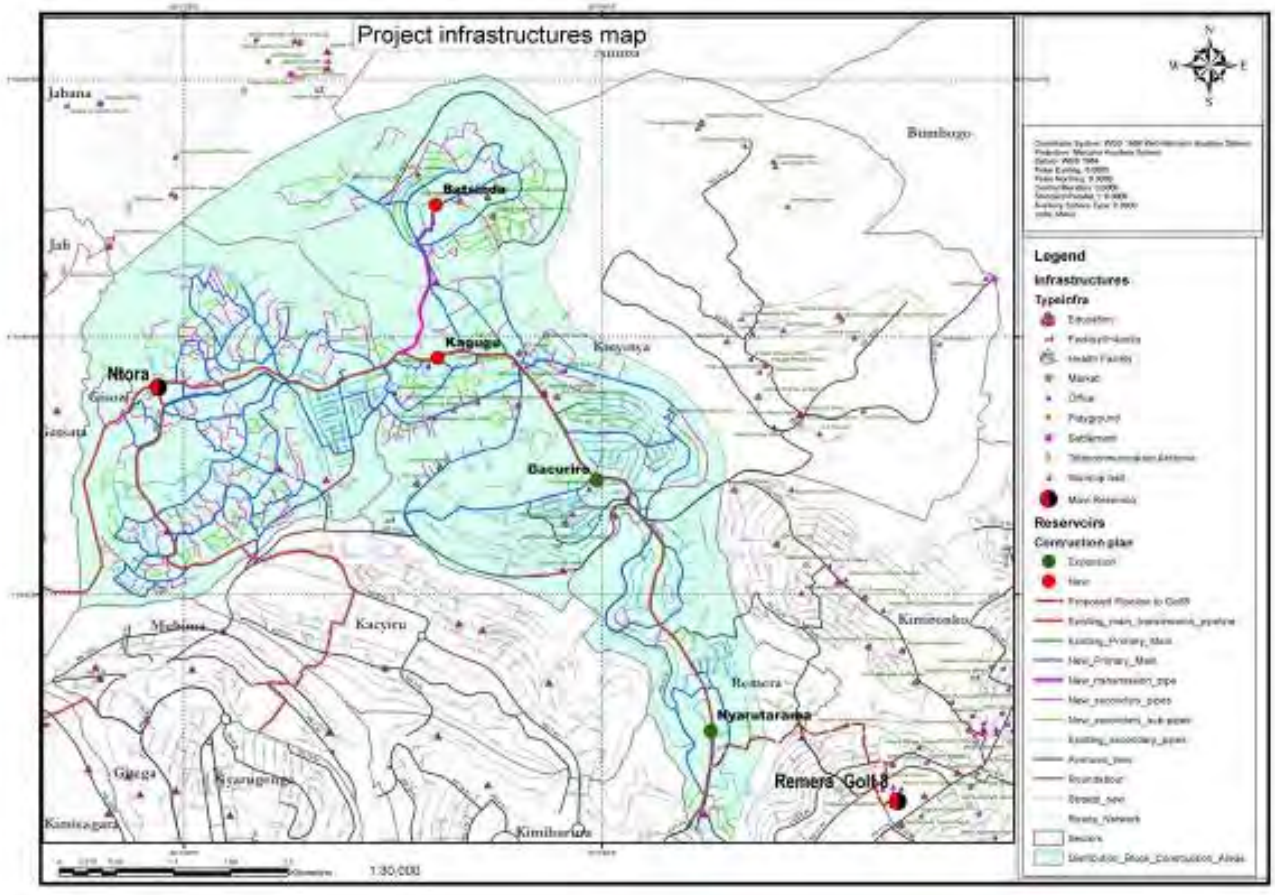


Figure 15: Socio-economic infrastructure and facilities in the project area
Source: Filed survey, 2022

4.2.2. Water supply

In this section, the study findings present the amount paid on water used (drinking and domestic), water fluctuation for these with water at home, and type of water usage (cooking, shower, laundry, car wash and gardening).

- Water availability

Though the country made important steps in ensuring that people have clean water, the project area is still facing water fluctuation and as presented in the next table.

Table 11: Status of average number of days for water availability in the entire week.

Sector	Cell	Average days that water was available for entire / Week (Days)	Average days of non-availability of water through the Week (Days)	Average days water partially available for entire week / Week (Days)
Bumbogo	Ngara	5.2	0.0	1.8
Gisozi	Musezero	5.0	0.7	1.4
	Ruhango	4.6	0.7	1.7
Kimironko	Bibare	4.5	1.0	1.9
	Kibagabaga	4.2	1.6	1.2
	Nyagatovu	5.1	0.9	1.1
Kinyinya	Gacuriro	4.4	1.3	1.3
	Gasharu	4.5	1.7	0.8
	Kagugu	4.6	1.0	1.5
	Murama	5.1	0.9	1.1
Remera	Nyabisindu	4.7	1.3	1.2
	Nyarutarama	5.8	0.5	1.1
	Rukiri I	5.4	1.0	1.3
	Rukiri II	5.2	0.8	1.0
Grand Total		4.8	0.9	1.4

Source: Household survey 2022

As seen from Table 11 among 300 sampled households in the project area, during the 7 days of the week; in the average 4.8 days water was available for the entire day and night, 0.9-days water was not available for the entire day and night and 1.4 days water was partially available for entire day and night.

- Distance or time between or spend respectively between household and water source

In this section, the study results presented are related to the distance between household and drinking water sources in both seasons (dry and rainy) and distance between household and domestic water source in dry and rainy season. This section also presents the waiting time in the queue as well as time it takes for going and come back from the main domestic water source.

Table 12: Distance (%) between household and drinking water source by season

Sector	Cell	1-30		31-60		61-120		121-500		501-1,000		1,001-4,000		N/A		Average (Meters)		Count/ Sample
		D.S	R. S	D.S	R. S	D.S	R. S	D.S	R. S	D.S	R. S	D.S	R. S	D.S	R. S	D.S	R. S	
Bumbogo	Ngara	12.5	25.0	12.5	6.3	6.3	6.3	12.5	6.3	0.0	12.5	18.8	6.3	37.5	37.5	293.8	379.25	16
Gisozi	Musezero	2.6	5.3	5.3	7.9	15.8	15.8	18.4	18.4	2.6	0.0	5.3	2.6	50.0	50.0	128.2	109.87	38
	Ruhango	17.2	6.9	13.8	13.8	13.8	10.3	13.8	24.1	0.0	6.9	6.9	0.0	34.5	37.9	121.7	150.45	29
Kimironko	Bibare	6.3	12.5	31.3	25.0	12.5	18.8	12.5	25.0	12.5	0.0	0.0	0.0	25.0	18.8	122.8	126.25	16
	Kibagabaga	8.7	4.3	8.7	13.0	34.8	34.8	30.4	30.4	0.0	0.0	0.0	0.0	17.4	17.4	106.5	109.43	23
	Nyagatovu	10.5	0.0	21.1	10.5	10.5	5.3	15.8	36.8	5.3	5.3	0.0	0.0	36.8	42.1	92.9	121.05	19
Kinyinya	Gacuriro	0.0	0.0	0.0	7.1	7.1	14.3	28.6	35.7	21.4	0.0	0.0	0.0	42.9	42.9	167.9	107.14	14
	Gasharu	0.0	7.7	15.4	7.7	15.4	15.4	23.1	30.8	7.7	0.0	0.0	0.0	38.5	38.5	104.6	100.92	13
	Kagugu	5.0	5.0	5.0	5.0	18.3	16.7	16.7	23.3	8.3	1.7	1.7	0.0	45.0	48.3	115.7	104.22	60
	Murama	10.0	10.0	5.0	10.0	5.0	5.0	30.0	25.0	5.0	0.0	0.0	0.0	45.0	50.0	96.5	76.50	20
Remera	Nyabisindu	0.0	0.0	0.0	0.0	18.2	18.2	31.8	31.8	0.0	4.5	4.5	0.0	45.5	45.5	136.4	136.36	22
	Nyarutarama	5.6	11.1	5.6	5.6	27.8	16.7	27.8	33.3	22.2	22.2	0.0	0.0	11.1	11.1	281.7	299.72	18
	Rukiri I	0.0	0.0	28.6	28.6	28.6	28.6	14.3	14.3	0.0	0.0	0.0	0.0	28.6	28.6	84.3	84.29	7
	Rukiri II	0.0	0.0	0.0	0.0	20.0	20.0	60.0	60.0	0.0	0.0	0.0	0.0	20.0	20.0	140.0	140.00	5
Grand Total		6.3	6.3	9.3	9.0	16.7	15.7	21.3	26.0	6.0	3.7	3.0	0.7	37.3	38.7	137.4	139.08	300

Source: Household survey 2022

As seen from Table 12 among 300 sampled households in the project area, there is no large change in distance between the dwelling and the drinking water source from dry season to rainy season. 21.3% of households in dry season and 26% in rainy season are in distance between 121 meters to 500 meters in between dwelling to drinking water source, 16.7% in dry season and 15.7% in rainy season are in distance between 61 meters to 120 meters, 9.3% in dry season and 9% in rainy season are in between distance of 31 meters to 60 meters, 6.3% in dry season which not change in rainy season live at distance between 1-30 meters, 6% in dry season and 3.7% in rainy season are distance between 501-1,000 meters from dwelling to drinking water source and 3% in dry season and 0.7% in rainy season situated in distance between 1,001-4,000 meters from dwelling to drinking water source.

By average there is around 137.4 meters between each household / dwelling in the project area to the main source of drinking water in dry season and 139.08 meters in rainy season. The minimum average distance in dry season is 84.3 meters and the maximum average is 293.8 meters while in the rainy season the minimum obtained was 76.5 meters and 379.25 meters as the highest average distance between dwelling and drinking water source.

- Quantity of water used in households by seasons

In this section, the study results were presented as number of 20 litters jerrican used in households for drinking and domestic use in either dry or rainy season. Data are presented as percentage of households in each range of water (range of number of 20 litter's jerrican) and average number of 20 liters jerrican.

Table 13: Distribution (%) of quantity of 20-liter of jerrican use for drinking water per week by season

Sector	Cell	0.1-1		1.1-2		2.1-6		N/A		Average (Number of Jerrican)		Count/ Sample
		D.S	R. S	D.S	R. S	D.S	R. S	D.S	R. S	D.S	R. S	
Bumbogo	Ngara	43.8	43.8	18.8	18.8	0.0	0.0	37.5	37.5	1.30	0.73	16
Gisozi	Musezero	44.7	36.8	5.3	5.3	0.0	7.9	50.0	50.0	1.07	0.72	38
	Ruhango	51.7	44.8	6.9	10.3	6.9	6.9	34.5	37.9	1.25	0.84	29
Kimironko	Bibare	56.3	62.5	12.5	18.8	6.3	0.0	25.0	18.8	1.33	1.00	16
	Kibagabaga	60.9	56.5	17.4	21.7	4.3	4.3	17.4	17.4	1.22	1.08	23
	Nyagatovu	36.8	36.8	26.3	21.1	0.0	0.0	36.8	42.1	1.27	0.70	19
Kinyinya	Gacuriro	28.6	28.6	28.6	28.6	0.0	0.0	42.9	42.9	1.50	0.84	14
	Gasharu	38.5	53.8	15.4	0.0	7.7	7.7	38.5	38.5	1.50	0.77	13
	Kagugu	33.3	38.3	16.7	8.3	5.0	5.0	45.0	48.3	1.45	0.69	60
	Murama	45.0	40.0	5.0	10.0	5.0	0.0	45.0	50.0	0.97	0.41	20
Remera	Nyabisindu	40.9	36.4	9.1	18.2	4.5	0.0	45.5	45.5	1.27	0.66	22
	Nyarutarama	50.0	50.0	27.8	27.8	11.1	11.1	11.1	11.1	1.56	1.39	18
	Rukiri I	28.6	28.6	28.6	42.9	14.3	0.0	28.6	28.6	1.80	1.07	7
	Rukiri II	40.0	40.0	20.0	20.0	20.0	20.0	20.0	20.0	1.75	1.40	5
Grand Total		43.0	42.3	15.0	14.7	4.6	4.3	37.3	38.7	1.33	0.81	300

Source: Household survey 2022

As seen from Table 13, from 300 sampled households in the project area 43% in dry season are using 0.1-1 20 litters jerrican of drinking water per week and 42.3% in rainy season, 15% in dry season and 14.7% in rainy season use between 1.1-2 20 litters jerrican, 4.6% in dry season and 4.3% in rainy season use 2.1-6 20 litters jerrican of drinking water while 37.3% in dry season. By Average each household was found using 1.33 average number of 20 litters jerrican of drinking water and 0.81 average number of 20 litters of jerrican in rainy season (in rainy season, they use less quantity of drinking water rather than in dry season).

4.2.3. Gender issues

- ✓ Daily household activities

For each household member mainly at working age, each has capacity for allocating time per activities. The assessed activities are housework, work (to earn money), childcare, community activity and other activities such as studying and rest. Here below are details in percentage (%).

Table 14: Daily time spending on specific activities (average % of day partition)

Sector	Cell	Housework (%)	Work (to earn money) (%)	Childcare (%)	Community activity (%)	Others: Study, Rest
Bumbogo	Ngara	36.56	38.63	22.38	2.44	0.13
Gisozi	Musezero	33.08	30.13	31.84	5.00	0.00
	Ruhango	40.69	30.03	16.24	7.24	2.24

Sector	Cell	Housework (%)	Work (to earn money) (%)	Childcare (%)	Community activity (%)	Others: Study, Rest
Kimironko	Bibare	39.06	39.69	16.56	4.69	6.25
	Kibagabaga	32.48	42.87	11.00	5.83	3.48
	Nyagatovu	29.63	43.63	23.95	2.79	0.11
Kinyinya	Gacuriro	33.50	48.93	9.00	0.71	1.07
	Gasharu	33.46	33.46	30.77	2.31	0.00
	Kagugu	46.83	24.75	25.05	3.28	0.08
	Murama	40.00	24.20	24.25	5.15	4.25
Remera	Nyabisindu	33.73	45.23	17.86	5.23	0.00
	Nyarutarama	40.67	29.44	17.22	8.22	4.44
	Rukiri I	18.29	61.43	17.14	2.71	0.43
	Rukiri II	38.00	48.00	7.00	7.00	0.00
Grand Total		37.54	34.56	21.28	4.53	1.46

In general, among 300 sampled respondents equivalent to 300 households visited in the project area, the most work consuming time is the housework which occupy around 37.54% of total time allocated to the activities with interests to the households, and this is followed by work to earn money which occupy 37.54%, childcare 21.28%, community activities occupy 4.53% and other activities like studies and rest or other not listed occupy 1.46%.

- Women involvement in household

In this section, the survey results present the status at which women participate in productive or income generating activities, and the kind of activities, women occupation which take long time and women burned works among household's works.

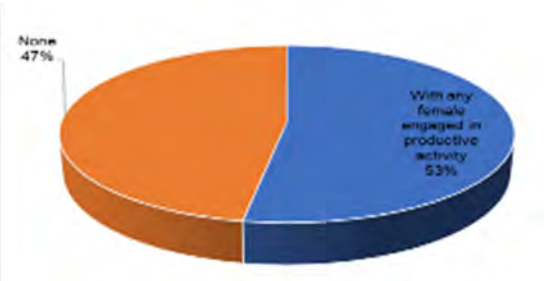


Figure 16: Distribution of households (%) with female engaged in productive activity
Source: Household survey 2022

As seen from Figure 16, among 300 households assessed in the project area 53% are with women engaged in productive activities and 47% are not.

4.3. Physical environment baseline data

The physical environment assessed in the present environment and social impact assessment study include geological formation and soil, hydrology and water resources, climate and weather conditions and land use set up in project area.

4.3.1. Topography of the project area

The project area of intervention is extended on three different sectors of Gasabo district namely Gisozi, Kinyinya and Remera cells. The project starts from Ntora water reservoir located in Gisozi Sector and goes to Nyarutarama Water reservoir. It passes through Kagugu, Batsinda and Gacuriro areas. There is also a section for the project that will be connected from Golf 8 reservoir to Nyarutarama via Nyabisindu area. The topography of the site is characterized by the lowest elevation point to be located at 1,377 m above sea level, and the highest point is located at 1,625 m above sea level at Ntora water reservoir. The area encounters general characteristics of Gasabo district where from west to east, the district is characterized by a succession of mountains and hills, usually with marshlands between them. The altitude varies from 1300 m to 1900 m above sea level.

4.3.2. Climate

With reference to records of mean monthly temperatures and rainfall of the Kigali meteorological station, the project of improvement of water supply services in North Central Kigali will be implemented in the zone which is characterized by a humid tropical climate. The area has two major climatic seasons in a year, the dry and rain seasons. The two major climatic seasons alternate within the year. However, the duration for these seasons is irregular and one cannot

precisely fix the temporal limits of each season. The rainy season may extend for some weeks into the dry season and vice versa. These variations may be associated to the challenge of global climate change. The two seasons are marked by an alternate succession of rains and drought.

According to three levels of drought (atmospheric dryness, pedological dryness and geological/hydrological dryness) as developed by Roger Lambert, the area experiences four months of long dry season (mid-May to mid-September) followed by a short rainy season (Mid-September, October, November, and mid-December), another short dry season (mid-December, January and mid- February) and finally a long rainy season (Mid-February, March, April and mid-May). In general, the mean temperature varies between 21.5°C and 24°C, while the precipitations range from 65 mm to 200 mm.

4.3.3. Land use

The project will be implemented in urban area of Kigali city, Gasabo district. The most dominant land use of the project is residential and the mixture of residential and commercial. Other land uses of the project area are arable land, bush land, and recreational area/ pitch. There are no industrial zones that have been identified to be affected by the project. Plots where reservoir are to be constructed in Batsinda are dominated by by banana plantation mixed with other crops but is zoned for residential area by the Kigali city land use master plan. Other plots are free and owned by government and used to accommodate water reservoirs.

4.3.4. Geology and Soil

Gasabo District like elsewhere in Kigali City presents a soil relatively young. The area consists of sandy loams characterized by small particles and gravel. The base rock in the region is mainly granite series which form a small island and consist of patches of quartzite. According to the soil classification taxonomy on the soil map of Rwanda, three dominant units of soils characterize the landscape of Gasabo District following their pedogenesis. In general, the District of Gasabo has good soils which are well drained and deep enough to support various crops suitable for the zone, except for top of hills, especially Jali and some in Bumbogo Sectors where 70% of soils have rocks and saprolites limitation at 50 cm, making them inappropriate for agriculture.

4.3.5. Air pollution level in project area

The project is in the neighborhoods of urban areas where the ambient air is slightly polluted by man-made related activities including transportation and combustion of fuels. The ambient air quality is also expected to be affected during the construction and decommissioning phases of the project due to particulate matters that shall be released in the atmosphere from project activities such as excavation and earth movement. The poor management of solid waste through burning could also contribute to negative impact on air quality. More specifically the pollutants of air include suspended matter, sulfur dioxide, nitrogen dioxide, hydrocarbons, and ozone due to population growth, urbanization, industrialization, and increased use of motor vehicles. Rwanda has one of the lowest emissions per capita in the world, estimated at 0.65 tones CO2/person (including land use change), compared to a global average of 4.63 tones CO2/person. According to the second National Communication (SNC) to the UNFCCC, the majority of GHG emissions were CO2 (87%) at 531 Gg, dominated by transport (52%) and industrial processes (28.5%). Therefore, even though there are no air pollution measurements conducted in the project area, this shows that the project area presents less quantities of air polluting matters that are generated from transportation and human activities being carried out in the project area.

4.3.6. Noise and vibration level in the project area

Noise and vibrations are expected to be generated during constructions from operation of excavation machines and trucks transporting material, soil stripping, trenching, pipe stringing, welding, and laying and backfilling activities. Noise and vibration impacts are of temporary by nature. Baseline noise levels of the proposed project area were measured during field survey at three different areas namely Kagugu, Batsinda and Gacuriro. This was done using Digital noise level meter MS6708 which has an active range of 30-130 decibels (dB). In Rwanda Noise pollution is determined when sound goes beyond 80 decibels, but Rwanda has adopted the East Africa Community (EAC) standards that sets the maximum permissible noise levels for residential areas at 60 dB (A).

Table 15: Noise exposure limits for EAC countries

No	Area	Time during day (hours)	Limits dB(a)
1.	Industrial Noise	07:00-21:00 21:00-07:00	60.0 55.0
2.	Neighborhood Noise	07:00-18:00 18:00-21:00 21:00-07:00	60.0 55.0 50.0

Source: EAC, 2016

Some of the proposed project components will be implemented in the areas with some settlements and some of them fall within a commercial area and or in multipurpose uses. The baseline noise levels within the proposed project area were therefore assessed based on the maximum permissible noise levels for residential areas which are set at 60 dB (A). Noise levels were recorded on 2nd and 6th April 2022 between 8h00am and 5h00 PM at four different points where reservoir tanks will be constructed. Full noise level was recorded and the maximum, minimum and the average e measurements found are presented in the following table.

Table 16: Average noise levels determined in the project area

Full name of the feature/area	Maximum dB(A)	Minimum dB(A)	Average dB(A)
Batsinda water reservoir site	63,4	38,6	51
Kagugu water reservoir site	72,3	42.1	57.2
Gacuriro water tank site	74,3	53,6	63.9
Nyarutarama elevated tank site	70,8	41,9	56.3

Source: On field measurement, 2022

Based on the results presented in Table 16, the maximum noise levels recorded in the project area is slightly above the permissible limits for residential and industrial areas as provided by EAC. Since the main sources of noise during this project implementation are vehicles, trucks and machines, the noise level is expected to increase during construction phase. These shall occur during the excavations and with vehicles and truck transporting people, material, and other equipment to and from the project sites. The contractor will ensure that it remains in permissible limits. However, construction activities should not continue during night to avoid project impacts.

4.3.7. Hydrology

There is no water body in direct project area except at Nyarutarama Golf 8 reservoir section where a small river is found in Nyabisindu area. In general, the hydrology of Gasabo district is made up of streams and rivers that are part of the Akagera river basin. There are many watercourses in Gasabo district of low importance, but the main ones are Lake Muhazi, Akagera River and Nyabugogo River. The hydrographic network of the district is composed of only one basin, the Nyabugogo River which after having recovered water of its affluent flows into Nyabarongo, which further and out of the Gasabo District meets the Akanyaru River and flows into Akagera. Effluents of Nyabarongo River are primarily fed during rainy seasons and each year the maximum risings occur in April.

4.4. Biological environment baseline data

The ecological survey at the project area consisted of desktop and field survey. A literature review was undertaken to assess the list of animal species that are found in the project area. This was outsourced from existing documents, and previous studies conducted in the project vicinities. The animal species provided herewith consists of a list of species that occur or could occur in the study area based upon their habitat affinities and ranges.

4.4.1. Fauna

Birds are the most fauna species that may be found in the project area except that their occurrence is low considering that the project areas are in urban developing areas. There are no fish species recorded or reported to be found within the project sites. Only some species of reptiles can be rarely found at Nyabisindu swamp according to the information recorded from residents. The list of animal species recorded within the project area is provided in the table below.

Table 17: Bird species recorded in the study area and their IUCN conservation status

No	*Order*	*Family*	*Common Name*	*Vernacular Name*	*Scientific Name*
1	*Coliiformes*	*Coliidae*	*Spickled Mousebird*	*Umusure*	*Colius striatus*
2	*Passeriformes*	*Motacillidae*	*African-Pied Wagtail*	*Inyamanza*	*Motacilla aguimp*
3	*Passeriformes*	*Ploceidae*	*Fan-tailed widowbird*		*Euplectes axillaris*
4	*Passeriformes*	*Ploceidae*	*Slender-Billed Weaver*	*Isandi*	*Ploceus pelzelni*
5	*Pelecaniformes*	*Ardeidae*	*Cattle Egret*	*Inyange*	*Bubulcus ibis*
6	*Pelecaniformes*	*Threskiornithidae*	*Hadada Ibis*	*Nyirabarazana*	*Bostrychia Hagedash*
7			*snake*	*incarwatsi*	*Philothamnus heterolepidotus*

No	Order	Family	Common Name	Vernacular Name	Scientific Name
8	Charadriiformes	Charadriidae	Grey-Headed Heron	Uruyongoyongo	Ardea cinerea

4.4.2. Flora

The project of improvement of water supply services in North Central Kigali will be implemented in zones of urban area where there is no remaining natural vegetation.

Along the roads where pipelines will be laid only ornamental trees can be found. Some seasonal and perennial crops such maize, potatoes, bananas, beans, cassava, and others were also identified at Batsinda site while other sites are dominated by paspalum plantations.

Table 18: Plant species identified in project area and its vicinities

No	Order	Family	Scientific Name	Vernacular Name
1	Lamiales	Bignoniaceae	Markhamia lutea	Umusave
2	Proteales	Proteaceae	Grevillea robusta	Gereveriya
3	Laurales	Lauraceae	Persea gratissima	Avoka
4	Lamiales	Verbenaceae	Lantana camara	Umuhengeri
5	Fabales	Fabaceae	Acacia sieberana	Umunyinya
6	Poales	Poaceae	Pennisetum purpureum	Urubingo
7	Alismatales	Araceae	Colocasia esculenta	Amateke
8	Zingibenales	Musaceae	Musa spp.	Insina
9	Myrtales	Myritaceae	Eucalyptus sp.	Inturusu
10	Sapindales	Anacardiacea	Mangifera indica	Umwembe
12	Arecales	Arecaeae	Phoenix reclinata	Umukindo
13	Fabales	Fabaceae	Acacia senegalensis	Umukonji
14	Malpighiales	Euphrobiacea	Manihot esculenta	Imyumbati
15	Caryophyllales	Amaranthaceae	Achyrantes aspera	Umuhurura
16	Asparagales	Asparagaceae	Agave sisalana	umugwegwe
17	Lamiales	Lamialeae	Clerodendrum rotundifolium	Ikiziranyenzi
18	Asterales	Asteraceae	Vernonia amygdalina	Umubirizi
19	Fabales	Fabaceae	Phaselolus vulgaris	Igishyimbo
20	Fabales	Fabaceae	Acacia Sieberiana	Umunyinya
21	Malpighiales	Poaceae	Zea mays	Ikigoli
22	Solanales	Solanaceae	Solanum lycopersicum	Inyanya
23	Lamiales	Verbenaceae	Lantana camara	Umuhengeri
24	Proteales	Proteaceae	Grevillea robusta	Gereveriya
15	Malpighiales	Euphorbiaceae	Euphorbia tirucalli	Umuyenzi

The following Plate illustrates the vegetation in targeted plots for reservoirs construction

Figure 17: Flora species nearby the river passing Nyarutarama to Golf 8 Reservoir section

Source: Field survey, BESST Ltd, 2022

5. PUBLIC CONSULTATION AND PARTICIPATION

5.1. General overview

To build a strong, constructive, and responsive relationships and for the successful management of project's environmental and social impacts, public consultation and stakeholders' engagement are mandatory for such kind of project. Stakeholders' engagement is an on-going process that involves different elements that include stakeholders' analysis and planning, consultation and participation, disclosure and dissemination of information, grievance mechanism and on-going reporting to affected communities.

5.2. Purpose of public involvement

The purpose of stakeholder consultation and public involvement are mainly:

- To ensure effective engagement with local communities and key stakeholders throughout all project phases
- To build a trusting relationship with the affected communities and other interested stakeholders based on a transparent and timely supply of information and open dialogue.
- To collected relevant and trustable information that shall be based on to formulate project impacts as well their mitigation measures.
- To prepare communities on potential emergency scenarios that could be caused by the project and can affect the community.
- To actively build and maintain productive working relationships based on principles of transparency, accountability, accuracy, trust, respect and mutual interests with affected communities and other stakeholders.

5.3. Consultation at central and district level

Consultation at central and district level consisted at explaining the proposed project, project environmental concern, legal and regulatory requirements as well as roles and responsibilities of different stakeholders for the EMP monitoring. The consultation at central and district level took place during the period of 6th and 18th January 2022 and consulted institutions at central level are:

- Rwanda Land Management and Use Authority (RLMUA)
- Rwanda Water Board (RWB);
- Rwanda Environment Management Authority (REMA)
- Rwanda Development Board (RDB)
- Water and Sanitation Authority (WASAC Ltd)
- Gasabo District

Key outcomes of the consultations at central and local level are summarized in the table below:

Table 19:Outcome consultation at central and local level

Stakeholder	Summary of discussion	Key outcomes
RLMUA	- Land rights and land use for the buffer zone of the roads - Land transfer ad registration after project implementation especially for Batsinda water tank area - Zoning Plan of the project areas	- Land located within the buffer zone of the road is under public land. Therefore, the project will be implemented in consideration with the existing laws related to land use and rights. - It is mandatory that after compensation the expropriated land be register under government properties via WASAC. All procedures required must be fulfilled to get the land register. RLMUA will facilitate in this regard by its staff located at Gasabo District. - This project is not compromising the land use plan of the City of Kigali
RWB	– Impact of project implementation on water resources. – Project activities and project impacts at project location. - Water allocations	– This is an extension and rehabilitation of on existing water supply system. No major impacts will be noted at the water abstraction source (Nzove WTP). There will be no additional daily water abstraction within Nyabarongo than the allowed at the water Plant. – Some impacts will be in the project areas. Mitigation measures have to be implemented as requisite to avoid those that will be noted at the project site. – Regular monitoring has to be implemented by all parties involved and regular reporting to competent institution is recommended. – No water abstraction permitting is required for the project. - Regular monitoring of water quality is mandatory.
REMA	– Project activities and environmental pollution. – Potential source of pollution within project area	– Main potential source of water pollution would be associated to human activities within the project area.

Stakeholder	Summary of discussion	Key outcomes
	– Impacts of the project implementation on the surrounding environment. - REMA's responsibilities in the project life span	– Efforts should be made to minimize project's environmental impacts by application of appropriate mitigation measures to each identified and predicted impact. – REMA will play key role in the EMP during all phases of the project. – Impacts compensation measures of the identified impacts would be clearly developed and implemented. However, efforts have to be made to refuse and avoid those identified impacts. - Various impacts connected to this project implementation were discussed and are incorporated in this report. - Monitoring is recommended to be undertaken on regular basis to avoid potential environmental pollution.
RDB	- ESIA process and requirement. - Project impacts and mitigation measures - ESIA report review and analysis - ESIA approval and Certification	- All processes and steps have to be meet as required. - Project impacts were discussed and are incorporated in this report. - Regular monitoring of the proposed mitigation measure is mandatory during the project life span.
WASAC Ltd	- Need for and importance of the project implementation - Project requirements. - Water issues in the project areas - Labor and work force. - Safety and health management during project implementation - Land requirements and land issues - Compensation and expropriation issues - Project's waste generation and management plan	- This project implementation is a necessity to meet the fixed target and existing policies and programs objectives to supply 100% of clan water to all Rwandans by 2024. - The project is within the mandate of WASAC Ltd. - The land for the project will be acquired via the existing laws related to the expropriation/ compensation in public interests. Fair compensation will be made when necessary - The work force is available in the project area and willing to support. New jobs will be created, and manpower is available in the project area. - The project will be implemented in compliance with the existing laws and regulations related to environmental, health and social protection. - No chemicals are expected to be used by the present project. Therefore, no impacts associated to the use of chemical are expected. - Waste management plan will be developed and be followed with maximum effort by the contractor. . .
REG/ EUCL	- Utilities property under the project working areas (pipeline routes)	- Prior to any activities that shall affect the electrical utilities, information shall be given to the nearby EUCL branch for them to be prepared accordingly. - Maximum efforts shall be made to avoid such impacts. - Project designs shall take into consideration the existing electrical utilities within the project areas.
MoE	- Environmental concerns related to the project implementation - Laws and regulation related to environmental protection	- The project will be implemented in line with the existing environmental protection laws and regulations. - Regular monitoring of the project implementation is required. - Mitigation measure to the identified impacts must be implemented as well as the regular reporting is required. - Project impacts were discussed and are incorporated in this report.
District, Sector and Cell officials	– Impact of project implementation in the project area – Water availability and water issues – Project's impacts in the project area. - Land ownership and land issues. - Land required for the project. - Challenges and impacts associated to the project implementation - Labor and work force - Compensation of affected properties	- The project is of high importance since it will contribute to the development, sanitation increases, availability, and reliable clean water in the project areas, etc. - Project implementation would be beneficial to the local population and where possible RURA should intervene in terms of water tariff fixing. - It is recommended that water tariffs be revised since water will be available in the area. - All households in the project areas should be connected and for the residents to benefit from the project implementation. - Other affected properties that land shall be also fairly compensated as required. - Different project positive and negative impacts were discussed and incorporated in this report. - Mitigation measures for the identified impacts were also discussed.

The list of stakeholders consulted is presented in annex 1 of this report.

5.4. Consultations with local community

Consultation at community were conducted at three stages: (i) initial consultation at inception phase, (ii) consultation at scoping phase, and (iii) consultation at EIA/ARAP draft phase. In consultation with local authorities, it was agreed

that consultations with local people at the project zones should be organized during the community works known as umuganda which are held on the last Saturday of each month countrywide. This was proposed as the best option as it allows to have a good number of participants and an opportunity to inform and consult with larger community given that everyone is requested to attend the event. During the consultations, the restrictions imposed by COVID-19 were respected.

5.4.1. Initial consultations at inception phase January 14th – February 4th, 2022

Initial consultations were conducted at inception phase and before the socio-economic survey which covered 5 sectors of Gasabo district and 14 cells. The main purposes of these initial consultations were:

- To disseminate project information and proposed studies,
- To understand initial households d perception about water supply status;
- To get the cooperation of households especially during the household survey,
- To explain the objectives of EIA, ARAP and the socio-economic survey

These consultations were held during the period of January 14th, 2022, to 4th February 2022 and a total number of 300 households were consulted spread of over 10 cells as presented in the table below.

Table 20:Questions /Suggestions and responses provided during initial consultaion-inception phase

No	Names	Questions/Suggestions	Responses provided by the consultant
Gisozi sector			
1	DUSABIMANA Samuel	At this stage do you know where pipelines will pass?	Pipelines routes are still under evaluation, but it anticipated that pipelines will be laid where existing pipelines are passing.
2	ERIC RUBIBI	In other areas where WASAC implemented projects we have heard delays in compensation. What are you doing to avoid this situation?	The design will be done in a way that avoid involuntary resettlement or land acquisition. Further, an abbreviated resettlement Plan will be prepared to ensure timely compensation
3	Mahoro Solange	During the previous projects some of the pipelines that were supplying us water were not re-connected and we are still struggling. Will the project do the same mistakes?	Normally the pipes to be installed are not directly supplying water to locals. These are transmissions pipes while connection is done to distribution pipes. It is expected that this project will not cause such impacts to locals.
4	MUREFU Vincent	Will be there any compensation to those who will temporally close their businesses such as kiosk, fence and pavement?	This will be assessed during detail EIA study and this impact is identified then will be covered under Resettlement plan.
5	Nyirahabimana Aline	What will happen to structure such as Road, pavement and electrical installation that maybe affected by construction works?	Construction methods for crossing roads will be included in the study and where structure are affected rehabilitation will be made
Remera sector			
1	KABANDA Diane	Currently we are experiencing water shortage and sometimes we only have water twice a week. Is this project going to resolve these issues?	This is one of the objectives of this project and the issue will be addressed through increased capacity of reservoirs and new pipes
2	BIZIMANA Cynthia	Will the project give job opportunities to local people or only engineers will be employed by the project	Local people will be employed and are priorities when allocating jobs. Both local and non-locals will be employed during project implementation
3	Kansayiza Janviere	After the construction works especially where pipes will pass, people are they allowed to continue using their land?	After construction works and pipes laying, landowners will continue to use their land as usual. However no major structures such as fences will be allowed on the pipelines.
4	Eric BYUMVUHORE	Some have assets on the land where probably the project will pass. Will the project compensate them?	All affected properties will be compensated according to the existing laws related to the compensation in public interests. However, no major land acquisition anticipated because pipelines will use existing road reserve and reservoir are on public land except in Batsinda
5	MUNYAWERA Charles	Water is currently expensive and is becoming more expensive. WASAC in charge should look on these issues and act accordingly.	The message is taken into consideration and will be forwarded to WASAC for consideration.
Kinyinya Sector			
1.	Benineza Claudien	This project is very important because it will help as to resolve issues related to water shortage. When the project will be completed?	The project is still at feasibility stage and the timelines will be communicated to you in next consultation meetings
2	GAKUNZI Janvier	When the maps of the project will be available, it will be better to be displayed at the villages and at open spaces so that different people can have access to	Maps of the project location will be published to cell/ villages information will be made public to all.

No	Names	Questions/Suggestions	Responses provided by the consultant
		the information related to the line route and other project components?	
3	INGABIRE Christa	Who will implement this project?	The project will be implemented by WASAC in collaboration with city of Kigali and JICA will provide funds.
4	ISHIMWE Brian	Water is currently expensive and is becoming more expensive. WASAC in charge should look on these issues and act accordingly.	The message is taken into consideration and will be forwarded to WASAC for consideration.
5	KAYITESI Jacqueline	Recently WASAC increased water tariff and yet the water is not available all the time. What are you planned to address this situation?	WASAC is still discussing with its development partners to first address water shortage in the city of Kigali and rural areas, but the tariff will be also discussed.
Kimironko Sector			
1.	DUSABIMANA Erneste	Which cells will be covered in Kimiroko sector?	The socio-economic survey will cover all three cells of Kimironko sector but there is no components that will be implemented in Kimironko.
2	KAGABA Alexis	How Kimironko sector will benefits from this project?	Improvement of water supply system in neighboring sector from Ntora reservoir will allow Kimironko sector to receive water from other networks. Further, other project that will supply water in kimironko are planned
3	MUGENI Theonira	Water is currently expensive and is becoming more expensive. WASAC in charge should look on these issues and act accordingly.	The message is taken into consideration and will be forwarded to WASAC for consideration.
4	Mukamusoni Mariane	The key issues we have is water shortage and high cost of water. Is the project going to resolve these issues?	The project aims at reducing water losses which will increase water supplied to people. This may also contribute to the reduction of high cost of water. This concern will also be reported in the study.

Source: Field survey, BESST Ltd, 2022

Table 21: Number of households consulted during inception phase

Sector	Cell	Sample Size
Bumbogo	Sb-total	16
	Ngara	16
Gisozi	Sb-total	67
	Musezero	38
	Ruhango	29
Kimironko	Sb-total	58
	Bibare	16
	Kibagabaga	23
	Nyagatovu	19
Kinyinya	Sb-total	107
	Gacuriro	14
	Gasharu	13
	Kagugu	60
	Murama	20
Remera	Sb-total	52
	Nyabisindu	22
	Nyarutarama	18
	Rukiri I	7
	Rukiri II	5
GRAND TOTAL		300

List of people who attended these meetings are presented in annex 2

5.4.2. Consultations at scoping phase- March 26th, 2022

The second round of consultations were conducted at scoping stage and were conducted on March 26th in three sectors where the project will be implemented namely Gisozi, Kinyinya and Remera. These consultations focused on project components, scoping issues as well as the draft terms of reference for EIA study. Communities were provided with time to ask questions, provide inputs and suggestions. Information and comments collected from the public consultations are all summarized in the Table 22 below and lists of attendance are presented in annex 3

Table 22:Questions /Suggestions and responses provided during public consultations

No	Names	Questions/Suggestions	Responses provided by the consultant
Gisozi sector, Saturday, 26th March, 2022			
1	NIBISHAKA Isaac	-Where will the pipelines pass?	-The pipelines will pass where the existing pipes pass especially in the road reserve from Ntora to Gacuriro
2	MUKANDOLI Chantal	You said that during the project implementation, some of the pipes will be replaced. Will be therewater shortages during the period of replacement?	The project is designed in a way that there will be np water shortages during project implementation. In case these happen, people will be informed in advance for them to get prepared.
3	MUKAKABERA Seraphine	We have experienced cases where some of our crops have not been compensated by WASAC. Example is made to my crops affected during the recent constructed Ntora –Gasanze pipe. How can you ensure that this project will be implemented differently while the developer is the same?	Maximum efforts are being done to avoid compensation during the project implementation. In case it happens, compensation will be made before project works. Local people are also required to get all required conditions such and land documents, account numbers etc. in order to get paid. Details in order to get paid shall be discussed during the valuation process.
4	BAMPORIKI Jean Baptiste	During the previous projects some of the pipelines that were supplying us water were not re-connected and we are still struggling. Will the project do the same mistakes?	Normally the pipes to be installed are not directly supplying water to locals. These are transmissions pipes while connection is done to distribution pipes. It is expected that this project will not cause such impacts to locals.
5	YANGIRIYENEZA Egide	Will be there any compensation to those who will temporally close their businesses such as MTN kiosk owner during the project implementation	So far it is expected that compensation will be made at only damaged assets. Those having movable properties shall be requested to move them in order to pave the way project activities. However, those owning such business shall be allocated jobs during project implementation and bring back their kiosks after project works.
Remera sector, March 26th ,2022			
1	UWINGABIRE Marianna	When is the implementation of the project expected to start for us to get prepared?	Different studies related to the project studies are going on and the kick of is expected as soon as the studies are finished and approved and the funds available. It is expected that the project will be start during the next fiscal year and this section to be completed within two years
2	KURADUSENGE David	Will the project give job opportunities to local people or only engineers will be employed by the project	Considering the project nature, local people will be employed and are priorities when allocating jobs. Both local and non-locals will be employed during project implementation
3	SEZIBERA Issa	After the construction works especially where pipes will pass, people are they allowed to continue using their land?	After construction works and pipes laying, landowners will continue to use their land as usual. However no major structures such as fences will be allowed on the pipelines.
4	NDAYISABA Valens	Some have assets on the land where probably the project will pass. Will the project compensate them? ,	All affected properties will be compensated according to the existing laws related to the compensation in public interests.
Kinyinya Sector, Saturday, March 26th , 2022			
1.	MUGISHA Jean Claude	We would like to know the exact location of the water tanks in this area. Is only one water tanks or the project will build different tanks in our area?	The water tank in Kagugu will be constructed in the plot located near Batsinda Central Catholic Church. Other tanks will be located nearby the exiting tanks in Gacuriro and Nyarutarama except the other new tank to be constructed opposite Kagugu Catholic Parish
2	NIYONZIMA Jean d'Amour	When the maps of the project will be available, it will be better to be displayed at the villages and at open spaces so that different people can have access to the information related to the line route and other project components?	For sure. Maps of the project location will be published to cell/ villages information will be made public to all.
3	NIYONSENGA Jean Bosco	It should be better that WASAC also take part in the project implementation	For sure. The project will not be implemented only by JICA. WASAC ltd is project developer and will definitively be part of the project implementation.
4	NDABARORA Eliezer	Water is currently expensive and is becoming more expensive. WASAC in charge should look on these issues and act accordingly.	The message is taken into consideration and will be forwarded to WASAC for consideration.
5	NYIRABUHORO M. Aimee	When do you think the project should start?	The project has started with detailed design and onsite works are expected to start next fiscal year that will start in June 2022.
6	MURATABIGWI Fidele	Regarding the work to be available for the project will JICA fully own the payment of manpower? How about the compensation of damaged properties?	Payment of local manpower will be done by the contractor who will be doing the implementation. While compensation of damaged properties will be done through Government budget via WASAC Ltd.
7	MASUMBUKO Oscar	Is it possible for WSAC to think about het prepaid system as this was done for electricity?	Message is taken and will be forwarded to WASAC for consideration

Source: Field survey, BESST Ltd, 2022

Source: Photos taken during the on-site consultation meetings

5.4.3. Consultations at draft stage-June 4th, 2022

These consultation meetings were held Saturday 04th -06-2022 Nyabisindu Village (Remera sector, Nyabisindu cell), Nyakabungo village (Kinyinya Sector, Kagugu Cell,) and Gasharu village (Gisozi Sector, Musezero Cell). These meetings were attended by local communities and local leaders at cell and sector levels. These meetings aimed at keeping informed the residents and authorities about the project progress and activities as well as collected their views and concerns about the project implementation. Specifically, the meeting focused on showing participants final pipelines routes and selected sites for water reservoirs. Participants were also informed about potential environmental and Social Impacts as well as proposed mitigation measures. Participants were also given time for comments, views, and questions. The next table present key outcomes of this consultations meeting.

Table 23: Outcomes of the consultations at draft EIA/ARAP report- June 4th , 2022

No	Names	Questions/Suggestions	Responses provided by the consultant
Gisozi sector			
1	KARUMUNA Jean Willison	The approach you are using to keep us informed about the project is well appreciated and we request you to inform other institution such as REG and others having project of simile nature to keep local people informed to avoid any inconvenient or misunderstanding that shall occurred during the project implementation.	Message taken and will noted. Usually, the ESIA studies require this kind of consultation, and your message will be transmitted as required.
2	KAYITARE jean Paul	Was there any change about the pipeline routes from the existing line with the new lines?	No major changes have been done. The new pipes will be installed parallel to the existing lines.
3	KARANGWA	Is there anyone that will be relocated? Is yes how the compensation will be done	According to the project designs no one will be relocated. Those having properties to be affected will be compensated according to the compensation law in public interests.
4	MUKASHAYAKA Odette	We are lucky to have this project as it aims at the general development of our region. Will this project supply water to those not connected? We will be able be employed during project activities?	The project will supply water to some areas/ zones not connected to WASAC or to any other water service providers. Those wishing to be connected will have opportunity to get connected. For sure job will be given and priority will be residents.
Remera sector,			
1	MUDAHARISHEMA Jean Baptiste	Will have opportunity to get jobs from this project	For sure. Job opportunities will be available during project implementation and those willing to be employed will get the opportunity. However, job numbers are limited based on the project nature and type.
2	UWAMARIYA Dative	Those having land will be compensated?	land for pipes lines will be temporally used during pipes laying and installation. No land

No	Names	Questions/Suggestions	Responses provided by the consultant
			compensation is planned during this project. However, any assets to be damaged shall be compensated as per the expropriation laws and regulation in palace.
3	MUKANGENZI Vestine	When is the implementation starting?	It is expected that the project shall start in the next financial year according to the required agreement between Rwanda and JICA. People will be kept informed about the project progress
Kinyinya Sector			
1.	NSENGUMUREMYI Felicien	Thank you for keeping us informed about the project. We are suggesting that during the project implementation WASAC should look for alternatives for water supply for those connected. Otherwise, people will suffer from lack of water and yet the project will be a challenge to them and not well appreciated.	Alternatives for water supply will be provided and are being discussed between WASAC and project funder and this will be implemented during project works. People would not worry about this. Effort shall be made to minimize water shortages.
2	GATABAZI Pascal	We are requesting that WASAC look on how the payment system for water tariffs shall be pre-payment as we are familiar for electricity. We only use the electricity that we have paid. And WASAC is advised to look for this possibility to use	The message is taken and will be forwarded to WASAC for consideration
3	MUKAKIGELI Josephine	Will the project give jobs to local people?	Job opportunities will be available even if are limited. Priority considerations will be given to residents.
4	UWANYIRIGIRA Jacky	Water is expensive. Will the project contribute to the reduction of prices of water tariffs?	The message will be taken to WASAC for consideration and assessment. We cannot confirm now that water tariffs will be reduced due to project implementation.

In general, the consultations were successfully conducted as planned before. The local community appreciated the project progress as well as the approach being made of keeping them about the project. They requested to be considered as priorities when allocating jobs that not require specific and additional knowledge. Lists of participants are presented in annex 4.

6. ANALYSIS OF PROJECT ALTERNATIVES

6.1. Overview

The present section describes different project alternatives that were examined while designing the proposed project and identify other alternatives, which would achieve the same objective of the project implementation. The 'No action' alternative was also analyzed to demonstrate environmental and social conditions without the project. Consideration of alternatives should extend to sitting, design, technology, construction techniques, phasing, and schedule, and operating and maintenance procedures alternatives. Alternatives were compared in terms of potential environmental and social impacts; capital and operating costs; suitability under local conditions; and institutional, training, and monitoring requirements. For the present project of improvement of water supply services in north Central Kigali, alternative focused on choice of line route, the location of water reservoirs and the implication of each line route it terms of different criteria including environmental and social Impacts, resettlement implication and the project cost.

6.2. No- Project option

The no Project alternative option will entail leaving the water supply mechanism in the present situation and this option is not desirable considering the importance of the project implementation. Besides, there are many significant and specific benefits that would not be accrued if the proposed development is not to be implemented. The project targets to improve the water supply system and assumes NRW reduction from 40.3% (ratio in the area is as of the data in Feb. 2022) to 20.9% by the extensive rehabilitation and expansion of the project facilities. The completion of the project is expected to be in the year 2025, its target year for water demand was set as 2030, five years after the completion, in accordance with the benchmark year of the Kigali Water Supply Masterplan.

The project implementation is also justified by the need of increasing the capacity of water supply in Kigali City to satisfy its growing population. The project is also implemented in line with the targets and objectives and visions of Rwanda to have access to safe clean water to all as per the water supply master plan considering that the study area needs 21, 300m3 / day by 2030. In the case of no project option, this means that project is not implemented. This option is the most suitable alternative from environmental perspective as it ensures non-interference with the existing environmental conditions. However, this option involves several losses on socio-economic conditions both to the local population and the nation in general. The loss is not only associated to the scarcity of drinking water in the project area, the economic gains; however, the negative impacts associated to the project implementation will be aggravated and worsened. For the above reasons the consultant could not recommend No-Option alternative. Instead, the consultant is recommending the implementation of the proposed project with appropriate mitigation measures.

6.3. Project alternatives with mitigation measures

The design team has proposed different line route alternatives and based on the present criteria the best line routes were proposed. Maximum efforts have been made to minimize resettlement impacts as the line routes for the project are the buffer zones of the existing roads. The replacement of the existing pipes will be done parallel to the old ones to be replaced. The EIA consultant assessed the proposed alternatives and confirmed the selected line routes but proposed mitigation measures for the identified potential environmental and social impact including avoiding narrow spaces along the existing roads, rehabilitation of the damaged areas, compensation of damages etc. and these are discussed in detail in chapter seven and eight.

6.3.1. Alternative analysis for pipelines

The next table presents different options explored on both pipelines' routes explored and the construction sites for reservoirs.

Table 24: Alternatives considered for transmission pipeline routes

	Finalized route Nyagatovu	Alternative 1 Nyabisindu	Alternative 2 KN5 (RDB) - KG17 route (to Golf 8)	Alternative 3 KG201 (Gasabo District) – KG17(to Golf 8)
Total length	3.05 km	3.14 km	3.01 km	2.96 km
Route composition				
Wetland crossing	No	Yes (100m)	No	
Impact on Road Structures	Limited impact on asphalt paved road (Most of the road are unpaved and will impact pavement only at the road crossing part.)	Necessary to lay pipe under the car road on KG16 Avenue (Approx. 1.0km)	Limited impact on pavement (Pipe can be installed under the walkways and will impact the pavement only at the road crossing part.)	Limited impact on pavement (Pipe can be installed under the walkways and will impact the pavement only at the road crossing part.)
Impact on traffic	Positive impact. Most of the roads are unpaved so the pipe construction will improve the road condition after completion.	Pipe laying under the car road (KG16) will incur one-side traffic closure.	Construction on National Road (KN5) and the major city road (KG17) will have high impact on heavy traffic.	Minimized the impact on national road but heavy traffic the major city road (KG17).
Resettlement	No	No	No	No
Land acquisition	No	No	No	No
Construction period	Shorter than other alternatives.	Long because of the wetland crossing and construction under the car road.	Long because of the construction along national road and congested road (KG17).	Long because of the construction along congested road (KG17).
Construction cost	Low	High	Low	Low
Environmental impacts	Low environmental Impacts given that no site clearance is limited, traffic disturbance is limited in time	Substantial Environmental impacts due to wetland crossing and traffic disturbance	Moderate to medium Environmental impacts due longer traffic disturbance	Moderate to medium Environmental impacts due longer traffic disturbance
Conclusion	Selected	Not selected to avoid wetland crossing and the construction under the car road.	Not selected to avoid the construction under the national road (KN5).	Not selected to avoid the construction under the congested road (KG17).

6.3.2. Alternative analyis for reservoir construction

Table 25: Alternatives considered for construction sites of reservoirs

	Finalized Plan	Alternative 1	Alternative 2	Zero Option
Location and type of reservoirs	1. Kagugu (Elevated Tank) 2. Gacuriro (Elevated Tank) 3. Batsinda (Ground reservoir) 4. Nyarutarama-South (Elevated Tank) +4 Pressure Breaking Chambers	1. Kagugu (Elevated Tank) 2. Gacuriro (Elevated Tank) 3. Batsinda (Ground reservoir) 4. Nyarutarama-South (Elevated Tank) 5. Gisozi-Low Reservoir 6. Gisozi-Middle Reservoir	1. Kagugu (Elevated Tank) 2. Gacuriro (Elevated Tank) 3. Batsinda (Ground reservoir) 4. Nyarutarama-South (Elevated Tank) 5. Fawe Reservoir 6. Nyarutarama North Reservoir 7. Gisozi-Low Reservoir	No reservoirs to be constructed.

	Finalized Plan	Alternative 1	Alternative 2	Zero Option
		+ 6 Pressure Breaking Chamber	8. Gisozi-Middle Reservoir	
Physical Resettlement	No resettlement is expected.	No resettlement is expected.	No resettlement is expected.	No resettlement is expected.
Land acquisition	Kagugu (public land) and Batsinda (private land) needs to be acquired. Both land acquisition can be settled as the WASAC has good communication with their owners.	In addition to Kagugu and Batsinda, Gisozi-middle needs land acquisition from the University. Gisozi-low may have difficulty in land acquisition because the road expansion is planned.	Nyarutarama North, is the private land that needs land acquisition.	No land acquisitions
Impact on traffic	No significant impact on traffic.	No significant impact on traffic.	No significant impact on traffic.	If there is no construction, the leakage on the pipes will be accelerated because the pressure in the pipelines will not be reduced. As a result, the traffic will be interrupted by the leakage and leakage repairs.
Construction period	Shorter than Alt 1 and 2.	Shorter than Alt 2.	Longer.	No construction.
Construction cost	Lower than Alt 1 and 2.	Lower than Alt 2.	Higher.	
Maintenance cost	Lower than Alt 1 and 2.	Lower than Alt 2.	Higher.	Maintenance cost will be higher due to increased leakages.
Environmental Impacts	Low impacts due to reduce site clearance and construction sites	Moderate to medium impacts due to increased site clearance and construction sites	Moderate to medium impacts due to increased site clearance and construction sites	No environmental Impacts
Evaluation	Selected	Not selected due to the difficulties in land acquisition and moderate Environmental impacts due to the number of construction sites	Not selected due to the difficulties in land acquisition and moderate Environmental impacts due to the number of construction sites	Not selected because the Positive social impact and viability of water supply will be lost if there is no construction.

6.4. Recommended project alternatives

Based on the proposed project nature, extend and location as well as the technical designs and proposed mitigation measures, and based on the social and environmental assessment of the project site, the consultant can conclude that the most preferred alternative would be implementing the project with the proposed and detailed mitigation measures in place. The selected pipeline route has been found to be the most option as it minimizes the potential environmental and social impacts especially those related to resettlement impacts. No Physical displacement identified in all options. Only private land will be acquired at Batsinda reservoir.

The project has more positive impacts especially increasing the capacity of water supply in Kigali and does not have any irreversible environmental and social impacts. The identified potential impacts to both social and environment have been found to be at an extent that can be avoided, minimized, or compensated when applying the proposed mitigation measures the Environmental Management Plan and monitoring plan as developed in this report.

7. IMPACT PREDICTION ANALYSIS AND MITIGATION MEASURES

7.1. General overview

Environmental and social impact refers to the changes of existing conditions of any area or environment caused by human activities or any internal or external influence which may be positive or negative (Government of Rwanda, 2018). The impact may be direct or indirect, long term or short term and may be local or extensive. The process of identification of the impacts associated to the present project revealed that there might be different environmental and socio impacts both positive and negative during the project phases especially during construction and operation.

The objective of impacts assessment is to identify and assess all the significant impacts that may arise from the undertaking of an activity and findings used to inform the competent authority's decision as to whether the activity should be either authorized, authorized subject to conditions that will mitigate the impacts to within acceptable levels or refused.

7.1.1 Scoping of impacts

In compliance with the JICA guidelines, the positive/adverse impacts resulting from the project were evaluated with the application of scoping matrix. The scoping of the predicted impacts for the project was done and different impacts were identified as described in the table below.

Table 26: Scoping of the project impacts

Category	No.	Items	Evaluation		Reason	
			Before/ During Construction	Operation	Construction of Reservoir Installment/Replacement of Distribution piles	Installation of Transmission pipes
Anti-pollution measures	1	Air pollution	B-	D	[During Construction] Emission gas and dust will be generated; however, their impact on ambient air quality is expected to be limited, due to the limited number of heavy vehicles & trucks and limited period of construction work at each place.	
					[During operation] There is no plan to install pumps at the newly constructed reservoirs, so no impacts on air quality is expected.	[During Operation] There will be no impacts on the ambient air quality.
	2	Water pollution	B-	D	[During Construction] At the most parts of the primary distribution lines, re will be replaced with new pipes, and there need to be treatment of water residue. [During Operation] There will be no impacts on the water quality.	[During Construction] There is one wetland-crossing points, but the area is limited and water flow is very small during the dry season.
	3	Soil pollution	C	D	[During Construction] There could be oil contamination during the maintenance work of heavy vehicles and trucks; however, its impact would be limited.	
	4	Waste Municipal solid waste (MSW)	D	D	[During Construction] It is likely that workers are recruited locally and accommodations and camps for workers would not be prepared. Therefore, MSW would not cause a serious problem. [During operation] No MSW is generated.	
		Construction waste (CW)	B-	D	[During Construction] Construction waste such as excavated soil and concrete debris will be generated. Some of them can be reused as road construction materials. It is necessary to formulate a waste management plan to promote recycling.	
					[During operation] No waste is generated.	
	5	Noise and Vibrations	B-	C	[During Construction] There will be problems of noise and vibrations due to the construction work of the new reservoirs. In particular pile driving work would cause serious noise and vibration problems. There will be also problems by distribution pipeline installation/replacement works	[During Construction] There will be temporary problems by transmission pipeline installation works

Category	No.	Items	Evaluation		Reason	
			Before/ During Construction	Operation	Construction of Reservoir Installment/Replacement of Distribution piles	Installation of Transmission pipes
					[Operation] There is no plan to install pumps at the newly constructed reservoirs, so no problems of noise and vibrations will be expected.	
	6	Ground subsidence	D	D	Design based on the boring survey can prevent ground subsidence	
	7	Odor	D	D	Problems of odor are not expected	
	8	Bottom sediment	D	D	There will be no activities which have impacts on bottom sediment	
Natural Environment	9	Protection area	D	D	The project area is located in urban areas and there are no protection area such as national park inside the Project area.	
	10	Biota and ecosystems	B-	D	[During Construction] The project area is located in urban areas and the impact of the project on ecosystem is very limited.	[Before/during construction] There is a wetland crossing but the target area is very limited
	11	Hydrology	D	D	There will be no activities which would affect the Hydrology.	
	12	Geographical features/Soil erosion	C	D	[During construction] There will be no activities which affect geographical features and soil erosion.	[During construction] There is a wetland crossing but the target area is very limited
Social Environment	13	Resettlement/ Land acquisition	B-	D	[Before Construction] There would be no need of resettlement, but one plots of lands would need to be acquired for the construction of reservoirs.	[Before Construction] There would be no need of resettlement and land acquisition
	14	Vulnerable groups /Poor people	B-	D	「Before/during Construction」No issues of minority and indigenous people are identifies. Based on the result of the socio-economic survey, support for vulnerable groups and poor people will be considered, if necessary [During Operation] No negative impact would be expected.	
	15	Local economy such as employment and livelihood	B+/-	B+	[During Construction] The project would create jobs such as construction workers. Demand for food and daily necessities from construction personnel could have positive impact on the local economy. On the other hand, there would be loss of land	[During Construction] The project would create jobs such as construction workers.
					[Operation] The introduction of the block distribution system could decrease the fluctuation including leakage in water delivery. This could improve the business environment and then enhance the local economy and increase jobs	[Operation] The installation of transmission pipeline could improve water supply system, and this improve business environment.
	16	Utilization of land and local resources	D	D	[During Construction] There would be no activities which affect the use of the land and local resources	
	17	Water use Water for drinking and domestic use	B-	B+	[During Construction] Water supply will be suspended for a certain period of time due to the replacement work of distribution pipes. [Operation] The introduction of the block distribution system could decrease the fluctuation including leakage in water delivery.	[During construction] Electric and communication cables could cause interruption of the construction work. [Operation] Supply Water volume will be increased, and this makes it possible for WASAC to improve the management.
	18	Existing social infrastructures and services	B-	B+	[During Construction] Traffic congestions would be expected along some of the main roads such as KG 14.	
					[Operation] The water supply system is improved.	[Operation] The water supply system is improved. The surface of unpaved roads would be improved by the transmission pipe installation work

Category	No.	Items	Evaluation		Reason	
			Before/ During Construction	Operation	Construction of Reservoir Installment/Replacement of Distribution piles	Installation of Transmission pipes
	19	social institutions such as social infrastructure and local decision-making institutions	D	D	There will be little impact on social infrastructure and local decision-making institutions	
	20	Misdistribution of benefits and damages	B-	D	[During Construction] Some of local people would face problems of noise and vibrations. Some others would benefit from the project by getting jobs or selling goods and food. [During Operation] The project area would benefit from the improvement of water supply.	
	21	local conflict of interests	D	D	[During Construction] The construction work is mainly the replacement of pipes, and the project will bring the benefit for all the communities, so the local conflict of interests would not be expected.	
	22	Cultural heritage	D	D	No cultural heritages are not identified	
	23	Landscape	C	D	The project could not change the landscape significantly. Some trees would be cut down and, in this case, trees of the same species would be planted.	
	24	Gender Children's right	C	D	[Before/During Construction] The negative impact on gender issues is not expected; however, socio-economic survey will check the economic situations of female headed household, and supporting measure will be considered, if necessary. The negative impact on Children's right is not expected; however, if socio-economic survey identifies problems related to children, supporting measures will be considered.	
	25	infectious diseases such as HIV/AIDS	B-	D	[Before/During Construction] Workers will be employed locally and it is unlikely that the Project would spread infectious diseases such as HIV/AIDS; however, HIV/AIDS issue is one of concerns in Rwanda, and it is important to promote awareness about HIV/AIDS for not only workers but also local people in order to prevent further infection.	
	26	Work Conditions including Work Safety	B-	D	[Before/During Construction] There would be a possibility of accidents, injuries, and diseases at the construction site. Contractor will be required to follow Rwandan laws and international rules such as OHSAS in order to make sure of work safety.	
	27	Accidents	B-	D	[Before/During Construction] There would be a possibility of traffic accident during the construction work.	
	28	Global warming	D	D	The operation of heavy vehicles and trucks generates greenhouse gas; but the generation amount is limited.	

Legend	Impact
A+	Significant Positive impact
A-	Significant Adverse Impact
B+	Positive Impact
B-	Negative Impact
C	Moderate Impact
D	No /Negligible Impact

7.1.2 Impact types

Different types of impacts may occur from the implementation of this type of project. The impact may be positive or negative and can be categorized as being either direct (primary), indirect (secondary) or cumulative. Direct impacts are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity (for example, dust generation resulting from excavation activities). These impacts are usually associated with the construction, operation or maintenance activities and are obvious and quantifiable.

Indirect impacts are induced changes that may occur because of the activity (for example the use of water from a natural source at the activity will reduce the capacity for supply to other users). These types of impacts include all the potential impacts that either do not manifest immediately when the activity is undertaken, or which occur at a different place because of the activity (REMA, 2006).

Cumulative impacts are those that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present, or reasonably foreseeable future activities (for example, removal of vegetation may cause soil erosion, leading to excessive sediments in receiving water body, leading to reduced sunlight penetrating the water and thus reducing dissolved oxygen in the water and adversely affecting aquatic life and water

quality). Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.

7.1.3 Identification of potential impacts

To identify the potential impacts of this project, a matrix was designed and used with the aim to assess the impacts associated with almost any type of development project. Its main strength is a checklist that incorporates qualitative information on cause-and-effect relationships.

Table 27: Matrix used for identification of potential impacts associated to the project implementation

Environmental components			Physical (Land-Water-Air)								Biological				Socio-economic						
			Geology	Soil		Water			Air	Visual	Flora		Fauna		Resettlement			Quality of life			
Project activities			Geological formation	Soil pollution	Soil erosion	Water Pollution	Runoff and infiltration	Underground water	Air quality	Visual impacts	Flora disappearance	Flora succession	Fauna disappearance	Fauna habitat	Loss of Crops	Loss of private land	Effects on infrastructure and public utilities	Occupational health and safety	Employment	Skills transfer	Noise and vibration
Project Phase	#	Main Activity																			
Design and Planning	1	Preliminary Survey and detailed design including EIA and ARAP																	X	X	
Construction	2	Site clearing	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	3	Installation of pipes	X	X	X	X		X	X		X	X	X	X	X		X	X	X	X	X
	4	Installation of elevated tank		X	X	X	X	X	X	X							X	X	X	X	X
	5	Construction of water pumps	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X
	6	construction of pressure breaking chambers	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X
	7	Modification of existing transmission mains from Ntora reservoir	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X
	8	Construction / installation of flowmeter	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X
	9	Construction / installation of level gauges	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X
	10	Construction / installation of monitoring system	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X
	11	Storage for construction materials	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X
	12	Disposal of construction wastes	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X
	13	Influx of workers																X	X	X	
Operation and maintenance	14	Operation of the project facilities																			X
	15	Maintenance and rehabilitation of water infrastructure	X	X	X	X	X	X	X										X	X	X
Decommissioning	16	Site closure	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X
	17	Decommissioning	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X

7.1.4 Impact analysis

Impact analysis was done through conducting risk assessment, risk evaluation and risk management (relating directly to applicable mitigation measures to be implemented.) and the impact analysis matrix is presented in the next Table.

Table 28: Impact analysis matrix

Nature or Status of the Impact: The type of effect the activity would have on the environment		
Status		Description
Positive:		a benefit to the holistic environment
Negative:		a cost to the holistic environment
Neutral:		no cost or benefit to the holistic environment
Duration of the Impact: The lifetime of the impact		
Score	Duration	Description
1	Short term	Less than 2 years
2	Short to medium term	2 – 5 years

3	Medium term	6 – 25 years
4	Long term	26 – 45 years
5	Permanent	46 years or more
Extent or Scale of the Impact: The distance from source that impacts may be experienced		
Score	Extent	Description
1	Site specific	Within the site boundary
2	Local	Affects immediate surrounding areas
3	Regional	Extends substantially beyond the site boundary
4	National	Affects country
5	International	Across international borders.
Reversibility of the Impact: To what degree its influence on the relevant environment can be negated.		
Score	Reversibility	Description
1	Completely reversible	Reverses with minimal rehabilitation & negligible residual affects
3	Reversible	Requires mitigation and rehabilitation to ensure reversibility
5	Irreversible	Cannot be rehabilitated completely/rehabilitation not viable
Magnitude or intensity of the Impact: Severity of the negative and magnitude of positive impacts		
Score	Severe/beneficial effect	Description
1	Low	Little effect - negligible disturbance/benefit
2	Low to moderate	Effects observable - environmental impacts reversible with time
3	Moderate	Effects observable - impacts reversible with rehabilitation
4	Moderate to high	Extensive effects - irreversible alteration to the environment
5	High	Extensive permanent effects with irreversible alteration
The Probability of the Impact: Describes the likelihood of the impact actually occurring		
Score	Rating	Description
1	Unlikely	Less than 15% sure of an impact occurring
2	Possible	Between 15% and 40% sure of an impact occurring
3	Probable	Between 40% and 60% sure that the impact will occur
4	Highly Probable	Between 60% and 85% sure that the impact will occur
5	Definite	Over 85% sure that the impact will occur
The Consequence (C)		= Magnitude/Intensity (M/I) + Extent (E) + Duration (D) + Reversibility (R).
The Significance (S)		= Consequence (C) x Probability (P)

7.1.5 Determination of significance

After assessment of an impact in accordance to the criteria described above, the significance of an impact can be determined. The various ratings as indicated above are accorded to these criteria. These ratings are then used to calculate a significance (S) rating and are formulated by adding the sum of ratings given to the extent (E), duration (D), Reversibility (R) and intensity (I) and then multiplying the sum with the probability (P) of an impact as follows:

Significance (S) = (E+D+R+I) X P. The score is group as follow

Score out of 100	Significance
1 to 20	Very low
21 to 40	Low
40 to 70	Medium
Over 70	High

Description of significance

Significance	Description
Positive impacts	- Positive impacts are positive changes to the receiving environment
Very low	- No impacts on biophysical and social environments / livelihood / health / gender - No public concerns - No legal issues
Low	- Low/minor impact on environment / livelihood / health / gender - Minor social impacts - No legal issues
Medium	- Some level of impact on environment / livelihood / health / gender - Social issues apparent - May have legal implications
Severe/high	- High level impacts on environment / livelihood / health / gender

Significance	Description
	- High public concerns or perceptions - Legal non- compliance

The following table summarizes the evaluation of impacts associated with the proposed project of and it shows their significance through the projects phase.

Table 29: Project impact analysis matrix

Impacted Aspect	Impact	Positive/ Negative/ Neutral Impact	Magnitude (M)	Extent (E)	Duration (D)	Reversibility (R)	Probability (P)	Significance (S)	Mitigation
I. Planning Phase									
Activity 1. Preliminary survey									
General	Job creation and employment opportunities	Positive	4	2	3	5	5	70	NO
	Income generation	Positive	5	3	3	5	5	80	NO
	Increased savings for the local employees	Positive	3	2	4	3	5	60	NO
	Influx of job seekers	Negative	3	2	1	3	4	36	YES
	Child labor and sexual harassment	Negative	1	1	2	1	3	15	YES
	Risks of job accidents	Negative	2	1	1	5	3	27	NO
II. Construction of the pipelines									
Activities 2.1: Installation principal water pipe									
Soil	Risk of soil erosion	Negative	2	1	3	5	3	33	YES
	Risk of surface water pollution	Negative	1	2	3	5	3	33	YES
	Risk of ground water pollution	Negative	1	2	2	5	3	30	YES
	Risk of dust generation and air pollution	Negative	4	2	3	3	5	60	YES
	Risk of increase of noise levels at the project sites	Negative	4	1	2	3	4	40	YES
	Loss of fauna and flora	Negative	4	1	1	3	4	36	YES
Quality of life	Job creation	Positive	4	2	3	3	5	60	NO
	Risk of diseases contamination such as HIV/AIDS	Negative	3	4	5	5	2	34	YES
	Risk of onsite work accidents	Negative	4	1	1	3	4	36	YES
	Traffic congestions	Negative	4	2	1	1	4	32	YES
	Disruption of public utilities	Negative	4	3	2	1	3	30	YES
	Vandalism of infrastructures	Negative	2	2	4	5	2	26	YES
	Child labor and sexual harassment	Negative	2	2	2	1	3	21	YES
Activity 2.2: Construction of elevated water elevated tanks, water reservoirs and pressure braking chambers									
Property	Loss of land	Negative	4	2	1	1	4	32	YES
	Loss of income	Negative	2	2	2	1	3	21	YES
	Loss of crops and tress	Negative	4	3	2	1	3	30	YES
Soil excavation	Risk of soil erosion	Negative	3	2	1	3	4	36	YES
	Risk of surface water pollution	Negative	1	1	1	5	2	16	YES
	Risk of ground water pollution	Negative	1	1	1	5	1	8	YES
	Risk of dust generation and air pollution	Negative	4	2	3	3	5	60	YES
	Risk of increase of noise levels at the project sites	Negative	4	2	2	3	5	55	YES
	Loss of fauna and flora	Negative	2	2	4	5	2	26	YES
Construction	Oils spillages	Negative	3	2	1	3	3	27	YES
	Injuries or fatalities from improper manual handling	Negative	4	1	1	5	4	44	YES
	Traffic congestions	Negative	2	2	1	3	3	24	YES
	Disruption of public utilities	Negative	3	2	1	3	3	27	YES
	Soils waste generation	Negative	4	2	1	3	5	50	YES
Quality of life	Job creation	Positive	4	2	3	3	5	60	NO
	Risk of diseases contamination such as HIV/AIDS	Negative	3	4	5	5	2	34	YES
	Risk of onsite work accidents	Negative	4	1	1	3	4	36	YES
	Traffic congestions	Negative	2	2	1	3	3	24	YES
	Disruption of public utilities	Negative	3	2	1	3	3	27	YES
	Child labor and sexual harassment	Negative	2	2	2	1	3	21	YES
Activity 2.5: Project operation									
Operation	Access to potable water	Positive	5	5	4	4	5	90	NO
	Gender balance enhancement	Positive	4	4	4	4	2	34	NO
	Improved sanitation	Positive	5	4	4	4	3	72	NO
	Improved water supply services	Positive	4	4	4	4	4	68	NO
	Increased water revenues at central level	Positive	5	4	4	4	5	90	NO
	Water losses reduction	Positive	5	4	5	4	5	90	NO
Quality of life	Risk of social conflict with local communities	Negative	3	2	1	1	2	14	YES
	HIV/AIDS& communicable diseases	Negative	2	4	5	5	2	32	YES
	Gender Based Violence and sexual exploitation	Negative	3	4	3	3	3	39	YES

Impacted Aspect	Impact	Positive/ Negative/ Neutral Impact	Magnitude (M)	Extent (E)	Duration (D)	Reversibility (R)	Probability (P)	Significance (S)	Mitigation
Activity 3.1. Maintenance and rehabilitation of water infrastructure									
Maintenance and rehabilitation work	Employment opportunities	Positive	4	2	1	3	5	50	NO
	Risk of surface water pollution	Negative	3	2	2	5	2	24	YES
	Disruption of public utilities	Negative	2	1	1	1	3	15	YES
	Risk of ground water pollution	Negative	1	2	2	5	1	10	YES
	Risk of dust generation and emission	Negative	2	2	1	3	3	24	YES
	Increase of noise levels	Negative	1	2	1	3	3	21	YES
	Oils spillage	Negative	2	1	1	5	3	27	YES
	Solid waste generation	Negative	3	1	1	3	5	40	YES
	Loss of flora and fauna	Negative	2	1	1	3	4	28	YES
	Vandalism of infrastructures	Negative	1	1	1	1	2	8	YES
	Risk of work accidents	Negative	3	1	1	1	3	18	YES
IV. Decommissioning/closure and post-closure phase									
Activity 4.1: Project Closure									
Decommissioning	Soil contamination	Negative	3	1	1	5	4	40	YES
	Risk of surface and ground water pollution	Negative	3	3	1	5	1	12	YES
	Increase of noise levels	Negative	2	2	1	3	2	16	YES
	Improvement of the beauty of the area	Positive	3	3	3	5	3	42	NO
	Risk of accidents	Negative	4	1	1	1	2	14	YES
Activity 4.2. Pipeline routes revegetation									
Revegetation	Soil structure and texture improvement	Positive	5	1	3	3	4	48	NO
	Vegetation cover and proliferation of fauna habitats	Positive	4	3	4	3	4	56	NO
	Landscaping and aesthetic	Positive	5	3	4	3	4	60	NO
	Improvement of surface and ground water quality	Positive	4	3	4	3	4	56	NO
	Job creation	Positive	3	2	1	3	4	36	NO

7.2 Impacts identified and proposed mitigation measures

As per the general guidelines for Environmental Impact Assessment in Rwanda and JICA guidelines for environmental and social considerations both positive and negative impacts associated to the project implementation were assessed. A summary of impacts analysis in tabular form is also presented at the end of this section and an Environmental Management and Monitoring Plan is provided in Chapter 8.

7.2.1 Overall positive socio-economic impacts of the project implementation

The present project is likely to have substantial positive socio- and economic impacts in the City of Kigali in general and in the project area specifically. Direct positive impacts include the provision of employment and availability of water infrastructures that can support the country's objectives in terms of clean water supply and economic development. The following section highlights the potential social-cultural and economic impacts associated with the project of Improvement of water supply services in North Central Kigali.

- Employment opportunities

The implementation of this project will provide employment opportunities to local population. During the implementation of the project, new jobs will be created in the form of skilled and unskilled labor in the local community. Most of the unskilled labor will be sourced from the local residents. Indirect employment will be in the form of suppliers and other forms of sub-contracted works that will be required for planning and design of project components. These are positive outcomes of the project implementation to both national and for the local population.

- Income generation

The employment opportunities connected to project implementation will generate income to local population who will be directly or indirectly employed by the project as well as to the project workers in general. This will contribute to their increase of the family and personnel income generation through salary gained from the project.

- Increased savings for the local employees

The increase of the project's local work force and employee's revenue will lead to the possibility of savings in local banks such as SACCO and local micro-finances of the project area.

- Skills and knowledge transfer

In the process of planning and design, the local technical work force will work with the experts in different domain. This process of working together will transfer design and planning tools and other useful guidelines, which shall be used in the future in similar project implementation countrywide.

- Economic diversification and improved local socio-economy

It is no doubt that a big number of works related to the project implementation will provide a positive increase to the local and national economy. This will contribute to the socio-economic benefits within and around the project area. The economic expansion will enable alternative businesses and economic activities to develop and increased earnings by project workers will most likely be spent locally further supporting already established businesses in the area, as well as potential new businesses that may arise.

- Access to potable water and reliability of water supply system

Access to the new water supplied areas within Kigali city such as Batsinda will be emerged through the implementation of the present project. Hence the project will increase the number of people with access to clean water. The improvement and expansion of water supply system will enable greater responsiveness to the demand, also increasing the reliability of the operating system.

- Gender balance enhancement

During the project implementation women will equally benefit as men in terms of employment opportunities and benefits. This will contribute to the government vision of fighting against gender inequality and ensuring that women are given equal opportunity in terms of employment.

- Healthcare for employees

Employees and their immediate families will be provided with basic healthcare. This will benefit the overall health of the local population. HIV/AIDS information and COVID- 19 prevention will be dispersed to employees to prevent the spread of such diseases and other STDs amongst the project employees and their families.

- Improved sanitation in the project area

The project will significantly contribute to improvement of sanitation within its areas of intervention because of access to safe and clean water. Therefore, this will contribute to the improvement of living conditions of local population.

7.2.2 Negative impacts and mitigation measures for block system - construction of reservoirs and installation/replacement of distribution pipes

It is anticipated that construction of ground and elevated water storages, installation and replacement of existing pipes will have negative impacts on both social and physical environment. This section describes negative impacts associated with components covered under the JICA grant.

- Labor influx

There is within the local population, high expectations of getting employed by the project. During the public consultation, the issues raised were related to employment opportunities. Indeed, although the project will create employment opportunities, the jobs will be limited, and it is therefore important that the procurement processes be clear and fair. It is expected that creation of not enough jobs will create frustration on part of the local people and conflicts can occur or be generated in relation to the project.

Mitigation measures:

- Local and affected project persons (those having land that shall be affected by the project) should be prioritized when allocating jobs
- Recruitment should be done in a clear and fair process.
- Establish recruitment committees prior to job commencement while involving local authorities in recruitment as they are aware of the behavior of residents
- Women should equally benefit as men from job recruitments opportunities

- Resettlement implications

The project was designed in a way that it avoids and minimizes physical resettlement. The required land for water reservoirs will be acquired and some structures and assets privately owned may be partially affected by project

activities among them including the loss crops and trees and or fences. Fair compensation to those affected will be conducted before project implementations detailed in the ARAP report.

- High expectations of getting great compensation in case of compensation

It is no doubt that some people will lose their land or crops and some business may be temporally affected due to the project implementation. Some of them may have a bad behavior of highly benefitting from the project implementation while expecting more form the compensation.

Mitigation measures:

- Valuation of damaged assets should be done with the certified independent valuer as per the existing regulations and laws.
- Full replacement cost should be used to provide fair compensation and the application of market and value of money to be applied.
- The compensation exercise must involve different project partners including WASAC, Local population and local leaders, district etc.

- Conflicts among workers and the local population of the project area

Even though the project will try to employee local population, projects involving major works include, often, the potential for the occurrence of social conflicts between workers who may temporarily settle in the local and community residents. Such behaviors are generally related to socially unacceptable behavior according to local social standards and can be seen, for example, cases of drunkenness and disregard/lack of respect for local customs. This impact should be considered even though an important part of the manpower to be recruited locally.

Mitigation measures:

- Where possible maximum efforts should be made to recruitment of local population who returns to their homes after work.
- Elaborate and enforce the code of conduct to all project workers
- Punitive measures to be imposed to those not complying with the project regulations

- Injuries or fatalities from improper manual handling

The most common injuries or illnesses connect to similar projects because of manual handling are musculoskeletal disorders in various parts of the body (back, neck, shoulders, or other) and include from sprains and strains to damage to muscles, joints, and vessels. Other injuries include cuts, bruises, lacerations, and fractures due to unexpected events such as accidents caused by manual handling.

Mitigation measures:

- The entire project should be insured
- The contractor to establish health and safety measures that must be implemented at the project site by all workers.
- Provision of appropriate Personnel Protective Equipment (PPE) to all employees,
- Provide and avail permanent First aid kit at the work site,
- Provide health insurance for all workers as means of health affordability
- Working conditions should respect the requirement of the Law n° 66/2018 of 30/08/2018 regulating labour in Rwanda.
- Measures are taken to oblige workers to wear properly the PPEs and to properly manage generated waste to prevent any accidents during the construction works
- The safety plan and measure must be prepared and enforced at the project site.
- Basic trainings on safety measure to be conducted to the project workers.
- Provide sign boards at the project site to prevent accidents and troubles involving site workers

- Traffic congestion and injuries or fatalities

The project will consist at rehabilitation of existing water pipelines while new pipes will also be constructed. Efforts have been made to design the line routes along the existing roads in the buffer zone of the road. However, at some point the pipelines cross both paved and unpaved roads. During construction period there will be increase in traffic due to moving machineries and vehicle traffic for material supply. This may cause both congestion and accidents.

Mitigation measures

- Prepare traffic management plan before project works
- Rehabilitate of affected structures and infrastructures should be done as soon as possible after project works;

- Inform local population about the planned activities and the inconvenience that may be caused
- Use the traffic signs at the affected sections.
- Provide safety people to guide traffic especially where the works will be undertaken near paved roads

➢ Work related health issues

Health related issues are mainly resulted from emission of dust, noise and vibration which can result in possible respiratory irritation, discomfort, or illness to workers and local communities.

Mitigation measures

In addition to the safety measures mentioned above, the following additional measures should be implemented:

- PPE should be provided to workers who are exposed to dust, noise, and vibration for a prolonged period.
- Regularly watering the project site, when necessary, especially near business places to suppress dust during construction, use of gas masks and goggles for dusty sections is strongly recommended;
- Enforce the acquiring of medical insurance "mituelle de sante" for all workers as a means of affordability of treatment.
- The safety and sanitation plan will be prepared and implemented, and regular safety education will conduct, in consultation with a district work safety inspector.

➢ Possible increases of HIV/AIDS and other communicable diseases such Covid -19

Risk of increase of HIV/AIDS and other Sexually Transmitted Diseases (STD) as well as the increase of other contaminating diseases due to the increase of people from outside of the project zone may arise among workers.

Mitigation measures

- Regular sensitization on ways of HIV/AIDS prevention,
- Regularly enforce the measures of hygiene and workers should be sensitized on the prevention of such diseases.
- Hygiene should be mandatory to the works sites and disciplinary measures should be implied to those not complying.

➢ Disruption of public utilities such as water supply networks, roads, and electrical network etc.

Water supply network will be rehabilitated or replaced which may cause disruption in water supply. In addition, some electricity and communication cables as well as some road crossing sections were observed in the project zones. During construction works, some of these infrastructures are likely to be affected and causing temporally impacts to the local population. Father, the replacement of transmission pipeline will cause suspension of water distribution.

Mitigation measures

- A well-planned work schedule, including connection between newly installed distribution pipes and existing service pipes, as well as secondary and tertiary distribution pipes, could minimize the water suspension period.
- The contractor will avoid as much as possible to affect these infrastructures by properly planning in advance for the project activities and identify those to be affected and use alternatives
- The quick rehabilitation of affected infrastructures will be done to avoid greater impacts
- Before the excavation works get information from local authorities on the exact location of such utilities when not prior identified
- Inform residents ahead of time any expected impact on public utilities (such as power cuts etc)
- Where possible and deemed necessary identify new alternatives for water sources and electricity supply when performing project activities

✓ Child labor, forced labor, discrimination, and abusive dismissal

The implementation of the present project will necessitate the recruitment of local population. Among the recruited may be identified those that are under the age of employment. Others recruited may be exposed to forced labor and discrimination.

Mitigation measures

- Protect workers' rights and provide work contract to all project employees
- Establish, maintain, and improve the employee–employer relationship;
- Promote compliance with national legal requirements and provide supplemental due diligence requirements where national laws are silent;
- Comply with international Labor Organization, and the UNICEF Convention on the Rights of the Child, where national laws do not provide equivalent protection;
- Protect the workforce from inequality, social exclusion, child labor, and forced labor

- Adverse impacts on physical environment

The project of Improvement of water Supply services in North- central will be implemented in urban area with the topographic conditions characterized by a terrain of small step slops. At some areas the construction activities will contribute to the loss of the topsoil combined with soil compaction which may result in reduced capacity of the ground to retain water and increase surface water run-off especially during periods of rainfall. The construction around wetland will also cause water and soil pollution from drilling muds, borrow pits and quarries; as well as disturbance/loss of vegetation. The identified physical impacts to the project implementation are described above and their proposed mitigation measures:

- Impacts on soil

Soil damage includes compaction and disturbance of the soil profile. Soil erosion involves transport of the soil down slope by running water or, more rarely but still a significant factor, away from the site by wind. Soil compaction and disturbance, usually accompanied by vegetation and litter layer damage, are preconditions for accelerated soil erosion. Most soil damage occurs as the result of movement of machine, trucking, and to some extent through felling of trees during excavation works. Soil erosion depends not only on soil damage but also soil type, rainfall, and angle and length of slope. Soil erosion is mostly anticipated on steep slopes of Gisozi and Batsinda and soil contamination may occur from the spillage of oils and lubricants during construction and operation activities.

Mitigation measures

Among the mitigation measure include:

- Stockpile and use excavated soil for backfilling and land scaping

- Changes of landscape - Visual impact

Impacts on the physical environment will consist of landscape transformation causing visual impacts. These impacts will remain during operational phase. Temporary physical impacts will occur during the construction period at places selected to store construction material and pipes. However, the project could not change the landscape significantly. Some trees would be cut down and, in this case, trees of the same species would be planted.

Mitigation measures

- To clear only the area demarcated for project activities especially at the water reservoirs and elevated tanks
- Rehabilitate the damaged areas through trees plantation and landscaping

- Noise and vibration emissions

Noise will be caused by construction traffic transporting construction materials/workers to and from the site and from the construction sites. These would be also generated by the operation of heavy machines, heavy trucks, right of way preparation, soil stripping, trenching, welding, and laying and backfilling activities. However, the impacts are limited as the construction works will be for a short period and only to be done during normal working hours.

Mitigation measures

- Limitation of heavy works in daytime 7am to 5pm;
- Provision of PPE to workers;
- If necessary, local community should be given notice of intended noisy activities to reduce degree of annoyances.
- Workers operating equipment that generates noise should be equipped with noise protection gear.
- A regular monitoring of noise will be conducted as to check the compliance of noise pollution with permissible level.
- As most of the expected noise is from vehicles, truck and machines, the contractor will be requested to use equipment in good condition and certificate of technical control will be required
- Equipment with heavy noise and vibration will be restricted on normal working hours, from 7am to5 pm,
- Facing sites should be mandatory to limit noise emitted especially at water reservoirs areas.

- Air Quality / dust release and nuisance

Exposed surface with loosened topsoil contributes to the increase of dust raised in the project area especially during sites preparation and pipes removal. Dust will also be raised by haulage vehicles transporting materials to and from the sites of the project. The dust raised during construction can pose a nuisance to workers although the impact of this is considered relatively small and localized. This situation will be worse during the dry season and during the afternoons when the winds are most prevalent. Dust particulate matters may cause hazardous to the nearby project sites and residents.

Mitigation measures

- Exposed ground should be wetted when need be in a manner that effectively keeps down the dust.
- Exposed construction sites will be fenced with wind brokers to avoid dust emissions to neighboring areas especially in residential and commercial areas.
- Workers on the site should be issued with dust masks during dry and windy conditions.
- Most of the emissions are expected to come from vehicles, tractors, and machines to be used. The contractor will be required to present technical control certificate for all vehicles, machines, and trucks. The certificates are those issued by National police / motorbike inspection department.
- A regular monitoring on ambient air will be conducted to check the level of air pollution. In the case the level exceeds the minimum permissible air pollution level, the developer will be required to reduce his emissions.

- Generation of solid waste

Solid waste generated during project activities such as site preparations, construction works and pipes replacement would include several types of solid wastes that include off cut vegetation, typical construction waste, soil, metals, pipes leftovers and papers etc. These wastes would negatively impact the project sites and surrounding environment if not properly managed and disposed of accordingly.

Mitigation measures

- A site waste management plan should be prepared by the contractor prior to project commencement.
- Contractor to hire an approved waste collector of the project area
- Temporally waste deposit and storage area should be designated and marked.
- All generated waste to be transported at Nduba landfill depending on their types.
- Waste recycling would be the best option whereby construction recycled soil and concrete debris can be used as roadbed materials in different areas of the project interventions.

- Impacts on quarries and burrow pits

It is anticipated that the project will necessitate the use of construction material such as sand and stones. Therefore, it is appropriately to consider the environmental implications in selection of quarry sources since poor operations of quarry sites would create environmental problems and degradation in general.

Mitigation measures

- All construction materials must be outsourced from approved and licensed quarries.
- Borrow pits areas shall preferably be selected from high land and/or waste land. Although locations of the borrow areas are negotiated between contractor and local suppliers of construction materials it is recommended that all quarries for the sources of construction materials be approved and have the EIA certificate issued by competent authority as per the environmental regulations.

- Contamination by oil spillage

During the construction activities it is expected that machinery including trucks, bulldozer and other equipment that require re-fueling, maintenance works, and repair works which in effect result in oil spillage. At point sources, contamination of soils and run-off ending in the receiving bodies could cause water quality degradation.

Mitigation measures

- Re-fueling, oil change, maintenance works, repair works shall be allocated at a restricted area and far from water body and marshland and preferably positioned in an area that have no adverse effects if degraded.
- Water quality will be regularly monitored to compare the baseline and monitoring results. If during monitoring process water is contaminated, then additional correctional measures will be taken.

- Loss of trees

Some crops and trees established in the project area will have to be cleared where the pipeline and water reservoirs will be installed and constructed. Luckily, there is no plant or animal species of special attention or conservation purpose that was surveyed and that will be affected.

Mitigation measures

- This impact is unavoidable and will be mitigated through compensation measures which include fair compensation of affected crops and trees.
- The site clearance should be only done on an area demarcated for construction;
- The landscaping through rehabilitation and re-planting of affected trees is recommended after project construction works.

- Vandalism of water supply infrastructure

With the construction of the reservoirs, several infrastructures will be made from metal, steel and concrete and the replacement of the pipes shall generate pipes leftovers and some people may be involved in vandalism of that equipment's.

Mitigation measures

- Provide permanent guard at the project sites
- Sensitization of local communities on the project ownership and protection
- Use community policing as a means of ascertaining security to avoid vandalism.
- Regulations on penalties to perpetrators convicted of vandalism are necessary.
- Punitive actions towards perpetrators by the authorities will facilitate compliance by the locals thereby avoiding vandalism.

7.2.3 Negative impacts associated with the installation transmission line between RDB Junction and Remera Golf 8

Though this portion of water supply system is not part of JICA grant, it was agreed that impacts associated with planned works will be assessed under this EIA and WASAC will mobilize funds to construct this pipeline. Therefore, this section presents negative impacts associated with the installation of transmission pipeline between RDB Junction and Remera Golf 8.

- Water pollution at Nyabisindu bridge

The project will cross the Nyabisindu-Nyarutarama Bridge. The excavation and installation of project facilities may contribute to the nearby water pollution.

Mitigation measures

- Avoid at the maximum the use of machinery such as excavators instead of manpower.
- Consider establishing measure that prevent pollution of existing water such as proper location of construction material
- On site adequate sanitary facilities must be provided far from the water body and be well maintained
- Staff to be regularly sensitized on the best way of waste management at the site
- Avoid any form of dumping nearby the wetland
- All unused materials to be properly handled
- Regular monitoring of potential sources of water pollution at the site

- Risk of alteration of hydrology and wetland at Nyabisindu

Working nearby the water course may have impacts on the hydrological features of the areas. However, considering the project nature and site characteristics these anticipated impact are minor and attenuated by the proposed mitigation measures

Mitigation measures

- Watercourse crossing must be designed in a way that avoids any disturbance of normal water flowing that shall affect the stability and long-term performance of riverbanks and flood defenses
- Consider the seasonal sensitivity of ecological resources when planning river crossings;
- Use appropriate technology that do not alter with the hydrological aspect of the area.

- Loss of terrestrial biodiversity

Even though there are no terrestrial fauna that have been identified during the project survey, it is anticipated that some of them may occur especially nearby the riverbanks of the project areas. Mitigation measure to protect any of the fauna finds at the project sites include:

Mitigation measures

- Restrict construction activities do the daylight;
- Limit the area earmarked for site clearance
- Inspect the area to be cleared for any terrestrial fauna before bush clearing and digging;
- Protect any trench left overnight with a net fence to block fauna from being trapped inside;
- Capture and release fauna away from the direct influence zone (including species trapped in the trenches if any)

- Work health issues

Health related issues are mainly resulted from emission of dust, noise and vibration which can result in possible respiratory irritation, discomfort, or illness to workers and local communities.

Mitigation measures

- PPE should be provided to workers who are exposed to dust, noise, and vibration for a prolonged period.
- Regularly watering the project site, when necessary, especially near residential and business places to suppress dust during construction.
- Enforce the acquiring of medical insurance "mituelle de sante" for all workers as a means of affordability of treatment.
- Ensure all employees have health insurance to afford health facilities

- Possible injuries and incidents for the students at the nearby school (Good Shepherd Nursery and Primary School)

The project activities will be carried out nearby the good shepherd nursery and primary school located in Nyabisundu areas. Project activities should cause negative impacts to the school users and students.

Mitigation measures

- Proper demarcate the excavated trenched by waring tap
- Provide day guard in charge of student management especially during the project works
- Conduct awareness campaign related to safety at the school
- Liaise with the school management for proper management of the student especially during project works.
- Non authorize personnel/ student should not enter the working site

- Injuries or fatalities from improper manual handling

The improper handling of the project materials may cause some common injuries or illnesses that include musculoskeletal disorders in various parts of the body such as back, neck, shoulders and others and include from sprains and strains to damage to muscles, joints, and vessels. Other injuries include cuts, bruises, lacerations, and fractures due to unexpected events such as accidents caused by manual handling.

Mitigation measures:

- The project should be totally insured for any kind of incident or accident.
- The contractor should establish health and safety measures that must be implemented at the project site by all workers.
- Provision of appropriate Personnel Protective Equipment (PPE) to all employees,
- Provide and avail permanent First Aid Kit at the work site as means of emergency aid. ,
- All workers project workers shall have health insurance as means of health affordability.
- Conduct regular awareness campaign on safety measures and to all project workers.

- Air and noise pollution

Project implementation shall generate dusts that may contribute to air pollution.

Mitigation measures

- The machinery and automobiles to be used on site should have certification of good working conditions from "National Automobile inspection centre" to reduce noise or exhaust fumes emissions.
- Ensure routine maintenance, repair of trucks and machines.
- Spray water when deemed necessary to reduce dust in the ambient environment.
- Construction sites to be fenced by dust barriers and suppressors especially at good shred school.
- Provision of protective equipment to all workers
- Topsoil to be stored separately from subsoil.
- After completion of works, the topsoil must be spread over those areas which can be partially restored to facilitate natural regeneration of those areas.

- Nuisance of noise from construction activities

Different activities of the project may also cause disturbances at the project areas through noise emissions such as excavation etc.

Mitigation measures

- The Contractor shall restrict any of his operations, which result in undue noise disturbance between 7h00 am and 5h00 pm (e.g., blasting activities and operation of heavy machinery and construction traffic)
- Where not possible if any blasting activities are to be conducted prior notice shall be given to the concerns to suppress the impacts. Notice should indicate the location time and possible nuisance that the activities shall cause.
- Restrict construction and operation of heavy machines to daylight;

- Ensure noise emissions are kept down and meet the existing noise emission standards depending on sites of works.
- Regular and effective equipment maintenance to ensure all machinery is in good working order and use does not generate excess noise

➢ Disturbance of traffic

As the project will be carried out in Kigali city nearby the existing roads with regular traffic, the project may cause disturbance to the normal traffic of the areas of intervention. To avoid such impacts some mitigation measures are put in place.

Mitigation measures

- Provide appropriate equipment and manpower to complete the work in short time especially for the section that cross the roads
- Work closely with the national Police / traffic unit to control and manage traffic at the affected sites
- Use alternative road while conducting project activities that may cause incident to the road users.
- Appoint staff in charge of traffic management
- Use of appropriate traffic signpost
- Rehabilitation of affected section
- Excavation and backfilling of the affected section during evening hours where there is no heavy traffic

➢ Influx of job seekers

The nearby project resident may have intention and high expectations of getting employed by the project. Though, the project will create employment opportunities, the jobs will be limited. Therefore, the creation of not enough jobs will create frustration on part of the local people and conflicts can occur between those employed and non-employed.

Mitigation measures

- Disclosure the exact number of jobs available for the project; the job application period and the remuneration to be allocated for each type of work before project implementation Local persons should be prioritized when allocating jobs
- Recruitment should be done in a clear and fair process.
- Women should equally benefit as men from job recruitments opportunities
- Involve local leaders in local employee's recruitment process;
- Avail and sign work contract before project works

➢ Resettlement implications

Distribution pipes require limited space and do not involve permanent land acquisition. However, some privately-owned structures and assets may be partially affected by project activities such crops and trees, ornamental trees, movable kiosks etc.

Mitigation measures:

- Fair compensation to those affected will be conducted before project implementations.
- Involve local authorities in assets inventory and ownership testimonies.
- Affected persons shall be prioritized when allocating jobs.
- Land easement should be secured through negotiation with local community prior to the project activities.

➢ Conflicts among workers and the local population of the project area

Even though the project will try to employee local population, projects involving major works include, often, the potential for the occurrence of social conflicts between workers who may temporarily settle in the local and community residents. Such behaviors are generally related to socially unacceptable behavior according to local social standards and can be seen, for example, cases of drunkenness and disregard/lack of respect for local customs. This impact should be considered even though an important part of the manpower to be recruited locally.

Mitigation measures:

- Where possible maximum efforts should be made to recruitment of local population who returns to their homes after work.
- Elaborate and enforce the code of conduct to all project workers
- Punitive measures to be imposed to those not complying with the project regulations

➢ Child labour, forced labour and discrimination

The implementation of the present project will necessitate the recruitment of local population. Among the recruited personnel may be identified those that are under the age of employment as per the labor Law in Rwanda. Others recruited may be exposed to forced labour and discrimination.

Mitigation measures

- Record all site workers by sex and age
- Protect workers' rights and provide work contract to all project employees
- Establish, maintain, and improve the employee–employer relationship;
- Promote compliance with national legal requirements and provide supplemental due diligence requirements where national laws are silent;

➢ Disruption of public utilities such as water supply networks, roads, and electrical network etc.

Water supply network will be rehabilitated or replaced which may cause disruption in water supply. In addition, some electricity and communication cables as well as as some road crossing sections were observed in the project zones. During construction works, some of these infrastructures are likely to be affected and causing temporally impacts to the local population. Father, the replacement of transmission pipeline will cause suspension of water distribution.

Mitigation measures

- A well-planned work schedule, including connection between newly installed distribution pipes and existing service pipes, as well as secondary and tertiary distribution pipes, could minimize the water suspension period.
- The contractor will avoid as much as possible to affect these infrastructures by properly planning in advance for the project activities and identify those to be affected and use alternatives
- The quick rehabilitation of affected infrastructures will be done to avoid greater impacts
- Before the excavation works get information from local authorities on the exact location of such utilities when not prior identified
- Inform residents ahead of time any expected impact on public utilities (such as power cuts etc)
- Where possible and deemed necessary identify new alternatives for water sources and electricity supply when performing project activities

➢ Risk of increase of HIV/AIDS and other Sexually Transmitted Diseases and increasing of COVID- 19 Contamination

Risk of increase of HIV/AIDS and other Sexually Transmitted Diseases (STD) as well as the increase of other contaminating diseases due to the increase of people from outside of the project zone may arise among workers.

Mitigation measures

- Providing surveillance and active screening and treatment of workers
- Providing daily health and hygiene induction talk to prevent such diseases
- Providing basic health services facilities at the project sites
- Use of Personal Protective Equipment
- Enforce the health measures established by competent authorities to fight such diseases (wear of protective musk, regular hand washing, keeping distance among workers etc).

➢ Possible soil erosion on step slop

During the excavation works some of the soil erosion may happen in case the excavated soil is not well managed. The following are mitigations measure to avoid any soil erosion that may happen and caused by the project activities.

Mitigation measures

- Restrict clearing works to only project sites and at the minimum possible
- Remove and stockpile topsoil, sub-soils and any parent material separately to reuse it for backfilling and landscaping.

➢ Vandalism of project infrastructure

With the coming of the project some people may be involved in vandalism of project equipment's.

Mitigation measures

- Provide permanent guard at the project materials storage sites
- Sensitization of local communities on the project ownership and protection
- Use community policing as a means of ascertaining security to avoid vandalism.
- Regulations on penalties to perpetrators convicted of vandalism are necessary.

8. ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

The Environmental Management and Monitoring Plan (EMMP) is divided into two parts one is the Environmental Management Plan and the other is the Environmental Monitoring Plan. The Environmental Management Plan translates the proposed mitigation measures into actions and provides management measures to be undertaken during the construction and operational phases of the project. The Environmental Monitoring Plan details monitoring activities and measures to be undertaken during construction and operation phases of the project.

WASAC Ltd should designated an environmental officer who will make day to day the follow up of the implementation of the EMMP as well supervise and liaise with project stakeholders. The contractor will also require having an Environmental, Social Health and Safety officer to follow up the implementation of Environmental Management Plan.

8.1 Environmental Management Plan (EMP)

The table below (Table 30) presents the EMP and provides environmental adverse impacts of the project implementation, the proposed mitigation measures, responsible and the responsible for monitoring.

Table 30: Environmental Management Plan for block system- reservoirs and installation/replacement of distrubution pipes

Environmental /social impacts	Proposed mitigation measures	Responsible	Monitoring	Estimated cost (USD)
Influx of job seekers	- Disclosure the number of available jobs and required personnel for the project disclosure the job application period and deadline before project implementation. - Involve local authorities in local manpower recruitment process; - The employment opportunities to consider both male and female without any segregation. - Residents to be prioritized in the recruitment process.	Contractor	WASAC Ltd/Local authorities	No cost required
Land acquisition	- Fair compensation of land from owners should be done before project activities - Land should be acquired from only landowners with no intermediaries - Secure the required land from competent authorities especially for the land under public domain before project activities. - Involve and work with district/ Sectors authorities to better solve any conflict that may arise connect to right of way	Property valuer WASAC Ltd /District/ local authorities	MINECOFIN WASAC Ltd /District	Under ARAP budget
High expectations of getting great compensation	– Compensation mechanisms should be implemented in all justifiable cases. – Involve PAPs in all steps required for the fair compensation as stipulated in the expropriation laws and regulations. - Establish and make operational conflicts resolutions committees.	Contractor/WASAC Ltd / Local Authorities	WASAC Ltd/ Local authorities/ District	No cost required
Loss of individual owned crops, trees, and other assets	- Valuation of damaged assets to be conducted by independent valuer. - Valuation of damaged properties should be fair and done according to the existing law related to expropriation in public interest. - Fair compensation should be done prior to the project activities - Compensation to be done only at the property's owners without intermediaries	WASAC Ltd/ Independent valuer	WASAC Ltd/ Local authorities/MINECOFIN	Expropriation budget
Disruption of public utilities especially water supply networks, electrical network, and traffic etc	- A well-planned work schedule, including connection between newly installed distribution pipes and existing service pipes, as well as secondary and tertiary distribution pipes, could minimize the water suspension period. - The contractor will avoid as much as possible to affect these infrastructures by properly planning in advance for the project activities and identify those to be affected and use alternatives - The quick rehabilitation of affected infrastructures will be done to avoid greater impacts - Before the excavation works get information from local authorities on the exact location of such utilities when not prior identified - Inform residents ahead of time any expected impact on public utilities (such as power cuts etc) - Where possible and deemed necessary identify new alternatives for water sources and electricity supply when performing project activities	Contractor	WASAC Ltd/ REG-EUCL/ RURA/RTDA/ Local authorities	No cost required

Environmental /social impacts	Proposed mitigation measures	Responsible	Monitoring	Estimated cost (USD)
Incident and accident at excavated trenches	- Demarcate all hazardous trenches with signs posts and warning tapes - Conduct daily morning briefs related to safety measures for all workers - Only authorized personnel to enter the working areas - Provision of Personnel Protective Equipment to all project workers - Sensitization of workers on safety measures - Provide first aid kit on the site - Ensure all employees have health insurance	Contractor/ site workers	WASAC Ltd//Local authorities	5,000
Loss of trees cut during the construction work	- Replant trees which are cut during the construction works	Contractor	REMA/WASAC Ltd	1,800
Soil pollution	- To take necessary measures to prevent oil contamination and spillover of oil/fuels such as using a tray when filling fuels and installing a dyke at the fuel storage place	Contractor	WASAC Ltd/ REMA	Under construction budget
Soil erosion	- Remove and stockpile topsoil, sub-soils and any parent material separately and use it to refill trenches and landscaping - For the excavation work at the steep slope, a heavy vehicle of a suitable size should be used and soil erosion prevention measures such as installation of fences or barrier are taken.	Contractor	WASAC Ltd/ REMA	Under construction budget
Noise pollution	- Construction activities shall be restricted to normal working hours (7h00-17h00) to prevent noise for neighbors at night - The machinery and automobiles to be used on site should have certification of good working conditions from "National Automobile inspection centre" to reduce noise or exhaust fumes emissions. - Ensure routine maintenance, repair of trucks and machines. - Provision of protective equipment to all site workers. - The contractor to inform the general public any activity that shall emit noise prior to execution in order to minimize the impacts (e.g. blasting activities and operation of heavy machinery and construction traffic). - Restrict construction and operation of heavy machines to daylight; - Ensure noise emissions are kept within the Rwanda standards; - Reduce needed truck movements by careful planning of needs of delivery of construction materials.	contractor	WASAC Ltd/ REMA	2,500
Land degradation	- All earthworks for site preparation and levelling shall be carried out in a proper designated way and to be executed by the qualified engineers. - Excavated soil shall be well managed and re-used to backfilling the excavated trenches. - The unused soil and considered as waste shall be deposited in a well designated area to be approved in close collaboration with Gasabo District.	Contractor	WASAC Ltd/ Gasabo district/ REMA/Cok	1,400
Child labour, forced labour and discrimination	- All site workers to be recorded by sex and ages - Protect the workforce from inequality, social exclusion, child labour, and forced labour; - Promote compliance with national legal requirements and provide supplemental due diligence requirements where national laws are silent; - Establish, maintain, and improve the employee–employer relationship	Contractor	WASAC Ltd/ MIFOTRA/ Cok /District/ local authorities	No cost required
Conflicts among workers and local population	- Local population should be prioritized when recutting for project personnel and manpower. - Keeping a good relationship with local communities - Establishment and implementation of set of rules for the workplace	Contractor	WASAC Ltd	No cost required
Fugitive dust generated during excavation works and air pollution	- Spray water when deemed necessary in order to reduce the dust. - Compaction of soil to be minimized by careful stockpiling and separation of top and sub-soils.	Contractor	WASAC Ltd/ REMA	2,000
Pollution of surface and ground water	- Provide onsite adequate sanitary facilities - All unused materials to be properly handled at the construction sites - Work with the accredited companies in waste management and handling activities	Contractor	WASAC Ltd/ REMA/RWB	Under construction budget

Environmental /social impacts	Proposed mitigation measures	Responsible	Monitoring	Estimated cost (USD)
Disturbance of traffic	- Appoint staff in charge of traffic management - Use of appropriate traffic signpost at the working areas - Excavation and backfilling of the affected section during evening hours where there is no heavy traffic	Contractor	WASAC Ltd/ Traffic police/ RTDA	2,000
Vibrations and noise pollution	- To avoid noise and vibrations, construction activities shall be restricted to normal working hours (7h00-17h00) to prevent impacts to neighbors at night. - The machinery and automobiles for the project shall have certification of good working conditions from "National Automobile Inspection centre" to reduce noise or exhaust fumes emissions. - All workers should be equipped with protective equipment including protective masks. - Ensure noise emissions are kept down and meet the existing noise emission standards depending on sites of works.;	Contractor	WASAC Ltd/REMA	2,000
Injuries and accidents during construction works	- All workers shall be equipped with Personnel Protective Equipment - Ensure that all employees have health insurance to afford health facilities - Conduct daily morning briefs related to safety measures for all workers. - The safety and sanitation plan is formulated and safety trainings are provided for workers	Contractor	WASAC Ltd/Local authorities	3,000
Abuse of drugs and use of alcohol	- Avail free of charge potable and safe drinking water for all workers. - Avoid any kind of use of alcohol and other drugs at the project sites.	Contractor/site workers	WASAC Ltd/ local authorities/ RIB	No cost required
Poor solid waste management	- On site adequate sanitary facilities have shall be provided at the project sites - Appropriate waste management mechanisms shall be imposed at the project sites. - All unused materials shall be properly handled - Storage sites shall follow the appropriate regulations related to Waste Management. - No materials storages shall be located nearby water body - Contractor shall regularly monitor water pollution sources at the project sites - Contractor shall maximize efforts to avoid oil spillages at the construction sites	Contractor	WASAC Ltd/ REMA/ RWB	No cost required
Sediment load	- All excavated soil shall be properly handled and managed at the project sites to avoid any incident. - All excavated soil shall be carefully re-used to backfill the excavated trenches - The unused soil shall be dumped at the approved site selected in close collaboration with Gasabo District.	Contractor	WASAC Ltd/ RWB/ REMA	No cost required
Gender based violence and sexual Exploitation and Abuse (GBV/SEA	– Preparation and implementation workers Code of conduct – Conduct GBV/SEA awareness among all workers -	Contractor	WASAC Ltd/ Districts/ Isange One Stop Center	800
General occupational health and Safety (OHS)	- Contractor shall ensure that all employees have health insurance as means of health care affordability; - Contractor shall provide personal protective equipment (PPEs) to all project workers and visitors. - Avail permanent first aid kit at the project sites - Avail an Environmental and safety officer at the site to oversee environmental management, social concerns and the implementation of environmental policies and regulations; - Install safety and warning signage as appropriate - Appoint ESHS Manager to assist with sampling, monitoring and daily environmental compliance; - Provide environmental and health induction talks to all employees.	Contractor	REMA/ WASAC Ltd/Districts	2,000
Total				23,500

Table 31: Environmental Management Plan for transmission pipeline between RDB Junction and Remera Golf 8

Environmental/ social impacts	Proposed mitigation measure	Responsible	Monitoring responsibilities	Estimated cost (USD)
Water pollution at the Nyabisindu bridge	- Avoid at the maximum the use of polluting machinery at the site. - On site adequate sanitary facilities must be provided far from the water body and be well maintained - Staff to be regularly sensitized on the best way of waste management at the site. - Avoid any form of dumping nearby the wetland - All unused materials to be properly handled - Consider establishing measure that prevent pollution of existing water such as proper location of construction materials - Regular monitoring of potential sources of water pollution at the site	Contractor	WASAC Ltd/ REMA/ RWB	No cost required
Risk of alteration of hydrology and wetland at Nyabisindu	- Watercourse crossing must be designed in a way that avoids any disturbance of normal water flowing that shall affect the stability and long-term performance of riverbanks and flood defenses; - Consider the seasonal sensitivity of ecological resources when planning river crossings; etc.	Contractor	REMA/ RWB/ WASAC Ltd	No cost required
Disturbance and mortality of terrestrial fauna	- Restrict construction activities do the daylight; - Limit the area earmarked for site clearance - Inspect the area to be cleared for any terrestrial fauna before bush clearing and digging; - Protect any trench left overnight with a net fence to block fauna from being trapped inside; - Capture and release fauna away from the direct influence zone (including species trapped in the trenches if any)	Contractor	WASAC Ltd/ REMA/ CoK	5,00
Injuries and accidents of workers	- Provision of Personnel Protective Equipment to all staff - Sensitization of workers on safety measures - Provide first aid kit at the site - Ensure all employees have health insurance to afford health facilities	Contractor	WASAC Ltd/Local authorities	1,000
Possible injuries and incidents for the students of the nearby school (Good Shepherd Nursery and Primary School)	- Proper demarcate the excavated trenched by waring tap - Provide day guard in charge of student management especially during the project works - Conduct awareness campaign related to safety at the school - Liaise with the school management for proper management of the student especially during project works. - Non authorize personnel/ student should not enter the working site	Contracor/ students at the school	WASAC Ltd/ school manager/ local authorities/ Cok	2,000
Air and noise pollution	- Construction activities shall be restricted to normal working hours (7h00-17h00) to prevent noise for neighbors - The machinery and automobiles to be used on site should have certification of good working conditions from "National Automobile inspection centre" in order to reduce noise or exhaust fumes emissions. - Ensure routine maintenance, repair of trucks and machines. - Spray water when deemed necessary in order to reduce dust in the ambient environment. - Regularly watering when clearing land to reduce dust - Construction sites to be fenced by dust barriers and suppressors especially at the school. - Provision of protective equipment to all workers.	Contractor	WASAC Ltd/ REMA / Cok/ Local authorities/ district	1,700
Fugitive dust generated during excavation works	- Wetting the surface when deemed necessary during construction - Topsoil to be stored separately from subsoil. - After completion of works, the topsoil has to be spread over those areas which can be partially restored in order to facilitate natural regeneration of those areas. - Compaction of soil to be minimized by careful stockpiling and separation of top and sub-soils.	Contractor	WASAC Ltd/ REMA/ Local authorities	Under construction budget
Nuisance of noise from construction activities	- The Contractor shall restrict any of his operations, which result in undue noise disturbance between 7h00 am and 5h00 pm hour (e.g.	Contractor	WASAC Ltd/ Local	No cost required

Environmental/ social impacts	Proposed mitigation measure	Responsible	Monitoring responsibilities	Estimated cost (USD)
	blasting activities and operation of heavy machinery and construction traffic) - Where not possible if any blasting activities are to be conducted near the school and residential areas, prior notice shall be given to the concerns to suppress the impacts. Notice should indicate the location time and possible nuisance that the activities shall cause - Restrict construction and operation of heavy machines to daylight; - Ensure noise emissions are kept down and meet the existing noise emission standards depending on sites of works. - Reduce truck movements by careful planning of needs of delivery of construction materials. - Regular and effective equipment maintenance to ensure all machinery is in good working order and use does not generate excess noise.		authorities/ CoK	
Land degradation at the source of local construction materials	- Purchase of all raw materials and construction materials must be done from approved quarries and gravel pits. - Regular inspection of the source of construction materials and the contractor to outsources construction materials from the approved quarry sites	Contractor	WASAC Ltd/ local authorities/ REMA	No cost required
Land degradation	- All earthworks for site preparation and levelling shall be carried out in a proper designated manner and must be done by the qualified engineers. - Wastes produced must be disposed of in a designated area far from water body	Contractor	WASAC Ltd/ RLUMA/ Local authorities	500
Soil pollution	- To take necessary measures to prevent oil contamination and spillover of oil/fuels such as using a tray when filling fuels and installing a dyke at the fuel storage place	Contractor	WASAC Ltd/ REMA	Under construction budget
Disturbance of traffic	- Provide appropriate equipment and manpower to complete the work in short time especially for the section that cross the roads - Appoint staff in charge of traffic management - Use of appropriate traffic signposts - Rehabilitation of affected section - Excavation and backfilling of the affected section during evening hours where there is no heavy traffic	Contractor	WASAC Ltd/ Local authorities / Traffic police/ RTDA	Under construction budget
Influx of job seekers	- Disclosure the exact number of jobs available for the project; the job application period and the remuneration to be allocated for each type of work before project implementation - Involve local leaders in local employee's recruitment process; - Recruitment should consider both male and female. - Avail and sign work contract before project works	Contractor	WASAC Ltd/Local authorities	No cost required
Child labour, forced labour and discrimination	- Record all site workers by sex and age - Establish, maintain, and improve the employee–employer relationship; - Comply with international Labour Organization, and the UNICEF Convention on the Rights of the Child, where national laws do not provide equivalent protection; - Protect the workforce from inequality, social exclusion, child labour, and forced labour;	Contractor	WASAC Ltd/ MIFOTRA	No cost required
High expectations of getting great compensation cost in cases of assets and crops compensation	– Expropriation and compensation mechanisms should be implemented in all justifiable cases. – Full involve the PAPs in all steps required for the fair compensation as stipulated in the expropriation laws and regulations. - Establish and make operational conflicts resolutions committees.	Contractor WASAC Ltd Local Authorities	WASAC Ltd/ Local authorities/ District/ MINECOFIN	No cost required
Disruption of public utilities especially water supply networks, electrical network, and traffic etc	- A well-planned work schedule, including connection between newly installed distribution pipes and existing service pipes, as well as secondary and tertiary distribution pipes, could minimize the water suspension period. - The contractor will avoid as much as possible to affect these infrastructures by properly planning in advance for the project activities and identify those to be affected and use alternatives - The quick rehabilitation of affected infrastructures will be done to avoid greater impacts	Contractor	WASAC Ltd/ REG-EUCL/ RURA/RTDA/ Local authorities	No cost required

Environmental/ social impacts	Proposed mitigation measure	Responsible	Monitoring responsibilities	Estimated cost (USD)
	- Before the excavation works get information from local authorities on the exact location of such utilities when not prior identified - Inform community/residents ahead of time any expected impact on public utilities (such as power cuts etc) - Where possible and deemed necessary identify new alternatives for water sources and electricity supply when performing project activities			
Risk of increase of HIV/AIDS and other Sexually Transmitted Diseases and increasing of COVID-19 Contamination	- Providing surveillance and active screening and treatment of workers - Regular checkup of workers on site - Providing health and hygiene training - Providing basic health services facilities at the project sites - Use of Personal Protective Equipment - Enforce the health measures established by competent authorities to fight such diseases (wear of protective musk, regular hand washing, keeping distance among workers etc).	Contractor	WASAC Ltd/Local authorities MINISANTE/CoK	3,000
Gender based violence and sexual Exploitation and Abuse (GBV/SEA	- Preparation and implementation workers Code of conduct - Conduct GBV/SEA awareness	Contractor	WASAC Ltd/ Districts/Isange One Stop Center	1,000
Overall environmental management	- Avail an Environmental and Social Manager at the site to oversee environmental management, social concerns, environmental training, and the implementation of environmental policies; - Appoint ESHS Manager to assist with sampling, monitoring, and daily environmental compliance; - Provide environmental training to all employees.	Contractor	WASAC Ltd/REMA	1,800
Loss of individual owned crops, tress and other assets at pipelines	- Valuation of damaged assets to be conducted by independent valuer. - Valuation of damaged properties should be fair and done according to the existing law related to expropriation in public interest. - Fair compensation should be done prior to the project activities - Compensation to be done only at the property's owners without intermediaries	WASAC Ltd/ Residents	WASAC Ltd / local authorities and district	Expropriation budget
Land degradation at construction sites	- All earthworks for site preparation and levelling shall be carried out in a proper designated way and to be executed by the qualified engineers. - Excavated soil shall be well managed and re-used to backfilling the excavated trenches. - The unused soil and considered as waste shall be deposited in a well designated area to be approved in close collaboration with Gasabo District. - Backfilling borrows pits after excavation and rehabilitating with vegetation.	Contractor	WASAC Ltd/ local authorities/ REMA	No cost required
Possible incidents and accident to the passengers and project workers	- Demarcate all hazardous trenches with signs posts and warning tapes - Conduct daily morning briefs related to safety measures for all workers - Only authorized personnel to enter the working areas - Provision of Personnel Protective Equipment to all project workers - Sensitization of workers on safety measures - Provide first aid kit on the site - Ensure all employees have health insurance;	Contractor	WASAC Ltd/ Local authorities	4,000
Possible soil erosion at step slop between Nyarutarama and golf 8	- Preferably all earthworks for site shall be carried out during dry season. The tendering plan should take into consideration the weather conditions of the project works - Storm water drainage system shall be installed on sites susceptible to erosion. - Soil erosion barriers must be installed on site. - Restrict clearing works to only project sites and at the minimum possible - Only use appropriate machinery at each type of activity to minimize the risks;	Contractor	WASAC Ltd/ REMA	800

Environmental/ social impacts	Proposed mitigation measure	Responsible	Monitoring responsibilities	Estimated cost (USD)
	- Remove and stockpile topsoil, sub-soils, and any parent material separately. - Where necessary construct water ways with check dams to reduce sediments - After completion of works, the topsoil must be spread over those areas which can be partially restored to facilitate natural regeneration of those areas.			
Vibrations, air and noise pollution nearby primary schools and neighboring residential areas	- To avoid noise pollution, construction activities shall be restricted to normal working hours (7h00-17h00) to prevent noise for neighbors at night. - The machinery and automobiles for the project shall have certification of good working conditions from "National Automobile Inspection centre" to reduce noise or exhaust fumes emissions. - When the ambient air is polluted by dust generated from project activities, water should be sprayed when deemed necessary in order to reduce dust in the ambient environment. - All workers should be equipped with protective equipment including protective masks. - Ensure noise emissions are kept down and meet the existing noise emission standards depending on the area of works (residential, commercial etc);	Contractor	WASAC Ltd/ REMA	2,000
Disturbance of traffic during excavation and alignment of pipes	- Provide appropriate equipment and appropriate amount of manpower to complete the work in short time especially for the section that cross the roads - Appoint staff in charge of traffic management at each section crossing the road - Avail appropriate traffic signposts at working sites - Conduct quick rehabilitation of affected section - Excavation and backfilling of the affected section shall be conducted during evening hours where there is no heavy traffic	Contractor	WASAC Ltd/ Local authorities / Traffic police/ RTDA	Under construction budget
Abuse and use of drugs and alcohol at the site	- Avail free of charge potable and safe drinking water for all workers. - Avoid any kind of use of alcohol and other drugs at the project sites.	Contractor / Site workers	WASAC Ltd/ local authorities/ RIB	2,000
General occupational health and Safety (OHS)	- Contractor shall ensure that all employees have health insurance as means of health care affordability; - Contractor shall provide personal protective equipment (PPEs) to all project workers and visitors. - Avail permanent first aid kit at the project sites - Avail an Environmental and safety officer at the site to oversee environmental management, social concerns and the implementation of environmental policies and regulations; - Install safety and warning signage as appropriate	Contractor/ site workers	REMA/ WASAC Ltd /District	1,500
Total				21,800

8.2 Environmental Monitoring Plan

8.2.1. General Environmental Monitoring Parameters

The monitoring plan provided in this section is indicating measurements of parameters, responsibility, and cost estimates of outcomes of the proposed mitigation measures. A monitoring plan stands to facilitate and ensure the follow-up of the implementation of the proposed mitigation measures and helps to anticipate possible environmental hazards and/or detect unpredicted impacts over time. However, a general monitoring plan should be implemented on site as it facilitates and ensures the follow-up of the implementation of the proposed mitigation measures. It helps to anticipate possible environmental hazards and/or detect unpredicted impacts over time. Monitoring tools include the:

- Visual observations;
- Selection of environmental parameters/indicators at specific locations;
- Sampling and testing of the selected parameters.

To address all activities that may causes adverse impacts, this environmental monitoring plan should be implemented through the project phases. The implementation of this monitoring plan should be based on direct or indirect indicators

of emissions, effluents and resource use and the monitoring frequency should be sufficient to provide representative data for the parameter being monitored.
The following are key parameters to be monitored during this project implementation:

- Noise and vibration

It is expected that the project will cause noise and vibrations at the project sites. Therefore, period noise level measurements should be taken at the project sites especially nearby residential areas as well consultation with local Community with the aim to assess the project impacts regarding noise pollution.

- Water Quality Monitoring

Construction activities at river crossing in Nyabisindu area are subject to cause surface and ground water at the site if not well controlled and monitored. It is recommended therefore that WASAC monitor water quality parameters that shall include water temperature, PH, TSS and turbidity to assess the effects of water quality of the nearby river during the project activities.

- Soil erosion monitoring

The project is not likely to have major impact on soil quality as no major activities are anticipated nearby water bodies. However, soil erosion is anticipated at the sites where excavation works shall be carried out at high slops areas. A regular monitoring is then required to avoid any soil erosion that may occur.

- Soil pollution monitoring

Though there is no heavy machinery to be used, there might be Oil contamination/ spill over construction areas. Therefore, prevention measures will be monitored.

- Monitoring of accidents/incident

Most of the project activities will be carried out along different roads within the project areas. WASAC, JICA and any other contractor must make sure that appropriate signs are posted at appropriate locations/positions to minimize/eliminate risk of accidents. In addition, health inspectors should make sure that:

- Measures to create awareness regarding sexually transmitted diseases such as HIV/AIDS, Covid- 19 and other diseases are taken among project workers;

The following parameters could be used as indicators:

- Level of awareness of communities pertaining to dangers/risks associated with the project; and
- Accident and incidents reports: records on actual accidents associated with the project.

- Monitoring of social impacts

The monitoring of the social impacts of the project is based on the experience of the communities and households. The following impacts should be monitored with the help of local authorities and households.

- Employment opportunities associated to the project implementation
- Clean water availability within the project area
- Inclusion of women and men when allocating jobs
- Dust and air pollution in the project area

- Community relationship:

Conflicts between project workers and local community due to arrival of non-resident workers in the project area. The number of workers should be recorded by their origin, sex, and age. The following table summarizes the parameters to be monitored and the monitoring plan of the project.

8.2.2. Environmental Monitoring Plan for block system-Reservoirs and pipes

The next table presents Monitoring plan for the construction of reservoirs and installation/replacement of pipes covered under JICA grant.

Table 32: Environmental Monitoring Plan for block system - reservoirs and installation/replacement of distribution pipes

Environmental items	Monitoring item	Parameter/Indicator to be monitored	Location	Frequency	Responsible	Budget
Pre-construction and site mobilization phase						
Land securing and compensation	Compensation for private owned land	Area of land compensated	Project site	Once before construction works	WASAC Ltd	ARAP monitoring report
	Land easement and securing from public land	land for water tank and pipelines secured	Project area	Once before project activities	WASAC/ local Authorities	No cost required
	Complaints related to pipelines locations nearby residential areas	GRM logbook	Project area	Once before project activities	WASAC Ltd/ local authorities	no cost required
Air pollution	Equipment and automobiles in good conditions	certificate of good working condition issued by automobile inspection center	Project sites	As appropriate	Contractor/ traffic police	200
Noise and vibrations	Noise and vibrations	Noise level and vibrations	At reservoirs and water tanks sites	before and during project works	Contractor/ Cok/ wasac	800US$
Construction phase						
Accidents and incidents	Number of accidents and incidents	Incidents and accidents logbook	Project site	When deemed necessary	Contractor WASAC/ traffic police	Operational Cost
Air Pollution	Equipment and automobiles in good shape	Regular inspection and maintenance	at project site	Daily	Contractor	No cost applicable to monitor.
	Records on water spray at the project site	dust at the project site	project sites	regular and when necessary	Contractor	Operational cost
Noise and vibrations	Noise emissions	Noise level Vibration level	Reservoirs, pipelines and water tanks construction sites	During earth works or concrete vibrations.	Contractor/ WASAC / Cok	under implementation cost
Soil pollution	Oil contamination/ spill over prevention measures	Presence of oil contamination/ spill over prevention measures	project areas	daily	Contractor/ WASAC	Operational Cost
Soil Waste	Proper management of excavated soil and other waste generated from the project	presence of waste management plan	at project site	regular	Contractor/ WASAC	Under Operational Cost
Work conditions	Occupational health and Safety	Availability at site of OHS Plan	Project sites	Permanent through project activities	Contractor/ WASAC Ltd	Operational Cost
	Awareness meeting on social, health and safety	Number of meetings and trainings/ Induction	Project sites	Daily	Contractor/ WASAC Ltd	Operation cost
	Incidents and accidents at the project site	Presence of warning and signposts at the site	Project site	daily	WASAC/ Contractor/	5000 USD
	Personal Protective Equipment (PPEs)	Number of workers with PPEs	project area	daily	Contractor/ JICA/WASAC Project contractor/ project workers	2000 USD
Traffic congestions	Traffic management Plan and traffic signage	Availability of TMP Number of traffic signage	Project area	daily during project works nearby roads	Contractor/ WASAC/ traffic Police	Operational Cost
HIV/ AIDS and other transmitted diseases	Health and sanitation for labor workers	presence of sanitation facilities and diseases	Project sites	regular	Contractor/ WASAC Ltd	Operational Cost

Environmental items	Monitoring item	Parameter/Indicator to be monitored	Location	Frequency	Responsible	Budget
		preventive measures				
Child and forced labour	Minimum working age and working condition	Employment record by age	Construction areas	regular	Contractor /Local authorities/ project workers	no cost required
Disruption of public utilities especially water supply networks, electrical network, and traffic etc	Water, electricity, traffic etc	Duration of Disruption due to construction	Project area	Regular	Contractor/ WASAC Ltd	Operational Cost
Operational Phase						
Water losses	Water leakage	Infrastructures damages	Operation	Regular	WASAC Ltd/ water users	500

8.2.3. Environmental Monitoring Plan for pipeline between RDB junction and Remera golf 8

The next table presents Monitoring plan for the installation of water pipeline between RDB Junction and Remera golf 8.

Table 33: Environmental Monitoring Plan for transmission pipeline between RDB Junction and Remera Golf 8

Environmental items	Monitoring item	Parameter/Indicator to be monitored	Location	Frequency	Responsible	Budget (USD)
Pre-construction and site mobilization phase						
Land acquisition and easement	Land easement and securing	land for pipelines secured	Project site	Once before project activities	WASAC/ local Authorities/ CoK	No cost required
	Complaints related to pipelines locations in residential areas	GRM logbook	Project area	Once before project activities	WASAC Ltd/ local authorities	No cost required
Air pollution	Equipment and automobiles in good conditions	Certificate of good working condition issued by automobile inspection center	Project sites	As appropriate	Contractor/ traffic police/ WASAC	300
Water pollution especially at Nyabisindu area	Surface water quality	(Temperature, pH, TSS, Turbidity)	Upper site and lower site of the river	before, during and after project activities	Contractor/ WASAC Ltd	300
Noise and vibrations	Noise and vibrations	Noise level and vibrations	At project sites	before and during project works	Contractor/ Cok/ WASAC	600
Construction phase						
Accidents and incidents	Number of accidents and incidents	Incidents and accidents logbook	Project area	When deemed necessary	Contractor / WASAC/ traffic police	Operational Cost
Air Pollution	Equipment and automobiles in good shape	Regular inspection and maintenance	at project area	Daily	Contractor	No cost applicable to monitor.
	records on water spray at the project area	dust at the project area	project areas	regular and when necessary	Contractor	Operational cost
Water pollution at Nyabisindu river crossing	Surface water quality	temperature, pH, TSS, Turbidity	Upper site/ lower site of the river	during project activities at the river crossing site	Contractor/ WASAC Ltd	1,900
Noise and vibrations	Noise emissions	Noise level Vibration level	At pipelines construction sites	During earth works or and compaction	Contractor/ WASAC / Cok	under implementation cost
Soil Waste	Proper management of excavated soil and other waste generated from the project	presence of waste management plan	at project site	regular	Contractor/ WASAC	Under Operational Cost

Environmental items	Monitoring item	Parameter/Indicator to be monitored	Location	Frequency	Responsible	Budget (USD)
Loss of trees	Replant trees cut during construction	Restored area	At the project area	After project implementation	Communities/local authorities / Contractor	4000
Work conditions	Occupational health and Safety	Availability at site of OHS Plan	Project sites	Permanent through project activities	Contractor/ WASAC Ltd	Operational Cost
	Awareness meeting on social, health and safety	Number of meetings and trainings/ Induction	Project sites	Daily	Contractor/ WASAC Ltd	Operation cost
	Incidents and accidents at project site	Presence of warning and signposts at the site	Project site	daily	WASAC/ Contractor/	1000
	Appropriate Personal Protective Equipment (PPEs)	Number of workers with PPEs	project area	daily	Contractor/ JICA/WASAC Project contractor/ project workers	2000
Traffic congestions	Traffic management Plan and traffic signage	Availability of traffic Management Plan Number of traffic signage available on site	Project area	daily during project works nearby roads	Contractor/ WASAC/ traffic Police	Operational Cost
HIV/ AIDS and other transmitted diseases	Health and sanitation for labor workers	presence of sanitation facilities and diseases preventive measures	Project sites	regular	Contractor/ WASAC Ltd	Operational Cost
Child and forced labor	Minimum working age and working condition	Employment record by age	Construction areas	regular	Contractor /Local authorities/ project workers	no cost required
Disruption of public utilities especially water supply networks, electrical network	Water, electricity, traffic etc	Duration of utilities due to construction	Project area	Reguler	Contractor/ WASAC Ltd	Operational Cost
Operation phase						
Water losses	Water leakage	Infrastructures damages	Operation	Regular	WASAC Ltd/ water users	500

8.3 EMP implementation arrangements

8.3.1 Overall implementation responsibility

The overall responsibility of implementation of this EMP is under Contractor and Water and Sanitation Corporation (WASAC Ltd). WASAC Ltd will designate a staff in charge of Environmental and Social safeguard who will be responsible for addressing environmental and social issues on a routine basis. The staff will have an oversight of environmental aspects of the construction contracts, including the enforcement of all monitoring provisions, etc. The project Contractor will also have an Environmental Health and Safety Manager to oversee the implementation of project during construction. The main duties of the designated Environmental and social officers will include but not limited to:

- Have an insight on the designs and ensure they adhere to the environmental and social specifications and the requirements of the Environmental and Social Management Plan (EMP).
- Co-ordinate and liaise with government institutions on environmental and social issues and obtaining the necessary clearances from the regulatory authorities.
- Collect and dissemination of relevant environmental documents

- Monitor the environmental and social aspects especially during construction phase to ensure that the environmental requirements of the contract and the mitigation measures proposed in this ESMP are implemented.

8.3.2 Environmental and social awareness campaigns

The awareness campaigns will cover health and safety, traffic management, measurement techniques in the field, tools for the prediction of pollutants, waste management, etc. various competent authorities may be consulted for such campaigns. The need for additional and specialized campaign shall be examined and appropriate training will be undertaken as required. Training of personnel to be deployed on the proposed project during construction and operation, about environmental requirements should be an integral part of the planning. In addition, all employees will be trained on safety, HIV/AIDS prevention, methods of disaster prevention, action required in case of emergency, fire protection, environmental risk analysis etc.

8.3.3 Monitoring and reporting procedures

During the project implementation WASAC will designate an EHS officer who will visually assess contractor's practices and if high pollutant levels are suspected instruct the contractor to make corrections. Photographic records will be established to provide useful environmental monitoring tools. A full record will be kept as part of normal contract monitoring. All applicable regulations need to be enforced by the Project Manager and designated EHS manager. The regular monitoring of noise and dust will also be carried out as provided in the environmental monitoring program. It is the mandate for the contractor to use the materials which meet the standards being in civil construction works, the machinery to be used or the pipe to be installed

8.3.4 Record keeping

Monitoring reports should be documented and recorded. The focus shall be done on issues that are environmental and social harmful and provide feedback for the future stages of the work. Daily project diaries would record environmental problems (spills, dust, noise, etc.) as well as safety incidents and will be retained as part of accepted modern contract management and summarized in monthly and Quarterly Environmental and social safeguard Reports.

8.3.5 Implementation schedule

The most important aspect of the implementation is the appointment of the Environmental Officer at WASAC level and at Contractor level to oversee the implementation of the environmental mitigation measures incorporated in the design and contract specifications. Most of the planned mitigation measure will be implemented along with project activities and is provided in Environmental Management Plan and Environmental Monitoring Plan.

9. CONCLUSIONS AND RECOMMENDATIONS

9.1 Conclusions

The conduct of this Environmental and Social Impact Assessment study has revealed several issues associated to the proposed project of improvement of water supply services in North Central Kigali. The impacts identified have been analyzed in detail to formulate mitigation measures in response to negative aspects which have been raised. The proposed Environmental Management Plan (EMP) provides a way forward for implementation of the mitigation measures and should be implemented as a requirement for a positive Record of Decision by appropriate authorities.

The pertaining impacts have been assessed and described in detail to gain an adequate understanding of possible socio and environmental effects of the proposed project in all its implementation phases. When the mitigation measures listed in this document are fully implemented in the design, construction, and post-construction phases, it is no doubt that the project will benefit to both people and the environment. The cost for the implementation of the EMP are estimates indicative to the general cost and were estimated based on the current local prices on the market. Appropriate bills of quantities should clearly give the real costs in any case the consultant has used judgment and cost for similar project to come up with these figures

In any case potential disputed among workers arise and connected to the project activities, a project Grievance Mechanism (GRM) is proposed as a dispute resolution mechanism option available to redress grievances and disputes emanating or associated with this project to avoid potential social impact. Therefore, based on the study findings, the Consultant is of the opinion that most of the potential environmental impacts identified can be mitigated. The proposed Environmental Management Plan and Environmental Monitoring Plan if implemented will safeguard the integrity of the environment. To this extent, the consultant is concluding that the potential impacts associated with the proposed development are of a nature and extent that can be reduced, limited, and eliminated by the application of appropriate mitigation measures

9.2 Recommendations

In addition to the mitigation measures proposed in the Environmental Management Plan, consultant is recommending the following:

- Before the implementation of the project, WASAC shall secure in full the locations of the water distribution facilities via fair compensation such as the location of water tanks (such as Batsinda site) and fair compensation of other assets to be affected by the project. Agreed compensation should be paid prior to commencement of works
- The project should assign the Health, Social and Environmental officer who will oversee undertaking the monitoring of the mitigation measures for the project through its existence. This will help to achieve sustainable project implementation at reduced cost for undertaking the monitoring despite the facts that regular internal monitoring shall be carried out by the project developer
- Local and affected people should be given priority in works;
- Taking into consideration that most of the project activities will be carried out longest the existing roads, special attention shall be given to the management of traffic and roads repair to avoid any incident associated to the project activities.
- Prior to the project implementation, WASAC Ltd is required to involve local authorities and establish a joint monitoring team including the representative of City of Kigali, REMA, RWB, WASAC, National Traffic Police, and Gasabo district to regularly monitor the implementation of the proposed EMP.
- Mid-term environmental audit should be conducted to evaluate the effectiveness of proposed mitigation measures and provide corrective measures as appropriate.
- Prior to the project implementation, the contractor shall prepare the Construction Environmental and Social Management Plan (CSEMP) as well as the Construction Environmental Health Safety Plan (CEHSP) related to the project
- The negative socio-cultural impacts associated to the project are very low as there is no involuntary settlement that may be associated to the project implementation. Hence, the project developer (WASAC ltd) should work closely with local authorities in raising awareness among local communities for the protection and maintenance of the project infrastructures.

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ANNEXES

Annex 1: List of consulted people at central and local institutions

No	Names	Contact	Institution	Function
1	ABIMANA Eric	0787812829	Bibare Cell	CEDO
2	Alain SEZIBERA	0788521930	Rwanda Development Board	EIA Analyst
3	BUGINGO Davis	0788230018	Rwanda Water Board	Flood Management and Water Storage Development Division Manager
4	BYUKUSENGE Jean d'Amour	0788984400	Musezero Cell	CEDO
5	DUFATANYE Israel	0788481541	REMA	Environmental Inspector
6	DUSABIMANA Annuaritte	0788452328	Gisozi Sector	Health and Sanitation Officer
7	Eng. MUHORAKEYE Jeanne	0788875101	Kimironko sector	Act land management & Notary team leader
8	Enode NIYONSABA	0787958813	Nyabisindu	ES
9	GASANA Donatien	0785984429	Gasharu Cell	CEDO
10	HABINSHUTI Jean Pierre	0788881465	Gasabo District	Water District Engineer
11	HAVUGUZIGA NTABWIKO Charles	0788300397	Kanyinya sector	Executive secretary
12	Jean Pacifique TUYISHIMIRE	0783393820	Murama cell	CEDO
13	Jeannine MUKARUKUNDO	0783441942	Kibagabaga cell	CEDO
14	KALISA Hamza Fidel	0788876579	Gisozi Sector	Land manager support Officer
15	KARAMUZI Godfrey	0788861810	Remera sector	Executive secretary
16	KARURANGA Dismas	0788779208	Rwanda Water and Forest Authority	In charge of Water Quality
17	KAYITESI Redempta	0783877212	Gacuriro cell	Executive Secretary
18	MBONAMPEKA Claudine	0788492092	Rukiri II	Executive Secretary
19	MUKAMANA Phoebe	0788583832	Gasabo District	Environmental Officer
20	MUKAMANA Phoebe	0788583832	Gasabo District	District Environmental Officer
21	MUKAMURENZI Antoinette	0788683611	Gisozi Sector	Health and good governance
22	MUKANTWARI Sandrine	0787433065	Gasharu Cell	ES of the cell
23	MUSASANGOHE Providence	0788451827	Gisozi Sector	Executive Secretary
24	NDAMYIMANA Elysée	0788414332	Remera sector	Land bureau
25	NIYONSABA Pascal	0738583283	Rukiri I	Executive Secretary
26	NSENGIMANA Janvier	0788668943	Remera sector	Community Heath and Sanitation Officer
27	RUGAMBIRWA Deo	0788815450	Bumbogo Sector	Executive Secretary
28	RUKUNDO Augustin	0782756565	Gasabo District	District Sanitation Officer
29	RUSINE Alphonse	0788440290	Gasabo District	Land Survey & GIS
30	RUTARINDWA Alphonse	0784902626	Gasabo District	Director of Health and Socio-economic development
31	SHUMBUSHO Faustin	0789198930	Bumbogo Sector	Ngara Cell Executive Secretary
32	TUYISHIMIRE Evelyne	0784388649	Nyagatovu cell	CEDO
33	UMUHOZA MBATEYE Aimee Francine	0788486203	Water and Sanitation Corporation	In Charge of Planning
34	UMUHOZA RWABUKUMBA	0788304546	Kimironko sector	Executive secretary
35	UMURERWA Josiane	0788627922	Bumbogo Sector	Social affairs
36	UWAMAHORO Chantal	0788946525	Kimironko sector	Community heath and sanitation officer
37	UWAMAHORO Jeanne d'Arc	0788315593	Nyarutarama cell	CEDO
38	UWAMAHORO Jeanne d'Arc	0788649667	Kimironko sector	Social affairs
39	UWERA Jeanne d'Arc	0787959858	Bumbogo Sector	Customer care

Annex 2: Participnats to initial consultations-inception phase – Januray 16th 0Feburary 4th 2022

No	Names	Sector	Cell	Village	Contacts
	Remera sector				
1	Alexis RUBAYITA	Remera	Nyabisindu	Amarembo I	784459211
2	BARAHIRA	Remera	Rukiri I	Gashyitsi	788482700
3	BIRUNGI Vivien	Remera	Nyabisindu	Gihogere	788423773
4	BIZIMANA Cynthia	Remera	Rukiri I	KISIMENTI	781557214
5	BYUKUSENGE Elisabeth	Remera	Nyabisindu	Gihogere	788593480
6	Clarisse Uwimana	Remera	Nyarutarama	Kibiraro I	788234784
7	Eric BYUMVUHORE	Remera	Nyabisindu	Gihogere	732267644
8	Eugenie	Remera	Rukiri I	Kisimenti	788570259
9	FOCAS	Remera	Rukiri II	Amahoro	788789087
10	Francoise	Remera	Nyarutarama	Kangondo II	788679936
11	GATARI Fabrice	Remera	Nyarutarama	Kangondo I	788465982
12	HABAKUBANA	Remera	Rukiri I	Gashyitsi	786114000
13	Harelimana Jean Claude	Remera	Nyabisindu	Marembo I	782281088
14	INGABIRE Clemantine	Remera	Nyarutarama	Kangondo	
15	Jeanne	Remera	Nyabisindu	Amarembo I	780973528
16	Jeanne d'Arc	Remera	Nyabisindu	Amarembo I	788581458
17	KABANDA Diane	Remera	Rukiri I	Kisimenti	788885318
18	KABERA Manzi Gerard	Remera	Nyarutarama	Kangondo I	788675347
19	Kansayiza Janviere	Remera	Nyarutarama	Kangondo II	788895929
20	KANYANGE Jacqueline	Remera	Nyarutarama	Kangondo I	784721707
21	Kanyarukiga NGABONZIZA Richard	Remera	Nyabisindu	Marembo I	786058158
22	Kevin	Remera	Nyabisindu	Gihogere	785282685
23	KIREZI	Remera	Nyarutarama	Kangondo I	784441109
24	MAHIRWEYOGUSENGA Hycenthe	Remera	Nyarutarama	Kangondo I	783558352
25	MBONINGABO	Remera	Rukiri I	Gashyitsi	784217545
26	Mukakabeza P	Remera	Nyarutarama	Kibiraro I	783605451
27	MUNYAWERA Chrales	Remera	Rukiri II	Rebero	786231642
28	Musoni Didas	Remera	Nyabisindu	Amarembo 1	782536496
29	Mutwarasibo Leonidas	Remera	Rukiri II	Amahoro	788478833
30	MVUYEKURE J.de Dieu	Remera	Nyabisindu	Gihogere	784898199
31	NIBEMA Brigurigitte	Remera	Nyarutarama	Kangondo II	787020945
32	NIWEMWANA Donata	Remera	Nyarutarama	Kangondo I	788232479
33	NSABIMANA Emmanuel	Remera	Nyabisindu	Gihogere	789139341
34	NSABIMANA Evaliste	Remera	Nyabisindu	Marembo	782500886
35	NSABIMANA Ibrahim	Remera	Rukiri I	Gisiment	788540442
36	NTAGENGWA Patrick	Remera	Nyabisindu	Gihogere	783542031
37	NYANGABIRE Lucie	Remera	Nyarutarama	Kangondo II	
38	Nyirabashumba	Remera	Nyarutarama	Kibiraro I	789610360
39	Nyirahabimana	Remera	Nyarutarama	Kangondo II	786134842
40	NYIRAMATABARO Epiphanie	Remera	Nyarutarama	Kibiraro I	786191900
41	NZIRORERA Issa	Remera	Nyabisindu	Marembo I	788496382
42	Odette	Remera	Nyabisindu	Gihogere	786821102
43	Sakindi Esperance	Remera	Rukiri II	Amahoro	788516762
44	TWAGIRAMUNGU Emmanuel	Remera	Nyabisindu	Marembo I	788290249
45	UMUGWANEZA Clarisse	Remera	Nyabisindu	Gihogere	782502944
46	Umugwaneza Diane	Remera	Rukiri II	Rebero	788876974
47	Uwamurera	Remera	Nyabisindu	Gihogere	7823919113
48	Uwayezu Diane	Remera	Nyabisindu	Amarembo I	785894573
49	UWAYISABA Berthlide	Remera	Nyarutarama	Kangondo I	
50	UWINGABE Christella	Remera	Nyarutarama	Kangondo I	
51	UWINGABIRE	Remera	Nyabisindu	Amarembo I	7888680623
	Kinyinya Sector				
1	AZAMU Busingye	Kinyinya	Kagugu	Nyakabungo	788564818
2	BAYISINGIZE M. Claire	Kinyinya	Kagugu	Gicikiza	787350435
3	Benineza Claudien	Kinyinya	Gacuriro	Akaruvusha	780509037
4	Buregeya J Bosco	Kinyinya	Kagugu	Nyakabungo	783413506
5	Claude	Kinyinya	Gacuriro	Karuvusha	783769209
6	DUSABE	Kinyinya	Kagugu	GIHEKA	
7	GAKUNZI Janvier	Kinyinya	Murama	Rusenyi	788413033
8	Habineza Olivier	Kinyinya	Kagugu	Giheka	783496903
9	HABUMUKIZA Lucien	Kinyinya	Kagugu	Giheka	
10	HATEGEKIMANA Patrick	Kinyinya	Murama	Binunga	783987448
11	INGABIRE Christa	Kinyinya	Kagugu	Gicikiza	781405289

No	Names	Sector	Cell	Village	Contacts
12	INGABIRE Regine	Kinyinya	Kagugu	Kabuhunde II	784131344
13	INGABIRE Sandrine	Kinyinya	Kagugu	Nyakabungo	787713266
14	IRADUKUNDA Claudine	Kinyinya	Kagugu	Rukingo	783077684
15	ISHIMWE Brian	Kinyinya	Gacuriro	Akarambo	
16	Ishimwe Saratiel	Kinyinya	Gacuriro	Karuvusha	783003883
17	ISIMBI Nicole	Kinyinya	Murama	Taba	780508017
18	IYAMUREMYE Emmanuel	Kinyinya	Gacuriro	Karambo	784533541
19	Jean Claude	Kinyinya	Kagugu	Dusenyi	786194521
20	Jean Pierre	Kinyinya	Murama	Rusenyi	780074007
21	KANEZA Julienne	Kinyinya	Gacuriro	Akarambo	
22	KANNKINDI Dafroza	Kinyinya	Kagugu	Nyakabungo	786425728
23	KANYAMUHUNGU Paifique	Kinyinya	Murama	Binunga	788586045
24	KANYANDWI	Kinyinya	Kagugu	Gicikiza	788845128
25	KANYARAMA Epiphanie	Kinyinya	Kagugu	Nyakabungo	
26	KANYARWANDA Daniel	Kinyinya	Kagugu	Gicikiza	788652064
27	KARANGWA	Kinyinya	Murama	Taba	788237922
28	KARANGWA Judith	Kinyinya	Gacuriro	Akarambo	788687784
29	KARIMBA Alexis	Kinyinya	Kagugu	Giheka	786825285
30	Kayitare Maurice	Kinyinya	Kagugu	Giheka	783610375
31	Kayitesi Christine	Kinyinya	Kagugu	Dusenyi	788731960
32	Kayitesi Clarisse	Kinyinya	Murama	Rusenyi	787341533
33	KAYITESI Jacqueline	Kinyinya	Gacuriro	Urugarama	
34	KEZA Tania	Kinyinya	Gacuriro	Akaruvusha	787288141
35	MANEZA Emeline	Kinyinya	Kagugu	Gicikiza	788378081
36	MISIGARO Francois Xavier	Kinyinya	Kagugu	Nyakabungo	789188311
37	MUGABEKAZI	Kinyinya	Murama	Taba	785045789
38	Muhawenimana Jeannette	Kinyinya	Kagugu	Giheka	782116321
39	MUHIRWA Adeliphine	Kinyinya	Murama	Binunga	788598220
40	Mujawayezu	Kinyinya	Kagugu	Muhororo	789478363
41	MUKAHIRWA Veneranda	Kinyinya	Kagugu	Gicikiza	783267798
42	MUKALETA Claudine	Kinyinya	Gasharu	Kami	78844560
43	MUKAMANA Edissa	Kinyinya	Kagugu	Giheka	787863529
44	MUKAMASABO Florence	Kinyinya	Kagugu	Kabuhunde II	7890870999
45	MUKAMBARUSHA Joselyne	Kinyinya	Kagugu	Giheka	785119660
46	MUKAMURENZI Jeanette	Kinyinya	Gasharu	Gasharu	785312232
47	MUKANDAYAMBAJE Christine	Kinyinya	Gasharu	Agatare	790597653
48	MUKANDEKEZI Immaculee	Kinyinya	Gacuriro	Akarambo	785385041
49	MUKANGOMA Herene	Kinyinya	Kagugu	Giheka	
50	MUKANTABANA	Kinyinya	Murama	Taba	785844182
51	Mukanyandwi Josiane	Kinyinya	Kagugu	Giheka	787145101
52	Mukarukundo Jeanne	Kinyinya	Kagugu	Gicikira	788725139
53	MUNEZERO Florence	Kinyinya	Murama	Binunga	787163276
54	MURENZI Emmanuel	Kinyinya	Kagugu	Gicikiza	785203460
55	MUSHIMIYIMANA	Kinyinya	Murama	Taba	781549723
56	MUTONI Esperance	Kinyinya	Kagugu	Rwangu	784261381
57	MUTUMWIREHE Dohve	Kinyinya	Murama	Taba	788446280
58	Mutuni Clementine	Kinyinya	Kagugu	Giheka	785329388
59	MUTUYIMANA Yvanny	Kinyinya	Murama	Taba	
	Kimironko Sector				
1	Brian	Kimironko	Kibagabaga	Rugero	788460545
2	Chantal UWANYIRIGIRA	Kimironko	Kibagabaga	Nyirabwana	788470414
3	DUFITIMANA INGABIRE Joyce	Kimironko	Kibagabaga	Kamihanda	788945225
4	DUSABIMANA Erneste	Kimironko	Bibare	Imena	7872268436
5	Elie UWIMANA	Kimironko	Nyagatovu	Urugwiro	788329273
6	GAKIRE Damien	Kimironko	Nyagatovu	Ibuhoro	785538112
7	GAKWAVU Bonus	Kimironko	Bibare	Imena	788521362
8	HATUNGIMANA Jean de Dieu	Kimironko	Nyagatovu	Itetero	788709780
9	IKIMPAYE Petronile	Kimironko	Bibare	Inyange	788858042
10	IKISHATSE Claude	Kimironko	Bibare	Inganji	727390877
11	INGABIRE Jeannette	Kimironko	Bibare	Intashyo	783072767
13	ISHIMWE MUHUMUZA Christian	Kimironko	Kibagabaga	Kamahinda	780460175
14	KABATESI Flora	Kimironko	Bibare	Imitari	787701022
15	KAGABA Alexis	Kimironko	Bibare	Intashyo	788504277
16	KAMARIZA Justine	Kimironko	Nyagatovu	ijabiro	790875644
17	KAMARIZA Liliane	Kimironko	Nyagatovu	Urugwiro	788817189

No	Names	Sector	Cell	Village	Contacts
18	KARANGANWA Venuste	Kimironko	Kibagabaga	karongi	788520936
19	KAYIGEMA Jacques	Kimironko	Kibagabaga	Kageyo	788866769
20	KAYIRANGA Theophile	Kimironko	Kibagabaga	Rindiro	788846374
21	MAPENDO Esperance	Kimironko	Kibagabaga	Nyirabwana	788541945
22	Mbarubukeye Derick	Kimironko	Kibagabaga	kalisimbi	782658913
23	MUBANDAKAZI Egidie	Kimironko	Bibare	Inyange	783470290
24	MUGABO Frank	Kimironko	Kibagabaga	Ibuhoro	788531996
25	MUGENI Theonira	Kimironko	Nyagatovu	ijabiro	788851451
26	MUHIRWA Francois	Kimironko	Nyagatovu	Isangano	787831113
27	MUHSHAPUNDU Eriane	Kimironko	Nyagatovu	Itetero	783849888
28	MUKABAGIRE Nadine	Kimironko	Bibare	Inganji	788312860
29	Mukamusoni Mariane	Kimironko	Nyagatovu	Ibuhoro	786553694
30	MUKAMUVUNYI Eugenie	Kimironko	Nyagatovu	Rukinanyana	783664985
31	MUKANKUBITO Speciose	Kimironko	Kibagabaga	Rugero	788304341
32	MUKANYIRIGIRA Alfonsine	Kimironko	Nyagatovu	Urugwiro	781096535
33	MUKESHIMANA J. Claude	Kimironko	Kibagabaga	Ibuhoro	788256037
34	MUMPOREZE Jeanettte	Kimironko	Kibagabaga	Karisimbi	791447011
35	MUREGO Eugene	Kimironko	Nyagatovu	Rukinanyana	788593189
36	MUREKEYISONI Therese	Kimironko	Bibare	Imanzi	788572557
37	MURUNGI Deliphine	Kimironko	Bibare	Intashyo	788801227
38	MUTABAZI Stiven	Kimironko	Bibare	Intashyo	788541147
39	MWENEMAMA Sania	Kimironko	Nyagatovu	Urugwiro	788997103
40	NTABAJYANA J. Bosco	Kimironko	Kibagabaga	Rindiro	788885579
41	NYINAWABO Margaritte	Kimironko	Kibagabaga	Kageyo	788653985
42	NYIRANZIYINO Esther	Kimironko	Kibagabaga	Rindiro	780121151
43	NYIRARUKUNDO Immaculee	Kimironko	Nyagatovu	Bukinanyana	788539620
44	Odette Niyotwizera	Kimironko	Bibare	Imitari	733075875
45	RUTAZIGWA Louis	Kimironko	Bibare	Amariza	788309959
46	Ryamuhenga Emmanuel	Kimironko	Kibagabaga	Rugero	788748343
47	UBIFITIYE Therese	Kimironko	Nyagatovu	Buhoro	788583528
48	UMUGWANEZA Oreri	Kimironko	Nyagatovu	Isangano	788548492
49	UMUTESI Eduige	Kimironko	Kibagabaga	Kalisimbi	788471520
50	UMUTONI Imacullee	Kimironko	Bibare	Intashyo	788760995
51	UWIMBABAZI Alexia	Kimironko	Kibagabaga	Rugero	783284528
52	UWINGABIRE jACQUELINE	Kimironko	Bibare	Inyange	788826286
53	UZAMUSHAKA Anne Marie	Kimironko	Nyagatovu	Bukinanyana	
	Gisozi Sector				
1	Batamuriza Beline	Gisozi	Ruhango	Murambi	
2	BIKORIMANA S.	Gisozi	Musezero	Gasharu	785701106
3	DUSABIMANA Samuel	Gisozi	Musezero	Gasharu	783000237
4	ERIC RUBIBI	Gisozi	Ruhango	Kumukenke	788736545
5	HAKIZIMANA Andre	Gisozi	Musezero	Amajyambere	788353246
6	HARELIMANA Eliel	Gisozi	Musezero	Gasharu	788848365
7	Harindintwali Theogene	Gisozi	Ruhango	Kanyinya	784482576
8	INGABIRE	Gisozi	Ruhango	Kanyinya	788522152
9	Ingabo Roger	Gisozi	Ruhango	Kanyinya	787896454
10	Joffrey Kwizera	Gisozi	Ruhango	Murambi	785842245
11	Kwibuka Hozanna	Gisozi	Musezero	Nyakariba	780982329
12	Mahoro Solange	Gisozi	Musezero	Nyakariba	783284523
13	Mbabazi Kevine	Gisozi	Musezero	kagara	787797605
14	Mugorewindinda Aloysie	Gisozi	Ruhango	Murambi	783042741
15	MUKAMAZIMPAKA Prudencienne	Gisozi	Musezero	Amajyambere	788719740
16	MUKAMUHIRWA Florence	Gisozi	Musezero	Nyakariba	784533664
17	Mukandamutsa Vestine	Gisozi	Ruhango	Kumukenke	788443796
18	Mukanyirigira Jeanette	Gisozi	Ruhango	Kumukenke	788696021
19	Mukasonga Madelaine	Gisozi	Ruhango	Kumukenke	788499981
20	MUKAYISENGA Claudine	Gisozi	Musezero	Nyakariba	786074887
21	Mukunzi Diane	Gisozi	Musezero	Nyakariba	788697781
22	Munezero Joseline	Gisozi	Musezero	Nyakiriba	784599979
23	MUNYABUGINGO Eric	Gisozi	Ruhango	Rukeri	788278356
24	MUREFU Vincent	Gisozi	Musezero	Amajyambere	785802440
25	Murekatete Solange	Gisozi	Musezero	Nyakariba	788227125
26	Murorunkwere Gaudence	Gisozi	Ruhango	Kanyinya	783559020
27	Murungi Sharon	Gisozi	Musezero	Kagara	788695418

No	Names	Sector	Cell	Village	Contacts
28	MURYARA Stella	Gisozi	Musezero	Amajyambere	789185020
29	MUTESI Jeanette	Gisozi	Musezero	Kagara	783835024
30	MUTESI Yvone	Gisozi	Musezero	Amajyambere	782185564
31	Mutoni Ange Sandrine	Gisozi	Ruhango	Kumukenke	787401102
32	Mutoniwase Fatuma	Gisozi	Ruhango	Kanyinya	785586037
33	NDAYISENGA Florence	Gisozi	Musezero	Gasharu	788229901
34	NDUNGUTSE Jonas	Gisozi	Ruhango	Ntora	788960166
35	NGENDAHIMANA Valens	Gisozi	Ruhango	Rukeri	788979000
36	Niyomufasha Arivela	Gisozi	Musezero	Amarembo	787891336
37	NSENGIYUMVA M. Marc	Gisozi	Ruhango	Kumukenke	783584127
38	NSHIIYIMANA Zche	Gisozi	Musezero	Amajyambere	782777863
39	NTAKIRUTIMANA Shabani	Gisozi	Musezero	Amajyambere	784021217
40	Nyamwiza Margot	Gisozi	Ruhango	Kanyinya	781837236
41	Nyirahabimana Aline	Gisozi	Musezero	Nyakariba	784147506
42	NYIRAHABINEZA Edissa	Gisozi	Ruhango	Ntora	780346714
43	NYIRANSABIMANA Donatha	Gisozi	Musezero	Amajyambere	780123826
44	NYIRANSHIMIYIMANA Claire	Gisozi	Ruhango	Ntora	786792234
45	TUYIZERE Evod	Gisozi	Ruhango	Ntora	786507279
46	Umuhoza Bijoux	Gisozi	Ruhango	Murambi	790741160
47	UMUTESI Solange	Gisozi	Musezero	Gasharu	
48	UMUTONI Carine	Gisozi	Ruhango	Rukeri	788565881
49	UMUTONI Vanessa	Gisozi	Ruhango	Umurava	782288399
50	UTAMURIZA Gloriose	Gisozi	Ruhango	Kanyinya	788407589
51	Uwamahoro Zuena	Gisozi	Musezero	Nyakiriba	788212472
52	UWAMARIYA Claire	Gisozi	Ruhango	Umurava	782039103
53	UWAMARIYA Olive	Gisozi	Musezero	Nyakariba	783558150
54	UWAMBAJE Phelomene	Gisozi	Ruhango	Kanyinya	788875401
55	Uwera Chantal	Gisozi	Musezero	Nyakariba	789801457
56	Uwimana Dancilla	Gisozi	Musezero	Nyakariba	789980515
57	UWINEZA Jeannette	Gisozi	Ruhango	Umurava	787285742
58	UWINGABIRE Rachel	Gisozi	Ruhango	Ntora	789684848
	Bumbogo Sector				
1	Gatabazi Emmanuel	Bumbogo	Ngara	Birembo	786944544
2	KUNDAWIZERE Emmanuel	Bumbogo	Ngara	Birembo	786669823
3	MUKANKUSI Mediatrice	Bumbogo	Ngara	Birembo	78824651
4	MUSONI Alex	Bumbogo	Ngara	Birembo	783104414
5	NAKABONYE Antoinette	Bumbogo	Ngara	Birembo	785383547
6	NTEZIRIZAZA Silivestre	Bumbogo	Ngara	Birembo	788811522
7	Shyaka Felix	Bumbogo	Ngara	Birembo	781680749
8	UWIMANA Marie	Bumbogo	Ngara	Birembo	782510077

Annex 3: Participnats to the consultations at scoping phase-March 26, 2022

PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SERVICES IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA

STAKEHOLDERS CONSULTATIVE MEETING

PREPARATION OF ENVIRONMENTAL IMPACT ASSESSMENT HELD AT.....Nyabisindu............... ON ..26th......03..2022.

#	Name	Sector	Cell	Phone number	Email	Signature
1	Habyarimana Sam	Remera	Nyabisindu	0788517850	—	
2	Nyiransekuye A. Louise	Remera	Nyabisindu	0783093950		
3	Uwitonze Aline	Remera	Nyabisindu	0785420040		
4	Ninani Frodeald	Remera	Nyabisindu	0785414346		
5	Bagwaneza chantal	Remera	Nyabisindu	0785255694		
6	Gahamanyi teonest	Remera	Nyabisindu	0783891368		
7	NYIRABIZIMANA Anita	"	"	0788603402		
8	Nyirabagenzi mama Wroben	"	"	0785328981		
9	NYIRANSENGIMANA Valentine	Remera	Nyabisindu	0786418846		
10						
11						

PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SERVICES IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA

STAKEHOLDERS CONSULTATIVE MEETING

PREPARATION OF ENVIRONMENTAL IMPACT ASSESSMENT HELD AT.....Nyabisindu..... **ON** ...26/4/03/2022

#	Name	Sector	Cell	Phone number	Email	Signature
1	NYIRAWUMUNTU Alexie	Remera	Nyabisindu	0789391999		
2	NDAYISABA Valens	"	"	0787981341		
3	NGIRUWONSANGA	"	"	0783529068		
4	NDUKIMUNGU Theophile	Remera	Nyabisindu	0788649576		
5	GATETE Stéphanie	"	"	0788890261		
6	Ngendahimana Sebastien	"	"	0782128923		
7	UWIZEYIMANA Esther	Remera	Nyabisindu	0781006092		
8	Kwitonda J.M.V	"	"	0788448274		
9	NDIZEYE Bernard	Remera	Nyabisindu	0780647475		
10	NYIRANDAGIJIMANA Claudine	Remera	Nyabisindu	0786369739		
11	BINDIKUBWABO Joseph	Remera	Nyabisindu	0787551259		

PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SERVICES IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA

STAKEHOLDERS CONSULTATIVE MEETING

PREPARATION OF ENVIRONMENTAL IMPACT ASSESSMENT HELD AT......Nyabisindu......... ON ..26th..03..2022...

#	Name	Sector	Cell	Phone number	Email	Signature
1	DUSABIMANA ARRUS	RETERA	NYABISINDU	0788453200		[signature]
2	Sezibera ISSA	Remera	Nyabisindu	0788889390		[signature]
3	MUKANYANDWI	Remera	Nyabisindu	0788575600		[signature]
4	Uwizingiyimana	Remera	Nyabisindu	0784611070		[signature]
5	MOSHIMIYIMANA Edison	"	"	0785899530		[signature]
6	BAHORUKIYE Bernard	"	"	0786963203		[signature]
7	HABARUKUZE Laurance	Remera	Nyabisindu	0725726667		[signature]
8	NIYONSABA	"	"	0788208514		[signature]
9	NTWARI Augustin	"	"	0788746687		[signature]
10	CASIMIRARE J. Baptiste	"	"	—		[signature]
11	KURADUSENGE David	Remera	Nyabisindu	0788995571		[signature]

PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SERVICES IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA

STAKEHOLDERS CONSULTATIVE MEETING,

PREPARATION OF ENVIRONMENTAL IMPACT ASSESSMENT HELD AT....Nyabisindu.......... ON......26th..03..2022

#	Name	Sector	Cell	Phone number	Email	Signature
1	Munyampeta Emmanuel	Remera	Nyabisindu	0788535336		
2	Gahizi Eugene	Remera	Nyabisindu	0788303674		
3	Niyonsaba Madeleine	Remera	Nyabisindu	0788539292		
4	Gashusa Emmanuel	Remera	Nyabisindu	0788015103		
5	Nsengimana Evariste	Remera	Nyabisindu	0782500386		
6	Mukamana Odette	Remera	Nyabisindu	0788769390		
7	Bikorimana Shimwe Robert	Remera	NYABISINDU	0782478104		
8	Uwizeyimana Justine	REMERA	Nyabisindu	0786676350		
9	Kubwimana Epimaque	"	"	0788611136		
10	Rugambage Eugene	"	"	0788849812		
11	Nyirangendahayo Fortunée	"	"	0783453113		

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PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SERVICES IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA

STAKEHOLDERS CONSULTATIVE MEETING

PREPARATION OF ENVIRONMENTAL IMPACT ASSESSMENT HELD AT....Nyabisindu............. ON ..26th......05.2022

#	Name	Sector	Cell	Phone number	Email	Signature
1	UWIMANA MONIQUE	REMERA	NYABISINDU	0782610804		[signature]
2	UWINGABIYE Mariane	Remera	Nyabisindu	0785487142		[signature]
3	Nyiroshumbusho Vestine	Remera	Nyabisindu	0788744682		[signature]
4	NYiramahuka Herveze	"	"	0783664734		[signature]
5	TUYISABE Dioene	"	"	078451402[illegible]		[signature]
6	IKITEGEDE Janvière	"	"	0785655296		[signature]
7	MOREKATETE Anita	"	"	0735110190		[signature]
8	Munyandamutsi Emmanuel		"	0788884550		[signature]
9	Nyiranshuti Danielle	"	"	0787866249		[signature]
10	Mukeshimana Pascal	Remera	Nyabisindu	078858967		[signature]
11	Habimana Sylvestre	Remera	"	0786166107		[signature]

KINYINYA - KAGUGU

PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SERVICES IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA

STAKEHOLDERS CONSULTATIVE MEETING

PREPARATION OF ENVIRONMENTAL IMPACT ASSESSMENT HELD AT NYAKABUNGO VILLAGE ON 26th/03/2022

#	Name	Sector	Cell	Phone number	Email	Signature
1	Mugisha J. Claude	Kinyinya	Kagugu	0788602077	[illegible]	[signature]
2	Muringagije Francine	Kinyinya	Kagugu	0783863773	—	[signature]
3	Hakizimana Claudine	Kinyinya	Kagugu	0790052707		[signature]
4	NGABONZIZA Adèle	-//-	-//-	0788444500	adeudo…7@gmail	[signature]
5	NSENGIMANA					
6	Hakizabera J.M.V	Kinyinya	Kagugu	0785007490		[signature]
7	Dusabimana J de Dieu	—	—	0783269895	dusabimana…@gmail	[signature]
8	Nitonsenga Jean Bosco	Kinyinya	Kagugu	078226475		[signature]
9	UWIRINGIYIMANA	"	"	0781776166	—	[signature]
10	Ntawiuwareatabanye Jean	"	"	078149072	—	[signature]
11	Twagirimana Venuste	"	"	0778872558	—	[signature]
12	Tumbuliye J de Dieu	"	"	0788299535		[signature]

ENGINEERING-ENVIRONMENT-CLIMATE CHANGE-SOCIO-ECONOMIC

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KINYINYA - KAGUGU

PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SERVICES IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA

STAKEHOLDERS CONSULTATIVE MEETING

PREPARATION OF ENVIRONMENTAL IMPACT ASSESSMENT HELD AT NYAKABUNGA VILLAGE ON 26th/03/2022

#	Name	Sector	Cell	Phone number	Email	Signature
1	NSHIMIYIMANA ABDARA		KINYINYA	0789236865	—	
2	Ndacyayisenga Eugène		Kagugu	0785144779	—	
3	Iyamuremye Théogène		Kagugu	0788682152	—	
4	Habarimana Théogène			0786554026		
5	Kamukeza Marie Thérèse		Kagugu	0780464461	-	
6	Mukangenzi Patricia		Kagugu	0784601613	-	
7	Mukantabana Ceremotine		"	0786065399	-	
8			"	0789679636	—	
9	Iradukunda Claudine					
10	Uwase Igabe Olive		"	0726730371	- -	
11	MUGABO Salim		"	0722180591	—	

KINYINYA -KAGUGU

PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SERVICES IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA

STAKEHOLDERS CONSULTATIVE MEETING

PREPARATION OF ENVIRONMENTAL IMPACT ASSESSMENT HELD AT NYAKABUNGO VILLAGE ON 26th/03/2022

#	Name	Sector	Cell	Phone number	Email	Signature
1	NGABONZIZA Alain	KINYINYA	KAGUGU	0788221916		
2	Muratabigeri Fidele	KINYINYA	KAGUGU	0788217326		
3	Twagiramungu Hamud	Kinyinya	Kagugu	0785056958		
4	Nyirakamana Henriette	Kinyinya	Kagugu	0787384575		
5	Twagiramungu Joseph	Kinyinya	Kagugu	0785607198		
6	Olivier Ukobumugabo	Kinyinya	Kagugu	0788484709	[illegible] gmail.com	
7	Nsengiyumva Abdoulatif	Kinyinya	Kagugu	0789301438	[illegible]@gmail	
8	Nkundabagenzi	|		0782206042		
9	Nyirabahire M. Aimee	Kinyinya	Kagugu	0788876865	—	
10	Nyirahabimana Marianne		Kagugu	0783719937	—	
11	Kwitonda Blaise	Kinyinya	Kagugu	0784696184	—	

KINYINYA - KAGUGU

PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SERVICES IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA

STAKEHOLDERS CONSULTATIVE MEETING

PREPARATION OF ENVIRONMENTAL IMPACT ASSESSMENT HELD AT NYAKABUNGO VILLAGE ON 26th /03/ 2022

#	Name	Sector	Cell	Phone number	Email	Signature
1	RUGELINYANGE Frodouard	KINYINYA KAGUGU	KAGUGU	0788592916	—	[signature]
2	NIYONZIMA S.d'Amour	KINYINYA	KAGUGU	0780320297	—	[signature]
3	Ntiyangaye J. christian	Kinyinya	Kagugu	0788449985	—	[signature]
4	Ntawihaba Emanuel	Kinyinya	Kagugu	0788362107	—	[signature]
5	Eleazar Ndabaramye	Kinyinya	Kagugu	0785371340		[signature]
6	HABYARIMANA Jean Damascène	Kinyinya	Kagugu	0788468357		[signature]
7	UMUGWANEZA Ambroise	Kinyinya	KAGUGU	0788572205	—	[signature]
8	Mukandutiye ANNYENSI	Kinyinya	KAGUGU	0783679287	—	[signature]
9	UWINEZA Zainab	Kinyinya	KAGUGU	0785831342	—	[signature]
10	NIYONSENGA FIDEL	KINYA	KAGUGU	078748476	—	[signature]
11	Uwizeyimana Théogène	KINYINYA	KAGUGU	0782133939	—	[signature]

12 Lukundo Valens " " Kagugu 0786243737 — [signature]

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KINYINYA -KAGUGU

PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SERVICES IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA

STAKEHOLDERS CONSULTATIVE MEETING

PREPARATION OF ENVIRONMENTAL IMPACT ASSESSMENT HELD AT NYAKABUNGO VILLAGE ON 26th/03/2022

#	Name	Sector	Cell	Phone number	Email	Signature
1	MUGABURA Dieudonne	Kinyinya	KAGUGU	0787377380		
2	NSHIM[illegible]	Kinyinya	Kagugu		—	
3	Ndamage Elie	Kinyinya	Kagugu	0788541480	diendamage@gmail.com	
4	Karangwa Faustin	Kinyinya	Kagugu	0788693241	=	
5	Mukabarara Béatha	Kinyinya	Kagugu	0780731797	—	
6	MUKABUTAMU [illegible]	Kinyinya	Kagugu	0728837085	—	
7	HAKIZA [illegible] Justin	KINYINYA	KAGUGU	0788419955	—	
8	Nsengiyumva Jclaude	Kinyinya	Kagugu	0783109887	—	
9	Uwimana Tabita	Kinyinya	Kagugu	0728292933	—	
10						
11						

UMURENGE WA GISOZI

AKAGARI KA MUSEZERO

UMUDUGUDU WA GASHARU

ABITABIRIYE UMUGANDA USOZA UKWEZI KWA WERURWE 2022

N	AMAZINA YOMBI	ISIBO ABARIZWAMO	TELEFONE	UMUKONO
1.	Ntibaziyaremye	Umuhuza	0782658086	[signature]
2.	Rutabingwa J.D		0787773534	[signature]
3.	UZABISENGA Emmanuel	TUZAMURANE	0781240022	[signature]
4.	MUNANA M.A.	I.M.V	0785634509	[signature]
5.	Masiyili Meite		07855659?	[signature]
6.	Hogoro Serafini			
7.	ABR A [illegible]		0788905778	[signature]
8.	KAMANA		0784000823	
9.	NSABIMANA M PASCAL		0788559689	[signature]
10.	NDAHIRO Willy Aristide		0788790671	[signature]
11.	MUKANDIZA Joselyne		0788442751	[signature]
12.	[illegible]		0788715110	[signature]
13.	[illegible] Noël			
14.	Nyandwi Mathias		0791530438	[signature]
15.	Elira Etienne		783996067	[signature]
16.	IRAKIZA	Isiludone	079[illegible]	[signature]
17.	Niyonsenga Emmanuel		783718221	[signature]
18.	Yamuremyeyi S.		0784449247	[signature]
19.	STEVEN		0780576326	[signature]
20.	NYANDWI	DIOLA S	0788475494	[signature]

RENGE WA GISOZI

AGARI KA MUSEZERO

MUDUGUDU WA GASHARU

ABITABIRIYE UMUGANDA USOZA UKWEZI KWA WERURWE 2022

N	AMAZINA YOMBI	ISIBO ABARIZWAMO	TELEFONE	UMUKONO
1.	IRAKOZE Kevin	Umucyo	0791150830	
2.	MAHIRWE [illegible] Theo		0785660922	
3.	[illegible]		0725554874	
4.	HARINDINTWALI Leopord	UMUTEKANO	0788643825	
5.	UWERGIMANA [illegible]		0785483807	
6.	SABUHORO Ernest		0784573328	
7.	Tuyishime [illegible]		0788444241	
8.	Nzamuranyimana Beniite		0780164180	
9.	Nkundabagenzi Vianney		0784488915	
10.	NSHIMIYIMANA EZECHIEL		0788928345	
11.	Harelimana Alphonse		0788767996	
12.	Mukeshimana [illegible]	[illegible]	0783737262	
13.	Nijimgemo	Kirehoni		
14.	MANIZIMANA [illegible]			
15.	NDAYIMANA	[illegible]	078149[illegible]	
16.	MUSHABA	Umucyo	078883[illegible]324	
17.	Bisehera	Umurimo	0788462[illegible]	
18.	Uwiringiyimana peter		0787[illegible]769	
19.	TURIKUMANA (MED GERSE)	TUZAMURANE	0786118720	
20.	KANEZA [illegible]	TUZAMURANE	0781701560	
			0788637457	

IGE WA GISOZI

RI KA MUSEZERO

GUDU WA GASHARU

ABITABIRIYE UMUGANDA USOZA UKWEZI KWA WERURWE 2022

AMAZINA YOMBI	ISIBO ABARIZWAMO	TELEFONE	UMUKONO
NDAYISABA Nepo.	INGENZI	0785395888	[signature]
KAYITANA J Damascene	URUMURI	0788305379	[signature]
NGIRABABYEYI Pierre	INGENZI	0786090708	[signature]
NIBISHAKA ISaac	INTWARI	0786020494	[signature]
HARIMANA	UMA	0782202708	
Kimonyo J.M.V.	urumuri	0788786468	[signature]
NTEZinyimana pierre Celestin	Intabwe	0788717966	[signature]
Habimana Fidele	umutekano	078527239	[signature]
Habumugisha J.D	umutekano		[signature]

UMURENGE WA GISOZI

AKAGARI KA MUSEZERO

UMUDUGUDU WA GASHARU

ABITABIRIYE UMUGANDA USOZA UKWEZI KWA WERURWE 2022

N	AMAZINA YOMBI	ISIBO ABARIZWAMO	TELEFONE	UMUKONO
1.				
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MURENGE WA GISOZI

KAGARI KA MUSEZERO

IMUDUGUDU WA GASHARU

ABITABIRIYE UMUGANDA USOZA UKWEZI KWA WERURWE 2022

N	AMAZINA YOMBI	ISIBO ABARIZWAMO	TELEFONE	UMUKONO
1.	NGOGA Olivier	Ndashikira	0784651130	
2.	HAKIZIMANA Dominique	ABADACOGORA	0783693602	
3.	Daniel NDAMUZIGIYE	ABIZERWA	0788391432	
4.	NSIKAHABIMANA Jean	Ingeri	0784700011	
5.	KARYMUNA Jean	WILSON (INKIKI)	0787964213	
6.				
7.	Uwambaje Jeanne	Abizerwa	0788350987	
8.	Mukeshimana Clarisse	Intambwe	0786879445	
9.	nyirahumumuntu marie (17)		0782554155	
10.	Mukambarushimana Christine		0789483576	
11.	Mukamuriza Pascal	Umucyo	0788256815	
12.	nyiransabimana Claud	Intambwe	0781365593	
13.	Nyiramadagamije	-	0781805575	
14.	Nsanzinyana Bea (7)		0786543115	
15.	Mukakalisa Seraphine (7)		0788217525	
16.	Mukanyandwi Grace	Umucyo	0780349958	
17.	NTAHOMVUKIYE	SIRIRO	0783693549	
18.	BUGINGE PASIKARI		0787839005	
19.	Niyonsenga Vincent	Abizerwa	0788439261	
20.	Niyomufasha Emmanuel	Abadahinwa	0788261761	

UMURENGE WA GISOZI

AKAGARI KA MUSEZERO

UMUDUGUDU WA GASHARU

ABITABIRIYE UMUGANDA USOZA UKWEZI KWA WERURWE 2022

N	AMAZINA YOMBI	ISIBO ABARIZWAMO	TELEFONE	UMUKONO
1.	Niyonzima Emmanuel			
2.	KIBASHA Andre	Abahizi 12	0788947898	[signature]
3.	Bamparirl jean Baptiste	Gasharu	0788356290	[signature]
4.	HAHYURANIMFUZA Jean	Abahizi	0789009710	[signature]
5.	SEBACURUCI Evariste	Ingenzi	0788302288	[signature]
6.	Wikeze Olestine	Urumuri 8	078823006	[signature]
7.	Kamikazi Francine	Intore ICYEREKEZO	0783608510	[signature]
8.	KYAKUNTA JENNIFER	ICYEREKEZO	0788466669	[signature]
9.	Mukamutesi [illegible]			
10.	mukomutesi	19 Abadacogora	0784449263	[signature]
11.	mukakarani Chantal	7	0787455267	[signature]
12.	Mujawimana [illegible]	8 Inyange	0788465972	[signature]
13.	MUTEZIMANA Epiph		0783480477	[signature]
14.	NIYITEZA Rafiki		0788376686	[signature]
15.	NGENDAMBIZI Emmanuel	Abatabaz	0788756214	[signature]
16.	Twizerimana Jean d'Amour	7	0788641152	[signature]
17.	AGANZE JONAS	[illegible]	0781992692	[signature]
18.				
19.				

Annex 4: Participants to the consultation meeting at draft stage, June 4th , 2022

UMURENGE WA GISOZI

AKAGARI KA MUSEZERO

UMUDUGUDU WA GASHARU

ABITABIRIYE UMUGANDA WO KU WA 4/6/ 2022

N	AMAZINA YOMBI	ISIBO ABARIZWAMO	TELEFONE	UMUKONO
1	MUTWARE Félix	Intabwe??	0787849643	[signature]
2	NZABAHIMANA		078 9626 989	[signature]
3	NYIRANGIMANA &		07902[illegible]	[signature]
4	INGABIRE V St Anne	Intambwe	0739[illegible]	[signature]
5	M. Kamberkarijeme Christine		0789483516	[signature]
6	Tonatiba	13	07882 01190	[signature]
7	[illegible]	19	0788995978	[signature]
8	NTAKIRUTIMANA Vincent	IMBONI 11	0788924090	[signature]
	NYIREBA Janet	[illegible]	0786721682	
9	Mukamana Jeannette	Ubumwe	0789644[illegible]	[signature]

UMURENGE WA GISOZI

AKAGARI KA MUSEZERO

UMUDUGUDU WA GASHARU

ABITABIRIYE UMUGANDA WO KU WA 4/6/ 2022

N	AMAZINA YOMBI	ISIBO ABARIZWAMO	TELEFONE	UMUKONO
1	Ntezyamaze Emmanuel	Kuganidana	0784405978	
2	KANUMUNA J. Nelson	INGELI	0781864253	
3	MAMBOMA [illegible]	Ndeniabera	0787569972	
4	HABIYAKARE Augustin	Abagijamugayi	0783275386 / 0788715911	
5	BVIRINGIRO VIANA			
6	Ndagijimana	Dutelimbere	078580247	
7	~~NSABIMANA JOHN~~		0787155762	
8	HAKINDIMANA [illegible]	Umutekano	0788840563	
9	NGOMA OLIVIER	Intore Sun	0788465133	
10	IRAGUHA RUGIRA J Claude		0788522058	
11	HARAGIRIMANA Emmanuel		0788821419	
12	NSENGIYUMVA		0788219112	
13	HAMUGISHA		0790577426	
14	HABIMANA Jean Claude	GASAVE	0790074531	
15	Hakuzimana Nativa	GASHARU	0782209188	
16	KAYITARE J. Paul	GASHARU	0782271580	
17	UMUTONI Christina	GASHARU	0788843940	

UMURENGE WA GISOZI

AKAGARI KA MUSEZERO

UMUDUGUDU WA GASHARU

ABITABIRIYE UMUGANDA WO KU WA 4/6/ 2022

N	AMAZINA YOMBI	ISIBO ABARIZWAMO	TELEFONE	UMUKONO
1	Kampire Odette	Ikizere	07848546[illegible]	
2	KYAKUTTA JENNIFER	ICYEREKEZO	0788481669	
3	MBARUSHIMANA INNOCENT	Gasharu	0785196[illegible]1	
4	Kundusenge Fatma	Gasharu	078[illegible]	
5	Mukandori Vestine	INTAMBWE INKABIRI	078[illegible]38	
6	Byiringiro Obed Franck		0783986566	
7	Habineza Theogene		0—	
8	Ntakarutimana		078537029	
9	Mukamaheri Laetitia	Ingeri	0787528146	
10	Mbaru Chinemana	Ingeri	078520845	
11	Kibarka Andre	12 Abeba	078342[illegible]	
12	NIBISHAKA ISAAC		078608494	
13	Fabien NSHIMIYIMANA		0788737544	
14	Twizerimana Jed'Amour	Umurava A1	078862150	

UMURENGE WA GISOZI

AKAGARI KA MUSEZERO

UMUDUGUDU WA GASHARU

ABITABIRIYE UMUGANDA WO KU WA 4/6/ 2022

N	AMAZINA YOMBI	ISIBO ABARIZWAMO	TELEFONE	UMUKONO
1.	Gashumba Faustin	Ingangurarugo	0783379374	[signature]
2.	Kagabo Thadee	Intambwe	0780378785	[signature]
3.	Mihani Paulin	Abiterwa	0783034104	[signature]
4	Uwimaniemye jacqueline	ubumwe	0781276399	[signature]
5	Twagirayezu Damascene	ubumwe	0785715946	[signature]
6.	Mukashyaka Donatha	ubumwe	0788849551	[signature]
7	Karangwa	ubumwe	0785185216	[signature]
8.	Marigosha	ubumwe	0729147922	[signature]
9	Kavubi [illegible]	ubumwe	0788374306	[signature]
10	Mutesiadashya EVA	INDATSINDA	0785581565	[signature]
11	BYIRINGIRO Eliso	ubumwe	0788840310	[signature]
12	Niyikizimana Stefe	ubumwe	078269[illegible]	[signature]
13	MAKUZA		0787175749	[signature]
14	IRINGIRA clement	[illegible]	0738[illegible]25	[signature]
15	SINDIKUBWABO Jephte	Ubumwe	07838[illegible]	[signature]
16	Baziruwiha Kanazi		078869036[illegible]	[signature]
17	Mukashyaka editte	Ubumwe	0788507791	[signature]
18	[illegible]	Indatsinda	078295[illegible]	[signature]

UMURENGE WA GISOZI

AKAGARI KA MUSEZERO

UMUDUGUDU WA GASHARU

ABITABIRIYE UMUGANDA WO KU WA 4/6/ 2022

N°	AMAZINA YOMBI	ISIBO ABARIZWAMO	TELEFONE	UMUKONO
01	NGENDAHIMANA Emmanuel	Amahoro	0788578671	
02	MUKANDANGA Espérance	Amahoro	078878[illegible]	
03.	GAKIMAKA Charlotte	KAZIRE	0784538874	
04	Byukusenge J.D'Amour	=	0788984400	
05	Hodukunda J claude	-	078867818	
06	ABlahum		078866[illegible]	
7.	Uwambaye Frederic	-	0788849540	
8	HAKIZIMANA OSCAR	IRIBONI	0788916413	
9.	Uwamaliya Agatha	ABISHYIRAHAMWE	0783157949	
10.	Mukiza Aimable	ABISHYIRAHAMWE	0782[illegible]342	
11	NSHIMIYIMANA Emmanuel	ABAHIZI [illegible]	0789370869	
12	mukakamari chantal	Umurava	0789[illegible]5[illegible]	
13	uwingabire clarisse	Umurava	0788[illegible]638	
14	nyirabashumba	umurava	078202[illegible]03	
15	BALGIZA JUSTIN	TUZAMURANE	0789181030	
16	NIKUZWIMANA Pascal	UMURAVA	078822[illegible]	
17	[illegible]	umurava	07885896[illegible]	
18	mukankusi [illegible]	IKIZERE	0784546215	
19	Nkurunziza Alphonsi	umurikabasi	0791890100	

UMURENGE WA GISOZI

AKAGARI KA MUSEZERO

UMUDUGUDU WA GASHARU

ABITABIRIYE UMUGANDA WO KU WA 4/6/ 2022

N	AMAZINA YOMBI	ISIBO ABARIZWAMO	TELEFONE	UMUKONO
	Nyiraneza Donata	Intambwe?	0789441184	[illegible]
	Mukamana Jean Claude	intambwe?	0780539913	[illegible]
	Nyirahabaye Jeannette	intambwe?	0780019760	[illegible]
	Akimana	Imena	078[illegible]	[illegible]
	[illegible]	umutikano	0739596911	[illegible]
	HAKIZIMANA Louis		0789009700	[illegible]
	BAMPORINEZA J. Baptiste		0783061330	[illegible]
	Ndikubwayo Mediatrice		0721575500	[illegible]
	Mukeshimana epiphanie		0783480477	[illegible]
	Uwayezu Beranadeta		0782706532	[illegible]
	Uwimpabiye Liberatha	UMURAVA	078533[illegible]	[illegible]
	Mukabera Fromina	Umurava	073	[illegible]
	Muhoracyeye	Umurava		[illegible]
	Nsanzinfura Beatrice	Umurava	0786543105	X
	NDAYISABA Eric		0785682173	[illegible]
	Ntamanayo Simon Pierre	Ingenzi	0782 [illegible]	[illegible]
	SABUHORO ERNEST	Indashyikirwa	0784533 C6	[illegible]
	SINDIKUBWABO Alexis	Ingenzi	0785497279	[illegible]
	FISI	Ubumwe	0781676733	[illegible]
	Ndayisaba Jean	Intwari	078[illegible]306	[illegible]
	NGABO Ali	Umurava	0788631901	[illegible]
	Ndayizeramana Emmanuel	Umurava	078772863	[illegible]

PROJECT OF IMPROVEMENT OF WATER SUPPLY SERVICES IN NORTH-CENTRAL KIGALI.

STAKEHOLDER CONSULTATION MEETING / ATTENDANCE LIST.

DATE: 04/06/2022

No	Names	~~Cell~~ Village	~~Village~~ Cell	Telephone	Signature
16	SEBUTAMA Elias	Nyakabungo	Kagugu	0787521783	
17	BIMENYIMANA Emmanuel	"	"	—	
18	NGABONZIZA Adéodatus	"	"	0788444500	
19	MUKAMANA Béatha	"	"	0780731792	
20	MUKARUTAMU Marcjane	"	"	0782509397	
21	UMUBEZA Esidia	Nyakabungo	KAGUGU	078989445	
22	Ntusanganyi Jean	Nyakabungo		0782164292	
23	BITEGEKIMANA Jean de Dieu	= " =	KAGUGU	0788847955	
24	Mukandayisenga Julienne	Nyakabungo	Kagugu	0789328150	
25	Kabanda Aline	Nyakabungo	Kagugu	0781312736	
26	UMUGEZA Jeannette	NYAKABUNGO	KAGUGU	078092607	
27	NFITUMUKIZA JEAN PIERRE	NYAKABUNGO	KAGUGU	0785735530	
28	Twagirayezu Theoneste	"	Kagugu	0788306237	
29	J. Marie	"		0785776166	

PROJECT OF IMPROVEMENT OF WATER SUPPLY SERVICES IN NORTH-CENTRAL KIGALI.

STAKEHOLDER CONSULTATION MEETING / ATTENDANCE LIST.

DATE:..04/06/2022.....

No	Names	Cell Village	Village - Cell	Telephone	Signature
30	Kantengwa Xaverine	Nyakabungo	Kagugu	0788755952	
31	Ndanzubukire Ali	Nyakabungo	Kagugu	0788560212	
32	Kotikumuremyi D. J. D	Nyakabungo	Kagugu	0788570300	
33	Ngobo Olivier	"	"	0783295415	
34	Rutanyisire laurent	Nyakabungo	Kagugu	0788647780	
35	Gatabazi Paskal	Nyakabungo	Kagugu	- "	
36	NYAMUREMYE Théogène	Nyakabungo	Kagugu	0788682152	
37	Murwatabiyeri Fidele	Nyakabungo	KAGUGU	078821732	
38	Nsengumuremyi Felicien	Nyakabungo	KAGUGU	0786660493	
39	UWIMBEYIMANA Kasimu	Nyakabungo	Kagugu	0799593615	

PROJECT OF IMPROVEMENT OF WATER SUPPLY SERVICES IN NORTH-CENTRAL KIGALI.

STAKEHOLDER CONSULTATION MEETING / ATTENDANCE LIST.

DATE: 04/06/2022

No	Names	Cell	Village	Telephone	Signature
1	RURAHA GILBERT	KAGUGU	NYAKABUNGO	0788518405	[signature]
2	NTIRENGANYA j. christostome	KAGUGU	NYAKABUNGO	0788447981	[signature]
3	Rutayisire Abdoul	KAGUGU	Nyakabungo	0788615776	[signature]
4.	Nyirakamana Henriette	KAGUGU	Nyakabungo	0787384575	[signature]
5	NDHIMIYIMANA Alphonse	Kagugu	Nyakabungo	0788574744	[signature]
6	MUZONDOGOMWA Angelique	kagugu	Nyakabungo	0785098739	[signature]
7	Mukakigeli josephine	Kagugu	Nyakabungo	0788601626	[signature]
8	NSENGANUNGU Jean Pierre	KAGUGU	NYAKABUNGO	078619835	[signature]
9	NSENGIYUMVA Emmanuel	KAGUGU	NYAKABUNGO	0788876926	[signature]
10	Uwingeyimana Libérathe	Kagugu	Nyakabungo	078827538	[signature]
11	Mukampore Fiona	Kagugu	Nyakabungo	07	[signature]
12	Mukandoli Consolée	Kagugu	Nyakabungo	0784252656	[signature]
13/14	Uwangingira Jacky	Kagugu	Nyakabungo	0784896763	[signature]
15	Jankurije Virginia	Kagugu	Nyakabungo	0784881278	[signature]

PROJECT OF IMPROVEMENT OF WATER SUPPLY SERVICES IN NORTH-CENTRAL KIGALI.

STAKEHOLDER CONSULTATION MEETING / ATTENDANCE LIST.

DATE: 04/06/2022

No	Names	Cell	Village	Telephone	Signature
	MUSABYIMANA Claudine	NYABISINDU	NYABISINDU	[illegible]	
	NSIBONZIMA Flugence	NYABISINDU	NYABISINDU	0785218518	
	BIZIMANA Athanase	Nyabisindu	Nyabisindu	0783772255	
	Nsabimana Jean Claude	//	//	0783[illegible]	
	Munyantamate Emmanuel	//	//	0788884550	
	Ngendahimana Sharise	//	//	0788236636	
	Mumpangate Innocent	//	//	0789453322	
	Korugwa Athanaris	//	//	078893628	
	Uwimana Emmanuel	//	//	0788867929	

PROJECT OF IMPROVEMENT OF WATER SUPPLY SERVICES IN NORTH-CENTRAL KIGALI.

STAKEHOLDER CONSULTATION MEETING / ATTENDANCE LIST.

DATE: 04/06/2022

No	Names	Cell	Village	Telephone	Signature
1	Ntirenvita Muze Gilbert	Nyabisindu	Nyabisindu	0782276045	
2	NIYITEGEKA Jonas	Nyabisindu	Nyabisindu	0783511304	
3	MUKAMPUNGA Jeannette	Nyabisindu	Nyabisindu	0784657944	
4	NZIYUMVIRAMASUMBUKO	NYABISINDU	NYABISINDU	0780618982	
5	Nzeyimana Telesphore	Nyabisindu	Nyabisindu	078805727	
6	UWIZEYIMANA MNA	murijani		0786593621	
7	Mukangatsinzi Julienne	Nyabisindu	Nyabisindu	0783856134	
8	Mukandayisenga Verenacie	Nyabisindu	Nyabisindu	0786682890	
9	Mukamana Claudine	Nyabisindu	Nyabisindu	0781202240	
10	Kubwimana Epimène	Nyabisindu	Nyabisindu	0788611136	
11	NDERERIMANA Naice	Nyabisindu	Nyabisindu	0789517852	

PROJECT OF IMPROVEMENT OF WATER SUPPLY SERVICES IN NORTH-CENTRAL KIGALI.

STAKEHOLDER CONSULTATION MEETING / ATTENDANCE LIST.

DATE: 09/06/2022

No	Names	Cell	Village	Telephone	Signature
	UWAGAZE Thomas	NYABISINDU	Nyabisindu	0783165514	
	MUKARUTA MU Triphine	NYABISINDU	Marembo I	0784313491	
	CYIZA Jean	NYABISINDU	Marembo I	0783959157	
	MUREKATETE M. Jeanne	''	''	0780659054	
	MUTUYIMANA Irene	''	''	0788665256	
	MUKARURANGWA Colette	''	''	0782215449	
	Umutoni clementine	''	''	0780668113	
	UWAMAHORO Octave	Nyabisindu	''	0788233357	
	MUKAMPARAGE Providence	''	''	0789400744	
	Mugorewera Josiane	''	Marembo I	0783500281	
	Uwamariya Dative	''	Marembo I	0784837707	
	NZAMUYUKUZE Marcel	''	''	0782826731	
	MUKANGENZI Vestin	''	''	0781522602	
	DUSABE Berancine	Nyabisindu	''	0787163060	

PROJECT OF IMPROVEMENT OF WATER SUPPLY SERVICES IN NORTH-CENTRAL KIGALI.

STAKEHOLDER CONSULTATION MEETING / ATTENDANCE LIST.

DATE: 24.10.2022

No	Names	Cell	Village	Telephone	Signature
	MUTABAZIMANA Eugen				
1	HAKIZIMANA André	MYABISINDU	NYABISINDU	0784251384	
2	UWIRINGIYIMANA Espérance	"	"	0788630966	
	NYABYENDA H	"	"	0786458817	
3	NYABYENDA ARON	"	"	0790126900	
4	NYIRANTEZIMANA SHARIRATI	"	"	0783427008	
5	MUDAHERANEMA Joyeuse		"	0788279870	
6	SUBUGA Marc	NYABISINDU	NYABISINDU	0785718537	
7	NDIKUBWIMANA Jean Claude	"	Mayembo I	0781499381	
8	BIMENYIMANA Joseph	"	"	0783111807	
9	MANIRAKORA Damascène	"	"	0788440458	
10	HABIMANA Alexis	"	"	0781959775	
11	NIYIBIZIHACI Jean	"	"	0788434410	
12	RUBASIMWA IMV		Mayembo I	0788701026	
13	Nyirishema Benaventure	"	"	0785305908	

Annex 5: Interview guiding questionnaire

Ibibazo bizayobora ikiganiro hamwe n'abaturage ku mushinga wo kongera ubushobozi kw'itangwa ry'amazi muri gice cy' Amajyaruguru yo hagati y'Umujyi wa Kigali/ Interview guide with local population / Project of Improvement of water Supply services in North Central Kigali

1. Mwigeze mubwirwa ko hari umushinga wo kongerera ubushobozi kw'itangwa ry'amazi meza muri aka gace mutuyemo? *Have you ever been told about the present project improvement of water supply services in this area?*
2. Niba mwarawumenye n'ubu mukaba muwusobanuriwe muwishimiye mute? *How do you appreciate this project?*
3. Mwumva uruhare rwanyu rwaba uruhe kugira ngo uyu mushinga uzagere ku ntego zizagerweho? *What do you think can be your role and contribution to the sustainability of the present project?*
4. Mubona uyu mushinga wo kubagezaho amazi meza hari icyo uzahindura ku mibereho yanyu ya buri munsi/*Do you think that this project will improve your living conditions?*
5. Niba ari yego mu buhe buryo? *If yes, kindly explain.*
6. Ni iki kindi mubona umushinga uzahindura ku imibereho yanyu bitari ukubagezaho amazi meza gusa? /*What else do you think the project will contribute to your normal living conditions except the accessibility to clean water?*
7. Hamwe na hamwe aho umushinga uzakorera hari ibizangirika. Mubona ari iki cyakorwa ngo umushinga uzagende neza? *During the project implementation, there will be some negative impacts on land and vegetation. What do you think can be done to avoid those negative impacts?*
8. Hari ingaruka ku bidukikije mwaba muzi ziterwa no gushyira mu bikorwa imishinga imwe n'imwe? Niba ari yego izihe? *Do you have any information about the environmental impacts caused by the implementation of some projects? If yes, what are they?* Ni izihe ngaruka ku bidukikije mubona zizatezwa n'uyu mushinga? *What do you think are the main environmental impacts of the present project implementation?*
9. Ingaruka mwavuze haruguru mubona zakwirindwa zite? *What are your suggestions related to mitigation measures to those identified impacts?*
10. Ni iki mwumva mwasaba kugira ngo uyu mushinga uzabagirire akamaro muri rusange kandi uzabungabunge ibidukikije? *What can you suggest that this project may be useful and successfully implemented while conserving the environment?*

Murakoze ku kiganiro tugiranye/thank you

END

Japan International CooperationAgency

FINAL REPORT

ABBREVIATED RESETTLEMENT ACTION PLAN FOR PROJECT OF IMPROVEMENT OF WATER SUPPLY SERVICES IN NORTH-CENTRAL KIGALI, REPUBLIC OF RWANDA

Prepared by:

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July 2022

EXECUTIVE SUMMARY

Project background

Water and Sanitation Corporation (WASAC Ltd) with the support from Government of Japan through Japan International Cooperation Agency (JICA) have achieved a series of actions in water supply sector. This includes the formulation of the Kigali Water Supply Master Plan (KWSMP) for efficient and effective facility development from a long-term perspective, the renewal of water transmission pipelines for the purpose of strengthening transmission capacity from the city's largest Nzove WTP to the Ntora Reservoir and technical cooperation for non-revenue water (NRW) reduction, as well as.

One of the projects under KWSMP is the development and renewal of water transmission and distribution facilities in the section between the Ntora Reservoir and the Remera Golf 8 Reservoir. NRW reduction measurement in the entire city of Kigali is planned under a long-term investment plan with 4 phases during the next 10 years and the project contributes to the first phase of NRW reduction and will be implemented in Kigali city, district of Gasabo, Gisozi Sector (Musezero and Ruhango cells); in Kinyinya Sector (Gacuriro and Kagugu Cells) and in Remera Sector (Nyarutarama and Nyabisindu cells.

Objectives of the A-RAP

The objective of the A-RAP is to ensure immediate and fair compensation or other supports to Project Affected Persons (PAPs) for their affected properties at the project sites prior to project implementation. The present report principally describes the proposed project components/activities and associated resettlement impacts. The A-RAP also provides the legal and regulatory framework for assets valuation, eligibility, compensation framework, implementation, and monitoring arrangement.

Approach and methodology of the study

To achieve the objectives, consultant followed procedures stipulated in JICA guidelines for environmental and social consideration and national expropriation and evaluations laws. The study adopted the following approach: (i) preliminary assessment and review of preliminary design of the projects, (ii) review of secondary data on baseline information (iii) review of policies and regulations, (iv) meetings and consultations with stakeholders, (v) field surveys at the project sites including socio-economic baseline data and asset inventory of the affected personnel.

Project location and description

The proposed project will be implemented in Kigali City, Gasabo district, Gisozi sector (Musezero and Ruhango cells); and Kinyinya sector (Gacuriro and Kagugu cells). The project also has a section of Nyarutarama – Golf 8 Reservoir located in Remera Sector (Nyarutarama and Nyabisindu cells). The project consists at construction of grounded water reservoirs (Kagugu and Batsinda sites) and elevated tanks at Nyarutarama and Kibagabaga sites as well as constructions of 5 pressures breaking chambers. It also includes construction of water transmission and distribution pipelines of around 57 km (with dimension varying between ND 160-300); modification of the existing transmission main from Ntora reservoir (ND 400 and ND 500) and the installation of flowmeters, level gauges and monitoring system.

Project Resettlement Impacts

The proposed project is not expected to involve massive land acquisition as new pipeline will be installed in road reserve where existing pipeline are installed. Further, three of four sites targeted for reservoir constructions are either owned by public institutions or WASAC. So far, only one private plot will be affected at Batsinda reservoir. The identified personnel to be affected by project activities is in Gasabo district, Kinyinya Sector, Kagugu Cell, Nyakabungo Village in UPI 1/02/10/03/11112. The land to be affected is currently used as agricultural despite being zoned for residential. The project will be mostly implemented along the walkways and in the buffer of the existing roads (both tarmac and non-tarmac depending of the area). No access roads shall be constructed and there will be no construction of camp site as most of the project workers will return to their home after work. Project facilities will be constructed at the existing nearby water tanks where land belongs to WASAC, project developer. Where not applicable land lease agreement was discussed and concluded between landowner and WASAC.

A-RAP budget

The proposed project was designed in a way that avoids or minimizes physical and economic resettlement impacts. The water pipelines are located along the walkways and in the buffer of the existing roads (both tarmac and non-tarmac depending on the area) and other project facilities will be constructed at the existing nearby water tanks where the required land is owned by WASAC, project developer. Only one location at Batsinda was identified to be affected. There is no house or other structure within the plot except some crops and different tree species. The affected land will be lost permanently because It will be used for grounded water tank. According to the current market value, the estimated valued cost for compensation of the affected person is **67,966,937** Frw(**65,352 US$).** This budget includes land value and the estimated cost value of crops and trees and will be born from government of Rwanda funds via WASAC Ltd. The monitoring fees are estimated at **770,000 Frw(740US$).**

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ACRONYMS

A-RAP	: Abbreviated Resettlement Action Plan
BESST	: Bureau for Engineering and Environmental Studies
DDP	: District Development Plan
EIA	: **Environmental Impact Assessment**
FRW	: Franc Rwandais/Rwandan Franc
GDP	: Gross Domestic Product
GoR	: Government of Rwanda
JICA	: Japan International Cooperation Agency
M&E	: Monitoring and Evaluation
MoE	: Ministry of Environment
NGO	: Non-Governmental Organization
OP	: Operational Policy
PAPs	: Project Affected Parties/People
REMA	: Rwanda Environment Management Authority
RLMUA	: Rwanda Land management and Use Authority
RPF	: Resettlement Policy Framework
ToRs	: Terms of Reference
UPI	: Unique Personnel Identification
USD	: United States Dollars
WB	: World Bank
WASAC	: Water and Sanitation Corporation

DEFINITIONS OF TERMS

- **Census** is a data collection technique of completing enumeration of Project Affected Householdsand their assets through household questionnaire.
- **Compensation:** means payment in cash or in kind to replace losses of land, housing, income, and other assets caused by a project.
- **Cut-off date:** This refers to the date prior to which the project affected family was in possession ofthe immovable or movable property within the affected zone.
- **Entitlement:** is defined as the right of project affected persons (PAPs) to receive various types of compensation, relocation assistance, and support for income restoration in accordance with the policy provisions.
- **Household** includes a person, his' or her spouse, minor sons, unmarried daughters, minor brothers, unmarried sisters, father, mother and other relatives residing with him or her and dependent on him or her for their livelihood; and includes "nuclear family" consisting of a person, his or her spouse and minor children.
- "**Involuntary Displacement**" means the involuntary taking of land resulting in direct or indirect economic and social impacts caused by:
    - loss of benefits from use of such land;
    - relocation or loss of shelter;
    - loss of assets or access to assets; or
    - loss of income sources or means of livelihood, whether or not the project affectedperson has moved to another location
- **Land acquisition"** means the taking of or alienation of land, buildings or other assets thereon the land,
- **Loss of income**: In this A-RAP, loss of income is defined as the future benefit that was going to begained if the project was not implemented.
- Non-titleholder: Affected persons/families with no legal title to the land, structures and other assets adversely affected by the project. Non-titleholders include encroachers, squatters, etc.
- **Project affected persons (PAPs)** means persons who, for reasons of the involuntary taking or voluntary contribution of their land and other assets under the project, result in direct economic andor social adverse impacts, regardless of whether or not Project affected persons physically relocate. These people may have their:
    - Standard of living adversely affected, whether or not the Project Affected Person must move to another location;
    - Right, title, interest in any house, land (including premises, agricultural and grazing land) or any other fixed or movable asset acquired or possessed, temporarily or permanently, adversely affected;
    - Business, occupation, work or place of residence or habitat adversely affected.
- **Resettlement and Compensation Plan**, also known as a "Resettlement Action Plan (A-RAP)" or "Resettlement Plan" - is a resettlement instrument (document) to be prepared when subproject locations are identified. In such cases, land acquisition leads to physical displacement of persons, and/or loss of shelter, and /or loss of livelihoods and/or loss, denial or restriction of access to economic resources. When the projects affects lees than 200 households or the has low impacts, anAbbreviated Resettlement Action(A-RAP) may be appropriate;
- **Resettlement Assistance** means the measures to ensure that project affected persons who may require to be physically relocated are provided with assistance such as moving allowances, residential housing or rentals whichever is feasible and as required, for ease of resettlement during relocation,
- **Replacement cost/value**: Replacement cost is the cost of purchasing comparable assets elsewhere by the affected person in lieu of the acquired land, buildings, structures, and other immovable assets, etc.

- **Socio-economic survey**: is carried out in order to prepare profile of PAPs and to prepare for Resettlement Action Plan. The survey result is used (i) to assess incomes, identify productive activities, and plan for income restoration, (ii) to develop relocation options where applicable, and (iii) to develop social preparation phase for vulnerable groups.
- **Titleholder**: A PAP who has legal title to land, structures and other assets in the affected zone and theland has a unique personnel Identification;
- "**Vulnerable Groups**" refers to: a. Widows, the disabled, marginalized groups, b. Incapacitated households – those no one fit to work, Child- headed households and street children, old people,

1. INTRODUCTION

1.1. Project background

Government of Rwanda has made sustainable water supply one of the priorities of the National Development Agenda and is establishing supportive policies and legislation. The government also acknowledges that access to safe and clean water plays a vital role in social and economic development, poverty reduction and public health. The main objective of water supply and sanitation policy is to ensure safe, reliable, and affordable water supply services for all 100% by 2024 thereby ensuring universal and equitable access to safe and affordable drinking water for the people while achieving NST-1 along with Sustainable Development Goals (SDGs). In this regards, the Government of Rwanda with the support from Government of Japan through Japan International Cooperation Agency (JICA) have achieved a series of actions in water supply sectors which include the renewal of water transmission pipelines for the purpose of strengthening transmission capacity from the city's largest Nzove WTP to the Ntora Reservoir, technical cooperation for non-revenue water (NRW) reduction, as well as the formulation of the Kigali Water Supply Master Plan (KWSMP) for efficient and effective facility development from a long-term perspective.

One of the priority projects identified under KWSMP selected the development and renewal of water transmission and distribution facilities in the section between the Ntora Reservoir and the Remera Golf 8 Reservoir. NRW reduction measurement in the entire city of Kigali is planned under a long-term investment plan with 4 phases during the next 10 years and the present project contributes to the first phase of NRW reduction and will be implemented in Kigali city, district of Gasabo, Gisozi, Kinyinya and in Remera Sectors. The implementation of the present project will be conducted via accomplishment of a series of activities to be done which include but not limited to the construction of water storages and water transmission and distribution facilities such as water reservoirs and water tanks, water pipelines and equipment required for block systems.

Four (4) water reservoirs are planned to be constructed or extended during this project at (i) Kagugu (Elevated Tank (500 $m^{3)}$ (ii) Batsinda: (Ground Reservoir, 1,000 m^3) (iii) Gacuriro: (Elevated Tank, 500 $m^{3)}$ and at (iv) Nyarutarama: (Elevated Tank, 200 m^3).

1.2. Scope of the A-RAP

The aim of the A-RAP report is to develop an action plan that ensures that the PAP livelihoods and standards of living are improved or at least restored, in real terms, to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher. The scope ofwork undertaken during the RAP preparation included public consultation, PAPs identification, and assets inventory, establishment of legal and regulatory framework for assets valuation and compensation, monitoring, and grievance redress mechanism. The provisional assets inventory and estimated cost was included in the A-RAP but shall be updated by independent valuer upon the completion of final design studies and compensation made prior construction.

1.3. Methodology

The preparation of this A-RAP followed the combination of different steps including desk study, field surveys and involved the consultations with local resident and PAP identification. The desk study involved review of previous study; field surveys and measurement of land and inventory of crops which are likely to be affected. Discussions withPAP and key stakeholders including district administration local authorities were also other tools used along the preparation of this A-RAP.

1.4. Project description

1.4.1. Project Location

Administratively, the proposed project is in Kigali City in Gasabo, Gisozi Sector (Musezero and Ruhango cells) and Kinyinya Sector (Gacuriro and Kagugu Cells). The project also has a section of Nyarutarama – Golf 8 Reservoir located in Remera Sector (Nyarutarama and Nyabisindu cells). The present A-RAP was developed for the site for construction of Batsinda ground water tank located in Gasabo district, Kinyinya Sector, Kagugu Cell, Nyakabungo Village in UPI 1/02/10/03/11112.

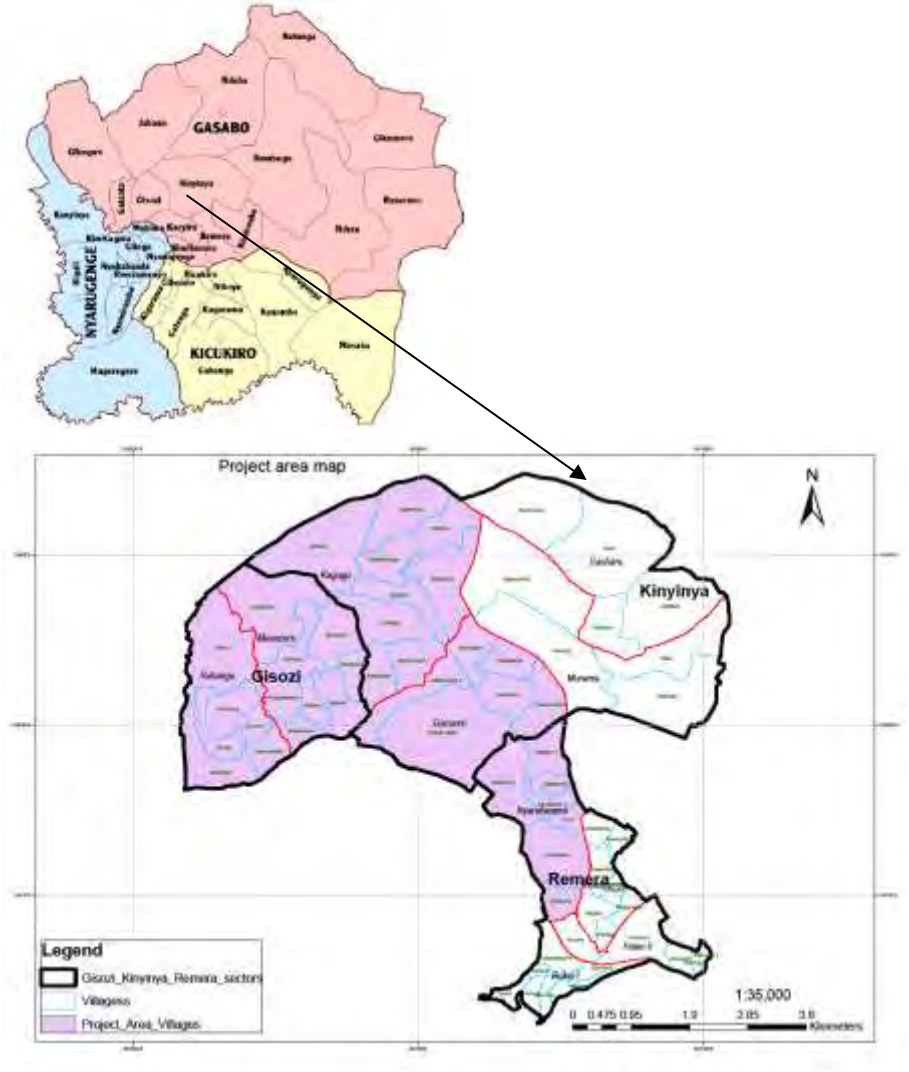


Figure 1: Administrative location of project area
Source: BESST Ltd, 2022

1.4.2. Project description

The proposed project will consist at construction of 5 different water reservoirs and elevated tanks as described in the table below and at the construction of 5 pressures breaking chambers, the construction of water transmission and distribution pipelines of approximately 57 km (dimension varying between ND 160-300); the modification of the existing transmission main from Ntora reservoir (ND 400 and ND 500) and the installation of flow meters, level gauges and monitoring system. There are no access roads that shall be constructed as most efforts have been made to use the buffer zones and walkways for transmission pipes.

Table 1: Summary of the project description

Code	Name	Type and Capacity	Description
N2	Kagugu	Elevated Tank, 500m^3	The elevated tank is to supply water to the entire Kagugu hill including the Kadobogo village. The selected land is located along the main road KG14 opposite the church (Catholic Church_ Kagugu Parish).
N3	Gacuriro	Elevated Tank, 500m^3	The elevated tank is to supply water to the top of Gacuriro hill where the water pressure is not enough by the existing reservoir, and currently supplied water by the by-pass from transmission pipeline.
N4	Batsinda	Ground Reservoir, 1,000m^3	The reservoir is to supply water to the new development areas at the Batsinda commercial area and surrounding residential areas with high development (R3). The location is at the top of the village named Muhororo. The land is located near the church (Catholic Church Centrale Batsinda).
N5	Nyarutarama-South	Elevated Tank, 200m^3	The elevated tank is to supply water to the top of the southern part of Nyarutarama sector where the water pressure is not enough by the existing reservoir, and currently supplied water by the by-pass from transmission pipeline.

1.4.3. Project activities

Different activities will be done throughout the project implementation and among them include Construction works of elevated water tanks and water reservoirs, replacement of old water transmission and distribution pipes with new pipes and the installation of flow meter as well as the installation of level gauges systems. The construction of new water reservoirs and elevated tanks will be done on some land fully owned by the government of Rwanda and these are Gacuriro and Nyarutarama sites, while others will be done at the land where a full guarantee of land use was concluded between WASAC Ltd/ and landowner (Kagugu sites).

The site for Batsinda is privately owned by MPAGAZEHE Augustin a local resident. The water pipes and other project facilities such as pressure breaking chambers, flow meters and level gauges will be constructed and installed within the walkways of the existing buffer zone of the roads. The total length of the pipes both distribution and transmission to be installed is estimated at 57 km. There are no other planned activities that require land such as construction of access roads, construction of camp site for the project (people will return to their respective resident areas after works) or the necessity of land for storage of construction materials as these will be stored at the identified land at Ntora Reservoirs owned by WASAC Ltd. This Abbreviated Resettlement Action Plan (A-RAP) report was prepared as one of the components of the requirements before project activities as it provides the necessary information on project land requirements and involuntary resettlement implication. It includes socio-economic status the affected PAP, an inventory of assets that are likely to be affected and proposes mitigation and compensation measures. This was only developed at Batsinda plot in Kagugu where a grounded water reservoir of 1,000 m^3 will be constructed.

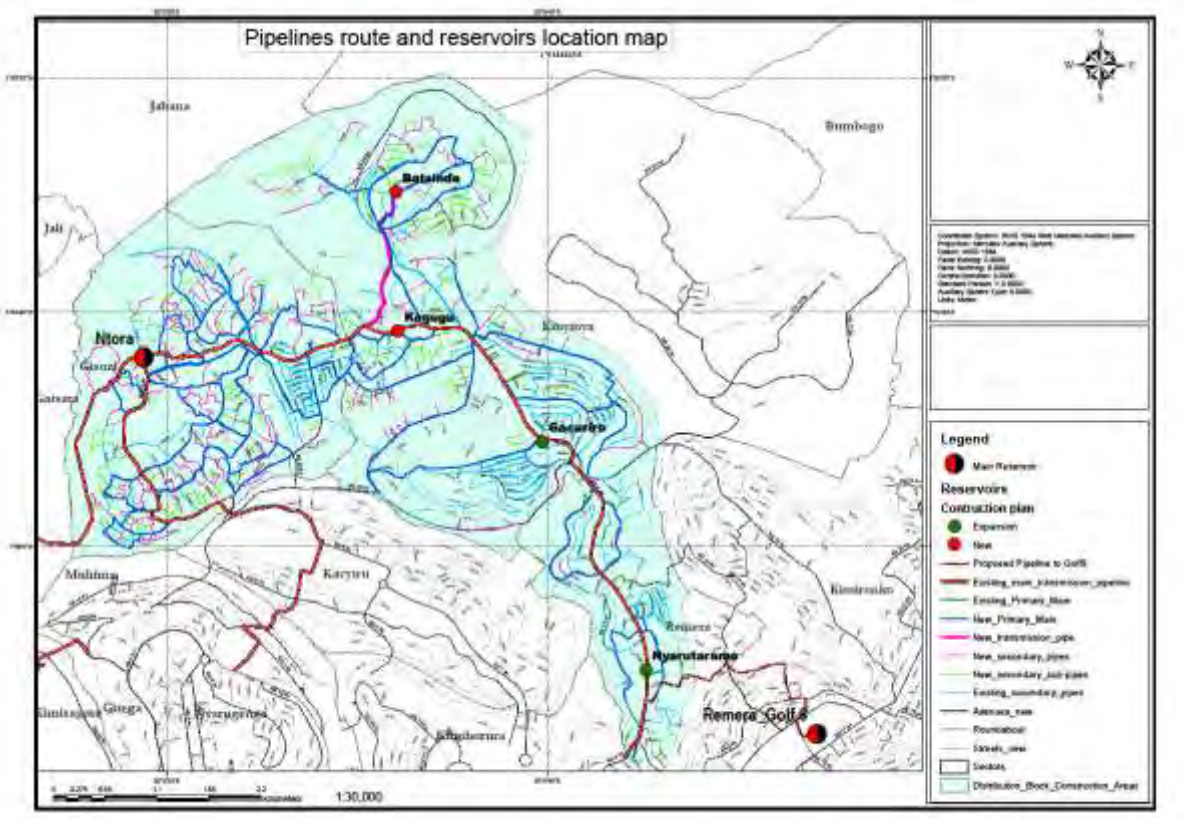


Figure 2: Proposed principal pipeline route and project's reservoir locations
Source: Preliminary design study, 2022

1.4.4. Project land requirement

As described in the previous paragraphs, installation of all principal and secondary water pipes for the project will follow the existing roads both tarmac and earth roads. The pipes will be located under the walkways and in the buffer zones of the roads and hence no land will be permanently used for such pipe installation. The required land not owned by project developer will be used during the project works in form of easement and returns to the owner after project execution. Compensation of land and affected properties will be made at Batsinda where land will be permanently used. The table below summarized the required land for the project

Table 2: Total land to be affected by the proposed project

Sector	Cell	Village	Reservoir/ tank name	Land required (m2)	Ownership
Kinyinya	Kagugu	Nyakabungo	Batsinda	1000	Privately owned by MPAGAZEHE Augustin
	Kagugu	Kabuhunde	Kagugu	450	Owned by RSSB/ Lease agreement available
	Gacuriro	Estate 2020	Gacuriro	750	Fully owned by GoR
Remera	Nyarutarama	Gishushu	Nyarutarama South	750	Fully owned by GoR

Source: Field survey, BESST Ltd, 2022

The following Plate illustrates the sites targeted for reservoirs construction

1.5. Project Schedule

The project schedule includes preliminary works, project approvals and construction work that will be undertaken both in Rwanda and in Japan. The project schedule is provided below:

Table 3: Project construction schedule

Item	Year	2022						2023												2024												2025												2026					
	Month	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6
	Count				3	2	1	4	1	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
Draft Outline Design																																																
Cabinet Meeting (Japan)	-																																															
Exchange of Note (E/N, GtoG)	-																																														
Grant Agreement (G/A, Exe. Agency)	-																																														
Consultant Appoval and Concurrence by JICA	2M																																														
Detailed Designed (D/D)	5M																																														
Tender Assistant (Bid/Contract/Concurrence)	3M																																														
Construction	24M																																														
Preparation and Procurement	3M																																														
Reservoirs and Elevated Tanks	12M																																														
Transmission and Distribution Pipelines	21M																																														
Flow Meter/Monitoring System	3+6M																																														
Replacement of Customer Connections	24M																																														
Soft Components(Management Guidance/Training)	6M																																														

Source: Preliminary design, JST, 2022

2. LEGAL AND INSTITUTIONAL FRAMEWORK

2.1. Introduction

This chapter describes policies, strategies, legal instruments, and institutional framework applicable to the proposed project. This project will not affect structures however; land, crops and trees will be damaged. Much of all trees to be destroyed are owned by the government as are located within road buffers and few are owned by individual. The accessibility to water will enable people to be connected to the water supply system and be able to transform their socio-economic wellbeing. Concerning the ARAP implementation especially inventory and asset valuation, an independent the contractor had the responsibility of conducting inventory and asset valuation and WASAC Ltd via its ordinary budget from MINEFOFIN has the responsibility to compensate the identified PAP.

2.2. National land related regulations

- ✓ **National land policy**

The National Land Policy of Rwanda seeks to establish a land tenure system that guarantees tenure security for all Rwandans and give guidance to the necessary land reforms with a view to good management and rational use of national land resources.
The policy seeks to ensure this through the following objectives:

- To promote good allocation of land to enhance rational use of land resources according to their capacity
- To focus on land management towards more viable and sustainable production by choosing reliable and time-tested methods of land development
- To put in place mechanisms which guarantee land tenure security to land users for the promotion of investments in land
- To establish mechanisms which facilitate giving land its productive value to promote the country's socio-economic development
- To develop actions that protects land resources from the various effects of land degradation.
- To promote the involvement and sensitization of the public at all levels to infuse land use practices that are favorable to environmental protection and good land management

- ✓ **Law N° 27/2021 of 10/06/2021 governing land in Rwanda, 2021**

The law governing land in Rwanda determines modalities of acquisition, registration, allocation, possession, transfer, management, and use of land in Rwanda. The law defines expropriation as an action based on the powers of the State, public institutions, and decentralized entities with legal personality to remove a person from his or her property due to public interest upon prior payment of fair compensation;

Article 22 related to Consent to transfer land rights says that: "A transfer of land rights, before it is carried out, is consented by all persons registered on the land title. However, the transfer of land rights jointly detained by spouses is approved by both, even if one of the spouses is not registered on the land title. A person who has been deprived of legal capacity by a competent court or a minor are represented in accordance with relevant laws".

Article 31: States that lands in public domain consist of all lands intended to be used by the public or all the lands reserved for organs of State services and national lands reserved for environmental

protection. Among the state lands include the national roads and their boundaries that will be used for the project activities.

Article 39 related to the rights to use State lands states that "A public institution or decentralized entities have the right to use the State lands required for accomplishing its mission and responsibilities". Therefore, it is from the land title that it can understand category of land use for and also determine who the rightful landowner is, in the process of the asset inventory and compensation.

- ✓ **Organic law n° 32/2015 of 11/06/2015 law relating to expropriation in the public interest**

This law determines the procedures relating to expropriation in the interest of the public. Thelaw stipulates that the government has the authority to carry out expropriation. However the project, atany level, which intends to carry out acts of expropriation in public interest, shall provide funds for inventory of assets of the person to be expropriated. According to the organic law, no person shall hinder the implementation of the program of expropriation on pretext of self-centered justifications and no land owner shall oppose any underground or surface activity carried out on his or her land withan aim of public interest. In case it causes any loss to him or her, he or she shall receive fair compensation for it.

Eligibility for compensation is enshrined under the Rwandan constitution and the expropriation law. The two laws regulate and give entitlement to those affected, whether or not theyhave written customary or formal tenure rights. The person to be expropriated is defined under article2 (8) of the expropriation law to mean any person who is to be removed from his or her private property due to public interest shall be legally entitled to payment of compensation.

Article 3 of the law states that "Only the Government shall order expropriation in the public interest. Expropriation as provided for under this Law shall be carried out only in the public interest and with prior and fair compensation. No person shall hinder the implementation of the program of expropriation in the public interest on pretext of self-centered interests. No person shall oppose any underground or surface activity carried out on his/her land with an aim of public interest. In case it causes any loss to him/her, he/she shall receive fair compensation for it.

Article 4 states that "Every project, at any level, which intends to carry out acts of expropriation in the public interest, shall budget for valuation of the property of the person to be expropriated and for fair compensation". The article 6 states that the price or value of assets affected by the project shall be paid by the initiator of the project before any commencement of activities

Article 35 related to payment of fair compensation states that "Fair compensation can be paid in monetary form in the Rwandan currency or in any other form mutually agreed upon by the expropriator and the person to be expropriated. In order for the expropriation to be authorized, the fair compensation must be paid to the expropriated person before he/she relocates. The article 36 promulgates that approved fair compensation shall be paid within a period not exceeding one hundred and twenty (120) days from the day of its approval by the district.

- ✓ **Law n°.17/2010 of 2010 establishing and organizing the real property valuation profession in Rwanda**

According to the requirement of this law, the valuation of properties and land to be affected shall be done by an approved property valuer and registered by the Rwandan institute for property valuers. IRPV). Article 4 related to the Requirements to exercise the profession says that "Any person wishing to practice as a real property valuer

in Rwanda shall have to be a member of the Institute this law".

Article 26 says that "Only registered valuer members of the Institute shall be authorized to exercise the real property valuation profession in Rwanda. However, Government employees fulfilling requirements of the Council shall also be authorized to conduct valuation when mandated by their government institutions. The attributed prices to the assets shall be fair and compared to the local market as per the article 28 stating that "The proposed price for the real property shall be close or equal to the market value. The valuer shall compare prices by referring to the prices recently assigned to a real property that is similar or comparable to the real property subject to valuation.

2.3.International regulations

2.3.1. JICA Guidelines for Environmental and Social Considerations

The project of improvement of Water Supply Services in North Central Kigali will be funded by Japan Government through Japan International Cooperation Agency (JICA) and it is very important to consider the JICAguidelines for environmental and social consideration in preparation and implementation of the A-RAP.

The key principle of JICA's policy on involuntary resettlement is summarized below:

- Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives.
- When population displacement is unavoidable, effective measures to minimize the impact and to compensate for losses should be taken.
- People who must be resettled involuntarily and people whose means of livelihood will be hinderedor lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels.\
- Compensation must be based on the full replacement cost as much as possible.
- Compensation and other kinds of assistance must be provided prior to displacement.
- For projects that entail large-scale involuntary resettlement, A-RAPs must be prepared and made available to the public. It is desirable that the A-RAP include elements laid out in the WB, OP 4.12Annex A.

2.3.2. World Bank O.P. 4.12 on involuntary resettlement policy

The WB involuntary resettlement related policies are also critical in preparation and implementation of this A-RAP. The main objectives of the WB O.P. 4.12 include: avoiding or minimizing involuntary resettlement where feasible, exploring all viable alternative project design; where it is not feasible to avoid resettlement. Resettlement activities should be conceived and executed as sustainable development programs, providing sufficient investment resources to give the persons displaced by the project the opportunity to share in project benefits.

Displaced persons should be meaningfully consulted and have opportunities to participate in planning and implementing resettlement programs. Those displaced persons should be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them, in real terms, to pre- displacement levels or to levels prevailing prior to beginning of project implementation, whichever is higher. Specifically, the production systems of a community are safeguarded to the extent that guarantees their livelihoods and that their skills base remain relevant

regardless of the resettlement site. The policy objectives are also designed to minimize kinship group dislocation that might subject the affected persons to unfair competition when mutual help is diminished or lost. The project consultant met the objective of the WB OP 4.12, by conducting public participation in the project area; evaluating project alternatives to enable minimize involuntary resettlement and developed an entitlement matrix to guide in calculation of resettlement and replacement costs.

Table 4: Gap between Rwandan laws and JICA guidelines for environmental and social considerations

JICA Guidelines	Rwandan regulation	Gaps	Comment
[Avoidance of involuntary resettlement] Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives.	▪ The national laws on environment and EIA guidelines require the developer to examine project alternatives but not mention avoidance or minimization of involuntary resettlement.	The national laws and regulations only require the provision of compensation.	JICA guidelines shall apply
[Mitigation measures for displacement] When population displacement is unavoidable, effective measures to minimize impact and to compensate for losses should be taken.	▪ Resettlement is only acceptable for public interest. Affected persons are fully informed of expropriation issues. ▪ Laws relating to expropriation define valuation of land and assets for the fair compensation, but loss of income is not covered.	Loss of means of livelihoods is not captured in the expropriation law	JICA guidelines shall apply
[Securing livelihood and assistance] People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels.	▪ Laws relating to expropriation define valuation of land and assets for the fair compensation	The laws relating to expropriation do not mention loss of income and compensation for illegal occupants.	Priority for job of construction work will be considered for those who will lose a part of income sources
[Valuation based on replacement cost] Compensation must be based on the full replacement cost as much as possible.	▪ Compensation shall be calculated based on their size, nature and location and the prevailing market rates. ▪ The compensation for disruption caused by expropriation to be paid to the expropriated person shall be equivalent to five percent (5%) of the total value of his/her property expropriated.	The Rwanda Expropriation law does not mention the full replacement cost. The valuation law recognizes replacement cost as valuation methods. what is not covered is full replacement cost (this includes administrative cost, additional cost due to relocation etc)	Compensation based on the market value such as materials and labor cost without depreciation, and disturbance allowances as 5% of market value were used. The proposed price for the real property will be made close or equal to replacement value, referring to the recent data of the transaction in land. Transaction tax and commission fee shall be added as compensation.
[Compensation prior to displacement] Compensation and other kinds of assistance must be provided prior to displacement.	▪ The Article 36 of the Expropriation law (2015) states that approved fair compensation shall be paid within a period not exceeding one hundred and twenty (120) days from the day of its approval.	JICA Guideline does not specify the period of payment and assistance.	Compensation and other kinds of assistance must be provided prior to displacement
Development and disclosure of RAP: For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public.	▪ Article 10 of expropriation law requires the project developer to submit documents, which contain such information as the outline, environmental and socio-economic impact, and concerned people's understanding of the project, along with the application	The Rwandan laws do not stipulate the RAP. Only expropriation report is required. However, donor agencies in general	This ARAP was prepared in this regard.

JICA Guidelines	Rwandan regulation	Gaps	Comment
		recommend preparing for RAP.	
Holding public consultation meetings: In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. Use of local language: When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people.	▪ The Law 48/2018 of 13/08/2018 on environment requires public hearings and consultation during Environmental studies. ▪ The article 11 of the expropriation law requires that the relevant committee in charge of monitoring projects of expropriation in the public interest shall consider the relevance of the project within a period not exceeding thirty (30) days after receiving the request for expropriation and shall conduct a consultative meeting with the population living where the land is located concerning the relevance of the project of expropriation in the public interest. The committee shall inform them about the date, time and venue of that meeting.	Both JICA and Rwandan law require consultation with affected people with enough information	For the preparation of the EIA report and ARAP, consultation meetings were organized, and sufficient information was provided in the local language
Promoting public involvement: Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans.	▪ Under the expropriation law, the relevant committee in charge of monitoring projects of expropriation shall conduct a consultative meeting with the affected population.	Under the expropriation law, consultative meeting shall be conducted; however, not promoted in the beginning stage.	Consultation meetings were organized in the planning process for EIA and A-RAP preparation.
Establishing grievance redness mechanism: Appropriate and accessible grievance mechanisms must be established for the affected people and their communities.	▪ The expropriation law provides for rights of persons to be expropriated and stipulates the process for redress of problems with expropriation decision by the affected persons (Article 18, 19, 20 of Section 3) ▪ Article 18 also guarantees the right for appeal and provides for the mechanism for appeal for any person affected by the decision on expropriation in the public interest. Any person to be expropriated who is not satisfied with the assessed land and property value shall indicate in writing grounds for his/her dissatisfaction with the valuation report. (Article 33 and 34)	No gap	For this case no grievance committees are required. Amicable settlement in case of grievance shall eb applied and local authorities shall be mediators for both parties.
[Identifying eligibility] Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advantage of such benefits. (WB OP 4.12 Para. 6)	▪ The Rwandan expropriation law requires the census and asset inventory survey. ▪ The District or City of Kigali administration or the relevant Ministry must inform the persons to be expropriated in the public interest of the expected start date of measurement of land and inventory of property	The social assessment is part of Environmental Impact assessment, but the expropriation law does not require social assessment.	Census survey was done upon identification of the necessity of resettlement and/or land acquisition under the preparatory survey, and to be updated by final valuation stage. Socio-economic survey was also conducted under the preparatory survey, and to be updated by final valuation stage.

JICA Guidelines	Rwandan regulation	Gaps	Comment
[Eligibility requirements] Eligibility of benefits includes the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying. (WB OP 4.12 Para. 15)	▪ Under the Rwanda Expropriation law compensation is limited only those with land titles and documentary evidence that he/she is the owner of property incorporated on land. He/she shall also provide a civil status certificate and a document evidencing his/her chosen matrimonial regime in case of a married person.	The World Bank OP4.12 policy is much broader and includes both legal and illegal occupants of the land.	There would be no PAPs without formal legal right in this project.
[Land-to-land Compensation] Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based. (WB OP 4.12 Para. 11)	▪ Under the expropriation law, fair compensation can be paid in monetary form in the Rwandan currency or in any other form mutually agreed upon by the expropriator and the person to be expropriated. (Article 35 of Section 2)	The Rwanda Expropriation law confirms Land for land compensation.	In Kigali, where land is a limited resource, it is very difficult to implement land for land compensation; therefore, compensation will be paid in cash.
[Assistance during transition] Provide support for the transition period (between displacement and livelihood restoration). (WB OP 4. 12, para.6)	▪ There are no explicit support for transition period and livelihood restoration	There are no explicit supports for transition period and livelihood restoration.	No transition period is required as per PAP is not residing at the affected land.

Source: WB OP 4. 12, JICA guidelines and National regulations on expropriation and lands

2.4. Institutional arrangement for A-RAP preparation and implementation

In Rwanda, there is no specific institution governing resettlement activities and social impact are assessed and managed through EIA process and different institutions shares responsibilities in terms of land acquisition and land transfer. In any case the project implementing agency is the responsible institution and should work with other stakeholders and affected people to ensure that land is acquired in compliance with existing regulations. For this project, WASAC Ltd is the lead institution in implementing this ARAP but will be supported by other institutions. WASAC Ltd is the implementing entity for the construction of pipelines but also is responsible for land acquisition. For this reason, WASAC ltd is responsible for the preparation and implementation of this A-RAP and will be responsible for securing funds from Central Government (MINECOFIN) to meet compensation and ensuring that the PAP receives adequate compensation before project implementation. The summary of institutions responsibilities is provided in the table below:

Table 5: Institution arrangement for A-RAP implementation

Organization	Responsibility
WASAC Ltd	✓ Designate a social safeguard specialist who will be the focal point for A-RAPs implementation and will liaise with other stakeholders. ✓ Initiate the expropriation process and compensation requirements; ✓ Preparation and signature of compensation grant agreement with the district; ✓ Ensure funds are allocated appropriately, according to A-RAP; ✓ Prepare the A-RAP closure report and file all documentation related to A-RAP implementation; ✓ Hire independent assets valuer upon the completion of final detailed design study.
Rwanda Land Management and Use Authority	✓ RLMUA through its department of land administration and mapping is the organ responsible for overall management and coordination of all activities related to land administration, land use planning and management in Rwanda. The role of RLMUA role in RAP process is to advise on matters related to land ownership and expropriation. ✓ RLMUA will be also responsible for land transfer and registration after compensation is fairly done and conclude
Gasabo District	✓ Ensure that all procedures related to property valuation and fair compensation have been adhered to and that there is consistency in approach used ✓ Review and approve by signing all documentation related to compensation such as valuation form.

	✓ Responsible for monitoring of valuation and fair compensation to the PAP ✓ Monitoring and follow up of the RAP implementation; ✓ Resolution of grievance if any is raised
Local authorities (Village, cell, and Sector)	✓ Review and sign off of all documentation (e.g. completed expropriation form); related to the compensation and that indicates their affected assets for payment ✓ Participation in the different consultation meetings ✓ Participate in the valuation activities for affected assets; ✓ Sign and approve the individual PAPs list; ✓ Following up and participate in resolving issues that may be raised
Rwanda Institute of Property Valuers	✓ Set up reference prices ✓ Approval of independent valuers ✓ Supervise assets valuation activities
Project Affected Person (PAP)	✓ The primary role of the PAP during the process of property census/measuring land and assessing property thereon is to be physically present and ascertain that indeed the measurements are correct and to his satisfaction. Upon being adequately satisfied with the measurements, his signature will be given as proof of approval. ✓ Be present when the land survey and inventory is being carried out ✓ Provides all required necessary information in regard to compensation activities.

3. SOCIO-ECONOMIC STATUS OF THE AFFECTED PERSON AND CONSULTATION

3.1. Introduction

This section describes the current situation of the PAP to be affected by the project and provides the baseline socio-economic status that will be used to measure the project impact on him. The information presented has been collected through socio-economicsurvey conducted to the person owning the land for the site for construction of Batsinda grounded water reservoirs.

Considering the project nature and extent whereby installation of all principal and secondary water pipes will follow the existing roads both tarmac and earth roads and where the pipes will be located under the walkways and in the buffer zones of the roads, no land for the pipelines will be permanently used for by the project. The affected properties in those buffer zones are also the government trees and these do not require the compensation. However, they will be re-planted after project activities. The required land not owned by project developer will be used during the project works in form of easement and returns to the owner after project execution. Compensation of land and affected properties will be made at Batsinda where land will be permanently used. Hence only one (1) PAP has been identified as project affected person.

3.2. Data collection and analysis

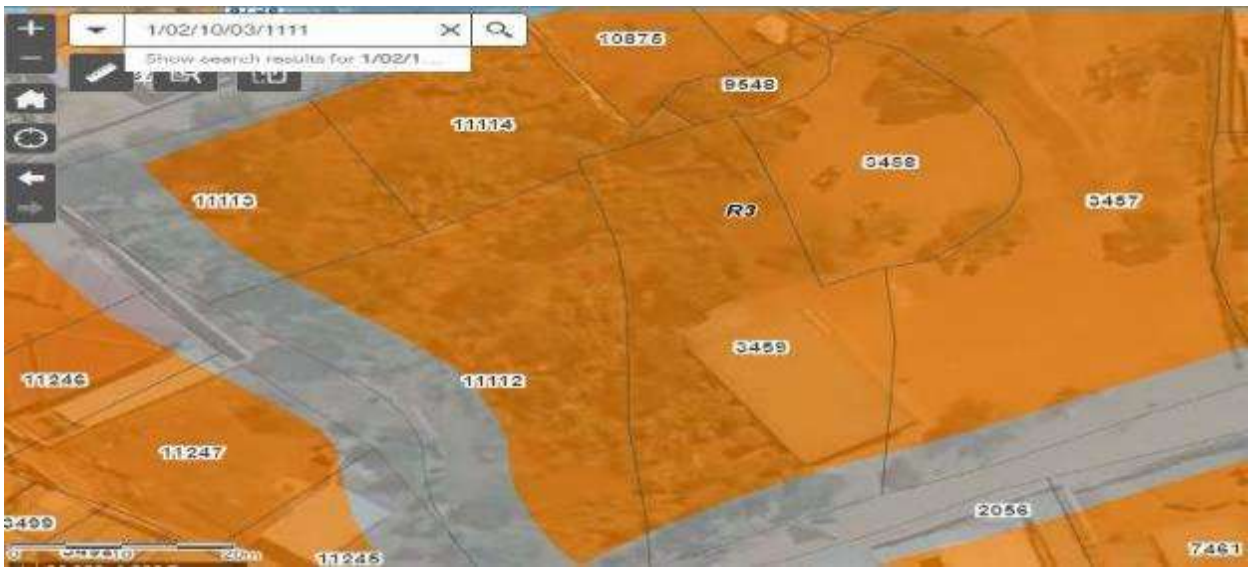
Data collection on the PAP was done using a predefined of questionnaire that was filled at the project site together with the PAP and two of his two (2) sons. Responses obtained from field survey were interpreted and used in this A-RAP.

3.2.1. Characteristics of PAP

The affected person is MPAGAZEHE Augustin, born in 1950(72 years). He is a widow and head of the family. He resides in Nyakabungo Village, Kagugu Cell, Kinyinya Sector, Gasabo district with ID number 1195080001367182. Due to his his age, Augustin has no temporarily or permanent job. He lives for daily substances form agricultural activities and from support of his children. He has no permanent disability. According to him on monthly basis, he gains almost 50,000 Frw from his agricultural activities outside the project area.

3.2.2. Characteristics of the affected plot

The affected plot is register under UPI: 1/02/10/03/11112 and is in Nyakabungo Village, Kagugu Cell, Kinyinya Sector, Gasabo district. The total area of the plot is 1308 sqm while the required land for the project activities is approximately 1000m2. The land has the land tiles and is designed for residential by Kigali city land use master plan. However, there is not any house within the plot. The expiration date of the freehold title is 8-03-2040. It worth to not that during site visits and review of ownership documents, inconsistencies were observed in terms of plot area as well as the shape of the plot. This has to be well checked during the final valuation. As it can be seen on the following map there a portion of surveyed area which is not part of the plot. According to the owner the error is being rectified and for the moment we considered the area included on the land title with 1308m2. This should be rectified before purchasing the land.



Plot shape

Surveyed area

3.2.3. Affected properties

The affected trees located at the project site as per the date of site survey are summarized in the table below:

The targeted land is planned for residential use but currently is being used for agriculture purposes as it can be seen on these photos.

Key crops properties inventoried are presented in the next table.

Table 6: Affected asset at the project site

No	Names	Local name	Unit	Quantity	Unit price	Estimated cost
1	Land	Ubutaka	sqm	1308	47,110	61,619,880
2	*Persea gratissima*	Avoka	number	46	20,000	920,000
3	*Phaselolus vulgaris*	Ibishyimbo	sqm	1,000	150	150,000
4	*Zea mays*	Ibigori	sqm	1,000	150	150,000
5	*Colocasia esculenta*	Amateke	number	45	250	11,250
6	*Manihot esculenta*	Imyumbati	sqm	1,000	400	400,000
7	*Musa spp.*	Insina	number	102	5,000	510,000
8	*Markhamia lutea*	Umusave	number	41	10,000	410,000
9	*Mangifera indica*	Imyembe	number	3	10,000	30,000
10	*Eucalyptus sp.*	Inturusu	number	33	6,500	214,500
11	*Grevillea robusta*	Gerevelia	number	1	5,500	5,500
12	Euphorbia candelabrum	Umuduha	number	1	10,000	10,000
13	Tetradenia riparia	Imiravumba	number	3	20,000	60,000
14	*Euphorbia tirucalli*	Imiyenzi	number	25	1,000	25,000
	Subtotal					**64,516,130**
	5% of disturbance allowances					**3,225,807**
General Total						**67,741,937**

Source: Field survey, 2022

3.3. Stakeholder engagement and consultation

According to the JICA guidelines for environmental and social consideration and national regulations related to land acquisition, affected persons and host communities are supposed to be meaningfully consulted early in the planning process and encouraged to participate in the planning and implementation of the resettlement program. Hence, the first consultation meeting was held on 26th March 2022 between cells and village authorities to discuss issues related to compensation connected to the project.

3.3.1. Consultation with affected Person

While preparing this A-RAP, another discussion with PAP and his sons was held on site on 16th April 2022. Where present Augustin and his sons Theoneste NGABONZIZA and Vedaste NSANZIMANA. The purpose of the meeting was to inform the affected person were informed about project activities, and requirement and options and rights pertaining to the resettlement. After that, the PAP was fully involved in all the processes of the development of this Abbreviated

Resettlement Action plan (ARAP). Compensation requirements were discussed, and provisional assets valuation was conducted to be used as benchmark for the ARAP budgeting. The real asset valuation shall be conducted by the approved property valuer. The Table below summarizes issues raised during the consultation meetings with the PAP along with the responses given.

Table 7: Issues of PAP and responses given

Issues	Responses
The project is good as we don't have enough water in our region. Why the project was designed to be carried out in my plot.	The location of the water reservoir was selected based on different technical alternatives. Among them include the best location to allow easy distribution of the supplied water. Your plot has been found being at the best as being on the highest elevated point in Batsinda and taking into consideration that water from the reservoir will be supplied to the rest of the area by gravity. Therefore, the plot has been found to be the best among other reasons it has been selected.
Will the valuation take into consideration of our land as registered on the land document (crops andtrees)	It is envisaged that the valuation of land will take into consideration only the affected land and required for the project. The remaining part of the land will be your property and your will get the land document according after land transfer.
Will all crops and trees be valued during the valuation?	The valuation of the crops and trees will be done with reference to current compensation rates applied in Rwanda and the compensation package is based on the age and type of the crop or tree.
How will I know the amount of money to be compensated?	It is your full right to know the exact amount of the compensation you will get. The entire package of the expropriation form will be displayed to you before signing. It is your right to accept the amount of money before signing.
How will I receive my money?	All payment will be made directly to your personal bank accounts or Saving and Credit Cooperatives (SACCOs) with no intermediaries.
I used to get around 300 kg of beans from this land and every season. Will this also be catered for during the valuation?	Valuation will consider assets on site. However, 5% of the total amount calculated will be added as disturbance allowance.
After valuation of the crops, will I allow to harvest them even though compensated?	Normally compensation id done to the affected crops. In case the valuation is done after you harvested your crops, they will be no compensation. In case this is done, and the onsite works delayed being implemented yet you have been compensated you will be allowed to harvest your crops.

During consultations done through the conduct of this ARAP, it was indicated that all the residents around the project area and the PAP himself and his relatives had a positive attitude towards the proposed project. All people reached a conclusion that this is a developmental and feasible project, and it must be supported by all parties involved. However, the PAP insisted that fair compensation should be conducted taking into consideration the value of land and local market in project area as well to be done in due time without delays in payment process that are mostly observed in such water supply projects.

After the feasibility study, another consultation was organized with affected households to provide more information on land requirement. The meeting was held on July 26th, 2022, and both owner Augustin and his sons Theoneste NGABONZIZA and Vedaste NSANZIMANA attended the meeting. The affected person was informed that the land required for the project implementation is 1000m2 instead of 750m2 as initially communicated. The PAP was also informed that during the final valuation, it will be agreed whether the entire plot will be taken or only the required land will be compensated. This will depend on whether the remaining portion can be used by the owner. In addition to that, the PAP was informed that during the filed survey, it was found that there are discrepancies on both size and shape of the plot. The size on the ground is different from the one on the land tittle and the one recorded on the Kigali Master Plan. The PAP recognizes these discrepancies and indicates that he has initiated the process for correction.

During this meeting, the affected person reiterated his request about fair compensation, timely payment of agreed amount and compliance with existing regulations. Minutes of this consultation in local language is provided in Annex 2

3.3.2. Consultation with community

Though only one person will be affected, it is critical to inform the larger communities about the project especially those closer to water reservoirs and pipelines. Consultation with larger communities is conducted in tandem with consultation for environmental studies and are mainly held during community work as agreed with local authorities. During the consultations, the restrictions imposed by COVID-19 were respected. In our context, the community works took place on 26th March 2022 and 3 different study teams attended the in 3 different areas Gisozi, Kagugu and Nyabisindu as detailed in table below. Information and comments collected from the public consultations are all summarized in the table below.

Table 8: Questions /Suggestions and responses provided during public consultations

No	Names	Questions/Suggestions	Responses provided by the consultant
Gisozi, Musezero Cell, Gasharu village Saturday, 26th March, 2022			
1	NIBISHAKA Isaac	-Where will the pipelines pass?	-The pipelines will pass where the existing pipes pass especially in the road reserve from Ntora to Gacuriro
2	MMUKANDORLI Chantal	You said that during the project implementation, some of the pipes will be replaced. Will be water shortages during the period of replacement?	The project is designed in a way that there will be np water shortages during project implementation. In case these happen, people will be informed in advance for them to get prepared.
3	MUKAKABERA Seraphine	We have experienced cases where some of our crops have not been compensated by WASAC. Example is made to my crops affected during the recent constructed Ntora – Gasanze pipe. How can you ensure that this project will be implemented differently while the developer is the same?	Maximum efforts are being done to avoid compensation during the project implementation. In case it happens, compensation will be made before project works. Local people are also required to get all required conditions such and land documents, account numbers etc. to get paid. Details to get paid shall be discussed during the valuation process.
4	BAMPORIKI Jean Baptiste	During the previous projects some of the pipelines that were supplying us water were not re-connected and we are still struggling. Will the project do the same mistakes?	Normally the pipes to be installed are not directly supplying water to locals. These are transmissions pipes while connection is done to distribution pipes. It is expected that this project will not cause such impacts to locals.
5	YANGIRIYENEZA Egide	Will be there any compensation to those who will temporally close their businesses such as MTN kiosk owner during the project implementation	So far it is expected that compensation will be made at only damaged assets. Those having movable properties shall be requested to move them to pave the way project activities. However, those owning such business shall be allocated jobs during project implementation and bring back their kiosks after project works.
Remera sector, Nyabisindu cell			
1	UWINGABIRE Marianna	When is the implementation of the project expected to start for us to get prepared?	Different studies related to the project studies are going on and the kick of is expected as soon as the studies are finished and approved and the

No	Names	Questions/Suggestions	Responses provided by the consultant
			funds available. It is expected that the project will be start during the next fiscal year and this section to be completed within two years
2	KURADUSENGE David	Will the project give job opportunities to local people or only engineers will be employed by the project	Considering the project nature, local people will be employed and are priorities when allocating jobs. Both local and non-locals will be employed during project implementation
3	SEZIBERA Issa	ter the construction works especially where pipes will pass, people are they allowed to continue using their land?	ter construction works and pipes laying, landowners will continue to use their land as usual. However no major structures such as fences will be allowed on the pipelines.
4	NDAYISABA Valens	me have assets on the land where probably the project will pass. Will the project compensate them? ,	affected properties will be compensated according to the existing laws related to the compensation in public interests.
Kinyinya Sector, Kagugu Cell, Nyakabungo Village Saturday, 26th March, 2022			
1.	MUGISHA Jean Claude	We would like to know the exact location of the water tanks in this area. Is only one water tanks or the project will build different tanks in our area?	The water tank in Kagugu will be constructed in the plot located near Batsinda Central Catholic Church. Other tanks will be located nearby the exiting tanks in Gacuriro and Nyarutarama except the other new tank to be constructed opposite Kagugu Catholic Parish
2	NIYONZIMA Jean d'Amour	When the maps of the project will be available, it will be better to be displayed at the villages and at open spaces so that different people can have access to the information related to the line route and other project components?	For sure. Maps of the project location will be published to cell/ villages information will be made public to all.
3	NIYONSENGA Jean Bosco	It should be better that WASAC also take part in the project implementation	For sure. The project will not be implemented only by JICA. WASAC ltd is project developer and will definitively be part of the project implementation.
4	NDABARORA Eliezer	Water is currently expensive and is becoming more expensive. WASAC in charge should look on these issues and act accordingly.	The message is taken into consideration and will be forwarded to WASAC for consideration.
5	NYIRABUHORO M. Aimee	When do you think the project should start?	The project has started with detailed design and onsite works are expected to start next fiscal year that will start in June 2022.
6	MURATABIGWI Fidele	Regarding the work to be available for the project will JICA fully own the payment of manpower? How about the compensation of damaged properties?	Payment of local manpower will be done by the contractor who will be doing the implementation. While compensation of damaged properties will be done through Government budget via WASAC Ltd.
7	MASUMBUKO Oscar	Is it possible for WSAC to think about het prepaid system as this was done for electricity?	Message is taken and will be forwarded to WASAC for consideration

Source: Field survey, BESST Ltd, 2022

3.3.3. Consultation with regulatory agencies and local community

In addition to the Project Affected Person and local community, efforts were made to consult and inform regulatory agencies and local authorities about the project, its implications in terms of land acquisition but also roles and responsibilities in resettlement process. Consultation at central and district level consisted at explaining the proposed project, project environmental concern, legal and regulatory requirements as well as roles and responsibilities of different stakeholders for the abbreviated Resettlement Action Plan. The consultation at central and district level took place during the period of 6th and 18th January 2022 and consulted institutions at central level are summarized and issues discussed are summarized in next table:

Table 9: Outcome consultation at central and local level

Stakeholder	Summary of discussion	Key outcomes
RLMUA	- Land rights and land use for the buffer zone of the roads - Land transfer ad registration after project implementation especially for Batsinda water tank area - Zoning Plan of the project areas	- Land located within the buffer zone of the road is under public land. Therefore, the project will be implemented in consideration with the existing laws related to land use and rights. - It is mandatory that after compensation the expropriated land be register under government properties via WASAC. All procedures required must be fulfilled in order to get the land register. RLMUA will facilitate in this regard by its staff located at Gasabo District. - This project is not compromising the land use plan of the City of Kigali
REMA	- Project activities and environmental pollution. - Potential source of pollution within project area - Impacts of the project implementation on the surrounding environment. - REMA's responsibilities in the project life span	- REMA will play key role in the EMP during all phases of the project. - Impacts compensation measures of the identified impacts would be clearly developed and implemented. However, efforts must be made to refuse and avoid those identified impacts. - Various impacts connected to this project implementation were discussed and are incorporated in this report. - Monitoring is recommended to be undertaken on regular basis to avoid potential environmental pollution.
WASAC Ltd	- Land requirements and land issues - Compensation and expropriation issues - Project's waste generation and management plan	- This project implementation is a necessity to meet the fixed target and existing policies and programs objectives to supply 100% of clan water to all Rwandans by 2024. - The land for the project will be acquired via the existing laws related to the expropriation/ compensation in public interests. Fair compensation will be made, when necessary, - And independent valuer should be hired to conduct final valuation
MoE	- Environmental concerns related to the project implementation - Laws and regulation related to land acquisition	- Mitigation measure to the identified impacts have to be implemented as well as the regular reporting is required. - Project impacts were discussed and are incorporated in this report.
District, Sector and Cell officials	- Land ownership and land issues. - Land required for the project.	- All households in the project areas should be connected and for the residents to benefit from the project implementation.

Stakeholder	Summary of discussion	Key outcomes
	- Challenges and impacts associated to the project implementation - Compensation of affected properties	- Other affected properties that land shall be also fairly compensated as required. - Different project positive and negative impacts were discussed and incorporated in this report. - Mitigation measures for the identified impacts were also discussed.

4. PROJECT RESETTLEMENT IMPACT AND COMPENSATION PROCESS

The project of Improvement of Water Supply Services in Kigali City was designed in a way that avoids or minimizes resettlement impacts. Some components of the project such as the installation of pipes and associated infrastructures require land. It is good enough that the required land belongs to the government (road buffer zones) and others belonging to private owners will be temporally used as easement and will return to the owners after project construction works. This section assesses the likely impact to occur to the PAP and propose mitigation measures.

4.1. Asset inventory and valuation

Asset valuation was at the project site for the project land requirement. Final valuation will be conducted by a certifiedvaluer and other parties including local authorities and PAP. Through consultation with PAP and its relatives, it was explained the way the valuation would be done. The following are key activities explained, discussed, and agreed on:

- It was suggested by the PAP to measure by tape measure the size of the plot however, as the land has land title with exact surface area, it was agreed that this provided surface of the plot be considered. Considering that the hall plot will not be affected by project activities, it was agreed that tape measure will be used while conducting final evaluation and determining the required area for the project. .This was done in the presence of the PAP and his two sans who follow-up the asset inventory and valuation.
- Crops valuation was done based on the area of coverage, their type in other cases number of standing crops and age.
- Regarding crops, an agreed estimation was done for annual crops since the seasonal crops shall be harvested by the time of project commencement.
- Trees valuation criteria was based on the number of trees, age and type of tree.

The valuation form shall be well completed and signed off bythe village, Cell and Sector authorities before they are sent to the district land commission forendorsement and for payment processing by WASAC ltd.

4.2. Expected resettlement impacts

The project activities showed that there they will be no loss of shelter (household) during the project implementation. However, some of the public infrastructures will be affected such as road, electrical poles and water pipes. Some of the private land will be temporally used for the project activities and return to the owners on conditional use. There will be also loss of perennial crops and trees.

4.2.1. Loss of private land

The installation of pipeline will involve land clearance and the excavation area has been reduced to 2m to avoid private structures such as wall and fences. The land will be lost temporary or use

under conditions where water pipe will be installed and during maintenance works. The remaining land will be taken only during construction.

4.2.2. Loss of government land

Article 31 of the land law **states the lands in public domain as** lands consisting of all lands intended to be used by the public or all the lands reserved for organs of State services and national lands reserved for environmental protection. These lands include the also the national roads and their boundaries. The article 39 states that "A public institution or decentralized entities have the right to use the State lands required for accomplishing its mission and responsibilities" most of the land to be used for pipelines and associated facilities belongs to the government of Rwanda and hence no local implications or impacts are associated to their use.

4.2.3. Loss of crops and trees

The installation of water pipe Construction works entail clearing of the vegetation inherent in the project site. Some of the trees are within the road boundaries and belongs to the City of Kigali while others may belong to the locals. According to both national regulations and international policies on environmental and social considerations requires the compensation of affected assets including tress and perennial crops. Trees located on the private land at Batsinda site has been counted and included in this report.

4.3. Eligibility for compensation and Entitlement Matrix

4.3.1. Eligibility criteria

In this ARAP, eligibility for compensation was established by comparing what is stipulated inthe Rwandan Constitution (Article 29), the Expropriation Law of Rwanda (N° 32/2015 of 11/06/2015) and the Bank's operational policy, WB OP 4.12. These documents regulate and give entitlement to the affected persons. The WB OP 4.12 goes further and recognizes the affected persons as that one using the land at the time, whether they have written customary or formal tenure rights. However, in the Rwandan Expropriation Law, the personto be expropriated is defined as "any person or a legally accepted association operating in the country that is to have his or her private property transferred due to public interest as well as legally accepted local administrative entities.

JICA guidelines for environmental and social considerations request the recipient country to consider international eligibility criteria including those provided by World Bank Policy OP 4.12 on involuntarily resettlement. The WB OP 4.12 also provides eligibility of benefits including the PAPs who have formal legal rights to land (including customary and traditional land rights recognized underlaw), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets, and the PAPs who have no recognizable legal rights to the land they are occupying. Theeligibility criteria used in this assessment are based on the three criteria given in clause 15 of the World Bank's Operational Policy 4.12: involuntary resettlement:

- ✓ Those who have formal legal rights to land (including customary and traditional rights recognized under the laws of the country);
- ✓ Those who do not have formal legal rights to land at the time the census begins but have a claim to such land or assets – provided that such claims are recognized under the laws of thecountry or become recognized through a process identified in the resettlement plan;

JICA requires recipient country to comply with JICA guidelines on environmental and social consideration

and World Bank OP 4.12. Therefore, the eligibility was determined in compliance withthose guidelines together with national expropriation regulations as far as this project is concerned, the Rwandan expropriation law will take precedence.

4.3.2. Entitlement matrix

Entitlement matrix proposes eligibility and payments for the losses triggered by the project such as land, trees, and crops, Therefore, based on the analysis of the impact of the project and the criteria for eligibility, the following entitlement matrix was developed for the affected people found in the project

Table 10: Entitlement Matrix

Type of loss	Entitled Person	Type of Impact	Eligibility criteria	Entitlement
Permanent loss of land	Land title holder	Displacement	Landowner where the water tank will be constructed	Cash compensation plus 5% disturbance allowances as per the expropriation law If the remaining part of the land is too small to be viable or usable, the whole plot will be expropriated.
Temporally loss of private land at the pipeline construction	Landowner	Disturbance	Landowners where the proposed pipeline will be temporarily constructed	People will be notified on time and the shortened
Loss of government land	GoR	Loss of land	Current users of affected land	No compensation required because as in the government land and only small portion will be affected. Affected people should be allowed to use the land outside the pipeline area
Loss of trees on government land	City of Kigali	Loss of trees	Not applicable	No compensation is required.

4.4. Assets inventory and valuation methods

This section describes the methods to be used in valuing assets that will be eligible for compensation consistent with either Rwandan laws or JICA guidelines for environmental and social consideration. Law No.17/2010 of 2010 establishes and organizes the Real Property Valuation Profession in Rwanda. It provides the registration of land valuers in Rwanda and conditions for registration. The law also allows the Government to conduct valuation when mandated by their government institutions. Articles 27, 29, 30 and 31 of the law deal with valuation methods and stipulate that the price for the real property shall be close or equal to the market value. Land values could also be compared country wide. Where comparable prices are not available to determine the value of improved land, the replacement cost approach shall be used to determine the value of improvements to land by taking real property as a reference. The law also allows the use of international methods not covered by the law after approval of the Institute of Valuers.

4.4.1. Valuation methods

The valuation law recognizes different valuation methods and those include:

- **Use of Standard Valuation Tables**

This method is based on reference prices published by Rwanda Institute of valuers every year. Under this method, the compensation rates / valuation tables would be developed using legally acceptable valuation procedures accepted by both the Government of Rwanda and funding agency for purposes of fairness and consistency. The approach considers replacement costs and types and levels of compensation under the Rwanda law. Valuation of lost assets will be made at their replacement cost.

- **Comparison of Land/Property Values Countrywide**

In case there are no compensation rates, the Valuer shall compare prices by referring to the prices recently assigned to a real property that is similar or comparable to the real property subject to valuation. Where comparable prices are not available for land in a particular area, the Valuer may use comparable prices of similarly classified land from other areas of the country

- **Replacement Cost Approach**

The replacement cost approach is based on the premise that the costs of replacing productive assets is based on damages caused by project operations. These costs are taken as a minimum estimate of the value of measures that will reduce the damage or improve on on-site management practices and thereby prevent damage. The approach involves direct replacement of expropriated assets and covers an amount that is sufficient for asset replacement, moving expenses and other transaction costs.

- **Gross Current Replacement Cost**

Gross Current Replacement Cost (GCRC) is defined as the estimated cost of erecting a new building having the same gross external area as that of the existing one, with the same site works and services and on a similar piece of land.

- **Other methods**

Rates from Contractors: When rate schedules do not exist or are out of date, recent quotations by contractors for similar types of construction in the vicinity of the project can be used for calculating replacement costs. In projects offering the options of cash compensation or alternative accommodation, the construction cost estimates for alternative accommodation could be used for calculating cash compensation payable.

It is recommended that the replacement Cost is used as valuation methods. This is because the Replacement cost valuation methods is recommended by funding agency and recognized by valuation law in Rwanda.

4.4.2. Calculation of compensation by assets

The following methods of calculation should be adopted for the preparation of the standardized asset valuation tables and/or the application of specific case by case valuations in the case of projects that have significant impacts.

- **Compensation for Land**

Compensation for land is aimed at providing a farmer whose land is acquired and used for project purposes, with compensation for land labour and crop loss. For this reason, and for transparency,

land is defined as an area or homestead (i) in cultivation, (ii) being prepared for cultivation, or (iii) cultivated during the last agricultural season. This definition recognizes the farmer's labour as the biggest investment he/she makes in producing a crop which is higher than all other inputs such as seed and fertilizer. As a result, compensation relating to land will cover the market price of labour invested as well as the market price of the crop lost.

- **Land Measurement**

For purposes of measuring land, the unit of measurement would be that which is used and understood by the affected farmers and if a traditional unit of measure exists in the rural areas, that unit should be used. If a traditional unit of measurement does not exist in a particular area, then it is recommended that land should be measured in meters or any other internationally accepted unit of measurement. However, in such an event, the unit that is being used must be explained to the affected farmers/users and must somehow be related to easily recognizable land features that the communities are familiar with, such as using location of trees, stumps, etc as immovable pegs. The most important concern of this exercise is to ensure that the affected person can verify using his/her own standards/units of measurement, the size of land that is being lost. This will ensure transparency in the system and will thus avoid subsequent accusations of wrong measurements or miscalculation of areas. A farmer should know how much land he/she is losing, in terms of size and the replacement land must be at least of that same size and comparable value as land lost.

- **Calculation of Crops Compensation Rate**

The current prices for cash crops will be determined and all crops will be valued using a single rate considering the crop at mature age. This rate incorporates the value of crops and the value of the labour invested in preparing new land. Determining compensation using a single rate creates transparency because anyone can measure the area of land for which compensation is due and multiply that by a single rate known to all. This approach also allows assignment of values to previous year's land (land in which a farmer has already invested labour) and land that have been planted but crops have not germinated. Further, it avoids contention over crop density and quality of mixed cropping.

The value of the labour invested in preparing agricultural land will be compensated at the average wage in the community for the same period. The rate used for land compensation should be updated to reflect values at the time compensation is paid. Table below, derives a total value for a one-hectare land from the value of the crops on the land and the value of labour invested in preparing a replacement land.

Table 11: Example of method to be used to determine a monetary compensation rate for land*

Item Compensated	Basis of Value	Rwandese Francs/ha
	Average of the highest 2021 official and market survey land prices per ha of staple food crops (maize, rice etc.), plus cash crops (e.g. sugar cane, corn).	
	Labour costs of preparing a replacement land.	
Total	Replacement value of crops plus labour.	

(Rwandan Francs payments will be revised to reflect crop values and labour rates in effect at the time of compensation). This example assumes a one-hectare land. Crop values will be determined on:

- A combination of staple foods and cash crops. The 80/20 ratio of land that a farmer typically has in food crops and cash crops is used to determine the chances s/he would lose food crop rather than a cash crop income.
- The value of stable crops to be taken as the highest market price (over 3 years) reached during the year, in recognition of the following factors:
- Although most farmers grow staple crops mainly for home consumption, they always have the option of selling these crops to take advantage of the market.
- Farmers most often purchase cereals when they have run out, during drought when prices are high. Compensating at a lower value might put the individual or household at risk.
- On average, the highest price of stable food yields a high per hectare value reimburses for the vegetables and other foods that are commonly inter-cropped with staples but are almost impossible to measure for compensation.
- The labour cost for preparing replacement land is calculated on what it would cost a farmer to create a replacement land. This value is found by adding together the average costs of clearing, ploughing, sowing, weeding twice, and harvesting the crop.

- **Compensation for fruit trees**

Banana and Mango trees are featured here below as two examples of the set of primary fruit trees that are likely to be found in project targeted area and are estimated to account for a significant amount of all fruit bearing trees. They are primarily important as a source of:

- Subsistence food for families
- Cash produce that contributes to the export economy
- Petty market income in some areas, and
- Shade (in the case of mango trees).

For banana trees, they have a relatively much shorter productive life, normally, than mango trees. For species, banana trees will not bear fruit more than once. Therefore, compensation for banana trees would be compensated at the full market rates for bananas harvested in that year and for another year. The second-year payment is for the replacement cost of planting a new tree, looking after it and harvesting it which could all be done in one year. Therefore, the farmer should have restored his pre-project position by the end of the second year. This example of bananas is an example for trees/plants that have a relatively short life.

As defined in this policy, individuals will be compensated for wild trees which are in their land. Wild productive trees belong to the community when they occur in the bush as opposed to fallow land. These trees will be compensated for under the umbrella of the community compensation.

4.4.3. Preparation of asset inventory and PAPs identification

To prepare for compensation and other resettlement benefits, it is imperative that a comprehensive asset and affected persons inventory in the designated areas for the different project components is done. The inventory will specify the different assets, properties affected

in each plot of land and their owners. The Land Valuation Bureau which is the entity responsible for undertaking valuation of assets will be responsible for the valuation exercise and will therefore provide independent valuation experts. The valuation document will indicate when the affected person will be notified, and that the inventory will not be official until a second signed copy, verified by project supervisory staff, is returned to the affected person. At this time, a copy of the grievance procedure will also be given to the affected person as stated in the grievance redress mechanism. The valuation experts will work hand in hand with the local leaders of the area. So far, one PAP has been identified and initial assets inventory conducted. Final assets inventory and valuation will be conducted by independent valuer.

4.4.4. Forms of Compensation

Individual and household compensation will be made in cash, in kind, and/or through assistance. The type of compensation will be an individual choice although every effort will be made to instill the importance and preference of accepting in kind compensation if the loss amounts to more than 20% of the total loss of subsistence assets. Compensation payments raises issues regarding inflation, security and timing that must be considered. One purpose of providing in-kind compensation is to reduce inflationary pressure on the cost of goods and services. Local inflation may still occur and thus market prices will be monitored within the time that compensation is being made to allow for adjustments in compensation values. The issue of security, especially for people who will be receiving cash compensation payments should be addressed by the local administration. The ARAP has provided an entitlement matrix that shows type of compensation for each category.

4.4.5. Procedures for delivery of compensation

It is recommended that compensation be made through reputable local banks. This will ensure security of the PAPs money especially for those receiving large sums. Forms acknowledging receipt of the compensation packages shall be signed by each PAP.

4.4.6. Verification and Disclosure of entitlements

PAP will be fully involved in the process of valuation of his land, trees and crops and the property valuation form shall be presented tohim for verification and in return, the form will sign or thumb press in ink as a sign of agreement. The form will be approved by village, Cell and Sector authorities who countersign as a sign of approval and authorization of legal process. Thereafter the form will be forwarded to WASAC for approval and payment process by MINECOFIN.

4.4.7. Cut - off date

Under World Bank OP 4.12, cut-off date is defined as the date of completion of the census and assets inventory of persons affected by the project. Any people occupying the project area after the cut-off date are not eligible for compensation and/or resettlementassistance. The cut-off date in this ARAP refers to the timeframe to be advertised by WASAC in close collaboration by Gasabo District and local authorities beyond which no more claims could be made at which point any assessment of new persons and their property would be undertaken. The establishment of a cut-off date is required to prevent opportunistic invasions/rush migration into the chosen land areas. Persons who encroach on the area after the cut-off date are not entitled to compensation. It should benoted that the cut-off date should be determined

before the census is conducted and agreed by all thestakeholders.

The cut of date in our case is not yet fixed and communicated officially. This is planned after all project designs and approvals are in place. WASAC will write officially to all sectors and the communication will be handed to all village leaders of the project area and communicated to local communities during monthly community work.

4.5. A-RAP implementation arrangements

The overall coordination of this A-RAP implementation will be provided Water and Sanitation Corporation (WASAC Ltd). Other stakeholders that will be involved inits implementation are described in detail below. The implementation arrangement builds on responsibilities already in place to ensure that the requirements of this A-RAP are met. At local level, Gasabo district is responsible institution of A-RAP implementation while Kigali City ensures that the proposed project is in line with the city development plans and do not compromise the requirements of the Kigali City Master Plan.

4.5.1. A-RAP implementing Institutions

- ✓ **Ministry of Infrastructures**

Government of Rwanda represented by Ministry of Infrastructure via WASAC Ltd is responsible forland acquisition and hence responsible for A-RAP implementation. The A-RAP implementation will be done through Water and Sanitation Corporation (WASAC Ltd which is the main agency involved in implementation of the project. Ministry of Infrastructure will work together with Ministry of Finance to ensure that compensations funds are secured on time and compensation is made in due time.

- ✓ **Water and Sanitation Corporation Limited**

WASAC Ltd is the technical institution responsible for the project on government side. Therefore, WASAC Ltd will be the leading institution in the implementation of this A-RAP. The role of WASAC Ltd will be but not limited to recruitment of independent assets valuer, responsible for coordination and monitoring activities related to asset valuation, and WASAC will appoint an environmental and social safeguard specialist who hewill be the focal point for A-RAP implementation and will liaise with other stakeholders in this regard. The designated staff will ensure that procedures and requirements of the Rwandan laws and JICA consideration on environment and social consideration are complied with. A key role will be to implement the A-RAP and other resettlement-related activities and to ensure that all procedures have been adhered to and that there is consistency in approach between sub-projects activities. He/ She will also undertake the main monitoring and evaluation role of resettlement activities during and post implementation.

- ✓ **Rwanda Land Management and Use Authority/ RLMUA**

RLMUA is the organ responsible for overall management and coordination of all activities related to land administration, land use planning and management in Rwanda. The role of RLMUA in A-RAP process will be to advise on matters related to land ownership and expropriation. District land office in close collaboration with project staff will check and approve valuation forms, and after compensation RLMUA will also play a key role in in the process of transferring and registering land titles as appropriate.

- ✓ **Gasabo district**

Gasabo District through its land office will be responsible for ensuring that activities undertaken comply with the national laws and regulations. The district will assess the validity of land tenure rights of affected

persons and will be responsible for ensuring that effective grievance mechanisms are in place. Gasabo district will also be used in the implementation of A-RAP as much as possible to reduce the dispute that may occur during the A-RAP implementation Gasabo district will be supported with land office at sector level and community development officer at cell level.

- ✓ **Project Affected Person**

The project affect person will also participate in the A-RAP implementation and is required to be present during finalvaluation and participate in complaints resolutions.

4.5.2. Grievance Redress Mechanism (GRM)

The district is an acknowledged institution for which the PAP has been made aware of as avenue for expressing discontent and disapprovals related to compensation process. Article 26 of the expropriation law N0 18/2015 of 19/04/2015 provides complaints procedures for individuals dissatisfied with the value of their compensation. The law stipulates that dissatisfied person have a period of 30 days after project approval decision has been taken to appeal (Article 19). Grievance procedures are required to ensure that PAPs can lodge complaints or concerns, without cost, and with the assurance of a timely and satisfactory resolution of the issue. Grievances may arise from members of communities who are dissatisfied with eligibility criteria use, community planning and actual implementation or compensation. Considering the number of PAP during this project implementation, the grievance shall be addressed directly to WASAC Ltd and whom will in return receives the complaint and thereafter together with the local leaders from village to district level will ensure the case is amicably solved with satisfaction to both parties during a complains resolution meeting that will include the PAP and his relatives.

4.5.3. A-RAP Monitoring

The objective of the monitoring and evaluation process will be to determine whether PAP has been paid in full and before implementation of the project the affected person is now living a higher standard than before, living at the same standard as before, or is poorer than before. This will be done regarding the income generated before from the project site comparatively to the income generated after the project is implemented. The arrangements for monitoring the compensation activities will fit into the overall monitoring program of the entire project which will fall under the overall responsibility of the JICA and WASAC.

- ✓ **Monitoring indicators**

Different indicators would be used to determine the status of affected people (land beingused compared to before, , level of living conditions compared to before, health standards and soon). The affected personnel is able to maintainhis pre-project standard of living, and even improve on it; and the local communities remain supportive of the project.

- ✓ **Monitoring of livelihood restoration**

The affected land is allocated to residential but there is no house constructed on the land. Therefore, there is no loss of income or means of livelihoods. However, WASAC will ensure that the affected person is compensated and monitor the status of affected compensation plans performance.

Table 12: ARAP Implementation Cost

No	Item description	HHs	Unit	Quantity	Total Cost(frw)[1]
1	Permanent loss of land	1	Sqm	1,308	61,619,880
2	Loss of trees and crops	1	Pces/ Sqm	569 4408	2,896,250
	Subtotal				**64,516,130**
	5% of disturbance allowances	1	%	5	3,225,807
3	Final valuation	1	Ls		225,000
	TOTAL RAP implementation				**67,966,937**

Table 13 : Monitoring Cost

Activity	Indicator	Qty	Unit cost (FRW)	Total Cost (FRW)
Follow up valuation and compensation process	Field report	1	70,000	70,000
Meetings for grievance redress	Meetings/grievance resolved	8	70,000	560,000
PAPs Livelihoods assessment	Assessment report	2	70,000	140,000
Total				**770,000**

4.5.4. A-RAP disclosure

JICA and other international policies on environmental and social safeguards require the implementing agency to disclose publicly the A-RAP. Therefore, WASAC will disclose this A-RAP by making copies available at its head office and at District and sector offices. The A-RAP will be disclosed to the WASAC Website, and the Government of Rwanda will also authorize JICA to disclose this A-RAP electronically.

A completion report of the entire compensation process for this project will be prepared andwill include a hand over certificate which will ostensibly provide a verification of when the compensationand assistance were undertaken and to whom these services were provided as well as to indicate that indeed all the compensation has been delivered. This report will be prepared and submitted to JICA after the end of compensation payment by WASAC. The A-RAP implementation report should include (but not be limited to) the following information:

- Background of the A-RAP preparation including a description of the project activities, scope of impacts, number of affected persons, and estimate budget;
- Update of ARAP implementation including compensation paid, issues/complaints raised and solutions provided;
- Early assessment of the impacts of resettlement and compensation on affected categories at the timeof the report production;
- Lessons learned from the A-RAP implementation;

[1] 1USD=1035 Rwandan Francs

ANNEXES

Annex 1:List of consulted people at central and local institutions

No	Names	Contact	Institution	Function
1	ABIMANA Eric	0787812829	Bibare Cell	Community and Economic Development Officer
2	Alain SEZIBERA	0788521930	RDB	EIA Analyst
3	BUGINGO Davis	0788230018	Flood Management and Water Storage Development Division Manager	Rwanda Water Board
4	BYUKUSENGE Jean d'Amour	0788984400	Musezero Cell	Community and Economic Development Officer
5	DUFATANYE Israel	0788481541	REMA	Environmental Inspector
6	DUSABIMANA Annuaritte	0788452328	Gisozi Sector	Health and Sanitation Officer
7	Eng. MUHORAKEYE Jeanne	0788875101	Kimironko sector	Act land management & Notary team leader
8	Enode NIYONSABA	0787958813	Nyabisindu	Executive Secretary
9	GASANA Donatien	0785984429	Gasharu Cell	Community and Economic Development Officer
10	HABINSHUTI Jean Pierre	0788881465	Gasabo District	Water District Engineer
11	HAVUGUZIGA NTABWIKO Charles	0788300397	Kanyinya sector	Executive secretary
12	Jean Pacifique TUYISHIMIRE	0783393820	Murama cell	Community and Economic Development Officer
13	Jeannine MUKARUKUNDO	0783441942	Kibagabaga cell	Community and Economic Development Officer
14	KALISA Hamza Fidel	0788876579	Gisozi Sector	Land manager support Officer
15	KARAMUZI Godfrey	0788861810	Remera sector	Executive secretary
16	KARURANGA Dismas	0788779208	Rwanda Water and Forest Authority	In charge of Water Quality
17	KAYITESI Redempta	0783877212	Gacuriro cell	Executive Secretary
18	MBONAMPEKA Claudine	0788492092	Rukiri II	Executive Secretary
19	MUKAMANA Phoebe	0788583832	Gasabo District	Environmental Officer
20	MUKAMANA Phoebe	0788583832	Gasabo District	District Environmental Officer
21	MUKAMURENZI Antoinette	0788683611	Gisozi Sector	Health and good governance
22	MUKANTWARI Sandrine	0787433065	Gasharu Cell	ES of the cell
23	MUSASANGOHE Providence	0788451827	Gisozi Sector	Executive Secretary
24	NDAMYIMANA Elysée	0788414332	Remera sector	Land bureau
25	NIYONSABA Pascal	0738583283	Rukiri I	Executive Secretary
26	NSENGIMANA Janvier	0788668943	Remera sector	Community Heath and Sanitation Officer
27	RUGAMBIRWA Deo	0788815450	Bumbogo Sector	Executive Secretary
28	RUKUNDO Augustin	0782756565	Gasabo District	District Sanitation Officer
29	RUSINE Alphonse	0788440290	Gasabo District	Land Survey & GIS
30	RUTARINDWA Alphonse	0784902626	Gasabo District	Director of Health and Socio-economic development
31	SHUMBUSHO Faustin	0789198930	Bumbogo Sector	Ngara Cell Executive Secretary
32	TUYISHIMIRE Evelyne	0784388649	Nyagatovu cell	Community and Economic Development Officer
33	UMUHOZA MBATEYE Aimee Francine	0788486203	Water and Sanitation Corporation	In Charge of Planning
34	UMUHOZA RWABUKUMBA	0788304546	Kimironko sector	Executive secretary
35	UMURERWA Josiane	0788627922	Bumbogo Sector	Social affairs
36	UWAMAHORO Chantal	0788946525	Kimironko sector	Community heath and sanitation officer
37	UWAMAHORO Jeanne d'Arc	0788315593	Nyarutarama cell	Community and Economic Development Officer
38	UWAMAHORO Jeanne d'Arc	0788649667	Kimironko sector	Social affairs
39	UWERA Jeanne d'Arc	0787959858	Bumbogo Sector	Customer care

UMURENGE WA GISOZI

AKAGARI KA MUSEZERO

UMUDUGUDU WA GASHARU

ABITABIRIYE UMUGANDA USOZA UKWEZI KWA WERURWE 2022

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IGE WA GISOZI

RI KA MUSEZERO

GUDU WA GASHARU

ABITABIRIYE UMUGANDA USOZA UKWEZI KWA WERURWE 2022

AMAZINA YOMBI	ISIBO ABARIZWAMO	TELEFONE	UMUKONO
NUHISABA Nepo.	INGENZI	078[illegible]5535	[illegible]
FATIFAMA J [illegible]	URUMULI[illegible]	0788305[illegible]	[illegible]
KARABINSTETI [illegible]	INGENZI	078[illegible]90[illegible]	[illegible]
NIBISHAKA ISaac	INTWARI	0786[illegible]	[illegible]
HABIMANA	UMA	0[illegible]	[illegible]
KIMONYO J.M.V	umumurikan	0738786468	[illegible]
N[illegible] [illegible]	Intabaza	078[illegible]06	[illegible]
[illegible] Fidele	umutekano	0788[illegible]	[illegible]
[illegible]	umutekano		[illegible]

UMURENGE WA GISOZI

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MUDUGUDU WA GASHARU

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KAGARI KA MUSEZERO

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UMURENGE WA GISOZI

AKAGARI KA MUSEZERO

UMUDUGUDU WA GASHARU

ABITABIRIYE UMUGANDA USOZA UKWEZI KWA WERURWE 2022

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Annex 2: Minutes of additional consultation with affected person, July 26, 2022

Le 26/07/2022

INAMA/IKIGANIRO KUSANYAMAKURU

Uyu munsi tariki ya 26/7/2022 mu mudugudu wa Nyakabungo, akagari ka Kagugu Umurenge wa Kinyinya habereye ikiganiro hagati ya Fabien NSHIMIYIMANA Umukozi wa BESST Ltd na Augustin MPAGAZEHE ku bijyanye n'ubutaka bwe (Augustin) buzubakwaho ikigega cy'amazi na WASAC.

Ibyaganiriweho: - Ingano y'ubutaka buzubakwaho ikigega n'ubuzasigara.
- Uburyo bw'igenagaciro
- Igihe cyo kugena agaciro no kwishyura
- Imbago z'ubutaka

Imyanzuro yafashwe

- Bitewe n'uko ubutaka buzasigara butavamo cyangwa ngo bukoreshwe ikindi bikorwa bitewe n'ingano yabwo (308m²), Augustin yifuje ko ubutaka bwose buzakorerwa igenagaciro bukishyurwa bwose (1308m²).
- Augustin yifuje ko mu gihe cy'igenagaciro byakorwa neza agahabwa ingurane y'amafaranga ikwiye kandi ijyanye n'agaciro k'aho ubutaka buherereye (mu mugi wa Kigali, ahegereye imihanda, ku muhanda n'ibindi)
- Hifujwe ko kugena agaciro byakorwa vuba kuko hari benshi bifuza kugura ubutaka bwa Augustin akaba abahakanira kuko yiteze ko WASAC izabubaka ikigega cy'amazi (byibuze mu mezi abiri uhereye ubu).
- Ku bijyanye n'imbago, Augustin avuga ko ubutaka bwe bufatanye n'ubwa centrale kuko nta wundi bafitanye imbibi. Haramutse hari ikibazo mu makimbirane ajyanye ku cyangombwa cy'ubutaka byazasubirwaho neza bigakosorwa.
- Igihe cy'igenagaciro ingano y'atomu ku ijana y'agaciro kose (5%) izomba kuzubahirizwa kandi igihe cyo kwishyurwa bigakorwa vuba amategeko yubahirijwe.

Fabien NSHIMIYIMANA 0788737544 [signature]

Augustin MPAGAZEHE 0788499955 [signature]

HAKIZIMANA Justin 0788499955 [signature] (Fils)

KABARANGE Aurelie 078777 1392 [signature]

Annex 3:Crops reference prices 2021 in the project area

INSTITUTE OF REAL PROPERTY VALUERS IN RWANDA

ORDRE DES EVALUATEURS DES BIENS IMMOBILIERS AU RWANDA

CROPS REFERENCE PRICES (IBICIRO NGENDERWAHO BY'IBIHINGWA/IBITI)

IBITI BIBAZWA /BOIS D' OEUVRE

Minimum rate is meant for trees fresh from nursery and Maximum price is for trees ready for production. It is important to note that after optimum age of production, this type of trees may depreciate when they can no longer serve the core purpose because of age.

Commonly known as	Unit	Minimum rate (FRW)	Maximum rate (FRW)
Gereveliya	piece	1000	5,500
Umusave	pces	1000	10,000
Inturusu	pces	1000	6,500
Umuko	pces	1000	8000
Sipure	pces	1000	5300
Pinusi	pces	1000	5500
Sakaranda	pces	1000	6500
Acacia	pces	1000	6500
Lilas	pces	1000	5200
Araucaria	pces	1000	6500
Filawo	pces	1000	4500

CULTURES /IMYAKA

Minimum rate is for crops comparable to nursery level and maximum rate is for pick production stage. Other factors may be the type of seeds, the nature of soil and normal production from it in the area; guidance by an agronomist may be useful if necessary.

Commonly known as	Unit	Minimum rate (FRW)	Maximum rate (FRW)
Ibishyimbo/beans	sqm	80	150
Amashaza/Petit poids	sqm	80	150
Ubunyobwa/Arachides	sqm	100	220
Ingano/Orge	sqm	60	100
Amasaka/Sorgho	sqm	60	100
Mais/Ibigoli	sqm	80	150
Uburo/Eleusine	sqm	300	500
Ibirayi/Pomme de terre	sqm	250	400
Amateke/Colocases	sqm	150	250
Ibikoro/Ignames	sqm	50	100
Ibijumba/Patates douces	sqm	150	250
Imyumbati/Maniocs	sqm	250	400
Isombe/Maniocs-legumes	sqm	800	1.500
Soya/Soja	sqm	100	250
Amashu/ Choux	sqm	500	900
Ibitunguru/Oignons	sqm	250	400

CHIC Building 2nd Floor, P.O Box 6736 KIGALI, Cell : +250 788501515/ +250
email : irpv.rw@gmail.com, website: www.irpv.rw

Inyanya/Tomates	sqm	500	800
Intoryi/Abergines	sqm	600	1,000
Karoti/Carottes	sqm	200	300
Saladi/Salades	sqm	150	250
Sereli/Celery	sqm	200	300
Inzuzi/Courges	sqm	3,000	4,000
Izindi mboga/Autres legumes	sqm	50	300
Ananasi/Ananas	sqm	1,350	2,000
Ipamba/Coton	sqm	720	1,500
Umuceli /Riz paddy	sqm	360	700
Itabi/Tabac	sqm	1,000	1,200
Ibisheke/Canne a sucre	sqm	400	1,000

IBITI BYERA IMBUTO ZIRIBWA N'IBITI BIVAMO IMITI/ PLANTES FRUITIERES ET MEDICINALES/ FRUIT AND MEDICINAL PLANTS

Minimum rate is meant for trees fresh from nursery and Maximum price is for trees ready for production. It is important to note that after optimum age of production, this type of trees may depreciate when they can no longer serve the core purpose because of age. Other factors may be the state of care and appearance and visible level of production for items in that age.

Commonly known as	Unit	Minimum rate (FRW)	Maximum rate (FRW)
Maracouja	pce	1,000	3,000
Ibinyomoro/Prunier du Japon	pce	1,000	3,000
Umutima w'imfizi /Coeur de boeuf	pces	2,000	10,000
Umwembe/Manguier	pces	2,000	10,000
Ipera/Goyavier	pces	2,000	10,000
Ipapayi/Papayer	pces	2,000	10,000
Les Agrumes	pces	3,000	12,000
Macadamia	pces	2,000	30,000
Igiti cy'avoka/Avocatier	pces	3,000	20,000
Vanilla	pces	2,000	10,000
Igiti cya Moringa	pces	3,000	12,000
Ibobere/Murier	pces	1,500	8,000
Ibindi biti byera imbuto ziribwa Bitavuzwe/Autres arbres fruitiers	pces	2,000	10,000
Ibiti bitanga imiti ya Kinyarwanda/Plantes medecinales	pces	5,000	20,000

IBIHINGWA N'IBITI NKONDABUTAKA/ CULTURES PLURIANNUELES ET PERENNES/ MULTI-ANNUAL AND PERENNIAL CROPS

Minimum rate is meant for trees fresh from nursery and Maximum price is for trees ready for production. It is important to note that after optimum age of production, this type of trees may depreciate when they can no longer serve the core purpose because of age. Other factors may be the state of care and appearance and visible level of production for items in that age.

Commonly known as	Unit	Minimum rate (FRW)	Maximum rate (FRW)
Ikawa/Cafeier	pces	1,500	10,000
Ibireti/Pyrethre	pces	50	200
Icyayi/Theiers	pces	500	3,000
Ikinini/Quinquina	pces	300	1,000
Urutoki/Bananeraie	pces	1,500	5,000
Urusenda/Pili pili	pces	200	500
Ikibingo/Pennisetum	sqm	350	2,000
Tiribusakumu/Tripsacum	sqm	350	1,000
Vetiveri/Vetivers	sqm	350	1,000
Setariya/Setaria	sqm	350	1,000
Kikuyu grass	sqm	3,000	8,000
Macyayicyayi/Citronnelle	sqm	350	500
Desmodium	sqm	5,000	12,000
Luzeme	sqm	7,000	15,000
Trefle	sqm	7,000	15,000
Mucuna	sqm	7,000	15,000
Umugwegwe/Sisal	pces	350	1,500
Umugano/Bambou	pces	300	2,000
Imiyenzi/Euphorbes	pces	500	1,000
Urugo rw'imiyenzi	sqm	500	3,000
Imihati	pces	500	1,500
Urugo rw'imihati	sqm	500	2,500
Urugo rw'imbingo cyangwa imiseke	sqm	1,600	3,000
Urugo rwa sipure	sqm	1,500	5,000
Imivumu	pces	6,000	20,000
Umuko	pces	1,000	10,000
Utundi duti tutavuzwe ariko twatewe	pces	600	1,000
Ikinobonobo/Ricin	pces	400	1,000

Annex 4: Land reference prices 2021 in the project area

INSTITUTE OF REAL PROPERTY VALUERS IN RWANDA

ORDRE DES EVALUATEURS DES BIENS IMMOBILIERS AU RWANDA

Sector	Cell	Village	Land Use	Minimum Value Per Sqm	Weighted Average Value Per Sqm	Maximum Value Per Sqm
			Farm Land (General)	16,782	24,210	65,720
			Low Rise Residential	14,198	22,646	58,797
			Plantation	15,160	21,870	68,614
			Vacant Land	13,961	25,162	29,330
		Kabuhunde II		11,547	15,340	34,281
			Farm Land (General)	11,547	15,340	34,281
		Kadobogo		13,242	22,635	73,691
			Farm Land (General)	18,515	23,069	73,691
			Health Facilities	15,558	25,305	28,342
			Low Rise Residential	13,242	22,342	44,287
			Vacant Land	17,368	19,824	36,746
		Kagarama		13,759	22,992	98,449
			Existing Forest	18,479	34,128	41,821
			Farm Land (General)	13,759	18,788	98,449
			Low Rise Residential	18,847	19,309	46,932
			Plantation	14,457	19,742	83,752
		Muhororo		9,646	14,386	71,865
			Farm Land (General)	9,887	13,661	71,865
			Low Rise Residential	11,244	16,168	37,571
			Plantation	9,646	13,328	70,398
		Nyakabungo		13,261	23,963	64,246
			Commercial General	19,749	33,883	38,200
			Farm Land (General)	13,261	19,995	64,246
			Low Rise Residential	13,545	23,272	47,110
			Plantation	15,377	23,186	51,192
			Religious Facilities	17,368	21,287	36,746
			Wetland	17,368	22,154	36,746
		Rukingu		11,853	21,349	82,348
			Commercial General	21,729	26,276	60,908

RDB | RWANDA DEVELOPMENT BOARD

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) CERTIFICATE

N°: RDB/EIA/4427/07/22 **Issued Date: 29/07/2022**

This is to certify that the Environmental Impact Statement (EIS) was received from **Water and Sanitation Corporation (WASAC Ltd).**

Project title: **IMPROVEMENT OF WATER SUPPLY SERVICES IN NORTH-CENTRAL KIGALI in Gisozi, Remera, Kinyinya Sector, Gasabo**

Project objective:

Develop and renew water transmission and distribution facilities between Ntora reservoir and Remera Golf 8 reservoir with the aim to secure water supply capacity by reducing NRW

Location: **Gasabo** District(s) , **Gisozi, Remera, Kinyinya** Sector(s), **Nyabisindu, Kagugu, Gacuriro, Musezero, Nyarutarama, Ruhango** Cell(s).

The EIS has been submitted in accordance with the Laws and Regulations relating to the requirements & procedures for Environmental Impact Assessment in Rwanda and has been reviewed and found to have sufficient and relevant mitigation measures to the identified likely impacts of the project on the environment.

It was therefore approved subject to fulfilment of the conditions attached to this certificate.

Clare AKAMANZI

Chief Executive Officer

Fred KAREMERA

Copies to: REMA, MININFRA,Gasabo District

添付資料 7 ソフトコンポーネント計画書

ルワンダ国キガリ市中央北部給水サービス改善計画

ソフトコンポーネント計画

1 ソフトコンポーネントを計画する背景

1.1 本事業の概要

「ルワンダ国キガリ市中央北部給水サービス改善計画」は、キガリ市中央北部において、給水圧力の安定化・漏水の減少を目的とするブロック配水システムの導入を行うことで、同地域の安定的な水供給を図るものである。実施機関は水衛生公社（WASAC : Water and Sanitation Corporation）である。**表 1** に本事業の概要を示す。

表 1　ルワンダ国キガリ市中央北部給水サービス改善計画の概要

A.	**施設建設**	
1.	配水池および高架水槽	2 か所（付帯配管・場内整備含む） (1)　Kagugu 高架水槽, 500 m^3 (2)　Batsinda 配水池, 1,000 m^3
2.	減圧設備	減圧水槽　4 か所、減圧弁　2 か所
3.	送水管および配水本管	配水用高密度ポリエチレン（HDPE）管　口径*1160 mm-355 mm: 63 km ダクタイル鋳鉄管（DIP）　口径*1 200 mm: 1.8 km
4.	配水支管および給水管	Batsinda 給水区域内: 配水用高密度ポリエチレン（HDPE）管　口径 63 mm-110 mm: 20 km 配水用高密度ポリエチレン（HDPE）管　口径 25mm: 50 km
5.	既存送水管改修	既存送水管 ダクタイル鋳鉄管（DIP）口径 400 mm および 500 mm ・仕切弁・空気弁および排水設備
6.	配水管理システム	流量計:20 箇所, 水位計: 7 箇所 既存 SCADA システム改修（配水管理システム） 付帯電気設備・通信設備
B.	**資機材調達**（建設工事契約の一部として調達）	
1.	配水支管・補助管	配水用高密度ポリエチレン（HDPE）管 口径 63 mm – 110 mm: 68 km
2.	給水管および付帯設備	配水用高密度ポリエチレン（HDPE）管　口径 25 mm (3/4”): 100 km ・サドル分水栓(5,000 組)、バルブ等 ・水道メーター（7,500 件）
3.	その他	・配水支管・給水管接続用資機材 2 セット

*1 配水用高密度ポリエチレン管は外径、ダクタイル鋳鉄管は内径表示（いずれも呼び径）

出典：調査団

1.2 ソフトコンポーネントの必要性

本事業においては、WASAC が相手国負担事項の適切な実施と、整備・更新した施設の適切な運用と維持管理を行う必要がある。その現状の課題は以下の通りである。

(1) 相手国負担事項の実施

1) 配水支管・給水管の施工と施工監理

本事業においては、150-300mm の配水本管は配水ブロックを構成する重要な管路であり、ルートを確定した上での確実な施工が必要であるため、本邦業者の施工とする。他方、配水支管・補助管、給水管の多くは資材調達を無償資金協力で行い、WASAC が施工する。

「キガリ市無収水対策強化プロジェクト」（2016 年 7 月～2022 年 9 月）（以下、「前無収水技プロ」）では、配水支管及び給水管の施工に関する設計・施工指針（STANDARDISATION FOR NRW REDUCTION）を作成した。しかしながら、協力準備調査中の現地工事視察時において、給水管が設計・施工指針通りの適切な深度に埋設されていないケースが見られた。舗装のない浅層埋設により、車両等の荷重が給水管に伝わり漏水の発生が予想される等、WASAC の布設技術はまだ十分とは言い難く、品質の悪い管材やメーターを使っている事例も見られた。特に管材質については、現状では PVC が主に使われているが本事業では HDPE を用いる予定であり、WASAC は HDPE 管の扱いに十分慣れていない。

配水支管及び給水管の布設を WASAC が直営で行うか、民間工事業者へ委託するかについては、WASAC が検討中であり、DOD ミッションにおいて具体的な方針を確認する予定である。もし直営で行う場合は、現行の WASAC の体制では、本事業で想定する数量の配水支管及び給水管を布設するための施工技術者及び施工監理技術者がともに不足している。そのために給配水管路施工技術者を新規に雇用する必要があるが、新規に配属される予定の技術職員に対し、適切な給配水管路の施工および施工監理技術について教育を行う必要がある。WASAC 直営での工事経験は多くはないため、WASAC が組織的に施工品質を管理する体制も検討する必要がある。また、民間工事業者へ委託する場合でも、WASAC が適切な給配水管路の施工および施工監理技術について理解し、民間工事会社への技術指導や施工管理、工程管理を行う必要がある。

2) 給配水管布設記録の作成・保管（GIS マッピングシステムの更新）

GIS での顧客情報の入力や管路データの更新について、実際の新規給水管の接続工事から、数日遅れて入力され、WASAC のサーバへの反映にも時間がかかるケースが確認されている。また、顧客メーターの位置は GPS を使って比較的正確に管理されているものの、給水管の埋設位置が正確に入力されていないケースがみられる。

GIS システムの運用体制については、キガリ市内の 6 支所、全国の 14 支所の管路更新のすべてを UWSSD の GIS ユニット担当者が 1 名で管理している。各支所においては、テクニシャンと呼ばれる配管技術者が GIS タブレットを現地に持参し、顧客メーターの位置を特定し、顧客メーターを設置する。その後、管路を入力し、配水係員（以下、「Water Distribution Officer：WDO）がその入力内容を確認している。人員や能力の不足から、データ入力の遅れや不正確な管路位置の入力がみられる。このように GIS データの更新に関し、人員の配置計画の検討や手順改善等について支援が必要である。

3) 本事業に使用する管路資材の入出庫管理

本事業では、60km 以上の管材や 7,500 個の水道メーター等、大量の資材が必要となる。これらはノトラ配水池の資材置き場で保管される予定だが、適切な資材管理と工事工程に合わせた計画的かつ迅速な入出庫管理が求められる。そのために新たな出入庫管理台帳を作成し、トレーニン

グする必要がある。具体的には、資材管理者が、今後予定される工事に必要とされる資材を事前に想定し、出庫予定台帳を作成する。出庫予定台帳に合わせ、実際の工事資材を事前に準備し、WASAC の複数の配水支管工事班、給水管工事班の工事進捗に合わせて出庫する。その後、出庫台帳を更新し、管路資材の入出庫を管理する必要がある。

(2) 本事業で整備・更新した施設の運用と維持管理

1) モニタリングシステムの運用と保守

本事業で構築する配水ブロックの適切な運用のため、配水ブロックの配水状況や配水池の状態把握、送水ポンプの稼働状態、施設の故障発生状況等をリアルタイムで集中監視し、その状況に応じて WASAC が施設の故障の発生等に適切に対応するためのモニタリングシステムを導入する。対象とする配水ブロックのモニタリング対象範囲は、各配水ブロックへの流入量、ンゾベ浄水場からの送水量、さらに途中の配水池の運用をするための水位情報が主な管理情報である。

本事業で整備するモニタリングシステムは、前無収水技プロにより設置された現在のモニタリングシステムを拡張して運用する予定である。具体的には、被監視設備として配水ブロックへの流入地点における流量計や配水池と高架水槽の水位計等を追加して、漏水を含む機器の故障等の突発的な異常の発生を監視する。加えて、常時監視用の大型モニターを設置し、個々の PC 上においても容易に監視が可能となるよう Web 監視機能を強化するとともに、常時監視体制（管理者および 24 時間カスタマーセンターでの常時監視）を構築する。これにより、漏水や給水不良等の異常の早期発見と異常解決のための早期対応が可能となる。

また、本事業では、収集したデータの集計や評価機能の強化策として、配水ブロック流入流量等のデータベースシステムを追加する。このシステムにより、料金徴収システムからの転送されたデータに基づき、無収水率（漏水率）の算出、ブロック毎の集計の照合、集計データによる年報、月報、日報の作成を含む、ブロック内の水需要予測を始めとする各種シミュレーションが可能となる。

このモニタリングシステムにより、異常の早期発見とその対応と配水ブロック内の無収水率の経時変化の確認や水需要予測が可能となるが、その異常に応じた対応策の実施や無収水率の算定、水需要予測によって必要となる配水量の検討等のための能力強化支援が必要である。

また、現状では、モニタリングシステムの故障に対応する技術者がおらず、メンテンナンスに必要な機器の供給体制も不明確である。現在のサーバ室内では基本的な目視点検・清掃等が行われていないため、機器にゴミが溜まってオーバーヒートするなどの問題が発生している。モニタリングシステムの運用・保守のためのメンテナンス技術・点検フォームを使った管理が必要である。

2) 水道施設の維持管理

前無収水技プロにおいて、配水支管および給水管を含む地下埋設管の漏水調査についての能力

強化に取り組んだが、依然として目視で発見して修繕できるはずの地上漏水や、必要な際にバルブが動作しない等の基礎的な問題が解決されていない。管路については、地元住民からの通報があった場合に、地表面に確認された漏水を修繕対応しているのみである。また、コンクリート配水池本体の維持管理のための定期点検は実施されておらず、配水場内においても、機能していないバルブが交換されていないケースがみられる。

これらは、水道設備の維持管理に必要な技術的能力が WASAC にまだ不十分であることが一因となっている。本事業で整備した常時監視モニタリングシステムにより検出された異常値や警報に基づき、現場で迅速に対応するためにも、こうした技術を総合的に強化する必要がある。また、維持管理計画に基づいた定期的な点検活動が実施されていないことも課題であり、本事業で整備した施設を含む定期点検計画を策定し、実施する必要がある。

1.3 本ソフトコンポーネントで対象とする内容

上記の課題を踏まえ、**表 2** にまとめたソフトコンポーネントを実施する。その際には前無収水技プロを通して移転した技術も活用しつつ、本ソフトコンポーネント終了後も技術定着のため、2022 年 3 月より実施中の技術協力「キガリ市水道事業体運営改善プロジェクト」で継続的に支援を行う。

配水支管・給水管の施工は、本事業における最も重要な相手国負担事項の一つである。その円滑な実施開始のためには、配水支管・給水管・メーターの品質理解や布設・接続技術の習得、施工監理・工程管理計画の立案が重要であり、本ソフトコンポーネントで支援を行う。一方、水道施設の維持管理に関しては中長期的な技術力の向上が必要となるため、本ソフトコンポーネントの対象外とし、「キガリ市水道事業体運営改善プロジェクト」で支援を行う。

表 2　ソフトコンポーネントでの支援内容と本事業での WASAC の課題

ソフトコンポーネントでの支援内容	前無収水技プロの活動	本事業での WASAC の課題
1.配水支管・給水管の施工と施工監理		
1.1　配水支管・給水管・メーターの品質・検査規定の理解、布設・接続技術の習得・技術指針の理解、施工監理・工程管理の理解	WASAC が利用する資材（PVC）での接続指針の見直し等、技術移転を実施した。	・本事業で実施する配水支管布設や給水管接続の数量は多く、WASAC が直営で布設、もしくは民間の工事会社へ委託することになるが、適切な配水支管・給水管・メーターの施工及び施工管理・工程管理のための支援が必要である。 ・給配水管材料とメーターの品質を適切に管理する必要がある
1.2 給配水管施工記録の作成・保管（GIS データ更新含む）	GIS マッピングのソフトウェア操作の技術を移転した。	・給水管工事施工後の迅速で正確な GIS 更新の体制が確立されていない。
1.3 資材入出庫管理体制の構築	-	・本事業では膨大な量の資材管理が必要であり、配水支管・給水管工事の進捗に合わせた資材の迅速な入出庫管理体制が構築されていない。

ソフトコンポーネントでの支援内容	前無収水技プロの活動	本事業での WASAC の課題
2. モニタリングシステムの運用と保守		
2.1 モニタリングシステムの運用（保守点検を含む）	モニタリングシステムを導入し、モニタリングに関する基礎的な技術を移転した。	・本事業で導入するモニタリングシステムについての理解、その運用・保守体制が確立されていない。 ・警報発生、異常値表示の原因分析、その対応方法が確立されていない。
2.2 データベースを活用した無収水率（漏水率）の算出、水需要の把握と分析	GIS ソフトウェアの操作技術習得、エクセルを使った無収水率の算定等についての技術を移転した。	・本事業で整備するデータベースで蓄積されたデータの分析による水需要予測等の各種シミュレーションができない。また、ブロック配水システムの改善点を把握できない。 ・GIS を使った顧客使用水量の算出ができない。 ・無収水率の算定方法が確立されていない。

出典：調査団

2 ソフトコンポーネントの目標

表 2 の整理を踏まえ、本ソフトコンポーネントの目標は以下とする。

本ソフトコンポーネントの目標は、「相手国負担事項である配水支管・給水管の施工促進と常時監視モニタリングシステムとデータベースの活用に必要な基礎的な技術を習得する」ことである。

3 ソフトコンポーネントの成果

本ソフトコンポーネントの成果を**表 3** に示す。

表 3　ソフトコンポーネントの成果

No.	項目	成果
1	配水支管・給水管の施工と施工監理	1.1 配水支管・給水管・メーターの品質・検査規定の理解、布設・接続技術の習得・技術指針の理解、施工監理・工程管理の理解 1.2 給配水管施工記録の作成・保管（GIS データ更新含む） 1.3 資材入出庫管理体制の構築
2	モニタリングシステムの運用と保守	2.1 モニタリングシステムの運用（保守点検を含む） 2.2 データベースを活用した無収水率（漏水率）の算出、水需要の把握と分析

出典：調査団

4 成果達成度の確認方法

ソフトコンポーネント終了時の成果と評価達成度の確認方法を**表 4** に示す。技術研修指導者は、成果チェックリストを用いて確認し、職員の知識と技術の理解度を評価する。

表 4　ソフトコンポーネントの成果とその確認方法

No.	成果	達成度の確認項目	達成度の確認方法
1	1.1 配水支管・給水管・メーターの品質・検査規定の理解、布設・接続技術の習得・技術指針の理解、施工監理・工程管理の理解 1.2 給配水管施工記録の作成・保管（GIS データ更新含む） 1.3 資材入出庫管理体制の構築	1.1 ・給配水管材料とメーターの検査規定と品質確認方法を理解する ・適切な管路施工および管路施工監理を理解し、施工監理・工程管理計画を作成する ・工程管理体制を検討する 1.2 ・人員の配置計画を作成する ・給配水管施工記録データを GIS へ入力し、更新する方法を理解する 1.3 ・表計算ソフト（Microsoft Excel、Access 等）を使い、配水支管・給水管工事の進捗に合わせた資材の入出庫管理を理解する	1.1 ・講義内容に対する試験を実施し、結果を確認 ・施工技術については、管路布設の実技により習得・理解度を確認 ・施工監理・工程管理計画の作成有無、また、それに基づき工事の一部が実施されているか確認 ・工程管理体制の検討有無 1.2 ・人員配置計画の作成有無の確認 ・工事進捗部分の給配水管施工及びメーター設置記録データが GIS へ更新されているか確認 1.3 ・入出庫台帳の作成有無、給配水管路工事の工程を基にした出庫計画の作成有無、配管資材の入出庫管理運用の一部が実施されているか確認 ・給配水管施工・監理マニュアル作成有無の確認
2	2.1 モニタリングシステムの運用（保守点検を含む） 2.2 データベースを活用した無収水率（漏水率）の算出、水需要の把握と分析	2.1 ・流量・水位、減圧水槽等を自動監視するモニタリングシステムと、その運用と保守・点検方法を理解する ・警報、異常値表示の原因分析とその対応を理解する 2.2 ・配水量データベースの変化に基づいた、水需要予測（シミュレーション）の方法を理解する ・GIS データを使った顧客使用水量を算出する方法を理解する ・ブロック内の配水量、給水量の測定値が適切か確認の上、無収水率の算出のために必要なデータを継続的に管理し、無収水率を算定する方法を理解する	2.1 ・モニタリングシステム運用・保守マニュアルの作成有無の確認 ・講義内容に対する試験を実施し、モニタリングシステムの運用と保守・点検方法、警報、異常値表示の原因分析とその対応についての理解度を確認 2.2 ・一部のデータを使った顧客使用水量と無収水率の算定、水需要予測が実施されているか確認

出典：調査団

5　ソフトコンポーネントの活動（投入計画）

本ソフトコンポーネントの活動内容を**表 5** に示す。

表 5　ソフトコンポーネントの概要

成果	必要とされる技術	必要とされる技術レベル/施設・資材	活動内容及び研修項目	活動方法	必要な投入量	成果品
成果 1. 1.1 ※1 配水支管・給水管・メーターの品質・検査規定の理解、布設・接続技術の習得・技術指針の理解、施工監理・工程管理の理解 1.2 給配水管施工記録の作成・保管（GIS データ更新含む） 1.3 資材入出庫管理体制の構築	技術：給配水管工事施工･監理、工程管理、在庫管理 業種：給配水管施工・監理、工事工程管理、在庫管理	1.1 ･適切な品質の配管･給水管材やメーターを使用し、本事業の設計に沿った布設ができるようになる。 ･適切な施工監理･工程管理を理解できる。 1.2 ・給配水管データ更新のための人員配置計画ができる ・GIS で管路及びメーターのデータが適切に更新されるようになる 1.3 ・本事業用管路資材の在庫を管理し、工事工程に合わせた出庫業務ができるようになる。	1.1 ・給配水管材料とメーターの品質確認・特徴の理解 ・工程管理計画案の策定（工程管理体制の立案、給水を維持しながらの工事手順、ブロック毎の工事順序や既存管の通水切断手順、既存管の静水圧管理、本邦工事と連携した工程等を含む） ・施工監理計画案の策定（施工監理体制、施工基準、使用した資機材の保管と管理、掘削時の安全管理、写真撮影・施工箇所の GPS での記録方法等を含む） ・給配水管布設技術、水圧試験・竣工検査方法の理解・習得・実践 1.2 ・人員配置計画の作成 ・給配水管施工記録の作成・保管と GIS データ更新 1.3 ・入出庫台帳の作成 ・工事工程を基にした出庫計画の作成 ・在庫・出庫管理 【1.1、1.2 施工及び施工監理対象者】 UWSSD5 名、カチル支所 2×5 名、レメラ支所 2×5 名、合計 25 名 【1.3 資材管理対象者】 レメラ支所中央倉庫 1 名、新ノトラ資材置き場担当者 2 名、UWSSD2 名、合計 5 名	・講義 ・配水支管・給水管布設現場での OJT（バチンダ地区を想定） ・資材置き場での OJT（ノトラ資材置き場を想定）	1.1、1.2 ・給配水管施工技術者（日本人コンサルタント）（企画/準備/実施/報告書）：1 名×2 カ月（現地） ・コンサルタント施工技術者：1 名×1.8 カ月 1.3 ・在庫管理技術者（日本人コンサルタント）（企画/準備/実施/報告書）：1 名×1 カ月（現地） ・現地コンサルタント技術者：1 名×0.8 カ月	・給配水管施工・監理マニュアル

成果	必要とされる技術	必要とされる技術レベル/施設・資材	活動内容及び研修項目	活動方法	必要な投入量	成果品
成果 2. 2.1 ※2 モニタリングシステムの運用（保守点検を含む） 2.2 データベースを活用した無収水率（漏水率）の算出、水需要の把握と分析	技術： ・配水管理・運転、維持管理 業種：計装システム	2.1 ・モニタリングシステム及びその保守点検を理解できる。 ・警報発生、異常値表示の原因と対応方法が理解できる（座学レベル）。 2.2 ・新設される配水ブロックエリアにおいて、無収水率の算定や水需要の把握と分析ができるようになる。	2.1 ・モニタリングシステム（機能や構成、計装設備等）の理解 ・モニタリングシステムの運転方法の理解 ・モニタリングシステム（配水池・高架水槽・減圧水槽の計装含む）の保守・点検方法の理解 ・異常検出時、警報発生時、遠隔強制遮断機能（配水池、高架水槽、減圧水槽）発生時の対応方法の理解 2.2 ・データベースシステムの構成、機能（無収水率の算出、ブロックごとの集計の照合、集計データによる年報、月報、日報の自動作成、各種シミュレーション等）の理解 ・GIS データと配水量データベースを活用した無収水率の算定 ・データベースを利用した水使用量の把握・分析 【対象】 UWSSD 職員 5 名、カチル支所 2 名、レメラ支所 2 名、他希望支所 3 名 合計 12 名	・講義 ・配水池、高架水槽、流量計設置地点、UWSSD 等での OJT	・モニタリングシステム技術者（日本人コンサルタント）企画/準備/実施/報告書 :1 名×1 カ月（現地） ・現地コンサルタント技術者：1 名×0.8 カ月	・モニタリングシステム運用・保守マニュアル

※1 配水支管布設や給水管接続を WASAC が直営で布設、もしくは民間の工事会社へ委託、いずれの場合でも内容・項目はほぼ同じ（各内容・項目の詳細は若干変わる可能性がある）。民間工事会社へ委託する場合は、その従事者も研修対象に加える。

※2 モニタリングシステムの一部（流量計及び水位計等の測定器の保守管理（分解点検調整及びゼロ・スパンの調整・電池交換等））の保守点検を民間企業へ委託する可能性があるが、そのような場合でも WASAC が理解しておくべき保守点検に関する基礎的な知識の習得を支援する。

出典：調査団

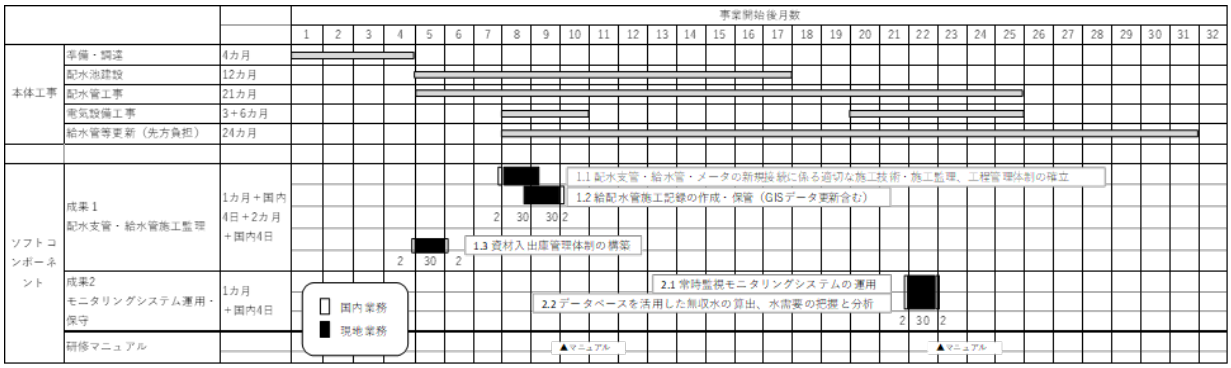
6　ソフトコンポーネントの実施リソースの調達方法

本ソフトコンポーネントは、上水道コンサルタント技術者（本邦コンサルタント：配水支管・給水管接続、管路資材在庫管理、モニタリングシステム運用・保守）の計 3 名による直接支援型とし、その期間は国内作業も含めて 4.6 カ月とし、本邦コンサルタントの現地作業支援のため、現地コンサルタントを 3.4 カ月雇用する。

7　ソフトコンポーネントの実施工程

ソフトコンポーネントの全体実施工程を**表 6** に示す。

表 6　　ソフトコンポーネント実施工程



出典：調査団

ソフトコンポーネント実施にあたっては、国内で各項目の実施計画を策定し、具体的な実施工程、研修手順を決定する。

ソフトコンポーネントについては、配水支管・給水管の資材の調達が完了した全体事業開始 5 カ月後から、資材管理にかかる指導を実施し、配水支管・給水管工事に備え、それの着手予定である全体事業開始 8 カ月後から配水支管・給水管施工管理及び給配水管施工記録にかかる指導を実施する。

その後、モニタリングシステム設備の設置完了後である 22 カ月後からモニタリングシステム運用・保守にかかる指導を行う。

8　ソフトコンポーネントの成果品

本ソフトコンポーネントにおける成果品および提出時期を**表 7** に示す。

表 7　成果品一覧

分類	成果品	内容	提出時期	頁数
マニュアル	給配水管施工・監理マニュアル	・配水支管・給水管の品質確認・布設方法 ※前無収水技プロで設計・施工指針を作成しており、そこに HDPE 管の接続方法等、必要な情報を追記する ・顧客メーターの品質確認・設置方法 ・GIS 更新方法 ・工事工程管理及び施工監理における留意点 ・入出庫管理	事業開始後 10 カ月	20

分類	成果品	内容	提出時期	頁数
	モニタリングシステム運用・保守マニュアル	・モニタリングシステムの運用・保守 ・データベースシステムの活用 ・無収水率の算定方法 ・水需要の把握と分析	事業開始後 23 カ月	20
報告書		・活動計画と実績 ・活動・成果の達成度 ・成果の達成度に影響を与えた要因 ・成果の持続・発展のための今後の課題・提言等 ・各マニュアル一式	事業開始後 25 カ月	10

出典：調査団

9 相手国側の責務

ソフトコンポーネントの実施に関して、WASAC の責務は以下のとおりである。

- ソフトコンポーネントに必要な人員、講習施設及び資材を確保する。
- ソフトコンポーネントの活動時に必要な人件費を負担する。
- ソフトコンポーネント完了後も、活動の継続に必要な人員、資材等を確保する。

添付資料 8　免税情報シート

UPDATED:XX XXth, 20XX

Information on Tax Exemption in RWANDA

Sheet 1 Tax with respect to corporate income (Corporate Tax)

Sheet 2 Tax with respect to personal income (Personal Income Tax)

Sheet 3 Indirect taxes such as Value Added Tax (VAT)

Sheet 4 Custom Duties and related fiscal charges with respect to the import and/or re-export of materials and equipment

Sheet 5 Other taxes or fiscal charges

Followings are JICA internal use ONLY
Person in charge in JICA office (Name, Name of the office, E-mail)

更新日：●年●月●日

●●国免税情報シート

（シート１）企業の所得に課される税金（法人税など）

（シート２）企業の従業員の所得に課される税金（個人所得税など）

（シート３）付加価値税（VAT)等の間接税

（シート４）資機材の輸入及び再輸出の際に課される税金や手数料

（シート５）その他、優先的に免税を確保すべき税目

以下、JICA内部情報
在外事務所の担当者（名前、連絡先）：

Update History

Developed: Septemer 7th, 2018 (Registration No.:JICA(PD)8-28002)
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Sheet 1 Tax with respect to corporate income (Corporate Tax)

【Points of Attention】
【Reference】
URL: Interview to Rwanda Revenue Authority. https://www.rra.gov.rw/index.php?id=30

Corporate Income tax : CIT
Personal income tax : PIT
Pay As You Earn : PAYE

Items	Exemption	How to exempt	Applicable Law	rate(%)	How to calculation	Necessary Information	Previous Results, Lessons and Learned, etc
Corporate income tax (for Japanese company)	○ possible	Exempt (Advanced)	Law No 016/2018 of 13/04/2018 on Direct Taxes on Income Law No 06/2015 of 28/03/2015 relating to Investiment Promotion and Facilitation	0%-30%	Exempt Donor funded projectであるため、課税対象ではない。	Organization in charge : RRA (RWANDA Revenue Authority) RDB (Rwanda Development Board) Procedure : □ 特定の案件などのために一時的にルワンダで業務を行う場合（無償案件など）は本邦コンサルタント、本邦施工業者の支払い義務はない。 ・通常の法規登録ではなく、外国企業としてRDBにて登録を行うことでTIN番号（納税者番号）を取得する。 □ルワンダ国内で登記している会社の場合は利益の30%をRwanda Revenue Authority（以下、RRA）に支払う義務あり。 □ルワンダ国内で登記していない会社の場合は受注額の15%をRRAに支払う義務あり。 ・会社の登記を行う場合はRDBへ申請（所要時間は約1日）。 Duration :	
Corporate income tax (for Third-country company)	- impossible			0%-30%	資本市場に新規に上場している企業は、以下の税率で5年間課税される。 1.会社の株式の40%以上が一般に売却されている企業の場合は 20%の課税 2.会社の株式の30%以上が一般に売却されている企業の場合は 25%の課税 3.会社の株式の20%以上が一般に売却されている企業の場合は 28%の課税 また、以下の条件に該当する企業の場合は法人税は0%となる。 ・CMA (Capital Markets Authority) に登録されたベンチャーキャピタル企業 ・自由貿易ゾーン (Free Trade Zone) で運営する投資企業 ・「ル」国に本社を置く外国企業 ・マイクロファイナンス活動を行う企業 (5年間は税率0%)		
Corporate income Tax (for local sub-contractor (Rwandan company))	- impossible			0%-30%			

Sheet 2 Tax with respect to personal income (Personal Income Tax)

【Points of Attention】
【Reference】
URL: Interview to Rwanda Revenue Authority. https://www.rra.gov.rw/index.php?id=169&L=230, https://www.rra.gov.rw/index.php?id=31&L=622

Corporate Income tax : CIT
Personal income tax : PIT
Pay As You Earn : PAYE

Items	Exemption	How to exempt	Applicable Law	rate(%)	How to calculation	Necessary Information	Previous Results, Lessons and Learned, etc
PAYE (Pay As You Earn) （一般的に企業などから受け取る給与に対して課税される）	○ possible	Exempt (Advanced)	Law No 016/2018 of 13/04/2018 on Direct Taxes on Income	0%～30%	(Monthly Dedcution) 所得(Net salary)（月額）：税率 0 - 30,000Rwf：0% 30,001 - 100,000 (70,000 taxable income)Rwf：20% 100,001Rwf以上：30% (Annual Dedcution) 所得(Net salary)（月額）：税率 0-36,000Rwf：0% 36,001-1,200,000 Rwf：20% 120,001Rwf以上 ： 30%	Organization in charge：RRA Procedure： 企業によって雇用されている個人の給与所得はPAYEの対象となり、個人事業所得や季節雇用等などの所得はPITの対象となる。PAYEは、雇用主が毎月給与支払い後15日以内にRRAに申告し支払う。本邦施工業者・コンサルタント等が「ル」国で雇用を行う場合には、原則としてその「ル」国民の給与に係るPAYEをRRAに支払う必要がある。PAYE支払いの義務は、企業が「ル」国で企業登録をされている場合、および、企業が「ル」国で企業登録をされていないが「恒久施設基準（permanent establishment (PE) criteria）」を満たすかどうかで判断される。 ・本邦コンサルタント：納税の義務はない。 ・本邦施工業者：納税の義務はない。 ・第三国サブコントラクター：納税の義務はない。 Duration：	・「キガリ市ンゾベーノトラ間送水幹線強化計画」の本邦コンサルタント、本邦施工業者へのヒアリングでは、邦人、第三国人は日本での契約となるためルワンダでの納税の義務はなく、現地人は現地での雇用契約となるため、課税の対象となり納税の義務が発生する、ということが確認されている。
Personal Income Tax (for Japanese company) （フリーランスや個人事業主としての稼得に対しての税金）	○ possible	Exempt (Advanced)		0～30%		Organization in charge：RRA 「恒久施設基準（permanent establishment (PE) criteria）」を満たさない本邦フリーランス・個人事業主の無償事業に関する収入は、免税の対象となる。 「ル」国での個人所得税は、居住者・非居住者ともに「ル」国内での稼得（フリーランスや個人事業主としての稼得）に限り課税される。	
Personal Income Tax (for Third-country company)	○ possible	Exempt (Advanced)		0～30%	年間所得が 1) 0～360,000Rwf: 0% 2) 360,001～1,200,000Rwf: 20% 3) Over 1,200,001Rwf: 30% 2)の場合は所得から30,001Rwfを差し引いた金額に対して課税される。3)の場合は所得のうち、30,001 - 100,000 Rwfは20%、100,000Rwfを越える所得に対して30%が課税される。所得税は毎月の支払いであるが、売上高が200,000,000Rwf未満/年の場合は、四半期に1回の納税とすることができる。	Organization in charge：RRA 「恒久施設基準（permanent establishment (PE) criteria）」を満たさない第三国企業の無償事業に関する収入は、免税の対象となる。 居住者・非居住者ともに「ル」国内での稼得（フリーランスや個人事業主としての稼得）がある場合は課税対象となる。	
Personal income tax (Rwandan (local contractor))	- impossible			0～30%	短期労働者（1ヶ月未満の雇用期間）：15% 短期労働者（1ヶ月未満の雇用期間、かつ報酬が30,000RWF未満の場合）：0% 30,001-100,000Rwf：20% 100,001Rwf以上：30%	Organization in charge：RRA (RWANDA Revenue Authority) Procedure： ・現地傭人（ルワンダ人）を雇用する場合は、雇用者は以下の個人所得税分等をRRAに支払う必要がある。しかし、現地傭人との雇用契約書に以下の税目を含んで給与を支払い、かつRRAへの納税についても被雇用者自身が行うことを明記すれば、雇用者が納税をする必要はない。 ☐ Personal income tax（個人所得税） 所得（Net salary）： 税率 1) 0～360,000 Rwf: 0% 2) 360,001～1,200,000 Rwf: 20% 3) Over 1,200,001 Rwf: 30% ☐ Pension scheme： 雇用者と被雇用者がそれぞれグロス給与の3% ☐ Medical Community-Based Health Insurance (CBHI)： 被雇用者のNet給与の15%（雇用者が7.5%、被雇用者が7.5%を負担）。給与支給翌月の10日までにRSSB（Rwanda Social Security Board）に支払う。 ☐ Occupational Hazards： 雇用者が被雇用者に支払うグロス給与の2% なお、被雇用者が税金をRRAに収める場合は、現地傭人が税金をRRAに確実に支払っているか確認する必要がある。	
Withholding Taxes（源泉徴収税）	○ possible	Exempt (Reimbursed)		15%	支払い額の15%	個人事業主や季節労働者（Casual Labor）の給与についてはPAYEでなくPITのWithholding Taxとして毎年支払い予定額の15%相当額を4半期に一度、雇用主企業がRRAに源泉徴収税として納付する必要がある。源泉徴収税は、VATの免税手続きと同様の方法で事後還付される。 源泉徴収税は領収書（Electric Billing Machine（EBM）を発行できないサービスや物品を購入した際に、購入者側がサービス提供者に代わって納税する税金についても適用される。	

(Sheet3) indirect tax etc (such as VAT, Commercial Tax)

【Points of Attention】
【Reference】
VAT
n° 37/2012 of 09/11/2012 on the code of Value Added Tax & PWC Tax guide
添付資料

Items	Exemption	How to exempt	Applicable Law	rate(%)	How to calculation	Necessary Information	Previous Results, Lessons and Learned, etc
Value added tax	○ possible	borne by the Recipient(Reimburse)	Official Gazette n° 37/2012 of 09/11/2012 on the code of Value Added Tax &PWC Tax guide Official Gazette n° 11 bis of 16/03/2015 MODIFYING AND COMPLEMENTING LAW N° 37/2012 OF 09/11/2012 ESTABLISHING THE VALUE ADDED TAX Official Gazette n° Special of 18/10/2016 Law modifying and complementing Law n°	18%	物品やサービスの価格の18%	Organization in charge：WASAC Procedure：事後還付方式 （・WASACがMINECOFIN（ルワンダ財務省）に対し、発生見込の還付総額分の予算の確保を申し入れる。） □VATの事後還付を希望する本邦企業は、事前にRRA(ルワンダ歳入庁）に登録を行う。登録は1日で完了する。 ・RRAへの登録後、ルワンダ国内で案件に必要とされる物品（私物は免税されない）を購入する際には、一旦VATを含んだ金額で購入する。物品を購入した月（毎月末）に本邦企業がRRAのシステム上でVATの事後還付申請を行う。※ ・申請内容のRRAによる承認後、RRAは還付の妥当性を確認するための監査を実施し、妥当性が確認された後にRRAが本邦企業へ還付額を支払う。 【留意点】 □ 法人登録とVATの事後還付のための登録は別であり、法人登録をする必要はない。 ・物品の購入月を過ぎて（物品購入月の翌月以降）にVATの事後還付を申請することは基本的には不可である。 Duration： □ RRAにVATの事後還付を申請してから約1ヶ月後～2ヵ月後に返還される。	
Fuel tax	- impossible				燃料費にはThrough-put Charges 、Excise Duty、National Road Fund、Strategic Reserve Levy、African Union levyInfrastructure development levy (1.5%*CIF)が含まれる。		燃料費にはVAT（付加価値税）は含まれていない。

(Sheet4) Duties etc.

【Points of Attention】
●ルワンダ政府と直接契約している本邦コンサルタントや本邦施工業者の名義で輸入する場合には輸入税は免税となる（C/P機関が本邦コンサルタントや本邦施工業者の代わりに輸入税をRRAに支払う）。
●ルワンダ政府と直接契約していない本邦コンサルタントや本邦施工業者の下請け（ルワンダの業者など）の名義で輸入する場合は免税とはならない。
●C/P機関が輸入税を支払うため、事前にC/P機関に予算を確保するよう促す必要がある。C/P機関（WASAC）の会計年度は毎年7月から始まり、7月からの予算編成は前年の11月までに計画される。したがって、案件の開始時期を考慮して前年の11月までにC/P機関に予算確保の打診をする必要がある。
・事前に書類を準備し、RRAに申請しなければ税関で輸入品が止められてしまう。税関で輸入品が止められた場合は税関によって保管された日数分の費用が発生する。
【Reference】
Import dutiesのうち、VAT
Import dutiesのうち、Withholding Tax on Imports
Commissioner General rules no 009/2010 of 03/09/2010 implementing the Law n° 24/2010 of 28/05/2010 modifying and complementing law n° 16/2005 of 18/08/2005 on direct taxe on income
URL: https://www.rra.gov.rw/fileadmin/user_upload/compulation_2017__final_.pdf

Items	Exemption	How to exempt	Applicable Law	rate(%)	How to calculation	Necessary Information	Previous Results, Lessons and Learned, etc
Import duties (other taxes and levies)	○ possible	borne by the Recipient(Advanced)	①LAW N° 17/2017 OF 28/04/2017 ESTABLISHING THE NATIONAL REHABILITATION SERVICE AND DETERMINING ITS MISSION, ORGANISATION AND FUNCTIONING ②Official Gazette n° Special of 01/07/2015 ESTABLISHING THE INFRASTRUCTURE DEVELOPMENT LEVY ON IMPORTED GOODS	0.2%, 1.5%	①に基づき取引価格(CIF価格)の0.2%, インフラ開発案件としては②に基づき取引価格の1.5%の関税が一般に課税される。ただし、EAST AFRICAN COMMUNITY CUSTOMS MANAGEMENT ACT, 2004 (REVISED EDITION 2018) に基づきドナーの援助による物品は免税となる（FIFTH SCHEDULE THE EXEMPTIONS REGIME 10. Goods and Equipment for Use in Aid Funded Projects).	Organization in charge : WASAC Procedure : 1. 本邦コンサルタント、もしくは本邦施工業者は輸入代行業者に依頼して輸入を行う。 2. 輸入代行業者をとおして輸入品（輸入品リスト）について事前にRRA(RWANDA Revenue Authority)に申告する。 3. 輸入代行業者が輸入品に係る税額を算出し、C/P機関に請求する。 4. C/P機関がRRAに税金を支払う。 5. 税関に輸入品が到着し、輸入品リストを元に輸入品の確認を輸入代行業者が行う（書類等に不備がなければ約1日で通関できる。この際に金銭のやり取りはない。） 免税には以下の書類が必要となる。 □ マスターリスト □ 航空貨物運送状（船荷証券） □ 請求書原本 □ パッキングリスト □ ライン省庁と先方実施機関からのレター □ ルワンダ国政府の批准書 □ 到着通知（Arrival notice）（必要であれば） 関税および輸入に係るVATについて、実務上実施機関の予算確保が物品の入に先んじて行われない可能性があり、この場合事前に合意しておくことで、輸入業者は関税および輸入に係るVATを事後払いとした事例がある（灌漑省実施プロジェクト）。	
Import dutiesのうち、VAT	○ possible	borne by the Recipient(Reimburse)	Commissioner General rules no 009/2010 of 03/09/2010 implementing the Law n° 24/2010 of 28/05/2010 modifying and complementing law n° 16/2005 of 18/08/2005 on direct taxe on income	18%	「ル」国の税関にて物品の価値（輸出地の船積港価格（cost）に海上保険料（Insurance）、運賃（freight）を足した値（CIF価格）の18%が課せられる。		
Import dutiesのうち、Withholding Tax on Imports	○ possible	borne by the Recipient(Advanced)	Commissioner General rules no 009/2010 of 03/09/2010 implementing the Law n° 24/2010 of 28/05/2010 modifying and complementing law n° 16/2005 of 18/08/2005 on direct taxe on income	5%	Exemption (Donor funded Project) : (C/P機関が支払う) 無償案件に必要な資機材全て (Donor funded Project) Exemption : 蚊帳、車椅子など社会貢献に寄与する物品 ※基本的にExemptionについて恒久的に免税が担保されている。 以下の課税については、適宜、どの費目がどのカテゴリーに分類されるか見直しされる。 0% : コットンなどルワンダで生産されておらず、重要なもの 10%の課税 : Semi-finish（加工前の材料） 25%の課税 : Finished（加工後の商品） 35%-100%の課税 : 既にルワンダ広く流通している商品 「ル」国の税関にて物品の価値（輸出地の船積港価格（cost）に海上保険料（Insurance）、運賃（freight）を足した値（CIF価格）の5%が課せられる。		

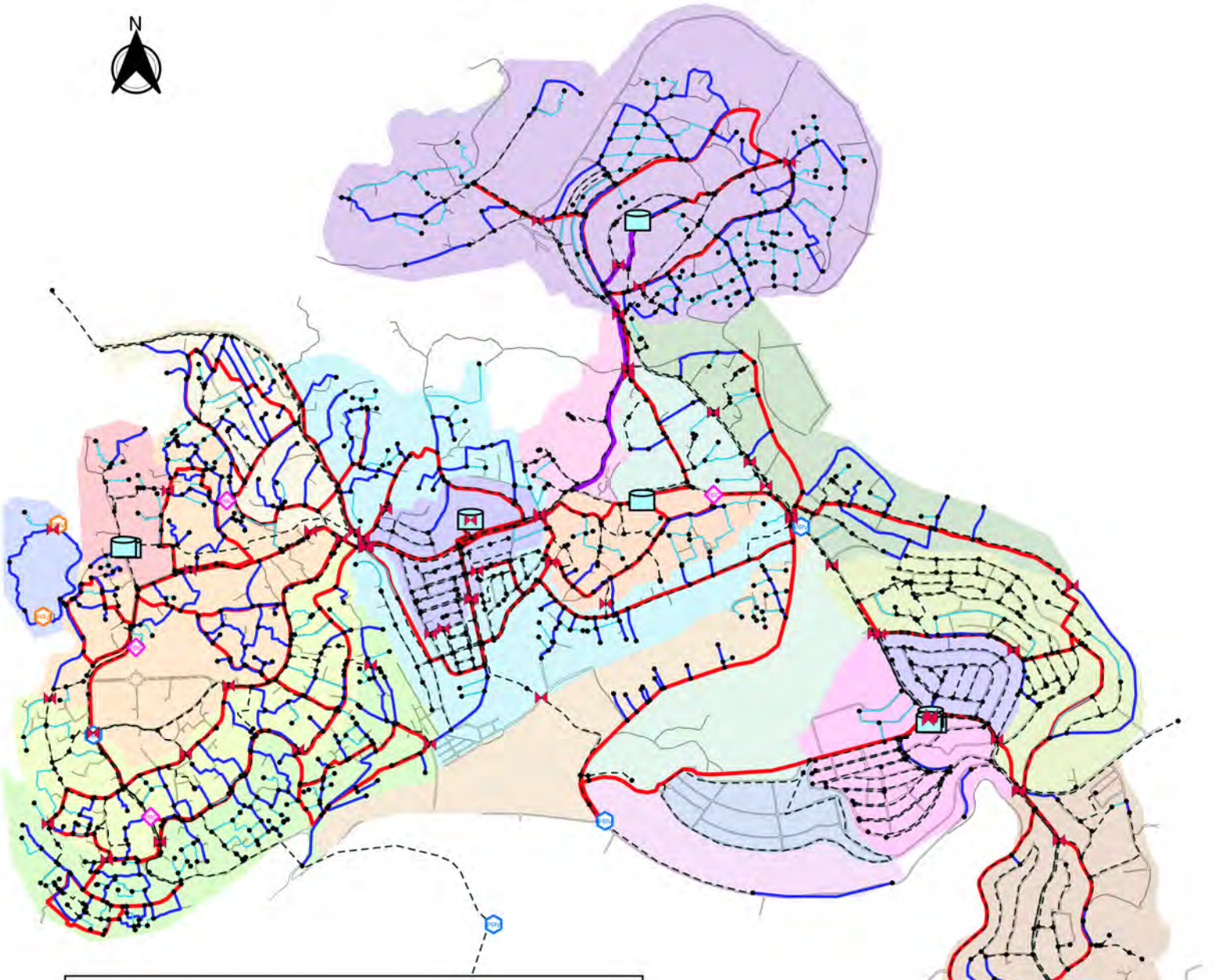
(Sheet 5) Other taxes and levies

【Points of Attention】
【Reference】

Items	Exemption	How to exempt	Applicable Law	rate(%)	How to calculation	Necessary Information	Previous Results, Lessons and Learned, etc
						Organization in charge : Procedure : Duration :	
						Organization in charge : Procedure : Duration :	

添付資料 9　水理計算

General Map for Hydraulic Calculation



Legend

Reservoir (Existing & Plan)

Pipe

- Transmission Pipe (Plan)
- Primary Distribution Pipe (Plan)
- Secondary Distribution Pipe (Plan)
- Secondary (Sub) Distribution Pipe (Plan)
- Existing Transmission & Distribution Pipe
- Block Boundary Valve (Closed)
- Junction
- Pressure Breaking Chamber
- New Pressure Release Valve
- Ex Pressure Release Valve
- Road

Distribution Block Plan (ID)

- K-F1
- K-F2
- K-Ga1N
- K-Ga1S
- K-Ga2N
- K-Ga2V
- K-Ga2W
- K-Ga3N
- K-Ga3S
- K-Ga3W
- K-Gi1
- K-Gi2
- K-Gi3N
- K-Gi3S
- K-Gi4
- K-Gi5
- K-K1
- K-K2S
- K-K2W
- K-KB
- R-N1
- R-N2E
- R-N2W
- R-N1N

Deatail Map for Hydraulic Calculation (1)

KEY MAP

Legend

- Reservoir (Existing & Plan)

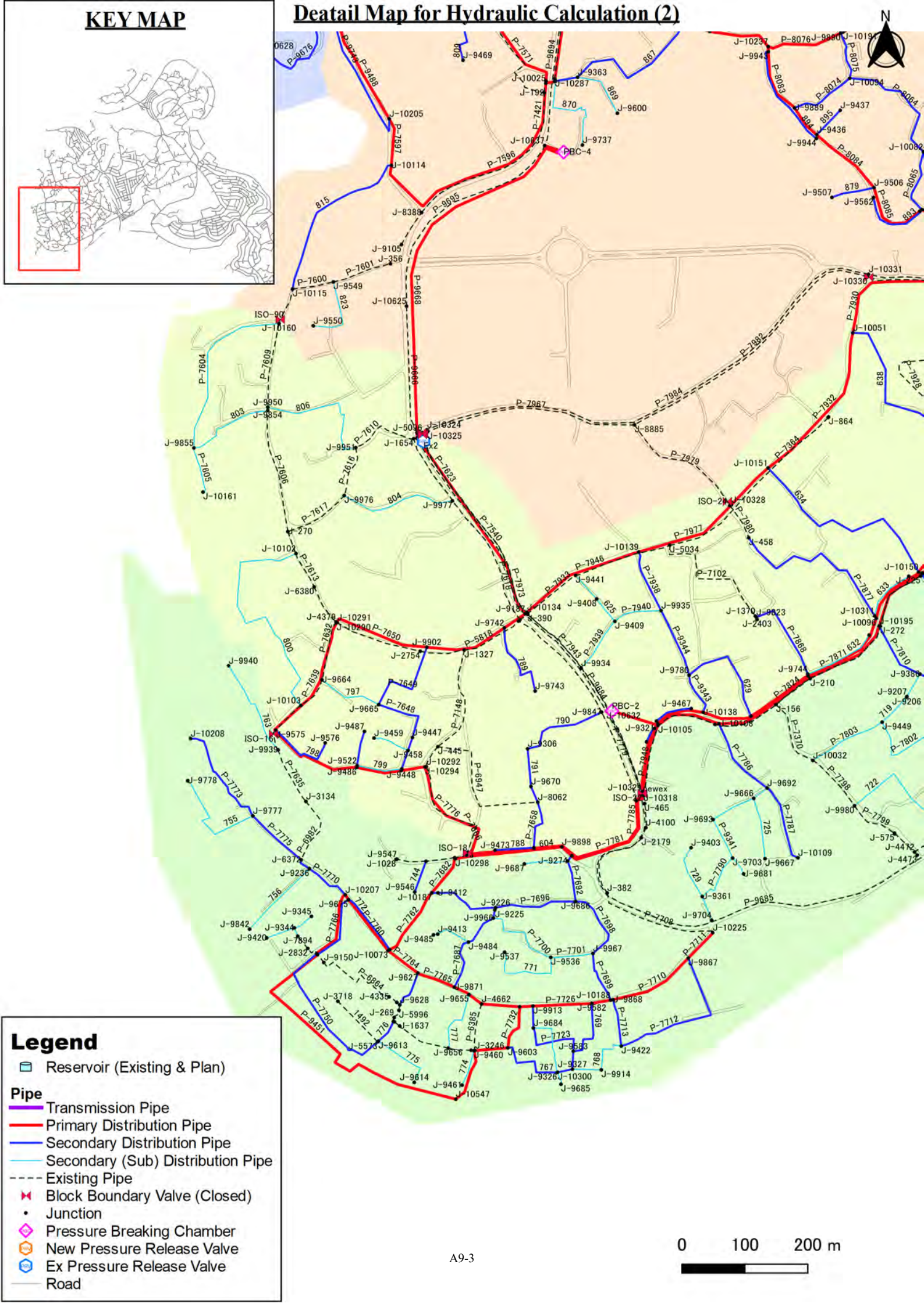
Pipe

- Transmission Pipe
- Primary Distribution Pipe
- Secondary Distribution Pipe
- Secondary (Sub) Distribution Pipe
- Existing Pipe
- Block Boundary Valve (Closed)
- Junction
- Pressure Breaking Chamber
- New Pressure Release Valve
- Ex Pressure Release Valve
- Road

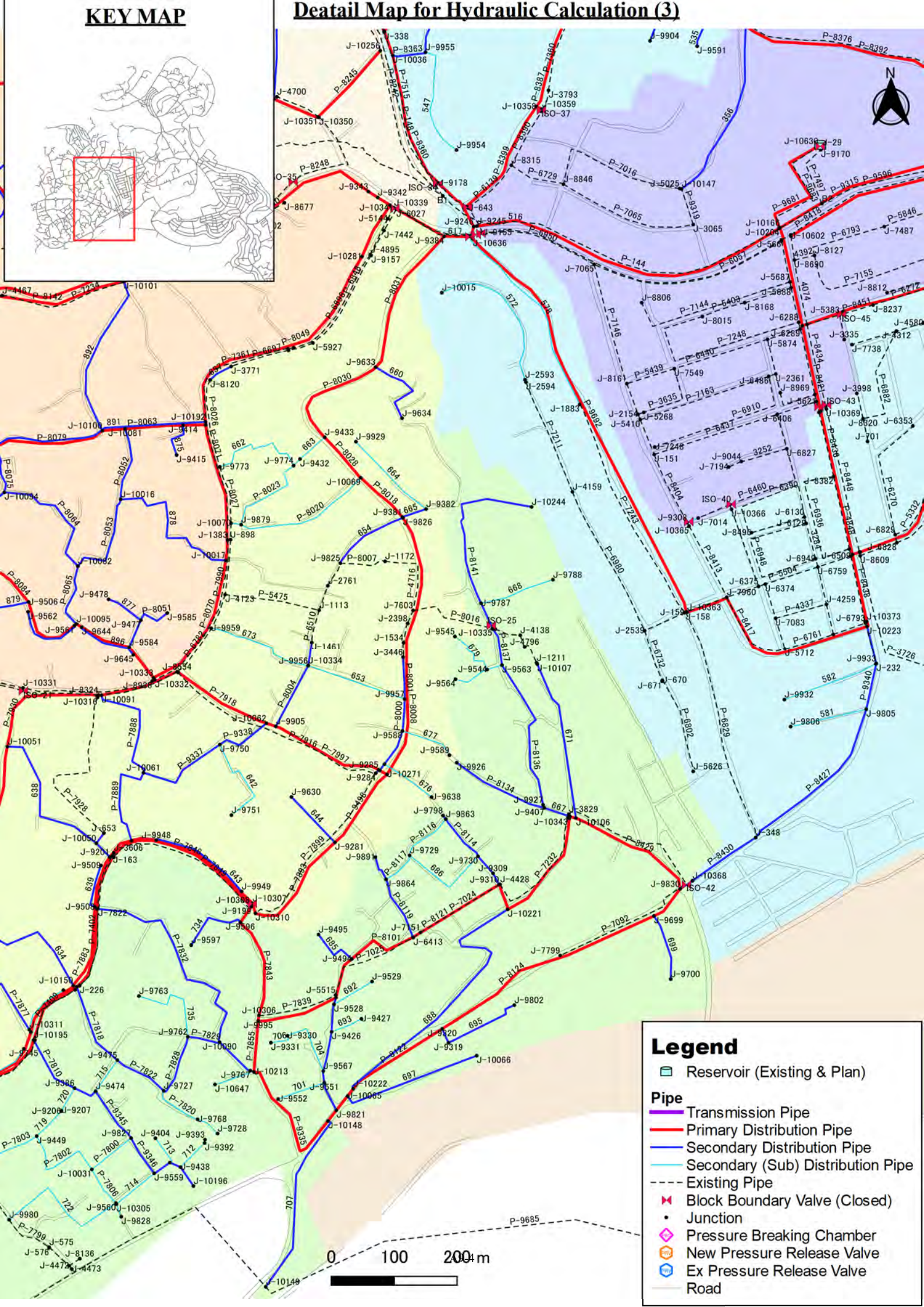
N

0 100 200 m

Deatail Map for Hydraulic Calculation (2)

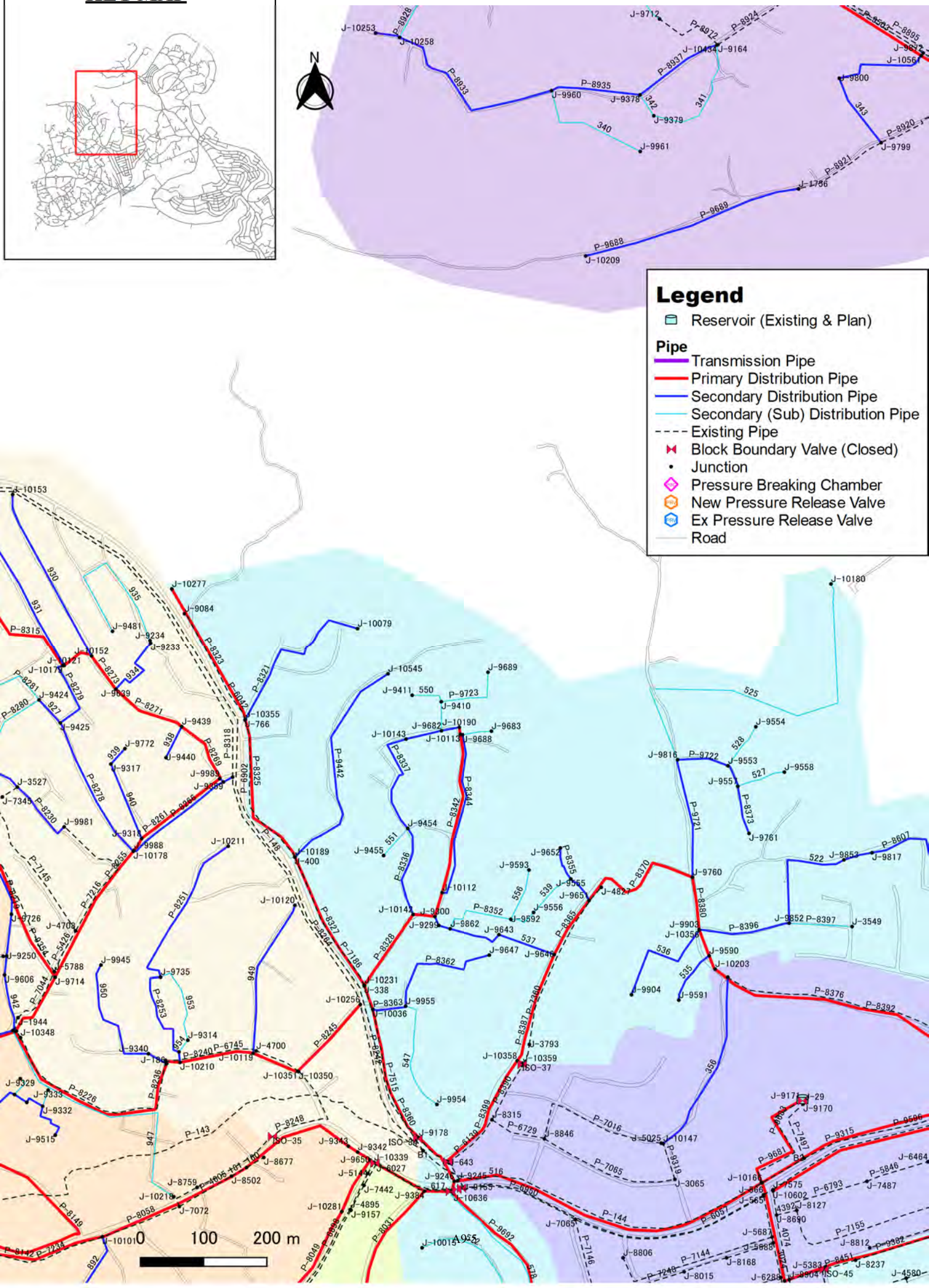


Deatail Map for Hydraulic Calculation (3)

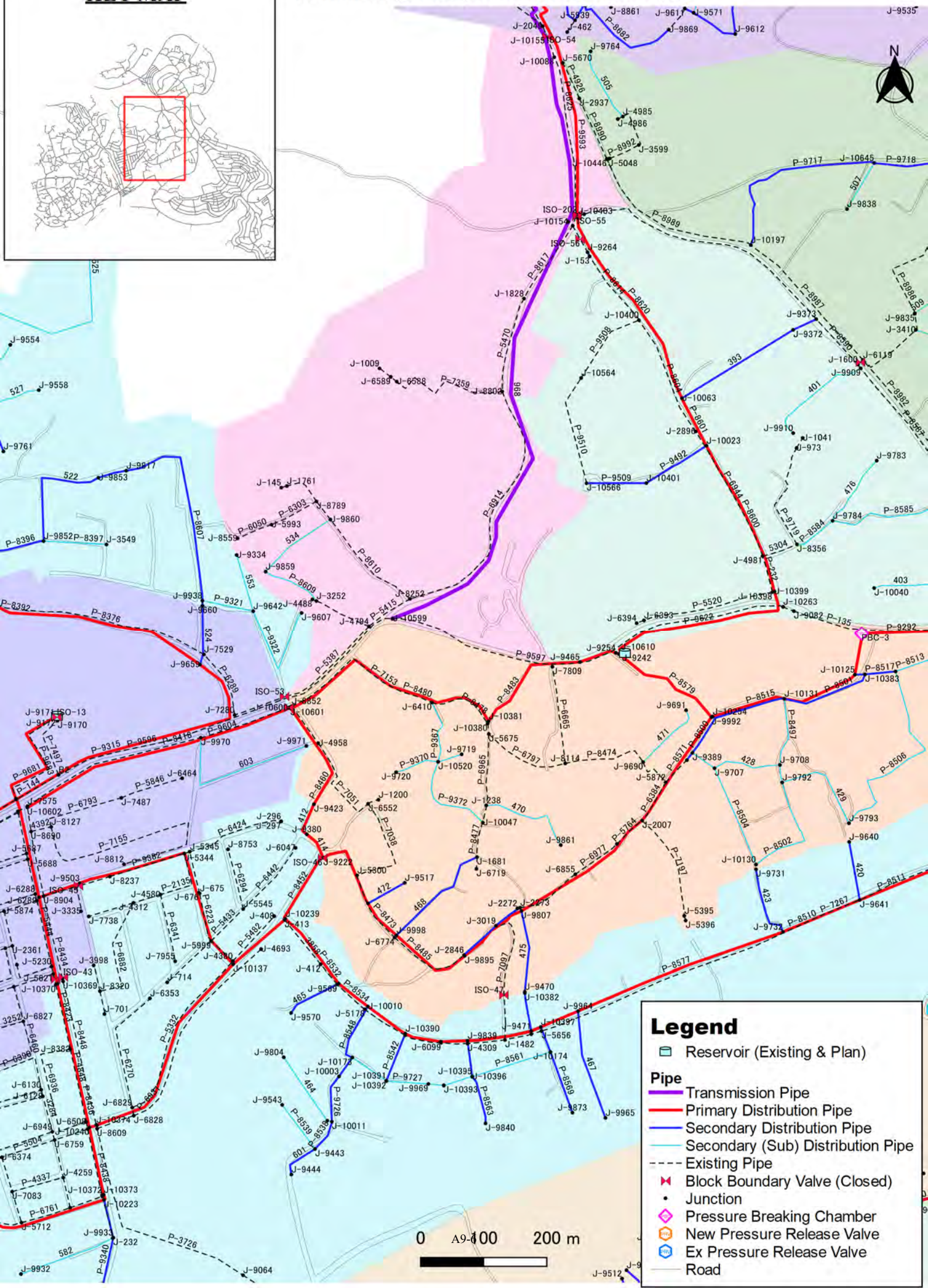


KEY MAP

Deatail Map for Hydraulic Calculation (4)

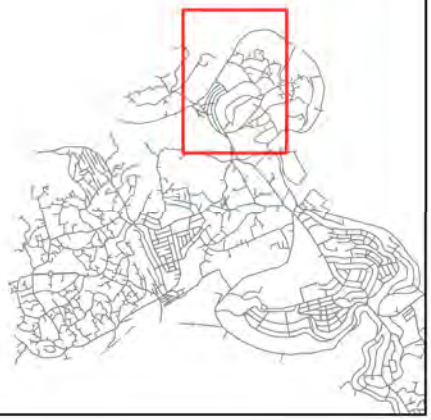


Deatail Map for Hydraulic Calculation (5)



Deatail Map for Hydraulic Calculation (6)

KEY MAP



N

Legend

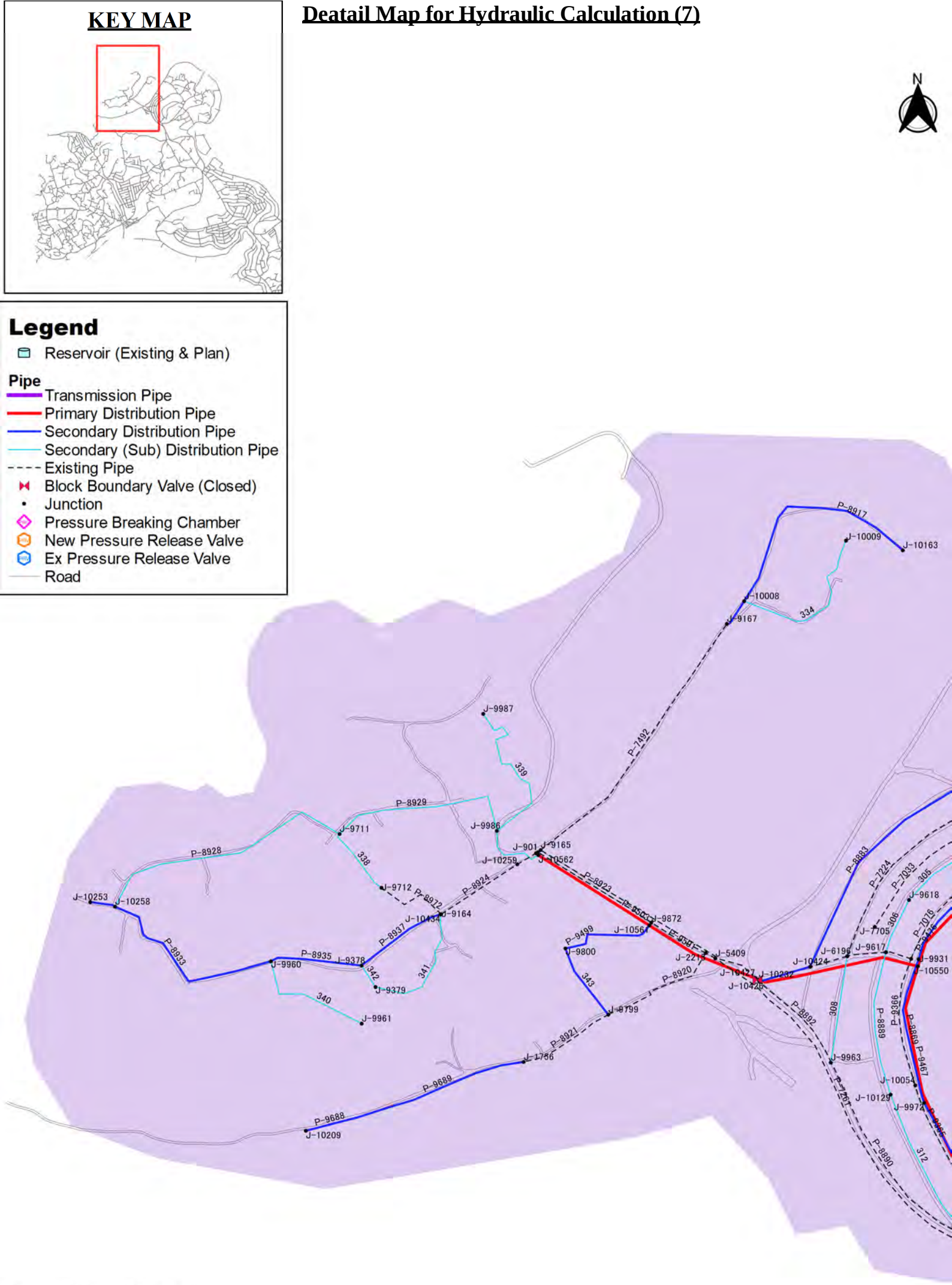
- Reservoir (Existing & Plan)

Pipe

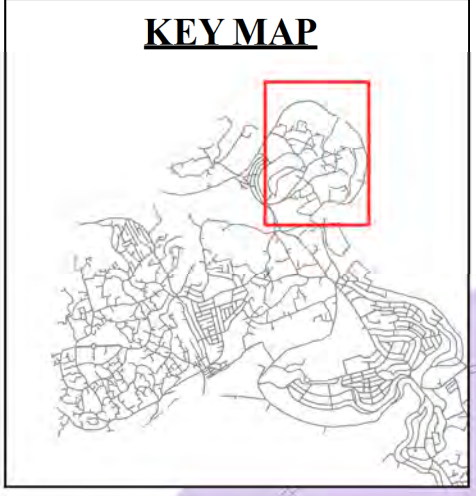
- Transmission Pipe
- Primary Distribution Pipe
- Secondary Distribution Pipe
- Secondary (Sub) Distribution Pipe
- Existing Pipe
- Block Boundary Valve (Closed)
- Junction
- Pressure Breaking Chamber
- New Pressure Release Valve
- Ex Pressure Release Valve
- Road

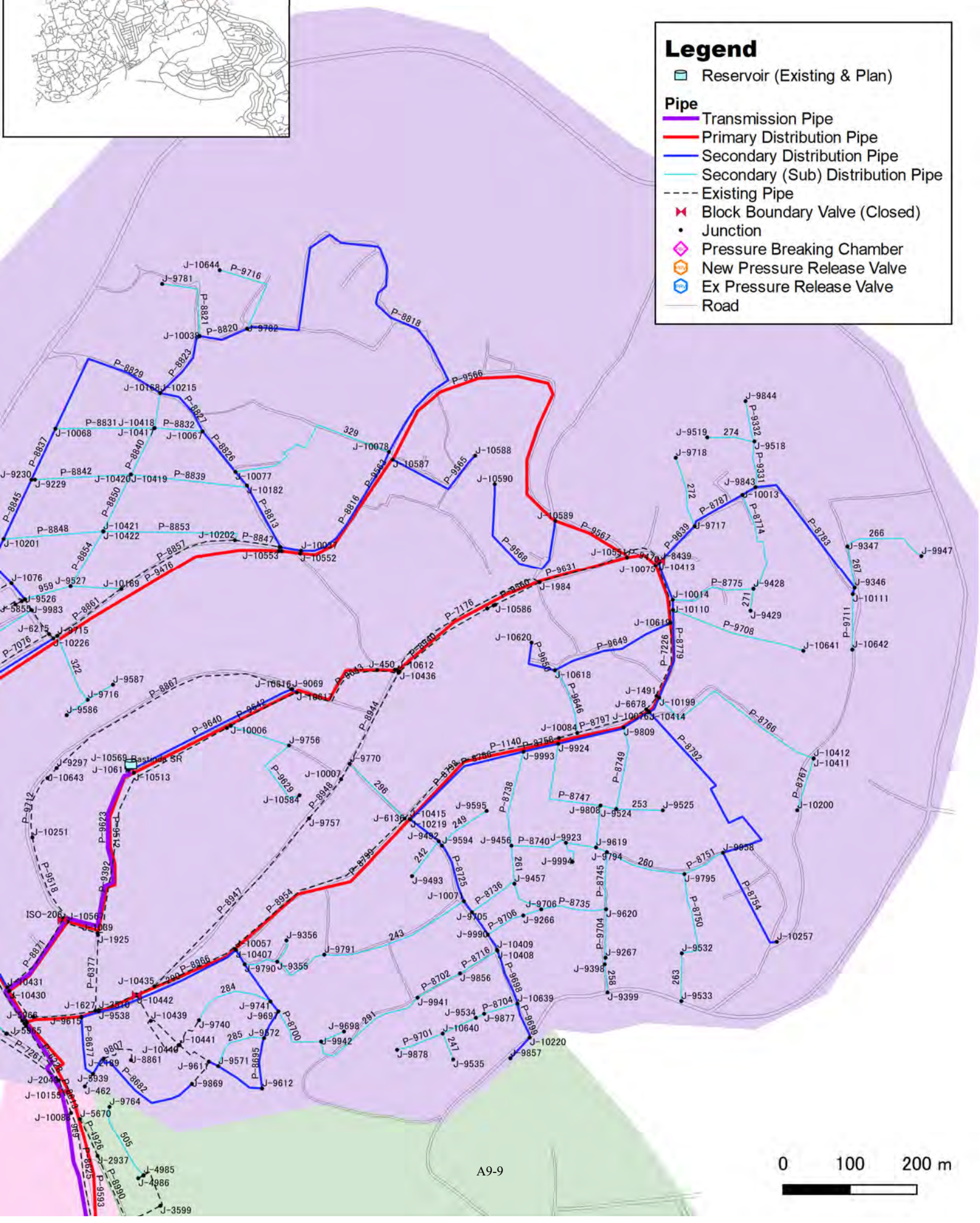
0 100 200 m

Deatail Map for Hydraulic Calculation (7)

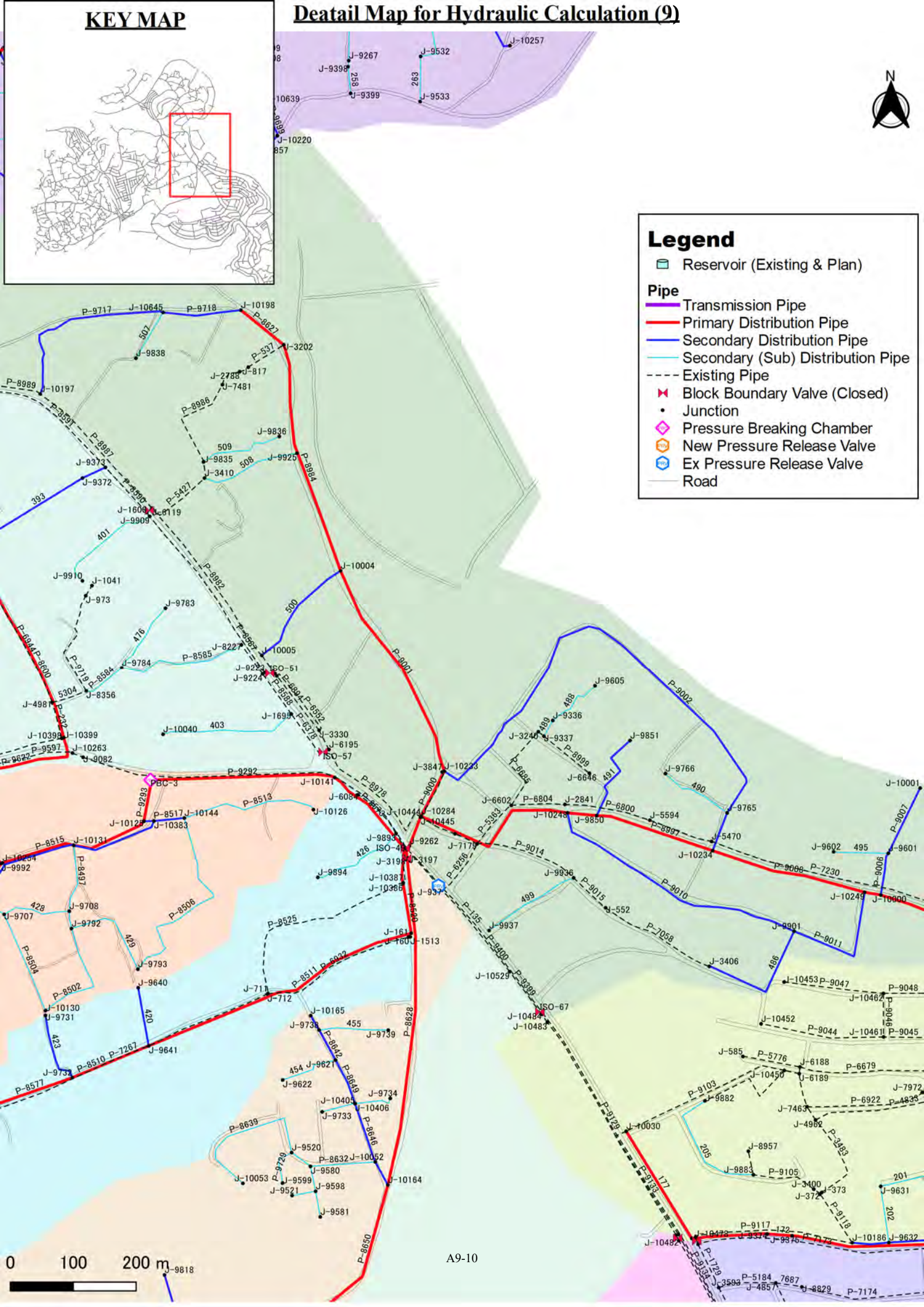


Deatail Map for Hydraulic Calculation (8)

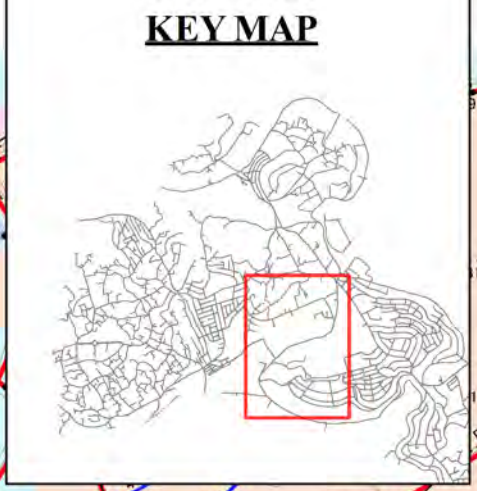




Deatail Map for Hydraulic Calculation (9)



Deatail Map for Hydraulic Calculation (10)



Legend

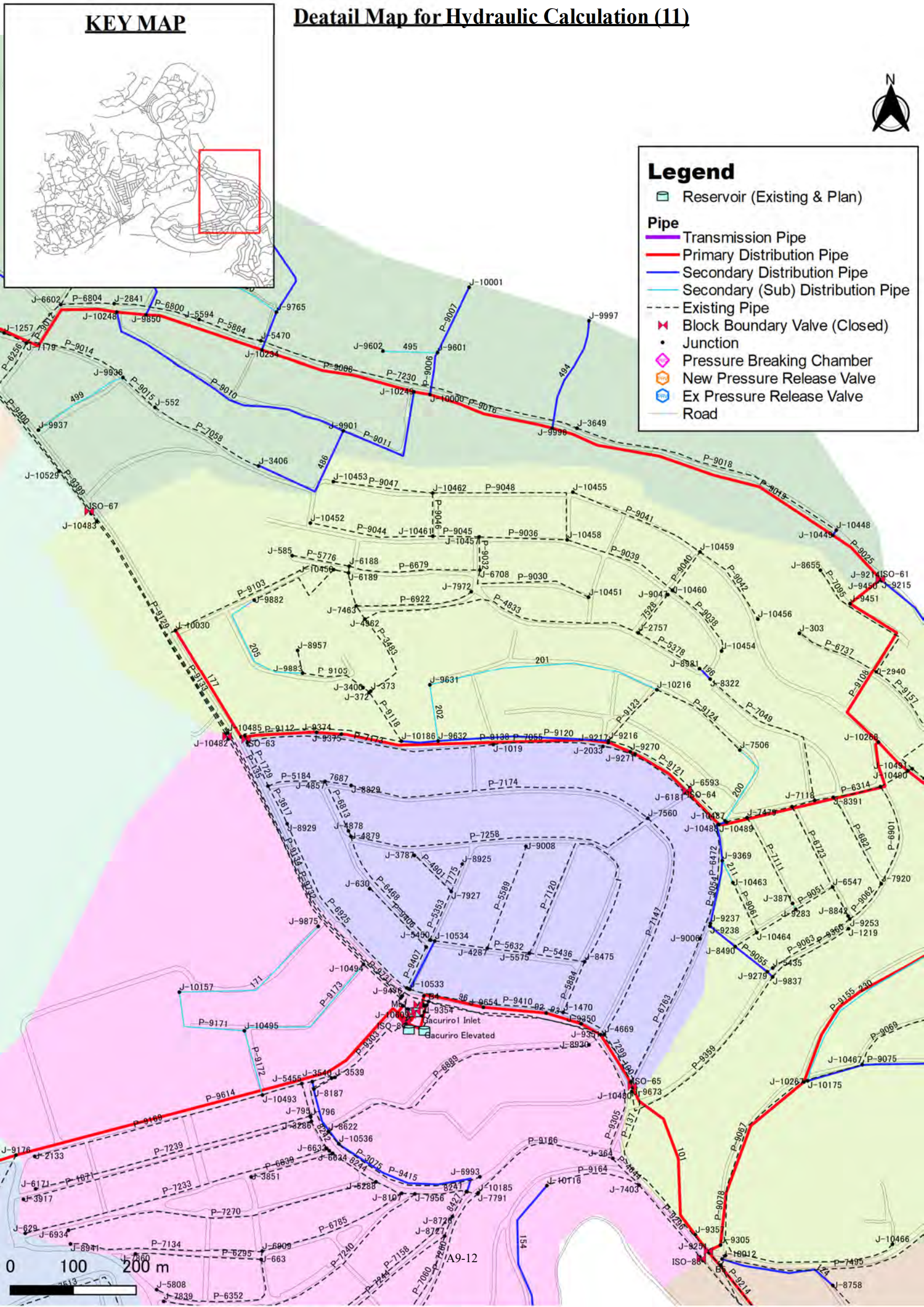
- Reservoir (Existing & Plan)

Pipe

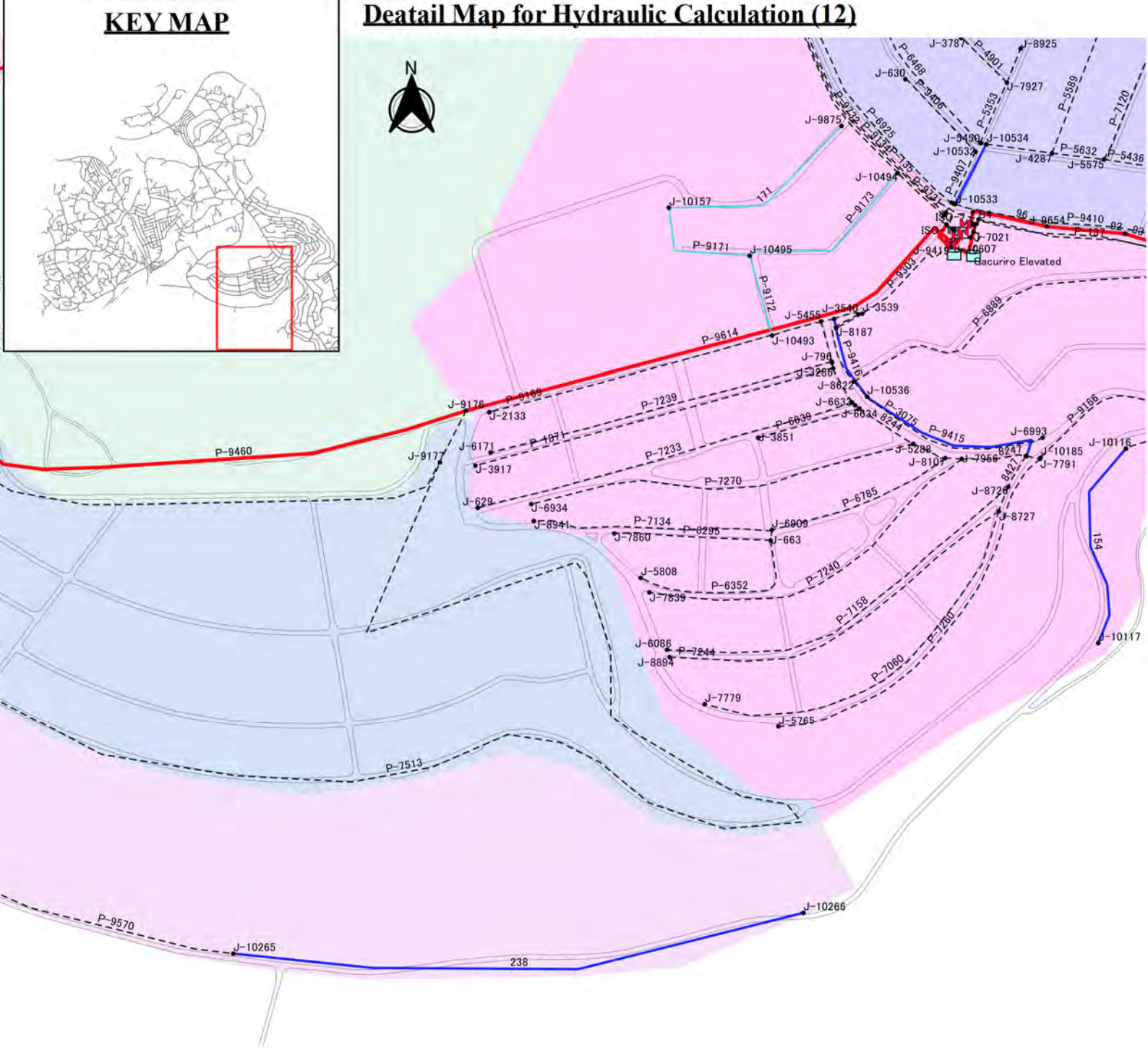
- Transmission Pipe
- Primary Distribution Pipe
- Secondary Distribution Pipe
- Secondary (Sub) Distribution Pipe
- Existing Pipe
- Block Boundary Valve (Closed)
- Junction
- Pressure Breaking Chamber
- New Pressure Release Valve
- Ex Pressure Release Valve
- Road

0 100 200 m

Deatail Map for Hydraulic Calculation (11)



Deatail Map for Hydraulic Calculation (12)



Legend

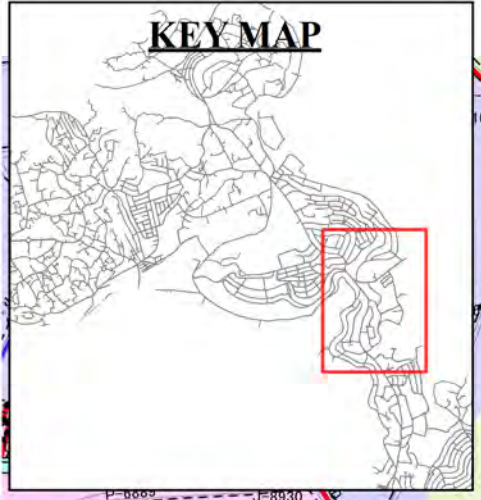
- Reservoir (Existing & Plan)

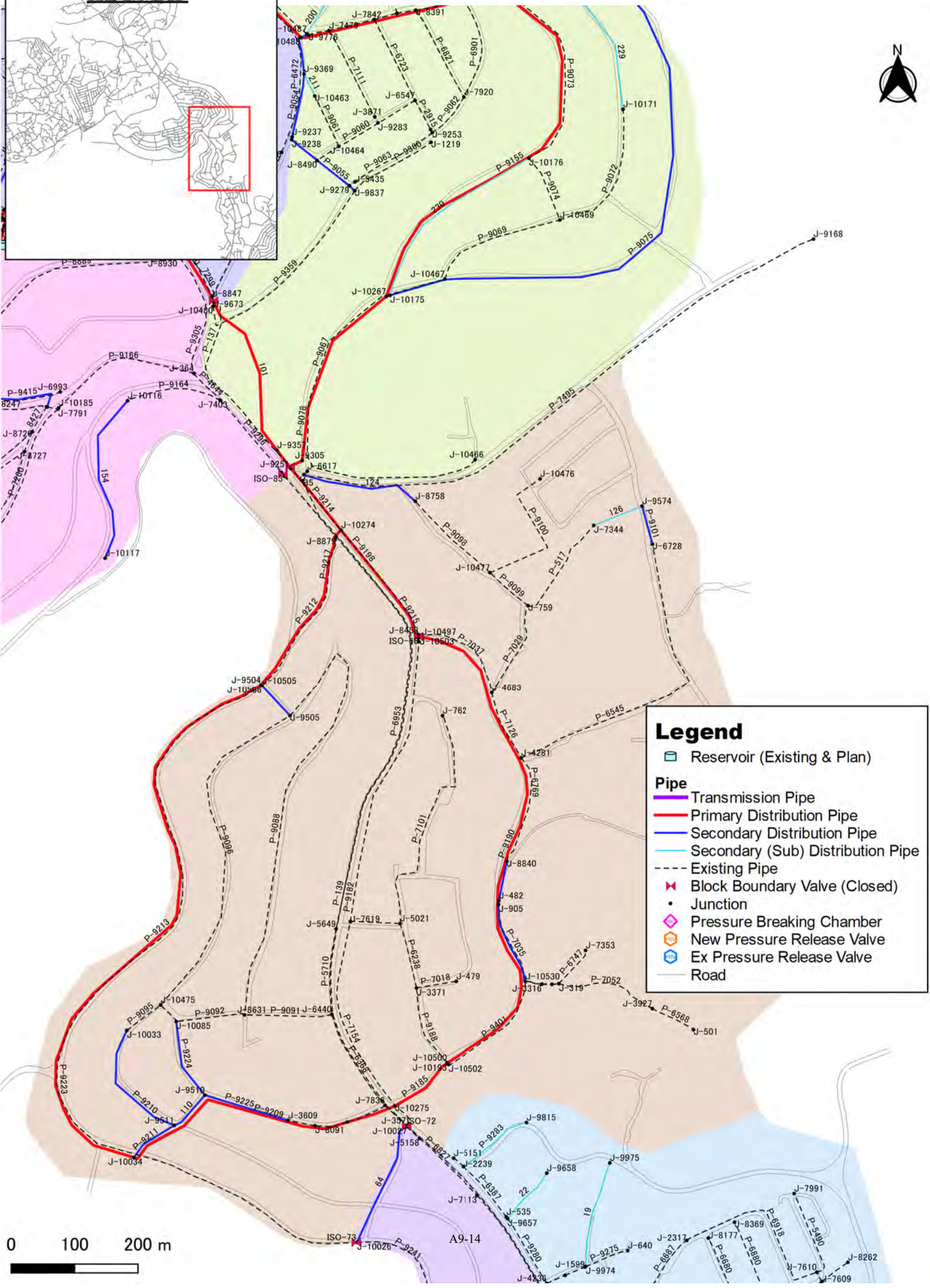
Pipe

- Transmission Pipe
- Primary Distribution Pipe
- Secondary Distribution Pipe
- Secondary (Sub) Distribution Pipe
- Existing Pipe
- Block Boundary Valve (Closed)
- Junction
- Pressure Breaking Chamber
- New Pressure Release Valve
- Ex Pressure Release Valve
- Road

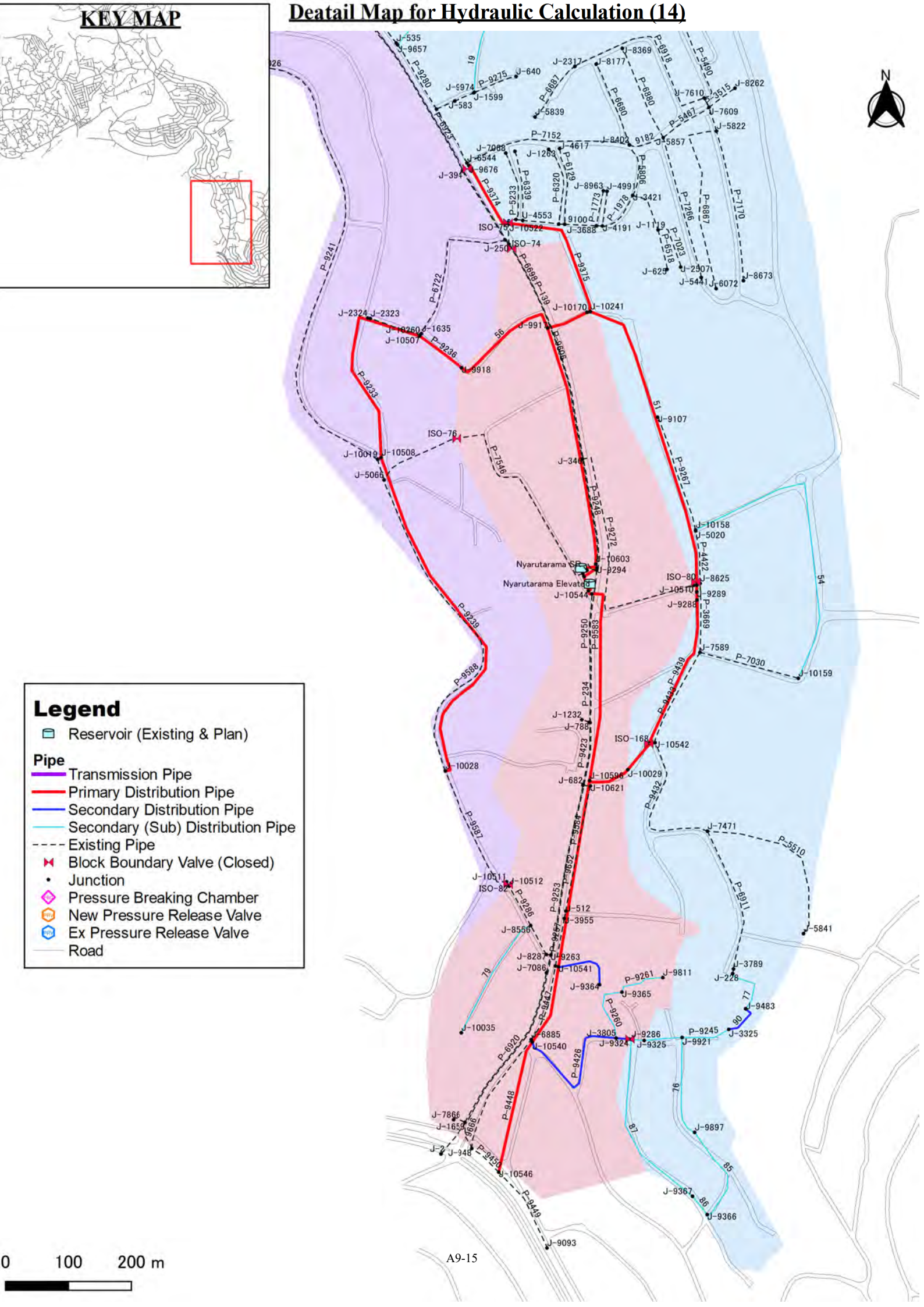
0 100 200 m

Deatail Map for Hydraulic Calculation (13)





Deatail Map for Hydraulic Calculation (14)



Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-10000	1,416	0	1,424	7.1
J-10001	1,391	0	1,401	9.6
J-10002	1,512	16	1,517	5.2
J-10003	1,398	20	1,405	6.8
J-10004	1,422	28	1,428	6.7
J-10005	1,447	46	1,451	4.3
J-10006	1,491	47	1,497	6.0
J-10007	1,477	3	1,479	1.4
J-10008	1,425	0	1,431	6.1
J-10009	1,411	17	1,419	7.4
J-10010	1,424	13	1,428	4.3
J-10011	1,401	11	1,407	6.5
J-10012	1,442	26	1,447	5.0
J-10013	1,468	14	1,470	2.3
J-10014	1,479	1	1,481	1.1
J-10015	1,431	23	1,434	3.5
J-10016	1,509	19	1,515	5.6
J-10017	1,494	6	1,501	7.1
J-10018	1,548	10	1,550	1.9
J-10019	1,433	201	1,437	3.9
J-10020	1,484	36	1,492	8.2
J-10021	1,409	6	1,418	8.8
J-10023	1,476	17	1,477	1.9
J-10024	1,560	0	1,561	0.7
J-10025	1,550	0	1,552	1.7
J-10026	1,416	202	1,421	5.1
J-10027	1,448	11	1,450	2.0
J-10028	1,464	0	1,465	0.9
J-10029	1,465	0	1,467	2.7
J-10030	1,470	0	1,473	2.6
J-10031	1,420	20	1,425	4.5
J-10032	1,440	28	1,443	2.6
J-10033	1,428	4	1,435	6.5
J-10034	1,413	23	1,421	8.0
J-10035	1,468	64	1,470	2.2
J-10036	1,449	2	1,451	1.9
J-10037	1,464	0	1,466	2.6
J-10038	1,425	11	1,431	6.3
J-10040	1,466	36	1,469	2.6

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-10043	1,545	22	1,547	2.1
J-10045	1,542	4	1,544	2.2
J-10047	1,462	26	1,466	3.1
J-10049	1,464	6	1,466	2.5
J-10050	1,460	16	1,468	7.6
J-10051	1,489	16	1,494	4.8
J-10052	1,436	31	1,441	5.3
J-10053	1,396	27	1,405	9.1
J-10054	1,459	46	1,462	3.1
J-10055	1,543	3	1,545	2.1
J-10056	1,512	7	1,517	5.2
J-10057	1,461	0	1,464	2.9
J-10059	1,480	0	1,481	1.2
J-10061	1,481	91	1,486	5.6
J-10062	1,479	0	1,485	5.8
J-10063	1,475	28	1,477	2.0
J-10064	1,561	0	1,561	0.7
J-10065	1,389	1	1,396	7.6
J-10066	1,379	18	1,387	8.5
J-10067	1,439	5	1,444	4.9
J-10068	1,421	3	1,428	6.7
J-10069	1,456	11	1,464	8.0
J-10070	1,492	2	1,496	4.5
J-10071	1,441	17	1,446	4.8
J-10073	1,420	0	1,425	4.6
J-10074	1,414	0	1,419	5.2
J-10075	1,479	0	1,481	1.2
J-10076	1,474	0	1,476	1.6
J-10077	1,449	27	1,453	4.0
J-10078	1,466	149	1,468	2.3
J-10079	1,396	27	1,403	7.1
J-10080	1,457	0	1,461	3.8
J-10081	1,505	4	1,511	6.0
J-10082	1,514	64	1,519	5.2
J-10083	1,483	16	1,490	6.9
J-10084	1,471	31	1,473	1.9
J-10085	1,436	13	1,442	5.8
J-10087	1,453	33	1,457	4.1
J-10088	1,443	48	1,448	5.1

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-10089	1,456	18	1,457	1.0
J-1009	1,436	36	1,442	5.6
J-10090	1,414	41	1,419	5.1
J-10091	1,499	14	1,503	3.8
J-10092	1,456	4	1,464	8.0
J-10094	1,527	15	1,531	3.9
J-10095	1,510	10	1,516	5.5
J-10096	1,457	0	1,465	8.0
J-10098	1,512	11	1,517	5.2
J-10099	1,513	8	1,518	5.1
J-10100	1,509	11	1,514	5.7
J-10101	1,510	11	1,516	5.5
J-10102	1,492	28	1,497	4.5
J-10103	1,476	37	1,483	6.1
J-10104	1,397	6	1,407	9.8
J-10105	1,456	0	1,457	1.2
J-10106	1,417	33	1,422	4.7
J-10107	1,418	21	1,423	4.6
J-10108	1,456	14	1,457	1.2
J-10109	1,424	19	1,428	4.2
J-10110	1,479	13	1,480	1.1
J-10111	1,442	22	1,446	4.8
J-10112	1,429	18	1,433	3.9
J-10113	1,410	0	1,416	5.7
J-10114	1,524	26	1,528	4.2
J-10115	1,502	22	1,508	6.4
J-10116	1,448	27	1,453	5.8
J-10117	1,436	15	1,443	6.9
J-10118	1,458	10	1,461	3.2
J-10119	1,475	29	1,477	2.1
J-10120	1,435	9	1,441	6.0
J-10121	1,426	11	1,433	6.9
J-10122	1,403	20	1,412	9.1
J-10125	1,461	0	1,464	3.4
J-10126	1,450	40	1,454	4.4
J-10128	1,446	15	1,450	4.3
J-10129	1,451	40	1,455	3.8
J-10130	1,437	69	1,443	5.6
J-10131	1,462	32	1,465	3.2

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-10133	1,534	7	1,539	4.5
J-10134	1,489	0	1,494	4.9
J-10136	1,554	11	1,557	2.5
J-10137	1,422	0	1,426	4.6
J-10138	1,458	0	1,465	7.9
J-10139	1,489	8	1,494	4.8
J-10140	1,441	0	1,444	2.5
J-10141	1,449	0	1,454	4.2
J-10142	1,436	3	1,439	3.2
J-10143	1,410	19	1,416	5.7
J-10144	1,458	140	1,462	3.6
J-10146	1,436	31	1,441	4.8
J-10147	1,457	10	1,459	2.8
J-10148	1,386	6	1,394	7.8
J-10149	1,379	4	1,387	8.5
J-10150	1,457	11	1,465	7.9
J-10151	1,491	27	1,496	4.6
J-10152	1,419	16	1,426	7.6
J-10153	1,396	19	1,406	9.8
J-10157	1,488	30	1,490	1.8
J-10158	1,451	9	1,453	2.2
J-10159	1,432	66	1,436	4.0
J-10160	1,501	44	1,505	3.6
J-10161	1,468	8	1,474	6.9
J-10163	1,392	16	1,401	9.3
J-10164	1,437	4	1,442	5.2
J-10165	1,426	9	1,432	6.2
J-10166	1,469	0	1,470	1.0
J-10167	1,444	0	1,447	2.4
J-10168	1,429	9	1,435	5.9
J-10169	1,462	12	1,465	2.8
J-10170	1,457	0	1,459	1.7
J-10171	1,423	74	1,429	6.5
J-10172	1,429	49	1,435	6.1
J-10173	1,414	25	1,419	5.3
J-10174	1,416	29	1,421	5.1
J-10175	1,419	196	1,426	7.2
J-10176	1,445	120	1,450	4.6
J-10177	1,461	2	1,464	3.3

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-10178	1,446	11	1,451	4.9
J-10179	1,426	6	1,433	6.9
J-10180	1,405	11	1,411	6.2
J-10182	1,452	1	1,456	3.7
J-10184	1,490	0	1,492	1.8
J-10185	1,462	22	1,467	4.4
J-10186	1,476	14	1,478	1.9
J-10187	1,447	11	1,449	1.9
J-10188	1,413	8	1,418	5.3
J-10189	1,423	10	1,428	4.4
J-1019	1,478	64	1,481	2.4
J-10190	1,408	1	1,414	5.9
J-10191	1,527	28	1,531	3.9
J-10192	1,488	4	1,496	7.7
J-10193	1,445	0	1,450	4.9
J-10195	1,455	13	1,456	1.1
J-10196	1,399	6	1,405	6.6
J-10197	1,447	55	1,451	4.2
J-10198	1,412	12	1,419	7.6
J-10199	1,475	63	1,477	1.5
J-10200	1,410	3	1,418	7.8
J-10201	1,434	0	1,439	5.5
J-10202	1,463	3	1,466	2.6
J-10203	1,435	0	1,438	3.3
J-10204	1,469	0	1,470	1.0
J-10205	1,523	91	1,527	4.4
J-10206	1,526	2	1,530	4.1
J-10207	1,421	1	1,425	4.5
J-10208	1,395	3	1,402	7.0
J-10209	1,394	53	1,402	7.3
J-10210	1,477	0	1,479	1.9
J-10211	1,422	38	1,430	7.2
J-10212	1,455	47	1,456	1.1
J-10213	1,408	0	1,413	5.7
J-10214	1,438	23	1,443	5.1
J-10215	1,429	8	1,435	5.9
J-10216	1,470	87	1,472	2.4
J-10217	1,491	10	1,498	7.2
J-10218	1,502	14	1,508	6.1

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-10219	1,461	53	1,464	2.9
J-10220	1,413	6	1,421	7.6
J-10221	1,419	31	1,424	4.6
J-10222	1,390	27	1,397	7.5
J-10223	1,423	0	1,428	4.4
J-10225	1,420	19	1,424	4.6
J-10226	1,462	0	1,465	2.9
J-10231	1,447	0	1,450	2.1
J-10232	1,432	0	1,438	5.6
J-10233	1,444	76	1,449	4.5
J-10234	1,421	19	1,428	6.7
J-10237	1,538	0	1,541	2.9
J-10238	1,488	0	1,496	7.7
J-10239	1,424	0	1,428	4.3
J-10240	1,432	0	1,436	3.6
J-10241	1,456	0	1,458	1.7
J-10244	1,409	48	1,415	5.5
J-10248	1,438	61	1,443	5.1
J-10249	1,416	8	1,423	7.2
J-10251	1,482	28	1,489	6.6
J-10253	1,398	17	1,407	8.6
J-10254	1,464	0	1,467	3.1
J-10256	1,450	36	1,455	4.6
J-10257	1,417	30	1,424	7.2
J-10258	1,407	58	1,414	7.8
J-10259	1,445	14	1,449	4.2
J-10260	1,449	16	1,451	2.5
J-10263	1,475	67	1,484	9.1
J-10265	1,389	63	1,394	5.6
J-10266	1,421	0	1,423	2.4
J-10267	1,419	0	1,427	7.2
J-10268	1,451	0	1,455	4.2
J-10269	1,458	0	1,462	3.2
J-10270	1,445	0	1,449	4.2
J-10271	1,458	0	1,466	7.8
J-10274	1,447	0	1,452	4.8
J-10275	1,450	0	1,455	4.4
J-10276	1,453	0	1,455	1.5
J-10277	1,393	0	1,400	7.4

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-1028	1,456	2	1,457	1.0
J-10280	1,559	0	1,560	0.9
J-10281	1,471	0	1,480	9.4
J-10282	1,560	0	1,561	0.7
J-10284	1,446	0	1,450	4.4
J-10285	1,444	0	1,449	4.6
J-10286	1,550	0	1,552	1.7
J-10287	1,550	0	1,552	1.7
J-10288	1,510	0	1,513	2.9
J-10289	1,510	0	1,513	2.9
J-10290	1,490	0	1,494	4.8
J-10291	1,490	24	1,495	4.8
J-10292	1,473	22	1,479	6.4
J-10294	1,473	0	1,479	6.4
J-10295	1,456	9	1,457	1.0
J-10298	1,456	0	1,457	1.1
J-10300	1,383	4	1,391	8.2
J-10301	1,457	12	1,465	8.0
J-10302	1,454	19	1,463	8.2
J-10303	1,454	0	1,455	1.3
J-10305	1,409	1	1,415	5.6
J-10306	1,425	18	1,429	4.0
J-10307	1,458	0	1,466	7.8
J-10308	1,457	16	1,458	0.9
J-10310	1,457	28	1,465	7.9
J-10311	1,457	27	1,465	7.9
J-10313	1,496	17	1,500	4.1
J-10315	1,496	0	1,500	4.1
J-10316	1,498	11	1,502	3.9
J-10317	1,499	0	1,502	3.8
J-10318	1,454	0	1,455	1.3
J-10320	1,454	22	1,463	8.2
J-10321	1,454	0	1,463	8.2
J-10322	1,454	0	1,463	8.2
J-10323	1,454	0	1,462	8.2
J-10324	1,511	0	1,516	5.5
J-10325	1,510	11	1,516	5.5
J-10326	1,510	0	1,513	2.9
J-10327	1,510	45	1,513	2.9

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-10328	1,492	0	1,496	4.6
J-10329	1,492	24	1,496	4.5
J-10330	1,501	20	1,507	6.4
J-10331	1,502	8	1,508	6.4
J-10332	1,497	4	1,504	6.8
J-10333	1,498	0	1,504	6.8
J-10334	1,475	8	1,481	6.1
J-10335	1,430	9	1,433	3.5
J-10336	1,430	2	1,433	3.5
J-10337	1,466	0	1,473	7.0
J-10339	1,466	1	1,476	9.9
J-10341	1,466	0	1,476	9.9
J-10342	1,418	0	1,423	4.6
J-10343	1,419	13	1,423	4.6
J-10345	1,545	4	1,548	3.4
J-10348	1,483	16	1,484	1.4
J-10349	1,487	0	1,488	1.0
J-10350	1,476	31	1,478	2.0
J-10351	1,476	0	1,478	2.0
J-10352	1,434	6	1,440	6.1
J-10354	1,401	4	1,410	9.4
J-10355	1,416	50	1,421	5.1
J-10356	1,429	6	1,432	3.9
J-10358	1,444	0	1,446	2.4
J-10359	1,445	0	1,447	2.3
J-10360	1,445	4	1,449	3.9
J-10361	1,453	0	1,455	1.5
J-10362	1,453	4	1,455	1.5
J-10363	1,427	0	1,431	4.1
J-10364	1,427	12	1,431	4.1
J-10365	1,446	8	1,448	2.2
J-10366	1,449	5	1,451	1.9
J-10368	1,391	5	1,398	7.6
J-10369	1,444	0	1,446	2.4
J-10370	1,444	8	1,447	2.4
J-10371	1,444	0	1,449	4.7
J-10372	1,424	10	1,428	4.4
J-10373	1,424	0	1,428	4.4
J-10374	1,431	0	1,435	3.6

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-10375	1,431	0	1,435	3.7
J-10376	1,452	0	1,454	1.6
J-10377	1,450	10	1,455	4.3
J-10378	1,450	0	1,455	4.3
J-10380	1,472	10	1,474	2.3
J-10381	1,472	0	1,474	2.3
J-10382	1,433	2	1,436	3.4
J-10383	1,460	0	1,464	3.4
J-10386	1,442	0	1,445	2.5
J-10387	1,442	28	1,445	2.5
J-10389	1,423	9	1,428	4.4
J-1039	1,481	6	1,488	6.8
J-10390	1,424	9	1,428	4.3
J-10391	1,413	9	1,419	5.3
J-10392	1,413	27	1,419	5.3
J-10393	1,415	12	1,420	5.2
J-10394	1,415	19	1,420	5.2
J-10395	1,416	3	1,421	5.1
J-10396	1,415	25	1,420	5.1
J-10397	1,424	3	1,428	4.3
J-10398	1,477	29	1,479	1.8
J-10399	1,476	0	1,478	1.9
J-10400	1,472	66	1,474	2.2
J-10401	1,484	105	1,485	1.0
J-10402	1,454	6	1,458	4.0
J-10403	1,453	0	1,457	4.0
J-10404	1,454	0	1,458	4.0
J-10405	1,433	17	1,438	5.6
J-10406	1,433	9	1,438	5.6
J-10407	1,460	10	1,463	3.0
J-10408	1,430	7	1,436	6.0
J-10409	1,430	3	1,436	5.9
J-1041	1,465	29	1,467	2.8
J-10410	1,475	0	1,476	1.6
J-10411	1,431	11	1,437	5.7
J-10412	1,431	29	1,437	5.7
J-10413	1,479	2	1,480	1.2
J-10414	1,474	8	1,476	1.6
J-10415	1,461	0	1,464	2.9

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-10416	1,464	0	1,466	2.5
J-10417	1,435	0	1,441	5.3
J-10418	1,435	0	1,441	5.3
J-10419	1,441	0	1,446	4.8
J-10420	1,441	0	1,446	4.8
J-10421	1,447	0	1,451	4.2
J-10422	1,447	0	1,451	4.2
J-10423	1,449	0	1,453	4.0
J-10424	1,440	4	1,445	5.0
J-10425	1,439	43	1,444	5.0
J-10426	1,432	22	1,438	5.7
J-10427	1,432	6	1,437	5.5
J-10428	1,453	0	1,457	3.8
J-10429	1,454	1	1,458	3.6
J-10430	1,459	0	1,462	3.2
J-10431	1,459	9	1,462	3.2
J-10432	1,452	0	1,456	3.8
J-10433	1,454	4	1,458	3.5
J-10434	1,448	23	1,452	3.8
J-10435	1,462	23	1,465	2.9
J-10436	1,479	14	1,486	7.3
J-10437	1,462	56	1,465	2.8
J-10439	1,455	5	1,458	3.6
J-10440	1,443	3	1,448	4.7
J-10441	1,443	23	1,448	4.7
J-10442	1,462	0	1,465	2.9
J-10443	1,462	0	1,465	2.8
J-10444	1,446	0	1,450	4.4
J-10445	1,446	0	1,450	4.4
J-10446	1,446	18	1,450	4.3
J-10447	1,445	2	1,449	4.4
J-10448	1,411	20	1,419	7.6
J-10449	1,414	4	1,421	7.4
J-10450	1,453	32	1,457	4.4
J-10451	1,458	29	1,462	3.3
J-10452	1,446	29	1,450	4.5
J-10453	1,437	20	1,443	5.3
J-10454	1,458	14	1,461	3.2
J-10455	1,440	28	1,445	5.0

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-10456	1,447	24	1,451	4.2
J-10457	1,447	20	1,451	4.4
J-10458	1,450	72	1,454	4.1
J-10459	1,443	70	1,448	4.6
J-10460	1,453	69	1,457	3.7
J-10461	1,444	48	1,449	4.6
J-10462	1,437	94	1,442	5.3
J-10463	1,477	9	1,478	1.6
J-10464	1,469	28	1,471	2.4
J-10466	1,416	85	1,423	7.0
J-10467	1,416	42	1,423	7.1
J-10468	1,442	35	1,447	5.0
J-10469	1,426	72	1,433	6.2
J-10471	1,395	22	1,405	9.7
J-10472	1,431	222	1,437	5.7
J-10475	1,432	32	1,438	6.1
J-10476	1,413	15	1,421	7.7
J-10477	1,432	26	1,438	5.8
J-10478	1,478	0	1,480	1.7
J-10479	1,478	56	1,480	1.7
J-10480	1,471	5	1,474	2.1
J-10481	1,477	39	1,479	2.0
J-10482	1,478	0	1,481	2.8
J-10483	1,462	187	1,466	3.3
J-10484	1,461	2	1,465	3.5
J-10485	1,477	0	1,479	2.0
J-10486	1,477	0	1,479	2.0
J-10487	1,477	28	1,478	1.7
J-10488	1,478	0	1,480	1.6
J-10489	1,478	0	1,479	1.6
J-10490	1,443	0	1,448	4.9
J-10491	1,443	0	1,448	5.0
J-10493	1,491	77	1,492	1.6
J-10494	1,494	21	1,495	1.2
J-10495	1,486	124	1,488	2.1
J-10496	1,443	9	1,447	4.6
J-10497	1,460	0	1,464	3.5
J-10498	1,460	19	1,463	3.6
J-10499	1,461	6	1,465	3.4

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-10500	1,445	9	1,450	4.9
J-10502	1,445	62	1,450	4.9
J-10503	1,460	0	1,464	3.5
J-10504	1,460	0	1,464	3.5
J-10505	1,432	102	1,438	6.2
J-10506	1,432	0	1,438	6.2
J-10507	1,449	0	1,451	2.4
J-10508	1,434	0	1,438	3.9
J-10509	1,453	0	1,455	2.0
J-10510	1,454	152	1,457	3.7
J-10511	1,459	35	1,461	1.4
J-10512	1,460	9	1,463	3.1
J-10513	1,491	0	1,492	1.0
J-10514	1,445	208	1,451	6.1
J-10515	1,445	29	1,450	4.9
J-10517	1,494	0	1,494	0.3
J-10518	1,396	11	1,406	9.6
J-10519	1,461	9	1,464	3.2
J-10520	1,461	26	1,464	3.2
J-10521	1,452	0	1,454	2.1
J-10522	1,452	0	1,454	2.1
J-10523	1,453	0	1,454	1.6
J-10529	1,455	27	1,458	3.0
J-10530	1,443	0	1,448	4.9
J-10531	1,494	0	1,495	1.1
J-10532	1,493	0	1,495	1.2
J-10533	1,494	0	1,495	1.1
J-10534	1,494	0	1,495	1.1
J-10535	1,482	0	1,484	2.1
J-10536	1,482	0	1,485	2.5
J-10538	1,476	0	1,478	1.5
J-10540	1,482	44	1,483	1.0
J-10541	1,475	0	1,477	1.7
J-10542	1,449	500	1,451	2.4
J-10543	1,463	0	1,464	1.0
J-10544	1,476	0	1,478	1.6
J-10545	1,413	0	1,419	5.4
J-10546	1,482	0	1,483	1.0
J-10547	1,400	0	1,406	6.6

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-10548	1,402	0	1,411	9.0
J-10549	1,401	0	1,410	9.1
J-10550	1,443	0	1,447	4.7
J-10551	1,479	0	1,481	1.2
J-10552	1,464	633	1,466	2.5
J-10553	1,463	0	1,465	2.6
J-10555	1,464	0	1,466	2.5
J-10557	1,515	0	1,520	5.1
J-10561	1,433	0	1,438	5.5
J-10562	1,444	0	1,449	4.3
J-10563	1,487	0	1,488	1.0
J-10564	1,481	0	1,482	1.3
J-10566	1,491	0	1,491	0.4
J-10567	1,469	0	1,471	2.2
J-10568	1,482	0	1,489	6.7
J-10569	1,493	0	1,500	7.2
J-10572	1,491	0	1,497	6.0
J-10584	1,478	0	1,485	7.3
J-10586	1,483	0	1,490	6.9
J-10587	1,468	4	1,470	2.2
J-10588	1,475	34	1,477	1.5
J-10589	1,477	26	1,478	1.4
J-10590	1,478	5	1,479	1.3
J-10591	1,385	385	1,391	6.0
J-10592	1,543	0	1,546	2.3
J-10593	1,548	0	1,550	1.8
J-10594	1,549	0	1,550	1.8
J-10595	1,548	0	1,550	1.9
J-10596	1,476	0	1,478	1.6
J-10597	1,453	0	1,457	4.1
J-10598	1,453	0	1,457	3.8
J-10600	1,450	0	1,454	4.1
J-10601	1,450	0	1,455	4.3
J-10602	1,469	0	1,471	2.3
J-10603	1,476	0	1,477	1.0
J-10604	1,477	0	1,478	1.6
J-10605	1,494	0	1,496	1.5
J-10606	1,494	0	1,495	1.3
J-10607	1,494	0	1,495	0.3

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-10608	1,494	0	1,494	0.3
J-10609	1,495	0	1,495	0.3
J-10610	1,481	0	1,482	1.5
J-10611	1,493	0	1,500	7.2
J-10612	1,479	0	1,480	1.2
J-10616	1,486	0	1,492	6.7
J-10617	1,487	0	1,493	6.6
J-10618	1,481	3	1,482	1.0
J-10619	1,477	0	1,479	1.3
J-10620	1,481	23	1,482	1.0
J-10621	1,476	0	1,478	1.5
J-10624	1,381	9	1,391	9.8
J-10625	1,522	0	1,526	4.5
J-10627	1,423	0	1,428	5.7
J-10628	1,466	0	1,476	9.9
J-10629	1,475	0	1,475	0.6
J-10630	1,471	0	1,472	1.0
J-10631	1,469	0	1,470	1.0
J-10632	1,468	0	1,478	9.7
J-10633	1,465	0	1,469	4.2
J-10635	1,478	0	1,479	1.0
J-10636	1,456	0	1,457	1.3
J-10637	1,544	0	1,547	2.3
J-10639	1,420	0	1,426	6.9
J-10640	1,423	0	1,429	6.6
J-10641	1,459	0	1,462	3.1
J-10642	1,443	0	1,448	4.7
J-10643	1,484	0	1,490	6.4
J-10644	1,424	0	1,430	6.4
J-10645	1,422	0	1,429	6.6
J-10647	1,409	0	1,415	5.6
J-10648	1,456	0	1,457	1.0
J-10649	1,525	0	1,529	4.2
J-10650	1,525	0	1,529	4.2
J-10651	1,505	0	1,511	5.9
J-10652	1,521	0	1,525	4.3
J-1076	1,444	25	1,449	4.5
J-1113	1,475	15	1,482	6.1
J-1119	1,439	20	1,442	3.2

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-1172	1,464	16	1,471	7.2
J-1200	1,448	4	1,453	4.5
J-1211	1,418	1	1,423	4.6
J-1219	1,458	104	1,461	3.5
J-1232	1,472	11	1,474	2.0
J-1238	1,465	102	1,468	2.9
J-1257	1,446	18	1,450	4.1
J-1263	1,453	5	1,455	2.0
J-1327	1,490	40	1,495	4.8
J-1366	1,401	0	1,408	6.4
J-1370	1,472	22	1,478	6.5
J-1383	1,494	4	1,501	7.2
J-1419	1,546	18	1,548	2.1
J-145	1,421	25	1,428	7.1
J-1461	1,476	7	1,482	6.0
J-1470	1,489	47	1,490	1.5
J-1482	1,423	24	1,427	4.1
J-1491	1,476	12	1,477	1.5
J-151	1,457	13	1,460	3.4
J-1513	1,441	0	1,444	2.4
J-153	1,459	5	1,463	3.4
J-1534	1,456	10	1,464	8.0
J-156	1,456	15	1,457	1.1
J-1575	1,465	6	1,468	3.0
J-158	1,427	9	1,431	4.1
J-159	1,426	28	1,430	4.1
J-1599	1,442	9	1,445	2.7
J-160	1,441	19	1,444	2.4
J-1600	1,446	2	1,451	4.7
J-161	1,441	0	1,444	2.4
J-162	1,455	14	1,456	1.1
J-1627	1,460	10	1,463	3.0
J-163	1,455	0	1,456	1.2
J-1635	1,449	52	1,451	2.4
J-1637	1,401	0	1,408	6.4
J-1654	1,510	7	1,513	2.9
J-1659	1,483	1	1,484	0.9
J-1681	1,459	24	1,462	3.5
J-1695	1,450	48	1,454	4.3

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-1753	1,407	1	1,413	5.8
J-1756	1,416	61	1,423	6.7
J-1761	1,420	3	1,428	7.2
J-178	1,447	0	1,451	4.2
J-1828	1,460	57	1,463	3.4
J-1831	1,453	24	1,457	4.0
J-1840	1,456	48	1,464	7.9
J-186	1,476	0	1,478	2.0
J-1883	1,444	41	1,446	2.4
J-192	1,549	295	1,551	1.8
J-1925	1,480	0	1,481	1.1
J-1944	1,486	6	1,487	1.0
J-1965	1,477	4	1,485	8.8
J-1976	1,454	44	1,458	3.9
J-1984	1,484	0	1,491	6.8
J-2	1,481	0	1,490	8.4
J-2007	1,455	56	1,458	3.8
J-2033	1,479	26	1,481	2.4
J-2049	1,445	53	1,450	4.5
J-210	1,455	10	1,457	1.1
J-2127	1,551	2	1,552	1.6
J-2133	1,481	36	1,484	2.6
J-2154	1,461	6	1,464	3.0
J-2164	1,469	27	1,471	2.1
J-2179	1,449	6	1,451	1.8
J-2189	1,449	15	1,453	4.1
J-2215	1,430	7	1,436	5.7
J-2239	1,442	4	1,444	2.6
J-225	1,456	14	1,457	1.0
J-226	1,456	0	1,457	1.1
J-2264	1,560	0	1,561	0.7
J-2272	1,450	0	1,454	4.4
J-2273	1,450	18	1,454	4.4
J-228	1,442	18	1,445	2.7
J-2284	1,557	6	1,559	2.2
J-2317	1,432	20	1,436	3.4
J-232	1,416	2	1,421	5.1
J-2323	1,437	23	1,440	3.6
J-2324	1,436	3	1,440	3.7

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-233	1,416	0	1,421	5.1
J-2361	1,455	2	1,459	3.6
J-2363	1,479	9	1,480	1.3
J-2374	1,544	0	1,546	2.1
J-2398	1,456	3	1,464	7.9
J-2403	1,471	2	1,477	6.6
J-2484	1,426	13	1,430	4.1
J-250	1,457	140	1,458	1.1
J-2507	1,436	26	1,439	3.4
J-2539	1,413	31	1,418	5.4
J-2558	1,482	18	1,488	6.7
J-2593	1,424	4	1,428	4.2
J-2594	1,424	10	1,428	4.2
J-269	1,402	0	1,409	6.3
J-270	1,493	21	1,497	4.5
J-272	1,455	12	1,456	1.1
J-2754	1,489	17	1,494	4.9
J-2757	1,462	19	1,466	3.2
J-2761	1,476	12	1,482	6.1
J-2788	1,423	4	1,429	6.5
J-279	1,553	23	1,555	1.4
J-2806	1,556	0	1,558	2.3
J-2832	1,395	4	1,402	7.0
J-2841	1,437	31	1,442	4.6
J-2846	1,440	37	1,446	5.3
J-2896	1,475	52	1,477	1.8
J-29	1,472	0	1,481	9.4
J-2929	1,494	0	1,494	0.3
J-2937	1,443	0	1,448	4.5
J-2940	1,438	31	1,443	5.2
J-296	1,439	20	1,442	2.8
J-297	1,439	0	1,442	2.8
J-3019	1,447	24	1,452	4.6
J-303	1,436	35	1,441	5.4
J-3065	1,465	40	1,467	2.0
J-3134	1,456	25	1,457	1.0
J-319	1,441	314	1,445	4.8
J-3197	1,444	0	1,448	4.1
J-3198	1,444	3	1,446	2.3

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-3202	1,412	3	1,420	7.6
J-3240	1,433	16	1,438	5.0
J-3246	1,400	1	1,406	6.5
J-3247	1,400	0	1,406	6.6
J-3252	1,446	10	1,451	4.7
J-3286	1,492	43	1,493	1.2
J-3311	1,447	22	1,451	4.2
J-3316	1,443	10	1,448	4.9
J-3325	1,436	30	1,439	3.3
J-3330	1,448	1	1,452	4.1
J-3335	1,450	2	1,454	4.2
J-3371	1,469	21	1,472	2.5
J-338	1,448	29	1,450	2.1
J-3395	1,461	30	1,464	3.0
J-3400	1,468	20	1,471	2.7
J-3406	1,441	80	1,446	4.6
J-3410	1,435	30	1,441	5.3
J-3413	1,453	0	1,457	4.1
J-3421	1,443	19	1,446	2.7
J-3446	1,456	4	1,464	8.0
J-346	1,467	144	1,470	2.4
J-348	1,390	60	1,397	7.7
J-3510	1,460	1	1,463	3.0
J-3527	1,457	21	1,461	3.8
J-3539	1,492	16	1,493	1.7
J-3540	1,492	115	1,493	1.7
J-3549	1,429	22	1,433	3.9
J-356	1,524	32	1,528	4.2
J-357	1,448	62	1,452	4.6
J-3593	1,484	13	1,486	2.0
J-3599	1,439	21	1,444	5.0
J-3606	1,455	0	1,457	1.1
J-3609	1,440	6	1,446	5.3
J-364	1,457	71	1,462	4.9
J-3649	1,421	110	1,427	6.1
J-3688	1,449	392	1,451	2.3
J-37	1,494	0	1,501	7.2
J-3718	1,391	2	1,398	7.4
J-372	1,469	1	1,471	2.6

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-373	1,468	10	1,471	2.7
J-3771	1,482	8	1,487	5.5
J-3787	1,488	12	1,490	1.6
J-3789	1,442	20	1,445	2.8
J-3793	1,442	30	1,444	2.7
J-3805	1,466	39	1,469	2.5
J-382	1,438	11	1,441	2.8
J-3829	1,419	40	1,423	4.6
J-3847	1,444	17	1,449	4.6
J-3851	1,489	22	1,490	1.4
J-3871	1,469	20	1,471	2.4
J-3885	1,423	22	1,428	4.2
J-390	1,489	4	1,494	4.9
J-3917	1,478	44	1,480	2.6
J-3927	1,426	40	1,432	6.1
J-394	1,449	53	1,451	1.8
J-3948	1,510	0	1,513	2.9
J-3955	1,477	5	1,478	1.3
J-3998	1,441	3	1,444	2.6
J-400	1,423	9	1,428	4.4
J-4007	1,423	3	1,427	4.2
J-408	1,425	2	1,429	4.2
J-409	1,425	3	1,429	4.2
J-4100	1,449	5	1,451	1.7
J-412	1,424	29	1,428	4.2
J-4123	1,494	33	1,498	4.3
J-413	1,424	20	1,428	4.3
J-4138	1,420	3	1,424	4.4
J-4159	1,423	31	1,427	4.4
J-416	1,477	26	1,486	8.8
J-417	1,477	1	1,483	5.9
J-4191	1,448	0	1,450	2.4
J-4234	1,453	16	1,455	2.0
J-4236	1,444	15	1,446	2.5
J-4259	1,431	6	1,434	3.7
J-4281	1,456	68	1,459	3.7
J-4287	1,494	36	1,495	1.0
J-4309	1,423	29	1,427	4.2
J-4312	1,444	14	1,446	2.3

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-4335	1,407	10	1,413	5.8
J-4379	1,490	13	1,495	4.8
J-4380	1,422	8	1,427	4.4
J-4428	1,423	19	1,428	4.1
J-445	1,476	17	1,482	6.1
J-4467	1,525	26	1,529	4.1
J-4472	1,402	0	1,408	5.8
J-4473	1,401	42	1,407	5.9
J-448	1,489	0	1,493	4.9
J-4488	1,445	16	1,450	4.8
J-449	1,479	18	1,486	7.3
J-450	1,479	1	1,486	7.3
J-4546	1,446	1	1,450	4.4
J-4553	1,457	4	1,458	1.7
J-458	1,485	42	1,490	5.2
J-4580	1,440	11	1,443	2.7
J-4617	1,452	11	1,454	2.0
J-462	1,449	8	1,453	4.1
J-463	1,442	0	1,446	4.8
J-465	1,452	5	1,454	1.5
J-4662	1,414	8	1,419	5.1
J-4669	1,482	94	1,484	2.2
J-4670	1,567	0	1,568	1.3
J-4671	1,566	0	1,568	1.3
J-4683	1,452	14	1,456	4.1
J-4693	1,420	24	1,425	4.6
J-4700	1,474	9	1,477	2.2
J-4708	1,470	37	1,472	2.6
J-479	1,469	18	1,472	2.5
J-4794	1,459	33	1,463	3.5
J-4796	1,419	6	1,424	4.5
J-482	1,446	7	1,450	4.6
J-4827	1,414	17	1,420	5.3
J-4857	1,484	19	1,486	1.9
J-4878	1,488	15	1,489	1.6
J-4879	1,488	69	1,489	1.5
J-4895	1,469	18	1,479	9.6
J-4958	1,448	41	1,452	4.6
J-4962	1,458	17	1,462	3.7

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-4981	1,478	25	1,480	1.5
J-4985	1,440	23	1,444	4.9
J-4986	1,441	3	1,446	4.8
J-4991	1,447	4	1,450	2.5
J-501	1,415	42	1,422	7.1
J-5020	1,451	11	1,453	2.2
J-5021	1,475	74	1,477	2.0
J-5025	1,456	28	1,459	2.9
J-5034	1,491	36	1,495	4.6
J-5048	1,445	0	1,450	4.3
J-5066	1,433	176	1,437	4.0
J-5096	1,510	0	1,516	5.5
J-512	1,477	162	1,478	1.3
J-5136	1,510	0	1,516	5.6
J-5144	1,468	23	1,478	9.7
J-5151	1,443	22	1,445	2.5
J-5158	1,446	43	1,448	2.2
J-5178	1,423	6	1,427	4.2
J-5230	1,447	8	1,451	4.4
J-5268	1,461	4	1,464	2.9
J-5288	1,485	66	1,487	1.7
J-5300	1,439	61	1,444	5.5
J-532	1,494	19	1,495	1.1
J-533	1,494	14	1,495	1.1
J-5344	1,443	8	1,445	2.4
J-5345	1,443	11	1,445	2.4
J-535	1,439	14	1,442	2.8
J-5372	1,569	3	1,570	1.1
J-5383	1,453	3	1,457	3.9
J-5395	1,434	73	1,440	5.6
J-5396	1,433	7	1,439	5.7
J-5401	1,452	42	1,456	4.2
J-5406	1,544	5	1,546	2.2
J-5409	1,430	101	1,436	5.7
J-5410	1,460	15	1,463	3.0
J-5435	1,458	15	1,461	3.5
J-5441	1,431	11	1,435	3.6
J-5446	1,446	21	1,450	4.8
J-5450	1,494	34	1,495	1.1

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-5455	1,490	9	1,492	1.8
J-5460	1,454	8	1,456	1.9
J-5470	1,420	43	1,426	6.2
J-5515	1,423	14	1,427	4.2
J-552	1,446	66	1,450	3.9
J-5545	1,429	12	1,433	3.7
J-5573	1,393	7	1,400	7.2
J-5575	1,493	111	1,494	1.1
J-5585	1,456	29	1,457	1.2
J-5594	1,427	33	1,432	5.5
J-5610	1,545	7	1,547	2.2
J-5621	1,446	2	1,450	4.5
J-5626	1,394	15	1,401	7.2
J-5649	1,466	82	1,468	2.9
J-565	1,469	16	1,471	2.3
J-5656	1,423	128	1,427	4.2
J-566	1,469	0	1,471	2.3
J-5670	1,444	7	1,449	4.5
J-5675	1,471	33	1,474	2.3
J-5687	1,464	16	1,467	2.7
J-5688	1,463	2	1,466	2.8
J-5712	1,428	25	1,432	4.0
J-5723	1,454	15	1,456	1.9
J-575	1,411	7	1,416	5.4
J-576	1,411	0	1,416	5.4
J-5765	1,458	73	1,463	4.8
J-5788	1,478	34	1,480	1.8
J-5808	1,470	11	1,474	3.1
J-5822	1,422	53	1,426	4.4
J-583	1,443	8	1,446	2.6
J-5839	1,448	20	1,450	1.8
J-5841	1,426	0	1,430	4.5
J-585	1,453	17	1,457	4.3
J-5854	1,449	20	1,453	4.0
J-5855	1,449	0	1,453	4.0
J-5857	1,434	53	1,437	3.4
J-5872	1,460	8	1,463	3.3
J-5874	1,460	18	1,463	3.1
J-5927	1,475	28	1,481	6.1

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-5939	1,446	9	1,450	4.4
J-5965	1,452	2	1,456	3.8
J-5966	1,453	8	1,457	3.8
J-5993	1,426	11	1,433	6.6
J-5996	1,405	0	1,411	6.0
J-5999	1,428	12	1,432	3.8
J-6027	1,466	10	1,473	7.0
J-6047	1,434	20	1,437	3.2
J-6072	1,428	23	1,432	3.8
J-6084	1,448	24	1,449	1.9
J-6086	1,464	63	1,468	4.2
J-6099	1,423	10	1,427	4.1
J-6102	1,450	9	1,454	4.0
J-6119	1,445	81	1,449	4.4
J-6129	1,439	9	1,442	2.8
J-6130	1,440	4	1,443	2.8
J-6136	1,462	43	1,465	2.8
J-6171	1,479	56	1,481	2.5
J-618	1,494	199	1,495	1.2
J-6181	1,479	18	1,481	2.4
J-6188	1,451	26	1,456	4.5
J-6189	1,452	0	1,457	4.4
J-6193	1,456	0	1,458	1.7
J-6195	1,449	27	1,453	4.1
J-6196	1,446	20	1,450	4.3
J-6215	1,461	11	1,464	3.0
J-625	1,439	6	1,442	3.1
J-6277	1,441	21	1,446	5.0
J-6288	1,458	13	1,461	3.4
J-6289	1,457	7	1,460	3.4
J-629	1,474	93	1,477	2.8
J-630	1,492	25	1,493	1.3
J-6353	1,429	16	1,433	3.8
J-6372	1,422	10	1,427	4.3
J-6374	1,438	5	1,441	3.0
J-6375	1,438	6	1,441	3.0
J-6380	1,492	18	1,496	4.6
J-6388	1,527	0	1,531	3.8
J-6393	1,482	43	1,483	1.3

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-6394	1,482	9	1,483	1.3
J-640	1,436	38	1,439	3.2
J-6406	1,450	11	1,454	4.1
J-6410	1,463	108	1,466	3.1
J-6413	1,424	16	1,428	4.1
J-643	1,454	4	1,457	3.2
J-6440	1,464	22	1,467	3.0
J-6464	1,454	9	1,458	3.8
J-648	1,454	9	1,455	1.3
J-6486	1,455	18	1,459	3.6
J-6508	1,433	22	1,437	3.5
J-6509	1,432	7	1,436	3.5
J-6520	1,446	50	1,450	4.4
J-653	1,461	16	1,468	7.6
J-6544	1,450	37	1,452	2.3
J-6547	1,467	39	1,469	2.6
J-6552	1,446	48	1,451	4.7
J-6579	1,428	2	1,432	3.6
J-6588	1,436	37	1,442	5.6
J-6589	1,436	2	1,442	5.6
J-6593	1,478	40	1,479	1.6
J-6602	1,442	47	1,446	4.1
J-6617	1,442	0	1,447	5.1
J-663	1,484	18	1,486	1.8
J-6633	1,491	53	1,492	1.2
J-6634	1,491	13	1,492	1.2
J-6646	1,431	29	1,436	5.2
J-6678	1,475	17	1,476	1.6
J-670	1,405	21	1,411	6.2
J-6708	1,452	74	1,456	3.9
J-671	1,404	3	1,411	6.2
J-6719	1,458	14	1,461	3.6
J-6728	1,408	85	1,416	7.9
J-675	1,436	11	1,439	3.0
J-6759	1,436	6	1,439	3.2
J-676	1,437	0	1,440	3.0
J-6774	1,437	49	1,443	5.6
J-6793	1,424	1	1,428	4.4
J-682	1,476	4	1,478	1.5

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-6827	1,445	11	1,450	4.5
J-6828	1,426	22	1,430	4.1
J-6829	1,426	26	1,430	4.1
J-6855	1,451	43	1,455	4.2
J-6885	1,482	0	1,483	0.9
J-6909	1,485	65	1,487	1.7
J-6934	1,472	46	1,475	3.0
J-6949	1,437	10	1,440	3.1
J-695	1,483	15	1,490	6.9
J-6993	1,466	23	1,470	4.1
J-701	1,435	0	1,438	3.2
J-7014	1,448	3	1,452	4.2
J-7021	1,494	0	1,501	7.2
J-7065	1,465	50	1,467	2.4
J-7068	1,454	4	1,456	2.0
J-7072	1,502	28	1,508	6.3
J-7083	1,433	9	1,436	3.5
J-7086	1,476	31	1,478	1.6
J-711	1,424	60	1,428	4.1
J-7113	1,441	64	1,443	2.7
J-7118	1,467	72	1,469	2.6
J-712	1,424	90	1,428	4.1
J-714	1,430	4	1,433	3.7
J-7151	1,424	6	1,428	4.0
J-7179	1,446	43	1,450	4.0
J-7194	1,453	2	1,456	3.8
J-7248	1,458	12	1,461	3.3
J-7252	1,479	32	1,482	2.5
J-7280	1,452	3	1,456	3.2
J-7344	1,419	37	1,426	6.9
J-7345	1,462	0	1,466	3.3
J-7353	1,430	20	1,436	5.8
J-7403	1,451	50	1,457	5.5
J-7442	1,468	5	1,475	6.8
J-7463	1,457	32	1,461	3.9
J-7471	1,440	84	1,443	3.1
J-7479	1,475	25	1,477	1.8
J-7481	1,426	79	1,432	6.2
J-7487	1,461	16	1,464	3.1

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-7506	1,468	41	1,471	2.5
J-7529	1,448	36	1,452	3.6
J-7549	1,466	18	1,469	2.4
J-756	1,490	6	1,495	4.8
J-7560	1,483	220	1,485	1.9
J-757	1,490	13	1,494	4.8
J-7575	1,469	0	1,471	2.3
J-7589	1,455	112	1,457	1.8
J-759	1,445	55	1,449	4.6
J-7603	1,457	13	1,465	7.9
J-7609	1,423	16	1,427	4.4
J-7610	1,423	22	1,427	4.3
J-7619	1,469	41	1,471	2.6
J-762	1,474	57	1,476	2.1
J-766	1,416	14	1,421	5.1
J-7695	1,541	0	1,544	2.6
J-7705	1,449	30	1,453	4.1
J-772	1,541	2	1,544	2.5
J-773	1,541	2	1,544	2.5
J-7738	1,448	5	1,450	1.9
J-7779	1,456	56	1,461	4.9
J-7790	1,465	0	1,469	4.1
J-7791	1,462	86	1,467	4.4
J-7799	1,394	42	1,401	6.9
J-7809	1,483	38	1,484	1.1
J-7815	1,455	14	1,457	1.1
J-7822	1,455	5	1,456	1.1
J-7836	1,451	31	1,455	4.3
J-7839	1,470	57	1,473	3.3
J-7842	1,470	74	1,473	2.3
J-7860	1,474	29	1,477	2.8
J-7866	1,482	0	1,483	0.9
J-787	1,473	80	1,475	1.9
J-788	1,473	0	1,475	1.9
J-7894	1,396	1	1,403	6.9
J-7920	1,462	49	1,465	3.1
J-7927	1,491	17	1,492	1.4
J-795	1,492	31	1,493	1.3
J-7955	1,430	8	1,434	3.6

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-7956	1,477	68	1,480	2.5
J-796	1,492	0	1,493	1.2
J-7960	1,436	16	1,439	3.2
J-7972	1,455	19	1,459	4.1
J-7991	1,419	13	1,424	4.7
J-8015	1,469	23	1,472	2.2
J-8062	1,464	17	1,471	7.3
J-8091	1,443	6	1,448	5.1
J-8107	1,481	16	1,483	2.2
J-8114	1,471	27	1,473	2.3
J-8120	1,483	4	1,488	5.3
J-8127	1,464	25	1,467	2.8
J-8136	1,402	5	1,408	5.8
J-8161	1,463	16	1,466	2.8
J-8168	1,467	10	1,470	2.4
J-817	1,421	9	1,428	6.7
J-8177	1,432	13	1,436	3.7
J-8187	1,492	0	1,493	1.7
J-8227	1,448	34	1,453	4.4
J-8237	1,450	10	1,452	1.8
J-8252	1,462	16	1,466	3.2
J-8262	1,416	3	1,421	5.0
J-8287	1,474	0	1,476	1.7
J-8315	1,450	22	1,454	3.5
J-8320	1,438	23	1,440	2.9
J-8322	1,462	97	1,465	3.2
J-8324	1,499	0	1,503	3.8
J-8356	1,474	49	1,476	1.9
J-8369	1,429	20	1,433	3.8
J-8382	1,438	15	1,441	3.0
J-8388	1,530	17	1,534	3.7
J-8391	1,464	26	1,467	2.9
J-8402	1,441	40	1,444	2.9
J-8439	1,479	13	1,480	1.2
J-8458	1,460	11	1,463	3.6
J-8466	1,477	11	1,479	2.0
J-8475	1,490	111	1,491	1.3
J-849	1,457	6	1,460	2.9
J-8490	1,470	15	1,473	2.3

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-8496	1,445	11	1,447	2.3
J-850	1,457	18	1,460	3.5
J-8502	1,494	7	1,501	7.0
J-8503	1,492	13	1,499	7.3
J-8515	1,554	2	1,556	1.3
J-8554	1,496	8	1,501	4.1
J-8556	1,469	33	1,471	2.2
J-8559	1,424	4	1,431	6.8
J-8609	1,431	0	1,435	3.7
J-8622	1,492	536	1,493	1.6
J-8625	1,452	0	1,454	2.1
J-863	1,488	23	1,493	4.9
J-8631	1,448	248	1,453	4.6
J-864	1,488	5	1,493	4.9
J-8655	1,426	21	1,432	6.4
J-8673	1,419	21	1,424	4.6
J-8677	1,488	1	1,496	7.6
J-8690	1,466	0	1,469	2.6
J-8726	1,464	57	1,468	4.2
J-8727	1,464	69	1,468	4.2
J-8742	1,450	21	1,455	4.4
J-8753	1,439	3	1,442	2.7
J-8758	1,432	12	1,438	6.0
J-8759	1,499	28	1,506	6.6
J-8789	1,427	1	1,433	6.5
J-8802	1,466	24	1,469	2.8
J-8806	1,470	17	1,472	2.2
J-8812	1,450	7	1,454	4.2
J-8829	1,484	58	1,486	1.9
J-8840	1,447	8	1,451	4.5
J-8842	1,461	7	1,464	3.2
J-8846	1,457	33	1,459	2.8
J-8847	1,472	29	1,475	3.1
J-8852	1,450	26	1,454	4.3
J-8861	1,447	5	1,452	4.3
J-8879	1,448	80	1,452	4.6
J-8885	1,511	55	1,516	5.5
J-8894	1,463	50	1,467	4.3
J-8904	1,457	0	1,460	3.5

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-8925	1,489	4	1,490	1.6
J-8929	1,487	48	1,489	1.7
J-8930	1,483	60	1,485	2.4
J-8936	1,497	3	1,504	6.8
J-8941	1,469	25	1,473	3.2
J-8957	1,468	17	1,470	2.7
J-8963	1,448	4	1,450	2.4
J-8969	1,452	5	1,456	3.9
J-898	1,493	3	1,497	4.3
J-8981	1,462	0	1,465	3.2
J-9006	1,478	78	1,480	2.5
J-9008	1,488	15	1,490	1.5
J-901	1,445	13	1,449	4.3
J-9022	1,431	7	1,437	6.4
J-9044	1,452	0	1,456	3.9
J-9047	1,454	13	1,458	4.0
J-905	1,446	10	1,450	4.6
J-9064	1,388	31	1,396	7.9
J-9069	1,486	39	1,492	6.7
J-9082	1,473	0	1,483	9.2
J-9084	1,396	23	1,404	7.1
J-9093	1,480	0	1,481	1.2
J-9105	1,526	5	1,530	4.0
J-9107	1,450	0	1,452	2.3
J-9148	1,455	0	1,456	1.2
J-9149	1,456	2	1,457	1.0
J-9150	1,397	4	1,404	6.8
J-9155	1,457	0	1,460	2.9
J-9157	1,469	5	1,476	6.7
J-9161	1,469	7	1,471	2.7
J-9164	1,448	9	1,452	3.8
J-9165	1,444	84	1,449	4.3
J-9167	1,427	62	1,433	5.9
J-9170	1,472	0	1,481	9.4
J-9171	1,471	0	1,472	1.0
J-9172	1,471	0	1,472	1.0
J-9175	1,385	0	1,395	9.9
J-9176	1,480	2459	1,481	1.5
J-9177	1,478	536	1,480	1.6

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-9178	1,449	4	1,451	1.9
J-9179	1,399	2	1,409	9.5
J-9181	1,477	31	1,478	1.6
J-9183	1,548	0	1,550	1.8
J-9187	1,489	0	1,494	4.9
J-9192	1,487	0	1,488	1.0
J-9196	1,518	0	1,523	4.9
J-9199	1,457	0	1,458	0.9
J-9201	1,456	0	1,464	8.1
J-9202	1,456	11	1,464	8.0
J-9203	1,456	0	1,464	8.1
J-9206	1,437	9	1,440	2.9
J-9207	1,437	7	1,440	2.9
J-9208	1,490	1	1,498	7.3
J-9211	1,502	0	1,508	6.4
J-9213	1,480	0	1,489	8.2
J-9214	1,413	1	1,421	7.9
J-9215	1,413	41	1,421	7.9
J-9216	1,478	86	1,479	1.6
J-9217	1,478	0	1,480	1.6
J-9222	1,435	0	1,440	5.9
J-9223	1,448	16	1,453	4.5
J-9224	1,449	14	1,453	4.4
J-9225	1,440	0	1,443	2.6
J-9226	1,441	17	1,443	2.6
J-9229	1,427	0	1,433	6.1
J-9230	1,427	0	1,433	6.2
J-9233	1,405	7	1,414	8.9
J-9234	1,405	8	1,414	9.0
J-9236	1,420	3	1,425	4.5
J-9237	1,477	8	1,478	1.7
J-9238	1,476	0	1,478	1.7
J-9239	1,527	5	1,531	3.7
J-9240	1,527	0	1,530	3.7
J-9242	1,481	0	1,483	1.5
J-9243	1,457	4	1,465	8.0
J-9244	1,456	0	1,464	8.0
J-9245	1,457	0	1,458	1.2
J-9246	1,457	0	1,458	1.2

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-9247	1,494	0	1,496	1.6
J-9249	1,495	0	1,502	6.8
J-9250	1,494	3	1,501	6.9
J-9251	1,444	0	1,449	5.1
J-9252	1,443	0	1,449	5.2
J-9253	1,460	10	1,463	3.3
J-9254	1,481	0	1,483	1.4
J-9255	1,481	0	1,482	1.5
J-9261	1,444	0	1,449	4.6
J-9262	1,445	0	1,449	4.5
J-9263	1,475	0	1,477	1.7
J-9264	1,459	8	1,462	3.4
J-9266	1,413	7	1,420	7.6
J-9267	1,412	0	1,420	7.6
J-9268	1,487	0	1,494	7.7
J-9269	1,490	13	1,498	7.3
J-9270	1,479	0	1,480	1.5
J-9271	1,479	0	1,480	1.5
J-9274	1,446	6	1,448	2.0
J-9275	1,446	0	1,448	2.0
J-9279	1,457	3	1,461	3.5
J-9281	1,457	15	1,465	7.9
J-9283	1,468	14	1,471	2.5
J-9284	1,460	42	1,467	7.6
J-9285	1,460	0	1,467	7.6
J-9286	1,463	54	1,463	0.7
J-9288	1,454	0	1,456	1.9
J-9289	1,453	0	1,455	2.0
J-9290	1,444	0	1,449	4.6
J-9292	1,453	1000	1,455	2.0
J-9293	1,476	25	1,478	1.6
J-9294	1,476	5	1,478	1.6
J-9297	1,484	58	1,490	6.4
J-9298	1,481	1	1,489	8.2
J-9299	1,430	1	1,434	3.8
J-9300	1,432	3	1,435	3.6
J-9303	1,476	0	1,485	8.7
J-9305	1,441	0	1,446	5.1
J-9306	1,472	22	1,479	6.5

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-9308	1,446	11	1,451	4.4
J-9309	1,426	3	1,430	3.9
J-9310	1,424	1	1,428	4.1
J-9312	1,498	21	1,505	6.8
J-9313	1,474	5	1,477	2.2
J-9314	1,471	1	1,474	2.5
J-9316	1,494	0	1,494	0.3
J-9317	1,430	10	1,436	6.5
J-9318	1,429	0	1,436	6.6
J-9319	1,386	2	1,394	7.8
J-9320	1,394	1	1,401	7.1
J-9321	1,456	2	1,464	8.0
J-9322	1,457	3	1,465	8.0
J-9324	1,463	0	1,466	2.8
J-9325	1,459	2	1,460	1.0
J-9326	1,382	2	1,391	8.2
J-9327	1,385	3	1,393	7.9
J-9328	1,492	6	1,499	7.2
J-9329	1,488	4	1,495	7.6
J-9330	1,419	6	1,424	4.6
J-9331	1,417	2	1,422	4.8
J-9332	1,491	4	1,498	7.3
J-9333	1,485	1	1,493	7.8
J-9334	1,427	4	1,431	4.0
J-9336	1,429	10	1,434	5.4
J-9337	1,432	13	1,437	5.1
J-9338	1,551	5	1,553	2.9
J-9339	1,551	10	1,554	2.9
J-9340	1,474	53	1,477	2.2
J-9341	1,477	0	1,479	1.9
J-9342	1,470	0	1,479	9.5
J-9343	1,472	0	1,481	9.3
J-9344	1,396	3	1,403	6.9
J-9345	1,404	3	1,410	6.1
J-9346	1,445	6	1,449	4.5
J-9347	1,436	20	1,441	5.4
J-9350	1,486	0	1,487	1.1
J-9351	1,482	0	1,484	1.4
J-9354	1,494	500	1,496	1.5

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-9355	1,450	6	1,454	4.0
J-9356	1,452	10	1,456	3.8
J-9357	1,445	0	1,450	5.1
J-9358	1,444	0	1,449	5.1
J-9359	1,422	7	1,430	7.2
J-9360	1,420	45	1,428	7.5
J-9361	1,428	13	1,432	3.8
J-9362	1,550	0	1,552	1.7
J-9363	1,551	24	1,552	1.6
J-9364	1,464	33	1,467	2.8
J-9365	1,458	18	1,461	3.3
J-9366	1,457	37	1,458	1.2
J-9367	1,460	46	1,461	1.0
J-9369	1,478	23	1,479	1.5
J-937	1,446	27	1,450	4.0
J-9371	1,401	0	1,407	6.5
J-9372	1,452	29	1,456	4.1
J-9373	1,447	8	1,452	4.6
J-9374	1,478	0	1,480	1.7
J-9375	1,478	0	1,480	1.8
J-9378	1,440	13	1,445	4.5
J-9379	1,438	31	1,443	4.7
J-9380	1,436	0	1,442	5.7
J-9381	1,456	3	1,464	8.0
J-9382	1,449	20	1,458	8.7
J-9384	1,458	0	1,466	7.8
J-9385	1,456	0	1,457	1.3
J-9386	1,439	18	1,442	2.7
J-9387	1,558	4	1,560	2.1
J-9388	1,547	6	1,550	3.2
J-9389	1,461	20	1,464	3.2
J-9392	1,406	2	1,412	5.9
J-9393	1,413	4	1,418	5.2
J-9395	1,499	4	1,506	6.4
J-9396	1,551	6	1,552	1.6
J-9397	1,548	7	1,550	1.9
J-9398	1,422	71	1,428	6.6
J-9399	1,410	0	1,418	7.8
J-9400	1,523	4	1,527	4.4

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-9401	1,513	2	1,518	5.3
J-9403	1,435	19	1,438	3.1
J-9404	1,416	6	1,421	4.9
J-9405	1,410	2	1,416	5.5
J-9406	1,418	0	1,423	4.6
J-9407	1,425	37	1,429	4.0
J-9408	1,481	13	1,486	5.6
J-9409	1,475	19	1,482	6.2
J-9410	1,402	7	1,409	6.5
J-9411	1,399	2	1,406	6.8
J-9412	1,440	7	1,443	2.6
J-9413	1,432	4	1,435	3.4
J-9414	1,493	1	1,500	7.2
J-9415	1,497	8	1,504	6.8
J-9416	1,459	9	1,462	3.7
J-9417	1,450	4	1,454	4.6
J-9419	1,494	30	1,496	1.5
J-9420	1,385	2	1,393	8.0
J-9421	1,385	3	1,393	7.9
J-9422	1,398	31	1,404	6.7
J-9423	1,440	0	1,446	5.3
J-9424	1,436	18	1,442	5.9
J-9425	1,436	27	1,442	5.9
J-9426	1,415	6	1,420	5.0
J-9427	1,414	11	1,419	5.1
J-9428	1,470	14	1,472	2.1
J-9429	1,464	8	1,467	2.6
J-9430	1,410	3	1,417	7.8
J-9431	1,410	30	1,418	7.7
J-9432	1,468	2	1,475	6.8
J-9433	1,456	2	1,464	8.0
J-9434	1,537	12	1,540	2.8
J-9435	1,538	1	1,541	2.8
J-9436	1,527	1	1,531	3.9
J-9437	1,528	8	1,531	3.9
J-9438	1,407	7	1,413	5.8
J-9439	1,421	18	1,428	7.4
J-9440	1,428	5	1,435	6.7
J-9441	1,485	42	1,491	5.2

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-9443	1,392	1	1,399	7.4
J-9444	1,389	49	1,397	7.7
J-9446	1,422	0	1,427	4.3
J-9447	1,477	16	1,483	6.0
J-9448	1,472	1	1,479	6.5
J-9449	1,436	17	1,439	2.9
J-9450	1,414	0	1,422	7.8
J-9451	1,422	0	1,429	7.0
J-9452	1,513	8	1,518	5.1
J-9453	1,499	0	1,505	6.4
J-9454	1,422	11	1,427	4.5
J-9455	1,418	1	1,423	4.9
J-9456	1,445	14	1,450	4.4
J-9457	1,438	21	1,443	5.1
J-9458	1,475	2	1,482	6.2
J-9459	1,477	4	1,483	6.0
J-9460	1,399	1	1,406	6.6
J-9461	1,386	3	1,394	7.9
J-9462	1,490	0	1,491	0.7
J-9465	1,483	0	1,485	1.2
J-9467	1,457	0	1,465	7.9
J-9468	1,545	4	1,547	2.2
J-9469	1,543	7	1,545	2.4
J-9470	1,433	26	1,439	6.0
J-9471	1,423	3	1,428	4.3
J-9473	1,455	3	1,463	8.2
J-9474	1,433	12	1,437	3.2
J-9475	1,433	20	1,436	3.3
J-9476	1,494	0	1,495	1.2
J-9477	1,505	7	1,511	6.1
J-9478	1,510	20	1,516	5.6
J-9479	1,565	0	1,567	1.4
J-948	1,482	296	1,483	1.0
J-9480	1,561	0	1,563	1.8
J-9481	1,410	22	1,419	8.4
J-9483	1,436	12	1,439	3.3
J-9484	1,432	10	1,435	3.4
J-9485	1,432	2	1,435	3.4
J-9486	1,470	17	1,477	6.7

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-9487	1,477	11	1,483	6.0
J-9488	1,477	5	1,486	8.6
J-9489	1,486	3	1,493	7.7
J-9492	1,454	1	1,457	3.6
J-9493	1,455	7	1,458	3.5
J-9494	1,429	6	1,433	3.6
J-9495	1,444	16	1,446	2.2
J-9497	1,458	4	1,466	7.9
J-9498	1,402	7	1,410	8.6
J-9499	1,414	3	1,422	7.4
J-9500	1,526	10	1,530	3.8
J-9501	1,522	6	1,526	4.2
J-9502	1,457	0	1,458	1.2
J-9503	1,453	0	1,454	1.6
J-9504	1,432	0	1,438	6.2
J-9505	1,437	265	1,443	5.7
J-9506	1,517	2	1,522	4.9
J-9507	1,519	8	1,523	4.7
J-9508	1,456	7	1,464	8.0
J-9509	1,457	2	1,465	8.0
J-9510	1,435	28	1,441	5.9
J-9511	1,425	17	1,432	6.9
J-9512	1,401	1	1,410	8.6
J-9513	1,417	0	1,424	7.1
J-9514	1,491	1	1,499	7.2
J-9515	1,499	5	1,505	6.5
J-9516	1,437	5	1,443	5.6
J-9517	1,446	21	1,450	4.8
J-9518	1,460	9	1,463	3.0
J-9519	1,465	13	1,467	2.5
J-9520	1,417	30	1,424	7.1
J-9521	1,412	11	1,420	7.5
J-9522	1,471	8	1,477	6.6
J-9523	1,473	19	1,479	6.4
J-9524	1,457	17	1,460	3.2
J-9525	1,458	14	1,461	3.2
J-9526	1,450	0	1,454	4.0
J-9527	1,453	0	1,456	3.7
J-9528	1,421	3	1,426	4.4

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-9529	1,421	5	1,425	4.4
J-9530	1,398	3	1,407	8.9
J-9531	1,414	5	1,422	7.3
J-9532	1,424	20	1,430	6.5
J-9533	1,408	1	1,416	8.0
J-9534	1,417	1	1,424	7.2
J-9535	1,418	4	1,425	7.1
J-9536	1,428	14	1,432	3.7
J-9537	1,429	7	1,433	3.7
J-9538	1,460	0	1,463	3.0
J-9540	1,555	9	1,557	2.5
J-9541	1,553	6	1,556	2.6
J-9543	1,393	3	1,401	7.3
J-9544	1,432	4	1,435	3.2
J-9545	1,444	2	1,446	2.1
J-9546	1,447	7	1,449	2.0
J-9547	1,456	10	1,457	1.0
J-9548	1,476	20	1,477	1.4
J-9549	1,514	18	1,519	5.2
J-9550	1,508	33	1,514	5.8
J-9551	1,400	4	1,407	6.4
J-9552	1,402	9	1,409	6.2
J-9553	1,410	22	1,416	5.7
J-9554	1,400	10	1,407	6.7
J-9555	1,413	6	1,418	5.4
J-9556	1,412	6	1,418	5.5
J-9557	1,410	7	1,415	5.8
J-9558	1,401	9	1,408	6.6
J-9559	1,410	10	1,415	5.5
J-9560	1,409	16	1,415	5.6
J-9561	1,510	7	1,516	5.5
J-9562	1,516	9	1,521	5.0
J-9563	1,427	14	1,431	3.7
J-9564	1,443	4	1,445	2.2
J-9565	1,399	11	1,408	8.9
J-9566	1,417	3	1,424	7.1
J-9567	1,404	4	1,410	6.0
J-9569	1,423	10	1,427	4.3
J-9570	1,409	22	1,415	5.8

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-9571	1,426	21	1,432	6.4
J-9572	1,426	20	1,432	6.3
J-9574	1,410	40	1,418	7.7
J-9575	1,469	9	1,476	6.7
J-9576	1,474	21	1,481	6.3
J-9577	1,504	0	1,510	5.9
J-9578	1,563	34	1,565	1.6
J-9579	1,553	8	1,555	2.6
J-9580	1,420	10	1,427	6.8
J-9581	1,420	20	1,427	6.8
J-9582	1,414	12	1,419	5.2
J-9583	1,394	2	1,401	7.1
J-9584	1,504	1	1,510	6.2
J-9585	1,502	6	1,508	6.4
J-9586	1,481	20	1,482	1.1
J-9587	1,481	9	1,482	1.0
J-9588	1,458	13	1,466	7.8
J-9589	1,449	16	1,458	8.6
J-9590	1,432	8	1,436	3.6
J-9591	1,433	7	1,437	3.5
J-9592	1,410	3	1,415	5.8
J-9593	1,405	4	1,411	6.2
J-9594	1,453	30	1,456	3.7
J-9595	1,452	13	1,456	3.7
J-9596	1,451	16	1,452	1.5
J-9597	1,435	12	1,438	3.0
J-9598	1,420	3	1,427	6.7
J-9599	1,399	2	1,408	8.8
J-9600	1,545	7	1,547	2.2
J-9601	1,404	6	1,413	8.3
J-9602	1,409	10	1,417	7.9
J-9603	1,398	7	1,405	6.7
J-9605	1,416	11	1,422	6.7
J-9606	1,495	4	1,501	6.8
J-9607	1,444	17	1,446	2.4
J-9609	1,457	4	1,461	3.8
J-9610	1,471	4	1,474	2.5
J-9611	1,430	2	1,436	5.9
J-9612	1,416	2	1,423	7.4

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-9613	1,394	4	1,401	7.1
J-9614	1,385	4	1,393	8.0
J-9615	1,458	0	1,461	3.2
J-9617	1,454	21	1,458	3.6
J-9618	1,452	22	1,456	3.7
J-9619	1,447	12	1,451	4.2
J-9620	1,434	20	1,439	5.5
J-9621	1,430	39	1,436	5.8
J-9622	1,421	24	1,427	6.7
J-9623	1,546	9	1,548	2.1
J-9624	1,535	16	1,538	3.2
J-9625	1,545	7	1,547	2.1
J-9626	1,533	3	1,536	3.3
J-9627	1,419	5	1,424	4.7
J-9628	1,407	1	1,413	5.8
J-9630	1,469	12	1,476	6.7
J-9631	1,467	38	1,470	2.8
J-9632	1,475	60	1,477	2.0
J-9633	1,458	14	1,466	7.8
J-9634	1,436	8	1,446	9.9
J-9635	1,559	7	1,561	2.0
J-9636	1,558	34	1,560	2.2
J-9637	1,459	19	1,467	7.7
J-9638	1,448	12	1,457	8.7
J-9639	1,420	22	1,427	7.5
J-9640	1,434	11	1,437	3.3
J-9641	1,424	3	1,428	4.3
J-9642	1,435	44	1,438	3.3
J-9643	1,412	1	1,418	5.5
J-9644	1,510	12	1,515	5.6
J-9645	1,502	2	1,509	6.3
J-9646	1,432	6	1,435	3.6
J-9647	1,413	17	1,419	5.4
J-9648	1,567	22	1,568	1.3
J-9650	1,467	0	1,477	9.8
J-9651	1,418	2	1,423	5.0
J-9652	1,404	10	1,411	6.3
J-9654	1,493	0	1,493	0.4
J-9655	1,417	6	1,422	4.9

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-9656	1,400	10	1,407	6.5
J-9657	1,439	78	1,442	2.8
J-9658	1,427	20	1,431	4.0
J-9659	1,451	0	1,453	1.8
J-9660	1,438	12	1,441	3.0
J-9662	1,386	0	1,396	9.8
J-9663	1,384	0	1,393	9.9
J-9664	1,482	11	1,487	5.6
J-9665	1,481	26	1,487	5.6
J-9666	1,443	7	1,446	2.4
J-9667	1,426	9	1,430	4.1
J-9668	1,546	3	1,548	2.1
J-9669	1,556	10	1,557	1.2
J-9670	1,466	2	1,473	7.0
J-9672	1,527	9	1,532	5.2
J-9673	1,472	0	1,474	2.5
J-9674	1,421	5	1,425	4.5
J-9675	1,420	5	1,425	4.5
J-9676	1,450	0	1,453	2.3
J-9678	1,396	1	1,403	6.9
J-9679	1,421	0	1,425	4.5
J-9681	1,421	4	1,425	4.5
J-9682	1,410	4	1,415	5.8
J-9683	1,402	15	1,408	6.5
J-9684	1,407	6	1,413	5.9
J-9685	1,379	0	1,388	8.6
J-9686	1,441	21	1,444	2.5
J-9687	1,452	3	1,453	1.5
J-9688	1,410	13	1,416	5.7
J-9689	1,397	3	1,404	7.0
J-9690	1,466	38	1,469	2.7
J-9691	1,468	20	1,470	2.6
J-9692	1,444	26	1,446	2.3
J-9693	1,435	18	1,438	3.1
J-9694	1,509	5	1,514	5.5
J-9695	1,523	3	1,527	4.1
J-9696	1,522	1	1,526	4.2
J-9697	1,438	13	1,444	5.1
J-9698	1,429	2	1,435	6.0

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-9699	1,396	22	1,403	6.8
J-9700	1,381	22	1,389	8.3
J-9701	1,430	3	1,436	6.5
J-9702	1,418	8	1,426	7.6
J-9703	1,426	5	1,430	4.0
J-9704	1,422	5	1,426	4.4
J-9705	1,438	2	1,443	5.1
J-9706	1,433	18	1,439	5.6
J-9707	1,456	45	1,460	3.7
J-9708	1,450	14	1,454	4.3
J-9709	1,419	4	1,426	6.9
J-9710	1,400	20	1,409	8.7
J-9711	1,424	53	1,430	6.1
J-9712	1,439	34	1,444	4.6
J-9714	1,478	0	1,480	1.8
J-9715	1,462	3	1,465	2.9
J-9716	1,480	15	1,481	1.1
J-9717	1,474	11	1,476	1.6
J-9718	1,469	16	1,471	2.2
J-9719	1,466	12	1,468	2.8
J-9720	1,453	28	1,457	4.0
J-9722	1,521	4	1,526	4.3
J-9723	1,428	3	1,435	6.7
J-9724	1,428	6	1,434	6.7
J-9725	1,518	5	1,522	4.6
J-9726	1,488	3	1,496	7.5
J-9727	1,421	24	1,425	4.5
J-9728	1,405	9	1,411	6.0
J-9729	1,441	33	1,444	2.4
J-973	1,462	9	1,465	3.1
J-9730	1,431	18	1,434	3.4
J-9731	1,437	38	1,440	3.0
J-9732	1,425	15	1,429	4.2
J-9733	1,426	19	1,432	6.2
J-9734	1,440	22	1,445	4.8
J-9735	1,452	33	1,456	4.4
J-9736	1,550	6	1,552	1.7
J-9737	1,544	15	1,546	2.3
J-9738	1,427	5	1,433	6.1

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-9739	1,439	20	1,444	4.9
J-9740	1,439	14	1,444	5.1
J-9741	1,442	9	1,447	4.8
J-9742	1,490	11	1,495	4.8
J-9743	1,481	10	1,486	5.7
J-9744	1,456	8	1,464	8.0
J-9745	1,457	6	1,465	7.9
J-9746	1,445	8	1,450	5.0
J-9747	1,448	7	1,453	4.7
J-9748	1,515	1	1,520	5.1
J-9749	1,545	13	1,547	2.2
J-9750	1,482	14	1,488	5.4
J-9751	1,473	10	1,480	6.3
J-9752	1,419	8	1,427	7.5
J-9753	1,399	19	1,409	9.5
J-9754	1,516	1	1,520	4.8
J-9755	1,480	3	1,488	8.2
J-9756	1,487	32	1,493	6.4
J-9757	1,475	32	1,477	1.6
J-9758	1,396	15	1,405	9.2
J-9759	1,415	46	1,422	7.3
J-9760	1,422	19	1,426	4.6
J-9761	1,408	5	1,414	5.9
J-9762	1,417	28	1,422	4.8
J-9763	1,434	26	1,437	3.1
J-9764	1,438	11	1,443	5.0
J-9765	1,412	31	1,419	7.7
J-9766	1,417	8	1,424	7.1
J-9767	1,408	8	1,414	5.7
J-9768	1,411	13	1,417	5.4
J-9770	1,478	19	1,479	1.4
J-9772	1,429	12	1,436	6.6
J-9773	1,488	12	1,493	4.8
J-9774	1,471	23	1,477	6.5
J-9776	1,476	0	1,478	1.7
J-9777	1,420	15	1,425	4.5
J-9778	1,383	6	1,391	8.2
J-9779	1,456	10	1,464	8.0
J-9780	1,464	31	1,471	7.3

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-9781	1,422	55	1,428	6.6
J-9782	1,434	81	1,439	5.5
J-9783	1,455	45	1,459	3.7
J-9784	1,468	58	1,471	2.4
J-9785	1,448	10	1,453	4.7
J-9786	1,433	4	1,439	6.2
J-9787	1,435	33	1,438	3.0
J-9788	1,406	8	1,412	5.8
J-9789	1,478	0	1,480	1.8
J-9790	1,456	1	1,459	3.4
J-9791	1,446	24	1,450	4.4
J-9792	1,447	35	1,452	4.6
J-9793	1,437	61	1,443	5.6
J-9794	1,446	21	1,451	4.3
J-9795	1,443	84	1,447	4.6
J-9796	1,547	2	1,550	3.2
J-9797	1,559	4	1,561	2.0
J-9798	1,443	3	1,445	2.2
J-9799	1,418	100	1,425	6.8
J-9800	1,431	71	1,437	5.6
J-9802	1,387	10	1,395	7.7
J-9803	1,400	9	1,407	6.6
J-9804	1,398	23	1,405	6.8
J-9805	1,410	79	1,415	5.8
J-9806	1,415	10	1,420	5.3
J-9807	1,449	34	1,454	4.5
J-9808	1,458	22	1,461	3.2
J-9809	1,473	18	1,475	1.7
J-9811	1,451	106	1,455	4.0
J-9812	1,568	6	1,569	1.2
J-9813	1,561	0	1,563	1.9
J-9815	1,429	40	1,432	3.8
J-9816	1,397	0	1,404	7.0
J-9817	1,410	37	1,416	5.8
J-9818	1,395	0	1,404	9.3
J-9819	1,416	15	1,423	7.2
J-9821	1,387	1	1,395	7.7
J-9822	1,521	4	1,525	4.3
J-9823	1,471	12	1,478	6.5

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-9824	1,456	0	1,464	8.0
J-9825	1,474	5	1,480	6.3
J-9826	1,456	8	1,464	8.0
J-9827	1,421	19	1,425	4.5
J-9828	1,405	5	1,411	6.0
J-9830	1,393	0	1,400	7.1
J-9831	1,451	9	1,455	4.4
J-9832	1,472	3	1,475	2.4
J-9833	1,533	8	1,536	3.1
J-9834	1,513	8	1,518	5.1
J-9835	1,434	7	1,439	5.5
J-9836	1,418	29	1,425	7.0
J-9837	1,455	53	1,459	3.8
J-9838	1,422	24	1,429	6.6
J-9839	1,424	9	1,428	4.3
J-9840	1,402	25	1,409	6.4
J-9842	1,381	9	1,390	8.4
J-9843	1,465	12	1,467	2.6
J-9844	1,453	3	1,456	3.7
J-9845	1,555	1	1,557	1.2
J-9846	1,549	2	1,551	1.8
J-9847	1,470	17	1,476	6.7
J-9848	1,418	7	1,426	7.7
J-9849	1,422	16	1,430	7.2
J-9850	1,435	33	1,440	5.4
J-9851	1,419	26	1,426	6.9
J-9852	1,429	27	1,433	3.9
J-9853	1,409	6	1,415	5.9
J-9854	1,499	43	1,503	3.9
J-9855	1,473	9	1,480	6.4
J-9856	1,432	11	1,438	5.7
J-9857	1,412	0	1,420	7.7
J-9858	1,545	14	1,547	2.2
J-9859	1,432	24	1,438	6.0
J-9860	1,435	37	1,441	5.7
J-9861	1,458	43	1,461	3.5
J-9862	1,424	8	1,428	4.4
J-9863	1,442	15	1,444	2.4
J-9864	1,440	12	1,442	2.5

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-9865	1,549	2	1,550	1.7
J-9866	1,543	7	1,545	2.3
J-9867	1,417	32	1,422	4.8
J-9868	1,413	8	1,418	5.3
J-9869	1,432	24	1,438	5.7
J-9871	1,419	8	1,423	4.7
J-9872	1,433	31	1,438	5.4
J-9873	1,394	10	1,401	7.2
J-9875	1,493	26	1,494	1.3
J-9876	1,527	1	1,531	3.7
J-9877	1,422	9	1,429	6.7
J-9878	1,423	5	1,429	6.6
J-9879	1,490	17	1,495	4.6
J-9880	1,522	4	1,526	4.2
J-9881	1,538	12	1,541	2.6
J-9882	1,464	40	1,467	3.1
J-9883	1,470	66	1,473	2.5
J-9886	1,438	20	1,444	5.7
J-9887	1,506	7	1,512	5.7
J-9888	1,505	3	1,511	5.8
J-9889	1,532	1	1,535	3.4
J-9890	1,527	6	1,531	3.9
J-9891	1,447	4	1,448	1.9
J-9892	1,424	4	1,428	4.1
J-9893	1,445	25	1,447	2.2
J-9894	1,442	47	1,444	2.5
J-9895	1,440	0	1,445	5.3
J-9897	1,440	26	1,443	2.9
J-9898	1,450	0	1,451	1.7
J-9899	1,455	0	1,457	1.1
J-9901	1,428	82	1,434	6.0
J-9902	1,490	23	1,494	4.8
J-9903	1,428	8	1,432	3.9
J-9904	1,420	14	1,425	4.7
J-9905	1,477	7	1,483	5.9
J-9909	1,446	116	1,451	4.7
J-9910	1,463	33	1,466	3.0
J-9911	1,412	6	1,420	8.2
J-9912	1,397	64	1,406	9.8

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-9913	1,414	8	1,419	5.2
J-9914	1,385	3	1,393	7.9
J-9915	1,420	24	1,427	6.8
J-9916	1,397	4	1,406	9.0
J-9917	1,464	0	1,465	1.0
J-9918	1,462	0	1,463	1.1
J-9921	1,448	21	1,450	2.1
J-9923	1,448	13	1,452	4.1
J-9924	1,468	13	1,470	2.2
J-9925	1,412	7	1,420	7.6
J-9926	1,447	12	1,449	1.8
J-9927	1,425	7	1,429	3.9
J-9929	1,448	13	1,457	8.7
J-9931	1,463	12	1,466	3.0
J-9932	1,420	20	1,425	4.8
J-9933	1,416	2	1,421	5.1
J-9934	1,477	5	1,483	6.0
J-9935	1,476	16	1,482	6.1
J-9936	1,447	41	1,450	3.9
J-9937	1,450	25	1,454	3.5
J-9938	1,436	33	1,439	3.2
J-9939	1,457	18	1,458	0.9
J-9940	1,457	6	1,458	0.9
J-9941	1,432	14	1,438	5.7
J-9942	1,429	7	1,435	6.0
J-9943	1,537	19	1,540	2.9
J-9944	1,527	7	1,531	4.0
J-9945	1,460	15	1,464	3.5
J-9947	1,391	4	1,401	9.7
J-9948	1,458	4	1,466	7.8
J-9949	1,459	1	1,467	7.7
J-9950	1,499	17	1,503	3.9
J-9951	1,506	67	1,510	3.2
J-9952	1,566	0	1,568	1.3
J-9953	1,539	0	1,543	4.0
J-9954	1,435	11	1,438	3.3
J-9955	1,439	28	1,442	2.9
J-9956	1,475	8	1,481	6.1
J-9957	1,458	32	1,465	7.8

Node ID	Elevation (m)	Demand (m^3/day)	Head (m)	Pressure (m)
J-9958	1,445	27	1,449	4.5
J-9959	1,495	2	1,499	4.2
J-9960	1,430	18	1,436	5.5
J-9961	1,426	19	1,432	5.9
J-9962	1,446	20	1,450	4.4
J-9963	1,436	24	1,441	5.4
J-9964	1,425	41	1,430	4.1
J-9965	1,390	15	1,397	7.6
J-9966	1,439	9	1,441	2.8
J-9967	1,427	21	1,431	3.9
J-9968	1,423	12	1,428	4.3
J-9969	1,396	28	1,403	7.1
J-9970	1,456	94	1,459	3.6
J-9971	1,447	14	1,452	4.4
J-9972	1,460	12	1,463	3.1
J-9973	1,459	13	1,462	3.2
J-9974	1,442	39	1,445	2.7
J-9975	1,422	28	1,426	4.6
J-9976	1,502	60	1,506	3.6
J-9977	1,503	57	1,507	3.4
J-9978	1,396	6	1,403	6.9
J-9980	1,423	44	1,427	4.2
J-9981	1,455	21	1,459	4.1
J-9982	1,477	3	1,479	1.9
J-9983	1,453	20	1,456	3.7
J-9984	1,459	0	1,467	7.7
J-9986	1,443	27	1,448	4.4
J-9987	1,409	18	1,416	7.7
J-9988	1,446	6	1,451	5.0
J-9989	1,423	4	1,430	7.1
J-9990	1,434	1	1,439	5.5
J-9992	1,464	0	1,467	3.1
J-9993	1,464	6	1,466	2.6
J-9994	1,443	6	1,448	4.6
J-9995	1,423	0	1,427	4.2
J-9996	1,422	9	1,429	6.6
J-9997	1,391	17	1,401	9.6
J-9998	1,438	23	1,443	5.5

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
1	J-4670	J-4671	3	63	110	Existing	7	0.03
4	J-9263	J-8287	7	63	110	Existing	106	0.59
11	J-10604	J-9294	25	110	110	Primary	301	0.55
16	J-9181	J-10604	5	100	110	Yard Pipe	31	0.05
19	J-9974	J-9975	170	63	110	Secondary (Sub)	28	0.15
22	J-9657	J-9658	96	63	110	Secondary (Sub)	20	0.11
51	J-10241	J-10509	492	315	110	Primary	2049	0.45
54	J-10158	J-10159	511	63	110	Secondary (Sub)	12	0.07
56	J-9917	J-9918	188	225	110	Primary	1047	0.46
64	J-10026	J-10027	205	110	110	Secondary	107	0.2
76	J-9921	J-9897	161	110	110	Secondary (Sub)	71	0.13
77	J-228	J-9483	84	110	110	Secondary (Sub)	229	0.42
79	J-8556	J-10035	207	63	110	Secondary (Sub)	64	0.35
81	J-9288	J-9289	13	315	110	Primary	904	0.2
85	J-9897	J-9366	162	110	110	Secondary (Sub)	45	0.08
86	J-9366	J-9367	38	110	110	Secondary (Sub)	8	0.01
87	J-9367	J-9286	297	110	110	Secondary (Sub)	38	0.07
90	J-3325	J-9483	57	110	110	Secondary	216	0.39
91	J-10517	J-9316	13	315	110	Primary	2228	0.49
92	J-9654	J-9462	100	315	110	Primary	2228	0.49
93	J-9462	J-9350	58	315	110	Primary	2228	0.49
94	J-9350	J-9351	35	315	110	Primary	2228	0.49
96	J-9316	J-9654	98	315	110	Primary	2228	0.49
100	J-9351	J-9673	99	315	110	Primary	2228	0.49
101	J-9673	J-9357	270	315	110	Primary	2228	0.49
110	J-9510	J-9511	69	110	110	Secondary	134	0.24
121	J-9251	J-9252	6	225	110	Primary	0	0
122	J-9252	J-9305	17	225	110	Primary	0	0
124	J-10012	J-8758	189	110	110	Secondary	102	0.19
126	J-7344	J-9574	82	63	110	Secondary (Sub)	55	0.3
137	J-9247	Gacuriro Elevated	8	300	110	Yard Pipe	4636	0.76
142	J-772	J-773	2	90	110	Existing	2	0
144	J-7695	J-772	17	90	110	Existing	0	0
154	J-10116	J-10117	275	63	110	Secondary	15	0.09
155	J-10605	J-10606	40	100	110	Yard Pipe	1399	2.06
160	J-8503	J-8677	32	90	110	Existing	1	0
161	J-8502	J-8503	28	90	110	Existing	14	0.03
168	J-1575	J-7345	17	63	110	Existing	14	0.05
171	J-9875	J-10157	264	63	110	Secondary (Sub)	26	0.15
172	J-9374	J-9375	40	225	110	Primary	1367	0.6
173	J-9270	J-9271	8	225	110	Primary	1273	0.55
177	J-9789	J-10030	201	225	110	Primary	1720	0.75
196	J-8981	J-8322	25	110	110	Secondary	181	0.33
200	J-7506	J-10487	141	63	110	Secondary (Sub)	32	0.18
201	J-10216	J-9631	373	63	110	Secondary (Sub)	51	0.29
202	J-9631	J-9632	91	110	110	Secondary (Sub)	90	0.16
204	J-9216	J-9217	3	110	110	Secondary	94	0.17
205	J-9882	J-9883	207	63	110	Secondary (Sub)	37	0.21
206	J-7072	J-8759	51	63	110	Existing	28	0.11
208	J-9237	J-9238	4	110	110	Secondary	99	0.18
211	J-10463	J-9369	39	110	110	Secondary (Sub)	117	0.21
216	J-3871	J-9283	11	110	110	Secondary (Sub)	83	0.15
218	J-5435	J-9279	11	63	110	Secondary (Sub)	19	0.1
221	J-8842	J-9253	5	63	110	Secondary (Sub)	63	0.35
226	J-9214	J-9215	3	110	110	Secondary	87	0.16
229	J-10171	J-10172	324	63	110	Secondary (Sub)	64	0.36
230	J-10175	J-10176	323	110	110	Secondary (Sub)	246	0.45
238	J-10265	J-10266	740	110	110	Secondary	0	0
242	J-9492	J-9493	66	63	110	Secondary (Sub)	7	0.04
243	J-10071	J-9791	230	63	110	Secondary (Sub)	12	0.07
247	J-10640	J-9535	42	63	110	Secondary (Sub)	4	0.02
249	J-9594	J-9595	86	63	110	Secondary (Sub)	13	0.07

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
253	J-9524	J-9525	70	63	110	Secondary (Sub)	14	0.08
258	J-9398	J-9399	43	63	110	Secondary (Sub)	0	0
260	J-9794	J-9795	122	63	110	Secondary (Sub)	9	0.05
261	J-9456	J-9457	57	63	110	Secondary (Sub)	1	0.01
263	J-9532	J-9533	72	63	110	Secondary (Sub)	1	0.01
266	J-9347	J-9947	126	63	110	Secondary (Sub)	4	0.02
267	J-9346	J-9347	64	63	110	Secondary (Sub)	24	0.13
271	J-9428	J-9429	33	63	110	Secondary (Sub)	8	0.05
272	J-9717	J-9718	108	63	110	Secondary (Sub)	16	0.09
274	J-9518	J-9519	72	63	110	Secondary (Sub)	13	0.07
277	J-9355	J-9356	37	63	110	Secondary (Sub)	10	0.06
284	J-9740	J-9741	129	63	110	Secondary (Sub)	10	0.06
285	J-9571	J-9572	92	63	110	Secondary (Sub)	10	0.06
290	J-10118	J-10407	255	110	110	Secondary	85	0.15
291	J-9941	J-9942	192	63	110	Secondary (Sub)	29	0.16
296	J-6136	J-9770	117	63	110	Secondary (Sub)	40	0.22
305	J-9618	J-9983	178	63	110	Secondary (Sub)	11	0.06
306	J-10433	J-9618	89	63	110	Secondary (Sub)	32	0.18
308	J-9962	J-9963	167	63	110	Secondary (Sub)	29	0.16
312	J-10128	J-10129	267	63	110	Secondary (Sub)	15	0.08
322	J-9715	J-9716	107	110	110	Secondary (Sub)	44	0.08
329	J-10077	J-10078	281	63	110	Secondary (Sub)	24	0.13
334	J-10008	J-10009	256	63	110	Secondary (Sub)	17	0.1
338	J-9711	J-9712	110	63	110	Secondary (Sub)	13	0.07
339	J-9986	J-9987	276	63	110	Secondary (Sub)	18	0.1
340	J-9960	J-9961	191	63	110	Secondary (Sub)	19	0.1
341	J-9379	J-10434	196	63	110	Secondary (Sub)	23	0.13
342	J-9378	J-9379	40	63	110	Secondary (Sub)	9	0.05
343	J-9799	J-9800	123	110	110	Secondary	171	0.31
356	J-10146	J-10147	296	110	110	Secondary	70	0.13
375	J-7014	J-9308	19	63	110	Secondary (Sub)	25	0.14
389	J-9264	J-153	7	110	110	Secondary	8	0.01
393	J-10063	J-9372	207	110	110	Secondary	186	0.34
397	J-9223	J-9224	4	63	110	Secondary (Sub)	170	0.95
400	J-9372	J-9373	40	110	110	Secondary	157	0.29
401	J-9909	J-9910	176	63	110	Secondary (Sub)	33	0.18
403	J-1695	J-10040	216	63	110	Secondary (Sub)	36	0.2
404	Kagugug Elevated	J-9242	5	300	110	Yard Pipe	5986	0.98
410	J-9465	J-9254	61	225	110	Primary	1428	0.62
412	J-9380	J-9423	55	225	110	Primary	66	0.03
414	J-9222	J-9380	47	225	110	Primary	66	0.03
416	J-9254	J-9255	5	225	110	Primary	1428	0.62
420	J-9640	J-9641	94	63	110	Secondary	11	0.06
423	J-9731	J-9732	118	63	110	Secondary	38	0.21
425	J-9389	J-9707	43	63	110	Secondary (Sub)	34	0.19
426	J-9893	J-9894	149	63	110	Secondary (Sub)	47	0.26
428	J-9707	J-9708	109	63	110	Secondary (Sub)	40	0.22
429	J-9792	J-9793	157	63	110	Secondary (Sub)	30	0.17
439	J-9290	J-10285	2	225	110	Primary	2190	0.95
441	J-9662	J-9663	99	160	110	Primary	0	0
444	J-9709	J-9710	109	63	110	Secondary	20	0.11
445	J-9758	J-9759	113	63	110	Secondary	15	0.08
446	J-9498	J-9499	66	63	110	Secondary	7	0.04
447	J-9530	J-9531	71	63	110	Secondary	3	0.02
448	J-9565	J-9566	82	63	110	Secondary	11	0.06
449	J-9512	J-9513	76	63	110	Secondary	1	0.01
450	J-9915	J-9916	160	63	110	Secondary	4	0.02
452	J-9430	J-9431	54	63	110	Secondary (Sub)	30	0.17
454	J-9621	J-9622	94	63	110	Secondary (Sub)	24	0.13
455	J-9738	J-9739	110	63	110	Secondary (Sub)	20	0.11
464	J-9803	J-9804	122	63	110	Secondary (Sub)	23	0.13
465	J-10389	J-9570	90	110	110	Secondary	22	0.04

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
467	J-9964	J-9965	177	63	110	Secondary	15	0.08
468	J-9998	J-1681	186	110	110	Secondary	104	0.19
470	J-1238	J-9861	153	63	110	Secondary (Sub)	43	0.24
471	J-9690	J-9691	115	63	110	Secondary (Sub)	20	0.11
472	J-9516	J-9517	67	110	110	Secondary	21	0.04
475	J-9807	J-9470	130	110	110	Secondary	26	0.05
476	J-9783	J-9784	120	63	110	Secondary (Sub)	45	0.25
478	J-9261	J-9262	7	225	110	Primary	1695	0.74
486	J-3406	J-9901	206	110	110	Secondary	226	0.41
488	J-9336	J-9605	93	63	110	Secondary (Sub)	11	0.06
489	J-9336	J-9337	29	63	110	Secondary (Sub)	21	0.12
490	J-9765	J-9766	119	63	110	Secondary (Sub)	8	0.04
491	J-9850	J-9851	154	110	110	Secondary	26	0.05
494	J-9996	J-9997	184	110	110	Secondary	17	0.03
495	J-9601	J-9602	87	63	110	Secondary (Sub)	10	0.05
499	J-9936	J-9937	159	63	110	Secondary (Sub)	25	0.14
500	J-10004	J-10005	189	110	110	Secondary	61	0.11
505	J-4985	J-9764	119	63	110	Secondary (Sub)	11	0.06
507	J-10645	J-9838	85	63	110	Secondary (Sub)	24	0.13
508	J-3410	J-9925	158	63	110	Secondary (Sub)	7	0.04
509	J-9835	J-9836	134	63	110	Secondary (Sub)	29	0.16
512	J-9245	J-9246	5	225	110	Primary	866	0.38
516	J-10204	J-9245	518	225	110	Primary	866	0.38
520	J-9502	J-9503	68	225	110	Primary	855	0.37
522	J-9852	J-9853	193	110	110	Secondary	0	0
524	J-9659	J-9660	96	110	110	Secondary	152	0.28
525	J-9816	J-10180	622	63	110	Secondary (Sub)	11	0.06
527	J-9557	J-9558	78	63	110	Secondary (Sub)	9	0.05
528	J-9553	J-9554	76	63	110	Secondary (Sub)	10	0.06
534	J-9859	J-9860	133	63	110	Secondary (Sub)	20	0.11
535	J-9590	J-9591	88	110	110	Secondary	7	0.01
536	J-10356	J-9904	185	110	110	Secondary	14	0.02
537	J-9646	J-9643	93	110	110	Secondary	62	0.11
539	J-9555	J-9556	80	63	110	Secondary (Sub)	18	0.1
545	J-9299	J-9300	15	110	110	Secondary	57	0.1
547	J-9954	J-9955	185	63	110	Secondary (Sub)	11	0.06
550	J-9410	J-9411	54	63	110	Secondary (Sub)	2	0.01
551	J-9454	J-9455	58	63	110	Secondary (Sub)	1	0.01
553	J-9642	J-9334	93	63	110	Secondary (Sub)	4	0.02
556	J-9592	J-9593	84	63	110	Secondary (Sub)	4	0.02
572	J-2593	J-10015	250	63	110	Secondary (Sub)	23	0.13
578	J-10636	J-1883	329	63	110	Secondary (Sub)	27	0.15
581	J-9805	J-9806	123	63	110	Secondary (Sub)	10	0.06
582	J-9932	J-9933	157	63	110	Secondary (Sub)	20	0.11
601	J-9443	J-9444	63	110	110	Secondary	49	0.09
603	J-9970	J-9971	256	63	110	Secondary (Sub)	14	0.08
604	J-9898	J-9899	144	160	110	Primary	276	0.24
609	J-10307	J-9199	6	225	110	Primary	0	0
617	J-9384	J-9385	43	225	110	Primary	0	0
619	J-9321	J-9322	27	63	110	Secondary	3	0.01
625	J-9408	J-9409	46	63	110	Secondary (Sub)	0	0
626	J-9441	J-9408	51	63	110	Secondary (Sub)	13	0.07
627	J-9243	J-9467	61	63	110	Secondary	0	0
628	J-9243	J-9244	4	63	110	Secondary	4	0.02
629	J-9779	J-9780	174	110	110	Secondary	46	0.08
632	J-9744	J-9745	119	63	110	Secondary (Sub)	6	0.03
633	J-10311	J-9497	87	63	110	Secondary (Sub)	4	0.02
634	J-10150	J-10151	340	110	110	Secondary	63	0.11
638	J-10050	J-10051	243	110	110	Secondary	67	0.12
639	J-9508	J-9509	73	110	110	Secondary	2	0
642	J-9750	J-9751	157	63	110	Secondary (Sub)	10	0.05
643	J-9948	J-9949	166	110	110	Secondary	1	0

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
644	J-9281	J-9630	101	110	110	Secondary	12	0.02
653	J-10334	J-9957	163	63	110	Secondary (Sub)	15	0.08
654	J-9825	J-9826	126	110	110	Secondary	19	0.03
657	J-8120	J-3771	40	110	110	Secondary	18	0.03
660	J-9633	J-9634	134	110	110	Secondary	8	0.02
662	J-9773	J-9774	164	63	110	Secondary (Sub)	7	0.04
663	J-9432	J-9433	53	63	110	Secondary (Sub)	24	0.14
664	J-9382	J-9929	155	63	110	Secondary (Sub)	13	0.07
665	J-9381	J-9382	40	110	110	Secondary	34	0.06
667	J-9406	J-9407	43	110	110	Secondary	151	0.27
668	J-9787	J-9788	121	63	110	Secondary (Sub)	8	0.04
671	J-10106	J-10107	258	110	110	Secondary	61	0.11
673	J-9956	J-9959	172	63	110	Secondary (Sub)	2	0.01
675	J-9284	J-9285	7	110	110	Secondary	10	0.02
676	J-9637	J-9638	92	63	110	Secondary (Sub)	12	0.07
677	J-9588	J-9589	88	63	110	Secondary (Sub)	16	0.09
679	J-9544	J-9545	89	63	110	Secondary (Sub)	2	0.01
682	J-9309	J-9310	21	110	110	Secondary	38	0.07
685	J-9494	J-9495	79	110	110	Secondary	16	0.03
686	J-9729	J-9730	149	63	110	Secondary (Sub)	2	0.01
688	J-10221	J-10222	467	110	110	Secondary	31	0.06
692	J-9528	J-9529	70	63	110	Secondary (Sub)	5	0.03
693	J-9426	J-9427	52	63	110	Secondary (Sub)	11	0.06
695	J-9319	J-9802	126	110	110	Secondary	10	0.02
696	J-9319	J-9320	25	110	110	Secondary	12	0.02
697	J-10065	J-10066	226	110	110	Secondary	18	0.03
699	J-9699	J-9700	107	110	110	Secondary	22	0.04
701	J-9551	J-9552	78	63	110	Secondary (Sub)	9	0.05
704	J-9567	J-9330	106	63	110	Secondary (Sub)	8	0.05
706	J-9330	J-9331	35	63	110	Secondary (Sub)	2	0.01
707	J-10148	J-10149	299	110	110	Secondary	4	0.01
711	J-9392	J-9393	6	63	110	Secondary (Sub)	4	0.02
712	J-9392	J-9438	54	63	110	Secondary (Sub)	5	0.03
713	J-9404	J-9405	49	63	110	Secondary (Sub)	6	0.04
714	J-9559	J-10305	78	63	110	Secondary (Sub)	24	0.14
715	J-9474	J-9475	61	63	110	Secondary (Sub)	27	0.15
719	J-9449	J-9206	56	63	110	Secondary (Sub)	22	0.12
720	J-9207	J-9386	42	63	110	Secondary (Sub)	38	0.21
721	J-9206	J-9207	1	63	110	Secondary (Sub)	31	0.17
722	J-9560	J-9980	229	63	110	Secondary (Sub)	21	0.12
725	J-9666	J-9667	99	63	110	Secondary (Sub)	9	0.05
729	J-9361	J-9403	89	63	110	Secondary (Sub)	19	0.11
734	J-9596	J-9597	107	110	110	Secondary	12	0.02
735	J-9762	J-9763	148	63	110	Secondary (Sub)	26	0.15
739	J-9225	J-9226	4	110	110	Secondary	82	0.15
743	J-9274	J-9275	11	110	110	Secondary	182	0.33
744	J-9546	J-10648	52	110	110	Secondary	7	0.01
746	J-9627	J-9628	61	110	110	Secondary	35	0.06
755	J-9777	J-9778	179	63	110	Secondary (Sub)	6	0.03
756	J-9236	J-9842	136	63	110	Secondary (Sub)	9	0.05
758	J-9344	J-9345	34	63	110	Secondary (Sub)	3	0.02
763	J-9939	J-9940	161	63	110	Secondary (Sub)	6	0.03
767	J-9603	J-9326	114	110	110	Secondary	6	0.01
768	J-9421	J-9422	70	63	110	Secondary (Sub)	3	0.02
769	J-9582	J-9583	104	110	110	Secondary	5	0.01
771	J-9536	J-9537	134	63	110	Secondary (Sub)	7	0.04
772	J-9674	J-9675	105	110	110	Secondary	32	0.06
774	J-9460	J-9461	59	63	110	Secondary (Sub)	3	0.02
775	J-9613	J-9614	104	63	110	Secondary (Sub)	4	0.02
776	J-9613	J-9371	41	110	110	Secondary	9	0.02
777	J-9655	J-9656	104	63	110	Secondary (Sub)	5	0.03
787	J-9202	J-9203	1	110	110	Secondary	56	0.1

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
788	J-9202	J-9473	62	110	110	Secondary	3	0.01
789	J-9742	J-9743	135	110	110	Secondary	10	0.02
790	J-9306	J-9847	143	110	110	Secondary	12	0.02
791	J-9306	J-9670	61	110	110	Secondary	34	0.06
796	J-9458	J-9459	59	63	110	Secondary (Sub)	4	0.02
797	J-9664	J-9665	103	63	110	Secondary (Sub)	14	0.08
798	J-9575	J-9576	115	110	110	Secondary	21	0.04
799	J-9522	J-9523	72	63	110	Secondary (Sub)	10	0.05
800	J-10102	J-10103	395	63	110	Secondary (Sub)	16	0.09
803	J-9854	J-9855	139	63	110	Secondary (Sub)	13	0.07
804	J-9976	J-9977	187	63	110	Secondary (Sub)	38	0.21
806	J-9950	J-9951	217	63	110	Secondary (Sub)	40	0.22
807	J-9400	J-9858	140	110	110	Secondary	23	0.04
808	J-9400	J-9401	43	110	110	Secondary	20	0.04
809	J-9468	J-9469	71	110	110	Secondary	7	0.01
810	J-9668	J-9669	83	110	110	Secondary	10	0.02
815	J-10114	J-10115	275	110	110	Secondary	105	0.19
819	J-9748	J-9749	120	63	110	Secondary (Sub)	5	0.03
820	J-9623	J-9624	106	110	110	Secondary	16	0.03
823	J-9549	J-9550	118	63	110	Secondary (Sub)	33	0.18
828	J-9342	J-9343	18	160	110	Primary	35	0.03
835	J-9434	J-10002	263	110	110	Secondary	200	0.36
837	J-9625	J-9626	89	110	110	Secondary	3	0.01
840	J-9500	J-9501	87	63	110	Secondary (Sub)	6	0.03
841	J-9880	J-9881	182	110	110	Secondary	80	0.15
844	J-9298	J-9303	16	110	110	Secondary	53	0.1
845	J-9268	J-9298	15	110	110	Secondary	52	0.09
846	J-9268	J-9269	9	110	110	Secondary	52	0.09
847	J-9488	J-9489	105	63	110	Secondary (Sub)	5	0.03
849	J-9452	J-9453	55	63	110	Secondary (Sub)	42	0.23
850	J-9239	J-9722	122	63	110	Secondary (Sub)	17	0.1
851	J-9239	J-9240	4	63	110	Secondary (Sub)	13	0.07
854	J-9887	J-9888	143	110	110	Secondary	39	0.07
859	J-9453	J-9213	67	63	110	Secondary (Sub)	42	0.23
861	J-9833	J-9834	132	63	110	Secondary (Sub)	8	0.05
862	J-10098	J-10099	271	110	110	Secondary	8	0.01
863	J-9434	J-9435	52	110	110	Secondary	213	0.39
867	J-9363	J-10018	239	110	110	Secondary	119	0.22
869	J-9363	J-9600	95	63	110	Secondary (Sub)	7	0.04
870	J-9736	J-9737	162	63	110	Secondary (Sub)	15	0.08
871	J-9396	J-9397	49	63	110	Secondary (Sub)	7	0.04
875	J-9414	J-9415	62	110	110	Secondary	8	0.01
877	J-9477	J-9478	62	110	110	Secondary	20	0.04
878	J-10016	J-10017	246	110	110	Secondary	18	0.03
879	J-9506	J-9507	69	110	110	Secondary	8	0.01
888	J-9328	J-9329	35	63	110	Secondary (Sub)	4	0.02
890	J-9332	J-9333	27	63	110	Secondary (Sub)	1	0.01
891	J-10191	J-10192	341	110	110	Secondary	52	0.09
892	J-10100	J-10101	264	110	110	Secondary	53	0.1
893	J-9561	J-9562	112	110	110	Secondary	9	0.02
894	J-9943	J-9944	171	110	110	Secondary	7	0.01
895	J-9436	J-9437	54	110	110	Secondary	8	0.01
896	J-9644	J-9645	99	110	110	Secondary	2	0
901	J-9952	J-9953	221	63	110	Secondary (Sub)	0	0
904	J-9387	J-9388	43	63	110	Secondary (Sub)	6	0.03
905	J-9648	J-9636	116	110	110	Secondary	102	0.19
906	J-9812	J-9813	124	63	110	Secondary (Sub)	0	0
907	J-9540	J-9541	75	63	110	Secondary (Sub)	6	0.03
909	J-9479	J-9480	66	63	110	Secondary (Sub)	0	0
912	J-9746	J-9747	138	110	110	Secondary	7	0.01
915	J-9723	J-9724	110	63	110	Secondary (Sub)	6	0.03
916	J-9785	J-10352	128	110	110	Secondary	33	0.06

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
918	J-9786	J-10104	259	110	110	Secondary	22	0.04
926	J-9416	J-9417	48	63	110	Secondary (Sub)	26	0.14
927	J-9424	J-9425	50	110	110	Secondary	1	0
929	J-9848	J-9849	145	110	110	Secondary	16	0.03
930	J-10152	J-10153	289	110	110	Secondary	19	0.03
931	J-10121	J-10122	256	110	110	Secondary	25	0.05
932	J-9359	J-9360	17	110	110	Secondary	29	0.05
934	J-9233	J-9639	122	110	110	Secondary	37	0.07
935	J-9234	J-9481	284	63	110	Secondary (Sub)	22	0.12
936	J-9233	J-9234	4	110	110	Secondary	29	0.05
938	J-9439	J-9440	55	110	110	Secondary	5	0.01
939	J-9317	J-9772	33	110	110	Secondary	12	0.02
940	J-9317	J-9318	128	110	110	Secondary	22	0.04
941	J-9249	J-9250	6	63	110	Secondary (Sub)	62	0.34
942	J-9606	J-9208	89	110	110	Secondary	91	0.16
947	J-10217	J-10218	446	63	110	Secondary (Sub)	14	0.08
949	J-10119	J-10120	252	110	110	Secondary	9	0.02
950	J-9340	J-9945	199	110	110	Secondary	15	0.03
951	J-9340	J-9341	33	110	110	Secondary	68	0.12
953	J-9314	J-9735	131	63	110	Secondary (Sub)	13	0.07
954	J-9313	J-9314	23	63	110	Secondary (Sub)	14	0.08
959	J-10423	J-9527	71	63	110	Secondary (Sub)	11	0.06
960	J-9229	J-9230	5	63	110	Secondary (Sub)	19	0.11
964	J-9796	J-9797	142	63	110	Secondary (Sub)	4	0.02
965	J-9338	J-9339	31	63	110	Secondary (Sub)	22	0.12
971	J-9609	J-9610	90	63	110	Secondary (Sub)	4	0.02
972	J-9636	J-9672	100	110	110	Secondary	9	0.02
995	J-756	J-757	3	90	110	Existing	39	0.07
1362	J-4100	J-2179	18	63	110	Existing	67	0.25
1457	J-3246	J-3247	6	63	110	Existing	7	0.02
1492	J-5573	J-3718	91	25	110	Existing	2	0.05
1663	J-575	J-576	1	63	110	Existing	0	0
1664	J-5096	J-3948	7	110	110	Existing	0	0
1666	J-163	J-3606	5	110	110	Existing	0	0
1684	J-390	J-448	1	110	110	Existing	203	0.25
1726	J-863	J-864	1	90	110	Existing	5	0.01
1803	J-6413	J-7151	14	50	110	Existing	13	0.08
1885	J-10343	J-3829	6	63	110	Existing	81	0.3
2052	J-9148	J-163	1	25	110	Existing	0	0
2100	J-4472	J-4473	7	25	110	Existing	42	1
2101	J-8136	J-4472	20	25	110	Existing	5	0.11
2218	J-7603	J-2398	23	63	110	Existing	30	0.11
2247	J-4138	J-4796	21	50	110	Existing	33	0.19
2251	J-1211	J-10107	2	50	110	Existing	40	0.23
2706	J-850	J-10339	153	110	110	Existing	0	0
2713	J-5096	J-5136	9	200	110	Existing	0	0
2732	J-1965	J-416	10	110	110	Existing	5	0.01
2941	J-849	J-9155	3	90	110	Existing	211	0.38
3023	J-5687	J-5688	9	110	110	Existing	363	0.44
3024	J-5688	J-6288	57	110	110	Existing	318	0.39
3025	J-6288	J-6289	11	110	110	Existing	316	0.38
3030	J-5230	J-5621	12	110	110	Existing	110	0.13
3039	J-6508	J-6509	12	110	110	Existing	44	0.05
3049	J-232	J-233	1	110	110	Existing	0	0
3094	J-849	J-1840	26	63	110	Existing	0	0
3152	J-2154	J-5410	9	63	110	Existing	91	0.34
3175	J-2484	J-6793	54	63	110	Existing	45	0.17
3201	J-5268	J-2154	10	63	110	Existing	6	0.02
3209	J-8969	J-5230	73	63	110	Existing	73	0.27
3210	J-2361	J-6486	12	63	110	Existing	88	0.33
3252	J-6827	J-9044	75	63	110	Existing	2	0.01
3264	J-6509	J-6759	55	63	110	Existing	38	0.14

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
3268	J-6374	J-6375	11	63	110	Existing	5	0.02
3269	J-6375	J-7960	54	63	110	Existing	15	0.06
3275	J-158	J-159	2	63	110	Existing	180	0.67
3282	J-6129	J-6130	11	63	110	Existing	15	0.05
3284	J-6949	J-6129	58	63	110	Existing	16	0.06
3287	J-6759	J-6949	14	63	110	Existing	34	0.13
3318	J-2593	J-2594	4	63	110	Existing	28	0.1
3372	J-670	J-671	2	63	110	Existing	3	0.01
3627	J-160	J-1513	2	50	110	Existing	0	0
3699	J-711	J-712	1	90	110	Existing	181	0.33
3830	J-2272	J-2273	4	63	110	Existing	0	0
3857	J-5395	J-5396	8	50	110	Existing	7	0.04
3858	J-412	J-413	91	63	110	Existing	169	0.63
4074	J-8690	J-8904	105	110	110	Existing	5	0.01
4392	J-8690	J-8127	33	63	110	Existing	57	0.21
4411	J-296	J-297	1	63	110	Existing	0	0
4417	J-5344	J-5345	9	63	110	Existing	42	0.16
4457	J-6828	J-6829	13	63	110	Existing	106	0.39
4469	J-408	J-409	0	63	110	Existing	3	0.01
4481	J-675	J-676	2	63	110	Existing	0	0
4658	J-566	J-7575	17	90	110	Existing	572	1.04
4659	J-565	J-566	2	90	110	Existing	554	1.01
5054	J-160	J-161	1	25	110	Existing	0	0
5252	J-3252	J-4488	7	50	110	Existing	60	0.35
5304	J-4981	J-8356	58	63	110	Existing	151	0.56
5314	J-6588	J-6589	12	50	110	Existing	38	0.22
5364	J-8789	J-1761	62	50	110	Existing	28	0.16
5370	J-6393	J-6394	12	63	110	Existing	9	0.03
5372	J-4985	J-4986	9	63	110	Existing	3	0.01
6785	J-3197	J-3198	5	90	110	Existing	0	0
6956	J-3311	J-178	5	63	110	Existing	197	0.73
6986	J-1600	J-6119	11	63	110	Existing	0	0
7298	J-1470	J-4669	76	110	110	Existing	316	0.39
7299	J-4669	J-8847	87	110	110	Existing	125	0.15
7338	J-6181	J-6593	12	63	110	Existing	0	0
7383	J-7479	J-7842	74	90	110	Existing	180	0.33
7384	J-7842	J-7118	37	90	110	Existing	86	0.16
7385	J-7118	J-8391	30	90	110	Existing	99	0.18
7517	J-372	J-373	4	90	110	Existing	178	0.32
7528	J-2757	J-9047	77	90	110	Existing	13	0.02
7687	J-4857	J-8829	42	63	110	Existing	116	0.43
7736	J-4878	J-4879	9	63	110	Existing	13	0.05
7775	J-7927	J-8925	47	63	110	Existing	4	0.02
7890	J-532	J-533	3	110	110	Existing	391	0.48
7947	J-6188	J-6189	11	90	110	Existing	634	1.15
7948	J-6189	J-7463	55	90	110	Existing	468	0.85
8013	J-372	J-3400	13	50	110	Existing	66	0.39
8195	J-3539	J-3540	6	110	110	Existing	847	1.03
8239	J-5455	J-795	54	63	110	Existing	418	1.55
8240	J-795	J-796	2	63	110	Existing	331	1.23
8241	J-796	J-3286	7	63	110	Existing	331	1.23
8242	J-3286	J-6633	50	63	110	Existing	244	0.91
8244	J-6634	J-5288	83	63	110	Existing	63	0.23
8247	J-7956	J-7790	83	63	110	Existing	338	1.25
8249	J-8107	J-7956	21	63	110	Existing	213	0.79
8410	J-6909	J-663	13	90	110	Existing	57	0.1
8427	J-7790	J-8726	46	90	110	Existing	296	0.54
8428	J-8726	J-8727	34	90	110	Existing	175	0.32
8607	J-5585	J-250	9	110	110	Existing	140	0.17
8779	J-3316	J-463	16	50	110	Existing	313	1.85
8982	J-3789	J-228	7	90	110	Existing	247	0.45
9080	J-2323	J-2324	4	63	110	Existing	3	0.01

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
9096	J-6193	J-4553	11	110	110	Existing	685	0.83
9099	J-5723	J-4234	10	110	110	Existing	653	0.8
9100	J-4234	J-3688	50	110	110	Existing	626	0.76
9101	J-3688	J-4191	10	110	110	Existing	230	0.28
9165	J-7609	J-7610	17	63	110	Existing	74	0.27
9182	J-8402	J-5857	57	63	110	Existing	275	1.02
9666	J-948	J-6885	202	50	110	Existing	56	0.33
9667	J-7866	J-1659	22	100	110	Existing	0	0
9779	J-787	J-788	2	63	110	Existing	11	0.04
9797	J-5854	J-5855	11	50	110	Existing	0	0
9807	J-2189	J-8861	65	63	110	Existing	5	0.02
10298	J-449	J-450	2	63	110	Existing	1	0
10318	J-1627	J-3510	5	110	110	Existing	64	0.08
10770	J-5409	J-2215	17	90	110	Existing	147	0.27
P-1135	J-8161	J-2154	52	63	110	Existing	78	0.29
P-1140	J-6136	J-2164	274	75	110	Existing	40	0.11
P-1231	J-2398	J-1534	32	63	110	Existing	33	0.12
P-135	J-9082	B4	1878	500	110	Existing	21	0
P-137	B4	B5	734	500	110	Existing	21	0
P-139	B5	B6	2272	500	110	Existing	0	0
P-1393	J-2788	J-817	16	63	110	Existing	89	0.33
P-1403	J-1753	J-4335	15	63	110	Existing	26	0.1
P-1412	J-2832	J-7894	25	63	110	Existing	8	0.03
P-143	Ntora	B1	1308	500	110	Existing	1041	0.06
P-144	B1	B2	662	500	110	Existing	1041	0.06
P-148	B1	EFM2	2388	250	110	Existing	0	0
P-1591	J-7836	J-357	46	110	110	Existing	36	0.04
P-1619	J-5383	J-3335	40	63	110	Existing	2	0.01
P-162	J-25	J-27	876	400	110	Existing	0	0
P-163	J-27	St. Famille	800	400	110	Existing	0	0
P-164	J-27	Kimihururа-2	95	300	110	Existing	0	0
P-1729	J-7252	J-3593	77	110	110	Existing	122	0.15
P-176	B4	J-37	7	200	110	Existing	0	0
P-1773	J-8963	J-3688	57	63	110	Existing	4	0.01
P-178	J-7021	Gacuriro2 Inlet	57	200	110	Existing	0	0
P-180	J-7021	Gacuriro1 Inlet	8	200	110	Existing	0	0
P-181	J-37	Mb1	38	90	110	Existing	0	0
P-1871	J-3286	J-3917	475	90	110	Existing	44	0.08
P-1903	J-5656	J-4007	17	90	110	Existing	36	0.07
P-193	B6	Ub6	18	110	110	Existing	0	0
P-1952	J-9044	J-7194	22	63	110	Existing	2	0.01
P-1978	J-4191	J-3421	74	63	110	Existing	226	0.84
P-2071	J-7481	J-2788	39	63	110	Existing	85	0.32
P-2124	J-5965	J-4546	36	90	110	Existing	208	0.38
P-2135	J-5344	J-4580	104	63	110	Existing	65	0.24
P-2288	J-4962	J-7463	25	90	110	Existing	418	0.76
P-232	J-10398	J-4981	60	63	110	Existing	227	0.84
P-234	B6	J-2	994	500	110	Existing	0	0
P-237	J-37	J-7021	11	200	110	Existing	0	0
P-2418	J-5288	J-8107	46	63	110	Existing	49	0.18
P-2456	J-8904	J-5383	54	63	110	Existing	5	0.02
P-2631	J-5822	J-7609	40	63	110	Existing	97	0.36
P-2668	J-5927	J-417	41	63	110	Existing	10	0.04
P-2673	J-462	J-5939	23	63	110	Existing	8	0.03
P-2712	J-565	J-5687	67	110	110	Existing	396	0.48
P-273	J-1761	J-145	9	50	110	Existing	25	0.15
P-2890	J-675	J-5345	68	25	110	Existing	12	0.27
P-2915	J-6547	J-8842	52	90	110	Existing	70	0.13
P-3075	J-8622	J-6993	272	110	110	Existing	23	0.03
P-313	J-269	J-5996	17	63	110	Existing	7	0.03
P-3312	J-7619	J-5021	79	90	110	Existing	15	0.03
P-3314	J-3539	J-8187	38	200	110	Existing	1361	0.5

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
P-3470	J-1419	J-7695	57	90	110	Existing	103	0.19
P-3476	J-4553	J-5723	58	110	110	Existing	673	0.82
P-3481	J-4380	J-5999	47	63	110	Existing	51	0.19
P-3483	J-373	J-4962	153	90	110	Existing	188	0.34
P-3515	J-7609	J-8262	52	63	110	Existing	3	0.01
P-3523	J-8287	J-8556	53	90	110	Existing	106	0.19
P-3553	J-7083	J-5712	52	63	110	Existing	0	0
P-3567	J-6406	J-6827	57	63	110	Existing	49	0.18
P-3617	J-3593	J-8929	68	110	110	Existing	298	0.36
P-362	J-2929	Mb1	11	90	110	Existing	0	0
P-3635	J-7549	J-5268	116	63	110	Existing	2	0.01
P-3653	J-8742	J-7280	89	110	110	Existing	0	0
P-3655	J-159	J-2539	70	63	110	Existing	138	0.51
P-3669	J-7589	J-8625	111	90	110	Existing	113	0.2
P-3726	J-8609	J-9064	369	110	110	Existing	31	0.04
P-3798	J-5144	J-4895	64	110	110	Existing	17	0.02
P-3831	J-463	J-319	11	50	110	Existing	313	1.85
P-3936	J-905	J-482	6	50	110	Existing	122	0.72
P-3966	J-8852	J-4958	72	90	110	Existing	133	0.24
P-4006	J-8609	J-6828	62	63	110	Existing	151	0.56
P-401	J-757	J-448	15	90	110	Existing	56	0.1
P-4020	J-8091	J-3609	43	63	110	Existing	61	0.23
P-4079	J-648	J-465	13	63	110	Existing	77	0.29
P-4160	J-948	J-1659	45	110	110	Existing	105	0.13
P-4172	J-1681	J-6719	19	63	110	Existing	14	0.05
P-4292	J-7179	J-1257	39	63	110	Existing	329	1.22
P-4337	J-7083	J-4259	84	63	110	Existing	6	0.02
P-4395	J-6678	J-1491	26	75	110	Existing	39	0.1
P-4400	J-6552	J-1200	18	90	110	Existing	4	0.01
P-4407	J-6589	J-1009	22	50	110	Existing	36	0.21
P-4422	J-8625	J-5020	85	75	110	Existing	32	0.08
P-4490	J-4259	J-2484	49	63	110	Existing	17	0.06
P-4516	J-8320	J-3998	42	63	110	Existing	3	0.01
P-4605	J-7072	J-8502	96	90	110	Existing	21	0.04
P-4640	J-1534	J-3446	24	63	110	Existing	44	0.16
P-4644	J-364	J-7403	60	110	110	Existing	301	0.37
P-4660	J-6759	J-4259	61	63	110	Existing	5	0.02
P-4693	J-6374	J-7083	57	63	110	Existing	3	0.01
P-4704	J-465	J-4100	39	63	110	Existing	72	0.27
P-4716	J-1172	J-7603	128	63	110	Existing	17	0.06
P-4792	J-575	J-4472	44	25	110	Existing	47	1.12
P-4833	J-4962	J-2757	452	90	110	Existing	213	0.39
P-4836	J-4796	J-1211	38	50	110	Existing	39	0.23
P-4844	J-5874	J-2361	57	63	110	Existing	23	0.09
P-4848	J-8382	J-6508	118	110	110	Existing	19	0.02
P-4856	J-2361	J-8969	31	63	110	Existing	68	0.25
P-4889	J-4312	J-7738	74	63	110	Existing	5	0.02
P-4897	J-2179	J-382	133	63	110	Existing	61	0.22
P-4900	J-2239	J-5151	21	63	110	Existing	22	0.08
P-4901	J-7927	J-3787	82	63	110	Existing	12	0.05
P-491	J-8320	J-701	37	63	110	Existing	0	0
P-4926	J-2937	J-5670	62	110	110	Existing	7	0.01
P-4972	J-5446	J-8091	52	63	110	Existing	55	0.2
P-5025	J-10468	J-6277	25	63	110	Existing	117	0.44
P-5126	J-394	J-5585	129	110	110	Existing	64	0.08
P-517	J-759	J-7344	172	50	110	Existing	91	0.54
P-5184	J-3593	J-4857	92	63	110	Existing	162	0.6
P-5204	J-6195	J-3330	35	110	110	Existing	220	0.27
P-5218	J-6102	J-7014	55	63	110	Existing	27	0.1
P-5233	J-7068	J-6193	111	63	110	Existing	4	0.01
P-5234	J-279	J-8515	60	63	110	Existing	2	0.01
P-5271	J-6520	J-3847	85	63	110	Existing	17	0.06

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
P-5274	J-3599	J-4985	66	63	110	Existing	37	0.14
P-528	J-3527	J-7345	28	63	110	Existing	14	0.05
P-5287	J-4580	J-4312	45	63	110	Existing	45	0.17
P-5318	J-6289	J-5874	55	63	110	Existing	119	0.44
P-5332	J-6829	J-4380	292	63	110	Existing	64	0.24
P-5353	J-5450	J-7927	85	63	110	Existing	34	0.13
P-5363	J-7179	J-6602	83	63	110	Existing	244	0.91
P-537	J-817	J-3202	67	63	110	Existing	98	0.36
P-5372	J-6406	J-5621	66	63	110	Existing	107	0.4
P-5378	J-2757	J-8981	113	90	110	Existing	181	0.33
P-5387	J-4794	J-8742	174	110	110	Existing	21	0.03
P-5403	J-8168	J-8015	71	63	110	Existing	34	0.13
P-5404	J-5688	J-8168	78	63	110	Existing	44	0.16
P-5408	J-8496	J-6130	88	63	110	Existing	6	0.02
P-5410	J-4991	J-4191	56	63	110	Existing	4	0.02
P-5415	J-8252	J-4794	79	200	110	Existing	124	0.05
P-5426	J-5788	J-4708	73	90	110	Existing	106	0.19
P-5427	J-6119	J-3410	112	63	110	Existing	68	0.25
P-5433	J-5999	J-5545	72	63	110	Existing	36	0.13
P-5436	J-5575	J-8475	89	63	110	Existing	4	0.02
P-5439	J-7549	J-8161	79	63	110	Existing	62	0.23
P-5440	J-898	J-4123	88	63	110	Existing	46	0.17
P-5444	J-6289	J-5230	107	110	110	Existing	190	0.23
P-5455	J-5999	J-714	95	63	110	Existing	4	0.01
P-5456	J-4794	J-3252	93	50	110	Existing	70	0.41
P-5462	J-6793	J-232	68	110	110	Existing	92	0.11
P-5467	J-5857	J-7609	88	63	110	Existing	190	0.71
P-5470	J-1828	J-8802	153	200	110	Existing	301	0.11
P-5474	J-3540	J-8622	114	110	110	Existing	619	0.75
P-5475	J-4123	J-1113	152	63	110	Existing	10	0.04
P-5482	J-4380	J-408	97	63	110	Existing	5	0.02
P-5490	J-7610	J-7991	142	63	110	Existing	13	0.05
P-5504	J-6759	J-6374	88	63	110	Existing	3	0.01
P-5510	J-5841	J-7471	284	90	110	Existing	0	0
P-5520	J-10398	J-6393	209	63	110	Existing	51	0.19
P-5536	J-788	J-1232	12	63	110	Existing	11	0.04
P-5589	J-4287	J-9008	174	63	110	Existing	15	0.05
P-5632	J-4287	J-5575	67	63	110	Existing	105	0.39
P-5636	J-4007	J-1482	43	90	110	Existing	40	0.07
P-5701	J-7836	J-5446	66	63	110	Existing	34	0.13
P-5702	J-2806	J-2284	15	110	110	Existing	52	0.06
P-5710	J-5649	J-6440	136	110	110	Existing	19	0.02
P-5736	J-2558	J-1039	57	90	110	Existing	288	0.52
P-5764	J-1831	J-2007	55	63	110	Existing	37	0.14
P-5776	J-585	J-6188	92	90	110	Existing	17	0.03
P-5806	J-3421	J-8402	87	63	110	Existing	154	0.57
P-5818	J-1327	J-756	100	90	110	Existing	30	0.05
P-5846	J-7487	J-6464	101	63	110	Existing	9	0.03
P-5864	J-5594	J-5470	104	63	110	Existing	55	0.21
P-5880	J-4236	J-583	32	63	110	Existing	121	0.45
P-5884	J-8475	J-1470	88	63	110	Existing	117	0.43
P-5890	J-4309	J-6099	42	63	110	Existing	93	0.34
P-5895	J-6579	J-4138	41	50	110	Existing	30	0.18
P-5900	J-1113	J-2761	42	63	110	Existing	35	0.13
P-5912	J-2127	J-5406	221	50	110	Existing	5	0.03
P-5964	J-5872	J-10177	49	63	110	Existing	113	0.42
P-6042	J-766	J-9084	197	90	110	Existing	23	0.04
P-6050	J-5993	J-8559	58	50	110	Existing	4	0.03
P-6057	J-566	J-850	508	110	110	Existing	18	0.02
P-6077	J-6099	J-3885	59	63	110	Existing	102	0.38
P-6129	J-4617	J-4234	124	63	110	Existing	11	0.04
P-6139	J-643	J-8315	98	90	110	Existing	207	0.38

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
P-6163	J-3885	J-5178	76	63	110	Existing	124	0.46
P-6167	J-6544	J-4236	100	63	110	Existing	315	1.17
P-6220	J-1257	J-6520	60	63	110	Existing	347	1.29
P-6223	J-5999	J-675	79	63	110	Existing	0	0
P-6228	J-2049	J-5965	95	200	110	Existing	302	0.11
P-6238	J-5021	J-3371	106	90	110	Existing	117	0.21
P-6244	J-5788	J-9161	359	63	110	Existing	32	0.12
P-6256	J-937	J-7179	94	63	110	Existing	54	0.2
P-6270	J-6829	J-6353	202	63	110	Existing	16	0.06
P-6272	J-8237	J-5344	124	63	110	Existing	114	0.43
P-6289	J-7280	J-7529	111	63	110	Existing	3	0.01
P-6294	J-5545	J-8753	98	63	110	Existing	3	0.01
P-6295	J-663	J-7860	201	90	110	Existing	29	0.05
P-6303	J-8789	J-5993	80	50	110	Existing	16	0.09
P-6314	J-8391	J-1976	77	90	110	Existing	43	0.08
P-6320	J-1263	J-5723	127	63	110	Existing	5	0.02
P-6339	J-5460	J-4553	112	63	110	Existing	8	0.03
P-6341	J-4580	J-7955	109	63	110	Existing	8	0.03
P-6352	J-663	J-5808	235	90	110	Existing	11	0.02
P-6367	J-5410	J-151	60	63	110	Existing	48	0.18
P-6368	J-6440	J-7836	169	110	110	Existing	32	0.04
P-6377	J-1627	J-1925	114	50	110	Existing	0	0
P-6378	J-6195	J-1695	94	90	110	Existing	0	0
P-6384	J-5872	J-2007	72	63	110	Existing	99	0.37
P-6385	J-4662	J-3246	76	63	110	Existing	7	0.02
P-6387	J-535	J-2239	106	63	110	Existing	66	0.25
P-6390	J-6130	J-8496	197	63	110	Existing	4	0.02
P-6424	J-5345	J-296	156	63	110	Existing	20	0.07
P-6437	J-151	J-6406	206	63	110	Existing	47	0.18
P-6440	J-5874	J-7549	155	63	110	Existing	78	0.29
P-6442	J-5545	J-6047	128	63	110	Existing	20	0.08
P-6450	J-7695	J-4467	168	63	110	Existing	102	0.38
P-6452	J-6181	J-2033	152	63	110	Existing	0	0
P-6460	J-6827	J-6102	163	63	110	Existing	36	0.13
P-6468	J-4879	J-5450	211	63	110	Existing	122	0.45
P-6472	J-9006	J-6181	258	63	110	Existing	18	0.07
P-6510	J-1113	J-1461	53	63	110	Existing	60	0.22
P-6514	J-6380	J-4379	67	90	110	Existing	53	0.1
P-6515	J-3421	J-1119	75	63	110	Existing	52	0.19
P-6518	J-1119	J-625	65	63	110	Existing	6	0.02
P-6530	J-583	J-1599	34	63	110	Existing	113	0.42
P-6545	J-4281	J-6728	522	50	110	Existing	70	0.41
P-6552	J-3330	J-3311	120	63	110	Existing	40	0.15
P-6568	J-3927	J-501	74	50	110	Existing	42	0.25
P-6619	J-5300	J-6774	118	63	110	Existing	21	0.08
P-6665	J-8114	J-7809	155	90	110	Existing	38	0.07
P-6679	J-6188	J-6708	209	90	110	Existing	591	1.08
P-6680	J-8402	J-8177	140	63	110	Existing	13	0.05
P-6685	J-6602	J-3240	153	63	110	Existing	78	0.29
P-6687	J-5839	J-2317	104	63	110	Existing	20	0.07
P-6695	J-1482	J-4309	60	63	110	Existing	64	0.24
P-6697	J-417	J-3771	95	63	110	Existing	11	0.04
P-6698	J-250	J-346	366	100	110	Existing	0	0
P-6719	J-2754	J-1327	71	90	110	Existing	40	0.07
P-6722	J-5585	J-1635	253	63	110	Existing	233	0.87
P-6723	J-7842	J-6547	144	90	110	Existing	20	0.04
P-6729	J-8315	J-8846	90	90	110	Existing	181	0.33
P-6732	J-2539	J-670	86	63	110	Existing	38	0.14
P-6737	J-2940	J-303	139	63	110	Existing	35	0.13
P-6745	J-4700	J-8466	146	63	110	Existing	42	0.16
P-6747	J-319	J-7353	69	50	110	Existing	20	0.12
P-6750	J-1840	J-6027	126	63	110	Existing	48	0.18

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
P-6761	J-5712	J-2484	81	63	110	Existing	15	0.06
P-6763	J-8847	J-9006	254	63	110	Existing	96	0.36
P-6769	J-4281	J-8840	178	75	110	Existing	66	0.17
P-6782	J-4123	J-8554	148	63	110	Existing	69	0.25
P-6785	J-8107	J-6909	243	90	110	Existing	148	0.27
P-6793	J-8127	J-7487	132	63	110	Existing	25	0.09
P-6797	J-5675	J-8114	139	63	110	Existing	117	0.44
P-6800	J-2841	J-5594	138	63	110	Existing	88	0.33
P-6802	J-670	J-5626	156	32	110	Existing	15	0.21
P-6804	J-6602	J-2841	85	63	110	Existing	119	0.44
P-6813	J-4857	J-4878	88	63	110	Existing	28	0.1
P-6821	J-8391	J-7920	158	90	110	Existing	29	0.05
P-6827	J-5158	J-7113	130	110	110	Existing	53	0.06
P-6829	J-158	J-348	381	63	110	Existing	25	0.09
P-6839	J-6634	J-3851	135	90	110	Existing	22	0.04
P-6848	J-9157	J-5927	170	63	110	Existing	18	0.07
P-6855	J-773	J-6388	142	90	110	Existing	0	0
P-6864	J-4335	J-9150	147	63	110	Existing	17	0.06
P-6867	J-6072	J-5822	298	63	110	Existing	23	0.09
P-6870	J-8554	J-8324	132	63	110	Existing	22	0.08
P-6880	J-5857	J-8369	157	63	110	Existing	20	0.07
P-6882	J-4312	J-8320	178	63	110	Existing	26	0.1
P-6889	J-8622	J-8930	463	90	110	Existing	60	0.11
P-6894	J-3330	J-3311	110	110	110	Existing	180	0.22
P-6898	J-4895	J-1965	199	110	110	Existing	1	0
P-6901	J-1976	J-7920	168	63	110	Existing	0	0
P-6902	J-400	J-766	247	90	110	Existing	37	0.07
P-6906	J-7960	J-5712	140	63	110	Existing	9	0.04
P-6910	J-7248	J-6486	250	63	110	Existing	12	0.05
P-6911	J-7471	J-3789	234	90	110	Existing	267	0.48
P-6914	J-8802	J-8252	432	200	110	Existing	202	0.07
P-6918	J-2317	J-7610	291	63	110	Existing	40	0.15
P-6920	J-1659	J-7086	276	100	110	Existing	104	0.15
P-6921	J-2264	J-1419	241	110	110	Existing	121	0.15
P-6922	J-7463	J-7972	188	90	110	Existing	19	0.03
P-6923	J-7113	J-394	284	110	110	Existing	11	0.01
P-6925	J-8929	J-532	329	110	110	Existing	346	0.42
P-6931	J-6828	J-4693	345	63	110	Existing	24	0.09
P-6932	J-711	J-160	249	50	110	Existing	19	0.11
P-6936	J-8382	J-6508	219	63	110	Existing	3	0.01
P-6944	J-4981	J-2896	225	63	110	Existing	52	0.19
P-6947	J-445	J-8062	238	50	110	Existing	12	0.07
P-6948	J-6129	J-6949	247	63	110	Existing	7	0.03
P-6950	J-7065	J-849	188	63	110	Existing	217	0.8
P-6953	J-8879	J-5649	685	110	110	Existing	101	0.12
P-6965	J-5675	J-1238	114	63	110	Existing	123	0.46
P-6967	J-2273	J-6855	105	63	110	Existing	105	0.39
P-6977	J-6855	J-1831	82	63	110	Existing	62	0.23
P-6980	J-4159	J-2539	250	63	110	Existing	69	0.26
P-6982	J-3134	J-6372	111	63	110	Existing	49	0.18
P-7016	J-5025	J-8846	243	90	110	Existing	74	0.13
P-7018	J-3371	J-479	64	90	110	Existing	18	0.03
P-7023	J-1119	J-2507	79	63	110	Existing	26	0.1
P-7024	J-7151	J-4428	148	50	110	Existing	7	0.04
P-7025	J-5515	J-6413	168	50	110	Existing	29	0.17
P-7029	J-4683	J-759	157	50	110	Existing	98	0.58
P-7030	J-7589	J-10159	162	90	110	Existing	53	0.1
P-7033	J-5854	J-7705	252	63	110	Existing	30	0.11
P-7035	J-10496	J-905	159	50	110	Existing	112	0.66
P-7037	J-8458	J-4683	169	75	110	Existing	300	0.79
P-7038	J-6552	J-5300	169	63	110	Existing	40	0.15
P-7044	J-1944	J-5788	99	90	110	Existing	172	0.31

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
P-7049	J-7118	J-8322	280	63	110	Existing	85	0.31
P-7051	J-4958	J-6552	159	90	110	Existing	92	0.17
P-7052	J-319	J-3927	161	50	110	Existing	82	0.49
P-7055	J-2033	J-1019	175	63	110	Existing	26	0.1
P-7058	J-552	J-3406	191	63	110	Existing	145	0.54
P-7060	J-8727	J-7779	508	90	110	Existing	56	0.1
P-7065	J-8846	J-3065	223	90	110	Existing	75	0.14
P-7066	J-6774	J-2846	135	63	110	Existing	70	0.26
P-7076	J-3395	J-6215	237	110	110	Existing	141	0.17
P-7092	J-3829	J-7799	475	63	110	Existing	42	0.16
P-7095	J-2940	J-8655	237	63	110	Existing	21	0.08
P-7097	J-1482	J-3019	212	50	110	Existing	0	0
P-7101	J-5021	J-762	391	90	110	Existing	57	0.1
P-7102	J-5034	J-1370	222	63	110	Existing	26	0.1
P-7111	J-7479	J-3871	155	90	110	Existing	103	0.19
P-7114	J-192	J-279	189	63	110	Existing	25	0.09
P-7120	J-5575	J-8475	447	63	110	Existing	2	0.01
P-7122	J-2284	J-5372	239	110	110	Existing	58	0.07
P-7126	J-4683	J-4281	115	75	110	Existing	188	0.49
P-7134	J-6909	J-8941	307	90	110	Existing	25	0.05
P-7137	J-8439	J-1984	199	63	110	Existing	0	0
P-7144	J-5687	J-8806	272	63	110	Existing	17	0.06
P-7145	J-4708	J-1575	238	63	110	Existing	20	0.07
P-7146	J-7065	J-8161	198	63	110	Existing	125	0.46
P-7147	J-7560	J-4669	385	63	110	Existing	97	0.36
P-7148	J-1327	J-445	178	63	110	Existing	30	0.11
P-7152	J-6544	J-8402	267	63	110	Existing	173	0.64
P-7153	J-8852	J-6410	270	90	110	Existing	71	0.13
P-7154	J-357	J-7619	365	63	110	Existing	26	0.1
P-7155	J-8127	J-8812	405	63	110	Existing	7	0.03
P-7158	J-8726	J-6086	510	90	110	Existing	63	0.12
P-7163	J-6486	J-5410	216	63	110	Existing	58	0.21
P-7170	J-8673	J-5822	244	63	110	Existing	21	0.08
P-7173	J-1019	J-7252	395	63	110	Existing	90	0.34
P-7174	J-8829	J-7560	488	63	110	Existing	58	0.21
P-7176	J-449	J-1984	262	90	110	Existing	17	0.03
P-7178	J-565	J-7065	318	63	110	Existing	142	0.53
P-7186	J-338	J-400	234	90	110	Existing	46	0.08
P-7197	J-2007	J-5395	173	50	110	Existing	81	0.48
P-7211	J-2594	J-4159	190	63	110	Existing	38	0.14
P-7216	J-4708	J-9981	236	90	110	Existing	49	0.09
P-7224	J-6196	J-1076	324	63	110	Existing	43	0.16
P-7226	J-1491	J-8439	212	75	110	Existing	52	0.14
P-7230	J-5470	J-3649	523	63	110	Existing	12	0.04
P-7232	J-4428	J-10343	204	63	110	Existing	12	0.05
P-7233	J-6633	J-629	499	90	110	Existing	93	0.17
P-7234	J-4467	J-7072	335	63	110	Existing	77	0.28
P-7239	J-795	J-6171	453	90	110	Existing	56	0.1
P-7240	J-7956	J-7839	467	90	110	Existing	57	0.1
P-7243	J-1883	J-159	374	63	110	Existing	14	0.05
P-7244	J-8727	J-8894	484	90	110	Existing	50	0.09
P-7248	J-8015	J-6288	325	63	110	Existing	11	0.04
P-7258	J-4879	J-7560	493	63	110	Existing	65	0.24
P-7260	J-7791	J-5765	513	110	110	Existing	73	0.09
P-7261	J-2049	J-5409	718	90	110	Existing	248	0.45
P-7266	J-5441	J-5857	232	63	110	Existing	11	0.04
P-7267	J-712	J-5656	752	90	110	Existing	91	0.17
P-7270	J-5288	J-6934	501	90	110	Existing	46	0.08
P-7359	J-8802	J-6588	202	50	110	Existing	75	0.44
P-7360	J-3793	J-4827	278	50	110	Existing	17	0.1
P-7361	J-416	J-1383	405	110	110	Existing	32	0.04
P-7364	J-5034	J-863	331	90	110	Existing	27	0.05

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
P-7370	J-156	J-10032	116	63	110	Existing	116	0.43
P-7378	J-7822	J-162	88	63	110	Existing	16	0.06
P-7393	J-210	J-272	146	63	110	Existing	46	0.17
P-7394	J-272	J-225	111	63	110	Existing	34	0.13
P-7397	J-225	J-7822	141	63	110	Existing	21	0.08
P-7402	J-226	J-163	221	110	110	Existing	0	0
P-7407	J-648	J-7815	212	63	110	Existing	70	0.26
P-7408	J-7815	J-210	175	63	110	Existing	56	0.21
P-7409	J-156	J-226	335	110	110	Existing	0	0
P-7420	J-9105	J-8388	60	63	110	Existing	5	0.02
P-7421	J-8388	J-192	301	63	110	Existing	22	0.08
P-7429	J-9150	J-2832	40	63	110	Existing	12	0.04
P-7448	J-186	J-8466	3	90	110	Existing	0	0
P-7473	J-9155	J-643	46	90	110	Existing	211	0.38
P-7476	J-7442	J-9157	45	63	110	Existing	23	0.09
P-7489	J-3955	J-512	12	50	110	Existing	31	0.18
P-7492	J-9165	J-9167	459	75	110	Existing	95	0.25
P-7494	J-901	J-9165	5	75	110	Existing	186	0.49
P-7495	B5	J-9168	935	300	110	Existing	0	0
P-7497	B2	J-9170	102	110	110	Existing	0	0
P-7498	J-9170	J-29	4	110	110	Existing	0	0
P-7502	J-9170	J-9172	5	110	110	Existing	0	0
P-7503	J-9172	J-9171	2	110	110	Existing	0	0
P-7513	J-9176	J-9177	3305	200	110	Existing	536	0.2
P-7515	J-9178	J-338	261	90	110	Existing	75	0.14
P-7521	J-25	Ex3	23	200	110	Existing	0	0
P-7522	Ex3	Kacyiru	20	200	110	Existing	0	0
P-7525	J-937	Ex1	9	90	110	Existing	0	0
P-7526	Ex1	J-3197	71	90	110	Existing	0	0
P-7540	Ex2	J-390	327	110	110	Existing	352	0.43
P-7546	J-9181	J-5066	480	90	110	Existing	0	0
P-7548	Ntora	J-10064	226	400	110	Existing	6866	0.63
P-7550	J-10064	J-10024	18	400	110	Existing	6866	0.63
P-7552	J-10024	J-10282	5	250	110	Primary	2656	0.93
P-7554	J-10282	J-10280	39	250	110	Primary	1473	0.52
P-7557	J-9362	J-10025	15	250	110	Primary	719	0.25
P-7558	J-9362	J-9736	2	110	110	Secondary	171	0.31
P-7559	J-9736	J-9363	36	110	110	Secondary	150	0.27
P-7562	J-192	J-10286	20	110	110	Existing	342	0.42
P-7565	J-10286	J-10025	3	225	110	Primary	535	0.23
P-7567	J-10287	J-2264	188	110	110	Existing	121	0.15
P-7568	J-10280	J-10287	153	250	110	Primary	1011	0.36
P-7569	J-10287	J-9362	4	250	110	Primary	889	0.31
P-7571	J-9468	J-10286	189	225	110	Primary	193	0.08
P-7573	J-9858	J-9468	19	225	110	Primary	182	0.08
P-7575	J-9749	J-9858	67	225	110	Primary	144	0.06
P-7577	J-9668	J-9749	9	225	110	Primary	127	0.06
P-7578	J-9196	J-9623	184	225	110	Primary	89	0.04
P-7579	J-9623	J-9668	5	225	110	Primary	114	0.05
P-7582	J-9401	J-9748	48	225	110	Primary	91	0.04
P-7584	J-9578	J-9635	64	110	110	Secondary	34	0.06
P-7585	J-9635	J-9579	58	110	110	Secondary	8	0.01
P-7586	J-9635	J-9387	48	63	110	Secondary (Sub)	49	0.27
P-7587	J-9387	J-9636	53	63	110	Secondary (Sub)	58	0.32
P-7590	J-5372	J-9648	189	110	110	Existing	75	0.09
P-7591	J-9648	Ntora Elevated	25	110	110	Existing	199	0.24
P-7595	J-9312	J-10020	518	110	110	Secondary	42	0.08
P-7596	J-10025	J-10114	394	225	110	Primary	184	0.08
P-7597	J-10114	J-10205	77	225	110	Primary	53	0.02
P-7600	J-10115	J-9549	66	90	110	Existing	82	0.15
P-7601	J-9549	J-356	96	90	110	Existing	32	0.06
P-7603	J-10160	J-10115	60	90	110	Existing	0	0

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
P-7604	J-10160	J-9855	285	63	110	Secondary (Sub)	4	0.02
P-7605	J-9855	J-10161	76	63	110	Secondary (Sub)	8	0.04
P-7606	J-270	J-9854	198	90	110	Existing	82	0.15
P-7608	J-9854	J-9950	5	90	110	Existing	26	0.05
P-7609	J-9950	J-10160	135	90	110	Existing	48	0.09
P-7610	J-1654	J-9951	111	90	110	Existing	317	0.58
P-7612	J-270	J-10102	38	90	110	Existing	9	0.02
P-7613	J-10102	J-6380	61	90	110	Existing	35	0.06
P-7616	J-9951	J-9976	83	90	110	Existing	210	0.38
P-7617	J-9976	J-270	109	90	110	Existing	112	0.2
P-7618	J-757	J-9977	223	25	110	Existing	4	0.1
P-7619	J-9977	J-1654	118	25	110	Existing	15	0.35
P-7620	J-3948	J-10288	10	90	110	Existing	457	0.83
P-7621	J-10288	J-1654	5	90	110	Existing	338	0.61
P-7623	J-10289	J-9187	333	225	110	Primary	1350	0.59
P-7625	J-10289	J-10288	1	225	110	Primary	795	0.35
P-7628	J-4379	J-10291	2	90	110	Existing	114	0.21
P-7629	J-10291	J-2754	141	90	110	Existing	57	0.1
P-7630	J-10290	J-10291	2	225	110	Primary	196	0.09
P-7632	J-4379	J-9664	96	63	110	Existing	48	0.18
P-7633	J-9664	J-10103	55	63	110	Existing	51	0.19
P-7635	J-9939	J-3134	94	63	110	Existing	24	0.09
P-7636	J-10103	J-9575	56	63	110	Existing	30	0.11
P-7637	J-9575	J-9939	35	63	110	Existing	0	0
P-7639	J-9486	J-10290	363	160	110	Primary	163	0.14
P-7640	J-9486	J-9522	3	110	110	Secondary	28	0.05
P-7641	J-9522	J-9487	56	110	110	Secondary	11	0.02
P-7643	J-9448	J-9486	72	160	110	Primary	118	0.1
P-7645	J-9523	J-9448	3	110	110	Secondary	31	0.06
P-7646	J-9447	J-9458	22	110	110	Secondary	47	0.09
P-7647	J-9458	J-9523	31	110	110	Secondary	40	0.07
P-7648	J-9447	J-9665	102	110	110	Secondary	62	0.11
P-7649	J-9665	J-9902	151	110	110	Secondary	102	0.19
P-7650	J-10290	J-9902	156	225	110	Primary	359	0.16
P-7652	J-9902	J-9742	134	225	110	Primary	484	0.21
P-7653	J-9742	J-9187	40	225	110	Primary	505	0.22
P-7655	J-9847	J-756	200	25	110	Existing	4	0.08
P-7656	J-9670	J-8062	27	110	110	Secondary	36	0.07
P-7658	J-8062	J-9202	82	110	110	Secondary	41	0.08
P-7664	J-445	J-10292	37	63	110	Existing	2	0.01
P-7666	J-9203	J-10294	286	160	110	Primary	116	0.1
P-7668	J-10292	J-10294	2	160	110	Primary	33	0.03
P-7669	J-10294	J-9448	39	160	110	Primary	148	0.13
P-7670	J-9149	J-10295	20	63	110	Existing	2	0.01
P-7676	J-9899	J-10298	27	160	110	Primary	276	0.24
P-7678	J-10298	J-10295	2	160	110	Primary	30	0.03
P-7681	J-9547	J-1028	1	63	110	Existing	2	0.01
P-7682	J-10298	J-10187	68	160	110	Primary	246	0.21
P-7687	J-9484	J-9871	84	110	110	Secondary	46	0.08
P-7690	J-9225	J-9966	13	110	110	Secondary	82	0.15
P-7691	J-9966	J-9484	57	110	110	Secondary	63	0.11
P-7692	J-9686	J-9274	66	110	110	Secondary	174	0.32
P-7693	J-9274	J-9687	71	63	110	Secondary (Sub)	3	0.02
P-7695	J-9275	J-9898	21	160	110	Primary	276	0.24
P-7696	J-9226	J-9686	130	110	110	Secondary	66	0.12
P-7698	J-9686	J-9967	121	110	110	Secondary	87	0.16
P-7699	J-9967	J-10188	83	110	110	Secondary	57	0.1
P-7700	J-9966	J-9536	130	63	110	Secondary (Sub)	11	0.06
P-7701	J-9536	J-9967	67	63	110	Secondary (Sub)	9	0.05
P-7706	J-10188	J-9868	4	160	110	Primary	44	0.04
P-7708	J-382	J-10225	198	63	110	Existing	50	0.19
P-7710	J-9868	J-9867	141	160	110	Primary	13	0.01

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
P-7711	J-9867	J-10225	57	160	110	Primary	31	0.03
P-7712	J-9867	J-9422	251	110	110	Secondary	11	0.02
P-7713	J-9422	J-9868	76	110	110	Secondary	23	0.04
P-7716	J-9583	J-9327	29	110	110	Secondary	5	0.01
P-7717	J-9327	J-9914	46	63	110	Secondary (Sub)	3	0.01
P-7718	J-9684	J-10300	101	63	110	Secondary (Sub)	1	0
P-7719	J-9326	J-9685	20	63	110	Secondary (Sub)	0	0
P-7720	J-9326	J-10300	1	110	110	Secondary	4	0.01
P-7721	J-10300	J-9327	24	110	110	Secondary	1	0
P-7722	J-9913	J-9684	35	110	110	Secondary	10	0.02
P-7723	J-9684	J-9583	109	110	110	Secondary	3	0
P-7726	J-9913	J-9582	94	160	110	Primary	11	0.01
P-7727	J-9582	J-10188	30	160	110	Primary	5	0
P-7732	J-9603	J-10074	73	160	110	Primary	17	0.01
P-7733	J-10074	J-9913	21	160	110	Primary	29	0.03
P-7735	J-4662	J-10074	61	160	110	Primary	47	0.04
P-7738	J-9871	J-9655	26	160	110	Primary	71	0.06
P-7739	J-9655	J-4662	25	160	110	Primary	61	0.05
P-7740	J-3247	J-9656	37	63	110	Existing	7	0.02
P-7741	J-9656	J-1637	87	63	110	Existing	2	0.01
P-7744	J-5996	J-9628	9	63	110	Existing	7	0.03
P-7745	J-9628	J-1753	6	63	110	Existing	28	0.1
P-7749	J-10547	J-9460	88	160	110	Primary	0	0
P-7750	J-9978	J-5573	256	110	110	Secondary	8	0.02
P-7751	J-5573	J-9613	2	110	110	Secondary	1	0
P-7754	J-9978	J-9678	2	160	110	Primary	8	0.01
P-7759	J-10207	J-9978	114	160	110	Primary	6	0
P-7760	J-10073	J-9679	103	160	110	Primary	84	0.07
P-7761	J-9679	J-10207	9	160	110	Primary	101	0.09
P-7762	J-10187	J-9674	115	160	110	Primary	194	0.17
P-7763	J-9674	J-10073	3	160	110	Primary	157	0.14
P-7764	J-10073	J-9627	60	160	110	Primary	74	0.06
P-7765	J-9627	J-9871	63	160	110	Primary	33	0.03
P-7766	J-9678	J-9675	112	110	110	Secondary	10	0.02
P-7767	J-9675	J-9679	1	110	110	Secondary	17	0.03
P-7768	J-9420	J-9344	47	63	110	Secondary (Sub)	2	0.01
P-7769	J-9344	J-7894	15	63	110	Secondary (Sub)	8	0.04
P-7770	J-10207	J-9236	74	110	110	Secondary	94	0.17
P-7773	J-9777	J-10208	174	110	110	Secondary	3	0.01
P-7774	J-9236	J-6372	22	110	110	Secondary	82	0.15
P-7775	J-6372	J-9777	104	110	110	Secondary	23	0.04
P-7776	J-10292	J-10301	185	63	110	Existing	12	0.04
P-7777	J-10301	J-9149	5	63	110	Existing	0	0
P-7779	J-10302	J-9847	152	25	110	Existing	1	0.03
P-7781	J-10302	J-9203	231	160	110	Primary	59	0.05
P-7783	J-10303	J-648	1	63	110	Existing	155	0.58
P-7785	J-10303	J-9275	184	160	110	Primary	458	0.39
P-7786	J-10108	J-9692	132	110	110	Secondary	125	0.23
P-7787	J-9692	J-10109	127	110	110	Secondary	19	0.03
P-7788	J-9692	J-9666	27	110	110	Secondary (Sub)	81	0.15
P-7789	J-9666	J-9693	73	63	110	Secondary (Sub)	64	0.36
P-7790	J-9703	J-9361	84	63	110	Secondary (Sub)	37	0.21
P-7791	J-9361	J-9704	41	63	110	Secondary (Sub)	5	0.03
P-7796	J-9244	J-9321	9	160	110	Primary	188	0.16
P-7798	J-10032	J-9980	99	63	110	Existing	77	0.29
P-7799	J-9980	J-575	81	63	110	Existing	54	0.2
P-7800	J-9827	J-10031	80	63	110	Secondary (Sub)	22	0.12
P-7802	J-10031	J-9449	154	63	110	Secondary (Sub)	16	0.09
P-7803	J-9449	J-10032	127	63	110	Secondary (Sub)	11	0.06
P-7805	J-10305	J-9828	22	63	110	Secondary (Sub)	5	0.03
P-7806	J-10031	J-9560	67	63	110	Secondary (Sub)	18	0.1
P-7807	J-9560	J-10305	2	63	110	Secondary (Sub)	19	0.11

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
P-7810	J-10195	J-9386	105	110	110	Secondary	197	0.36
P-7811	J-9386	J-9474	39	110	110	Secondary	141	0.26
P-7814	J-9559	J-9405	31	110	110	Secondary	27	0.05
P-7816	J-9405	J-9438	19	110	110	Secondary	19	0.04
P-7817	J-9438	J-10196	36	110	110	Secondary	6	0.01
P-7818	J-10089	J-9475	138	110	110	Secondary	149	0.27
P-7820	J-9727	J-9768	78	63	110	Secondary (Sub)	22	0.12
P-7821	J-9768	J-9728	40	63	110	Secondary (Sub)	9	0.05
P-7822	J-9475	J-9727	90	110	110	Secondary	156	0.28
P-7824	J-10108	J-10195	311	225	110	Primary	1181	0.51
P-7826	J-10195	J-10089	116	225	110	Primary	971	0.42
P-7828	J-9727	J-9762	99	110	110	Secondary	111	0.2
P-7829	J-9762	J-10090	52	110	110	Secondary	57	0.1
P-7831	J-9767	J-10213	6	110	110	Secondary	119	0.22
P-7832	J-10212	J-10090	361	110	110	Secondary	111	0.2
P-7833	J-10090	J-9767	67	110	110	Secondary	127	0.23
P-7836	J-10089	J-10212	133	225	110	Primary	804	0.35
P-7839	J-10306	J-5515	127	50	110	Existing	43	0.25
P-7842	J-9199	J-9596	31	225	110	Primary	632	0.27
P-7843	J-9596	J-10306	162	225	110	Primary	604	0.26
P-7846	J-10212	J-10308	352	225	110	Primary	646	0.28
P-7847	J-10308	J-9199	4	225	110	Primary	632	0.27
P-7849	J-10308	J-162	261	63	110	Existing	2	0.01
P-7851	J-10310	J-10307	17	160	110	Primary	199	0.17
P-7854	J-10306	J-9995	9	225	110	Primary	543	0.24
P-7855	J-9995	J-10213	82	160	110	Primary	160	0.14
P-7856	J-9494	J-9446	69	160	110	Primary	316	0.27
P-7857	J-9446	J-9995	131	160	110	Primary	383	0.33
P-7861	J-10105	J-10108	105	225	110	Primary	1321	0.58
P-7863	J-10138	J-9244	79	160	110	Primary	184	0.16
P-7865	J-9779	J-10138	79	160	110	Primary	190	0.16
P-7867	J-9824	J-9779	112	160	110	Primary	226	0.19
P-7868	J-9823	J-9744	145	110	110	Secondary	11	0.02
P-7869	J-9744	J-9824	3	110	110	Secondary	24	0.04
P-7871	J-10096	J-9824	150	160	110	Primary	202	0.17
P-7875	J-10150	J-10096	105	160	110	Primary	194	0.17
P-7876	J-10096	J-10311	5	110	110	Secondary	8	0.02
P-7877	J-10311	J-458	287	110	110	Secondary	23	0.04
P-7878	J-1370	J-9823	2	63	110	Existing	4	0.02
P-7879	J-9823	J-2403	4	63	110	Existing	2	0.01
P-7882	J-9201	J-9508	85	160	110	Primary	236	0.2
P-7883	J-9508	J-10150	135	160	110	Primary	245	0.21
P-7884	J-9201	J-10050	31	110	110	Secondary	38	0.07
P-7885	J-10050	J-653	20	110	110	Secondary	14	0.02
P-7887	J-10092	J-9201	46	160	110	Primary	274	0.24
P-7888	J-10091	J-10061	182	110	110	Secondary	81	0.15
P-7889	J-10061	J-10092	157	110	110	Secondary	66	0.12
P-7890	J-10307	J-9948	188	160	110	Primary	199	0.17
P-7891	J-9948	J-10092	40	160	110	Primary	204	0.18
P-7893	J-9281	J-10310	186	160	110	Primary	151	0.13
P-7899	J-9284	J-10310	308	63	110	Existing	21	0.08
P-7902	J-9285	J-9984	2	160	110	Primary	187	0.16
P-7904	J-9984	J-9637	13	110	110	Secondary	126	0.23
P-7915	J-8554	J-10313	2	63	110	Existing	55	0.2
P-7916	J-10313	J-9284	366	63	110	Existing	32	0.12
P-7917	J-10313	J-10315	1	160	110	Primary	103	0.09
P-7918	J-10315	J-10062	164	160	110	Primary	250	0.22
P-7922	J-10091	J-10315	129	225	110	Primary	353	0.15
P-7924	J-10317	J-10091	7	225	110	Primary	448	0.19
P-7926	J-10317	J-10316	4	225	110	Primary	36	0.02
P-7927	J-8324	J-10316	4	63	110	Existing	22	0.08
P-7928	J-10316	J-653	304	63	110	Existing	2	0.01

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
P-7930	J-10051	J-10317	203	225	110	Primary	483	0.21
P-7932	J-10151	J-10051	268	225	110	Primary	567	0.25
P-7933	J-390	J-9441	99	90	110	Existing	145	0.26
P-7934	J-9441	J-5034	158	90	110	Existing	90	0.16
P-7938	J-9935	J-10139	102	110	110	Secondary	93	0.17
P-7939	J-9934	J-9409	93	63	110	Secondary (Sub)	26	0.15
P-7940	J-9409	J-9935	78	63	110	Secondary (Sub)	7	0.04
P-7943	J-448	J-9934	122	110	110	Existing	147	0.18
P-7945	J-9187	J-10134	4	315	110	Primary	845	0.19
P-7946	J-10134	J-10139	206	225	110	Primary	845	0.37
P-7948	J-10318	J-156	319	110	110	Existing	131	0.16
P-7949	J-10105	J-10318	113	160	110	Primary	745	0.64
P-7950	J-10318	J-10303	2	160	110	Primary	614	0.53
P-7955	J-10323	J-10321	1	160	110	Primary	115	0.1
P-7958	J-10320	J-10303	6	63	110	Existing	0	0
P-7959	J-9934	J-10321	222	110	110	Existing	115	0.14
P-7960	J-10321	J-10318	4	110	110	Existing	0	0
P-7961	J-9321	J-10322	105	160	110	Primary	192	0.17
P-7962	J-10322	J-10320	1	160	110	Primary	38	0.03
P-7963	J-10322	J-10323	1	160	110	Primary	154	0.13
P-7964	J-10323	J-10302	18	160	110	Primary	39	0.03
P-7966	J-10324	J-5096	9	110	110	Existing	0	0
P-7967	J-8885	J-10325	339	63	110	Existing	28	0.1
P-7969	J-10324	J-10325	3	110	110	Secondary	39	0.07
P-7970	J-3948	J-10326	3	110	110	Existing	457	0.56
P-7971	J-10326	Ex2	4	110	110	Existing	352	0.43
P-7972	J-10325	J-10327	15	63	110	Existing	0	0
P-7973	J-10327	J-10320	676	63	110	Existing	59	0.22
P-7974	J-10326	J-10327	2	63	110	Secondary (Sub)	105	0.58
P-7976	J-10328	J-10151	83	225	110	Primary	656	0.29
P-7977	J-10139	J-10328	171	225	110	Primary	744	0.32
P-7978	J-10329	J-10328	3	225	110	Primary	88	0.04
P-7979	J-8885	J-10329	208	63	110	Existing	0	0
P-7980	J-10329	J-458	60	63	110	Existing	64	0.24
P-7981	J-8324	J-10330	123	63	110	Existing	0	0
P-7982	J-10330	J-8885	461	63	110	Existing	27	0.1
P-7983	J-8936	J-10331	209	110	110	Existing	94	0.12
P-7984	J-10331	J-10324	803	110	110	Existing	39	0.05
P-7985	J-10330	J-10331	5	110	110	Secondary	47	0.09
P-7989	J-10333	J-10332	4	225	110	Primary	137	0.06
P-7990	J-1383	J-10332	269	110	110	Existing	35	0.04
P-7991	J-10332	J-8936	4	110	110	Existing	97	0.12
P-7993	J-9584	J-10333	63	160	110	Primary	82	0.07
P-7995	J-9644	J-9584	83	160	110	Primary	115	0.1
P-7996	J-10062	J-9905	16	160	110	Primary	283	0.24
P-7997	J-9905	J-9285	182	160	110	Primary	177	0.15
P-7998	J-9637	J-9588	61	110	110	Secondary	95	0.17
P-8000	J-9588	J-9957	51	110	110	Secondary	65	0.12
P-8001	J-9957	J-3446	67	110	110	Secondary	48	0.09
P-8003	J-10334	J-1461	38	110	110	Secondary	67	0.12
P-8004	J-9905	J-9956	110	110	110	Secondary	100	0.18
P-8005	J-9956	J-10334	0	110	110	Secondary	90	0.16
P-8006	J-2761	J-9825	42	63	110	Existing	23	0.08
P-8007	J-9825	J-1172	74	63	110	Existing	1	0
P-8008	J-10271	J-9826	430	160	110	Primary	184	0.16
P-8010	J-9826	J-9381	1	160	110	Primary	195	0.17
P-8015	J-10336	J-10335	2	110	110	Secondary	19	0.04
P-8016	J-7603	J-10335	138	50	110	Existing	0	0
P-8017	J-10335	J-6579	5	50	110	Existing	28	0.17
P-8018	J-9381	J-10069	92	160	110	Primary	159	0.14
P-8020	J-10069	J-9879	219	63	110	Secondary (Sub)	13	0.07
P-8021	J-9879	J-10070	16	63	110	Secondary (Sub)	13	0.07

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
P-8022	J-9432	J-9774	15	63	110	Secondary (Sub)	22	0.12
P-8023	J-9774	J-9879	145	63	110	Secondary (Sub)	8	0.05
P-8025	J-10070	J-898	26	63	110	Existing	42	0.16
P-8026	J-8120	J-9773	143	63	110	Existing	23	0.08
P-8027	J-9773	J-10070	93	63	110	Existing	27	0.1
P-8028	J-10069	J-9433	86	160	110	Primary	135	0.12
P-8030	J-9433	J-9633	188	160	110	Primary	109	0.09
P-8031	J-9633	J-9384	244	160	110	Primary	87	0.07
P-8034	J-9384	J-10337	88	160	110	Primary	87	0.07
P-8036	J-10337	J-6027	0	63	110	Existing	87	0.32
P-8037	J-6027	J-7442	39	63	110	Existing	28	0.11
P-8038	J-10281	J-9650	94	160	110	Primary	77	0.07
P-8039	J-9650	J-9342	23	160	110	Primary	35	0.03
P-8040	J-10337	J-10341	5	225	110	Primary	0	0
P-8045	J-10339	J-5144	20	110	110	Existing	41	0.05
P-8046	J-10339	J-10341	1	225	110	Primary	42	0.02
P-8047	J-10341	J-9650	7	160	110	Primary	42	0.04
P-8049	J-10192	J-10281	408	160	110	Primary	77	0.07
P-8050	J-9584	J-9477	47	110	110	Secondary	32	0.06
P-8051	J-9477	J-9585	55	110	110	Secondary	6	0.01
P-8052	J-10081	J-10016	118	110	110	Secondary	26	0.05
P-8053	J-10016	J-10082	154	110	110	Secondary	11	0.02
P-8055	J-9414	J-10238	36	160	110	Primary	72	0.06
P-8057	J-10238	J-10192	5	160	110	Primary	30	0.03
P-8058	J-9343	J-10101	446	160	110	Primary	35	0.03
P-8062	J-10100	J-10081	36	160	110	Primary	111	0.1
P-8063	J-10081	J-9414	92	160	110	Primary	81	0.07
P-8064	J-10094	J-10082	206	110	110	Secondary	65	0.12
P-8065	J-10082	J-10095	104	110	110	Secondary	10	0.02
P-8068	J-9561	J-10095	4	160	110	Primary	148	0.13
P-8069	J-10095	J-9644	10	160	110	Primary	129	0.11
P-8070	J-10333	J-10017	234	160	110	Primary	55	0.05
P-8071	J-10017	J-10238	222	160	110	Primary	43	0.04
P-8074	J-9889	J-10094	105	110	110	Secondary	60	0.11
P-8075	J-10094	J-9890	77	110	110	Secondary	21	0.04
P-8076	J-10237	J-9890	122	160	110	Primary	281	0.24
P-8078	J-9890	J-10191	4	160	110	Primary	255	0.22
P-8079	J-10191	J-10100	174	160	110	Primary	175	0.15
P-8081	J-9889	J-9436	56	160	110	Primary	182	0.16
P-8083	J-9943	J-9889	106	160	110	Primary	244	0.21
P-8084	J-9436	J-9506	125	160	110	Primary	174	0.15
P-8085	J-9506	J-9561	118	160	110	Primary	164	0.14
P-8087	J-10237	J-9943	8	160	110	Primary	269	0.23
P-8088	J-10043	J-5610	315	110	110	Secondary	158	0.29
P-8091	J-9845	J-10282	85	225	110	Primary	1183	0.51
P-8092	J-10280	J-9846	170	160	110	Primary	463	0.4
P-8094	J-9845	J-9396	108	110	110	Secondary	159	0.29
P-8095	J-9396	J-9846	32	110	110	Secondary	146	0.27
P-8096	J-9846	J-10018	32	160	110	Primary	606	0.52
P-8098	J-9426	J-9528	44	110	110	Secondary	59	0.11
P-8099	J-9528	J-9446	11	110	110	Secondary	66	0.12
P-8101	J-9892	J-9494	119	160	110	Primary	294	0.25
P-8105	J-10065	J-10222	15	160	110	Primary	267	0.23
P-8107	J-9821	J-10065	29	160	110	Primary	285	0.25
P-8109	J-9551	J-9821	48	110	110	Secondary	17	0.03
P-8110	J-9426	J-9567	64	110	110	Secondary	42	0.08
P-8111	J-9567	J-9551	19	110	110	Secondary	30	0.05
P-8112	J-9309	J-9730	36	110	110	Secondary	36	0.06
P-8114	J-9730	J-9863	80	110	110	Secondary	16	0.03
P-8115	J-9863	J-9798	7	110	110	Secondary	3	0.01
P-8116	J-9863	J-9729	84	63	110	Secondary (Sub)	2	0.01
P-8117	J-9729	J-9864	56	63	110	Secondary (Sub)	34	0.19

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
P-8118	J-9891	J-9864	42	110	110	Secondary	4	0.01
P-8119	J-9864	J-9892	104	110	110	Secondary	50	0.09
P-8121	J-9310	J-9892	161	160	110	Primary	241	0.21
P-8122	J-10222	J-9320	172	160	110	Primary	208	0.18
P-8124	J-9320	J-9699	386	160	110	Primary	195	0.17
P-8127	J-10342	J-9310	227	160	110	Primary	201	0.17
P-8129	J-10343	J-10342	3	160	110	Primary	107	0.09
P-8131	J-9406	J-10342	3	160	110	Primary	94	0.08
P-8133	J-10106	J-9406	10	160	110	Primary	57	0.05
P-8134	J-9926	J-9407	158	110	110	Secondary	12	0.02
P-8135	J-9407	J-9927	5	110	110	Secondary	102	0.19
P-8136	J-9927	J-9563	249	110	110	Secondary	95	0.17
P-8137	J-9563	J-10336	62	110	110	Secondary	72	0.13
P-8138	J-9563	J-9544	25	63	110	Secondary (Sub)	10	0.06
P-8139	J-9544	J-9564	58	63	110	Secondary (Sub)	4	0.02
P-8140	J-10336	J-9787	45	110	110	Secondary	89	0.16
P-8141	J-9787	J-10244	280	110	110	Secondary	48	0.09
P-8142	J-10101	J-10043	416	160	110	Primary	77	0.07
P-8147	J-9435	J-9183	118	160	110	Primary	636	0.55
P-8149	J-10002	J-9435	498	160	110	Primary	423	0.36
P-8151	J-10098	J-10002	3	160	110	Primary	607	0.52
P-8153	J-9694	J-10098	43	160	110	Primary	588	0.51
P-8154	J-9694	J-9328	98	110	110	Secondary	21	0.04
P-8155	J-9328	J-9514	23	110	110	Secondary	11	0.02
P-8156	J-9514	J-9332	32	110	110	Secondary	10	0.02
P-8157	J-9332	J-9515	69	110	110	Secondary	5	0.01
P-8158	J-9577	J-9395	40	160	110	Primary	899	0.77
P-8160	J-9208	J-10217	2	110	110	Secondary	90	0.16
P-8161	J-10217	J-9395	44	110	110	Secondary	66	0.12
P-8163	J-9577	J-9694	142	160	110	Primary	562	0.48
P-8165	J-9888	J-9577	6	160	110	Primary	337	0.29
P-8167	J-10056	J-9888	58	160	110	Primary	301	0.26
P-8169	J-9500	J-10056	110	110	110	Secondary	122	0.22
P-8170	J-10055	J-9833	75	110	110	Secondary	154	0.28
P-8171	J-9833	J-9500	55	110	110	Secondary	138	0.25
P-8175	J-9865	J-10055	356	160	110	Primary	568	0.49
P-8176	J-9338	J-9796	118	63	110	Secondary (Sub)	18	0.1
P-8177	J-9796	J-10136	161	63	110	Secondary (Sub)	11	0.06
P-8180	J-9339	J-9540	54	110	110	Existing	37	0.04
P-8181	J-9540	J-2806	18	110	110	Existing	52	0.06
P-8182	J-5372	J-9812	179	63	110	Existing	13	0.05
P-8183	J-9812	J-4670	96	63	110	Existing	7	0.03
P-8184	J-4671	J-9952	1	110	110	Secondary	7	0.01
P-8186	J-9952	J-9479	21	110	110	Secondary	7	0.01
P-8187	J-9479	J-10133	295	110	110	Secondary	7	0.01
P-8188	J-10055	J-2374	11	160	110	Primary	411	0.35
P-8190	J-2374	J-10345	11	110	110	Existing	0	0
P-8191	J-10345	J-9339	69	110	110	Existing	4	0.01
P-8195	J-9722	J-10045	106	110	110	Secondary	82	0.15
P-8196	J-9876	J-9240	47	110	110	Secondary	39	0.07
P-8198	J-9303	J-9489	44	110	110	Secondary	53	0.1
P-8199	J-9489	J-9722	114	110	110	Secondary	61	0.11
P-8201	J-9452	J-9269	118	110	110	Secondary	38	0.07
P-8202	J-9240	J-9695	52	110	110	Secondary	52	0.09
P-8203	J-9695	J-9452	46	110	110	Secondary	11	0.02
P-8205	J-9822	J-9696	17	110	110	Secondary	79	0.14
P-8206	J-9822	J-9725	27	110	110	Secondary	112	0.2
P-8208	J-10652	J-9754	51	63	110	Secondary (Sub)	1	0
P-8213	J-9250	J-9606	30	110	110	Secondary	95	0.17
P-8214	J-9725	J-9887	70	110	110	Secondary	107	0.2
P-8215	J-9887	J-9249	41	63	110	Secondary (Sub)	62	0.34
P-8217	J-9726	J-9250	67	110	110	Secondary	37	0.07

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
P-8218	J-9213	J-9755	104	110	110	Secondary	42	0.08
P-8219	J-9755	J-9726	82	110	110	Secondary	39	0.07
P-8224	J-9192	J-10349	1	160	110	Primary	715	0.62
P-8225	J-10349	J-10563	2	160	110	Primary	248	0.21
P-8226	J-8466	J-10348	345	90	110	Existing	53	0.1
P-8230	J-9981	J-3527	113	110	110	Secondary	29	0.05
P-8232	J-3527	J-9416	73	110	110	Secondary	21	0.04
P-8233	J-9416	J-9982	80	110	110	Secondary	14	0.03
P-8236	J-9192	J-9341	358	160	110	Primary	246	0.21
P-8238	J-9341	J-10210	23	160	110	Primary	178	0.15
P-8240	J-10210	J-10119	118	160	110	Primary	101	0.09
P-8242	J-9178	J-10256	253	63	110	Existing	0	0
P-8245	J-10351	J-10256	145	160	110	Primary	66	0.06
P-8246	J-10119	J-10351	76	160	110	Primary	64	0.06
P-8247	J-10351	J-10350	2	160	110	Primary	1	0
P-8248	J-8759	J-10350	330	63	110	Existing	0	0
P-8249	J-10350	J-4700	75	63	110	Existing	33	0.12
P-8251	J-9735	J-10211	267	110	110	Secondary	38	0.07
P-8252	J-10210	J-9313	17	110	110	Secondary	77	0.14
P-8253	J-9313	J-9735	159	110	110	Secondary	58	0.11
P-8255	J-10178	J-9714	236	160	110	Primary	269	0.23
P-8257	J-9988	J-10178	2	160	110	Primary	200	0.17
P-8259	J-9318	J-9988	23	160	110	Primary	146	0.13
P-8261	J-9989	J-9318	156	160	110	Primary	124	0.11
P-8264	J-10256	J-9360	420	63	110	Existing	30	0.11
P-8266	J-9988	J-9359	181	110	110	Secondary	47	0.09
P-8267	J-9359	J-9989	8	110	110	Secondary	12	0.02
P-8269	J-9439	J-9989	108	160	110	Primary	131	0.11
P-8271	J-9639	J-9439	123	160	110	Primary	109	0.09
P-8273	J-10152	J-9639	65	160	110	Primary	50	0.04
P-8275	J-10121	J-10152	52	160	110	Primary	16	0.01
P-8277	J-10179	J-10121	4	160	110	Primary	20	0.02
P-8278	J-10178	J-9425	238	110	110	Secondary	58	0.11
P-8279	J-9425	J-10179	122	110	110	Secondary	31	0.06
P-8280	J-9417	J-9424	92	63	110	Secondary (Sub)	21	0.12
P-8281	J-9424	J-9886	227	63	110	Secondary (Sub)	4	0.02
P-8282	J-9161	J-9886	151	63	110	Existing	25	0.09
P-8284	J-9982	J-10080	93	160	110	Primary	180	0.16
P-8286	J-10080	J-9831	30	110	110	Secondary	63	0.11
P-8287	J-9831	J-9785	224	110	110	Secondary	43	0.08
P-8288	J-9831	J-9609	46	63	110	Secondary (Sub)	10	0.06
P-8289	J-9609	J-9832	84	63	110	Secondary (Sub)	3	0.01
P-8290	J-10080	J-9746	261	160	110	Primary	118	0.1
P-8292	J-9746	J-10352	110	160	110	Primary	103	0.09
P-8296	J-10352	J-9786	3	160	110	Primary	130	0.11
P-8299	J-10104	J-9179	214	63	110	Existing	2	0.01
P-8300	J-9786	J-9752	89	160	110	Primary	104	0.09
P-8302	J-9886	J-9701	77	63	110	Existing	8	0.03
P-8303	J-9701	J-9022	55	63	110	Existing	7	0.03
P-8304	J-9701	J-9723	18	110	110	Secondary	2	0
P-8305	J-9723	J-9702	84	110	110	Secondary	10	0.02
P-8306	J-9752	J-9848	110	160	110	Primary	92	0.08
P-8308	J-9848	J-9702	8	160	110	Primary	69	0.06
P-8311	J-9753	J-10104	372	63	110	Existing	15	0.05
P-8312	J-9911	J-10122	73	110	110	Secondary	49	0.09
P-8313	J-10122	J-9912	62	110	110	Secondary	55	0.1
P-8314	J-9702	J-9911	63	160	110	Primary	51	0.04
P-8315	J-9911	J-10179	236	160	110	Primary	4	0
P-8316	J-9752	J-10354	99	110	110	Secondary	4	0.01
P-8318	J-9360	J-9912	640	63	110	Existing	14	0.05
P-8319	J-9912	J-9753	70	63	110	Existing	4	0.02
P-8321	J-10355	J-10079	278	110	110	Secondary	27	0.05

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
P-8323	J-10355	J-10277	239	160	110	Primary	0	0
P-8325	J-10189	J-10355	250	160	110	Primary	76	0.07
P-8327	J-10231	J-10189	232	160	110	Primary	87	0.07
P-8328	J-10231	J-10142	136	160	110	Primary	45	0.04
P-8330	J-10142	J-9300	35	160	110	Primary	18	0.02
P-8332	J-9300	J-10112	40	160	110	Primary	72	0.06
P-8336	J-10142	J-9454	146	110	110	Secondary	24	0.04
P-8337	J-9454	J-10143	186	110	110	Secondary	12	0.02
P-8338	J-10143	J-9682	58	110	110	Secondary	8	0.01
P-8339	J-9682	J-10190	29	110	110	Secondary	25	0.04
P-8340	J-9682	J-9410	46	63	110	Secondary (Sub)	13	0.07
P-8342	J-10112	J-10113	257	160	110	Primary	39	0.03
P-8343	J-10113	J-10190	12	160	110	Primary	26	0.02
P-8344	J-10112	J-9688	266	110	110	Secondary	14	0.03
P-8345	J-9688	J-10113	5	110	110	Secondary	13	0.02
P-8348	J-9688	J-9683	46	63	110	Secondary (Sub)	15	0.08
P-8350	J-9299	J-9862	19	110	110	Secondary	58	0.11
P-8351	J-9862	J-9643	87	110	110	Secondary	61	0.11
P-8352	J-9862	J-9592	117	63	110	Secondary (Sub)	5	0.03
P-8353	J-9592	J-9556	44	63	110	Secondary (Sub)	11	0.06
P-8354	J-9651	J-9555	46	110	110	Secondary	34	0.06
P-8355	J-9555	J-9652	55	110	110	Secondary	10	0.02
P-8360	J-10276	J-10036	279	160	110	Primary	190	0.16
P-8361	J-10036	J-10231	41	160	110	Primary	132	0.11
P-8362	J-9647	J-9955	197	110	110	Secondary	17	0.03
P-8363	J-9955	J-10036	54	110	110	Secondary	56	0.1
P-8365	J-9646	J-9651	102	160	110	Primary	18	0.02
P-8366	J-9246	J-10276	33	160	110	Primary	406	0.35
P-8369	J-9385	J-9246	17	225	110	Primary	460	0.2
P-8370	J-9651	J-9760	218	160	110	Primary	17	0.01
P-8373	J-9557	J-9761	78	110	110	Secondary	5	0.01
P-8375	J-9553	J-9557	38	110	110	Secondary	21	0.04
P-8376	J-7529	J-10146	370	63	110	Existing	39	0.14
P-8380	J-9760	J-9903	84	160	110	Primary	101	0.09
P-8381	J-9903	J-10356	1	160	110	Primary	159	0.14
P-8386	J-10358	J-10359	10	160	110	Primary	47	0.04
P-8387	J-10358	J-9646	180	160	110	Primary	86	0.07
P-8389	J-10359	J-3793	33	90	110	Existing	47	0.09
P-8390	J-8315	J-10360	100	90	110	Existing	4	0.01
P-8391	J-10360	J-10359	4	90	110	Existing	0	0
P-8392	J-10203	J-9659	397	160	110	Primary	193	0.17
P-8395	J-9817	J-9853	46	110	110	Secondary	6	0.01
P-8396	J-9903	J-9852	145	110	110	Secondary	50	0.09
P-8397	J-9852	J-3549	100	63	110	Secondary (Sub)	22	0.12
P-8399	J-10361	J-10358	200	160	110	Primary	133	0.11
P-8400	J-643	J-10362	3	90	110	Existing	0	0
P-8401	J-10362	J-9178	60	90	110	Existing	79	0.14
P-8402	J-10276	J-10361	4	160	110	Primary	216	0.19
P-8403	J-10362	J-10361	2	160	110	Primary	83	0.07
P-8404	J-151	J-9308	121	63	110	Existing	14	0.05
P-8409	J-10364	J-10363	1	225	110	Primary	275	0.12
P-8410	J-7960	J-10364	68	63	110	Existing	49	0.18
P-8411	J-10364	J-158	2	63	110	Existing	214	0.8
P-8412	J-9308	J-10365	6	63	110	Existing	0	0
P-8413	J-10365	J-7960	129	63	110	Existing	8	0.03
P-8414	J-6102	J-10366	8	63	110	Existing	0	0
P-8415	J-10366	J-6375	131	63	110	Existing	5	0.02
P-8417	J-10223	J-10363	347	225	110	Primary	158	0.07
P-8418	J-7575	J-9970	299	90	110	Existing	109	0.2
P-8420	J-10166	J-9502	161	225	110	Primary	1558	0.68
P-8421	J-9502	J-10167	140	225	110	Primary	703	0.31
P-8422	J-5621	J-10370	18	110	110	Existing	0	0

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
P-8423	J-10370	J-8382	105	110	110	Existing	8	0.01
P-8424	J-10223	J-9933	62	110	110	Secondary	60	0.11
P-8427	J-9805	J-348	279	110	110	Secondary	39	0.07
P-8428	J-9699	J-9830	61	160	110	Primary	151	0.13
P-8429	J-9830	J-10106	209	160	110	Primary	151	0.13
P-8430	J-348	J-10368	122	110	110	Secondary	5	0.01
P-8431	J-10368	J-9830	24	110	110	Secondary	0	0
P-8434	J-8904	J-10371	134	110	110	Existing	0	0
P-8435	J-10371	J-10369	5	110	110	Existing	0	0
P-8436	J-10167	J-10240	235	225	110	Primary	703	0.31
P-8438	J-10240	J-10373	110	225	110	Primary	141	0.06
P-8440	J-10372	J-10373	3	225	110	Primary	238	0.1
P-8441	J-10373	J-10223	10	225	110	Primary	97	0.04
P-8442	J-6509	J-10372	108	110	110	Existing	89	0.11
P-8443	J-10372	J-6793	2	110	110	Existing	139	0.17
P-8445	J-10375	J-10240	13	225	110	Primary	562	0.24
P-8447	J-10375	J-10374	2	225	110	Primary	182	0.08
P-8448	J-10369	J-10374	235	110	110	Existing	0	0
P-8449	J-10374	J-8609	6	110	110	Existing	182	0.22
P-8451	J-10376	J-8237	48	63	110	Existing	125	0.46
P-8452	J-9222	J-10239	118	225	110	Primary	0	0
P-8455	J-10137	J-10375	354	225	110	Primary	380	0.17
P-8460	J-9423	J-10378	181	225	110	Primary	66	0.03
P-8463	J-10377	J-8852	3	90	110	Existing	88	0.16
P-8464	J-10239	J-413	2	225	110	Primary	921	0.4
P-8465	J-413	J-10137	108	225	110	Primary	1110	0.48
P-8466	J-5178	J-9569	59	63	110	Existing	130	0.48
P-8467	J-9569	J-412	41	63	110	Existing	140	0.52
P-8469	J-9516	J-9222	129	160	110	Primary	66	0.06
P-8473	J-9998	J-9516	69	160	110	Primary	40	0.03
P-8474	J-8114	J-9690	136	63	110	Existing	52	0.19
P-8475	J-9690	J-5872	56	63	110	Existing	6	0.02
P-8476	J-1238	J-10047	28	63	110	Existing	23	0.08
P-8477	J-10047	J-1681	56	63	110	Existing	66	0.24
P-8478	J-6410	J-10380	109	90	110	Existing	239	0.43
P-8479	J-10380	J-5675	17	90	110	Existing	273	0.5
P-8480	J-10378	J-10381	378	225	110	Primary	906	0.39
P-8482	J-10381	J-10380	4	225	110	Primary	522	0.23
P-8483	J-10381	J-9465	192	225	110	Primary	1428	0.62
P-8485	J-9895	J-9998	137	160	110	Primary	87	0.07
P-8486	J-9895	J-2846	2	110	110	Secondary	255	0.46
P-8488	J-2846	J-3019	69	110	110	Secondary	147	0.27
P-8489	J-3019	J-2273	48	110	110	Secondary	123	0.22
P-8493	J-9807	J-9895	116	160	110	Primary	342	0.29
P-8495	J-10382	J-9471	62	110	110	Secondary	2	0
P-8497	J-9708	J-10131	109	110	110	Secondary (Sub)	159	0.29
P-8498	J-10177	J-9389	15	110	110	Secondary	115	0.21
P-8500	J-9389	J-10131	180	110	110	Secondary	169	0.31
P-8501	J-10131	J-10383	143	160	110	Secondary	360	0.31
P-8502	J-10130	J-9792	187	63	110	Secondary (Sub)	40	0.22
P-8503	J-9792	J-9708	28	110	110	Secondary (Sub)	105	0.19
P-8504	J-9707	J-10130	167	63	110	Secondary (Sub)	29	0.16
P-8506	J-10144	J-9793	339	63	110	Secondary (Sub)	31	0.17
P-8510	J-9732	J-9641	132	225	110	Primary	402	0.17
P-8511	J-9641	J-10140	459	225	110	Primary	388	0.17
P-8513	J-10144	J-10126	218	63	110	Secondary (Sub)	40	0.22
P-8515	J-10125	J-10254	242	315	110	Primary	2760	0.61
P-8516	J-10125	J-10383	16	160	110	Secondary	570	0.49
P-8517	J-10383	J-10144	49	110	110	Secondary	210	0.38
P-8520	J-10140	J-10386	80	225	110	Primary	388	0.17
P-8522	J-10386	J-10387	2	225	110	Primary	388	0.17
P-8524	J-3198	J-10387	43	90	110	Existing	100	0.18

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
P-8525	J-10387	J-711	334	90	110	Existing	260	0.47
P-8526	J-3198	J-9893	45	90	110	Existing	96	0.18
P-8527	J-9893	J-6084	88	90	110	Existing	24	0.04
P-8532	J-10239	J-10389	133	225	110	Primary	921	0.4
P-8534	J-10389	J-10010	59	225	110	Primary	889	0.39
P-8536	J-9803	J-10011	7	63	110	Secondary (Sub)	31	0.17
P-8538	J-10011	J-9443	53	110	110	Secondary	53	0.1
P-8539	J-9443	J-9543	88	63	110	Secondary (Sub)	3	0.02
P-8540	J-10010	J-10390	73	225	110	Primary	745	0.32
P-8542	J-10390	J-10391	81	110	110	Secondary	80	0.15
P-8544	J-10391	J-10392	1	110	110	Secondary	62	0.11
P-8546	J-10173	J-10391	65	63	110	Secondary (Sub)	9	0.05
P-8548	J-10010	J-10173	97	110	110	Secondary	131	0.24
P-8550	J-10390	J-9968	58	225	110	Primary	656	0.29
P-8554	J-10393	J-10394	0	110	110	Secondary	5	0.01
P-8558	J-9839	J-10395	57	110	110	Secondary	89	0.16
P-8560	J-10394	J-10395	48	63	110	Secondary (Sub)	25	0.14
P-8561	J-10396	J-10174	130	63	110	Secondary (Sub)	12	0.06
P-8562	J-10395	J-10396	1	63	110	Secondary (Sub)	62	0.34
P-8563	J-10396	J-9840	78	110	110	Secondary	25	0.05
P-8564	J-9968	J-9839	43	225	110	Primary	644	0.28
P-8565	J-9839	J-9471	102	225	110	Primary	546	0.24
P-8566	J-9471	J-10397	16	225	110	Primary	541	0.24
P-8568	J-10397	J-10174	43	110	110	Secondary	28	0.05
P-8569	J-10174	J-9873	103	110	110	Secondary	10	0.02
P-8570	J-10254	J-9992	2	315	110	Primary	2760	0.61
P-8571	J-9992	J-9807	440	160	110	Primary	401	0.35
P-8572	J-10386	J-9290	59	225	110	Primary	0	0
P-8573	J-9290	J-10141	161	225	110	Primary	2190	0.95
P-8574	J-10285	J-9261	1	225	110	Primary	2190	0.95
P-8576	J-10397	J-9964	64	225	110	Primary	510	0.22
P-8577	J-9964	J-9732	348	225	110	Primary	455	0.2
P-8578	J-9242	J-9255	5	300	110	Yard Pipe	4589	0.75
P-8579	J-9255	J-9992	184	315	110	Primary	3161	0.7
P-8583	J-9909	J-1600	8	110	110	Existing	335	0.41
P-8584	J-8356	J-9784	70	63	110	Secondary (Sub)	64	0.36
P-8585	J-9784	J-8227	206	63	110	Secondary (Sub)	39	0.22
P-8586	J-178	J-9223	16	110	110	Existing	0	0
P-8587	J-9223	J-9909	312	110	110	Existing	187	0.23
P-8588	J-1695	J-9224	79	90	110	Existing	84	0.15
P-8589	J-9224	J-8227	58	90	110	Existing	73	0.13
P-8590	J-1600	J-9373	98	110	110	Existing	337	0.41
P-8591	J-9373	J-5401	429	110	110	Existing	187	0.23
P-8595	J-10263	J-9082	18	500	110	Existing	21	0
P-8598	J-10398	J-10399	3	225	110	Primary	308	0.13
P-8600	J-10399	J-10023	257	250	110	Primary	1089	0.38
P-8601	J-10023	J-10063	85	250	110	Primary	889	0.31
P-8604	J-2896	J-10400	200	63	110	Existing	0	0
P-8606	J-9660	J-9938	8	110	110	Secondary	140	0.25
P-8607	J-9938	J-9817	322	110	110	Secondary	43	0.08
P-8609	J-4488	J-9859	94	63	110	Secondary (Sub)	44	0.25
P-8610	J-8252	J-9860	181	50	110	Existing	62	0.36
P-8611	J-9860	J-8789	36	50	110	Existing	44	0.26
P-8613	J-10088	J-2049	53	200	110	Existing	0	0
P-8614	J-10400	J-153	128	63	110	Existing	13	0.05
P-8615	J-10402	J-9264	48	63	110	Existing	0	0
P-8616	J-3413	J-10402	15	200	110	Existing	364	0.13
P-8617	J-10402	J-1828	140	200	110	Existing	358	0.13
P-8620	J-10063	J-10404	337	250	110	Primary	675	0.24
P-8621	J-10404	J-10403	4	250	110	Primary	230	0.08
P-8622	J-5401	J-10403	10	110	110	Existing	230	0.28
P-8623	J-10403	J-3413	5	110	110	Existing	0	0

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
P-8624	J-3413	J-10087	4	200	110	Existing	364	0.13
P-8625	J-10087	J-10088	255	200	110	Existing	48	0.02
P-8627	J-3202	J-10198	88	160	110	Primary	111	0.1
P-8628	J-9261	J-10164	541	160	110	Primary	495	0.43
P-8630	J-10164	J-10052	42	160	110	Secondary	298	0.26
P-8632	J-10052	J-9580	103	110	110	Secondary (Sub)	104	0.19
P-8634	J-9580	J-9598	41	63	110	Secondary (Sub)	35	0.19
P-8635	J-9598	J-9581	42	63	110	Secondary (Sub)	20	0.11
P-8636	J-9598	J-9521	38	63	110	Secondary (Sub)	11	0.06
P-8638	J-9580	J-9520	37	63	110	Secondary (Sub)	60	0.33
P-8639	J-9520	J-10053	253	63	110	Secondary (Sub)	27	0.15
P-8642	J-9621	J-9738	55	110	110	Secondary	34	0.06
P-8643	J-9738	J-10165	27	110	110	Secondary	9	0.02
P-8644	J-9733	J-10405	54	63	110	Secondary (Sub)	19	0.11
P-8645	J-10406	J-9734	63	63	110	Secondary (Sub)	22	0.12
P-8646	J-10052	J-10406	99	110	110	Secondary	163	0.3
P-8648	J-10406	J-10405	1	110	110	Secondary	133	0.24
P-8649	J-10405	J-9621	76	110	110	Secondary	96	0.18
P-8650	J-10164	J-9819	462	160	110	Primary	193	0.17
P-8652	J-9818	J-9430	94	63	110	Secondary	0	0
P-8653	J-9430	J-9819	31	63	110	Secondary	33	0.18
P-8654	J-9819	J-9531	187	160	110	Primary	146	0.13
P-8660	J-9531	J-9759	148	160	110	Primary	137	0.12
P-8661	J-9759	J-9499	14	160	110	Primary	76	0.07
P-8662	J-9499	J-9566	86	160	110	Primary	67	0.06
P-8664	J-9566	J-9513	17	160	110	Primary	53	0.05
P-8666	J-9513	J-9709	75	160	110	Primary	52	0.04
P-8670	J-9709	J-9915	67	160	110	Primary	27	0.02
P-8671	J-9915	J-9662	550	160	110	Primary	0	0
P-8676	J-9615	J-10118	1	110	110	Secondary	194	0.35
P-8677	J-10118	J-5939	91	110	110	Secondary	99	0.18
P-8679	J-9538	J-9615	27	160	110	Primary	283	0.24
P-8681	J-2189	J-5939	29	110	110	Secondary	82	0.15
P-8682	J-9869	J-2189	173	110	110	Secondary	61	0.11
P-8684	J-10057	J-10407	2	110	110	Secondary	8	0.01
P-8688	J-10407	J-9790	25	110	110	Secondary	83	0.15
P-8690	J-9790	J-9741	68	110	110	Secondary	29	0.05
P-8692	J-9741	J-9697	19	110	110	Secondary	30	0.05
P-8694	J-9697	J-9572	46	110	110	Secondary	21	0.04
P-8695	J-9572	J-9612	77	110	110	Secondary	32	0.06
P-8696	J-9611	J-9571	16	110	110	Secondary	65	0.12
P-8697	J-9571	J-9612	76	110	110	Secondary	34	0.06
P-8698	J-9790	J-9355	51	63	110	Secondary (Sub)	53	0.29
P-8699	J-9355	J-9791	91	63	110	Secondary (Sub)	36	0.2
P-8700	J-9697	J-9942	95	63	110	Secondary (Sub)	38	0.21
P-8701	J-9942	J-9698	38	63	110	Secondary (Sub)	2	0.01
P-8702	J-9941	J-9856	73	63	110	Secondary (Sub)	15	0.09
P-8704	J-10639	J-9877	52	63	110	Secondary (Sub)	19	0.11
P-8708	J-9857	J-10220	43	110	110	Secondary	0	0
P-8715	J-10409	J-10408	2	110	110	Secondary	28	0.05
P-8716	J-9856	J-10408	66	63	110	Secondary (Sub)	5	0.03
P-8720	J-9705	J-9990	42	110	110	Secondary	82	0.15
P-8721	J-9990	J-10409	27	110	110	Secondary	31	0.06
P-8723	J-10071	J-9705	21	110	110	Secondary	131	0.24
P-8725	J-9594	J-10071	90	110	110	Secondary	136	0.25
P-8727	J-9492	J-9594	8	110	110	Secondary	179	0.33
P-8735	J-9706	J-9620	99	63	110	Secondary (Sub)	52	0.29
P-8736	J-9705	J-9457	79	63	110	Secondary (Sub)	47	0.26
P-8737	J-9457	J-9706	62	63	110	Secondary (Sub)	27	0.15
P-8738	J-9993	J-9456	145	63	110	Secondary (Sub)	51	0.28
P-8740	J-9456	J-9923	86	63	110	Secondary (Sub)	35	0.19
P-8741	J-9923	J-9994	37	63	110	Secondary (Sub)	6	0.04

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
P-8742	J-9923	J-9619	46	63	110	Secondary (Sub)	16	0.09
P-8744	J-9619	J-9794	18	63	110	Secondary (Sub)	52	0.29
P-8745	J-9794	J-9620	86	63	110	Secondary (Sub)	40	0.22
P-8746	J-9619	J-9808	64	63	110	Secondary (Sub)	47	0.26
P-8747	J-9808	J-9924	162	63	110	Secondary (Sub)	46	0.26
P-8748	J-9808	J-9524	24	63	110	Secondary (Sub)	23	0.13
P-8749	J-9524	J-9809	126	63	110	Secondary (Sub)	54	0.3
P-8750	J-9532	J-9795	143	63	110	Secondary (Sub)	21	0.12
P-8751	J-9795	J-9958	67	110	110	Secondary (Sub)	114	0.21
P-8754	J-10257	J-9958	162	110	110	Secondary	30	0.06
P-8756	J-10219	J-9993	206	110	110	Secondary	51	0.09
P-8758	J-9993	J-9924	54	110	110	Secondary	5	0.01
P-8760	J-9924	J-9809	101	110	110	Secondary	65	0.12
P-8761	J-9809	J-10076	45	110	110	Secondary	137	0.25
P-8765	J-10199	J-10414	27	110	110	Secondary	36	0.07
P-8766	J-10199	J-10412	294	63	110	Secondary (Sub)	42	0.24
P-8767	J-10411	J-10200	82	63	110	Secondary (Sub)	3	0.02
P-8773	J-9346	J-10111	10	110	110	Secondary	22	0.04
P-8774	J-10013	J-9428	163	63	110	Secondary (Sub)	5	0.03
P-8775	J-9428	J-10014	130	63	110	Secondary (Sub)	18	0.1
P-8779	J-10110	J-10199	137	110	110	Secondary	142	0.26
P-8780	J-10413	J-10014	60	110	110	Secondary	174	0.32
P-8781	J-10014	J-10110	15	110	110	Secondary	155	0.28
P-8783	J-9843	J-9346	227	110	110	Secondary	52	0.09
P-8785	J-10013	J-9843	23	110	110	Secondary	88	0.16
P-8787	J-9717	J-10013	88	110	110	Secondary	107	0.19
P-8790	J-10075	J-10413	6	160	110	Secondary	375	0.32
P-8792	J-9958	J-10414	347	110	110	Secondary	171	0.31
P-8794	J-10414	J-10076	1	110	110	Secondary	143	0.26
P-8795	J-10076	J-10410	1	110	110	Secondary	279	0.51
P-8796	J-2164	J-10084	28	75	110	Existing	13	0.04
P-8797	J-10084	J-6678	110	75	110	Existing	22	0.06
P-8798	J-10410	J-10415	408	160	110	Primary	100	0.09
P-8799	J-10415	J-10057	336	160	110	Primary	190	0.16
P-8800	J-10415	J-10219	1	110	110	Secondary	290	0.53
P-8801	J-10219	J-9492	54	110	110	Secondary	187	0.34
P-8810	J-10182	J-10077	27	110	110	Secondary	74	0.13
P-8813	J-10416	J-10182	106	110	110	Secondary	51	0.09
P-8814	J-10037	J-10416	31	110	110	Secondary	123	0.22
P-8815	J-10416	J-10049	2	110	110	Secondary	174	0.32
P-8816	J-10037	J-10078	211	110	110	Secondary	123	0.22
P-8818	J-10078	J-9782	717	110	110	Secondary	3	0.01
P-8820	J-9782	J-10038	75	110	110	Secondary	84	0.15
P-8821	J-10038	J-9781	124	63	110	Secondary (Sub)	55	0.31
P-8823	J-10215	J-10038	110	110	110	Secondary	150	0.27
P-8825	J-10168	J-10215	0	110	110	Secondary	116	0.21
P-8826	J-10077	J-10067	79	110	110	Secondary	23	0.04
P-8827	J-10067	J-10215	92	110	110	Secondary	41	0.07
P-8829	J-10068	J-10168	237	110	110	Secondary	95	0.17
P-8831	J-10417	J-10068	148	63	110	Secondary (Sub)	21	0.12
P-8832	J-10067	J-10418	72	63	110	Secondary (Sub)	22	0.13
P-8833	J-10418	J-10417	1	63	110	Secondary (Sub)	52	0.29
P-8834	J-10168	J-10418	54	63	110	Secondary (Sub)	30	0.17
P-8837	J-9230	J-10068	85	110	110	Secondary	120	0.22
P-8839	J-10419	J-10182	176	63	110	Secondary (Sub)	24	0.13
P-8840	J-10417	J-10419	78	63	110	Secondary (Sub)	31	0.17
P-8842	J-9229	J-10420	144	63	110	Secondary (Sub)	19	0.11
P-8843	J-10420	J-10419	0	63	110	Secondary (Sub)	55	0.31
P-8844	J-10214	J-10201	42	110	110	Secondary	155	0.28
P-8845	J-10201	J-9230	99	110	110	Secondary	139	0.25
P-8847	J-10202	J-10049	68	50	110	Existing	46	0.27
P-8848	J-10201	J-10421	150	63	110	Secondary (Sub)	16	0.09

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
P-8850	J-10420	J-10421	95	63	110	Secondary (Sub)	36	0.2
P-8852	J-10421	J-10422	0	63	110	Secondary (Sub)	20	0.11
P-8853	J-10422	J-10202	212	63	110	Secondary (Sub)	14	0.08
P-8854	J-10422	J-9527	97	63	110	Secondary (Sub)	34	0.19
P-8855	J-9527	J-10169	76	63	110	Secondary (Sub)	37	0.21
P-8857	J-10169	J-10202	191	50	110	Existing	35	0.21
P-8861	J-9715	J-10169	119	50	110	Existing	84	0.49
P-8862	J-6215	J-10226	9	50	110	Existing	225	1.33
P-8863	J-10226	J-9715	7	50	110	Existing	131	0.77
P-8864	J-9586	J-9716	39	63	110	Secondary (Sub)	20	0.11
P-8865	J-9716	J-9587	44	63	110	Secondary (Sub)	9	0.05
P-8867	J-9297	J-9069	400	90	110	Existing	429	0.78
P-8868	J-10226	J-9931	229	110	110	Secondary	326	0.59
P-8869	J-9931	J-9972	230	110	110	Secondary	293	0.53
P-8870	J-5966	J-9973	62	90	110	Existing	161	0.29
P-8871	J-9973	J-2558	133	90	110	Existing	0	0
P-8872	J-6215	J-9983	44	50	110	Existing	113	0.67
P-8874	J-9983	J-9526	19	50	110	Existing	104	0.61
P-8875	J-9526	J-5854	5	50	110	Existing	50	0.29
P-8877	J-10423	J-9526	1	110	110	Secondary	54	0.1
P-8878	J-10214	J-1076	42	110	110	Secondary	75	0.14
P-8879	J-1076	J-10423	31	110	110	Secondary	57	0.1
P-8883	J-10425	J-10214	378	110	110	Secondary	103	0.19
P-8886	J-10426	J-10425	82	110	110	Secondary	131	0.24
P-8887	J-10425	J-10424	1	110	110	Secondary	14	0.03
P-8889	J-10129	J-9617	226	63	110	Secondary (Sub)	55	0.31
P-8890	J-4546	J-9963	368	110	110	Existing	207	0.25
P-8892	J-9963	J-10426	170	110	110	Existing	153	0.19
P-8894	J-10426	J-10427	9	110	110	Existing	0	0
P-8895	J-10427	J-9165	388	110	110	Existing	6	0.01
P-8896	J-9615	J-10428	83	160	110	Primary	477	0.41
P-8898	J-5966	J-10429	18	110	110	Existing	75	0.09
P-8899	J-10429	J-1627	94	110	110	Existing	74	0.09
P-8901	J-10428	J-10269	54	225	110	Primary	1102	0.48
P-8902	J-10269	J-10430	1	315	110	Primary	2171	0.48
P-8904	J-9972	J-10431	168	110	110	Secondary	286	0.52
P-8906	J-9973	J-10431	1	110	110	Secondary	173	0.32
P-8907	J-10431	J-10430	6	110	110	Secondary	171	0.31
P-8908	J-5965	J-10432	5	200	110	Existing	512	0.19
P-8909	J-10432	J-5966	6	200	110	Existing	113	0.04
P-8910	J-6196	J-9962	0	63	110	Existing	9	0.03
P-8911	J-9962	J-10424	59	63	110	Existing	18	0.07
P-8913	J-9617	J-6196	60	63	110	Existing	72	0.27
P-8914	J-3395	J-10433	40	63	110	Existing	185	0.69
P-8915	J-10433	J-9617	1	63	110	Existing	149	0.55
P-8916	J-9167	J-10008	46	110	110	Secondary	33	0.06
P-8917	J-10008	J-10163	362	110	110	Secondary	16	0.03
P-8919	J-10270	J-901	3	75	110	Existing	133	0.35
P-8920	J-2215	J-9799	190	50	110	Existing	43	0.25
P-8921	J-9799	J-1756	152	50	110	Existing	114	0.67
P-8922	J-2215	J-9872	96	90	110	Existing	97	0.18
P-8923	J-9872	J-901	206	90	110	Existing	66	0.12
P-8924	J-9164	J-10259	141	75	110	Existing	215	0.56
P-8925	J-10259	J-10270	34	75	110	Existing	229	0.6
P-8927	J-9986	J-10562	100	110	110	Secondary (Sub)	106	0.19
P-8928	J-10258	J-9711	410	63	110	Secondary (Sub)	20	0.11
P-8929	J-9711	J-9986	300	63	110	Secondary (Sub)	60	0.34
P-8931	J-10258	J-10253	39	110	110	Secondary	17	0.03
P-8933	J-9960	J-10258	305	110	110	Secondary	56	0.1
P-8935	J-9378	J-9960	142	110	110	Secondary	92	0.17
P-8936	J-9164	J-10434	1	110	110	Secondary	160	0.29
P-8937	J-10434	J-9378	146	110	110	Secondary	114	0.21

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
P-8940	J-695	J-10436	163	63	110	Existing	14	0.05
P-8941	J-10436	J-449	5	63	110	Existing	28	0.1
P-8942	J-2363	J-10612	5	110	110	Secondary	162	0.29
P-8944	J-9770	J-2363	156	90	110	Existing	153	0.28
P-8946	J-10007	J-9770	26	90	110	Existing	95	0.17
P-8947	J-10435	J-9757	343	90	110	Existing	60	0.11
P-8948	J-9757	J-10007	76	90	110	Existing	92	0.17
P-8954	J-10435	J-6136	460	90	110	Existing	44	0.08
P-8955	J-3510	J-10437	61	90	110	Existing	63	0.11
P-8956	J-10437	J-10435	30	90	110	Existing	20	0.04
P-8960	J-10439	J-10440	58	63	110	Existing	3	0.01
P-8961	J-10439	J-10441	85	90	110	Existing	78	0.14
P-8962	J-10441	J-9740	53	90	110	Existing	24	0.04
P-8964	J-10441	J-9611	57	90	110	Existing	30	0.06
P-8965	J-9611	J-9869	42	90	110	Existing	37	0.07
P-8966	J-10057	J-10443	165	160	110	Primary	198	0.17
P-8968	J-10437	J-10442	2	90	110	Existing	0	0
P-8969	J-10442	J-10439	43	90	110	Existing	85	0.16
P-8970	J-10442	J-10443	2	160	110	Primary	85	0.07
P-8971	J-10443	J-9538	61	160	110	Primary	283	0.24
P-8972	J-9164	J-9712	118	75	110	Existing	46	0.12
P-8975	J-9262	J-10445	49	225	110	Primary	1695	0.74
P-8976	J-10445	J-10444	1	225	110	Primary	662	0.29
P-8977	J-6520	J-10444	0	110	110	Existing	414	0.5
P-8978	J-10444	J-6195	226	110	110	Existing	247	0.3
P-8979	J-10445	J-10284	2	225	110	Primary	1034	0.45
P-8981	J-178	J-10005	37	110	110	Existing	197	0.24
P-8982	J-10005	J-6119	294	110	110	Existing	213	0.26
P-8984	J-10004	J-3202	376	160	110	Primary	212	0.18
P-8985	J-3410	J-9835	27	63	110	Existing	30	0.11
P-8986	J-9835	J-7481	169	63	110	Existing	6	0.02
P-8987	J-6119	J-10197	256	110	110	Existing	64	0.08
P-8989	J-10197	J-10446	286	110	110	Existing	85	0.1
P-8990	J-10446	J-2937	106	110	110	Existing	7	0.01
P-8991	J-5048	J-10447	3	63	110	Existing	0	0
P-8992	J-10447	J-3599	51	63	110	Existing	58	0.22
P-8993	J-10446	J-10447	6	63	110	Secondary (Sub)	60	0.34
P-8997	J-9850	J-10234	193	160	110	Primary	262	0.23
P-8998	J-3240	J-9337	11	63	110	Existing	63	0.23
P-8999	J-9337	J-6646	94	63	110	Existing	29	0.11
P-9000	J-10284	J-10233	81	160	110	Primary	490	0.42
P-9001	J-10233	J-10004	366	160	110	Primary	301	0.26
P-9002	J-10233	J-9765	781	110	110	Secondary	114	0.21
P-9003	J-9765	J-10234	65	110	110	Secondary	75	0.14
P-9006	J-10000	J-9601	68	110	110	Secondary	16	0.03
P-9007	J-9601	J-10001	116	110	110	Secondary	0	0
P-9008	J-10234	J-10249	251	160	110	Primary	319	0.27
P-9009	J-10249	J-10000	26	160	110	Primary	164	0.14
P-9010	J-10248	J-9901	426	110	110	Secondary	161	0.29
P-9011	J-9901	J-10249	208	110	110	Secondary	147	0.27
P-9012	J-10284	J-10248	276	160	110	Primary	543	0.47
P-9013	J-10248	J-9850	47	160	110	Primary	321	0.28
P-9014	J-7179	J-9936	167	63	110	Existing	13	0.05
P-9015	J-9936	J-552	70	63	110	Existing	79	0.29
P-9016	J-10000	J-9996	203	160	110	Primary	148	0.13
P-9018	J-3649	J-10448	450	50	110	Existing	98	0.58
P-9019	J-9996	J-10449	484	160	110	Primary	122	0.1
P-9021	J-10448	J-10449	10	110	110	Secondary	118	0.22
P-9022	J-6189	J-10450	24	300	110	Existing	1101	0.18
P-9024	J-10450	J-9882	169	50	110	Existing	77	0.45
P-9025	J-10449	J-9214	105	160	110	Primary	0	0
P-9026	J-9214	J-9450	5	160	110	Primary	88	0.08

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
P-9030	J-10451	J-6708	205	90	110	Existing	29	0.05
P-9032	J-6708	J-10457	53	90	110	Existing	488	0.89
P-9036	J-10457	J-10458	140	90	110	Existing	226	0.41
P-9038	J-10460	J-10454	130	90	110	Existing	14	0.02
P-9039	J-10458	J-10460	189	90	110	Existing	204	0.37
P-9040	J-10460	J-10459	75	90	110	Existing	122	0.22
P-9041	J-10455	J-10459	224	90	110	Existing	28	0.05
P-9042	J-10459	J-10456	144	90	110	Existing	24	0.04
P-9044	J-10461	J-10452	197	90	110	Existing	29	0.05
P-9045	J-10457	J-10461	74	90	110	Existing	242	0.44
P-9046	J-10462	J-10461	69	90	110	Existing	165	0.3
P-9047	J-10453	J-10462	159	90	110	Existing	20	0.04
P-9048	J-10462	J-10458	289	90	110	Existing	50	0.09
P-9049	J-9238	J-8490	52	110	110	Secondary	99	0.18
P-9051	J-6547	J-9283	69	90	110	Existing	89	0.16
P-9054	J-9369	J-9237	102	110	110	Secondary	107	0.2
P-9055	J-8490	J-9279	65	110	110	Secondary	146	0.27
P-9056	J-9279	J-9837	12	110	110	Secondary	162	0.29
P-9058	J-10464	J-8490	41	90	110	Existing	61	0.11
P-9060	J-9283	J-10464	73	90	110	Existing	19	0.04
P-9061	J-10464	J-10463	88	90	110	Existing	109	0.2
P-9062	J-7920	J-9253	76	90	110	Existing	19	0.04
P-9063	J-9253	J-5435	146	90	110	Existing	33	0.06
P-9067	J-10466	J-10467	687	75	110	Existing	85	0.22
P-9069	J-10467	J-10469	216	63	110	Existing	127	0.47
P-9072	J-10469	J-10171	231	63	110	Existing	10	0.04
P-9073	J-10468	J-10176	329	63	110	Existing	83	0.31
P-9074	J-10176	J-10469	111	63	110	Existing	209	0.78
P-9075	J-9215	J-10175	1271	110	110	Secondary	46	0.08
P-9076	J-10175	J-10267	6	225	110	Secondary	396	0.17
P-9078	J-10267	J-9305	308	225	110	Primary	0	0
P-9079	J-9357	J-9251	33	315	110	Primary	2228	0.49
P-9080	J-9251	J-9358	3	315	110	Primary	2228	0.49
P-9084	J-9064	J-10471	722	110	110	Existing	0	0
P-9085	J-10471	J-9175	302	110	110	Existing	0	0
P-9088	J-9505	J-8631	746	90	110	Existing	124	0.22
P-909	J-1637	J-1366	11	63	110	Existing	2	0.01
P-9091	J-6440	J-8631	138	90	110	Existing	36	0.07
P-9092	J-8631	J-10085	109	90	110	Existing	160	0.29
P-9093	J-10085	J-10475	37	90	110	Existing	135	0.25
P-9095	J-10033	J-10475	67	90	110	Existing	47	0.09
P-9096	J-10475	J-9505	562	90	110	Existing	119	0.22
P-9098	J-10477	J-8758	164	50	110	Existing	90	0.53
P-9099	J-759	J-10477	80	50	110	Existing	49	0.29
P-9100	J-10477	J-10476	241	50	110	Existing	15	0.09
P-9101	J-6728	J-9574	63	110	110	Secondary	15	0.03
P-9103	J-10450	J-10030	277	300	110	Existing	1211	0.22
P-9105	J-3400	J-9883	103	50	110	Existing	46	0.27
P-9106	J-9883	J-8957	38	50	110	Existing	17	0.1
P-9108	J-10268	J-9451	308	160	110	Primary	88	0.08
P-9109	J-9789	J-10478	4	225	110	Primary	1720	0.75
P-9111	J-10478	J-10479	5	225	110	Primary	353	0.15
P-9112	J-10478	J-9374	117	225	110	Primary	1367	0.6
P-9113	J-7252	J-10479	12	110	110	Existing	0	0
P-9115	J-8847	J-10480	16	110	110	Existing	0	0
P-9117	J-10479	J-10186	259	110	110	Existing	297	0.36
P-9118	J-10186	J-372	93	110	110	Existing	112	0.14
P-9119	J-10186	J-9632	59	160	110	Secondary	394	0.34
P-9120	J-9632	J-9216	272	110	110	Secondary	244	0.44
P-9121	J-6593	J-9216	152	75	110	Existing	144	0.38
P-9123	J-9216	J-10216	112	75	110	Existing	108	0.28
P-9124	J-10216	J-7506	166	75	110	Existing	73	0.19

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
P-9129	J-10481	J-10483	398	90	110	Existing	190	0.35
P-9131	J-10483	J-10484	15	90	110	Existing	2	0
P-9133	J-10030	J-10485	205	300	110	Existing	2931	0.52
P-9134	J-10485	Gacuriro2 Outlet	570	300	110	Existing	3159	0.56
P-9135	J-10482	J-10486	9	90	110	Existing	0	0
P-9136	J-10486	J-10481	1	90	110	Existing	228	0.42
P-9137	J-10485	J-10486	4	110	110	Secondary	228	0.42
P-9138	J-9375	J-9217	427	225	110	Primary	1367	0.6
P-9139	J-9217	J-9270	38	225	110	Primary	1273	0.55
P-9140	J-6593	J-10487	77	90	110	Existing	103	0.19
P-9142	J-10487	J-9776	4	90	110	Existing	108	0.2
P-9143	J-9776	J-7479	33	90	110	Existing	309	0.56
P-9145	J-10488	J-9369	62	110	110	Secondary	248	0.45
P-9146	J-9271	J-10489	176	225	110	Primary	1273	0.55
P-9147	J-10489	J-10268	347	225	110	Primary	825	0.36
P-9148	J-9776	J-10488	13	110	110	Secondary	201	0.37
P-9149	J-10489	J-10488	1	225	110	Primary	449	0.2
P-9150	J-1976	J-10490	50	63	110	Existing	1	0
P-9151	J-10490	J-6277	9	63	110	Existing	339	1.26
P-9152	J-10268	J-10491	66	225	110	Primary	736	0.32
P-9154	J-10491	J-10490	1	225	110	Primary	340	0.15
P-9155	J-10491	J-10267	680	225	110	Primary	396	0.17
P-9156	J-6277	J-10172	87	63	110	Existing	200	0.74
P-9157	J-10172	J-2940	139	63	110	Existing	87	0.32
P-9160	J-10184	J-8187	12	160	110	Secondary	658	0.57
P-9162	J-3540	J-10184	34	90	110	Existing	113	0.2
P-9163	J-10184	J-5455	17	90	110	Existing	771	1.4
P-9164	J-7403	J-10116	153	63	110	Existing	42	0.16
P-9166	J-364	J-10185	247	110	110	Existing	112	0.14
P-9167	J-10185	J-7791	2	110	110	Existing	90	0.11
P-9168	J-5455	J-10493	65	90	110	Existing	344	0.63
P-9169	J-10493	J-2133	376	90	110	Existing	36	0.07
P-9171	J-10495	J-10157	152	63	110	Secondary (Sub)	56	0.32
P-9172	J-10493	J-10495	107	110	110	Secondary (Sub)	231	0.42
P-9173	J-10495	J-10494	238	63	110	Secondary (Sub)	51	0.29
P-9175	J-10496	J-319	27	50	110	Existing	103	0.61
P-9180	J-8458	J-10498	1	110	110	Existing	311	0.38
P-9182	J-7619	J-10499	466	63	110	Existing	82	0.3
P-9185	J-10193	J-10275	109	225	110	Primary	282	0.12
P-9187	J-482	J-8840	63	110	110	Secondary	61	0.11
P-9188	J-3371	J-10500	133	90	110	Existing	155	0.28
P-9190	J-10497	J-10193	825	160	110	Primary	355	0.31
P-9191	J-10500	J-10193	2	160	110	Primary	637	0.55
P-9194	J-10500	J-10502	4	90	110	Existing	472	0.86
P-9198	J-10498	J-10012	322	63	110	Existing	128	0.47
P-9199	J-10012	J-6617	8	63	110	Existing	0	0
P-9201	J-10497	J-10498	9	225	110	Primary	458	0.2
P-9203	J-10503	J-10497	3	225	110	Primary	812	0.35
P-9205	J-10504	J-10503	3	225	110	Primary	88	0.04
P-9206	J-10499	J-10504	6	63	110	Existing	88	0.33
P-9207	J-10504	J-8458	4	63	110	Existing	0	0
P-9209	J-10034	J-10275	461	225	110	Primary	282	0.12
P-9210	J-10033	J-9511	203	110	110	Secondary	52	0.09
P-9211	J-9511	J-10034	83	110	110	Secondary	203	0.37
P-9212	J-10274	J-9504	285	225	110	Primary	1327	0.58
P-9213	J-9504	J-10034	987	225	110	Primary	508	0.22
P-9214	J-9358	J-10274	126	315	110	Primary	2228	0.49
P-9215	J-10274	J-10503	215	225	110	Primary	900	0.39
P-9217	J-10505	J-8879	273	90	110	Existing	210	0.38
P-9218	J-9504	J-10506	2	225	110	Secondary	820	0.45
P-9220	J-10506	J-10505	1	160	110	Secondary	312	0.27
P-9221	J-10506	J-9505	66	160	110	Secondary	507	0.44

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
P-9223	J-10026	J-10505	1369	90	110	Existing	0	0
P-9224	J-10085	J-9510	130	110	110	Secondary	39	0.07
P-9225	J-9510	J-3609	137	110	110	Secondary	67	0.12
P-9226	J-357	J-10027	2	110	110	Existing	0	0
P-9227	J-10027	J-5158	27	110	110	Existing	96	0.12
P-9228	J-10170	J-10241	5	315	110	Primary	3262	0.72
P-9231	J-9917	J-10170	68	315	110	Primary	3262	0.72
P-9233	J-10507	J-10508	339	225	110	Primary	721	0.31
P-9234	J-1635	J-10260	4	63	110	Existing	285	1.06
P-9235	J-10260	J-2323	84	63	110	Existing	26	0.09
P-9236	J-9918	J-10507	84	225	110	Primary	1047	0.46
P-9237	J-10260	J-10507	2	315	110	Primary	326	0.07
P-9238	J-10019	J-10508	6	225	110	Primary	654	0.28
P-9239	J-10508	J-10028	588	225	110	Primary	67	0.03
P-9240	J-5066	J-10019	35	90	110	Existing	144	0.26
P-9241	J-10019	J-10026	790	90	110	Existing	309	0.56
P-9244	J-9325	J-9921	60	110	110	Secondary (Sub)	95	0.17
P-9245	J-9921	J-3325	78	110	110	Secondary (Sub)	186	0.34
P-9248	J-346	J-9294	177	90	110	Existing	296	0.54
P-9250	J-787	J-9293	207	90	110	Existing	259	0.47
P-9252	J-7086	J-9263	29	90	110	Existing	73	0.13
P-9253	J-9263	J-682	277	90	110	Existing	33	0.06
P-9256	J-6885	J-9548	126	50	110	Existing	56	0.33
P-9257	J-9548	J-3955	77	50	110	Existing	36	0.21
P-9259	J-3805	J-9324	20	110	110	Secondary	0	0
P-9260	J-3805	J-9365	103	110	110	Secondary (Sub)	124	0.23
P-9261	J-9365	J-9811	75	110	110	Secondary (Sub)	106	0.19
P-9264	J-9324	J-9286	4	63	110	Secondary (Sub)	0	0
P-9265	J-9286	J-9325	21	110	110	Secondary (Sub)	93	0.17
P-9266	J-5020	J-10158	2	75	110	Existing	22	0.06
P-9267	J-10158	J-9107	191	75	110	Existing	0	0
P-9268	J-9289	J-10509	11	315	110	Primary	904	0.2
P-9269	J-10509	J-9292	2	315	110	Primary	1145	0.25
P-9271	J-9292	J-8625	5	90	110	Existing	145	0.26
P-9272	J-346	J-10510	406	90	110	Existing	152	0.28
P-9273	J-10510	J-9292	6	90	110	Existing	0	0
P-9274	J-1599	J-9974	2	63	110	Existing	105	0.39
P-9275	J-9974	J-640	71	63	110	Existing	38	0.14
P-9278	J-394	J-9676	17	63	110	Existing	0	0
P-9279	J-9676	J-6544	5	63	110	Existing	525	1.95
P-9280	J-4236	J-9657	120	63	110	Existing	178	0.66
P-9281	J-9657	J-535	4	63	110	Existing	80	0.3
P-9283	J-2239	J-9815	125	63	110	Secondary (Sub)	40	0.22
P-9286	J-8556	J-10512	72	90	110	Existing	9	0.02
P-9287	J-10512	J-10511	8	90	110	Existing	0	0
P-9288	J-10632	PBC-2	9	225	110	Primary	2066	0.9
P-9289	PBC-2	J-10105	77	225	110	Primary	2066	0.9
P-9290	J-9395	PBC-1	12	160	110	Primary	961	0.83
P-9291	PBC-1	J-9192	32	160	110	Primary	961	0.83
P-9292	J-10141	PBC-3	294	225	110	Primary	2190	0.95
P-9293	PBC-3	J-10125	67	225	110	Primary	2190	0.95
P-9295	J-10513	Bastinda SR	14	300	110	Yard Pipe	3506	0.57
P-9296	J-7403	J-10514	150	110	110	Existing	208	0.25
P-9298	J-10514	J-10515	7	110	110	Existing	0	0
P-9299	J-10515	J-8879	127	110	110	Existing	29	0.04
P-9300	J-618	J-9476	4	110	110	Existing	1230	1.5
P-9301	J-9476	J-533	15	110	110	Existing	1230	1.5
P-9303	J-9419	J-3539	150	200	110	Existing	2224	0.82
P-9304	Gacuriro1 Outlet	J-9354	18	110	110	Existing	0	0
P-9305	J-9354	J-364	493	110	110	Existing	483	0.59
P-9306	Gacuriro1 Outlet	J-2929	6	200	110	Existing	1357	0.5
P-9310	J-10609	J-10517	36	300	110	Yard Pipe	2228	0.36

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
P-9313	J-10018	J-5610	45	160	110	Primary	715	0.62
P-9314	J-5610	J-10237	102	160	110	Primary	551	0.47
P-9315	J-9659	J-10166	470	160	110	Primary	345	0.3
P-9316	J-10166	J-10204	1	225	110	Primary	1904	0.83
P-9317	J-10356	J-9590	44	160	110	Primary	178	0.15
P-9318	J-9590	J-10203	23	160	110	Primary	193	0.17
P-9319	J-3065	J-10147	60	90	110	Existing	35	0.06
P-9320	J-10147	J-5025	3	90	110	Existing	45	0.08
P-9321	J-9938	J-9642	82	63	110	Secondary (Sub)	65	0.36
P-9322	J-9642	J-9607	200	63	110	Secondary (Sub)	17	0.09
P-9323	J-2374	J-10045	69	160	110	Primary	411	0.35
P-9324	J-10045	J-9881	40	160	110	Primary	324	0.28
P-9325	J-9484	J-9413	57	63	110	Secondary (Sub)	7	0.04
P-9326	J-9413	J-9485	7	63	110	Secondary (Sub)	2	0.01
P-9329	J-10471	J-10518	4	63	110	Existing	22	0.08
P-9331	J-9843	J-9518	70	63	110	Secondary (Sub)	24	0.14
P-9332	J-9518	J-9844	63	63	110	Secondary (Sub)	3	0.01
P-9333	J-10412	J-10411	1	110	110	Secondary	14	0.03
P-9335	J-10213	J-10148	221	160	110	Primary	279	0.24
P-9336	J-10148	J-9821	22	160	110	Primary	269	0.23
P-9337	J-10061	J-9750	149	110	110	Secondary	56	0.1
P-9338	J-9750	J-10062	91	110	110	Secondary	33	0.06
P-9339	J-9933	J-232	0	110	110	Secondary	38	0.07
P-9340	J-232	J-9805	75	110	110	Secondary	128	0.23
P-9341	J-9693	J-9703	69	63	110	Secondary (Sub)	46	0.26
P-9342	J-9703	J-9681	31	63	110	Secondary (Sub)	4	0.02
P-9343	J-10138	J-9780	68	110	110	Secondary	6	0.01
P-9344	J-9780	J-9935	113	110	110	Secondary	84	0.15
P-9345	J-9474	J-9827	94	110	110	Secondary	102	0.19
P-9346	J-9827	J-9559	68	110	110	Secondary	61	0.11
P-9347	J-9881	J-9876	108	160	110	Primary	232	0.2
P-9350	J-9880	J-10056	140	160	110	Primary	186	0.16
P-9351	J-9876	J-9696	57	160	110	Primary	192	0.17
P-9352	J-9696	J-9880	28	160	110	Primary	111	0.1
P-9353	J-10349	J-9714	112	160	110	Primary	467	0.4
P-9354	J-9714	J-9982	322	160	110	Primary	198	0.17
P-9355	J-9865	J-9625	26	110	110	Secondary	17	0.03
P-9356	J-9625	J-9866	181	110	110	Secondary	7	0.01
P-9358	J-10083	J-695	11	63	110	Existing	1	0
P-9359	J-10480	J-9837	344	110	110	Existing	5	0.01
P-9360	J-9837	J-1219	144	110	110	Existing	104	0.13
P-9361	J-9450	J-9451	56	160	110	Primary	88	0.08
P-9363	J-10544	Nyarutarama Elevated	13	300	110	Yard Pipe	1313	0.21
P-9365	J-5966	J-10054	253	200	110	Existing	190	0.07
P-9366	J-10054	J-3395	203	200	110	Existing	144	0.05
P-9367	J-6410	J-10519	103	63	110	Secondary (Sub)	59	0.33
P-9369	J-9719	J-10520	39	63	110	Secondary (Sub)	12	0.07
P-9370	J-10519	J-9720	71	63	110	Secondary (Sub)	28	0.16
P-9371	J-10519	J-10520	0	63	110	Secondary (Sub)	22	0.12
P-9372	J-10520	J-10047	152	63	110	Secondary (Sub)	17	0.09
P-9374	J-10522	J-9676	119	315	110	Primary	525	0.12
P-9375	J-10241	J-10522	223	315	110	Primary	1213	0.27
P-9376	J-10522	J-10521	4	315	110	Primary	688	0.15
P-9377	J-250	J-10521	35	110	110	Existing	0	0
P-9378	J-10521	J-6193	17	110	110	Existing	688	0.84
P-9380	J-9211	J-9312	28	110	110	Secondary	71	0.13
P-9381	J-9503	J-10523	3	225	110	Primary	125	0.05
P-9382	J-9503	J-10137	370	225	110	Primary	731	0.32
P-9383	J-5383	J-10523	6	63	110	Existing	0	0
P-9384	J-10523	J-10376	1	63	110	Existing	125	0.46
P-9392	J-1039	J-10572	405	90	110	Existing	294	0.53
P-9399	J-10484	J-10529	85	90	110	Existing	0	0

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
P-9400	J-10529	J-937	170	90	110	Existing	27	0.05
P-9401	J-10502	J-10530	191	90	110	Existing	411	0.75
P-9402	J-10530	J-3316	26	90	110	Existing	323	0.59
P-9403	J-10530	J-482	140	110	110	Secondary	88	0.16
P-9404	J-5450	J-10531	1	63	110	Existing	190	0.71
P-9406	J-630	J-10532	130	63	110	Existing	25	0.09
P-9407	J-10532	J-532	72	63	110	Existing	25	0.09
P-9409	J-533	J-10533	2	110	110	Existing	826	1.01
P-9410	J-10533	J-1470	248	110	110	Existing	480	0.58
P-9411	J-10531	J-10534	7	63	110	Existing	190	0.71
P-9412	J-10534	J-4287	85	63	110	Existing	155	0.58
P-9413	J-10533	J-10534	87	110	110	Secondary	346	0.63
P-9415	J-10536	J-10633	251	160	110	Secondary	703	0.61
P-9416	J-8187	J-10536	98	160	110	Secondary	703	0.61
P-9418	J-6633	J-10535	6	63	110	Existing	98	0.36
P-9419	J-10535	J-6634	7	63	110	Existing	98	0.36
P-9422	J-682	J-10538	1	90	110	Existing	168	0.31
P-9423	J-10538	J-787	100	90	110	Existing	168	0.31
P-9426	J-10540	J-3805	233	110	110	Secondary	163	0.3
P-9429	J-10541	J-9364	97	110	110	Secondary	33	0.06
P-9432	J-7471	J-10542	240	90	110	Existing	351	0.64
P-9433	J-10542	J-7589	162	90	110	Existing	53	0.1
P-9436	J-10029	J-10543	54	315	110	Primary	0	0
P-9438	J-10543	J-10542	10	315	110	Primary	904	0.2
P-9439	J-10543	J-9288	248	315	110	Primary	904	0.2
P-9441	J-10544	J-9293	9	315	110	Primary	980	0.22
P-9442	J-10189	J-10545	368	110	110	Secondary	0	0
P-9447	J-10541	J-10540	130	225	110	Primary	664	0.29
P-9448	J-10540	J-10546	216	225	110	Primary	457	0.2
P-9449	J-9093	J-10546	146	110	110	Existing	0	0
P-9450	J-10546	J-948	57	110	110	Existing	457	0.56
P-9451	J-9678	J-10547	472	160	110	Primary	0	0
P-9453	J-1366	J-9371	2	63	110	Existing	2	0.01
P-9454	J-9371	J-269	8	63	110	Existing	7	0.03
P-9460	J-9176	J-10548	1245	225	110	Primary	704	0.31
P-9461	J-10548	Ex4	283	225	110	Primary	448	0.19
P-9462	J-10518	J-10549	38	63	110	Existing	34	0.12
P-9463	J-10549	J-10472	246	63	110	Existing	222	0.83
P-9464	J-10548	J-10549	26	110	110	Secondary	256	0.47
P-9467	J-10269	J-10550	390	225	110	Primary	1070	0.47
P-9468	J-10550	J-10232	252	160	110	Primary	710	0.61
P-9470	J-10551	J-10075	48	160	110	Primary	776	0.67
P-9476	J-10550	J-10553	608	160	110	Primary	360	0.31
P-9479	J-10553	J-10049	6	110	110	Secondary	134	0.24
P-9484	J-10553	J-10555	4	160	110	Primary	226	0.19
P-9485	J-10555	J-10552	28	160	110	Primary	226	0.19
P-9488	J-10205	J-10557	193	225	110	Primary	37	0.02
P-9489	J-10557	J-9401	57	225	110	Primary	109	0.05
P-9490	J-10557	J-9211	31	110	110	Secondary	71	0.13
P-9492	J-10401	J-10023	112	110	110	Secondary	183	0.33
P-9497	J-9984	J-10271	13	160	110	Primary	61	0.05
P-9498	J-10271	J-9281	138	160	110	Primary	123	0.11
P-9499	J-9800	J-10561	150	110	110	Secondary	243	0.44
P-9501	J-10232	J-10561	189	160	110	Primary	710	0.61
P-9503	J-10561	J-10562	203	160	110	Primary	467	0.4
P-9504	J-10562	J-10270	5	160	110	Primary	361	0.31
P-9505	J-10348	J-10563	12	90	110	Existing	69	0.13
P-9506	J-10563	J-1944	23	90	110	Existing	179	0.33
P-9508	J-10564	J-10400	136	63	110	Existing	78	0.29
P-9509	J-10401	J-10566	95	110	110	Secondary	78	0.14
P-9510	J-10566	J-10564	179	63	110	Existing	78	0.29
P-9511	J-10430	J-10567	137	315	110	Primary	2092	0.46

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
P-9512	J-10567	J-10513	310	315	110	Primary	2092	0.46
P-9513	J-2558	J-10568	2	90	110	Existing	270	0.49
P-9518	J-10568	J-10251	134	90	110	Existing	270	0.49
P-9521	J-10513	J-10059	423	315	110	Primary	1414	0.31
P-9560	J-1984	J-10586	74	63	110	Existing	17	0.06
P-9561	J-10586	J-10083	3	63	110	Existing	17	0.06
P-9563	J-10552	J-10587	211	160	110	Primary	407	0.35
P-9565	J-10587	J-10588	159	110	110	Secondary	34	0.06
P-9566	J-10587	J-10589	529	160	110	Primary	444	0.38
P-9567	J-10589	J-10551	123	160	110	Primary	476	0.41
P-9568	J-10589	J-10590	249	110	110	Secondary	5	0.01
P-9569	Ex4	J-10591	7	110	110	Existing	448	0.55
P-9570	J-10591	J-10265	876	110	110	Existing	63	0.08
P-9571	J-772	J-10592	79	50	110	Existing	4	0.02
P-9572	J-10592	J-2127	282	50	110	Existing	7	0.04
P-9573	J-9183	J-10593	2	160	110	Primary	599	0.52
P-9575	J-10593	J-10592	2	160	110	Primary	11	0.01
P-9576	J-10593	J-9865	128	160	110	Primary	588	0.51
P-9578	J-10594	J-9183	2	160	110	Primary	1235	1.06
P-9579	J-10043	J-10595	35	160	110	Primary	213	0.18
P-9580	J-10595	J-9845	125	160	110	Primary	1022	0.88
P-9581	J-10594	J-10595	18	160	110	Primary	1235	1.06
P-9582	J-9247	J-9354	39	200	110	Yard Pipe	983	0.36
P-9583	J-9293	J-10596	318	225	110	Primary	696	0.3
P-9584	J-10596	J-10541	302	225	110	Primary	696	0.3
P-9586	J-10596	J-10029	68	225	110	Primary	0	0
P-9587	J-10511	J-10028	212	90	110	Existing	35	0.06
P-9588	J-10028	J-5066	549	90	110	Existing	32	0.06
P-9591	J-10404	J-10597	4	250	110	Primary	446	0.16
P-9592	J-10597	J-10087	2	250	110	Primary	446	0.16
P-9593	J-10597	J-10598	425	225	110	Primary	0	0
P-9594	J-10428	J-10598	2	225	110	Primary	624	0.27
P-9595	J-10598	J-10432	4	225	110	Primary	624	0.27
P-9596	B2	J-10599	601	500	110	Existing	1041	0.06
P-9597	J-10599	J-10263	652	500	110	Existing	88	0.01
P-9598	J-9970	J-10600	146	90	110	Existing	0	0
P-9599	J-10600	J-10377	3	90	110	Existing	0	0
P-9600	J-10378	J-10601	1	225	110	Primary	840	0.37
P-9601	J-10601	J-10377	1	225	110	Primary	97	0.04
P-9602	J-7575	J-10602	2	110	110	Existing	681	0.83
P-9603	J-10602	J-8690	39	110	110	Existing	62	0.08
P-9604	J-10601	J-10602	449	160	110	Primary	743	0.64
P-9606	J-10603	J-9917	387	355	110	Primary	4309	0.75
P-9608	J-10604	J-10544	24	200	110	Yard Pipe	332	0.12
P-9609	J-9247	J-10605	24	200	110	Yard Pipe	3653	1.35
P-9610	J-10605	J-9419	2	200	110	Yard Pipe	2254	0.83
P-9611	Mb1	J-10606	9	110	110	Existing	0	0
P-9612	J-10606	J-618	19	110	110	Existing	1399	1.7
P-9614	J-10607	J-9176	692	315	110	Primary	3699	0.82
P-9615	J-2929	J-10608	14	200	110	Existing	1357	0.5
P-9616	J-10608	J-9419	3	200	110	Existing	0	0
P-9618	J-10607	J-10608	4	300	110	Yard Pipe	1357	0.22
P-9619	Gacuriro1 Outlet	J-10609	15	300	110	Yard Pipe	4570	0.75
P-9620	J-10609	J-10607	2	300	110	Yard Pipe	2342	0.38
P-9621	J-9242	J-10610	3	250	110	Primary	1396	0.33
P-9622	J-10610	J-10399	300	250	110	Primary	1396	0.49
P-9626	J-10572	J-10006	7	90	110	Existing	294	0.53
P-9628	J-10006	J-9756	93	63	110	Secondary (Sub)	32	0.18
P-9629	J-9756	J-10584	125	63	110	Secondary (Sub)	0	0
P-9630	J-10059	J-10612	31	315	110	Primary	1414	0.31
P-9631	J-10612	J-10551	391	315	110	Primary	1252	0.28
P-9638	J-10413	J-8439	4	110	110	Secondary	199	0.36

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
P-9639	J-8439	J-9717	74	110	110	Secondary	134	0.24
P-9640	J-10611	J-10616	273	110	110	Secondary	903	1.64
P-9641	J-10616	J-9069	1	110	110	Secondary	468	0.85
P-9642	J-10006	J-10617	111	90	110	Existing	372	0.68
P-9643	J-10617	J-449	179	90	110	Existing	63	0.11
P-9644	J-10616	J-10617	9	110	110	Secondary	435	0.79
P-9646	J-10618	J-10084	102	63	110	Secondary (Sub)	5	0.02
P-9647	J-10075	J-10619	92	160	110	Primary	401	0.35
P-9648	J-10619	J-10410	144	160	110	Primary	380	0.33
P-9649	J-10618	J-10619	189	110	110	Secondary	21	0.04
P-9650	J-10620	J-10618	73	110	110	Secondary	23	0.04
P-9651	J-682	J-10621	12	63	110	Existing	132	0.49
P-9652	J-10621	J-512	204	63	110	Existing	132	0.49
P-9657	J-10020	PRV-8	19	63	110	Secondary (Sub)	6	0.03
P-9658	PRV-8	J-10021	253	63	110	Secondary (Sub)	6	0.03
P-9663	J-10624	J-10627	304	63	110	Secondary	9	0.05
P-9666	J-10625	J-5136	205	400	110	Existing	2066	0.19
P-9667	J-10637	PBC-4	32	225	110	Primary	2144	0.93
P-9668	PBC-4	J-10289	606	225	110	Primary	2144	0.93
P-9673	J-10627	PRV-9	162	63	110	Secondary	9	0.05
P-9675	PRV-9	J-10628	3	63	110	Secondary	9	0.05
P-9676	J-10628	J-9312	207	63	110	Secondary	9	0.05
P-9677	J-10020	J-10629	34	63	110	Secondary	0	0
P-9678	J-10629	J-10624	346	63	110	Secondary	0	0
P-9679	Fawe SR	J-10630	3	100	110	Existing	2769	4.08
P-9680	J-10630	J-9171	1	100	110	Existing	2291	3.38
P-9681	J-9171	J-10631	204	225	110	Primary	2291	1
P-9682	J-10631	J-10204	1	315	110	Primary	2769	0.61
P-9683	J-10630	J-10631	200	100	110	Existing	478	0.71
P-9684	J-5136	J-10632	548	400	110	Existing	2066	0.19
P-9685	J-10632	J-25	2483	400	110	Existing	0	0
P-9686	J-7790	J-10633	1	63	110	Existing	634	2.35
P-9687	J-10633	J-7791	18	63	110	Existing	69	0.26
P-9688	J-10209	PRV-11	81	110	110	Secondary	53	0.1
P-9689	PRV-11	J-1756	274	110	110	Secondary	53	0.1
P-9690	Nyarutarama SR	J-10635	5	100	110	Yard Pipe	4309	6.35
P-9691	J-10635	J-10603	23	300	110	Yard Pipe	4309	0.71
P-9692	J-10363	J-10636	700	225	110	Primary	432	0.19
P-9693	J-10636	J-9385	5	225	110	Primary	460	0.2
P-9694	J-10024	J-10637	298	400	110	Existing	4210	0.39
P-9695	J-10637	J-10625	372	400	110	Existing	2066	0.19
P-9698	J-10408	J-10639	85	110	110	Secondary	26	0.05
P-9699	J-10639	J-10220	55	110	110	Secondary	6	0.01
P-9701	J-10640	J-9878	73	63	110	Secondary (Sub)	5	0.03
P-9702	J-9877	J-9534	14	63	110	Secondary (Sub)	10	0.06
P-9703	J-9534	J-10640	55	63	110	Secondary (Sub)	9	0.05
P-9704	J-9620	J-9267	73	63	110	Secondary (Sub)	71	0.39
P-9705	J-9267	J-9398	10	63	110	Secondary (Sub)	71	0.39
P-9706	J-9990	J-9266	61	63	110	Secondary (Sub)	50	0.28
P-9707	J-9266	J-9706	29	63	110	Secondary (Sub)	43	0.24
P-9708	J-10110	J-10641	206	63	110	Secondary (Sub)	0	0
P-9711	J-10642	J-10111	84	63	110	Secondary (Sub)	0	0
P-9712	J-10251	J-10643	98	90	110	Existing	251	0.46
P-9713	J-10643	J-9297	20	90	110	Existing	375	0.68
P-9714	J-9931	J-10643	159	63	110	Secondary (Sub)	625	3.49
P-9716	J-10644	J-9782	147	63	110	Secondary (Sub)	0	0
P-9717	J-10197	J-10645	302	110	110	Secondary	76	0.14
P-9718	J-10645	J-10198	125	110	110	Secondary	100	0.18
P-9719	J-8356	J-973	175	63	110	Existing	37	0.14
P-9720	J-973	J-1041	19	63	110	Existing	29	0.11
P-9721	J-9760	J-9816	191	110	110	Secondary	65	0.12
P-9722	J-9816	J-9553	82	110	110	Secondary	54	0.1

Pipe ID	Start Node	Stop Node	Length (m)	Diameter (mm)	C Value	Class	Flow (m3/day)	Velocity (m/s)
P-9723	J-9410	J-9689	113	63	110	Secondary (Sub)	3	0.02
P-9725	J-10173	J-10003	37	110	110	Secondary	115	0.21
P-9726	J-10003	J-10011	77	110	110	Secondary	96	0.17
P-9727	J-10392	J-9969	67	63	110	Secondary (Sub)	35	0.19
P-9728	J-9969	J-10393	25	63	110	Secondary (Sub)	6	0.03
P-9729	J-9520	J-9599	62	63	110	Secondary (Sub)	2	0.01
P-9731	J-618	J-10494	80	90	110	Existing	30	0.06
P-9732	J-10494	J-10482	424	90	110	Existing	0	0
P-9733	J-9767	J-10647	62	63	110	Secondary (Sub)	0	0
P-9735	J-10295	J-10648	46	63	110	Existing	19	0.07
P-9736	J-10648	J-9547	47	63	110	Existing	12	0.04
P-9737	J-9460	J-3246	2	160	110	Primary	4	0
P-9738	J-3246	J-9603	52	160	110	Primary	5	0
P-9739	J-9748	J-10206	40	225	110	Primary	87	0.04
P-9740	J-10206	J-9196	3	225	110	Primary	89	0.04
P-9742	J-10649	J-10206	108	110	110	Secondary	0	0
P-9743	J-10205	J-10650	229	110	110	Secondary	0	0
P-9746	J-10651	J-9755	94	63	110	Secondary (Sub)	0	0
P-9747	J-9695	J-10652	83	110	110	Secondary	37	0.07
P-9748	J-10652	J-9822	32	110	110	Secondary	36	0.07
P-9749	J-10187	J-9412	10	110	110	Secondary	40	0.07
P-9750	J-9412	J-9226	103	110	110	Secondary	33	0.06

Block Boundary Valve

Valve ID	Elevation (m)	Diameter (mm)	Referenced Pipe ID	Valve Status
ISO-7	1,494	90	P-181	Closed
ISO-13	1,471	110	P-7502	Closed
ISO-14	1,494	90	P-362	Closed
ISO-299	1,454	63	P-7958	Closed
ISO-23	1,510	63	P-7972	Closed
ISO-24	1,492	63	P-7979	Closed
ISO-25	1,431	50	P-8016	Closed
ISO-45	1,453	63	P-9383	Closed
ISO-46	1,431	225	P-8452	Closed
ISO-75	1,456	110	P-9377	Closed
ISO-76	1,463	90	P-7546	Closed
ISO-82	1,460	90	P-9287	Closed
ISO-83	1,445	110	P-9298	Closed
ISO-90	1,501	90	P-7603	Closed
ISO-91	1,510	200	2713	Closed
ISO-92	1,541	90	144	Closed
ISO-203	1,462	90	P-9599	Closed
ISO-206	1,482	90	P-8871	Closed
ISO-208	1,478	63	P-7137	Closed
ISO-210	1,484	63	P-9677	Closed
ISO-39	1,446	63	P-8412	Closed
ISO-26	1,456	225	617	Closed
ISO-49	1,444	225	P-8572	Closed
ISO-55	1,453	110	P-8623	Closed
ISO-62	1,443	225	122	Closed
ISO-168	1,462	315	P-9436	Closed
ISO-202	1,453	225	P-9593	Closed
ISO-34	1,450	63	P-8242	Closed
ISO-20	1,458	225	609	Closed
ISO-31	1,466	225	P-8040	Closed
ISO-61	1,413	160	P-9025	Closed
ISO-79	1,463	63	P-9264	Closed
ISO-15	1,510	110	1664	Closed
ISO-16	1,469	63	P-7637	Closed
ISO-18	1,456	63	P-7777	Closed
ISO-21	1,501	63	P-7981	Closed
ISO-22	1,454	110	P-7960	Closed

Valve ID	Elevation (m)	Diameter (mm)	Referenced Pipe ID	Valve Status
ISO-28	1,466	110	2706	Closed
ISO-30	1,456	63	3094	Closed
ISO-33	1,544	110	P-8190	Closed
ISO-35	1,486	63	P-8248	Closed
ISO-37	1,445	90	P-8391	Closed
ISO-38	1,453	90	P-8400	Closed
ISO-40	1,449	63	P-8414	Closed
ISO-41	1,445	110	P-8422	Closed
ISO-42	1,391	110	P-8431	Closed
ISO-43	1,444	110	P-8435	Closed
ISO-44	1,383	110	P-9084	Closed
ISO-47	1,432	50	P-7097	Closed
ISO-50	1,444	90	6785	Closed
ISO-51	1,448	110	P-8586	Closed
ISO-52	1,446	63	6986	Closed
ISO-53	1,450	110	P-3653	Closed
ISO-54	1,444	200	P-8613	Closed
ISO-56	1,455	63	P-8615	Closed
ISO-57	1,450	90	P-6378	Closed
ISO-58	1,432	110	P-8894	Closed
ISO-60	1,462	90	P-8968	Closed
ISO-63	1,479	110	P-9113	Closed
ISO-64	1,478	63	7338	Closed
ISO-65	1,472	110	P-9115	Closed
ISO-66	1,478	90	P-9135	Closed
ISO-67	1,462	90	P-9399	Closed
ISO-68	1,460	63	P-9207	Closed
ISO-72	1,448	110	P-9226	Closed
ISO-73	1,416	90	P-9223	Closed
ISO-74	1,457	100	P-6698	Closed
ISO-80	1,453	90	P-9273	Closed
ISO-81	1,450	63	P-9278	Closed
ISO-84	1,494	200	P-9616	Closed
ISO-85	1,494	110	P-9304	Closed

Pressure Breaking Chamber & Pressure Release Valve

PBC&PRV ID	Elevation (m)	Diameter (mm)	Setting Pressure (bar)
PBC-1	1,497	150	0.0
PBC-2	1,468	200	0.0
PBC-3	1,466	200	0.0
PBC-4	1,544	200	0.0
PRV-11	1,408	110	6.0
PRV-8	1,479	63	2.0
PRV-9	1,466	63	1.5
Ex1	1,445	90	6.0
Ex2	1,509	110	6.0
Ex3	1,448	200	6.0
Ex4	1,385	200	6.0

Reservoir

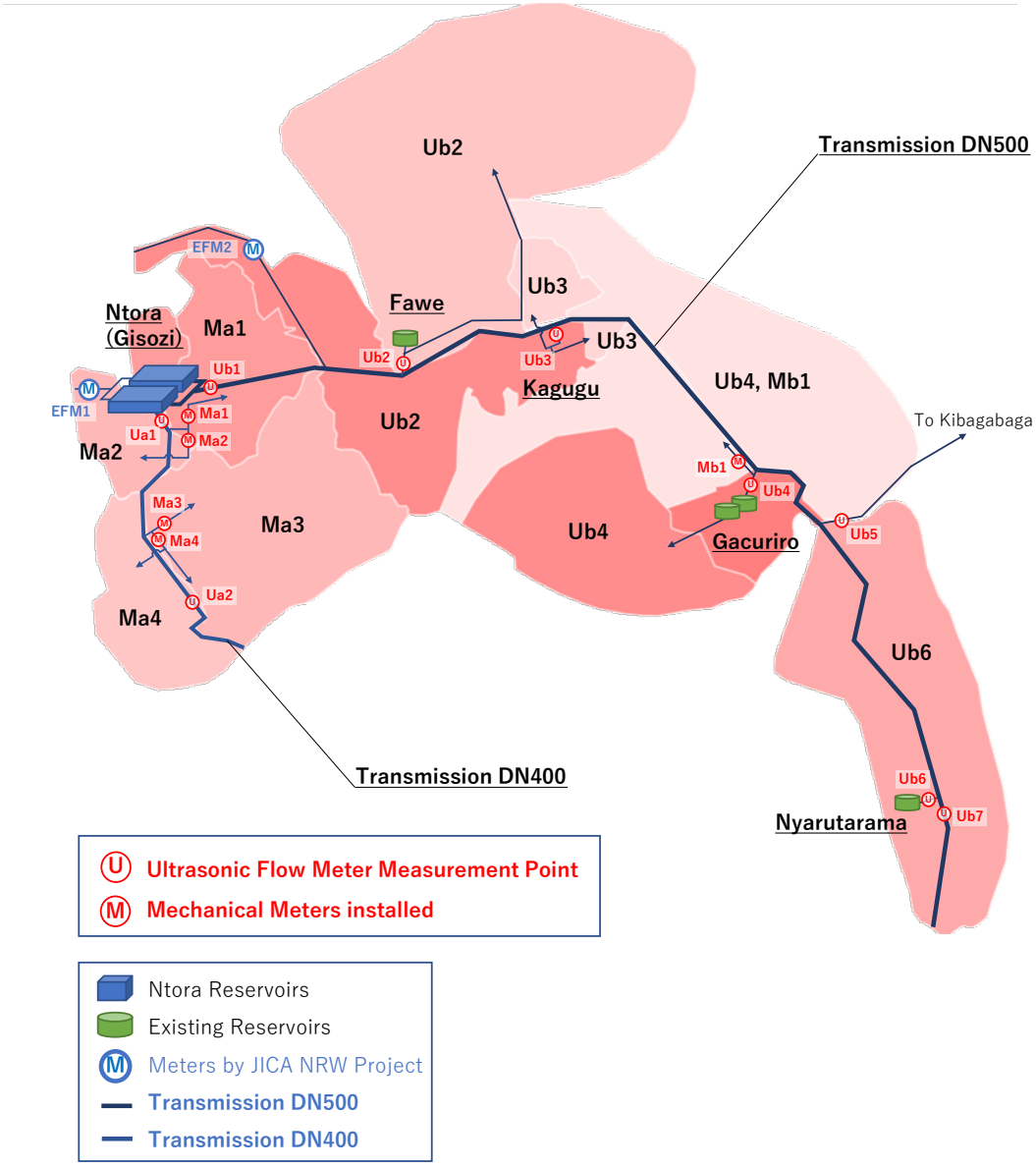
Reservoir ID	Low Water Level (m)	Note
Ntora Elevated	1,580	Existing
Ntora	1,565	Existing
Fawe SR	1,470	Existing
Gacuriro2 Outlet	1,494	Existing
Gacuriro1 Outlet	1,494	Existing
Nyarutarama SR	1,478	Existing
Nyarutarama Elevated	1,493	Plan
Kagugu Elevated	1,496	Plan
Gacuriro Elevated	1,510	Plan
Bastinda SR	1,493	Plan

添付資料 10 無収水ベースライン調査および圧力調査結果詳細

1.1.1 漏水量（無収水）ベースライン調査

本事業の対象地域は、本管および支管に区間流量計が設置されていないため、既存の送配水管路における漏水量（無収水）が把握されていない。このため、本準備調査では、ノトラ配水池の給水エリアにおける無収水量（率）と漏水量を把握することを目的としてベースライン調査を実施した。また、このベースライン調査結果から、プロジェクト実施後の結果と比較することで、プロジェクトから得られる効果を定量的に評価することも目的の一つである。調査対象はノトラ配水池からカチル方面に行く 400mm 送水本管（ライン A）と支管およびノトラ配水池からレメラ方面に行く 500mm 送水本管（ライン B）とその支管である。

流量測定については、管路の流入・流出側と分岐部分に機械式流量計または超音波流量計を設置した（**図 1.2-1**）。無収水量（率）は測定した送水管及び支管の流量と WASAC 支店が保有する請求水量の比較により算出した。他方、本事業で得られる効果は漏水削減により回収された水を有効活用することで新規顧客の接続や断水の改善を狙うものである。漏水量の算出方法には、①夜間最小流量を圧力変動により補正する方法、②見かけ無収水量（コマーシャル・ロス）を算出し配水量分析から漏水量を求める方法、の 2 つの方法があるが、①については調査結果後の考察から漏水以外が夜間の流量に寄与している可能性が否定できないので、②の方法で漏水量を算出する。漏水量（無収水）は季節や測定時期によって変動する場合があることから調査は複数回行い最も信頼できる結果を採用するものとし、2021 年 11 月から 2022 年 3 月までの期間に計 4 回実施した。ベースライン調査の概要を**表 1.2-1** に示す。



出典：調査団

図 1.2-1　給水区域の概略図と流量測定位置

表 1.2-1　漏水量（無収水）ベースライン調査の概要

対象ライン	期間名称	測定期間	対象請求月	無収水率（%）	測定誤差（%）*	備考
A	第 1 回調査	2021 年 11 月 12 日~14 日	2021 年 11 月	39.6%	-	送水管の流入・流出部分のみ測定し、分岐部分は測定していないため、測定値は参考程度とする。
	第 2 回調査	2022 年 1 月 1 日~31 日	2022 年 1 月	39.8%	1.9%	Ua1 には WASAC の機械式流量計、Ma1~4 には本調査で設置した機械式流量計を用いて 1 か月間の測定値を取得した。Ua2 には 2 週間の流量測定を実施した。ただし、Ma2 については一部データが欠損している。

対象ライン	期間名称	測定期間	対象請求月	無収水率（%）	測定誤差（%）*	備考
	第 3 回調査	2022 年 2 月 1 日~14 日	2022 年 2 月	37.3%	0.5%	Ua1 には WASAC の機械式流量計の値を用いた。Ma1~4 については、2 月 1 日～7 日は機械式流量計、2 月 8 日～14 日は超音波流量計を用いて計測した。2 月前半のみの測定となるため、測定値は参考程度とする。
	第 4 回調査	2022 年 3 月 1 日~29 日	2022 年 3 月	41.5%	1.2%	Ua1 には WASAC の機械式流量計、Ma1~4 には本調査で設置した機械式流量計を用いて約 1 か月間の測定値を取得した。長期間の測定結果であり最も信頼できる結果と考えられるため、ベースラインとして採用する。
B	第 1 回調査	2022 年 2 月 22 日~28 日	2022 年 2 月	42.1%	7.6%	測定期間が短く測定誤差が大きいため、測定値は参考程度とする。
	第 3 回調査	2022 年 2 月 22 日~28 日	2022 年 2 月	42.1%	7.6%	測定期間が短く測定誤差が大きいため、測定値は参考程度とする。
	第 4 回調査	2022 年 3 月 1 日~28 日	2022 年 3 月	37.0%	4.5%	測定期間が長く、欠損データが少ないため、ベースラインとして採用する。誤差も許容範囲である。

*「送水管の流入と対象区域外への流出部分の測定値の差分から算出したライン全体の流量」と「対象区域内の給水先に分岐している各支管の測定値の合計から算出したライン全体の流量」の差

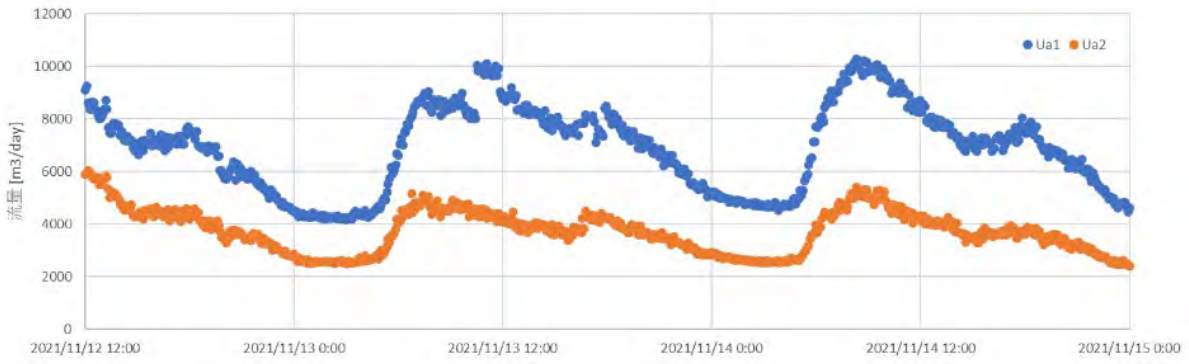
出典：調査団

1.2 400mm 送水本管（ライン A）

ノトラ配水池からカチル方面に送水する 400mm 送水本管（ライン A）については、400mm 送水本管のノトラ配水池直後と終点に超音波流量計を設置し、送水本管からの 4 か所の分岐に機械式流量計を設置した。

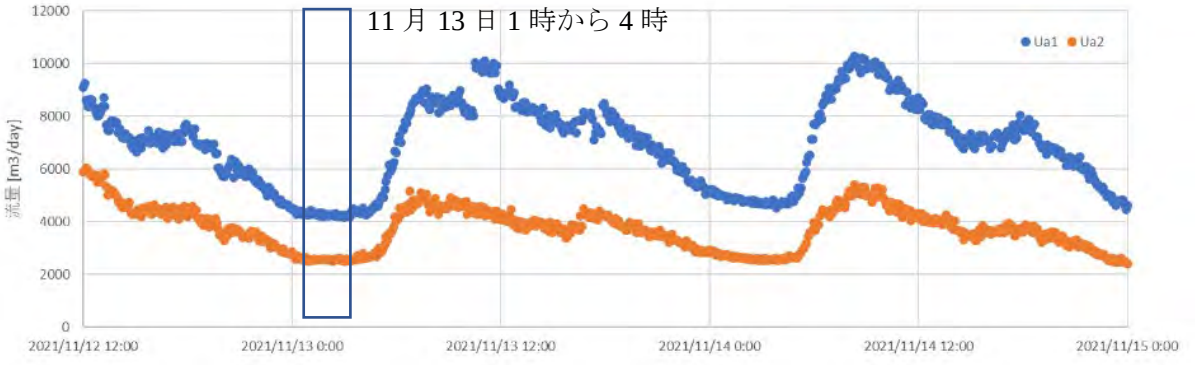
第 1 回調査

第 1 回調査では 400mm 送水本管のノトラ配水池直後（Ua1）と終点（Ua2）の流量測定を行い、一定の流量パターンが確認された（**図 1.2-1**）。



出典：調査団

ライン A の給水エリア全体の流量は Ua1 から Ua2 を除した 3,232 m^3/day であった。



出典：調査団

図 1.2-1　ライン A の流量測定結果

全体の流量は 1 ヵ月を通して大きな変化はないと仮定し、3 日間の測定データの平均を 11 月平均流量とした。11 月平均流量と 11 月請求水量の比より、ライン A の給水エリア全体の無収水率は 39.6%と推定された（**表 1.2-1**）。ただし、測定期間が短いため、測定値は参考程度とする。

表 1.2-1　400mm 送水本管の 11 月平均流量と 11 月平均請求水量および無収水率

ID	場所	口径 (mm)	11 月平均流量(m^3/d)	11 月平均請求水量 (m^3/d)	無収水率(%)
Ua1	Ntora-out 400mm	300	6,860		
Ua2	Gisozi Low	400	3,628		
	小計		3,232	1,953	39.6%

出典：調査団

第 2 回調査

第 2 回調査は 1 月 1 日~31 日の期間、400mm 送水本管のノトラ配水池直後（Ua1）と終点（Ua2）、Ma1, 2, 3, 4 において流量測定を行い、ライン A 全体および支管の給水区域の無収水率を算出した（**表 1.2-2**）。Ua1 については 1 か月間の WASAC の積算流量計の測定結果を用いた。Ua2 については 2 週間超音波流量計を設置した。Ma1~4 は調査団が設置した機械式流量計を用いて流量を測定した。ただし、Ma2 については 1 月 1 日~7 日のデータが欠損している。Ma2、Ua2 を除いて 1 か月間測定した値が得られている。400mm 送水管の流入部分（Ua1）・流出部分（Ua2）の測定値の差分から算出したライン A 全体の流量と各支管（Ma1~4）の測定値の合計から算出したライン A 全体の流量の差は 2%程度で許容範囲である。

表 1.2-2　ライン A の 1 月平均流量と 1 月平均請求水量および無収水率

ID	場所	口径（mm）	1 月平均流量 (m^3/d)	1 月平均請求水量 (m^3/d)	無収水率 (%)
Ua1	Ntora-out 400mm	300	3,229		
Ua2	Gisozi Low	400	67		
Ma1	Ntora	90	590	374	36.6%
Ma2	Ntora	110	273	147	46.0%
Ma3	ULK	110	983	1,382	41.4%
Ma4	ULK	110	1,376		
小計			3,162	1,903	39.8%

出典：調査団

第 3 回調査

第 3 回調査も 400mm 送水本管のノトラ配水池直後（Ua1）と終点（Ua2）、Ma1, 2, 3, 4 の流量測定を行い、ライン A 全体および支管の給水区域の無収水率を算出した（**表 1.2-3**）。期間は 2 月 1 日~14 日である。Ua1 と Ma1~4 については 2 月 1 日～7 日の期間を機械式流量計で、2 月 8 日~14 日を 1 日の流量の動きを詳細に確認するため超音波流量計を用いて測定した。Ua2 は 2 月 8 日~14 日の期間測定した。Ua2 以降のバルブが警察本部の消火栓を除きすべて閉じているため流量が小さい。

表 1.2-3　ライン A の 2 月平均流量と 2 月平均請求水量および無収水率

ID	場所	口径（mm）	2 月平均流量 (m^3/d)	2 月平均請求水量 (m^3/d)	無収水率 (%)
Ua1	Ntora-out 400mm	300	3,328		
Ua2	Gisozi Low	400	53		
Ma1	Ntora	90	630	378	29.9%
Ma2	Ntora	110	284	183	35.7%
Ma3	ULK	110	1,028	1,493	37.2%
Ma4	ULK	110	1,348		
対象給水エリア全体			3,275	2,054	37.3%

出典：調査団

第 4 回調査

第 4 回調査は 3 月 1 日~31 日の期間、400mm 送水本管のノトラ配水池直後（Ua1）と終点（Ua2）、Ma1, 2, 3, 4 において流量測定を行い、ライン A 全体および支管の給水区域の無収水率を算出した（**表 1.2-4**）。Ua1 については WASAC の積算流量計を用いた。Ua2 につ

いては流量計を設置していないため、暫定値を入力した。Ua2 以降のバルブが警察本部の消火栓を除きすべて閉じているため流量が小さい。Ma1~4 は調査団が設置した機械式流量計を用いて流量を測定した。

表 1.2-4　ライン A の 3 月平均流量と 3 月平均請求水量および無収水率

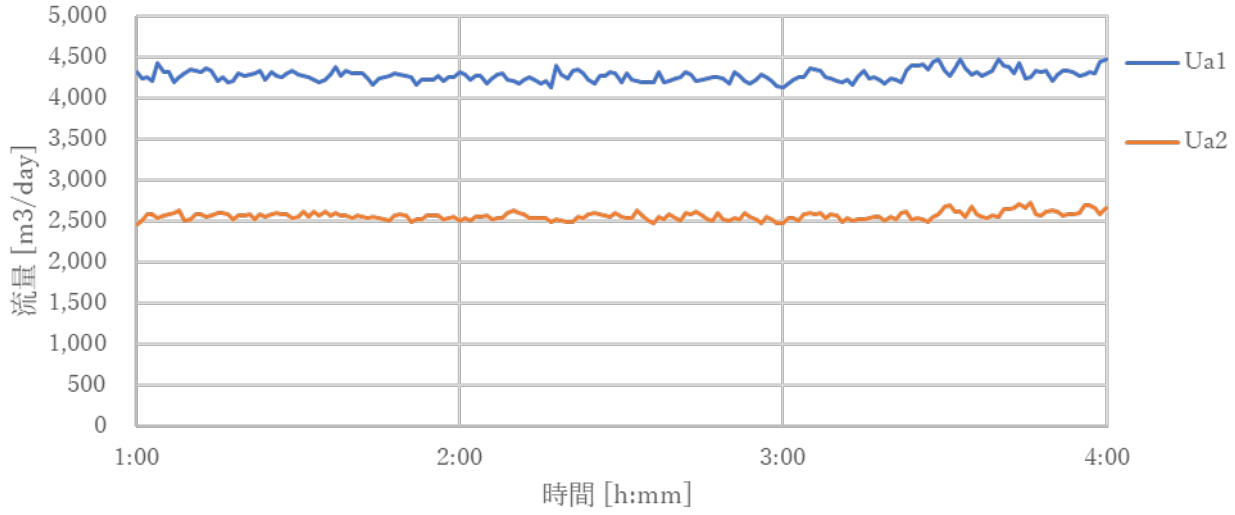
ID	場所	口径（mm）	3 月平均流量(m^3/d)	3 月平均請求水量 (m^3/d)	無収水率 (%)
Ua1	Ntora-out 400mm	300	3,343		
Ua2	Gisozi Low	400	60		
Ma1	Ntora	90	595	347	41.7%
Ma2	Ntora	110	274	142	48.3%
Ma3	ULK	110	982	1,431	39.7%
Ma4	ULK	110	1,391		
対象給水エリア全体			1,391	1,920	41.5%

出典：調査団

漏水量調査

次にライン A の給水エリア全体の漏水量を把握するため、調査期間のうち最小の流量を示した日における夜間最小流量（11 月 13 日 1 時から 4 時）を参考にした。該当部分を拡大した**図 1.2-2** より、夜間時の変動幅は約 1,600 m^3/日±100 m^3/日（70 L/分）で安定している。したがって、調査時間中継続的に充水されているような非常に大きな顧客のタンク等がない限りにおいては、夜間最小流量を漏水量と仮定することができると考えられる。Ua2 以降においては、警察本部等未調査の大口顧客があり大型顧客タンクの可能性は否定できないが、Ua1~Ua2 までの間では考えにくい。ただし、±70 L/分の継続的な変動は必ずしも相対的に小さい値ではなく（5~10 給水栓程度の使用量に相当）、顧客の使用量がゼロであったとはいえない。

したがって、漏水量に相当する最小流量が確認されたとはいえず、参考値である。



出典：調査団

図 1.2-2　11 月 13 日 1 時～4 時の夜間最小流量測定結果

以上が参考値であるという前提で、夜間最小流量がすべて漏水量であると仮定すると、ライン A の給水エリア全体の漏水量は Ua1 から Ua2 を減じた約 1,600m³/day である（**表 1.2-5**）。ただし、圧力の変動する対象地域において、昼間の漏水量は実際にはこれよりもかなり少ないと考えられるため、1 日あたりの漏水量は 1,600 m³ を大きく下回ると考えられる。対象地域の圧力は圧力調査において測定されているが、給水管が細く複雑な管路システムにおいて、給水圧力が一定に保たれていない既存施設においては域内の平均圧力を推定することが困難である。このような事象から、現段階での最終的なベースラインとしての漏水量推定値は、無収水量から推定する。

表 1.2-5　11 月 13 日 1 時～4 時の夜間最小流量と漏水量

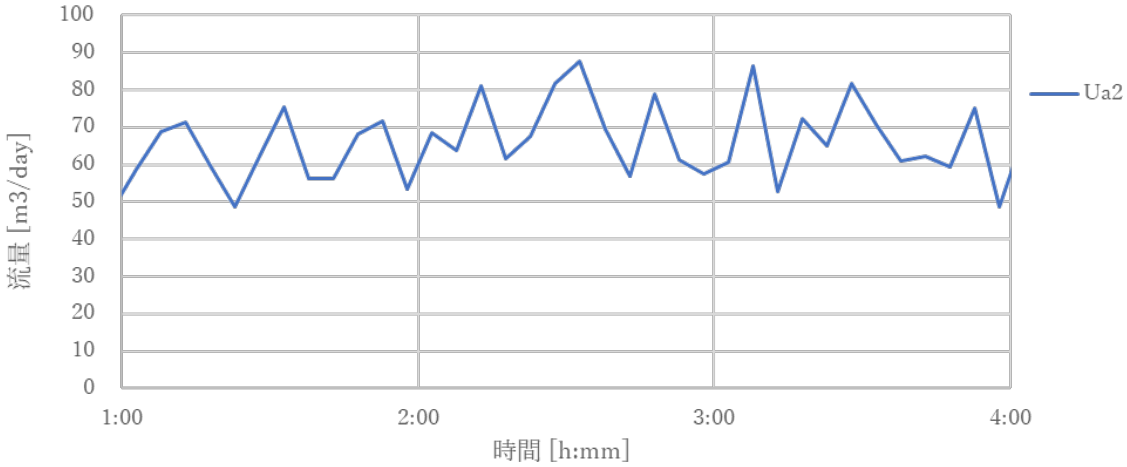
ID	場所	口径	夜間最小流量 (m³/day)
Ua1	Ntora-out 400mm	300	4,100
Ua2	Gisozi Low	400	2,500
	給水エリア全体の漏水量		1,600

出典：調査団

1 月 6 日 1 時から 4 時の Ua2 の夜間最小流量調査の測定結果を**図 1.2-3** に示す。2 回目調査（2022 年 1 月）では 11 月時点と調査条件が大きく異なり、測定期間中、400mm 送水本管の Ua2 以降のすべてのバルブが閉まっていたため、夜間最小流量が確認された場合 400mm 送水本管の漏水量であると仮定できる。しかし、**図 1.2-3** のように 5 分毎のデータで常時最大±40 m³/日（30 L/分）程度の変動があり、夜間最小流量が確認できたとは言い難

い。仮に観測された最小値を漏水量とすると、1 月実測時の平均流量 4,354 m^3/日に対して送水本管の漏水量は 49 m^3/day 以下であり、安全側の推定でも約 1.1%ときわめて少ない。

以上より、口径 400mm 既存送水本管の漏水量は少なく更新等の必要性はないと考えられる。



出典：調査団

図 1.2-3　1 月 6 日 1 時～4 時の夜間最小流量測定結果

1.3　500mm 送水本管（ライン B）

ノトラ配水池からレメラ方面に送水する 500mm 送水本管（ライン B）については、ノトラ配水池直後（Ub1）と終点（Ub7）に超音波流量計を設置し、送水本管からの分岐 6 か所のうち 5 ヶ所に超音波流量計、1 箇所に機械式流量計を設置した。

第 1 回調査

第 1 回調査は 2021 年 11 月 24 日～12 月 1 日の期間に送水本管および給水エリア全体を対象とした流量測定を実施した。11 月平均流量として 11 月 25 日～30 日の測定データの平均を用いた。**表 1.3-1** のとおり、ライン B の給水エリア全体の流量は Ub1 から EFM2、Ub5、Ub7 を減じた 9,071 m^3/day であった。ライン B の給水エリア全体の無収水率は 40.6%であった。Gacuriro と Nyarutarama は口径 110mm の配水本管で繋がっており給水区域を完全に分離することができない。

また、WASAC への聞き取り調査によると 11 月 24 日にレメラ側から Kibagabaga 配水池への送水が止まりノトラ配水池から Kibagabaga 方面への送水量が増加したため、Ub5 の流量およびノトラ配水池の流出流量（Ub1）が増加したが、請求水量との比較においては Kibagabaga 方面の流量の変動による大きな影響はない。

表 1.3-1　ライン B の 11 月平均流量 11 月平均請求水量および無収水率

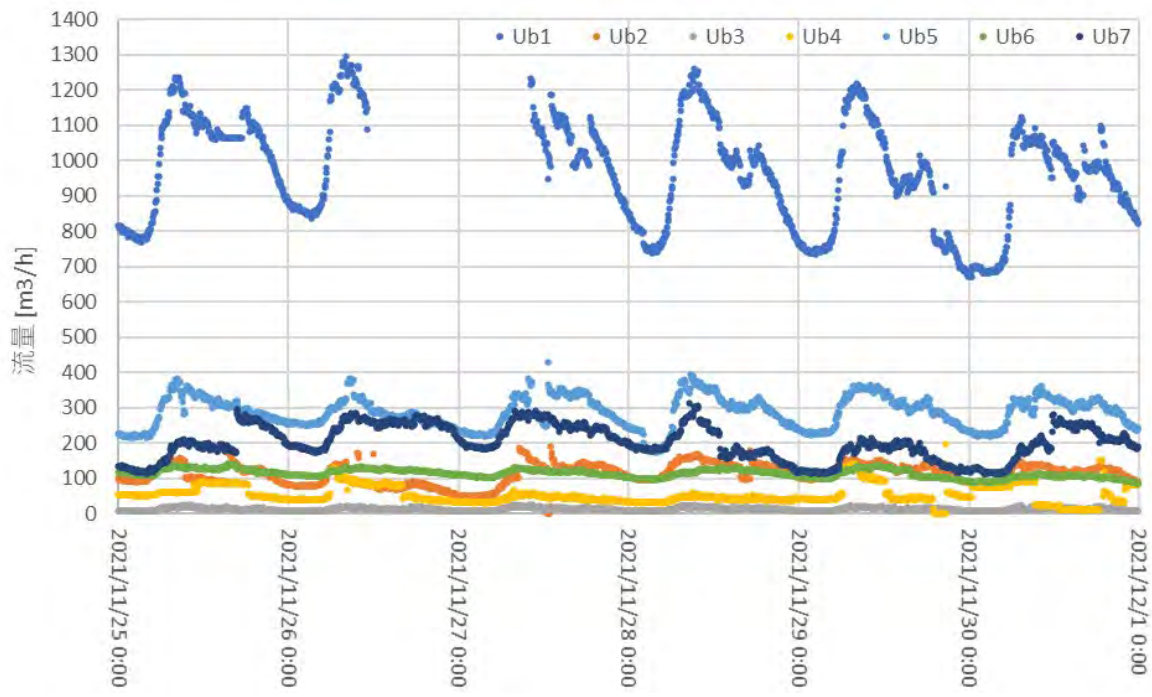
ID	場所	口径（mm）	11 月平均流量 (m3/d)	11 月平均請求水量 (m3/d)	無収水率 (%)
Ub1	Ntora-out 500mm	500	23,140		
EFM 2	To Amakawa	250	2,496		
Ub2	Fawe	110	2,604	1,805	30.7%
Ub3	Kagugu	80	297	194	34.5%
Ub4	Gacuriro	200	1,240	2,117	31.7%
Mb1	Gacuriro	80	1,861		
Ub5	To Kibagabaga	300	6,853		
Ub6	Nyarutarama -in	110	2,815	1,313	53.4%
Ub7	Nyarutarama 500mm	500	4,647		
対象給水エリア全体			9,144		40.6%

*Mb1 の流量は同時期に測定できなかったため、2022 年 1 月の実測値を参考にした。

出典：調査団

第 3 回調査

第 2 回調査は 2022 年 2 月 21 日～28 日の期間に第 1 回調査で得られた結果との比較と支管の給水区域を含めた流量測定を実施した。測定結果は**図 1.3-1** の通りである。



出典：調査団

図 1.3-1　第 1 回調査の流量測定結果

第 2 回調査は 500mm 送水本管のノトラ配水池直後（Ub1）と終点（Ub7）、各分岐の流量測定を行い、ライン B 全体および支管の給水区域の無収水率を算出した（**表 1.3-2**）。Ua1~7 については超音波流量計を用いて測定し、Amakawa 方面への送水管分岐 EFM2 について無収水技プロの流量計データを用いた。Mb1 については本調査で取り付けた機械式流量計を用いて測定した。ライン B の給水エリア全体の無収水率は 42.1%であった。

Kibagabaga 方面の Ub5 においてレメラ Golf 8 配水池側からの送水との兼ね合いにより、1 か月を通して日平均流量が安定しておらず、Ub1 のデータが一部欠損しており、誤差が大きい。

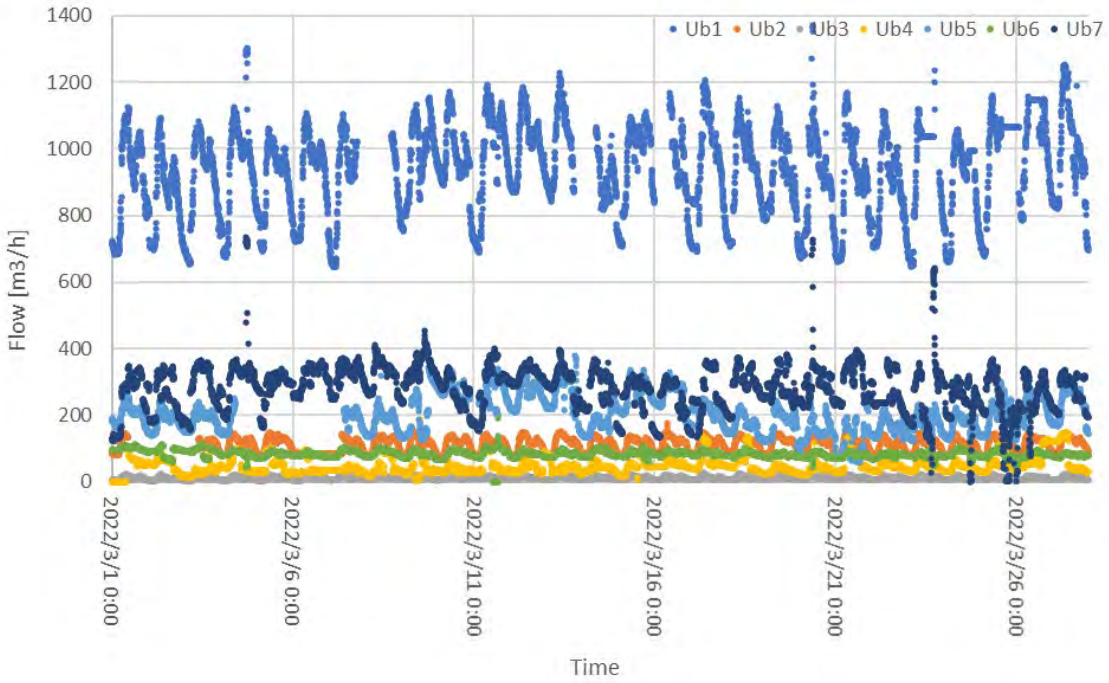
表 1.3-2　ライン B の 2 月平均流量、2 月平均請求水量および無収水率

ID	場所	口径（mm）	2 月平均流量(m3/d)	2 月平均請求水量 (m3/d)	無収水率(%)
Ub1	Ntora-out 500mm	500	22,834		
EFM 2	To Amakawa	250	2,019		
Ub2	Fawe	110	2,762	1,824	33.9%
Ub3	Kagugu	80	265	185	30.2%
Ub4	Gacuriro	200	1,352	2,172	30.7%
Mb1	Gacuriro	80	1,784		
Ub5	To Kibagabaga	300	5,066		
Ub6	Nyarutarama -in	110	2,330	1,141	51.0%
Ub7	Nyarutarama 500mm	500	6,560		
対象給水エリア全体			9,189		42.1%

出典：調査団

第 4 回調査

第 4 回調査も 500mm 送水本管のノトラ配水池直後（Ub1）と終点（Ub7）、各分岐の流量測定を行い、ライン B 全体および支管の給水区域の無収水率を算出した。測定結果は**図 1.3-2** の通りである。



出典：調査団

図 1.3-2　第 4 回調査の流量測定結果

これまでの調査に引き続き Ub5 や Ub7 の流量パターンが安定していない一方、測定期間が長く、比較的データの欠損も少ないため、他の調査期間に比べて測定結果からより確からしい月平均流量を推定できる。ライン B の給水エリア全体の無収水率は 37.0%であった（**表 1.3-3**）。500mm 送水管の流入部分（Ub1）と流出部分（Ub7）および対象区域外への分岐（EFM2, Ub5）の測定値の和の差分（Ub1-Ub7-EFM2-Ub5）から算出したライン B 全体の流量と各支管（Ub2, Ub3, Ub4, Mb1, Ub6）の測定値の合計から算出したライン B 全体の流量の差は 4%程度で許容範囲である。

表 1.3-3　ライン B の 3 月平均流量、3 月平均請求水量および無収水率

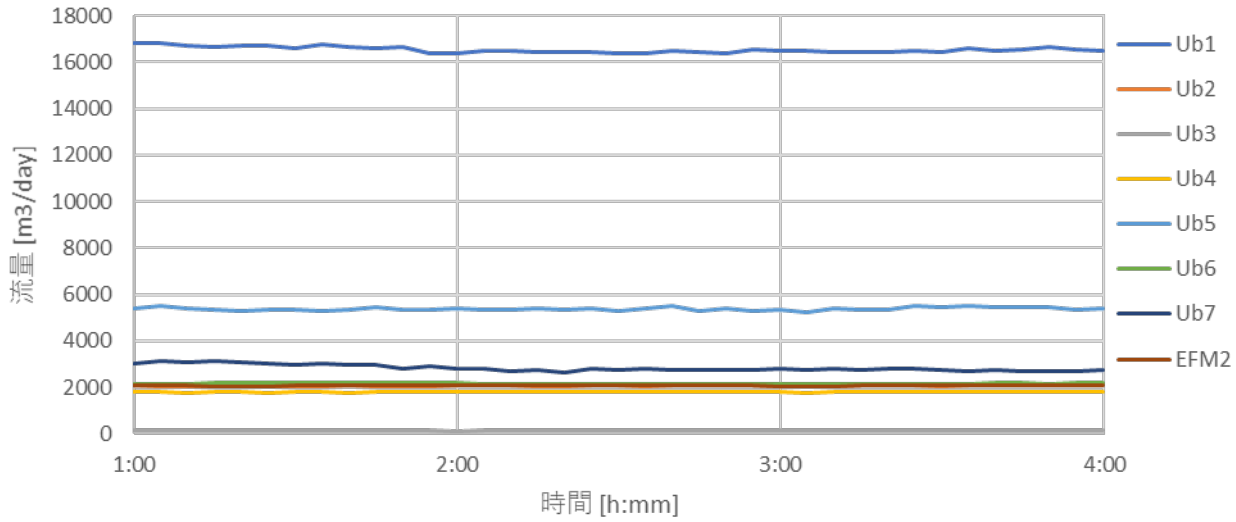
ID	場所	口径（mm）	3 月平均流量(m3/d)	3 月平均請求水量 (m3/d)	無収水率 (%)
Ub1	Ntora-out 500mm	500	22,570		
EFM2	To Amakawa	250	2,362		
Ub2	Fawe	110	2,854	1,866	34.6%
Ub3	Kagugu	80	253	170	32.9%
Ub4	Gacuriro	200	1,160	2,128	31.3%
Mb1	Gacuriro	80	1,937		
Ub5	To Kibagabaga	300	4,901		
Ub6	Nyarutarama-in	110	2,077	1,299	37.4%

ID	場所	口径（mm）	3 月平均流量(m3/d)	3 月平均請求水量 (m3/d)	無収水率 (%)
Ub7	Nyarutarama 500mm	500	6,637		
対象給水エリア全体			8,670	5,464	37.0%

出典：調査団

漏水量調査

11 月 30 日 1 時から 4 時の流量測定結果を**図 1.3-3** に示す。



出典：調査団

図 1.3-3　11 月 30 日 1 時～4 時の夜間最小流量測定結果

表 1.3-4 のとおり、500mm 送水本管の漏水量は平均水量 16,348 m^3/日に対し 276 m^3/day（約 1.7%）と推定された。500mm 送水本管の漏水量については、ライン A と同様に変動がみられるため正確に夜間最小流量が確認されてはいないが、安全側の推定で約 1.7%の漏水量であり大規模な更新等が不要で既存活用できるものと考えられる。他方、給水エリア全体の漏水量総和は、6,359 m^3/day と推定された。ただし、これはライン A と同様に昼間給水圧力を夜間圧力と同等と仮定したときの漏水量であり、過大な推定値である。最終的なベースラインとしての漏水量推定値は、ライン A と同様に無収水量から算定する。

表 1.3-4　11 月 30 日 1 時～4 時の夜間最小流量と漏水量

ID	場所	口径 (mm)	夜間最小流量 (m^3/day)
Ub1	Ntora-out 500mm	500	16,348
EFM2	To Amakawa	250	2,057
Ub2	Fawe	110	2,032
Ub3	Kagugu	80	141
Ub4	Gacuriro	200	1,774

ID	場所	口径 (mm)	夜間最小流量 (m^3/day)
Mb1	Gacuriro	80	0
Ub5	To Kibagabaga	300	5,261
Ub6	Nyarutarama-in	110	2,136
Ub7	Nyarutarama 500mm	500	2,671
		Ub1 以外の合計	16,071
		500mm の送水管の漏水量	276
		小計	6,359

出典：調査団

1.4 結果の解釈

本項冒頭に示した通り、代表値としては 2022 年 3 月 1 か月間の測定期間で計測した、38.2%が最も妥当と考え採用したが、全調査期間の結果からは無収水率もライン A が 37.3~41.5%、ライン B が 37.0%~42.1%で推移しており、測定期間の無収水率として約 37%~42%程度という幅を持った数字と考える必要がある。また、測定期間は季節的な偏りもあり、測定に現れない無収水率（量）の誤差としてさらに±5%程度は想定しておく必要がある。

まず、機器の誤差について、機器そのものの誤差は約±1%程度（メーカー聞取り）とのことだが、設置による誤差、設定の誤差などから流量に対して約±5%程度の誤差は想定する必要があると考えられる。特に、管厚は仕様値が正確にはわからないこと、経年劣化等によりスケールの蓄積なども考えうるため、誤差要因である。

また、とりわけ対象地域においては 1 ヵ月を通して流量パターンが一定でない場所（特に Ub1 や Ub4、Ub5、Ub7 等）があり、漏水事故や苦情などを原因として管路のバルブ操作などの運用状況の変更が頻繁に行われている状況が考えられる。調査においては WASAC 支店のエンジニアと協力し、バルブの操作があった場合には連絡するように伝えていたが、実際には全てが把握されずにテクニシャンレベルでバルブ操作が行われ支店で把握されていない可能性が高い。水運用が変更されると無収水は大きく変わりうるため、変動の一因となる。

さらに、水利用状況や突発的な漏水の影響で、無収水率は測定時期によって大きく変動する可能性がある。実際に、キガリ全体としても±7%程度の月変動（2020/2021 年度で 36.7%~50.1%の変動幅）がみられている。

このようなことから、事業完了後の効果を測定する際には実施時期・流量パターンなどの情報に注意しつつ、誤差による影響を考慮した考察が必要である。

第2章　圧力調査

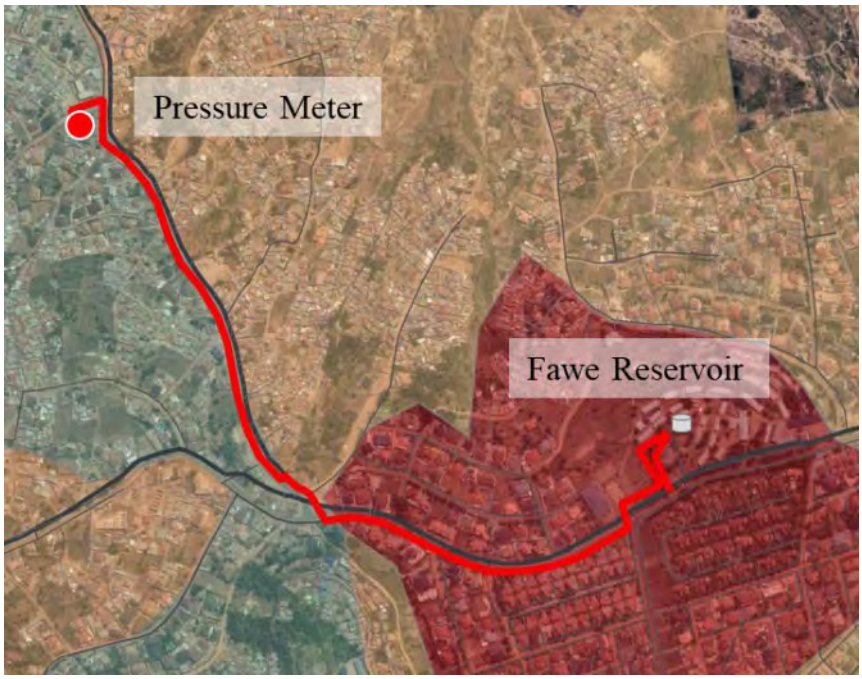
圧力センサ No. 14

Fawe に設置した圧力センサ No. 14 は、500 mm 送水本管から分岐している。**表 1.4-1** に基本情報を示す。

表 1.4-1　圧力センサ No. 14 の基本情報

No.	場所	配水池	タイプ	世帯人数	高さ	管路延長	管種と口径
14	Fawe	ノトラ	家庭	8	1,424 m	3.8 km	DI (ND500) – PVC (ND90~110) –HDPE (ND63) - Galvanized Pipe (ND25)

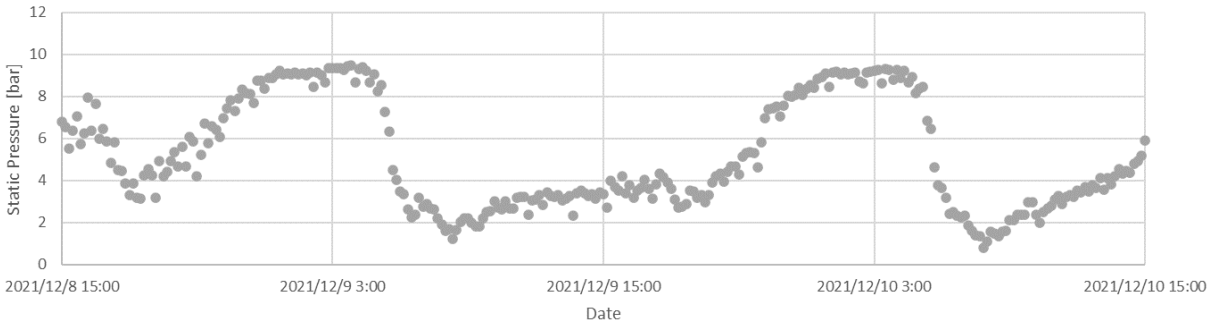
圧力センサ設置位置と配水ルートを**図 1.4-1** に示す。



出典：調査団

図 1.4-1　圧力センサ No. 14 設置位置と配水ルート

水圧測定結果を**図 1.4-2** に示す。観測された最大水圧は 9.92 bar、最小動水圧は 0.82 bar であった。標高差から求めた最大静水圧は 14.1 bar であった。



出典：調査団

図 1.4-2　圧力センサ No. 14 の水圧測定結果

圧力センサ No. 20

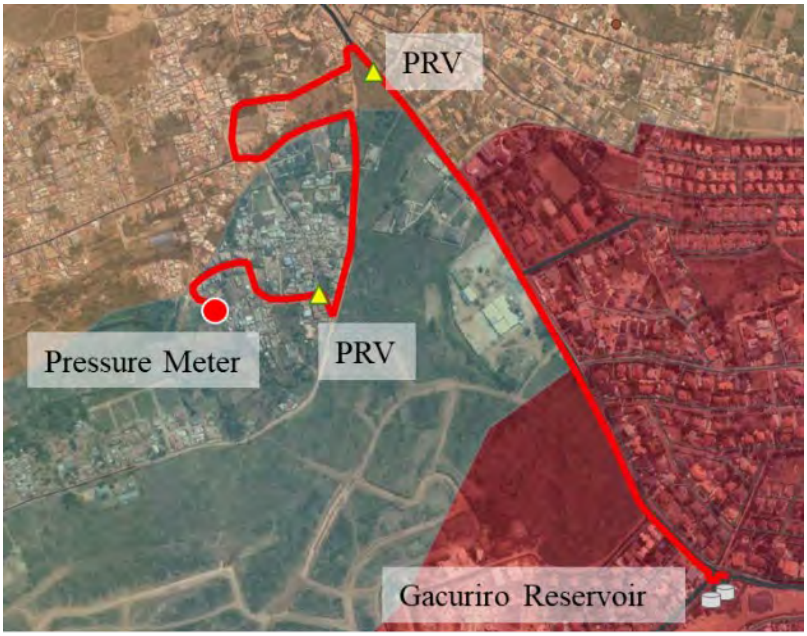
Gacuriro に設置した圧力センサ No. 20 は 500 mm 送水本管から分岐している。基本情報は**表 1.4-2** に示す。

表 1.4-2　圧力センサ No. 20 の基本情報

No.	場所	配水池	タイプ	世帯人数	高さ	管路延長	管種と口径
20	Gacuriro	ノトラ	家庭	5	1,396 m	8.0 km	DI (ND500) – PVC (ND90) – PVC (ND50) – PVC (ND25) – HDPE (ND40)

出典：調査団

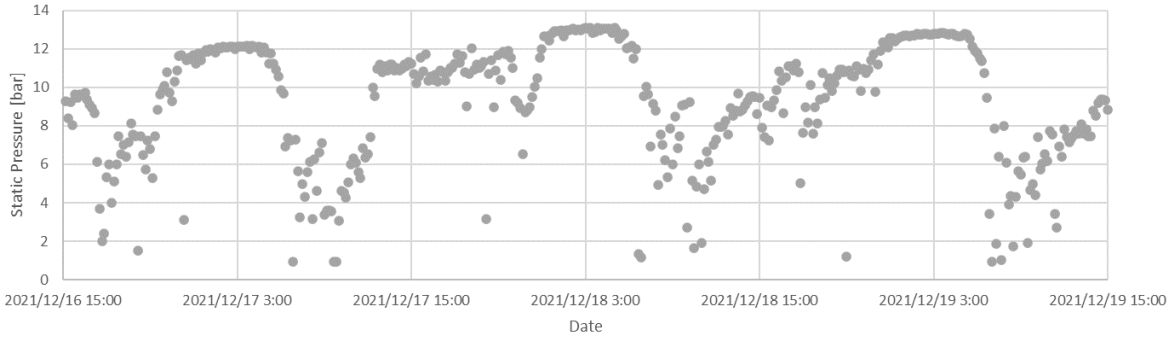
圧力センサ設置位置と配水ルートを**図 1.4-3** に示す。送水本管からの分岐後に PRV が 2 つ設置されており、口径が小さい管路（口径 25mm）の延長が大きい。



出典：調査団

図 1.4-3　圧力センサ No. 20 設置位置と配水ルート

測定結果を**図 1.4-4** に示す。観測された最大水圧は 13.1 bar、最小動水圧は 0.94 bar であった。標高差から求めた最大静水圧は 16.9 bar であった。



出典：調査団

図 1.4-4　圧力センサ No. 20 の水圧測定結果

圧力センサ No. 31

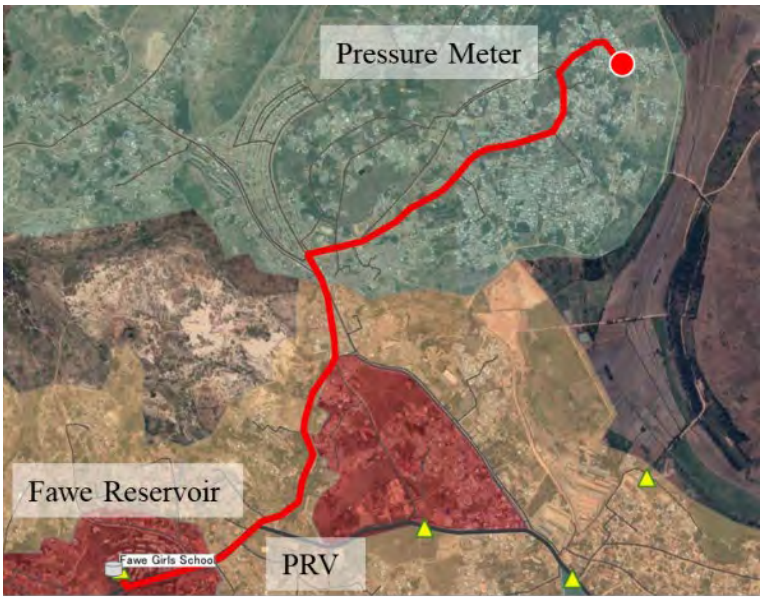
Batsinda に設置した圧力センサ No. 31 は 500 mm 送水本管から分岐している。顧客への聞き取り調査の結果、週に 2 日しか給水されていない。基本情報は**表 1.4-3** に示す。

表 1.4-3　圧力センサ No. 20 の基本情報

No.	場所	配水池		タイプ	世帯人数	高さ	管路延長	管種と口径
20	Batsinda	ノトラ		家庭	6	1,396 m	5.5 km	DI (ND500) – PVC (ND110~200) – PVC (ND50~75) – Galvanized Pipe (ND40)

出典：調査団

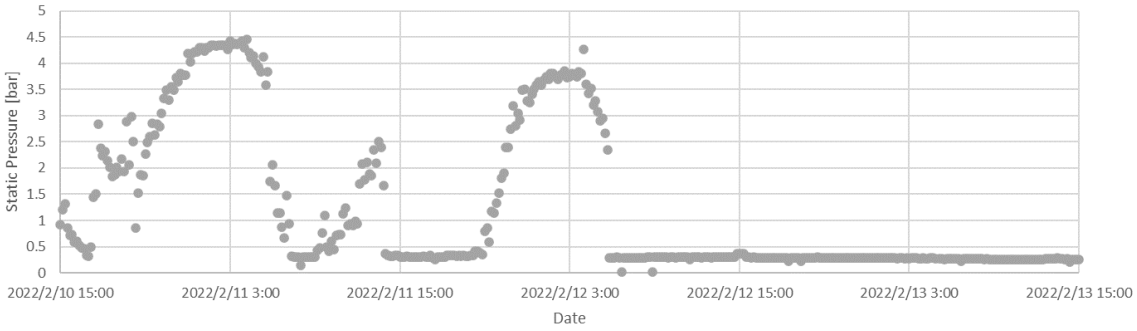
圧力センサ設置位置と配水ルートを**図 1.4-5** に示す。送水本管からの分岐後に PRV が 1 つ設置されている。



出典：調査団

図 1.4-5　圧力センサ No. 31 設置位置と配水ルート

測定結果を**図 1.4-6** に示す。観測された最大水圧は 4.5 bar、最小動水圧は 0.0 bar であった。標高差から求めた最大静水圧は 11.5 bar であった。ピーク時には給水圧が足りておらず、2 月 12 日午前 6 時以降は圧力が 0.3 bar 程度である。



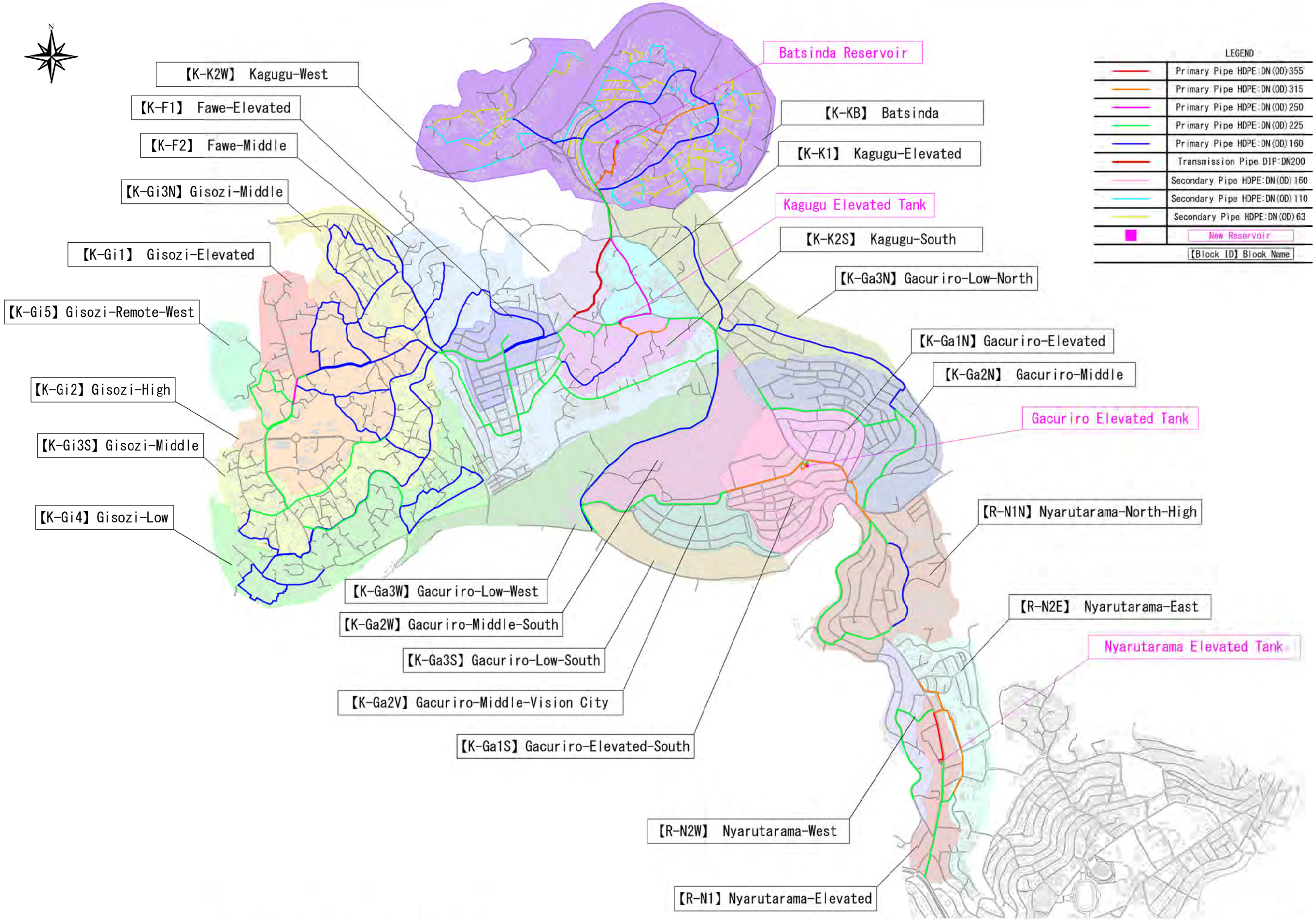
出典：調査団

図 1.4-6　圧力センサ No. 31 の水圧測定結果

添付資料 11　概略設計図・図面集

Drawing List

Facility Title	Drawing Title	No.	Scale
Pipeline	General Map for Pipeline Network	KG-G-001	1:30,000
	Typical Drawing for Pipe Laying (1) Earthwork 1	KG-TYP-001	None
	Typical Drawing for Pipe Laying (2) Earthwork 2	KG-TYP-002	None
	Typical Drawing for Pipe Laying (3) Sluice Valve, Blow off, Fire Hydrant	KG-TYP-003	None
	Typical Drawing for Pipe Laying (4) Air Valve, Culvert Crossing	KG-TYP-004	None
	Typical Drawing for Pipe Laying (5) Service Connection	KG-TYP-005	None
Gacuriro Pressure Reducing Facility	General Layout of Gacuriro	KG-R-101	1:300
	Pipe Layout of Gacuriro	KG-R-102	1:300
Kagugu Elevated Tank	General Layout of Kagugu Elevated Tank	KG-R-201	1:200
	Kagugu Elevated Tank Structure (1)	KG-R-202	1:200
	Kagugu Elevated Tank Structure (2)	KG-R-203	1:200
	Kagugu Elevated Tank Structure (3)	KG-R-204	1:50
	Kagugu Elevated Tank Structure (4)	KG-R-205	1:200
	Pipe Layout of Kagugu Elevated Tank	KG-R-206	1:200
Nyarutarama Pressure Reducing Facility	General Layout of Nyarutarama	KG-R-301	1:200
	Pipe Layout of Nyarutarama	KG-R-302	1:200
Batsinda Reservoir	General Layout of Batsinda Ground Reservoir	KG-R-401	1:200
	Batsinda Ground Reservoir Structure (1)	KG-R-402	1:100
	Batsinda Ground Reservoir Structure (2)	KG-R-403	1:100
	Batsinda Ground Reservoir Structure (3)	KG-R-404	1:100
	Batsinda Ground Reservoir Structure (4)	KG-R-405	1:100
	Pipe Layout of Batsinda Ground Reservoir	KG-R-406	1:200
Monitoring System	System Configuration Diagram (Plan)	KG-E-01	None
	System Configuration Diagram (Existing)	KG-E-02	None
	Instrumentation Diagram (1)	KG-E-03	None
	Instrumentation Diagram (2)	KG-E-04	None



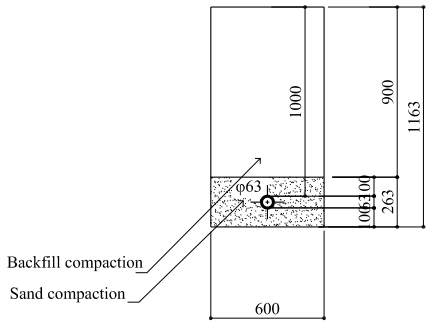
A11-2

PROJECT *PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA*	DESCRIPTION *General Map*		APPROVED BY	DATE	DRAWING No *KG-G-001*
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE *1:30000*

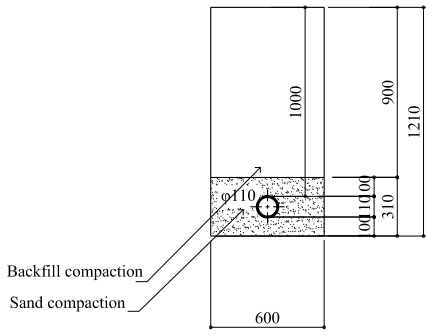
Typical Drawing for Pipe Laying

A11-3

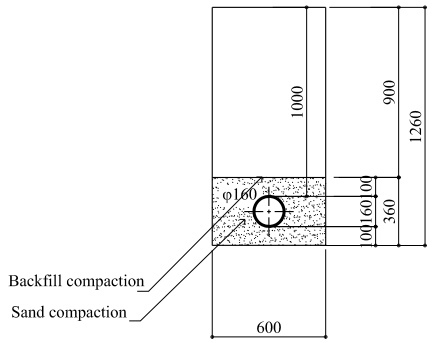
TYP 01
ϕ63, Road shoulder



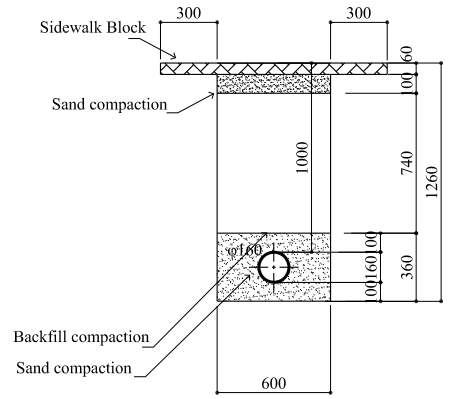
TYP 04
ϕ110, Road shoulder



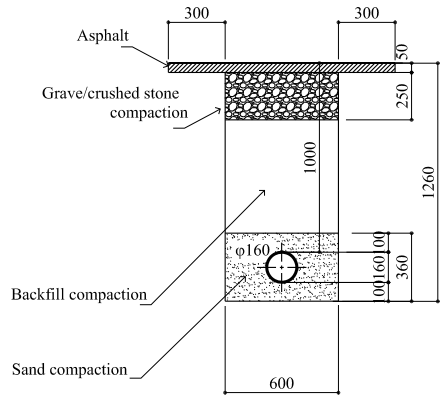
TYP 07
ϕ160, Road shoulder



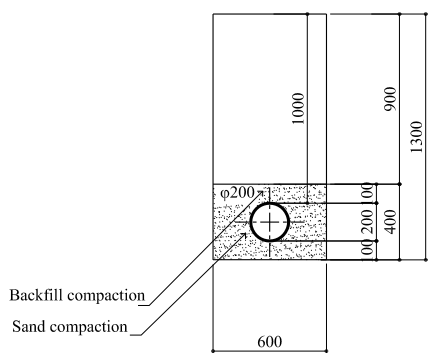
TYP 08
ϕ160, Walkway



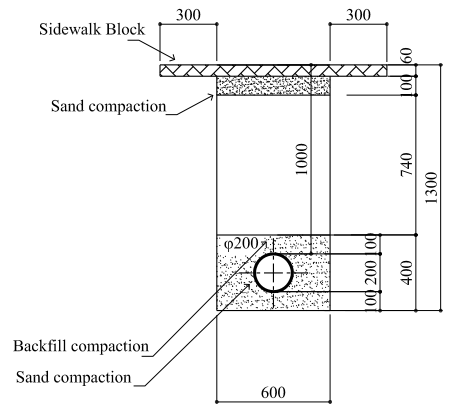
TYP 09
HDPE ϕ160, Pavement crossing



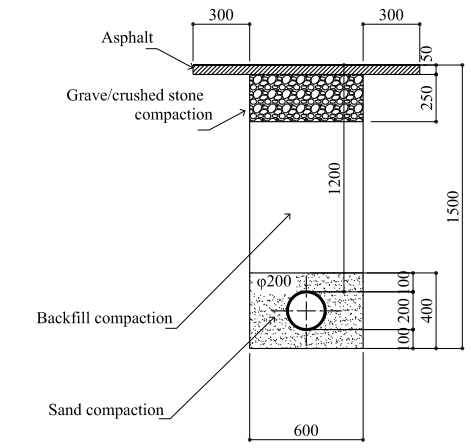
TYP 10
DIP ϕ200, Road shoulder



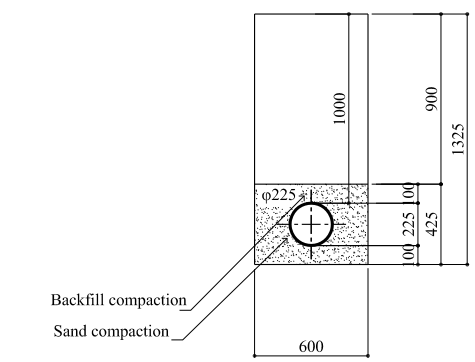
TYP 11
DIP ϕ200, Walkway



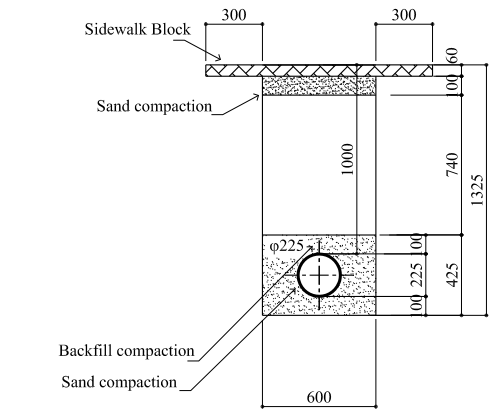
TYP 12
DIP ϕ200, Pavement crossing



TYP 13
ϕ225, Road shoulder



TYP 14
ϕ225, Walkway

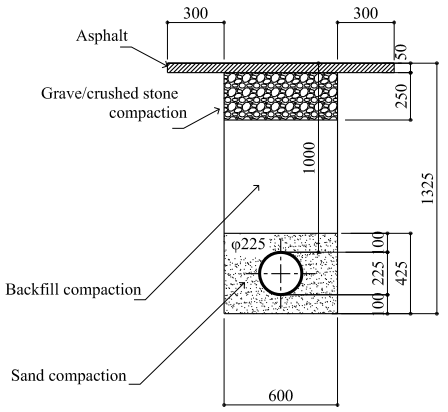


PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA	*Typical Drawing for Pipe Laying (1)*				*KG-TYP-001*
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE *1:40*

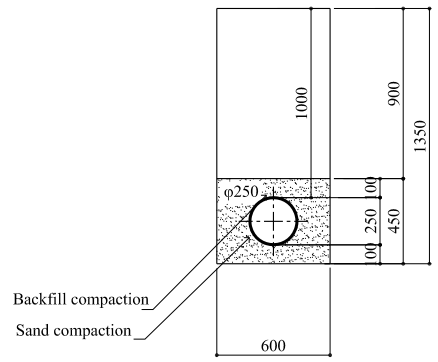
Typical Drawing for Pipe Laying

A11-4

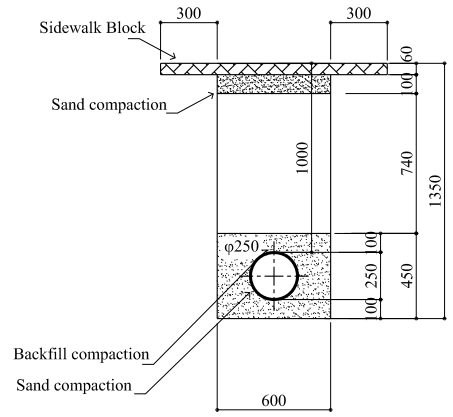
TYP 15
HDPE ϕ225, Pavement crossing



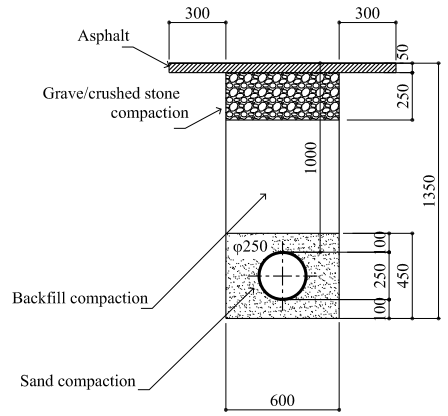
TYP 16
ϕ250, Road shoulder



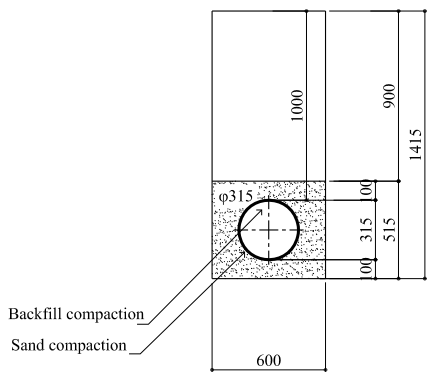
TYP 17
ϕ250, Walkway



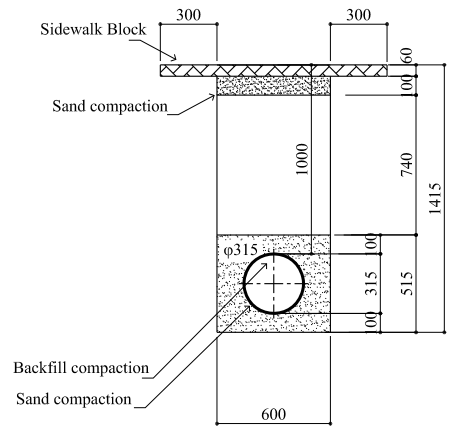
TYP 18
HDPE ϕ250, Pavement crossing



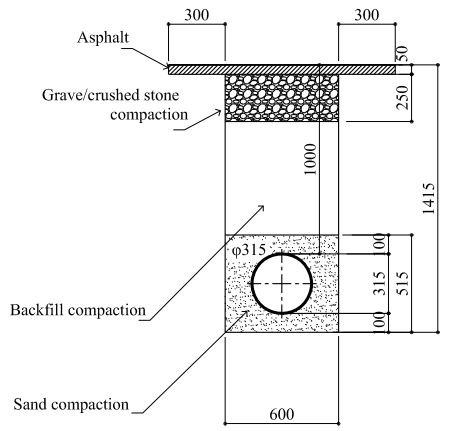
TYP 19
ϕ315, Road shoulder



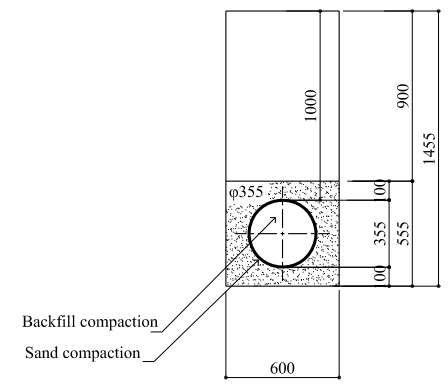
TYP 20
ϕ315, Walkway



TYP 21
HDPE ϕ315, Pavement crossing



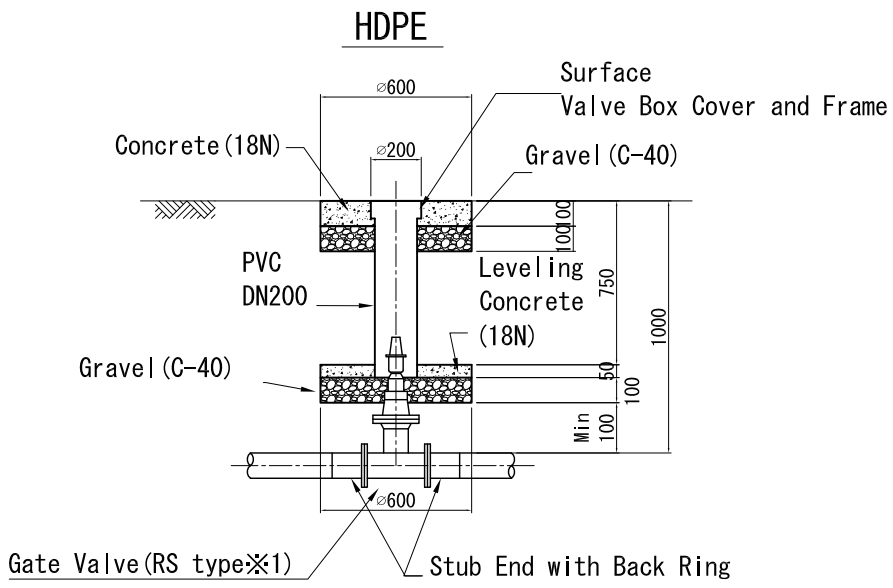
TYP 22
ϕ355, Road shoulder



PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA	*Typical Drawing for Pipe Laying (2)*				*KG-TYP-002*
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE *1:40*

GATE VALVE

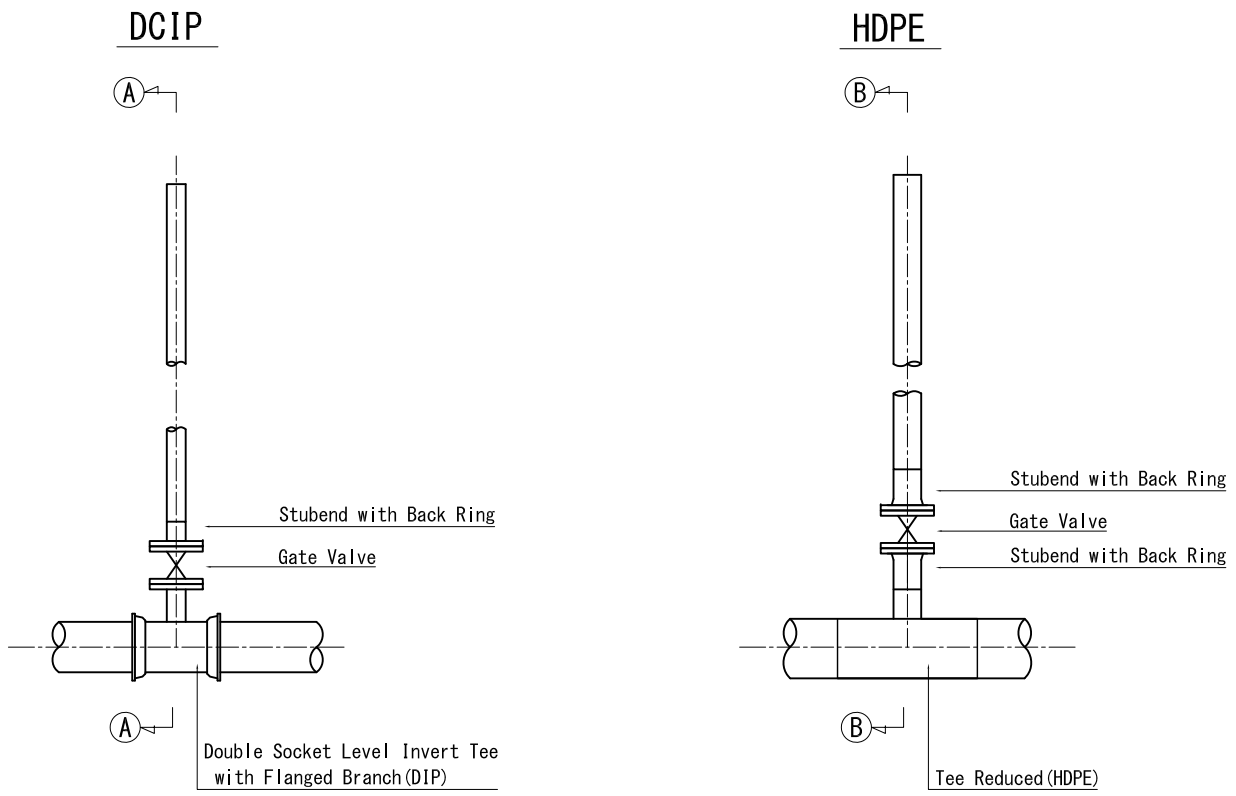
Scale=none



Blow off

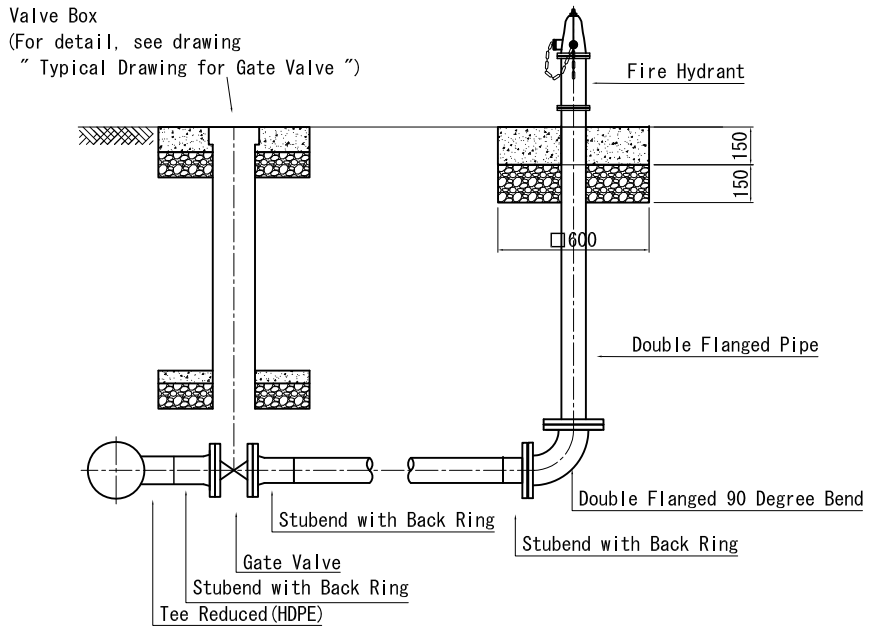
Scale=none

PLAN

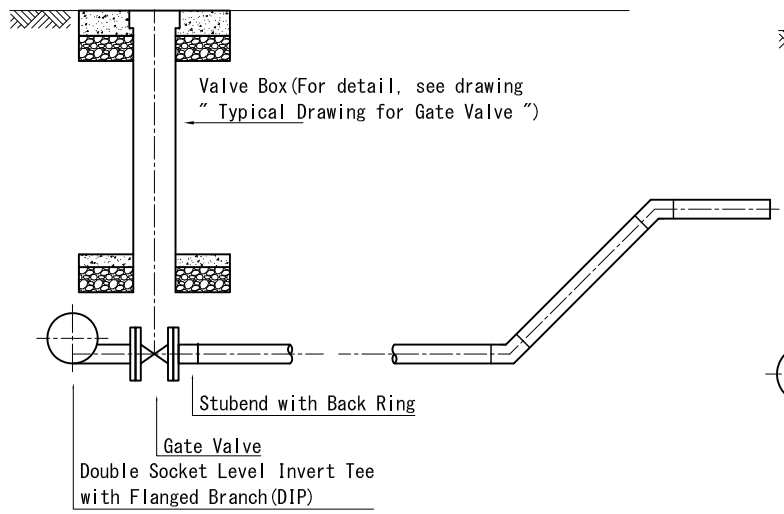


Fire Hydrant

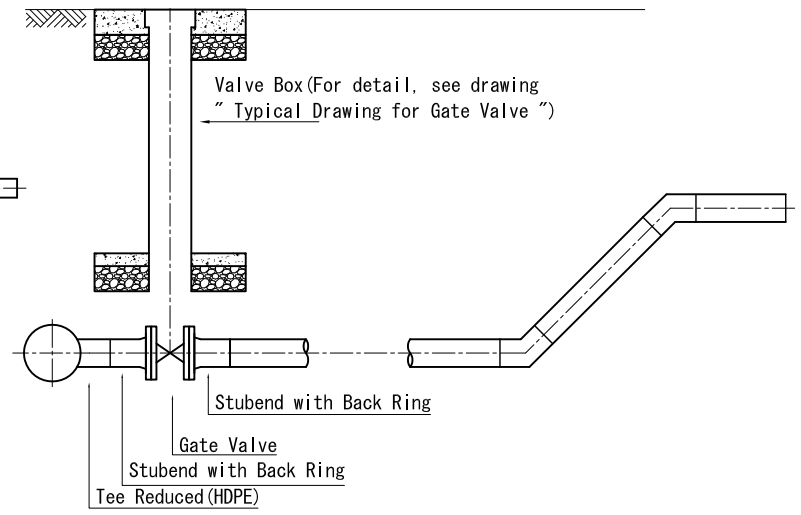
Scale=none



SECTION A-A



SECTION B-B



A11-5

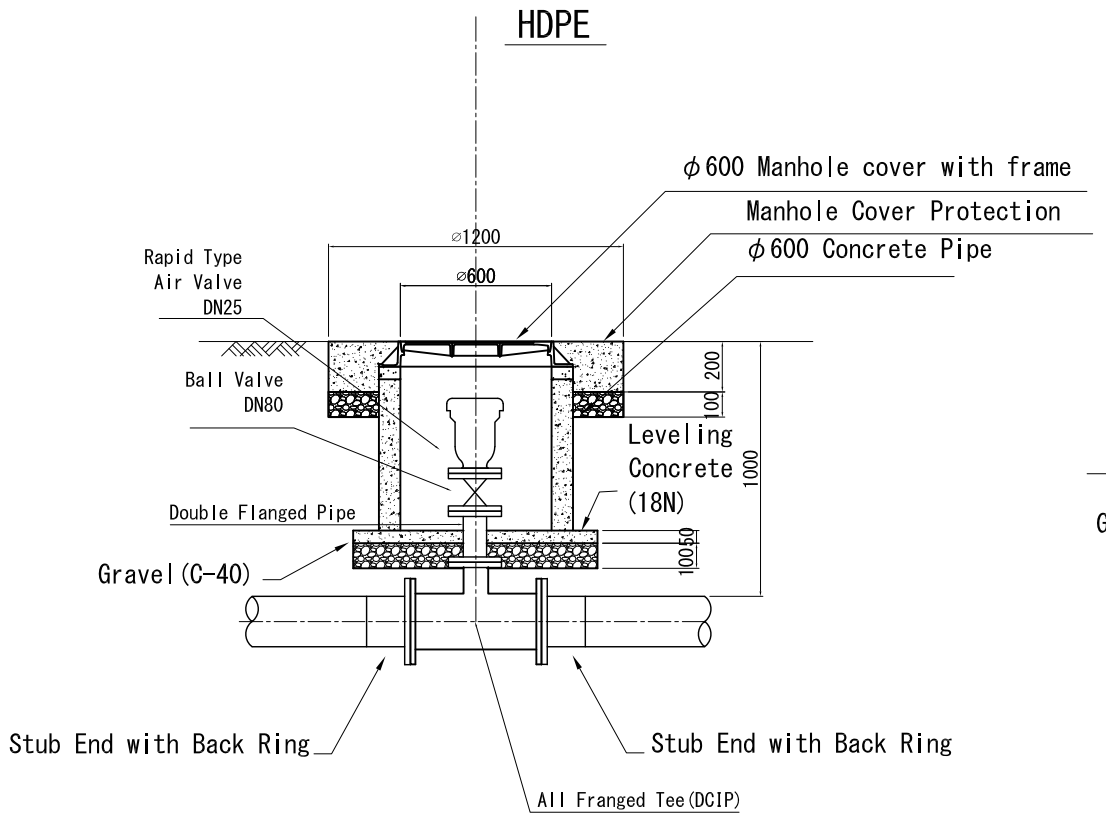
PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA	*Typical Drawing for Pipe Laying (3)*				*KG-TYP-003*
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE *None*

A11-6

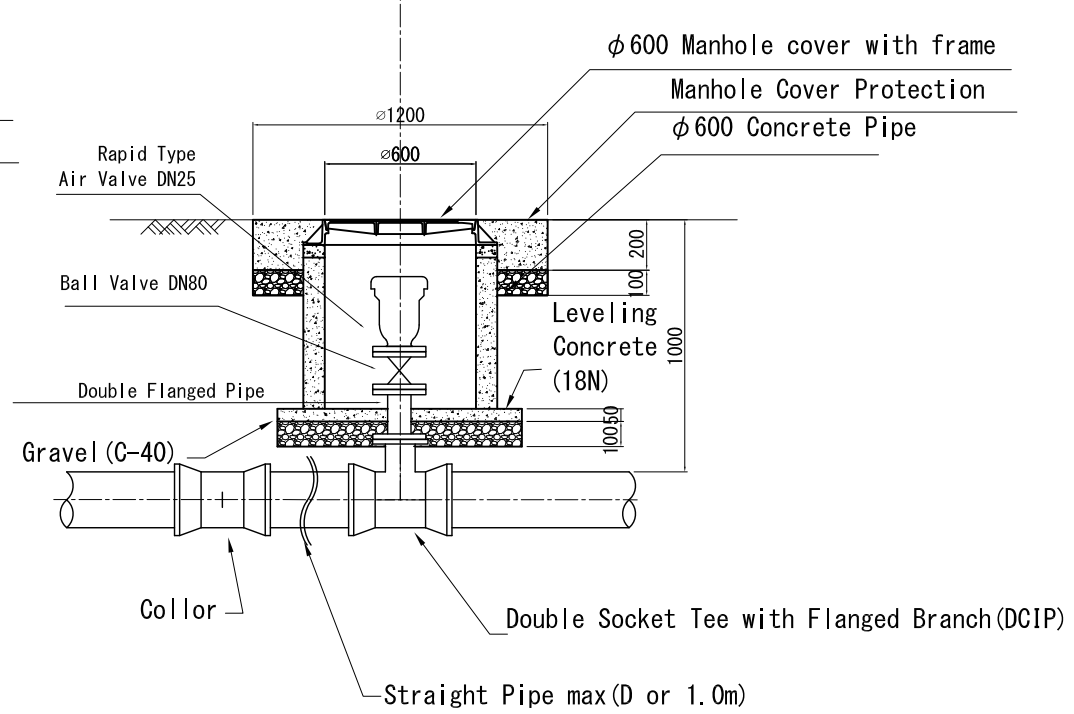
AIR VALVE

Scale=none

HDPE



DCIP



CLUVERT CROSSING

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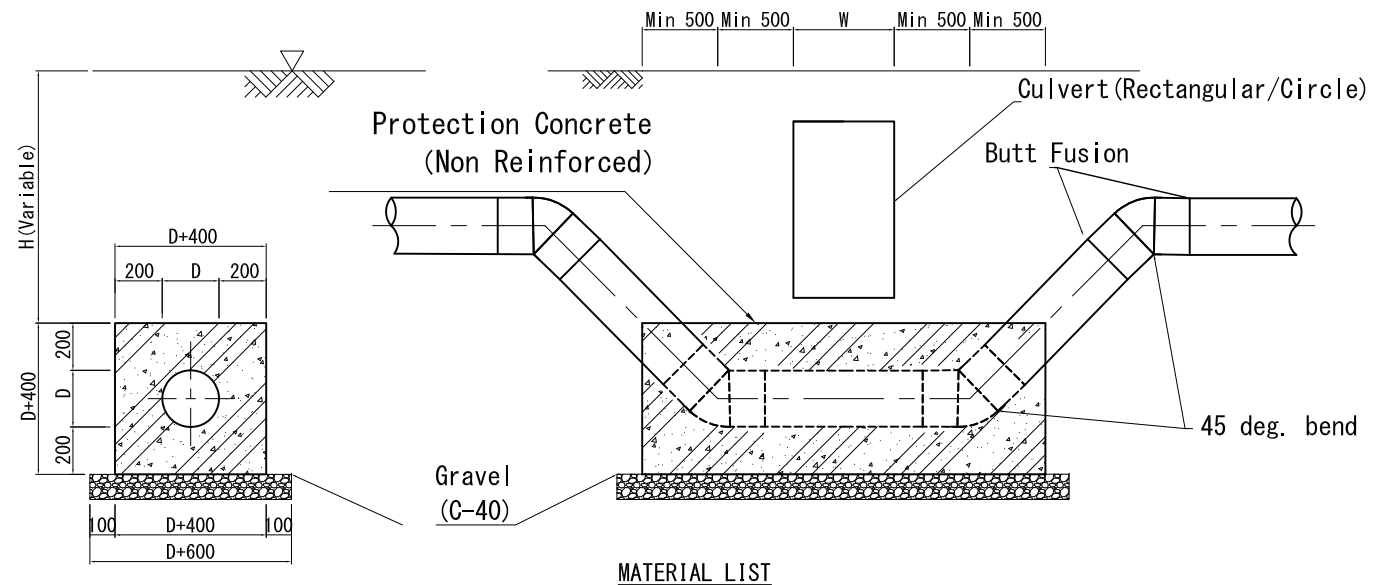


MATERIAL LIST

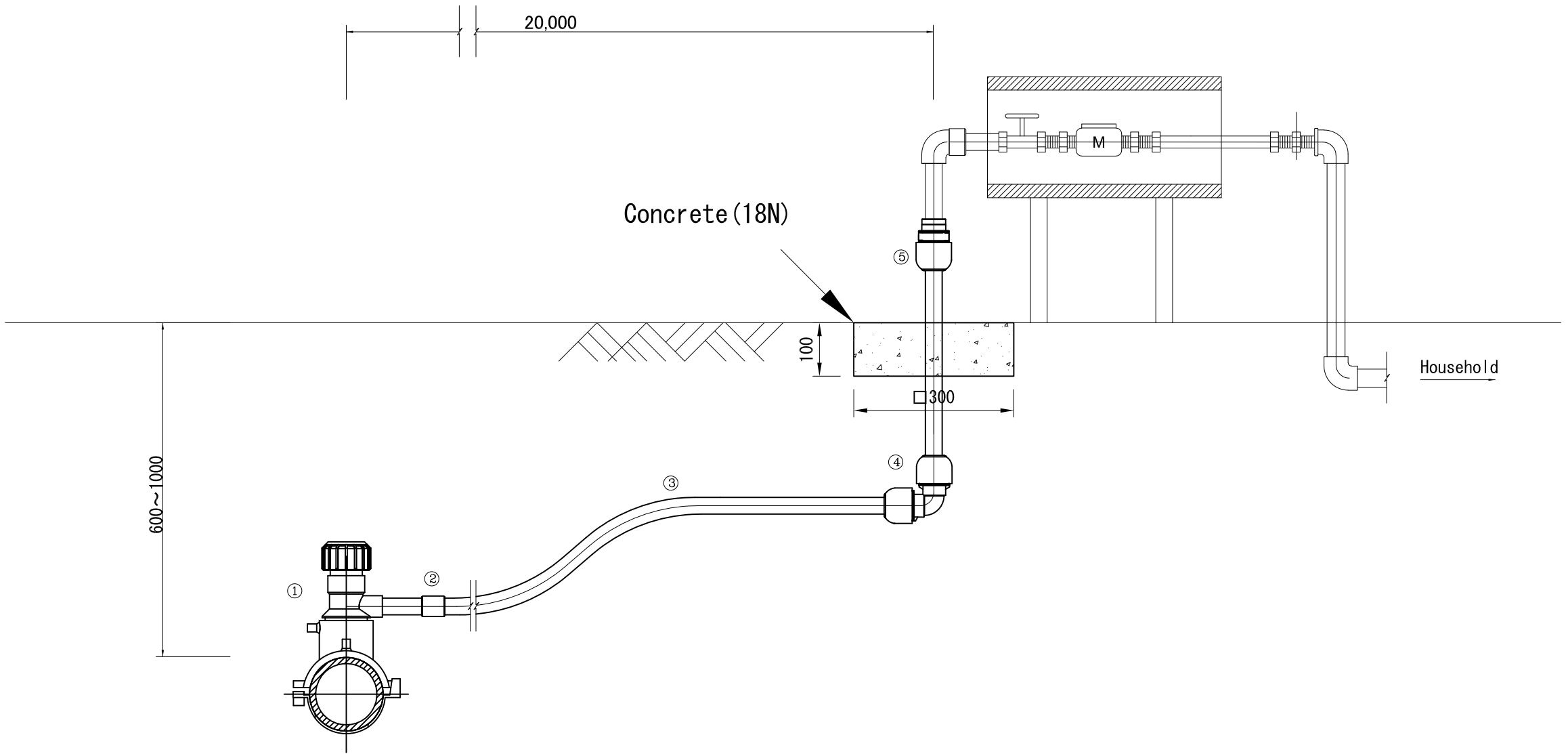
Material	Description	Quantity
HDPE	Straight Pipe	3 pcs
HDPE	45° Bend	4 pcs

PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA	*Typical Drawing for Pipe Laying (4)*				*KG-TYP-004*
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE *None*

A11-7

Service Pipe

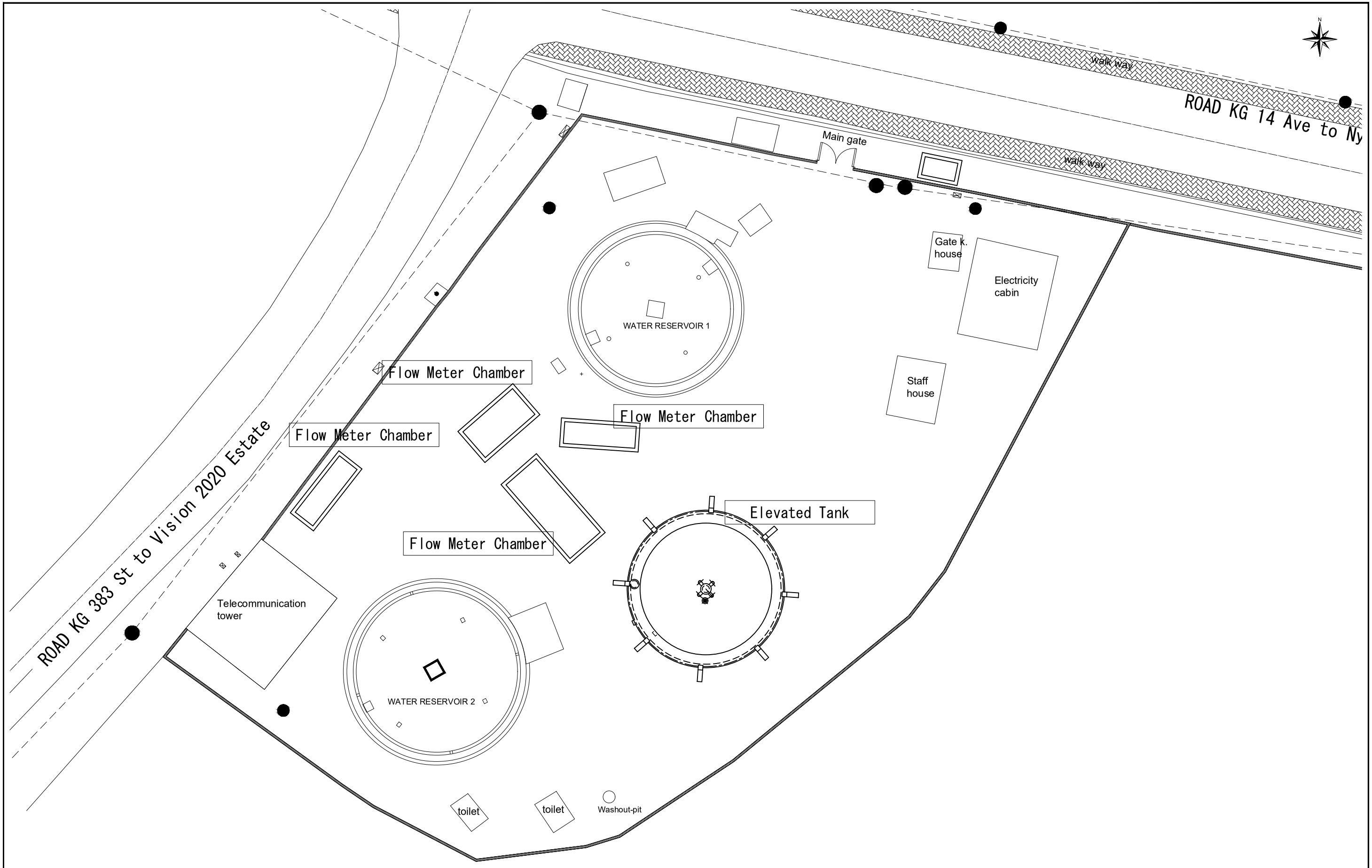
Scale=none



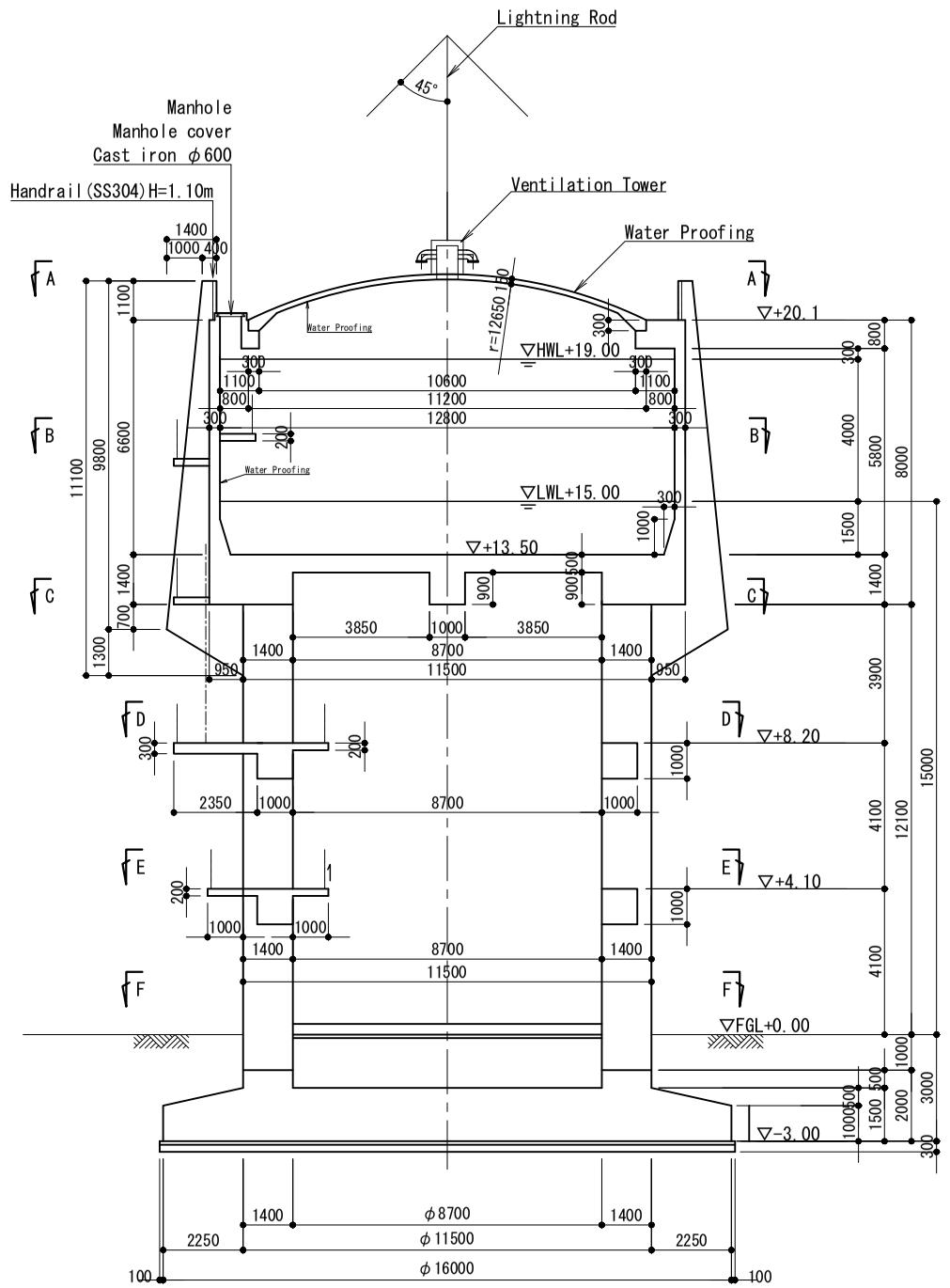
No	Description	Size	Unit	Quantity
1	Ferrule with EF Saddle Clamp for HDPE	⌀ Secondary Pipe X 1″	PC	1
2	HDPE Socket	1″	PC	3
3	HDPE Pipe	25mm X 1″	PC	1
4	HDPE 90 Degree Bend	25mm	m	20
5	Compression Male Adaptor	25mm	PC	1

PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA	*Typical Drawing for Pipe Laying (5)*				*KG-TYP-005*
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE *None*

A11-8



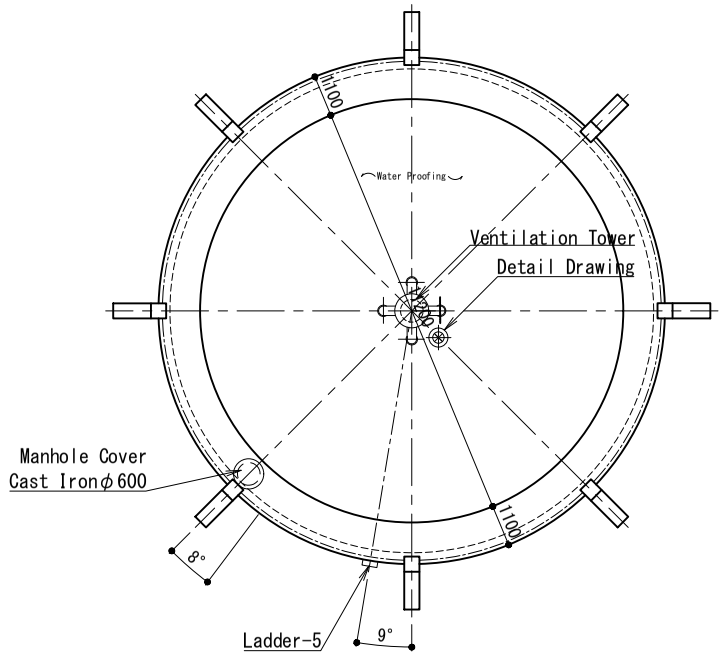
PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA	General Layout of GACURIRO Elevated Tank				*KG-R-101*
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE *1:300*



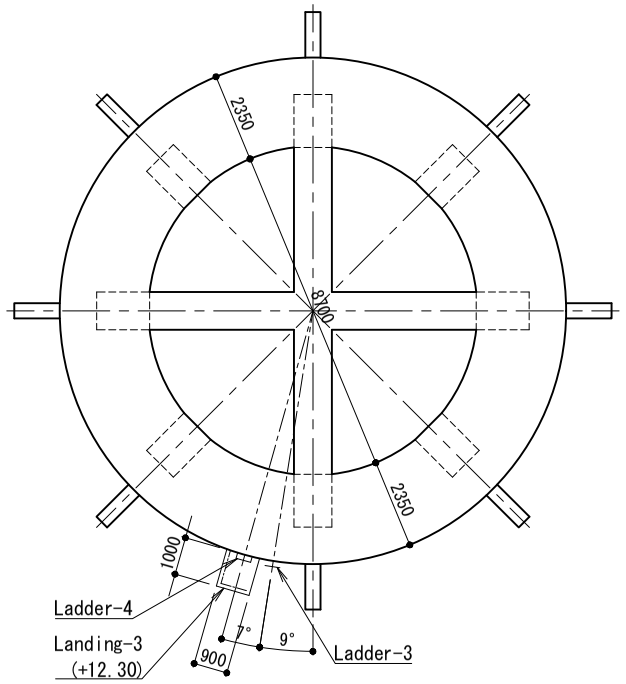
A11-9

PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA	*Gacuriro Elevated Tank Structure (1)*				*KG-R-102*
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE *1:200*

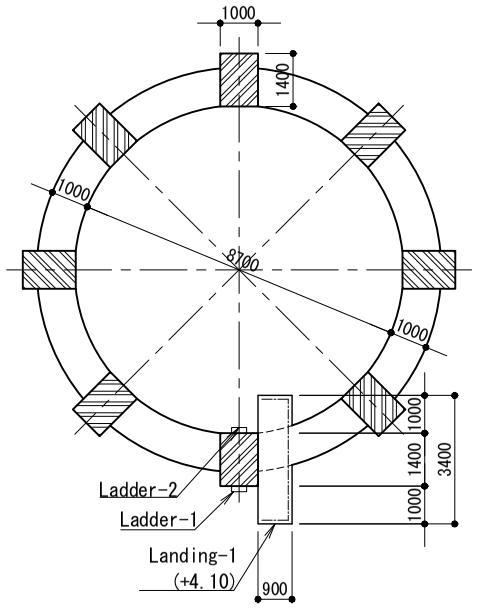
A11-10



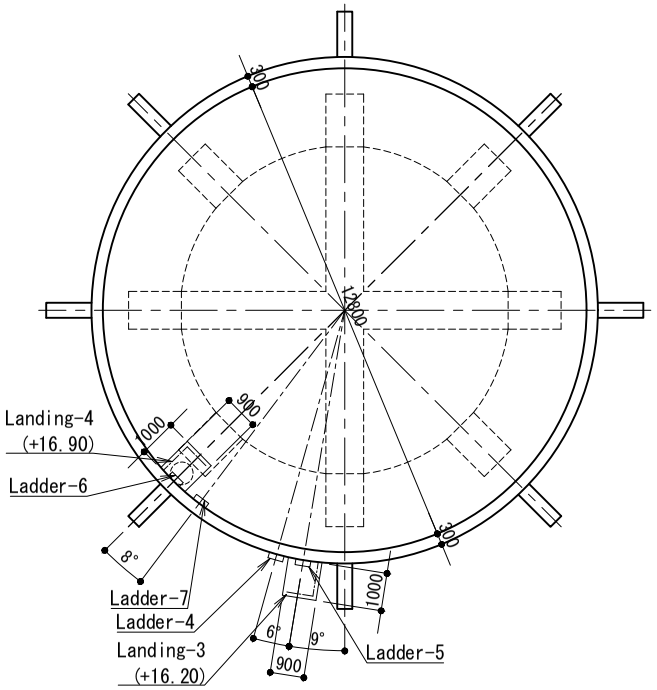
A - A SECTION



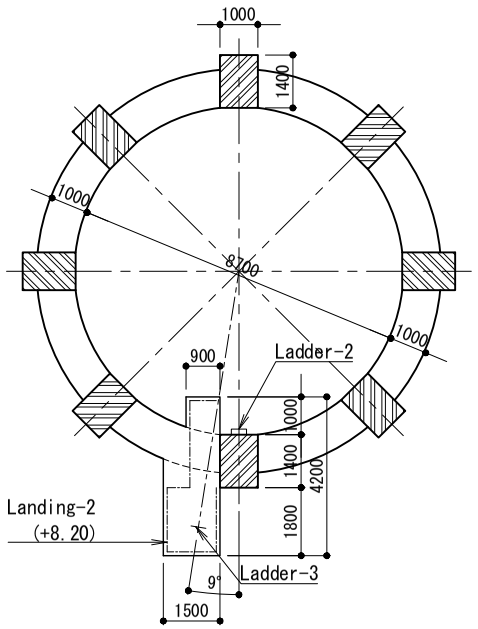
C - C SECTION



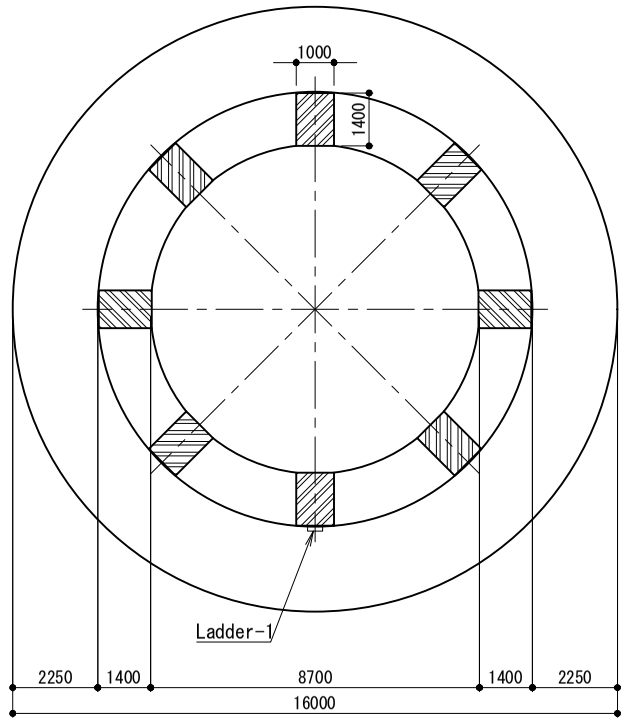
E - E SECTION



B - B SECTION



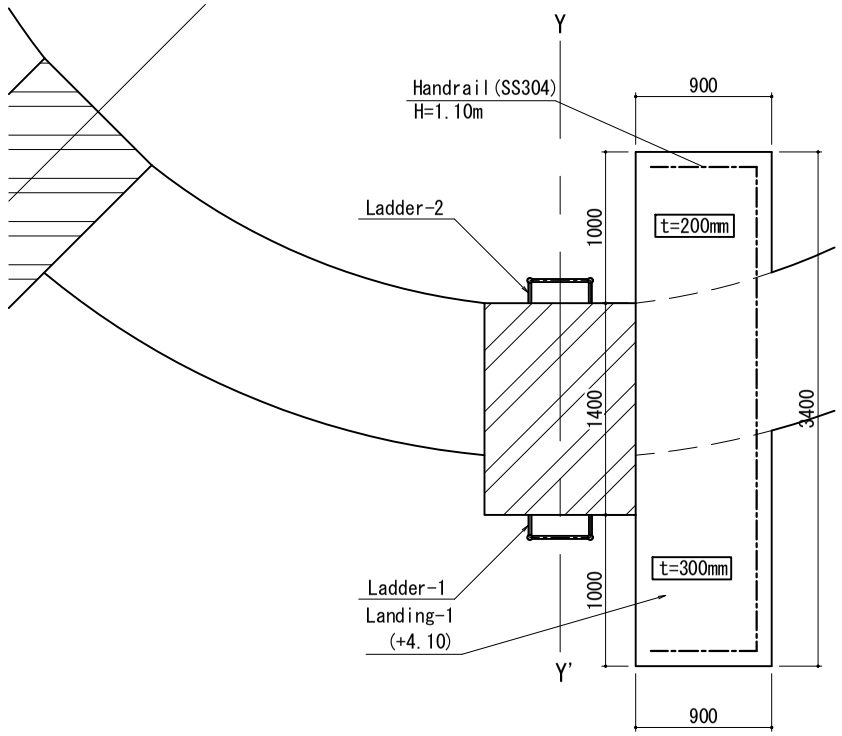
D - D SECTION



F - F SECTION

PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA	*Gaciriro Elevated Tank Structure (2)*				*KG-R-103*
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE *1:200*

A11-11



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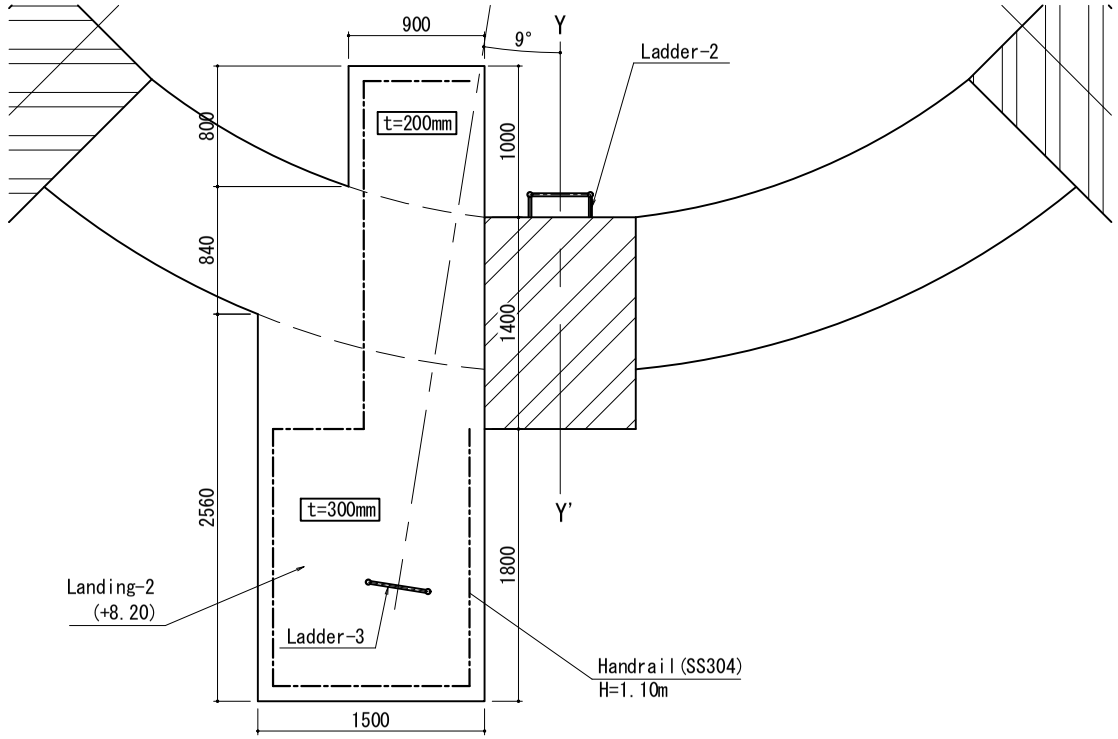
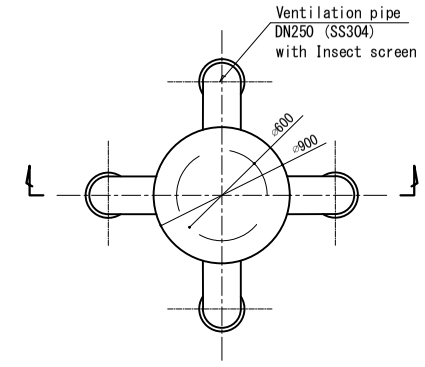
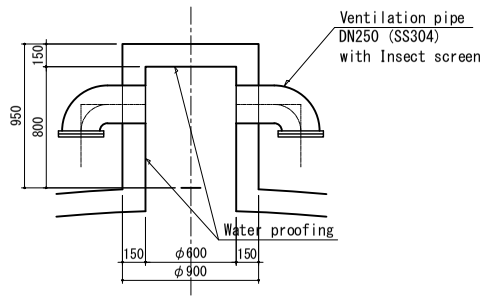


+8.20

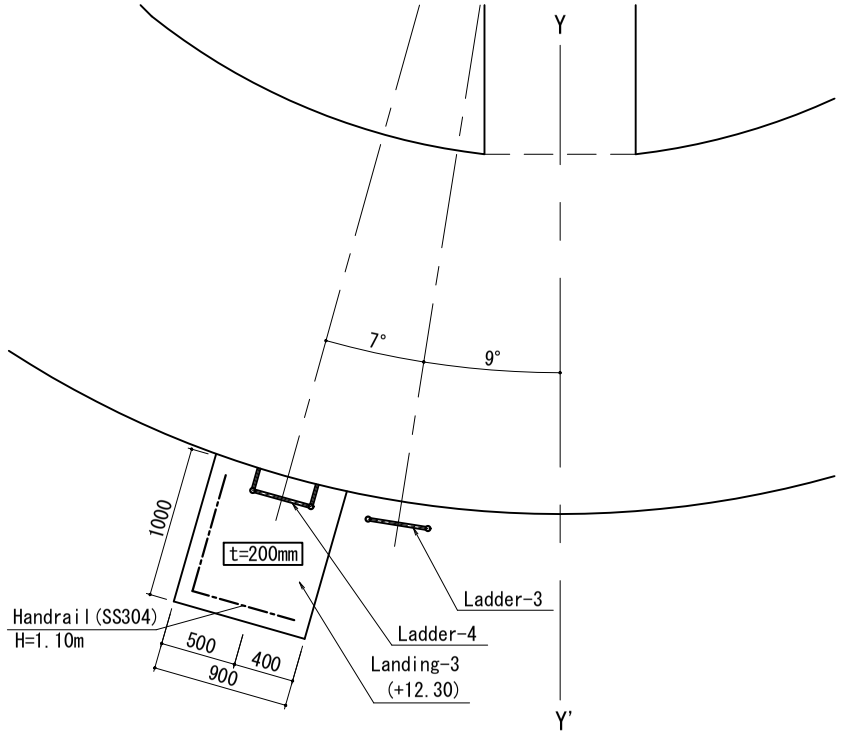


PLAN

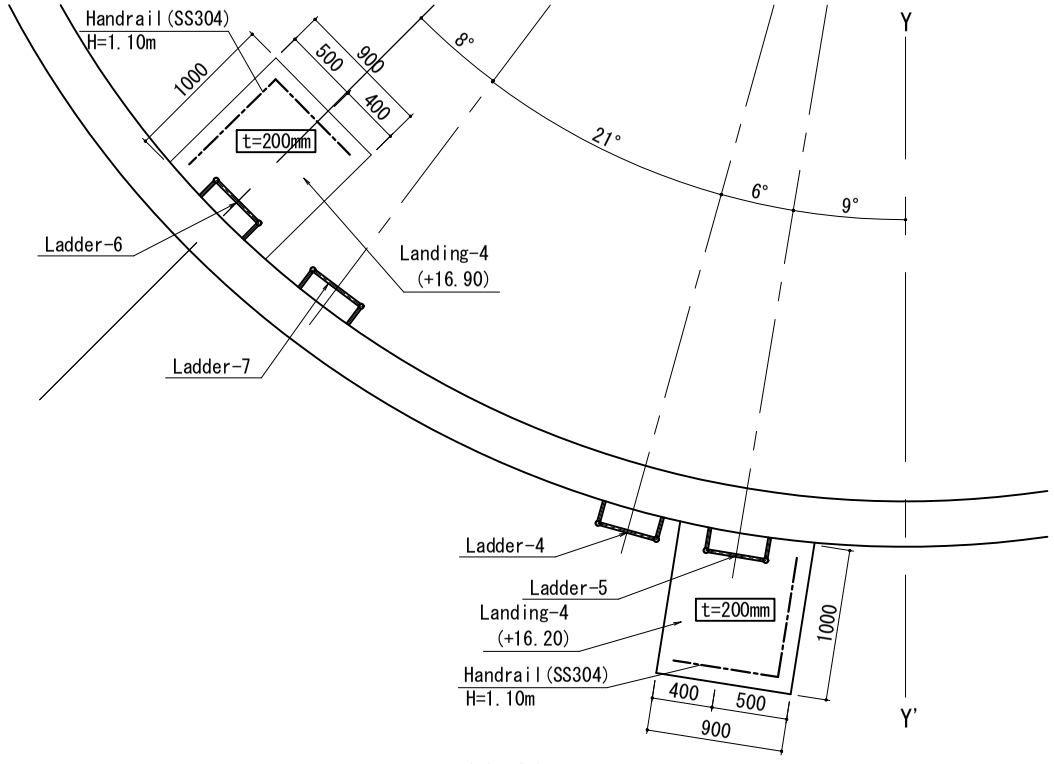


SECTION

Ventilation tower
S=1/50



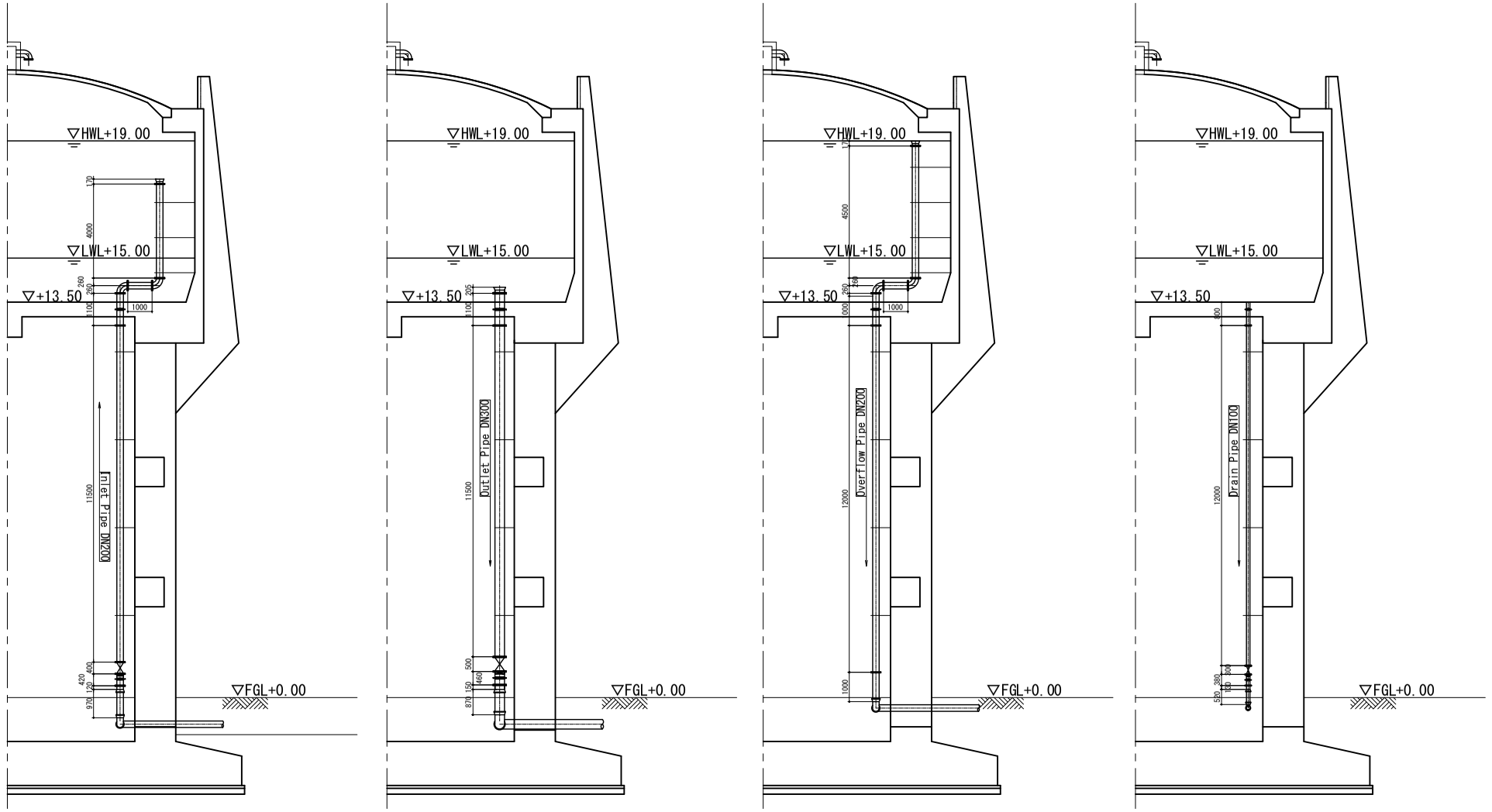
+12.30

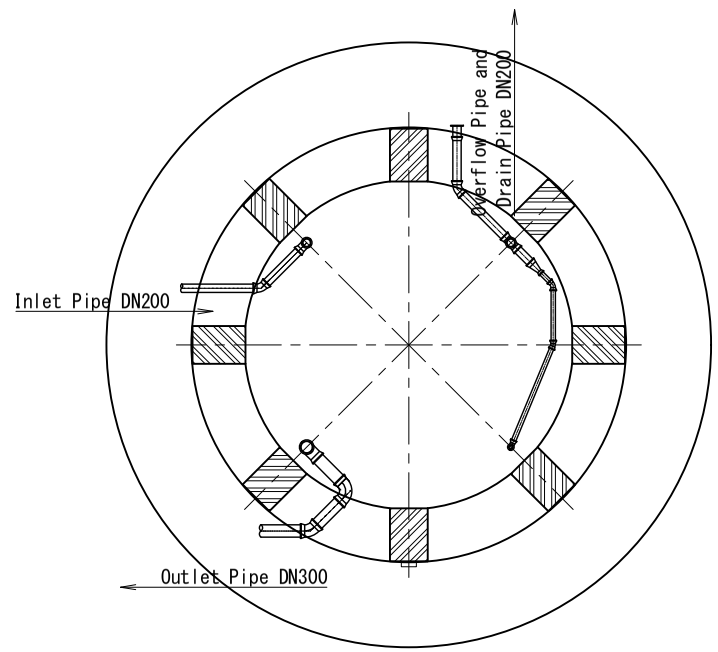


+16.20
+16.90

PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA	*Gaciriro Elevated Tank Structure (3)*				*KG-R-104*
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE *1:50*

A11-12

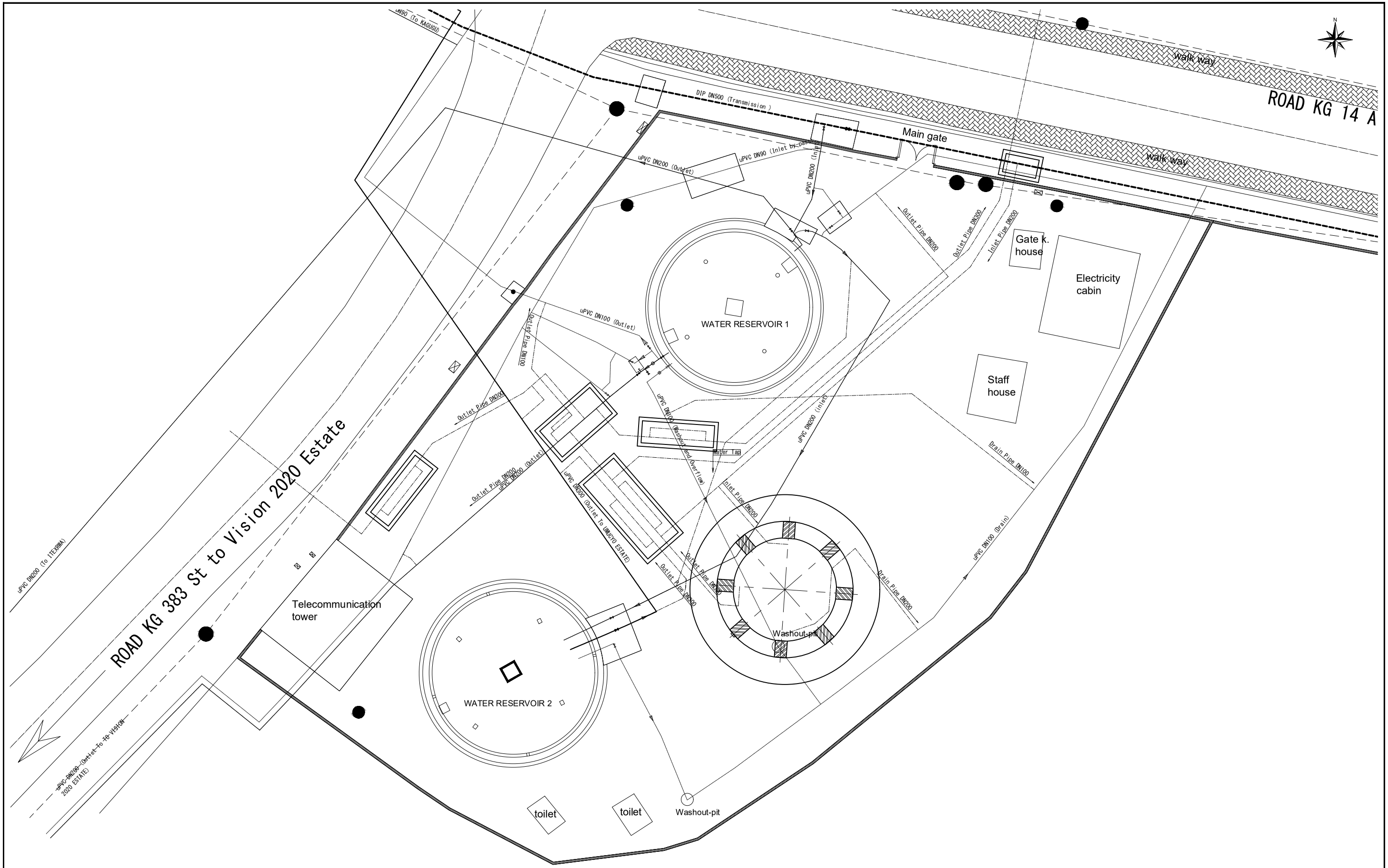




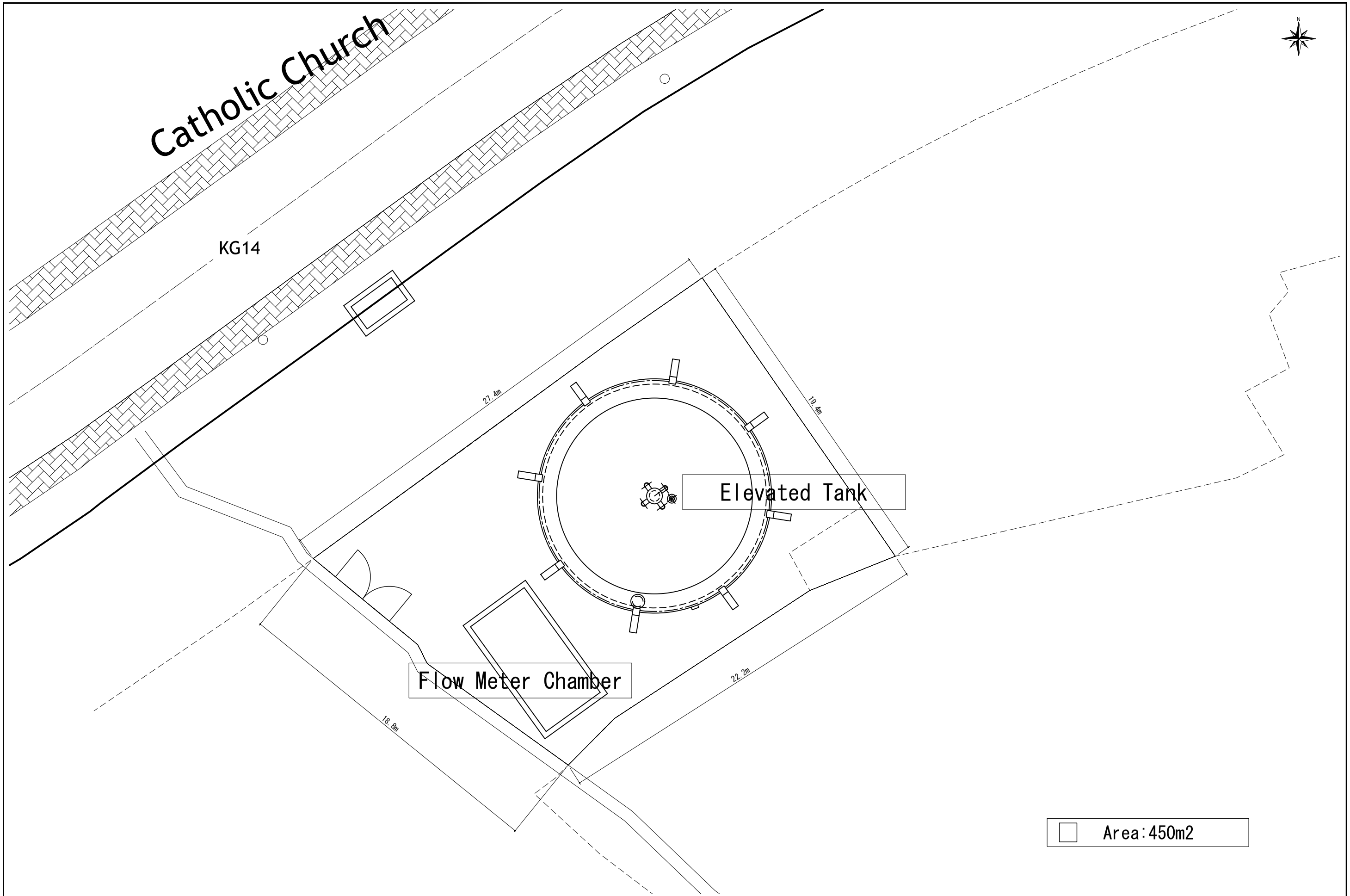
F - F SECTION

PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA	*Gacuriro Elevated Tank Structure (4)*				*KG-R-105*
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE *1:200*

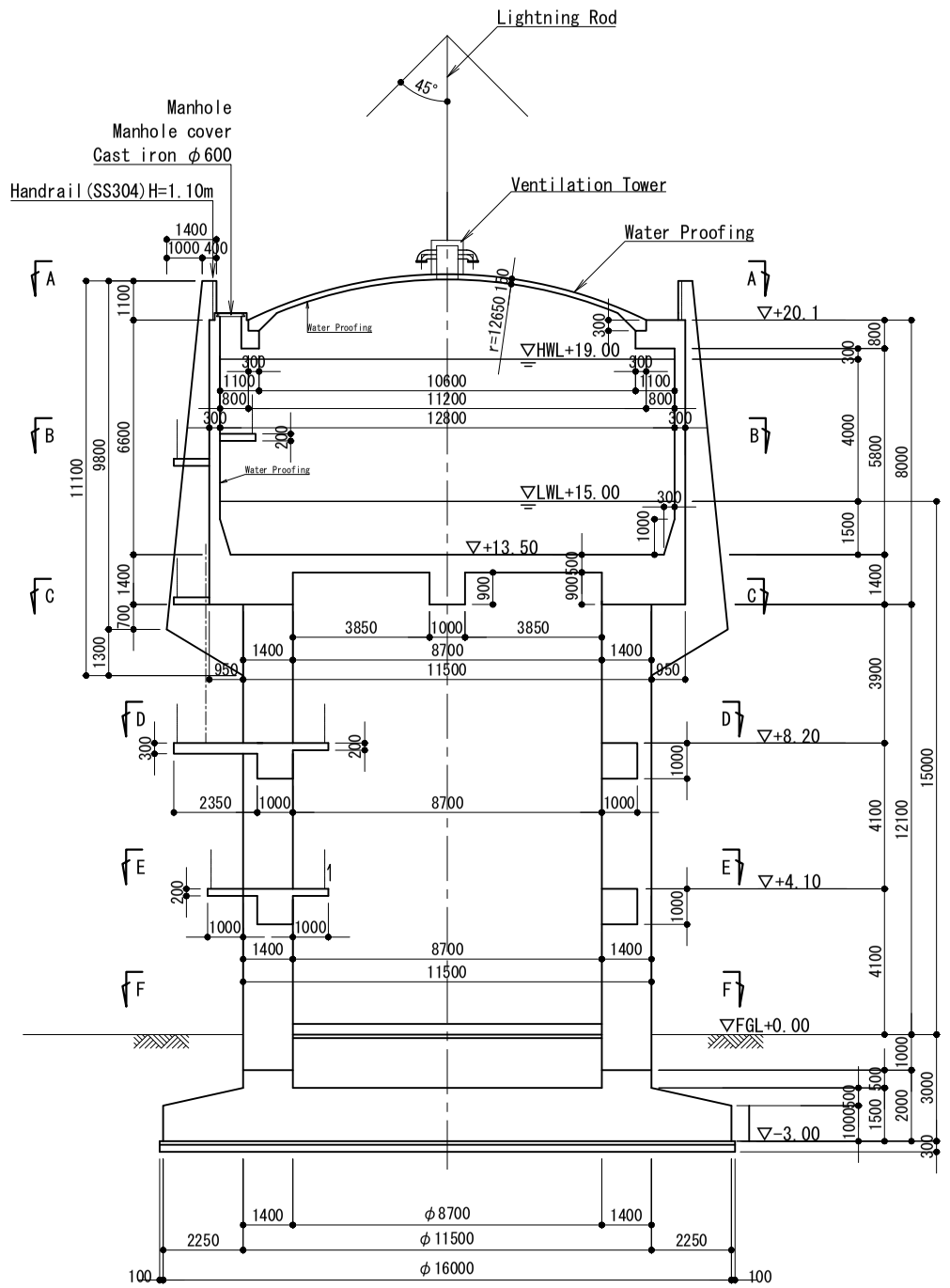
A11-13



PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA	Pipe Layout of GACURIRO Elevated Tank (1)	*XXX*			*KG-R-106*
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE *1:300*

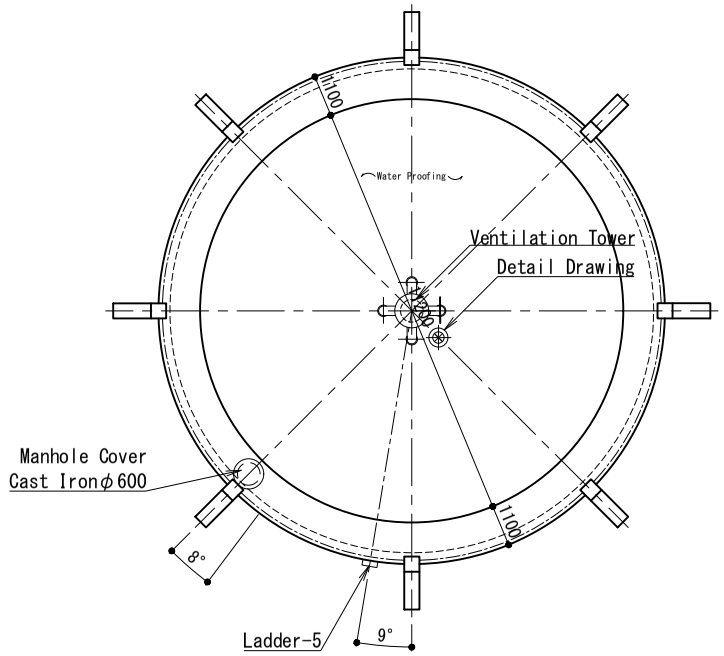


PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA	General Layout of Kagugu Elevated Tank	*NIHON SUIDO CONSULTANTS CO., LTD.*	PREPARED BY	DATE	SCALE *1:200*
					KG-R-201

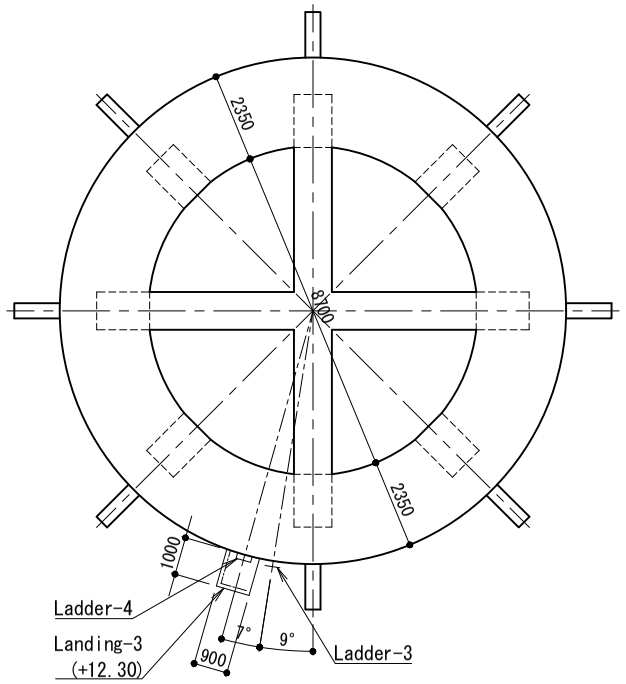


A11-15

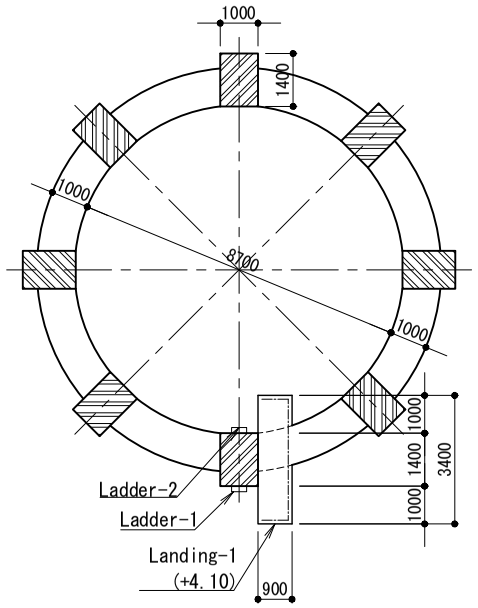
PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA	*Kagugu Elevated Tank Structure (1)*				*KG-R-202*
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE *1:200*



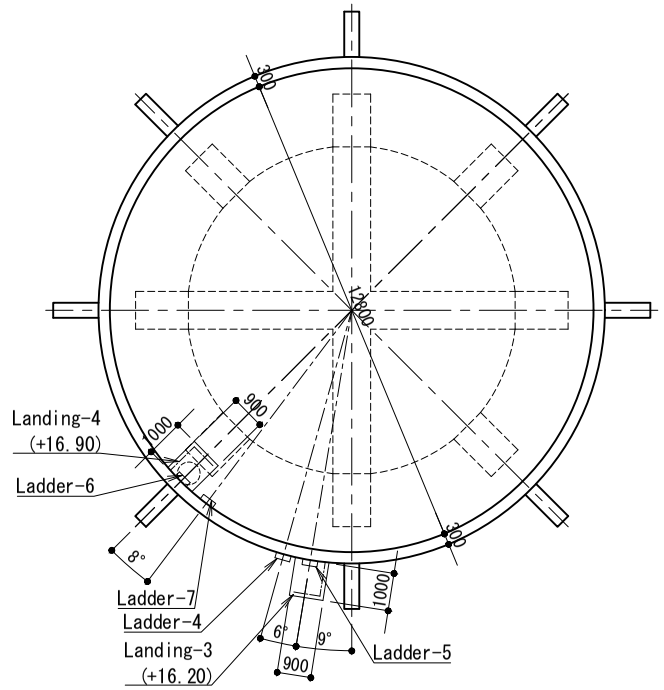
A - A SECTION



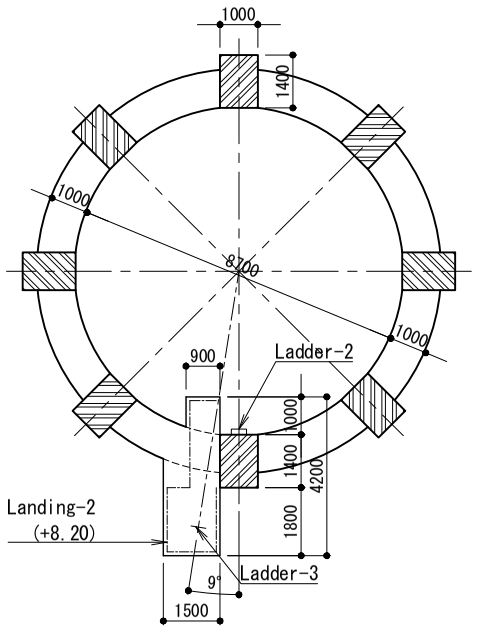
C - C SECTION



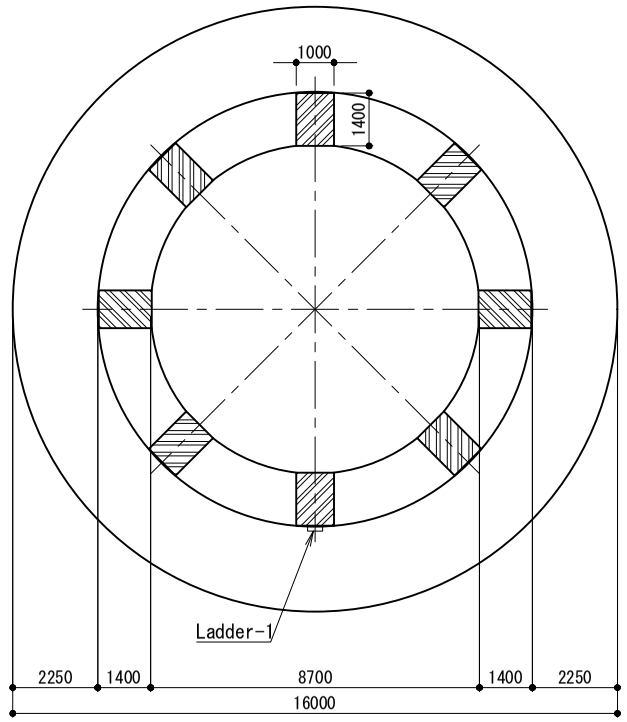
E - E SECTION



B - B SECTION



D - D SECTION

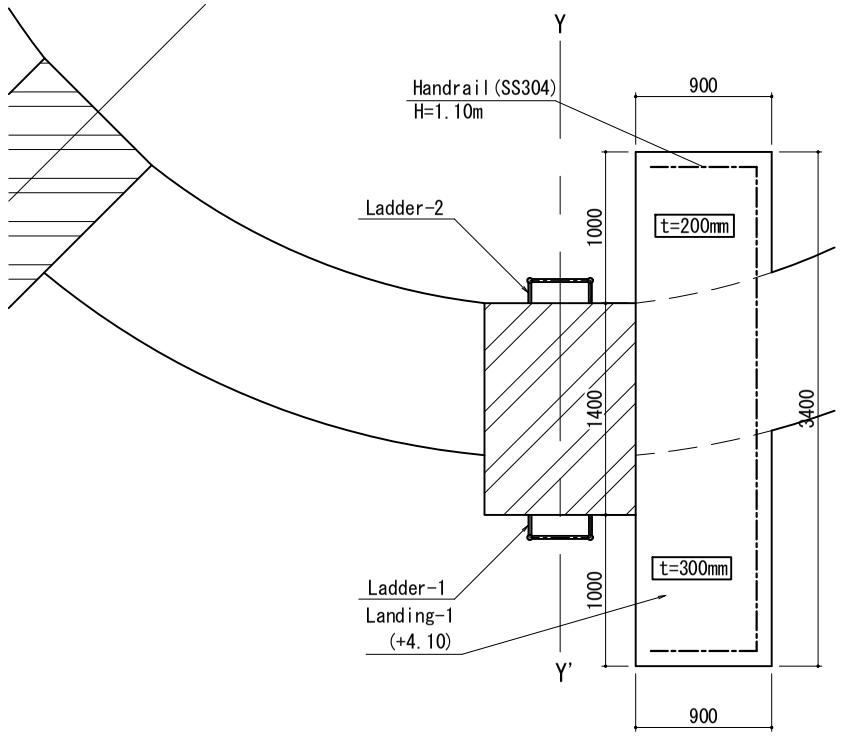


F - F SECTION

A11-16

PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA	*Kagugu Elevated Tank Structure (2)*				*KG-R-203*
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE *1:200*

A11-17



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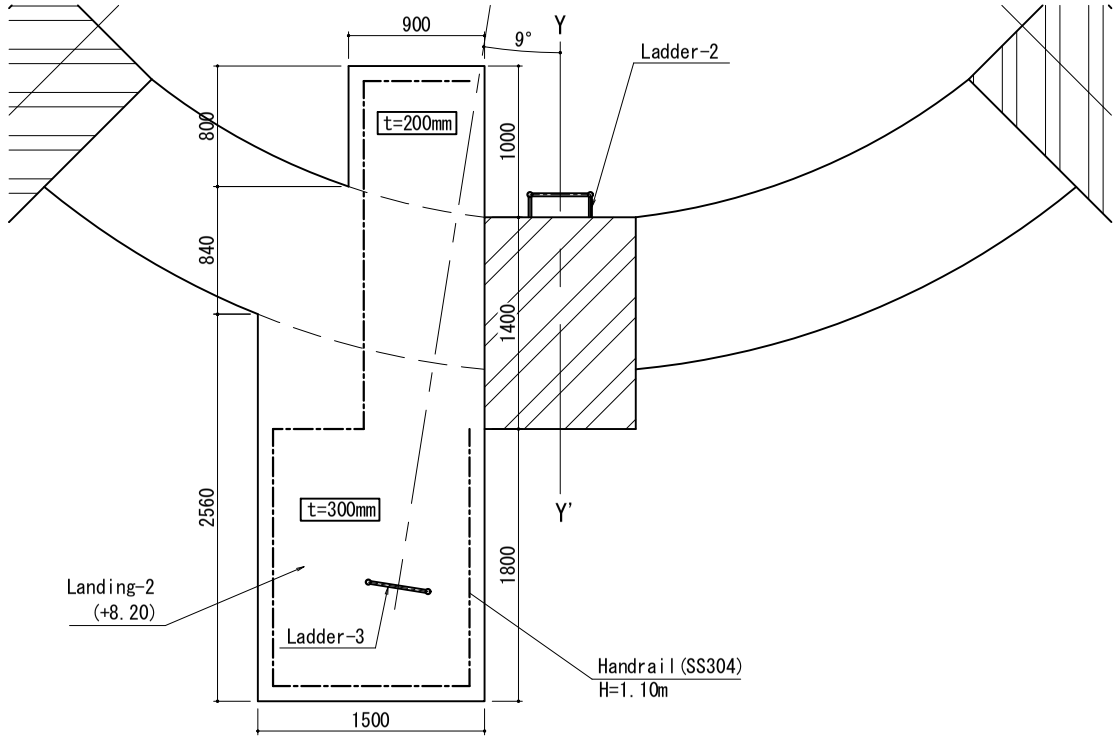
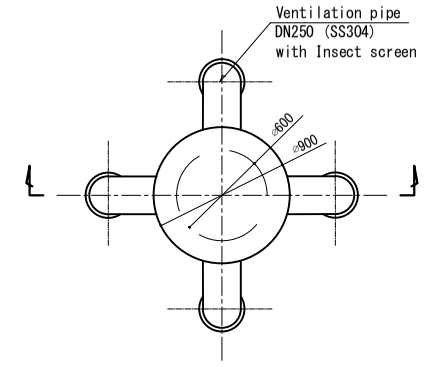
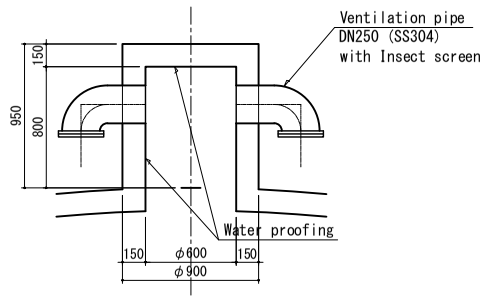


+8.20

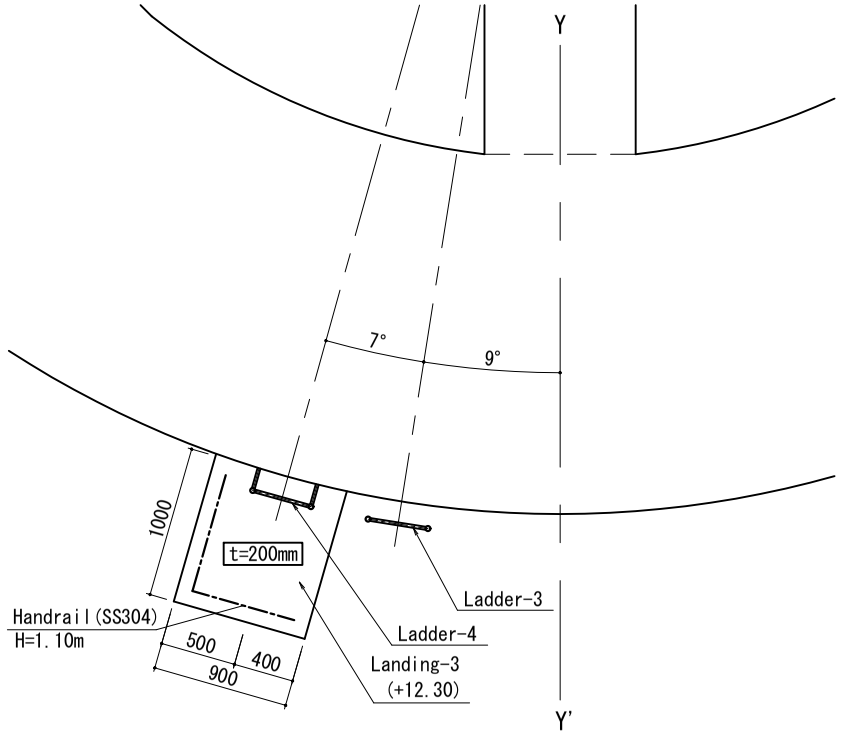


PLAN



SECTION

Ventilation tower
S=1/50



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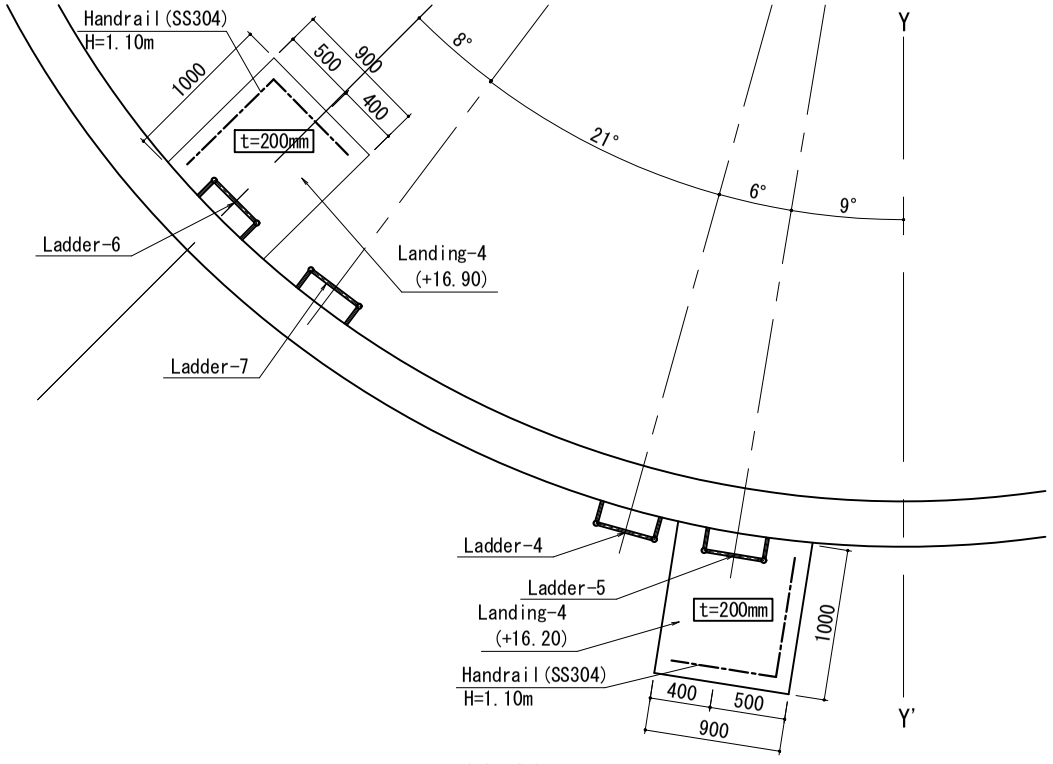
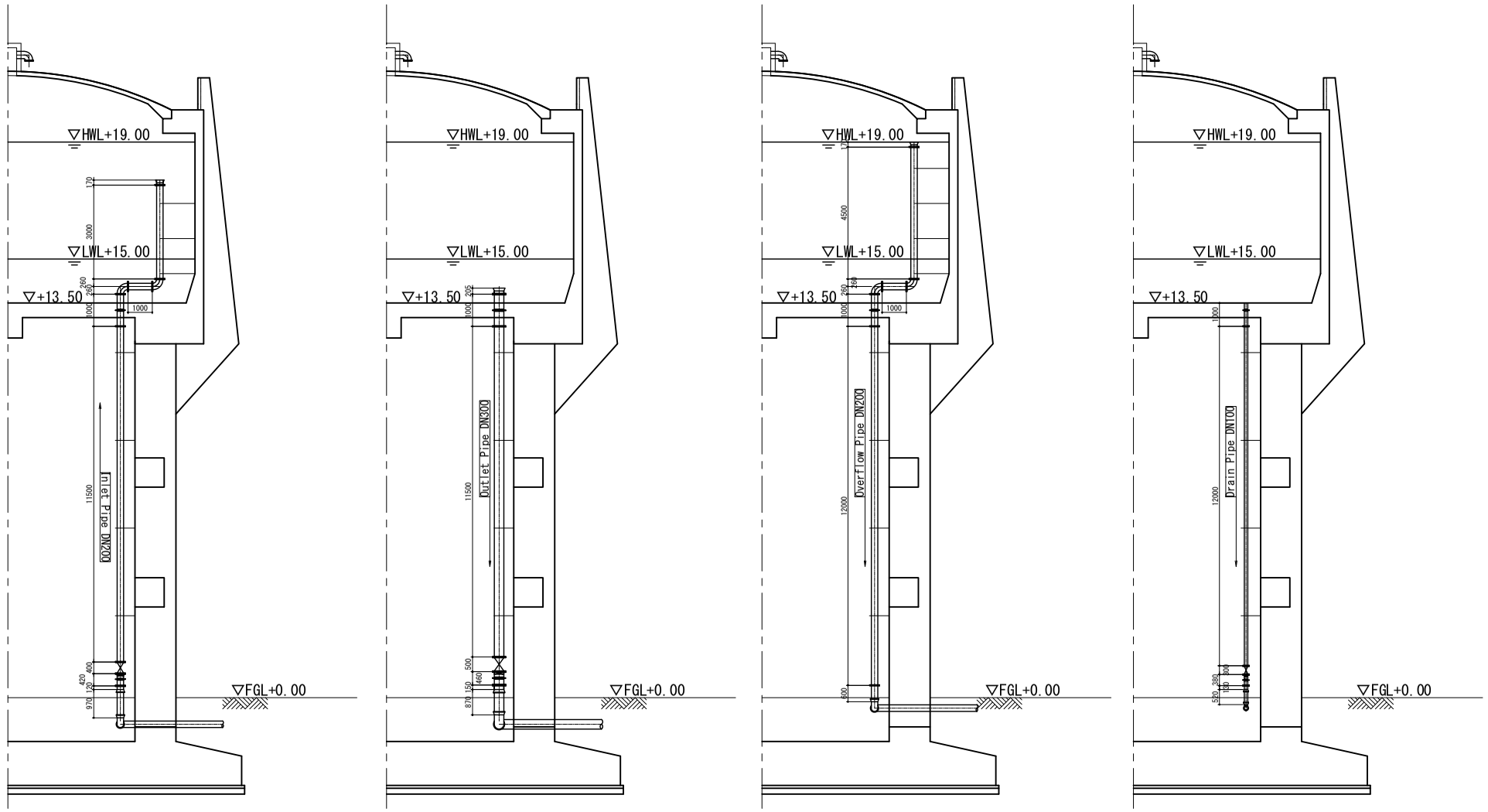


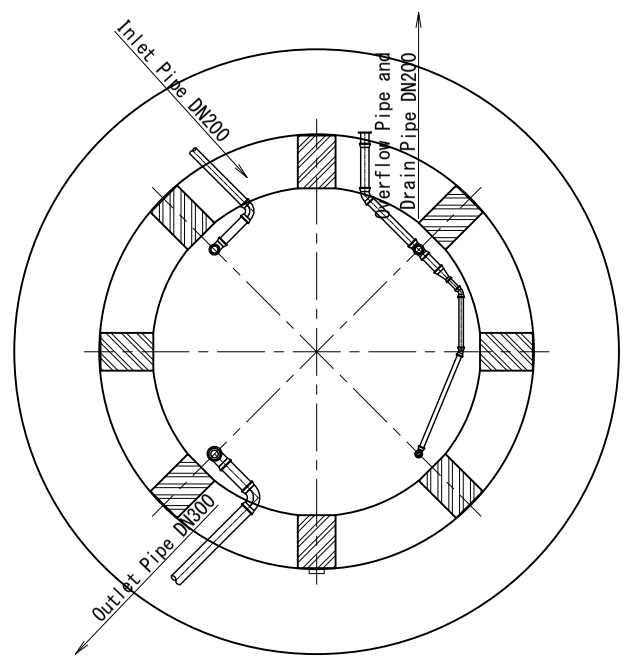
+16.20
+16.90

PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA	*Kagugu Elevated Tank Structure (3)*				*KG-R-204*
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE *1:50*

A11-18



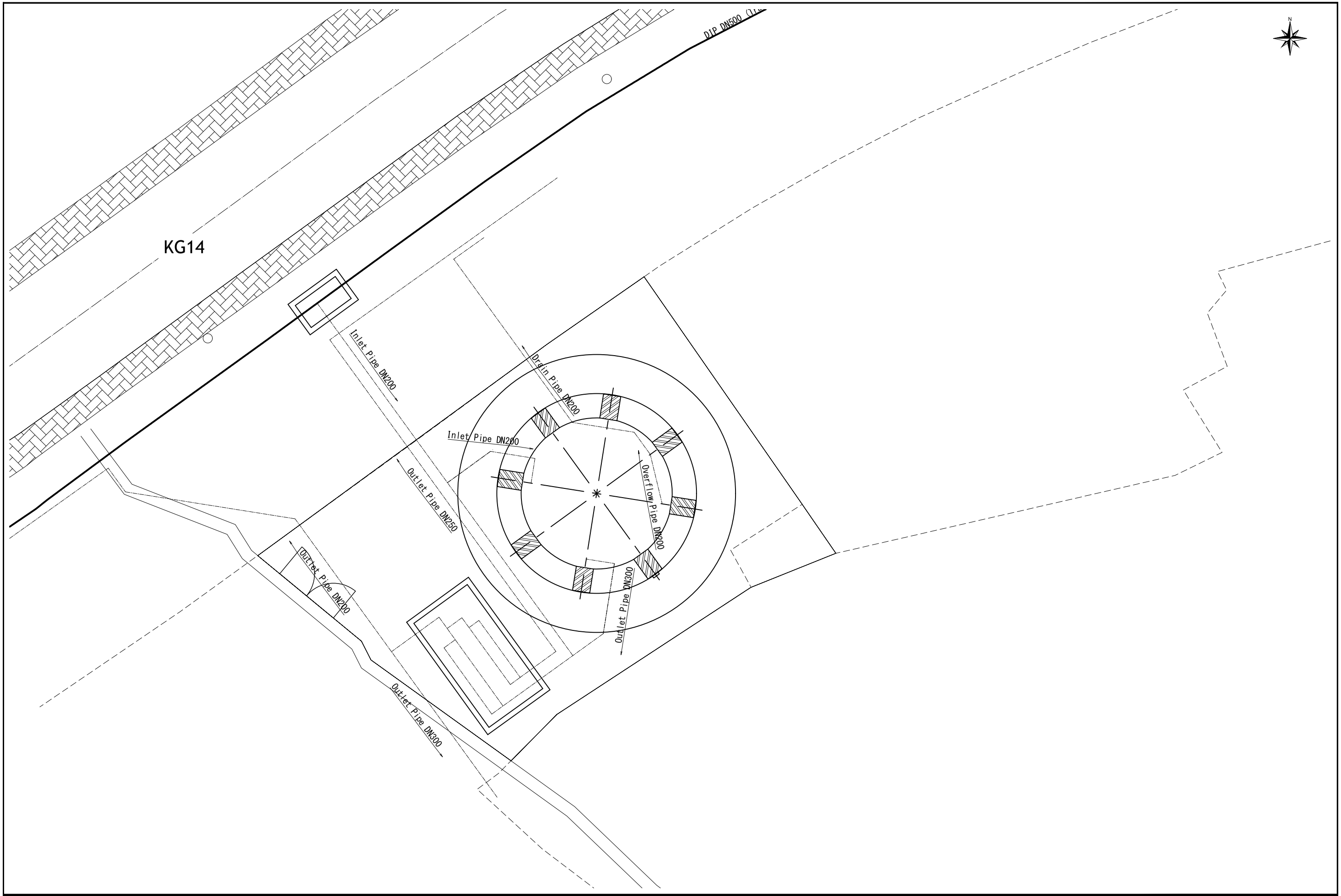
Inlet Pipe　　Outlet Pipe　　Overflow Pipe　　Drain Pipe



F - F SECTION

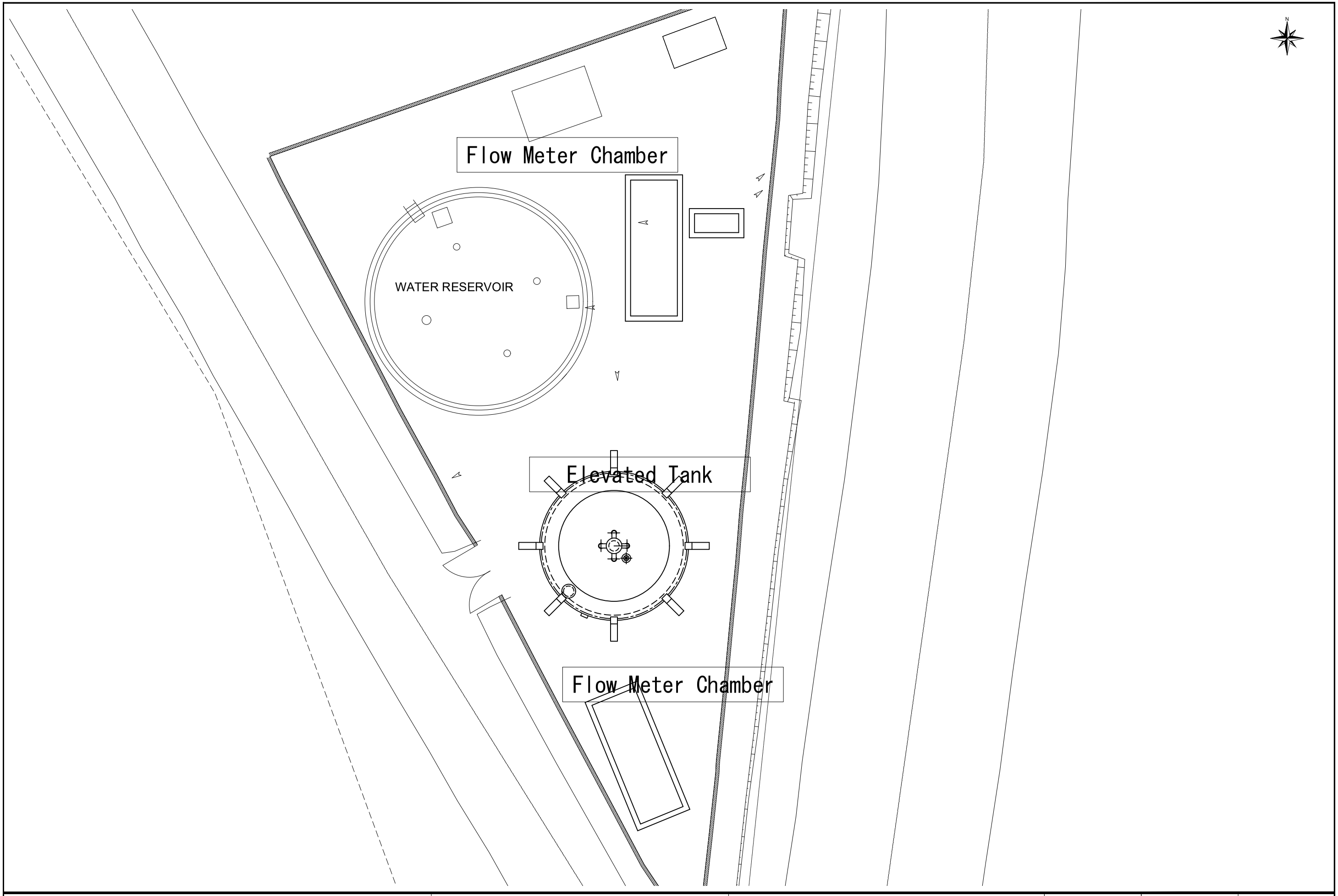
PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA	*Kagugu Elevated Tank Structure (4)*				*KG-R-205*
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE *1:200*

A11-19



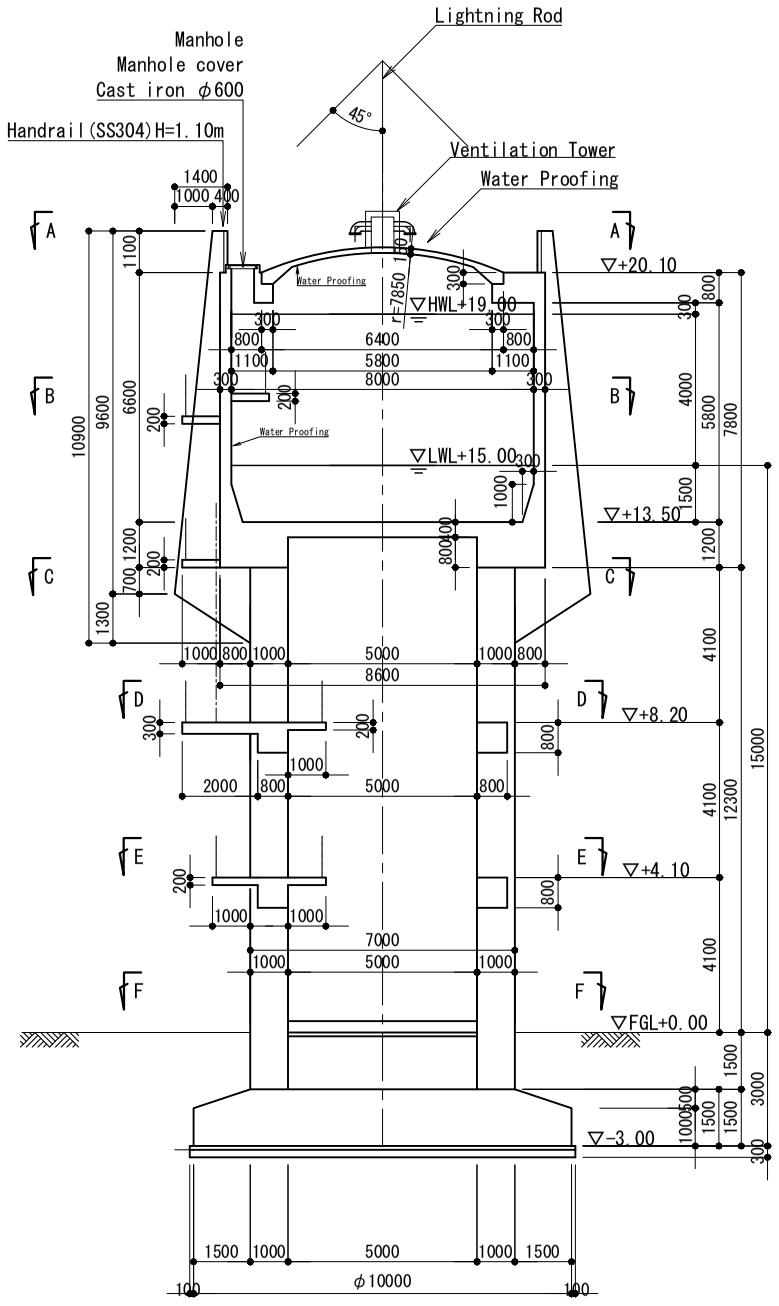
PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA	Pipe Layout of KAGUGU Elevated Tank(1)				*KG-R-206*
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE *1:200*

A11-20

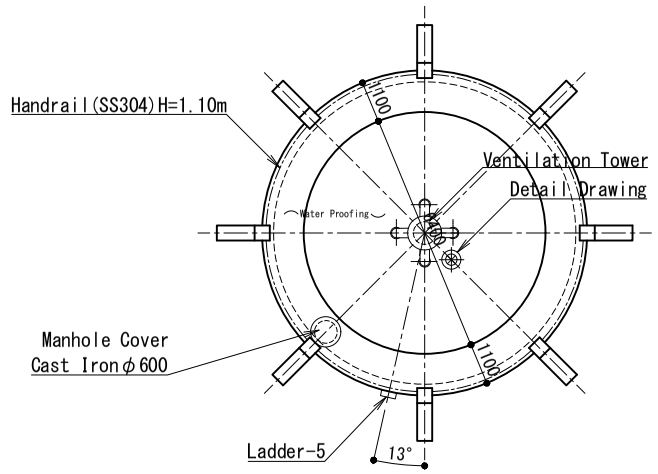


PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA	General Layout of NYARUTARAMA Elevated Tank				*KG-R-301*
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE *1:200*

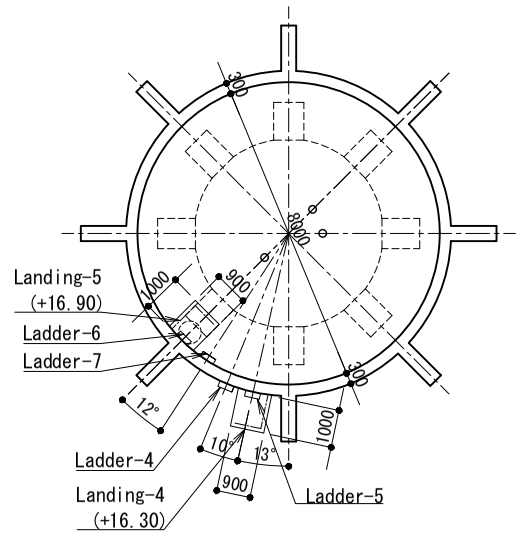
A11-21



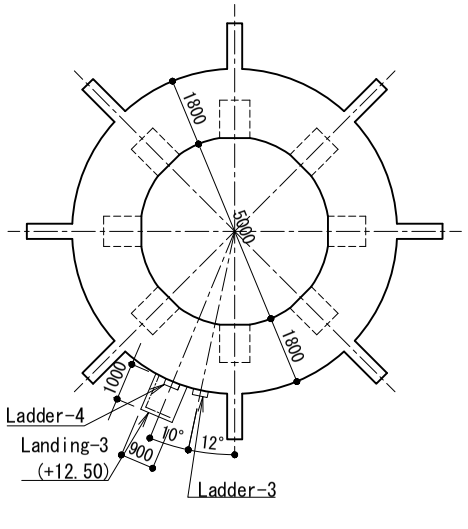
G - G SECTION



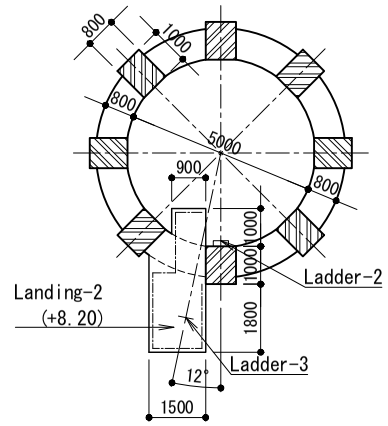
A - A SECTION



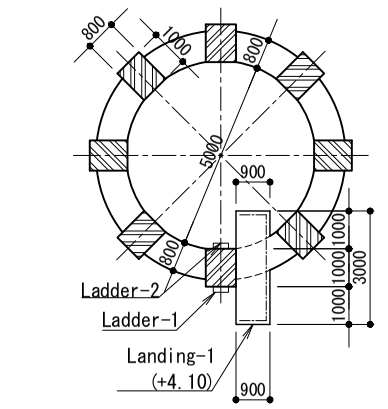
B - B SECTION



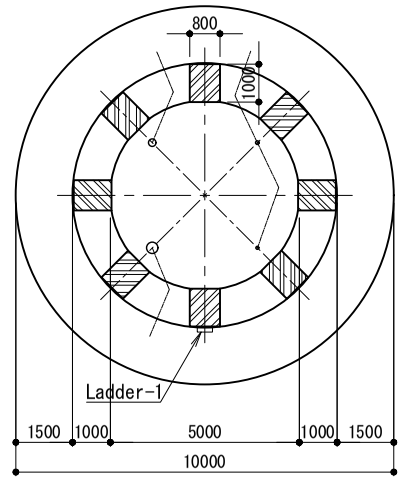
C - C SECTION



D - D SECTION



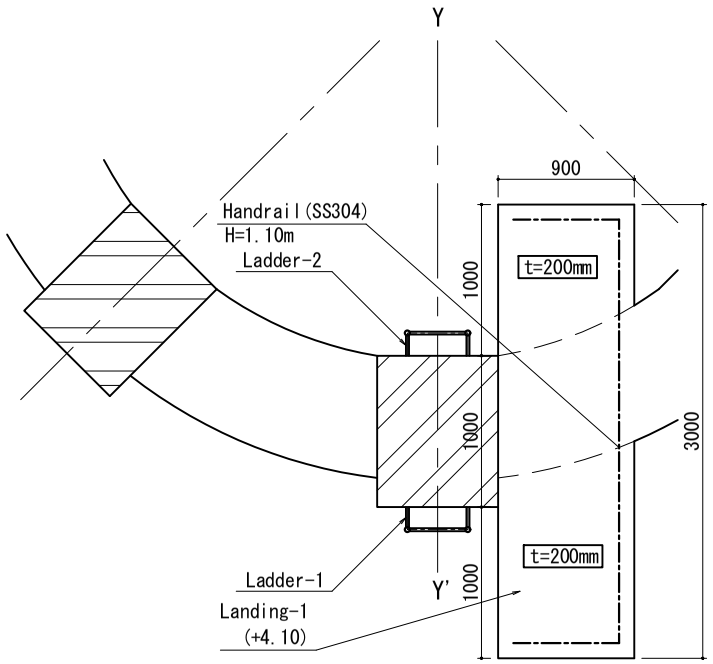
E - E SECTION



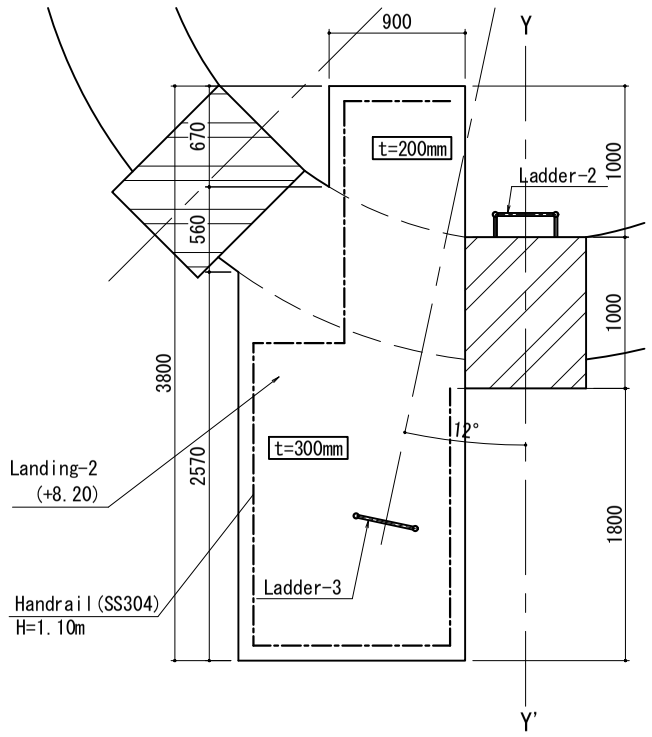
F - F SECTION

PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA	*Nyarutarama Elevated Tank Structure (1)*				*KG-R-302*
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE *1:200*

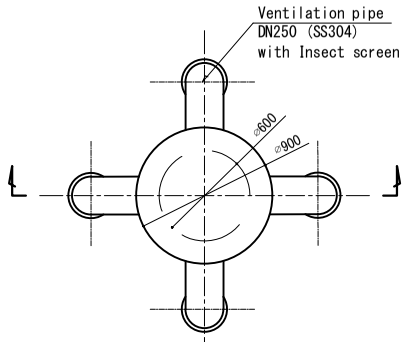
A11-22



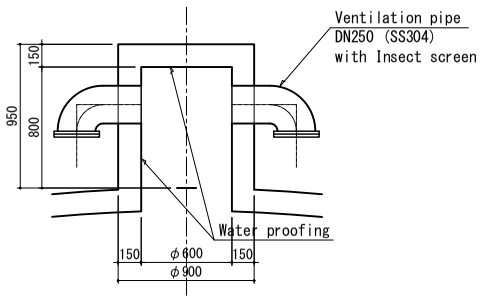
+4.10



+8.20

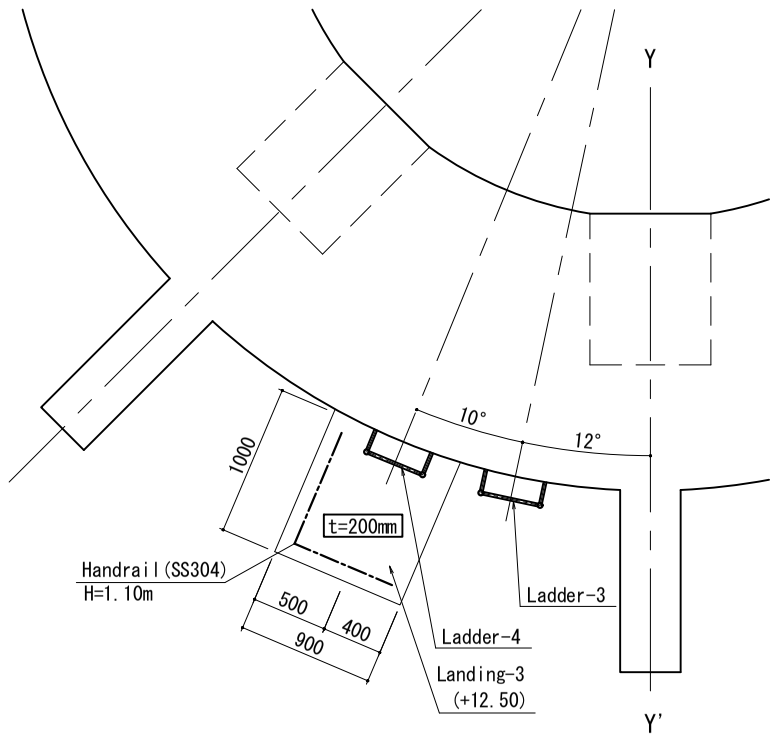


PLAN

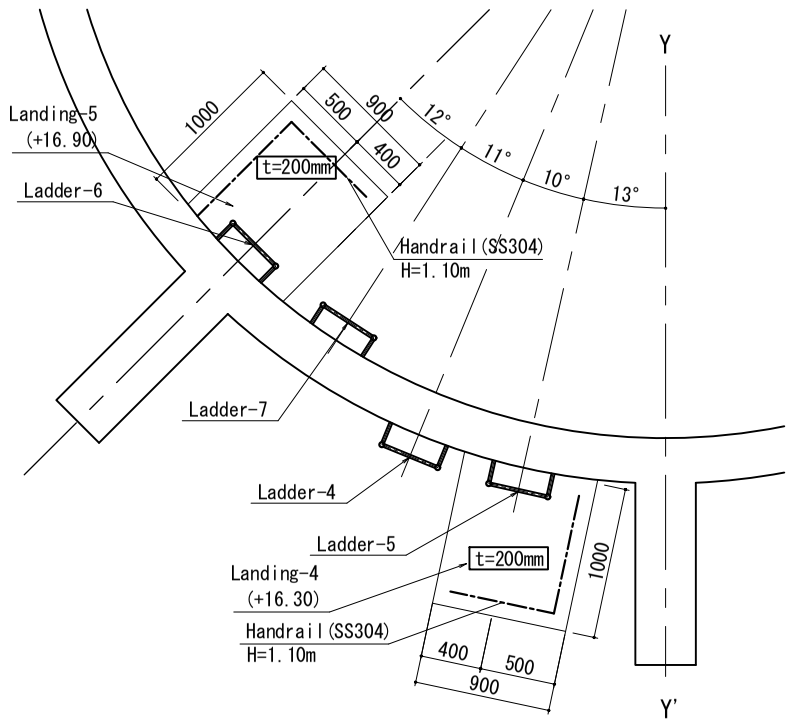


SECTION

Ventilation tower
S=1/50

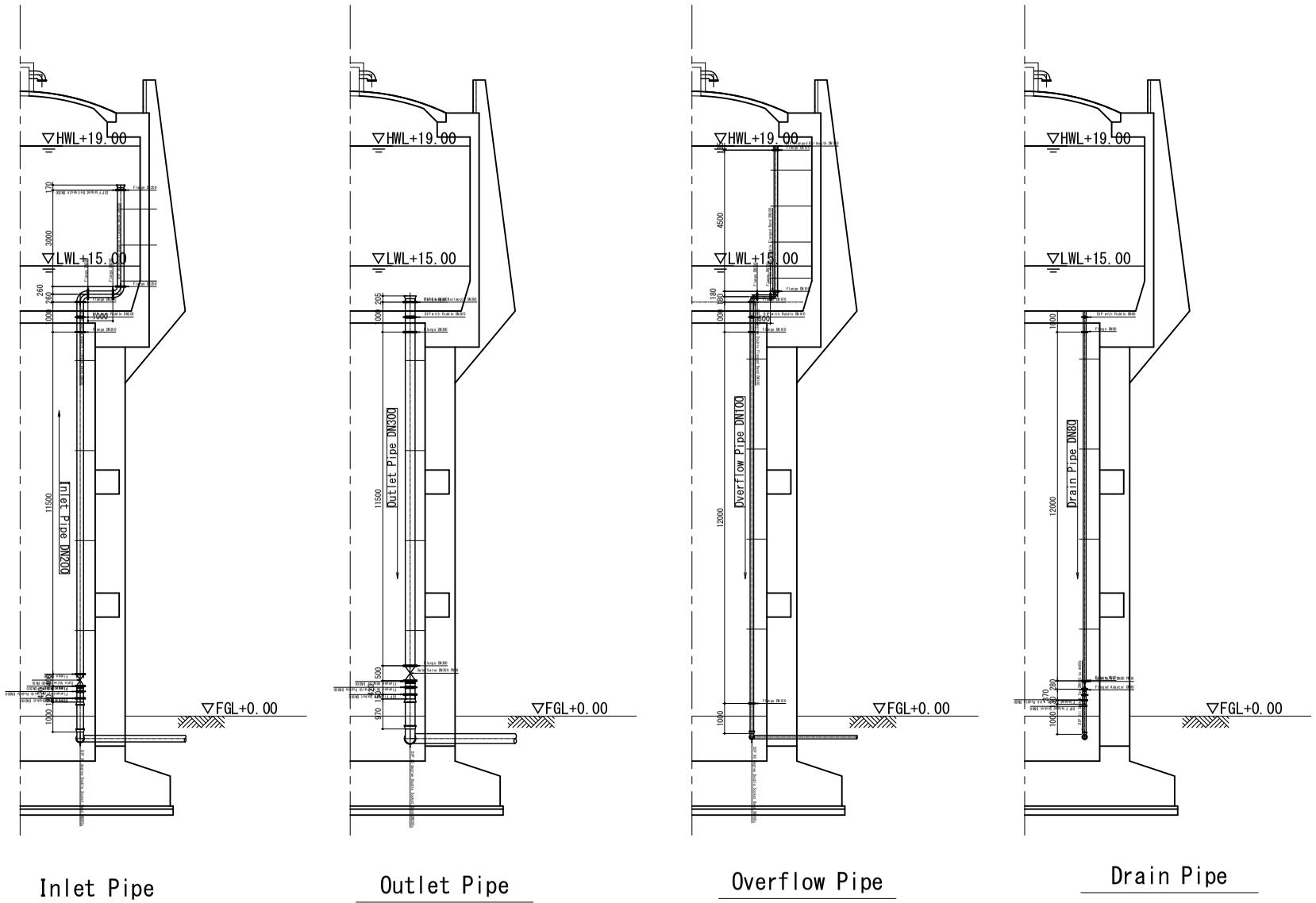


+12.50

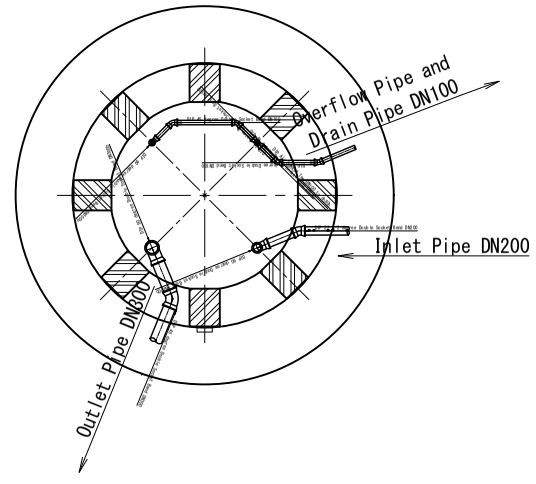


+16.30
+16.90

PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA	*Nyarutarama Elevated Tank Structure (2)*				*KG-R-303*
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE *1:50*



Inlet Pipe　Outlet Pipe　Overflow Pipe　Drain Pipe

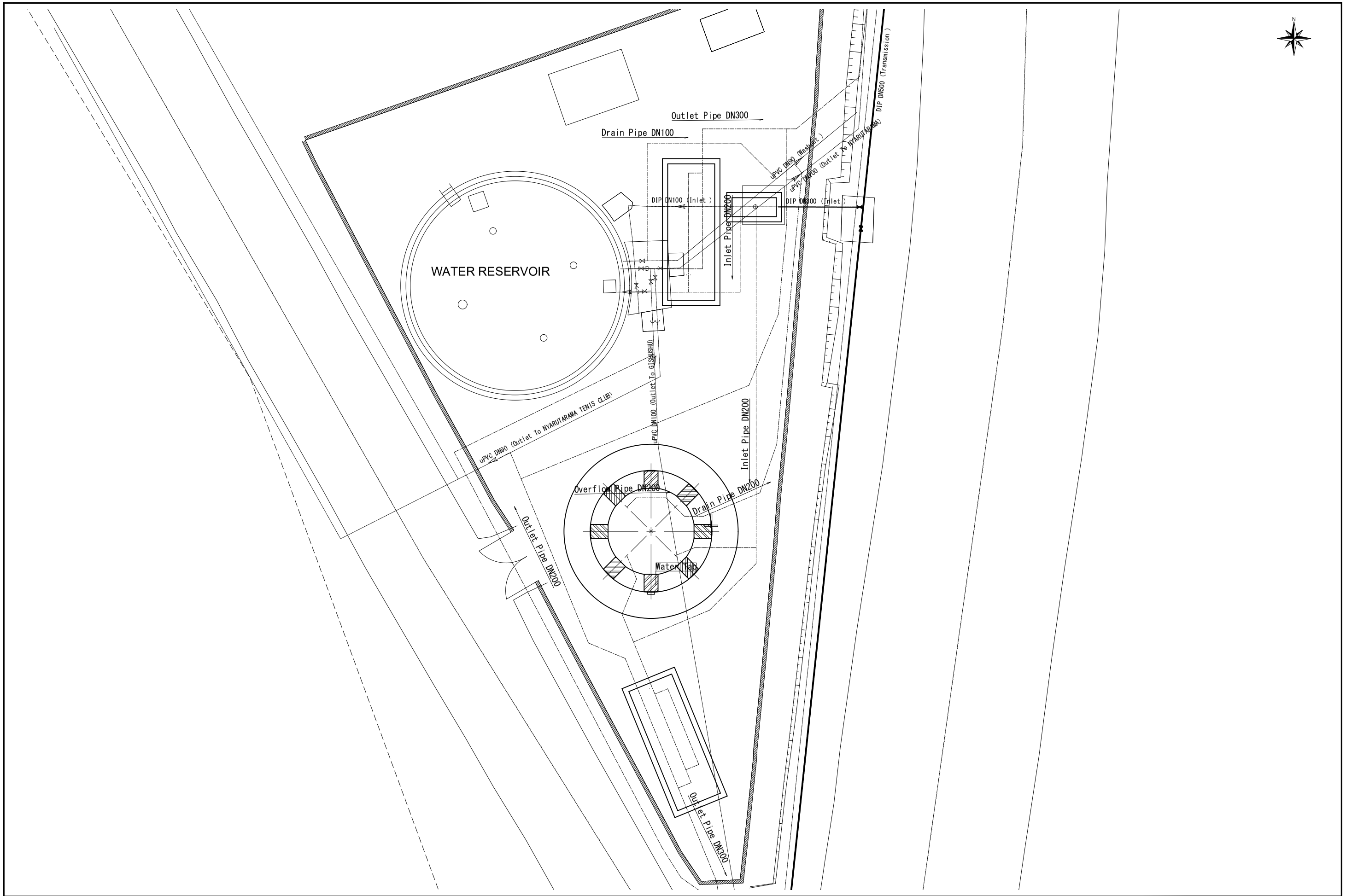


F - F SECTION

A11-23

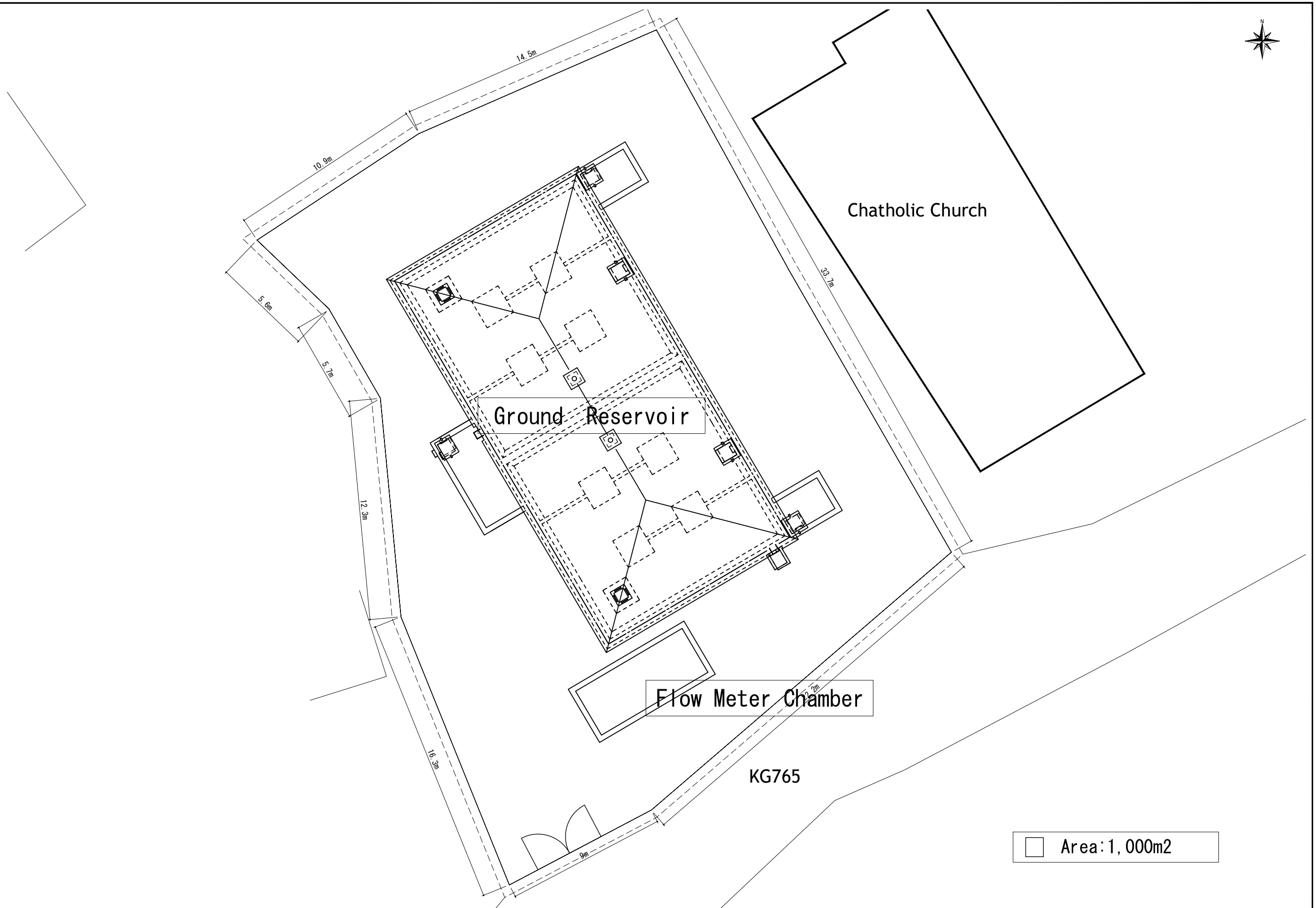
PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA	*Nyarutarama Elevated Tank Structure (3)*				*KG-R-304*
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE *1:200*

A11-24



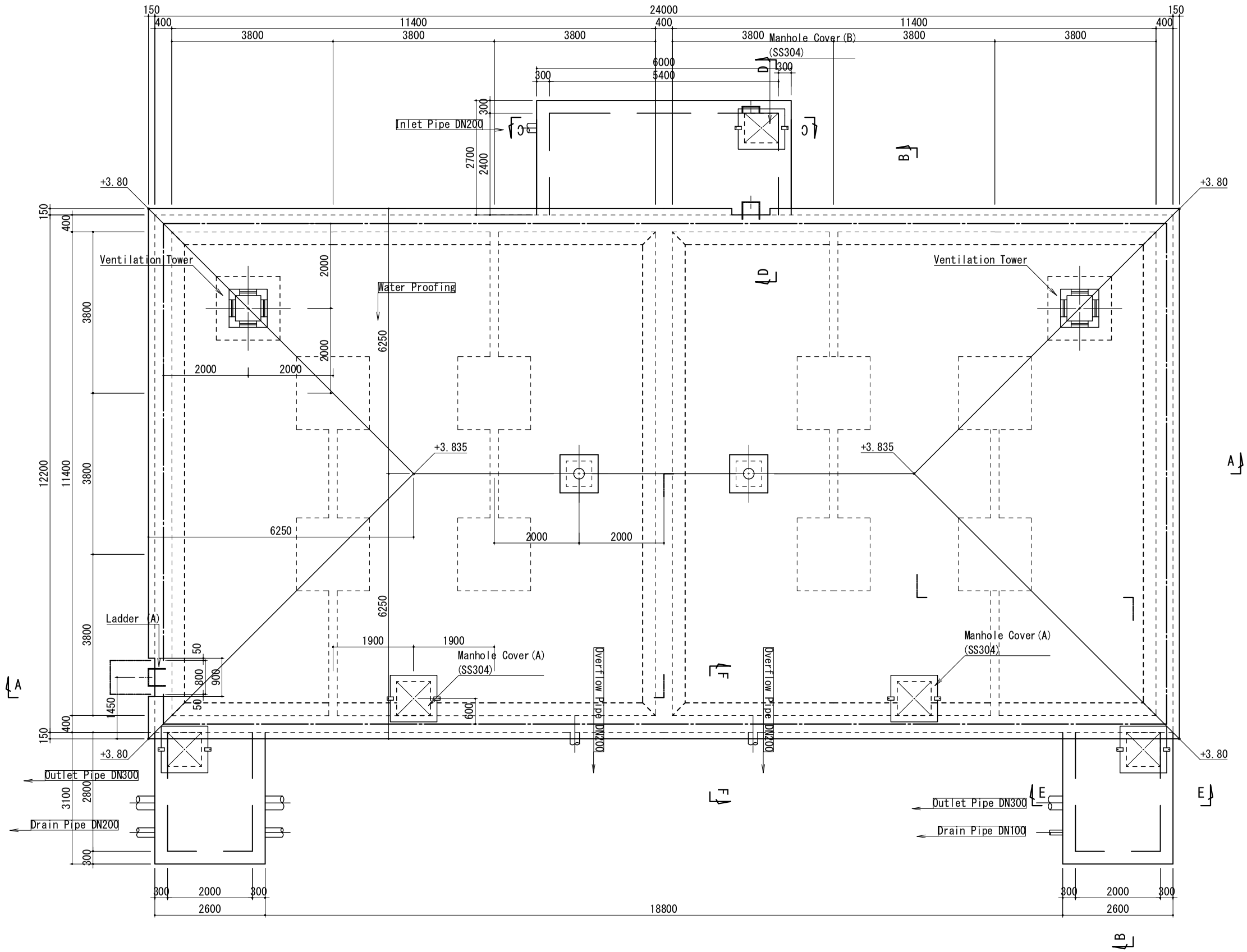
PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA	Pipe Layout of NYARUTARAMA Elevated Tank(1)				*KG-R-305*
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE *1:200*

A11-25



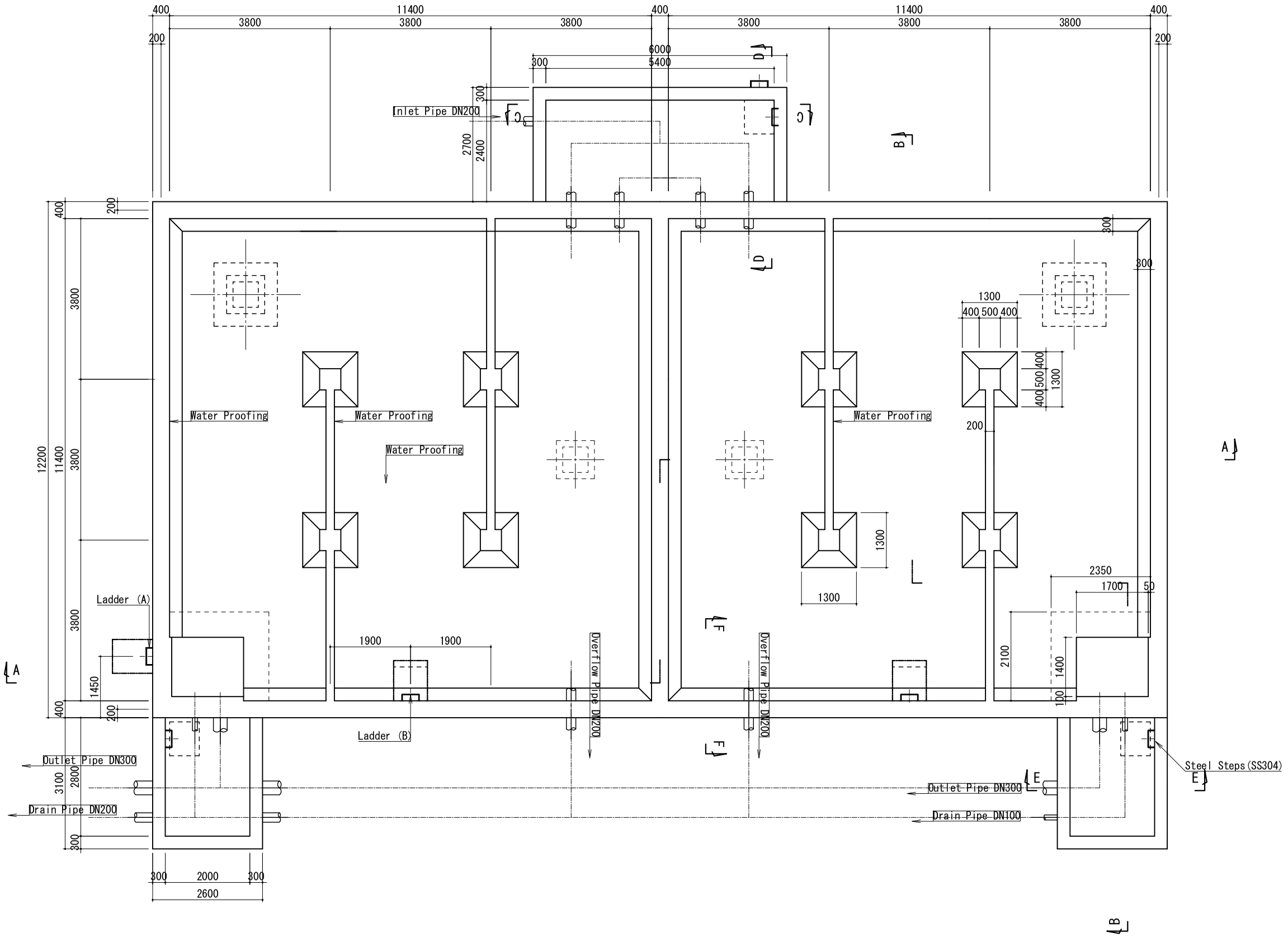
PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA	General Layout of BATSINDA Reservoir	*XXX*			*KG-R-401*
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE *1:200*

A11-26



PLAN

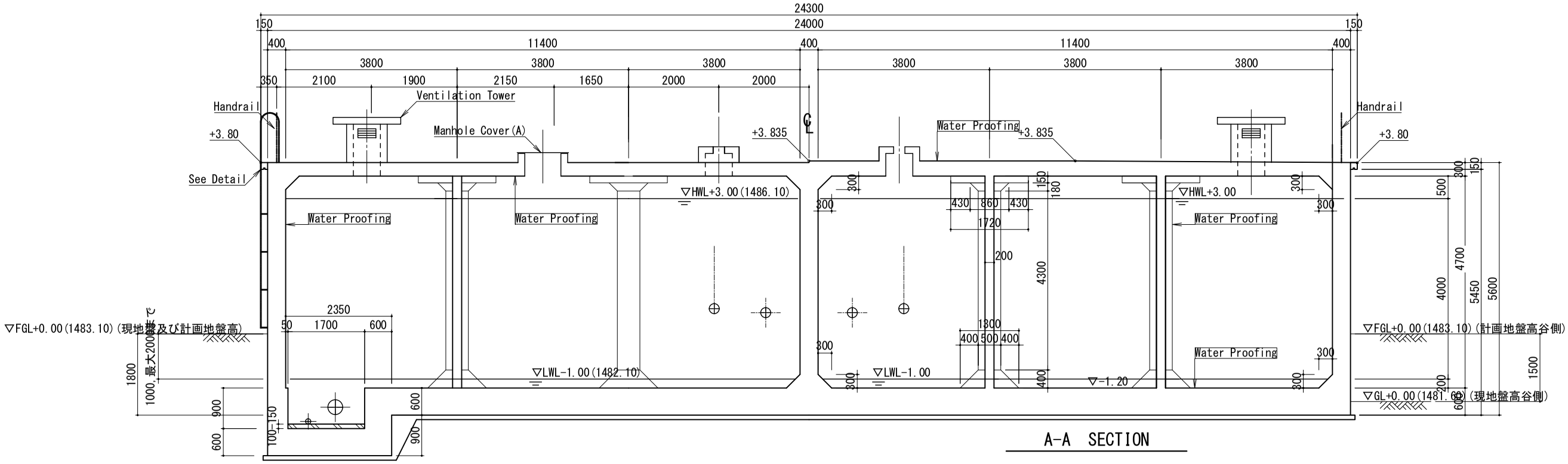
PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA	*Batsinda Reservoir Structure (1)*				*KG-R-402*
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE *1:100*



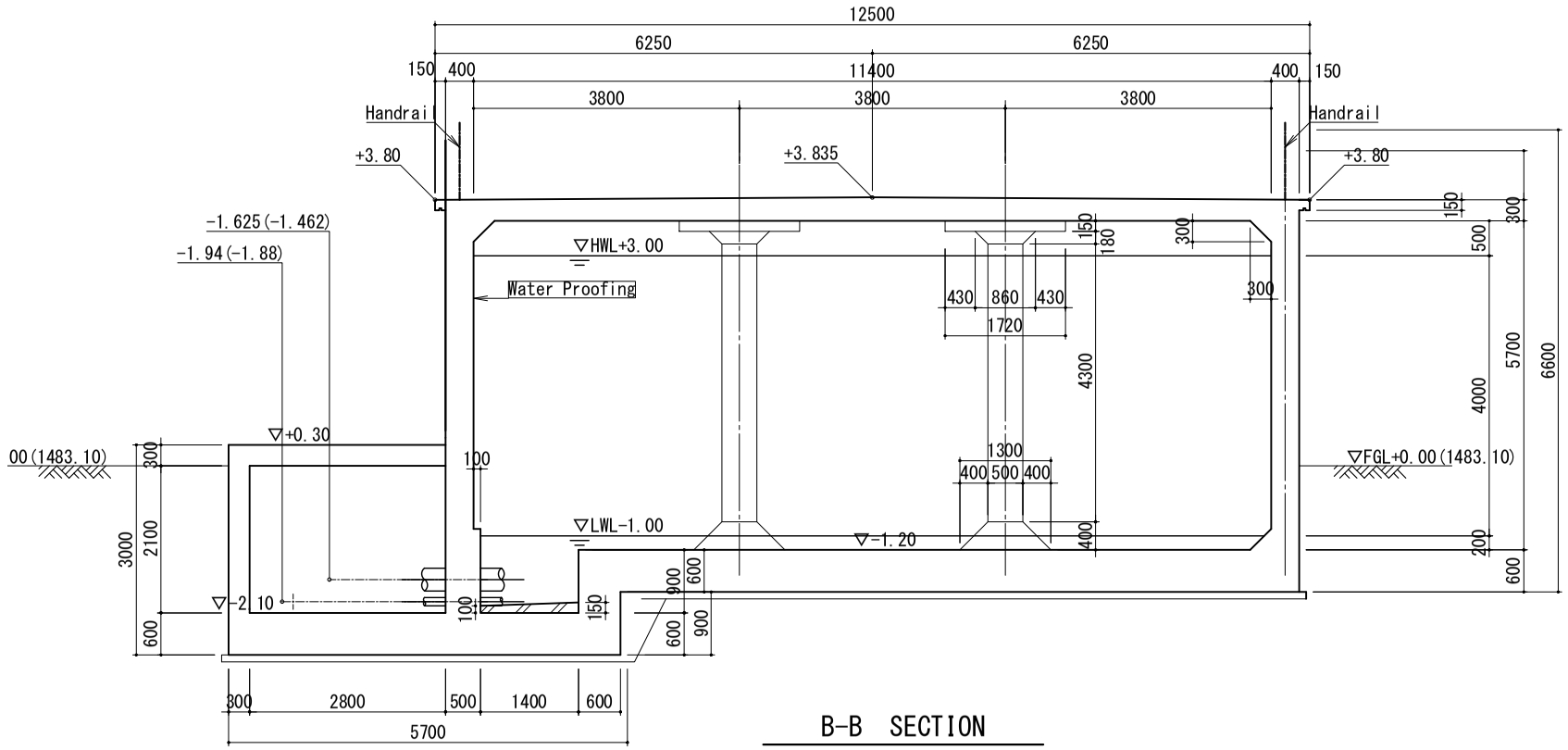
SECTIONAL PLAN

PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA	*Batsinda Reservoir Structure (2)*				*KG-R-403*
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE *1:100*

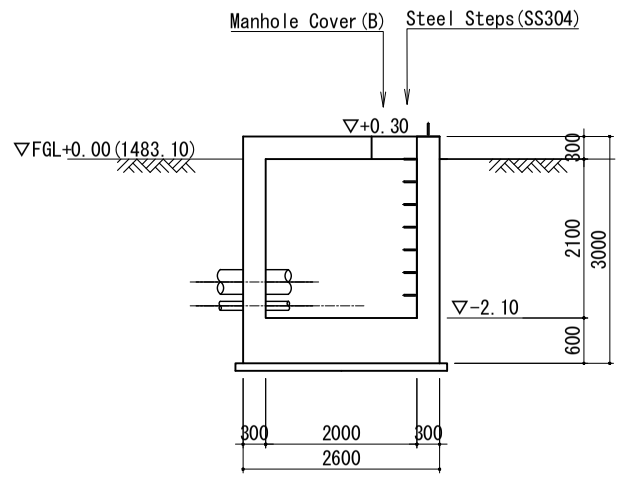
A11-28



A-A SECTION



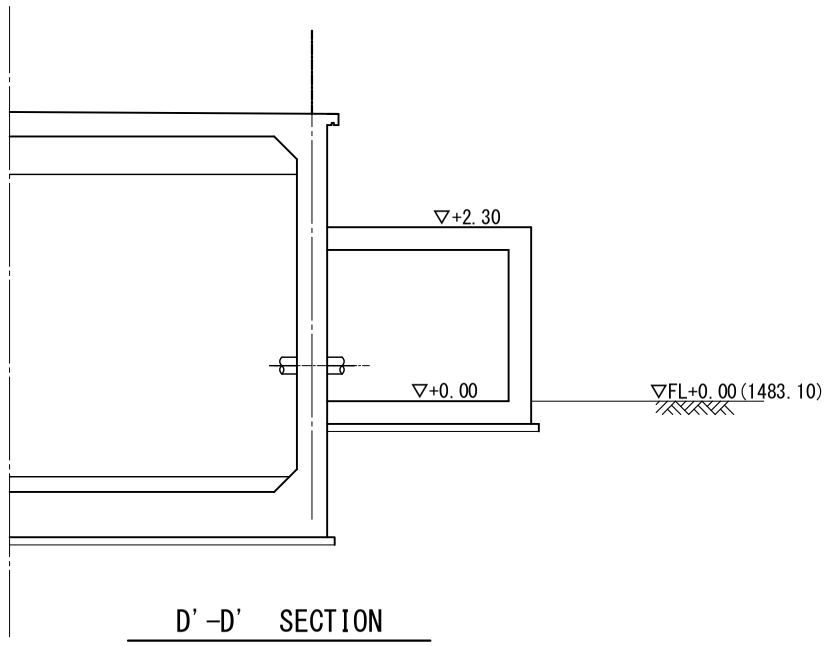
B-B SECTION



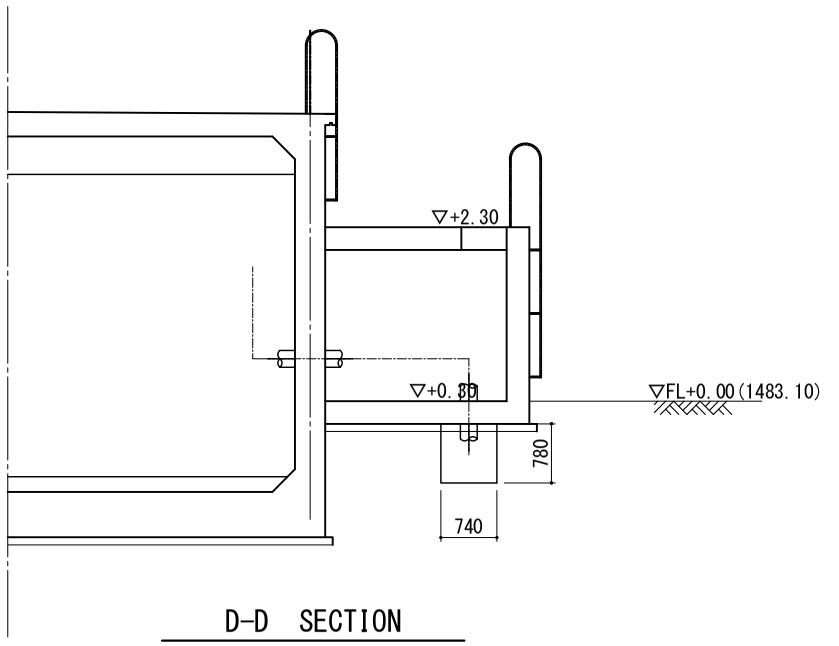
E-E SECTION

PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA	*Batsinda Reservoir Structure (3)*				*KG-R-404*
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE *1:100*

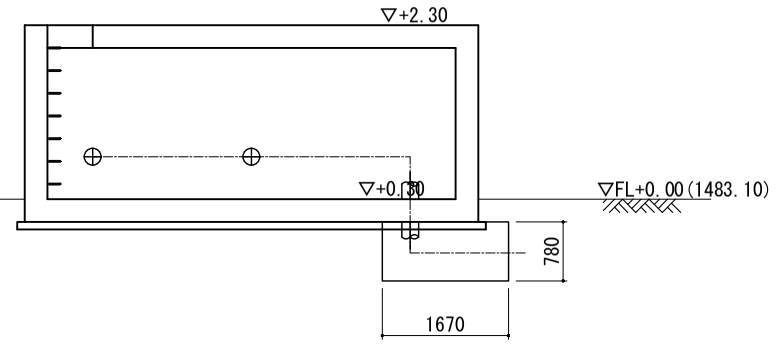
A11-29



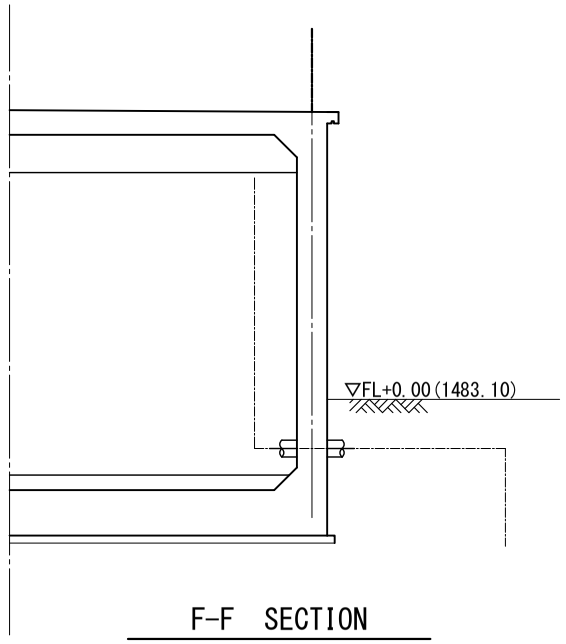
D'-D' SECTION



D-D SECTION



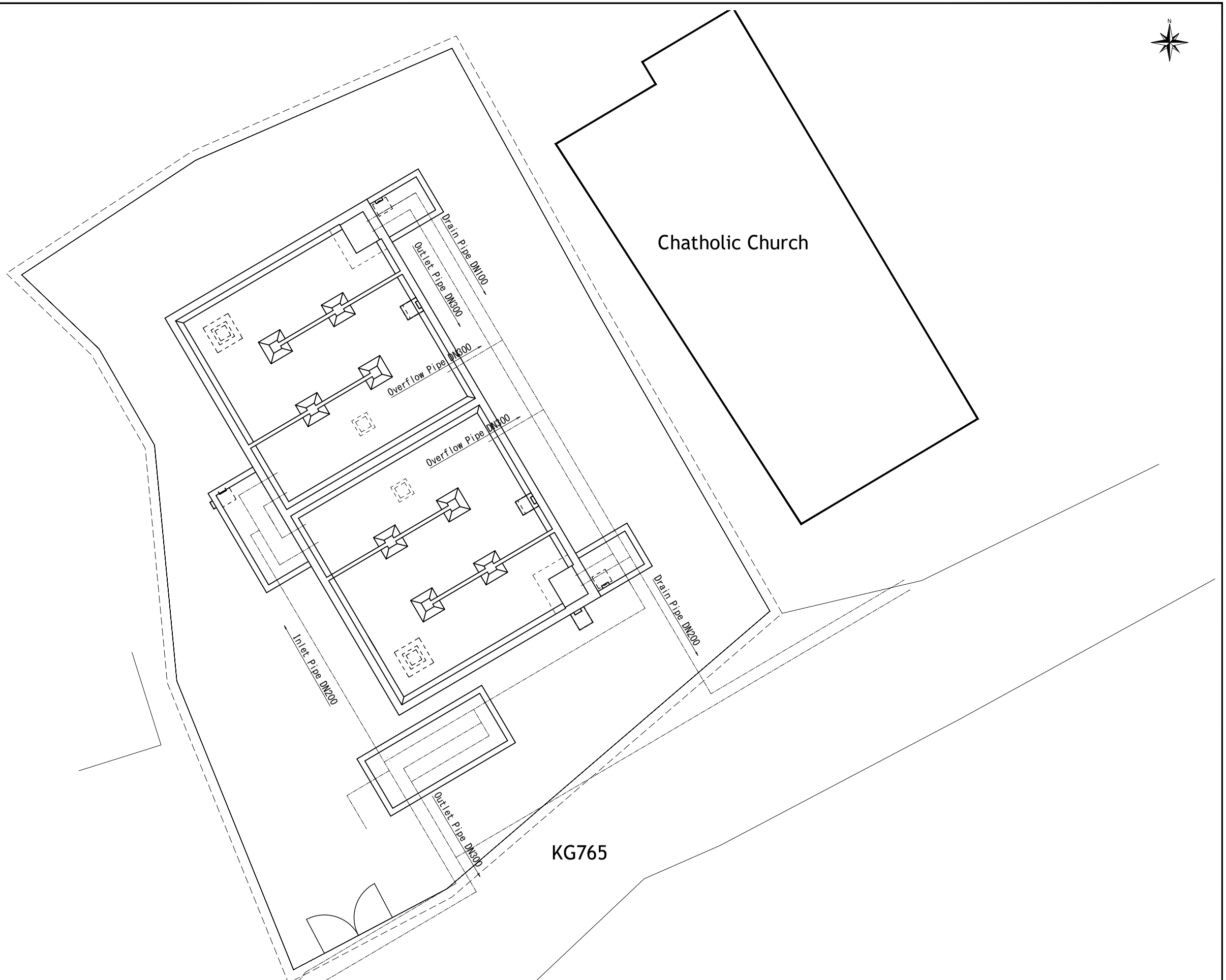
C-C SECTION



F-F SECTION

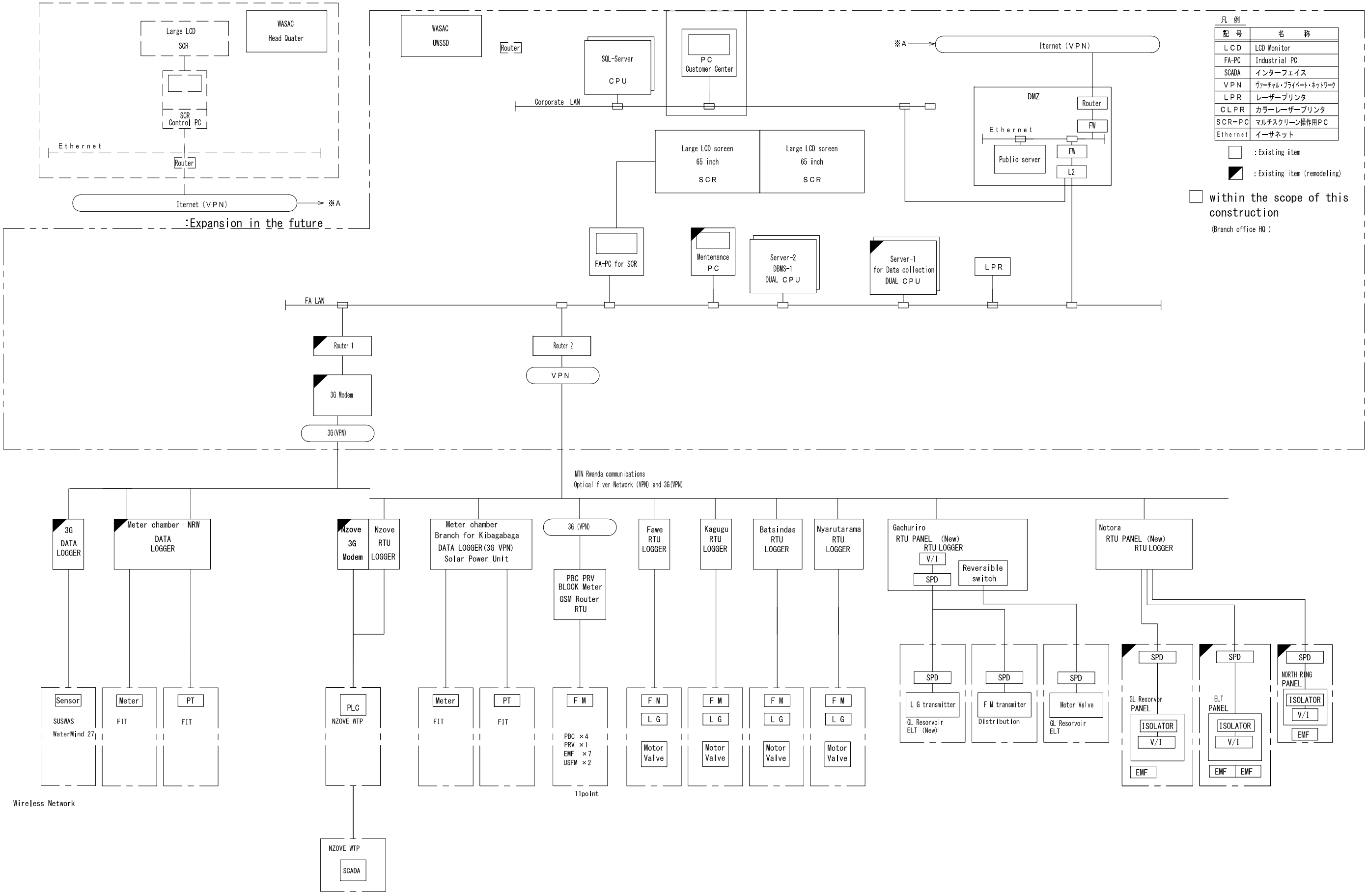
PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA	*Batsinda Reservoir Structure (4)*				*KG-R-405*
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE *1:100*

A11-30



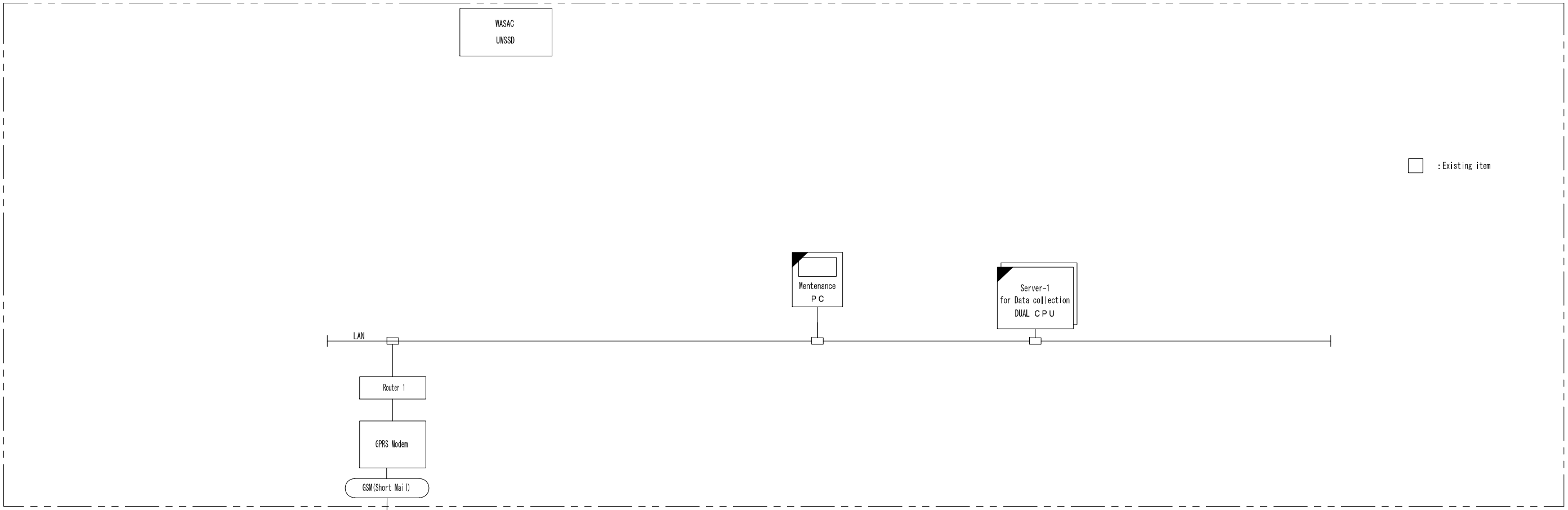
PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA	Pipe Layout of BATSINDA Reservoir(1)				*KG-R-406*
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE *1:200*

A11-31



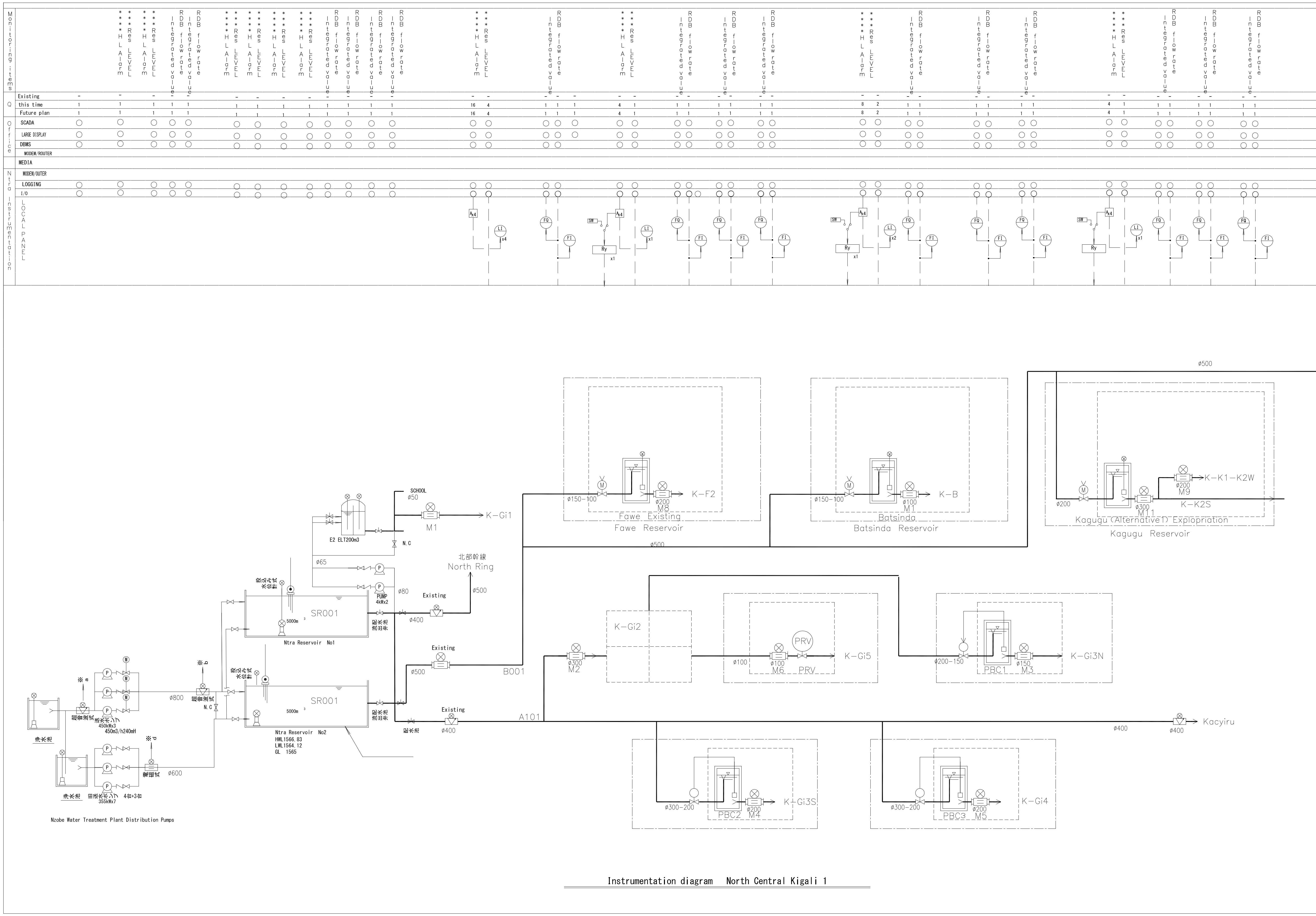
Expantion plan

PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA	*System configuration diagram (after expantion)*				*KG-E-001*
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE *NONE*

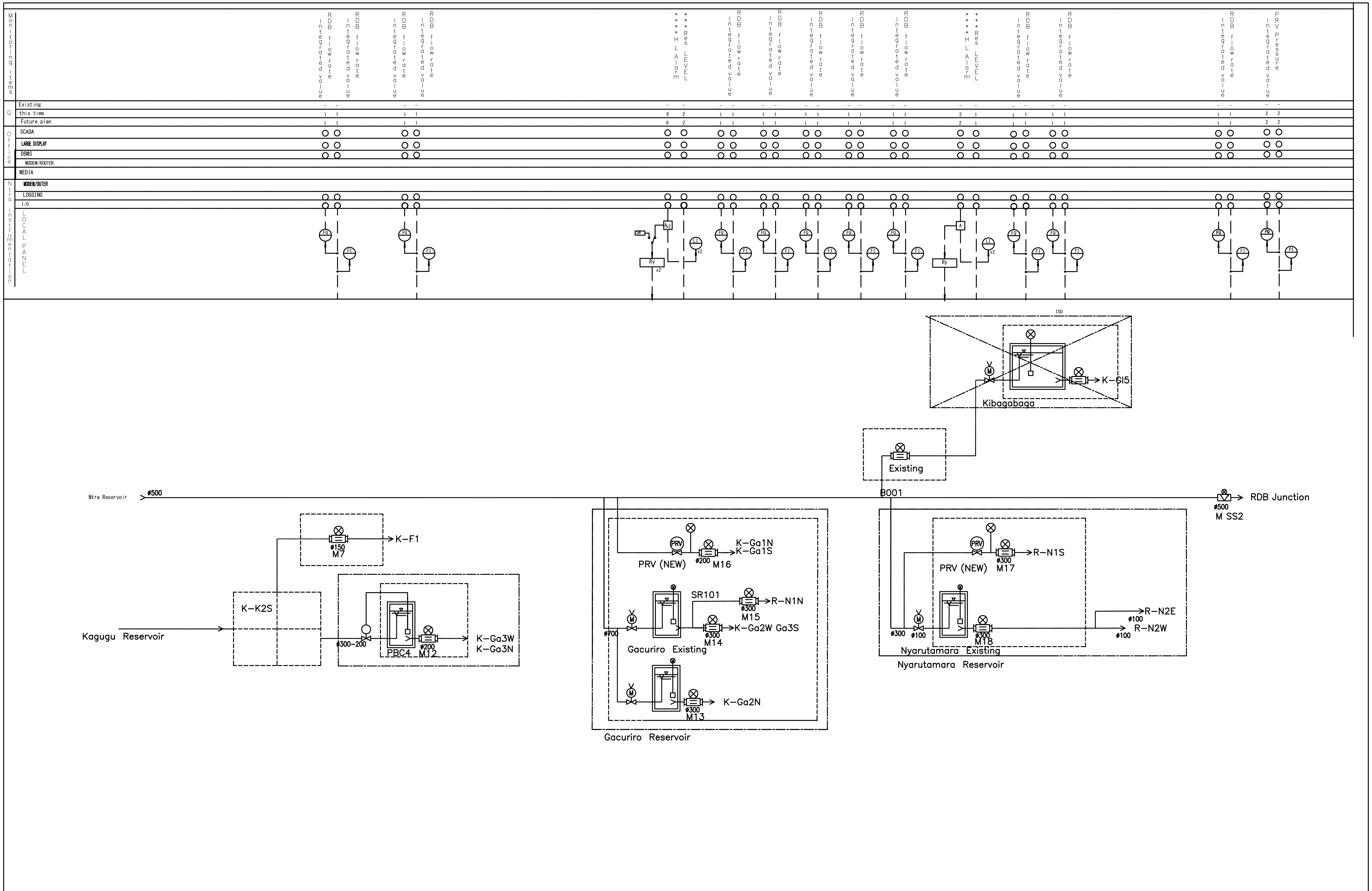


Existing system

PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA	*System configuration diagram (before expantion)*				*KG-E-002*
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE *NONE*



PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA	*Instrumentation flow chart (1)*				*KG-E-003*
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE *NONE*


Monitoring items
RDB flow rate
Integrated value
RDB Res LEVEL
H L Alarm
PRV Pressure
Existing
this time
Future plan
Q
Office
SCADA
LARGE DISPLAY
DBMS
MODEM/ROUTER
MEDIA
MODEM/OUTER
LOGGING
I/O
Ntra Instrumentation
LOCAL PANEL
Ry
Kibagabaga
K-Gl5
Existing
B001
Ntra Reservoir
ø500
RDB Junction
ø500
M SS2
K-F1
ø150
M7
K-K2S
Kagugu Reservoir
ø300-200
PBC4
ø200
M12
K-Ga3W
K-Ga3N
PRV (NEW)
ø200
M16
K-Ga1N
K-Ga1S
SR101
ø300
M15
R-N1N
ø300
M14
K-Ga2W Ga3S
ø700
Gacuriro Existing
ø300
M13
K-Ga2N
Gacuriro Reservoir
PRV (NEW)
ø300
M17
R-N1S
ø300
ø100
ø300
M18
R-N2E
R-N2W
ø100
ø100
Nyarutamara Existing
Nyarutamara Reservoir

Instrumentation diagram North Central Kigali2

PROJECT *PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEMS IN NORTH-CENTRAL KIGALI IN THE REPUBLIC OF RWANDA*	DESCRIPTION *Instrumentation flow chart (2)*	*XXX*	APPROVED BY	DATE	DRAWING No *KG-E-004*
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE *NONE*