1.7 Tender Evaluation

- The prime contractor(s), namely, SPC and the prime consulting firm, which enter into contracts with PPWSA, are limited to "Japanese nationals", in principle.
- Quality and Cost Based Selection (QCBS) that includes technical, commercial, financial and legal evaluation will be applied for the bidding of SPC.

Evaluation methodology

Note: This shall be reviewed and concurred by JICA.

Comprehensive Evaluation Score = Technical Score * X + Price Score * (1-X)

where X is a weight factor 1>X>0 (In this stage the Consultants propose 0.5 as X. Please refer the separate sheet for the analysis of the weight factor X of Price score)

Tentative Technical Score

	Category	Score
1	Tenderers experience with respect to comparable projects;	TBA
2	Proposed Organization	TBA
3	Experience of key staff in relation to the scope of work;	TBA
4	Proposed design by SPC for bidding	TBA
5	Construction Work Plan	TBA
6	Operation and Maintenance and Monitoring Plan	TBA
	Maximum possible score	100

Tentative Price Score

The tenderer bids on 10-year Life Cycle Cost (LCC) where

10-year LCC = EPC price + Net present value of O&M costs discounted at 4.5%

(SPC submit EPC price, 10-year average O&M Cost(α), 10-year average fixed volume of electricity usage(β), and the margin rate at bidding to calculate 10-year LCC)

Price score = Lowest Price / Price of the Tenderer * 100

Note that

(1) EPC price shall be below the Grant budget applicable to the EPC contract, and

(2) O&M cost will be reflected in the contract price of bulk water

2. Requirements

2.1. Preconditions

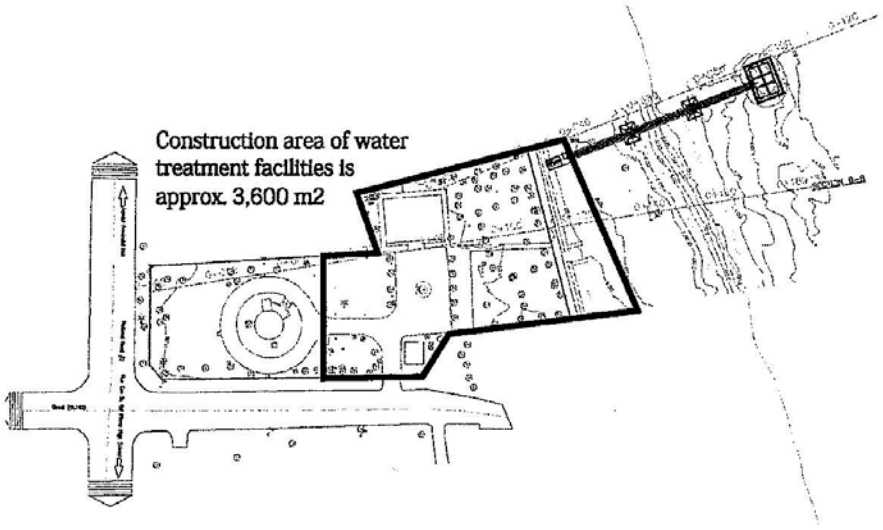
2.1.1. Construction Area

There are an existing elevated tank and a tariff collection station as major facilities within the PPWSA's property where the new WTP shall be constructed. The available construction area of water treatment facilities (WTFs) excluding headworks (intake and raw water transmission facilities) is approximately 3,600 m2.

Headworks shall be constructed in the river outside of PPWSA's property.

There is unleveled land along the river that are PPWSA's property but outside of existing fence. This area could be leveled as part of SPC's EPC work.

Existing tariff collection station shall be shifted to outside of construction area by PPWSA before commencement of the design-build work.



The site area is limited therefore, stockyard, workshop, temporary office etc. required for the constriction shall be provided by PPWSA.

Topographic and geotechnical features will be provided to SPC by PPWSA in later stage.

2.1.2. Raw Water Quality

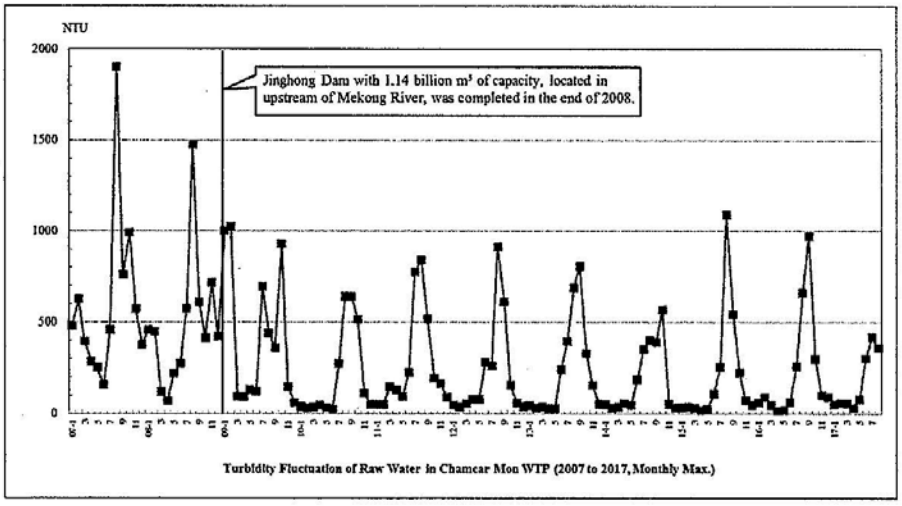
Raw water source shall be Bassac River.

The raw water quality recorded at intake of Chamcar Mon WTP located at upstream of Ta Khmau site along Bassasc River during 2009-2017 after Jinghong dam was commenced operation in 2008 shows following characteristics.

- Turbidities are quite different in dry season and wet season. Minimum turbidity in dry season was 7NTU, average turbidity in wet season is 250 NTU and maximum turbidity was 1088NTU.
- pH is generally high in wet season and low in dry season, average pH is 7.4, Minimum pH was 6.7.
- Color is a bit high, average color is approximately 30TCU.
- Average Ammonium (MH4) is approximately 0.5mg/l in wet season and approximately 0.2mg/l in dry season. However Ammonium (NH4) has been on the rise from 2016 and maximum was 1.81.

Followings are summary of raw water turbidity at intake of Chamcar Mon WTP during 2009-2016.

- Average Turbidity in Dry Season: 40NTU
- Average Turbidity in Wet Season: 245NTU
- Average Turbidity over 8 years: 115NTU
- Maximum Turbidity over 8 years: 1088NTU
- Minimum Turbidity over 8 years: 7NTU



Turbidity Fluctuation of Raw Water in Chamcar Mon WTP (2007 to 2017, Monthly Max.)

The result of monthly raw water quality analysis of March-May 2017 at intake location of Ta Khumau Site carried out under our Survey will be provided separately.

Emergency Response against Unexpected Raw Water Quality

a) In case turbidity becomes higher than 1000NTU, intake amount shall follow PPWSA's instruction

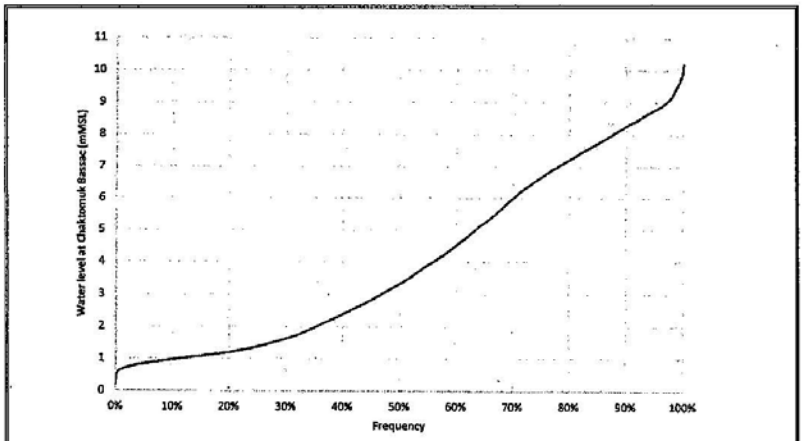
as same as other PPWSA's treatment plants.

b) In case serious issue (such as toxic substance or oil discharge) happens, SPC can autonomously reduce or stop intake operation to avoid serious damage on WTP facilities and contaminated water supply to customers, and report to and discuss with PPWSA as soon as possible.

If above restricted intake conditions continue until remaining water in the service reservoir is empty, both parties do not have responsibilities to suspend water supply.

2.1.3. Water Level of Bassac River

The feasibility study for expansion of Chamca Mon WTP gives minimum river water level and maximum river water level, as MSL+0.20m and MSL+10.28m respectively as shown below.



Based on these elements, the extreme levels for the 55 last years are as follows:

- ✓ Minimum Level : 0,20 m MSL (04/05/1960)
- ✓ Maximum Level : 10,18 m MSL (20/09/2000)

2.2. Output requirements

2.2.1. Requirement for the Facilities

2.2.1.1. Requirement of Treated Water Quantity

Water Treatment Capacity of nominal 30,000 m3/day.

2.2.1.2. Laboratory for water quality test in WTP

The layout and equipment of the laboratory attached to WTP should be in accordance with ISO9001 and ISO17025. The laboratory in WTP should be equipped with enough equipment to analyze daily test items in the National Drinking Water Quality Standards.

2.2.1.3. Intake Type

Intake facility shall be intake tower type.

2.2.1.4. Disinfection

Disinfection shall be by On-Site Electro-Chlorination System (OSEC System).

2.2.2. Requirements for the Operation

- WTP capacity of nominal 30,000m^3/day
- 10 years O&M period
- Intake tower type
- On-site chlorination system
- Volume of service reservoir of 5,000 m^3 or more
- Pressure of 4 bar at off-take point
- 24 hours supply
- Water quality standards described in Annex 13
- O&M manual in both Khmer Language and English
- Prevention against adhesion of shell inside raw water transmission pipe
- 5 % of production loss ratio from intake to the bulk meter
- prevention of oil inflow into the WTP

2.3. Work to be done by SPC

SPC shall work for followings.

1. Design of New WTP
   (a) Basic Design
   (b) Detailed Design
   (c) Application Work for Design
   (d) Laws and Regulations to be complied.
2. Construction of New WTP
   (a) Civil and Equipment Works
   (b) Plant Mechanical Work
   (c) Plan Electrical Work
   (d) Application Work for Construction
3. Operation and Maintenance of New WTP
   (a) Water Quality Control
   (b) Treated Water Volume Control in case required by PPWSA
   (c) Monitoring and Control of Water Treatment
   (d) Maintenance and Repair
   (e) Procurement of Fuel, Chemical and Other Consumables

(f) Management of Power Receiving, Water Use and Fuel / Chemical Storage and Safety

(g) Cleaning

(h) Security and Safety

(i) Emergency Action

4. Hand-Over Work at the End of the O&M period

(a) Performance Test of WTP

(b) Asset Check and Evaluation

2.4. Cost to be borne by SPC

Following cost shall be borne by SPC.

Design and Build Stage:

(a) Head office over-head cost related to construction work

Operation Stage

(b) Head Office over-head cost related to the operation and maintenance work

(c) Any other cost which is not directly related with operation of the new WTP

2.5. Reporting Obligations

Following submittals shall be provided by SPC. Detail shall be provided in later stage

(a) At the time of work commencement

(i) Work commencement application

(ii) Design, Construction and Operation Plan

(iii) Organization structure for the operation

(b) Design and Build period

(i) Report related to construction works including progress record

(ii) Draft of Operation and Maintenance Manual

(iii) Draft of Self-monitoring Report

(iv) Modification and additional work confirmation report

(v) Commissioning reports

(c) At the time of hand-over

(i) Completion report or substantial completion certificate and list of outstanding works

(ii) Final operation and maintenance manual

(iii) Final self-monitoring reports template

(d) During operation period

(i) Monthly report including self-monitoring report

(e) At the time of hand-back

(i) Performance check list of the facilities.

(ii) Remaining book value calculation and confirmation sheet.

(iii) Purchase agreement of SPC's facilities, if any.

(iv) Letter of Waiver of claims and liens and release of rights relating this project from PPWSA

to SPC.

(f) At the time of Expiration of warranty against defect period

(i) Report on Expiration of Warranty against Defect Period

3. Contract Terms

Draft O&M contract shall be prepared based on the following items. Draft EPC contract shall be prepared separately in accordance with JICA's standard form of contract.

1	**O&M period**	After the completion of the new WTP, the ownership of the WTP will be transferred from SPC to PPWSA, then PPWSA and SPC will agree the O&M contract for 10 years after commencement (definition is to be agreed) of O&M on the facilities owned by PPWSA.
2	**Production of bulk water**	Production of bulk water is fundamentally a responsibility of the SPC.
3	**Payment mechanism and price of bulk water**	On a separate sheet
4	**Repairment**	During O&M period, SPC may use leased facilities free of charge, however, the SPC shall be responsible for any repairment of the facilities at its own cost. SPC shall keep good conditions of the facility and equipment in accordance with PPWSA's Standard Operation Procedure (SOP).
5	**Conditions for the hand-back**	- After the end of O&M period, PPWSA has the right to be handed back the leased WTP facilities from the SPC under certain requirements (e.g. the result of the motor vibration test is within 5% of initial specification). - The SPC shall remove any additional facilities or equipment installed for its operation and restore the WTP to its initial condition at its own cost, if required by PPWSA. - PPWSA has the right to purchase any remaining inventories (e.g. raw materials) at their book value.
6	**Private investment**	The SPC may invest in some additional facilities, software, or any other equipment necessary for the operations. PPWSA has the right to purchase the private investments from the SPC at their residual value (net book value) at the end of O&M period.
7	**Self-monitoring**	SPC shall monitor and report to PPWSA its operation. Monitoring requirements shall be studied.
8	**Operation data and financial information**	The SPC shall record and report all the operation data and financial information in a required format. PPWSA may utilize the data to continue operation of the WTP after hand-back.
9	**Early termination / compensation events**	- Termination for convenience (Unilateral termination) PPWSA has the right to terminate the contract early for public

		interest. In this case the SPC shall be compensated in full, for all the private investments, inventories and additional costs incurred by the termination of the contract, and opportunity costs for the equity. Opportunity costs for the equity shall be a sum of net profit for the remaining contract period based on the SPC's initial financial plan initially agreed in the contract. - Termination for default by PPWSA The termination condition shall be in line with the case of the termination for convenience. - Termination for default by SPC PPWSA shall have the option to require SPC to transfer to PPWSA all of its right, title and interest in and to the assets and inventories. The value of the assets and inventories shall be net book value of the assets minus cost of damages and losses suffered by PPWSA due to the termination of the contract. - Termination for Force Majeure A Force Majeure is an event that is external, unpredictable, and irresistible and has a significant impact on the project. Both parties may terminate the contract if the impact of a Force Majeure lasts for 180 days. Neither party has any obligation to each other for the cost of mitigation measures to prevent increasing loss caused by Force Majeure. PPWSA shall have the option to require SPC to transfer to PPWSA all of its right, title and interest in and to the assets and inventories. The value of the assets and inventories shall be net book value of the assets.
10	**Invoice settlement**	SPC shall report and charge to PPWSA by the 10th day of each month for the bulk water produced in the previous month. PPWSA shall in return review the invoice and make payment within 30 days after the invoice receiving date. Currency to be used for the invoice settlement shall be Cambodian Riel.
11	**Staff Employment**	1) PPWSA shall take over the employment contracts from the SPC at the end of O&M period. 2) PPWSA intends to dispatch about 5 staff to SPC and bear their salary. PPWSA staff shall report to SPC in daily operation. Relative salaries shall be subtracted from the off-take price.

Payment mechanism – Price Formula for Bulk Water Supply

In the bidding documents, SPC shall submit EPC price, 10-year average O&M Cost(α), 10-year average fixed volume of electricity usage(β), and the margin rate at bidding to calculate 10-year LCC

SPC Invoice (PPWSA payment to SPC) = (1) sales of bulk water + (2) additional services – (3) penalties

(1) Sales of bulk water = (4) volume of water delivered * (5) unit price of bulk water

(4) volume of water delivered shall be confirmed by a volume meter just after distribution pump

(5) Unit price of bulk water = α * (6) inflation index + β * (7) electricity price
+ (8) additional production costs + (9) agreed margin for SPC

α is a fixed (agreed) basis for O&M costs excluding electricity defined in the contract

(6) Inflation index shall be All Item Index of Consumer Price Index published by National Institute of Statistics.

β is a fixed (agreed) volume of electricity usage per m3 defined in the contract

(7) Electricity price shall be the price determined in the contract between PPWSA and the electricity supplier.

(8) applies if and only if quality deterioration of raw water or change in water quality standard cause additional production costs.

(9) = agreed margin rate * (α * (6) + β * (7) + (8))

Agreed margin rate is a fixed (agreed) rate defined in the contract

(2) Additional services include deeper analysis of water quality or site visit tour or any other services that are not included in the ordinary O&M activities defined in the contract.

(3) In case the water delivered by SPC does not comply with required water quality, PPWSA will not pay for the delivered water by SPC. In addition, SPC shall compensate for any damage (e.g. compensation to end-customers) suffered by PPWSA as a result of the such poor operation of SPC.

Annex 9

Insurance or limited liability

In the private hearing carried out in Aug-Oct by JICA, we found that most of the private companies responded that **they would need Company Comprehensive Insurance to cover the facilities and third party compensation during O&M**.

This is the reasonable requirements from the tender participants because following cases could be happned.

1) Electrical leakage may cause fire, and such fire may damages monitoring system and electrical equipment.
2) Equipments could be soaked and damabed by the water of fire fighting activities
3) Visitors may be injured during their site visit; this project will be a model case of privately operated water purification plant, so a lot of plant visitors may be expected to come.

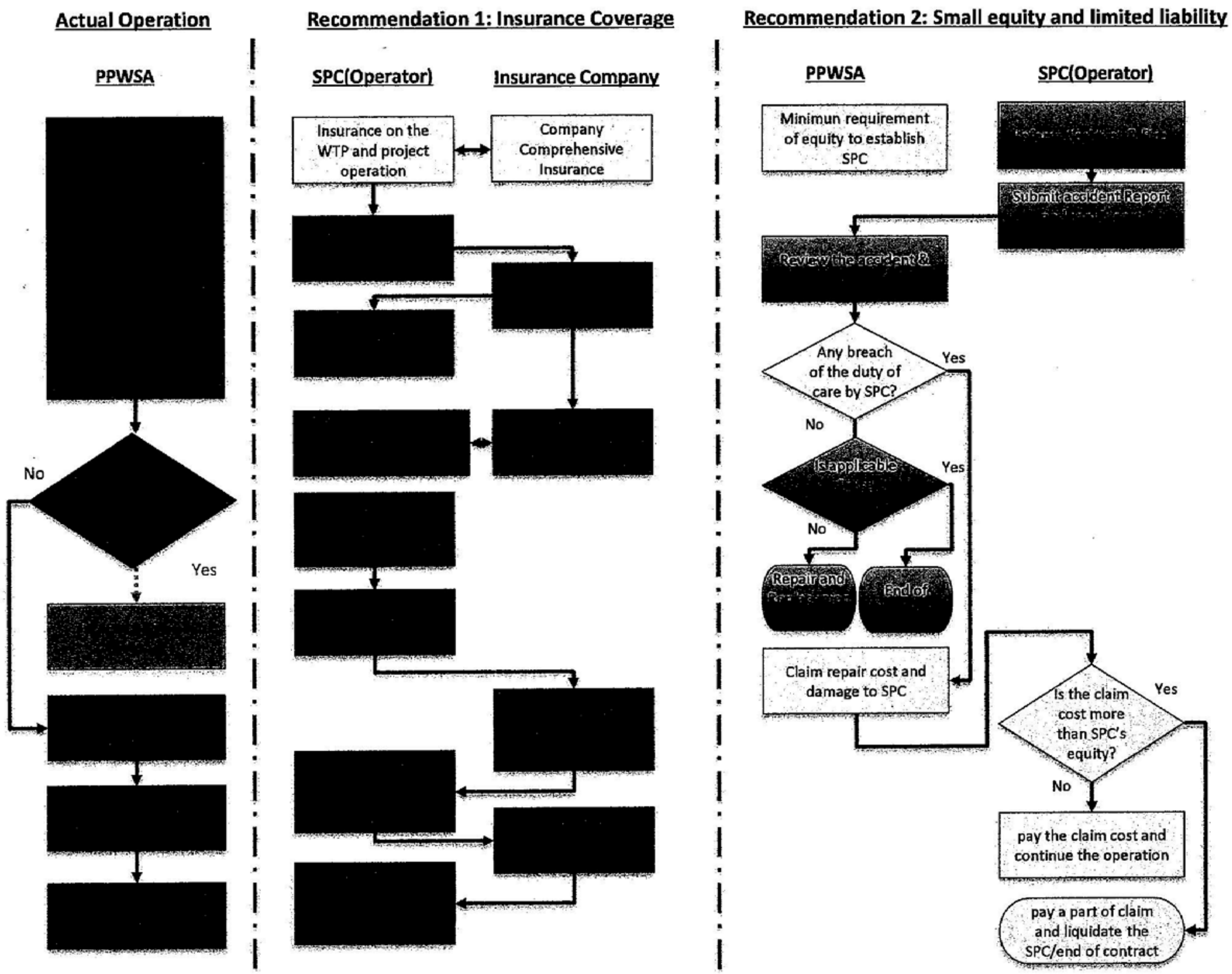
In actual situation, PPWSA does not use insurance, however no other third parties are involved in the operation, so any damage caused by any accident will be repaired or compensated by PPWSA.

However once the outsouce the WTP operation to other company(SPC), such company must have an obligation of the duty of care on their operation.

In order to assure competitive bidding and to avoid "no participants to the tender", we need to modify the contract terms.

We propose either;

1. PPWSA accepts to include insurance cost in the price of bulk water, or
2. PPWSA accepts that SPC will compensate the damage to the facilities or third party liabilities only to the extent of its equity whether or not it is caused by SPC's breach of the duty of care or Force Majeure.


Actual Operation
PPWSA
No
Yes
Recommendation 1: Insurance Coverage
SPC(Operator)
Insurance Company
Insurance on the WTP and project operation
Company Comprehensive Insurance
Recommendation 2: Small equity and limited liability
PPWSA
SPC(Operator)
Minimun requirement of equity to establish SPC
Any breach of the duty of care by SPC?
Yes
No
Yes
No
Claim repair cost and damage to SPC
Is the claim cost more than SPC's equity?
Yes
No
pay the claim cost and continue the operation
pay a part of claim and liquidate the SPC/end of contract

Recommendation 1: Insurance Coverage

According to our research on the insurance cost, it will be USD38,500~79,000/year, or KHR15.5~31.7/m3 as additional bulk water charge. Risk category will be assessed by insurance company, and accident prevention system may reduce the risk of the project and modify the risk category.

risk category	Insurance Value (USD)	Insurance USD/year	m3/year	USD/m3	Riel/m3
low risk	27,270,000	38,500	10,950,000	0.003516	15.5
high risk	27,270,000	79,000	10,950,000	0.007215	31.7

Source: Estimation of Cambodian Insurance company, Forte Insurance

Recommendation 2: Small equity and limited liability

1) SPC will take limited guarantee

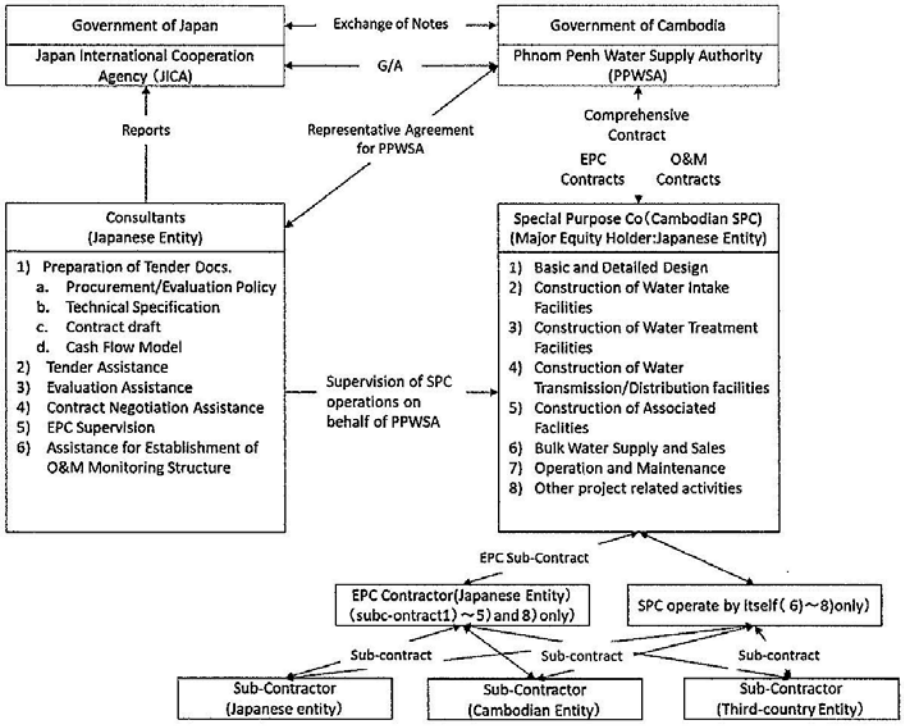
PPWSA accepts that SPC will compensate the damage to the facilities or third party liabilities only to the extent of its equity whether or not it is caused by SPC's breach of the duty of care or Force Majeure.

2) Minimum equity contribution required to SPC

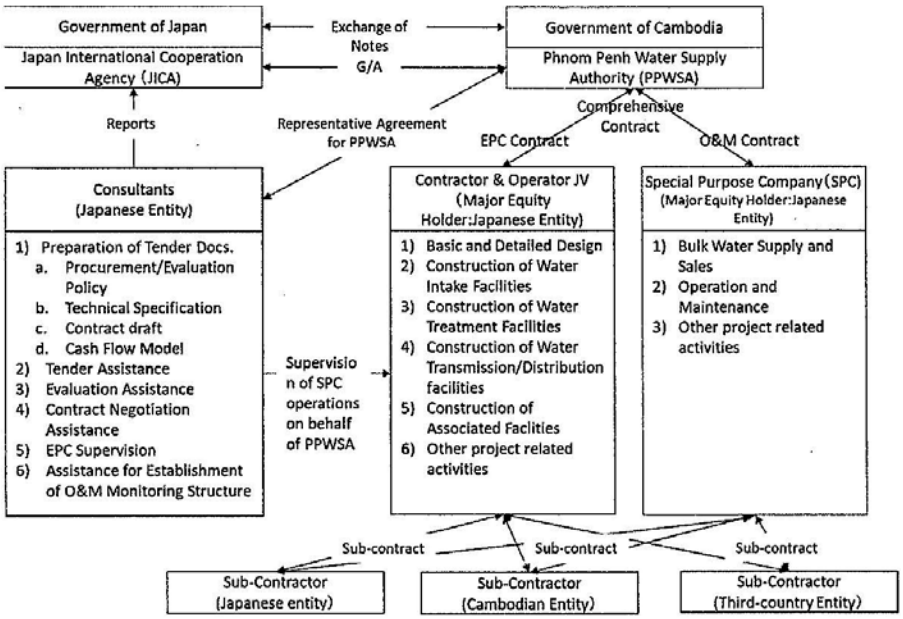
When we draft tender documents, we have to decide minimum equity contribution, for example, a working capital for 3 months of operation gives about JPY30,000,000. or USD272,700.- this is equivalent to 1% of total value of construction.

Annex10

Option A (local SPC for EPC and O&M)



Option B (Consortium for EPC+ local SPC for O&M)



1. Governing law of disputes and lawsuit and contracts

According to the procedure for preparing the contract for JICA grant aid, the disputes and lawsuit and governing law of contracts are as follows.

17. Dispute and lawsuit Following procedure shall be indicated; Firstly, try to settle problems, and if they cannot be resolved with the best effort, then necessary procedures can be taken thorough an international arbitration institution such as the Japan Commercial Arbitration Association (JCAA) or the International Chamber of Commerce (ICC). 18. Contract law Consult with the client to determine the country of the contract law.

Since the general grant aid is only for the facility construction, and the funds for facility construction payments are secured, no disputes or lawsuit related to the loss of the procurement agent are envisaged. Even if the governing law is Japanese law, the Cambodian government (the beneficiary government) may accept it.

However, considering the signing of O&M and bulk water sales contracts with the responsibility to pay for the purchase of bulk water, including facility maintenance and operation costs, Cambodia law will be required as applicable governing law of the contract.

The situation in Cambodia regarding litigation and arbitration is as follows.

- In 1960, Cambodia joined the New York Convention (the Convention on the Approval and Enforcement of Foreign Arbitration Judgments), but the law on the implementation of the New York Convention was enacted in 2001.

- The Arbitration Law was enacted in May 2006, and the Civil Procedure Law was enacted in July.

- Although the National Commercial Arbitration Center (NCAC) was established in the same year, the official operation of NCAC started in January 2013. In July 2014, the NCAC internal rules and NCAC rules were established at the first general meeting. Although it has been adopted, there are not many cases where NCAC is selected as an arbitration institution because not many days has passed after the establishment.

The following six international arbitration institutions will be alternatives to select:

1. **ICC (International Court of Arbitration)**
   Handles more than 21,900 arbitration cases since its establishment in 1923 (in recent years, about 1,000 cases per year). It has offices in Afghanistan, Australia, Bangladesh, China, Taiwan, Hong Kong, India, Indonesia, Japan, Korea, Macau, Malaysia, New Zealand, Pakistan, Philippines, Singapore, Sri Lanka and Thailand.
2. **The London Court of International Arbitration(LCIA)**
   Established in 1892. It is said that over 80% of cases referred to LCIA include non-UK parties, but due to confidentiality laws, LCIA has not disclosed facts and statistics regarding matters to be determined. In addition to headquarters in London, there are branches in India, Dubai and Mauritius.
3. **The American Arbitration Association-International Centre for Dispute Resolution(AAA-ICDR)**
   Established in 1996. In addition to the New York headquarters, it has regional offices throughout the United States and offices in Mexico City, Singapore and Bahrain.
4. **The Hong Kong International Arbitration Centre(HKIAC)**
   Established in 1985. In addition to Hong Kong headquarters, there is a branch in Seoul. Approximately 65% of all HKIAC arbitration cases are related to international disputes. Strong in China-related projects.
5. **The Singapore International Arbitration Centre (SIAC)**
   Established in 1990. They have a strategy to be international dispute resolution center in Asia. Established Maxwell Chambers, a complex dispute settlement facility, in 2009. The facility has offices of major European and American arbitration institutions such as ICC and AAA-ICDR and law firms specializing in arbitration. There are branch offices in Singapore and Mumbai.
6. **The Japan Commercial Arbitration Association (JCAA)**
   Established in 1953. There are offices in Tokyo and Osaka, handling both domestic and international arbitration.

Although this case is grant aid, since O&M and bulk water sales in Cambodia are included in the contract, the governing law is considered to be Cambodian law, and it is unlikely that the arbitration institution will be JCAA. .

It is considered necessary for PPWSA to adopt Cambodian law as a governing law, however choosing NCAC as an arbitration institution is not the best option for both parties because NCAC has a little experience in arbitration. Considering the geographical factors of Cambodia, it would be desirable for PPWSA and private operators to choose Singapore ICC or SIAC as the applicable arbitration institution.

Table 5-1: Urban water system parameters

Items to be Analyzed and Recorded in Ta Khmau WTP	Parameter	Unit	Permissible limite		Exception	Formal Monitoring Examination level		
			National Drinking water Standard	Requirement for Ta Khmau WTP		A Daily	B Quarterly	C Annually
	Microbial							
	E.Coli or thermoteloerant	CFU or MPN / 100 ml	0	0			B	
	Chemical							
	Aluminium (Al)	mg/l	0.2	0.2	in the case that alum is used		B	
	Ammonia (NH_3)	mg/l	1.5	1.5			B	
	Arsenic (As)	mg/l	0.05	0.05	for the case of groundwater source			C
	Barium (Ba)	mg/l	0.7	0.7				C
	Cadmium (Cd)	mg/l	0.003	0.003				C
	Chloride (Cl^-)	mg/l	250	250			B	
●	Chlorine Cl_2 * (free residual)	mg/l	0.1-1.0	0.1-1.0	for the case of using chlorine for disinfectant	A		
	Chromium (Cr)	mg/l	0.05	0.05				C

Items to be Analyzed and Recorded in Ta Khmau WTP	Parameter	Parameter			Exception	Formal Monitoring Examination level		
		Unit	Permissible limite			A	B	C
			National Drinking water Standard	Requirement for Ta Khmau WTP		Daily	Quarterly	Annually
	Copper (Cu)	mg/l	1	1	for the case that household plumbing uses copper pipes			C
	Fluoride (F)	mg/l	1.5	1.5	for the case of groundwater source			C
	Total hardness as $CaCO_3$	mg/l	300	300	For the case of groundwater source		B	
	Iron (Fe)	mg/l	0.3	0.3	case of groundwater		B	
	Lead (Pb)	mg/l	0.01	0.01				C
	Manganese (Mn)	mg/l	0.1	0.1	case of groundwater		B	
	Mercury (Hg)	mg/l	0.001	0.001				C
	Nitrate (NO_3^-)	mg/l	50	50			B	
	Nitrite (NO_2^-)	mg/l	3	3			B	
	Sodium (Na)	mg/l	250	250	case at coastal areas			C
	Sulfate ion (SO_4^{2-})	mg/l	250	250			B	
	Zinc (Zn)	mg/l	3	3				C

Items to be Analyzed and Recorded in Ta Khmau WTP	Parameter	Parameter			Exception	Formal Monitoring Examination level		
		Unit	Permissible limite			A	B	C
			National Drinking water Standard	Requirement for Ta Khmau WTP		Daily	Quarterly	Annually
	Physical							
●	Colour	TCU	5	5		A		
●	pH	n/a	6.5-8.5	6.5-8.5		A		
●	TDS or Conductivity	mg/l or µS/cm	800 or 1600	800 or 1600		A		
●	Turbidity	NTU	5	1		A		
●	Taste and Odour	-	Acceptable	Acceptable		A		

*Residual chlorine must be daily analysed in production system and fortnightly (two weeks) at end points of networks (water supply system with more than 3001 connections). The number of samples is dependent on situations of end points of networks of each unit or service provider. We can analyse thermoteloerant coliform bacteria for E Coli.

**Conductivity is an acceptable alternative to TDS. The above limits assume that Conductivity is twice TDS, but this relationship should be confirmed at each site if conductivity is used.

*** Whether the analysis of taste and odour by operators is acceptable depends on users.

Source: National Drinking Water Quality Standard (MIH)

資　料 5　参考資料（収集資料リスト）

収集資料リスト

		プロジェクト ID		調査団番号			
地域	東南アジア	調査名	タクマウ上水道拡張計画準備調査	調査の種類	協力準備調査	担当部課	地球環境部水資源グループ
国名	カンボジア	配属機関名	プノンペン水道公社（PPWSA）	現地調査期間	2019/3-2020/3		

発行機関	No.	資料名	説明	形式	収集資料	専門家作成資料	JICA作成資料	言語	翻訳状況	取り扱い区分	図書館記入欄	備考
PPWSA	A-1	As built drawing of Ta Khmau	タクマウ浄水場高架水槽建設工事竣工図	電子データ PDF	○			英語				
PPWSA	A-2	PPWSA-Organization Chart	PPWSA 組織図	電子データ PDF	○			英語				
PPWSA	A-3	Existing WTP WQ	既存浄水場の水質記録	電子データ エクセル	○			英語				
PPWSA	A-4	Master Plan	マスタープラン	電子データ PDF	○			英語				
PPWSA	A-5	Production Data WTP	各浄水場の浄水量、薬品使用量、電気使用量	電子データ Excel	○			英語				
EDC	A-6	Energy charge (Received 22kV and installed Photovoltaic solar generation system)	電力量料金（通常の場合と太陽光発電を導入した場合）	電子データ PDF	○			英語				
PPWSA	A-7	Data of Photovoltaic solar generation power generation at Phum Prek WTP from 2014 (monthly amount of power generation)	プンプレック浄水場の毎月の発電量データ	電子データ PDF	○			英語				
PPWSA	A-8	Data of Electricity Consumption from 2005	各浄水場の毎月の消費電力	電子データ PDF	○			英語				
MEF	B-1	Policy Paper on Public-Private Partnership for Public Investment Project Management (2016-2020)	公共投資プロジェクト管理のための PPP についての政策文書	電子データ PDF	○			英語				
MIH	B-2	PRAKAS ON	水道事業の事業許可の発行、改	電子データ			○	英語				

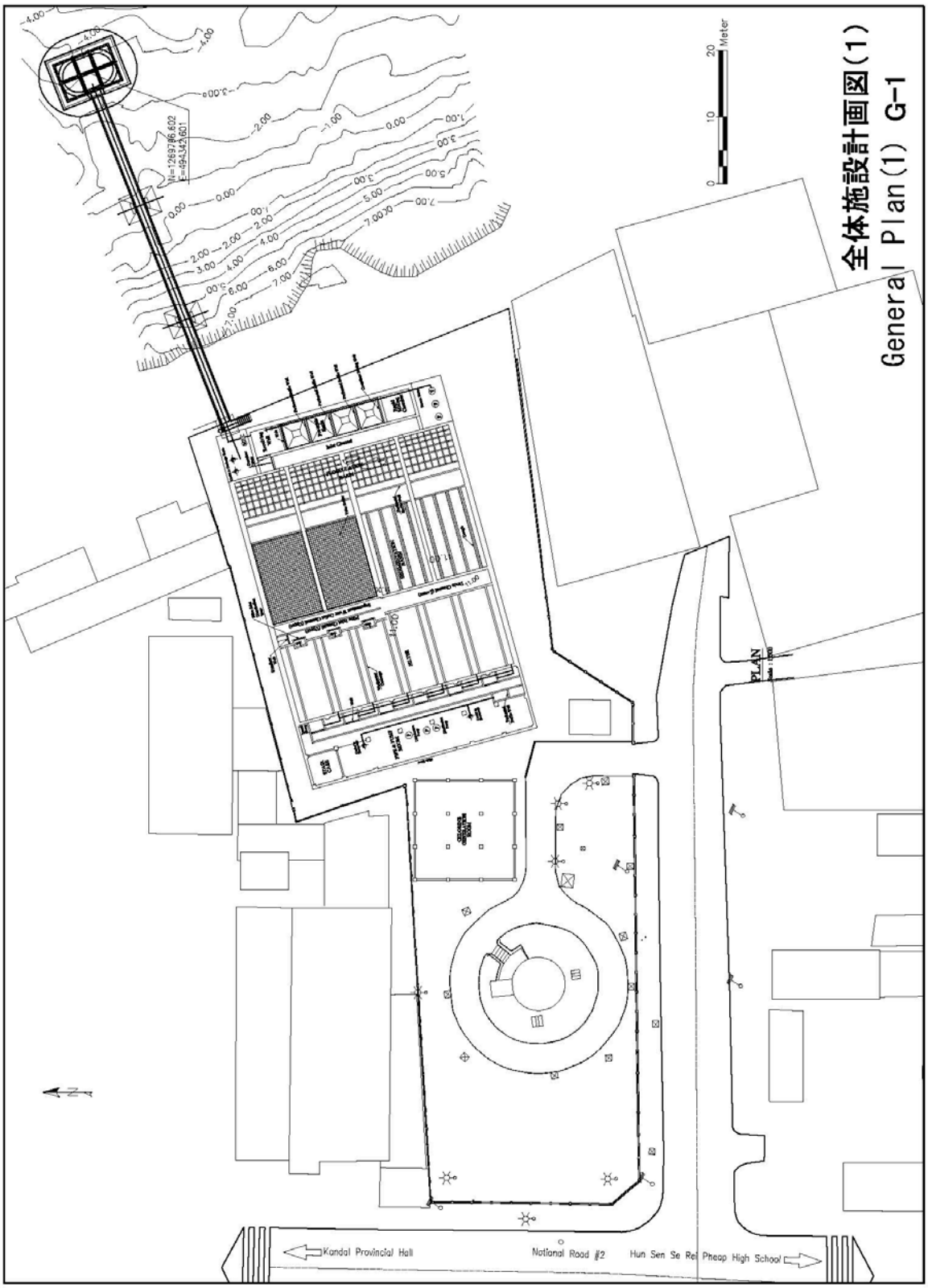
発行機関	No.	資料名	説明	形式	収集資料	専門家作成資料	JICA作成資料	言語	翻訳状況	取り扱い区分	図書館記入欄	備考
		PROCEDURE FOR ISSUING, REVISING, SUSPENDING AND REVOKING PERMIT FOR WATER SUPPLY BUSINESS	正、一時停止、取消手続きに関する省令	PDF								
TECHNICAL SECRETARIAT/ CENTRAL PUBLIC-PRIVATE PARTNERSHIP (PPP) UNIT, MEF	B-3	DRAFT PROCUREMENT MANUAL for PUBLIC-PRIVATE PARTNERSHIP PROJECTS, SELECTION OF CONSULTANTS AND PRIVATE PARTNERS	PPP 事業の調達アニュアルドラフト、コンサルタントと民間パートナーの選定	電子データ PDF	○			英語				
The Royal Government of Cambodia	B-4	Sub Decree on the Implementation of the Law on the Amendment to the Law on Investment, No. 111 ANK/BK DATED SEPTEMBER 27, 2005	修正投資法施行の Sub Decree	電子データ PDF	○			英語				
MEF	B-5	Law on Public Finance System	公共財政システム法	電子データ PDF	○			英語				
The Kingdom of Cambodia	B-6	Law on Foreign Exchange	外国為替法	電子データ PDF	○			英語				
MEF	B-7	Law on Expropriation	収用に関する法律	電子データ PDF	○			英語				
MLMUPC (Ministry of Land Management, Urban Planning and Construction)	B-8	Law on Amendment to the Law on Investment of Cambodia	修正投資法	電子データ PDF	○			英語				
National Accounting Council (NAC)	B-9	Law on Accounting and Auditing	会計監査法	電子データ PDF	○			英語				
The Kingdom of Cambodia	B-10	Law on Investment	投資法	電子データ PDF	○			英語				
The Kingdom of Cambodia	B-11	Law on Concessions	コンセッション法	電子データ PDF	○			英語				
The Kingdom of Cambodia	B-12	Procurement Manual	調達マニュアル	電子データ PDF	○			英語				
The Kingdom of Cambodia	B-13	Law on the General Statue of Public Enterprises	公営企業に関する一般法	電子データ PDF	○			英語				
The Kingdom of	B-14	Law on Water Resources	水資源マネジメント法	電子データ	○			英語				

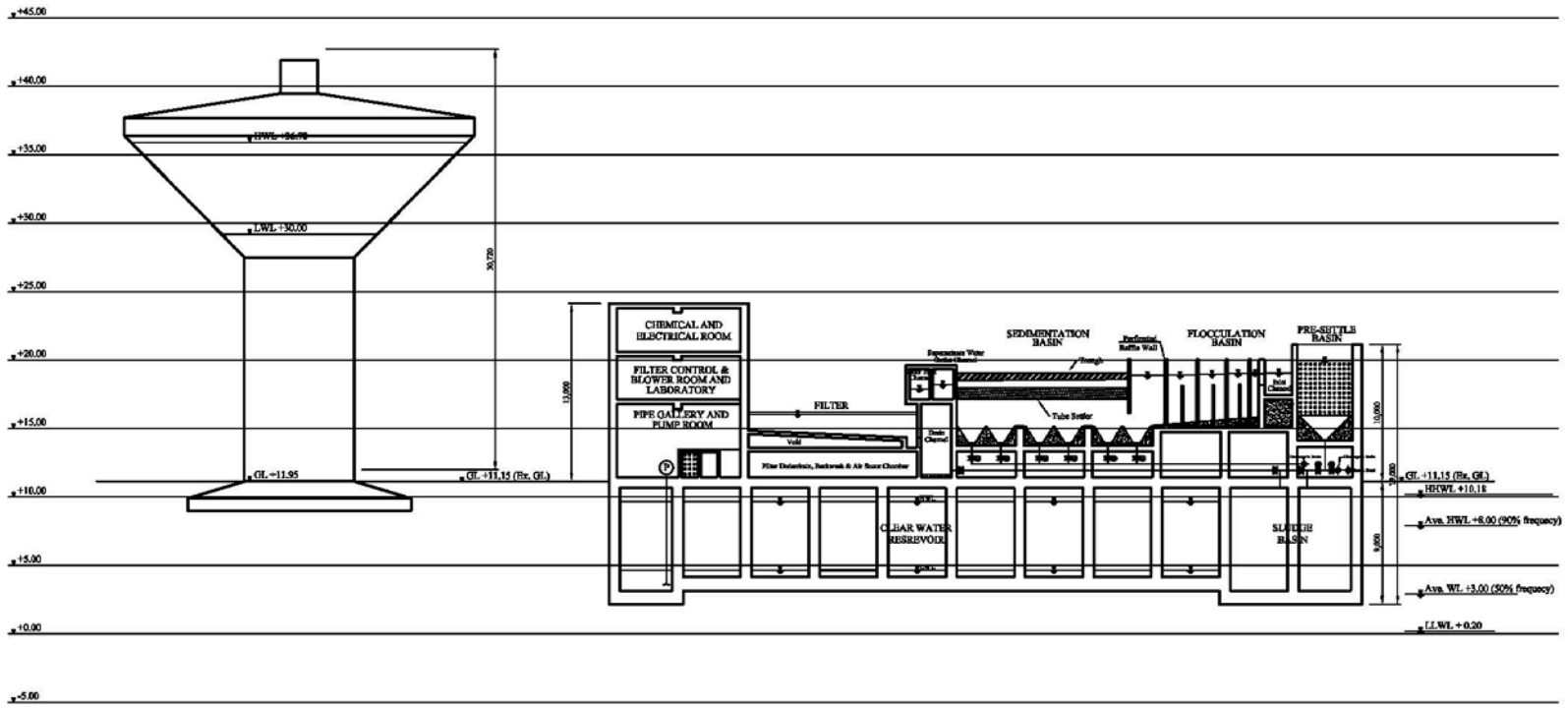
発行機関	No.	資料名	説明	形式	収集資料	専門家作成資料	JICA作成資料	言語	翻訳状況	取り扱い区分	図書館記入欄	備考
Cambodia		Management		PDF								
The Kingdom of Cambodia	B-15	Law on Commercial Enterprises	企業法	電子データ PDF	○			英語				
The Kingdom of Cambodia	B-16	Law on Labour	労働法	電子データ PDF	○			英語				
Ministry of Labor and Vocational Training	B-17	Guideline on The Procedure to Apply for and Extend Foreign Work Permit and Foreign Employment Card	外国労働許可と外国雇用カードへの申し込みと延長のガイドライン	電子データ PDF	○			英語				
The Kingdom of Cambodia	B-18	Civil Law of Cambodia	カンボジア王国民法典	電子データ PDF	○			日本語				
ADB	B-19	Cambodia, Water Supply and Sanitation Sector Assessment, Strategy, and Road Map	カンボジアの水道、衛生セクターの評価、戦略、ロードマップ	電子データ PDF	○			英語				
PPWSA	B-20	PPWSA Charter	PPWSA 設立許可書	電子データ PDF	○			英語				
The Kingdom of Cambodia	B-21	Land Registration	土地登録書	電子データ PDF	○			英語				
The Kingdom of Cambodia	B-22	Law on Public Procurement	公共調達法	電子データ PDF	○			英語				
PPWSA	B-23	Financial Information	PPWSA 財務情報	電子データ PDF	○			英語				
PPWSA	B-24	Debt and Loan Information	PPWSA ローン情報	電子データ PDF	○			英語				
PPWSA	B-25	Water Tariff History	PPWSA 料金改正履歴	電子データ PDF	○			英語				
PPWSA	B-26	Water Connection Fee	PPWSA 新規接続料金表	電子データ PDF	○			英語				
The Kingdom of Cambodia	B-27	Prakas on Mechanism for VAT Refund	VAT 還付に関する省令	電子データ PDF	○			英語（翻訳）				

資　料 6　その他の資料・情報

資　料 6.1　概略設計図

番号	施設区分	図面標題	図番号
1	全体施設	全体施設計画図（１）	G-1
2		全体施設計画図（２）	G-2
3		全体施設計画図（３）	G-3
4	取水施設	取水施設計画図（１）	I-1
5		取水施設計画図（２）	I-2
6		取水施設計画図（３）	I-3
7		取水施設計画図（４）	I-4
8		取水施設計画図（５）	I-5
9		取水施設計画図（６）	I-6
10		取水施設計画図（７）	I-7
11	浄水施設	浄水施設計画図（１）	W-1
12		浄水施設計画図（２）	W-2
13		浄水施設計画図（３）	W-3
14		浄水施設計画図（４）	W-4
15		浄水施設計画図（５）	W-5
16		浄水施設計画図（６）	W-6
17		浄水施設計画図（７）	W-7
18		浄水施設計画図（８）	W-8
19		浄水施設計画図（９）	W-9
20		浄水施設計画図（１０）	W-10


全体施設計画図(1)
General Plan(1) G-1
0
10
20
Meter
N
Kandal Provincial Hall
National Road #2
Hun Sen Se Rei Pheap High School

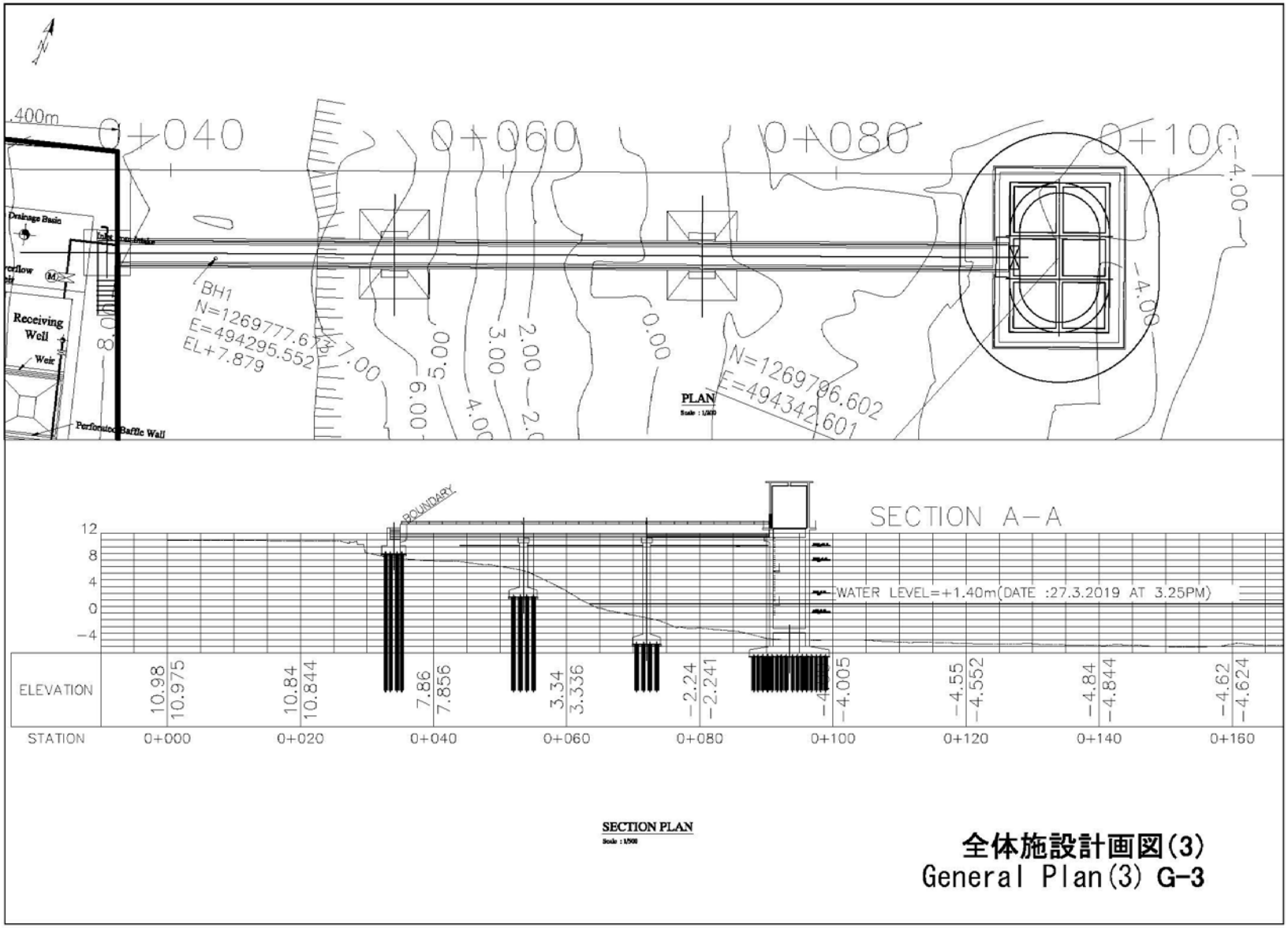


SECTION

Scale : 1/500

全体施設計画図(2)

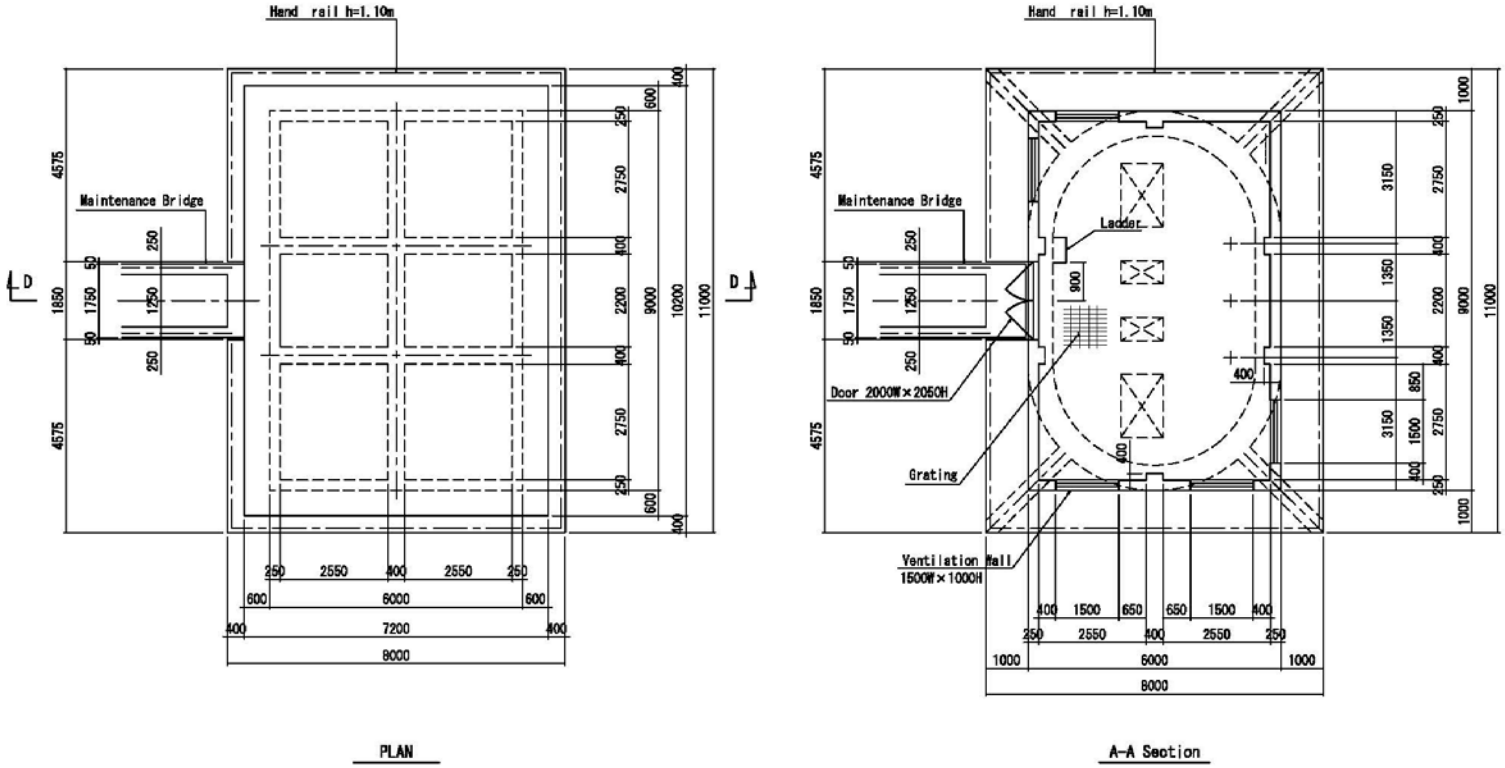
General Plan(2) G-2



全体施設計画図(3)
General Plan(3) **G-3**

Intake Tower

Structure(1/3)　Scale=1/100

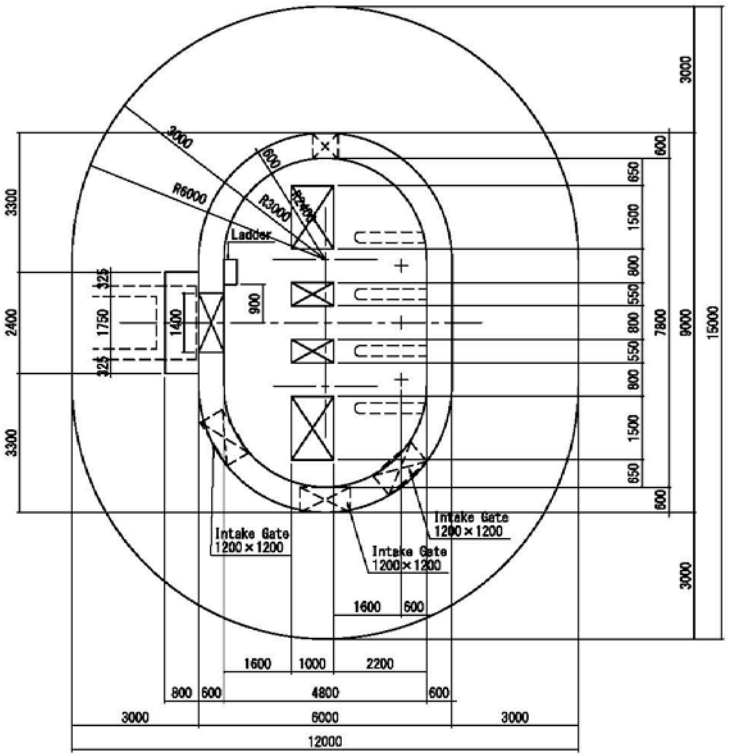


取水施設計画図(1)

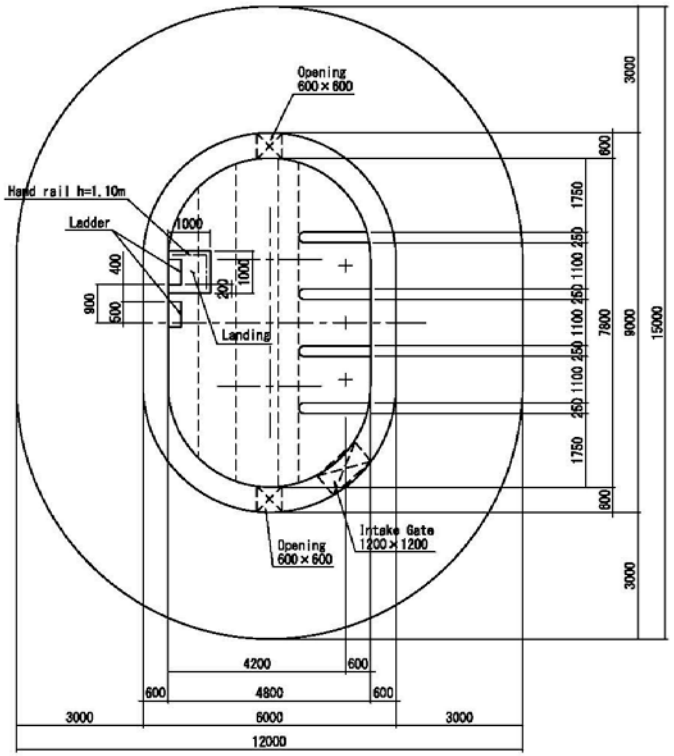
Intake Facility Plan(1) I-1

Intake Tower

Structure(2/3)　Scale=1/100



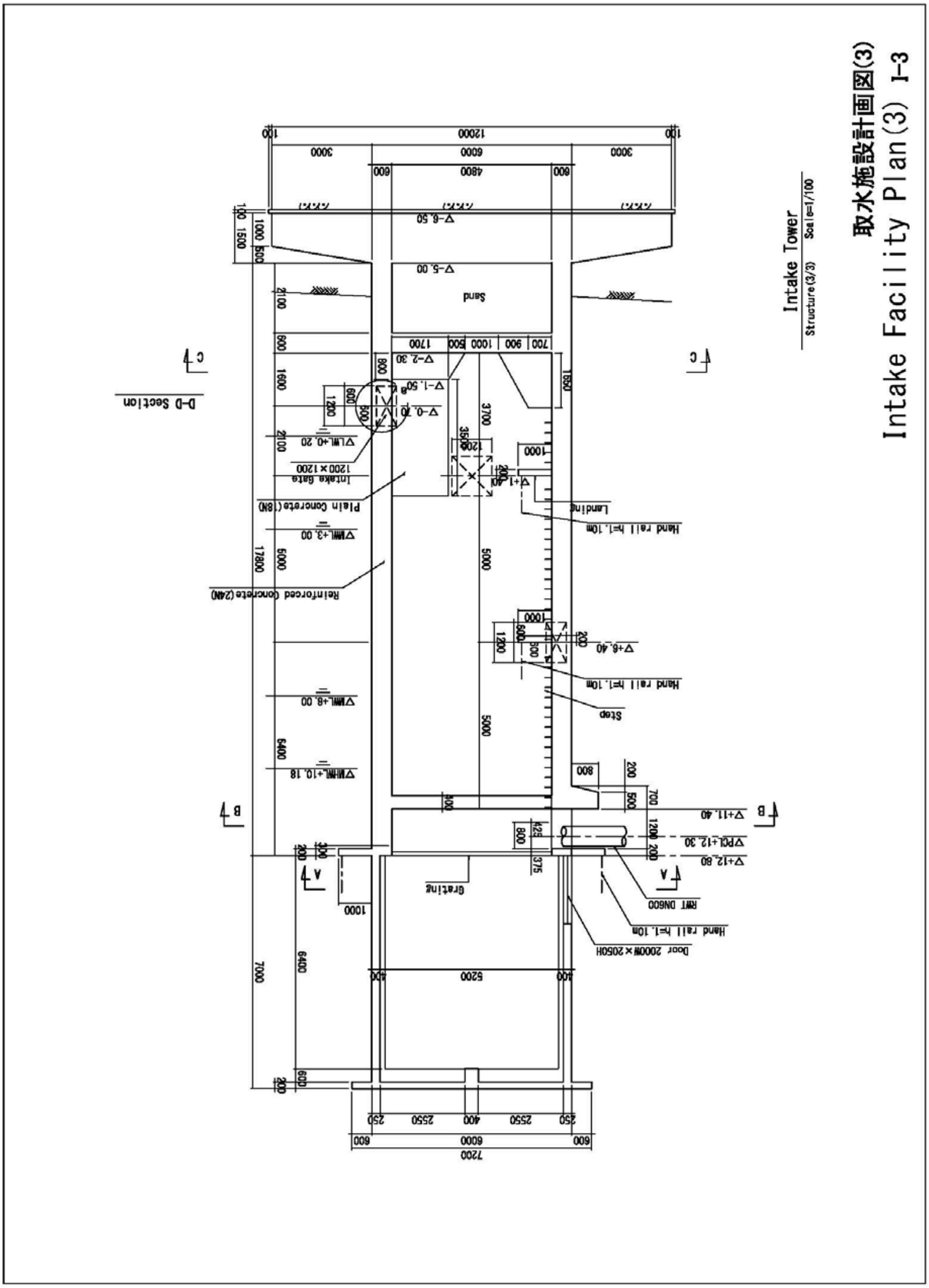
B-B Section



C-C Section

取水施設計画図(2)

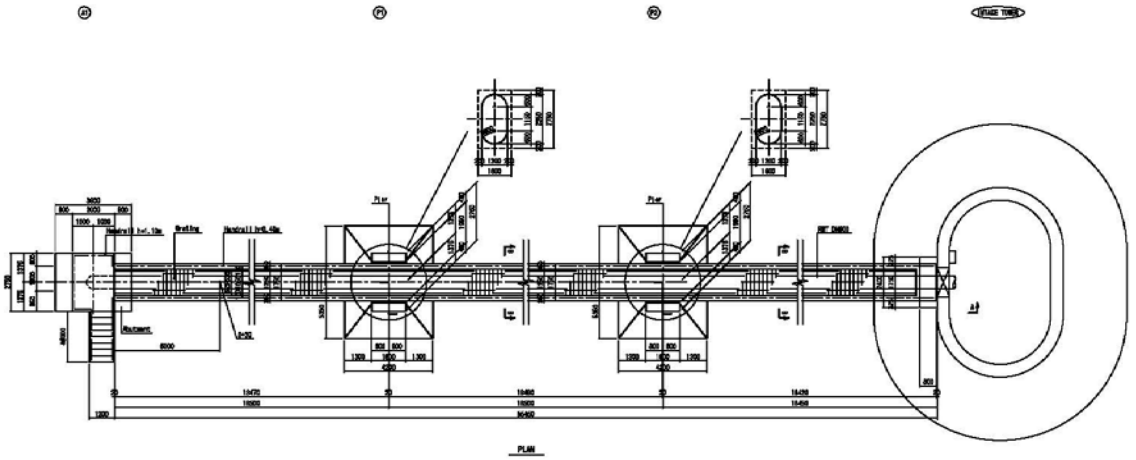
Intake Facility Plan(2)　I-2



取水施設計画図(3)
Intake Facility Plan(3) I-3
Intake Tower
Structure(3/3)
Scale=1/100
D-D Section
Sand
Intake Gate
1200×1200
Plain Concrete(18N)
Reinforced Concrete(24N)
Landing
Hand rail h=1.10m
Step
Grating
RWT DN600
Door 2000W×2050H

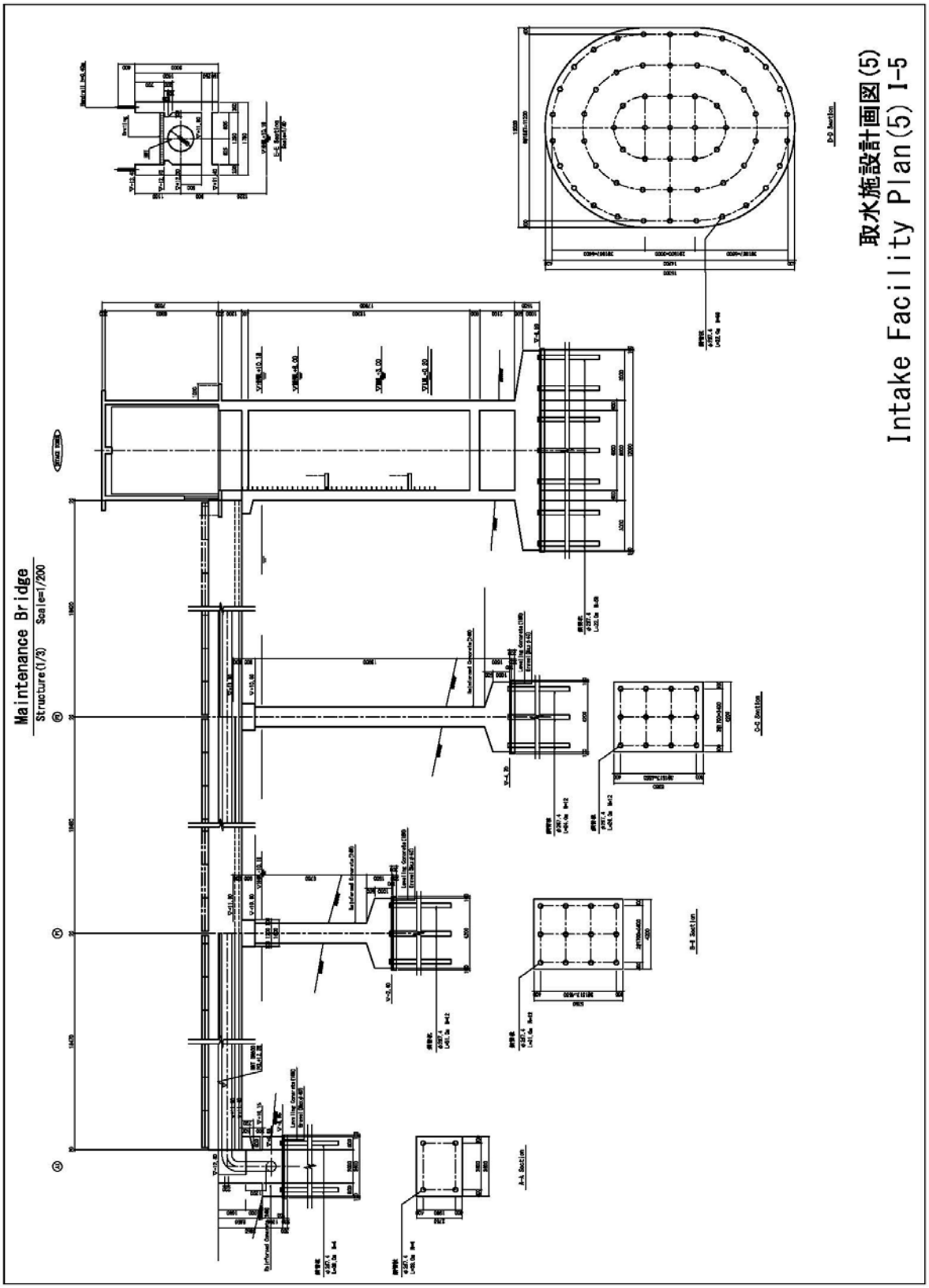
Maintenance Bridge

Structure(1/2)　Scale=1/200



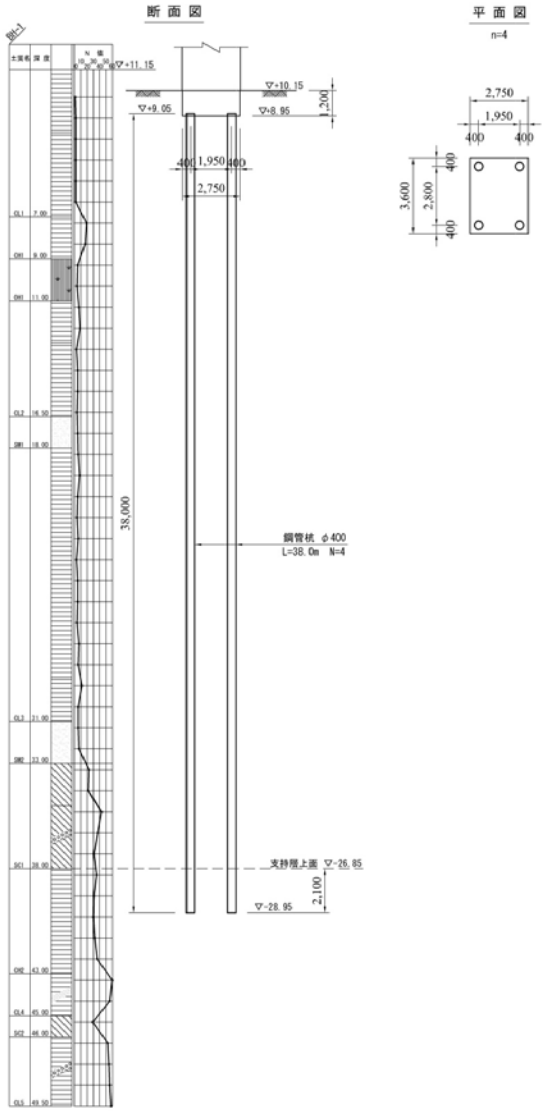
取水施設計画図(4)

Intake Facility Plan(4) I-4

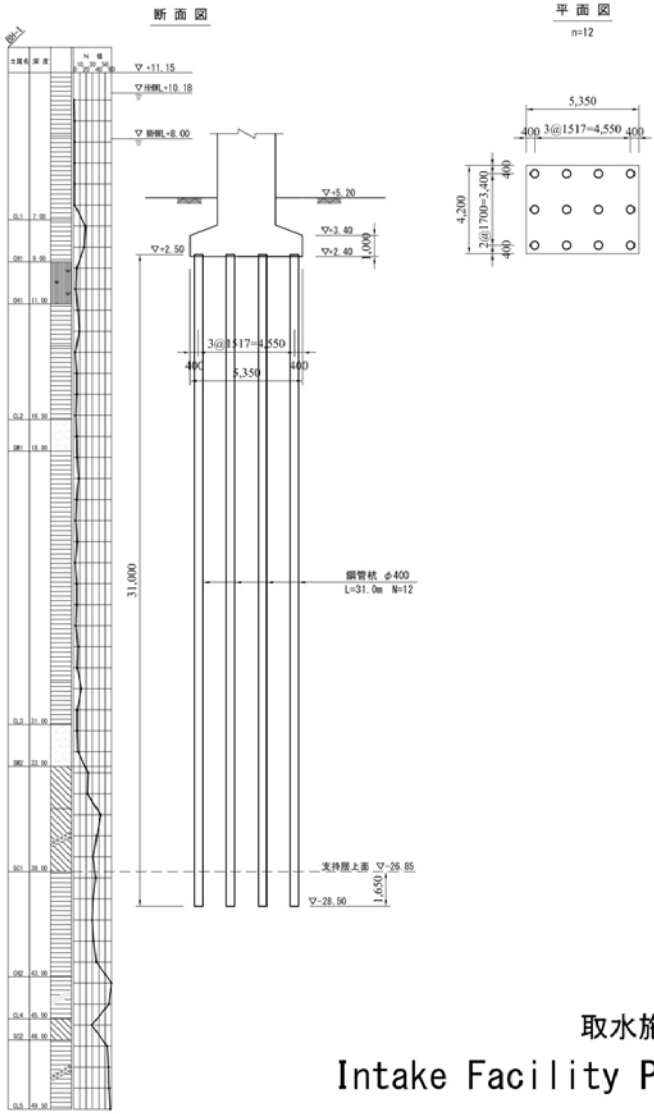

Maintenance Bridge
Structure(1/3) Scale=1/200
取水施設計画図(5)
Intake Facility Plan(5) 1-5

杭詳細図 (1/2) S=1:100

Ａ１橋台

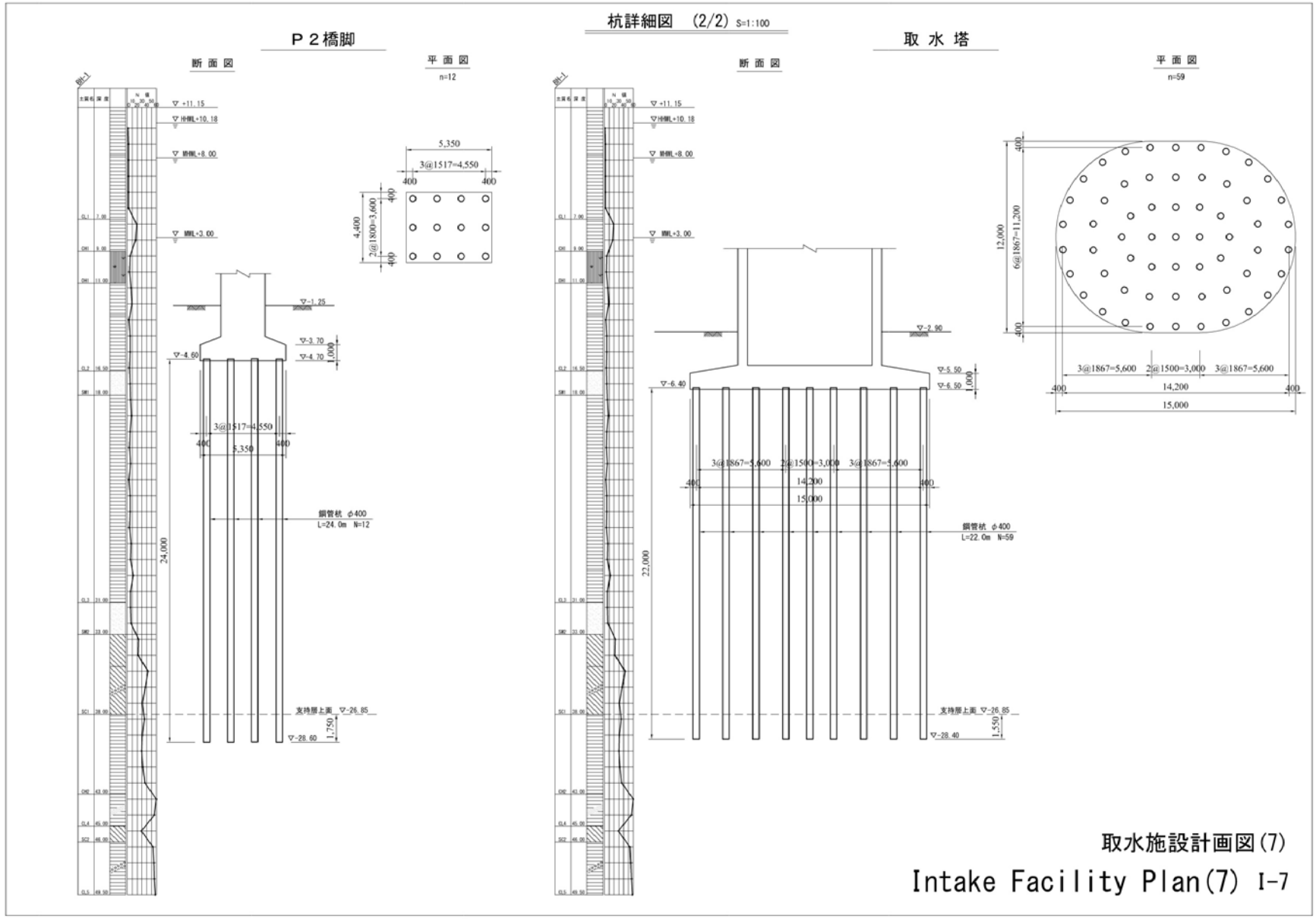


Ｐ１橋脚



取水施設計画図(6)

Intake Facility Plan(6) I-6

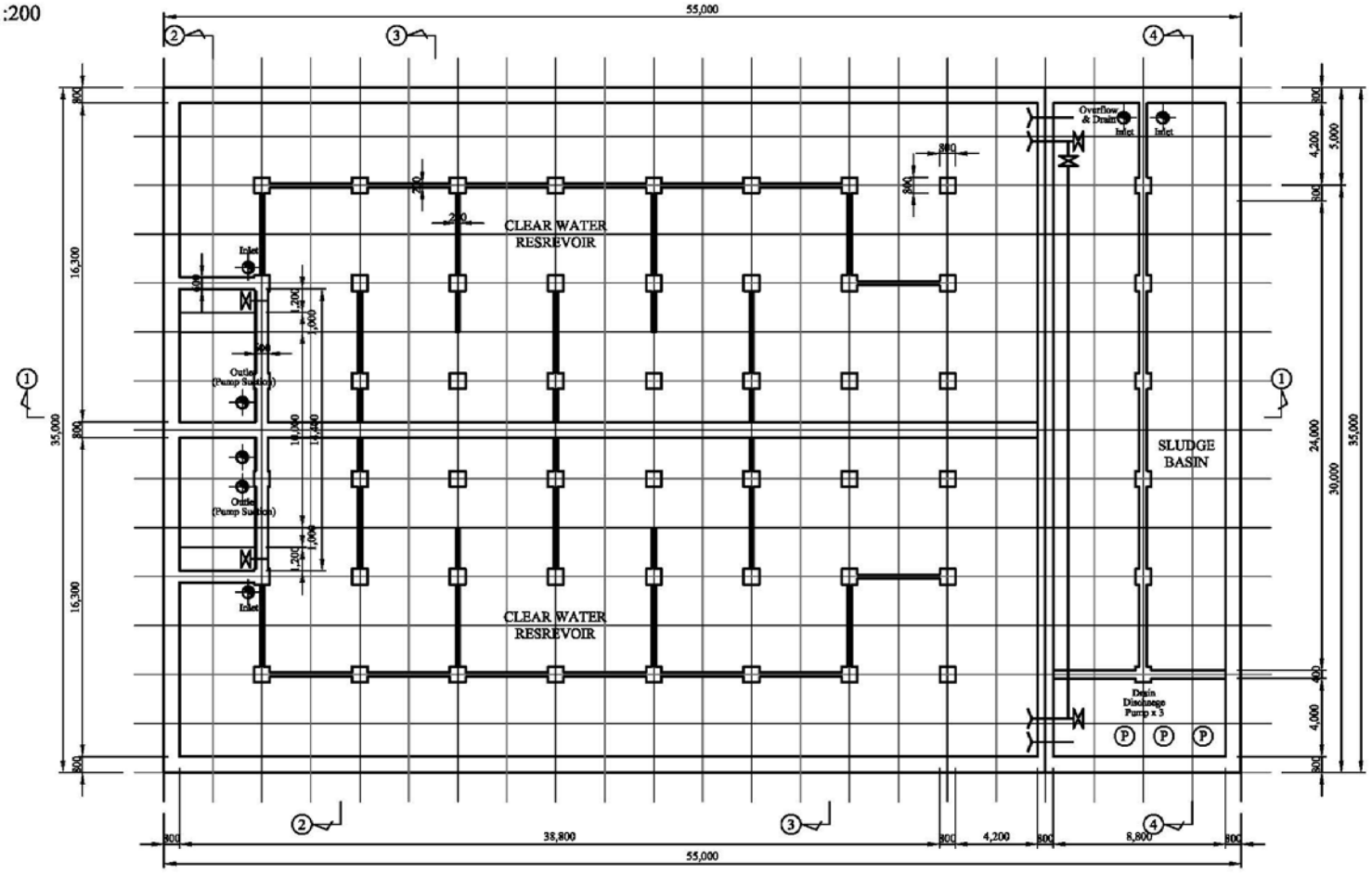


取水施設計画図(7)

Intake Facility Plan(7) I-7

WATER TREATMENT FACILITY
Clear Water Reservoir & Sludge Basin
BF
S=1:200

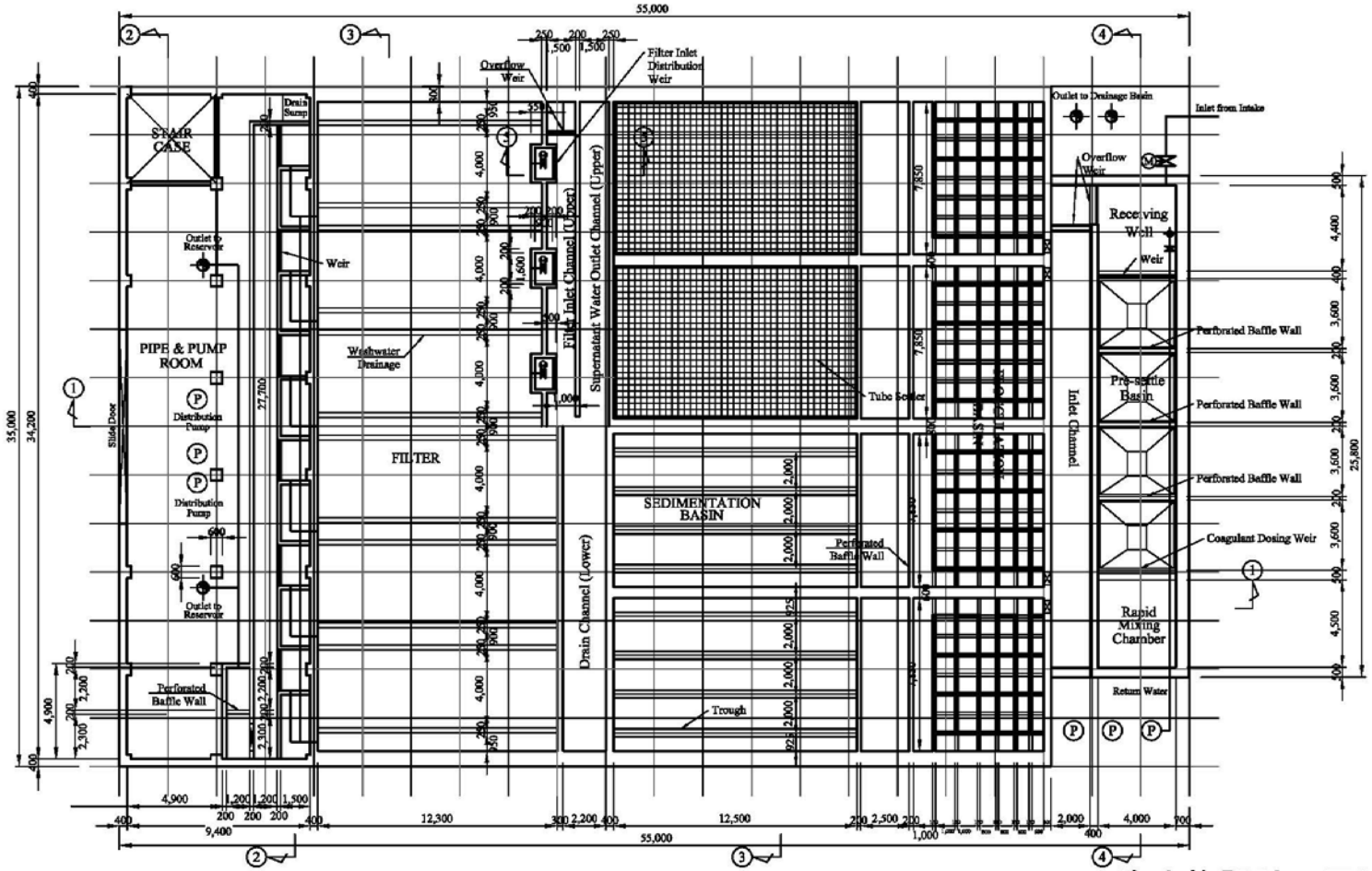
PLAN



浄水施設計画図(1)
Treatment Facility Plan(1) W-1

WATER TREATMENT FACILITY
Receiving Well, Pre-settle Basing, Rapid Mixing Chamber,
Flocculation Basin, Sedimentation Basin, Filter and Pipe & Pump Room
GF
S=1:200

PLAN

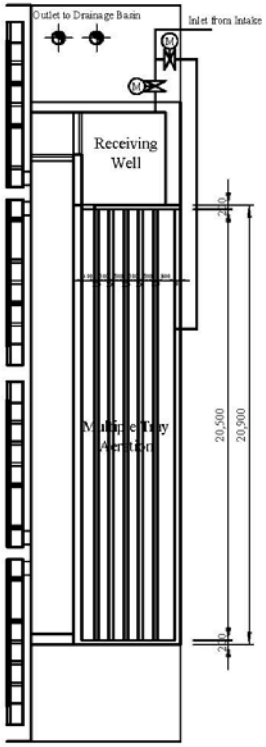


浄水施設計画図(2)

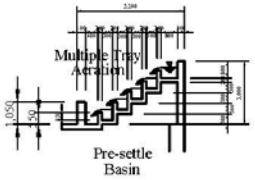
Treatment Facility Plan(2) W-2

WATER TREATMENT FACILITY
Multiple Tray Aeration
GF
S=1:200

PLAN



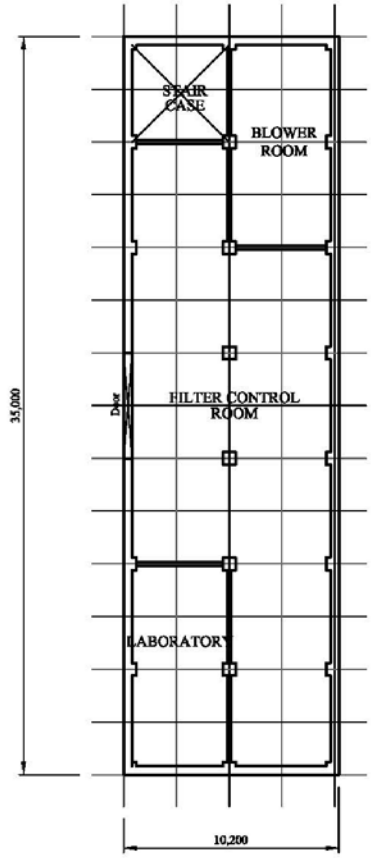
SECTION



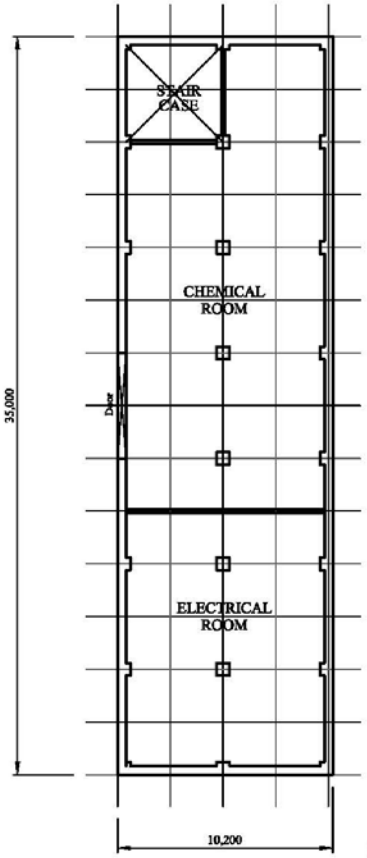
浄水施設計画図(3)
Treatment Facility Plan(3) W-3

WATER TREATMENT FACILITY
2F - Filter Control Room
3F - Chemical & Electrical Room
S=1:200

2F PLAN



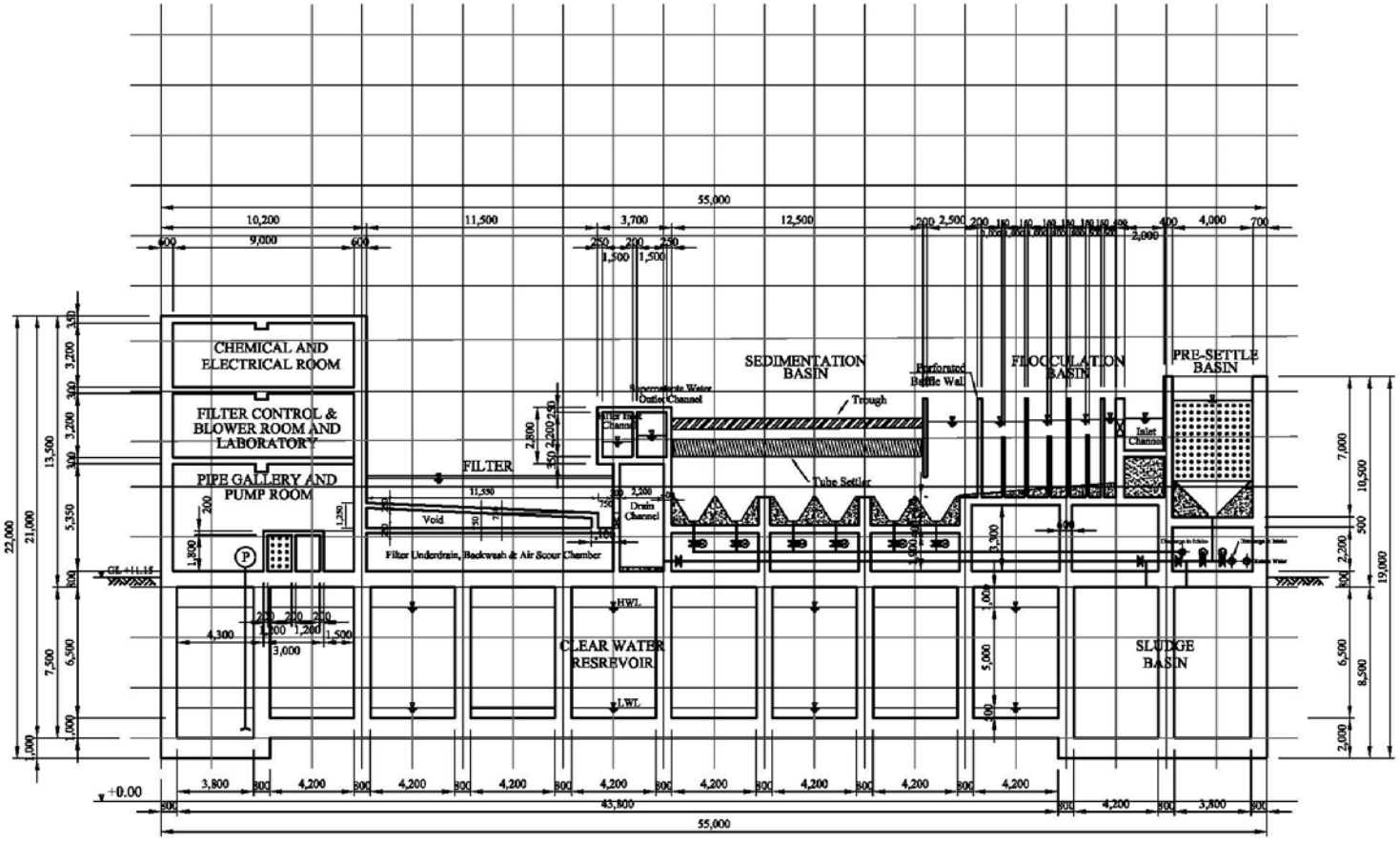
3F PLAN



浄水施設計画図(4)
Treatment Facility Plan(4) **W-4**

WATER TREATMENT FACILITY
General Section
S=1:200

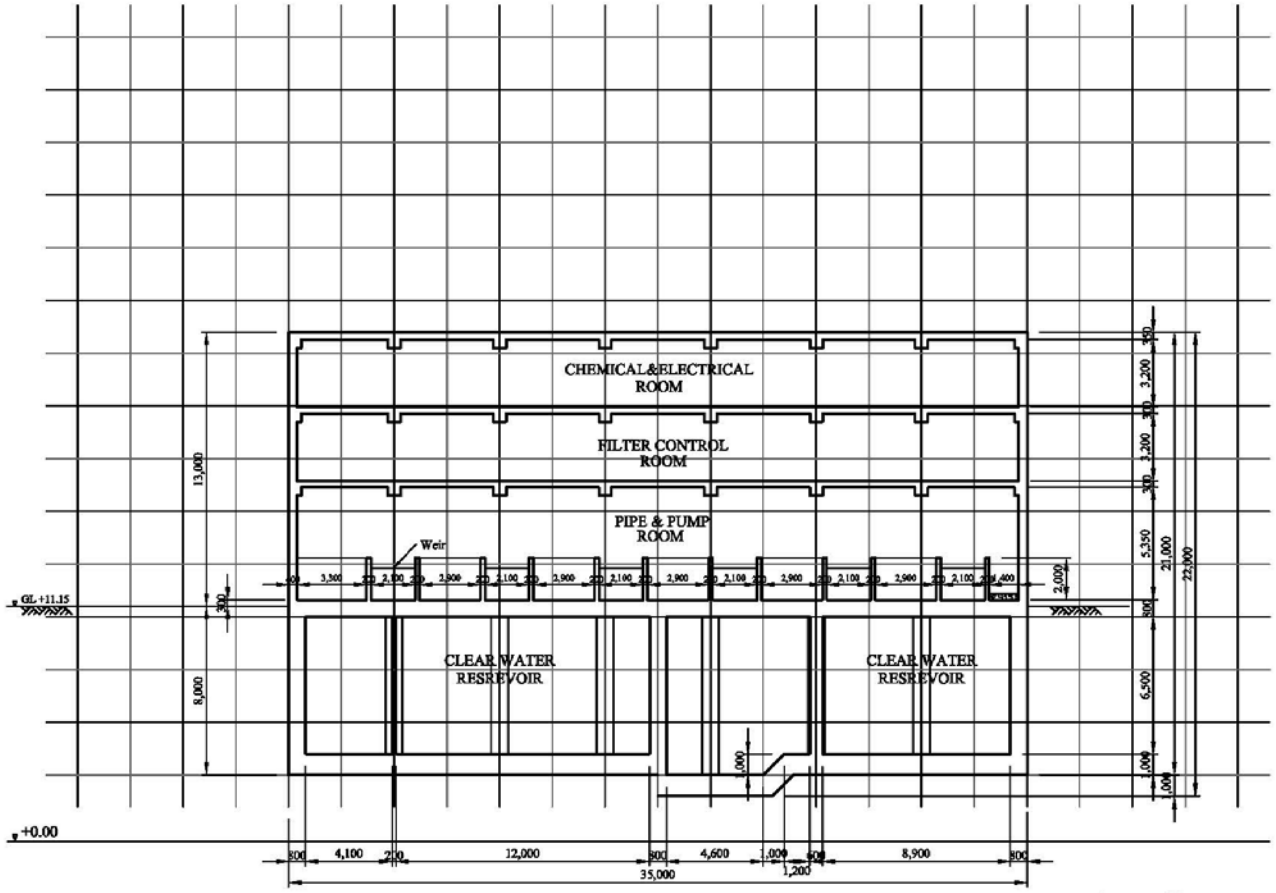
GENERAL SECTION 1-1



浄水施設計画図(5)
Treatment Facility Plan(5) W-5

WATER TREATMENT FACILITY
Section
S=1:200

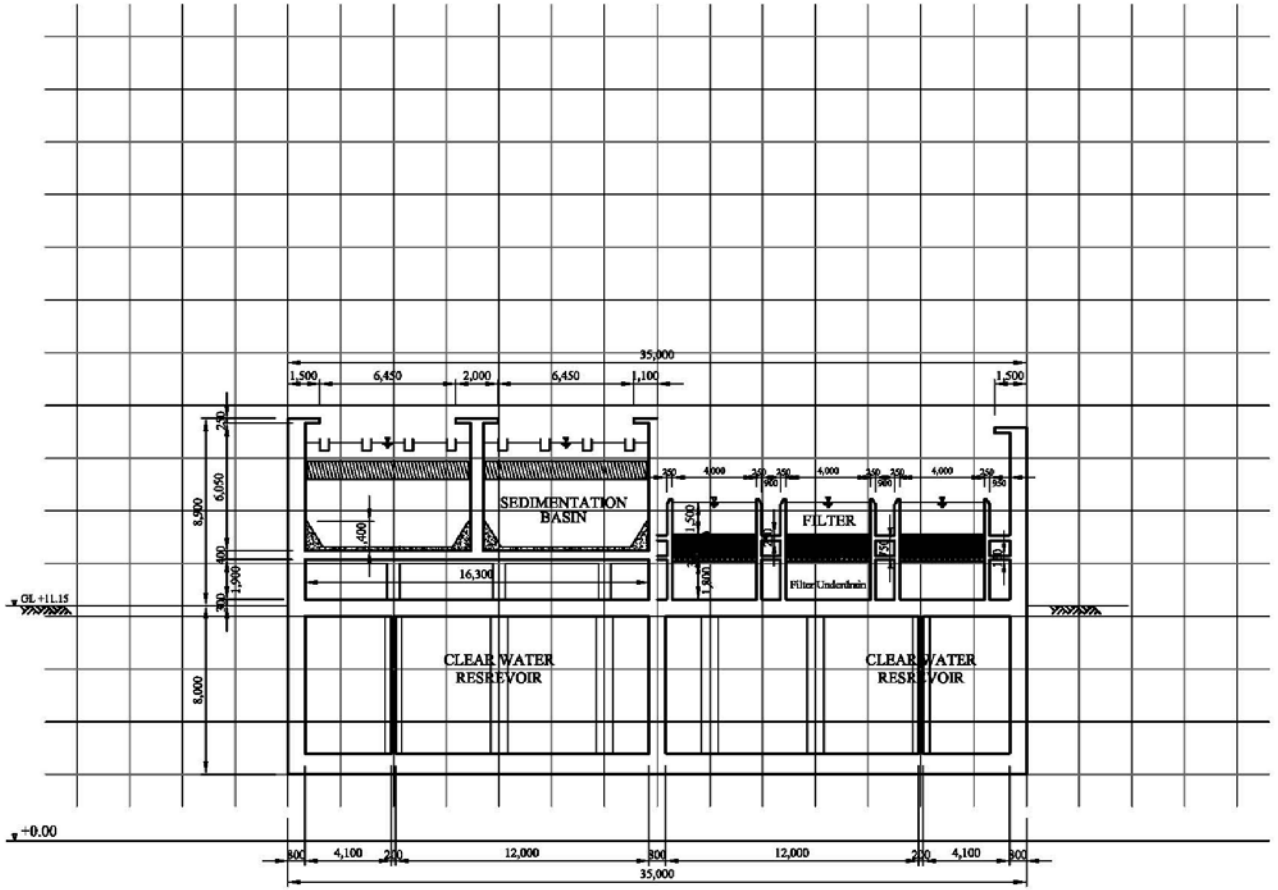
SECTION 2-2



浄水施設計画図(6)
Treatment Facility Plan(6) W-6

WATER TREATMENT FACILITY
Section
S=1:200

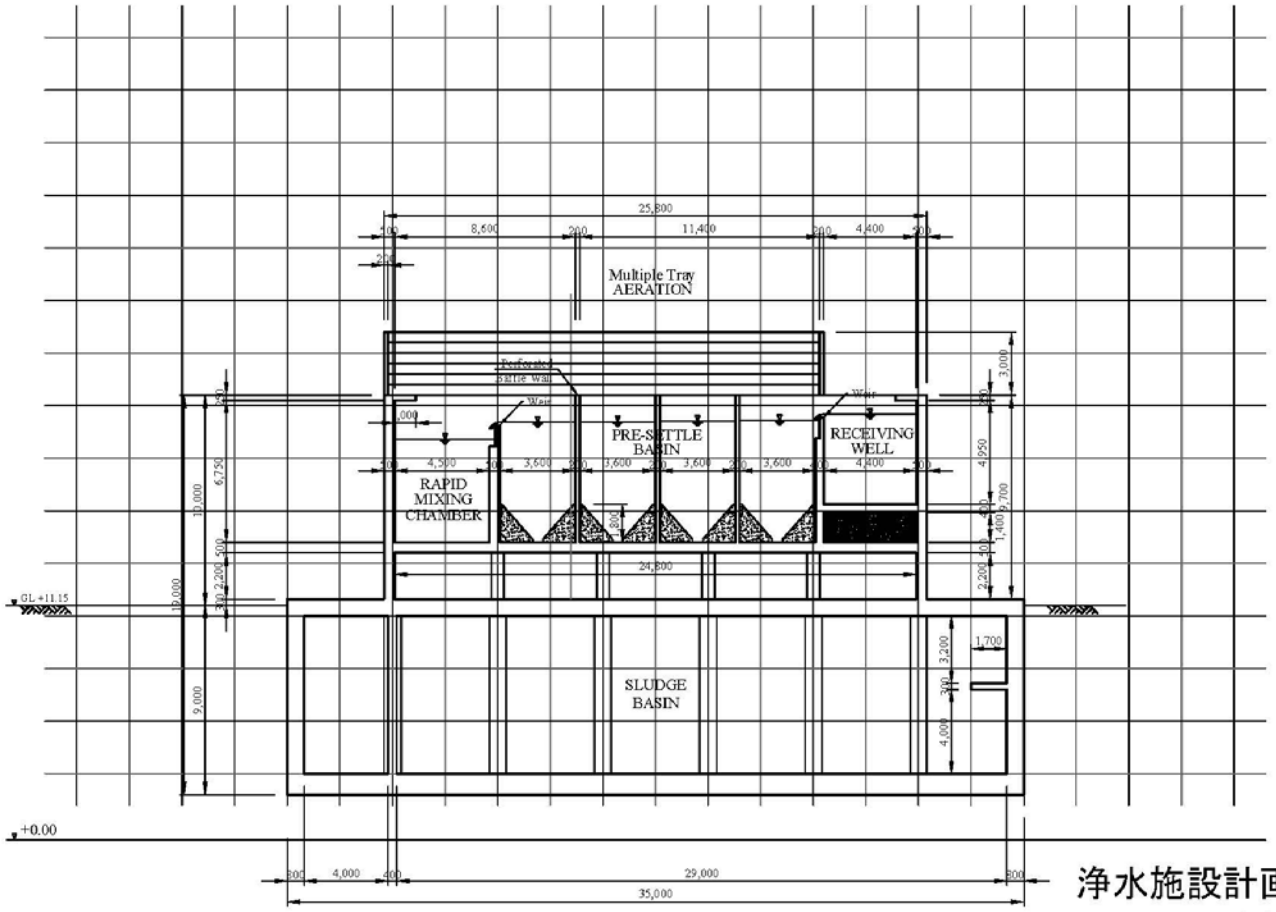
SECTION 3-3



浄水施設計画図(7)
Treatment Facility Plan(7) W-7

WATER TREATMENT FACILITY
Section
S=1:200

SECTION 4-4



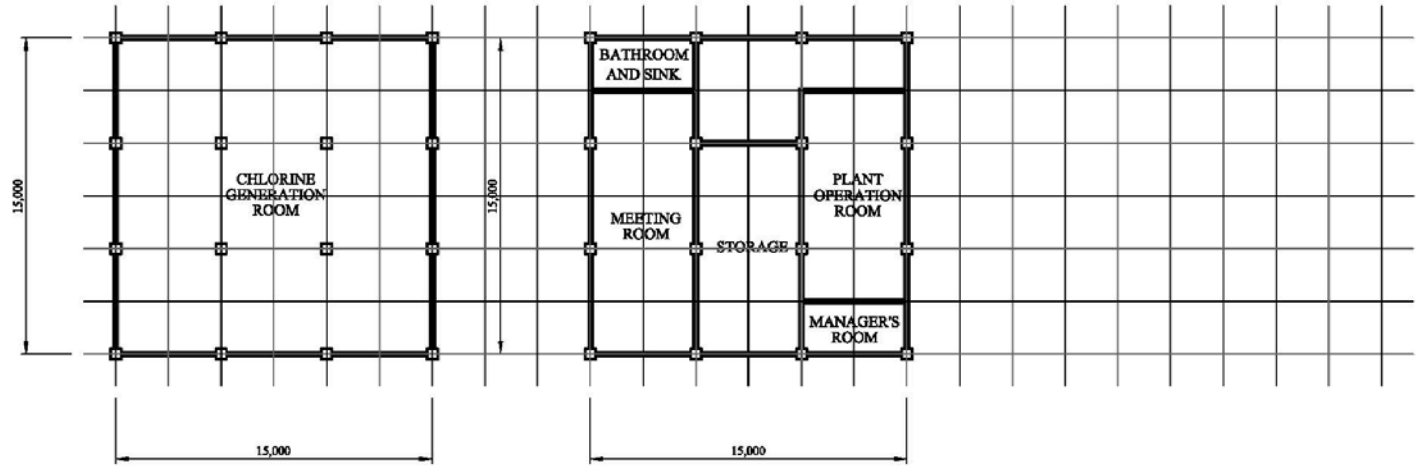
浄水施設計画図(8)
Treatment Facility Plan(8) W-8

CHEMICAL STORAGE AND ADMINISTRATION ROOM
S=1:200

PLAN

GF

2F

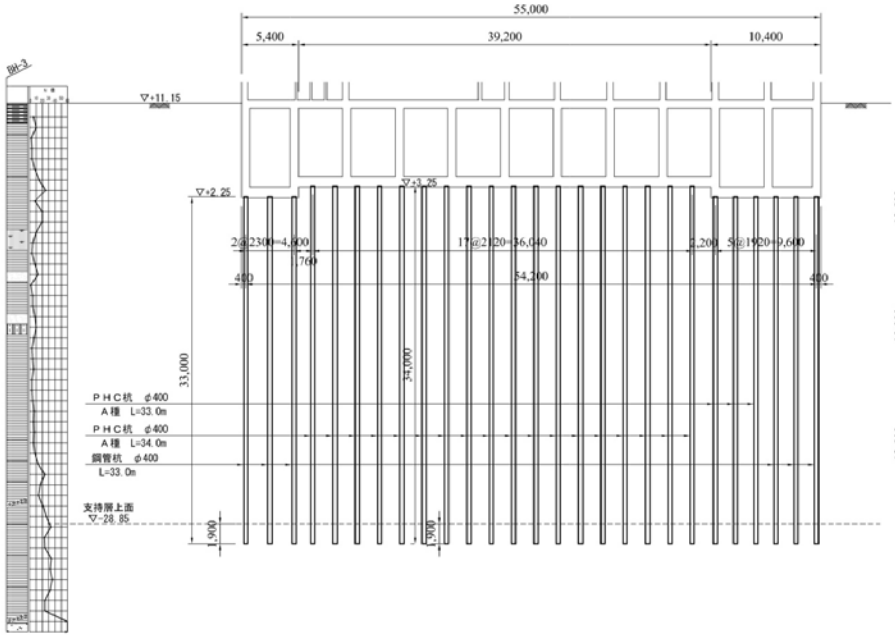


浄水施設計画図(9)
Treatment Facility Plan(9) W-9

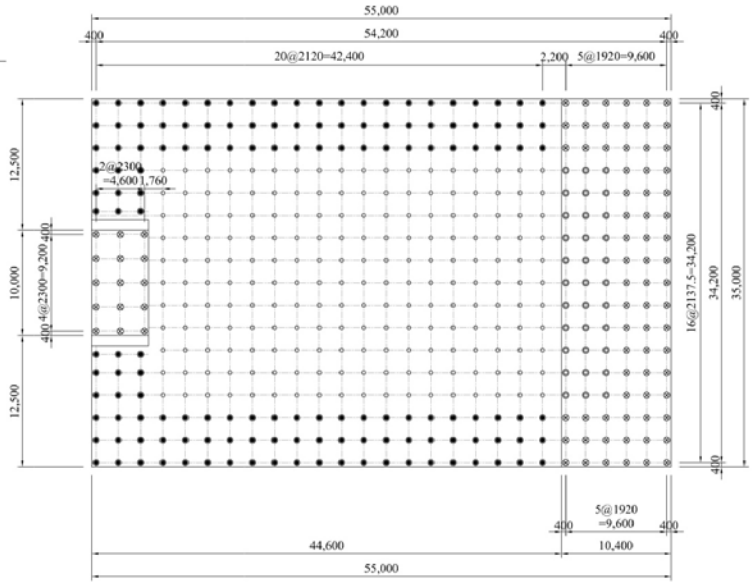
杭詳細図 S=1:200

浄水施設

断 面 図



平 面 図



		杭天端標高	杭長	杭本数
		+m	m	本
PHC杭 φ400 A種	○	3.25	34.0	198
PHC杭 φ400 A種	◎	2.25	33.0	33
鋼管杭 φ400	●	3.25	34.0	144
鋼管杭 φ400	⊗	2.25	33.0	84
Σ				459

浄水施設計画図(10)

Treatment Facility Plan(10) W-10

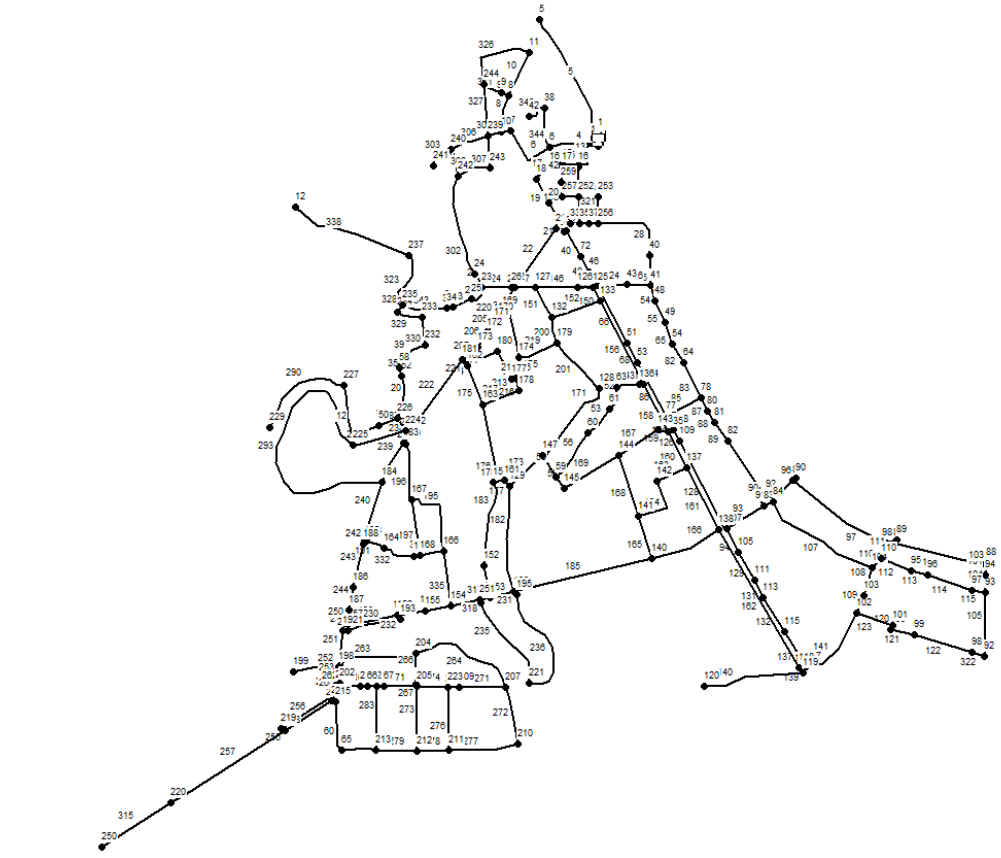
資　料 6.2　配水管網の水理検討

本調査の送配水管の管網計算は、EPANET ver2.0 を用い、下記条件で行った。

Item	Condition				Notes
Calculation	Hazen Williams Equation				
C Value	110				JWWA(2012) Design Criteria for Waterworks Facilities
Pump Head	2019:25m(Elevated Tank) 2024:40m 2030:40m				
Peak Factor	2019:1.0 2024:1.6 2030:1.6				
Distribution Area and Demand(m^3/day)(Day Max) from Ta Khmau WTP		2019	2024	2030	Chak Angre Krom(MC04) is located in Phnom Penh
	Ta Khmau	18,000	24,000	30,000	
	Chak Angre Krom(MC04)	-	6,000	0	

施設建設後の 2024 年に浄水量 30,000m^3/日に対して、タクマウの水需要は約 24,000m^3/日である。そのため、浄水量の余剰分 6,000m^3/日については、プノンペン南部に配水する条件とした。

既存管網における水理計算管網モデル、管網計算データ及び計算結果は次のとおり。



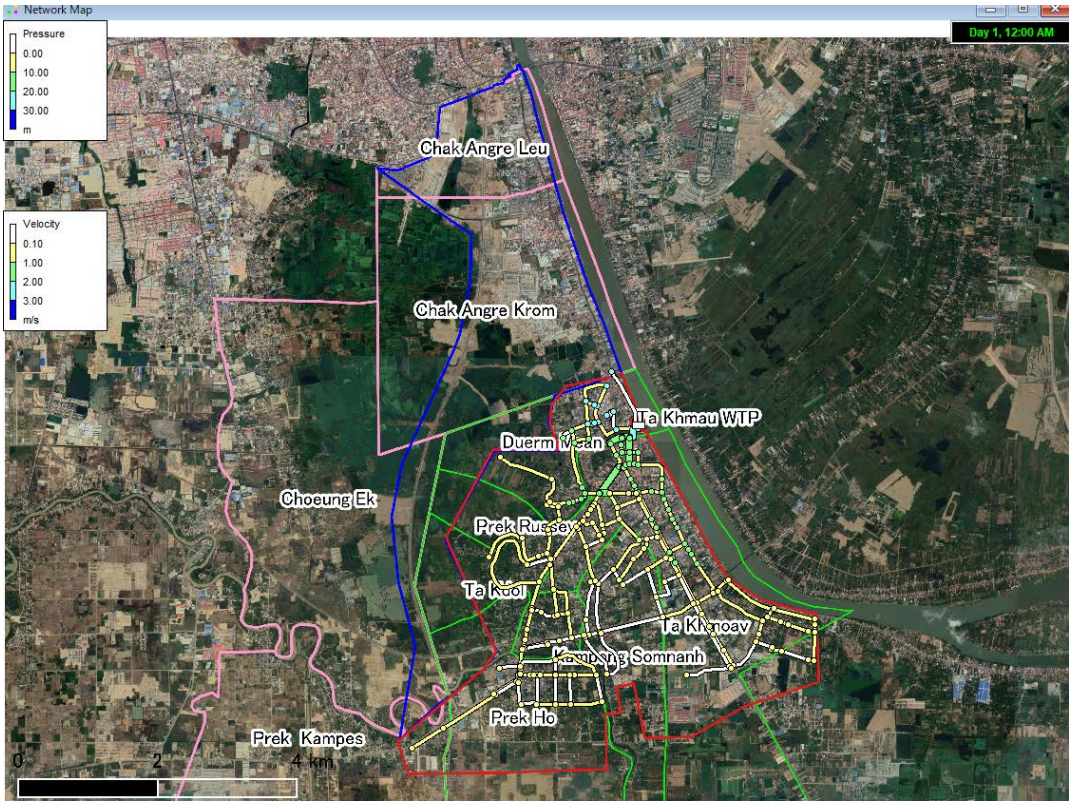


図 A6.1　水理計算管網モデルと管網計算結果（Pipe Network Analysis in 2019）

表 A6.1 管網計算結果（節点）（Pipe Network Analysis in 2019）

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
2	0	24.9	24.9
3	0	24.6	24.6
4	0	24.6	24.6
5	0	24.9	24.9
6	0	24.4	24.4
7	0	24.2	24.2
8	0	24.1	24.1
9	0	23.9	23.9
10	0	22.6	22.6
11	0	24.1	24.1
14	0	18.7	18.7
15	0	18.1	18.1
16	0	18.6	18.6
17	0	18.0	18.0
18	650	17.1	17.1
20	0	16.3	16.3
21	650	15.6	15.6
22	650	12.2	12.2
23	0	12.2	12.2
24	0	12.8	12.8
25	0	11.6	11.6
26	0	12.2	12.2
31	0	15.6	15.6
32	0	15.6	15.6
33	0	15.9	15.9
35	650	16.1	16.1
37	0	16.0	16.0
40	0	14.2	14.2
41	650	13.5	13.5
43	0	13.6	13.6
45	650	13.6	13.6
46	0	14.1	14.1
48	0	13.2	13.2
49	0	12.7	12.7
51	650	12.3	12.3
53	0	12.0	12.0
54	0	12.3	12.3
64	650	11.9	11.9
72	0	14.7	14.7
77	0	11.2	11.2
78	0	11.3	11.3
80	0	11.1	11.1
81	0	10.5	10.5
82	650	10.2	10.2
83	0	9.6	9.6
84	0	9.4	9.4
85	715	9.1	9.1
86	715	8.3	8.3
87	715	8.2	8.2
88	0	8.2	8.2

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
89	0	8.3	8.3
90	0	9.1	9.1
92	715	7.9	7.9
93	0	8.1	8.1
94	0	8.1	8.1
95	0	8.2	8.2
96	0	8.2	8.2
97	0	8.2	8.2
98	0	7.9	7.9
99	0	7.9	7.9
100	0	7.9	7.9
101	0	7.9	7.9
102	715	7.9	7.9
103	0	8.0	8.0
104	0	8.3	8.3
105	0	9.4	9.4
107	0	9.8	9.8
108	0	11.0	11.0
109	650	10.8	10.8
110	0	8.3	8.3
111	0	9.0	9.0
113	0	8.8	8.8
115	0	8.3	8.3
117	0	7.8	7.8
118	715	7.8	7.8
119	0	7.8	7.8
120	0	7.8	7.8
125	0	8.4	8.4
126	0	8.8	8.8
127	0	9.8	9.8
128	650	7.9	7.9
129	715	7.8	7.8
130	715	7.7	7.7
131	0	9.6	9.6
132	0	9.0	9.0
133	0	8.3	8.3
134	650	7.9	7.9
135	0	7.8	7.8
136	0	7.9	7.9
137	0	7.8	7.8
138	715	7.7	7.7
140	715	7.7	7.7
141	0	7.7	7.7
142	0	7.8	7.8
143	0	7.8	7.8
144	650	7.7	7.7
145	0	7.7	7.7
147	650	7.7	7.7
151	0	7.8	7.8
152	0	7.8	7.8

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
153	0	7.7	7.7
154	715	7.7	7.7
155	0	7.7	7.7
156	0	7.7	7.7
157	0	7.7	7.7
158	0	8.1	8.1
160	0	8.7	8.7
161	0	7.9	7.9
162	0	9.6	9.6
163	0	8.9	8.9
164	0	8.1	8.1
165	0	8.1	8.1
166	0	8.0	8.0
167	0	8.3	8.3
168	0	8.1	8.1
169	0	9.0	9.0
170	0	9.0	9.0
171	0	9.1	9.1
172	0	9.3	9.3
173	0	9.4	9.4
174	650	8.7	8.7
175	0	8.9	8.9
176	0	8.9	8.9
177	0	9.0	9.0
178	0	8.9	8.9
179	650	8.6	8.6
180	0	9.2	9.2
181	650	9.9	9.9
182	715	8.9	8.9
183	0	8.8	8.8
184	0	8.5	8.5
185	715	8.1	8.1
186	0	7.9	7.9
187	0	7.8	7.8
188	0	8.1	8.1
191	0	7.7	7.7
192	715	7.7	7.7
193	0	7.7	7.7
194	0	7.7	7.7
195	0	7.7	7.7
198	0	7.6	7.6
199	0	7.6	7.6
200	0	7.5	7.5
201	0	7.5	7.5
202	0	7.5	7.5
203	0	7.4	7.4
204	0	7.4	7.4
205	0	7.4	7.4
207	715	7.0	7.0
209	0	7.2	7.2

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
210	715	7.0	7.0
211	0	7.3	7.3
212	0	7.4	7.4
213	0	7.4	7.4
214	0	7.5	7.5
215	0	7.5	7.5
216	0	7.5	7.5
217	0	7.4	7.4
218	0	7.5	7.5
219	715	7.5	7.5
220	0	7.4	7.4
221	0	7.7	7.7
223	0	7.3	7.3
224	0	8.9	8.9
225	0	8.8	8.8
226	0	8.9	8.9
227	0	8.4	8.4
229	715	7.9	7.9
232	0	9.1	9.1
233	0	9.2	9.2
234	0	9.3	9.3
235	715	9.3	9.3
237	0	9.0	9.0
239	0	20.0	20.0
240	0	18.4	18.4
241	0	18.4	18.4
242	650	17.1	17.1
243	0	19.3	19.3
244	650	23.3	23.3
250	715	7.0	7.0
251	0	7.7	7.7
252	0	17.2	17.2
253	0	16.7	16.7
256	650	15.9	15.9
257	0	17.5	17.5
259	0	17.8	17.8
12	715	8.4	8.4
13	0	10.9	10.9
34	0	10.7	10.7
38	0	24.4	24.4
42	0	24.4	24.4
50	0	8.8	8.8
52	0	9.0	9.0
58	0	9.0	9.0
59	0	7.7	7.7
60	0	7.8	7.8
61	0	7.9	7.9
63	0	7.9	7.9
65	0	7.4	7.4
66	0	7.5	7.5
67	0	7.4	7.4

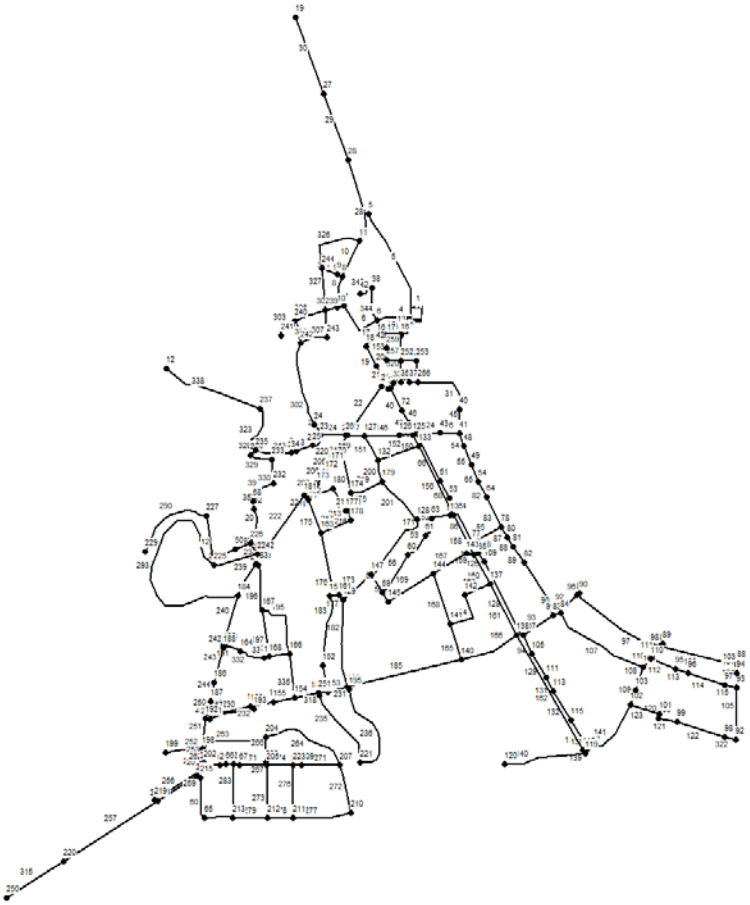
表 A6.2　管網計算結果（管）（Pipe Network Analysis in 2019）

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
2	2	3	27.18	400	110	Open	17,089	1.57
3	3	4	10.87	400	110	Open	14,884	1.37
4	3	6	312.42	300	110	Open	2,205	0.36
5	2	5	900.15	250	110	Open	0	0
6	6	7	385.89	300	110	Open	2,205	0.36
7	7	10	56.56	110	110	Open	1,143	1.39
8	7	8	240.17	300	110	Open	1,063	0.17
9	8	9	46.95	110	110	Open	424	0.52
10	8	11	305.7	300	110	Open	639	0.1
13	4	14	244.2	300	110	Open	14,884	2.44
14	14	16	13.83	300	110	Open	7,769	1.27
15	14	15	105.74	300	110	Open	7,115	1.16
16	15	17	20.74	150	110	Open	855	0.56
17	15	18	210.31	300	110	Open	6,259	1.02
19	18	20	169.63	300	110	Open	5,863	0.96
21	20	21	184.4	300	110	Open	5,863	0.96
22	21	22	458.88	300	110	Open	7,888	1.29
23	22	26	18.79	160	110	Open	−199	0.11
24	26	23	193.56	160	110	Open	−199	0.11
25	23	24	98.95	160	110	Open	−1,412	0.81
26	23	25	125.34	160	110	Open	1,213	0.7
32	31	21	76.83	300	110	Open	2,422	0.4
33	31	32	17.8	300	110	Open	−2,422	0.4
34	32	33	65.73	300	110	Open	−5,406	0.89
36	33	35	59.18	300	110	Open	−5,406	0.89
38	35	37	63.31	225	110	Open	1,661	0.48
40	32	72	189.04	225	110	Open	2,984	0.87
45	40	41	187.67	225	110	Open	2,425	0.71
46	41	43	154.11	160	110	Open	−278	0.16
48	72	46	111.47	225	110	Open	2,984	0.87
50	46	45	101.35	225	110	Open	2,984	0.87
54	41	48	104.45	225	110	Open	2,307	0.67
55	48	49	155.62	225	110	Open	2,307	0.67
65	49	54	143.09	225	110	Open	2,307	0.67
66	45	51	417.79	225	110	Open	2,310	0.67
68	51	53	144.07	225	110	Open	1,914	0.56
82	54	64	138.9	225	110	Open	2,307	0.67
83	64	78	255.3	225	110	Open	1,910	0.56
85	78	77	252.69	90	110	Open	77	0.14
86	53	77	391.46	225	110	Open	1,914	0.56
87	78	80	91.9	225	110	Open	1,833	0.53
88	80	81	285.79	225	110	Open	1,833	0.53
89	81	82	149.02	225	110	Open	1,833	0.53
90	82	83	489.98	225	110	Open	1,437	0.42
91	83	84	63.82	225	110	Open	2,310	0.67
92	84	85	194.61	225	110	Open	1,689	0.49
93	83	107	276.77	225	110	Open	−873	0.25
94	107	105	166.1	160	110	Open	720	0.41
96	85	90	24.11	160	110	Open	0	0
97	85	86	768.88	225	110	Open	1,253	0.36
98	86	89	27.93	160	110	Open	0	0
100	86	87	616.51	225	110	Open	608	0.18
101	87	94	61.35	160	110	Open	172	0.1
103	88	87	19.75	160	110	Open	0	0
104	94	93	110.6	160	110	Open	172	0.1
105	93	92	406.94	160	110	Open	402	0.23
107	84	104	788.69	160	110	Open	621	0.36
108	104	103	186.16	160	110	Open	600	0.35
109	103	102	122.52	160	110	Open	600	0.35
110	104	110	86.63	160	110	Open	21	0.01

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
111	110	86	125.24	160	110	Open	−209	0.12
112	110	95	209.06	160	110	Open	230	0.13
113	95	96	107.46	160	110	Open	230	0.13
114	96	97	299.79	160	110	Open	230	0.13
115	97	93	92.22	160	110	Open	230	0.13
120	101	100	28.76	160	110	Open	34	0.02
121	100	99	149.53	160	110	Open	34	0.02
122	99	98	388.58	160	110	Open	34	0.02
123	102	101	241.09	160	110	Open	34	0.02
124	77	108	97.16	225	110	Open	1,990	0.58
126	108	109	79.98	225	110	Open	1,990	0.58
128	109	107	649.05	225	110	Open	1,594	0.46
129	105	111	210.69	160	110	Open	720	0.41
131	111	113	123.66	160	110	Open	720	0.41
132	113	115	260.86	160	110	Open	720	0.41
137	115	117	258.79	160	110	Open	720	0.41
138	117	118	44.16	250	110	Open	850	0.2
139	118	119	39.5	250	110	Open	0	0
140	119	120	645.75	160	110	Open	0	0
141	117	102	504.75	160	110	Open	−129	0.07
146	127	126	272.57	160	110	Open	1,052	0.61
147	126	125	102.72	160	110	Open	1,052	0.61
150	125	133	98.06	250	110	Open	1,052	0.25
151	127	132	221.07	160	110	Open	1,036	0.6
152	133	132	332.95	110	110	Open	−274	0.33
155	136	134	25.68	160	110	Open	−66	0.04
156	133	134	604.2	250	110	Open	1,326	0.31
158	134	135	344.51	250	110	Open	864	0.2
159	143	135	66.74	160	110	Open	−280	0.16
160	135	137	258.04	250	110	Open	584	0.14
161	137	138	445.65	250	110	Open	422	0.1
162	138	118	1027.9	250	110	Open	−414	0.1
163	137	142	212.46	160	110	Open	162	0.09
164	142	141	375.09	160	110	Open	162	0.09
165	141	140	289.84	160	110	Open	132	0.08
166	138	140	476.94	225	110	Open	400	0.12
167	143	144	300.24	160	110	Open	280	0.16
168	144	141	410.99	110	110	Open	−30	0.04
169	144	145	413.28	160	110	Open	−86	0.05
171	128	147	598.71	160	110	Open	271	0.16
173	147	129	293.36	160	110	Open	−121	0.07
174	131	162	27.47	160	110	Open	805	0.46
175	162	163	272.14	160	110	Open	805	0.46
176	163	161	506.93	160	110	Open	775	0.45
177	161	129	53.84	160	110	Open	712	0.41
178	161	151	74.03	110	110	Open	63	0.08
182	129	130	681.68	160	110	Open	155	0.09
183	151	152	552.87	110	110	Open	63	0.08
184	152	153	686.29	110	110	Open	63	0.08
185	140	130	911.28	225	110	Open	95	0.03
186	130	153	157	225	110	Open	−159	0.05
188	154	155	168.89	225	110	Open	−53	0.02
189	155	156	180.54	225	110	Open	−53	0.02
190	156	157	322.27	225	110	Open	−37	0.01
191	158	164	124.35	110	110	Open	−4	0
195	167	166	503.36	160	110	Open	372	0.21
196	160	167	363.39	160	110	Open	510	0.29
197	167	168	362.07	110	110	Open	138	0.17
200	132	179	168.35	160	110	Open	762	0.44
201	179	128	401.89	160	110	Open	692	0.4

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
203	169	170	48.22	110	110	Open	−165	0.2
204	170	171	149.19	110	110	Open	−165	0.2
205	171	172	266	110	110	Open	−165	0.2
206	172	173	107.93	110	110	Open	−165	0.2
207	173	131	123.5	160	110	Open	−694	0.4
209	169	174	333.47	110	110	Open	165	0.2
210	174	175	119.64	160	110	Open	−559	0.32
211	173	180	167.26	160	110	Open	529	0.3
213	180	177	217.72	160	110	Open	529	0.3
215	177	176	72.45	160	110	Open	529	0.3
216	176	178	80.03	110	110	Open	−30	0.04
217	178	163	249.56	110	110	Open	−30	0.04
218	175	176	51.35	160	110	Open	−559	0.32
219	179	174	260.71	160	110	Open	−327	0.19
220	22	181	578.59	300	110	Open	5,603	0.92
221	181	131	25.02	150	110	Open	1,499	0.98
222	181	182	563.66	300	110	Open	3,708	0.61
230	193	191	349.77	160	110	Open	−17	0.01
231	130	195	22.34	160	110	Open	−27	0.02
232	156	193	31.21	160	110	Open	−17	0.01
233	157	191	126.11	225	110	Open	−37	0.01
234	191	192	31.85	250	110	Open	−53	0.01
235	194	221	634.06	225	110	Open	27	0.01
236	195	221	782.73	160	110	Open	−27	0.02
237	160	183	60.22	150	110	Open	−510	0.33
238	182	183	88.77	300	110	Open	2,971	0.49
239	183	184	286.9	300	110	Open	2,462	0.4
240	184	185	395.9	300	110	Open	2,666	0.44
241	185	158	16.02	150	110	Open	−4	0
242	185	188	19.85	300	110	Open	2,234	0.37
243	188	186	285.51	300	110	Open	2,234	0.37
244	186	187	146.45	300	110	Open	2,234	0.37
250	187	192	137.55	300	110	Open	2,234	0.37
251	192	198	238.62	300	110	Open	1,745	0.29
252	198	199	290.5	160	110	Open	0	0
253	198	200	119.83	300	110	Open	1,745	0.29
254	200	219	460.49	300	110	Open	817	0.13
255	219	218	25.44	200	110	Open	381	0.14
256	214	218	353.29	160	110	Open	55	0.03
257	218	220	868.13	225	110	Open	436	0.13
259	214	215	33.75	160	110	Open	161	0.09
260	201	214	107.36	160	110	Open	216	0.12
261	200	201	28.28	200	110	Open	928	0.34
262	201	202	17.78	110	110	Open	80	0.1
263	202	204	632.9	110	110	Open	80	0.1
264	204	207	713.14	110	110	Open	124	0.15
266	203	204	199.48	160	110	Open	44	0.03
267	203	205	16.29	160	110	Open	−44	0.03
271	209	207	300.21	160	110	Open	374	0.22
272	207	210	374.55	110	110	Open	62	0.08
273	205	212	412.83	225	110	Open	164	0.05
274	205	223	203.47	160	110	Open	381	0.22
275	223	209	69.13	160	110	Open	374	0.22
276	223	211	406.91	110	110	Open	8	0.01
277	211	210	449.15	160	110	Open	374	0.22
278	212	211	203.44	160	110	Open	367	0.21
279	213	212	270.61	160	110	Open	203	0.12
280	201	216	126.42	225	110	Open	631	0.18
283	217	213	412.13	110	110	Open	42	0.05
286	182	224	35.61	225	110	Open	300	0.09

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
287	224	226	97.56	160	110	Open	95	0.05
290	227	229	653.56	160	110	Open	436	0.25
292	224	225	348.98	225	110	Open	205	0.06
293	225	184	1849.61	160	110	Open	205	0.12
302	242	24	658.31	160	110	Open	1,412	0.81
303	240	241	173.51	160	110	Open	0	0
304	242	240	181.77	160	110	Open	−1,424	0.82
305	10	239	94.41	110	110	Open	1,143	1.39
306	239	240	251.41	160	110	Open	1,424	0.82
307	239	243	209.09	110	110	Open	385	0.47
308	243	242	216.99	90	110	Open	385	0.7
311	9	244	128.73	110	110	Open	424	0.52
315	220	250	526.13	160	110	Open	436	0.25
316	154	251	188.69	225	110	Open	123	0.04
317	251	153	69.35	225	110	Open	96	0.03
318	251	194	20.58	225	110	Open	27	0.01
319	16	252	193.95	300	110	Open	7,769	1.27
320	252	35	170.73	300	110	Open	7,463	1.22
42	17	259	94.34	160	110	Open	855	0.49
153	259	257	94.52	160	110	Open	855	0.49
193	257	252	111.05	160	110	Open	855	0.49
223	252	253	122.83	160	110	Open	1,161	0.67
321	253	256	172.15	160	110	Open	1,161	0.67
322	98	92	86.27	160	110	Open	34	0.02
323	235	237	381.35	160	110	Open	436	0.25
324	45	43	187.67	160	110	Open	278	0.16
326	244	11	496.38	160	110	Open	−639	0.37
327	239	244	329.6	110	110	Open	−666	0.81
328	235	234	55.05	160	110	Open	341	0.2
329	234	233	167.35	160	110	Open	341	0.2
330	233	232	182.39	160	110	Open	341	0.2
332	164	165	207.25	110	110	Open	−4	0
333	165	168	38.67	110	110	Open	−4	0
334	168	166	157.76	110	110	Open	134	0.16
335	166	154	349.81	160	110	Open	506	0.29
338	237	12	802.56	160	110	Open	436	0.25
341	25	13	131.31	160	110	Open	1,213	0.7
342	13	34	43.17	160	110	Open	1,213	0.7
343	34	235	284.57	160	110	Open	1,213	0.7
344	6	38	262.11	160	110	Open	0	0
346	38	42	143.69	160	110	Open	0	0
11	226	50	126.42	160	110	Open	436	0.25
12	50	227	499.62	160	110	Open	436	0.25
20	226	52	280.96	160	110	Open	−341	0.2
35	52	58	55.77	160	110	Open	−341	0.2
39	58	232	243.77	160	110	Open	−341	0.2
43	136	63	151.36	160	110	Open	66	0.04
51	63	128	111.52	160	110	Open	−25	0.01
52	63	61	156.22	110	110	Open	91	0.11
53	61	60	211	110	110	Open	91	0.11
56	60	59	353.71	110	110	Open	91	0.11
58	145	59	90.41	110	110	Open	−86	0.11
59	59	147	162.77	110	110	Open	5	0.01
60	215	65	318.75	160	110	Open	161	0.09
62	65	213	220	160	110	Open	161	0.09
67	216	66	49.94	225	110	Open	631	0.18
69	66	217	55.55	225	110	Open	631	0.18
70	217	67	46.22	225	110	Open	589	0.17
71	67	205	211.73	225	110	Open	589	0.17
27	127	22	128.62	150	110	Open	−2,088	1.37
1	1	2	19.87	400	110	Open	17,089	1.57
18	256	37	56.5	225	110	Open	−1,661	0.48
28	256	40	511.28	225	110	Open	2,425	0.71



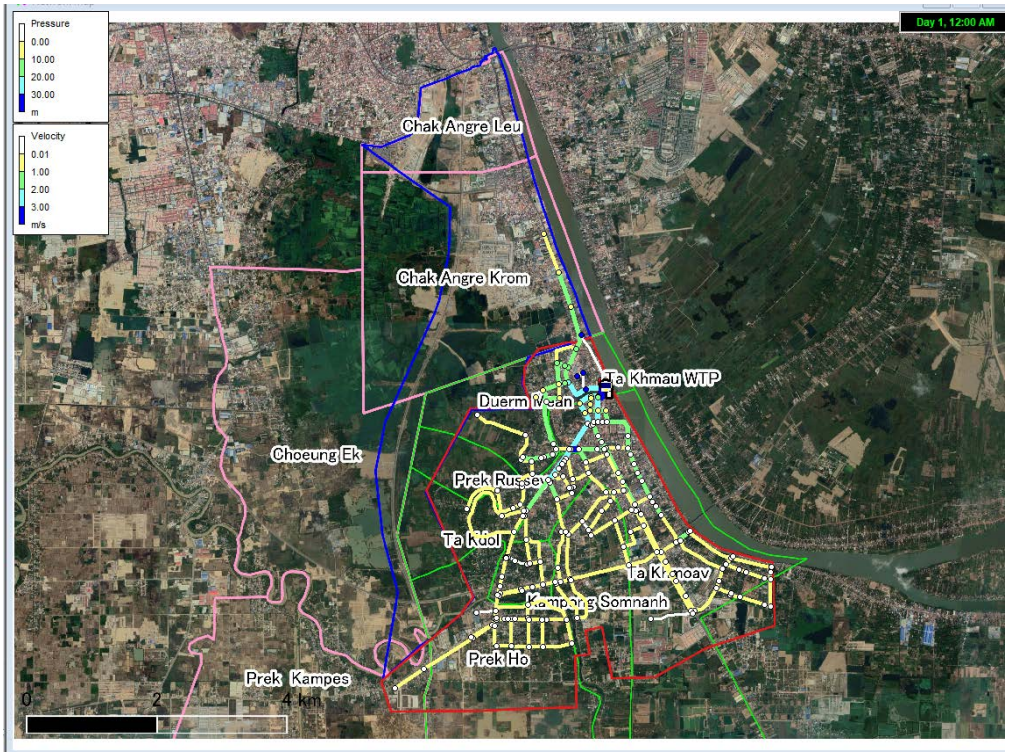


図 A6.2　水理計算管網モデルと管網計算結果（Pipe Network Analysis in 2024）

表 A6.3　管網計算結果（節点）（Pipe Network Analysis in 2024）

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
2	0	40.0	40.0
3	0	38.6	38.6
4	0	38.3	38.3
5	0	40.0	40.0
6	0	31.8	31.8
7	0	23.5	23.5
8	0	19.8	19.8
9	0	18.5	18.5
10	0	17.1	17.1
11	0	16.0	16.0
14	0	11.4	11.4
15	0	8.5	8.5
16	0	11.0	11.0
17	0	8.1	8.1
18	600	3.8	3.8
20	0	0.5	0.5
21	600	-3.2	-3.2
22	600	-18.5	-18.5
23	0	-18.5	-18.5
24	0	-16.5	-16.5
25	0	-21.0	-21.0
26	0	-18.5	-18.5
31	0	-2.9	-2.9
32	0	-2.8	-2.8
33	0	-1.7	-1.7
35	600	-0.5	-0.5
37	0	-0.9	-0.9
40	0	-9.2	-9.2
41	600	-12.1	-12.1
43	0	-11.9	-11.9
45	600	-11.7	-11.7
46	0	-9.5	-9.5
48	0	-13.6	-13.6
49	0	-15.7	-15.7
51	600	-17.5	-17.5
53	0	-18.8	-18.8
54	0	-17.7	-17.7
64	600	-19.6	-19.6
72	0	-7.0	-7.0
77	0	-22.5	-22.5
78	0	-22.0	-22.0
80	0	-22.8	-22.8
81	0	-25.2	-25.2
82	600	-26.5	-26.5
83	0	-29.1	-29.1
84	0	-29.9	-29.9
85	571	-31.3	-31.3
86	571	-34.4	-34.4
87	571	-35.1	-35.1
88	0	-35.1	-35.1

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
89	0	-34.4	-34.4
90	0	-31.3	-31.3
92	571	-36.3	-36.3
93	0	-35.2	-35.2
94	0	-35.1	-35.1
95	0	-34.7	-34.7
96	0	-34.8	-34.8
97	0	-35.1	-35.1
98	0	-36.3	-36.3
99	0	-36.3	-36.3
100	0	-36.3	-36.3
101	0	-36.3	-36.3
102	571	-36.3	-36.3
103	0	-35.6	-35.6
104	0	-34.5	-34.5
105	0	-29.8	-29.8
107	0	-28.5	-28.5
108	0	-23.5	-23.5
109	600	-24.3	-24.3
110	0	-34.5	-34.5
111	0	-31.5	-31.5
113	0	-32.5	-32.5
115	0	-34.5	-34.5
117	0	-36.6	-36.6
118	571	-36.6	-36.6
119	0	-36.6	-36.6
120	0	-36.6	-36.6
125	0	-34.7	-34.7
126	0	-33.0	-33.0
127	0	-28.7	-28.7
128	600	-36.6	-36.6
129	571	-37.1	-37.1
130	571	-37.3	-37.3
131	0	-29.2	-29.2
132	0	-32.2	-32.2
133	0	-34.8	-34.8
134	600	-36.5	-36.5
135	0	-36.9	-36.9
136	0	-36.5	-36.5
137	0	-37.0	-37.0
138	571	-37.1	-37.1
140	571	-37.3	-37.3
141	0	-37.2	-37.2
142	0	-37.1	-37.1
143	0	-37.0	-37.0
144	600	-37.4	-37.4
145	0	-37.4	-37.4
147	600	-37.3	-37.3
151	0	-36.7	-36.7
152	0	-37.0	-37.0

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
153	0	-37.2	-37.2
154	571	-37.2	-37.2
155	0	-37.2	-37.2
156	0	-37.2	-37.2
157	0	-37.2	-37.2
158	0	-35.4	-35.4
160	0	-33.1	-33.1
161	0	-36.7	-36.7
162	0	-29.5	-29.5
163	0	-32.2	-32.2
164	0	-35.4	-35.4
165	0	-35.4	-35.4
166	0	-35.8	-35.8
167	0	-34.6	-34.6
168	0	-35.4	-35.4
169	0	-32.1	-32.1
170	0	-32.0	-32.0
171	0	-31.5	-31.5
172	0	-30.5	-30.5
173	0	-30.2	-30.2
174	600	-33.3	-33.3
175	0	-32.6	-32.6
176	0	-32.3	-32.3
177	0	-32.0	-32.0
178	0	-32.3	-32.3
179	600	-33.8	-33.8
180	0	-31.0	-31.0
181	600	-28.1	-28.1
182	571	-32.3	-32.3
183	0	-32.7	-32.7
184	0	-33.8	-33.8
185	571	-35.4	-35.4
186	0	-36.3	-36.3
187	0	-36.8	-36.8
188	0	-35.5	-35.5
191	0	-37.2	-37.2
192	571	-37.2	-37.2
193	0	-37.2	-37.2
194	0	-37.2	-37.2
195	0	-37.3	-37.3
198	0	-37.6	-37.6
199	0	-37.6	-37.6
200	0	-37.8	-37.8
201	0	-37.9	-37.9
202	0	-37.9	-37.9
203	0	-38.4	-38.4
204	0	-38.4	-38.4
205	0	-38.4	-38.4
207	571	-39.7	-39.7
209	0	-39.0	-39.0

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
210	571	-39.9	-39.9
211	0	-38.9	-38.9
212	0	-38.5	-38.5
213	0	-38.3	-38.3
214	0	-38.0	-38.0
215	0	-38.0	-38.0
216	0	-38.1	-38.1
217	0	-38.2	-38.2
218	0	-38.0	-38.0
219	571	-38.0	-38.0
220	0	-38.5	-38.5
221	0	-37.2	-37.2
223	0	-38.9	-38.9
224	0	-32.3	-32.3
225	0	-32.4	-32.4
226	0	-32.3	-32.3
227	0	-34.1	-34.1
229	571	-36.1	-36.1
232	0	-31.1	-31.1
233	0	-30.7	-30.7
234	0	-30.4	-30.4
235	571	-30.2	-30.2
237	0	-31.4	-31.4
239	0	6.5	6.5
240	0	0.7	0.7
241	0	0.7	0.7
242	600	-3.4	-3.4
243	0	3.9	3.9
244	600	14.7	14.7
250	572	-40.1	-40.1
251	0	-37.2	-37.2
252	0	4.6	4.6
253	0	2.1	2.1
256	600	-1.5	-1.5
257	0	5.9	5.9
259	0	7.0	7.0
12	571	-33.7	-33.7
13	0	-23.6	-23.6
34	0	-24.5	-24.5
38	0	31.8	31.8
42	0	31.8	31.8
50	0	-32.7	-32.7
52	0	-31.7	-31.7
58	0	-31.6	-31.6
59	0	-37.3	-37.3
60	0	-36.9	-36.9
61	0	-36.7	-36.7
63	0	-36.6	-36.6
65	0	-38.2	-38.2
66	0	-38.1	-38.1
67	0	-38.2	-38.2
19	2000	5.4	5.4
27	2000	6.2	6.2
28	2000	9.0	9.0

表 A6.4　管網計算結果（管）（Pipe Network Analysis in 2024）

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
2	2	3	27.18	400	110	Open	47,987	4.42
3	3	4	10.87	400	110	Open	33,894	3.12
4	3	6	312.42	300	110	Open	14,093	2.31
5	2	5	900.16	250	110	Open	0	0
6	6	7	385.89	300	110	Open	14,093	2.31
7	7	10	56.56	110	110	Open	2,449	2.98
8	7	8	240.17	300	110	Open	11,644	1.91
9	8	9	46.95	110	110	Open	1,181	1.44
10	8	11	305.7	300	110	Open	10,463	1.71
13	4	14	244.2	300	110	Open	33,894	5.55
14	14	16	13.83	300	110	Open	17,658	2.89
15	14	15	105.74	300	110	Open	16,236	2.66
16	15	17	20.74	150	110	Open	1,939	1.27
17	15	18	210.31	300	110	Open	14,298	2.34
19	18	20	169.63	300	110	Open	13,338	2.18
21	20	21	184.4	300	110	Open	13,338	2.18
22	21	22	458.88	300	110	Open	17,788	2.91
23	22	26	18.79	160	110	Open	21	0.01
24	26	23	193.56	160	110	Open	21	0.01
25	23	24	98.95	160	110	Open	−2,573	1.48
26	23	25	125.34	160	110	Open	2,594	1.49
32	31	21	76.83	300	110	Open	5,410	0.89
33	31	32	17.8	300	110	Open	−5,410	0.89
34	32	33	65.73	300	110	Open	−12,106	1.98
36	33	35	73.14	300	110	Open	−12,106	1.98
38	35	37	49.39	225	110	Open	3,899	1.13
40	32	72	189.04	225	110	Open	6,696	1.95
45	40	41	187.67	225	110	Open	5,570	1.62
46	41	43	154.11	160	110	Open	−557	0.32
48	72	46	111.47	225	110	Open	6,696	1.95
50	46	45	101.35	225	110	Open	6,696	1.95
54	41	48	104.45	225	110	Open	5,167	1.5
55	48	49	155.62	225	110	Open	5,167	1.5
65	49	54	143.09	225	110	Open	5,167	1.5
66	45	51	417.79	225	110	Open	5,179	1.51
68	51	53	144.07	225	110	Open	4,219	1.23
82	54	64	138.9	225	110	Open	5,167	1.5
83	64	78	255.3	225	110	Open	4,207	1.22
85	78	77	252.69	90	110	Open	176	0.32
86	53	77	391.46	225	110	Open	4,219	1.23
87	78	80	91.9	225	110	Open	4,032	1.17
88	80	81	285.79	225	110	Open	4,032	1.17
89	81	82	149.02	225	110	Open	4,032	1.17
90	82	83	489.98	225	110	Open	3,072	0.89
91	83	84	63.82	225	110	Open	4,941	1.44
92	84	85	194.61	225	110	Open	3,607	1.05
93	83	107	276.77	225	110	Open	−1,869	0.54
94	107	105	166.1	160	110	Open	1,566	0.9
96	85	90	24.11	160	110	Open	0	0
97	85	86	768.88	225	110	Open	2,693	0.78
98	86	89	27.93	160	110	Open	0	0
100	86	87	616.51	225	110	Open	1,305	0.38
101	87	94	61.35	160	110	Open	392	0.23
103	88	87	19.75	160	110	Open	0	0
104	94	93	110.6	160	110	Open	392	0.23
105	93	92	406.94	160	110	Open	884	0.51
107	84	104	788.69	160	110	Open	1,334	0.77
108	104	103	186.16	160	110	Open	1,316	0.76
109	103	102	122.52	160	110	Open	1,316	0.76
110	104	110	86.63	160	110	Open	18	0.01

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
111	110	86	125.24	160	110	Open	−474	0.27
112	110	95	209.06	160	110	Open	492	0.28
113	95	96	107.46	160	110	Open	492	0.28
114	96	97	299.79	160	110	Open	492	0.28
115	97	93	92.22	160	110	Open	492	0.28
120	101	100	28.76	160	110	Open	30	0.02
121	100	99	149.53	160	110	Open	30	0.02
122	99	98	388.58	160	110	Open	30	0.02
123	102	101	241.09	160	110	Open	30	0.02
124	77	108	97.16	225	110	Open	4,395	1.28
126	108	109	79.98	225	110	Open	4,395	1.28
128	109	107	649.05	225	110	Open	3,435	1
129	105	111	210.69	160	110	Open	1,566	0.9
131	111	113	123.66	160	110	Open	1,566	0.9
132	113	115	260.86	160	110	Open	1,566	0.9
137	115	117	258.79	160	110	Open	1,566	0.9
138	117	118	44.16	250	110	Open	1,938	0.46
139	118	119	39.5	250	110	Open	0	0
140	119	120	645.75	160	110	Open	0	0
141	117	102	504.75	160	110	Open	−373	0.21
146	127	126	272.57	160	110	Open	2,291	1.32
147	126	125	102.72	160	110	Open	2,291	1.32
150	125	133	98.06	250	110	Open	2,291	0.54
151	127	132	221.07	160	110	Open	2,294	1.32
152	133	132	332.95	110	110	Open	−585	0.71
155	136	134	25.68	160	110	Open	−252	0.15
156	133	134	604.2	250	110	Open	2,876	0.68
158	134	135	344.51	250	110	Open	1,664	0.39
159	143	135	66.74	160	110	Open	−645	0.37
160	135	137	258.04	250	110	Open	1,019	0.24
161	137	138	445.65	250	110	Open	695	0.16
162	138	118	1027.9	250	110	Open	−1,025	0.24
163	137	142	212.46	160	110	Open	324	0.19
164	142	141	375.09	160	110	Open	324	0.19
165	141	140	289.84	160	110	Open	193	0.11
166	138	140	476.94	225	110	Open	806	0.23
167	143	144	300.24	160	110	Open	645	0.37
168	144	141	410.99	110	110	Open	−132	0.16
169	144	145	413.28	160	110	Open	−183	0.11
171	128	147	598.71	160	110	Open	564	0.32
173	147	129	293.36	160	110	Open	−389	0.22
174	131	162	27.47	160	110	Open	1,779	1.02
175	162	163	272.14	160	110	Open	1,779	1.02
176	163	161	506.93	160	110	Open	1,665	0.96
177	161	129	53.84	160	110	Open	1,544	0.89
178	161	151	74.03	110	110	Open	120	0.15
182	129	130	681.68	160	110	Open	241	0.14
183	151	152	552.87	110	110	Open	120	0.15
184	152	153	686.29	110	110	Open	120	0.15
185	140	130	911.27	225	110	Open	85	0.02
186	130	153	157	225	110	Open	−499	0.15
188	154	155	168.89	225	110	Open	−276	0.08
189	155	156	180.54	225	110	Open	−276	0.08
190	156	157	322.27	225	110	Open	−191	0.06
191	158	164	124.35	110	110	Open	1	0
195	167	166	503.36	160	110	Open	807	0.46
196	160	167	363.39	160	110	Open	1,104	0.64
197	167	168	362.07	110	110	Open	296	0.36
200	132	179	168.35	160	110	Open	1,709	0.98
201	179	128	401.89	160	110	Open	1,462	0.84

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
203	169	170	48.22	110	110	Open	-373	0.45
204	170	171	149.19	110	110	Open	-373	0.45
205	171	172	266	110	110	Open	-373	0.45
206	172	173	107.93	110	110	Open	-373	0.45
207	173	131	123.5	160	110	Open	-1,559	0.9
209	169	174	333.47	110	110	Open	373	0.45
210	174	175	119.64	160	110	Open	-1,300	0.75
211	173	180	167.26	160	110	Open	1,186	0.68
213	180	177	217.72	160	110	Open	1,186	0.68
215	177	176	72.45	160	110	Open	1,186	0.68
216	176	178	80.03	110	110	Open	-115	0.14
217	178	163	249.56	110	110	Open	-115	0.14
218	175	176	51.35	160	110	Open	-1,300	0.75
219	179	174	260.72	160	110	Open	-714	0.41
220	22	181	578.59	300	110	Open	12,222	2
221	181	131	25.02	150	110	Open	3,338	2.19
222	181	182	563.66	300	110	Open	7,924	1.3
230	193	191	349.77	160	110	Open	-85	0.05
231	130	195	22.35	160	110	Open	-88	0.05
232	156	193	31.21	160	110	Open	-85	0.05
233	157	191	126.11	225	110	Open	-191	0.06
234	191	192	31.85	250	110	Open	-276	0.07
235	194	221	634.06	225	110	Open	88	0.03
236	195	221	782.73	160	110	Open	-88	0.05
237	160	183	60.22	150	110	Open	-1,104	0.72
238	182	183	88.77	300	110	Open	6,421	1.05
239	183	184	286.9	300	110	Open	5,317	0.87
240	184	185	395.9	300	110	Open	5,760	0.94
241	185	158	16.02	150	110	Open	1	0
242	185	188	19.85	300	110	Open	4,846	0.79
243	188	186	285.51	300	110	Open	4,846	0.79
244	186	187	146.45	300	110	Open	4,846	0.79
250	187	192	137.55	300	110	Open	4,846	0.79
251	192	198	238.62	300	110	Open	3,656	0.6
252	198	199	290.5	160	110	Open	0	0
253	198	200	119.83	300	110	Open	3,656	0.6
254	200	219	460.49	300	110	Open	1,713	0.28
255	219	218	25.44	200	110	Open	799	0.29
256	214	218	353.29	160	110	Open	116	0.07
257	218	220	868.14	225	110	Open	915	0.27
259	214	215	33.75	160	110	Open	338	0.19
260	201	214	107.36	160	110	Open	454	0.26
261	200	201	28.28	200	110	Open	1,943	0.72
262	201	202	17.78	110	110	Open	168	0.2
263	202	204	632.9	110	110	Open	168	0.2
264	204	207	713.14	110	110	Open	260	0.32
266	203	204	199.48	160	110	Open	92	0.05
267	203	205	16.29	160	110	Open	-92	0.05
271	209	207	300.21	160	110	Open	783	0.45
272	207	210	374.55	110	110	Open	130	0.16
273	205	212	412.83	225	110	Open	343	0.1
274	205	223	203.47	160	110	Open	799	0.46
275	223	209	69.13	160	110	Open	783	0.45
276	223	211	406.91	110	110	Open	16	0.02
277	211	210	449.15	160	110	Open	784	0.45
278	212	211	203.44	160	110	Open	768	0.44
279	213	212	270.61	160	110	Open	425	0.24
280	201	216	126.42	225	110	Open	1,321	0.38
283	217	213	412.13	110	110	Open	87	0.11
286	182	224	35.61	225	110	Open	590	0.17

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
287	224	226	97.56	160	110	Open	147	0.08
290	227	229	653.56	160	110	Open	914	0.53
292	224	225	348.99	225	110	Open	443	0.13
293	225	184	1849.61	160	110	Open	443	0.25
302	242	24	658.31	160	110	Open	2,573	1.48
303	240	241	173.51	160	110	Open	0	0
304	242	240	181.77	160	110	Open	-2,781	1.6
305	10	239	94.41	110	110	Open	2,449	2.98
306	239	240	251.41	160	110	Open	2,781	1.6
307	239	243	209.09	110	110	Open	753	0.92
308	243	242	216.99	90	110	Open	753	1.37
311	9	244	128.73	110	110	Open	1,181	1.44
315	220	250	526.13	160	110	Open	915	0.53
316	154	251	188.69	225	110	Open	467	0.14
317	251	153	69.35	225	110	Open	378	0.11
318	251	194	20.58	225	110	Open	88	0.03
319	16	252	193.95	300	110	Open	17,658	2.89
320	252	35	167.94	300	110	Open	16,965	2.78
42	17	259	94.34	160	110	Open	1,939	1.12
153	259	257	94.52	160	110	Open	1,939	1.12
193	257	252	111.05	160	110	Open	1,939	1.12
223	252	253	122.83	160	110	Open	2,631	1.51
321	253	256	170.34	160	110	Open	2,631	1.51
322	98	92	86.27	160	110	Open	30	0.02
323	235	237	381.35	160	110	Open	914	0.53
324	45	43	187.67	160	110	Open	557	0.32
326	244	11	496.38	160	110	Open	-863	0.5
327	239	244	329.6	110	110	Open	-1,084	1.32
328	235	234	55.05	160	110	Open	767	0.44
329	234	233	167.35	160	110	Open	767	0.44
330	233	232	182.39	160	110	Open	767	0.44
332	164	165	207.25	110	110	Open	1	0
333	165	168	38.67	110	110	Open	1	0
334	168	166	157.76	110	110	Open	297	0.36
335	166	154	349.81	160	110	Open	1,104	0.64
338	237	12	802.56	160	110	Open	914	0.53
341	25	13	131.31	160	110	Open	2,594	1.49
342	13	34	43.17	160	110	Open	2,594	1.49
343	34	235	284.57	160	110	Open	2,594	1.49
344	6	38	262.11	160	110	Open	0	0
346	38	42	143.69	160	110	Open	0	0
11	226	50	126.42	160	110	Open	914	0.53
12	50	227	499.62	160	110	Open	914	0.53
20	226	52	280.96	160	110	Open	-767	0.44
35	52	58	55.77	160	110	Open	-767	0.44
39	58	232	243.77	160	110	Open	-767	0.44
43	136	63	151.36	160	110	Open	252	0.15
51	63	128	111.52	160	110	Open	62	0.04
52	63	61	156.22	110	110	Open	191	0.23
53	61	60	211	110	110	Open	191	0.23
56	60	59	353.71	110	110	Open	191	0.23
58	145	59	90.41	110	110	Open	-183	0.22
59	59	147	162.77	110	110	Open	7	0.01
60	215	65	318.75	160	110	Open	338	0.19
62	65	213	220	160	110	Open	338	0.19
67	216	66	49.94	225	110	Open	1,321	0.38
69	66	217	55.55	225	110	Open	1,321	0.38
70	217	67	46.22	225	110	Open	1,234	0.36
71	67	205	211.73	225	110	Open	1,234	0.36
27	127	22	128.62	150	110	Open	-4,585	3
28	11	28	658.78	300	110	Open	9,600	1.57
29	28	27	550.12	300	110	Open	6,400	1.05
30	27	19	633.7	300	110	Open	3,200	0.52
18	256	37	65.6	225	110	Open	-3,899	1.13
31	256	40	487.51	225	110	Open	5,570	1.62

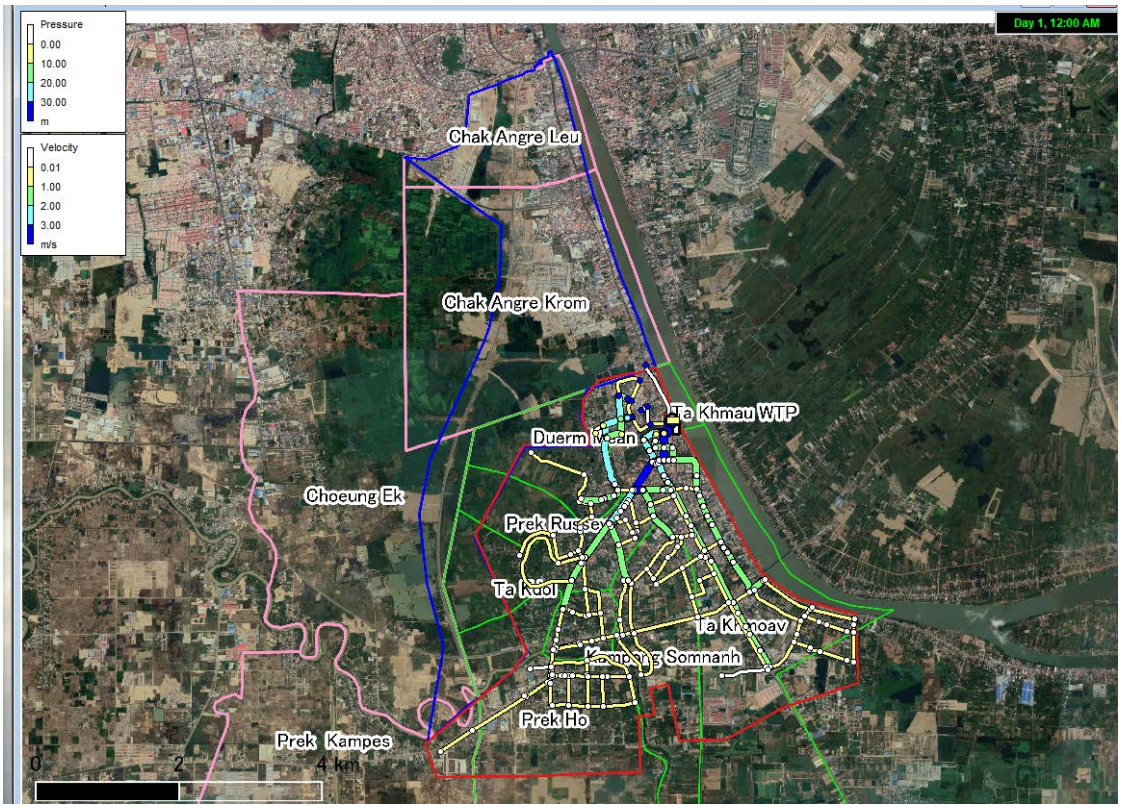


図 A6.3　水理計算管網モデルと管網計算結果（Pipe Network Analysis in 2030）

表 A6.5　管網計算結果（節点）（Pipe Network Analysis in 2030）

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
2	0	41.7	41.7
3	0	40.5	40.5
4	0	40.1	40.1
5	0	41.7	41.7
6	0	39.2	39.2
7	0	37.6	37.6
8	0	37.3	37.3
9	0	36.1	36.1
10	0	28.3	28.3
11	0	37.2	37.2
14	0	5.2	5.2
15	0	1.3	1.3
16	0	4.6	4.6
17	0	0.9	0.9
18	650	-4.8	-4.8
20	0	-9.1	-9.1
21	650	-13.8	-13.8
22	650	-34.1	-34.1
23	0	-33.8	-33.8
24	0	-30.0	-30.0
25	0	-37.5	-37.5
26	0	-34.0	-34.0
31	0	-13.5	-13.5
32	0	-13.4	-13.4
33	0	-12.0	-12.0
35	650	-10.4	-10.4
37	0	-10.9	-10.9
40	0	-21.8	-21.8
41	650	-25.7	-25.7
43	0	-25.4	-25.4
45	650	-25.1	-25.1
46	0	-22.1	-22.1
48	0	-27.6	-27.6
49	0	-30.5	-30.5
51	650	-32.8	-32.8
53	0	-34.7	-34.7
54	0	-33.1	-33.1
64	650	-35.7	-35.7
72	0	-18.9	-18.9
77	0	-39.8	-39.8
78	0	-39.0	-39.0
80	0	-40.1	-40.1
81	0	-43.6	-43.6
82	650	-45.4	-45.4
83	0	-49.1	-49.1
84	0	-50.3	-50.3
85	715	-52.3	-52.3
86	715	-56.9	-56.9
87	715	-57.9	-57.9
88	0	-57.9	-57.9

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
89	0	-56.9	-56.9
90	0	-52.3	-52.3
92	715	-59.6	-59.6
93	0	-58.0	-58.0
94	0	-57.9	-57.9
95	0	-57.3	-57.3
96	0	-57.5	-57.5
97	0	-57.9	-57.9
98	0	-59.6	-59.6
99	0	-59.5	-59.5
100	0	-59.5	-59.5
101	0	-59.5	-59.5
102	715	-59.5	-59.5
103	0	-58.5	-58.5
104	0	-57.0	-57.0
105	0	-50.1	-50.1
107	0	-48.3	-48.3
108	0	-41.1	-41.1
109	650	-42.2	-42.2
110	0	-57.0	-57.0
111	0	-52.5	-52.5
113	0	-53.9	-53.9
115	0	-56.9	-56.9
117	0	-59.8	-59.8
118	715	-59.9	-59.9
119	0	-59.9	-59.9
120	0	-59.9	-59.9
125	0	-56.7	-56.7
126	0	-54.3	-54.3
127	0	-48.2	-48.2
128	650	-59.3	-59.3
129	715	-60.3	-60.3
130	715	-60.7	-60.7
131	0	-49.1	-49.1
132	0	-53.0	-53.0
133	0	-56.9	-56.9
134	650	-59.3	-59.3
135	0	-59.9	-59.9
136	0	-59.3	-59.3
137	0	-60.1	-60.1
138	715	-60.3	-60.3
140	715	-60.7	-60.7
141	0	-60.5	-60.5
142	0	-60.3	-60.3
143	0	-60.0	-60.0
144	650	-60.6	-60.6
145	0	-60.5	-60.5
147	650	-60.4	-60.4
151	0	-59.8	-59.8
152	0	-60.2	-60.2

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
153	0	-60.7	-60.7
154	715	-60.7	-60.7
155	0	-60.7	-60.7
156	0	-60.7	-60.7
157	0	-60.7	-60.7
158	0	-58.2	-58.2
160	0	-54.9	-54.9
161	0	-59.7	-59.7
162	0	-49.5	-49.5
163	0	-53.2	-53.2
164	0	-58.2	-58.2
165	0	-58.2	-58.2
166	0	-58.7	-58.7
167	0	-57.0	-57.0
168	0	-58.2	-58.2
169	0	-53.0	-53.0
170	0	-52.7	-52.7
171	0	-52.1	-52.1
172	0	-50.9	-50.9
173	0	-50.4	-50.4
174	650	-54.5	-54.5
175	0	-53.6	-53.6
176	0	-53.3	-53.3
177	0	-52.8	-52.8
178	0	-53.2	-53.2
179	650	-55.1	-55.1
180	0	-51.4	-51.4
181	650	-47.6	-47.6
182	715	-53.7	-53.7
183	0	-54.4	-54.4
184	0	-55.8	-55.8
185	715	-58.2	-58.2
186	0	-59.5	-59.5
187	0	-60.1	-60.1
188	0	-58.3	-58.3
191	0	-60.7	-60.7
192	715	-60.7	-60.7
193	0	-60.7	-60.7
194	0	-60.7	-60.7
195	0	-60.7	-60.7
198	0	-61.3	-61.3
199	0	-61.3	-61.3
200	0	-61.6	-61.6
201	0	-61.8	-61.8
202	0	-61.8	-61.8
203	0	-62.6	-62.6
204	0	-62.6	-62.6
205	0	-62.6	-62.6
207	715	-64.5	-64.5
209	0	-63.5	-63.5

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
210	715	-64.8	-64.8
211	0	-63.3	-63.3
212	0	-62.6	-62.6
213	0	-62.4	-62.4
214	0	-61.9	-61.9
215	0	-62.0	-62.0
216	0	-62.0	-62.0
217	0	-62.2	-62.2
218	0	-62.0	-62.0
219	715	-62.0	-62.0
220	0	-62.7	-62.7
221	0	-60.7	-60.7
223	0	-63.3	-63.3
224	0	-53.7	-53.7
225	0	-53.8	-53.8
226	0	-53.8	-53.8
227	0	-56.5	-56.5
229	715	-59.4	-59.4
232	0	-52.1	-52.1
233	0	-51.6	-51.6
234	0	-51.2	-51.2
235	715	-51.0	-51.0
237	0	-52.7	-52.7
239	0	12.9	12.9
240	0	2.9	2.9
241	0	2.9	2.9
242	650	-4.3	-4.3
243	0	8.3	8.3
244	650	32.7	32.7
250	715	-65.0	-65.0
251	0	-60.7	-60.7
252	0	-3.7	-3.7
253	0	-7.0	-7.0
256	650	-11.6	-11.6
257	0	-2.0	-2.0
259	0	-0.6	-0.6
12	715	-56.3	-56.3
13	0	-41.4	-41.4
34	0	-42.7	-42.7
38	0	39.2	39.2
42	0	39.2	39.2
50	0	-54.3	-54.3
52	0	-53.0	-53.0
58	0	-52.8	-52.8
59	0	-60.4	-60.4
60	0	-59.9	-59.9
61	0	-59.6	-59.6
63	0	-59.3	-59.3
65	0	-62.2	-62.2
66	0	-62.1	-62.1
67	0	-62.3	-62.3

表 A6.6 管網計算結果（管）（Pipe Network Analysis in 2030）

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
2	2	3	27.18	400	110	Open	44,824	4.13
3	3	4	10.87	400	110	Open	39,037	3.6
4	3	6	312.42	300	110	Open	5,787	0.95
5	2	5	900.16	250	110	Open	0	0
6	6	7	385.89	300	110	Open	5,787	0.95
7	7	10	56.56	110	110	Open	2,998	3.65
8	7	8	240.17	300	110	Open	2,788	0.46
9	8	9	46.95	110	110	Open	1,113	1.36
10	8	11	305.7	300	110	Open	1,676	0.27
13	4	14	244.2	300	110	Open	39,037	6.39
14	14	16	13.83	300	110	Open	20,342	3.33
15	14	15	105.74	300	110	Open	18,696	3.06
16	15	17	20.74	150	110	Open	2,234	1.46
17	15	18	210.31	300	110	Open	16,462	2.7
19	18	20	169.63	300	110	Open	15,422	2.53
21	20	21	184.4	300	110	Open	15,422	2.53
22	21	22	458.88	300	110	Open	20,672	3.38
23	22	26	18.79	160	110	Open	-526	0.3
24	26	23	193.56	160	110	Open	-526	0.3
25	23	24	98.95	160	110	Open	-3,707	2.13
26	23	25	125.34	160	110	Open	3,181	1.83
32	31	21	76.83	300	110	Open	6,290	1.03
33	31	32	17.8	300	110	Open	-6,290	1.03
34	32	33	65.73	300	110	Open	-14,054	2.3
36	33	35	73.14	300	110	Open	-14,054	2.3
38	35	37	49.39	225	110	Open	4,454	1.3
40	32	72	189.04	225	110	Open	7,764	2.26
45	40	41	187.67	225	110	Open	6,442	1.88
46	41	43	154.11	160	110	Open	-664	0.38
48	72	46	111.47	225	110	Open	7,764	2.26
50	46	45	101.35	225	110	Open	7,764	2.26
54	41	48	104.45	225	110	Open	6,066	1.77
55	48	49	155.62	225	110	Open	6,066	1.77
65	49	54	143.09	225	110	Open	6,066	1.77
66	45	51	417.79	225	110	Open	6,059	1.76
68	51	53	144.07	225	110	Open	5,019	1.46
82	54	64	138.9	225	110	Open	6,066	1.77
83	64	78	255.3	225	110	Open	5,026	1.46
85	78	77	252.69	90	110	Open	206	0.38
86	53	77	391.46	225	110	Open	5,019	1.46
87	78	80	91.9	225	110	Open	4,820	1.4
88	80	81	285.79	225	110	Open	4,820	1.4
89	81	82	149.02	225	110	Open	4,820	1.4
90	82	83	489.98	225	110	Open	3,780	1.1
91	83	84	63.82	225	110	Open	6,070	1.77
92	84	85	194.61	225	110	Open	4,438	1.29
93	83	107	276.77	225	110	Open	-2,290	0.67
94	107	105	166.1	160	110	Open	1,895	1.09
96	85	90	24.11	160	110	Open	0	0
97	85	86	768.88	225	110	Open	3,294	0.96
98	86	89	27.93	160	110	Open	0	0
100	86	87	616.51	225	110	Open	1,599	0.47
101	87	94	61.35	160	110	Open	455	0.26
103	88	87	19.75	160	110	Open	0	0
104	94	93	110.6	160	110	Open	455	0.26
105	93	92	406.94	160	110	Open	1,058	0.61
107	84	104	788.69	160	110	Open	1,632	0.94
108	104	103	186.16	160	110	Open	1,580	0.91
109	103	102	122.52	160	110	Open	1,580	0.91
110	104	110	86.63	160	110	Open	52	0.03

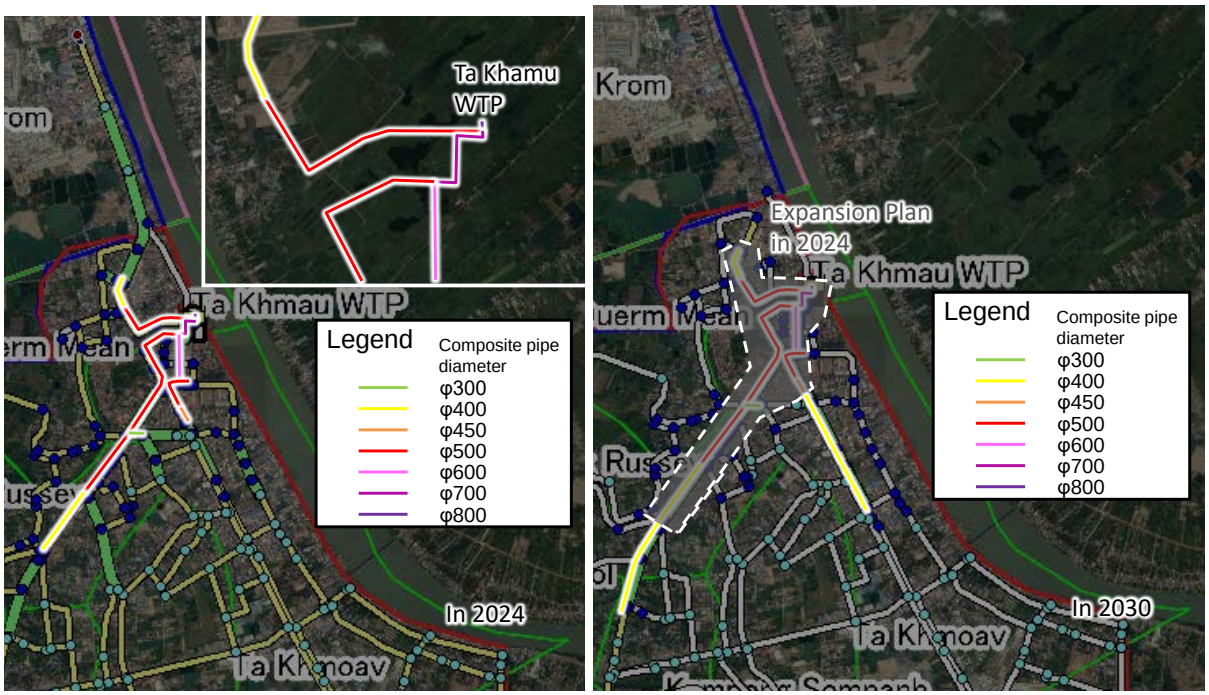
Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
111	110	86	125.24	160	110	Open	-551	0.32
112	110	95	209.06	160	110	Open	603	0.35
113	95	96	107.46	160	110	Open	603	0.35
114	96	97	299.79	160	110	Open	603	0.35
115	97	93	92.22	160	110	Open	603	0.35
120	101	100	28.76	160	110	Open	86	0.05
121	100	99	149.53	160	110	Open	86	0.05
122	99	98	388.58	160	110	Open	86	0.05
123	102	101	241.09	160	110	Open	86	0.05
124	77	108	97.16	225	110	Open	5,225	1.52
126	108	109	79.98	225	110	Open	5,225	1.52
128	109	107	649.05	225	110	Open	4,185	1.22
129	105	111	210.69	160	110	Open	1,895	1.09
131	111	113	123.66	160	110	Open	1,895	1.09
132	113	115	260.86	160	110	Open	1,895	1.09
137	115	117	258.79	160	110	Open	1,895	1.09
138	117	118	44.16	250	110	Open	2,245	0.53
139	118	119	39.5	250	110	Open	0	0
140	119	120	645.75	160	110	Open	0	0
141	117	102	504.75	160	110	Open	-350	0.2
146	127	126	272.57	160	110	Open	2,756	1.59
147	126	125	102.72	160	110	Open	2,756	1.59
150	125	133	98.06	250	110	Open	2,756	0.65
151	127	132	221.07	160	110	Open	2,715	1.56
152	133	132	332.95	110	110	Open	-719	0.88
155	136	134	25.68	160	110	Open	-175	0.1
156	133	134	604.2	250	110	Open	3,475	0.82
158	134	135	344.51	250	110	Open	2,260	0.53
159	143	135	66.74	160	110	Open	-735	0.42
160	135	137	258.04	250	110	Open	1,524	0.36
161	137	138	445.65	250	110	Open	1,100	0.26
162	138	118	1027.9	250	110	Open	-1,101	0.26
163	137	142	212.46	160	110	Open	425	0.24
164	142	141	375.09	160	110	Open	425	0.24
165	141	140	289.84	160	110	Open	346	0.2
166	138	140	476.94	225	110	Open	1,057	0.31
167	143	144	300.24	160	110	Open	735	0.42
168	144	141	410.99	110	110	Open	-79	0.1
169	144	145	413.28	160	110	Open	-226	0.13
171	128	147	598.71	160	110	Open	710	0.41
173	147	129	293.36	160	110	Open	-317	0.18
174	131	162	27.47	160	110	Open	2,110	1.21
175	162	163	272.14	160	110	Open	2,110	1.21
176	163	161	506.93	160	110	Open	2,031	1.17
177	161	129	53.84	160	110	Open	1,865	1.07
178	161	151	74.03	110	110	Open	166	0.2
182	129	130	681.68	160	110	Open	405	0.23
183	151	152	552.87	110	110	Open	166	0.2
184	152	153	686.29	110	110	Open	166	0.2
185	140	130	911.28	225	110	Open	259	0.08
186	130	153	157	225	110	Open	-411	0.12
188	154	155	168.89	225	110	Open	-133	0.04
189	155	156	180.54	225	110	Open	-133	0.04
190	156	157	322.27	225	110	Open	-95	0.03
191	158	164	124.35	110	110	Open	-10	0.01
195	167	166	503.36	160	110	Open	975	0.56
196	160	167	363.39	160	110	Open	1,336	0.77
197	167	168	362.07	110	110	Open	361	0.44
200	132	179	168.35	160	110	Open	1,997	1.15
201	179	128	401.89	160	110	Open	1,814	1.04

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
203	169	170	48.22	110	110	Open	-432	0.53
204	170	171	149.19	110	110	Open	-432	0.53
205	171	172	266	110	110	Open	-432	0.53
206	172	173	107.93	110	110	Open	-432	0.53
207	173	131	123.5	160	110	Open	-1,819	1.05
209	169	174	333.47	110	110	Open	432	0.53
210	174	175	119.64	160	110	Open	-1,465	0.84
211	173	180	167.26	160	110	Open	1,387	0.8
213	180	177	217.72	160	110	Open	1,387	0.8
215	177	176	72.45	160	110	Open	1,387	0.8
216	176	178	80.03	110	110	Open	-78	0.1
217	178	163	249.56	110	110	Open	-78	0.1
218	175	176	51.35	160	110	Open	-1,465	0.84
219	179	174	260.71	160	110	Open	-857	0.49
220	22	181	578.59	300	110	Open	14,687	2.4
221	181	131	25.02	150	110	Open	3,929	2.57
222	181	182	563.66	300	110	Open	9,718	1.59
230	193	191	349.77	160	110	Open	-38	0.02
231	130	195	22.34	160	110	Open	-70	0.04
232	156	193	31.21	160	110	Open	-38	0.02
233	157	191	38.44	225	110	Open	-95	0.03
234	191	192	31.85	250	110	Open	-133	0.03
235	194	221	634.06	225	110	Open	70	0.02
236	195	221	782.73	160	110	Open	-70	0.04
237	160	183	60.22	150	110	Open	-1,336	0.87
238	182	183	88.77	300	110	Open	7,786	1.27
239	183	184	286.9	300	110	Open	6,450	1.06
240	184	185	395.9	300	110	Open	6,987	1.14
241	185	158	16.02	150	110	Open	-10	0.01
242	185	188	19.85	300	110	Open	5,853	0.96
243	188	186	285.51	300	110	Open	5,853	0.96
244	186	187	146.45	300	110	Open	5,853	0.96
250	187	192	137.55	300	110	Open	5,853	0.96
251	192	198	238.62	300	110	Open	4,576	0.75
252	198	199	290.5	160	110	Open	0	0
253	198	200	119.83	300	110	Open	4,576	0.75
254	200	219	460.49	300	110	Open	2,143	0.35
255	219	218	25.44	200	110	Open	999	0.37
256	214	218	353.29	160	110	Open	145	0.08
257	218	220	868.13	225	110	Open	1,144	0.33
259	214	215	33.75	160	110	Open	423	0.24
260	201	214	107.36	160	110	Open	568	0.33
261	200	201	28.28	200	110	Open	2,433	0.9
262	201	202	17.78	110	110	Open	211	0.26
263	202	204	632.9	110	110	Open	211	0.26
264	204	207	713.14	110	110	Open	326	0.4
266	203	204	199.48	160	110	Open	115	0.07
267	203	205	16.29	160	110	Open	-115	0.07
271	209	207	300.21	160	110	Open	980	0.56
272	207	210	374.55	110	110	Open	162	0.2
273	205	212	412.83	225	110	Open	429	0.13
274	205	223	203.47	160	110	Open	1,000	0.58
275	223	209	69.13	160	110	Open	980	0.56
276	223	211	406.91	110	110	Open	20	0.02
277	211	210	449.15	160	110	Open	982	0.57
278	212	211	203.44	160	110	Open	961	0.55
279	213	212	270.61	160	110	Open	532	0.31
280	201	216	126.42	225	110	Open	1,654	0.48
283	217	213	412.13	110	110	Open	109	0.13
286	182	224	35.61	225	110	Open	788	0.23

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
287	224	226	97.56	160	110	Open	251	0.14
290	227	229	653.56	160	110	Open	1,144	0.66
292	224	225	348.98	225	110	Open	537	0.16
293	225	184	1849.61	160	110	Open	537	0.31
302	242	24	658.31	160	110	Open	3,707	2.13
303	240	241	173.51	160	110	Open	0	0
304	242	240	181.77	160	110	Open	-3,736	2.15
305	10	239	94.41	110	110	Open	2,998	3.65
306	239	240	251.41	160	110	Open	3,736	2.15
307	239	243	209.09	110	110	Open	1,011	1.23
308	243	242	216.99	90	110	Open	1,011	1.84
311	9	244	128.73	110	110	Open	1,113	1.36
315	220	250	526.13	160	110	Open	1,144	0.66
316	154	251	188.69	225	110	Open	315	0.09
317	251	153	69.35	225	110	Open	245	0.07
318	251	194	20.58	225	110	Open	70	0.02
319	16	252	193.95	300	110	Open	20,342	3.33
320	252	35	167.94	300	110	Open	19,548	3.2
42	17	259	94.34	160	110	Open	2,234	1.29
153	259	257	94.52	160	110	Open	2,234	1.29
193	257	252	111.05	160	110	Open	2,234	1.29
223	252	253	122.83	160	110	Open	3,028	1.74
321	253	256	170.34	160	110	Open	3,028	1.74
322	98	92	86.27	160	110	Open	86	0.05
323	235	237	381.35	160	110	Open	1,144	0.66
324	45	43	187.67	160	110	Open	664	0.38
326	244	11	496.38	160	110	Open	-1,676	0.96
327	239	244	329.6	110	110	Open	-1,748	2.13
328	235	234	55.05	160	110	Open	893	0.51
329	234	233	167.35	160	110	Open	893	0.51
330	233	232	182.39	160	110	Open	893	0.51
332	164	165	207.25	110	110	Open	-10	0.01
333	165	168	38.67	110	110	Open	-10	0.01
334	168	166	157.76	110	110	Open	351	0.43
335	166	154	349.81	160	110	Open	1,326	0.76
338	237	12	802.56	160	110	Open	1,144	0.66
341	25	13	131.31	160	110	Open	3,181	1.83
342	13	34	43.17	160	110	Open	3,181	1.83
343	34	235	284.57	160	110	Open	3,181	1.83
344	6	38	262.11	160	110	Open	0	0
346	38	42	143.69	160	110	Open	0	0
11	226	50	126.42	160	110	Open	1,144	0.66
12	50	227	499.62	160	110	Open	1,144	0.66
20	226	52	280.96	160	110	Open	-893	0.51
35	52	58	55.77	160	110	Open	-893	0.51
39	58	232	243.77	160	110	Open	-893	0.51
43	136	63	151.36	160	110	Open	175	0.1
51	63	128	111.52	160	110	Open	-64	0.04
52	63	61	156.22	110	110	Open	239	0.29
53	61	60	211	110	110	Open	239	0.29
56	60	59	353.71	110	110	Open	239	0.29
58	145	59	90.41	110	110	Open	-226	0.27
59	59	147	162.77	110	110	Open	14	0.02
60	215	65	318.75	160	110	Open	423	0.24
62	65	213	220	160	110	Open	423	0.24
67	216	66	49.94	225	110	Open	1,654	0.48
69	66	217	55.55	225	110	Open	1,654	0.48
70	217	67	46.22	225	110	Open	1,545	0.45
71	67	205	211.73	225	110	Open	1,545	0.45
27	127	22	128.62	150	110	Open	-5,471	3.58
18	256	37	65.6	225	110	Open	-4,454	1.3
28	256	40	493.84	225	110	Open	6,442	1.88

管網計算結果から、既存管網では、時間最大時に末端配水圧 20m 以上の確保が困難であることが明らかとなった。

そのため、時間最大時に末端配水圧の確保できるように口径検討を行った結果、**図 A6.4** に示すような新たな配管整備が必要となる。新たな配水本管の整備に基づく管網計算結果は次のとおりである。



Ex. Pipe	New Pipe	Expansion Length in 2024	Expansion Length in 2030
400	700	15	
400	800	30	
300	350	815	780
300	450	2635	
300	600	385	
300	700	250	
200	400	0	960
200	450	115	105
200	500	190	
150	300	130	
		unit m	unit m

図 A6.4　配水本管の整備概要

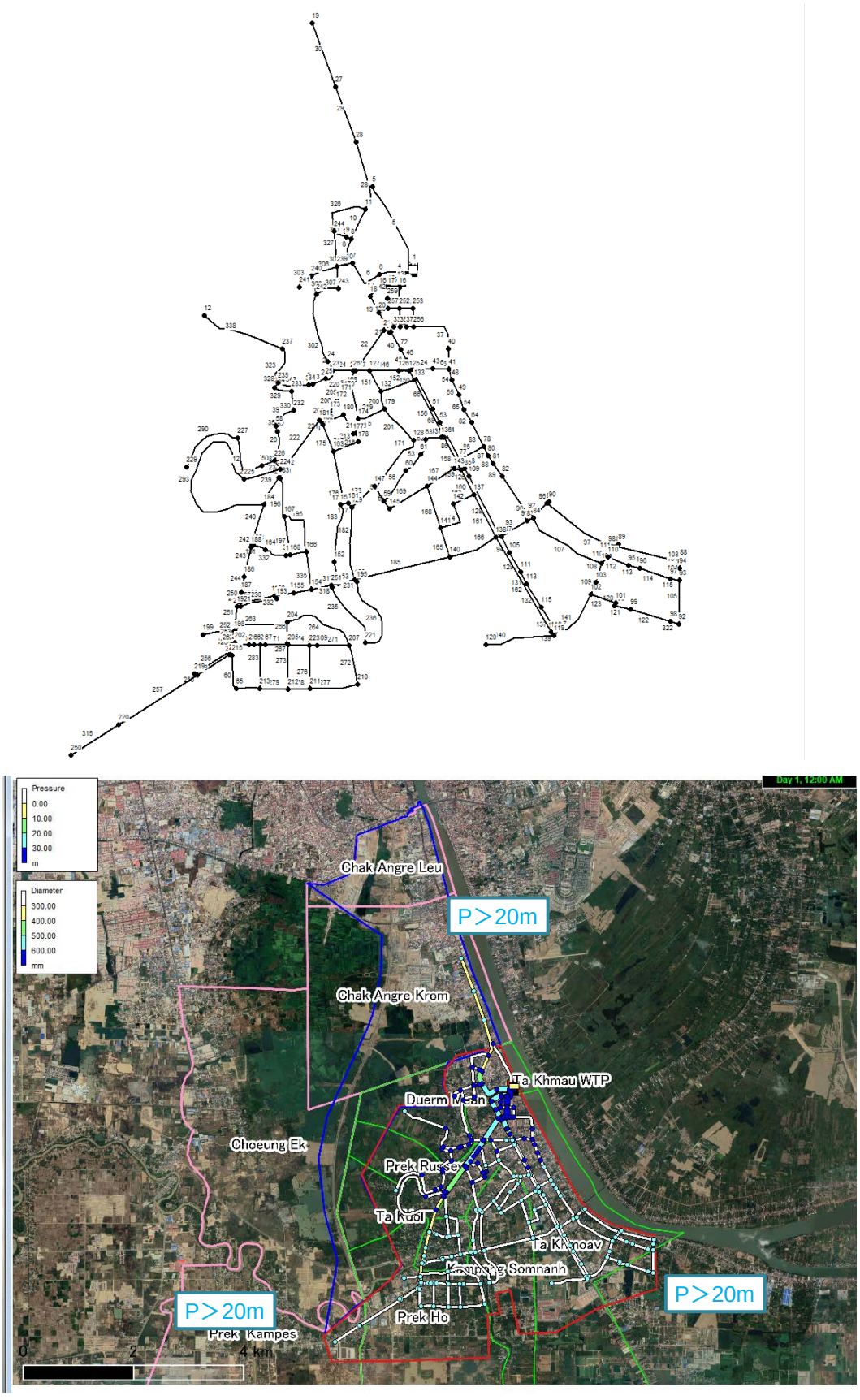


図 A6.5　水理計算管網モデルと管網計算結果（Pipe Expansion Plan in 2024）

表 A6.7 管網計算結果（節点）（Pipe Expansion Plan in 2024）

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
2	0	40.0	40.0
3	0	40.0	40.0
4	0	39.9	39.9
5	0	40.0	40.0
6	0	39.6	39.6
7	0	39.1	39.1
8	0	38.4	38.4
9	0	37.5	37.5
10	0	37.7	37.7
11	0	35.2	35.2
14	0	39.4	39.4
15	0	39.2	39.2
16	0	39.4	39.4
17	0	39.2	39.2
18	600	38.7	38.7
20	0	38.3	38.3
21	600	37.9	37.9
22	600	36.0	36.0
23	0	34.7	34.7
24	0	34.7	34.7
25	0	33.9	33.9
26	0	35.8	35.8
31	0	38.5	38.5
32	0	38.7	38.7
33	0	38.8	38.8
35	600	38.9	38.9
37	0	38.9	38.9
40	0	35.3	35.3
41	600	34.1	34.1
43	0	35.0	35.0
45	600	36.2	36.2
46	0	38.5	38.5
48	0	33.2	33.2
49	0	32.0	32.0
51	600	32.0	32.0
53	0	31.1	31.1
54	0	30.9	30.9
64	600	29.8	29.8
72	0	38.6	38.6
77	0	28.6	28.6
78	0	28.6	28.6
80	0	28.1	28.1
81	0	26.8	26.8
82	600	26.0	26.0
83	0	24.9	24.9
84	0	24.4	24.4
85	571	23.6	23.6
86	571	22.1	22.1
87	571	21.7	21.7
88	0	21.7	21.7

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
89	0	22.1	22.1
90	0	23.6	23.6
92	571	21.3	21.3
93	0	21.7	21.7
94	0	21.7	21.7
95	0	22.0	22.0
96	0	21.9	21.9
97	0	21.7	21.7
98	0	21.4	21.4
99	0	21.6	21.6
100	0	21.8	21.8
101	0	21.8	21.8
102	571	22.0	22.0
103	0	22.0	22.0
104	0	22.2	22.2
105	0	25.1	25.1
107	0	25.4	25.4
108	0	28.0	28.0
109	600	27.5	27.5
110	0	22.1	22.1
111	0	24.7	24.7
113	0	24.4	24.4
115	0	23.9	23.9
117	0	23.4	23.4
118	571	23.4	23.4
119	0	23.4	23.4
120	0	23.4	23.4
125	0	27.7	27.7
126	0	29.8	29.8
127	0	35.5	35.5
128	600	25.3	25.3
129	571	25.0	25.0
130	571	24.9	24.9
131	0	33.6	33.6
132	0	30.9	30.9
133	0	27.4	27.4
134	600	25.3	25.3
135	0	24.6	24.6
136	0	25.3	25.3
137	0	24.3	24.3
138	571	23.9	23.9
140	571	24.0	24.0
141	0	24.1	24.1
142	0	24.2	24.2
143	0	24.5	24.5
144	600	24.1	24.1
145	0	24.3	24.3
147	600	24.6	24.6
151	0	25.4	25.4
152	0	25.3	25.3

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
153	0	25.1	25.1
154	571	25.6	25.6
155	0	25.8	25.8
156	0	25.9	25.9
157	0	26.1	26.1
158	0	28.7	28.7
160	0	31.9	31.9
161	0	25.4	25.4
162	0	33.3	33.3
163	0	30.4	30.4
164	0	28.7	28.7
165	0	28.7	28.7
166	0	27.9	27.9
167	0	29.7	29.7
168	0	28.6	28.6
169	0	30.6	30.6
170	0	30.8	30.8
171	0	31.3	31.3
172	0	32.2	32.2
173	0	32.6	32.6
174	600	29.4	29.4
175	0	30.1	30.1
176	0	30.4	30.4
177	0	30.7	30.7
178	0	30.4	30.4
179	600	29.0	29.0
180	0	31.8	31.8
181	600	34.8	34.8
182	571	33.0	33.0
183	0	32.4	32.4
184	0	31.0	31.0
185	571	28.7	28.7
186	0	27.4	27.4
187	0	26.8	26.8
188	0	28.6	28.6
191	0	26.2	26.2
192	571	26.2	26.2
193	0	26.0	26.0
194	0	25.2	25.2
195	0	24.9	24.9
198	0	25.8	25.8
199	0	25.8	25.8
200	0	25.6	25.6
201	0	25.5	25.5
202	0	25.4	25.4
203	0	25.0	25.0
204	0	24.9	24.9
205	0	25.0	25.0
207	571	23.7	23.7
209	0	24.3	24.3

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
210	571	23.5	23.5
211	0	24.5	24.5
212	0	24.9	24.9
213	0	25.1	25.1
214	0	25.4	25.4
215	0	25.4	25.4
216	0	25.3	25.3
217	0	25.2	25.2
218	0	25.3	25.3
219	571	25.4	25.4
220	0	24.9	24.9
221	0	25.2	25.2
223	0	24.5	24.5
224	0	33.0	33.0
225	0	32.9	32.9
226	0	32.3	32.3
227	0	30.5	30.5
229	571	28.6	28.6
232	0	31.7	31.7
233	0	31.5	31.5
234	0	31.4	31.4
235	571	31.3	31.3
237	0	30.2	30.2
239	0	35.5	35.5
240	0	35.0	35.0
241	0	35.0	35.0
242	600	34.6	34.6
243	0	35.2	35.2
244	600	35.2	35.2
250	572	23.3	23.3
251	0	25.2	25.2
252	0	39.2	39.2
253	0	38.9	38.9
256	600	38.5	38.5
257	0	39.2	39.2
259	0	39.2	39.2
12	571	27.9	27.9
13	0	33.2	33.2
34	0	32.9	32.9
50	0	31.9	31.9
52	0	32.0	32.0
58	0	32.0	32.0
59	0	24.5	24.5
60	0	24.9	24.9
61	0	25.1	25.1
63	0	25.3	25.3
65	0	25.2	25.2
66	0	25.3	25.3
67	0	25.2	25.2
19	2000	24.5	24.5
27	2000	25.4	25.4
28	2000	28.2	28.2

表 A6.8　管網計算結果（管）（Pipe Expansion Plan in 2024）

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
2	2	3	27.18	800	110	Open	47,987	1.1
3	3	4	10.87	700	110	Open	36,517	1.1
4	3	6	312.42	500	110	Open	11,470	0.68
5	2	5	900.16	250	110	Open	0	0
6	6	7	385.89	500	110	Open	11,470	0.68
7	7	10	56.56	110	110	Open	1,069	1.3
8	7	8	240.17	400	110	Open	10,401	0.96
9	8	9	46.95	110	110	Open	910	1.11
10	8	11	305.7	300	110	Open	9,491	1.55
13	4	14	244.2	700	110	Open	36,517	1.1
14	14	16	13.83	600	110	Open	19,948	0.82
15	14	15	105.74	500	110	Open	16,570	0.98
16	15	17	20.74	150	110	Open	155	0.1
17	15	18	210.31	500	110	Open	16,414	0.97
19	18	20	169.63	500	110	Open	15,454	0.91
21	20	21	184.4	500	110	Open	15,454	0.91
22	21	22	458.88	500	110	Open	22,543	1.33
23	22	26	18.79	160	110	Open	1,364	0.79
24	26	23	193.56	160	110	Open	1,364	0.79
25	23	24	98.95	160	110	Open	50	0.03
26	23	25	125.34	160	110	Open	1,314	0.76
32	31	21	76.83	300	110	Open	8,049	1.32
33	31	32	17.8	300	110	Open	−8,049	1.32
34	32	33	65.73	500	110	Open	−14,763	0.87
36	33	35	73.14	500	110	Open	−14,763	0.87
38	35	37	49.39	500	110	Open	3,589	0.21
40	32	72	189.04	500	110	Open	6,714	0.4
45	40	41	187.67	225	110	Open	3,420	1
46	41	43	154.11	160	110	Open	−1,386	0.8
48	72	46	111.47	450	110	Open	6,714	0.49
50	46	45	101.35	225	110	Open	6,714	1.95
54	41	48	104.45	225	110	Open	3,846	1.12
55	48	49	155.62	225	110	Open	3,846	1.12
65	49	54	143.09	225	110	Open	3,846	1.12
66	45	51	417.79	225	110	Open	4,368	1.27
68	51	53	144.08	225	110	Open	3,408	0.99
82	54	64	138.9	225	110	Open	3,846	1.12
83	64	78	255.3	225	110	Open	2,886	0.84
85	78	77	252.69	90	110	Open	−48	0.09
86	53	77	391.46	225	110	Open	3,408	0.99
87	78	80	91.9	225	110	Open	2,934	0.85
88	80	81	285.79	225	110	Open	2,934	0.85
89	81	82	149.02	225	110	Open	2,934	0.85
90	82	83	489.98	225	110	Open	1,974	0.57
91	83	84	63.82	225	110	Open	3,649	1.06
92	84	85	194.61	225	110	Open	2,740	0.8
93	83	107	276.77	225	110	Open	−1,675	0.49
94	107	105	166.1	160	110	Open	725	0.42
96	85	90	24.11	160	110	Open	0	0
97	85	86	768.88	225	110	Open	1,826	0.53
98	86	89	27.93	160	110	Open	0	0
100	86	87	616.51	225	110	Open	1,008	0.29
101	87	94	61.35	160	110	Open	95	0.05
103	88	87	19.75	160	110	Open	0	0
104	94	93	110.6	160	110	Open	95	0.05
105	93	92	406.94	160	110	Open	483	0.28
107	84	104	788.69	160	110	Open	909	0.52
108	104	103	186.16	160	110	Open	425	0.24
109	103	102	122.52	160	110	Open	425	0.24
110	104	110	86.63	160	110	Open	484	0.28

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
111	110	86	125.24	160	110	Open	96	0.06
112	110	95	209.06	160	110	Open	388	0.22
113	95	96	107.46	160	110	Open	388	0.22
114	96	97	299.79	160	110	Open	388	0.22
115	97	93	92.22	160	110	Open	388	0.22
120	101	100	28.76	160	110	Open	431	0.25
121	100	99	149.53	160	110	Open	431	0.25
122	99	98	388.58	160	110	Open	431	0.25
123	102	101	241.09	160	110	Open	431	0.25
124	77	108	97.16	225	110	Open	3,360	0.98
126	108	109	79.98	225	110	Open	3,360	0.98
128	109	107	649.05	225	110	Open	2,400	0.7
129	105	111	210.69	160	110	Open	725	0.42
131	111	113	123.66	160	110	Open	725	0.42
132	113	115	260.86	160	110	Open	725	0.42
137	115	117	258.79	160	110	Open	725	0.42
138	117	118	44.16	250	110	Open	−194	0.05
139	118	119	39.5	250	110	Open	0	0
140	119	120	645.75	160	110	Open	0	0
141	117	102	504.75	160	110	Open	919	0.53
146	127	126	272.57	160	110	Open	2,643	1.52
147	126	125	102.72	160	110	Open	2,643	1.52
150	125	133	98.05	250	110	Open	2,643	0.62
151	127	132	221.07	160	110	Open	2,627	1.51
152	133	132	332.94	110	110	Open	−681	0.83
155	136	134	25.68	160	110	Open	5	0
156	133	134	604.2	250	110	Open	3,324	0.78
158	134	135	344.51	250	110	Open	2,370	0.56
159	143	135	66.74	160	110	Open	−601	0.35
160	135	137	258.04	250	110	Open	1,769	0.42
161	137	138	445.65	250	110	Open	1,489	0.35
162	138	118	1027.9	250	110	Open	1,108	0.26
163	137	142	212.46	160	110	Open	279	0.16
164	142	141	375.09	160	110	Open	279	0.16
165	141	140	289.84	160	110	Open	252	0.14
166	138	140	476.94	225	110	Open	−532	0.15
167	143	144	300.24	160	110	Open	601	0.35
168	144	141	410.99	110	110	Open	−27	0.03
169	144	145	413.28	160	110	Open	−332	0.19
171	128	147	598.71	160	110	Open	537	0.31
173	147	129	293.36	160	110	Open	−562	0.32
174	131	162	27.47	160	110	Open	1,840	1.06
175	162	163	272.14	160	110	Open	1,840	1.06
176	163	161	506.93	160	110	Open	1,762	1.01
177	161	129	53.84	160	110	Open	1,670	0.96
178	161	151	74.03	110	110	Open	93	0.11
182	129	130	681.68	160	110	Open	194	0.11
183	151	152	552.87	110	110	Open	93	0.11
184	152	153	686.29	110	110	Open	93	0.11
185	140	130	911.28	225	110	Open	−1,194	0.35
186	130	153	157	225	110	Open	−1,611	0.47
188	154	155	168.89	225	110	Open	−1,296	0.38
189	155	156	180.54	225	110	Open	−1,296	0.38
190	156	157	322.27	225	110	Open	−897	0.26
191	158	164	124.35	110	110	Open	85	0.1
195	167	166	503.36	160	110	Open	1,011	0.58
196	160	167	363.39	160	110	Open	1,354	0.78
197	167	168	362.07	110	110	Open	343	0.42
200	132	179	168.35	160	110	Open	1,946	1.12
201	179	128	401.89	160	110	Open	1,695	0.98

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
203	169	170	48.22	110	110	Open	-378	0.46
204	170	171	149.19	110	110	Open	-378	0.46
205	171	172	266	110	110	Open	-378	0.46
206	172	173	107.93	110	110	Open	-378	0.46
207	173	131	123.5	160	110	Open	-1,591	0.92
209	169	174	333.47	110	110	Open	378	0.46
210	174	175	119.64	160	110	Open	-1,291	0.74
211	173	180	167.26	160	110	Open	1,213	0.7
213	180	177	217.72	160	110	Open	1,213	0.7
215	177	176	72.45	160	110	Open	1,213	0.7
216	176	178	80.03	110	110	Open	-78	0.1
217	178	163	249.56	110	110	Open	-78	0.1
218	175	176	51.35	160	110	Open	-1,291	0.74
219	179	174	260.71	160	110	Open	-709	0.41
220	22	181	578.59	500	110	Open	14,950	0.88
221	181	131	25.02	150	110	Open	3,431	2.25
222	181	182	563.66	400	110	Open	10,558	0.97
230	193	191	349.77	160	110	Open	-399	0.23
231	130	195	22.34	160	110	Open	-302	0.17
232	156	193	31.21	160	110	Open	-399	0.23
233	157	191	126.11	225	110	Open	-897	0.26
234	191	192	31.85	250	110	Open	-1,296	0.31
235	194	221	634.06	225	110	Open	302	0.09
236	195	221	782.73	160	110	Open	-302	0.17
237	160	183	60.22	150	110	Open	-1,354	0.89
238	182	183	88.77	300	110	Open	7,698	1.26
239	183	184	286.9	300	110	Open	6,344	1.04
240	184	185	395.9	300	110	Open	6,864	1.12
241	185	158	16.02	150	110	Open	85	0.06
242	185	188	19.85	300	110	Open	5,865	0.96
243	188	186	285.51	300	110	Open	5,865	0.96
244	186	187	146.45	300	110	Open	5,865	0.96
250	187	192	137.55	300	110	Open	5,865	0.96
251	192	198	238.62	300	110	Open	3,656	0.6
252	198	199	290.5	160	110	Open	0	0
253	198	200	119.83	300	110	Open	3,656	0.6
254	200	219	460.49	300	110	Open	1,713	0.28
255	219	218	25.44	200	110	Open	799	0.29
256	214	218	353.29	160	110	Open	116	0.07
257	218	220	868.13	225	110	Open	915	0.27
259	214	215	33.75	160	110	Open	338	0.19
260	201	214	107.36	160	110	Open	454	0.26
261	200	201	28.28	200	110	Open	1,943	0.72
262	201	202	17.78	110	110	Open	168	0.2
263	202	204	632.9	110	110	Open	168	0.2
264	204	207	713.14	110	110	Open	260	0.32
266	203	204	199.48	160	110	Open	92	0.05
267	203	205	16.29	160	110	Open	-92	0.05
271	209	207	300.21	160	110	Open	783	0.45
272	207	210	374.55	110	110	Open	130	0.16
273	205	212	412.83	225	110	Open	343	0.1
274	205	223	203.47	160	110	Open	799	0.46
275	223	209	69.13	160	110	Open	783	0.45
276	223	211	406.91	110	110	Open	16	0.02
277	211	210	449.15	160	110	Open	784	0.45
278	212	211	203.44	160	110	Open	768	0.44
279	213	212	270.61	160	110	Open	425	0.24
280	201	216	126.42	225	110	Open	1,321	0.38
283	217	213	412.13	110	110	Open	87	0.11
286	182	224	35.61	225	110	Open	1,947	0.57

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
287	224	226	97.56	160	110	Open	1,427	0.82
290	227	229	653.56	160	110	Open	914	0.53
292	224	225	348.98	225	110	Open	520	0.15
293	225	184	1849.61	160	110	Open	520	0.3
302	242	24	658.31	160	110	Open	-50	0.03
303	240	241	173.51	160	110	Open	0	0
304	242	240	181.77	160	110	Open	-716	0.41
305	10	239	94.41	110	110	Open	1,069	1.3
306	239	240	251.41	160	110	Open	716	0.41
307	239	243	209.09	110	110	Open	194	0.24
308	243	242	216.99	90	110	Open	194	0.35
311	9	244	128.73	110	110	Open	910	1.11
315	220	250	526.13	160	110	Open	915	0.53
316	154	251	188.69	225	110	Open	1,821	0.53
317	251	153	69.35	225	110	Open	1,518	0.44
318	251	194	20.58	225	110	Open	302	0.09
319	16	252	193.95	600	110	Open	19,948	0.82
320	252	35	167.94	600	110	Open	19,311	0.79
42	17	259	94.34	160	110	Open	155	0.09
153	259	257	94.52	160	110	Open	155	0.09
193	257	252	111.05	160	110	Open	155	0.09
223	252	253	122.83	160	110	Open	791	0.46
321	253	256	170.34	160	110	Open	791	0.46
322	98	92	86.27	160	110	Open	431	0.25
323	235	237	381.35	160	110	Open	914	0.53
324	45	43	187.67	160	110	Open	1,386	0.8
326	244	11	496.38	160	110	Open	109	0.06
327	239	244	329.6	110	110	Open	159	0.19
328	235	234	55.05	160	110	Open	-513	0.3
329	234	233	167.35	160	110	Open	-513	0.3
330	233	232	182.39	160	110	Open	-513	0.3
332	164	165	207.25	110	110	Open	85	0.1
333	165	168	38.67	110	110	Open	85	0.1
334	168	166	157.76	110	110	Open	428	0.52
335	166	154	349.82	160	110	Open	1,438	0.83
338	237	12	802.56	160	110	Open	914	0.53
341	25	13	131.31	160	110	Open	1,314	0.76
342	13	34	43.17	160	110	Open	1,314	0.76
343	34	235	284.57	160	110	Open	1,314	0.76
11	226	50	126.42	160	110	Open	914	0.53
12	50	227	499.62	160	110	Open	914	0.53
20	226	52	280.96	160	110	Open	513	0.3
35	52	58	55.77	160	110	Open	513	0.3
39	58	232	243.77	160	110	Open	513	0.3
43	136	63	151.36	160	110	Open	-5	0
51	63	128	111.52	160	110	Open	-197	0.11
52	63	61	156.22	110	110	Open	192	0.23
53	61	60	211	110	110	Open	192	0.23
56	60	59	353.71	110	110	Open	192	0.23
58	145	59	90.41	110	110	Open	-332	0.4
59	59	147	162.77	110	110	Open	-140	0.17
60	215	65	318.75	160	110	Open	338	0.19
62	65	213	220	160	110	Open	338	0.19
67	216	66	49.94	225	110	Open	1,321	0.38
69	66	217	55.55	225	110	Open	1,321	0.38
70	217	67	46.22	225	110	Open	1,234	0.36
71	67	205	211.73	225	110	Open	1,234	0.36
27	127	22	128.62	300	110	Open	-5,270	0.86
28	11	28	658.78	300	110	Open	9,600	1.57
29	28	27	550.12	300	110	Open	6,400	1.05
30	27	19	633.7	300	110	Open	3,200	0.52
31	256	37	60.93	225	110	Open	-3,589	1.04
37	256	40	504.85	225	110	Open	3,420	1

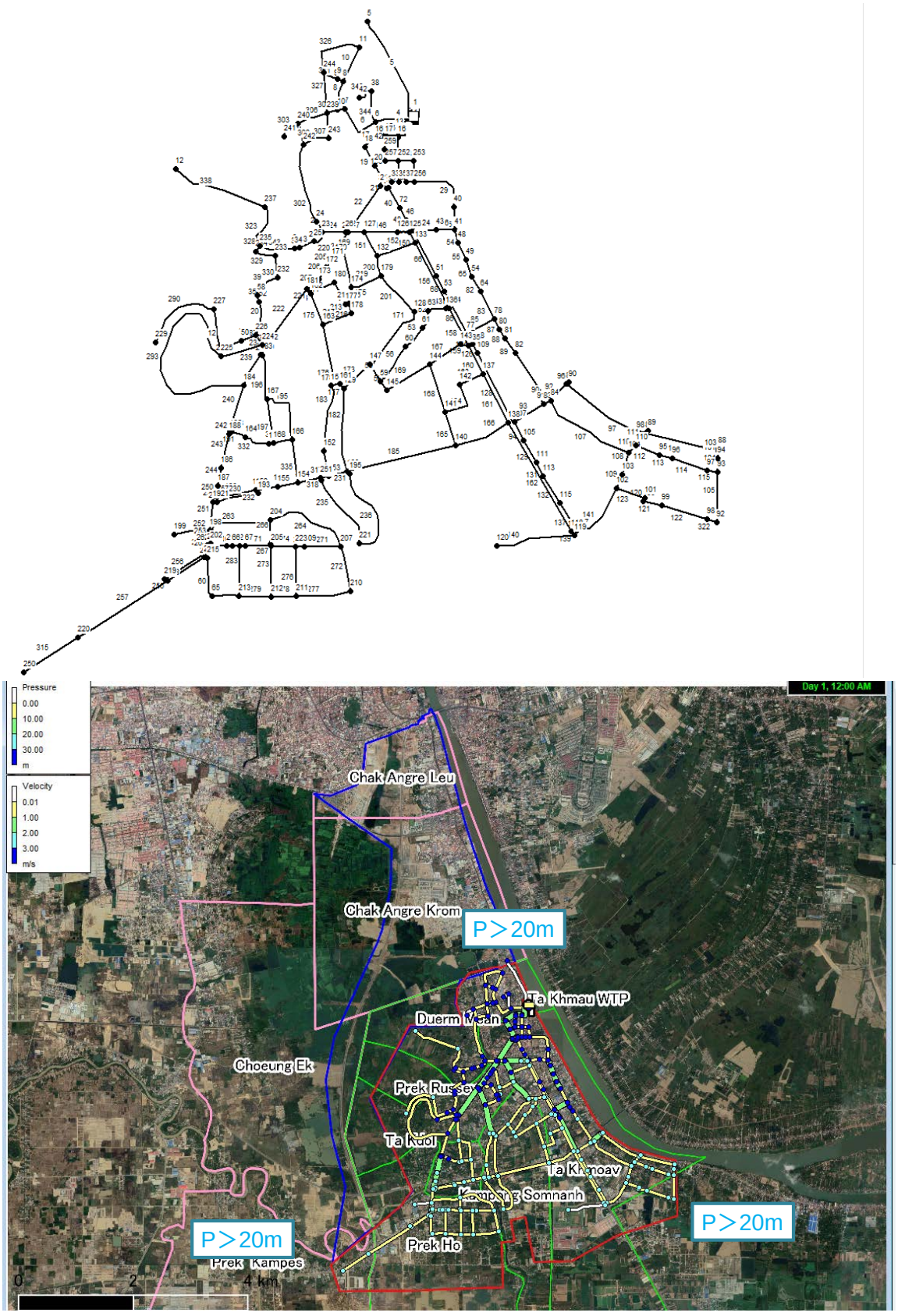


図 A6.6　水理計算管網モデルと管網計算結果（Pipe Expansion Plan in 2030）

表 A6.9　管網計算結果（節点）（Pipe Expansion Plan in 2030）

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
2	0	41.7	41.7
3	0	41.7	41.7
4	0	41.6	41.6
5	0	41.7	41.7
6	0	41.6	41.6
7	0	41.6	41.6
8	0	41.6	41.6
9	0	41.2	41.2
10	0	40.3	40.3
11	0	41.6	41.6
14	0	41.0	41.0
15	0	40.7	40.7
16	0	41.0	41.0
17	0	40.7	40.7
18	650	40.0	40.0
20	0	39.6	39.6
21	650	39.0	39.0
22	650	36.6	36.6
23	0	35.5	35.5
24	0	35.6	35.6
25	0	34.3	34.3
26	0	36.5	36.5
31	0	39.8	39.8
32	0	39.9	39.9
33	0	40.1	40.1
35	650	40.3	40.3
37	0	40.3	40.3
40	0	37.5	37.5
41	650	36.6	36.6
43	0	37.8	37.8
45	650	39.3	39.3
46	0	39.6	39.6
48	0	35.9	35.9
49	0	34.9	34.9
51	650	38.7	38.7
53	0	38.6	38.6
54	0	33.9	33.9
64	650	33.0	33.0
72	0	39.8	39.8
77	0	38.2	38.2
78	0	32.1	32.1
80	0	31.6	31.6
81	0	30.1	30.1
82	650	29.3	29.3
83	0	28.1	28.1
84	0	27.3	27.3
85	715	25.9	25.9
86	715	23.0	23.0
87	715	22.3	22.3
88	0	22.3	22.3

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
89	0	23.0	23.0
90	0	25.9	25.9
92	715	21.6	21.6
93	0	22.3	22.3
94	0	22.3	22.3
95	0	22.8	22.8
96	0	22.7	22.7
97	0	22.4	22.4
98	0	21.7	21.7
99	0	22.0	22.0
100	0	22.1	22.1
101	0	22.1	22.1
102	715	22.3	22.3
103	0	22.6	22.6
104	0	23.1	23.1
105	0	28.4	28.4
107	0	29.4	29.4
108	0	36.8	36.8
109	650	35.6	35.6
110	0	23.0	23.0
111	0	27.2	27.2
113	0	26.4	26.4
115	0	24.9	24.9
117	0	23.4	23.4
118	715	23.3	23.3
119	0	23.3	23.3
120	0	23.3	23.3
125	0	27.4	27.4
126	0	29.8	29.8
127	0	36.1	36.1
128	650	24.8	24.8
129	715	24.4	24.4
130	715	24.4	24.4
131	0	33.7	33.7
132	0	30.9	30.9
133	0	27.2	27.2
134	650	24.8	24.8
135	0	24.1	24.1
136	0	24.8	24.8
137	0	23.8	23.8
138	715	23.5	23.5
140	715	23.5	23.5
141	0	23.6	23.6
142	0	23.7	23.7
143	0	24.0	24.0
144	650	23.5	23.5
145	0	23.7	23.7
147	650	24.0	24.0
151	0	24.9	24.9
152	0	24.8	24.8

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
153	0	24.7	24.7
154	715	25.4	25.4
155	0	25.7	25.7
156	0	26.1	26.1
157	0	26.4	26.4
158	0	30.5	30.5
160	0	31.7	31.7
161	0	24.9	24.9
162	0	33.4	33.4
163	0	30.3	30.3
164	0	30.1	30.1
165	0	29.5	29.5
166	0	28.2	28.2
167	0	29.9	29.9
168	0	29.4	29.4
169	0	30.4	30.4
170	0	30.6	30.6
171	0	31.2	31.2
172	0	32.2	32.2
173	0	32.6	32.6
174	650	29.2	29.2
175	0	29.9	29.9
176	0	30.2	30.2
177	0	30.6	30.6
178	0	30.2	30.2
179	650	28.7	28.7
180	0	31.7	31.7
181	650	35.0	35.0
182	715	32.3	32.3
183	0	32.1	32.1
184	0	31.5	31.5
185	715	30.5	30.5
186	0	28.5	28.5
187	0	27.5	27.5
188	0	30.4	30.4
191	0	26.5	26.5
192	715	26.5	26.5
193	0	26.1	26.1
194	0	24.8	24.8
195	0	24.4	24.4
198	0	25.9	25.9
199	0	25.9	25.9
200	0	25.6	25.6
201	0	25.4	25.4
202	0	25.4	25.4
203	0	24.6	24.6
204	0	24.6	24.6
205	0	24.6	24.6
207	715	22.7	22.7
209	0	23.7	23.7

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
210	715	22.4	22.4
211	0	23.9	23.9
212	0	24.6	24.6
213	0	24.9	24.9
214	0	25.3	25.3
215	0	25.3	25.3
216	0	25.2	25.2
217	0	25.0	25.0
218	0	25.2	25.2
219	715	25.3	25.3
220	0	24.5	24.5
221	0	24.8	24.8
223	0	23.9	23.9
224	0	32.2	32.2
225	0	32.2	32.2
226	0	31.3	31.3
227	0	28.6	28.6
229	715	25.7	25.7
232	0	30.6	30.6
233	0	30.4	30.4
234	0	30.1	30.1
235	715	30.1	30.1
237	0	28.4	28.4
239	0	38.2	38.2
240	0	37.0	37.0
241	0	37.0	37.0
242	650	36.1	36.1
243	0	37.7	37.7
244	650	40.1	40.1
250	715	22.2	22.2
251	0	24.8	24.8
252	0	40.6	40.6
253	0	40.3	40.3
256	650	39.9	39.9
257	0	40.6	40.6
259	0	40.6	40.6
12	715	24.8	24.8
13	0	33.1	33.1
34	0	32.7	32.7
38	0	41.6	41.6
42	0	41.6	41.6
50	0	30.8	30.8
52	0	31.0	31.0
58	0	30.9	30.9
59	0	23.9	23.9
60	0	24.3	24.3
61	0	24.6	24.6
63	0	24.8	24.8
65	0	25.0	25.0
66	0	25.1	25.1
67	0	25.0	25.0

表 A6.10 管網計算結果（管）（Pipe Expansion Plan in 2030）

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
2	2	3	27.18	800	110	Open	44,824	1.03
3	3	4	10.87	700	110	Open	42,268	1.27
4	3	6	312.42	500	110	Open	2,556	0.15
5	2	5	900.16	250	110	Open	0	0
6	6	7	385.89	500	110	Open	2,556	0.15
7	7	10	56.56	110	110	Open	1,028	1.25
8	7	8	240.17	400	110	Open	1,529	0.14
9	8	9	46.95	110	110	Open	610	0.74
10	8	11	305.7	300	110	Open	919	0.15
13	4	14	244.18	700	110	Open	42,268	1.27
14	14	16	13.83	600	110	Open	23,323	0.95
15	14	15	105.74	500	110	Open	18,945	1.12
16	15	17	20.74	150	110	Open	208	0.14
17	15	18	210.31	500	110	Open	18,737	1.1
19	18	20	169.63	500	110	Open	17,697	1.04
21	20	21	184.4	500	110	Open	17,697	1.04
22	21	22	458.88	500	110	Open	25,569	1.51
23	22	26	18.79	160	110	Open	1,229	0.71
24	26	23	193.56	160	110	Open	1,229	0.71
25	23	24	98.95	160	110	Open	-476	0.27
26	23	25	125.34	160	110	Open	1,705	0.98
32	31	21	76.83	300	110	Open	8,913	1.46
33	31	32	17.8	300	110	Open	-8,913	1.46
34	32	33	65.73	500	110	Open	-18,488	1.09
36	33	35	59.29	500	110	Open	-18,488	1.09
38	35	37	63.39	500	110	Open	3,197	0.19
40	32	72	189.04	500	110	Open	9,575	0.56
45	40	41	185.54	225	110	Open	2,963	0.86
46	41	43	152.5	160	110	Open	-1,576	0.91
48	72	46	111.47	450	110	Open	9,575	0.7
50	46	45	101.34	400	110	Open	9,575	0.88
54	41	48	106.9	225	110	Open	3,499	1.02
55	48	49	155.62	225	110	Open	3,499	1.02
65	49	54	143.09	225	110	Open	3,499	1.02
66	45	51	417.79	400	110	Open	6,959	0.64
68	51	53	144.07	400	110	Open	5,919	0.55
82	54	64	138.9	225	110	Open	3,499	1.02
83	64	78	255.3	225	110	Open	2,459	0.72
85	78	77	252.69	90	110	Open	-628	1.14
86	53	77	391.46	400	110	Open	5,919	0.55
87	78	80	91.9	225	110	Open	3,087	0.9
88	80	81	285.79	225	110	Open	3,087	0.9
89	81	82	149.02	225	110	Open	3,087	0.9
90	82	83	489.98	225	110	Open	2,047	0.6
91	83	84	63.82	225	110	Open	4,958	1.44
92	84	85	194.61	225	110	Open	3,691	1.07
93	83	107	276.77	225	110	Open	-2,911	0.85
94	107	105	166.1	160	110	Open	1,340	0.77
96	85	90	24.11	160	110	Open	0	0
97	85	86	768.88	225	110	Open	2,547	0.74
98	86	89	27.93	160	110	Open	0	0
100	86	87	616.51	225	110	Open	1,325	0.39
101	87	94	61.35	160	110	Open	181	0.1
103	88	87	19.75	160	110	Open	0	0
104	94	93	110.6	160	110	Open	181	0.1
105	93	92	406.94	160	110	Open	691	0.4
107	84	104	788.69	160	110	Open	1,267	0.73
108	104	103	186.16	160	110	Open	835	0.48
109	103	102	122.52	160	110	Open	835	0.48
110	104	110	86.63	160	110	Open	432	0.25

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
111	110	86	125.24	160	110	Open	-78	0.04
112	110	95	209.06	160	110	Open	510	0.29
113	95	96	107.46	160	110	Open	510	0.29
114	96	97	299.79	160	110	Open	510	0.29
115	97	93	92.22	160	110	Open	510	0.29
120	101	100	28.76	160	110	Open	453	0.26
121	100	99	149.53	160	110	Open	453	0.26
122	99	98	388.58	160	110	Open	453	0.26
123	102	101	241.09	160	110	Open	453	0.26
124	77	108	97.16	225	110	Open	5,291	1.54
126	108	109	79.98	225	110	Open	5,291	1.54
128	109	107	649.05	225	110	Open	4,251	1.24
129	105	111	210.69	160	110	Open	1,340	0.77
131	111	113	123.66	160	110	Open	1,340	0.77
132	113	115	260.86	160	110	Open	1,340	0.77
137	115	117	258.79	160	110	Open	1,340	0.77
138	117	118	44.16	250	110	Open	578	0.14
139	118	119	39.5	250	110	Open	0	0
140	119	120	645.75	160	110	Open	0	0
141	117	102	504.75	160	110	Open	762	0.44
146	127	126	272.57	160	110	Open	2,785	1.6
147	126	125	102.72	160	110	Open	2,785	1.6
150	125	133	98.06	250	110	Open	2,785	0.66
151	127	132	221.07	160	110	Open	2,794	1.61
152	133	132	332.95	110	110	Open	-709	0.86
155	136	134	25.68	160	110	Open	-80	0.05
156	133	134	604.2	250	110	Open	3,494	0.82
158	134	135	344.51	250	110	Open	2,374	0.56
159	143	135	66.74	160	110	Open	-650	0.37
160	135	137	258.04	250	110	Open	1,725	0.41
161	137	138	445.65	250	110	Open	1,416	0.33
162	138	118	1027.9	250	110	Open	566	0.13
163	137	142	212.46	160	110	Open	309	0.18
164	142	141	375.09	160	110	Open	309	0.18
165	141	140	289.84	160	110	Open	240	0.14
166	138	140	476.94	225	110	Open	-294	0.09
167	143	144	300.24	160	110	Open	650	0.37
168	144	141	410.99	110	110	Open	-69	0.08
169	144	145	413.28	160	110	Open	-322	0.19
171	128	147	598.71	160	110	Open	585	0.34
173	147	129	293.36	160	110	Open	-571	0.33
174	131	162	27.47	160	110	Open	1,918	1.1
175	162	163	272.14	160	110	Open	1,918	1.1
176	163	161	506.93	160	110	Open	1,832	1.05
177	161	129	53.84	160	110	Open	1,764	1.02
178	161	151	74.03	110	110	Open	68	0.08
182	129	130	681.68	160	110	Open	49	0.03
183	151	152	552.87	110	110	Open	68	0.08
184	152	153	686.29	110	110	Open	68	0.08
185	140	130	911.28	225	110	Open	-1,198	0.35
186	130	153	157	225	110	Open	-1,929	0.56
188	154	155	168.89	225	110	Open	-1,800	0.52
189	155	156	180.54	225	110	Open	-1,800	0.52
190	156	157	322.27	225	110	Open	-1,245	0.36
191	158	164	124.35	110	110	Open	351	0.43
195	167	166	503.36	160	110	Open	992	0.57
196	160	167	363.39	160	110	Open	1,217	0.7
197	167	168	362.07	110	110	Open	225	0.27
200	132	179	168.35	160	110	Open	2,084	1.2
201	179	128	401.89	160	110	Open	1,751	1.01

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
203	169	170	48.22	110	110	Open	−395	0.48
204	170	171	149.19	110	110	Open	−395	0.48
205	171	172	266	110	110	Open	−395	0.48
206	172	173	107.93	110	110	Open	−395	0.48
207	173	131	123.5	160	110	Open	−1,660	0.96
209	169	174	333.47	110	110	Open	395	0.48
210	174	175	119.64	160	110	Open	−1,351	0.78
211	173	180	167.26	160	110	Open	1,265	0.73
213	180	177	217.72	160	110	Open	1,265	0.73
215	177	176	72.45	160	110	Open	1,265	0.73
216	176	178	80.03	110	110	Open	−86	0.1
217	178	163	249.56	110	110	Open	−86	0.1
218	175	176	51.35	160	110	Open	−1,351	0.78
219	179	174	260.71	160	110	Open	−706	0.41
220	22	181	578.59	500	110	Open	17,722	1.04
221	181	131	25.02	150	110	Open	3,578	2.34
222	181	182	563.66	400	110	Open	13,104	1.21
230	193	191	349.77	160	110	Open	−555	0.32
231	130	195	22.34	160	110	Open	−363	0.21
232	156	193	31.21	160	110	Open	−555	0.32
233	157	191	126.11	225	110	Open	−1,245	0.36
234	191	192	31.85	250	110	Open	−1,800	0.42
235	194	221	634.06	225	110	Open	363	0.11
236	195	221	782.73	160	110	Open	−363	0.21
237	160	183	60.22	150	110	Open	−1,217	0.8
238	182	183	88.77	400	110	Open	9,916	0.91
239	183	184	286.9	400	110	Open	8,699	0.8
240	184	185	395.9	400	110	Open	9,016	0.83
241	185	158	16.02	150	110	Open	351	0.23
242	185	188	19.85	300	110	Open	7,520	1.23
243	188	186	285.51	300	110	Open	7,520	1.23
244	186	187	146.45	300	110	Open	7,520	1.23
250	187	192	137.55	300	110	Open	7,520	1.23
251	192	198	238.62	300	110	Open	4,576	0.75
252	198	199	290.5	160	110	Open	0	0
253	198	200	119.83	300	110	Open	4,576	0.75
254	200	219	460.49	300	110	Open	2,143	0.35
255	219	218	25.44	200	110	Open	999	0.37
256	214	218	353.29	160	110	Open	145	0.08
257	218	220	868.13	225	110	Open	1,144	0.33
259	214	215	33.75	160	110	Open	423	0.24
260	201	214	107.36	160	110	Open	568	0.33
261	200	201	28.28	200	110	Open	2,433	0.9
262	201	202	17.78	110	110	Open	211	0.26
263	202	204	632.9	110	110	Open	211	0.26
264	204	207	713.14	110	110	Open	326	0.4
266	203	204	199.48	160	110	Open	115	0.07
267	203	205	16.29	160	110	Open	−115	0.07
271	209	207	300.21	160	110	Open	980	0.56
272	207	210	374.55	110	110	Open	162	0.2
273	205	212	412.83	225	110	Open	429	0.13
274	205	223	203.47	160	110	Open	1,000	0.58
275	223	209	69.13	160	110	Open	980	0.56
276	223	211	406.91	110	110	Open	20	0.02
277	211	210	449.15	160	110	Open	982	0.57
278	212	211	203.44	160	110	Open	961	0.55
279	213	212	270.61	160	110	Open	532	0.31
280	201	216	126.42	225	110	Open	1,654	0.48
283	217	213	412.13	110	110	Open	109	0.13
286	182	224	35.61	225	110	Open	2,044	0.59

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
287	224	226	97.56	160	110	Open	1,727	0.99
290	227	229	653.56	160	110	Open	1,144	0.66
292	224	225	348.98	225	110	Open	317	0.09
293	225	184	1849.61	160	110	Open	317	0.18
302	242	24	658.31	160	110	Open	476	0.27
303	240	241	173.51	160	110	Open	0	0
304	242	240	181.77	160	110	Open	−1,193	0.69
305	10	239	94.41	110	110	Open	1,028	1.25
306	239	240	251.41	160	110	Open	1,193	0.69
307	239	243	209.09	110	110	Open	323	0.39
308	243	242	216.99	90	110	Open	323	0.59
311	9	244	128.73	110	110	Open	610	0.74
315	220	250	526.13	160	110	Open	1,144	0.66
316	154	251	188.69	225	110	Open	2,225	0.65
317	251	153	69.35	225	110	Open	1,861	0.54
318	251	194	20.58	225	110	Open	363	0.11
319	16	252	193.95	600	110	Open	23,323	0.95
320	252	35	167.94	600	110	Open	22,725	0.93
42	17	259	94.34	160	110	Open	208	0.12
153	259	257	94.52	160	110	Open	208	0.12
193	257	252	111.05	160	110	Open	208	0.12
223	252	253	122.83	160	110	Open	806	0.46
321	253	256	170.34	160	110	Open	806	0.46
322	98	92	86.27	160	110	Open	453	0.26
323	235	237	381.35	160	110	Open	1,144	0.66
324	45	43	187.67	160	110	Open	1,576	0.91
326	244	11	496.38	160	110	Open	−919	0.53
327	239	244	329.6	110	110	Open	−489	0.6
328	235	234	55.05	160	110	Open	−583	0.34
329	234	233	167.35	160	110	Open	−583	0.34
330	233	232	182.39	160	110	Open	−583	0.34
332	164	165	207.25	110	110	Open	351	0.43
333	165	168	38.67	110	110	Open	351	0.43
334	168	166	157.76	110	110	Open	577	0.7
335	166	154	349.81	160	110	Open	1,569	0.9
338	237	12	802.56	160	110	Open	1,144	0.66
341	25	13	131.31	160	110	Open	1,705	0.98
342	13	34	43.17	160	110	Open	1,705	0.98
343	34	235	284.57	160	110	Open	1,705	0.98
344	6	38	262.11	160	110	Open	0	0
346	38	42	143.69	160	110	Open	0	0
11	226	50	126.42	160	110	Open	1,144	0.66
12	50	227	499.62	160	110	Open	1,144	0.66
20	226	52	280.96	160	110	Open	583	0.34
35	52	58	55.77	160	110	Open	583	0.34
39	58	232	243.77	160	110	Open	583	0.34
43	136	63	151.36	160	110	Open	80	0.05
51	63	128	111.52	160	110	Open	−125	0.07
52	63	61	156.22	110	110	Open	205	0.25
53	61	60	211	110	110	Open	205	0.25
56	60	59	353.71	110	110	Open	205	0.25
58	145	59	90.41	110	110	Open	−322	0.39
59	59	147	162.77	110	110	Open	−116	0.14
60	215	65	318.75	160	110	Open	423	0.24
62	65	213	220	160	110	Open	423	0.24
67	216	66	49.94	225	110	Open	1,654	0.48
69	66	217	55.55	225	110	Open	1,654	0.48
70	217	67	46.22	225	110	Open	1,545	0.45
71	67	205	211.73	225	110	Open	1,545	0.45
27	127	22	128.62	300	110	Open	−5,578	0.91
28	256	37	65.6	225	110	Open	−3,197	0.93
29	256	40	490.73	225	110	Open	2,963	0.86