No.

Guyana Water Incorporated (GWI)
The Co-operative Republic of Guyana

IMPLEMENTATION REVIEW STUDY REPORT ON THE PROJECT FOR WATER SUPPLY IN CORRIVERTON PHASE II CO-OPERATIVE REPUBLIC OF GUYANA

November 2008

JAPAN INTERNATIONAL COOPERATION AGENCY

TOKYO ENGINEERING CONSULTANTS CO., LTD.

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PREFACE

In response to a request from the Government of the Co-operative Republic of Guyana, the Government of Japan decided to conduct a implementation review study on the Project for Water Supply in Corriverton Phase II and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Guyana a study team from July 23 to August 11, 2008.

The team held discussions with the officials concerned of the Government of the Co-operative Republic of Guyana, and conducted a field study at the study area to review the implementation plan and the project cost estimation. After the team returned to Japan, further studies were made and the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Co-operative Republic of Guyana for their close cooperation extended to the teams.

November 2008

Ariyuki Matsumoto
Vice President
Japan International Cooperation Agency

November 2006

LETTER OF TRANSMITTAL

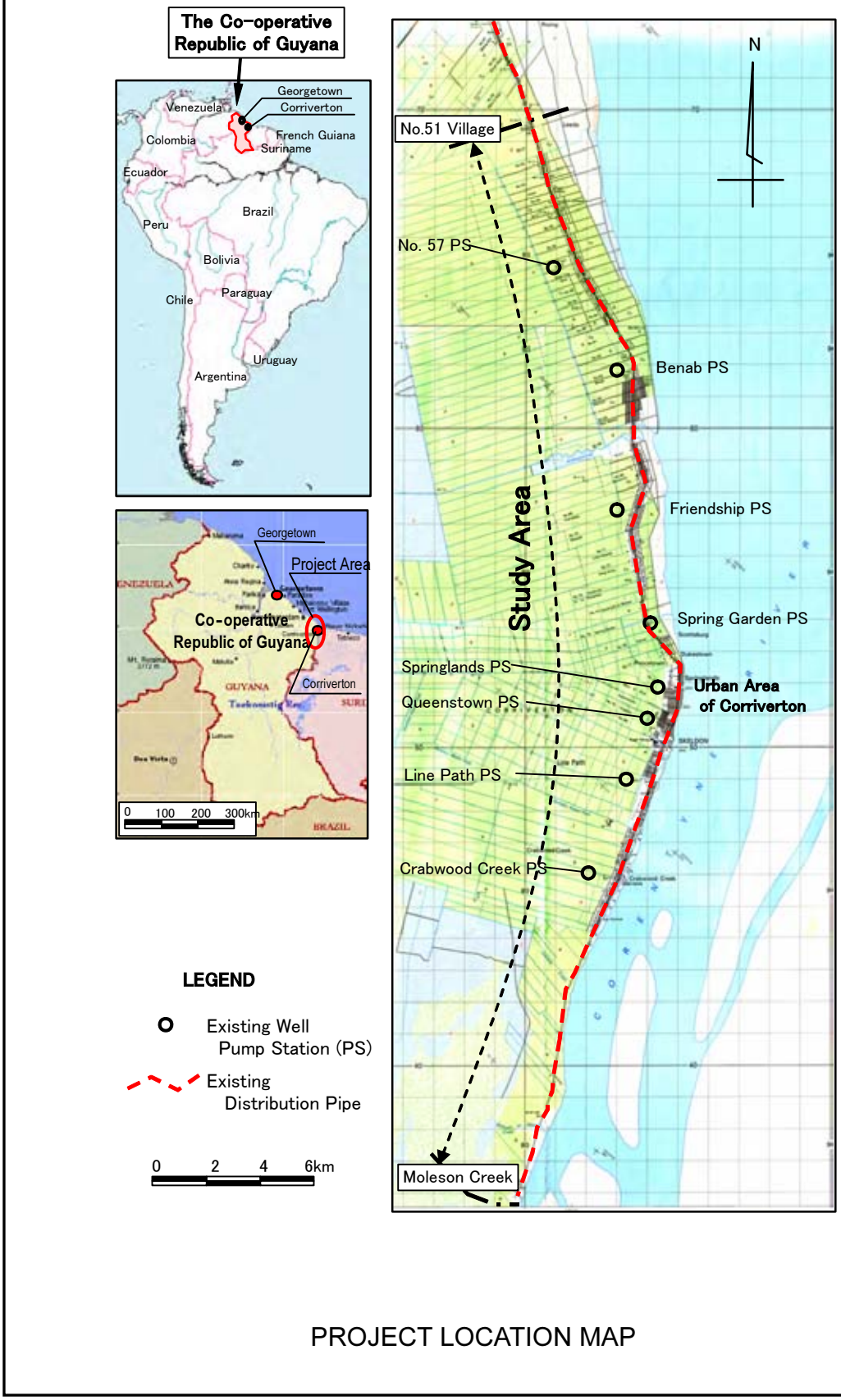
We are pleased to submit to you the implementation review report on the Project for Water Supply in Corriverton Phase II in the Co-operative Republic of Guyana.

This study was conducted by Tokyo Engineering Consultants Co., Ltd., under a contract to JICA, during the period from July 2008 to November 2008. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Guyana and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

Akira Takechi
Project Manager,
Implementation Review Study Team on
The Project for Water Supply in Corriverton Phase II,
The Co-operative Republic of Guyana
Tokyo Engineering Consultants Co., Ltd.



PROJECT LOCATION MAP

Photographs

Suburb area of the Project area. The existing distribution trunks run along both road shoulders.

Close set area in the Project area. The existing distribution trunks run along both road shoulders.

Existing No.57Village pumping station.
This well is a water source of the No.56 Village WTP. （Phase 1/2）

Existing Spring Garden pumping station.
This well is a water source of the Queenstown WTP.

Site for No.56Village WTP
Left side: Existing ditch.. Right side: Cricket ground. Back: WTP Site. There are several residences left of the ditch. （Phase 1/2）

Site for Queenstown WTP.
Presently sugar cane field surrounded by ditches. Access road will be construct by infilling the ditch. No house around.

River crossing of the existing distribution trunk by bridge suspension

River crossing by wooden pile. Locally available hard wooden pile is resistant to corrosion. River crossing by wooden pile is common works in GWI.

Low pressure water supply. Residents of this house can receive water only from this hydrant set at ground level.

Exposed water meter. Service pipe is exposed and there is no cover of meter.

Supplied water coloured by iron

Leakage form distribution pipe. Possible damage by being exposed.

PERSPECTIVE OF QUEENSTOWN WTP

Abbreviations

CARICOM	Caribbean Community and Common Market
CDB	Caribbean Development Bank
CHPA	Central Housing and Planning Authority
DFID	Department for International Development
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EN	Exchange of Notes
EPA	Environmental Protection Agency
EU	European Union
GDP	Gross Domestic Production
GPL	Guyana Power and Light Co.
GT&T	Guyana Telephone and Telegraph Company Limited
GUYSCO	Guyana Sugar Corporation
GWI	Guyana Water Incorporated
GYD	Gyanese Dollar
HIPCS	Heavily Indebted Poor Countries
IDA	International Development Association
IDB	Inter-American Development Bank
JICA	Japan International Cooperation Agency
JPY	Japanese Yen
MOA	Ministry of Agriculture
MOF	Ministry of Finance
MOFTIC	Ministry of Foreign Trade and International Cooperation
MOHW	Ministry of Housing and Water
NDC	Neighourhood Democratic Council
NDS	National Development Strategy
PRSP	Poverty Reduction Strategy Paper
PS	Pumping Station
PUC	Public Utilities Commission
PVC	Polyvinyl Chloride
USAID	U.S. Agency for International Development
USD	United States Dollar
WB	World Bank

SUMMARY

The Co-operative Republic of Guyana (hereinafter referred to as Guyana) situates in the northeast of the South America Continent facing to the Atlantic Ocean with population of 751 thousands (Census 2002) and area of 215 thousands km^2. Due to the small size of population, the industrial production has not very developed and the national economy mainly depends on the agricultural productions, such as rice and sugar cane. Gross national production per capita in 2007 is USD 1,111.

The Government of Guyana adopted in 2001 the National Development Strategy 2001 – 2010 (NDS) and Poverty Reduction Strategy Paper (PRSP) as a national development policy. NDS and PRSP highlight the importance of the development of the social sector as means of the poverty reduction and the fulfillment of the basin human needs and further stress the importance of supply of safe water among the sector.

For the water sector, PRSP points out the poor operation and maintenance of the facilities, low quality of the treated water and insufficient access to the water service as major issues and requires to address the issues by i) supplying safe water to 95% of the population, ii) establishing a consolidated water supply service company, iii) strengthening water supply service in the coastal areas by promoting water treatment and iv) to implement comprehensive rehabilitation and operation and maintenance plans.

Guyana Water Incorporation (GWI) was established in 2002 to consolidate country's water supply services as one of results of addressing the issues pointed out by PRSP, since then GWI has been operating water supply service under the license given by Ministry of Housing and Water (MOHW). Water supply coverage is estimated to reach at 83% in a nation wide average, it has however problems in quality of the supplied water, such as risk of the bacterial contamination and unacceptability due to unpleasant taste and odor and coloring by high concentration iron. It also has problems in water supply quantity as it can not maintain 24 hour operation of water lift of pumps of the water source wells due to high electricity cost and water can not distributed without lift pumps operation which is required to pump water to entire water supply area where no gravity flow is applied because of flat land. In addition, since installation of water meters remains low rate (25% in national average) and water quantity cannot be measured, it causes wastage of water by users and difficulty in estimating water leakage.

To address to the above issues, the Government of Guyana requested the Government of Japan a grant aid assistance in August 2003 to implement the following projects:

- Rehabilitation of 4 water source wells
- Installation of transmission Mains with a total length of 33 km.
- Installation of conduction lines with a total length of 7 km.
- Construction of 2 Water Treatment Plants.

- Installation of distribution mains with a total length of 35 km.
- Construction of 2 ground water reservoirs with each volume of 2000m^3.
- Construction of 2 elevated water tank with each volume of 400m^3.
- Installation of 9800 number of Water Meters.

The Basic Design Study for the requested project was implemented from November 2005 to July 2006. Based on the result of the study, Exchange of Note for the Phase 1/2 project (limited amount to be extended; 651 Million Yen) was concluded on 24 July 2006 and the project was completed in March 2008. Exchange of Note for the Phase 2/2 project was concluded on 25 July 2007 and the tender for the selection of a contractor was held in January 2008. However the tender was not successful and as the retendering was not possible due to constraint of implementation period the Phase 2/2 project was cancelled by implementing soft-component only. This Implementation Review Study is implemented to request the approval of the implementation of the remaining portions of the Phase 2/2 project under the budget of fiscal year 2008. The summary of the report is as follows:

The Project will construct water supply system to supply safe water continuously for 24 hours with sufficient water pressure and procure water meters to contribute to the improvement of financial conditions of the water supply operation by assisting water leakage control programme.

Basic policies of planning were determined by the Basic Design Study as follows:

- Average daily design water supply rate was set out 6,600m^3/day based on the population in 2015 of 35,598 estimated from the 2002 census population and the per capita water consumption rate of GWI's design standards, 180 l/capita/day. Water quality target was set out iron less than 0.3 mg/l, turbidity less than 5 NTU, pH between 6.5 and 8.5, no detection of coliform bacteria and residual chlorine between 0.5 and 0.6 mg/l/

- As the existence of iron bacteria in well water, slow sand filtration with iron removal by iron bacteria is adopted as a water treatment method.

- Queenstown site is selected as the water treatment site by considering easiness of land acquisition and required total pipe length. Queenstown WTP has capacity of 5,500 m^3/day, and a water reservoir and an elevated water tank are constructed in the plant site.

- Spring Garden well and Queenstown well for Queenstown WTP are selected as water source wells for WTP.

- Capacity of water reservoir is determined by 8 hour equivalent volume of daily maximum water supply rate to cover a peak flow rate.

- Height of the elevated water tank is set out less than 25 m considering soft ground condition.

- To avoid renewal and expansion of the existing distribution mains, treated water from each WTP is supplied at the two connection points so that the water pressure is

maintained minimum 0.7kg/cm^2 throughout the distribution network by the elevated tank with elevation of 25 m.

Outlines of the present Project facilities are as follows:

Outlines of the Facilities

Facilities	Component
Water Source Well (Rehabilitation)	• Spring Garden well: Replacement of lift pump (1 no)、Emergency generator (1) • Queenstown well: Replacement of lift pump (1 no)
WTPs	• Queenstown WTP：Slow sand filter, Water reservoir, Elevated tank, Distribution pump, Chlorine disinfecter, Emergency generator、Generator building and Office/store building
Conduction lines	• Spring Garden Well to Queenstown WTP: 4,332m • Queenstown well to Queenstown WTP: 100m
Distribution Mains	• Queenstown WTP to Springlands connection point: 1,805m • Queenstown WTP to Crabwood Creek connection point: 5,830m

Following direct benefits are expected by the implementation of the Project:

- Safe water with no coli form bacteria, and
- acceptable with iron less than 0.3 mg/l
- is supplied 24 hour continuously
- with sufficient (0.7kg/cm^2) pressure.

Expected indirect benefits are:

- Increase of water revenue by installing water meter to all the customers, ad
- Reduction of disease risk by safe water

The Project is implemented in one phase. A total work period is 18 months.

The Project is judged to be appropriate as a Japanese grant aid project from following points:

- The project will benefit all the residents in Corriverton area and the benefit population is estimated at 19,000 in 2006 and 21.600 in 2015. The Project ensures safety and acceptability of drinking water and 24 hour continuous water supply with sufficient water pressure, contributing to the improvement of the people's living environment.
- Water supply facilities constructed by the Project will be operated and maintained by GWI which has been operating the same type of facilities, GWI, therefore, is not expected to have particular difficulty in their operation and maintenance
- It can be expected that the water meters procured will be installed as scheduled and maintained properly since GWI has already established plans for the installation, repairing and calibrating of the water meters.
- The Project will be implemented as one of measures to achieve the improvement of the service quality which was specified as one of conditions of the GWI's Operation License.
- No adverse environmental effects are expected.

However, in order the Project to achieve the expected effects it is necessary to reduce the

leakage loss by installing water meters procured in the Project to all the users in the earlier stage, applying meter rate water tariff, accelerating the on-going leakage control programme and establishing leakage monitoring and repairing system.

CO-OPERATIVE REPUBLIC OF GUYANA
THE PROJECT FOR WATER SUPPLY IN CORRIVERTON PHASE II

IMPLEMENTATION REVIEW STUDY REPORT

Preface
Letter of Transmittal
Project Location Map
Photographs
Perspective of the Project
Abbreviations
Summary

Table of Contents

	Page
Chapter 1 Background of the Project	1 - 1
Chapter 2 Contents of the Project	2 - 1
2.1 Outlines of Implementation Review Study	2 - 1
2.2 Result of Implementation Review Study	2 - 3
2.2.1 Operation Conditions of 1/2 Project Facilities	2 - 3
2.2.2 Progress of GWI Water Leakage Control Programme	2 - 3
2.3 Design Change from Basic Design	2 - 3
2.3.1 Major Change in Queenstown Water Treatment Plant	2 - 3
2.3.2 Project Implementation Method	2 - 3
2.3.3 Basic Plan	2 - 4
2.3.4 Basic Design Drawings	2 - 8
2.3.5 Implementation Conditions	2 - 8
2.4 Project Cost	2 - 11
2.4.1 Costs Covered by Guyanese Side	2 - 11
2.4.2 Conditions of Costs Estimate	2 - 11
2.4.3 Operation and Maintenance Costs	2 - 12
2.5 Items to be Considered in Implementing the Project	2 - 14
Chapter 3 Project Evaluation and Recommendations	3 - 1
3.1 Project Effects	3 - 1
3.2 Recommendations	3 - 1
3.3 Appropriateness of the Project	3 - 4
3.4 Conclusion	3 - 4

List of Figures

		Page
Figure 2. 1	Location of Facilities (Queenstown WTP)	2 - 5
Figure 2. 2	Implementation Schedule	2 - 10

List of Tables

		Page
Table 2. 1	Components of the Project for Water Supply in Corriverton	2 - 1
Table 2. 2	Study of GWI's Requests on Design Changes of Queenstown WTP	2 - 4
Table 2. 3	Facility Plan of Water Source Wells	2 - 6
Table 2. 4	Size and Length of Conduction Pipelines	2 - 6
Table 2. 5	Facility Plan of WTPs	2 - 7
Table 2. 6	Design Calculations	2 - 7
Table 2. 7	Facility Plan of Distribution Main Pipeline	2 - 8
Table 2. 8	Scope of Work of the Guyanese Side and Their Required Costs	2 - 11
Table 2. 9	Production Costs	2 - 12
Table 2.10	Estimated Revenue in the Project Area	2 - 12
Table 2.11	Comparison of Production Costs and Revenues	2 - 13
Table 3. 1	Effects of Projects and Degree of the Improvement	3 - 1

Attachments

Attachment 1: Member List of Study Team

Attachment 2: Itinerary of Study Team

Attachment 3: List of Persons Concerned

Attachment 4: Minutes of Discussions

Attachment 5: Basic Design Drawings

Exchange Rates

1 USD = 105.81JPY
1 GYD = 0.54JPY

CHAPTER 1 BACKGROUND OF THE PROJECT

CHAPTER 1 BACKGROUND OF THE PROJECT

Water supply services in the Co-operative Republic of Guyana (hereinafter referred to as Guyana) is operated by Guyana Water Incorporated (GWI).

In Guyana, as most of population is concentrated along the coastal line, 90% of water sources rely on groundwater from rich aquifers of the coastal plain while only 10% rely on the surface water. Development of the water supply system was rather easy by digging wells in populated areas and laying down the distribution pipes along the trunk roads since inhabited areas expand along the trunk roads within a few kilo meter width. Water supply coverage has already reached to 83% in national average and nearly 90% in the coastal areas. The distribution trunk lines link throughout the sections divided by large rivers.

Water supply facilities development by such rich groundwater in flat land, while it has accelerated the coverage, causes water supply problems such as water supply failure by electricity failures, water shortage during peak flow periods and low water pressure in the network ends due to the direct water distribution without storage reservoirs and elevated tanks. Moreover, it has a difficulty in 24 hour continuous service because most of the water source wells are operated for only 12 hours due to the high electric power charge. It also has problems in operation and maintenance of the wells and distribution management because water is supplied from many wells to the distribution lines.

As for the water quality of the supplied water, the present system has erosion and iron separation problems due to high iron and carbon dioxide concentrations in the groundwater. A few systems have treatment plants with iron and carbon dioxide removal, however, as most of systems do not have any treatment system, users are suffering from unpleasant taste and odor and coloring by iron. Risk of the bacterial contamination is low because of deep aquifer water, in general. However, since most of the systems do not employ the disinfection, coliform bacteria are detected from tap water occasionally and safety of water is not maintained.

Water leakage are supposed to be high and due to low installation of water meters non revenue water cannot be analyzed, causing difficulty in the operation management.

As such, problems to be addressed Guyana water supply services are improvement of the service quality by supplying abundant safe water for 24 hour continuously with enough pressure and of the management by reducing non revenue water rather than increase of the water supply amount and water supply population by augmentation of the water supply facilities.

To improve such problems in the water supply services, the Government of Guyana requested the Government of Japan for the grant aid for the following provisions in August 2003.

- Rehabilitation of 4 water source wells
- Installation of transmission Mains with a total length of 33 km.
- Installation of conduction lines with a total length of 7 km.
- Construction of 2 Water Treatment Plants.
- Installation of distribution mains with a total length of 35 km.

- Construction of 2 ground water reservoirs with each volume of 2000m^3.
- Construction of 2 elevated water tank with each volume of 400m^3.
- Installation of 9800 number of Water Meters.

The requests aim to supply safe water continuously by centralizing scattered wells into two water treatment plants, securing peak flow by storage reservoirs, maintaining proper water pressure by elevated tanks and promoting the water meter coverage. Therefore, the project is judged to contribute to the improvement of the water supply service quality.

Among the requests above, "Installation of transmission Mains with a total length of 33 km." was deleted since its necessity was confirmed to be low and "Installation of 9800 number of Water Meters." was changed to "Procurement of 9800 number of Water Meters." since it was confirmed as a result of the Preliminary Study that GWI would install them.

The Basic Design Study for the requested project was implemented from November 2005 to July 2006. Based on the result of the study, Exchange of Note for the Phase 1/2 project (limited amount to be extended; 651 Million Yen) was concluded on 24 July 2006 and the project was completed in March 2008. Exchange of Note for the Phase 2/2 project was concluded on 25 July 2007 and the tender for the selection of a contractor was held in January 2008. However the tender was not successful and as the retendering was not possible due to constraint of implementation period the Phase 2/2 project was cancelled by implementing soft-component only. This Implementation Review Study is implemented to request the approval of the implementation of the remaining portions of the Phase 2/2 project under the budget of fiscal year 2008.

CHAPTER 2 CONTENTS OF THE PROJECT

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2.1 Outlines of the Implementation Review Study

The Basic Design Study for the Project for the Water Supply in Corriverton was conducted from November 2005 to June 2006 and the following project components were determined.

Table 2.1 Components of the Project for Water Supply in Corriverton

Phase	Category	Items	Contents
1 /2	Facility Construction	Water Source Wells (Rehabilitation of the Exiting Wells)	• No.57 Village Well PS: Replacement of well pump(1No.), Installation of emergency generator(1 No.)
		Water Treatment Plant	• No. 56 Village Water Treatment Plant (WTP): Slow sand filtration, Storage reservoir, Elevated tank, Lift pump, Disinfection equipment, Emergency generator, House, Office/Store
		Conduction Pipe	• From No. 57 Village well PS to No. 56 Village EWP: 798m
		Distribution Main Pipe	• From No. 56 Village WTP to Connection point at No. 57 Village: 798m • From No. 56 Village WTP to Connection point at No. 67 Village: 7,038m
	Material Procurement	Water Meter	Turbine type water meter: 8400 Nos.
2/2	Facility Construction	Water Source Wells (Rehabilitation of the Exiting Wells)	• Spring garden Well PS: Replacement of well pump(1No.), Installation of emergency generator(1 No.) • Queenstown Well PS: Replacement of well pump(1No.)
		Water Treatment Plant	• Queenstown Water Treatment Plant (WTP): Slow sand filtration, Storage reservoir, Elevated tank, Lift pump, Disinfection equipment, Emergency generator, House, Office/Store
		Conduction Pipe	• From Spring garden well PS to Queenstown WTP: 4,332m • From Queenstown well PS to WTP: 100m
		Distribution Main Pipe	• From Queenstown WTP to Connection point at Springlands: 1,805m • From Queenstown WTP to Connection point at Crab woods: 5,830m
	Soft Component	Technology transfer of slow sand filter operation	

Based on the result, Exchange of Note for the Project for Water Supply in Corriverton Phase 1/2 (Grant amount: JPY651 million) was concluded on 24 July 2006 and the project was completed in March 2008. Exchange of Note for the Project for Water Supply in Corriverton Phase 2/2 (Grant amount: JPY825 million), which is comprised of construction of water supply facilities

such as Queenstown Water Treatment Plant and related facilities and the Soft Component, was concluded on 25 June 2007. Consequently detailed designing was conducted and the tendering for the selection of contractor for the phase 2/2 project was opened in January 2008. However, the tendering ended in failure and as the retendering was not possible due to constraint of implementation period the Phase 2/2 project was cancelled by implementing soft-component only.

Hence, this Implementation Review Study was conducted in order to implement the facility construction portion of the 2/2 phase project (not shaded parts in Table 2.1) in fiscal year 2008.

In the Implementation Review Study, following works were conducted to review the design and cost estimates:

- Confirmation of the general conditions around the Project

  It was confirmed that there had been no major changes in dominating plans, implementation system and trends of other donors. It was also checked if changes of designing is required from the operational experience of the phase 1/2 facilities.

- Present site conditions

  It was confirmed that there was no major changes in the physical conditions of water treatment plant site and routes of conduction pipe line and distribution main pipe line.

- Implementation Plan

  It was confirmed that there was no major changes in general conditions, local conditions and institutional conditions related to the construction works and procurement activities. It was also confirmed that there would be no significant problems with construction supervision plan, quality assurance plan and implementation plan which were determined in the detailed design stage.

- Cost Estimates

  Unit prices which was supposed to have changed due to local market conditions were reviewed. Special attention was given to fuel price, transportation cost and wooden pile price.

As results of the consideration above, it was confirmed that there was no major changes in the situation around the project and thus planning policy, basic plan, basic design, implementation plan and operation maintenance plan by the Basic Design Study can be applied.

Meanwhile, since the market conditions were supposed to be affected by the world-wide construction booms, the project cost was reviewed by cost surveying of the construction materials, fuel price and transportation cost.

2.2 Result of the Implementation Review Study

2.2.1 Operation Conditions of 1/2 Phase Project Facilities

One of the objectives of the project is to remove iron in water, of which concentration in raw water is extremely high and causes coloring and odor/taste problems. Based on the confirmation of the existence of iron bacteria in water, slow sand filtration with iron removal by iron bacteria was adopted. The iron concentration in the treated water is less than 0.1 mg/l and the effectiveness of the iron removal by iron bacteria was confirmed.

2.2.2 Progress of GWI Water Leakage Control Programme

The facilities were designed based on the unit water demand 180 l/capita/day, which is standards of the GWI. However, according to the operation records of GWI, present water consumption rate in the project area was estimated at 500 l/capita/day and leakage and wastage in the distribution system were estimated to be major cause of shortage of the water. Under such conditions, if water is distributed at the design rate, 180 l/capita/day, it apparently causes water shortage. Therefore, the implementation of the leakage control programme is the precondition of the manifestation of the project effects.

GWI is being installing the water meters which were procured in the 1/2 phase, moreover detecting and repairing leakages which are found along with process of the meter installation. At the time of the Implementation Review Study, the meter installation and leakage repairing were completed in 2/3 of the 1/2 phase project area. As a result, water leakage was significantly reduced and sufficient water supply has been achieved by water supply rate of 180 l/capita/day in the 1/2 phase project area.

Therefore, it was confirmed that the objective of the project could be achieved in the Implementation Review Study area by the current GWI's water leakage control programme.

2.3 Design Change from the Basic Design

2.3.1 Minor Change in Queenstown Water Treatment Plant

At time of the Implementation Review Study, GWI has had 8 months experience of the operation of No. 56 Village Water Treatment Plant since the commencement in March 2008. Since frequency of the sand scraping of the slow sand filters is higher than the one originally planned, GWI requested minor design changes in order to reduce the work load of the sand scraping (Refer to Attachemnt-4: Technical Notes). The request was studied and the changes were incorporated in the project cost estimate. Study of GWI's requests is shown in Table 2.2.

Table 2.2 Study of GWI's Requests on Design Changes of Queenstown WTP

GWI' Requests	Result of Study
To caver peripheral parts of sand wash pit and sand drying pit with concrete or grave	To cover with concrete or gravel. (No design change because of no specific description in drawings and specifications)
To shorten the distance of or adjoin sand wash pit and sand drying pit to ease the transportation.	To shorten the distance to 50 cm.（No change in quantity）
To install one power outlet to each filter	To install one power outlet to each two filters. (Design change)
To increase diameter of the hose	To change to 50 mm (Change of specification）
To install a flapper to the filter guardrail to ease carrying out of the sand.	To install flappers. (Design change)
To change the material of caps of manhole.	To change to steel. (Change of specification）
To higher the level of drain outlet of drying pit.	To higher as high as possible. (Design change)
To install water level meter in the filtration pond.	To draw level marks on the wall of the filtration pond.
To install pressure meter at the outlet of the elevated tank.	Desirable but not essential. GWI shall install it by themselves, if necessary.

2.3.2 Project Implementation Method

The project is implemented in single year.

2.3.3 Basic Plan

There is no change in the basic plan from the one of the Basic Design Study, in principal. Basic plan for the Implementation Review Study is described hereunder:

(1) Overall Plan（Target Year and Water Demands)

Target year is set out 2015. Population in 2015 was estimated at 36,598 and among which population in the Implementation Review Study area was 21,791.

Per capita consumption rate adopts 180 l/capita/day based on the GWI Design Parameter. Maximum daily demand and maximum hourly demand are calculated by peak factors of the Design Parameter, 1.4 and 1.8 respectively. Design water supplies are determined as follows (the adopted for facility design in parentheses):

Average daily water supply: 6,588 m^3/day (6,600 m^3/day)
Maximum daily water supply: 9,223 m^3/day (9,300 m^3/day)
Maximum hourly water supply: 11,858 m^3/day (11,900 m^3/day)

(2) Facility Plan

Location of each facility is shown Fig. 2.1.

1) Water Source Wells

For the water source wells selected as water sources for WTPs, lift pumps are replaced with ones with proper specifications for the required head and discharge and new emergency generators are installed. The existing wells that will be not used for the WTPs will be left as they are and used as back up wells to supplement water supply in emergency cases.

Figure 2.1 Location of Facilities (Queenstown WTP)

Table 2.3 Facility Plan of Water Source Wells

Name of wells	WTP	Capacity of Emergency Generator	Replacement of Pumps	
Spring Garden Well	Queenstown WTP	150kVA	Discharge (m^3/min)	2.08
			Head (m)	65
			Output (kW)	37
Queenstown Well	Queenstown WTP	Not installed. Power is supplied from the emergency generator of Queenstown WTP.	Discharge (m^3/min)	1.74
			Head (m)	40
			Output (kW)	18.5

2) Conduction pipeline

Conduction pipe were designed for the maximum daily rates. All the conduction pipe will be buried under public ways. Size and length of the conduction pipelines are summarized in Table 2.13.

Table 2.4 Size and Length of Conduction Pipelines

WTP	Section	Material	Size (mm)	Length (m)
Queenstown WTP	From Spring Garden well to Queenstown WTP	Rigid PVC	250	4,332
	From Queenstown well to Queenstown WTP	Rigid PVC	200	100

3) WTP

WTP was designed based on the following concepts:

i) WTP is designed based on the maximum design daily water supply rate. It dose not have a back wash process since slow sand filtration is employed.

ii) In the Project, the filtration rate is set to be 5 m/day, on account that the normal rate is 4 – 5 m/day which is stated in “Guidelines for water supply facility design (Japan Water Works Association, 1999)”. Numbers of filter basins are to be three or four, that include a standby basin, and their filtration rates are to be kept under 7 m/day even when one basin is stopped, since the guidelines require two or more basins including standby and maximum filtration rate in good water quality is to be 8 m/day.

iii) Volume of storage reservoir is designed to have a capacity of 8 hour detention time to the maximum design daily water supply rate.

iv) Elevated tank shall have one our detention time to the maximum design hourly water supply rate and capacity of the lift pump shall have the design maximum hourly rate.

v) Chlorine disinfection employs gas chlorine and protective measures against the chlorine leakage shall be provided.

Facility plan of WTP is shown in Table 2.5. Ground level of the WTP is designed at +17.79m with 750mm filling on the existing ground level (+16.96m). Construction of the filter, storage reservoir, elevated tank and building apply pile foundation.

Design calculations are shown in Table 2.6.

Table 2.5 Facility Plan of WTPs

WTP	Distribution Area	Capacity	Facility/equipment
Queenstown	Population: 21,600 Area: From No.74Village to Moleson Creek	Maximum Daily: 5,500m^3/day Maximum Hourly: 7,030m^3/day	Slow sand filter, Storage reservoir, Lift pump, Elevated tank, Chlorine injector, Sand washing tank with storage, Emergency generator, Water quality test kit, Transformer, Office building

Table 2.6 Design Calculations

Facilities	Queenstown WTP
Receiving Chamber	Retention time: 15mins. Vol: 3.189m^3/min x 15 min＝57.3m^3. W6.0m×L3.0mxH3.1m (Ef. Depth :2.65m)
Slow Sand Filtration	Filtration rate: 5m/day. Area: 5,500m^3/day / 5.0m/day = 1,100m^2. Filtration layer: Sand 0.7m + Gravel 0.5m = 1.2m. Filtration depth: 1.2m. Overboard: 0.5m. Collector: Perforated pipe. W14.0m x L20.0m x H2.9m（Eff. Depth: 2.4m）x 4 beds. Flirtation rate in 3 bed operation: 6.5m/day
Storage Reservoir	Retention time: 8 hrs. Vol: 229.2m^3/hr x 8hrs = 1,834m^3. Depth: 3m, Area: 1,834m^3/ 3m＝612m^2. W910.0m x L30.6m x H3.7m (Eff. Depth: 3.0m) x 2.
Lift Pump	3 pumps including 1 stand-by. Capacity: 4.882m^3/min / 2min = 2.44m^3/min. Head: 29.0m. Shaft power: 0.163 x 1.0 x 2.44 x 293/0.73 = 15.80kW. Motor power: 15.88 x 1.15 = 18.17kW ≈ 22kW.
Elevated Tanks	Retention time: 1 hr. Vol: 292.9 m^3/ hr x 1.0hr = 293m^3. Effective depth: 2.6m. ϕ12m x H3.0m（Effective depth: 2.6m）. Height of tank bottom: 25.0m.
Disinfection Equipment	Disinfectant: Chlorine gas. Dosing rate: 1.0mg/l. 5,500m^3/day x 1.0mg/l = 5.5kg/day. Injection pump: 0.08m^3/min x 43m x 2.2 kW x 2 pumps (1 stand-by). Equipped with leakage detector.
Flow Measuring Equipment	Type: Turbine type meter. Range: 0 - 400m^3/hr. One meter for each distribution line.

4) Distribution Main Pipeline

Height of elevated tank, location of connection point of the distribution main pipe to the existing distribution trunk pipe and size of the pipe were designed so that the existing distribution trunks can be utilized as much as possible. Also maximum size of PVC pipe made

in Guyana (250mm) is taken into consideration. Facility plan of the distribution main pipelines is shown in Table 2.7.

Table 2.7 Facility Plan of Distribution Main Pipeline

WTP	Elevated Tank	Pipe No	Size (mm)	Connection Point	Length (m)
Queenstown WTP	Volume: 293m^3 Height: 25.0m	No.3	ϕ250	No78 Springlands	1,805
		No.4	ϕ250	Crabwood Creek	5,830

2.3.4 Basic Design Drawings

List of drawings of the basic design is shown below and each drawing is attached in the back of this report.

Drawing No.	Drawings	
001	Whole Project	General Plan
013	Queenstown WTP	General Plan
014	Queenstown WTP	Flow Diagram
015	Queenstown WTP	Plan
016	Queenstown WTP	Water Level Profile
017	Queenstown WTP	Slow sand filter - Plan
018	Queenstown WTP	Slow sand filter-Cross Section
019	Queenstown WTP	Storage reservoir - Plan
020	Queenstown WTP	Storage reservoir - Cross Section 1
021	Queenstown WTP	Storage reservoir - Cross Section 2
022	Queenstown WTP	Elevated tank
023	Queenstown WTP	General Plan of Pipe Line

2.3.5 Implementation Plan

(1) Implementation Conditions

<Access>

WTP sites face to the public road and all the conduction and distribution mains are buried under the public way. However, since the public way other than trunk roads is mostly unpaved, following restore work will be required

- Queenstown WTP: There would be no particular problems with access road from the trunk road (660m). Wooden bridge at 100m from WTP may require reinforcement work for heavy vehicles. As the site is surrounded by water channels with 5m width, the construction of an access road by filling the channel is required.
- Installation of Conduction/distribution pipe:
  Access road for the installation of conduction and distribution pipe can use the existing roads. Hand excavation will be required in the vicinity area of WTP because some of the existing distribution pipe in this area are asbestos pipe.

<Business Area>

A part of the conduction pipeline from Spring Garden well to Queenstown WTP and distribution main pipe from Queenstown WTP to Springlands connection point are buried in about 2 km of Corriverton urban area. In this area people use the road shoulders as parking space and business activities. Pipe installation in this area could interrupt their daily activity but it would be unavoidable because no alternative routes are available. To minimize the interruption, it is required to divide the work section into small size in which all the work such as excavation, laying down, back filling and replacement, can be completed within one day.

(2) Implementation Schedule

Implementation Schedule is shown in Fig. 2.2.

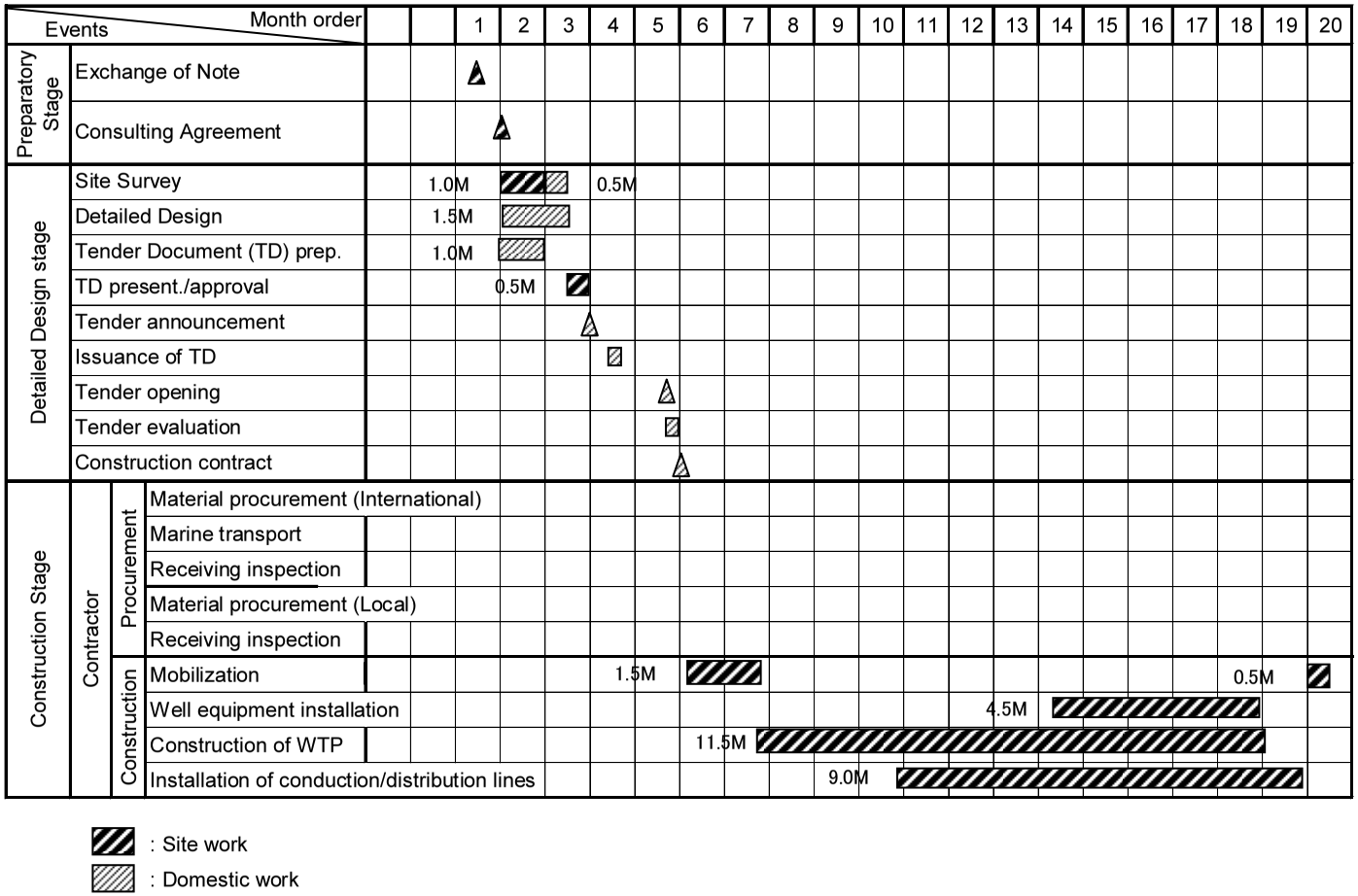


Fig 2.2 Implementation Schedule

2.4 Project Cost

2.4.1 Costs Covered by Guyanese Side

Scope of work covered by the Guyanese side are shown in Table 2. 8 together with the required costs. Among the scope covered by the Guyanese side, most of scope dose not cost the Guyanese side since all the required sites are already in possession of the Ministry of Housing and Water and most of works can be done by GWI's operators as their daily work. Only costs required for the installation of power lines to the facilities sites and the installation of water meters will be borne by the Guyanese side.

Table 2.8 Scope of Work of the Guyanese Side and Their Required Costs

Scope	Costs (Million Japanese Yen)	Remarks
(1) Securement of temporary work sites	-	Owned by Ministry of Housing and Water
(2) Securement of WTP sites	-	Owned by Ministry of Housing and Water
(3) Cutting over the Queenstown WTP	-	GUYSUCO
(4) Arrangement of	-	Will be dine by Mobile operators or Linesmen
(5) Securement of space for emergency generators and fuel storage tanks	-	Enough space in the existing well sites
(7) Information of underground structures and presence at the excavation	-	Will be dne by Mobile operators or Linesmen
(8) Presence at and announcement of the connection of new distribution main and existing distribution trunk	-	Will be done by Mobile operators or Linesmen
(9) Provision of water for pipe washing and pressure test	-	GWI's water
(10) Coordination at chlorine disinfection of new pipe lines	-	Will be done by Linesmen
(11) Installation of electric power line to the facility site	0.540	Contract to GPL
(17) Installation of water meters	0.918	Subcontractors
Total	1.458	

2.4.2 Conditions of Costs Estimate

<Time of Estimate>

July 2008.

<Exchange Rates>

The exchange rates applied are as follows:

- 1 USD = 105.81 Japanese Yen
- 1 GYD = 0.54 Japanese Yen

2.4.3 Operation and Maintenance Costs

(1) Production Costs

In the calculation of the production costs, following costs are added up:

- ✓ Manpower
- ✓ Electricity
- ✓ Chemicals
- ✓ Repairing
- ✓ Depreciation

Results are shown in Table 2. 9.

Table 2.9 Production Costs

（1000 GYD/year）

Case	Manpower[1)]	Electricity[2)]	Chemicals[3)]	Repair[4)]	Depreciation[5)]	Total ( ): not including depreciation
Leakage control is achieved at the completion of the project	9,881	52,540	862	2,000	40,000	105,283 (65,283)
Leakage control is not achieved at the completion of the project. It requires operation of existing wells	9,881	79,871	862	2,000	40,000	132,614 (92,614)

1): Manpower cost is calculated from cost for additional 8 operators (Grade DS1, salary 35,470 GYD/month: total: 3,405,120 GYD/year) for new WTPs and allocation of the present total manpower costs (estimated at 26,983,632 GYD/year) of Division 5 to the project area.
2): Calculated from operation length and power of each pump.
3) Cost of chlorine for disinfection.
4): Assuming 1% of the total equipment cost of the project (200 million GYD)
5): Straight line method; Asset value ;2,200 million GYD (Project cost – Engineering cost), Residual value; 10%, depreciation period; 50 years.

(2) Revenue

In the project site, 9.5% of customers have water meters, no metered rate, however, is applied but only the fixed rate is applied. Since water revenue specifically in the project area is not available, present revenue for the project area was estimated as shown in Table 2.10.

Table 2.10 Estimated Revenue in the Project Area

Category of Customers*		Number of Customers**	Fixed Water Rates （GYD/Year） *	Revenue （GYD/Year）
Small business		1,454	25,440	36,989,760
Residents	Low income (less than 60,000GYD/month)	4,509	4,500	20,290,500
	High income (more than or equal to 60,000GYD/month)	1,199	14,400	17,265,600
Total		7,162		74,545,860

*: From tariff table of GWI
**: Based on the social survey conducted in the Study. Self owned business and others in the categories of the survey are considered to be “Small Business” and “Resident” in the GWI’s tariff table, respectively.

Meanwhile there is a metered rate, although it is not applied in the project area. Supposing the metered rate is applied to all the costumers in the project area, revenue to be earned is calculated. In the calculation, the metered rate of 58 GYD/m^3 is applied and water consumption by each customer is presumed 135 l/capita/day (subtracting 25% of leakage loss from 180 l/capita/day).

31,643(population in 2005) x 0.135 l/capita/day x 58GYD/m^3 x 365days＝90,434,111GYD/year

GWI is now requesting the tariff increase by 10%. If it is approved, revenues of 82,000 thousand GYD/year by the fixed rate and 99,000thousand GYD/year are expected.

(3) Cost and Revenue Balance

Comparison of the estimated production costs and revenues is shown in Table 2.11.

In case where the leakage control is achieved and 10% tariff increase is approved, the revenue slightly lowers the production cost with depreciation. However, as the asset value is possibly overestimated in the calculation of the depreciation, actual depreciation rate may be smaller than it. It can be therefore judged that the revenue covers the production cost. Since ratio of the depreciation to the total production cost is as high as 25%, the production cost may be covered by the revenue without 10% increase depending on the asset value evaluation.

In case where the leakage control is not achieved and the pump operation of wells other than water resource wells of WTPs is continued, the production cost far exceeds the revenue because of high electricity cost.

Early achievement of the leakage control is desperately required from a view point of sound financial balance, too.

Table 2.11 Comparison of Production Costs and Revenues

Revenue (1000GYD/year)		Production Costs (1000GYD/year)		
By metered rate	90,434	Leakage control is achieved at the completion of the project	Including depreciation	105,283
			Excluding depreciation	65,283
By metered rate after 10% tariff increase	99,000	Leakage control is achieved at the completion of the project	Including depreciation	132,614
			Excluding depreciation	92,614

(4) Customer's Affordability

According to the results of the social survey, respondents showed the willingness-to-pay 10 % more than the present payment on the average on condition that the service quality is improved.

Supposing that 10% tariff increase is approved and the metered rate are applied to all the customers, the water tariff of the average family (4.1 persons per family) is 1,059 GYD/month. Average family income in the project area is estimated at 42,700 GYD/month (Median=39.000 GYD/month) by the social survey, which equivalent to 2.5 % of the average monthly income. Therefore, it can be considered to be affordable in general.

2.5 Items to be Considered in Implementing the Project

(1) Coordination with Related Organization

Although there would be no particular problems in negotiation with related organizations and persons since the sites are already under competence of the Ministry of Housing and Water, it is recommended to be beforehand with formality required in the various stage of the project.

Negotiation between GWI and GPL regarding the installation of the power line has been undergoing. It would be more desirable if the power line is installed before the commencement of the project without installing the temporally power line.

(2) Securement of WTP Operators

It is required to assign 4 operators of Queenstown WTP before the completion of the project.

(3) Installation of Water Meters

It is required to install all the water meters procured by the project before the completion of the Project. The Project can achieve the expected effects only when leakage is controlled by the water meters and the metered water tariff.

GWI had already completed the water mater installation which was procured by the 1/2 phase project. It is desired that GWI continues the work.

(4) Special Consideration to Residents in Corriverton Urban Area

In general, effects of the Project works to the residents are expected to be a very limited degree because major facilities of the Project are installed in the areas way off from residential areas and pipes are installed along the roads not busy. However, in the Corriverton area, residences and small business houses stand side by side along the road using road shoulder as trading place and parking place. Therefore, the pipe installation work in this area could cause negative impacts to their commercial activities. While the work will be carried out by dividing the section into a short piece in which all the works can be completed within one day to minimize the negative impacts, cooperation of the residents is inevitable. The Guyanese side is required to take necessary actions to inform the residents of purpose and components of the Project and work schedule, so that the residents become cooperative.

CHAPTER 3 PROJECT EVALUATION AND RECOMMENDATIONS

CHAPTER 3 PROJECT EVALUATION AND RECOMMENDATIONS

3.1 Project Effects

The existing conditions and issues to be addressed by the Project and expected direct and indirect effects was summarized as shown in Table 3.1 in the Basic Design Study and situation has not been changed since then.

Table 3.1 Effects of Projects and Degree of the Improvement

Present Situation and Constraints		Measures Taken by the Project (Project Components)	Project Effects and Extent of Improvement
Direct Effects			
1.	・ Water is directly distributed to the users from water lift pumps of the existing water source wells in Corriverton area. Operation time of the lift pumps are 12 hours per day from 6:00 AM to6:00 PM in principle to cut down the electricity cost. Water supply not only stops during night time and but also even day time in some areas due to low water pressure. ・ There is a high risk of bacteriological contamination as chlorine disinfection is not applied presently. Also acceptability is impaired by obnoxious smell and taste and colouring due to high iron concentration. ・ Low coverage of the water meter (Approx. 10%) results in difficulty in applying the metered water tariff.	・ Rehabilitation of the existing wells and installation of WTPs, water reservoirs and elevated water tanks. ・ Procurement of water meters	・ Bacteriological contamination risk is reduced by the installation of WTPs. ・ Iron concentration in supplied water is controlled under 0.3 mg/l and obnoxious smell and taste and colouring will be diminished. ・ 24 hour continuous water supply is enabled by 24 hour facilities operation and installation of water reservoirs. ・ Sufficient water pressure is ensured at the end of the network by the elevated water tank, enabling water flow from hydrants of the 2nd floor. ・ Revenue of GWI increases by adopting the metered water tariff.
Indirect Effects			
1.	・ Risk of alimentary disease by bacteriological contamination is high.	・ Safe water is supplied steadily.	・ Disease risk is reduced.
2.	・ Users consciousness to water saving is considered poor. ・ Water consumption is not grasped resulting in weak leakage water management.	・ Water consumption is measured.	・ Users' consciousness to water saving is encouraged decreasing .wasted water. ・ Leakage control is enabled by monitoring water use rate.

3.2 Recommendations

In order the Project facilities to achieve the expected effects, the facilities to be maintained properly and the water supply service in Guyana to be sustainable, Guyana is required to take the initiative in the following activities:

(1) Early Implementation of Leakage Control

The facilities in the Project were designed based on the per capita water consumption of 180 l/capita/day by adopting the GWI's Design Standards. However, actual water supply was estimated at 500 l/capita/day based on the GWI's pump operation records, consequently water wastage by users and leakage in the distribution network were estimated to be major causes of poor water quantity and water pressure. Under these circumstances, if the Project is implemented and water is supplied at the rate of 180 l/capita/day, it is concerned that apparent water shortage would occur. Therefore, the leakage control is the preconditions for the Project to achieve expected effects and the Project shall be implement only when the implementation of the leakage control is secured.

Through the Implementation Review Study, it was confirmed that GWI had started the Leakage Control Programme in accordance with the progress of the water meter installation in the Phase 1/2 project area. It is hoped that GWI continues its efforts after completion of the project.

(2) Enforcement of Chlorine Disinfection

Even the above Leakage Control Programme is implemented as scheduled, it is expected it will take a couple of years until complete effects are achieved. Therefore, the Project will leave the existing wells which are not used as the water sources for the new WTPs as they are so that they can supplement water in case when water shortage occurs. However, if water not disinfected is supplemented, bacteriological safety of water is secured no longer and one of objectives of the Project may not be achieved. Therefore, GWI shall enforce disinfection by installing chlorine disinfection equipment to the existing wells when GWI apply transitional supplemental operation of the existing wells.

As result of the leakage control programme, it was observed that the water consumption rate in the Phase 1/2 project area considerably was decreased and no supplemental operation of the existing well had not been required.

(3) Installation of Water Meters Procured

The installation of the water meters is considered a part of the leakage control mentioned in (1). GWI's Leakage Control Programme is based on the district metered area method, which requires installation of the water meters to each users to grasp the actual water consumption rate.

As mentioned in (1), GWI started and completed the installation of the water meters in the Phase 1/2 project area.

(4) Introduction of Meter Based Tariff

The installation of the water meter is considered as a part of the leakage control programme and is also considered to be means to enable the introduction of the meter based water tariff from management view point. The installation rate of water meter in the Project area is estimated at approximately 10%, no meter based water tariff, however is applied even to the users with water meter but the fixed rate is applied.

The introduction of the meter based water tariff will increase the revenue form the water tariff

and could encourage the users consciousness to water saving. Trial calculation in this study estimated 20% increase of revenue by introduction of the meter based water tariff.

Therefore, it is recommended that the meter based water tariff be applied as early as possible after the installation of the water meters.

GWI has already applied the meter based water tariff in the Phase 1/2 project area.

3.3 Appropriateness of the Project

The Project is judged to be appropriate as a Japanese grant aid project from following points:

- The project will benefit all the residents in Corriverton area and the benefit population is estimated at 32,000 in 2006 and 36,600 in 2015. The Project ensures safety and acceptability of drinking water and 24 hour continuous water supply with sufficient water pressure, contributing to the improvement of the people's living environment.
- Water supply facilities constructed by the Project will be operated and maintained by GWI which has been operating the same type of facilities, GWI, therefore, is not expected to have particular difficulty in their operation and maintenance
- It can be expected that the water meters procured will be installed as scheduled and maintained properly since GWI has already established plans for the installation, repairing and calibrating of the water meters.
- The Project will be implemented as one of measures to achieve the improvement of the service quality which was specified as one of conditions of the GWI's Operation License
- No adverse environmental effects are expected.

3.4 Conclusion

It was confirmed that the implementation of the Project is appropriate because the Project would contribute to the improvement of the sanitary and living environment of the residents in Corriverton area, as well as the above mentioned effects are expected from the Project. No problems are expected in the operation and maintenance of the facilities to be constructed by the Project. However, in order the Project to achieve the expected effects it is necessary to reduce the leakage loss by installing water meters procured in the Project to all the users in the earlier stage, applying meter rate water tariff, accelerating the on-going leakage control programme and establishing leakage monitoring and repairing system.

ATTACHMENTS

Attachment 1: Member List of Study Team

Team of Basin Design Study

Name	Title	Organization	Mission Period
Mr. TAKECHI Akira	Chief consultant/Water supply planner/O&M specialist	Tokyo Engineering Consultants Co., LTD.	23 July to 6 August 2008
Mr. IWASGIGE Hiroto	Construction planner/Cost estimate specialist	Tokyo Engineering Consultants Co., LTD.	23 July to 11 August 2008

Attachment 2: Itinerary of the Study Team

No	Date		Takechi	Iwashige
1	23-Jul	Wed	JL006 NRT/JFK 1145/1130(Leaving Tokyo) JL5836 JFK/MIA 1555/1830	
2	24-Jul	Thu	AA1647 MIA/POS 1005/1345	
3	25-Jul	Fri	8:45 Courtesy Call to EOJ in T&T BW483 POS/GEO 2135/2245	
4	26-Jul	Sat	Georgetown-New Amsterdam / Site Survey	
5	27-Jul	Sun	Site Survey / New Amsterdam – Georgetown	
6	28-Jul	Mon	Meeting with GWI	
7	29-Jul	Tue	Meeting with GWI	
8	30-Jul	Wed	Georgetown-New Amsterdam / Site Survey	
9	31-Jul	Thu	Site Survey	
10	1-Aug	Fri	New Amsterdam – Georgetown/Meeting with GWI	
11	2-Aug	Sat	Meeting with GWI	
12	3-Aug	Sun		
13	4-Aug	Mon	BW424 (GEO/POS) 1030/1140 AA1668 (POS/MIA) 1455/1850	Cost Survey
14	5-Aug	Tue	JL5837(MIA/JFK) 0830/1120 JL005 (JFK/NRT) 1331/1625	Cost Survey
15	6-Aug	Wed	JL005 1625NRT (Arriving at Tokyo)	Cost Survey
16	7-Aug	Thu		Cost Survey
17	8-Aug	Fri		Meeting with GWI
18	9-Aug	Sat		BW424 (GEO/POS) 1030/1140 AA1668 (POS/MIA) 1455/1850
19	10-Aug	Sun		JL5837(MIA/JFK) 0830/1120 JL005 (JFK/NRT) 1331/1625
20	11-Aug	Mon		JL005 1625NRT (Arriving at Tokyo)

Attachment 3: List of Persons Concerned

Ministry of Foreign Trade and International Cooperation
Mr. Shafraaz Shadood, Foreign Trade Officer

Ministry of Housing and Water
Hon.Harry Narine Nawbatt, M.P., Minister of Housing and Water

Guyana Water Incorporated: GWI
Mr. Karran Singh, Chief Exective
Mr. Altaf Gafoor, Director, Capital Investment and Planning Department
Mr. Sunildatt Barran, Project Implementation Officer

Embassy of Japan in Trinidad and Tobago
Ms. Mariko Chiba, Second Secretary

TECHNICAL NOTES
ON
IMPLEMENTATION REVIEW STUDY
ON
THE PROJECT FOR WATER SUPPLY IN CORRIVERTON

The Implementation Review Study Team of JICA (the Study Team) held a series of discussions with the Guyana Water Incorporated (GWI) and conducted field surveys from July 26th to August 8th 2008.

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

Georgetown, July 31st 2008

GUYANA WATER INC
Chief Executive

Akira Takechi
Chief Consultant
JICA Implementation Review Study

Karan Singh
Chief Executive
Guyana Water Incorporated
Co-operative Republic of Guyana

ATTACHMENT

Both parties agreed upon and confirmed the following items:

1. Implementation review study

   The Study Team explained, and GWI understood clearly, the background, objectives and scope of the Implementation Review Study.

2. Project Components

   The Study Team reported that no changes in site conditions were found and there will therefore be no change in the components of the Project from those of Phase 2. GWI agreed with this finding.

3. GWI requested the following minor design changes which were identified from their experience in operating the No. 56 Village Water Treatment Plant which was constructed during Phase 1 of the Project:

   - Area around sand washing pit and drying pit should be concreted or overlain with hardened material to avoid the formation of mud during sand washing, drying and transportation.
   - Sand washing pit and drying pit should be within close proximity to each other and preferably connected with a ramp to facilitate easy transportation of washed sand.
   - One power outlet should be available for each filter to avoid an excessively long power cable.
   - Sand washing pipeline should be at least 40mm diameter, preferably 50mm.
   - At least one segment of the guard rails on each unit should be of the folding type in order to facilitate the transportation of scraped sand.
   - Covers for valve box on effluent side are too heavy to handle.
   - At the No. 56 Village WTP, the outlet of the sand drying pit is too close to the ground and cannot be drained effectively.
   - Provisions for wall mounted measuring gauges on filters and outlet walls would facilitate monitoring and maintenance works.
   - Installation of warning lights for the elevated storage tank, if required by aviation regulations (GWI will confirm requirements).
   - Installation of pressure gauges at the outlet of distribution pipes.

The study team confirmed that these design changes would be conveyed to JICA.

N

Atlantic Ocean

No. 56 Village Water Treatment Plant

Start Point of Project

New valve φ150mm×2
Close of existing distribution trunk

Distribution main to No. 57 Village
PVCφ250mm L=798m

798m

No. 67 Village
Connection point to existing distribution trunk-PVCφ150mm

Distribution main to No. 67 Village
PVCφ250mm L=7038m

No. 57 Village
Connection point to existing distribution trunk-PVCφ150mm

1250m

Springlands
Connection point to existing distribution trunk-PVCφ250mm

Spring Garden
Well Pump Station

New valve φ150mm×2
Close of existing distribution trunk

3200m

New valve φ150mm×1
Close of existing distribution trunk

Springlands

Skeldon

Corriverton

Corentyne River

Benab

Armoraimise

Block 3 L=6015m

Block 2 L=6320m

Study Area L=36210m

Block 1 L=9535m

Line Path

Distribution main to Springlands
PVCφ250mm L=1805m

Conduction pipeline to Queenstown W.T.P
PVC φ250mm L=4332m

Distribution main to Crabwood Creek
PVCφ250mm×5930m

Crabwood Creek

Block 4 L=14340m

No. 51 Village

New valve φ150mm×2
Close of existing distribution trunk

No. 57 Well Pump Station

Conduction pipeline to No. 56 Village W.T.P
PVC φ250mm L=798m

Queenstown
Well Pump Station

Conduction pipeline to Queenstown W.T.P
PVC φ200mm L=100m

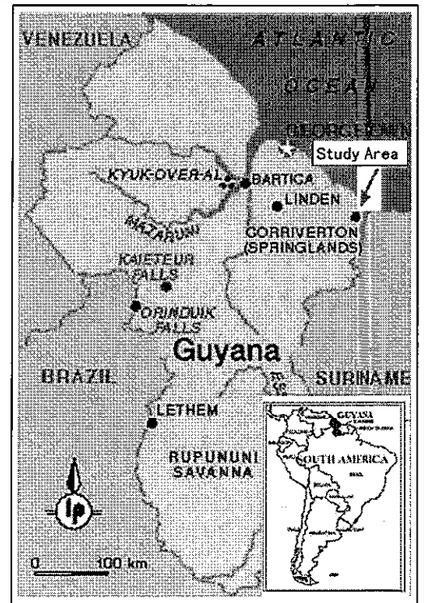
Queenstown Water Treatment Plant

Crabwood Creek
Connection point to existing distribution trauk-PVCφ150mm

Moleson Creek

End Point of Project

0 1 2 5 km
Scale



KEY PLAN

- Start/End point of Project
- Connection point to existing pipe
- Boundary of distribution block
- New Water Treatment Plant
- Existing Pump Station
- New Pipeline
- Existing distribution trunk

LEGEND

No	Date	Approved	Revised
◇			

THE PROJECT FOR WATER SUPPLY IN CORRIVERTON IN THE CO-OPERATIVE REPUBLIC OF GUYANA

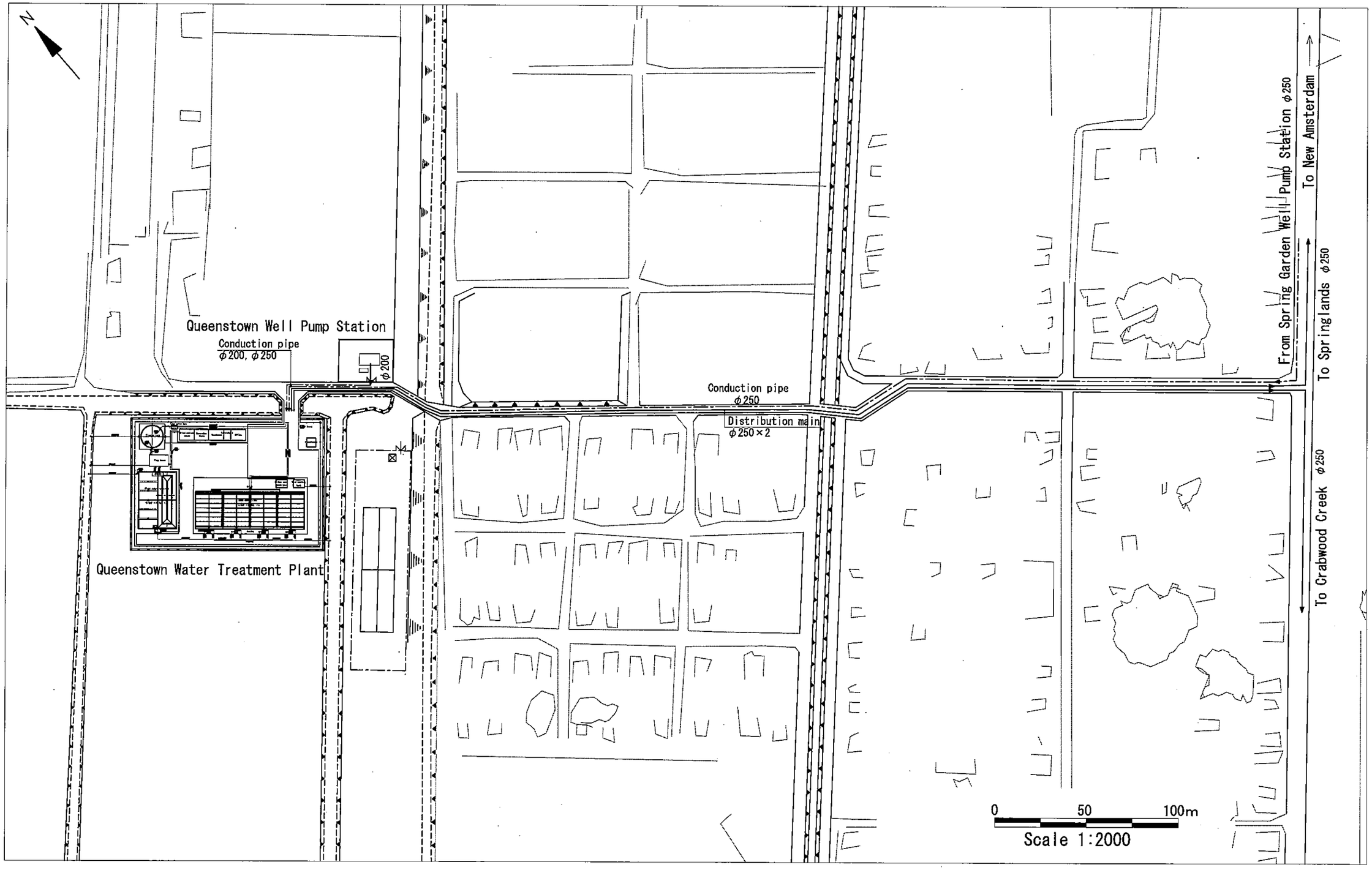
JICA
Japan International Cooperation Agency (JICA)

Title : General Plan

Date

Scale : 1 : 100,000

No 001 REV ◇



No	Date	Approved	Rrvised

THE PROJECT FOR WATER SUPPLY IN CORRIVERTON
IN THE CO-OPERATIVE REPUBLIC OF GUYANA

Japan International Cooperation Agency
(JICA)

Queenstown Water Treatment Plant

Title : General Plan

Date :

Scale : 1:2,000

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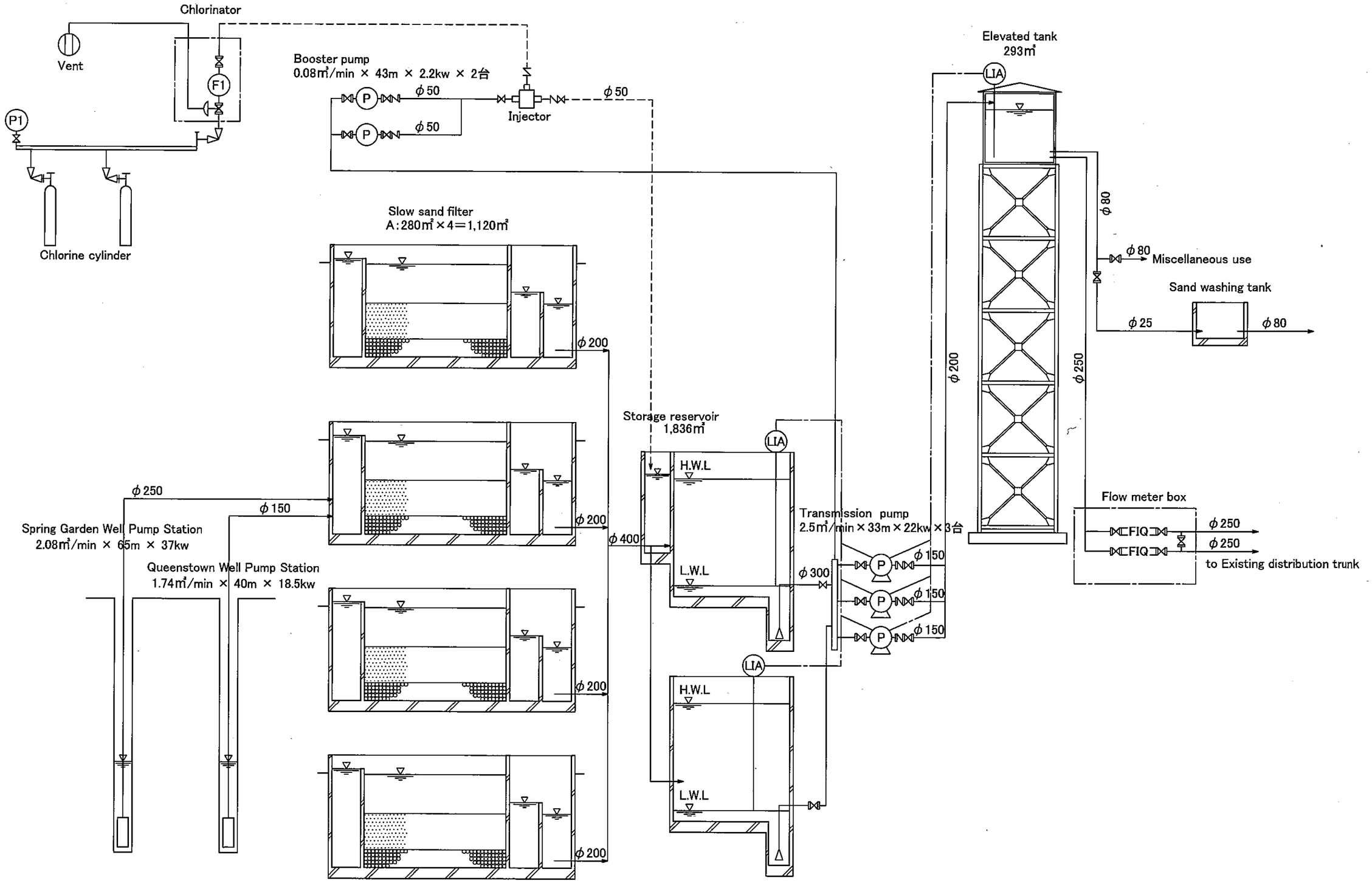
FLOW DIAGRAM



No	Date	Approved	Revised

THE PROJECT FOR WATER SUPPLY IN CORRIVERTON IN THE CO-OPERATIVE REPUBLIC OF GUYANA

Japan International Cooperation Agency (JICA)

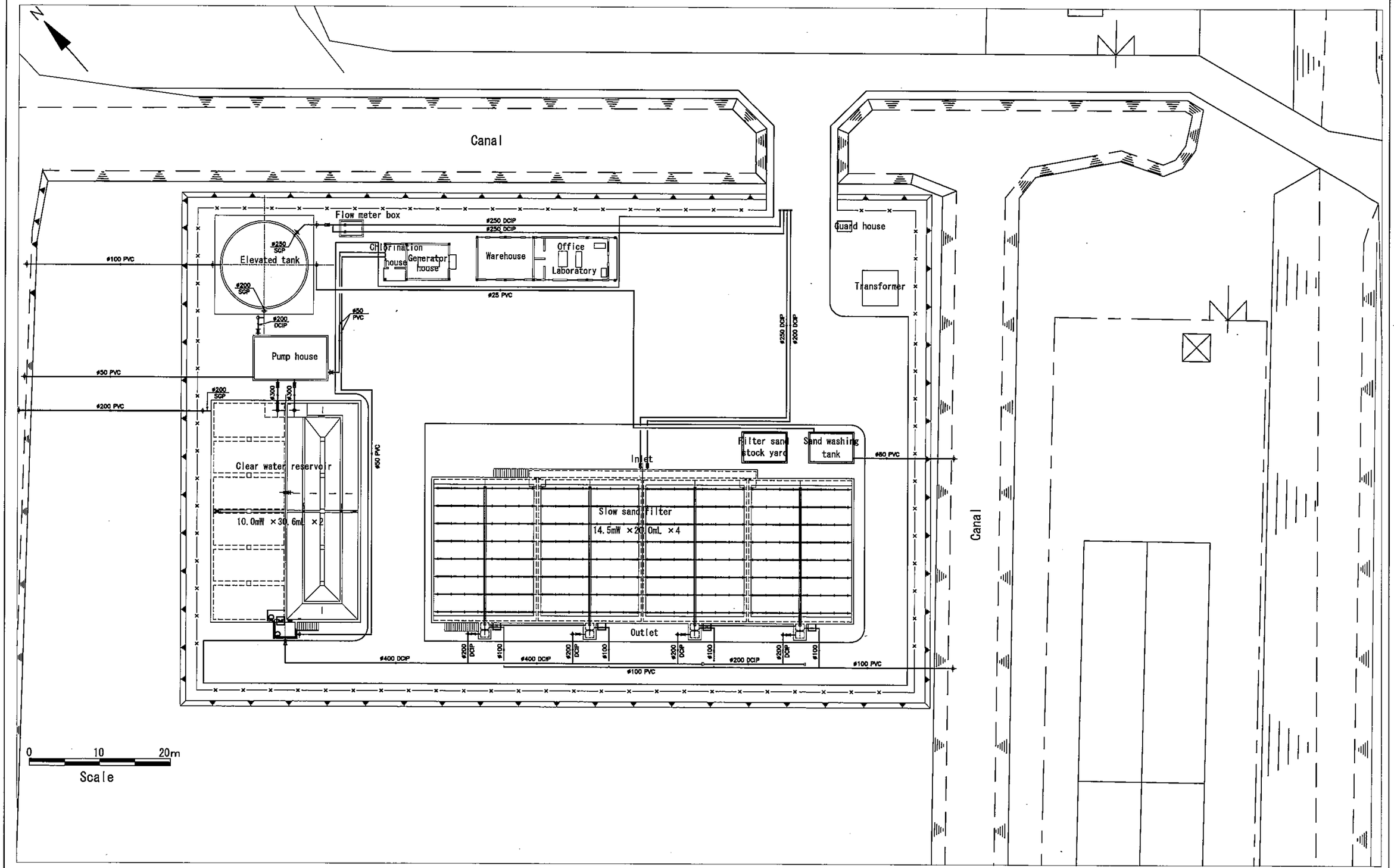
Queenstown Water Treatment Plant

Title : FLOW DIAGRAM

Date :

Scale : N/S

No 014 REV



No	Date	Approved	Revised

THE PROJECT FOR WATER SUPPLY IN CORRIVERTON IN THE CO-OPERATIVE REPUBLIC OF GUYANA

Japan International Cooperation Agency (JICA)

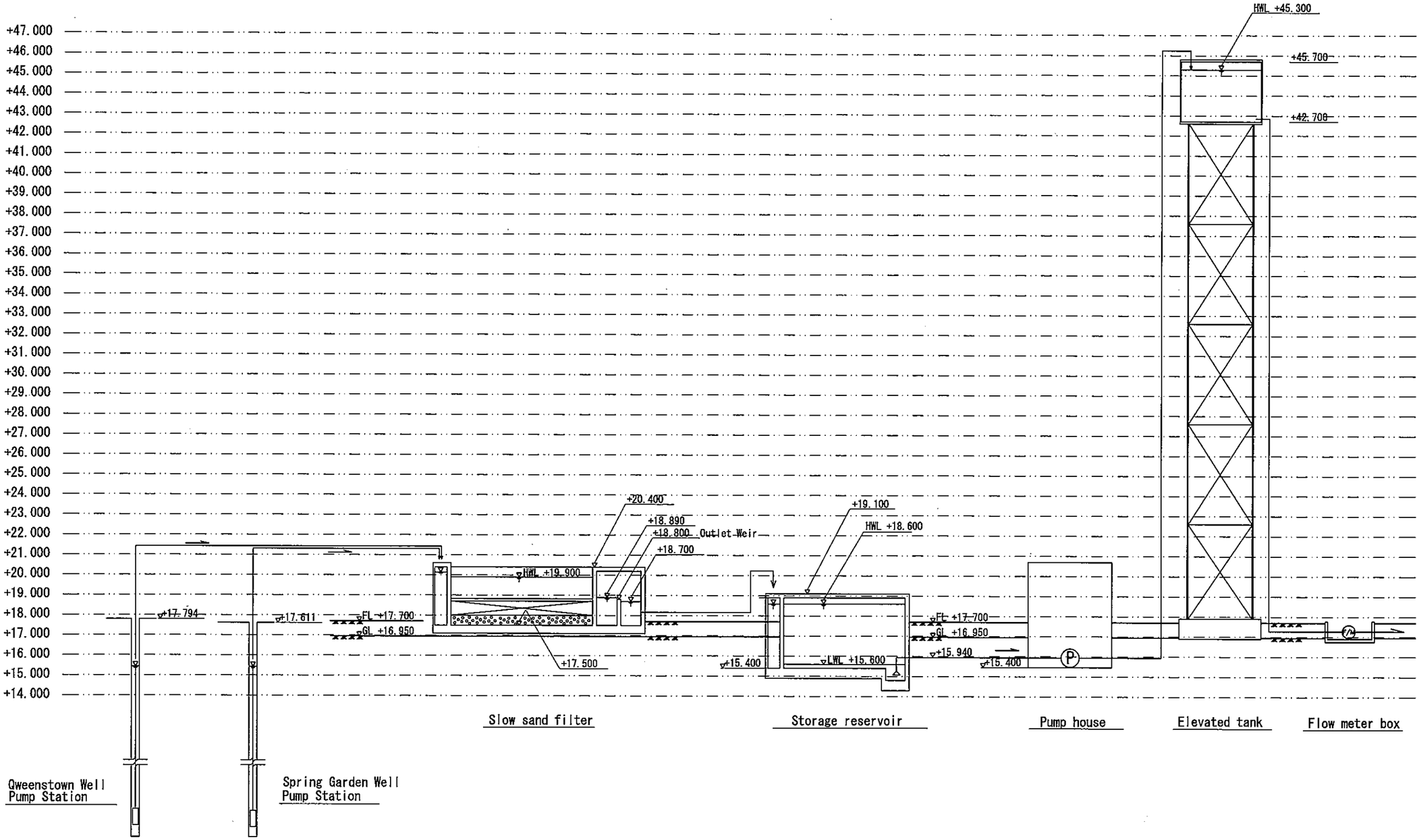
Queenstown Water Treatment Plant

Title : PLAN

Date

Scale : 1:500

No 015 REV



No	Date	Approved	Revised

THE PROJECT FOR WATER SUPPLY IN CORRIVERTON
IN THE CO-OPERATIVE REPUBLIC OF GUYANA

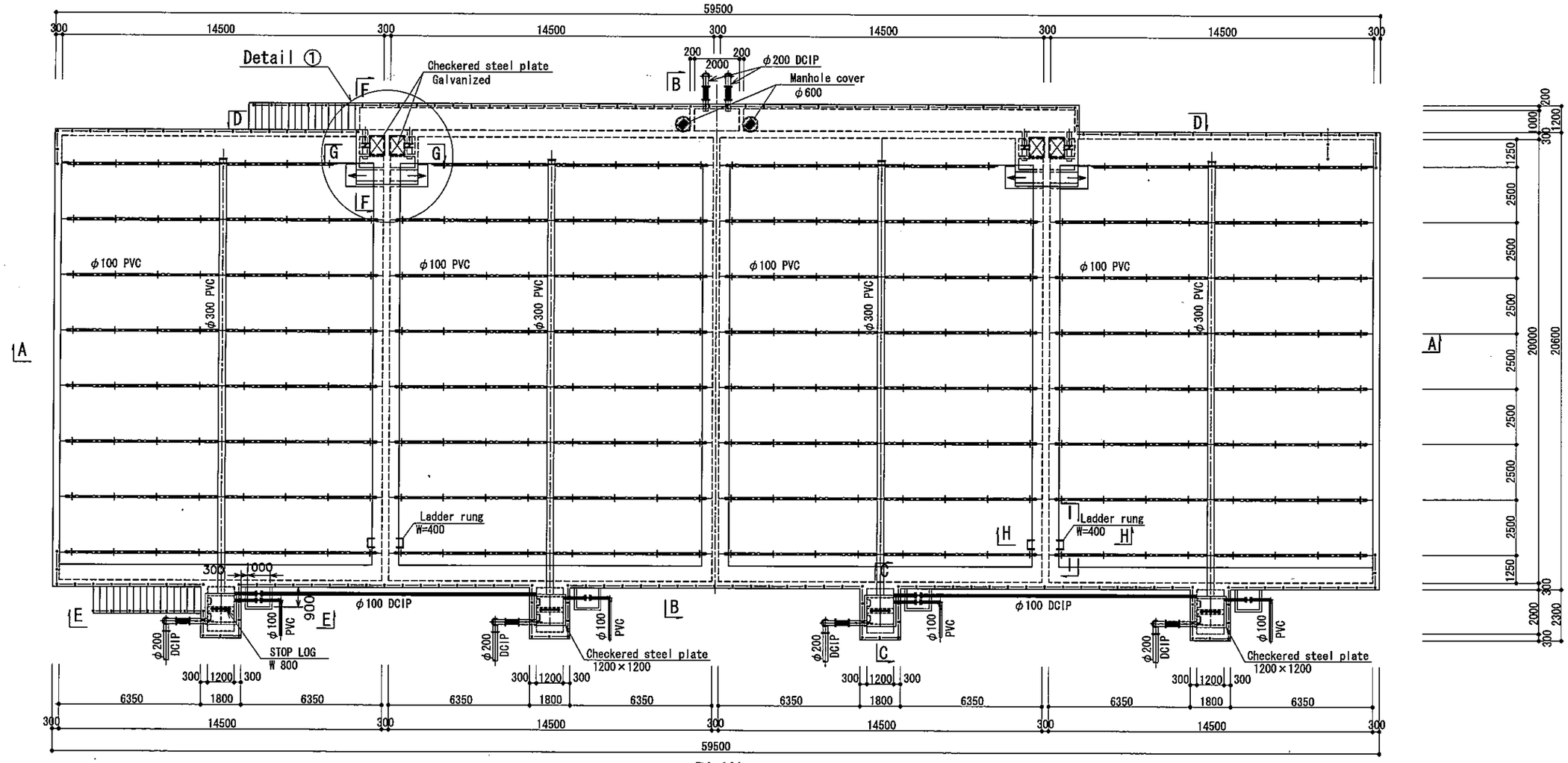
Japan International Cooperation Agency
(JICA)

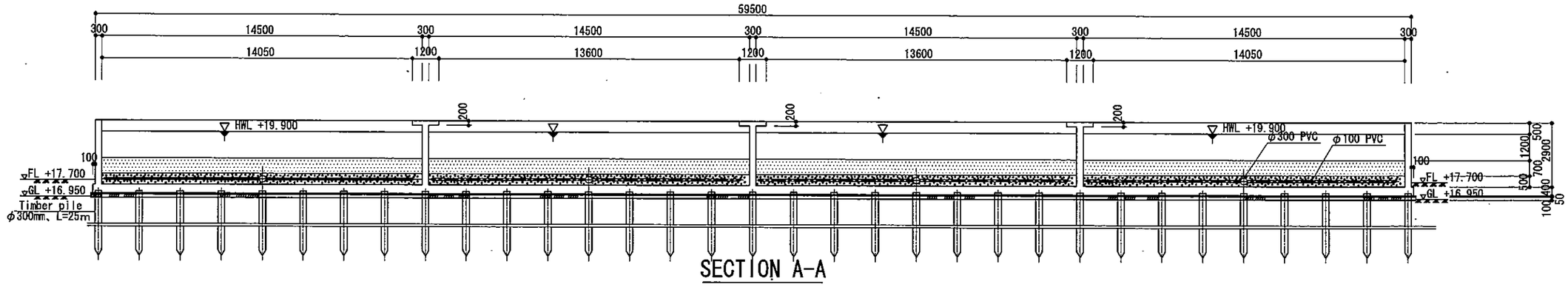
Queenstown Water Treatment Plant

Title : Water Level Profile

Scale : V= 1:200

No 016 REV





No	Date	Approved	Revised

THE PROJECT FOR WATER SUPPLY IN CORRIVERTON
IN THE CO-OPERATIVE REPUBLIC OF GUYANA

Japan International Cooperation Agency
(JICA)

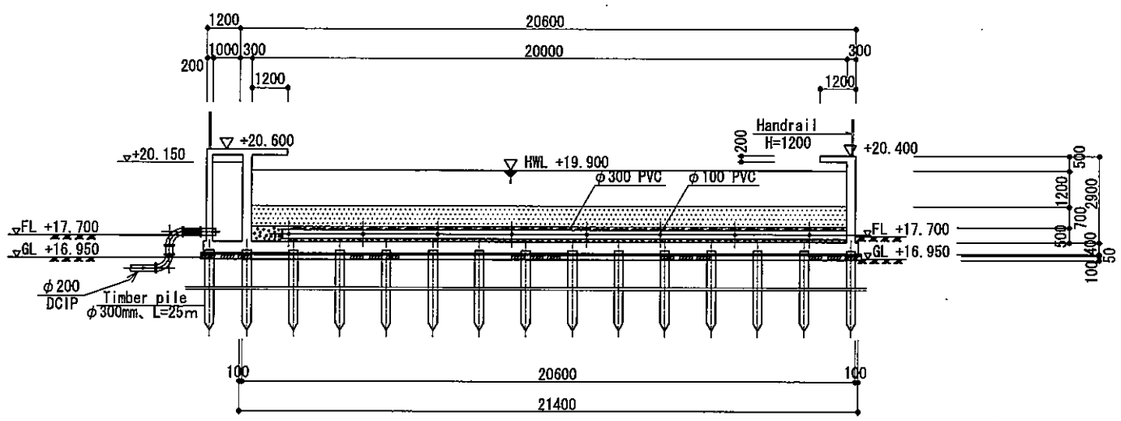
Queenstown Water Treatment Plant

Title : Slow sand filter(1/2)

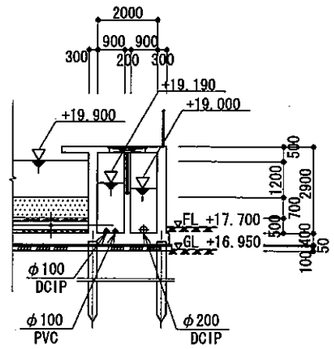
Date :

Scale : 1:200

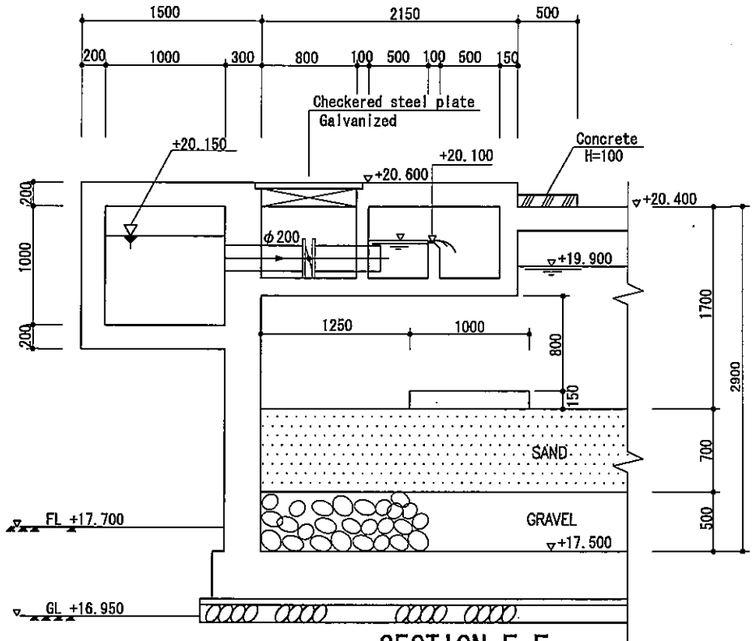
No 017 REV



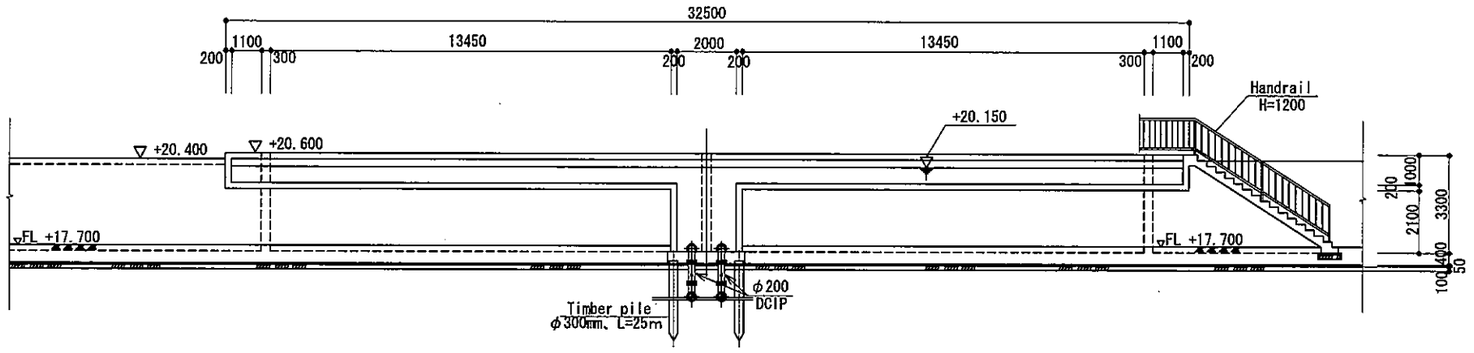
SECTION B-B



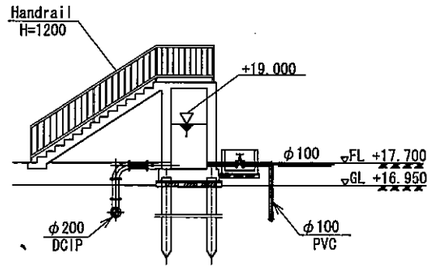
SECTION C-C



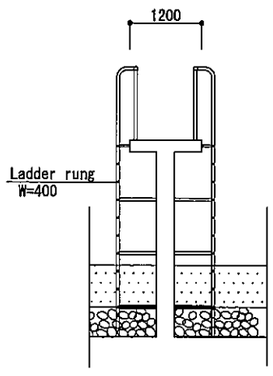
SECTION F-F
S=1:50



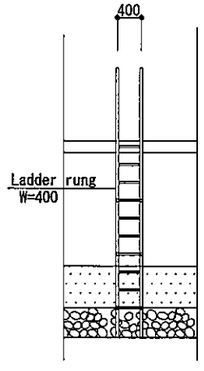
SECTION D-D



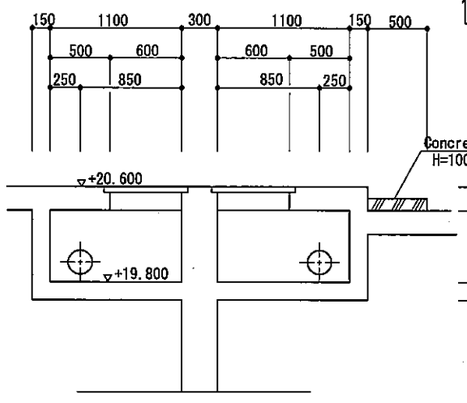
SECTION E-E



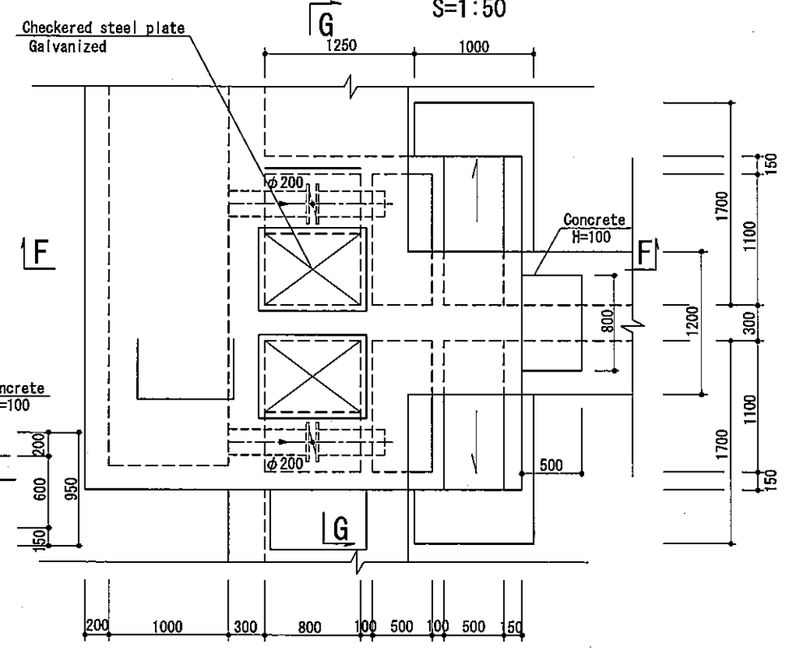
SECTION H-H
S=1:100



SECTION I-I
S=1:100

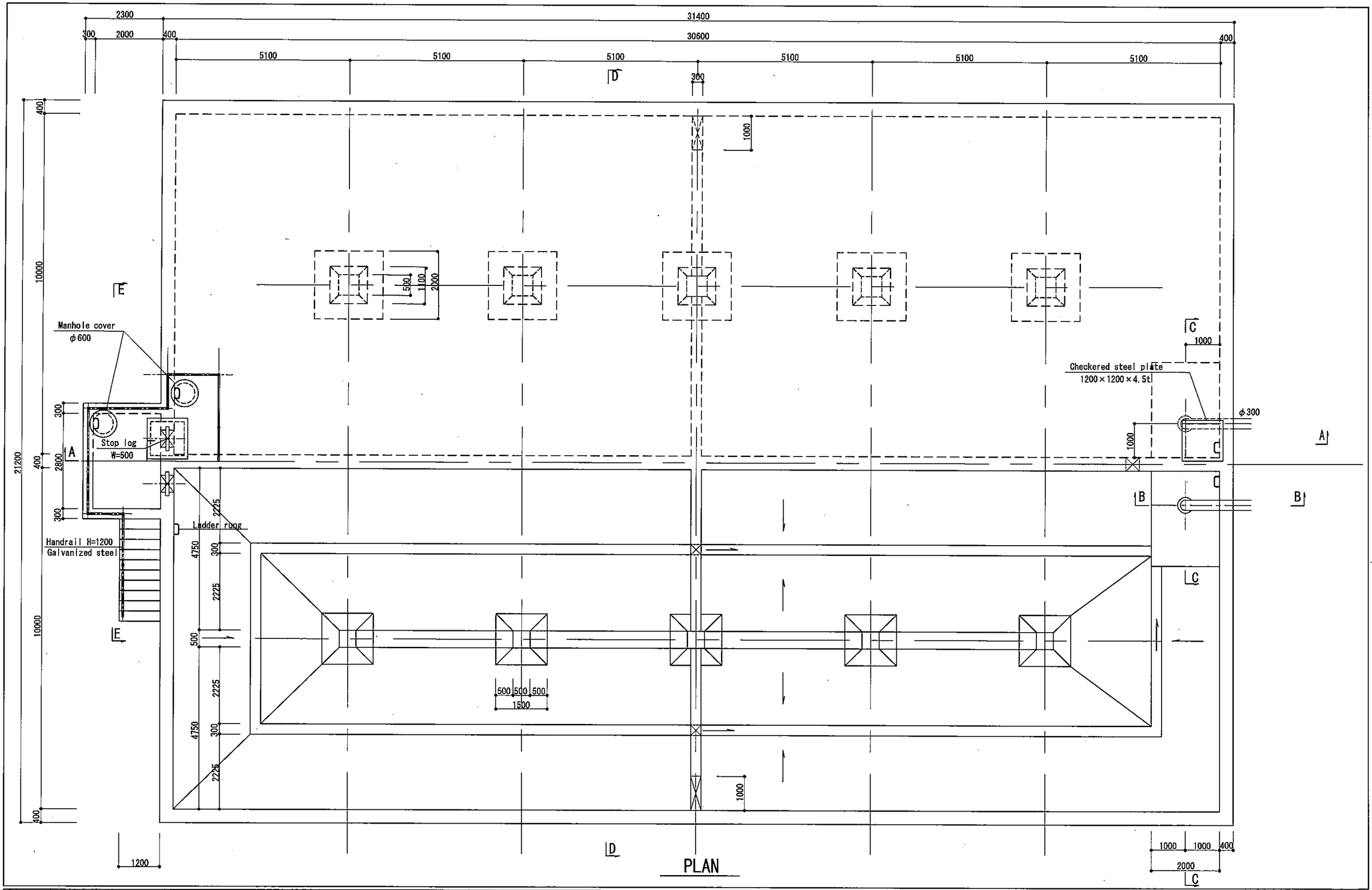


SECTION G-G



DETAIL ①

No	Date	Approved	Revised	THE PROJECT FOR WATER SUPPLY IN CORRIVERTON IN THE CO-OPERATIVE REPUBLIC OF GUYANA	Japan International Cooperation Agency (JICA)	Queenstown Water Treatment Plant	Date :	Scale :	1:200, 1:100, 1:50
						Title : Slow sand filter (2/2)		No 018	REV ◇



No	Date	Approved	Revised

THE PROJECT FOR WATER SUPPLY IN CORRIVERTON
IN THE CO-OPERATIVE REPUBLIC OF GUYANA

JICA
Japan International Cooperation Agency
(JICA)

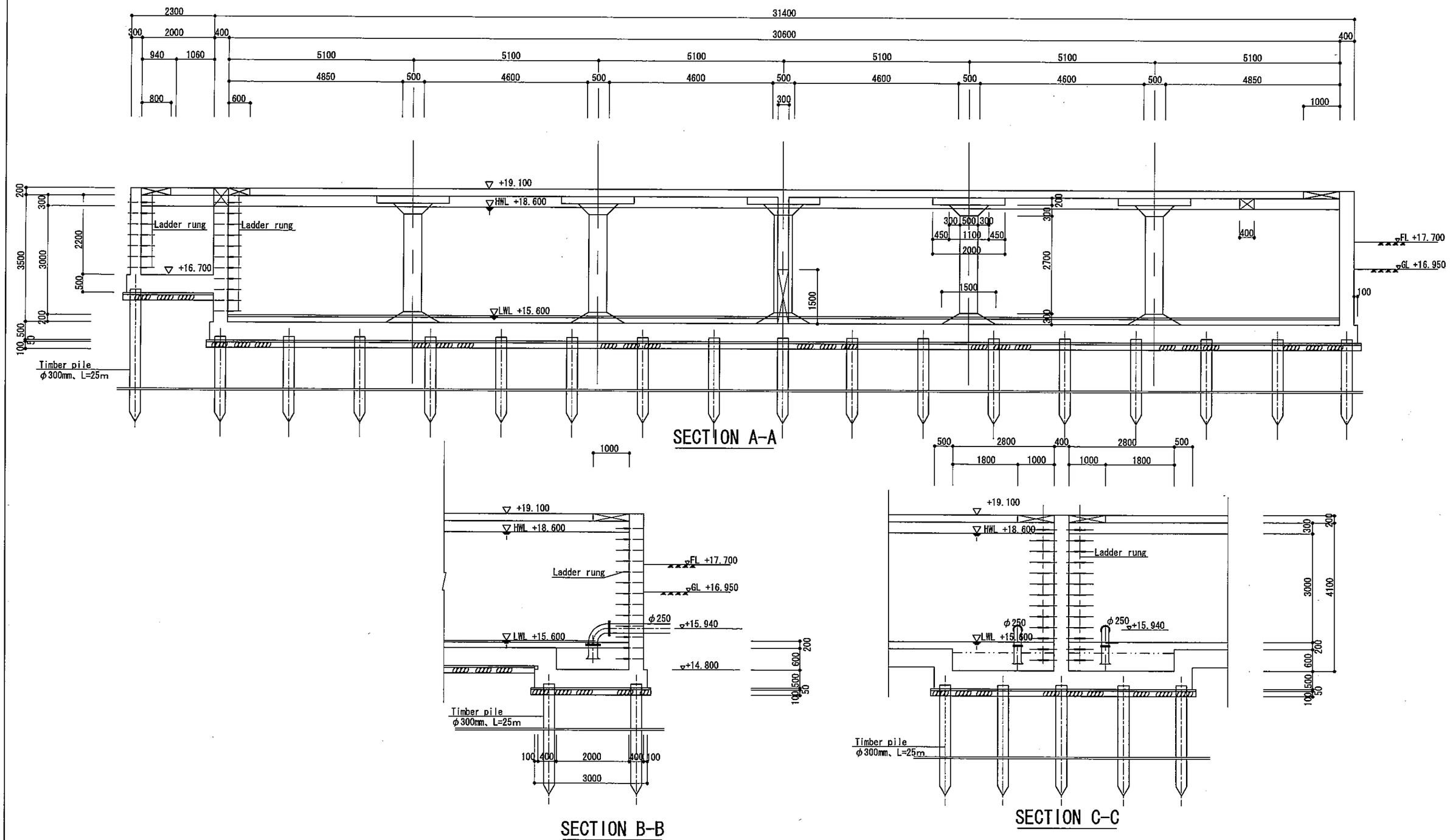
Queenstown Water Treatment Plant

Title : Storage reservoir (1/3)

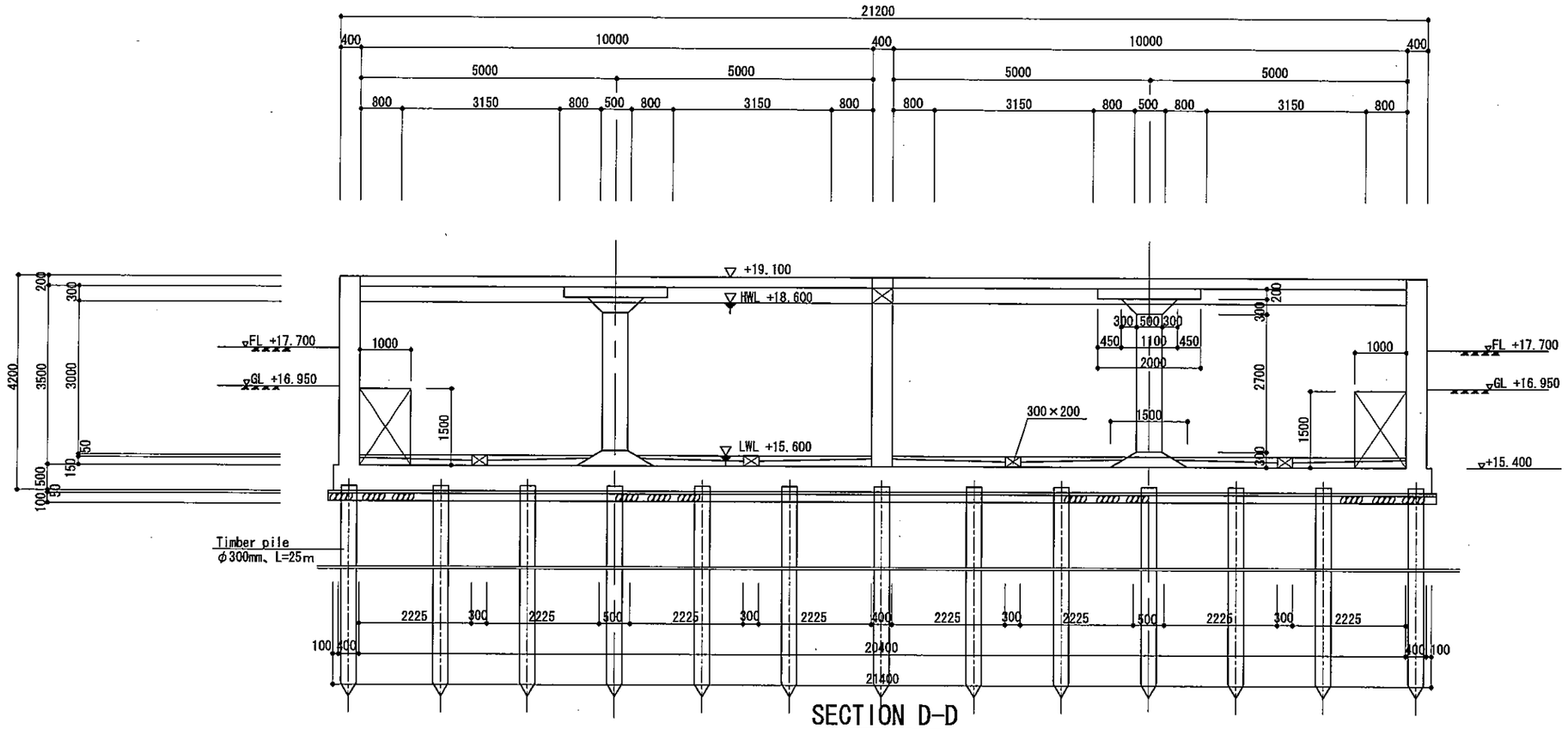
Date :

Scale : 1:100

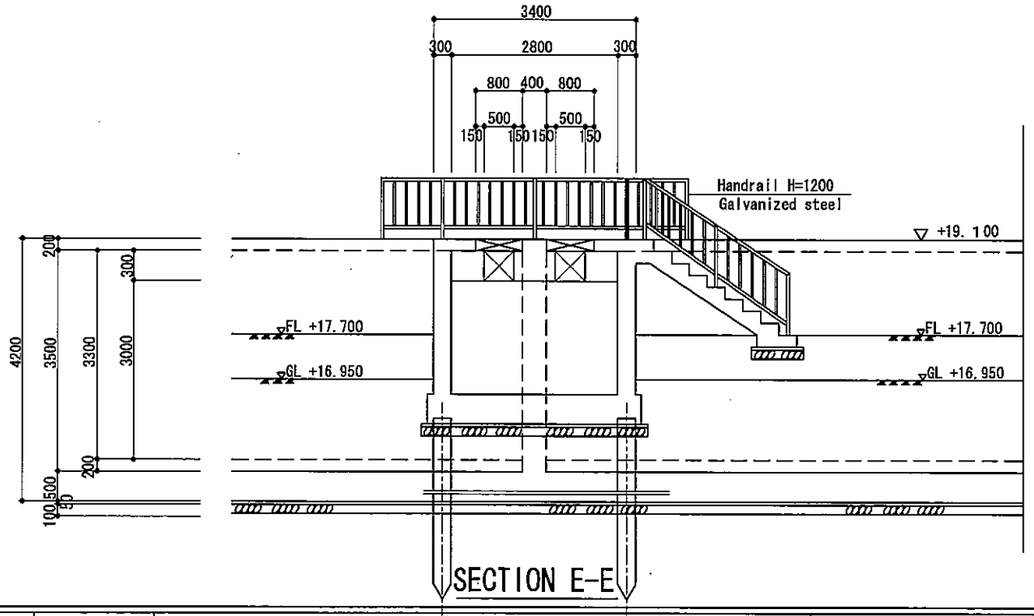
No 019 REV



No	Date	Approved	Revised	THE PROJECT FOR WATER SUPPLY IN CORRIVERTON IN THE CO-OPERATIVE REPUBLIC OF GUYANA	JICA Japan International Cooperation Agency (JICA)	Queenstown Water Treatment Plant	Date :	Scale : 1:100
						Title : Storage reservoir (2/3)		No 020 REV ◇



SECTION D-D



SECTION E-E

No	Date	Approved	Revised

THE PROJECT FOR WATER SUPPLY IN CORRIVERTON IN THE CO-OPERATIVE REPUBLIC OF GUYANA

JICA
Japan International Cooperation Agency (JICA)

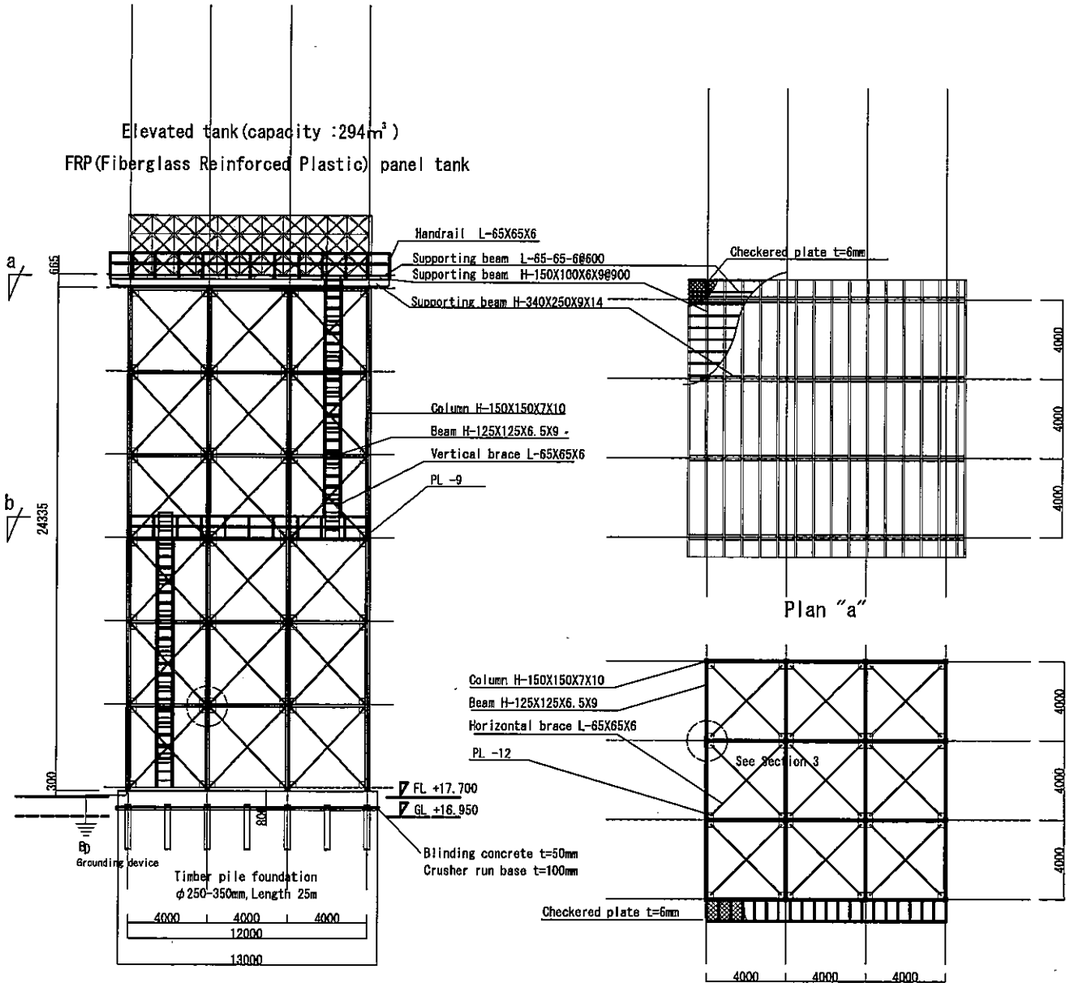
Queenstown Water Treatment Plant

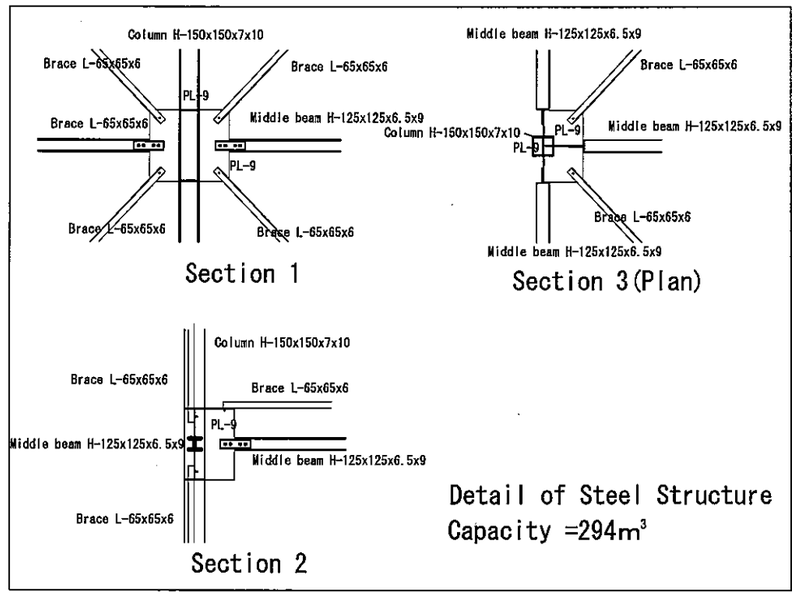
Title : Storage reservoir (3/3)

Date :

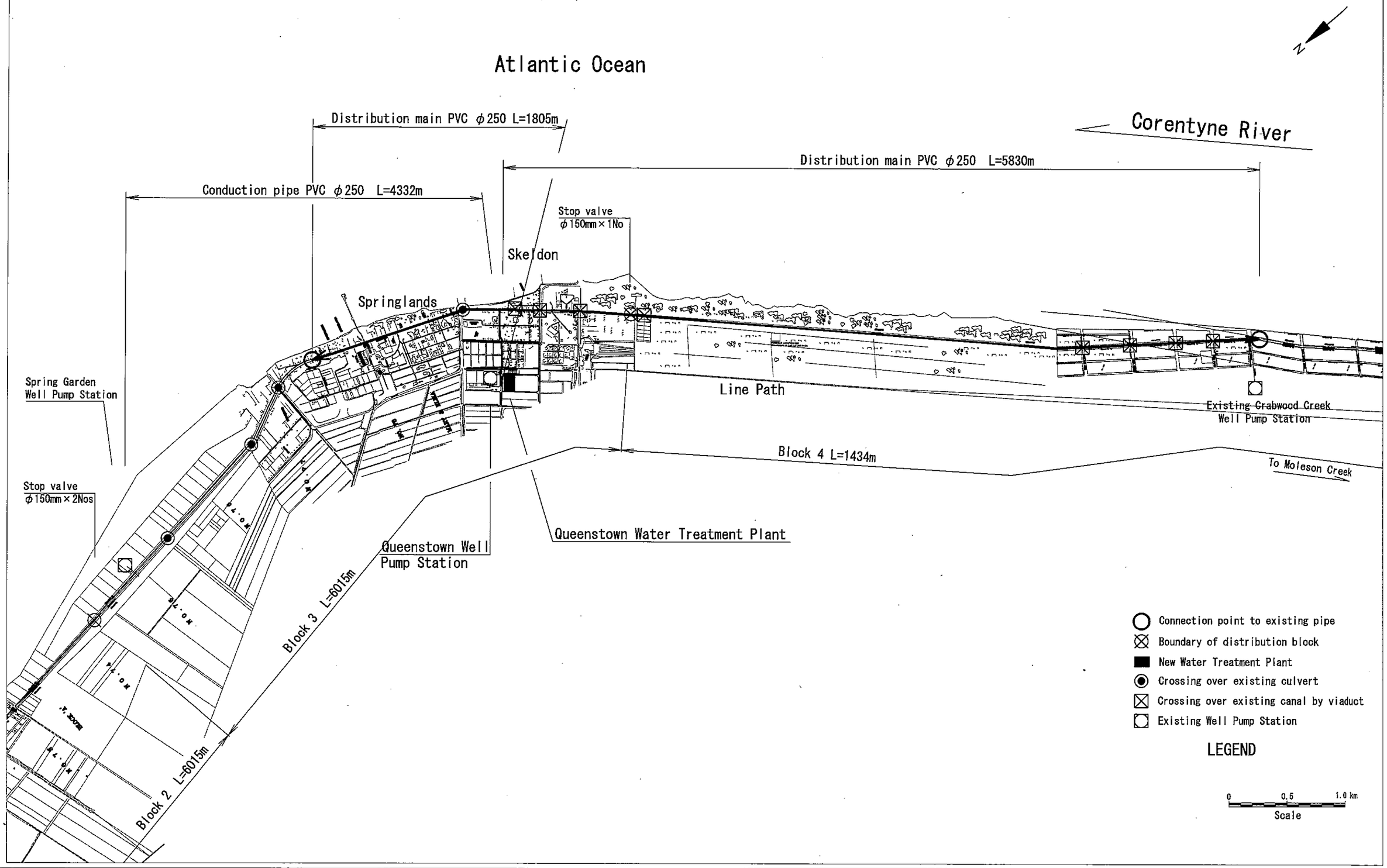
Scale : 1:100

No 021 REV





No	Date	Approved	Revised	THE PROJECT FOR WATER SUPPLY IN CORRIVERTON IN THE CO-OPERATIVE REPUBLIC OF GUYANA	JICA Japan International Cooperation Agency (JICA)	Queenstown Water Treatment Plant	Date :	Scale : 1:300
						Title : Elevated Tank		No 022 REV



No	Date	Approved	Revised

THE PROJECT FOR WATER SUPPLY IN CORRIVERTON
IN THE CO-OPERATIVE REPUBLIC OF GUYANA

Japan International Cooperation Agency
(JICA)

Queenstown Water Treatment Plant

Title : General Plan of Pipeline

Date :

Scale : 1:30,000

No 023 REV