THE LAO PEOPLE'S DEMOCRATIC REPUBLIC
DEPARTMENT OF HOUSING AND URBAN PLANNING (DHUP)
OF MINISTRY OF PUBLIC WORKS AND TRANSPORT,
DEPARTMENT OF PUBLIC WORKS AND TRANSPORT (DPWT)
OF VIENTIANE CAPITAL,
VIENTIANE CAPITAL WATER SUPPLY STATE ENTERPRISE (NPNL)

THE LAO PEOPLE'S DEMOCRATIC REPUBLIC

THE PREPARATORY SURVEY ON VIENTIANE CAPITAL WATER SUPPLY EXPANSION PROJECT

FINAL REPORT SUPPORTING REPORT

JUNE 2015

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

NIHON SUIDO CONSULTANTS CO., LTD.

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A.1 Project Location Map

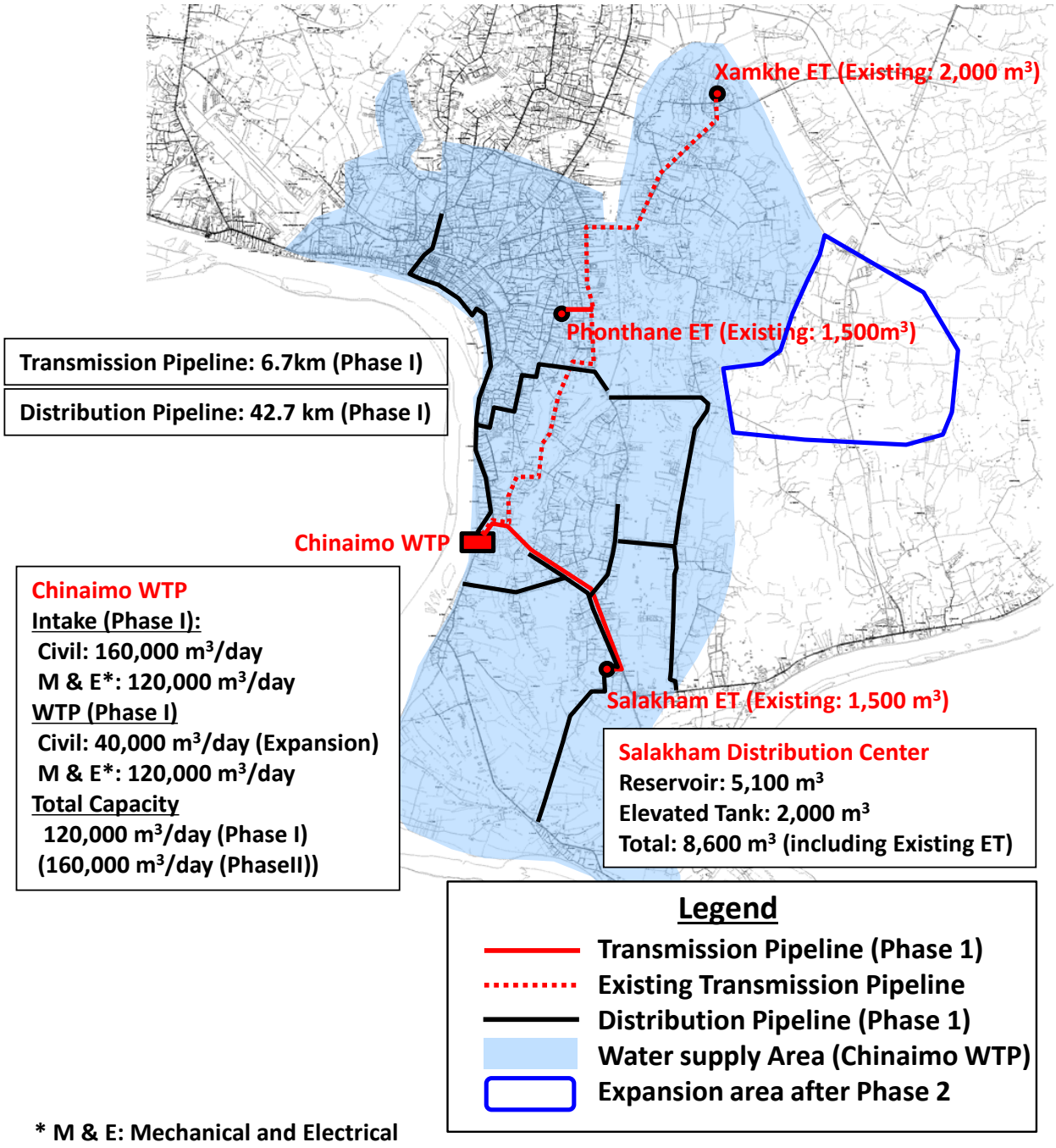


Figure A.1.1 Project Location Map

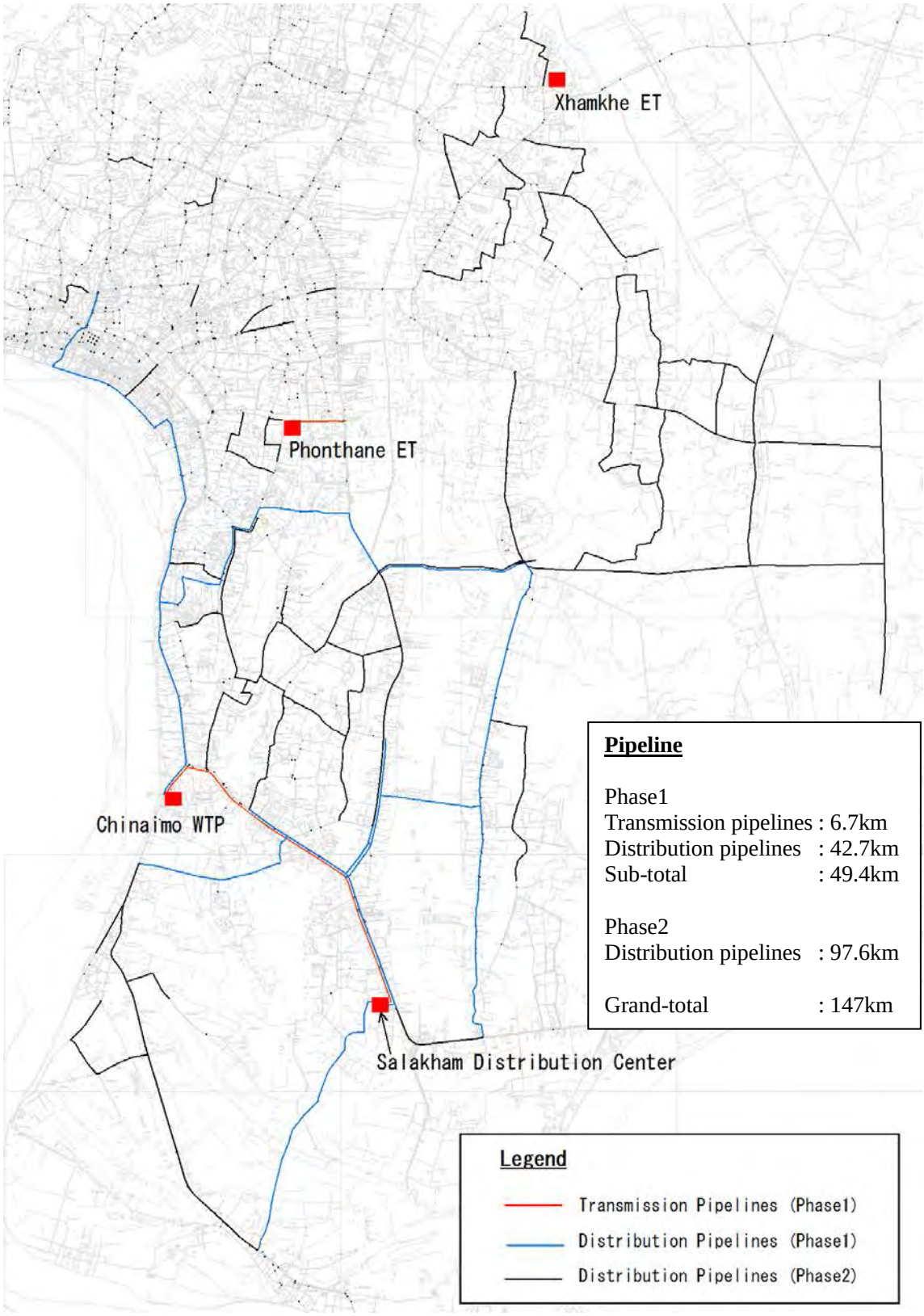


Figure A.1.2 Supplement Project Map for Pipeline Construction

A.2 Expected Project Scope (Tables)

Intake and Raw Water Transmission Facilities

Facility			Specifications and Dimensions
Function	Component	Item	
Raw Water Intake	Intake Screen		Reinforced Concrete Structure, 3sets
	Intake Pipe		DIP Pipe for Pipe Jacking Method ϕ 1,350 A Elevation of Installation : Upper level ＋161.00m L=15.50m Middle level ＋158.00m L=19.90m Lower level ＋155.00m L=28.00m
	Coarse Screen		2 sets of bar screen racks, FB 9 x 75 @70 mm, 3.0 m width x 20.5 m height 1 unit of movable trash rack rake, rake 3.7 kW, rake opening 3.0 kW and traveling 2.2 kW
	Fine Screen		2 units of dual flow traveling net screens, water channel width 3.0 m x depth of 20.5 m, screen surface width 1.83 m, 2.0 kW
	Intake Shaft		Reinforced Concrete Structure, Spread Foundation Parallelogram Shape: : W12.50～7.50m × L13.20m × H19.50m, 20.50m (inner dimension) Water Level : HWL＋170.45m LWL+157.00m
	Receiving Well		Reinforced Concrete Structure, Spread Foundation Rectangular Shape : W3.00m × L6.00m × H8.30m(inner dimension)× 2 Water Level : HWL＋170.60m LWL+175.50m Detention Time : T= 2min, Volume : V= 240 m^3
	Raw Water Intake Pump Facility	Raw Water Pump	Type: Water Sealed Submersible Motor Pump (Variable speed) Number: Phase I: 3 units (3 duty) Phase II: 2 units (1 duty and 1 standby) Capacity: 29.5 m3/min Head: 22 m Motor output: 160 kW
		Crane (Pump room)	Type: Single beam overhead motorized crane with motorized wire hoist Number: 1 unit Capacity:7.5 ton
		Crane (Pump suction well)	Type: Single beam overhead motorized crane with motorized wire hoist Number:1unit Capacity:2.0 ton
	Power Sub-station & Electrical Power Supply System		1unit of 22 kW incoming panel 2 units of 22 kW feeder panels 1 unit of 1,000 kVA transformer, 22 kV/380V (Phase I) 1 unit of 1,000 kVA transformer, 22 kV/380V (Phase II) 2 units of 380 V incoming panels 3 units of raw water pump panels (Phase I) 2 units of raw water pump panels (Phase II)
Raw Water Transmission	Pipes	Raw Water Transmission Pipe	DIP, Diameter : ϕ 900A Inflow of Receiving Well ϕ 1100A Outflow of Receiving Well ϕ 1200A From Intake Shaft to Receiving Well ϕ 1400A From Receiving Well to Rapid mixing basins
		Connecting Pipe	DIP, Diameter : ϕ 500A Conection to Exisnting Pipes
		Drain Pipe and Overflow Pipe for Receiving Well	DIP, Diameter : ϕ 300A Drain Pipe ϕ 800A Overflow Pipe

Water Treatment Facilities

Facility			Specifications and Dimensions
Function	Component	Item	
Water Treatment Facility	Rapid mixing basins		(Phase I : 44,000m3/ day) Reinforced Concrete Structure, Spread Foundation Rectangular Shape : W 4.00m × L2.00m × H3.50m(inner dimension)

Facility			Specifications and Dimensions
Function	Component	Item	
			Inflow Pipe：DIP, Diameter： ϕ 700A Outflow Pipe：DIP, Diameter ϕ 500A × 2 (Phase II：44,000m3/ day) Reinforced Concrete Structure, Spread Foundation Rectangular Shape：W 4.00m × L2.00m × H3.50m(inner dimension) Inflow Pipe：DIP, Diameter： ϕ 700A Outflow Pipe：DIP, Diameter ϕ 500A × 2
	Flocculation Basin		(Phase I：44,000m3/ day) Reinforced Concrete Structure, Spread Foundation Slow Mixing Method: Vertical channel bands flocculator Quantity： 4 Internal Dimension：W6.70m × L7.00m × H2.99m～3.85m Detention Time：T= 21min, Mean Velocity：V= 12.20 cm/s (Phase II：44,000m3/ day) Reinforced Concrete Structure, Spread Foundation Slow Mixing Method: Vertical channel bands flocculator Quantity: 4 Internal Dimension：W6.70m × L7.00m × H2.99m～3.85m Detention Time：T= 21min, Mean Velocity：V= 12.20 m/s
	Sedimentation Basin		(Phase I：44,000m3/day) Reinforced Concrete Structure, Spread Foundation Supernatant Collecting System: Collecting Trough + Submerged Orifice Quantity： 2 Internal Dimension：W13.60m × L63.80m × H3.01m～2.51m Surface Loading：Q/A=17.6 mm/min、Mean Velocity：V=0.40 m/min (Phase II：44,000m3/ day) Reinforced Concrete Structure, Spread Foundation Supernatant Collecting System: Collecting Trough + Submerged Orifice Quantity： 2 Internal Dimension：W13.60m × L63.80m × H3.01m～2.51m Surface Loading：Q/A=17.6 mm/min、Mean Velocity：V=0.40 m/min
	Rapid Sand Filter		(Phase I：44,000m3/ day) Reinforced Concrete Structure, Spread Foundation Quantity: 4 Internal Dimension：W5.50m × L14.00m × H2.77m Filtration Area：V=77.00 m^2, Filtration Rate：V=143.00 m/day Filter Sand Thickness：100 cm Underdrain System: Nozzle Type of Filtration: Common inlet and outlet water level, outlet flow control, constant filtration Washing Method: Air scouring and water backwashing Washing Rate: Air scouring:1 m^3/m^2/min Water backwash: High; 0.4 m^3/m^3/min and Low:0.2 m^3/m^2/min (Phase II：44,000m3/ day) Reinforced Concrete Structure, Spread Foundation Quantity: 4 Internal Dimension：W5.50m × L14.00m × H2.77m Filtration Area：V=77.00 m^2, Filtration Rate：V=143.00 m/day Filter Sand Thickness：100 cm Underdrain System: Nozzle Type of Filtration: Common inlet and outlet water level, outlet flow control, constant filtration Washing Method: Air scouring and water backwashing Washing Rate: Air scouring:1 m^3/m^2/min

Facility			Specifications and Dimensions
Function	Component	Item	
			Water backwash: High; 0.4 m^3/m^3/min and Low:0.2 m^3/m^2/min
	Filter Washing Facilities	Air Scouring Blowers	Type: Rotary, positive displacement roots type with acoustic box Number: 2 units (1 duty + 1 standby) Capacity: 77 m^3/min Pressure: 35 kPa Motor output: 110 kW
		Backwash Pumps	Type: Horizontal double suction volute pump Number: 3 units (2 duty + 1 standby) Capacity: 15.5 m^3/min Head: 10 m Motor output: 37 kW
	Clear Water Reservoir		Reinforced Concrete Structure, Spread Foundation Quantity : 1 Internal Dimension : W29.50m × L34.50m × H5.70m Water Level : HWL＋170.61m LWL+165.61m Effective Water Depth : H=5.00m, Effective Volume : V=9,800 m^3 (4,900m^3 × 2)
	Chemical Feeding Building		Reinforced Concrete Structure, Two Stories Building, Total Floor Area: 1,800 m^2 Usage: 1st Floor: Polymer Feed Room, Alum Storage Room, Chemical Unloading Space, Alum Feed Room, Chemical Control Room, Safety Equipment Storage Room, Control Room, Container Storage Room 2nd Floor: Chemical Feeding Room, Blower Room, Feeder Room, Control Room Common: Staircase
	Alum Feed System	Alum Solution Preparation Tanks	Type: Cylindrical FRP tank having stainless steel alum stone loading cage Number: 4 tanks Capacity:15 m^3 (effective volume)
		Alum Solution Mixing Blowers	Type: Root type rotary blower, V-belted with motor Number: 2 units Capacity:1.78 m3/min x 35 KPa Motor output: 2.2 kW
		Alum Feed Pumps	Phase I Large pump; Type: Manual diaphragm metering pump Number: 3 units (2 duty + 1 standby) Capacity: 13.7 - 1.37 L/min Motor output: 0.75 kW Small Pump; Type: Manual diaphragm metering pump Number: 3 units (2 duty + 1 standby) Capacity:7.5 - 0.75 L/min Motor output: 0.4 kW Phase II Small Pump; Type: Manual diaphragm metering pump Number: 3 units (2 duty + 1 standby) Capacity:7.5 - 0.75 L/min Motor output: 0.4 kW
		Alum Handling Hoist	Type: Motorized chain hoist with electric trolley Number: 1 unit Capacity: 1 ton

Facility			Specifications and Dimensions
Function	Component	Item	
		Alum Stone Handling Equipment 1	Type: Diesel engine drive forklift truck Number: 2 units Capacity: 2 ton
		Alum Stone Handling Equipment 2 Polymer Preparation Units	Type: Manual hand pallet truck Number: 2 units Capacity: 1 ton Type: Package type, automatic batch solution preparation system having powder feeder, mixing device and solution tank with mixer, piping and control panel Number: 2 units Capacity:40 batches, each batch having at least 5 kg/hr and 66,640 L/day
	Polymer Feed System	Polymer Feed Pumps	Phase I Large pump; Type: Progressing cavity pump Number: 2 units (1 duty + 1 standby) Capacity: 21 -1 L/min Pump speed: Not greater than 400 min-1 Motor output: 0.75 kW Small Pump; Type: Progressing cavity pump Number: 2 units (1 duty + 1 standby) Capacity: 10.5 -0.5 L/min Pump speed: Not greater than 400 min-1 Motor output: 0.4 kW Phase II Type: Progressing cavity pump Number: 2 units (1 duty + 1 standby) Capacity: 10.5 -0.5 L/min Pump speed: Not greater than 400 min-1 Motor output: 0.4 kW
		Polymer Handling Hoist	Type: Motorized chain hoist with electric trolley Number: 1 unit Capacity: 1 ton
		Ton Container Weighing Scales	Type: Platform electrical load cell Number: 2 units Weighing capacity: 6,000 kg Indication: 0 – 3,000 kgh Weighing graduation: Min. 5 kg
	Chlorination System	Chlorinators	Type: Manual control solution fed, vacuum type Number: Pre-chlorination: 2 units (1 duty and 1 standby) Post-chlorination: 2 units (1 duty and 1 standby) Capacity: 20 kg/hr Feed range: An adjustable range of 20:1 at least
		Container Handling Hoist	Type: Motorized wire hoist, low head with electric trolley Number: 1 unit Capacity: 2 ton
		Chlorine Water Booster Pumps	Type: Vertical multi-stage pump Number: Pre-chlorination: 2 units (1 duty and 1 standby) Post-chlorination: 2 units (1 duty and 1 standby) Capacity: 250 L/min Head: 50 m

Facility			Specifications and Dimensions
Function	Component	Item	
			Motor output: 5.5 kW
		Neutralization System	Type: Package type chlorine gas neutralization system having scrubber absorber, integral caustic soda tank, caustic soda circulation pump, air blower and control panel Capacity: 1 ton chlorine gas with leak rate, not less than 45 kg of chlorine gas per minutes, removing not less than 99 percent of chlorine gas Reaction solution: Caustic soda having chemical strength of 20% Caustic soda tank: FRP 8 m^3 Circulation pump: 1 unit x 124 m^3/hr x 15 kW Air blower: 1 unit x 5,000 m3/hr x 3.7 kW
		Chlorine Gas Leakage Detectors	Type: Not-reagent electrochemical gas sensing Number: 6 sets of sensor Detecting rage: 10 ppm Indication: Control panel with 6 indicators
		Safety Equipment	Safety Equipment consisting of: 2 sets of compressed air breathing apparatus consisting of 6 L air cylinder, full face mask, waist strap and others 2 sets of PVC protecting clothing consisting of long sleeve jacket, pants, hood, glove, boots 2 sets of first aid medicine kit with hard plastic carrying case 2 sets of emergency repair kit with hard plastic carrying case
	Calcium Hypochlorite Feed System (Emergency standby system for chlorination system)	Calcium Hypochlorite Preparation Tanks	Type: Cylindrical FRP tank Number: 2 tanks Capacity: 15 m^3 (effective volume) Accessories: Mechanical mixer, 2.2 kW for each tank
		Calcium Hypochlorite Circulation Pump	Type: PVC horizontal shaft chemical pump Number: 2 units (1duty + 1 standby) Capacity: 20 L/min Head: 12 m Motor output: 0.4 kW
		Gravity Measuring and Feeding Unit	Type: Rectangular tank Number: 1 unit Material: PVC Accessories: Rotameter type flow meters
		Calcium Hypochlorite Handling Hoist	Type: Motorized chain hoist with electric trolley Number: 1 unit Capacity: 1 ton
	Administration Building		Reinforced Concrete Structure, Two Stories Building, Total Floor Area: 550 m2 Usage: 1st Floor: Entrance, Administration office, Laboratory Manager Room, Laboratory Office, Laboratory, Examination Room and Toilet. 2nd Floor: Manager Room, Control Room, Meeting Room, Nap Room, Rest Room, Storage, Shower Room and Toilet. Common: Staircase
	Pipes	Raw Water Transmission Pipe	DIP, Diameter： ϕ 500A、 ϕ 700A、 ϕ 1200A 、 ϕ 1400A
		Connecting Pipe	DIP, Diameter： ϕ 1100A
		Backwash Pipe	DIP, Diameter： ϕ 600A
		Transmission Pipe	DIP, Diameter： ϕ 700A (to Salakham Reservoir)
		Distribution Pipe	DIP, Diameter： ϕ 1200A
	Power		1 unit of Incoming Panel

Facility			Specifications and Dimensions
Function	Component	Item	
	Sub-station & Electrical Power Supply System		4 units of Feeder Panel Transformer 22 kV/3.3 kW Phase I: 1 unit Phase II: 1 unit Transformer 22 kW/380 V Phase I: 1 unit Phase II: 1 unit 2 units of 3.3 kV Incoming Panel Distribution Pump Panel Phase I: 3 units Phase II 2 units 3 units of Transmission Pump A Panel Transmission Pump B Panel Phase I: 3 units Phase II: 1 unit 3 units of Backwash Pump Panel 2 units of Air Scouring Blower Panel 2 units of 380 V Incoming Panel 2 unit of 380 V Feeder Panel

Transmission Facilities

Facility			Specifications and Dimensions
Function	Component	Item	
Treated Water Transmission	Transmission Pump	Transmission Pump A (to Phonethan & Xamkhe Elevated Tanks)	Type: Water sealed submersible motor pump Number: Phase I:3 units (2 duty + 1 standby) Phase II: 0 unit Capacity: 5.6 m3/min Head: 50 m Motor output: 90 kW
		Transmission Pump B (to Salakham Reservoir)	Type: Water sealed submersible motor pump Number: Phase I:3 units (2 duty + 1 standby) Phase II: 1 unit Capacity: 11.5 m3/min Head: 30 m Motor output:132 kW
	Transmission Pipeline	to Salakham Reservoir	DIP, Diameter : ϕ 700A L=5,815m
		to Phonethan & Xamkhe Elevated Tanks	DIP, Diameter : ϕ 450A L=885m

Distribution Facilities

Facility			Specifications and Dimensions Component
Function	Component	Item	
Chinaimo WTP	Distribution Pump	Distribution Pump Large	Type: Horizontal double suction volute pump Number: Phase I: 3units (2 duty + 1 standby) Phase II: 2 units Capacity: 24 m^3/min Head: 60 m Motor output: 355 kW
		Distribution Pump Small (existing distribution pumps will be replaced with new	Type: Horizontal double suction volute pump Number: Phase I: 3units (2 duty + 1 standby) Phase II: 1 unit Capacity: 12 m^3/min

Facility			Specifications and Dimensions Component
Function	Component	Item	
		pumps)	Head: 60 m Motor output: 220 kW (to use existing motors)
		Crane (Pump room)	Type: Single beam overhead motorized crane with motorized wire hoist Number: 1 unit Capacity:7.5 ton
		Hoist (Pump room)	Type: Motorized wire hoist with electric trolley Number: 1 unit Capacity: 7.5 ton
		Crane (Pump room)	Type: Single beam overhead motorized crane with motorized wire hoist Number: 1 unit Capacity:5.0 ton
Salakham Distribution Center	Salakham Reservoir (1)		Reinforced Concrete Structure, Spread Foundation Quantity： 1 Internal Dimension： ϕ 33.00 m ×H7.20 m Water Level：HWL＋175.20m LWL+169.20m Effective Water Depth：H=6.00 m, Effective Volume：V=5,100 m^3
	Salakham Reservoir (2)		Reinforced Concrete Structure, Spread Foundation (elevated reservoir of reservoir (1)) Quantity： 1 Internal Dimension： ϕ 20.60 m ×H7.70 m(Top of dome) Water Level：HWL＋206.54m LWL+200.54m Effective Water Depth：H=6.00 m, Effective Volume：V=2,000 m^3
	Treated Water Pumping Facilities	High Lift Pumps	Type: Water sealed submersible motor pump Number: Phase I: 4 units (3 duty + 1 standby) Phase II: 1 unit Capacity: 12.5 m^3/min Head: 37 m Motor output: 132 kW
		Hoist (Pump room)	Type: Motorized wire hoist with electric trolley Number: 1 unit Capacity: 5.0 ton
	Power Sub-station and Electrical Power Supply System		1 unit of Incoming Panel 2 units of 22 kV Feeder Panel Transformer Phase I: 1 unit Phase II: 1 unit 2 units of 380 V Incoming Panel High Lift Pump Panel Phase I: 4 units Phase II: 1 unit
Distribution Pipe		to Salakham Area	(Phase I) DIP, Diameter： ϕ 300A L=2,308m DIP, Diameter： ϕ 350A L=6,221m DIP, Diameter： ϕ 400A L=11,086m DIP, Diameter： ϕ 500A L=724m DIP, Diameter： ϕ 600A L=1,093m DIP, Diameter： ϕ 800A L=1,341m DIP, Diameter： ϕ 1,000A L=2,224m DIP, Diameter： ϕ 1,100A L=258m (Phase II) DIP, Diameter： ϕ 150A L=9,578m DIP, Diameter： ϕ 200A L=7,299m DIP, Diameter： ϕ 250A L=6,019m DIP, Diameter： ϕ 300A L=9,173m DIP, Diameter： ϕ 350A L=841m DIP, Diameter： ϕ 400A L=1,679m
	Distribution Pipes	to Chinaimo Area	(Phase I) DIP, Diameter： ϕ 600A L=576m DIP, Diameter： ϕ 700A L=2,031m DIP, Diameter： ϕ 800A L=4,589m DIP, Diameter： ϕ 1,000A L=7,082m

Facility			Specifications and Dimensions Component
Function	Component	Item	
			DIP, Diameter : ϕ 1,200A L=3,156m (Phase II) DIP, Diameter : ϕ 150A L=13,377m DIP, Diameter : ϕ 200A L=13,361m DIP, Diameter : ϕ 250A L=2,877m DIP, Diameter : ϕ 300A L=2,321m DIP, Diameter : ϕ 350A L=6,015m DIP, Diameter : ϕ 400A L=1,577m DIP, Diameter : ϕ 500A L=2,607m DIP, Diameter : ϕ 600A L=845m DIP, Diameter : ϕ 700A L=2,308m
		to Phonethan Area	(Phase II) uPVC, Diameter : ϕ 150A L=3,277m uPVC, Diameter : ϕ 250A L=781m DIP, Diameter : ϕ 450A L=210m
		to Xamkhe Area	(Phase II) DIP, Diameter : ϕ 150A L=3,411m DIP, Diameter : ϕ 200A L=3,225m DIP, Diameter : ϕ 300A L=6,783m

A.3 Expected Project Scope (Drawings)

No.	Drawing Title	Dwg No.
Chinaimo Intake Facility		
Civil Drawings		
1 .	General Plan of Chinaimo Intake	IC-01
2 .	Intake Pipe Structure	IC-02
3 .	Intake Well Structure (1/9)	IC-03
4 .	Intake Well Structure (2/9)	IC-04
5 .	Intake Well Structure (3/9)	IC-05
6 .	Intake Well Structure (4/9)	IC-06
7 .	Intake Well Structure (5/9)	IC-07
8 .	Intake Well Structure (6/9)	IC-08
9 .	Intake Well Structure (7/9)	IC-09
10 .	Intake Well Structure (8/9)	IC-10
11 .	Intake Well Structure (9/9)	IC-11
12 .	Receiving Well Structure(1/1)	IC-12

No.	Drawing Title	Dwg No.
Architectural Drawings		
Administration Building		
1 .	Administration Building Elevation (1) (2)	IA - 01
2 .	Administration Building Elevation (3) (4)	IA - 02
3 .	Administration Building Plan of 1st Floor	IA - 03
4 .	Administration Building Plan of 2nd Floor	IA - 04
5 .	Administration Building Plan of Roof Top	IA - 05
6 .	Administration Building Section A-A	IA - 06
7 .	Administration Building Section B-B C-C	IA - 07
8 .	Administration Building Finishing Schedule Fitting List	IA - 08

No.	Drawing Title	Dwg No.
Mechanical Drawings		
1 .	Raw Water Pump Station Plan	IME-1
2 .	Raw Water Pump Station Section A-A	IME-2
3 .	Raw Water Pump Station Section B-B	IME-3

Chinaimo Water Treatment Plant

No.	Drawing Title	Dwg No.
Water Treatment Plant		
Civil Drawings		
1 .	General Plan of Chinaimo WTP	WC - 01
2 .	Water Treatment Facilities Structure	WC - 02
3 .	Flocculation Basin Structure (1/2)	WC - 03
4 .	Flocculation Basin Structure (2/2)	WC - 04
5 .	Sedimentation Basin Structure (1/4)	WC - 05
6 .	Sedimentation Basin Structure (2/4)	WC - 06
7 .	Sedimentation Basin Structure (3/4)	WC - 07
8 .	Sedimentation Basin Structure (4/4)	WC - 08
9 .	Rapid Sand Filter Structure (1/3)	WC - 09
10 .	Rapid Sand Filter Structure (2/3)	WC - 10
11 .	Rapid Sand Filter Structure (3/3)	WC - 11
12 .	Filter Piping Plan and Sections	WC - 12
13 .	Clear Water Reservoir Structure (1/4)	WC - 13
14 .	Clear Water Reservoir Structure (2/4)	WC - 14
15 .	Clear Water Reservoir Structure (3/4)	WC - 15
16	Clear Water Reservoir Structure (4/4)	WC - 16

No.	Drawing Title	Dwg No.
Architectural Drawings		
Chemical Feeding Building		
1 .	Chemical Building Elevation	WA - 01
2 .	Chemical Building Plan of 1st Floor	WA - 02
3 .	Chemical Building Plan of 2nd Floor	WA - 03
4 .	Chemical Building Section A-A	WA - 04
5 .	Chemical Building Section B-B	WA - 05
Chlorination Building		
6 .	Chlorination Building Elevation	WA - 06
7 .	Chlorination Building Plan of 1st Floor	WA - 07
8 .	Chlorination Building Plan of 2nd Floor	WA - 08
9 .	Chlorination Building Section A-A	WA - 09
10 .	Chlorination Building Section B-B	WA - 10
11 .	Chlorination Building Section C-C	WA - 11
Power Station House		
12 .	Power Station House Elevation Plan Section	WA - 12
Work Shop Building		
13 .	Work Shop Building Elevation Plan Section	WA - 13

No.	Drawing Title	Dwg No.
Water Treatment Plant		
Mechanical Drawings		
1 .	Plant Process Flow Diagram	WM-01
2 .	Alum and Polymer Feed System Flow Diagram	WM-02
3 .	Chlorination & Neutralization System Flow Diagram	WM-03
4 .	Chemical Building Plan of 1st Floor	WM-04
5 .	Chemical Building Plan of 2nd Floor	WM-05
6 .	Chemical Building Section A-A	WM-06
7 .	Chemical Building Section B-B	WM-07
8 .	Chlorination Building Plan 1st Floor	WM-08
9 .	Chlorination Building Plan 2nd Floor	WM-09
10 .	Chlorination Building Section A-A	WM-10
11 .	Chlorination Building Section B-B	WM-11
12 .	Chlorination Building Section C-C	WM-12
13 .	Pump Station Plan	WM-13
14 .	Pump Station Section	WM-14

No.	Drawing Title	Dwg No.
Water Treatment Plant		
Electrical Drawings		
1 .	Existing Electrical Power Receiving and Distribution Diagram	WE-01
2 .	Existing and New Electrical Power Receiving and Distribution Diagram	WE-02
3 .	Instrumentation Flow Diagram	WE-03
4 .	Schematic Diagram of SCADA	WE-04

Treated Water Transmission & Distribution

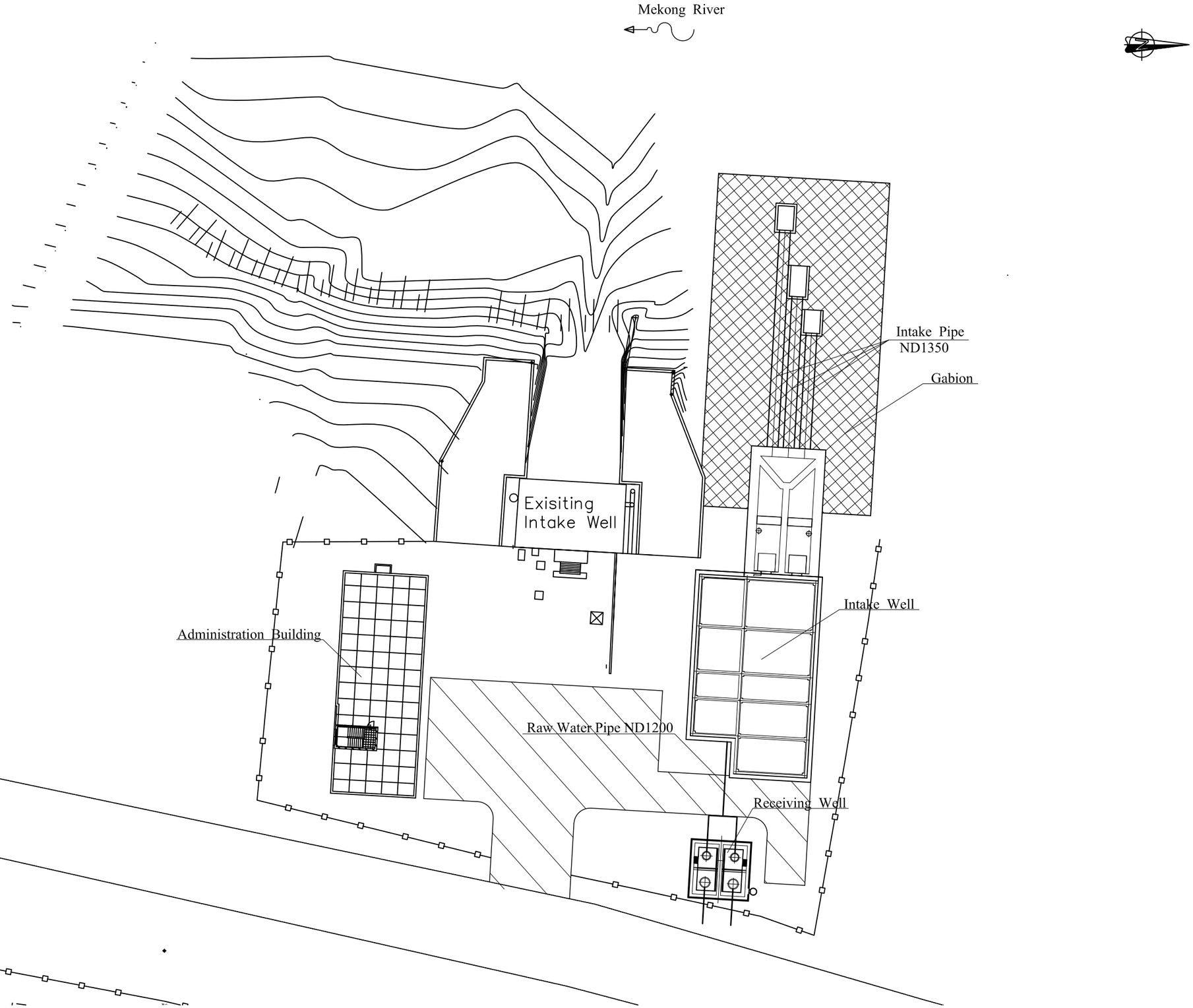
No.	Drawing Title	Dwg No.
Treated Water Transmission Main		
Pipe Drawings		
1 .	Key Plan	PW - 01

Salakham Reservoir and High Lift Pump Station

No.	Drawing Title	Dwg No.
Salakham Distribution Centre		
Civil Drawings		
1 .	General Plan of Salakham Distribution Centre	RC - 01
2 .	Salakham Reservoir Structure (1/3)	RC - 02
3 .	Salakham Reservoir Structure (2/3)	RC - 03
4 .	Salakham Reservoir Structure (3/3)	RC - 04
No.	**Drawing Title**	**Dwg No.**
Mechanical Drawings		
1	Salakham High Lift Pump Station Plan and Section	SDCME-01

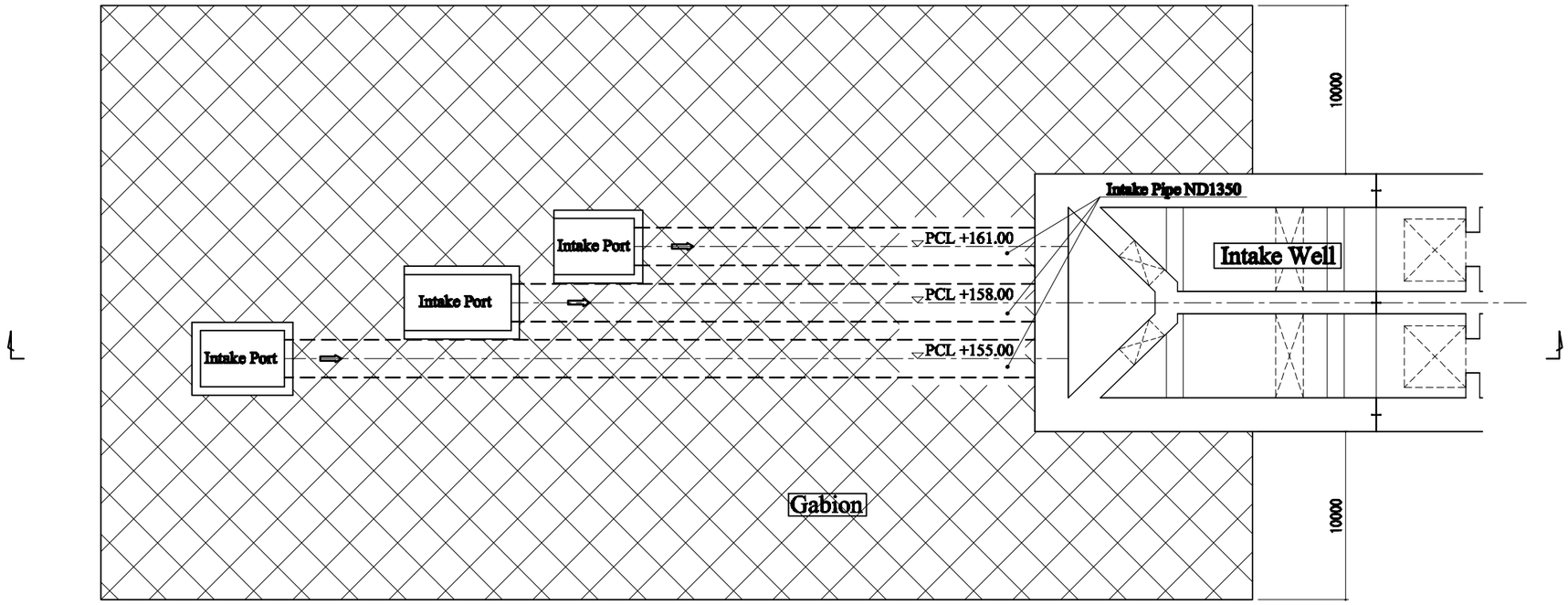
Transmission and Distribution Pipeline

No.	Drawing Title	Dwg No.
Transmission and Distribution Pipeline Drawings		
1 .	General Plan	VD - 01
2 .	Plan (1/4)	VD - 02
3 .	Plan (2/4)	VD - 03
4 .	Plan (3/4)	VD - 04
5 .	Plan (4/4)	VD - 05
6 .	Cross Section (1) (Transmission Pipeline)	VD - 06
7 .	Cross Section (2) (Chinaimo Distribution Area)	VD - 07
8 .	Cross Section (3) (Chinaimo Distribution Area)	VD - 08
9	Cross Section (4) (Chinaimo Distribution Area)	VD – 09
10	Cross Section (5) (Chinaimo Distribution Area)	VD – 10
11	Cross Section (6) (Salakham Distribution Area)	VD – 11
12	Cross Section (7) (Salakham Distribution Area)	VD – 12
13	Cross Section (8) (Salakham Distribution Area)	VD – 13
14	Cross Section (9) (Salakham Distribution Area)	VD – 14
15	Cross Section (10) (Salakham Distribution Area)	VD – 15
16	Typical Drawing for pipe laying (1)	TYP – 01
17	Typical Drawing for pipe laying (2)	TYP – 02

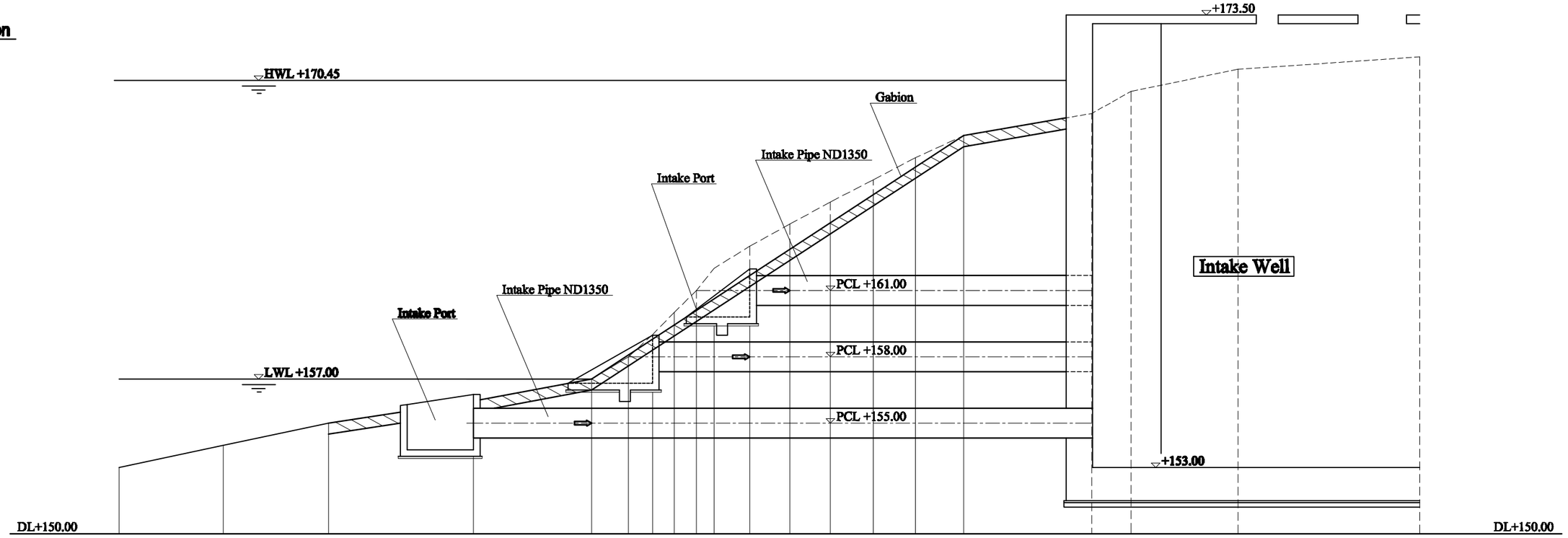


PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	General Plan of Chinaimo Intake				IC-01
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:500

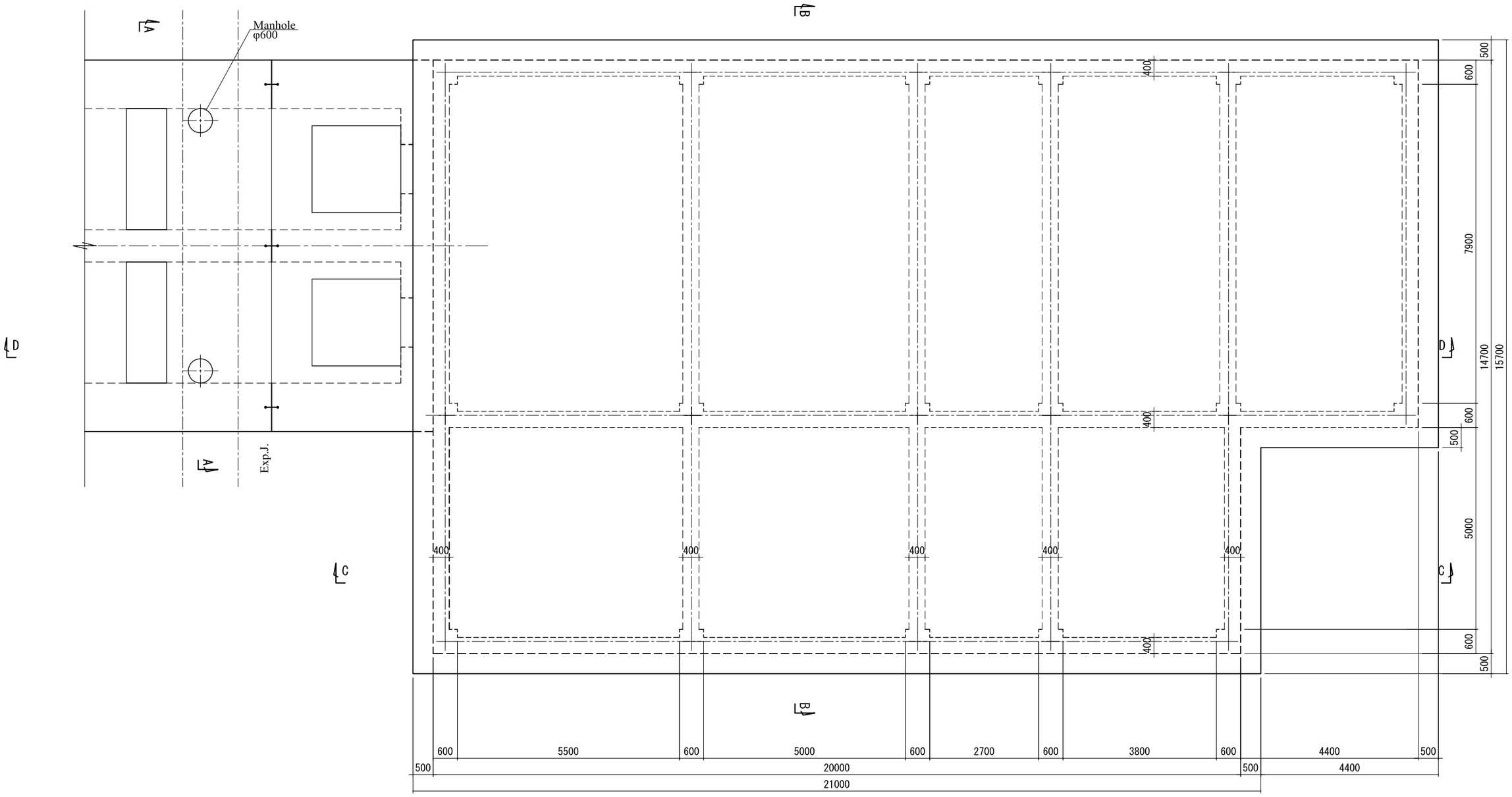
PLAN



Section

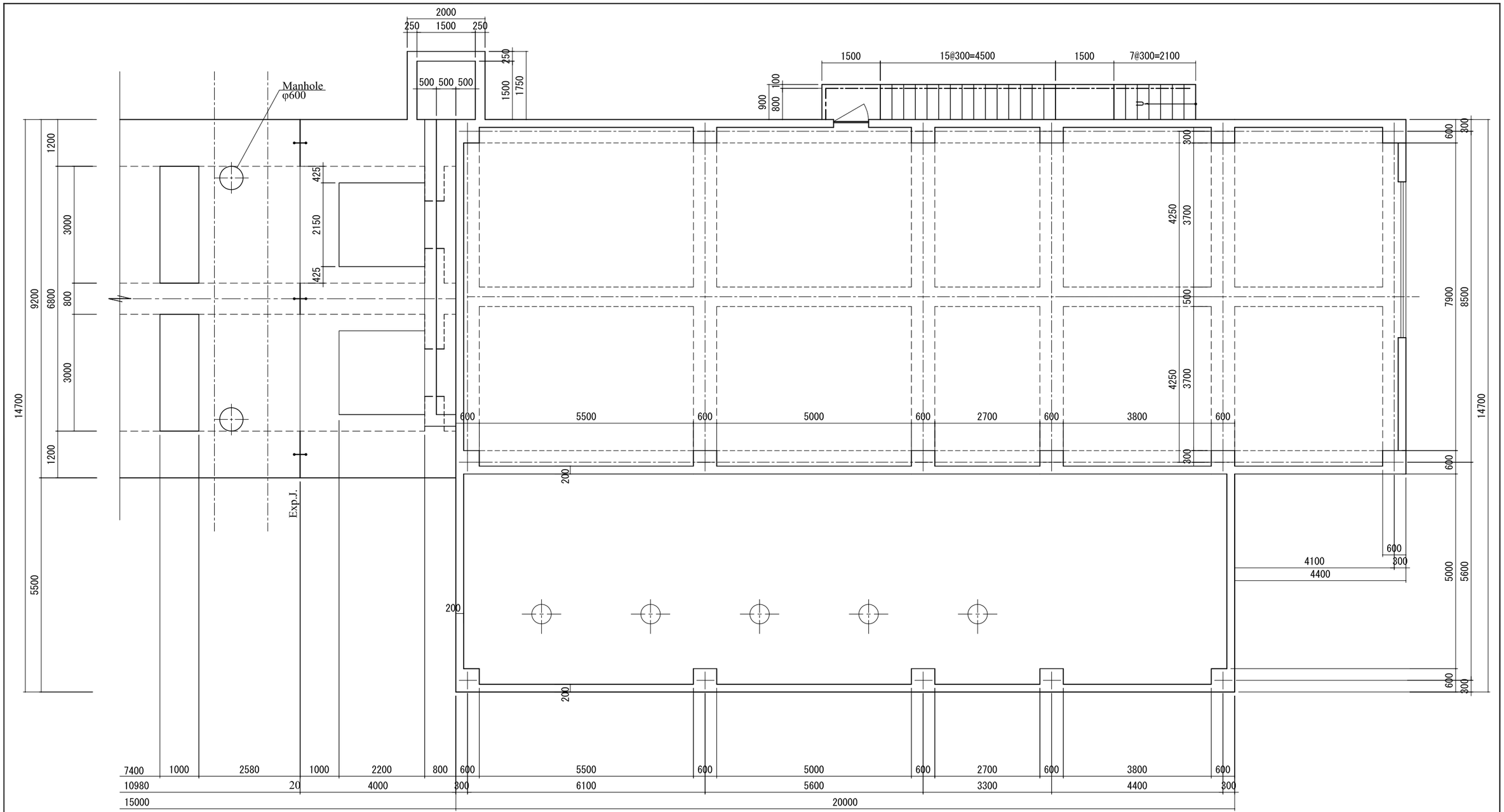


PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Intake Pipe Structure				IC-02
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:200



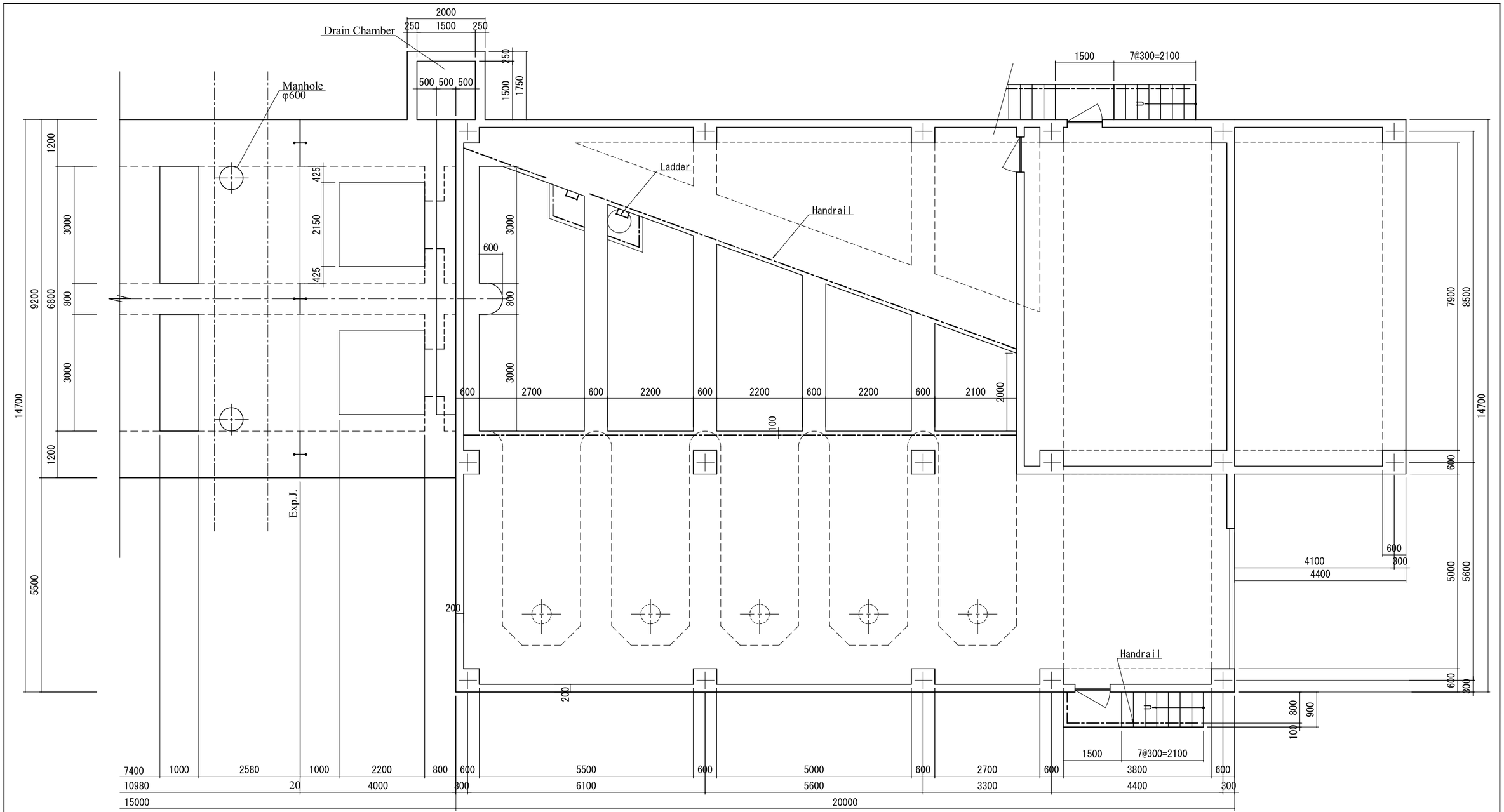
PLAN

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Intake Well Structure(1/9)				IC-03
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100



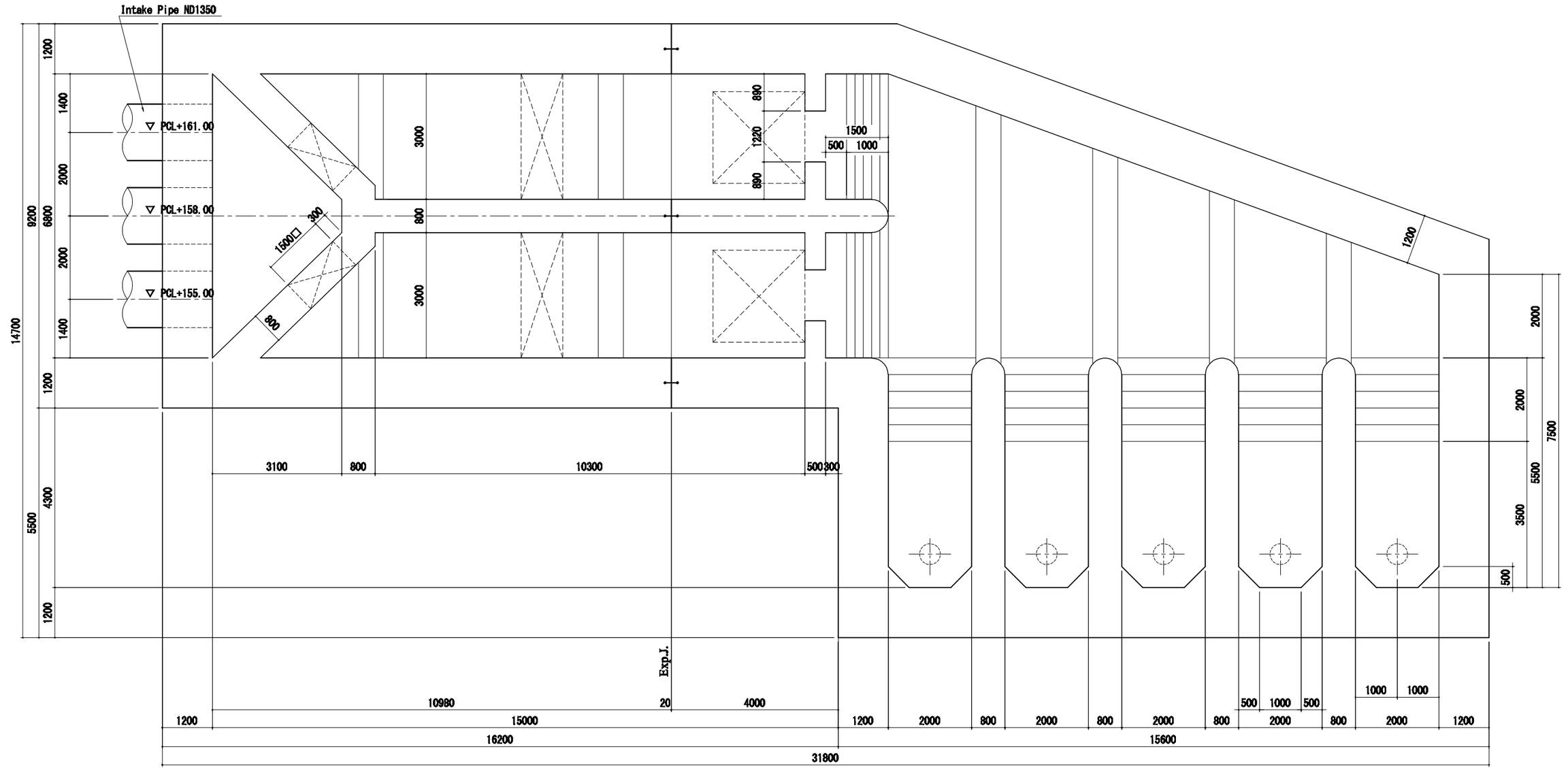
1 - 1 section

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Intake Well Structure(2/9)				IC-04
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100



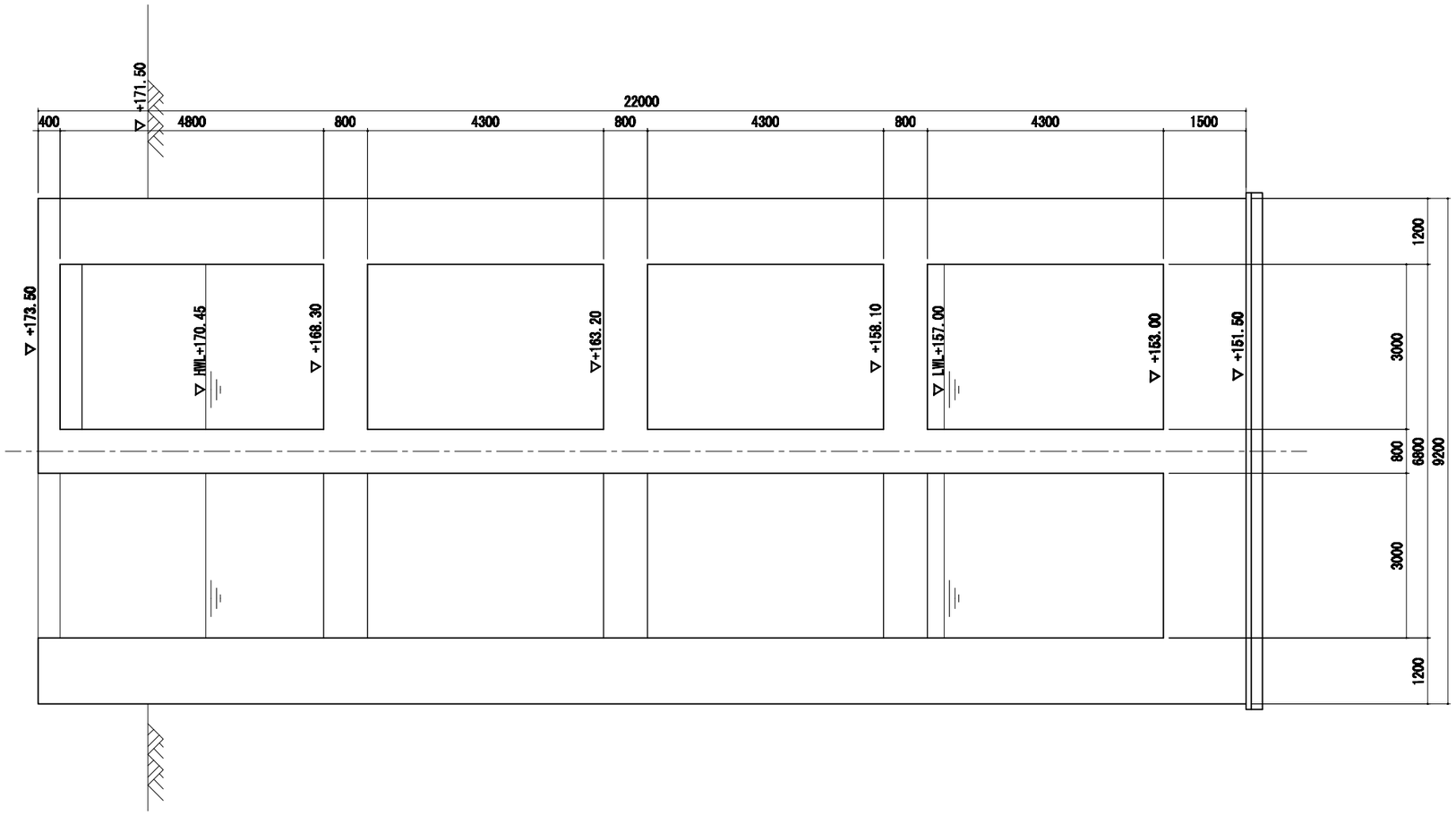
2 - 2 section

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Intake Well Structure(3/9)				IC-05
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100



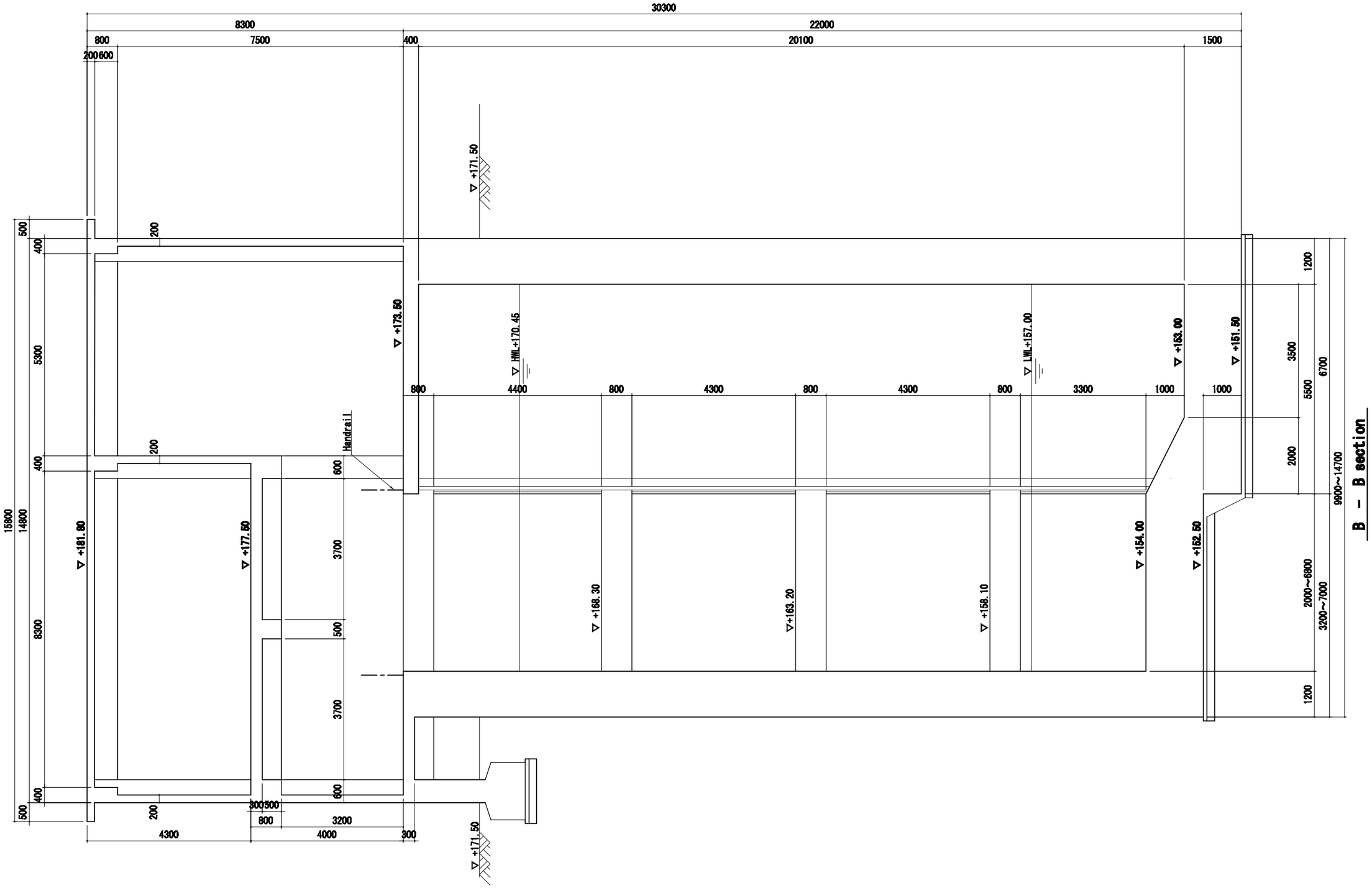
3 - 3 section

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Intake Well Structure(4/9)				IC-06
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100

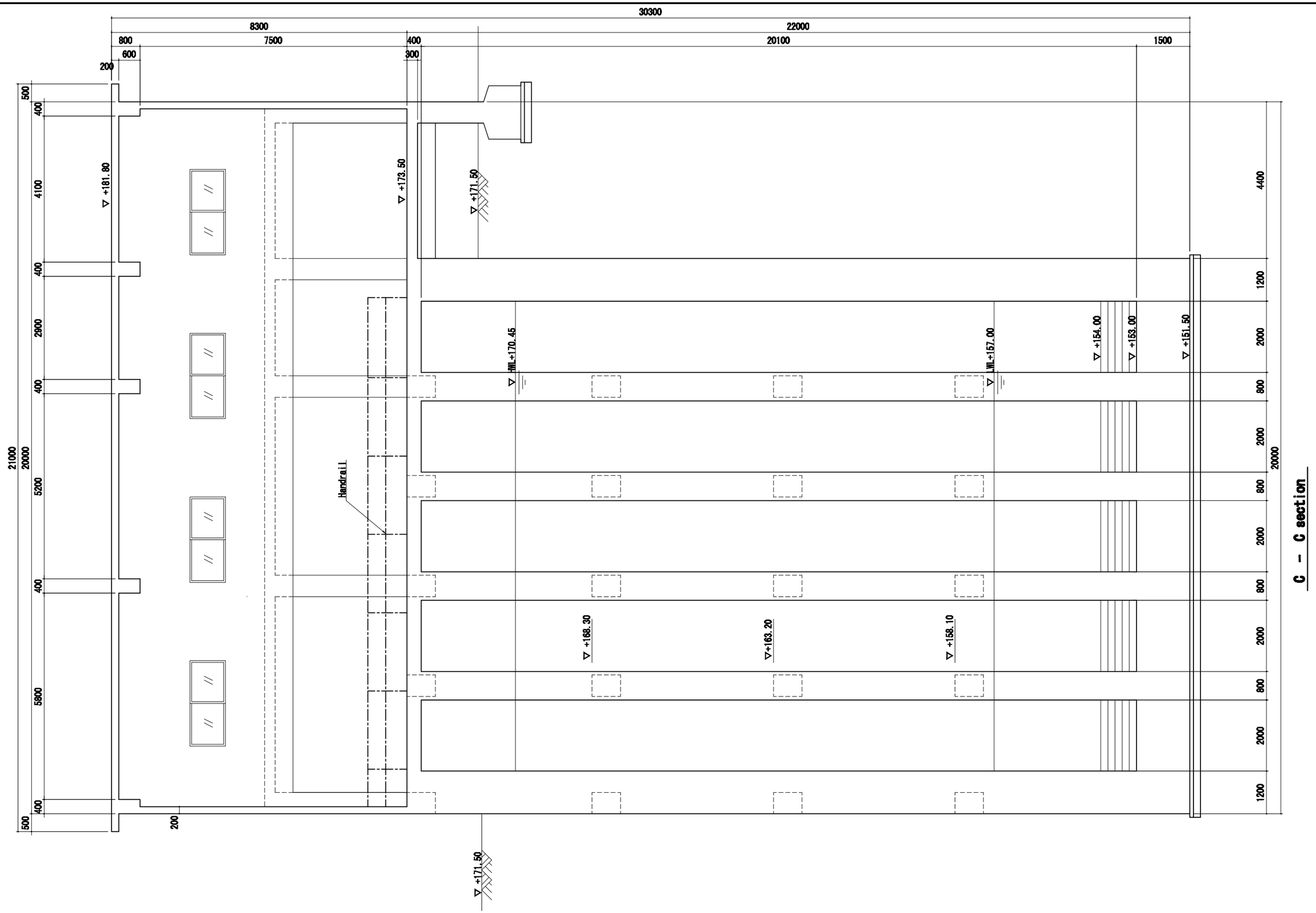


A – A section

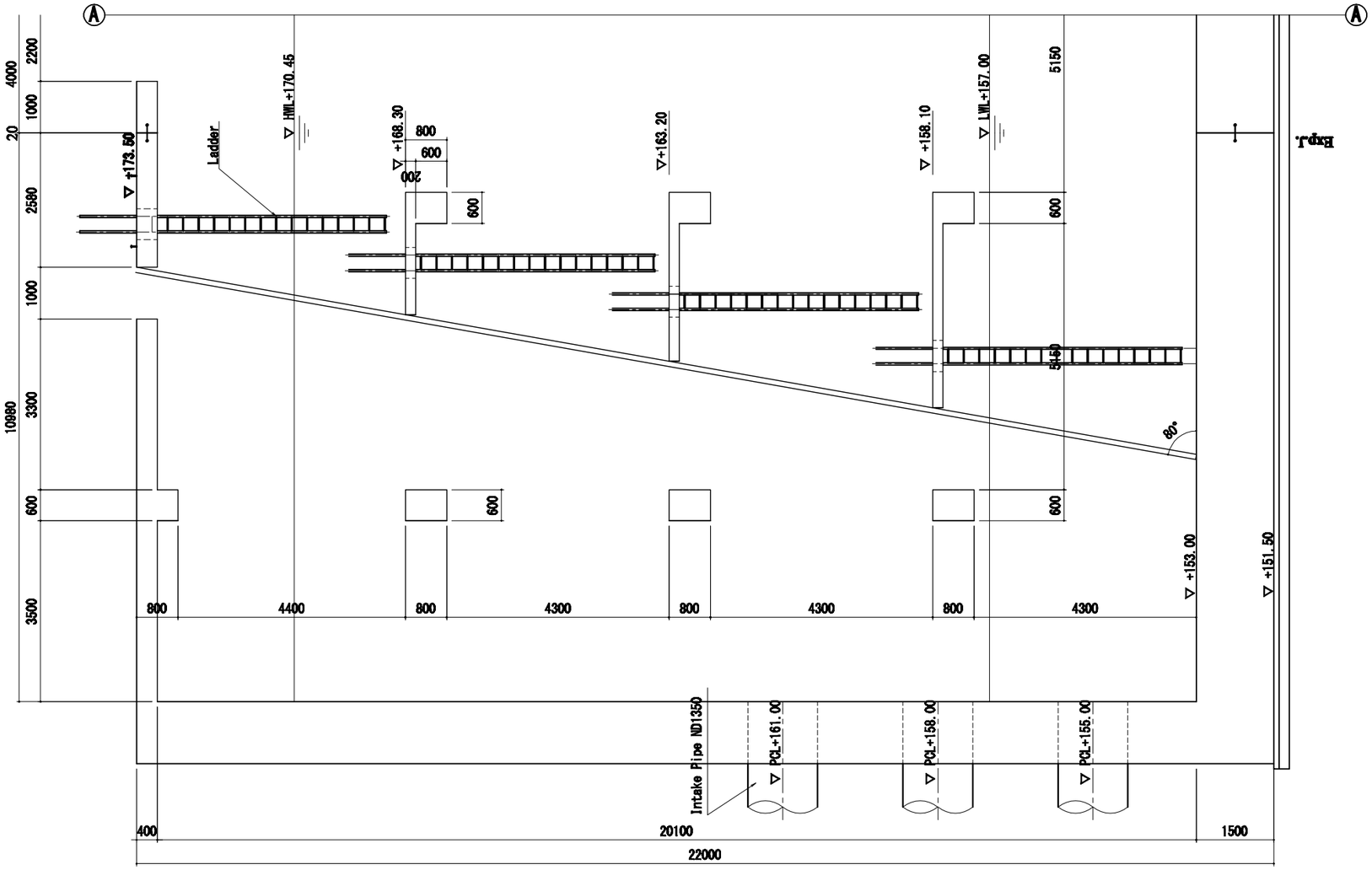
PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Intake Well Structure(5/9)				IC-07
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100



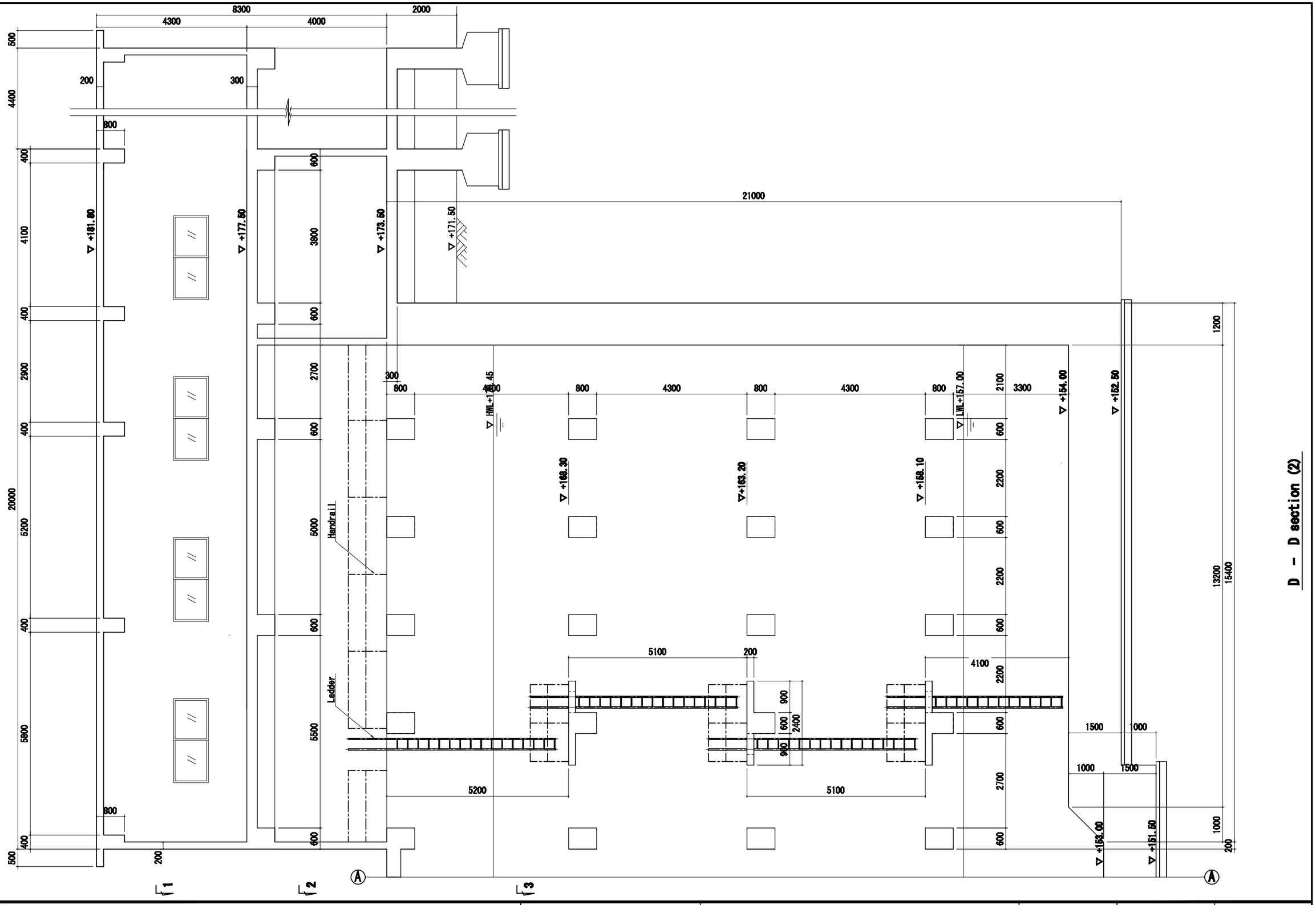
PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Intake Well Structure(6/9)				IC-08
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100



PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Intake Well Structure(7/9)				IC-09
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100

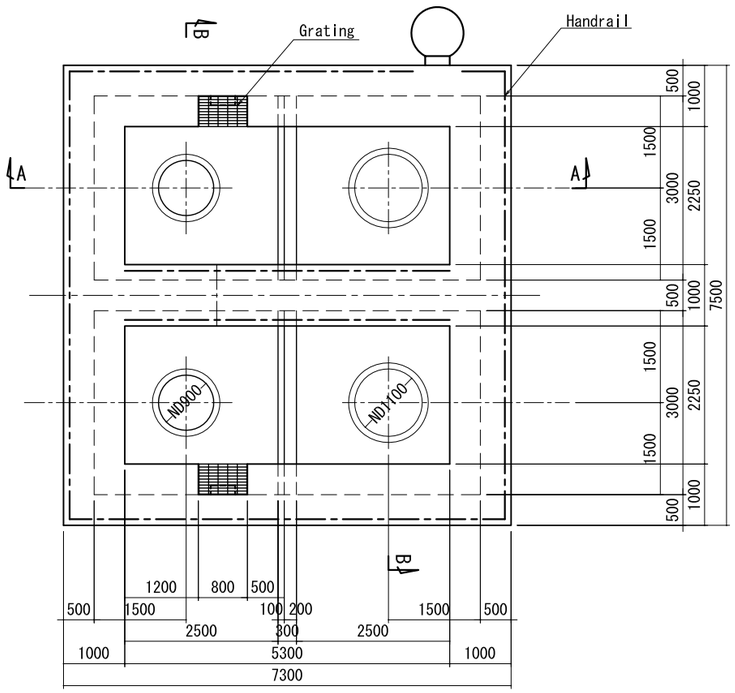


PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Intake Well Structure(8/9)				IC-10
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100

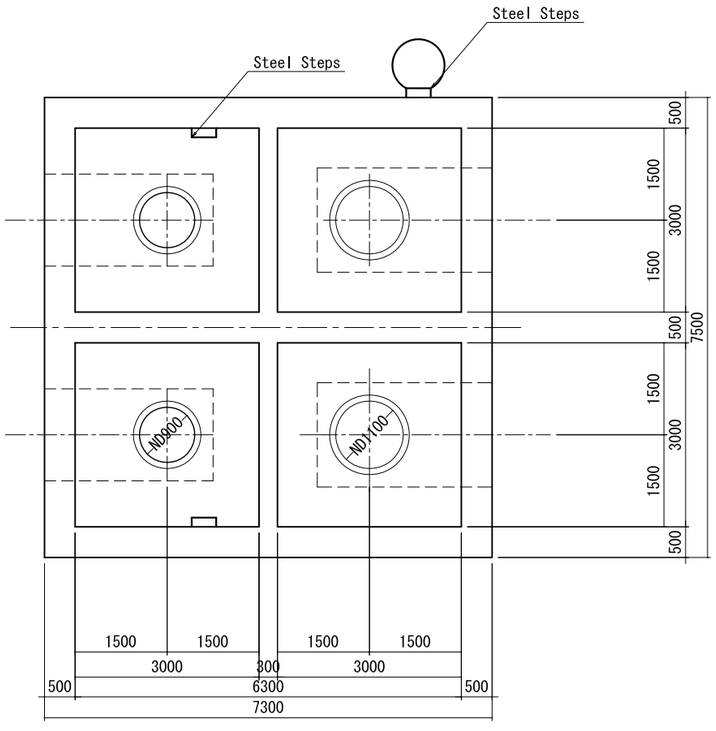


D - D section (2)

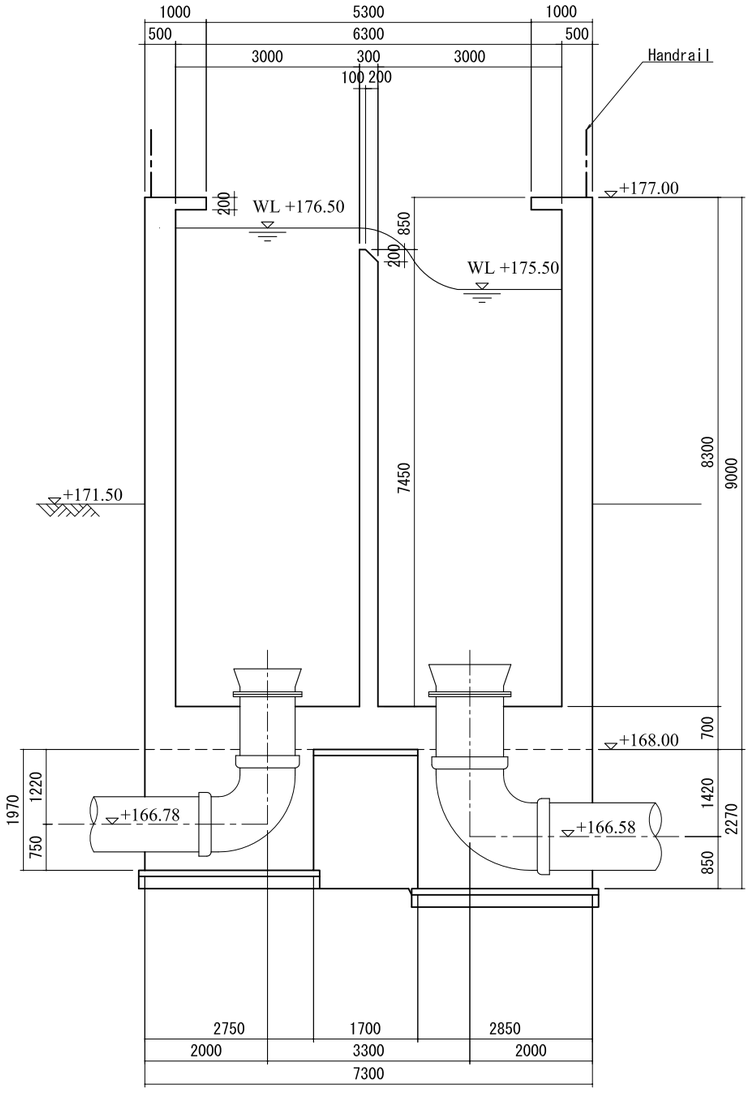
PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Intake Well Structure(9/9)				IC-11
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100



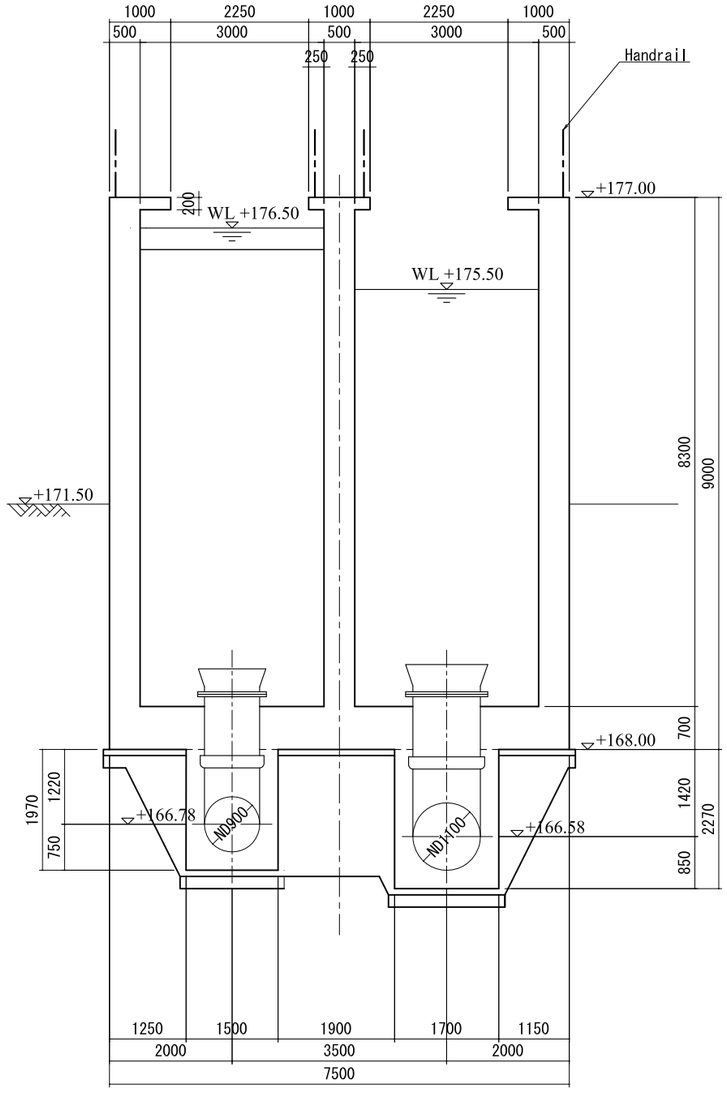
PLAN



1 - 1 section

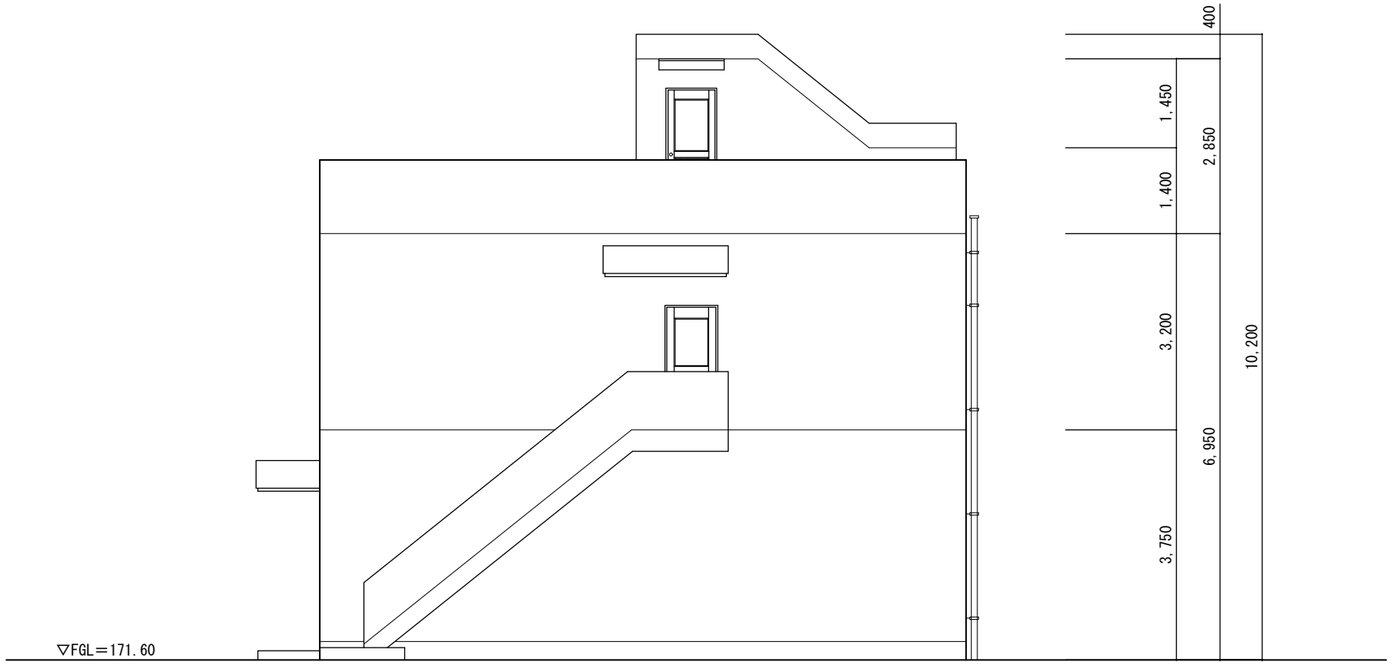


A - A section

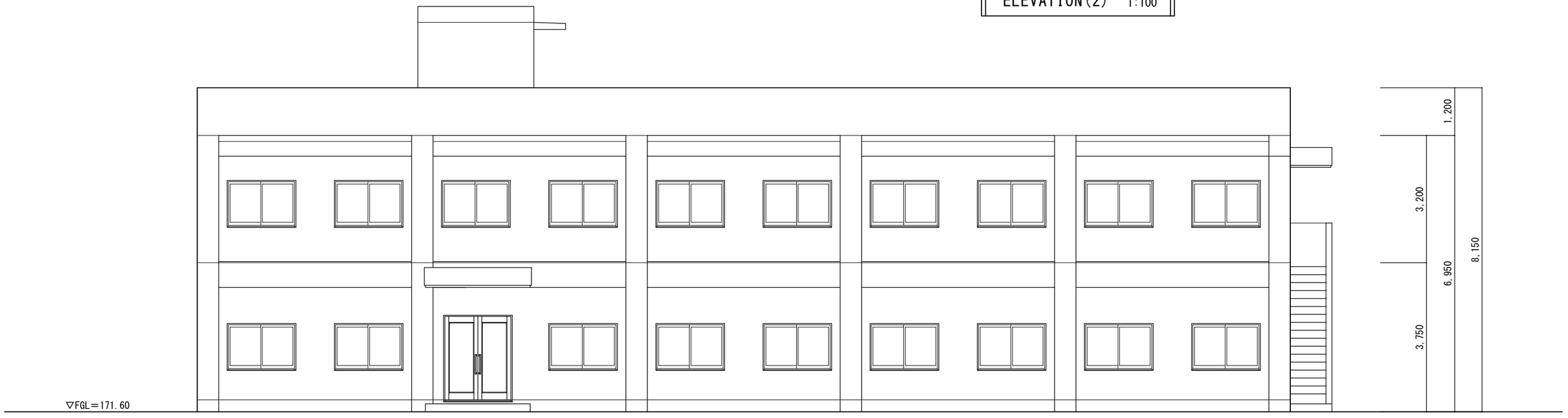


B - B section

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Receiving Well Structure(1/1)				IC-12
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100

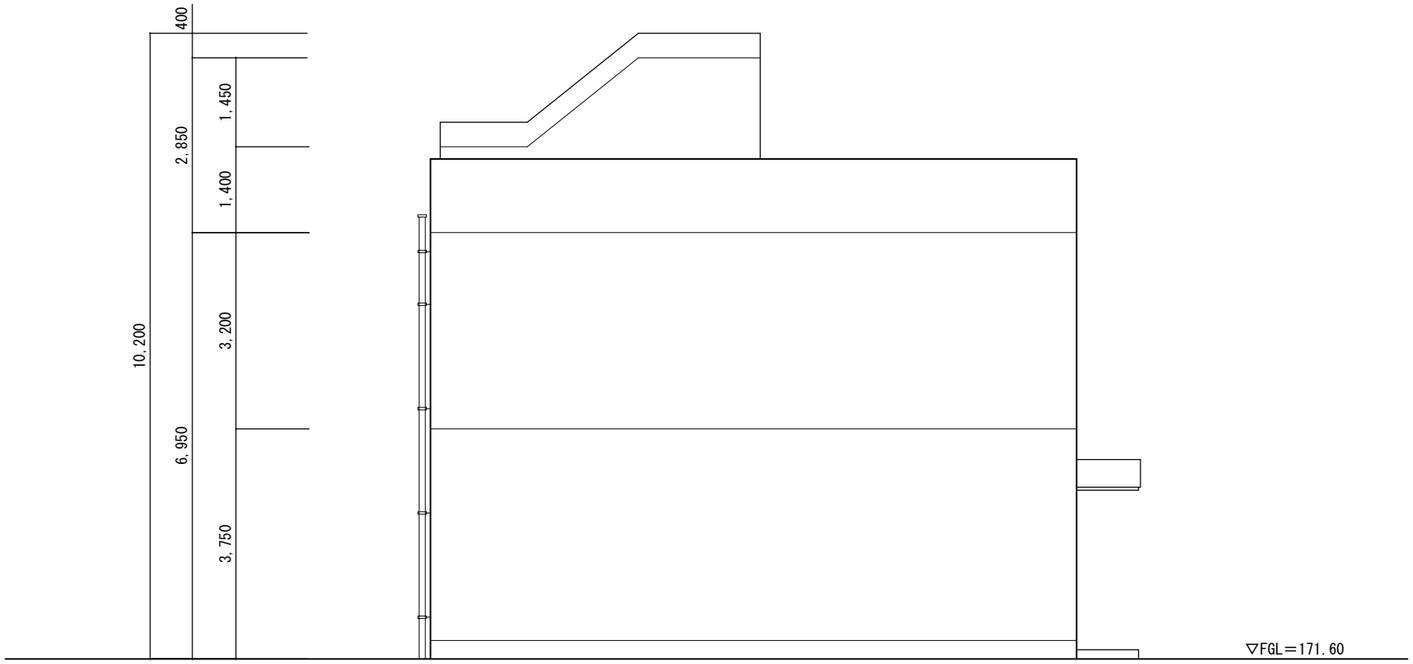


ELEVATION(2) 1:100

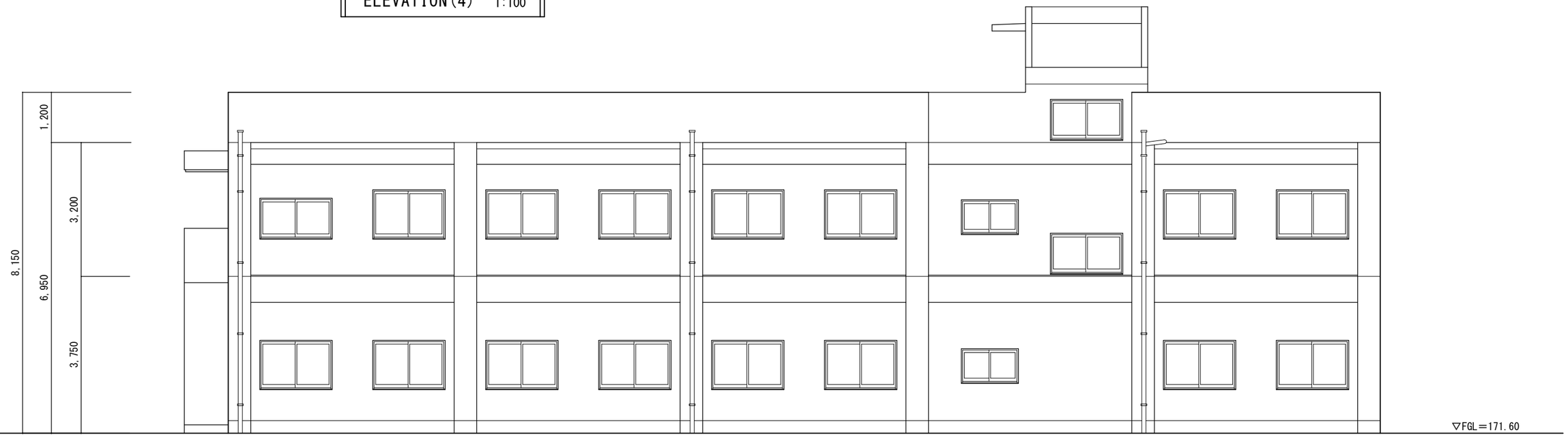


ELEVATION(1) 1:100

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	ADMINISTRATION BUILDING ELEVATION(1) (2)				IA－01
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE S＝1:100

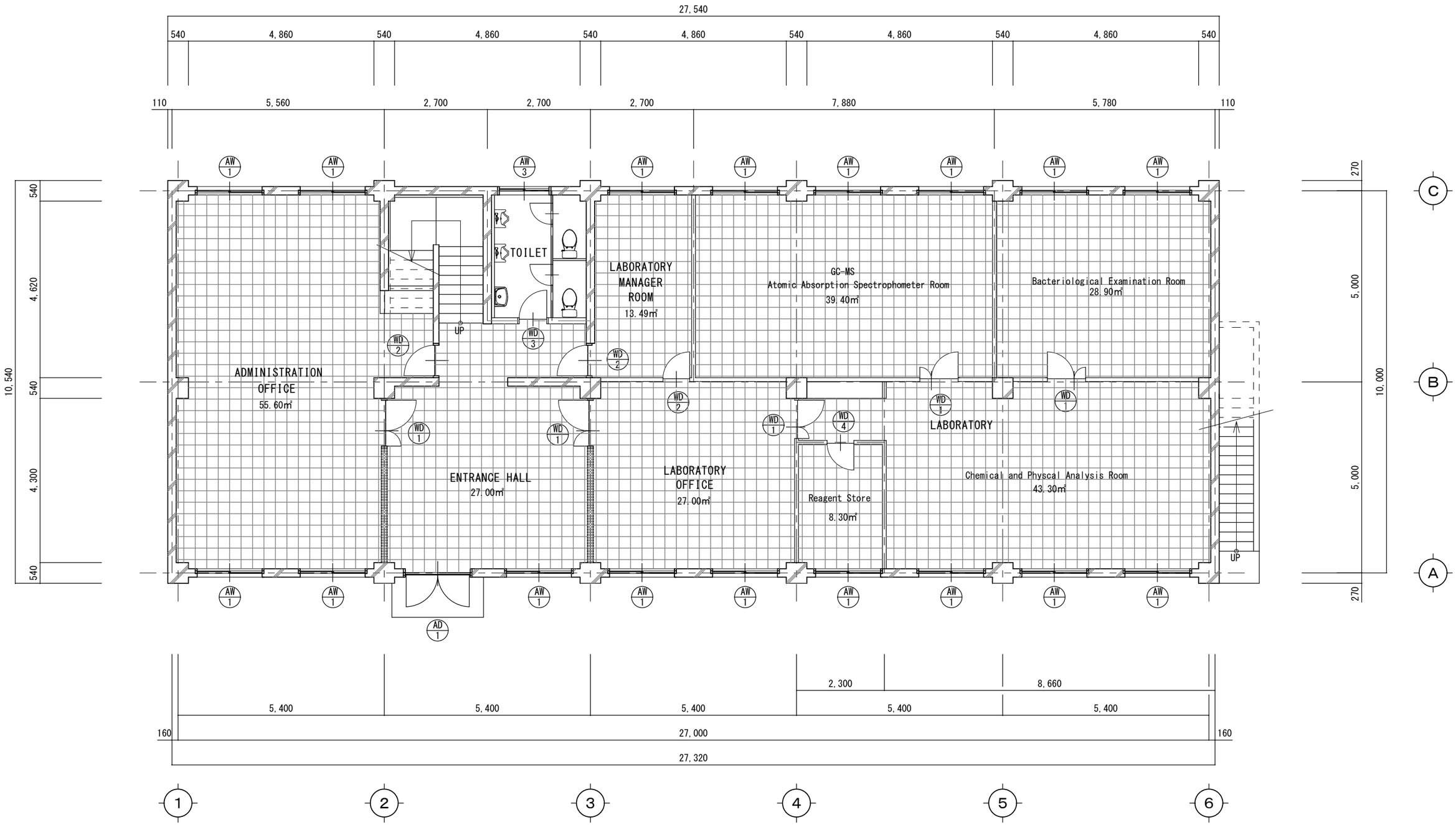


ELEVATION(4) 1:100



ELEVATION(3) 1:100

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	ADMINISTRATION BUILDING ELEVATION(3) (4)				IA－02
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE S＝1:100



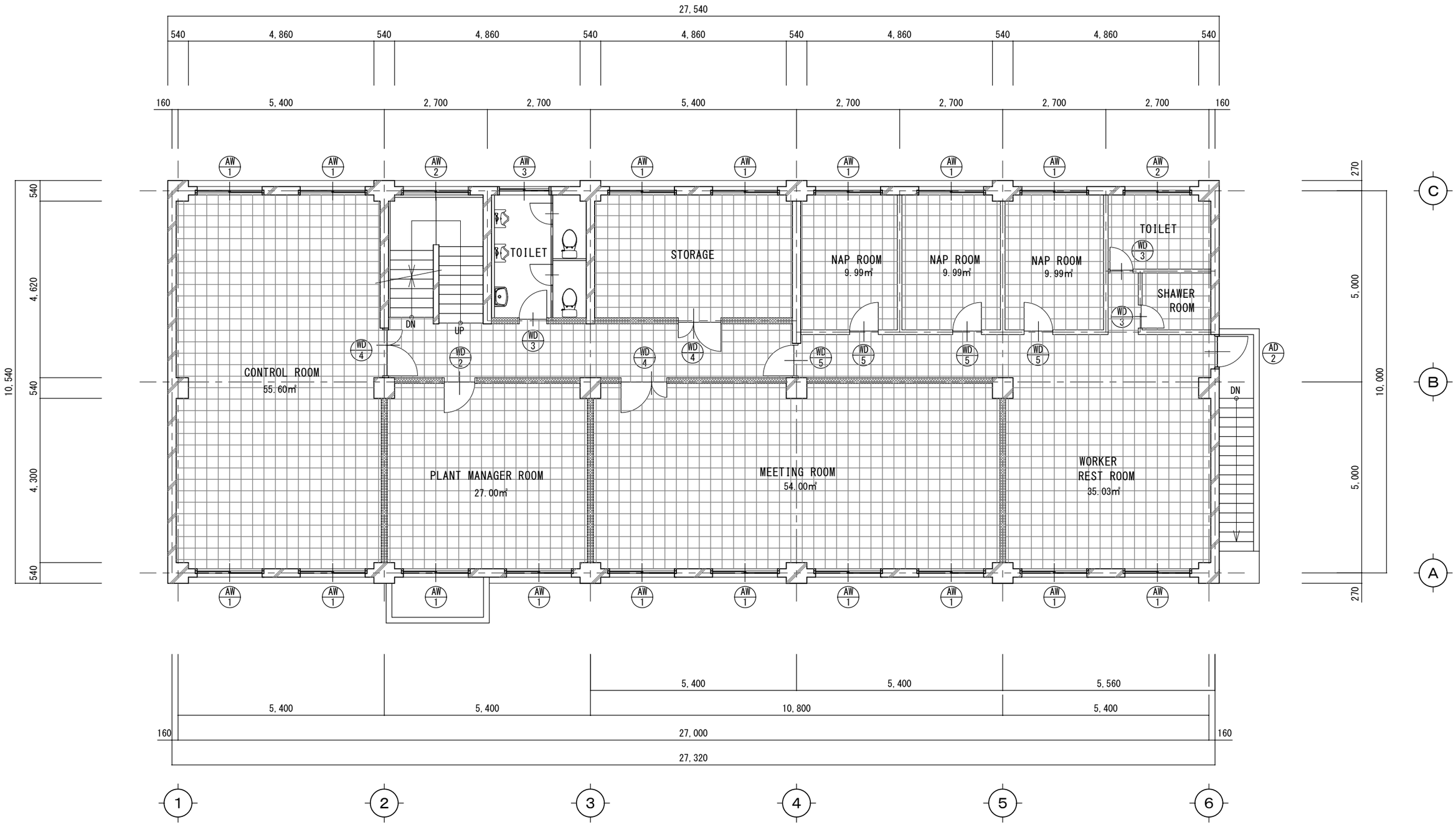
Reinforced Concrete

Brick Wall (thickness 100mm)

PLAN of 1st FLOOR 1:100

1st FLOOR AREA : 273.20㎡
10.00×27.32＝273.20

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	ADMINISTRATION BUILDING PLAN of 1st FLOOR				IA−03
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE S=1:100



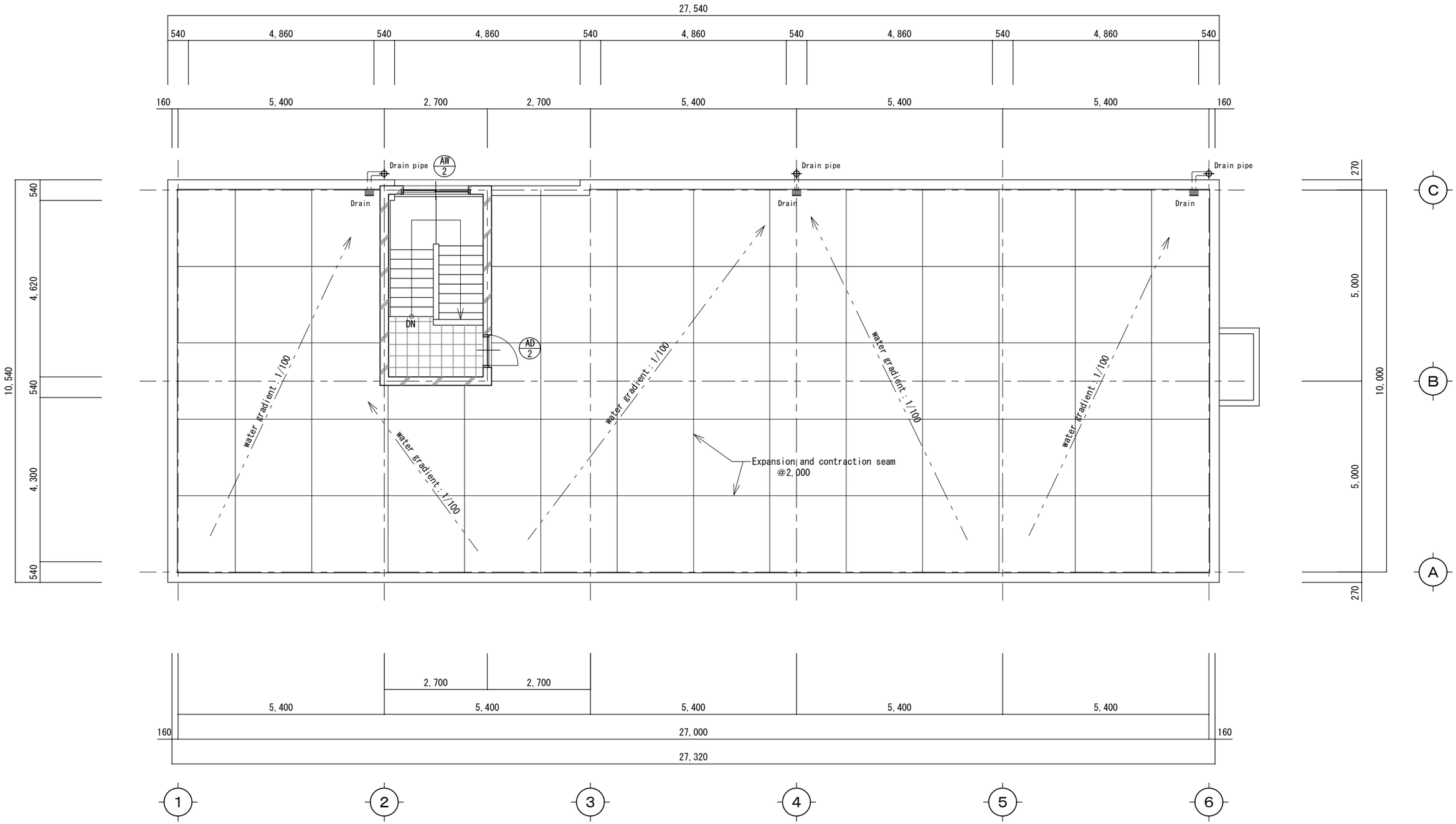
Reinforced Concrete

Brick Wall (thickness 100mm)

PLAN of 2nd FLOOR 1:100

2nd FLOOR AREA : 273.20㎡
10.00×27.32＝273.20

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	ADMINISTRATION BUILDING PLAN of 2nd FLOOR				IA−04
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE S=1:100



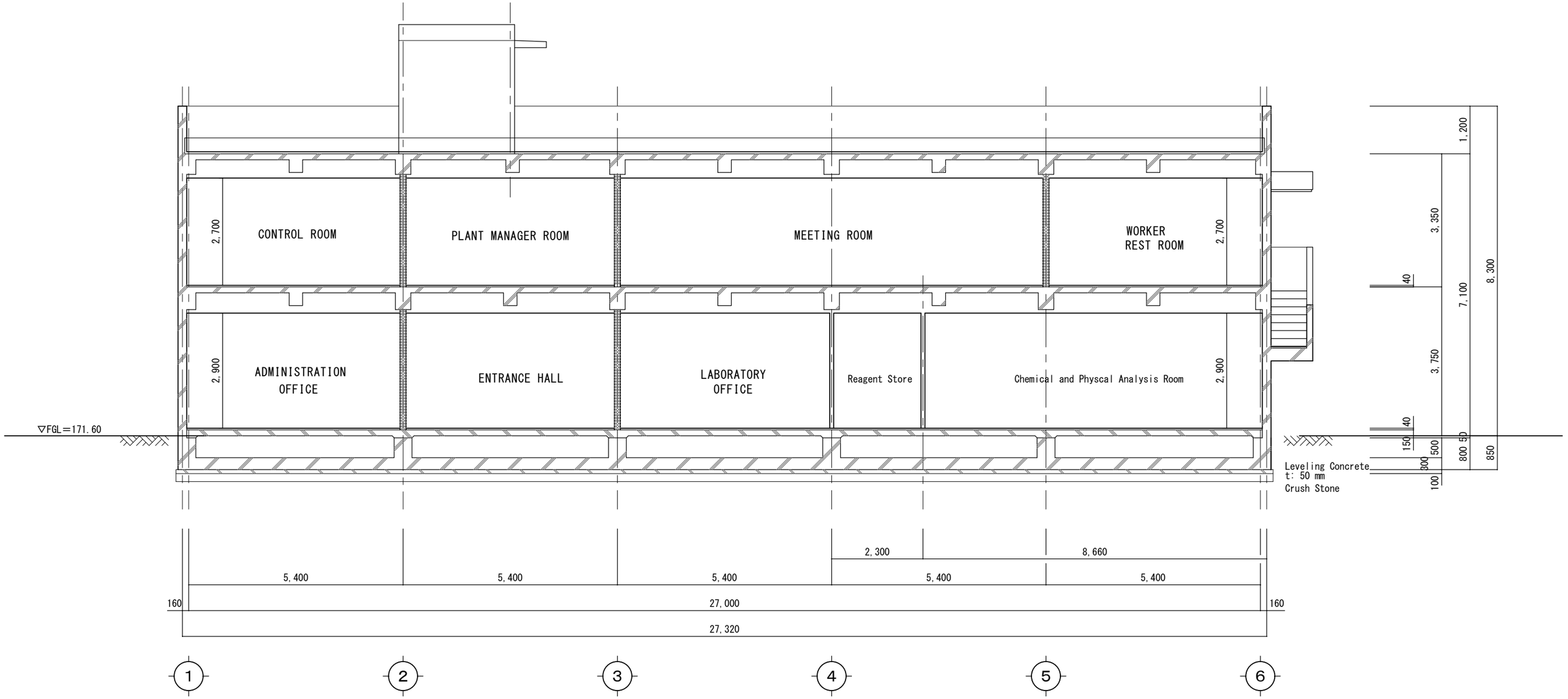
Reinforced Concrete

Brick Wall (thickness 100mm)

PLAN of ROOF TOP 1:100

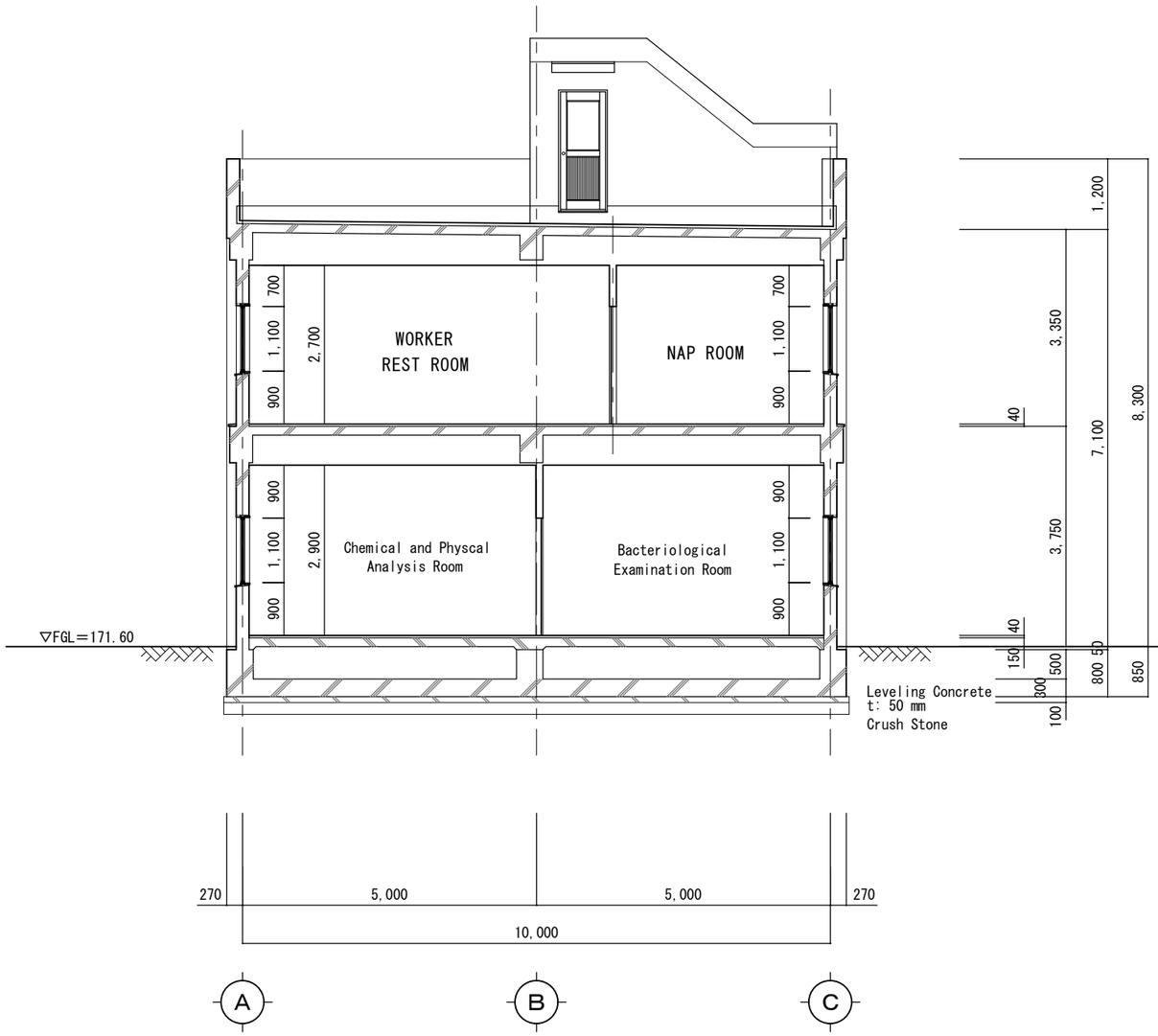
ROOF FLOOR AREA : 13.50㎡
5.00×2.70=13.50

PROJECT Vientiane Capital Water Supply Expansion Project	DESCRIPTION ADMINISTRATION BUILDING PLAN of ROOF TOP		APPROVE BY	DATE	DRAWING No IA−05
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE S=1:100

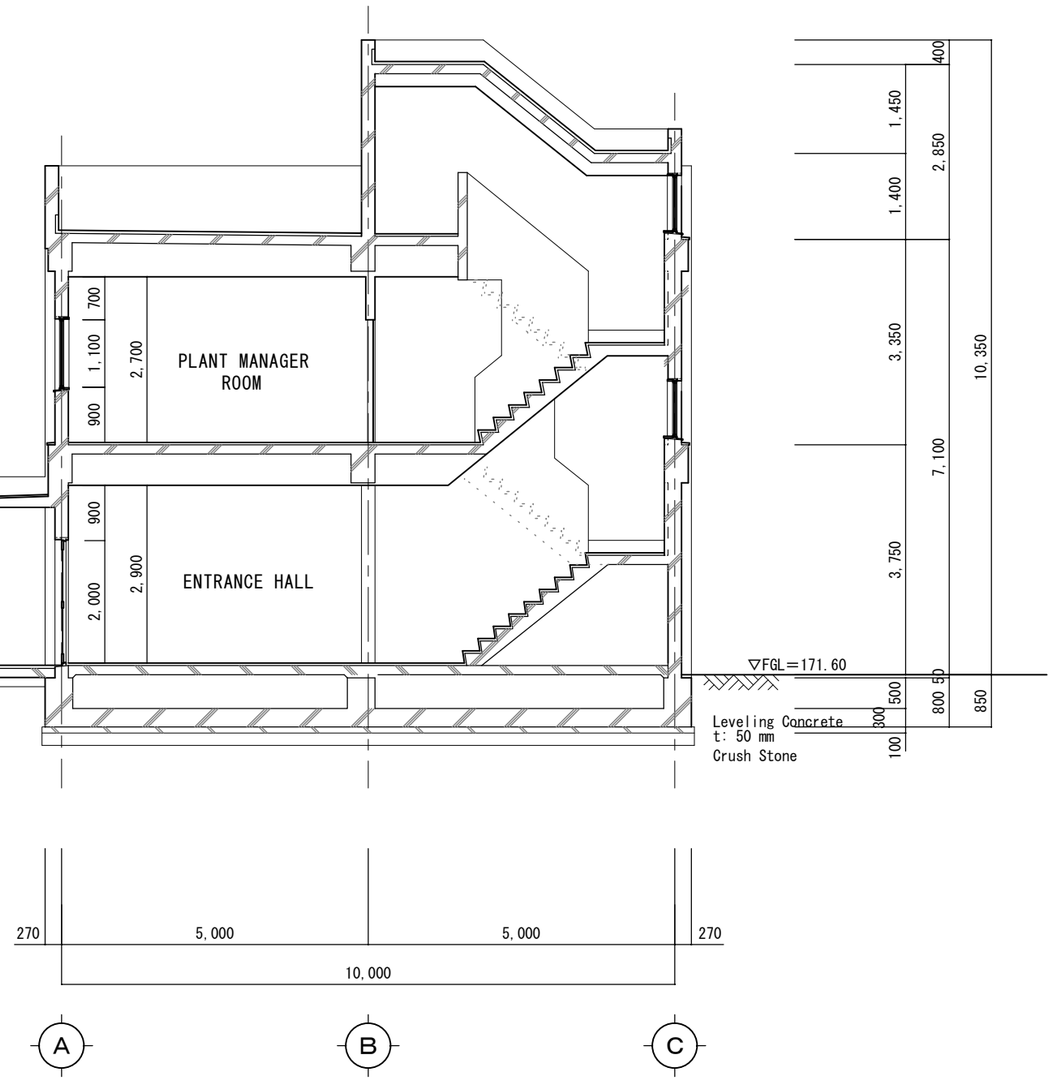


SECTION A-A 1:100

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	ADMINISTRATION BUILDING SECTION A-A				IA－06
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE S＝1:100



SECTION B-B 1:100



SECTION C-C 1:100

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	ADMINISTRATION BUILDING SECTION B-B C-C				IA－07
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE S=1:100

FINISHING SCHEDULE OF ADMINISTRATION AND CHEMICAL BUILDING

EXTERIOR FINISH

ROOF	APPLYING A LAYER OF "EXPOXY"
WALL	EMULSION PAINT ON EXPOSED CONCRETE
COLUMN & GIRDER	EMULSION PAINT ON EXPOSED CONCRETE
DOOR & WINDOW	SHOW AS DOOR &WINDOW SCHEDULE

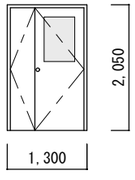
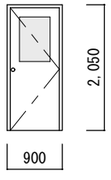
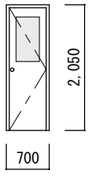
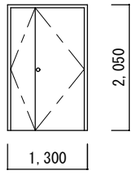
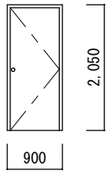
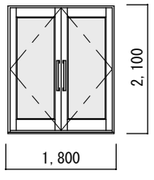
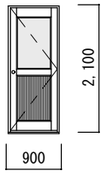
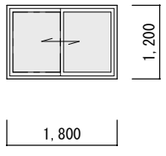
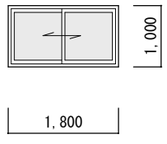
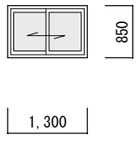
FLOOR AREA

1st FLOOR AREA	273.20㎡
2nd FLOOR AREA	273.20㎡
ROOF FLOOR AREA	13.50㎡
TOTAL FLOOR AREA	559.90㎡

INTERIOR FINISH

	FLOOR	WALL	BASEBOARD	COLUMN & GIRDER	CEILING
1ST FLOOR					
ENTRANCE HALL	FLOOR TILE ON MORTAR BED □:300×300	EMULSION PAINT ON CEMENT MORTAR	SKIRTING TILE ON MORTAR BED H=100	EMULSION PAINT ON EXPOSED CONCRETE	EMULSION PAINT ON PLASTER BOARD
ADMINISTRATION OFFICE	FLOOR TILE ON MORTAR BED □:300×300	EMULSION PAINT ON CEMENT MORTAR	SKIRTING TILE ON MORTAR BED H=100	EMULSION PAINT ON EXPOSED CONCRETE	EMULSION PAINT ON PLASTER BOARD
LABORATORY MANAGER ROOM	FLOOR TILE ON MORTAR BED □:300×300	EMULSION PAINT ON CEMENT MORTAR	SKIRTING TILE ON MORTAR BED H=100	EMULSION PAINT ON EXPOSED CONCRETE	EMULSION PAINT ON PLASTER BOARD
LABORATORY OFFICE	FLOOR TILE ON MORTAR BED □:300×300	EMULSION PAINT ON CEMENT MORTAR	SKIRTING TILE ON MORTAR BED H=100	EMULSION PAINT ON EXPOSED CONCRETE	EMULSION PAINT ON PLASTER BOARD
CHEMICAL AND PHYSCAL ANALYSIS ROOM	FLOOR TILE ON MORTAR BED □:300×300	EMULSION PAINT ON CEMENT MORTAR	SKIRTING TILE ON MORTAR BED H=100	EMULSION PAINT ON EXPOSED CONCRETE	EMULSION PAINT ON PLASTER BOARD
ATOMIC ABSORPTION SPECTROPHOMETER ROOM	FLOOR TILE ON MORTAR BED □:300×300	EMULSION PAINT ON CEMENT MORTAR	SKIRTING TILE ON MORTAR BED H=100	EMULSION PAINT ON EXPOSED CONCRETE	EMULSION PAINT ON PLASTER BOARD
BACTERIOLOGICAL EXAMINATION ROOM	FLOOR TILE ON MORTAR BED □:300×300	EMULSION PAINT ON CEMENT MORTAR	SKIRTING TILE ON MORTAR BED H=100	EMULSION PAINT ON EXPOSED CONCRETE	EMULSION PAINT ON PLASTER BOARD
REAGENT STORE	FLOOR TILE ON MORTAR BED □:300×300	EMULSION PAINT ON CEMENT MORTAR	SKIRTING TILE ON MORTAR BED H=100	EMULSION PAINT ON EXPOSED CONCRETE	EMULSION PAINT ON PLASTER BOARD
2ND FLOOR					
CONTROL ROOM	FLOOR TILE ON MORTAR BED □:300×300	EMULSION PAINT ON CEMENT MORTAR	SKIRTING TILE ON MORTAR BED H=100	EMULSION PAINT ON EXPOSED CONCRETE	EMULSION PAINT ON PLASTER BOARD
PLANT MANAGER ROOM	FLOOR TILE ON MORTAR BED □:300×300	EMULSION PAINT ON CEMENT MORTAR	SKIRTING TILE ON MORTAR BED H=100	EMULSION PAINT ON EXPOSED CONCRETE	EMULSION PAINT ON PLASTER BOARD
MEETING ROOM	FLOOR TILE ON MORTAR BED □:300×300	EMULSION PAINT ON CEMENT MORTAR	SKIRTING TILE ON MORTAR BED H=100	EMULSION PAINT ON EXPOSED CONCRETE	EMULSION PAINT ON PLASTER BOARD
WORKER REST ROOM	FLOOR TILE ON MORTAR BED □:300×300	EMULSION PAINT ON CEMENT MORTAR	SKIRTING TILE ON MORTAR BED H=100	EMULSION PAINT ON EXPOSED CONCRETE	EMULSION PAINT ON PLASTER BOARD
WORKER SHAWER ROOM	FLOOR TILE ON MORTAR BED □:300×300	EMULSION PAINT ON CEMENT MORTAR	SKIRTING TILE ON MORTAR BED H=100	EMULSION PAINT ON EXPOSED CONCRETE	EMULSION PAINT ON PLASTER BOARD
WORKER TOILET	MOZAIC FLOOR TILE ON MORTAR BED □:50×50	EMULSION PAINT ON CEMENT MORTAR	SKIRTING TILE ON MORTAR BED H=100	EMULSION PAINT ON EXPOSED CONCRETE	EMULSION PAINT ON PLASTER BOARD
STORAGE	MOZAIC FLOOR TILE ON MORTAR BED □:50×50	EMULSION PAINT ON CEMENT MORTAR	SKIRTING TILE ON MORTAR BED H=100	EMULSION PAINT ON EXPOSED CONCRETE	EMULSION PAINT ON PLASTER BOARD
ON EVERY FLOOR					
CORRIDOR	FLOOR TILE ON MORTAR BED □:300×300	EMULSION PAINT ON CEMENT MORTAR	SKIRTING TILE ON MORTAR BED H=100	EMULSION PAINT ON EXPOSED CONCRETE	EMULSION PAINT ON PLASTER BOARD
TOILET	MOZAIC FLOOR TILE ON MORTAR BED □:50×50	EMULSION PAINT ON CEMENT MORTAR	SKIRTING TILE ON MORTAR BED H=100	EMULSION PAINT ON EXPOSED CONCRETE	EMULSION PAINT ON PLASTER BOARD
STAIRCASE	CLINKER TILE ON MORTAR BED SLIP PROTECTION □:100×100	EMULSION PAINT ON CEMENT MORTAR	SKIRTING TILE ON MORTAR BED H=100	EMULSION PAINT ON EXPOSED CONCRETE	EMULSION PAINT ON PLASTER BOARD

FITTING LIST

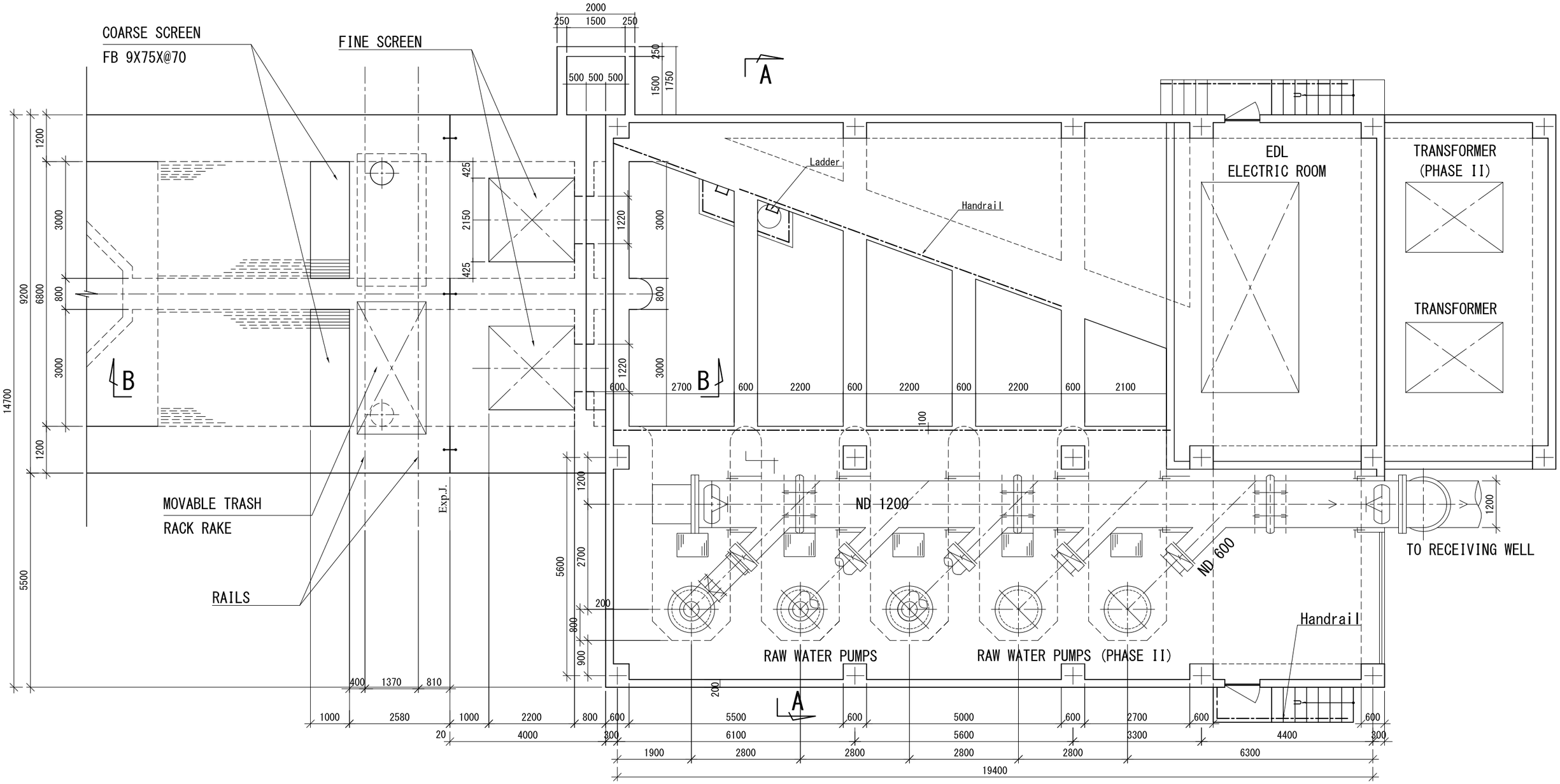
NO TYPE	WD 1 FRAME DOOR	WD 2 FRAME DOOR	WD 3 FRAME DOOR	WD 4 FRAME DOOR	WD 5 FRAME DOOR	AD 1 FRAME DOOR	AD 2 FRAME DOOR	AW 1 CASEMENT WINDOW	AW 2 CASEMENT WINDOW	AW 3 CASEMENT WINDOW
ELEVATION										
QUANTITY	5	4	4	3	5	1	8	32	5	2
MATERIAL, COATING	WOOD E.P.	WOOD E.P.	WOOD E.P.	WOOD E.P.	WOOD E.P.	ALUMINIUM E.C.	ALUMINIUM E.C.	ALUMINIUM E.C.	ALUMINIUM E.C.	ALUMINIUM E.C.
GLASS	3mm	3mm	3mm			5mm	4mm	5mm	4mm	4mm
HARDWARE	H. K. LO. LA.	H. K. LO. LA.	H. K. LO. LA.	H. K. LO. LA.	H. K. LO. LA.	H. A. LO. LA.	H. K. LO. LA.	P. H. LA. A. F.	P. H. LA. A. F.	P. H. LA. A. F.

ABBREVIATION

P.	PULL
H.	HING
LA.	LATCH
A.	ARM
F.	FLASH BOLT
LO.	LOCK
S.	SIDE ARM
K.	KNOB

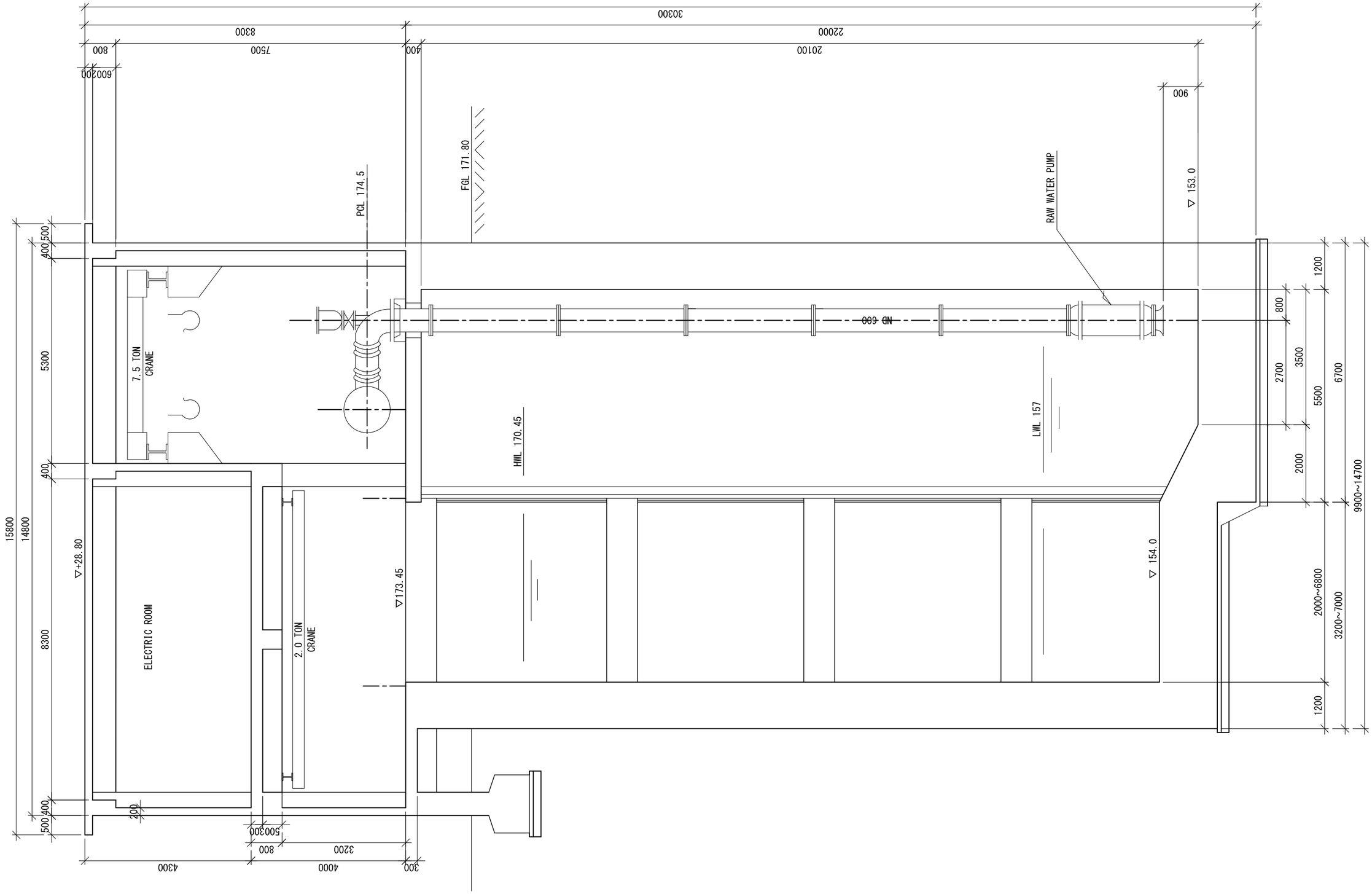
NOTE : ALL DOORS AND WINDOWS SHALL BE APPLIED ALUMINUM FRAME.

PROJECT: Vientiane Capital Water Supply Expansion Project	DESCRIPTION: ADMINISTRATION BUILDING FINISHING SCHEDULE FITTING LIST		APPROVE BY	DATE / DRAWING No: IA−08
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE / SCALE: S=1:100



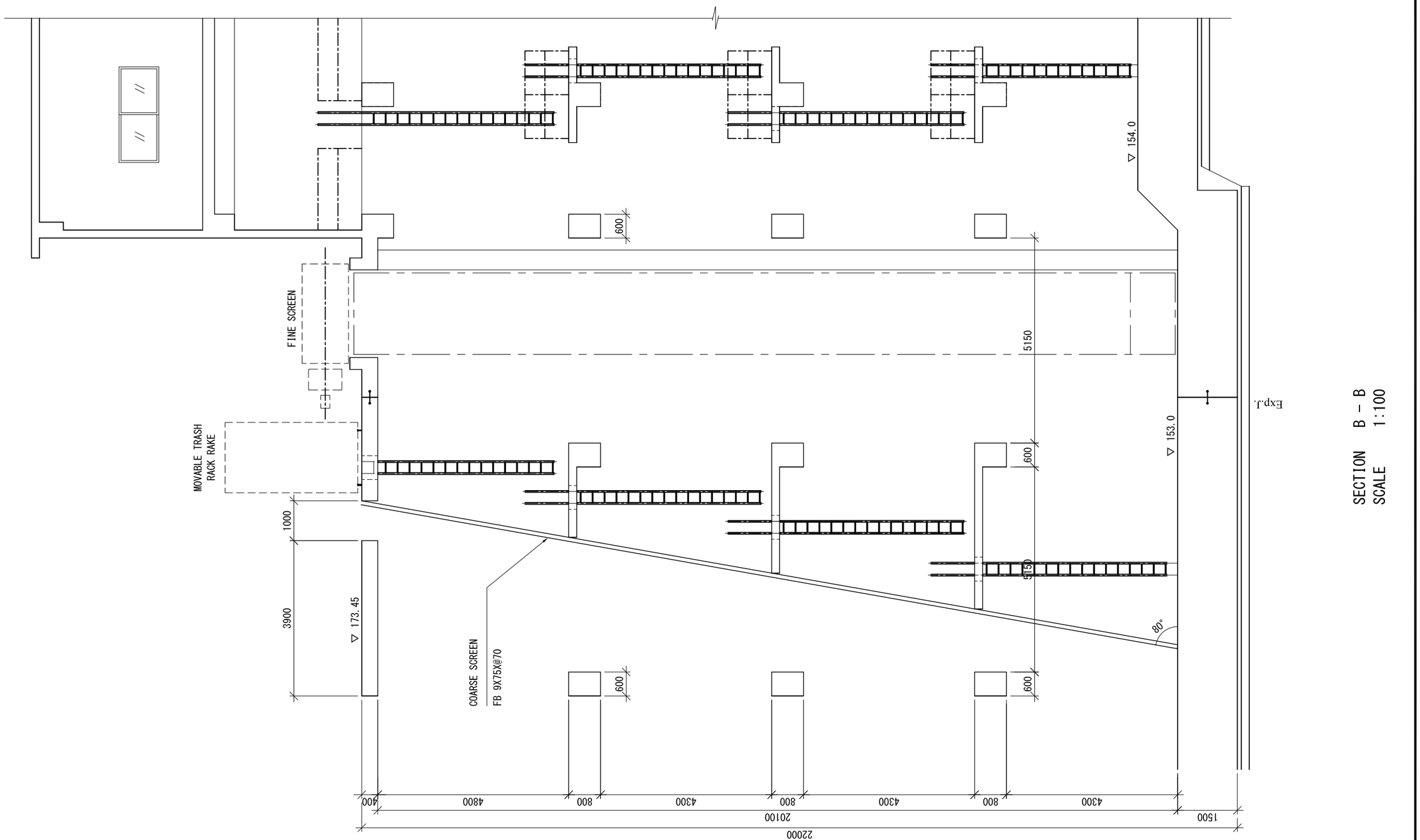
RAW WATER PUMP STATION PLAN
SCALE 1:100

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
VIENTIANE CAPITAL WATER SUPPLY EXPANSION PROJECT	RAW WATER PUMP STATION PLAN				IME - 1
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100



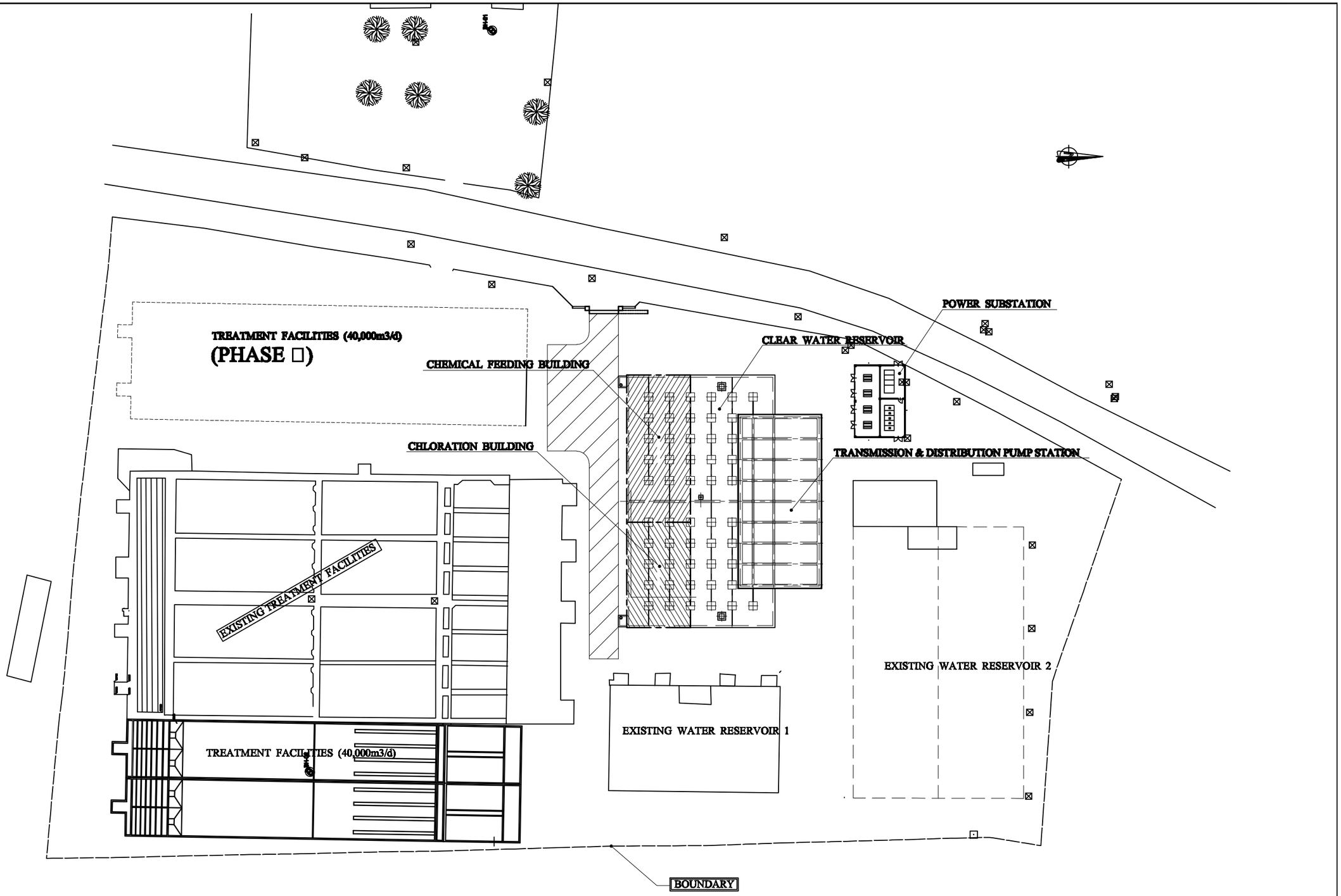
SECTION A – A
SCALE 1:100

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
VIENTIANE CAPITAL WATER SUPPLY EXPANSION PROJECT	RAW WATER PUMP STATION SECTION A-A				IME - 2
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100

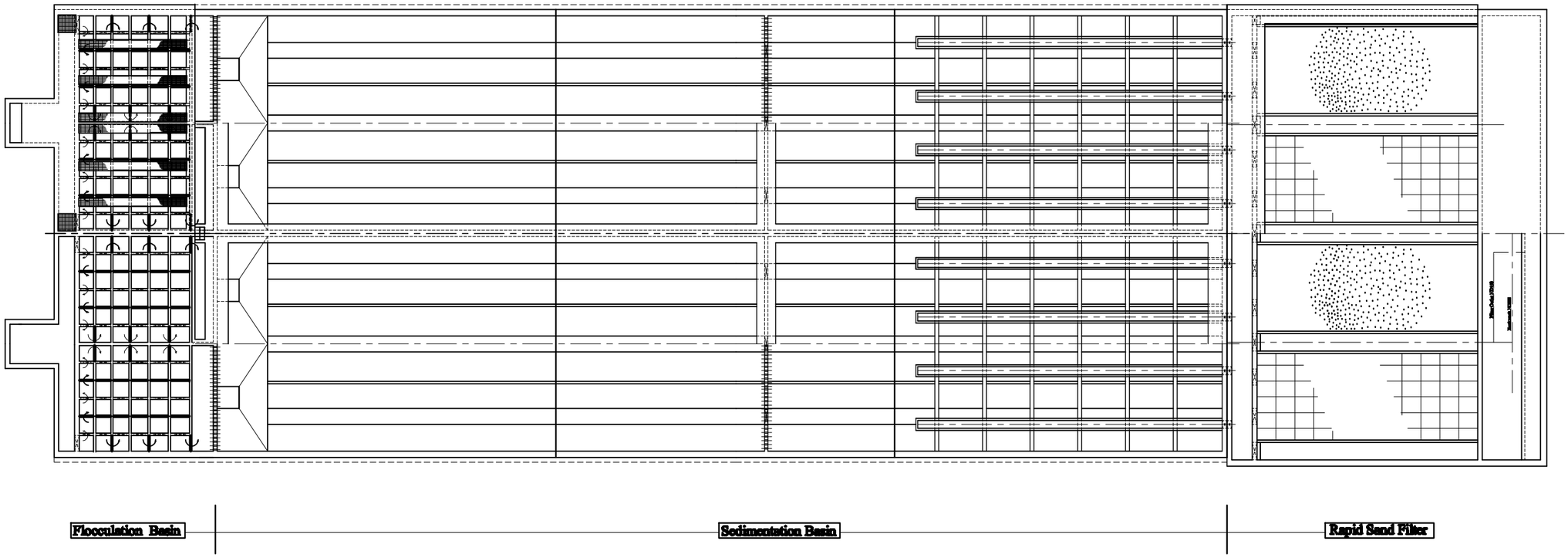


SECTION B – B
SCALE 1:100

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
VIENTIANE CAPITAL WATER SUPPLY EXPANSION PROJECT	RAW WATER PUMP STATION SECTION B–B				IME - 3
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100

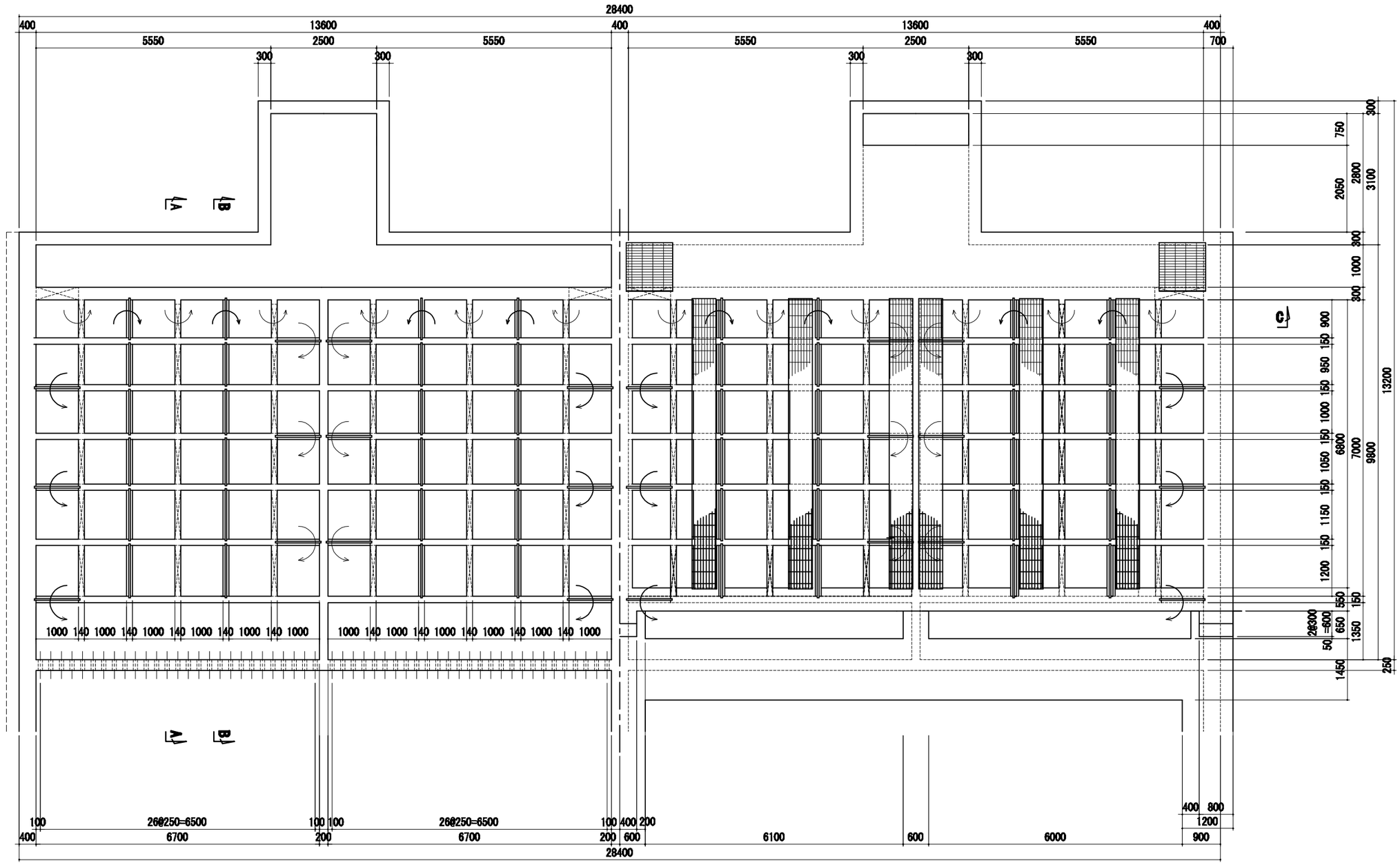


PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	General Plan of Chinaimo WTP				WC-01
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:1,000



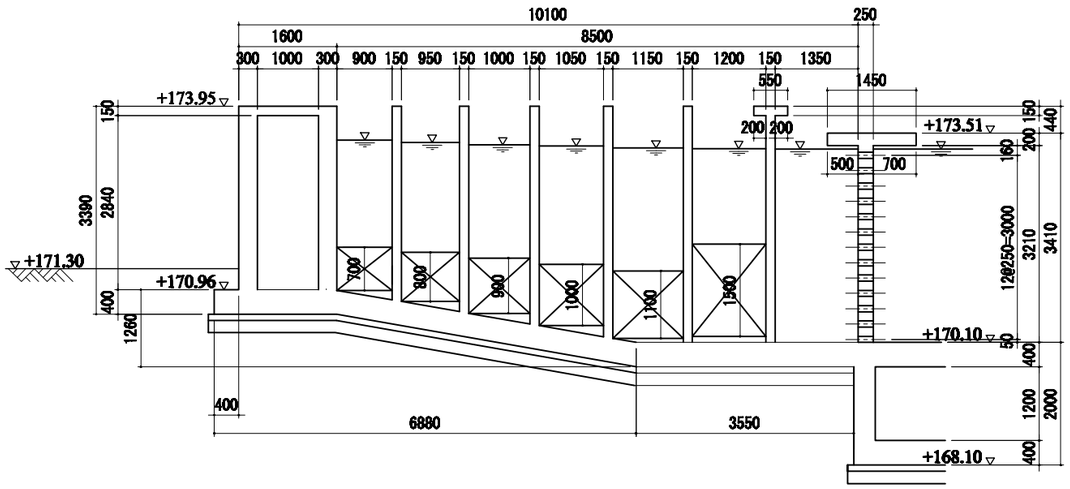
PLAN

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Water Treatment Facilites Structure				WC-02
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:300

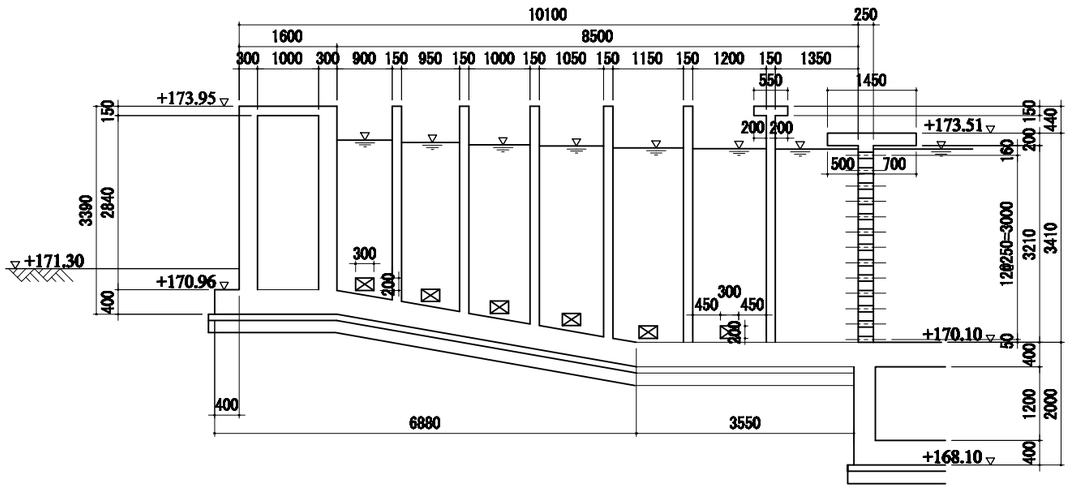


PLAN

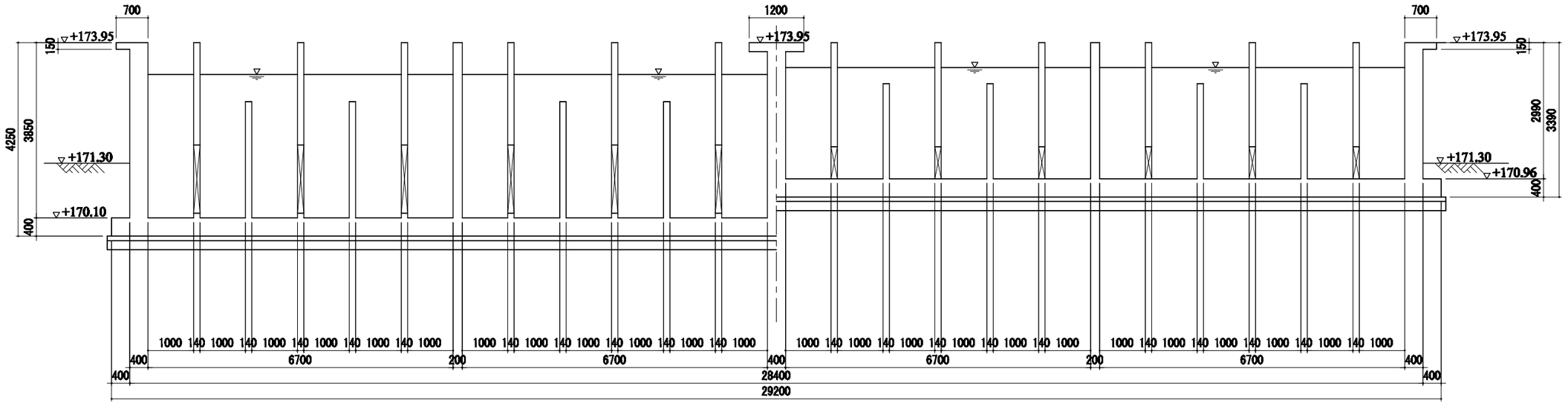
PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Flocculation Basin Structure(1/2)				WC-03
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100



A - A section

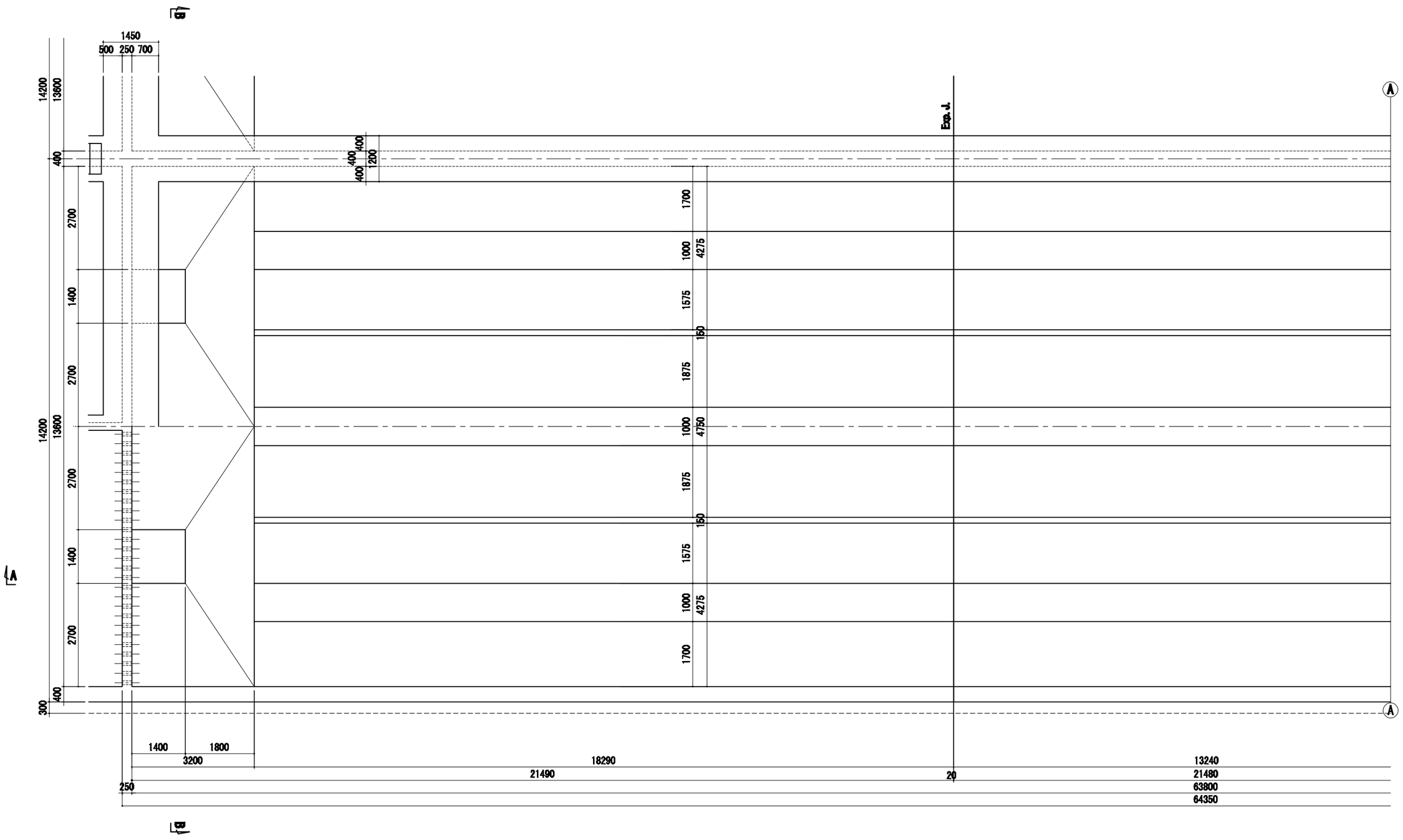


B - B section



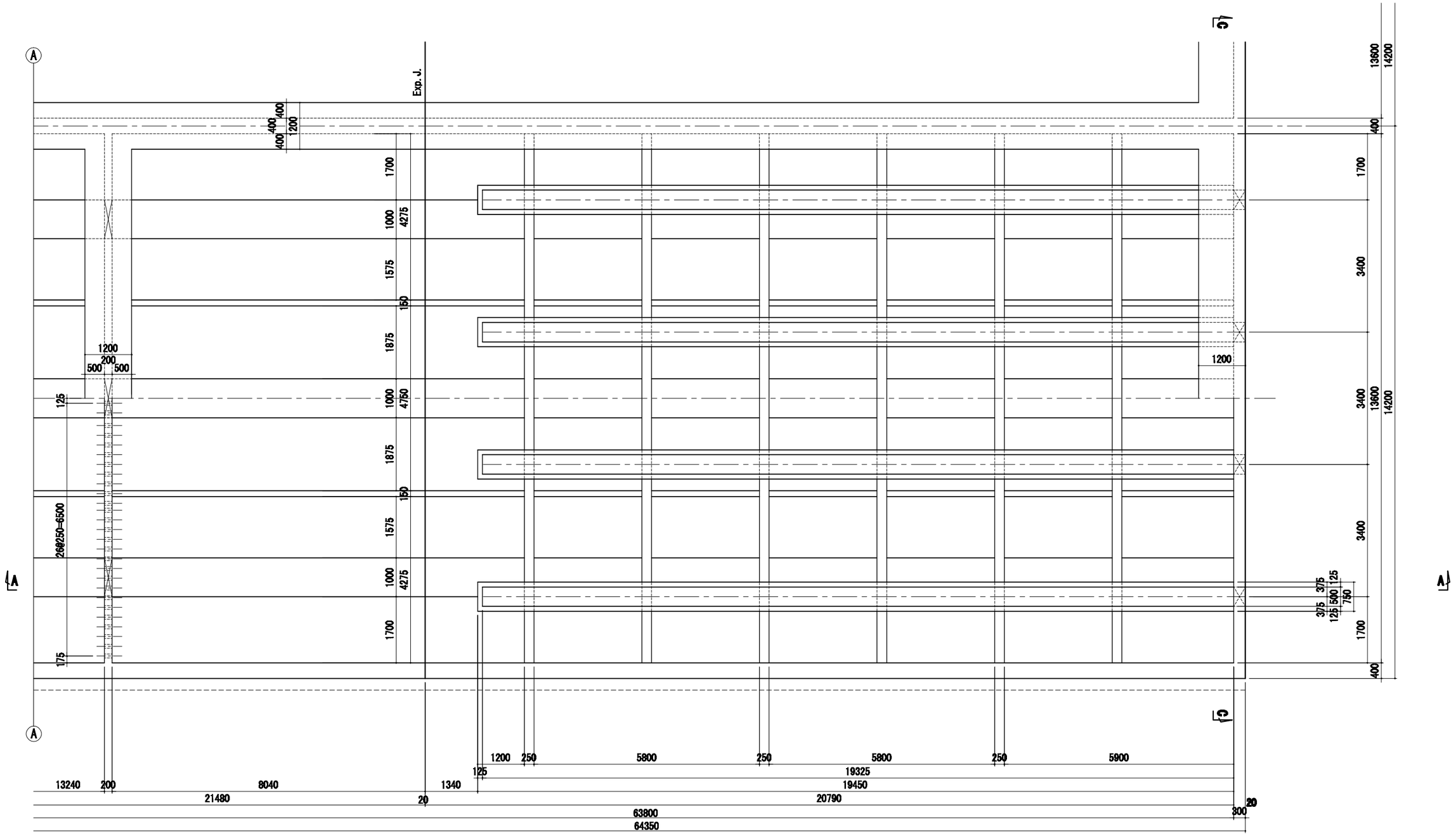
C - C section

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Flocculation Basin Structure(2/2)				WC-04
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100



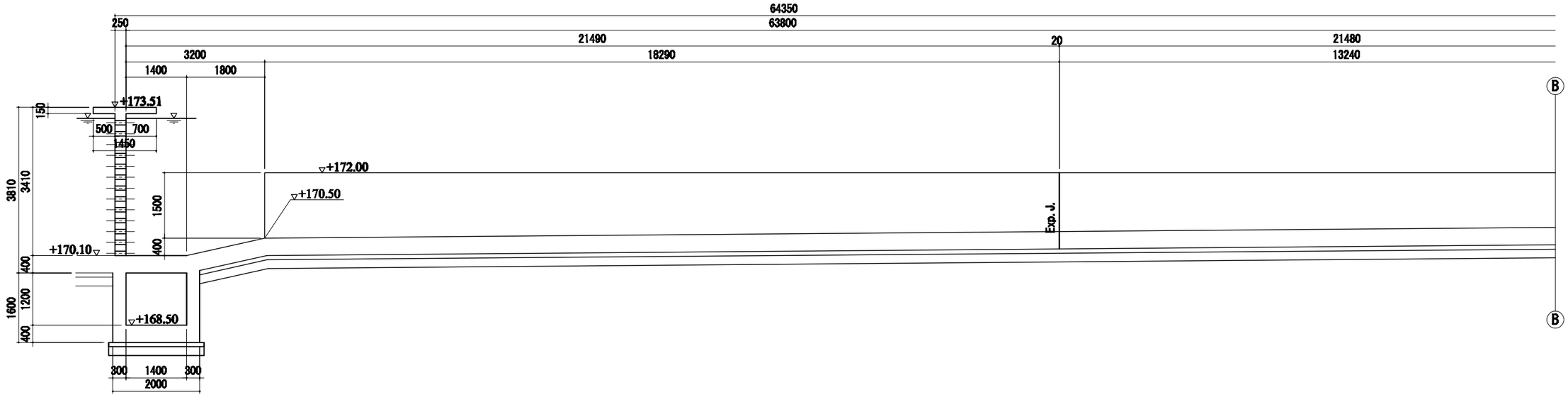
PLAN (1/2)

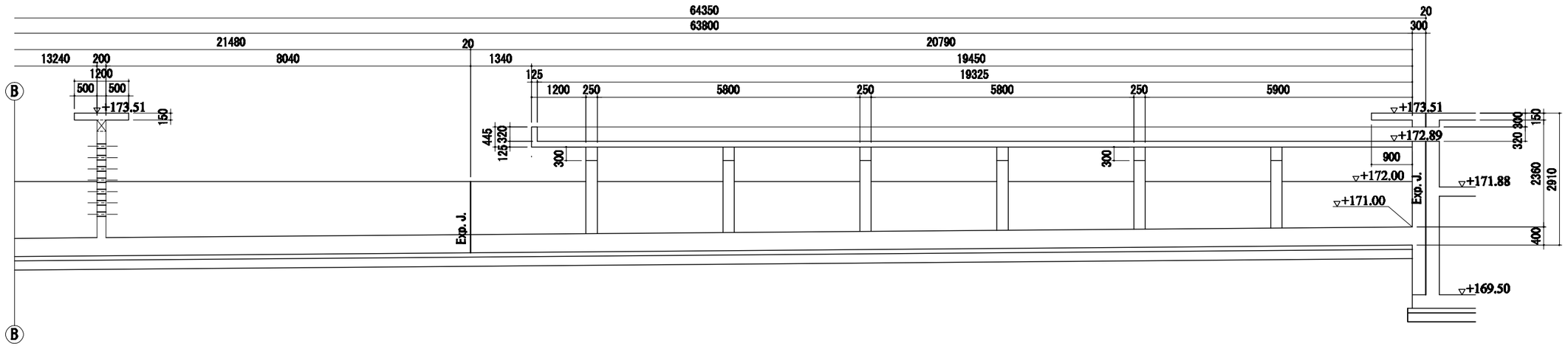
PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Sedimentation Basin Structure(1/4)				WC-05
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100



PLAN (2/2)

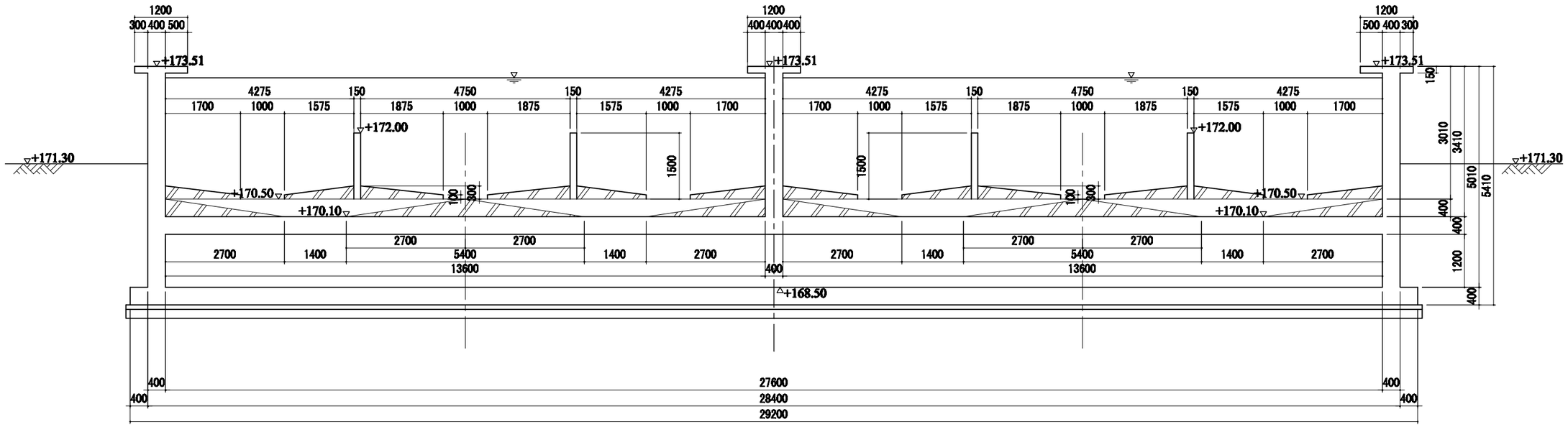
PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Sedimentation Basin Structure(2/4)				WC-06
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100



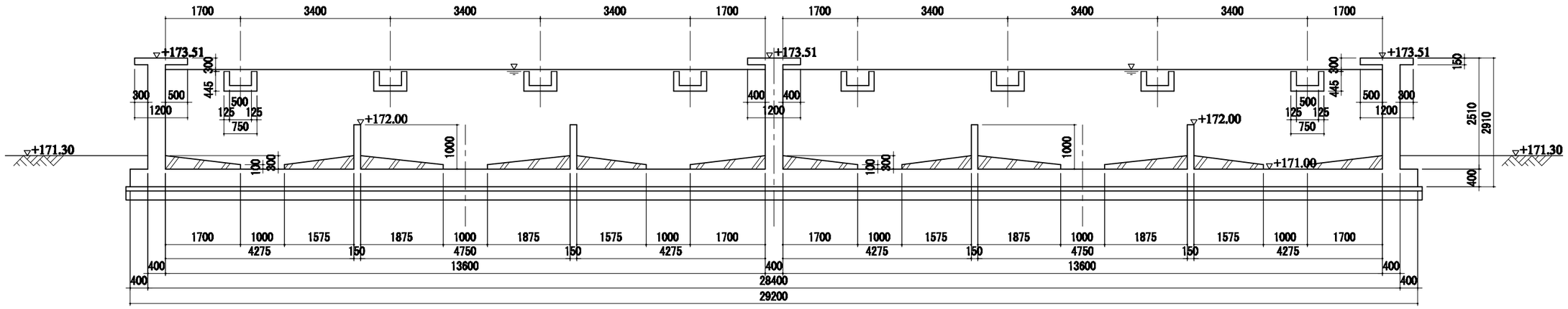


A - A section

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Sedimentation Basin Structure(3/4)				WC-07
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100

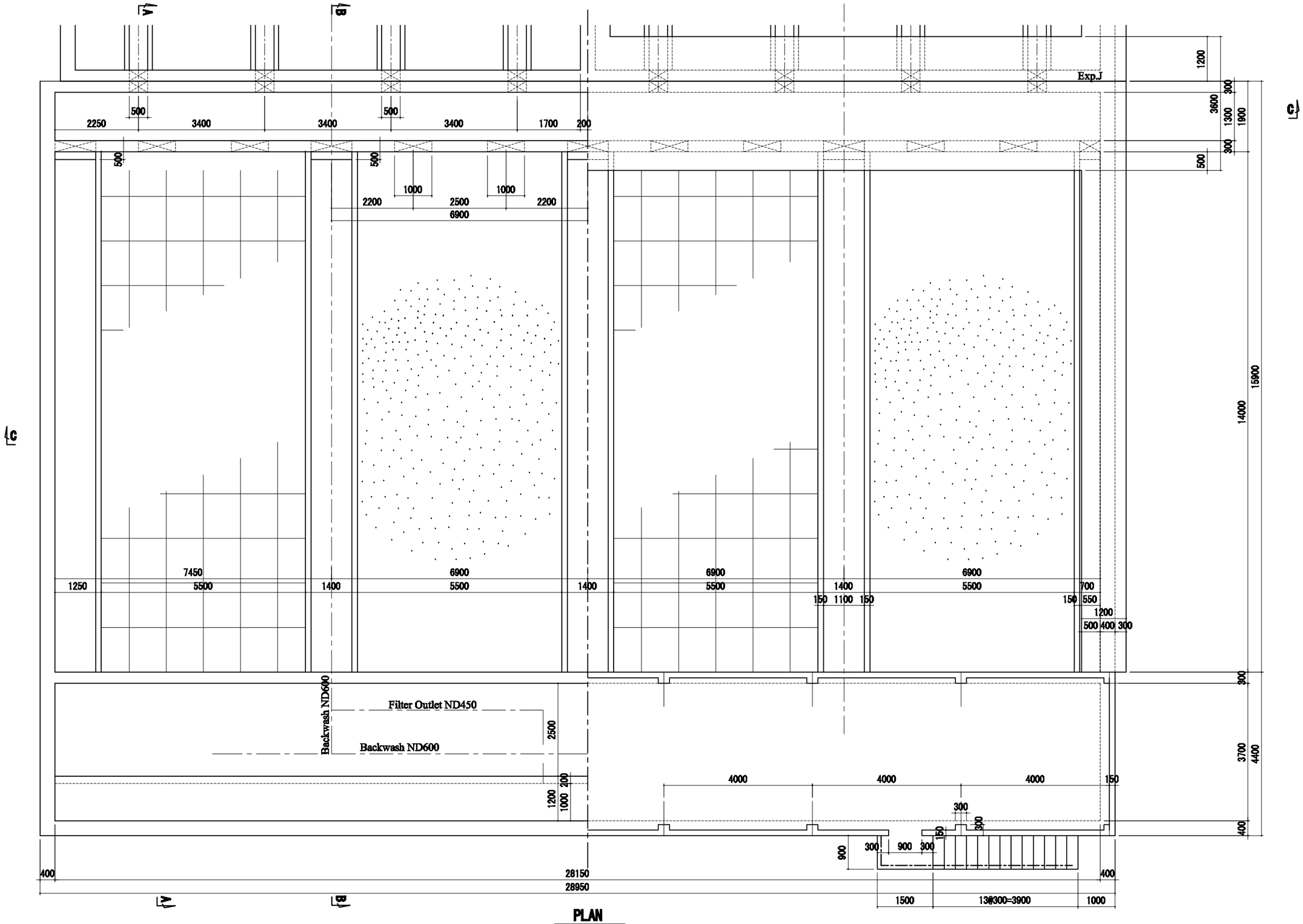


B - B section



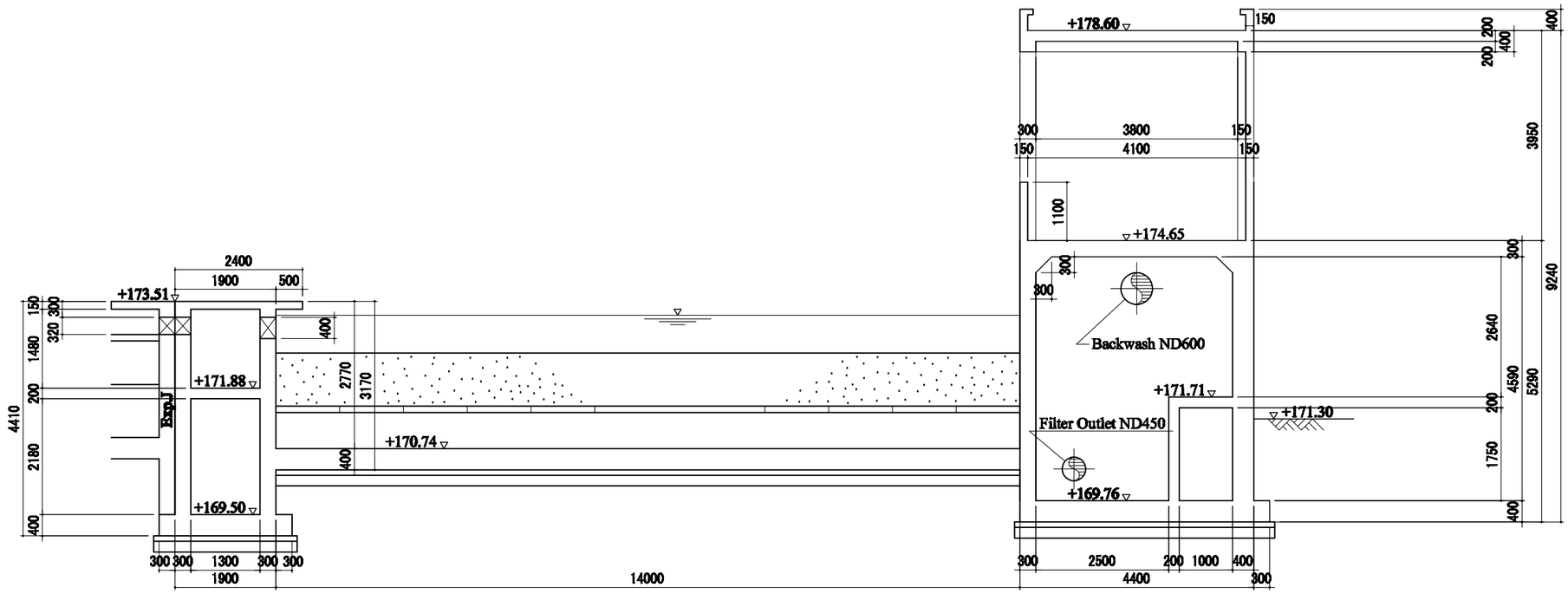
C - C section

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Sedimentation Basin Structure(4/4)				WC-08
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100

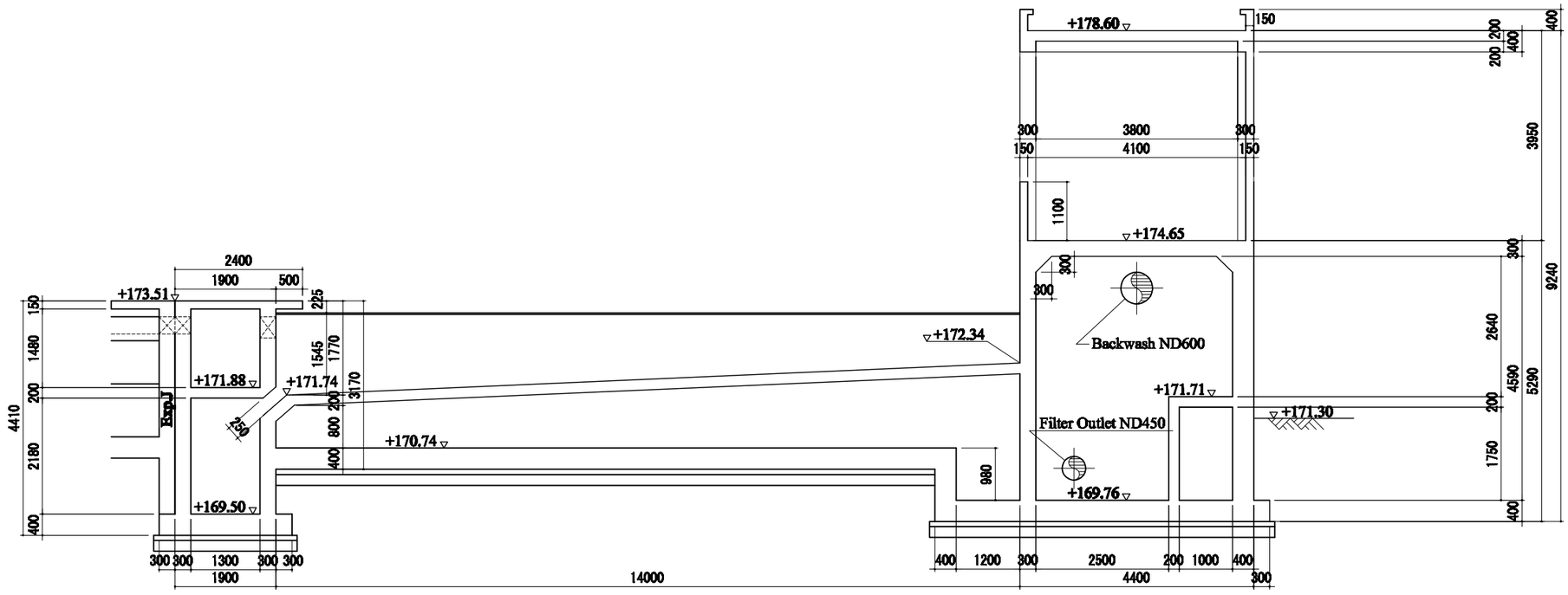


PLAN

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Rapid Sand Filter Structure(1/3)				WC-09
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100

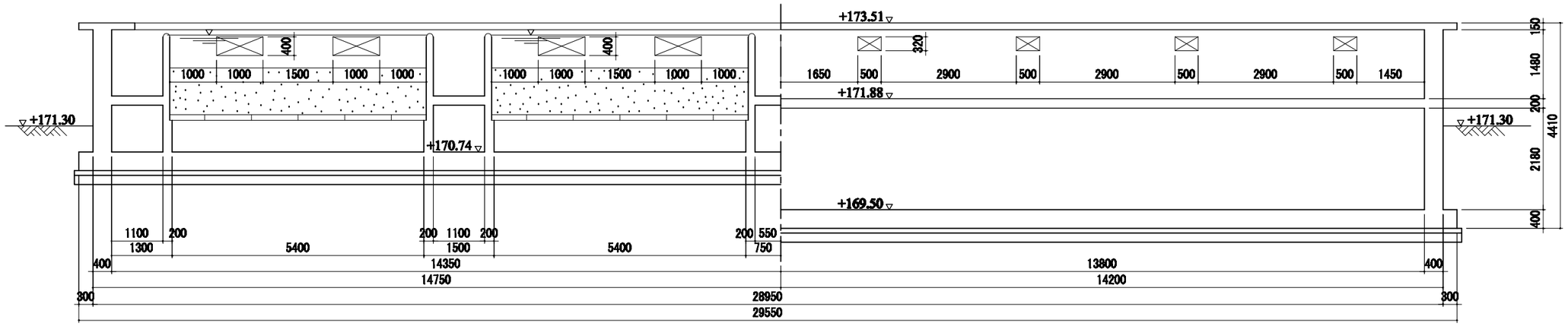


A - A section



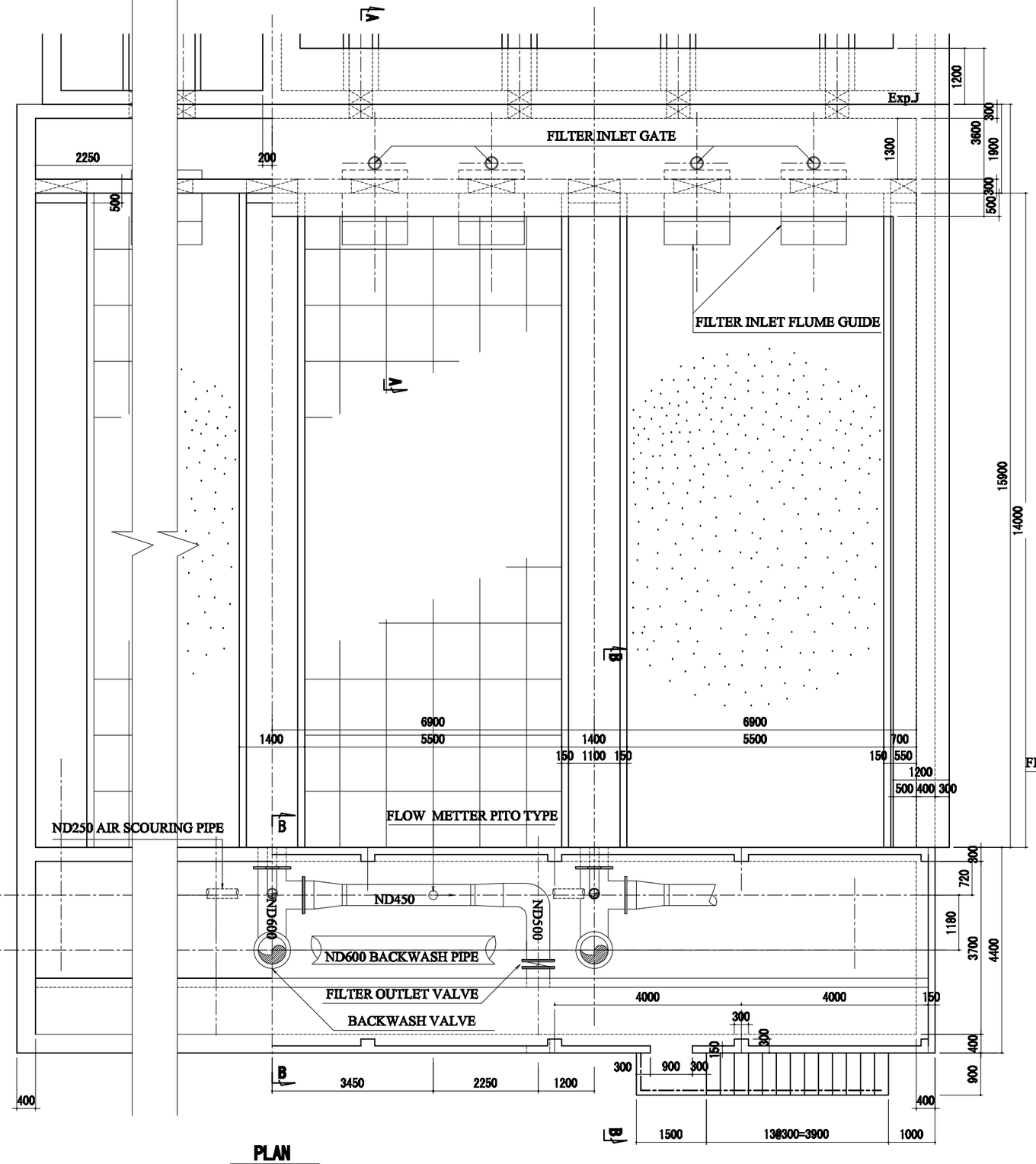
B - B section

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Rapid Sand Filter Structure(2/3)				WC-10
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100

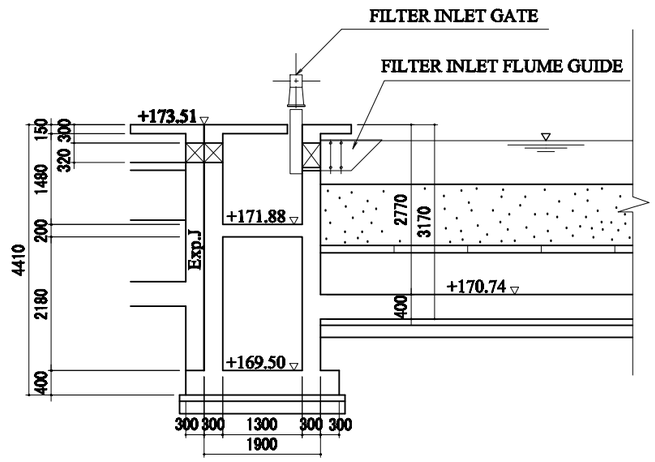


C - C section

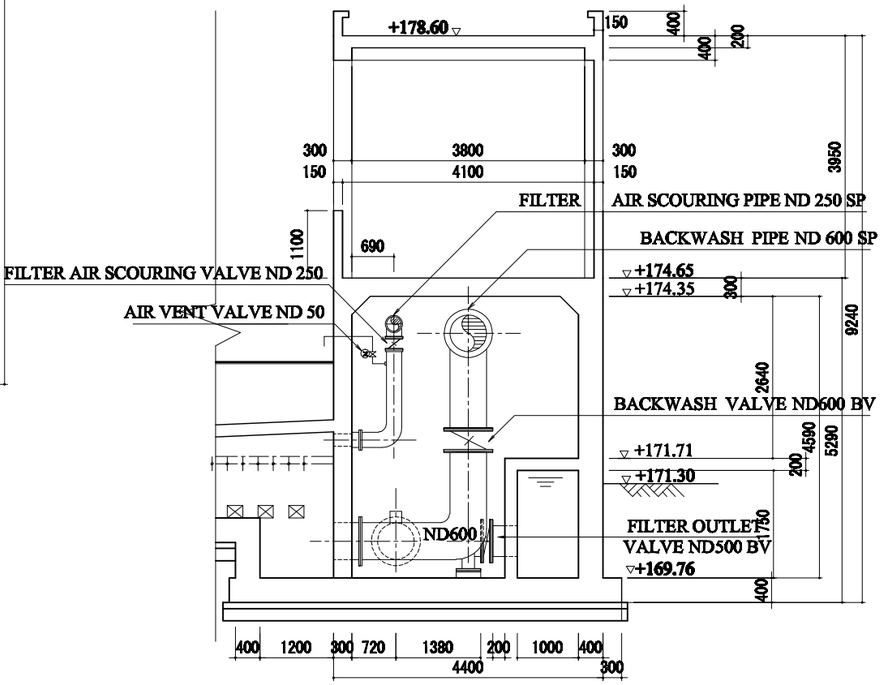
PROJECT Vientiane Capital Water Supply Expansion Project	DESCRIPTION Rapid Sand Filter Structure(3/3)		APPROVE BY	DATE	DRAWING No WC-11
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100



PLAN

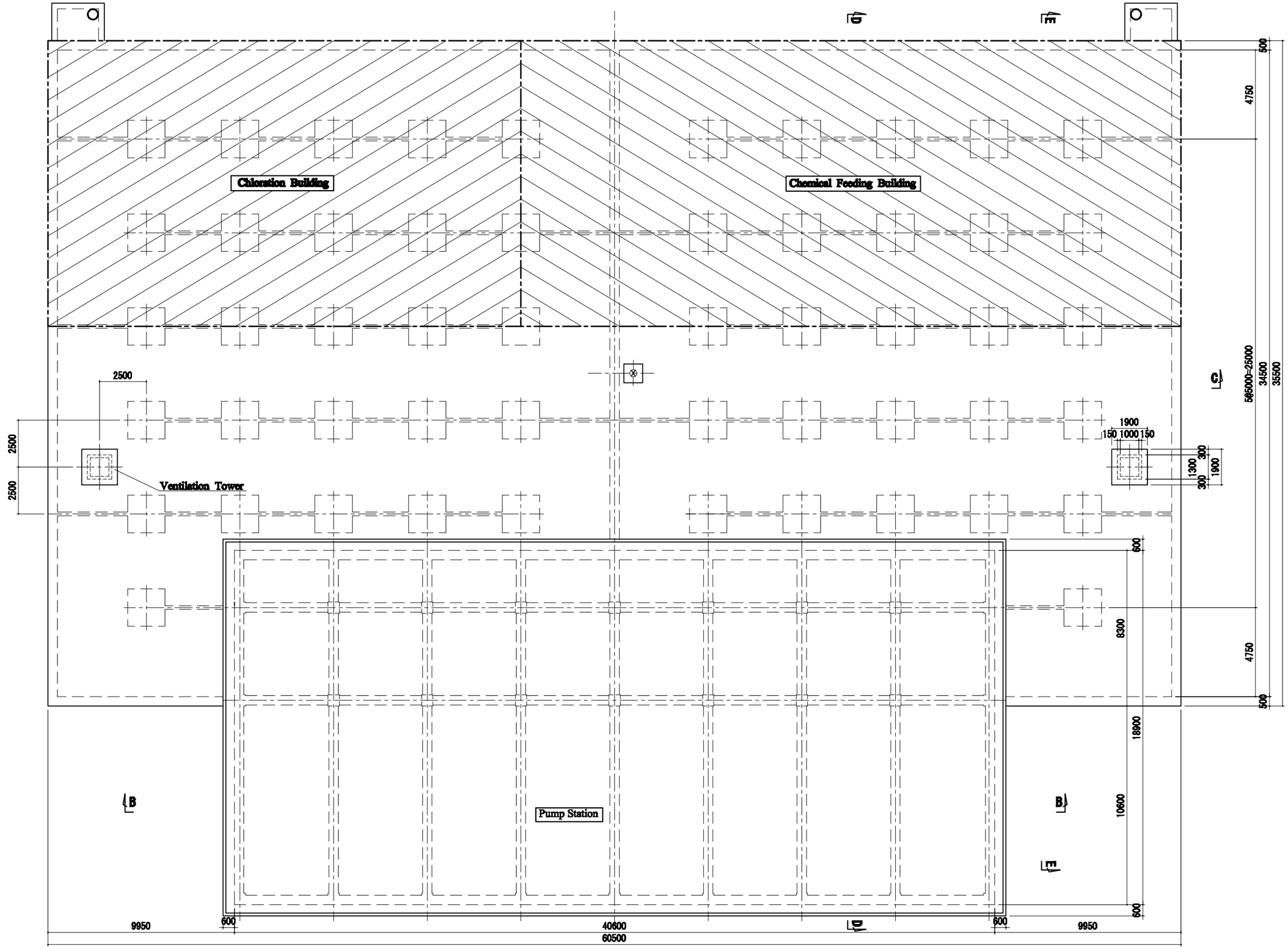


SECTION A-A

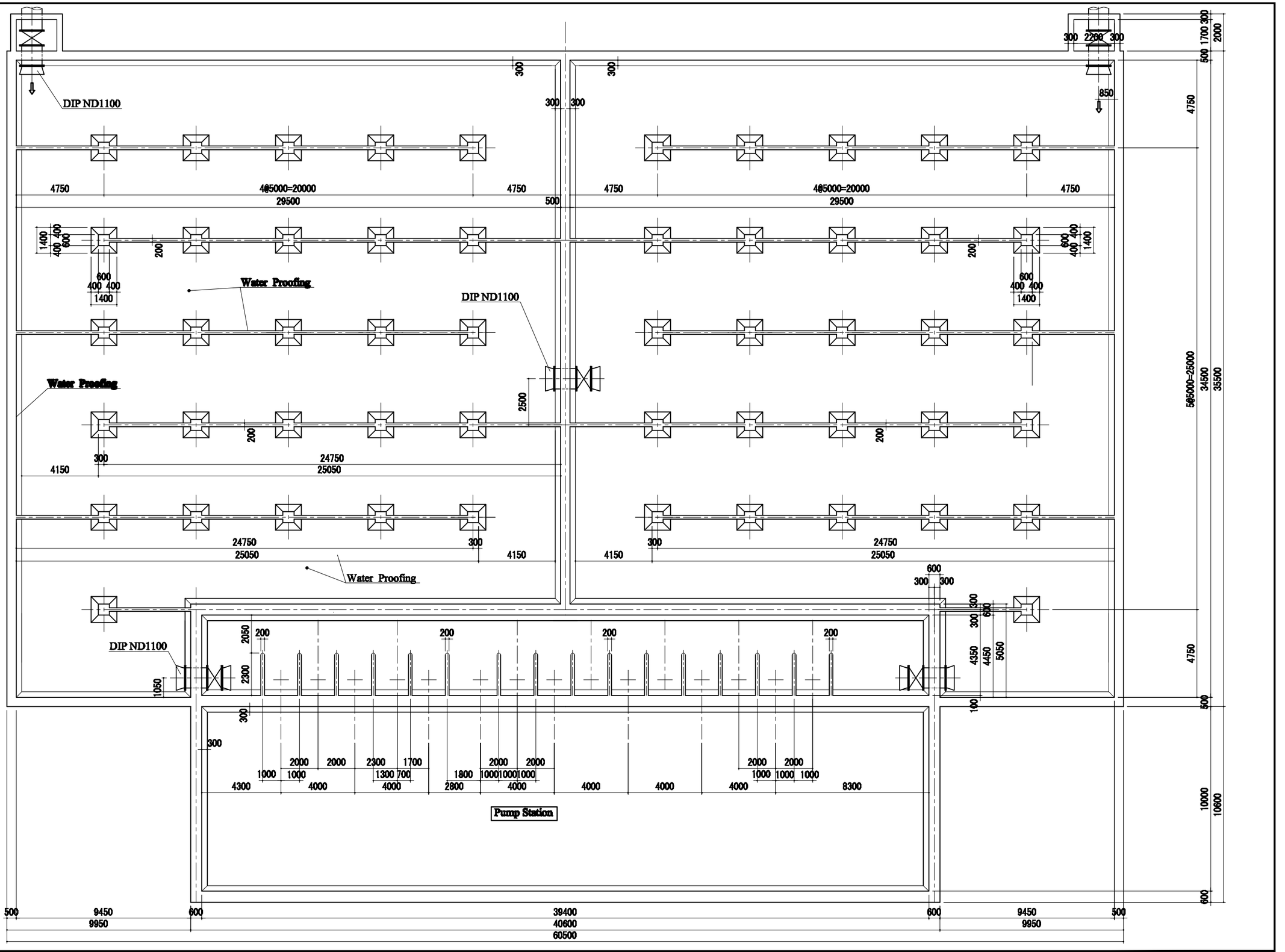


SECTION B-B

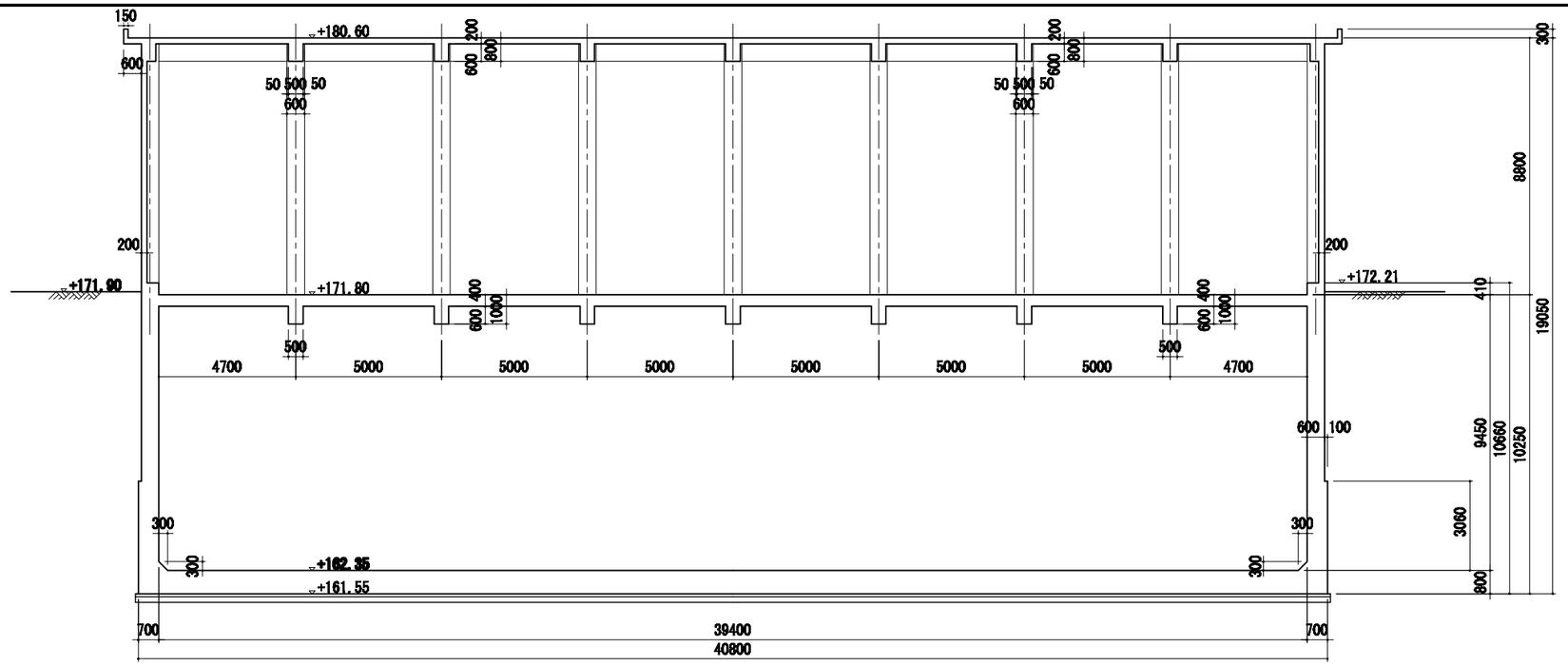
PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Rapid Sand Filter **Piping Details**				WC-12
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100



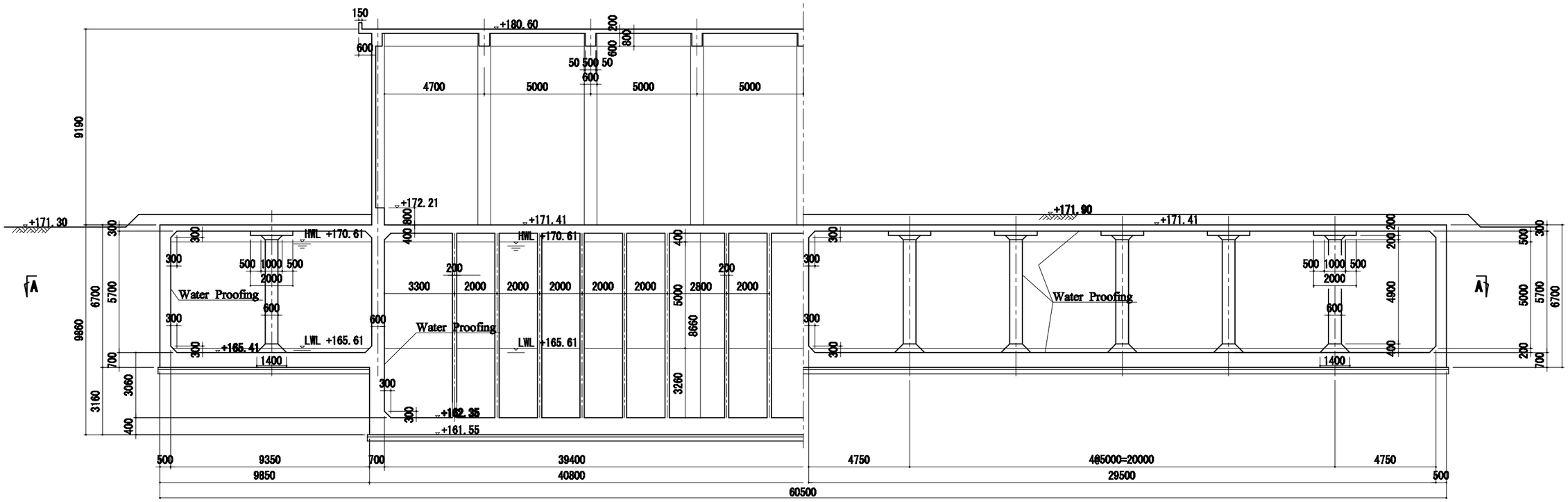
PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Clear Water Reservoir Structure(1/4)				WC-13
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:200



PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Clear Water Reservoir Structure(2/4)				WC-14
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:200

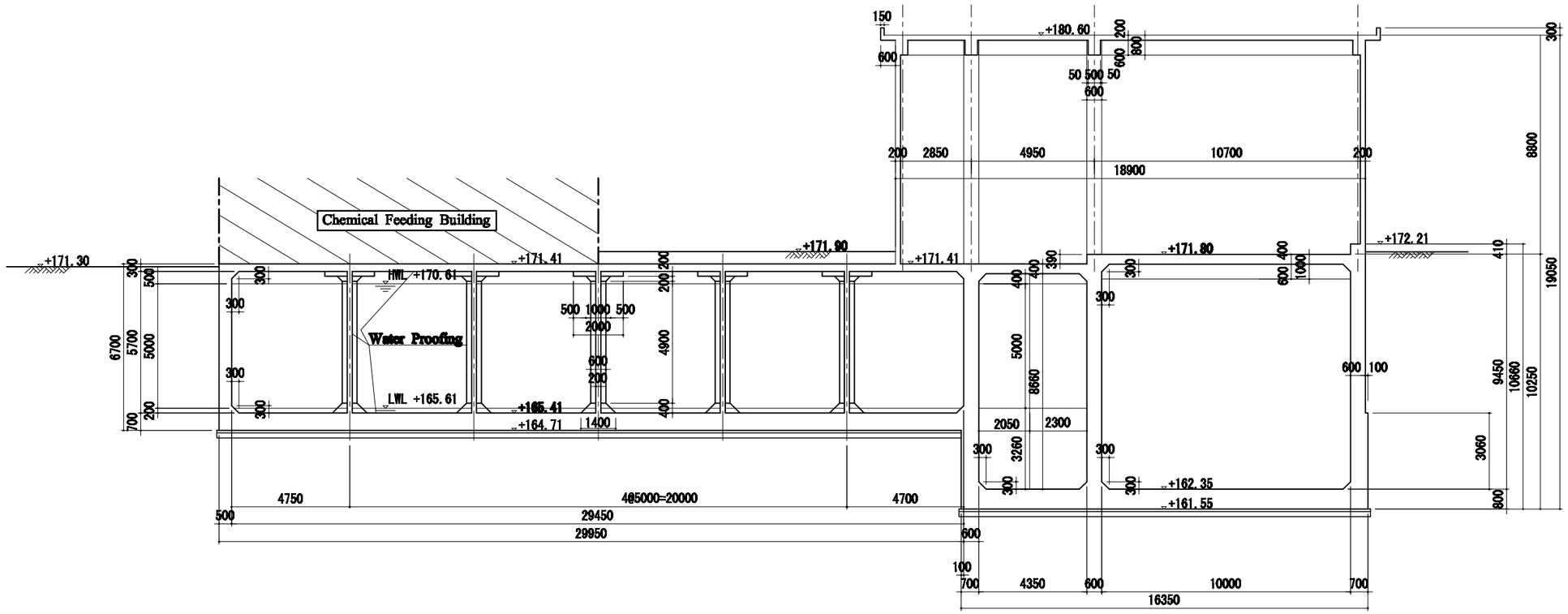


B - B Section

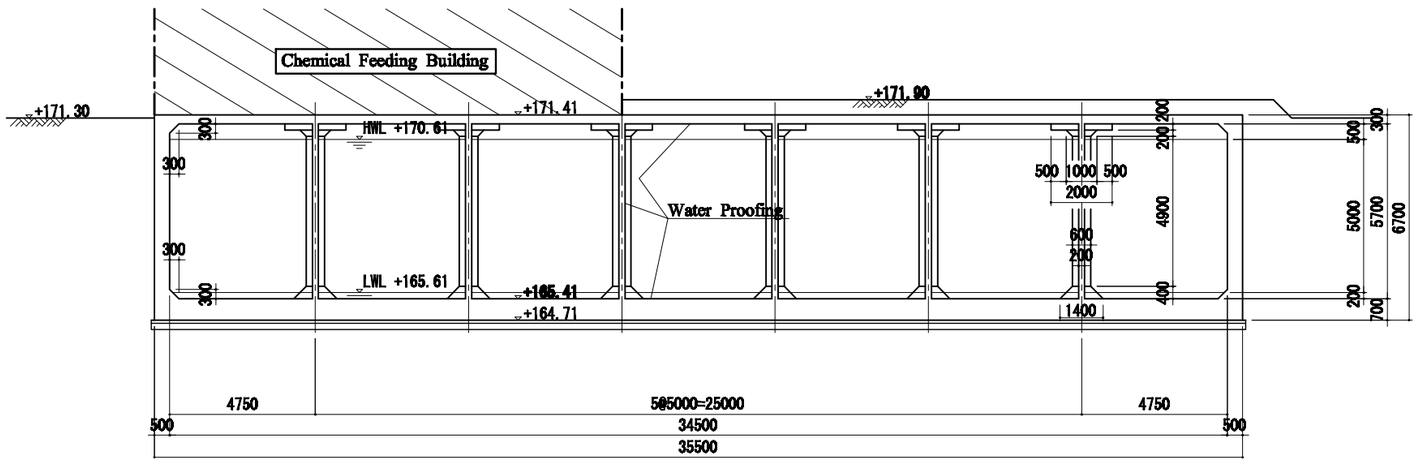


C - C Section

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Clear Water Reservoir Structure(3/4)				WC-15
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:200

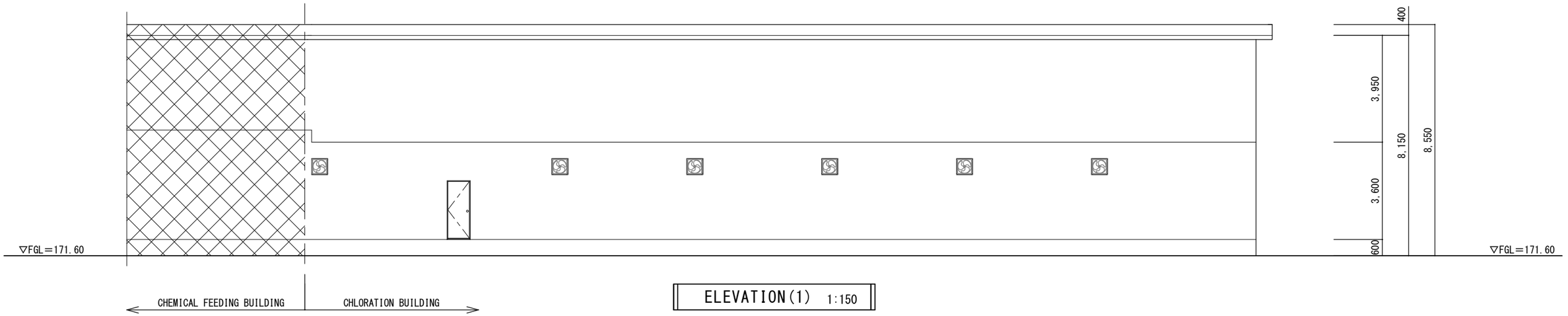


D - D Section

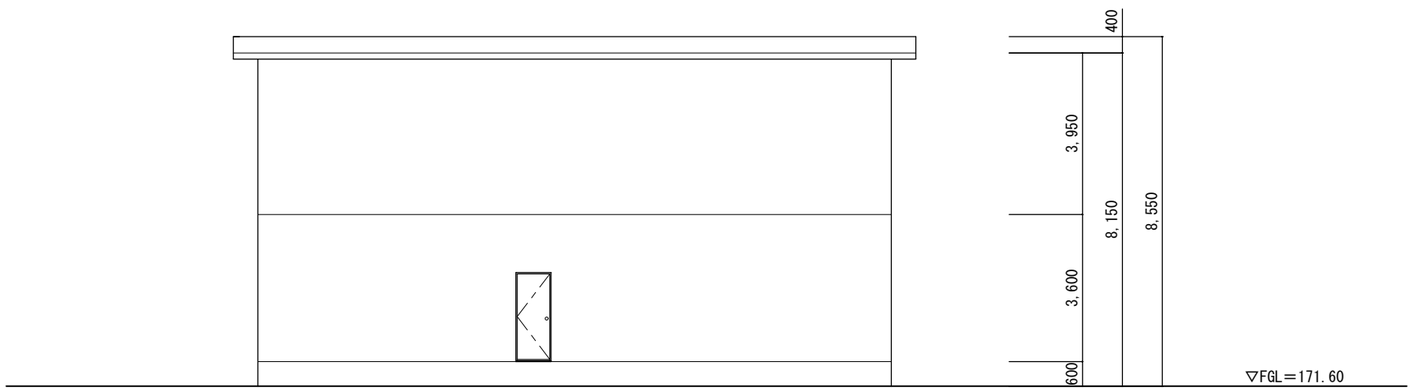


E - E Section

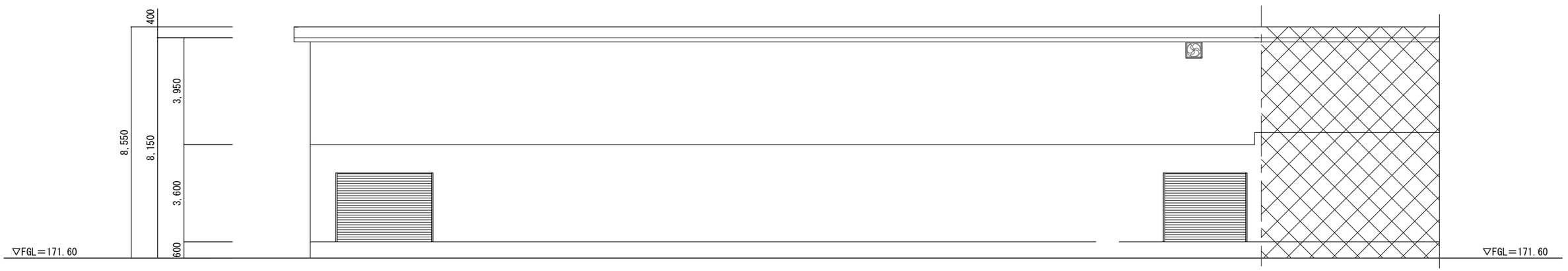
PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Clear Water Reservoir Structure(4/4)				WC-16
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:200



ELEVATION(1) 1:150

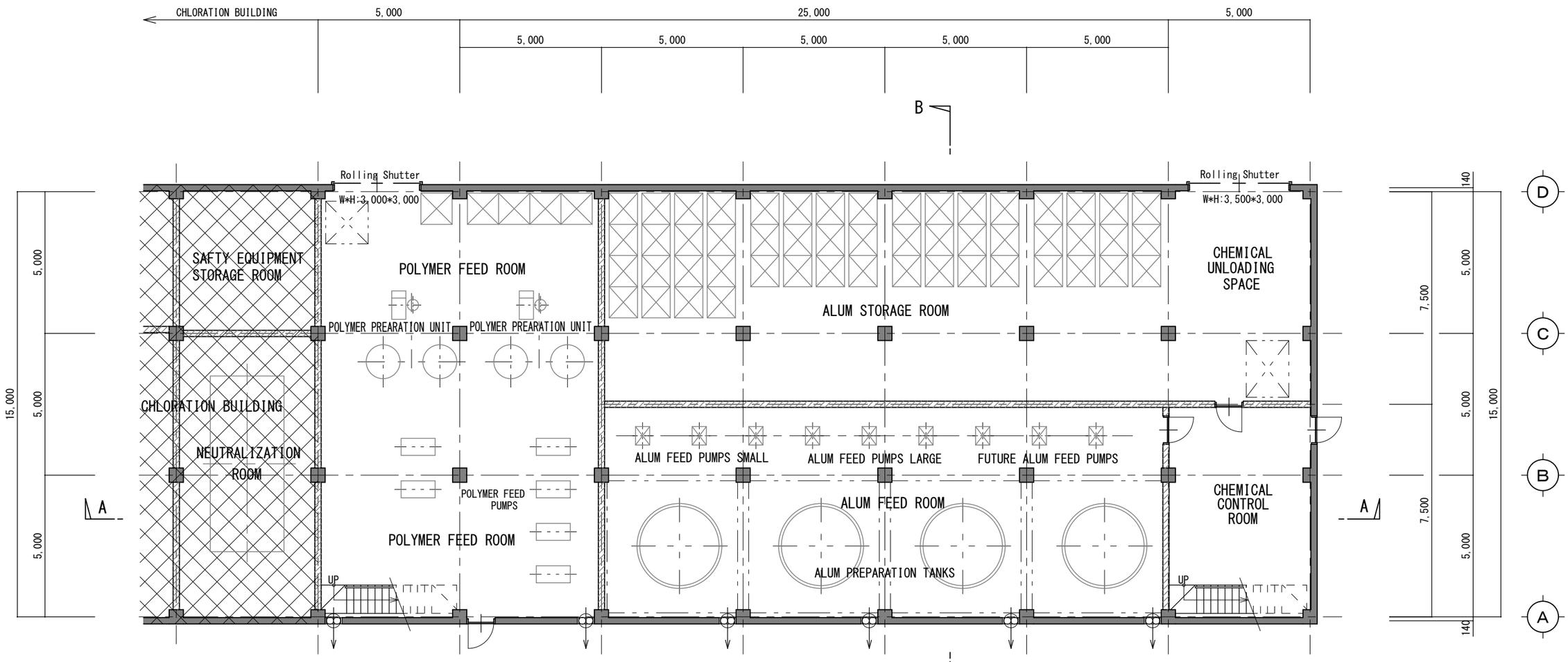


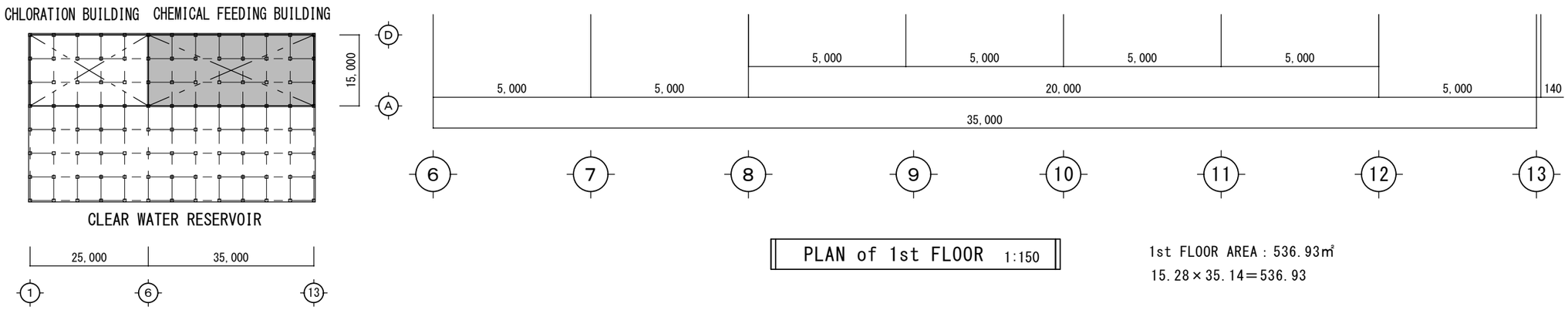
ELEVATION(2) 1:150



ELEVATION(3) 1:150

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	CHEMICAL FEEDING BUILDING ELEVATIONS				WA－01
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE S=1:150

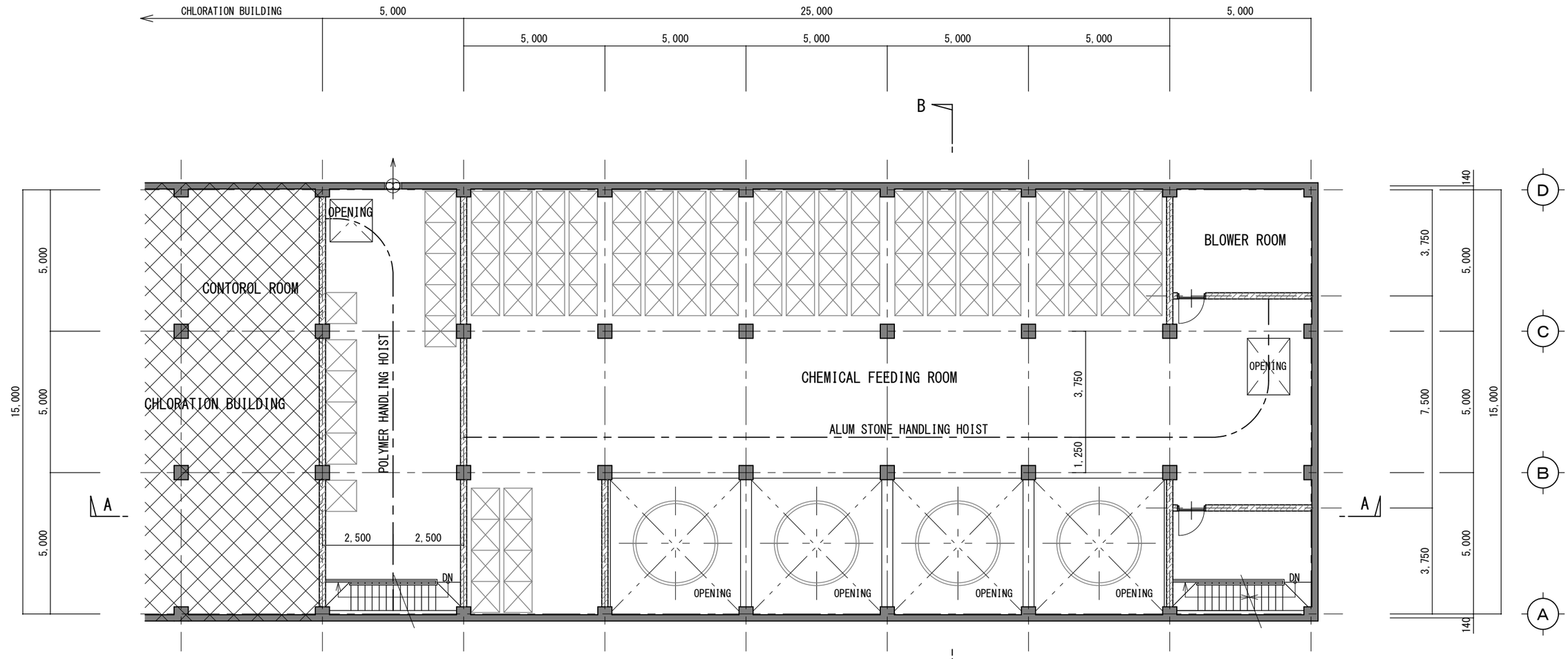


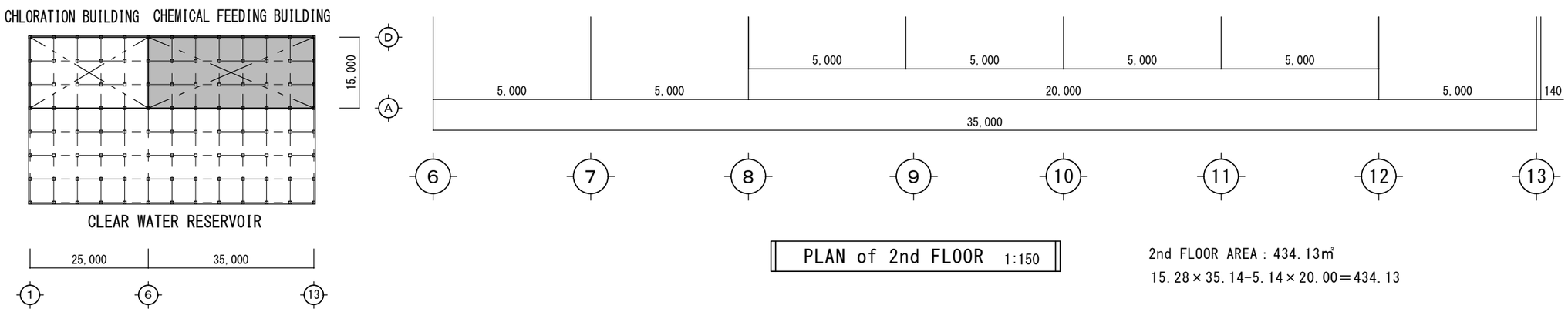


PLAN of 1st FLOOR 1:150

1st FLOOR AREA : 536.93㎡
15.28×35.14＝536.93

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	CHEMICAL FEEDING BUILDING PLAN of 1st FLOOR				WA－02
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE S=1:150

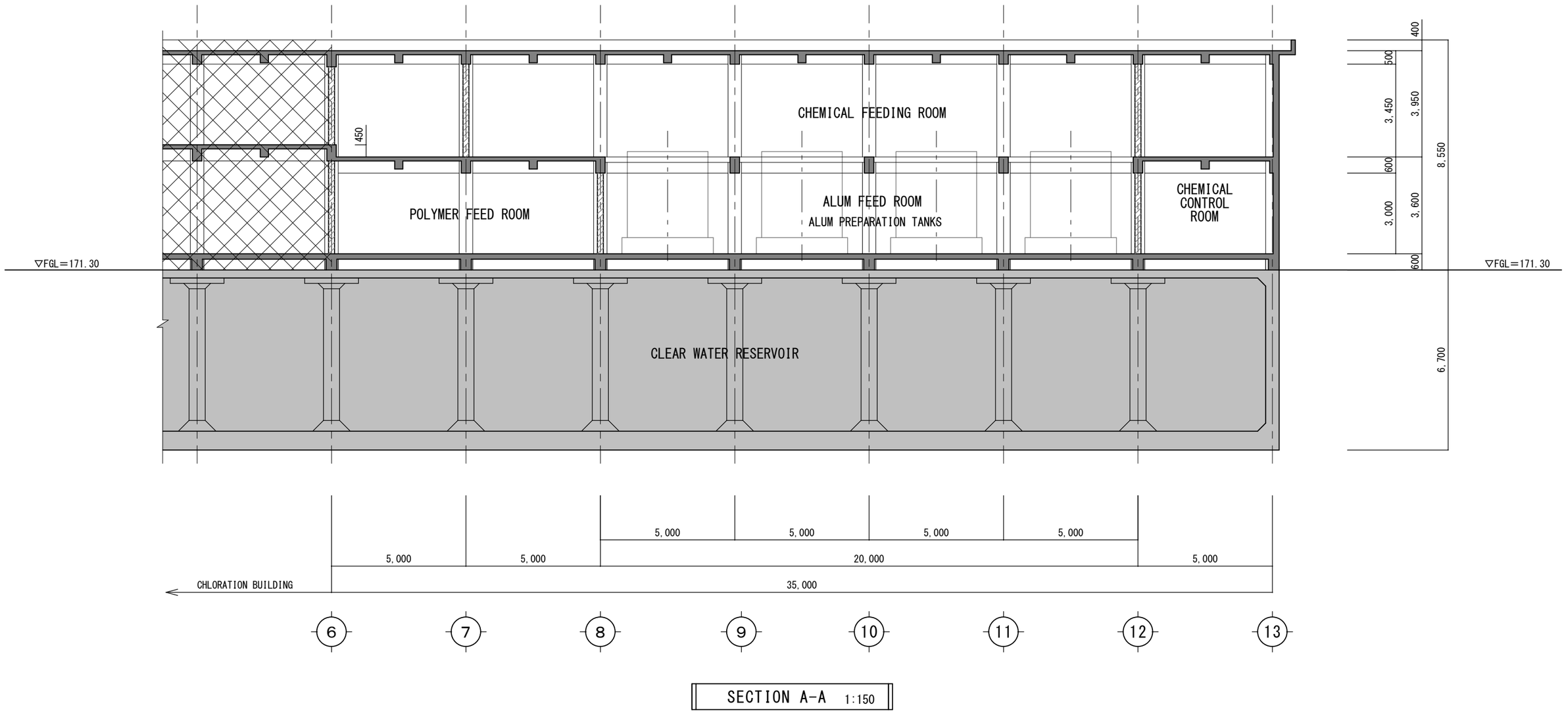




PLAN of 2nd FLOOR 1:150

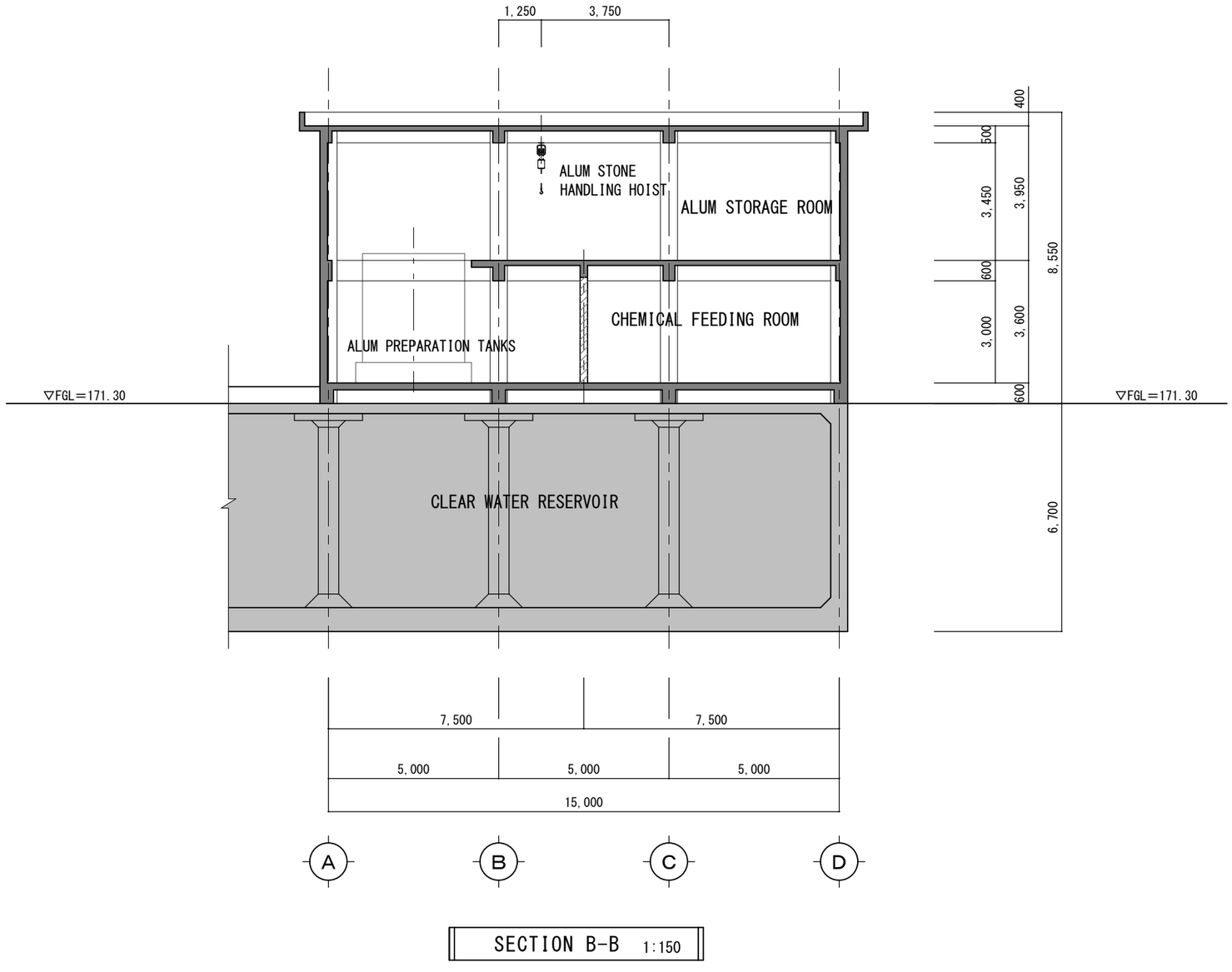
2nd FLOOR AREA : 434.13㎡
15.28×35.14-5.14×20.00=434.13

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	CHEMICAL FEEDING BUILDING PLAN of 2nd FLOOR				WA−03
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE S=1:150



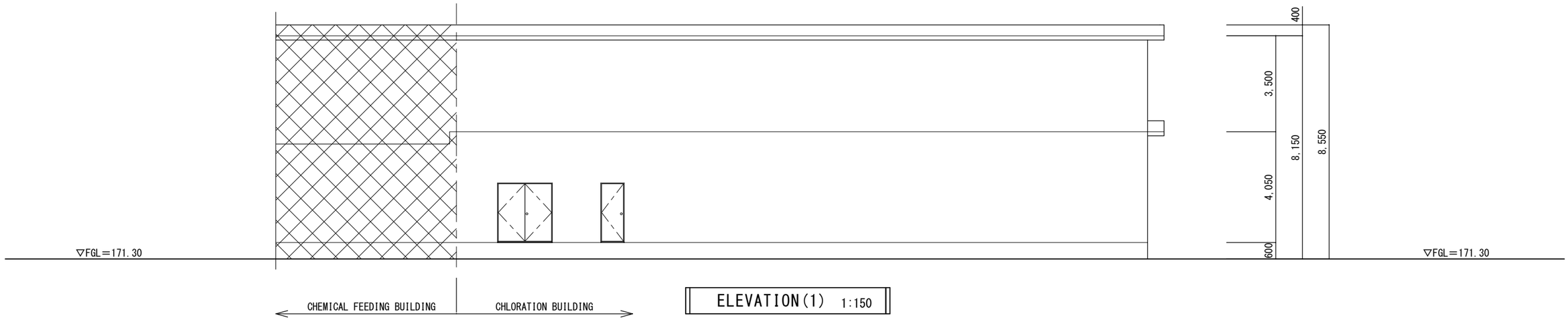
SECTION A-A 1:150

PROJECT Vientiane Capital Water Supply Expansion Project	DESCRIPTION CHEMICAL FEEDING BUILDING SECTION A-A		APPROVE BY	DATE	DRAWING No WA－04
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE S=1:150

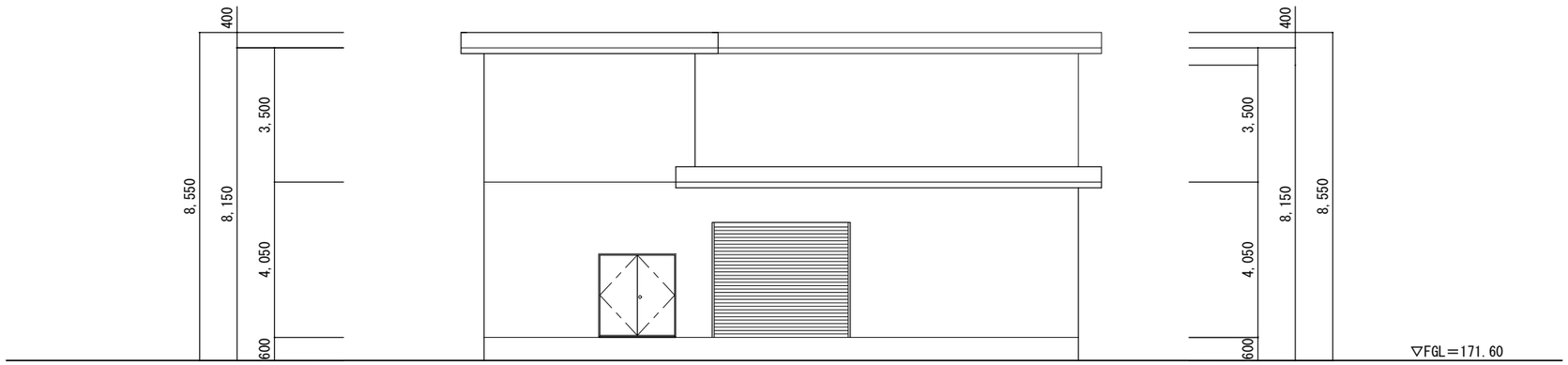


SECTION B-B 1:150

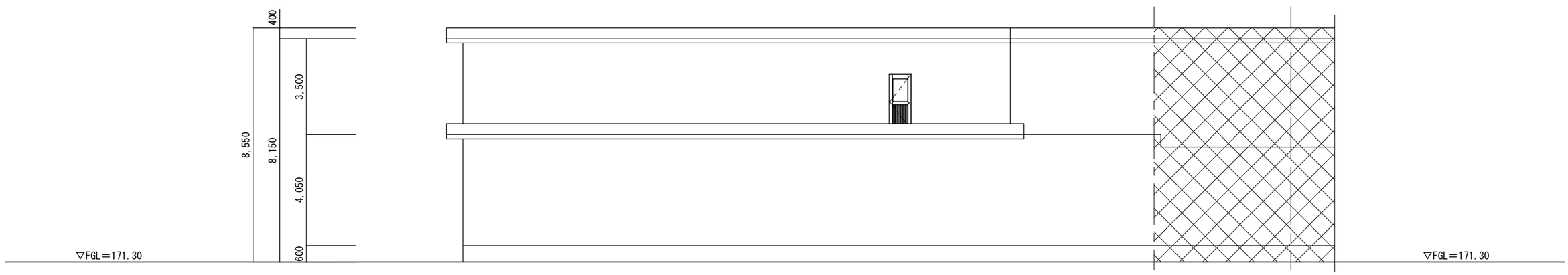
PROJECT Vientiane Capital Water Supply Expansion Project	DESCRIPTION CHEMICAL FEEDING BUILDING SECTION B-B		APPROVE BY	DATE	DRAWING No WA－05
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE S=1:150



ELEVATION(1) 1:150



ELEVATION(2) 1:150

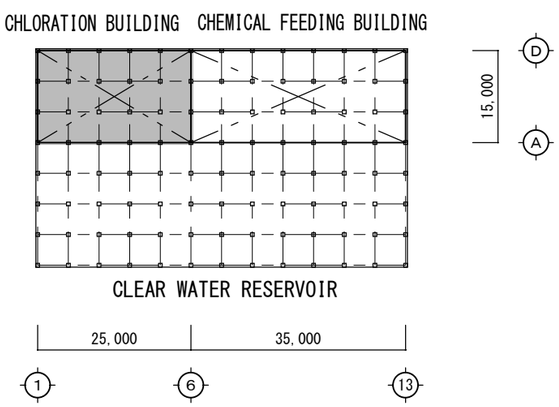


ELEVATION(3) 1:150

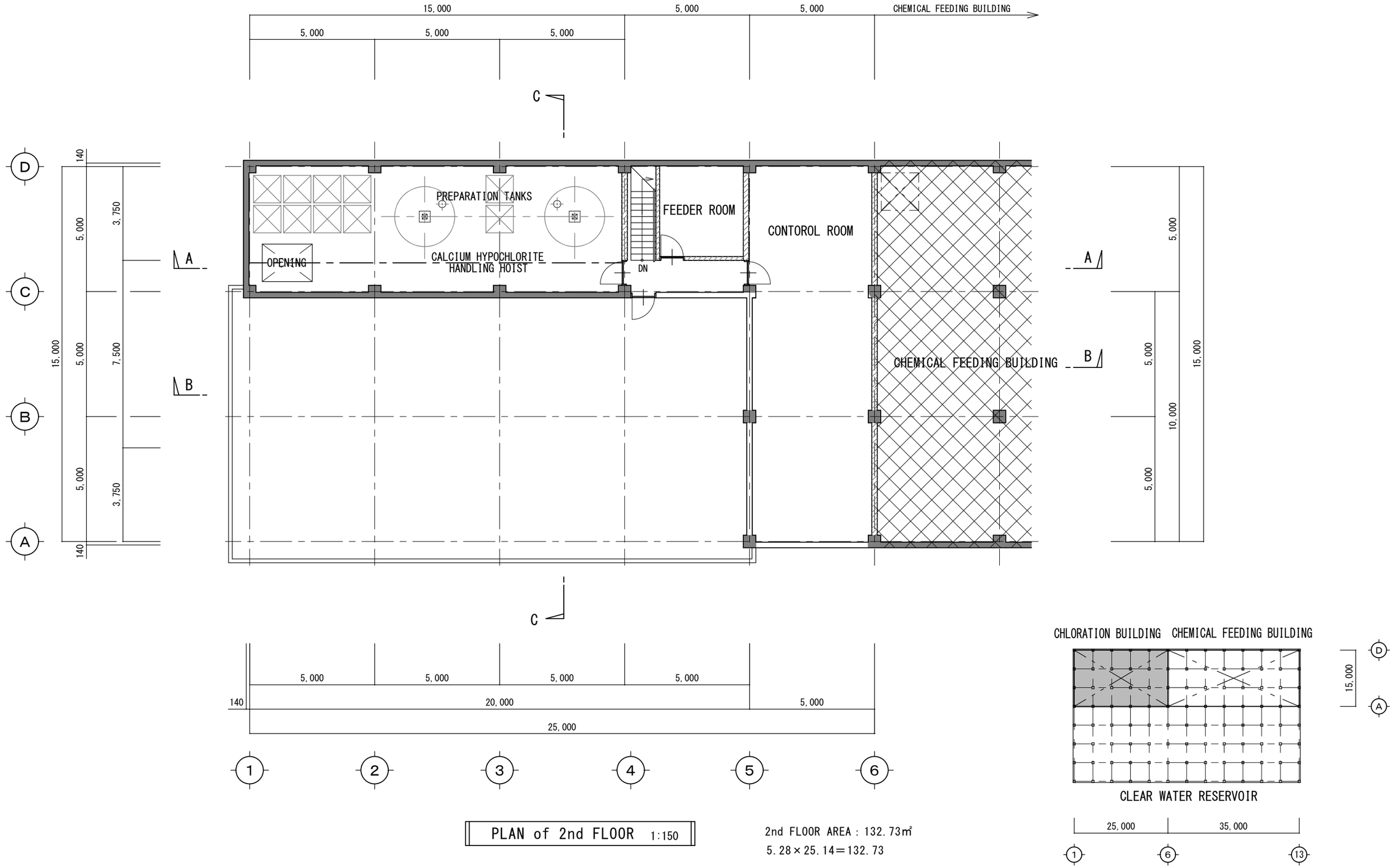
PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	CHLORATION BUILDING ELEVATIONS				WA－06
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE S=1:150

PLAN of 1st FLOOR 1:150

1st FLOOR AREA : 384.13㎡
15.28×25.14=384.13



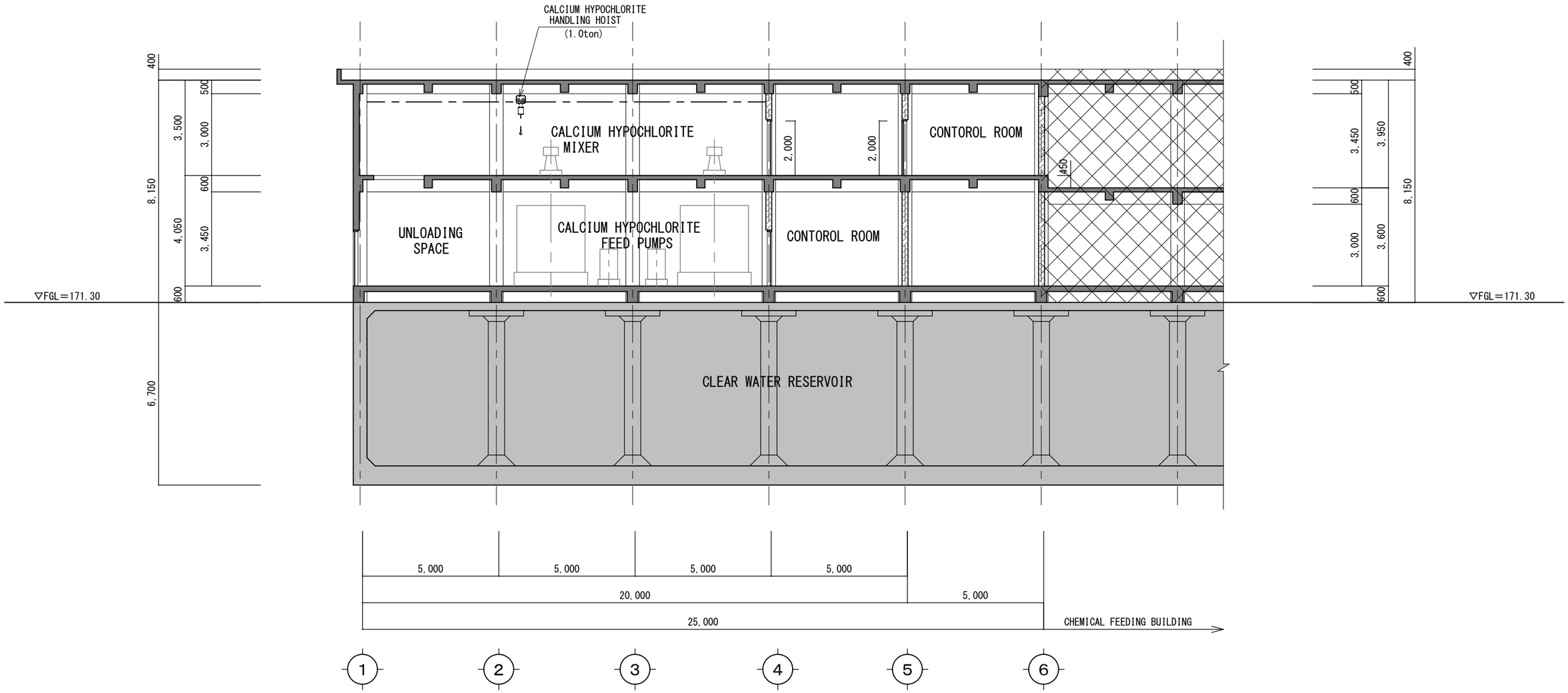
PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	CHLORATION BUILDING PLAN of 1st FLOOR				WA−07
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE S=1:150



PLAN of 2nd FLOOR 1:150

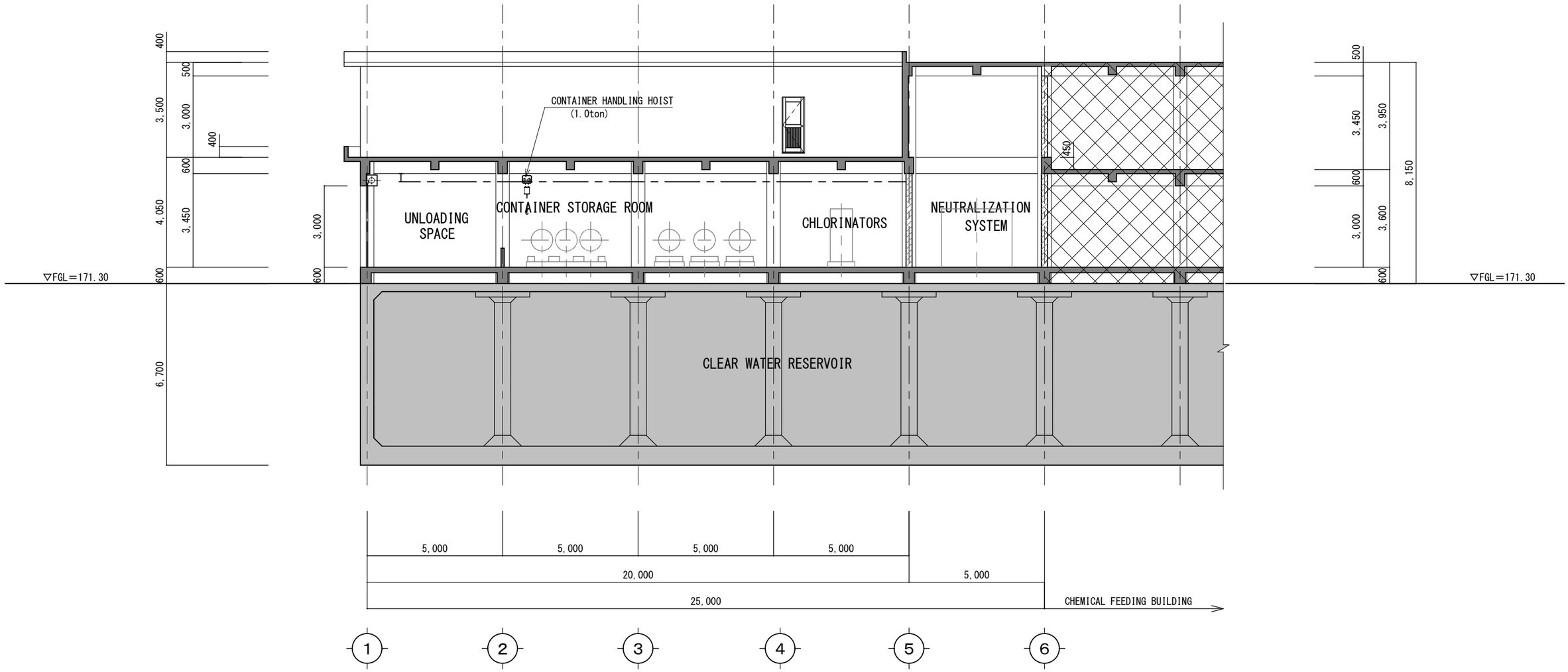
2nd FLOOR AREA : 132.73㎡
5.28×25.14=132.73

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	CHLORATION BUILDING PLAN of 2nd FLOOR				WA−08
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE S=1:150



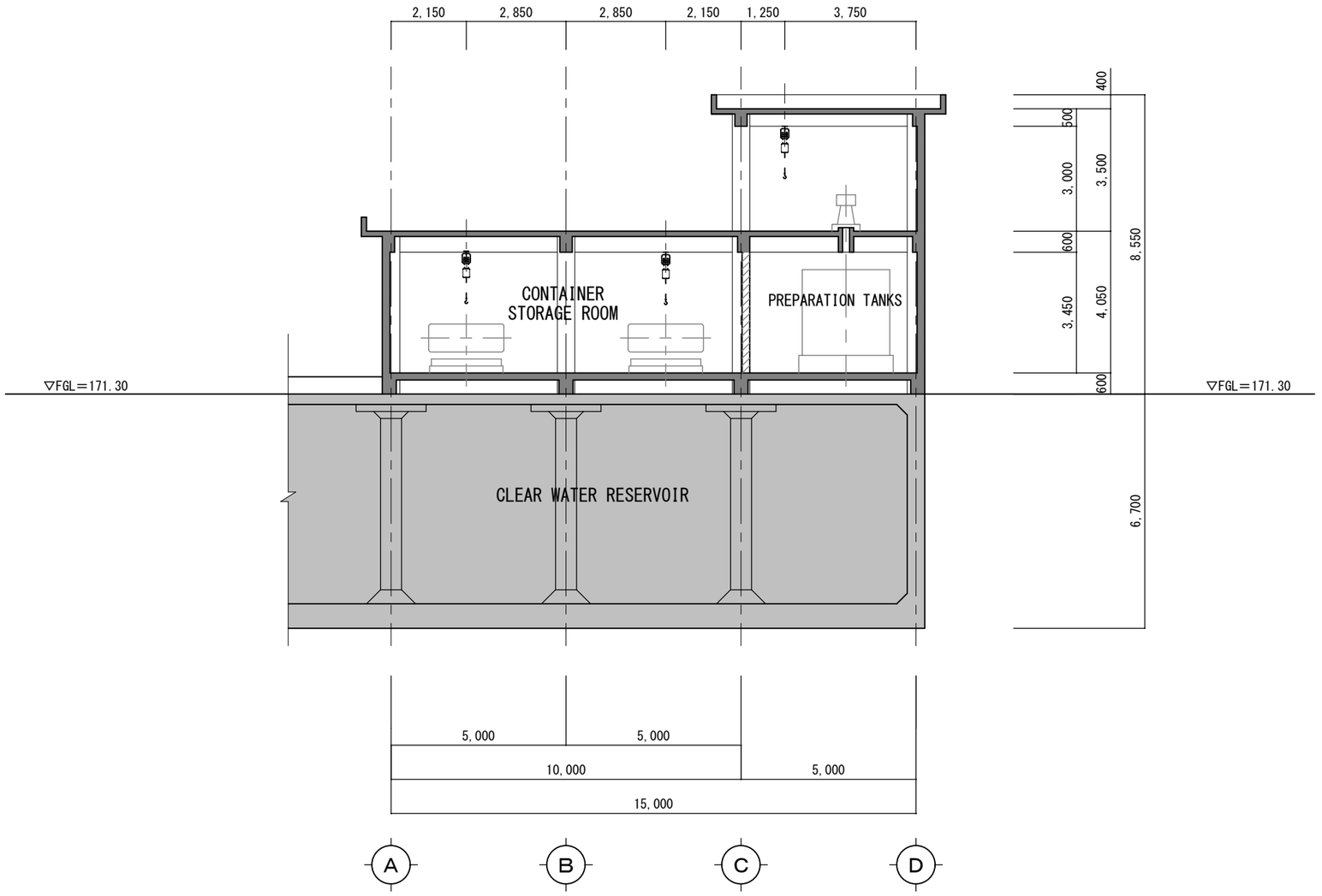
SECTION A-A 1:150

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	CHLORATION BUILDING SECTION A-A				WA－09
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE S=1:150



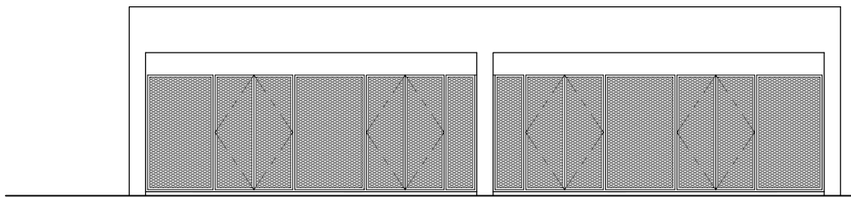
SECTION B-B 1:150

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	CHLORATION BUILDING SECTION B-B				WA－10
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE S=1:150

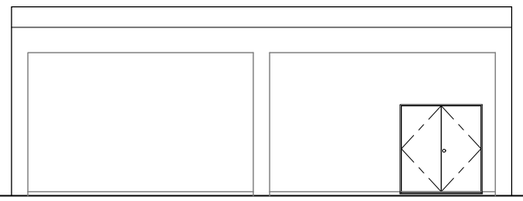


SECTION C-C 1:150

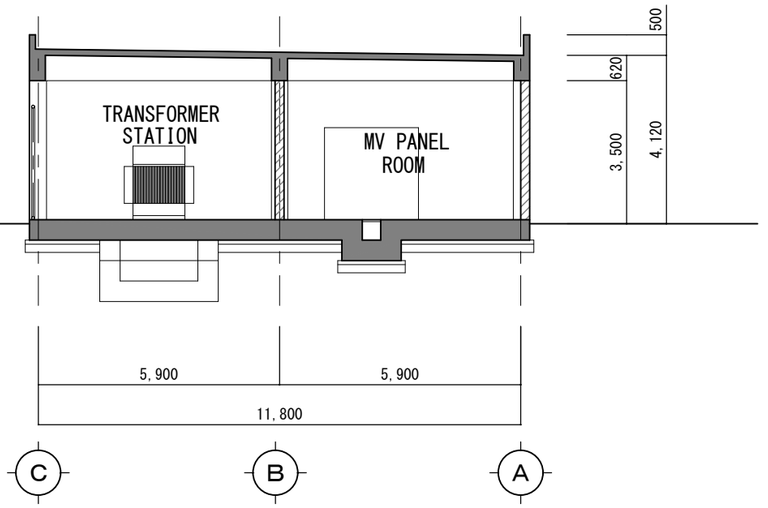
PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	CHLORATION BUILDING SECTION C-C				WA－11
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE S=1:150



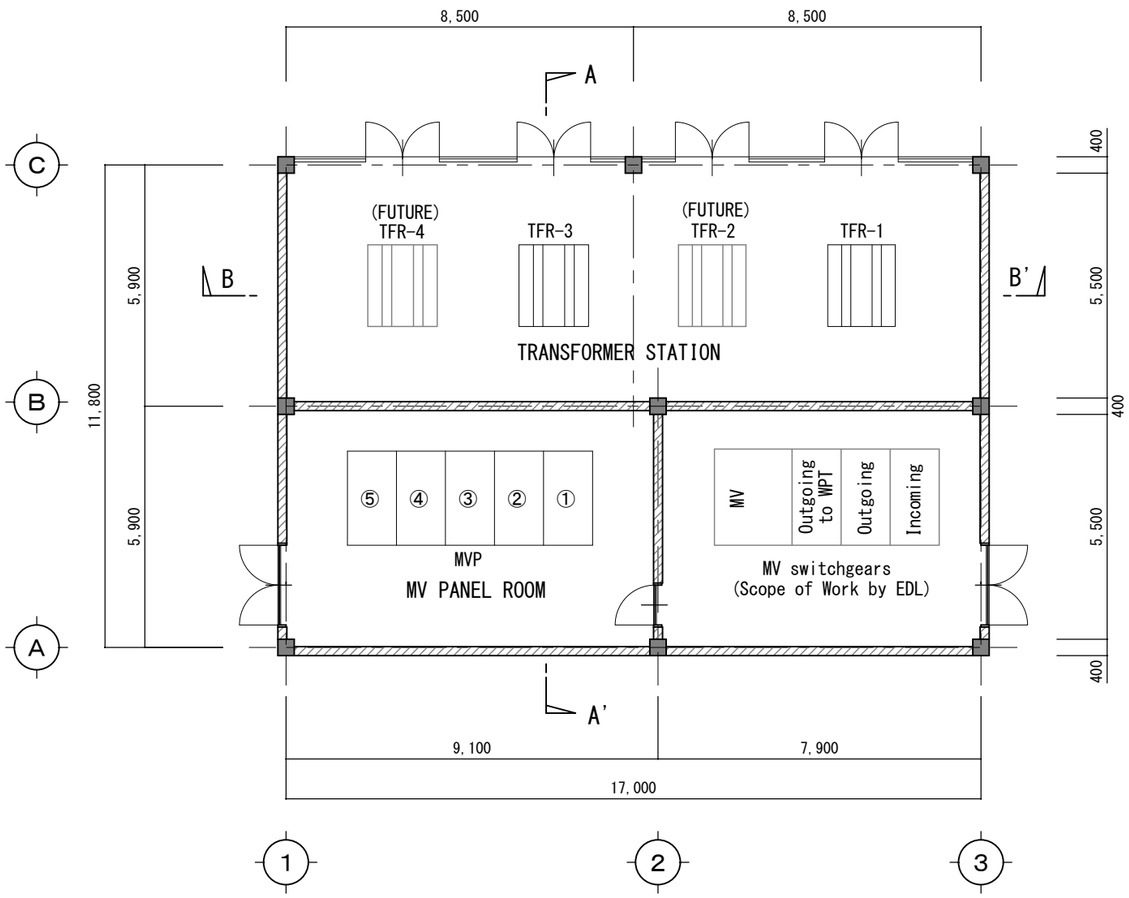
ELEVATION(1) 1:150



ELEVATION(2) 1:150

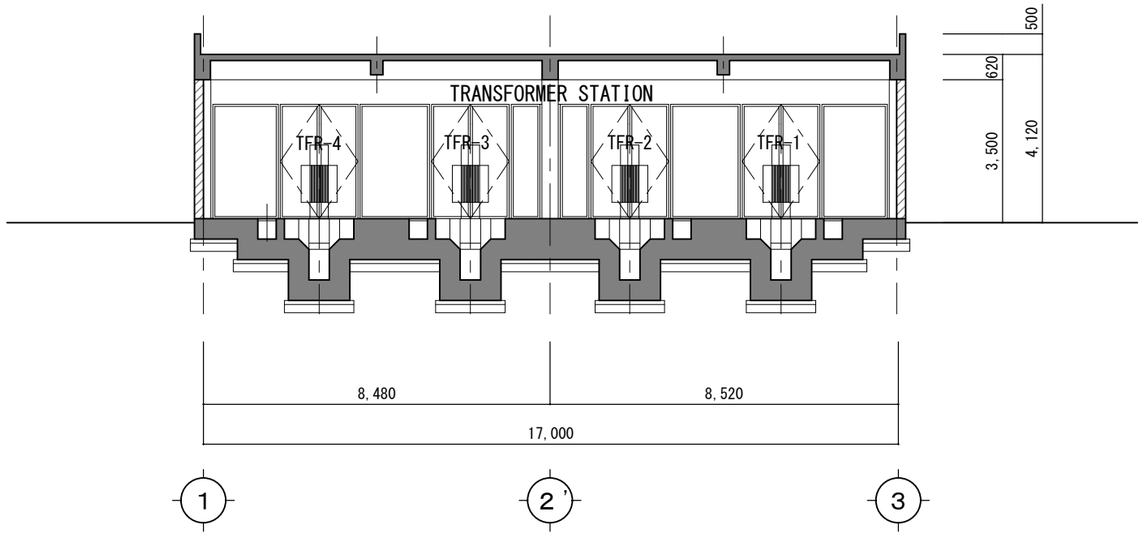


SECTION A-A' 1:150



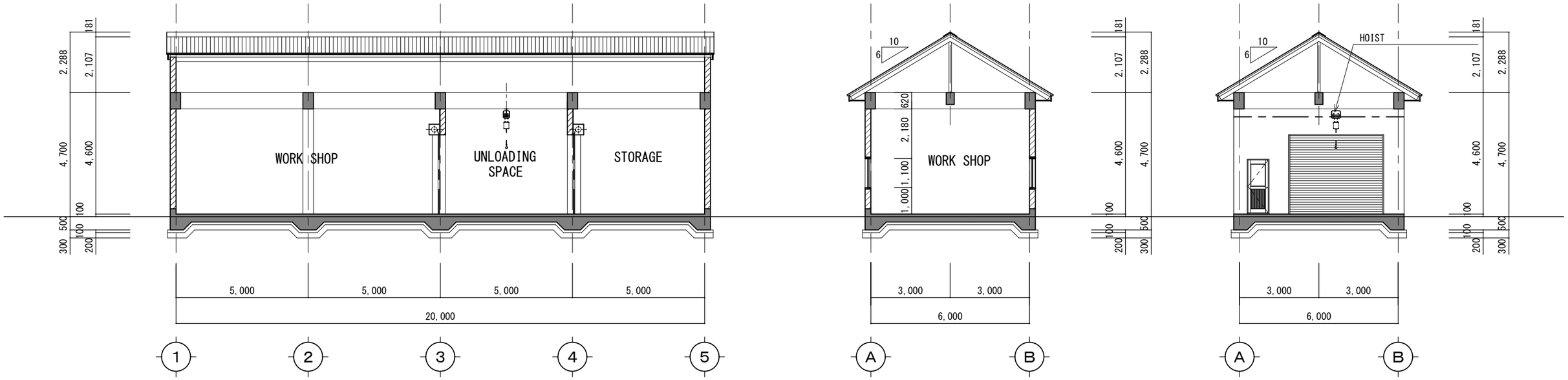
PLAN 1:150

AREA : 200.60㎡
17.00×11.80=200.60



SECTION B-B' 1:150

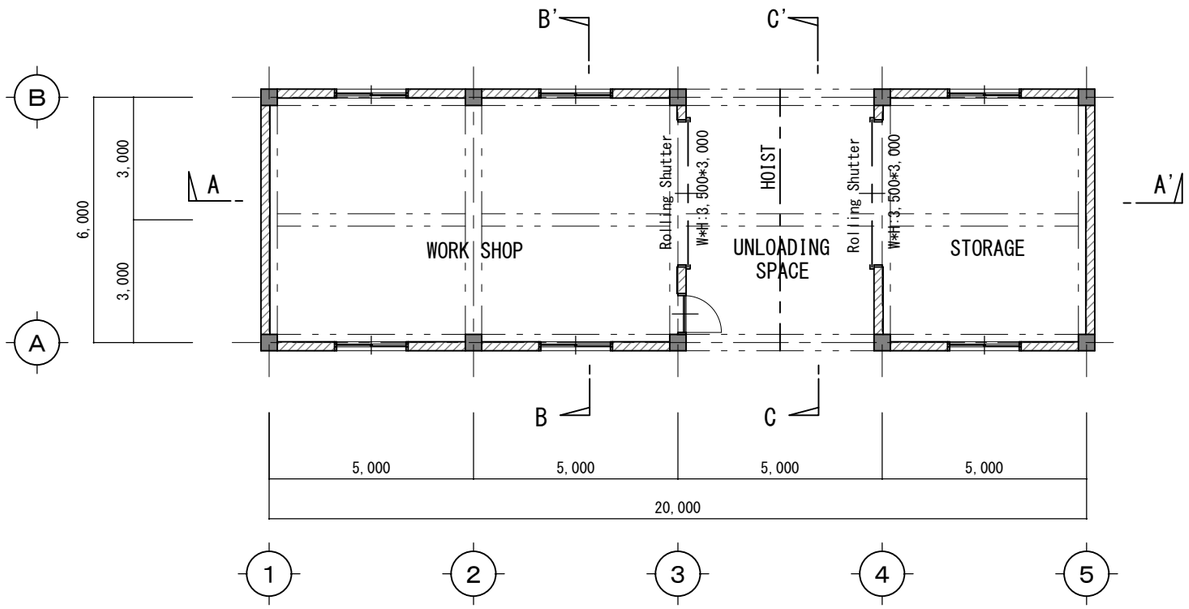
PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	POWER STATION HOUSE ELEVATION PLAN SECTION				WA−12
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE S=1:150



SECTION A-A' 1:150

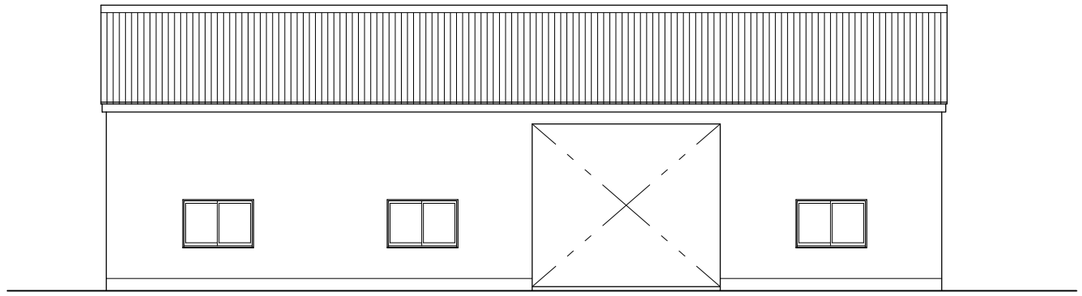
SECTION B-B' 1:150

SECTION C-C' 1:150

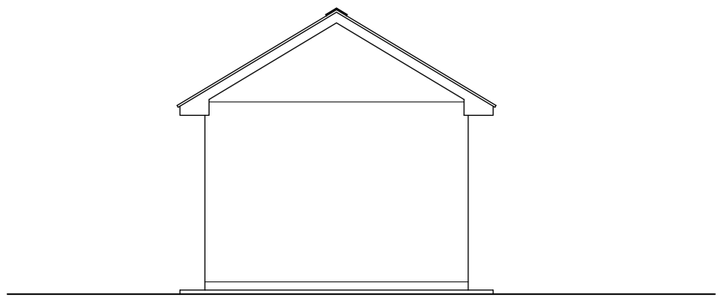


PLAN 1:150

AREA : 120.00㎡
20.00×6.00=120.00



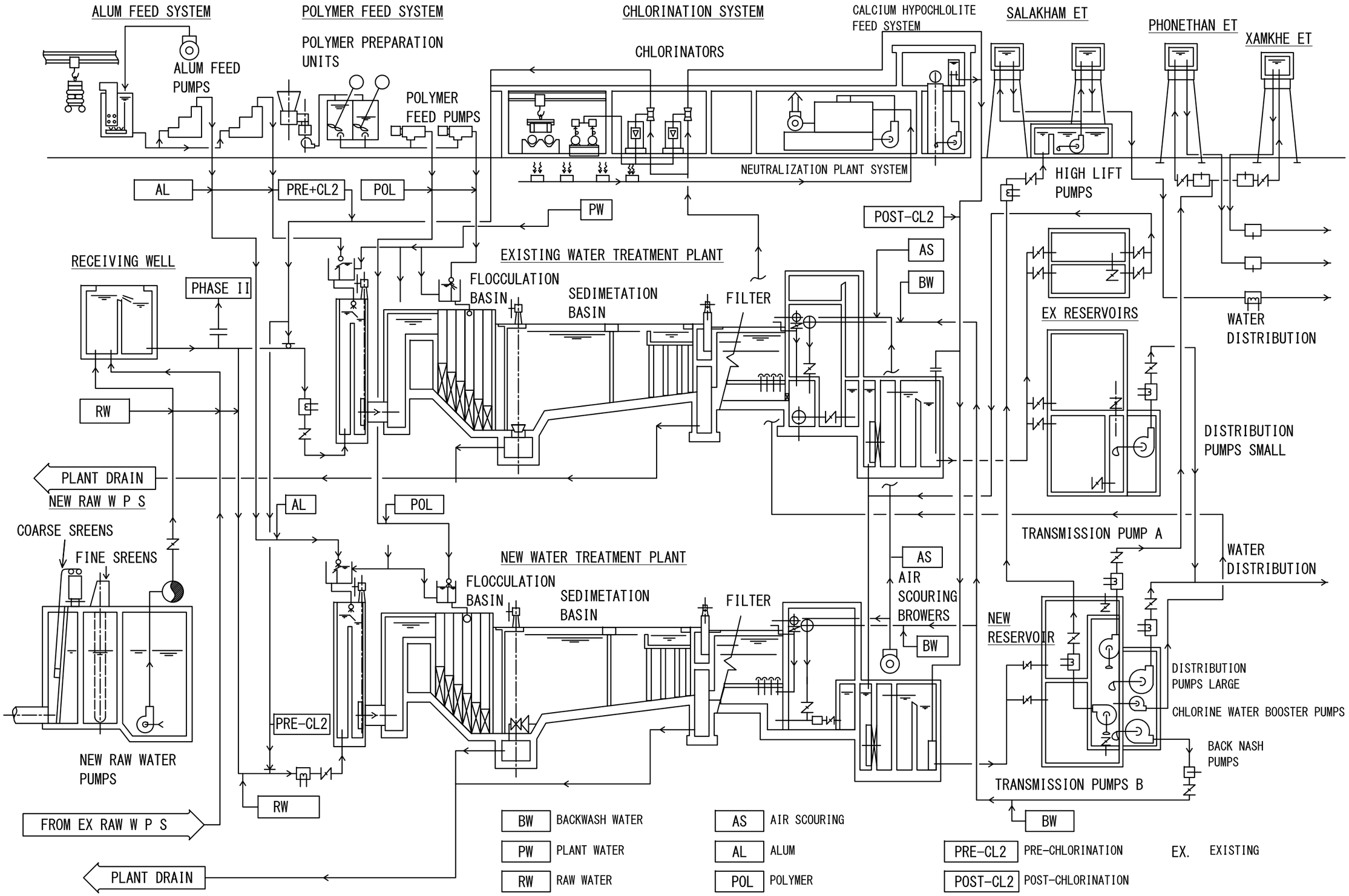
ELEVATION(1) 1:150



ELEVATION(2) 1:150

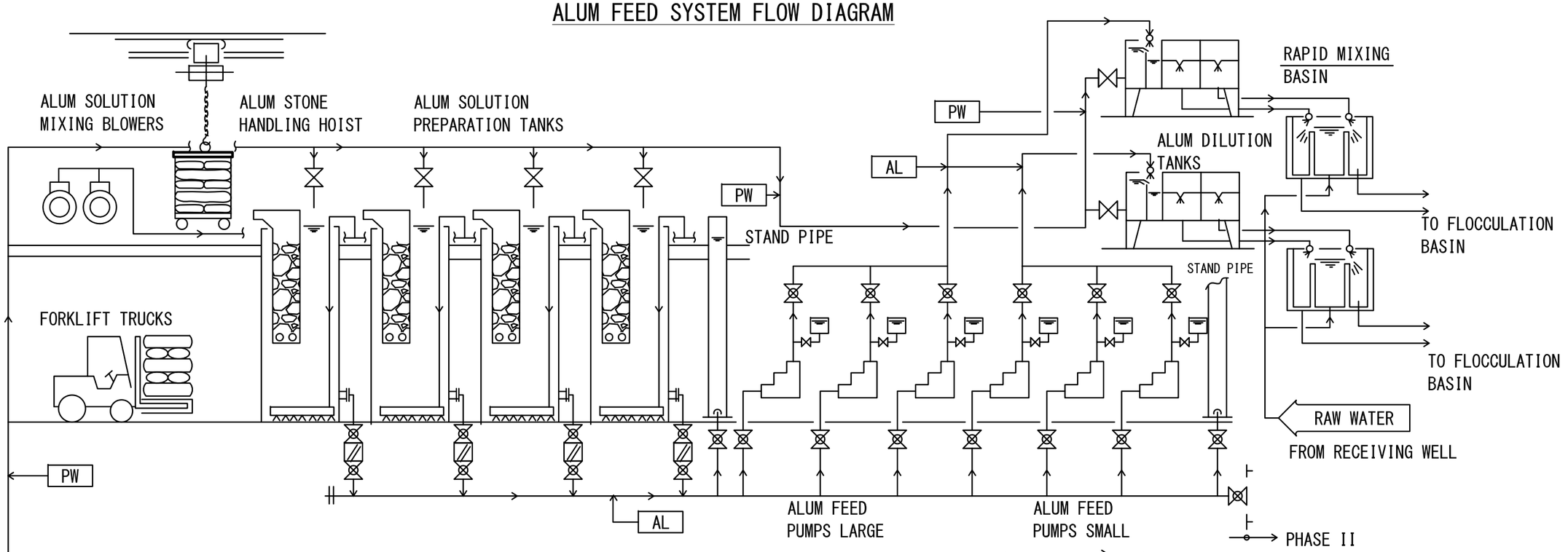
PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	WORK SHOP BUILDING PLAN of 1st FLOOR				WA−13
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE S=1:150

PLANT PROCESS FLOW DIAGRAM

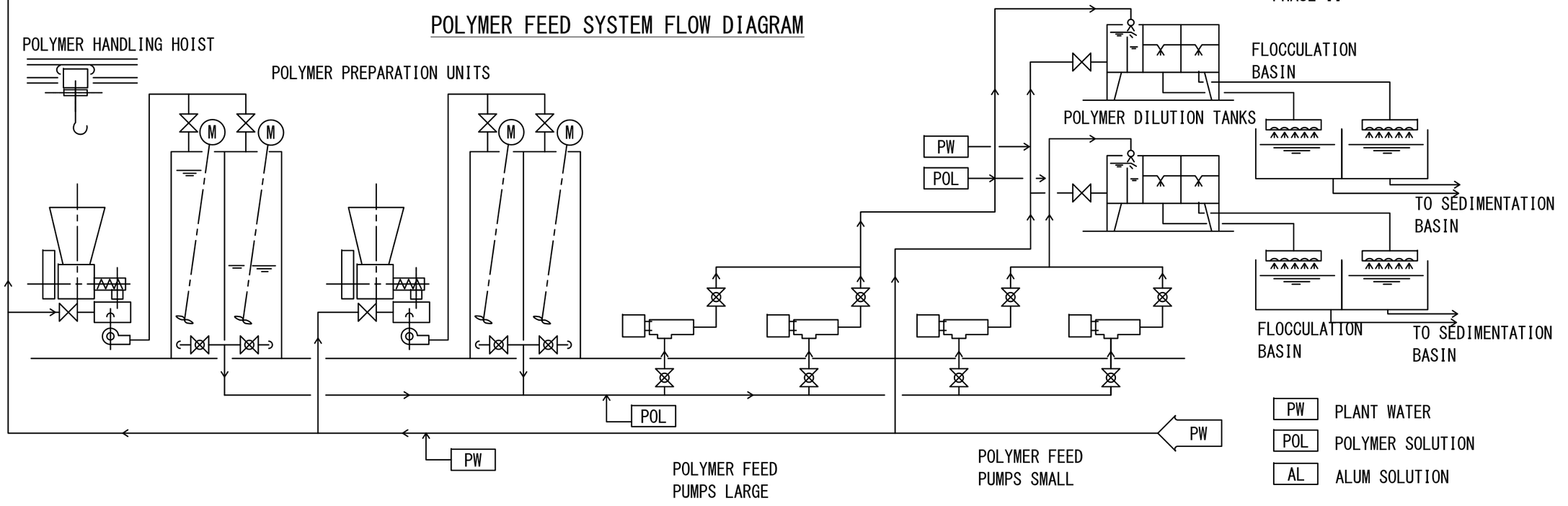


PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	PLANT PROCESS FLOW DIAGRAM				WM - 01
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE NONE

ALUM FEED SYSTEM FLOW DIAGRAM

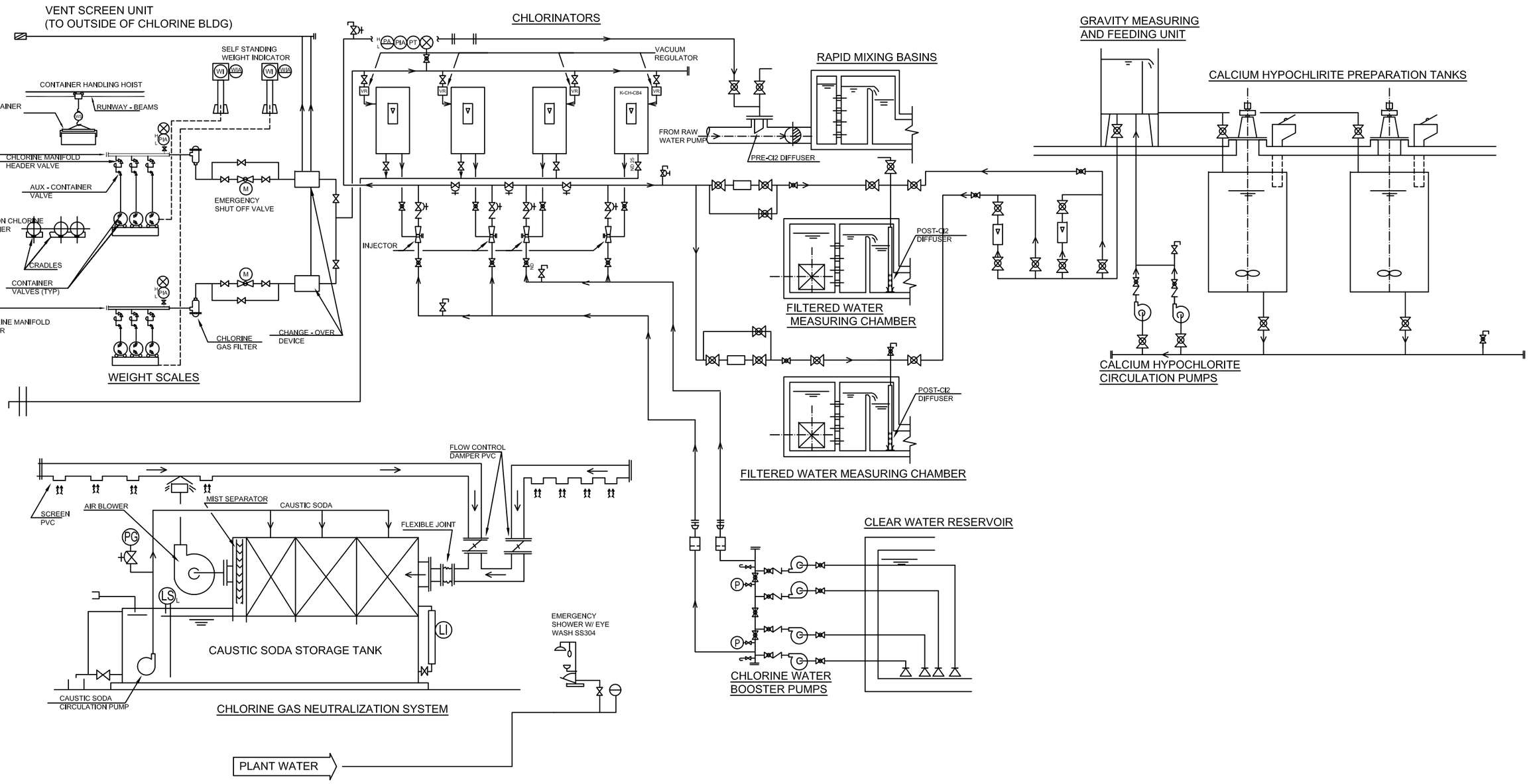


POLYMER FEED SYSTEM FLOW DIAGRAM

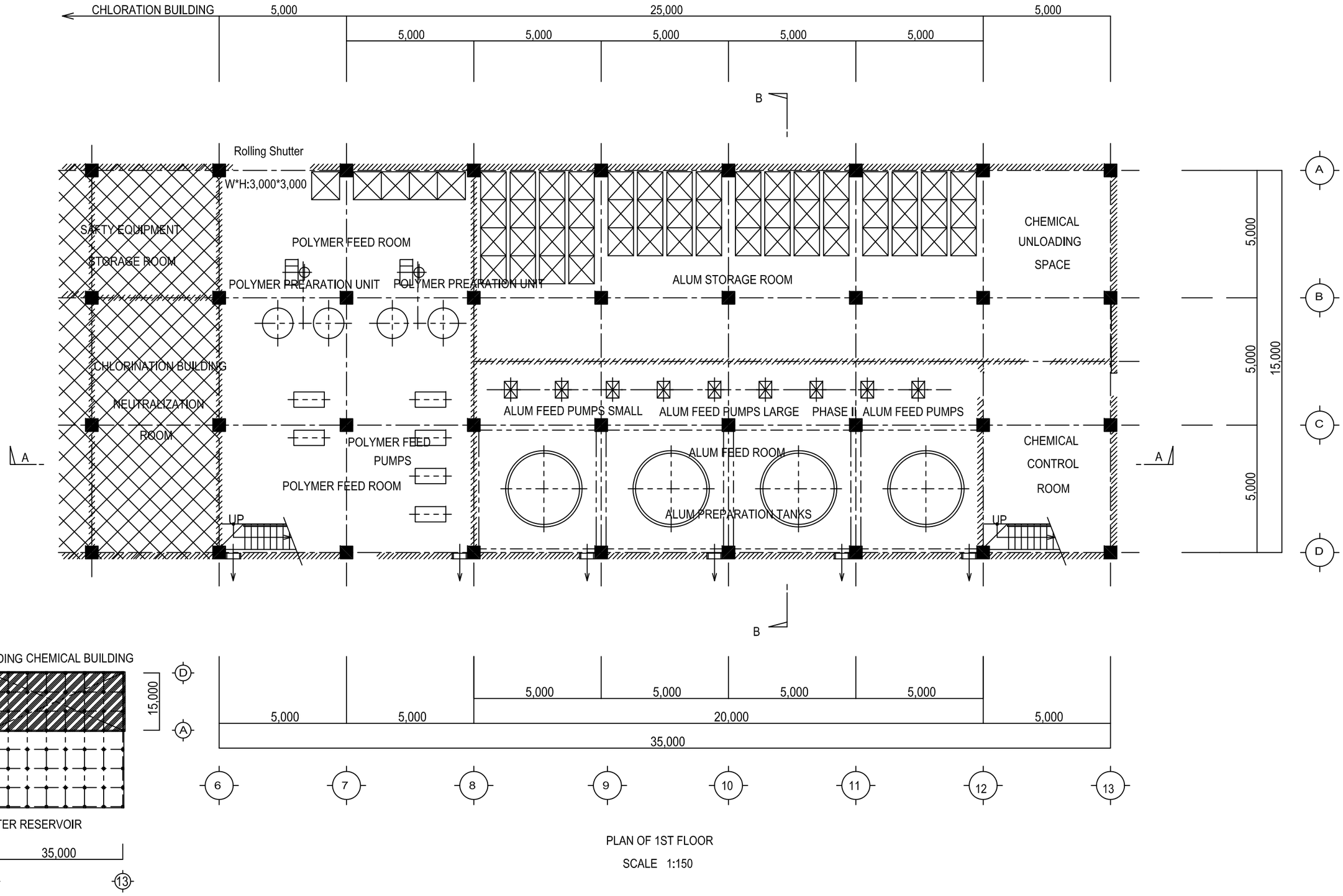


PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	ALUM AND POLYMER FEED FLOW DIAGRAM				WM - 02
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE NONE

CHLORINATION AND NEUTRALIZATION SYSTEM FLOW DIAGRAM



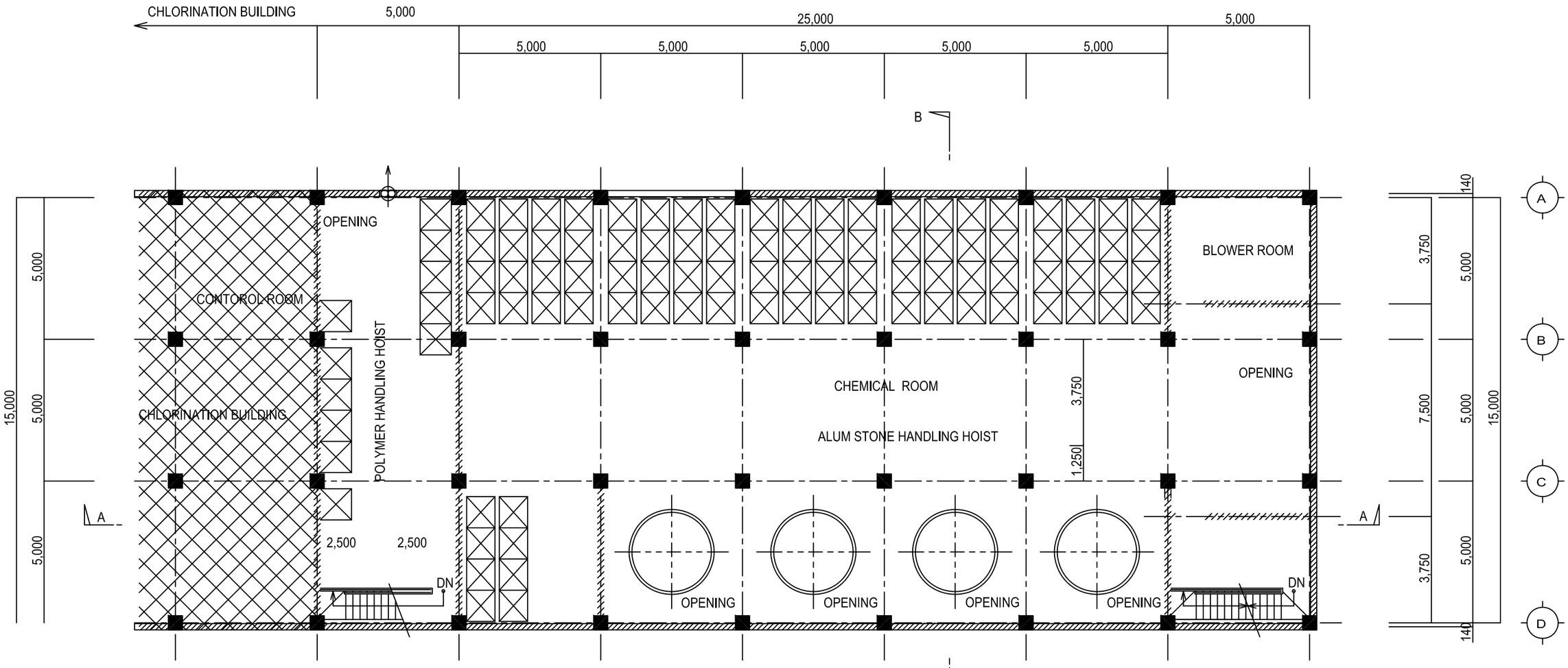
PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
VIENTIANE CAPITAL WATER SUPPLY EXPANSION PROJECT	CHLORINATION AND NEUTRALIZATION SYSTEM FLOW DIAGRAM				WM-03
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE SCALE

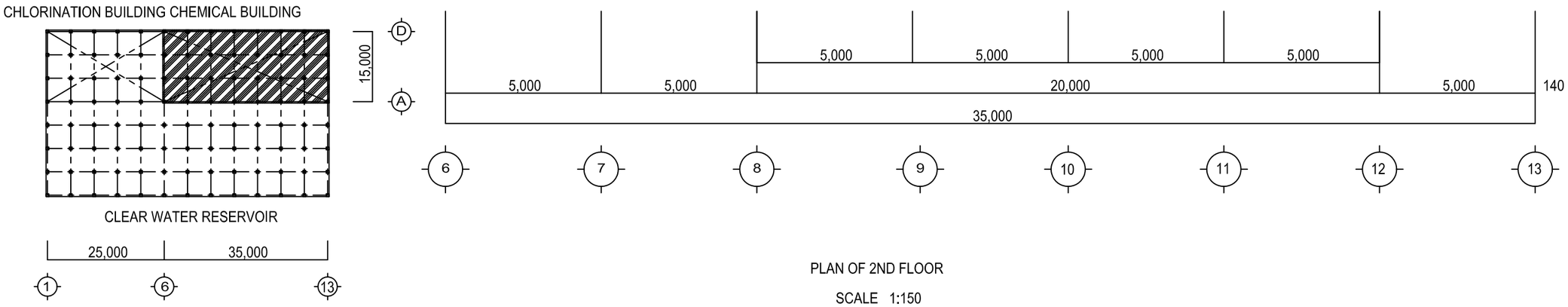


PLAN OF 1ST FLOOR

SCALE 1:150

PROJECT VIENTIANE CAPITAL WATER SUPPLY EXPANSION PROJECT	DESCRIPTION CHEMICAL BUILDING PLAN OF 1ST FLOOR		APPROVE BY	DATE	DRAWING No WM - 04
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE S= 1:150

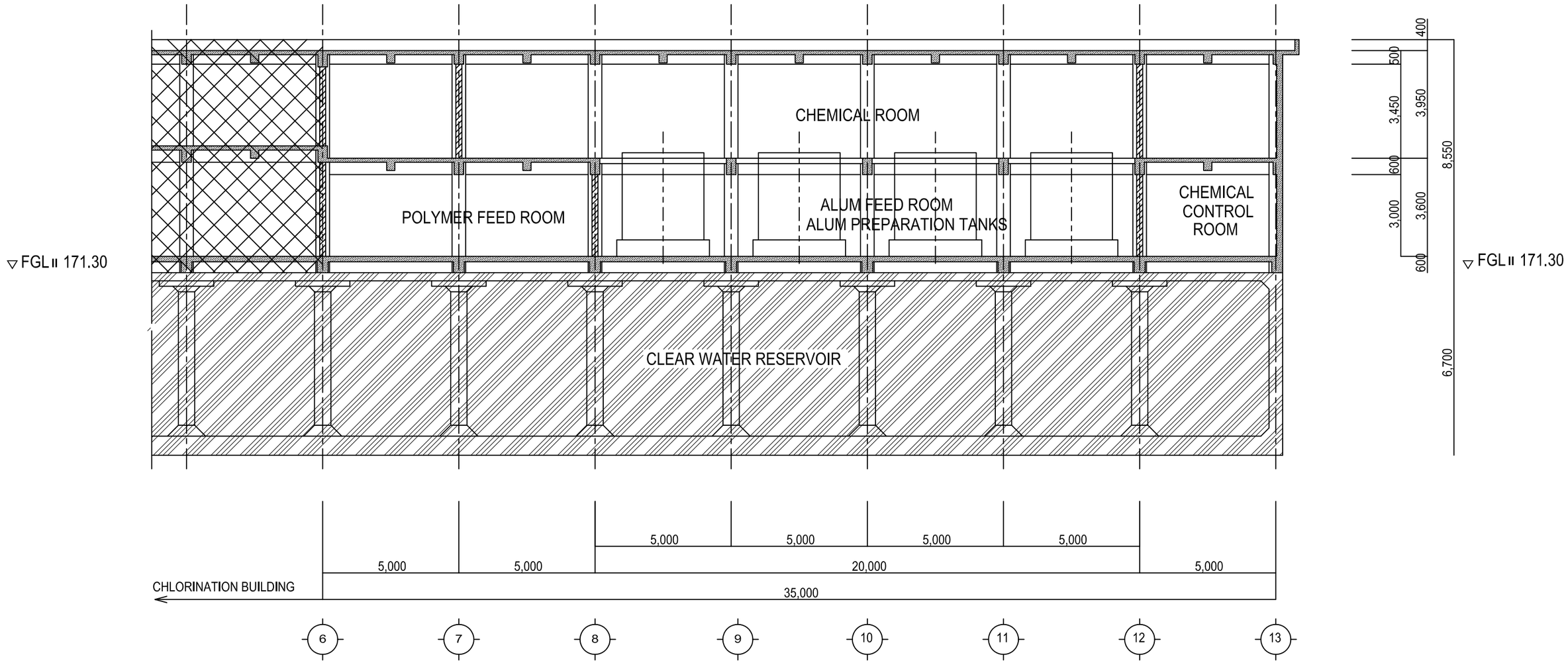




PLAN OF 2ND FLOOR

SCALE 1:150

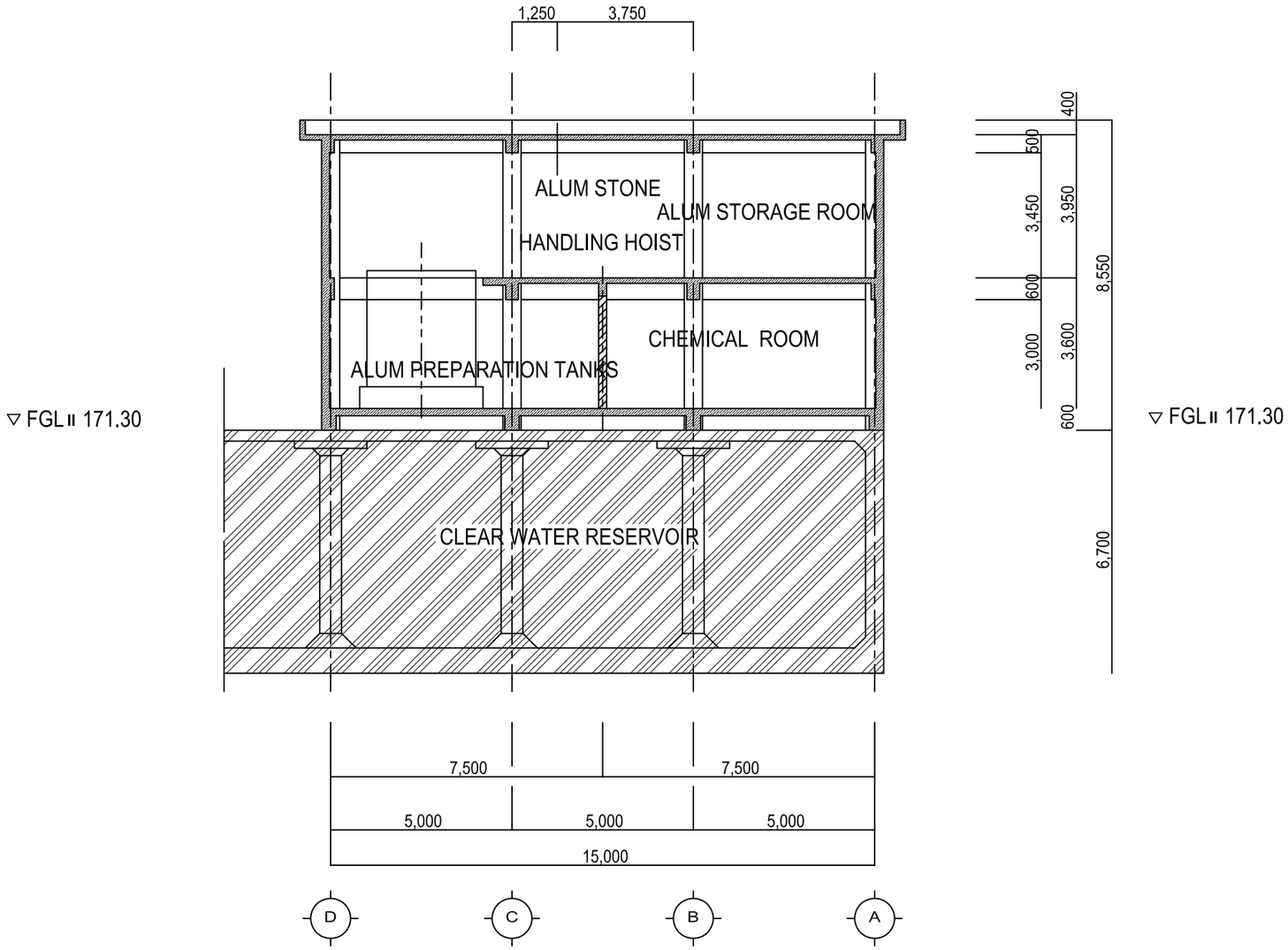
PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
VIENTIANE CAPITAL WATER SUPPLY EXPANSION PROJECT	CHEMICAL BUILDING PLAN OF 2ND FLOOR				WM - 05
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE S= 1:150



SECTION A-A

SCALE 1:150

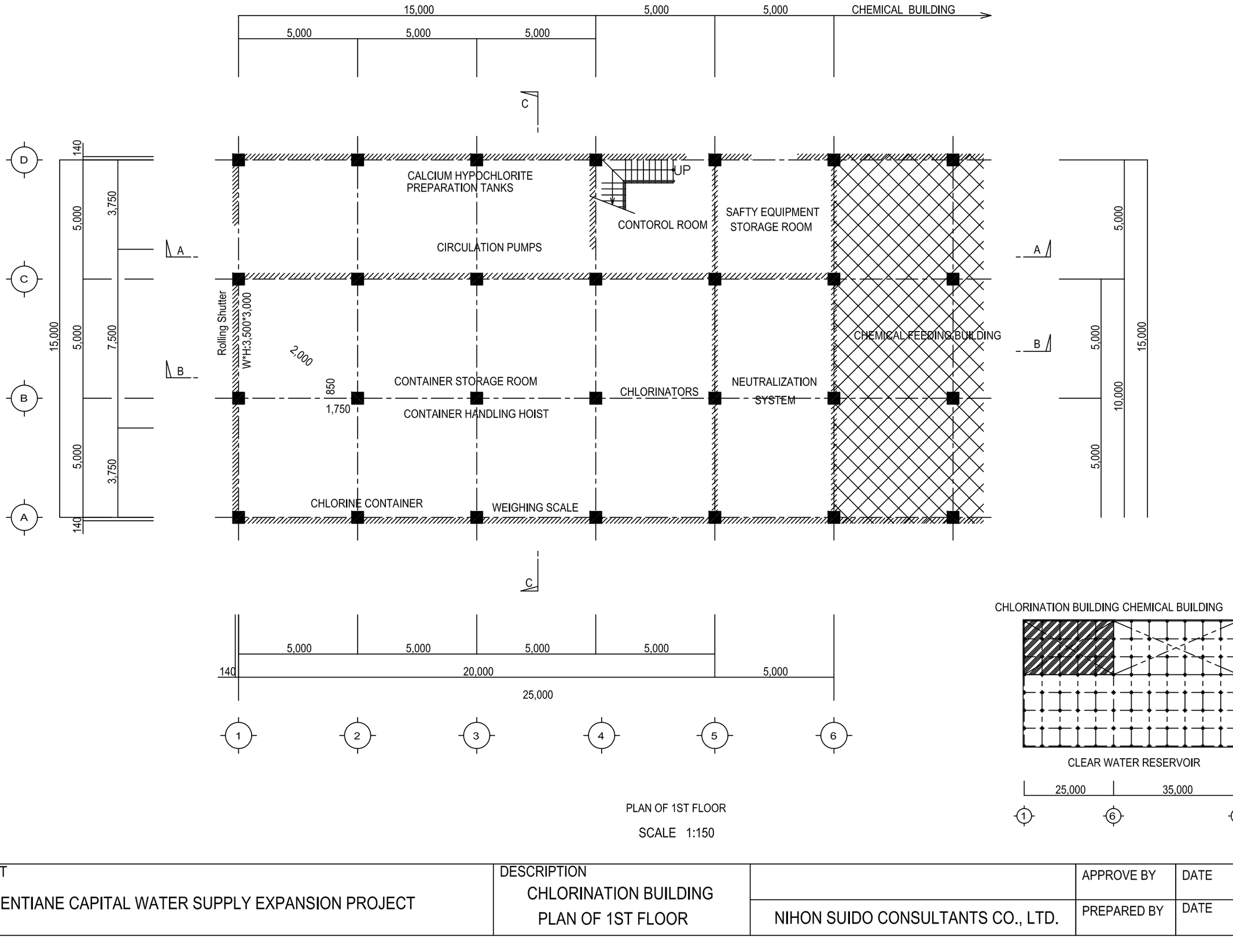
PROJECT VIENTIANE CAPITAL WATER SUPPLY EXPANSION PROJECT	DESCRIPTION CHEMICAL BUILDING SECTION A-A		APPROVE BY	DATE	DRAWING No WM - 06
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE S= 1:150



SECTION B-B

SCALE 1:150

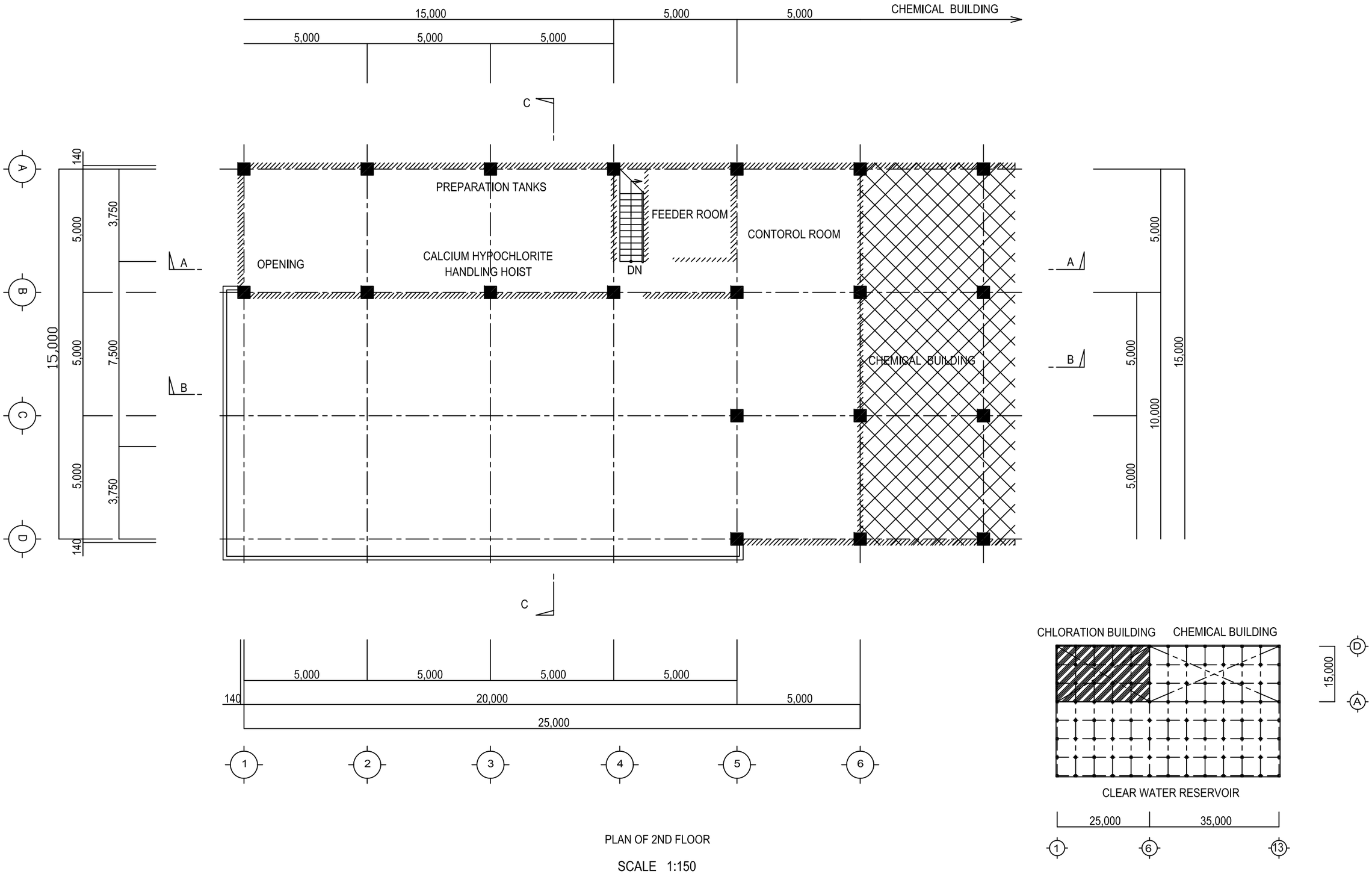
PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
VIENTIANE CAPITAL WATER SUPPLY EXPANSION PROJECT	CHEMICAL BUILDING SECTION B-B				WM - 07
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE S= 1:150



PLAN OF 1ST FLOOR

SCALE 1:150

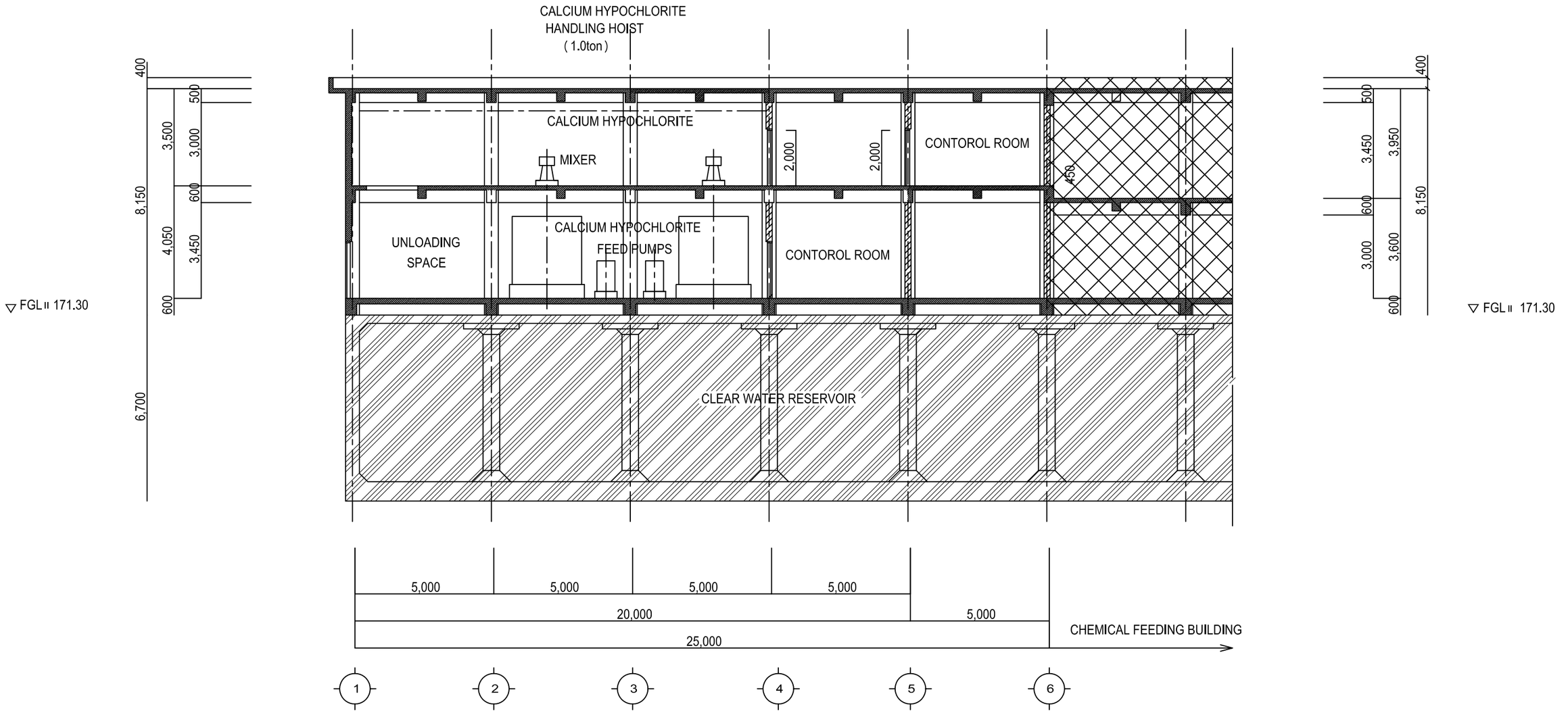
PROJECT VIENTIANE CAPITAL WATER SUPPLY EXPANSION PROJECT	DESCRIPTION CHLORINATION BUILDING PLAN OF 1ST FLOOR		APPROVE BY	DATE	DRAWING No WM - 08
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE S= 1:150



PLAN OF 2ND FLOOR

SCALE 1:150

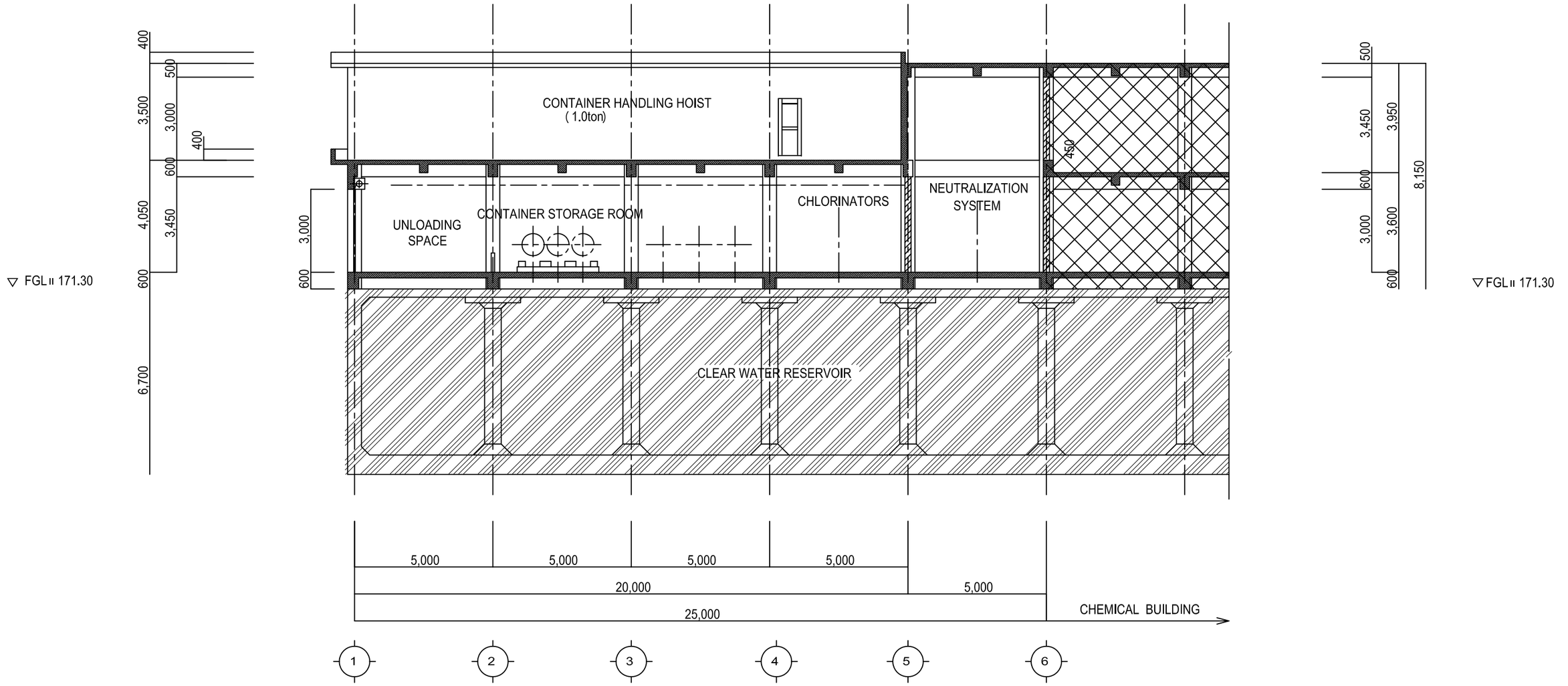
PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
VIENTIANE CAPITAL WATER SUPPLY EXPANSION PROJECT	CHLORINATION BUILDING PLAN OF 2ND FLOOR	NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	WM - 09 SCALE S= 1:150



SECTION A-A

SCALE 1:150

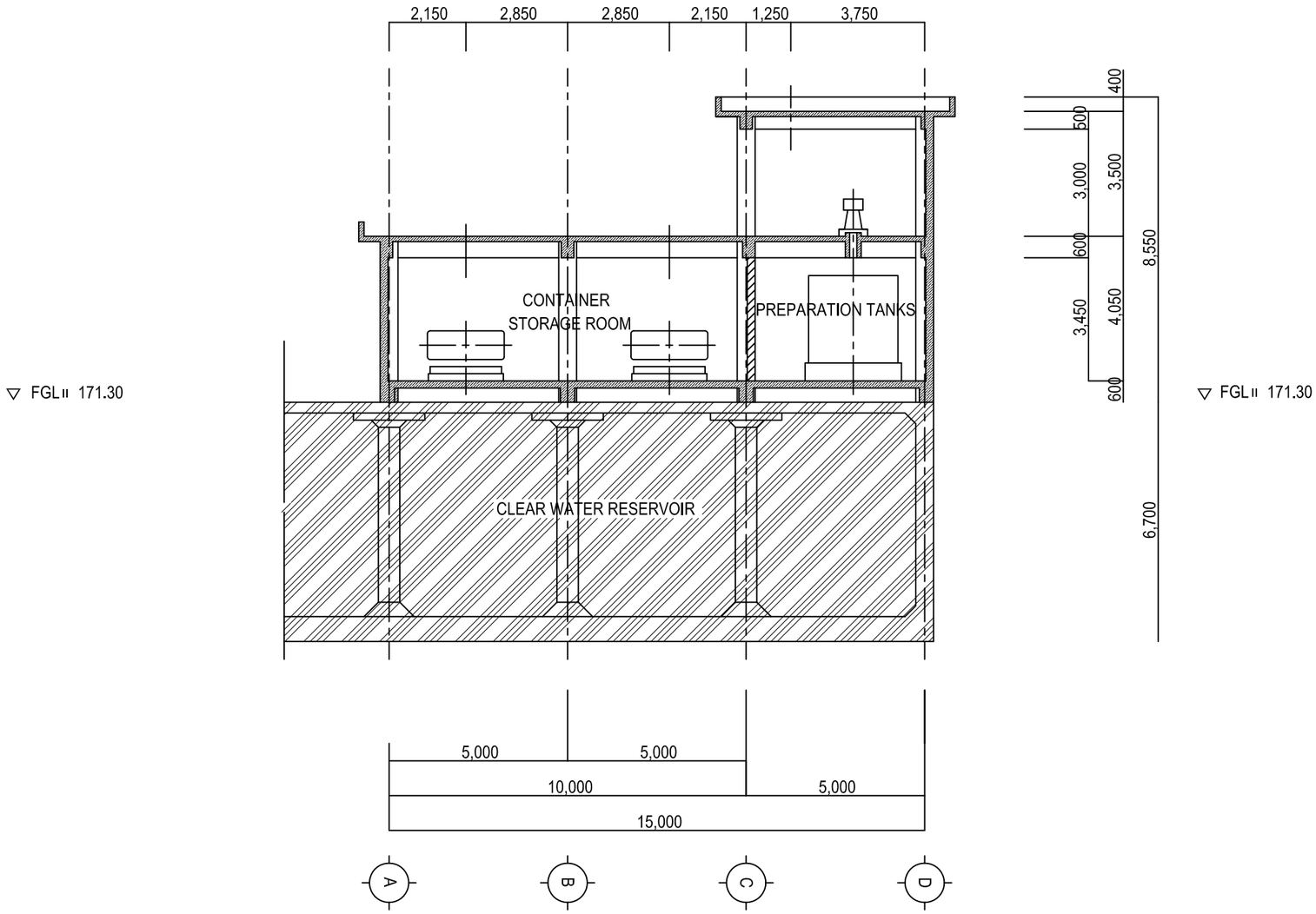
PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
VIENTIANE CAPITAL WATER SUPPLY EXPANSION PROJECT	CHLORINATION BUILDING SECTION A-A	NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	WM - 10 SCALE S= 1:150



SECTION B-B

SCALE 1:150

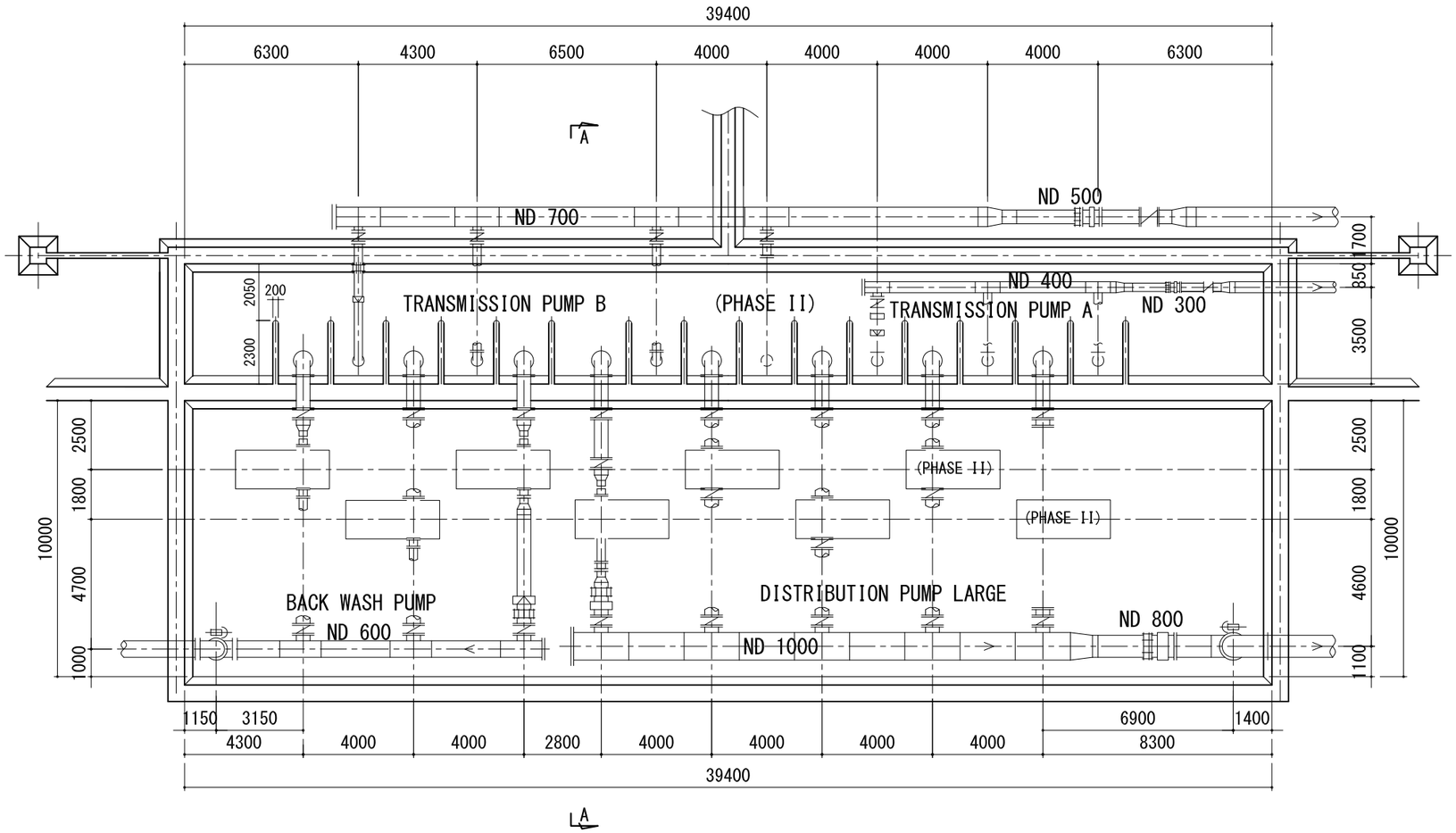
PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
VIENTIANE CAPITAL WATER SUPPLY EXPANSION PROJECT	CHLORINATION BUILDING SECTION B-B				WM - 11
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE S= 1:150



SECTION C-C

SCALE 1:150

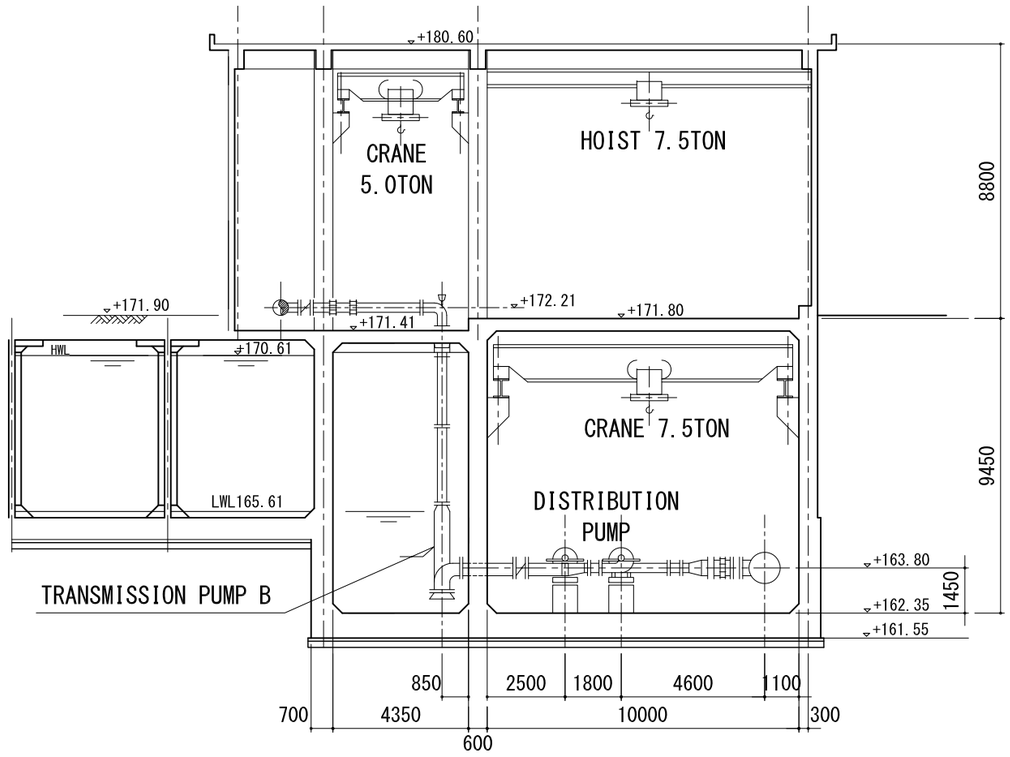
PROJECT VIENTIANE CAPITAL WATER SUPPLY EXPANSION PROJECT	CHLORINATION BUILDING SECTION C-C		APPROVE BY	DATE	DRAWING No WM - 12
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE S= 1:150



PUMP STATION PLAN

SCALE 1:200

PROJECT VIENTIANE CAPITAL WATER SUPPLY EXPANSION PROJECT	DESCRIPTION PUMP STATION PLAN		APPROVE BY	DATE	DRAWING No WM - 13
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE S = 1:200



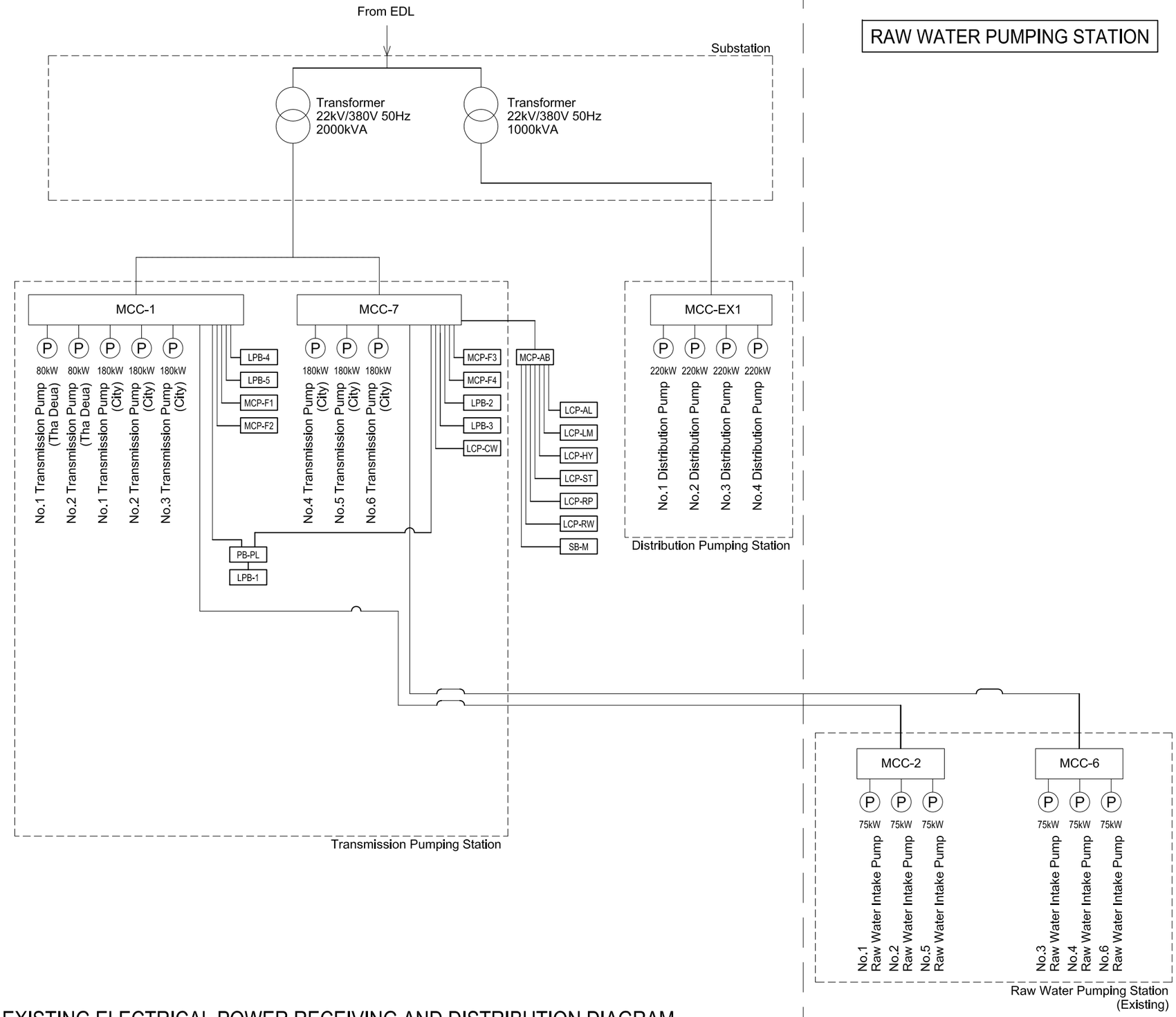
SECTION A - A

SCALE 1:200

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
VIENTIANE CAPITAL WATER SUPPLY EXPANSION PROJECT	PUMP STATION SECTION				WM - 14
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE S = 1:200

WATER TREATMENT PLANT

RAW WATER PUMPING STATION

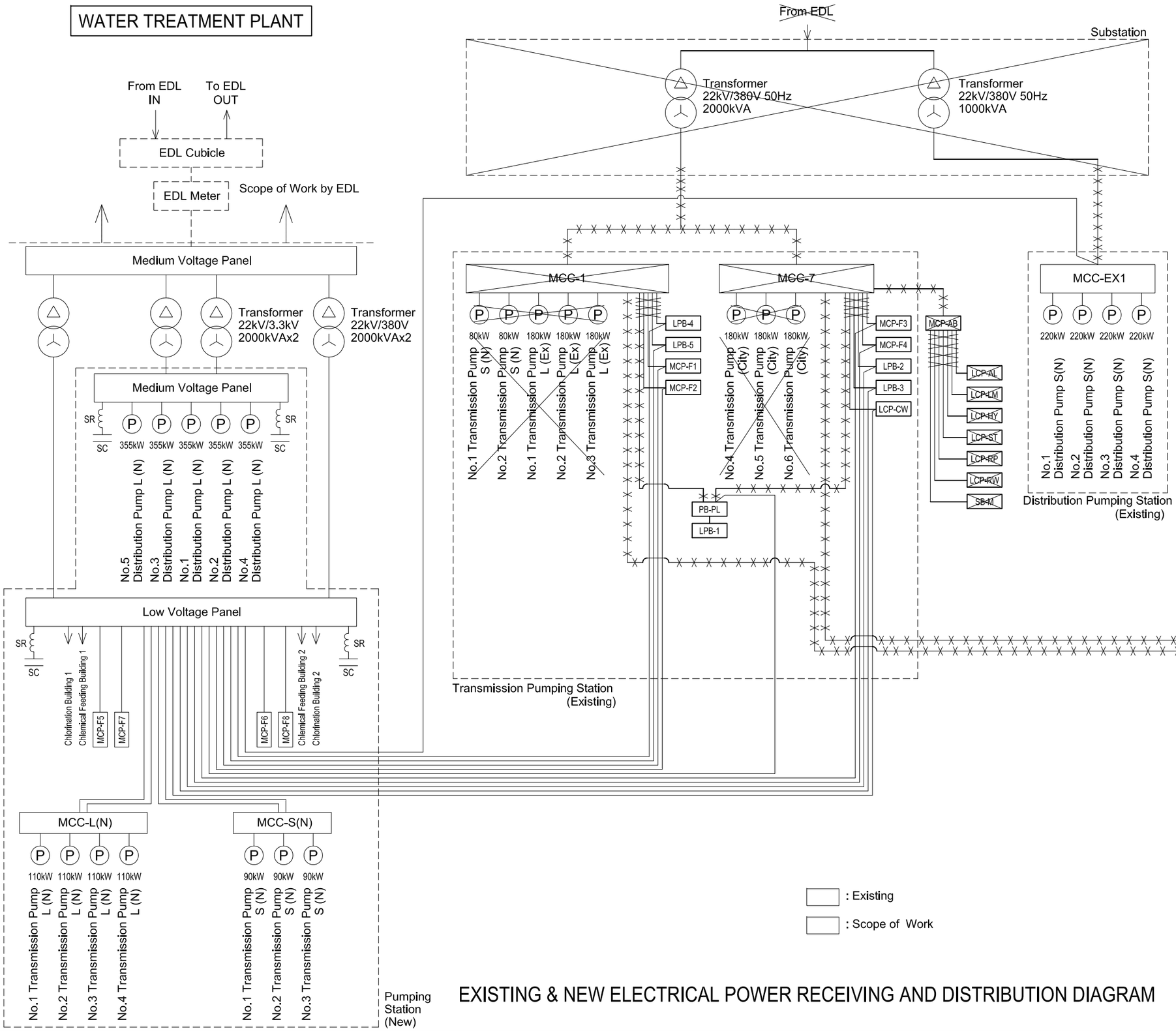


ID No.	NAME	REMARKS
MCC-1	MOTOR CONTROL CENTER	EXISTING
MCC-2	MOTOR CONTROL CENTER	EXISTING
MCC-6	MOTOR CONTROL CENTER	EXISTING
MCC-7	MOTOR CONTROL CENTER	EXISTING
MCC-EX1	MOTOR CONTROL CENTER	EXISTING
LPB-1	LIGHTING PANEL BOARD	EXISTING
LPB-2	LIGHTING PANEL BOARD	EXISTING
LPB-3	LIGHTING PANEL BOARD	EXISTING
LPB-4	LIGHTING PANEL BOARD	EXISTING
LPB-5	LIGHTING PANEL BOARD	EXISTING
LPB-6	LIGHTING PANEL BOARD	EXISTING
LCP-AL	ALUM LOCAL CONTROL PANEL	EXISTING
LCP-LM	LIME LOCAL CONTROL PANEL	EXISTING
LCP-HY	HYPO LOCAL CONTROL PANEL	EXISTING
LCP-ST	SATURATER LOCAL CONTROL PANEL	EXISTING
LCP-RP	RISING PUMP LOCAL CONTROL PANEL	EXISTING
LCP-RW	RAW WATER LOCAL CONTROL PANEL	EXISTING
LCP-CW	CLEAR WATER LOCAL CONTROL PANEL	EXISTING
MCP-F1	FILTER MONITOR CONTROL PANEL	EXISTING
MCP-F2	FILTER MONITOR CONTROL PANEL	EXISTING
MCP-F3	FILTER MONITOR CONTROL PANEL	EXISTING
MCP-F4	FILTER MONITOR CONTROL PANEL	EXISTING
MCP-AB	MONITOR AND CONTROL PANEL	EXISTING
PB-PL	PANEL BOARD	EXISTING
SB-M	SWITCH BOX (MAINTENANCE POWER SOURCE)	EXISTING

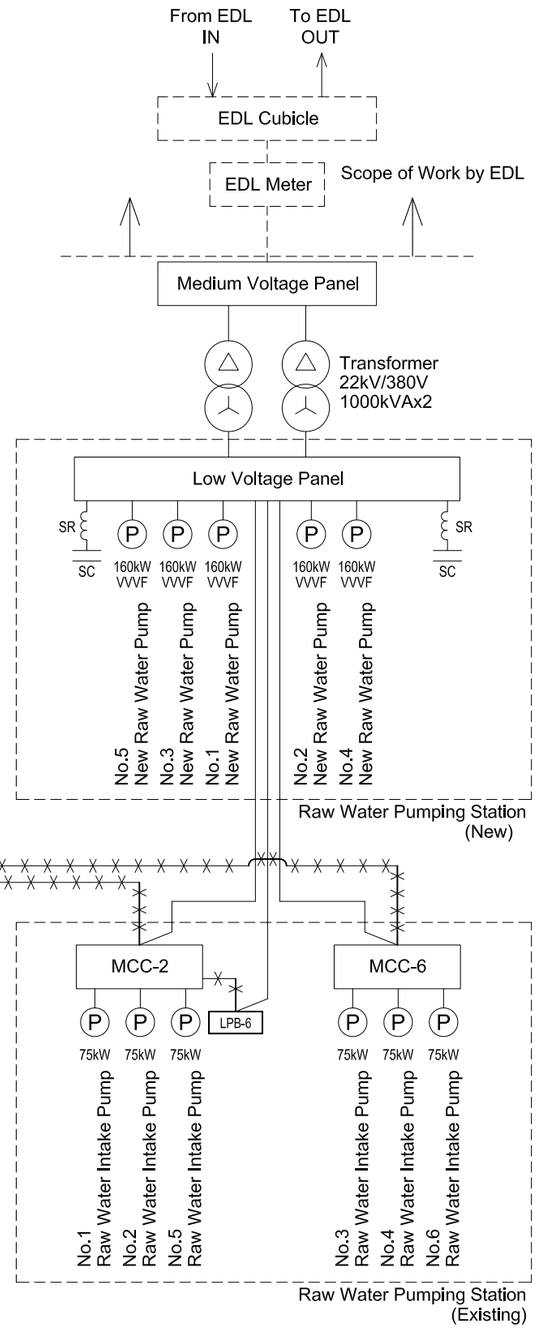
EXISTING ELECTRICAL POWER RECEIVING AND DISTRIBUTION DIAGRAM

PROJECT VIENTIANE CAPITAL WATER SUPPLY EXPANSION PROJECT	DESCRIPTION EXISTING ELECTRICAL POWER RECEIVING AND DISTRIBUTION DIAGRAM		APPROVE BY	DATE	DRAWING No WE - 01
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE

WATER TREATMENT PLANT



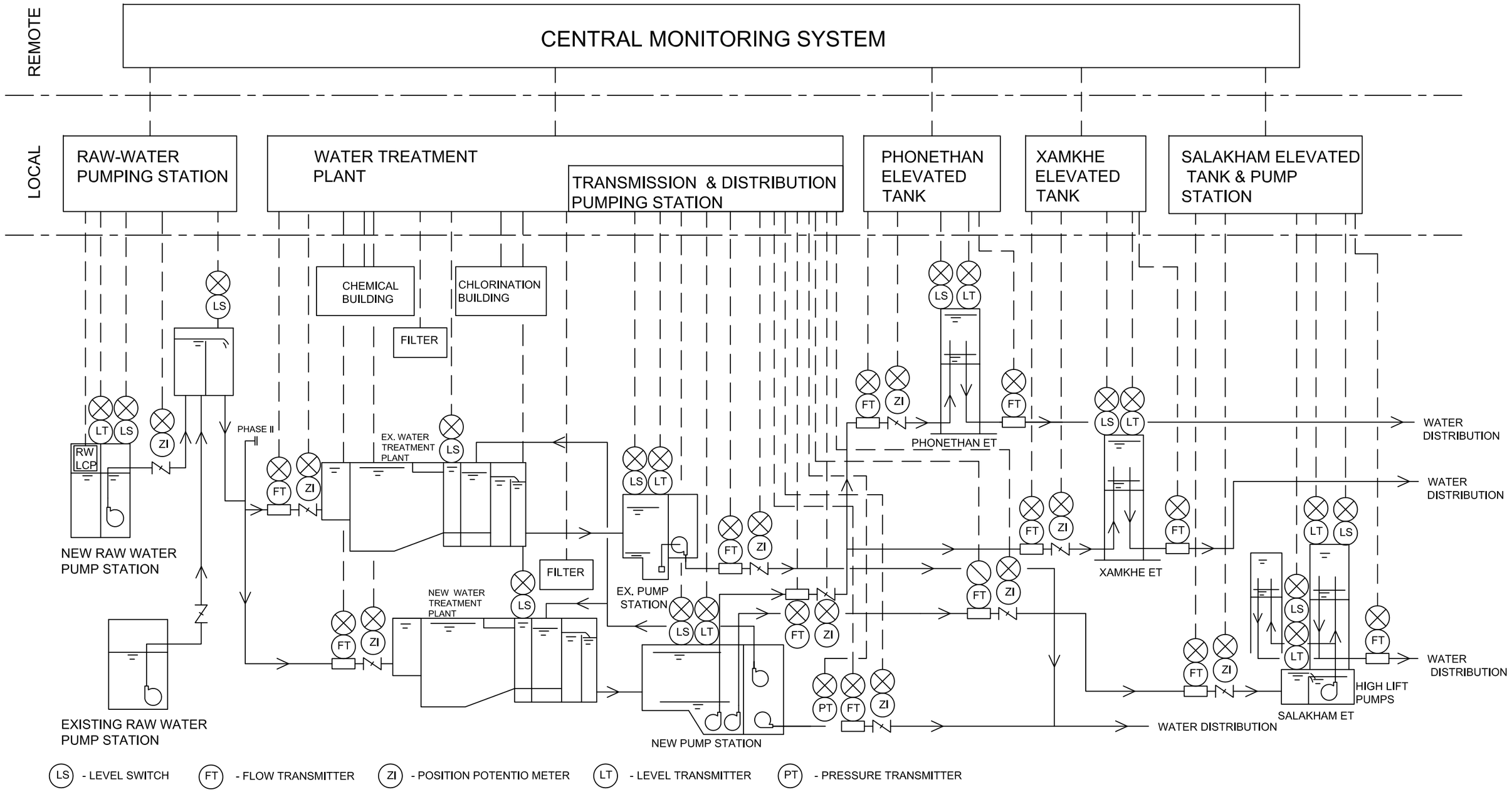
RAW WATER PUMPING STATION



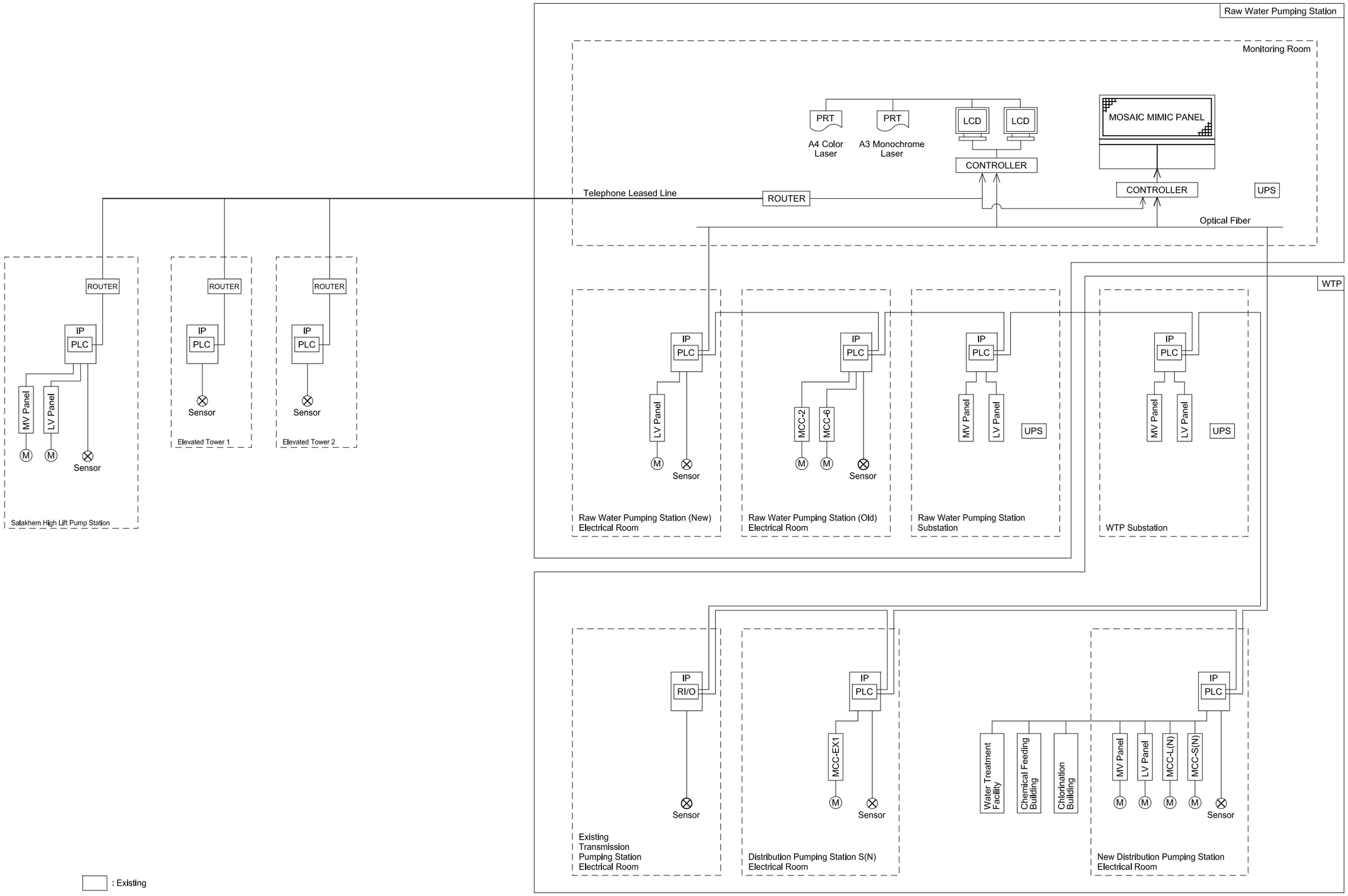
EXISTING & NEW ELECTRICAL POWER RECEIVING AND DISTRIBUTION DIAGRAM

PROJECT VIENTIANE CAPITAL WATER SUPPLY EXPANSION PROJECT	DESCRIPTION EXISTING & NEW ELECTRICAL POWER RECEIVING AND DISTRIBUTION DIAGRAM		APPROVE BY	DATE	DRAWING No WE - 02
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE

INSTRUMENTATION DIAGRAM

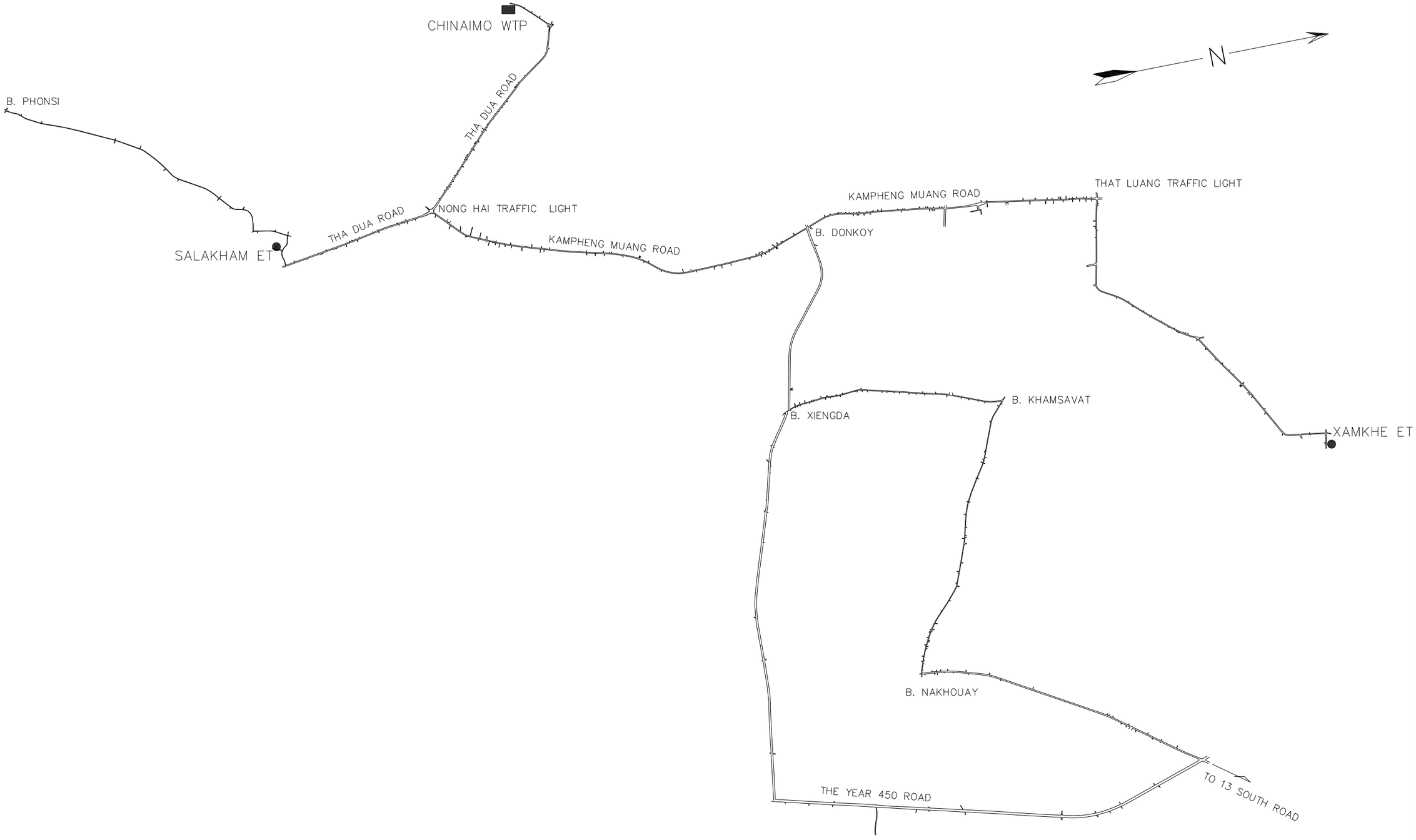


PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
VIENTIANE CAPITAL WATER SUPPLY EXPANSION PROJECT	INSTRUMENTATION FLOW DIAGRAM				WE – 03
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE NONE

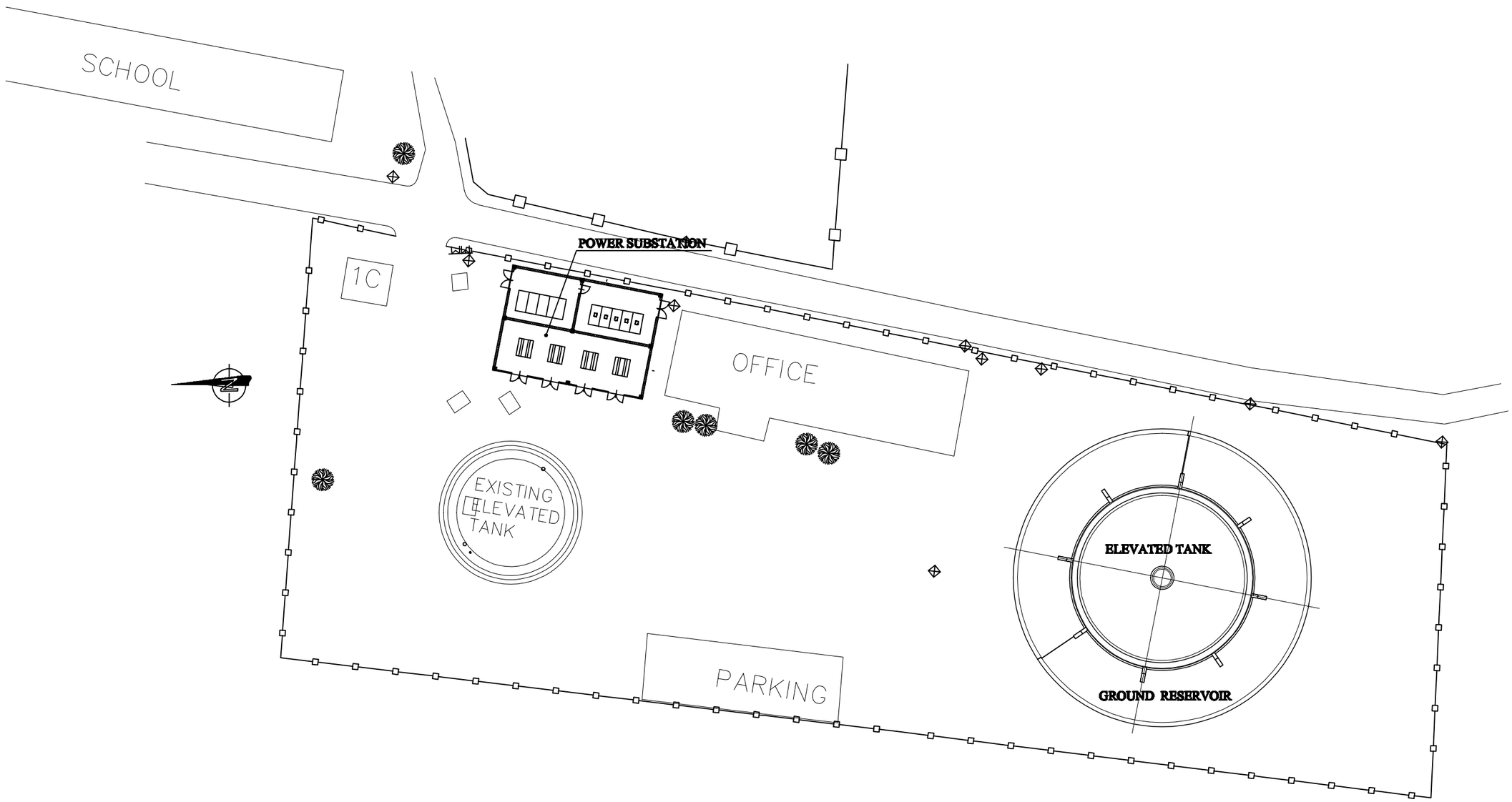


SCHEMATIC DIAGRAM OF SCADA

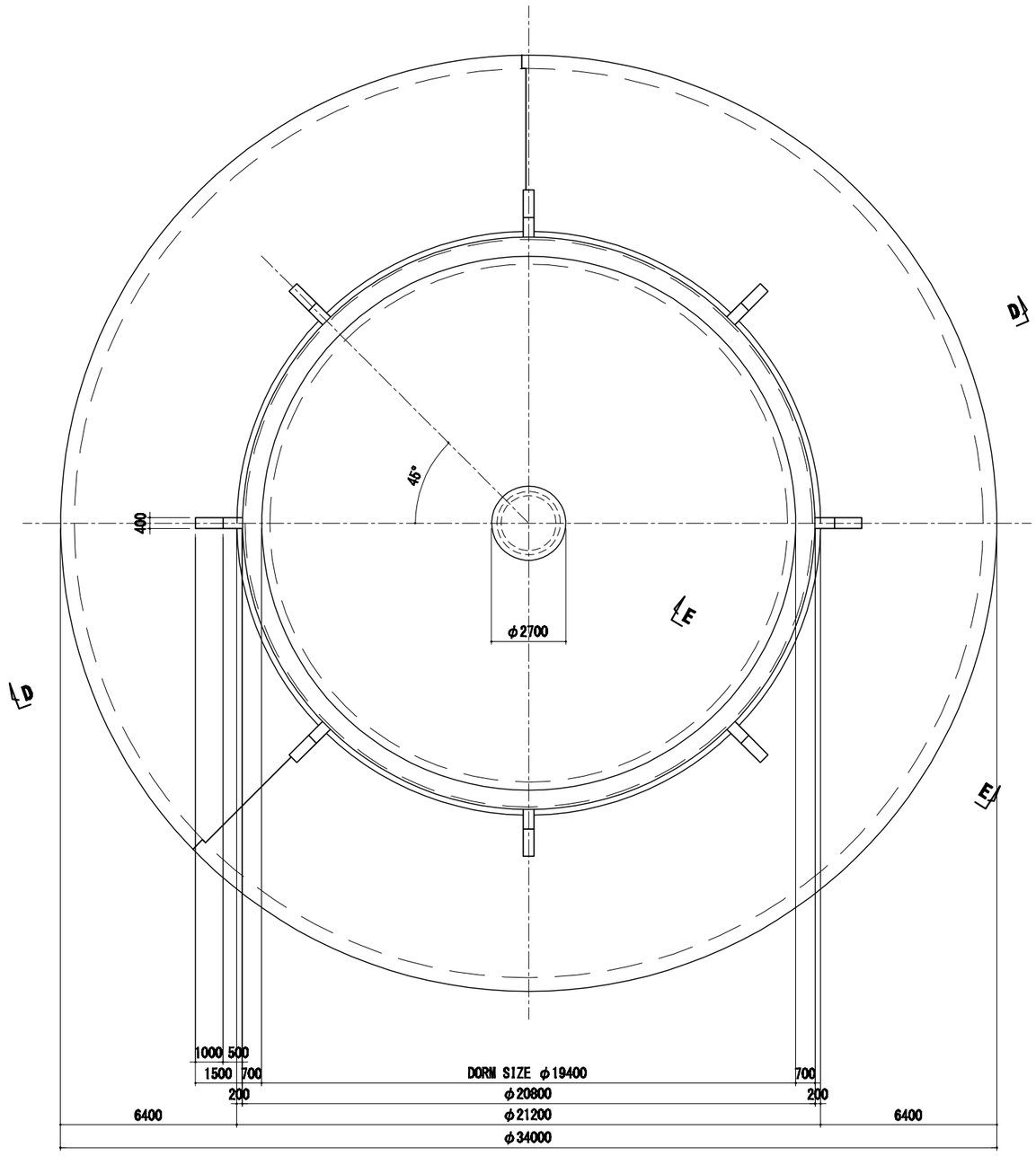
PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
VIENTIANE CAPITAL WATER SUPPLY EXPANSION PROJECT	SCHEMATIC DIAGRAM OF SCADA				WE - 04
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE NONE



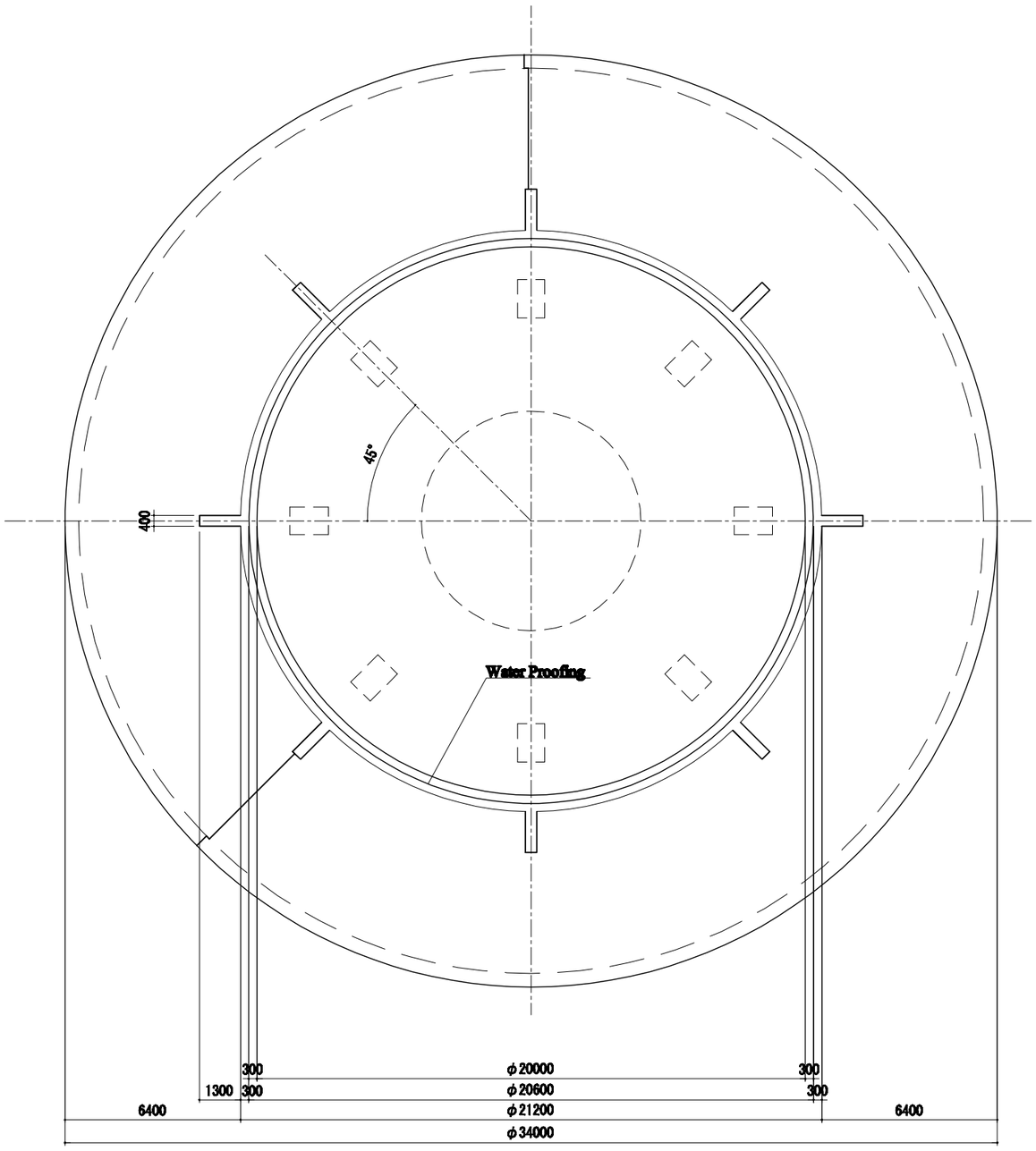
PROJECT	DESCRIPTION		APPROVED BY	DATE	DRAWING No
VIENTIANE CAPITAL WATER SUPPLY EXPANSION PROJECT	KEY PLAN TRANSMISSION AND DISTRIBUTION PIPE				PW-01
		NIHON SUIDO CONSULTANTS CO.,LTD.	RECEIVED BY	DATE	SCALE S1:5000



PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	General Plan of Salakham Distribution Center				RC-01
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:500

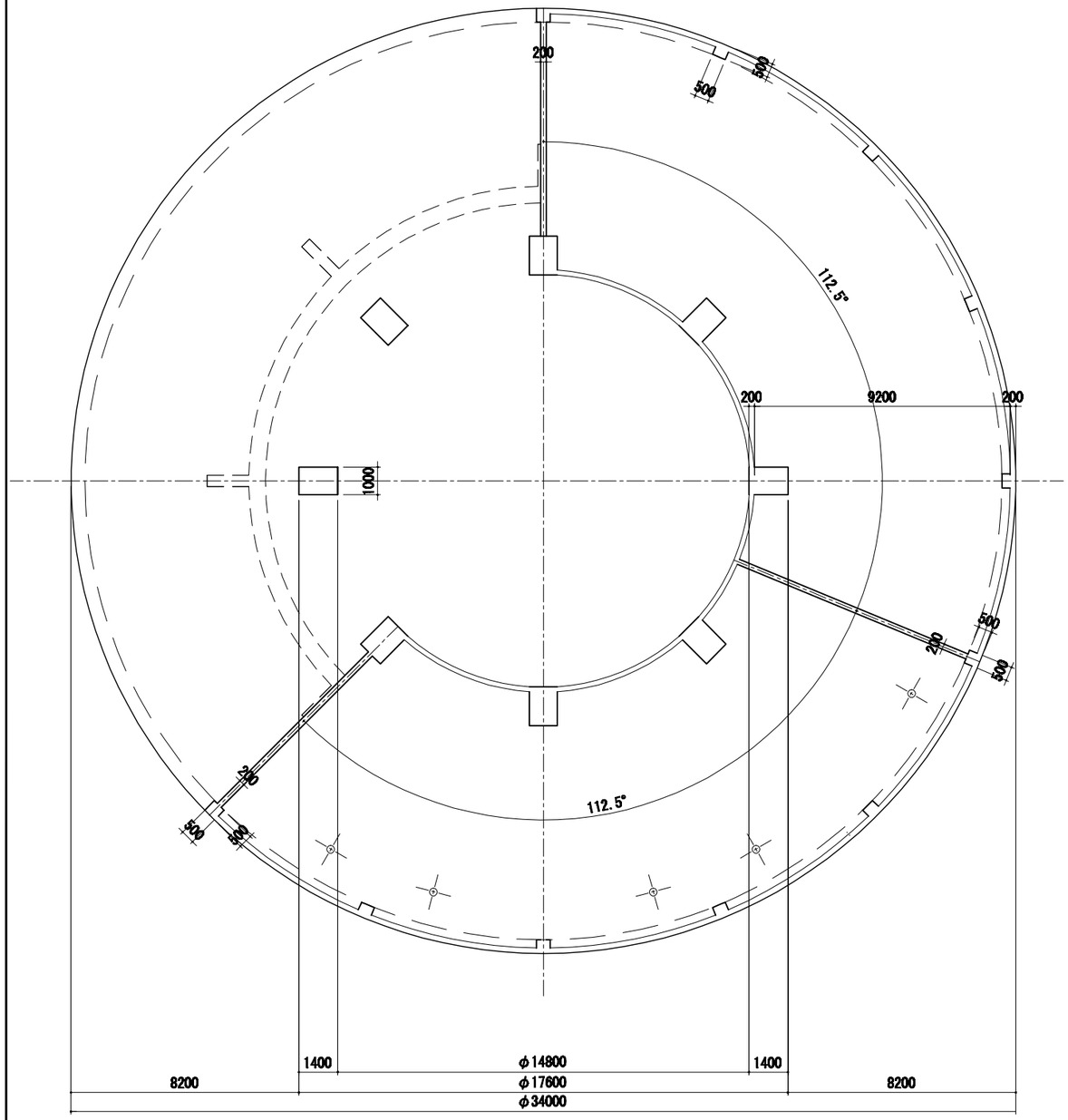


PLAN

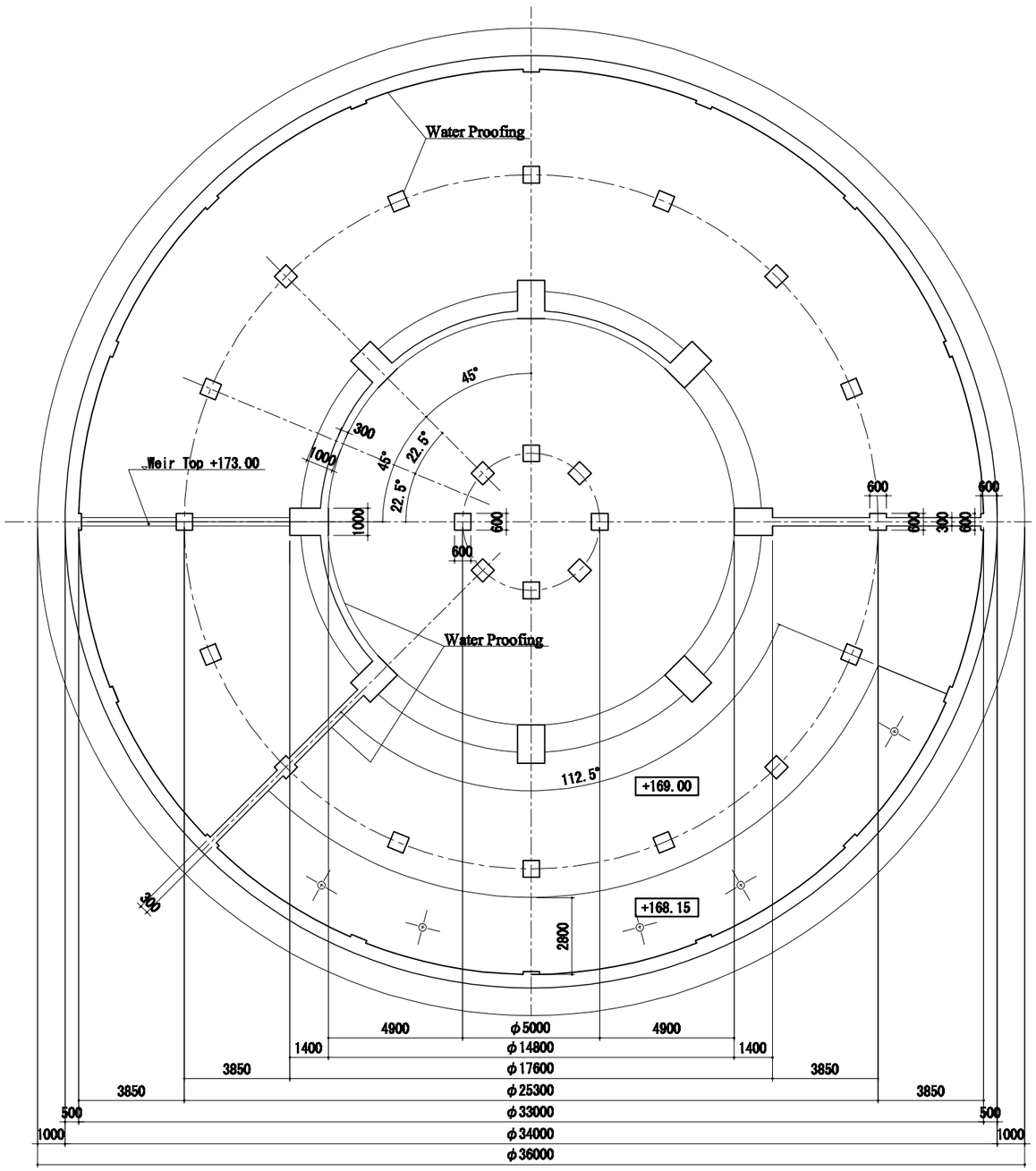


A - A Section

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Salakham Reservoir Structure(1/3)				RC-02
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:200

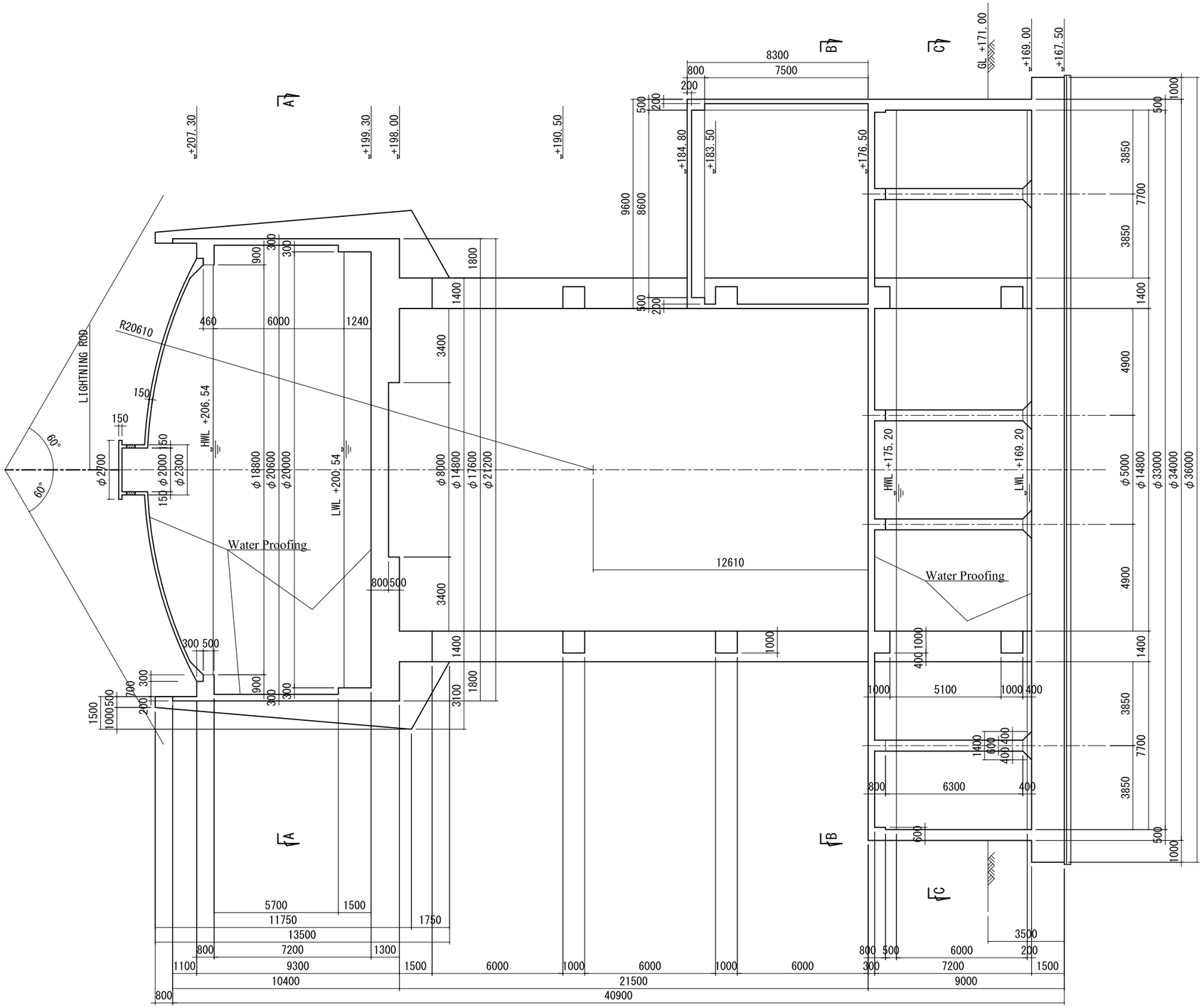


B - B Section

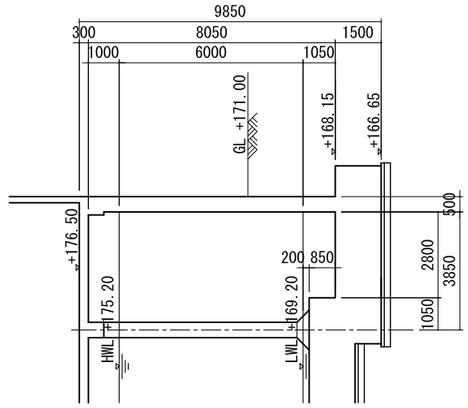


C - C Section

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Salakham Reservoir Structure(2/3)				RC-03
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:200

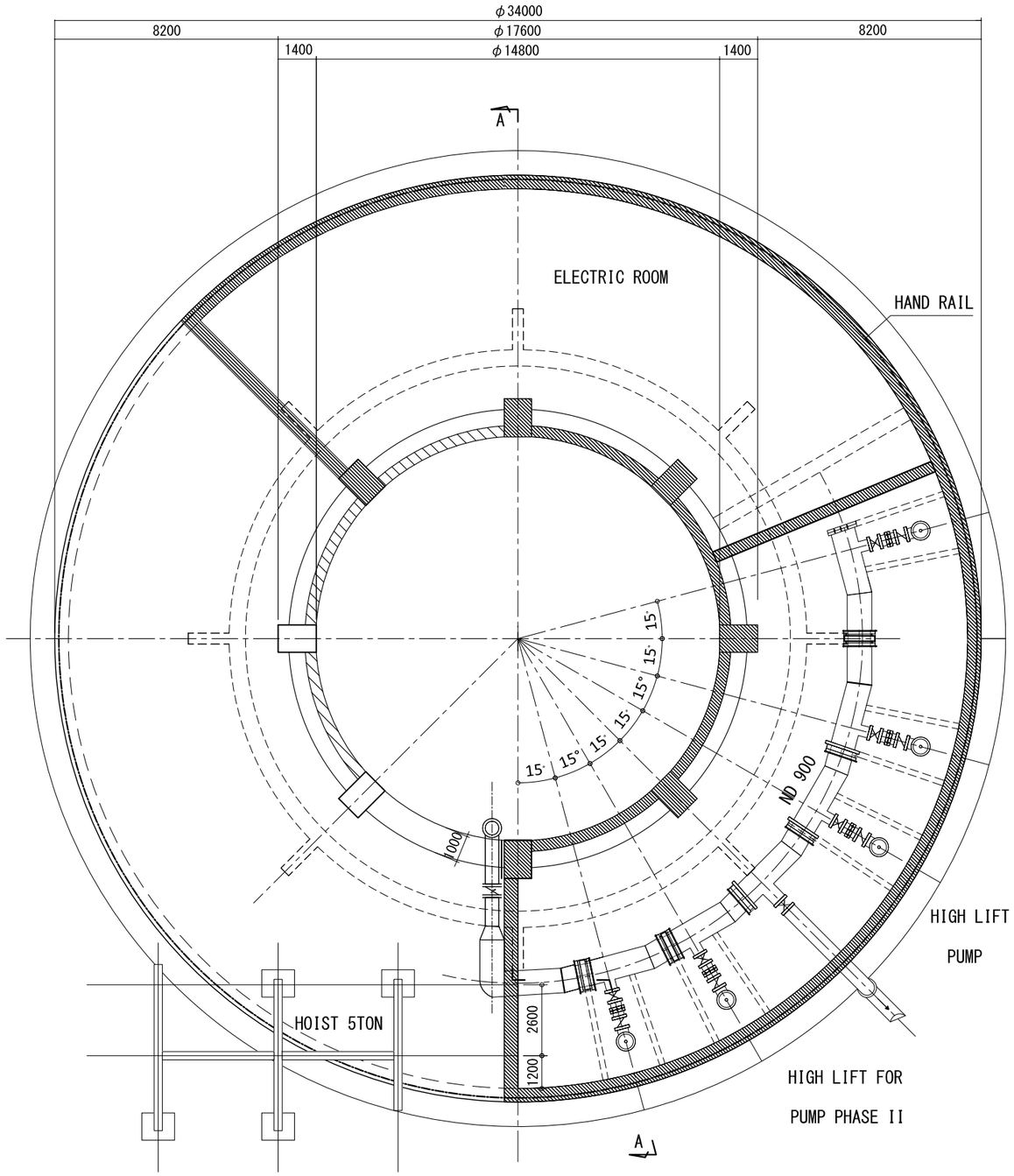


D – D Section



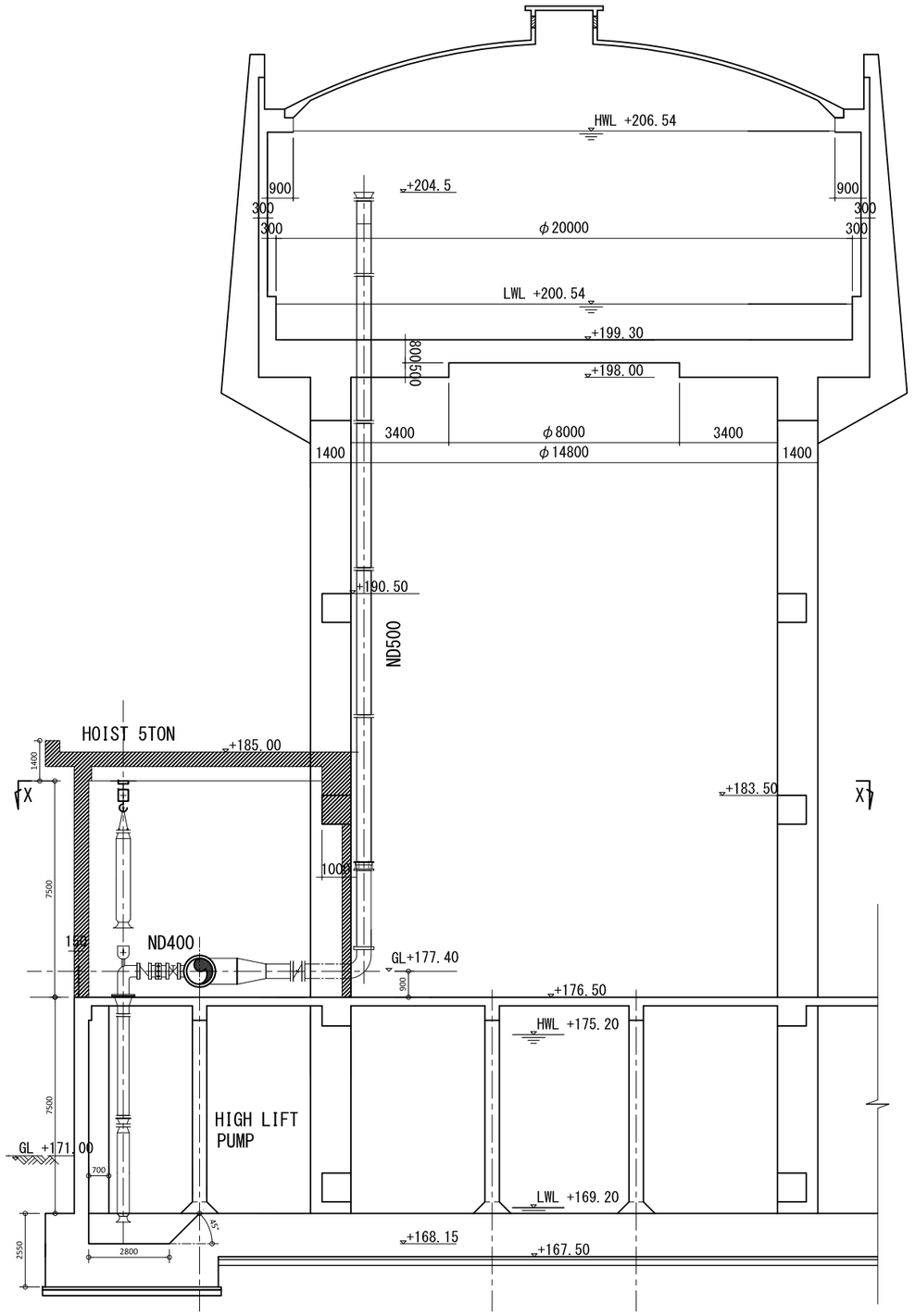
E – E Section

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Salakham Reservoir Structure(3/3)				RC-04
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:200



SALAKHAM HIGH LIFT PUMP STATION PLAN

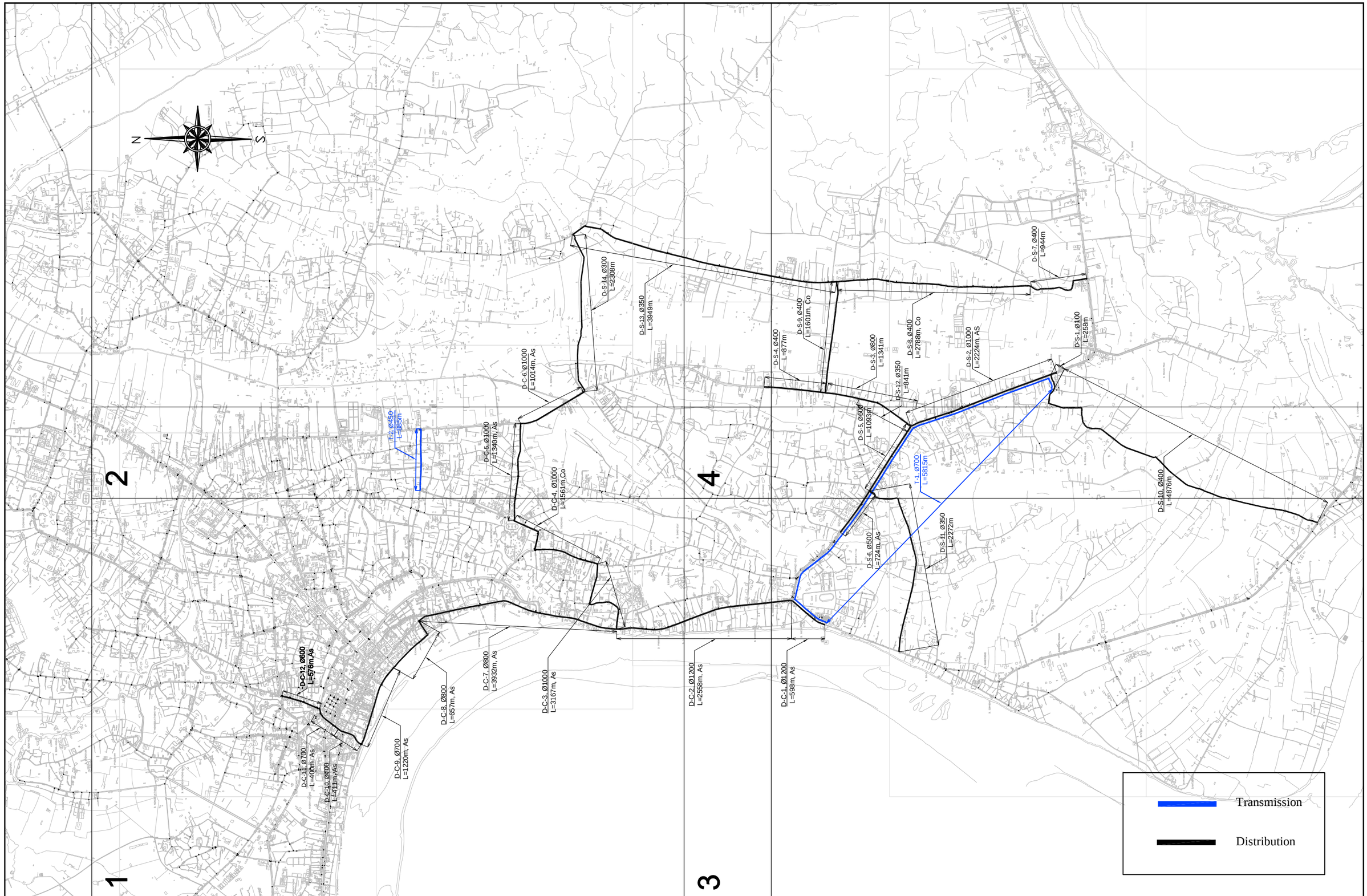
SCALE 1:200



SETION A-A

SCALE 1:200

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
VIENTIANE CAPITAL WATER SUPPLY EXPANSION PROJECT	SALAKHAM PUMPING STATION				SDCME - 01
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:200



PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	General Plan				VD-1
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:50000

T-2, Ø450
L=885m

D-C-5, Ø1000
L=1340m, As

D-C-4, Ø1000
L=1561m,Co

D-C-12, Ø600
L=576m,As

D-C-8, Ø800
L=657m, As

D-C-7, Ø800
L=3932m, As

D-C-3, Ø1000
L=3167m, As

D-C-2, Ø1200
L=2558m, As

D-C-11, Ø700
L=400m, As

D-C-10, Ø700
L=411m, As

D-C-9, Ø700
L=1220m, As

Transmission

Distribution

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Plan(1/4)				VD-2
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:25000

N

S

D-S-14, Ø300
L=2308m

D-S-13, Ø350
L=3949m

D-C-6, Ø1000
L=1014m, As

T-2, Ø450
L=885m

D-C-5, Ø1000
L=1340m, As

D-C-4, Ø1000
L=1561m,Co

Transmission

Distribution

PROJECT Vientiane Capital Water Supply Expansion Project	DESCRIPTION Plan(2/4)		APPROVE BY	DATE	DRAWING No VD-3
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:25000

D-S-5, Ø600
L=1093m

T-1, Ø700
L=5815m

D-S-6, Ø500
L=724m, As

D-S-11, Ø350
L=2272m

D-S-10, Ø400
L=4876m

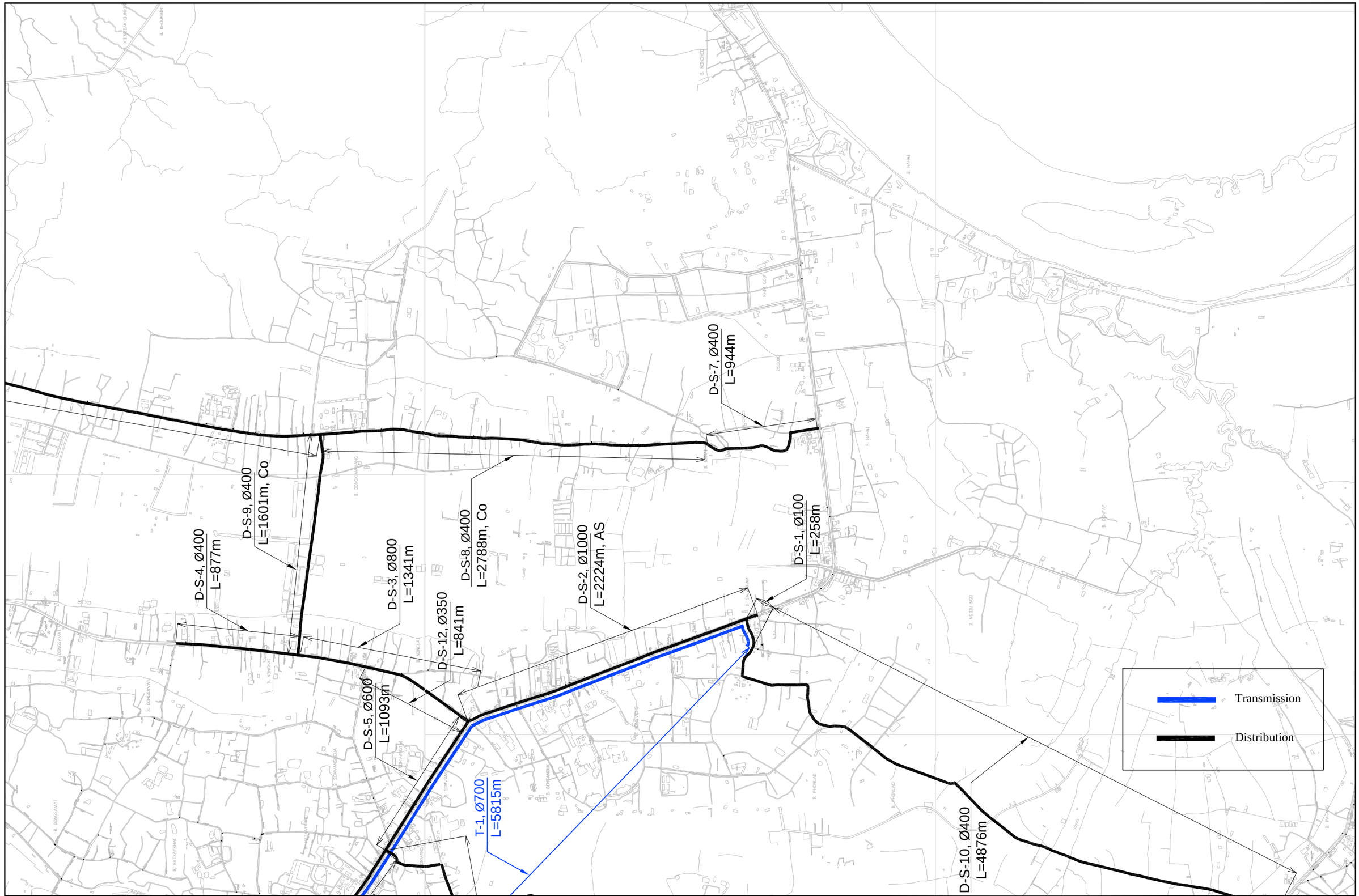
D-C-2, Ø1200
L=2558m, As

D-C-1, Ø1200
L=598m, As

Transmission

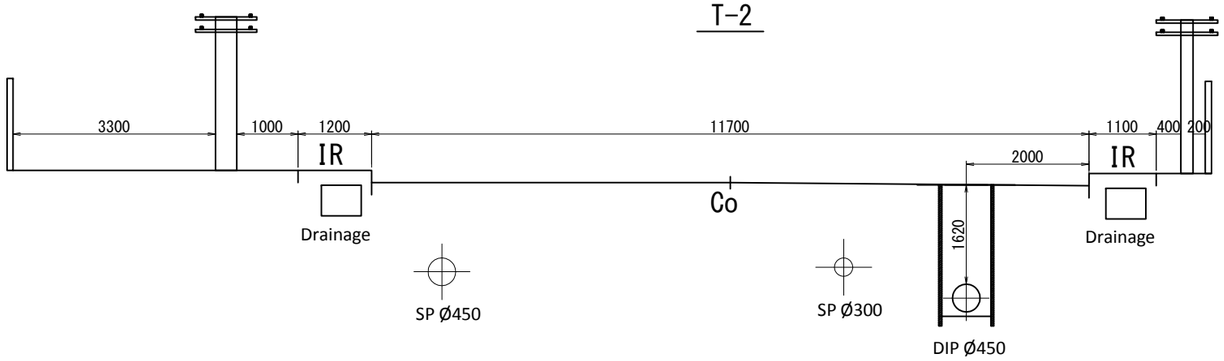
Distribution

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Plan(3/4)				VD-4
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:25000

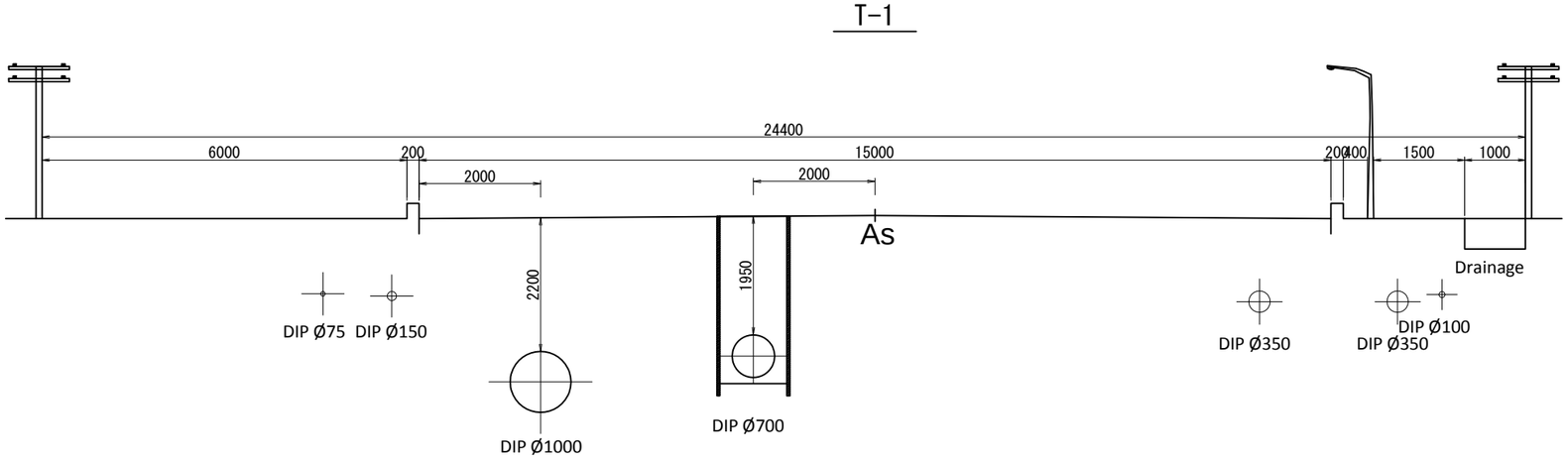


PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Plan(4/4)				VD-5
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:25000

T-2

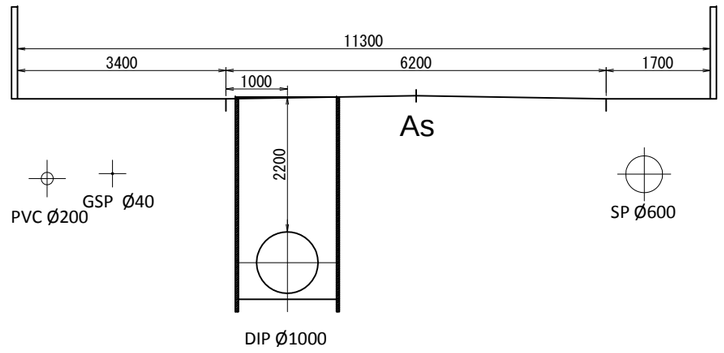


T-1

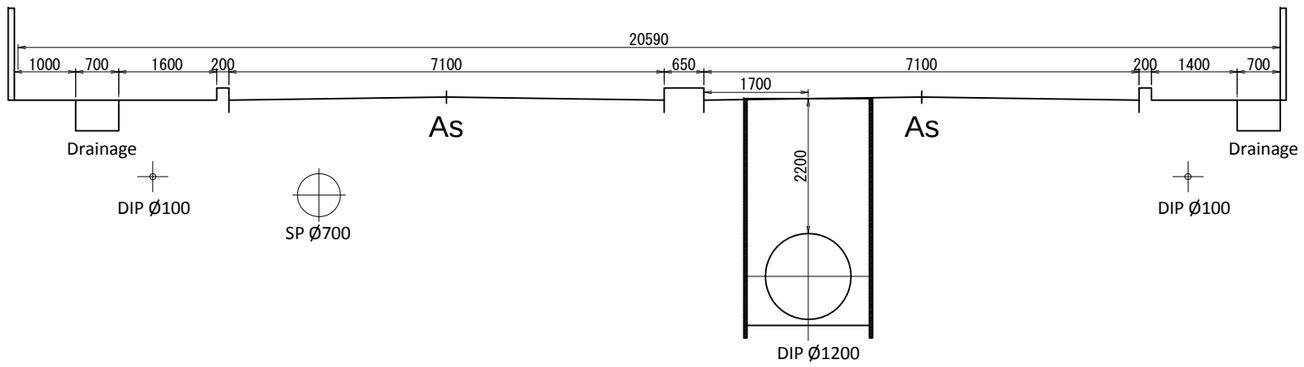


PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Cross Section (1) (Trancemission Pipeline)				VD-6
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100

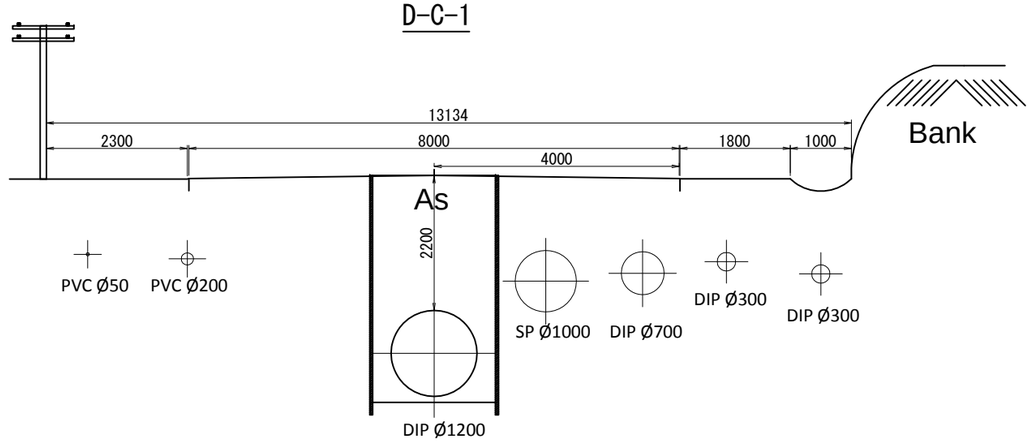
D-C-3



D-C-2

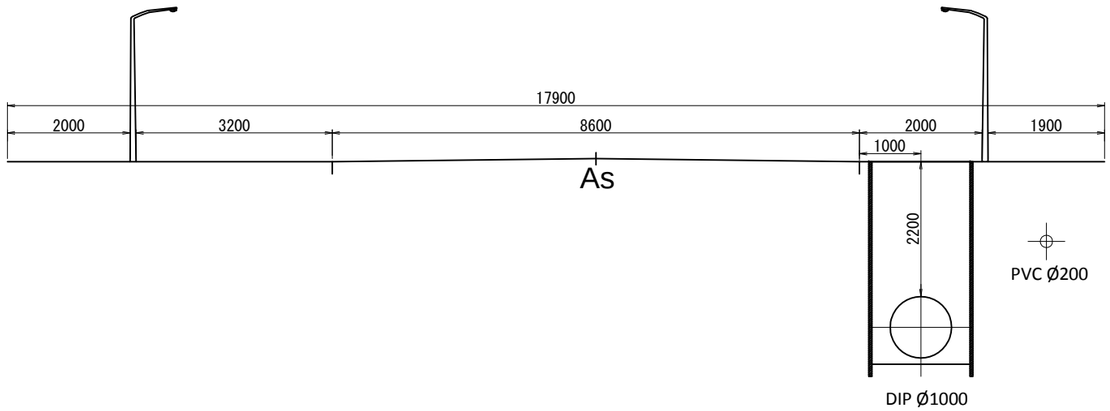


D-C-1

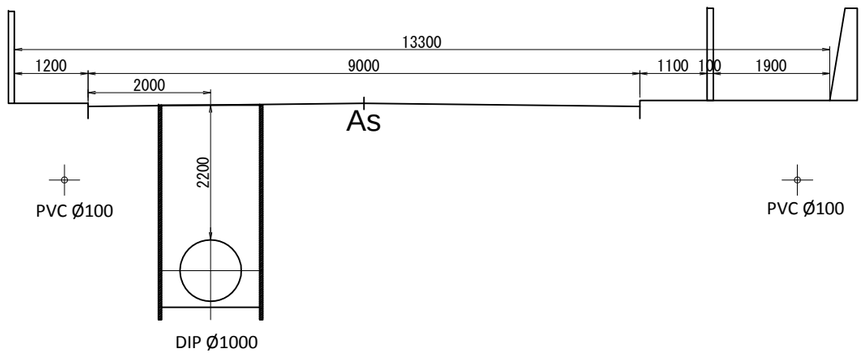


PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Cross Section (2) (Chinamo Disrtibution Area)				VD-07
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100

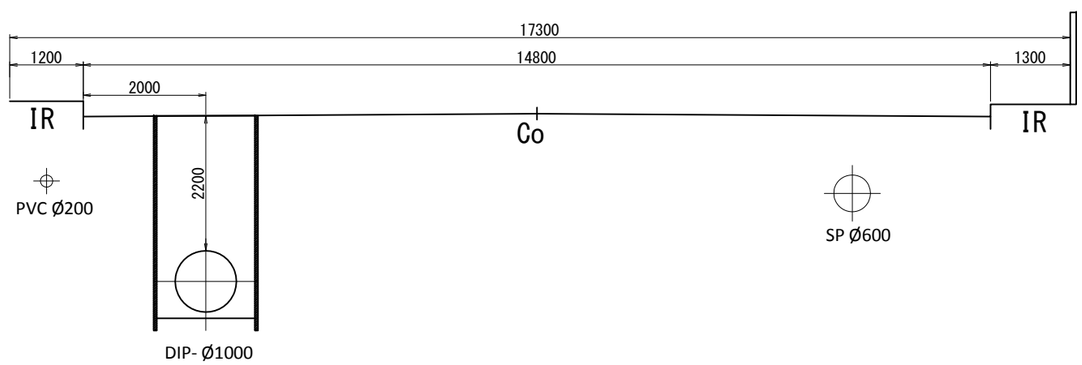
D-C-6



D-C-5

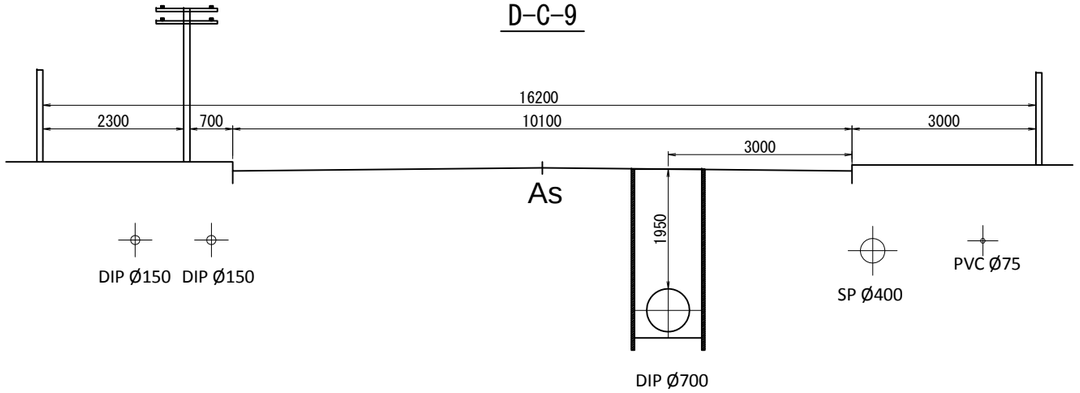


D-C-4

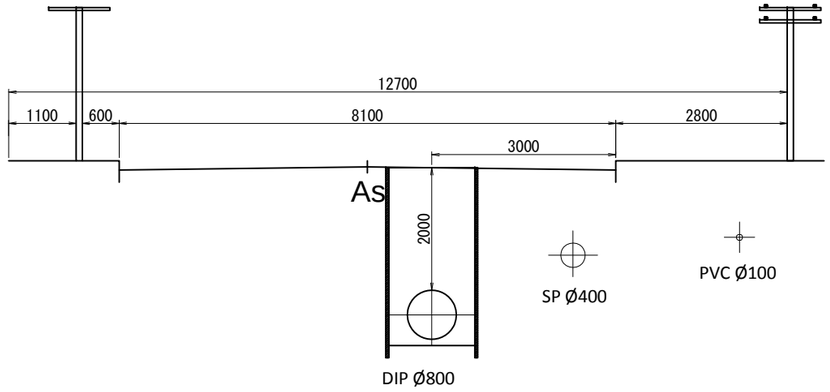


PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Cross Section (3) (Chinamo Disrtibution Area)				VD-08
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100

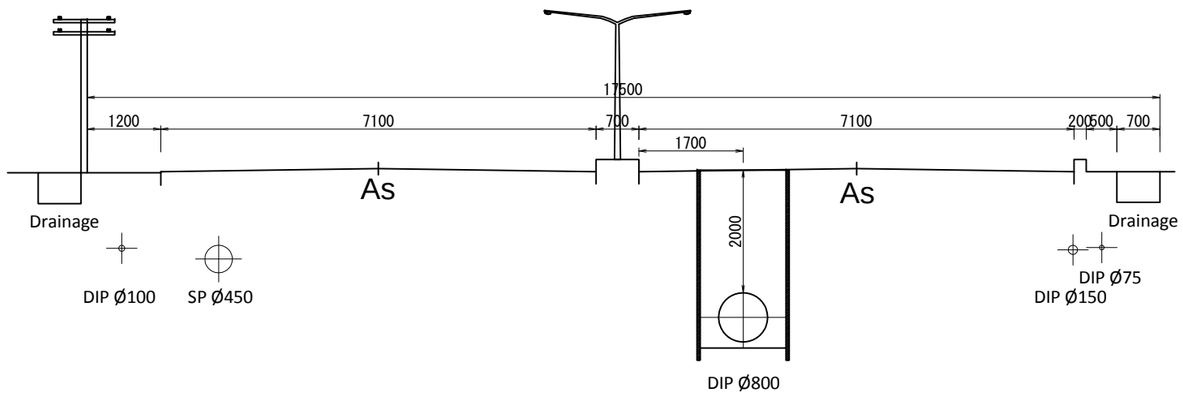
D-C-9



D-C-8

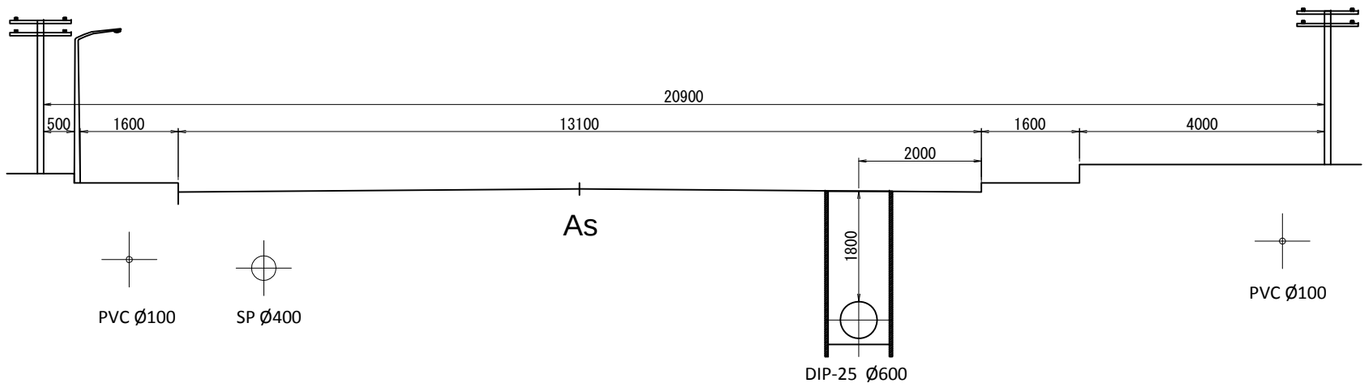


D-C-7

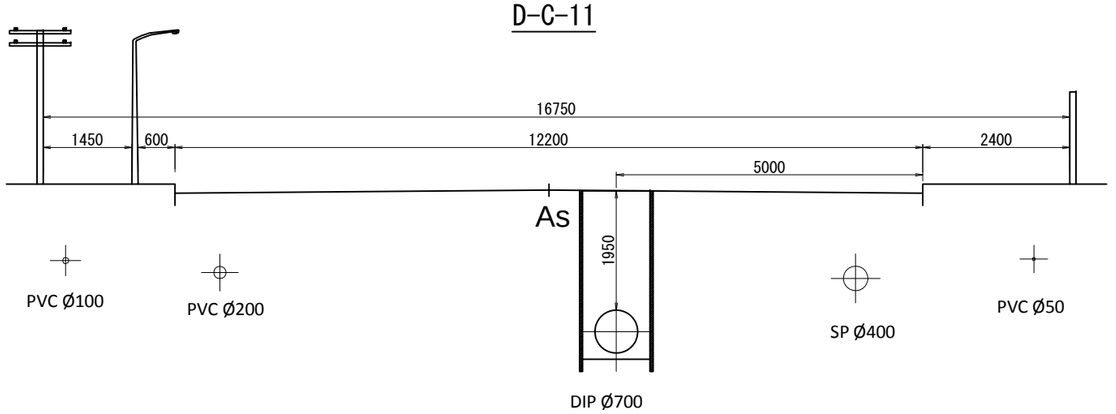


PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Cross Section (4) (Chinamo Disrtibution Area)				VD-09
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100

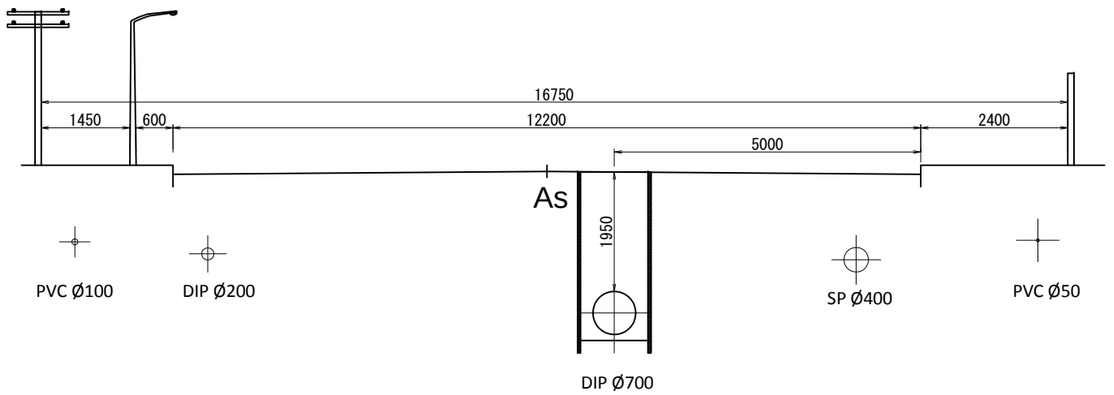
D-C-12



D-C-11

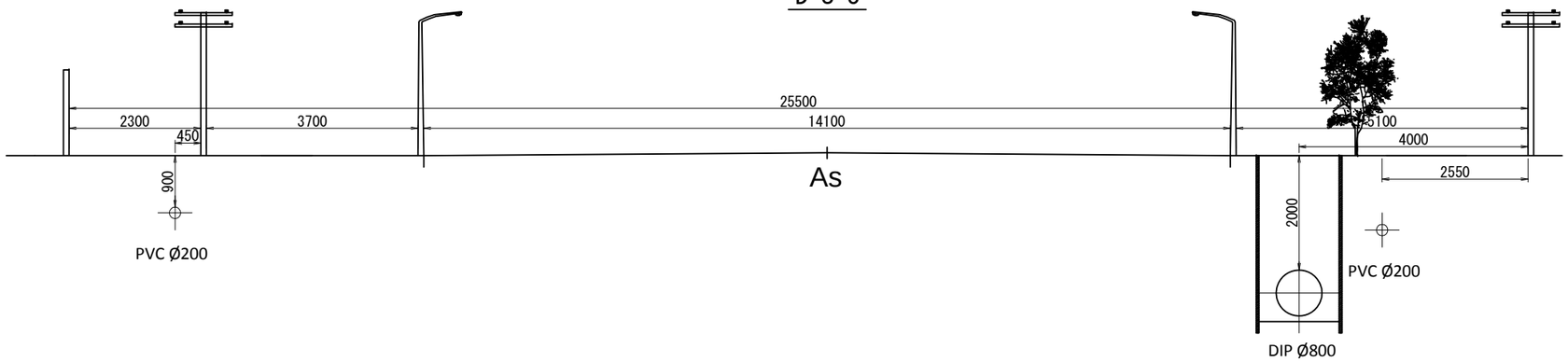


D-C-10

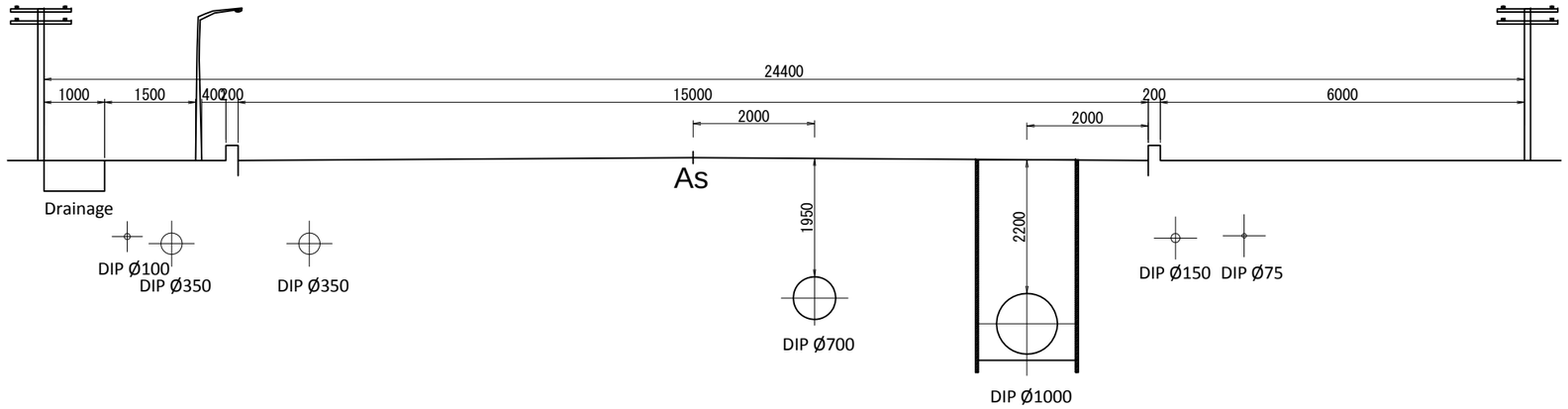


PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Cross Section (5) (Chinamo Disrtibution Area)				VD-10
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100

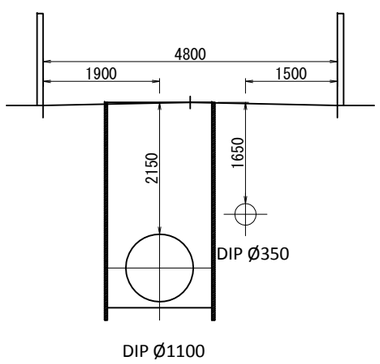
D-S-3



D-S-2

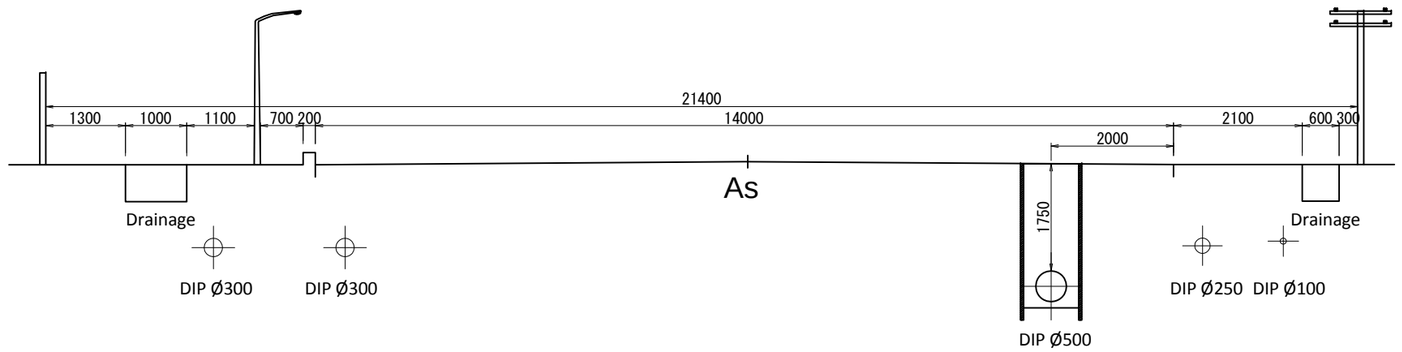


D-S-1

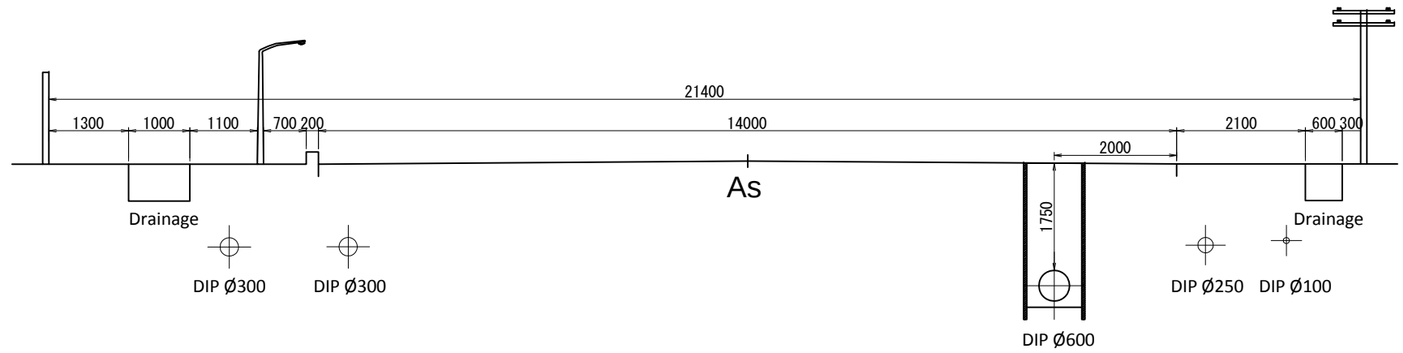


PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Cross Section (6) (Salakham Disrtibution Area)				VD-11
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100

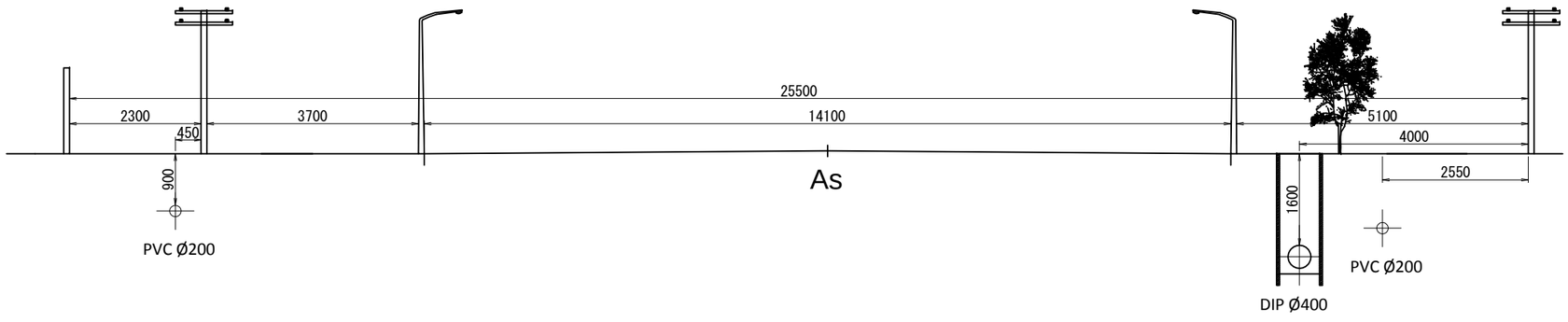
D-S-6



D-S-5

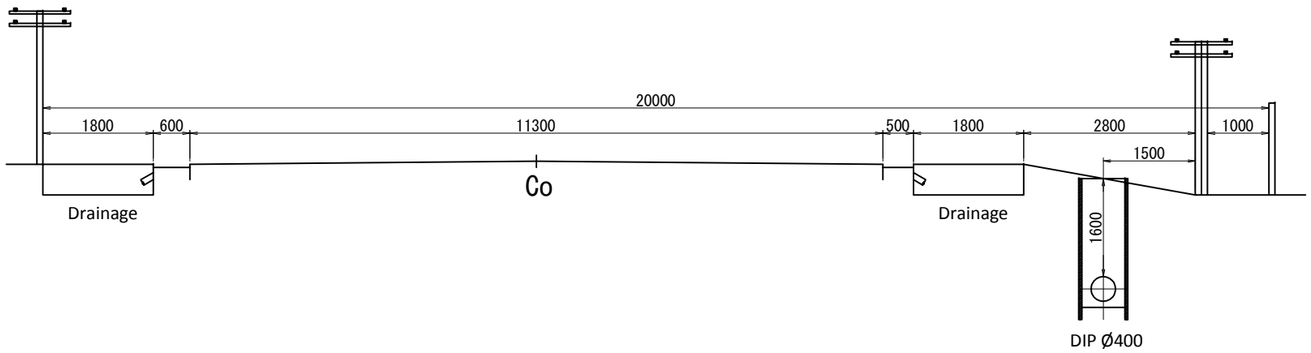


D-S-4

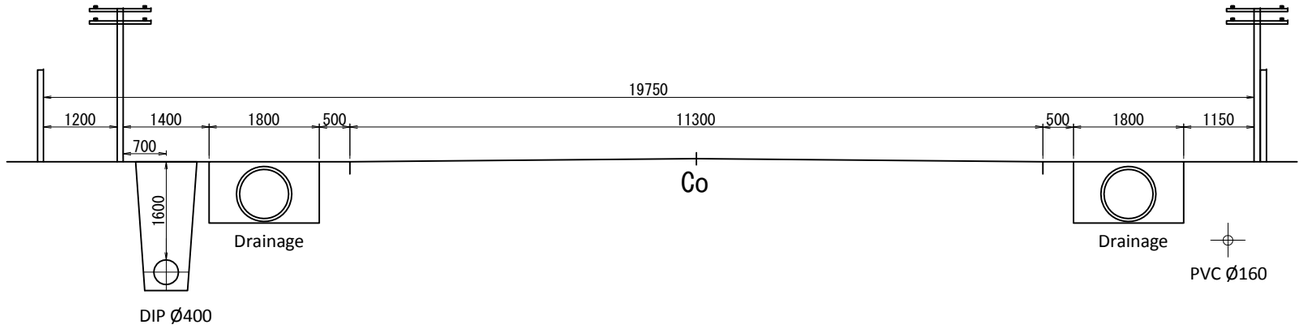


PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Cross Section (7) (Salakham Disrtibution Area)				VD-12
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100

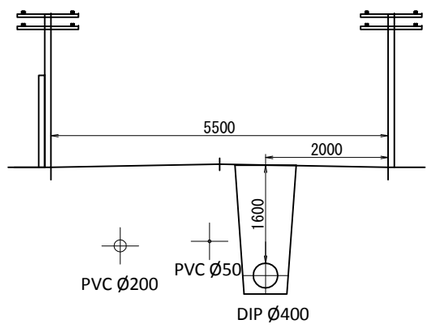
D-S-9



D-S-8

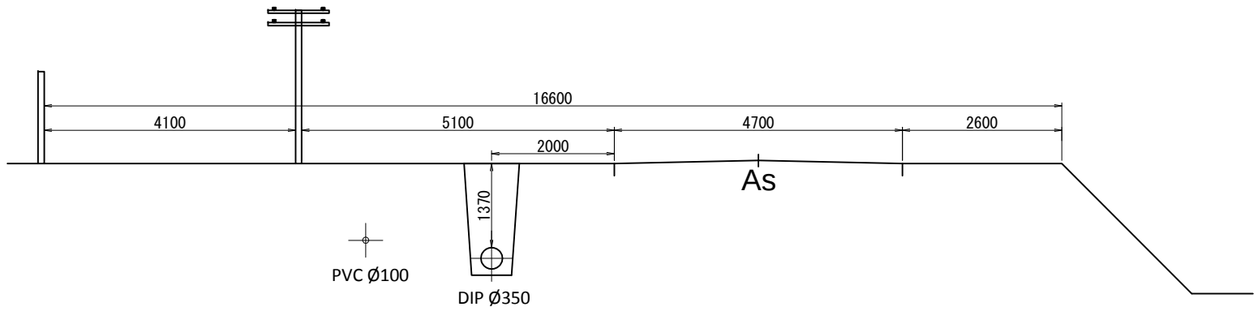


D-S-7



PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Cross Section (8) (Salakham Disrtibution Area)				VD-13
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100

D-S-11



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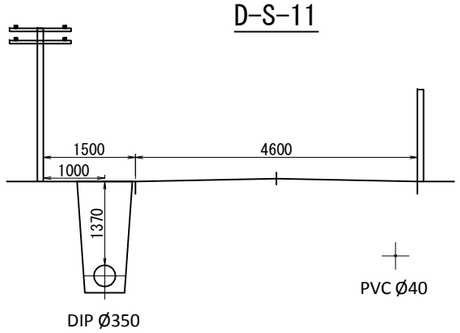

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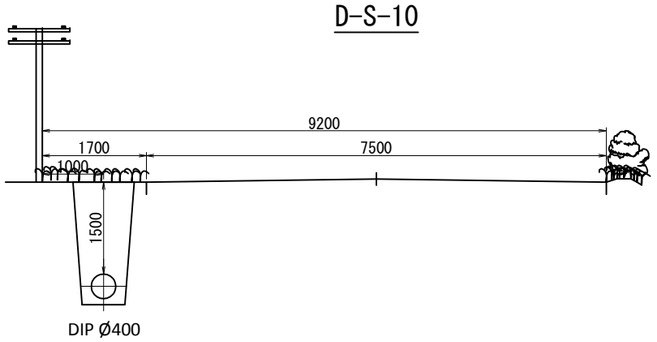

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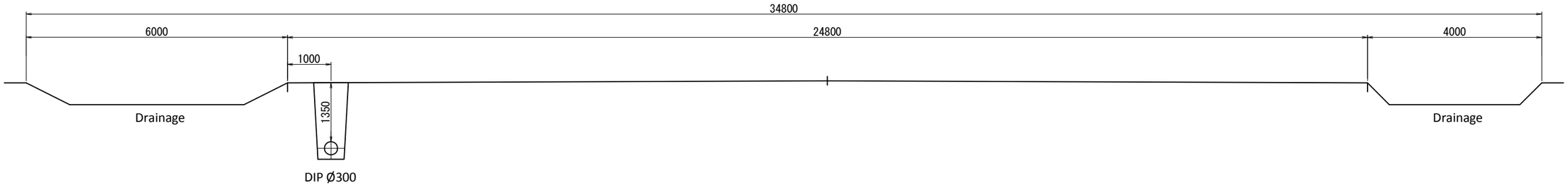
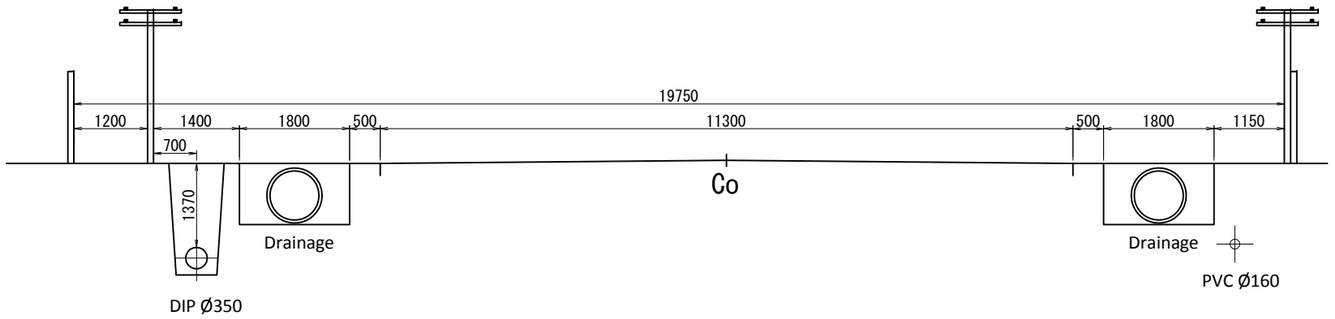
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100

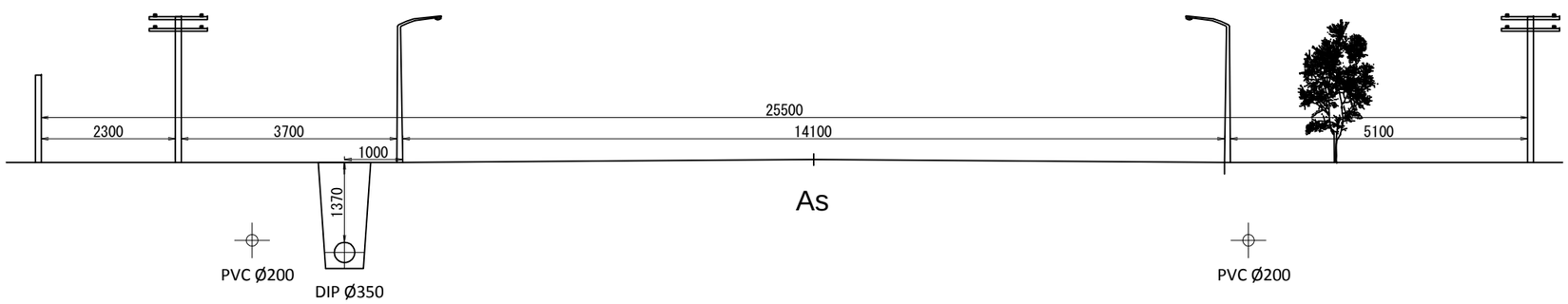
D-S-14



D-S-13



D-S-12



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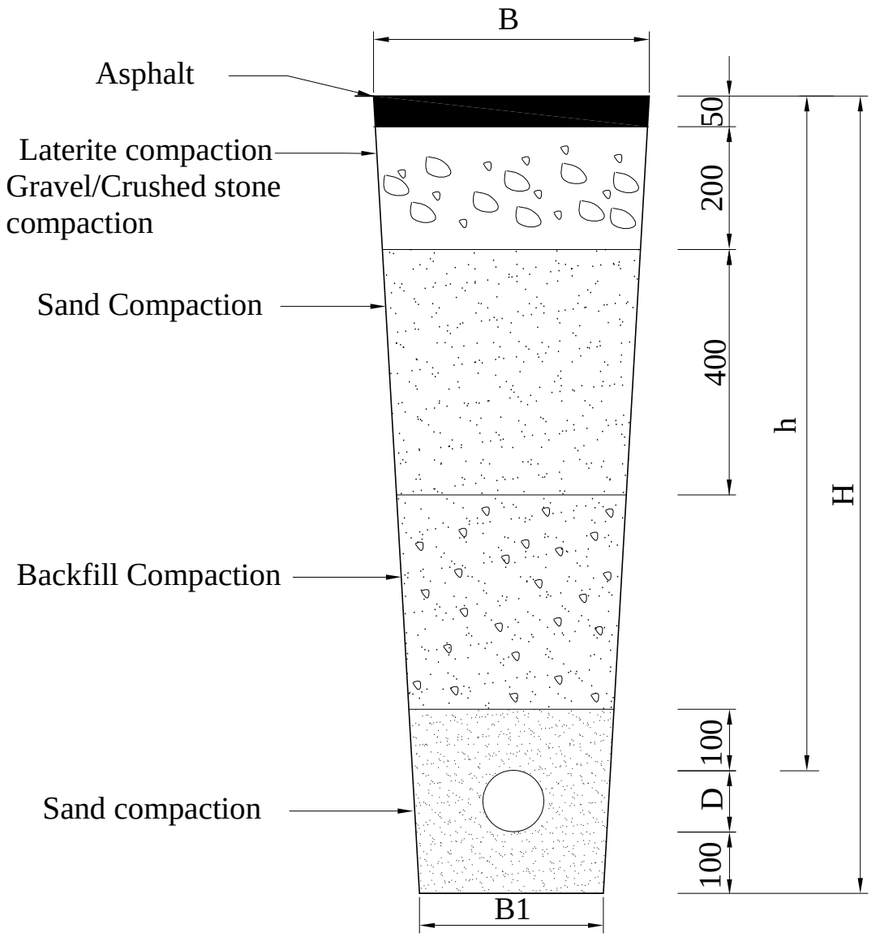
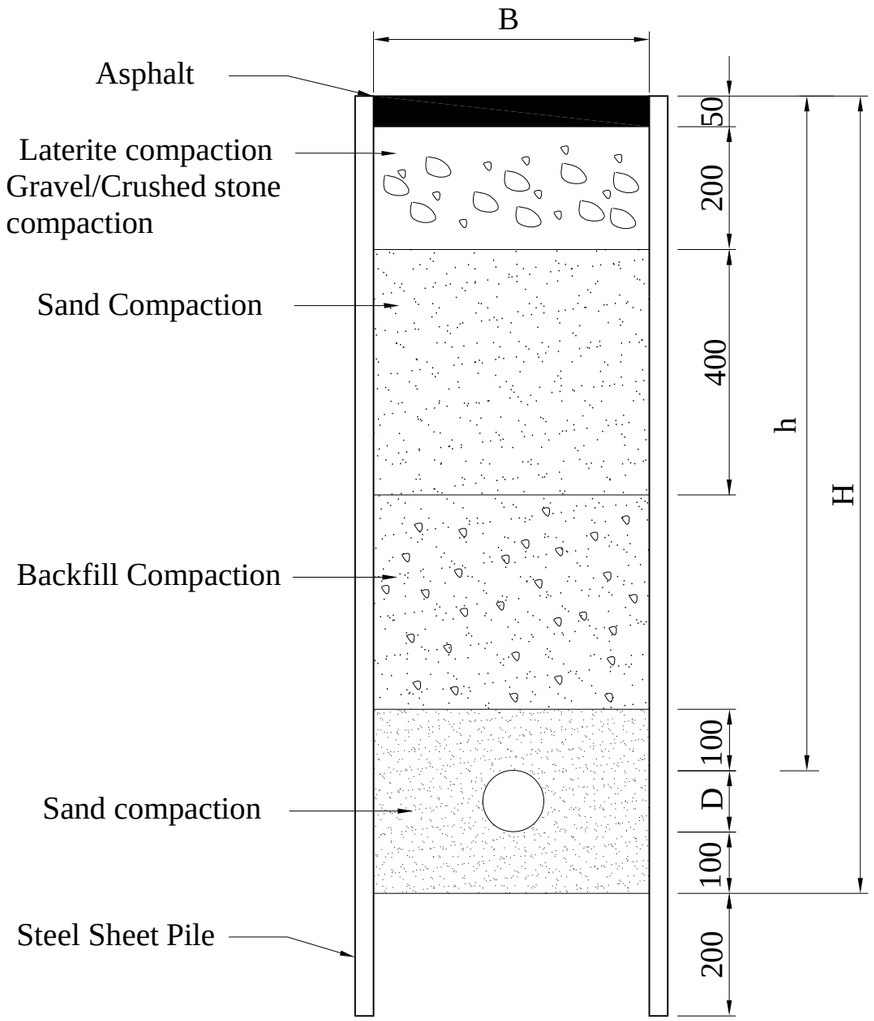
Vientiane Capital Water Supply Expansion Project	Cross Section (10) (Salakham Disrtibution Area)				VD-15
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:100



PIPE DIA(d)		DIP		TRENCH WIDTH	
Inch	mm	h mm	H mm	B1 mm	B2 mm
8	200	1200	1600	400	600
10	250	1220	1670	450	700
12	300	1350	1850	600	800
14	350	1370	1920	650	900
16	400	1500	2100	700	1000
18	450	1500	2170	800	1000
20	500	1600	2350	900	1200

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Typical Drawing for pipe laying				TYP-1
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:10



PIPE DIA(d)		DIP		TRENCH WIDTH
Inch	mm	h mm	H mm	B mm
16	400	1600	2100	700
18	450	1620	2170	800
20	500	1750	2350	900
24	600	1800	2500	1000
28	700	1950	2750	1100
32	800	2000	2900	1400
40	1000	2200	3300	1600
44	1100	2200	3400	1700
48	1200	2200	3500	1800

PROJECT	DESCRIPTION		APPROVE BY	DATE	DRAWING No
Vientiane Capital Water Supply Expansion Project	Typical Drawing for pipe laying				TYP-2
		NIHON SUIDO CONSULTANTS CO., LTD.	PREPARED BY	DATE	SCALE 1:10

A.4 Calculations for Intake and WTP

(1) Basic Design for Raw Water Pump

A. Raw Water Pump Basic Design

1 Design Condition

Flow : 160,000 x 1.0.5 = 168,000 CMD
116.67 CMM

Pump Static Head

Discharge WL (Receiving Well)	**176.5**
Suction WL (LWL)	**157**
Suction WL (HWL)	170.45
Pump Static Head, SH max.	19.5
Pump Static Head, SH min.	6.05

Pipe Loss of Head based on ND1.2 m pipe, LH **1.5 m**

Pump Total Dyanmic Head, TDH

TDH (max.)= SH max.+ LH + allowance **22 m**
19.5 + 1.5 + 1.0

TDH (min.)= SH min.+ LH + allowance
6.05 + 1.5 + 1.0 8.55 m

2 Type of Pump and Drive System

Water Sealed Submersible Motor Pump + Variable Speed Drive Unit (100 – 70 %)

3 Number of Pump

5 pumps (4 duty and 1 standby) is designed

Each pump capacity is 116.67 CMM x 1/4 = 29.16 = **29.5** CMM

4 Pump Specifications

4.1 Pump Duty Point

Considering the most high frequency operation of the pump, daily average flow, 152,727.3 CMD (106.06 CMM) and suction water level of 164.5, 3 pumps will be inservice and pump operation point is 35.35 CMM x 14.5 m head at approximately 89% pump speed.

Pump max. efficiency zone shall be designed at this operation point at 89% speed and duty point No.2 at 100% speed is calculated as 38 CMM x 19 m

Duty Point No.1 is 29.5 CMM x 22 m

Duty Point No.2 is 38 CMM x 19 m

Max. efficiency point is desinged at point near pump head of 19 m

5 Shaft Power and Motor Output

5.1 Case 1 Shaft Power of Submersible Pump under LWL of 157 (LWL)

Duty Point No.1			
Shaft power = 0.163 x 29.5 x 22 x 1/Eff of 0.76	139.1934	x1.15	**160.0724**
		equal to	**160 kW**
Duty Point No.2			
Shaft power = 0.163 x 38 x 19 x 1/Eff of 0.82=	143.5195	x1.10	**157.8715**
		<	**160 kW**

5.2 Motor Output

Motor output of pump shall be designed to be **160 kW**

6 Pump Specification

Type	Water Sealed Submersible Motor Pump
Number	
Phase I	3 units
Phase II	2 units
Capacity and Head	
Duty Point No.1	29.5 CMM x 22 m
Duty Point No.2	38 CMM x 19 m (maximum efficiency zone)
Pump Speed	740 min-1
Motor Output	160 kW x 380 V
Variable Speed Rang	100 - 70 %

(2) Design of Transmission and Distribution Pumps

Design of Transmission and Distribution Pumps

1 Basic Design Conditions

1.1 Total Flow

		Daily Average*1	Daily Max.	Peak *2
Phase I	CMD	109,090	120,000	184,800
Phase II	CMD	145,454	160,000	246,400

Note:
*1: Daily max. x 1/1.1
*2: Daily max. x 1.54

1.2 Transmission and Distribution Flow

	Trans. Flow to Xamkhe & Phonethan ET	Trans. Flow to Salakham ET	Distribution from WTP	Total CMD
Phase I Daily Max. CMD	11,940	36,818	70,965	119,723
Phase II Daily Max. CMD	15,920	49,090	94,620	159,630

2. Water Transmission from WTP to EL Tanks of PhonethanET and Xamkhe ET

2.1 Calcualtion for Loss of Haed of Transmission and Pump TDH

Tranmsission Flow **15,920 CMD = 9,080 CMD + 6,920 CMD = 11.05 CMM**

Pipe Route		Flow CMM	Pipe Dia m	Pipe Length m	C value	Loss of Head m
WTP	P1	11.05	0.7	12100	110	5.360723759
P1	P2	4.806	0.6	2200	110	0.442559184
		4.806	0.4	6000	110	8.694895348
					Total LH	14.49817829
		ET HWL:200 – WTP MWL:168		Static Head (WLET – WL Rese		32
				Pump Piping LH		3.5
				Pump TDH		**49.99817829**
P1	Phone	6.244	0.45	1100	120	1.241053657
			New Pipe		**New Pipe**	
				Total LH (WTP–P1–Phone)		6.601777416
		EH HWL:207.3–WTP MWL:168		Static Head (WLET – WL Rese		39.3
				Pump Piping LH		4.1
				Pump TDH		**50.00177742**

2.2 Installation and Operation Number of Transmission Pump (A) for Xamkhe ET

	Installa unit	Each Pump Capacity CMM	Operation Pump No.	Total Transmission CMM	
Phase 1	**3**	**5.6**	**2**	**11.2**	**>8.3 CMM = 0.75x11.05CMM**
Phase 2	**3**	**5.6**	**2**	**11.2**	**>11.05 CMM**

2.3 Design and Specifications for New Transmission Pumps (A) for Xamkhe ET

Type	**Water Sealed Submersible Motor Pump**	
Number	**3 units**	(2 duty and 1 standby)
Capacity	**5.6 m3/min**	
Head	**50 m**	
Discharge	**250**	
Motor output	**90** kW	
Pump speed	**1450** min-1	

3. Water Transmission System from WTP to EL Tank of Salakham ET

3.1 Calcualtion for Loss of Haed of Transmission and Pump TDH

Tranmsission Flow **49,090 CMD = 34.1 CMM**

Pipe Route	**Flow CMM**	**Pipe Dia m**	**Pipe Length m**	**C value**	**Loss of Head m**
WTP to Sal ET	**34.1**	**0.7**	**6600**	**120**	**20.0192841**
		New Pipe		**New Pipe**	

Sa RWL:173-WTP MWL:168	Static Head	5
	Pump Pipe LH	5
	Pump TDH	**30.0192841**

2.1 Installation and Operation Number of Transmission Pump (B) for Salakham ET

	Installe unit	Each Pump Capacity CMM	Operation Pump No.	Total Transmission CMM	
Phase 1	**3**	**11.5**	**2**	**23(25.6)**	**>25.6 CMM=34.1x0.75**
Phase 2	**4**	**11.5**	**3**	**34.5**	**>34.1 CMM**

Operation at 25.6 CMM can be done due to low loss of head

2.1.1 Design and Specifications for New Transmission Pumps (B) for Salakham ET

Type	**Water Sealed Submersible Pump**	
Number	**4 units**	(3 duty and 1 standby)
Capacity	**11.5 m3/min**	
Head	**30 m**	
Discharge Dia	**350**	
Motor output	**110** kW x 380 V	
Pump speed	**1450** min-1	

2.2 Salakham High Lift Pumps

2.2.1 Total Pump Capacity and Pump TDH Calculation

Distribution Flow	49,0900 x 1.54 = 75,598.6 CMD 52.5 CMM
Pump Number	5 units (4 duty and 1 standby)
Pump Capacity	75,598.6 CMD x 1/4 units 13.1 = 12.5 CMM
Pump TDH	Static Head = ET MWL 204.5 - Reservoir MWL 172 **32.5 m**
	Pump Piping Loss of head of **4.5 m**
	PumpTDH 37 m

2.2.2 Installation and Operation Number of Salakham High Lift Pumps

Phase 1 (Max.Distribution Flow of 75,598.6 CMD x 0.75 = 56,698.95 CMD = 39.4 CMM)

	Pump Installation	Pump Operation	Each Pump Capacit CMM	Discharge Flow CMM
Daily Max Period	4	2	12.5	**25 <25.6 CMM**
Peak Period	4	3	12.5	**37.5 >39.4 CMM**
Peak Period (Emergency Cas	4	4	12.5	**50 >39.4 CMM**

Phase 2 (Max.Distribution Flow of 75,598.6 CMD)

	Pump Installation	Pump Operation	Each Pump Capacit CMM	Discharge Flow CMM
Daily Max Period	5	3	12.5	**37.5 >34.09 CMM**
Peak Period	5	4	12.5	**50 <52.5 CMM**
Peak Period (Emergency Cas	5	5	12.5	**62.5 >52.5 CMM**

2.2.3 Design and Specification of Salakham High Lifht Pump

Type	**Water Sealed Submersible Motor Pump**	
Number	**5 units**	**(4 duty and 1 standby)**
Capacity	**12.5 m3/min**	**(Emergency 5 duty)**
Head	**37 m3/min**	
Pump Discharge Diameter	**350 mm**	
Motor output	**132** kW x 380 V 4 Poles	
Pump speed	1450 min-1	

3. Water Distribution System from WTP

3.1 Distribution Flow and Pressure

Phase 1

Dist Pressure	60 m		
Day Max.CMD	94620X0.75=	70,965.00 CMD	49.28125 CMM
Peak		109286.1 CMD	75.893125 CMM
(D Max x 1.54)			
Day Average		64513.636 CMD	44.80113636 CMM
(Day Max. x 1/1.1)			

Phase 2

Dist Pressure	60 m		
Day Max.		94,620 CMD	65.70833333 CMM
Peak		145,715 CMD	127.82 CMM
(D Max x 1.54)			
Day Average		86018.182 CMD	59.73484848 CMM
(Day Max. x 1/1.1)			

3.2 Pump Installaton and Operation Number for Phase 1

Peak Period

	Each Capa CMM	Installation	Opera	Distribution Flow CMM
Distribution Large	24	3	2	48
Distribution Small New	12	3	2	24
Total				72
			<75.89 CMM=	

Day Max. Period

	Each Capa CMM	Installation	Opera	Distribution Flow CMM
Distribution Large New	24	3	1	24
Distribution Small New	12	3	2	24
Total				48
			<49.28 CMM=	

Daily Average

	Each Capa CMM	Installation	Opera	Distribution Flow CMM
Distribution Large New	24	3	1	24
Distribution Small New	12	3	2	24
Total				48
			> 44.8 CMM	

Minimum (50% of Daily Average Assumed)

	Each Capa CMM	Installation	Opera	Distribution Flow CMM
Distribution Large New	24	3	1	24
Distribution Small New	12	3	0	0
Total				24
			> 22.4 CMM	

3.3 Pump Installaton and Operation Number for Phase 2

Peak Period

	Each Capa CMM	Installation	Opera	Distribution Flow CMM
Distribution Large	24	5	4	96
Distribution Small New	12	4	3	36
Total				132
			>127.82 CMM=	

Day Max. Period

	Each Capa CMM	Installation	Opera	Distribution Flow CMM
Distribution Large New	24	5	2	48
Distribution Small New	12	4	2	24
Total				72
			>65.708 CMM=	

Daily Average

	Each Capa	Installation	Opera	Distribution Flow CMM
Distribution Large New	24	5	2	48
Distribution Small New	12	4	1	12
Total				60
			>59.738 CMM=	

Minimum (50% of Daily Average Assumed)

	Each Capa	Installation	Opera	Distribution Flow CMM
Distribution Large New	24	5	1	24
Distribution Small New	12	4	1	12
Total				36
			>29.869 CMM=	

3.4 Design and Specification of Distribution Pumps

3.4.1 Distribution Pump Large

Type	Horizontal Double Suction Volute	
Number	5 units	(4 duty and 1 standby)
Capacity	24 m3/min	
Head	60 m	
Suction and Discharge	450 x 300	
Motor output	355 kW x 3 kV	
Pump speed	990 min-1	

3.4.1 Distribution Pump Small

Type	Horizontal Double Suction Volute	
Number	4 units	(3 duty and 1 standby)
Capacity	12 m3/min	
Head	60 m	
Suction and Discharge	300 x 200	
Shaft Power	150.461538 kW	
Motor output	220 kW x 380V	(Use the existing motor)
Pump speed	1450 min-1	

These pumps will be replaced with the existing distribution pumps

(3) Study on Energy Consumption for Raw Water Pump Operation

Study on Enegry Consumption for Raw Water Pump Operation

1 Study Condition

1.1 Raw Water Flow and Period

1.1.1 Phase 1 (2019 to 2023, 4 years)

	Mekong Plant Production Water L CMD		Pump Flow x1.05 CMD	CMM	Duration days
Jan	159.5 D ave	109090	114544.5	79.5447917	31
Feb	159.5 D ave	109090	114544.5	79.5447917	28
Mar	159.5 D max	120,000	126000	87.5	31
Apr	159.5 D max	120,000	126000	87.5	30
May	159.5 D max	120,000	126000	87.5	31
June	162 D ave	109,090	114544.5	79.5447917	30
July	165 D ave	109,090	114544.5	79.5447917	31
Aug	167 D ave	109,090	114544.5	79.5447917	31
Sep	167 D ave	109,090	114544.5	79.5447917	30
Oct	164 D ave	109,090	114544.5	79.5447917	31
Nov	162 D ave	109,090	114544.5	79.5447917	30
Dec	161 D ave	109,090	114544.5	79.5447917	31
					365

1.1.2 Phase 2 (2023 to 2038, 16 years)

	Mekong Plant Production Water L CMD		Pump Flow x1.05 CMD	CMM	Duration days
Jan	159.5 D ave	145454.5	152727.2	106.060573	31
Feb	159.5 D ave	145454.5	152727.2	106.060573	28
Mar	159.5 D max	160,000	168000	116.666667	31
Apr	159.5 D max	160,000	168000	116.666667	30
May	159.5 D max	160,000	168000	116.666667	31
June	162 D ave	145,455	152727.2	106.060573	30
July	165 D ave	145,455	152727.2	106.060573	31
Aug	167 D ave	145,455	152727.2	106.060573	31
Sep	167 D ave	145,455	152727.2	106.060573	30
Oct	164 D ave	145,455	152727.2	106.060573	31
Nov	162 D ave	145,455	152727.2	106.060573	30
Dec	161 D ave	145,455	152727.2	106.060573	31
					365

1.2 Raw Water Pump Specifications

Type	Water Sealed Submersible Pump with Mixed Flow Impeller
Number	5 (4 duty + 1 standby)
Each Pump Cap	29.5 CMM
Pump Head	22 m
Efficiency	0.77 at rated point
Veriable speed	100 – 70 %

2 Energy Consumption Calculation

2.1 Phase 1 (2019 – 2023, 4 years)

2.1.1 Variable Speed Pump

Period	OP Point	Total Flow CMM	Pump Number	Ope	Pump Head	Pump Efficiency	Pump Sha Power kW	Total Power kW
Jan	OP0	79.54479	3		18	0.8	97.2435078	291.7305
Feb	OP0	79.54479	3		18	0.8	97.2435078	291.7305
Mar	OP1	87.5	3		18	0.81	105.648148	316.9444
Apr	OP1	87.5	3		18	0.81	105.648148	316.9444
May	OP1	87.5	3		18	0.81	105.648148	316.9444
June	OP2	79.54479	3		16	0.81	96.0429707	288.1289
July	OP3	79.54479	3		13	0.81	96.0429707	288.1289
Aug	OP4	79.54479	3		11	0.81	96.0429707	288.1289
Sep	OP4	79.54479	3		11	0.81	96.0429707	288.1289
Oct	OP5	79.54479	3		14	0.8	97.2435078	291.7305
Nov	OP6	79.54479	3		16	0.81	96.0429707	288.1289
Dec	OP7	79.54479	3		17	0.81	96.0429707	288.1289

Period	Total Power kW	Duration days	x24hr	Power Con kWh/Month
Jan	291.7305	31		217047.509
Feb	291.7305	28		196042.912
Mar	316.9444	31		235806.667
Apr	316.9444	30		228200
May	316.9444	31		235806.667
June	288.1289	30		207452.817
July	288.1289	31		214367.911
Aug	288.1289	31		214367.911
Sep	288.1289	30		207452.817
Oct	291.7305	31		217047.509
Nov	288.1289	30		207452.817
Dec	288.1289	31		214367.911
		Total /year		**2595413.45 kWh/Year**

2.1.2 Fixed Speed Pump

Period	OP Point	Total Flow CMM	Pump Number	Ope	Pump Head	Pump Efficiency	Pump Sha Power kW	Total Power kW
Jan		79.54479	3		22	0.775	122.68715	368.0614
Feb		79.54479	3		22	0.775	122.68715	368.0614
Mar		87.5	3		21	0.8	124.796875	374.3906
Apr		87.5	3		21	0.8	124.796875	374.3906
May		87.5	3		21	0.8	124.796875	374.3906
June		79.54479	3		22	0.775	122.68715	368.0614
July		79.54479	3		22	0.775	122.68715	368.0614
Aug		79.54479	3		22	0.775	122.68715	368.0614
Sep		79.54479	3		22	0.775	122.68715	368.0614
Oct		79.54479	3		22	0.775	122.68715	368.0614
Nov		79.54479	3		22	0.775	122.68715	368.0614
Dec		79.54479	3		22	0.775	122.68715	368.0614

Period	Total Power kW	Duration days	x24hr	Power Con kWh/Month
Jan	368.0614	31		273837.718
Feb	368.0614	28		247337.294
Mar	374.3906	31		278546.625
Apr	374.3906	30		269561.25
May	374.3906	31		278546.625
June	368.0614	30		265004.243
July	368.0614	31		273837.718
Aug	368.0614	31		273837.718
Sep	368.0614	30		265004.243
Oct	368.0614	31		273837.718
Nov	368.0614	30		265004.243
Dec	368.0614	31		273837.718
		Total /year		**3238193.11 kWh/Year**

2.2 Phase 2(2023 – 2038, 16 years)

2.1.1 Variable Speed Pump

Period	OP Point	Total Flow CMM	Pump Ope Number	Pump Head	Pump Efficiency	Pump Sha Power kW	Total Power kW
Jan	OP0	106.0606	3	18	0.815	127.272688	381.8181
Feb	OP0	106.0606	3	18	0.815	127.272688	381.8181
Mar	OP1	116.6667	4	18	0.81	105.648148	422.5926
Apr	OP1	116.6667	4	18	0.81	105.648148	422.5926
May	OP1	116.6667	4	18	0.81	105.648148	422.5926
June	OP2	106.0606	3	16	0.82	112.441453	337.3244
July	OP3	106.0606	3	13	0.815	91.9191632	275.7575
Aug	OP4	106.0606	3	11	0.79	80.2390748	240.7172
Sep	OP4	106.0606	3	11	0.79	80.2390748	240.7172
Oct	OP5	106.0606	3	14	0.815	98.9898681	296.9696
Nov	OP6	106.0606	3	16	0.82	112.441453	337.3244
Dec	OP7	106.0606	3	17	0.815	120.201983	360.6059

Period	Total Power kW	Duration days	x24hr	Power Con kWh/Month
Jan	381.8181	31		284072.639
Feb	381.8181	28		256581.738
Mar	422.5926	31		314408.889
Apr	422.5926	30		304266.667
May	422.5926	31		314408.889
June	337.3244	30		242873.538
July	275.7575	31		205163.572
Aug	240.7172	31		179093.615
Sep	240.7172	30		173316.402
Oct	296.9696	31		220945.386
Nov	337.3244	30		242873.538
Dec	360.6059	31		268290.825
		Total/Year		**3006295.7 kWh/year**

2.1.2 Fixed Speed Pump

Period	OP Point	Total Flow CMM	Pump Ope Number	Pump Head	Pump Efficiency	Pump Sha Power kW	Total Power kW
Jan		106.0606	4	22	0.775	122.688134	490.7525
Feb		106.0606	4	22	0.775	122.688134	490.7525
Mar		116.6667	4	20.5	0.8	121.825521	487.3021
Apr		116.6667	4	20.5	0.8	121.825521	487.3021
May		116.6667	4	20.5	0.8	121.825521	487.3021
June		106.0606	4	22	0.775	122.688134	490.7525
July		106.0606	4	22	0.775	122.688134	490.7525
Aug		106.0606	4	22	0.775	122.688134	490.7525
Sep		106.0606	4	22	0.775	122.688134	490.7525
Oct		106.0606	4	22	0.775	122.688134	490.7525
Nov		106.0606	4	22	0.775	122.688134	490.7525
Dec		106.0606	4	22	0.775	122.688134	490.7525

Period	Total Power kW	Duration days	x24hr	Power Con kWh/Month
Jan	490.7525	31		365119.886
Feb	490.7525	28		329785.703
Mar	487.3021	31		362552.75
Apr	487.3021	30		350857.5
May	487.3021	31		362552.75
June	490.7525	30		353341.825
July	490.7525	31		365119.886
Aug	490.7525	31		365119.886
Sep	490.7525	30		353341.825
Oct	490.7525	31		365119.886
Nov	490.7525	30		353341.825
Dec	490.7525	31		365119.886
		Total/year		**4291373.61 kWh/year**

3.1 PVF

		PCF:3.27%	126,000	168,000
	Year	0.0327	CMD	CMD
0	2014	1		
1	2015	0.968335		
2	2016	0.937674		
3	2017	0.907982		
4	2018	**0.879232**		
5(1)	2019	0.851391		
6	2020	0.824432		
7	2021	0.798327		
8	2022	**0.773048**		
9(5)	2023	0.74857		
10	2024	0.724867		
11	2025	0.701914		
12	2026	0.679688		
13	2027	0.658166		
14(10)	2028	0.637326		
15	2029	0.617145		
16	2030	0.597604		
17	2031	0.578681		
18	2032	0.560357		
19(15)	2033	0.542614		
20	2034	0.525432		
21	2035	0.508794		
22	2036	0.492684		
23	2037	0.477083		
24(20)	2038	0.461976		
			3.247198	**9.51290092**

3.2 Costruction Cost for Pump Unit (to be paid in year 2018)

3.2.1 Costruction Cost for Fixed Speed Pumps (to be paid in year 2018)

Purchasing cost of 3 fixed speed pumps, CCPW in 2014 is
Pump unit cost is 44 MYen
Total pump cost is 3 units x Pump unit cost 132 Myem

Present worth of total pump cost by PVF 2018 based on 2014 is
G236 x E205

CCPW fp1 is **116.058572** MYen

3.2.2 Costruction Cost for Fixed Speed Pumps (to be paid in year 2022)

Purchasing cost of 2 fixed speed pumps, CCFP in 2014 is
Pump unit cost is 44 MYen
Total pump cost is 2 units x Pump unit cost 88 MYen

Present worth of total pump cost by PVF 2022 based on 2014 is
G246 x E209

CCPW fp2 is **68.0282433** MYen

3.2.3 Costruction Cost for Variable Speed Pumps (to be paid in year 2018)

Purchasing cost of 3variable speed pumps, CCVP in 2014 is
Pump unit cost including VFD control unit is 62 MYen
Total pump cost is 3 units x Pump unit cost 186 MYen

Present worth of total pump cost by PVF 2018 based on 2014 is
G256 x E205

CCPW vp1 **163.537079** MYen

3.2.4 Costruction Cost for Variable Speed Pumps (to be paid in year 2022)

Purchasing cost of 2 variable speed pumps, CCVP in 2014 is
Pump unit cost including VFD control unit is 62 MYen
Total pump cost is 2 units x Pump unit cost 124 MYen

Present worth of total pump cost by PVF 2018 based on 2014 is
G266 x E209

CCPW vp2 **95.8579791** MYen

3.3 Present Worth of Operation Cost

3.3.1 Present Worth of Energy Consumption of Variable Speed Pump

Phase 1(2019 – 2022, 4 years)

Total energy consumption per year x PVF (2014 to 2022) is
PWEC VP1 = G90 x F226 x 11yen/kWh x 1/1,000,000 **92.7060467 MYen**

Phase 2(2023 – 2038, 16 years)

Total energy consumption per year x PVF (2023 to 2038) is
PWEC VP2 = G161 x G233 x 11yen/kWh x 1/1,000,000 **314.584524 MYen**

1kWh = 734 Kip = 11 Yen

3.3.2 Present Worth of Energy Consumption of Fixed Speed Pump

Phase 1(2019 – 2022, 4 years)

Total energy consumption per year x PVF (2014 to 2022) is
PWEC FP1 = G125 x F2226 x 11yen/kWh x 1/1,000,000 **115.665611 MYen**

Phase 2(2023 – 2038, 16 years)

Total energy consumption per year x PVF (2023 to 2038) is
PWEC FP2 = G195 x G226 x 11yen/kWh x 1/1,000,000 **449.057531 MYen**

1kWh = 734 Kip = 11 Yen

4 Total Present Worth of Pump Equipment and Operation Cost for Pump

4.1 Total present worth of pump equipment & operation cost for variable speed pump, TPW vp is

TPW vp = CCPW vp1 + CCPW vp2 + PWEC VP1 + PWEC VP2= **666.6856 MYen**

4.2 Total present worth of pump equipment & operation cost for fixed speed pump, TPW fp is

TPW fp = CCPW fp1 + CCPW fp2 + PWEC FP1 + PWEC FP2= **748.81 MYen**

4.3 Comparison of TPW vp and TPW fp

TPW vp is cheaper than TPW fp and
Difference between TPW fp and TPW vp is 82.1243289 MYen

(4) Comparison Study of Energy Consumption between Fixed and Variable Speed Distribution Pumps

Comparison of Energy Consumption between Fixed and Variable Speed Distribution Pumps

1 Phase 1(120,000 CMD)

1.1 Daily Average Base

Daily max. flow of Phase 2 (160,000 CMD):	94,620.00	CMD
Daily average flow of Phase 2: Daily max. x 1/1.1	86018.1818	CMD
Daily max.flow of Phase 1: Daily max flow of Phase 2 x 0.75	70965	CMD
	49.28125	CMM
Daily average flow (daily average flow of Phase 2 x 0.75)	64,513.64	CMD
	44.8011364	CMM

1.2 Distribution Flow and Flow Pattern Assumed

1.2.1 Daily Average Flow Base with Duration of 9 Months

	Duration hour/day	Flow CMM	Total Flow CM	
Min. Flow, qmin	11	36.00539	23,763.56	
		Balance		
Average Flow, qa	9	44.8	24192	
Peak Flow, apek	4	68.992	16558.08	
		qav x 1.54	64,513.64	Total

1.2.2 Daily Max Flow Base with Duration of 3 Months

	Duration hour/day	Flow CMM	Total Flow CM	
Min. Flow, qmin	11	39.6042	26,138.78	
		Balance		
Average Flow, qa	9	49.28125	26611.875	
Peak Flow, apek	4	75.89313	18214.35	
		qav x 1.54	70,965.00	Total

1.3 Pump Operation Cost

1.3.1 Daily Average Flow Base Pump Shaft Power and Electric Consumption (9 months of 275 days)

a. Variable Speed Pump

	Duration hour/day	Flow CMM	Shaft Power kW *1	Electric Consumption kWh	
Min. Flow, qmin	11	36.00539	440.1658736	4841.82461	
Average Flow, qa	9	44.8	547.68	4929.12	
				0	
Peak Flow, apek	4	68.992	843.4272	3373.7088	
			Total	13144.6534	kWh/day
Electrci Consumption of duration of 275 days, ECVSPphase1 ave				3614779.69	kWh/275days

*1: Pump discharge pressure is determined 60 m according to dischargepipeline network analysis.

b. Fixed Speed Pump

	Duration hour/day	Flow CMM	Pump Operation	Pump Capa CMM	Shaft Pow kW *1	Electric C kWh
Min. Flow, qmin	11	36.00539	24CMM x 1 unit + 12CMM x 1 unit	36	440.1	4841.1
Average Flow, qa	9	44.8	24CMM x 2 units	48	586.8	5281.2
Peak Flow, apek	4	68.992	24CMM x 2 units + 12 CMM x 1unit	60	733.5	2934
				Total		13056.3

Electrci Consumption of duration of 275 days, ECFSPphase1 ave 3590482.5 kWh/275 days

*1: Pump discharge pressure is determined 60 m according to dischargepipeline network analysis.

1.3.1 Daily Max Flow Base Pump Shaft Power and Electric Consumption (3 months of 90 days)

a. Variable Speed Pump

	Duration hour/day	Flow CMM	Shaft Power kW *1	Electric Consumption kWh/day
Min. Flow, qmin	11	39.6042	484.16	5325.77541
Average Flow, qa	9	49.3	602.69	5424.2325
Peak Flow, apek	4	75.922	928.15	3712.5858
			Total	14462.5937 kWh/ days

Electrci Consumption of duration of 90 days, ECVSPphase1 max 1301633.43 kWh/90 days

*1: Pump discharge pressure is determined 60 m according to dischargepipeline network analysis.

b. Fixed Speed Pump

	Duration hour/day	Flow CMM	Pump Operation	Pump Capa CMM	Shaft Pow kW *1	Electric C kWh
Min. Flow, qmin	11	39.6042	24CMM x 1 unit + 12CMM x 1 unit	36	440.1	4841.1
Average Flow, qa	9	49.3	24CMM x 2 units	48	586.8	5281.2
Peak Flow, apek	4	75.922	24CMM x 2 units + 12 CMM x 2units	72	880.2	3520.8
				Total		13643.1

Electrci Consumption of duration of 90 days, ECFSPphase1 ave 1227879 kWh/90 days

*1: Pump discharge pressure is determined 60 m according to dischargepipeline network analysis.

2 Phase 1(160,000 CMD)

2.1 Daily Average Base

Daily max. flow of Phase 2 (160,000 CMD): 94,620.00 CMD
65.71 CMM

Daily average flow of Phase 2: Daily max. x 1/1.1 86018.1818 CMD
59.7348485 CMM

2.2 Distribution Flow and Flow Pattern Assumed

2.2.1 Daily Average Flow Base with Duration of 9 Months

	Duration hour/day	Flow CMM	Total Flow CM	
Min. Flow, qmin	11	56.36861	37,203.28	
		Balance		
Average Flow, qa	9	59.73485	32256.81818	
Peak Flow, apek	4	68.992	16558.08	
		qav x 1.54	86,018.18	Total

2.2.2 Daily Max Flow Base with Duration of 3 Months

	Duration hour/day	Flow CMM	Total Flow CM	
Min. Flow, qmin	11	52.80561	34,851.70	
		Balance		
Average Flow, qa	9	65.71	35482.5	
Peak Flow, apek	4	101.1908	24285.8	
		qav x 1.54	94,620.00	Total

2.3 Pump Operation Cost

2.3.1 Daily Average Flow Base Pump Shaft Power and Electric Consumption (9 months of 275 days)

a. Variable Speed Pump

	Duration hour/day	Flow CMM	Shaft Power kW *1	Electric Consumption kWh	
Min. Flow, qmin	11	56.36861	689.1062764	7580.16904	
Average Flow, qa	9	59.73485	730.2585227	6572.3267 0	
Peak Flow, apek	4	68.992	843.4272	3373.7088	
			Total	17526.2045	kWh/day

Electrci Consumption of duration of 275 days, ECVSPphase2 ave 4819706.25 kWh/275days

*1: Pump discharge pressure is determined 60 m according to dischargepipeline network analysis.

b. Fixed Speed Pump

	Duration hour/day	Flow CMM	Pump Operation	Pump Capa CMM	Shaft Pow kW *1	Electric C kWh
Min. Flow, qmin	11	56.36861	24CMM x 1 unit + 12CMM x 2 units	48	586.8	6454.8
Average Flow, qa	9	59.73485	24CMM x 2 units + 12 CMM x 1 unit	60	733.5	6601.5
Peak Flow, apek	4	68.992	24CMM x 2 units + 12 CMM x 2units	72	880.2	3520.8
				Total		16577.1

Electrci Consumption of duration of 275 days, ECFSPphase2 ave 4558702.5 kWh/275 days

*1: Pump discharge pressure is determined 60 m according to dischargepipeline network analysis.

2.3.2 Daily Max Flow Base Pump Shaft Power and Electric Consumption (3 months of 90 days)

a. Variable Speed Pump

	Duration hour/day	Flow CMM	Shaft Power kW *1	Electric Consumption kWh/day
Min. Flow, qmin	11	52.80561	645.55	7101.03388
Average Flow, qa	9	65.71	803.28	7229.55938
Peak Flow, apek	4	101.1908	1,237.06	4948.23175
			Total	19278.825 kWh/ days

Electrci Consumption of duration of 90 days, ECVSPphase2 max 1735094.25 kWh/90 days

*1: Pump discharge pressure is determined 60 m according to dischargepipeline network analysis.

b. Fixed Speed Pump

	Duration hour/day	Flow CMM	Pump Operation	Pump Capa CMM	Shaft Pow kW *1	Electric C kWh
Min. Flow, qmin	11	52.80561	24CMM x 1 unit + 12CMM x 2 units	48	586.8	6454.8
Average Flow, qa	9	65.71	24CMM x 2 units + 12 CMM x 1 unit	60	733.5	6601.5
Peak Flow, apek	4	101.1908	24CMM x 3 units + 12 CMM x 2units	96	1173.6	4694.4
				Total		17750.7

Electrci Consumption of duration of 90 days, ECFSPphase2 ave 1597563 kWh/90 days

*1: Pump discharge pressure is determined 60 m according to dischargepipeline network analysis.

3 Compsumption of Yearly Electric Consumption per Year

3.1 Yearly Electric Consumption of Variable Speed Pump

Phase 1(275days): ECVSPphase 1ave	3614779.69	kWh/275days
Phase 1(90days): ECVSPphase 1max	1301633.43	kWh/90days
Total Phase 1/year	**4916413.12**	**kWh/year**
Phase 2(275days): ECVSPphase 2ave	4819706.25	kWh/275days
Phase 2(90days): ECVSPphase 2max	1735094.25	kWh/90days
Total Phase 2/year	**6554800.5**	**kWh/year**

3.2 Yearly Electric Consumption of Fixed Speed Pump

Phase 1(275days): ECFSPphase 1ave	3590482.5	kWh/275days
Phase 1(90days): ECFSPphase 1max	1227879	kWh/90days
Total Phase 1/year	**4818361.5**	**kWh/year**
Phase 2(275days): ECFSPphase 2ave	4558702.5	kWh/275days
Phase 2(90days): ECFSPphase 2max	1597563	kWh/90days
Total Phase 2/year	**6156265.5**	**kWh/year**

4 Comparison of Yearly Electrci Consumption between Variable and Fixed Speed Pump

	Phase 1 Electric Consumption kWh/year	**Phase 2 Electrci Consumption kWh/year**
Variable Speed Pump	4916413	6554801
Fixed Speed Pump	4818362	6156266

(5) Study on Transmission Pipe Size from Chinaimo WTP to Salakham ET

1. Study on Pipe Size

1.1 Flow and Pipe Size with Length

Flow	Phase 1	2019 to 2022	33,470	CMD	23.24337121
Day Aver	Phase 2	2023 to 2038	44,627	CMD	30.99116162

Pipe Line Length 6,600 m

Pipe Size m 700 or 800

1.2 PVF

	Year	PCF:3.27% 0.0327	126,000 CMD	168,000 CMD	
0	2014	1			
1	2015	0.96833543			
2	2016	0.93767351			
3	2017	0.90798248			
4	2018	**0.87923161**			Installation Period
5(1)	2019	0.85139112			
6	2020	0.82443219			
7	2021	0.7983269			
8	2022	**0.77304822**			
9(5)	2023	0.74856998			
10	2024	0.72486683			
11	2025	0.70191424			
12	2026	0.67968843			
13	2027	0.65816639			
14(10)	2028	0.63732583			
15	2029	0.61714518			
16	2030	0.59760355			
17	2031	0.57868069			
18	2032	0.56035702			
19(15)	2033	0.54261355			
20	2034	0.52543193			
21	2035	0.50879435			
22	2036	0.4926836			
23	2037	0.47708299			
24(20)	2038	0.46197636			
			7.940421444	**9.512900918**	

2 Pump Operation Energy Cost

2.1 Case 1 (Pipe size: 700 mm)

	Flow CMM	Head m	S Power kW	Energy kWh/year	**Present Worth Price with 11Yen/kWh** PW PC
Phase 1	**23.24337**	**19**	**89.9809008**	**788,233**	**68,847,897**
Phase 2	**30.99116**	**26**	**164.1756787**	**1,438,179**	**150,493,792**
	Total		**PWPEC1**		**219,341,689**

2.1 Case 2 (Pipe size: 800 mm)

	Flow CMM	Head m	S Power kW	Energy kWh/year	**Present Worth Price with 11Yen/kWh**
Phase 1	**23.24337**	**14.5**	**68.66963482**	**601546.0011**	**52,541,816**
Phase 2	**30.99116**	**18**	**113.6600852**	**995662.3466**	**104,188,010**
	Total		**PWPEC2**		**156,729,826**

3. Pipe Material Cost (Present Worth)

3.1 Pipe Unit Cost

	6 m pipe weight kg	weight per m, kg	Unit Price 320 Y/kg	
700 mm	1119	186.5	59680	Yen
800 mm	1381	230.1667	73653.33333	Yen

Case 1	Length m	Unit Price Yen/m	Pipe Cost	**Present Worth Pipe Price with PVF 2018 PWPC1**
700 mm	6,600	59,680	393,888,000	**346,318,779**

Case 2	Length m	Unit Price Yen¥m	Pipe Price	**Present Worth Pipe Price with PVF 2018 PWPC2**
800 mm	6,600	73,653	486,112,000	**427,405,035**

4. Total Present Worth (Operation Energy Cost + Pipe Cost)

Case 1 TPW 1is PWPEC1 + PWPC1 = **565,660,468 Yen**

Case 2 TPW2 is PWPEC2 + PWPC2 = **584,134,861 Yen**

Difference between TPW1 and TPW2 is **−18,474,393 Yen**

Case 1 of pipe size, 700 mm is cheaper than Case 2 of 800 mm

A.5 Calculations for Pipe Networks

(1) Network Calculation

Calculation conditions for network analysis are shown in Table A.5.1.

Table A.5.1 Calculation Conditions

Item	Condition	Remark
Calculation Method	Hazen-Williams formula	$H=10.666\times C^{-1.85}\times D^{-4.87}\times Q^{1.85}\times L$ H: Friction Head Loss (m) C: Coefficient of flow velocity (C value) D: Internal diameter of pipe (m) Q: Flow rate (m^3/s) L: Length (m)
C value	110	Same condition with M/P(2005)
Hourly Factor	1.54	The condition which is for area of housing and factories was applied*

* Design Criteria for Japanese Waterworks Facilities (2012) was applied since materials to set the Hourly Factor weren't available in Vientiane.

The network calculation was calculated by EPANET with the above conditions. Condition of necessary water pressure was set as 15 meter at each node. However, in case that the necessary water pressure isn't secured due to physical condition, the condition of 10 meter that is shown in Guideline[1] was applied.

The diameter of pipeline is determined by the smallest diameter of pipeline which meets the necessary water pressure through the network calculation.

(2) Results of Network Calculation

The results of network calculation for Phase 1 and Phase 2 are shown in Figure A.5.1 and Figure A.5.2.

Water pressure after Phase 1 is almost enough although some area has water pressure with under 15 meters and over 10 meters. After Phase2, all supply area from Chinaimo WTP has enough water pressure with over 15 meters.

[1] Guideline: MANAGEMENT AND TECHNICAL GUIDELINES WATER SUPPLY (February 2009) Ministry of Public Works and Transport, Department of Housing and Urban Planning, Water Supply Division

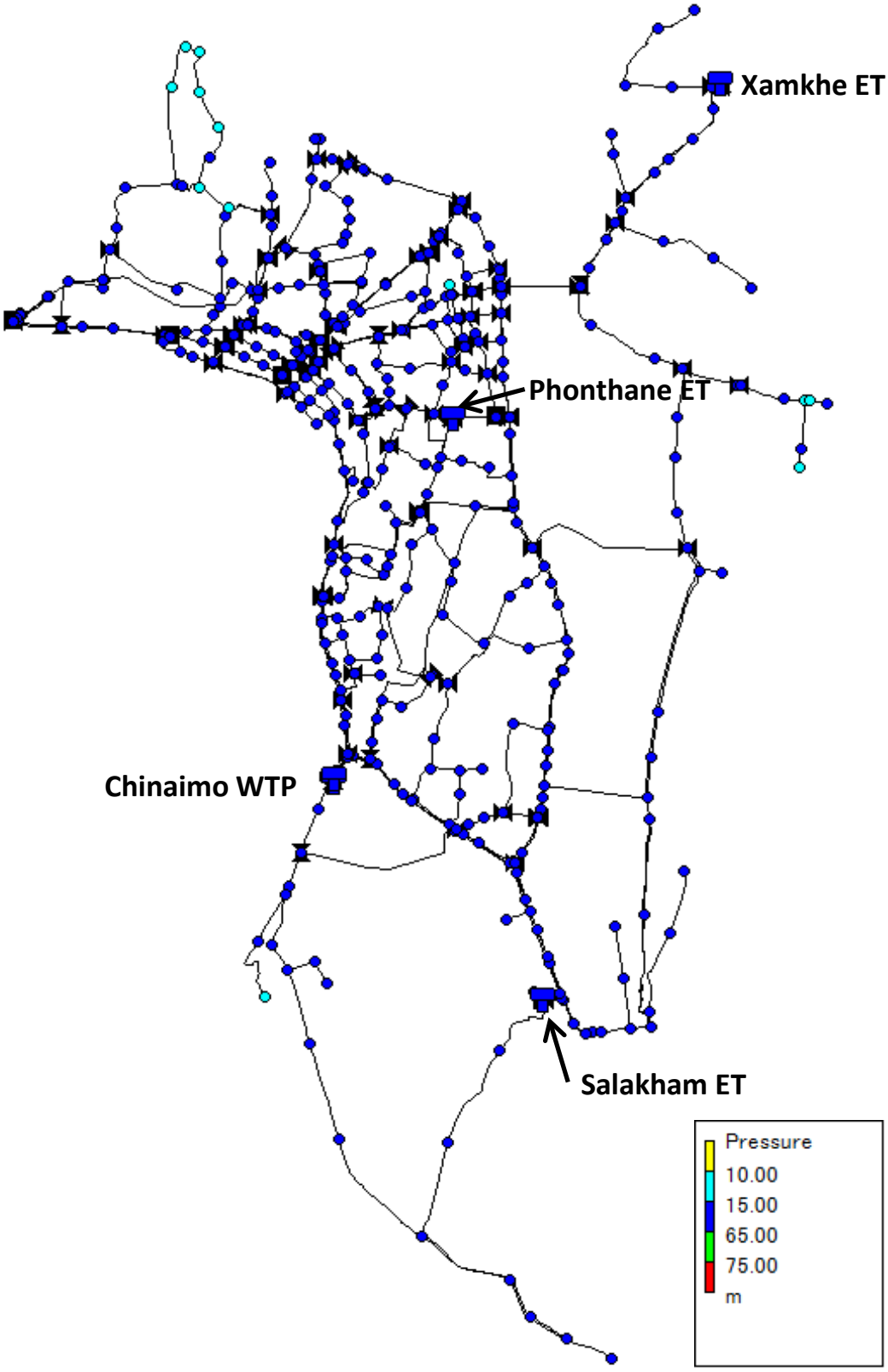


Figure A.5.1 Results of Network Calculation (After Phase 1)

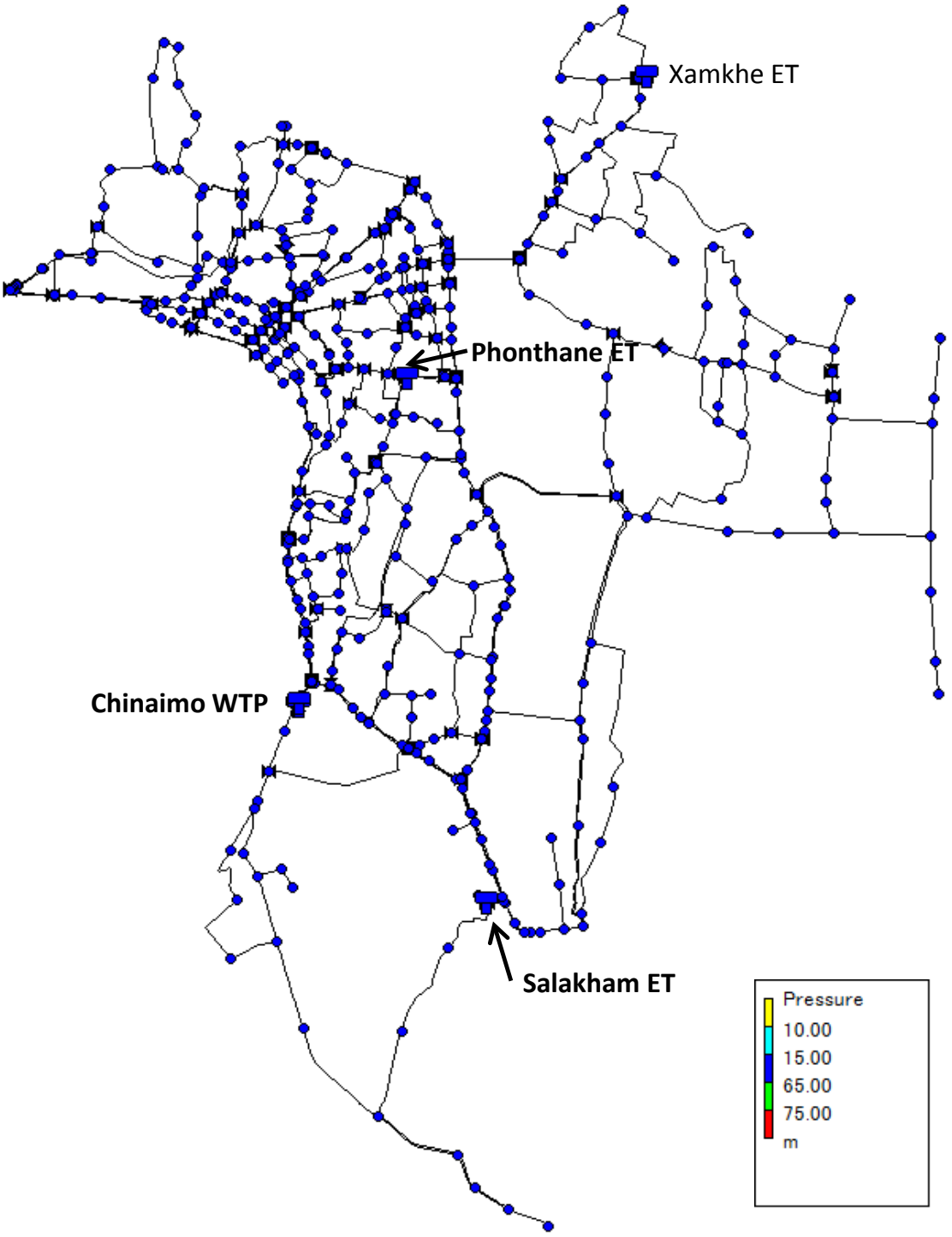


Figure A.5.2 Results of Network Calculation (After Phase 2)

A.6 Elaboration of Water Demand Projection by 2030

Water demand projection by 2030 was carried out with the following conditions.

- Numbers in 2013 is based on the past data collected from NPNL.
- Populations in 2013 are shown in Data Book of Final Report.
- Population growth in the current service area is assumed 1.5% reviewing WSM/P 2014.
- Population growth in future service area is assumed 3.0% reviewing WSM/P 2014.
- Coverage ratio (percentage of population served) in the current service area was 91 % in 2013, and it will be supposed to reach to 100% in 2030.
- Coverage ratio (percentage of population served) in future service area is 0% in 2013 and it will be supposed to reach to 100% in 2030.
- Per capita consumption in 2013 was 245 l/c/d, and it will be supposed to be sustained by 2030.
- Ratio of non-domestic water amount in 2013 was 24% (Non-domestic water / Domestic water), and it will be supposed to become 50% in 2030 reviewing WSM/P 2014.
- Rate of NRW in 2013 was 25% (i.e. Domestic water + Non-domestic water: NRW = 75: 25), and it will be supposed to reduce 10% in 2030.
- Factor for daily maximum in 2013 was 1.1 (maximum daily water supply / average water supply), and it will be supposed to be sustained by 2030.

The following table shows the elaboration of water demand projection by 2030.

		Unit	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
A	**Domestic Demand**																			
1	Total population in Vientiane Capital		854,069	879,691	906,082	933,264	961,262	990,100	1,019,803	1,050,397	1,081,909	1,114,366	1,147,797	1,182,231	1,217,698	1,254,229	1,291,856	1,330,612	1,370,530	1,411,646
2	Growth rate	%		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
3	Population in service area		534,846	542,869	551,012	559,277	567,666	576,181	584,824	593,596	602,500	611,538	620,711	630,022	639,472	649,064	658,800	668,682	678,712	688,893
4	Growth rate	%		1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
5	Population in extension area		140,905	145,132	149,486	153,971	158,590	163,348	168,248	173,295	178,494	183,849	189,364	195,045	200,896	206,923	213,131	219,525	226,111	232,894
6	Growth rate	%		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
7	Total population in urban Vientiane Capital [A3+A5]		675,751	688,001	700,498	713,248	726,256	739,529	753,072	766,891	780,994	795,387	810,075	825,067	840,368	855,987	871,931	888,207	904,823	921,787
8	Coverage in service area	%	91	92	93	94	95	96	97	98	99	100	100	100	100	100	100	100	100	100
9	Coverage in extension area	%	0	15	30	37	45	50	56	62	66	70	74	78	82	86	90	94	97	100
10	Served population in service area [A3xA8]		489,175	499,439	512,441	525,720	539,283	553,134	567,279	581,724	596,475	611,538	620,711	630,022	639,472	649,064	658,800	668,682	678,712	688,893
11	Served population in extension area [A5xA9]		0	21,770	44,846	56,969	71,366	81,674	94,219	107,443	117,806	128,694	140,129	152,135	164,735	177,954	191,818	206,354	219,328	232,894
12	Total served population in urban Vientiane Capital [A11+A12]		489,175	521,209	557,287	582,689	610,649	634,808	661,498	689,167	714,281	740,232	760,840	782,157	804,207	827,018	850,618	875,036	898,040	921,787
13	Service ratio in urban Vientiane Capital [A12/A7]	%	72	76	80	82	84	86	88	90	91	93	94	95	96	97	98	99	99	100
14	Per capita consumption	l/c/d	245	245	245	245	245	245	245	245	245	245	245	245	245	245	245	245	245	245
15	Total domestic demand [A12xA14]	m3/d	119,848	127,696	136,535	142,759	149,609	155,528	162,067	168,846	174,999	181,357	186,406	191,628	197,031	202,619	208,401	214,384	220,020	225,838
B	**Non Domestic Demand**																			
1	Government, Business, Factory	%	24	25	27	28	30	32	33	35	37	39	41	43	45	46	47	48	49	50
2	Non Domestic Demand [A15xB1]	m3/d	28,764	31,924	36,864	39,973	44,883	49,769	53,482	59,096	64,750	70,729	76,426	82,400	88,664	93,205	97,948	102,904	107,810	112,919
C	**Total Consumption**	m3/d	148,612	159,620	173,399	182,732	194,492	205,297	215,549	227,942	239,749	252,086	262,832	274,028	285,695	295,824	306,349	317,288	327,830	338,757
D	**NRW in Distribution System**																			
1	Rate of NRW	%	25	25	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10
2	NRW [C/(100-D1)xD1]	m3/d	49,537	53,207	57,800	57,705	58,095	57,904	57,298	56,986	56,237	55,336	53,833	52,196	50,417	48,157	45,776	43,267	40,518	37,640
E	**Average Daily Water Demand [C+D2]**	m3/d	199,619	212,827	231,199	240,437	252,587	263,201	272,847	284,928	295,986	307,422	316,665	326,224	336,112	343,981	352,125	360,555	368,348	376,397
F	**Daily Maximum Demand**																			
1	Peak daily factor		1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
2	Daily maximum demand [ExF1]	m3/d	219,581	234,110	254,319	264,481	277,846	289,521	300,132	313,421	325,585	338,164	348,332	358,846	369,723	378,379	387,338	396,611	405,183	414,037
3	Daily maximum demand [F2x1000/86400]	l/s	2,541	2,710	2,944	3,061	3,216	3,351	3,474	3,628	3,768	3,914	4,032	4,153	4,279	4,379	4,483	4,590	4,690	4,792
G	**Daily Maximum Demand (WTP Output)**	m3/d	**219,600**	**234,100**	**254,300**	**264,500**	**277,800**	**289,500**	**300,100**	**313,400**	**325,600**	**338,200**	**348,300**	**358,800**	**369,700**	**378,400**	**387,300**	**396,600**	**405,200**	**414,000**

A.7 ODA Loan AP Guidance for the Lao PDR FY2014

General Guidelines of FY2014 Japanese ODA Loan Projects

1. Exchange Rate

(1) US$ 1 = ¥ 120.4

(2) US$ 1 =8094.60 Kip

(3) Kip 1 = ¥ 0.0149

2. Price Escalation Rate（including Consultant）

(1) Foreign Currency Portion 2.0% p.a.

(2) Local Currency Portion 7.9% p.a.

3. Physical Contingency Rate:

In principle, 5 % (to be determined based on the accuracy of project planning, design and cost estimate). Additional consideration could be made only for those projects with clear and reasonable justification.

4. Spare Parts

Spare parts cost necessary for at least 2 years after project completion should be included in "equipment cost" when appropriate.

5. Billing Rate for Consultant Rate

(1) Professional (A): 3,049,000YEN ／M/M ±10%

(2) Professional (B): Approximately one-third of Professional (A)

(3) Professional (C):

<NOTE>

- Professional (A) is applied for International Consultant.
- Professional (B) is applied for Local Consultant with over 5 years of experience in consulting service and qualified either equaling or surpassing the Professional (A).
- Professional (C) is applied for Local Expert who does not fulfill the above requirements of (B).
- The quoted rates above are for cost estimate purpose at the time of appraisal and do not bind the actual unit price in each consulting services contract。

6. Base Year for Cost Estimation: March 2015 (TBC)

7. Procedure of Project Cost Estimation

(1) Estimate of Base Cost

(2) Estimated Base Cost x Price Escalation Rate

(3) ((1)+(2)) x Physical Contingency Rate

(4) Total Cost = (1) + (2) + (3)

Note: Price escalation and physical contingency of consulting services shall be included in the cost of consulting service, and shall NOT be counted in the contingencies of the total cost.

8. Annual Fund Requirements

Gregorian Calendar Year (January - December) is applied in principle

9. Standard Procedural Time for Procurement under JICA Loan

Project implementation schedule should be prepared using the following procedural period. However, the following procedural period is the minimum one, and it is recommended to use more realistic (usually longer) period when preparing Minutes of Discussion.

(1) Selection of Consulting Firm	: 12 Months
(in case of Direct Negotiation : 3 Months)	
(2) Construction, Procurement of Equipment	
(a) Preparation of Tender Documents and JICA Approval	: 3 Months
(b) Tender Period	: 3 Months
(c) Evaluation of Bids	: 2 Months
(d) JICA Approval of Bid Evaluation	: 1 Month
(e) Contract Negotiation	: 2 Months
(f) JICA Approval of Contract	: 1 Month
(g) Opening of Letter of Credit and Issuance of Letter of Commitment	: 1 Month
Total ((a)-(g))	: 13 Months

Note: In case of ICB with Pre-qualification : 15 Months
In case of Direct Negotiation : 8 Months

10. Others

(1) Those costs of goods and services envisaged to be imported (including the depreciation cost of imported construction equipment in the case of civil works) would be counted as foreign costs.

(2) The following items shall be included in the total project cost but are not eligible for JICA financing.

- Land Acquisition
- Compensation
- Taxes and Duties
- Administration cost

(3) Interest during construction shall be included in the total project cost and shall be financed by JICA.

A.8 Annual Fund Requirement

Table A.8.1 Annual Fund Requirement

Base Year for Cost Estimation: Apr, 2015 — FC & Total: million JPY
Exchange Rates: LAK = Yen 0.0149 — LC : million LAK
Price Escalation: FC: 2.0% LC: 7.9%
Physical Contingency: 10%
Physical Contingency for Consultant: 5%

Item	Total			2015			2016			2017			2018			2019			2020			2021		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
A. ELIGIBLE PORTION																								
Ⅰ) Procurement / Construction	6,472	149,750	8,703	0	0	0	0	0	0	0	0	0	999	27,110	1,403	2,661	56,573	3,504	2,514	60,555	3,416	299	5,512	381
Package1: Intake (G), WTP (G, E)	3,454	96,582	4,893	0	0	0	0	0	0	0	0	0	691	19,316	979	1,295	36,218	1,835	1,295	36,218	1,835	173	4,829	245
Package2: Pumps and related equipment	1,978	3,630	2,032	0	0	0	0	0	0	0	0	0	165	303	169	939	1,724	965	775	1,422	796	99	182	102
Base cost for JICA financing	5,432	100,213	6,925	0	0	0	0	0	0	0	0	0	856	19,619	1,148	2,235	37,943	2,800	2,070	37,640	2,631	272	5,011	346
Price escalation	452	35,924	987	0	0	0	0	0	0	0	0	0	52	5,027	127	184	13,487	385	215	17,410	475	0	0	0
Physical contingency	588	13,614	791	0	0	0	0	0	0	0	0	0	91	2,465	128	242	5,143	319	229	5,505	311	27	501	35
Ⅱ) Consulting services	794	29,347	1,231	0	0	0	113	3,271	162	193	6,331	287	138	3,621	192	141	6,997	246	180	7,790	296	28	1,338	48
Base cost	710	21,688	1,033	0	0	0	106	2,887	149	176	5,179	254	124	2,745	165	124	4,916	198	156	5,154	233	24	807	36
Price escalation	45	6,261	139	0	0	0	2	228	6	7	851	20	8	703	18	10	1,748	36	15	2,265	49	3	467	10
Physical contingency	38	1,397	59	0	0	0	5	156	8	9	301	14	7	172	9	7	333	12	9	371	14	1	64	2
Total (Ⅰ + Ⅱ)	7,266	179,097	9,934	0	0	0	113	3,271	162	193	6,331	287	1,137	30,731	1,595	2,802	63,570	3,749	2,694	68,345	3,712	327	6,849	429
B. NON ELIGIBLE PORTION																								
a Procurement / Construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Base cost for JICA financing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Price escalation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Physical contingency	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
b Land Acquisition	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Base cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Price escalation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Physical contingency	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
c Administration cost	0	33,336	497	0	0	0	0	544	8	0	963	14	0	5,352	80	0	12,581	187	0	12,457	186	0	1,438	21
d VAT	0	17,910	267	0	0	0	0	327	5	0	633	9	0	3,073	46	0	6,357	95	0	6,835	102	0	685	10
e Import Tax	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
f Frond End Fee	0	1,347	20	0	1,347	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (a+b+c+d+e+f)	0	52,593	784	0	1,347	20	0	871	13	0	1,596	24	0	8,425	126	0	18,938	282	0	19,292	287	0	2,123	32
TOTAL (A+B)	7,266	231,690	10,718	0	1,347	20	113	4,142	175	193	7,927	311	1,137	39,156	1,720	2,802	82,508	4,031	2,694	87,637	4,000	327	8,973	460
C. Interest during Construction	103	0	103	0	0	0	0	0	0	0	0	0	10	0	10	35	0	35	59	0	59	0	0	0
Interest during Construction(Const.)	103	0	103	0	0	0	0	0	0	0	0	0	10	0	10	34	0	34	59	0	59	0	0	0
Interest during Construction (Consul.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRAND TOTAL (A+B+C)	7,369	231,690	10,821	0	1,347	20	113	4,142	175	193	7,927	311	1,147	39,156	1,730	2,836	82,508	4,066	2,753	87,637	4,058	327	8,973	460
E. JICA finance portion incl. IDC (A + C)	7,369	179,097	10,037	0	0	0	113	3,271	162	193	6,331	287	1,147	30,731	1,605	2,836	63,570	3,784	2,753	68,345	3,771	327	6,849	429

Administration Cost = 5%
VAT= 10% of the expenditure in local currency of the eligible portion
Import Tax= 0%

A.9 MM Schedule for Consultation Services

Table A.9.1 MM Schedule for Consultation Services

		Position	2016											
			1	2	3	4	5	6	7	8	9	10	11	12
A	1	Project Manager							1	1	1	1	1	1
A	2	Civil Engineer							1	1	1	1	1	1
A	3	Pipeline Engineer								1	1	1	1	1
A	4	Mechanical Engineer								1	1	1	1	1
A	5	Electrical Engineer										1	1	1
A	6	Architect												
A	7	Cost Estimator / Construction Planner												
A	8	Contract Specialist												
A	9	Spec Writer												
A	10	Environmental Specialist											1	
A	11	Topo and Geo Survey							1	1	1	1	1	1
A	12	Operation and Maintenance												
A	13	NRW Specialist												
A	14	Finance Specialist												
A	15	Procurement (Private Consignment)												
B	1	Deputy Projectt Manager							1	1	1	1	1	1
B	2	Civil Engineer							1	1	1	1	1	1
B	3	Pipeline Engineer							1	1	1	1	1	1
B	4	Mechanical Engineer							1	1	1	1	1	1
B	5	Electrical Engineer										1	1	1
B	6	Archtect										1	1	1
B	6	Cost Estimator 1 / Construction Planner										1	1	1
B	7	Environmental Specialist											1	
B	8	Topo and Geo Survey							1	1	1	1	1	1
C	1	Office Manager							1	1	1	1	1	1
C	2	Secretary							1	1	1	1	1	1
C	3	Accountant							1	1	1	1	1	1
C	4	CAD Operator							4	4	4	4	4	4
C	5	Intake Inspector												
C	6	WTP Inspector												
C	7	Mechanical Inspector												
C	8	Electrical Inspector												
C	9	Pipeline Inspector												
C	10	Translator / Interpreter							1	1	1	1	1	1
C	11	Driver							3	3	3	3	3	3

		Position	2017											
			1	2	3	4	5	6	7	8	9	10	11	12
A	1	Project Manager	1	1	1	1	1	1	1	1	1	1	1	1
A	2	Civil Engineer			1	1	1	1	1			1	1	1
A	3	Pipeline Engineer			1	1	1	1	1					1
A	4	Mechanical Engineer			1	1	1	1	1			1	1	1
A	5	Electrical Engineer				1		1	1					1
A	6	Architect		1	1	1								
A	7	Cost Estimator / Construction Planner				1	1	1	1					
A	8	Contract Specialist				1	1	1	1					
A	9	Spec Writer				1	1	1	1					
A	10	Environmental Specialist												
A	11	Topo and Geo Survey												
A	12	Operation and Maintenance												
A	13	NRW Specialist												
A	14	Finance Specialist												
A	15	Procurement (Private Consignment)												
B	1	Deputy Projectt Manager	1	1	1	1	1	1	1	1	1	1	1	1
B	2	Civil Engineer	2	2	2	2	2	2	2	1	1	1	1	1
B	3	Pipeline Engineer	1	1	1	1	1	1	1	1	1	1	1	1
B	4	Mechanical Engineer	1	1	1	1	1	1	1			1	1	1
B	5	Electrical Engineer	1	1	1	1	1	1	1				1	1
B	6	Archtect	1	1	1	1	1	1	1					
B	6	Cost Estimator 1 / Construction Planner	1	1	1	1	1	1	1					
B	7	Environmental Specialist												
B	8	Topo and Geo Survey												
C	1	Office Manager	1	1	1	1	1	1	1	1	1	1	1	1
C	2	Secretary	1	1	1	1	1	1	1	1	1	1	1	1
C	3	Accountant	1	1	1	1	1	1	1	1	1	1	1	1
C	4	CAD Operator	4	4	4	1	4	4						
C	5	Intake Inspector												
C	6	WTP Inspector												
C	7	Mechanical Inspector												
C	8	Electrical Inspector												
C	9	Pipeline Inspector												
C	10	Translator / Interpreter	1	1	1	1	1	1				1	1	1
C	11	Driver	3	3	3	3	3	3	1	1	1	1	1	1

		Position	2018											
			1	2	3	4	5	6	7	8	9	10	11	12
A	1	Project Manager	1	1	1	1	1	1	1	1	1	1	1	1
A	2	Civil Engineer	1						1	1	1	1	1	1
A	3	Pipeline Engineer	1								1			
A	4	Mechanical Engineer	1	1	1	1	1							1
A	5	Electrical Engineer		1	1	1	1							
A	6	Architect												
A	7	Cost Estimator / Construction Planner												
A	8	Contract Specialist				1	1	1		1	1	1		
A	9	Spec Writer												
A	10	Environmental Specialist								1				
A	11	Topo and Geo Survey												
A	12	Operation and Maintenance												
A	13	NRW Specialist												
A	14	Finance Specialist												
A	15	Procurement (Private Consignment)												
B	1	Deputy Projectt Manager	1	1	1	1	1	1	1	1	1	1	1	1
B	2	Civil Engineer	1						1	1	1	1	1	1
B	3	Pipeline Engineer	1						1	1	1	1	1	1
B	4	Mechanical Engineer	1	1										
B	5	Electrical Engineer	1	1										
B	6	Archtect												
B	6	Cost Estimator 1 / Construction Planner												
B	7	Environmental Specialist								1			1	
B	8	Topo and Geo Survey												
C	1	Office Manager	1	1	1	1	1	1	1	1	1	1	1	1
C	2	Secretary	1	1	1	1	1	1	1	1	1	1	1	1
C	3	Accountant	1	1	1	1	1	1	1	1	1	1	1	1
C	4	CAD Operator												
C	5	Intake Inspector								2	2	2	2	2
C	6	WTP Inspector								2	2	2	2	2
C	7	Mechanical Inspector												
C	8	Electrical Inspector												
C	9	Pipeline Inspector								4	4	4	4	4
C	10	Translator / Interpreter	1	1	1	1	1	1	1	1	1	1	1	1
C	11	Driver	1	1	1	1	1	1	3	3	3	3	4	4

		Position	2019											
			1	2	3	4	5	6	7	8	9	10	11	12
A	1	Project Manager	1	1	1	1	1	1	1	1	1	1	1	1
A	2	Civil Engineer	1	1	1	1	1	1	1	1	1	1	1	1
A	3	Pipeline Engineer							1					
A	4	Mechanical Engineer	1					1	1				1	1
A	5	Electrical Engineer	1						1					1
A	6	Architect												
A	7	Cost Estimator / Construction Planner												
A	8	Contract Specialist						1						1
A	9	Spec Writer												
A	10	Environmental Specialist		1						1				
A	11	Topo and Geo Survey												
A	12	Operation and Maintenance												
A	13	NRW Specialist												
A	14	Finance Specialist												
A	15	Procurement (Private Consignment)												
B	1	Deputy Projectt Manager	1	1	1	1	1	1	1	1	1	1	1	1
B	2	Civil Engineer	1	1	1	1	1	1	1	1	1	1	1	1
B	3	Pipeline Engineer	1	1	1	1	1	1	1	1	1	1	1	1
B	4	Mechanical Engineer		1	1	1	1	1	1	1	1	1	1	1
B	5	Electrical Engineer		1	1	1	1	1	1	1	1	1	1	1
B	6	Archtect												
B	6	Cost Estimator 1 / Construction Planner												
B	7	Environmental Specialist		1			1			1			1	
B	8	Topo and Geo Survey												
C	1	Office Manager	1	1	1	1	1	1	1	1	1	1	1	1
C	2	Secretary	1	1	1	1	1	1	1	1	1	1	1	1
C	3	Accountant	1	1	1	1	1	1	1	1	1	1	1	1
C	4	CAD Operator												
C	5	Intake Inspector	2	2	2	1	2	2	2	2	2	2	2	2
C	6	WTP Inspector	2	2	2	1	2	2	2	2	2	2	2	2
C	7	Mechanical Inspector	2	2	2	1	2	2	2	2	2	2	2	2
C	8	Electrical Inspector	2	2	2	1	2	2	2	2	2	2	2	2
C	9	Pipeline Inspector	4	4	4	1	4	4	4	4	4	4	4	4
C	10	Translator / Interpreter	1	1	1	1	1	1	1	1	1	1	1	1
C	11	Driver	4	4	4	4	4	4	4	4	4	4	4	4

		Position	2020											
			1	2	3	4	5	6	7	8	9	10	11	12
A	1	Project Manager	1	1	1	1	1	1	1	1	1	1	1	1
A	2	Civil Engineer	1	1	1	1	1	1	1	1	1	1	1	1
A	3	Pipeline Engineer			1				1					1
A	4	Mechanical Engineer		1	1			1	1				1	1
A	5	Electrical Engineer			1				1					1
A	6	Architect												
A	7	Cost Estimator / Construction Planner												
A	8	Contract Specialist						1						1
A	9	Spec Writer												
A	10	Environmental Specialist		1					1					1
A	11	Topo and Geo Survey												
A	12	Operation and Maintenance		0.5					0.5					0.5
A	13	NRW Specialist		0.5					0.5					0.5
A	14	Finance Specialist		0.5					0.5					0.5
A	15	Procurement (Private Consignment)		0.5					0.5					0.5
B	1	Deputy Projectt Manager	1	1	1	1	1	1	1	1	1	1	1	1
B	2	Civil Engineer	1	1	1	1	1	1	1	1	1	1	1	1
B	3	Pipeline Engineer	1	1	1	1	1	1	1	1	1	1	1	1
B	4	Mechanical Engineer	1	1	1	1	1	1	1	1	1	1	1	1
B	5	Electrical Engineer	1	1	1	1	1	1	1	1	1	1	1	1
B	6	Archtect												
B	6	Cost Estimator 1 / Construction Planner												
B	7	Environmental Specialist		1					1				1	1
B	8	Topo and Geo Survey												
C	1	Office Manager	1	1	1	1	1	1	1	1	1	1	1	1
C	2	Secretary	1	1	1	1	1	1	1	1	1	1	1	1
C	3	Accountant	1	1	1	1	1	1	1	1	1	1	1	1
C	4	CAD Operator												
C	5	Intake Inspector	2	2	2	1	2	2	2	2	2	2	2	2
C	6	WTP Inspector	2	2	2	1	2	2	2	2	2	2	2	2
C	7	Mechanical Inspector	2	2	2	1	2	2	2	2	2	2	2	2
C	8	Electrical Inspector	2	2	2	1	2	2	2	2	2	2	2	2
C	9	Pipeline Inspector	4	4	4	1	4	4	4	4	4	4	4	4
C	10	Translator / Interpreter	1	1	1	1	1	1	1	1	1	1	1	1
C	11	Driver	4	4	4	4	4	4	4	4	4	4	4	4

		Position	2021											
			1	2	3	4	5	6	7	8	9	10	11	12
A	1	Project Manager			1			1			1			1
A	2	Civil Engineer												
A	3	Pipeline Engineer												
A	4	Mechanical Engineer						1.0						1.0
A	5	Electrical Engineer						1						
A	6	Architect												
A	7	Cost Estimator / Construction Planner												
A	8	Contract Specialist												
A	9	Spec Writer												
A	10	Environmental Specialist												
A	11	Topo and Geo Survey												
A	12	Operation and Maintenance												
A	13	NRW Specialist												
A	14	Finance Specialist												
A	15	Procurement (Private Consignment)												
B	1	Deputy Projectt Manager			1			1.0			1			1.0
B	2	Civil Engineer												
B	3	Pipeline Engineer												
B	4	Mechanical Engineer			1			1			1			1
B	5	Electrical Engineer			1			1			1			1
B	6	Archtect												
B	6	Cost Estimator 1 / Construction Planner												
B	7	Environmental Specialist												
B	8	Topo and Geo Survey												
C	1	Office Manager	1	1	1	1	1	1	1	1	1	1	1	1
C	2	Secretary												
C	3	Accountant												
C	4	CAD Operator												
C	5	Intake Inspector												
C	6	WTP Inspector												
C	7	Mechanical Inspector												
C	8	Electrical Inspector												
C	9	Pipeline Inspector												
C	10	Translator / Interpreter												
C	11	Driver												

A.10 TOR of Consulting Services

- Draft -
Terms of Reference (ToR)

Terms of Reference for Consulting Services on Detailed Design, Tender Assistance, Construction Supervision and Technical Transfer of Vientiane Water Supply Expansion Project

Chapter 1. Background

1.1 Background

In Vientiane, the Capital city of the Lao People's Democratic Republic, the population and industry of the urban area are steadily growing in line with economic growth. However, the development of social infrastructure is not catching up with those growths, particularly, improvement and expansion of water utilities are the urgent tasks for the development. The population of Vientiane in 2013 was approximately 854,000 and is expected to reach one million in 2020. Although the population has been increasing steadily, the living environment for residents in Vientiane is still not satisfactory due to insufficient infrastructures including water supply facilities.

There are 4 main water treatment plants (i.e. Chinaimo, Kaolieo, Dongmakhay, and Dongban Water Treatment Plants) are in operation in Vientiane, with a total production capacity of 180,000m3/day. However, recent data records indicate that those plants have been producing more than 199,000 m^3/day (total daily average) of water in 2013. It implies some of them are forced to over loaded operation to cope with the large demand of water, recently. Also, the latest water demand projection predicts that the need of water production would be over 310,000 m^3/day in 2020 and 400,000 m^3/day in 2030 to cope with the rapid population and industry growths. Under such circumstances, it is indispensable to increase the water supply amount urgently to meet the growing water demand and for better living condition in Vientiane.

For this, it was decided that the Lao People's Democratic Republic (hereafter referred to as the Lao PDR) receives a loan from the Japan International Cooperation Agency (hereinafter referred to as "JICA") to finance and carry out the Vientiane Water Supply Expansion Project.

1.2 Components of the Project

The existing capacity of Chinaimo WTP is 80,000 m^3/day. Chinaimo WTP would ultimately be expanded to 160,000 m^3/day. The expansion would be carried out in a stepwise way, that is phase 1 with expansion of 40,000 m^3/day and Phase 2 with another 40,000 m^3/day expansion. Facilities, which can be expanded in a stepwise way such as water treatment facility, pumps, power sub-station, and electrical power supply system, would be expanded in Phase 1 and Phase 2 respectively. Facilities such as intake civil structure and pipeline would be expanded to the capacity of 160,000

m^3/day in Phase 1 since such facilities would not be able to be expanded in stepwise way realistically. Existing pumps and the related facilities are required to be rehabilitated since the existing those are very old. Therefore pumps, power sub-station, electrical power supply system and the related facilities of capacity 120,000 m^3/day would be constructed in Phase 1.

Considering the stepwise expansion, the Phase 1 Project consists of the following components:

1) Chinaimo raw water intake facilities
   - Construction of new Chinaimo raw water intake civil structure (160,000 m^3/day)
   - Construction of intake pump station and related facilities including power sub-station and electrical power supply system (120,000 m^3/day)
   - Construction of raw water transmission pipeline (160,000 m^3/day)
   - Construction of administration building
2) Construction/Expansion of Chinaimo WTP facilities with 40,000 m^3/d production capacity,
   - Expansion of water treatment facility (expansion of 40,000 m^3/day)
   - Construction of clear water reservoir (9,800m^3) and chemical feeding building
   - Construction of chemical feeding facilities (120,000 m^3/day)
   - Construction of monitoring system
   - Rehabilitation of existing rapid sand filter (80,000 m^3/day) (exchange of filter underdrain from existing porous concrete slabs to nozzle type under drain system)
3) Construction of Salakham Distribution Center (reservoirs and pumping station)
   - Construction of reservoirs (semi-basement type with 5,100 m^3 and elevated tank with 2,000m^3)
   - Construction of high lift pump which pumps up water from reservoir of semi-basement type to elevated tanks and related facilities including power sub-station and electrical power supply system (36,818 m^3/day)
4) Expansion of the water transmission and distribution pumping facilities, and
   - Construction of transmission and distribution pumps and related facilities including power sub-station and electrical power supply system (120,000 m^3/day)
5) Augmentation and replacement of the existing transmission and distribution pipes.
   - Construction of transmission pipeline
   - Construction of distribution pipeline

1.3 Procurement Package and Procedure

(1) Procurement Package

The construction works for the Phase 1 Project will be divided into two (2) contract packages as follows:

Package	Scope	Component	ICB/ LCB
Package 1	- Intake (G) - Raw water pipeline (G) - Chinaimo WTP (G) - Chinaimo WTP (E) - Laboratory equipment - Salakham Reservoir (G) - Transmission Pipeline (G) - Distribution Pipeline (G)	<u>Procurement and construction of following facilities</u> - Intake Civil (160,000 m^3/day) - Intake pipe (by pipe jacking) - Raw water pipeline (by open cut) - Chinaimo WTP Civil and Building (40,000m^3/day) (by the method of non-suspension water) - Chinaimo WTP Mechanical and Electrical Equipment (excluding water supply pump equipment) - Rehabilitation of existing rapid sand filter (80,000 m^3/day) - Equipment for laboratory in Chinaimo WTP - Salakham Reservoirs Civil (5,100 m^3+2,000m^3) - Transmission pipeline (6,700m) - Distribution pipeline (42,689m)	ICB
Package 2	- Intake pump (E) - Transmission and distribution pump (E) - Salakham Center pump (E) - Monitoring System	<u>Procurement and installation of following facilities</u> - Intake pump and related facilities (120,000 m^3/day) including electrical facilities - Transmission and distribution pump and related facilities (Total of 120,000 m^3/day) including electrical facilities - Salakham high lift pump and related facilities (37,000 m^3/day) including electrical facilities - Monitoring system (at WTP)	ICB

(G) means “General” works including civil, pipeline and building works.
(E) means “Equipment” works including mechanical and electrical works (Procurement and Installation).

(2) Procurement Procedure

All Packages will be procured based on Two-Stage Bidding Procedure with Pre-qualification process in accordance with the JICA’s Procurement Guideline (2012). Life Cycle Cost (LCC) Bidding Method will be adopted for procurement of Package 2 in order to procure the pumps and related equipment by the lowest cost considering Equipment costs and O/M costs for the certain life cycle

periods of the equipment.

1.4 Funding source

The Government of Lao PDR received a Japanese ODA Loan to finance the Project and intends to use part of the proceeds of the Japanese ODA Loan for eligible payments for consulting services for which this TOR is issued.

1.5 Project Schedule

The Project is expected to initiate on July 2016 and be completed by the end of 2020 excluding defect liability period.

1.6 Location of the Project

Main area of the Project is at existing Chinaimo WTP and Salakham Elevated Tank and water supply areas distributed by the Chinaimo WTP, Salakham Elevated Tank, Phonethane Elevated Tank and Xamkhe Elevated Tank.

1.7 Executing Agency

The Executing Agency is expected to be the Department of Public Works and Transportation of Vientiane Capital (DPWT-VC).

1.8 Technical Information

The final report of the "*Preparatory Survey Report on Vientiane Capital Water Supply Expansion Project in The Lao People's Democratic Republic, 2015*" as well as the results of topographic and geological surveys at the facility sites conducted for the Project are available at Executing Agency.

Chapter 2. Objectives of Consulting Services

The consulting services shall be provided by international consulting firms (hereinafter referred to as "the Consultant") in association with national consultants in compliance with Guidelines for the Employment of Consultants under Japanese ODA Loans, April 2012. The objective of the consulting services is to achieve the efficient and proper preparation and implementation of the Project through the following works:

(1) Detailed Design
(2) Tender Assistance
(3) Construction Supervision
(4) Safety Measures
(5) Facilitation of Implementation of Environmental and Social Management and Monitoring Plan (ESMMP)
(6) Technical Transfer

Chapter 3. Scope of Consulting Services

(1) Detailed Design

The Consultant shall:

(a) review and verify all available primary and secondary data and information;

(b) carry out necessary engineering surveys and investigations such as topographical survey, hydrological survey, geotechnical survey, test pit survey, material availability survey, hydraulic analysis and other related engineering works required for preparation of basic and detail designs, as applicable to the project components;

(c) prepare works plan, progress reports and implementation schedule for the Project to ensure effective monitoring and timely project outputs, and regularly update the same;

(d) prepare the detail design of all the project components to ensure clarity and understanding by Executing Agency, contractors and other relevant stakeholders; All the designs must be in conformity with the Lao P.D.R. Standards (if available) or with the appropriate international standards. The detail design shall, as a minimum, include (i) drawings and design reports for all facilities (ii) detail cost estimates, and (iii) necessary calculations to determine and justify the engineering details for the Project. The detail design shall be prepared in close consultation with, and to meet the requirements of Executing Agency, and shall be incorporated into the detail design report to be submitted for approval of Executing Agency; and

(e) prepare Specifications, Bill of Quantities (BOQ) and Tender Drawings to be incorporated into Tender Documents. Such Specifications shall contain those in relation to i) quality control of plant, materials and workmanship, ii) safety and iii) protection of the environment, etc.

(2) Tender Assistance

- Assistance in Pre-Qualification (PQ)

The Consultant shall:

(a) define technical and financial requirements, capacity and/or experience for PQ criteria taking into consideration technical feature of the Project;

(b) prepare PQ documents in accordance with the latest version of Standard Prequalification Documents under Japanese ODA Loans;

(c) assist Executing Agency in PQ announcement, addendum/corrigendum, and clarifications to the applicants' queries;

(d) evaluate PQ applications in accordance with the criteria set forth in PQ documents; and

(e) prepare a PQ evaluation report for approval of the PQ evaluation committee and JICA.

- Assistance in the Bidding Procedures

The Consultant shall:

(a) prepare bidding documents in accordance with the latest version of Standard Bidding Documents under Japanese ODA Loans for Procurement of Works together with all relevant specifications, drawings and other documents;

(b) prepare bidding documents which includes i) clauses stating that the Contractor is to comply with the requirement of the Environmental and Social Management and Monitoring Plan (ESMMP) and JICA Guidelines for environmental and social considerations (April 2010) (JICA Environmental Guidelines), ii) the specification clearly stipulating the safety requirements in accordance with the laws and regulations in the country of the Borrower, relevant international standards (including guidelines of international organization), if any, and also in consideration of "the Guidance for the Management of Safety for Construction Works in Japanese ODA Projects of JICA," iii) the requirement to furnish a safety plan to meet the safety requirements, iv) the requirement for the personnel for key positions to include an accident prevention officer, and v) the requirement to submit method statements of safety to (Executing Agency) and the consultant at the construction stage.

*(*In case that borrower agrees to apply "The Guidance for the Management of Safety for Construction Works in Japanese ODA Projects", the underlined sentences will be remained. Otherwise the underlined sentences will be deleted)*

(c) prepare bidding documents for LCC bidding. The bidding documents include reasonable criteria which can evaluate all bidders equally and reasonably to procure the most suitable mechanical and electrical facilities for this Project. The bidding documents also include the penalty which would be applied to bidders in case that the bidder cannot meet the proposed contents by own for LCC bidding.

(d) assist Executing Agency in issuing bid invitation, conducting pre-bid conferences, issuing addendum/corrigendum, and clarifications to bidders' queries.

(e) evaluate bids in accordance with the criteria set forth in the bidding documents. In such evaluation, the Consultant shall carefully confirm that bidders' submissions in their technical proposal including, but not limited to; site organization, mobilization schedule, method statement, construction schedule, safety plan, and EMP, have been prepared in consistent with each other and meet requirements set forth in applicable laws and regulations, specifications and other parts of the bidding documents;

(f) evaluate bids for LCC bidding in accordance with the criteria set forth in the LCC bidding documents. The Consultant coordinates all the procedures for LCC bid evaluation as necessary.

(f) prepare a bid evaluation report for approval of the bid evaluation committee and JICA;

(g) assist Executing Agency in contract negotiation by preparing agenda and facilitating negotiations including preparation of minutes of negotiation meeting; and
(h) prepare a draft and final contract agreement.

(3) Construction Supervision

The Consultant shall perform his duties during the construction period in accordance with the contracts to be executed between Executing Agency and the contractors. FIDICMDB Harmonized Edition (2010) complemented with the Specific Provisions as included in the Standard Bidding Documents under Japanese ODA Loans for Procurement of Works will be applied to the civil works of the Project. In this context, the Consultant shall:

(a) act as the Engineer to execute construction supervision and contract administration services in accordance with the power and authority delegated by Executing Agency ;
(b) provide assistance to the Employer concerning variations and claims which are to be ordered/issued at the initiative of Executing Agency;
(c) issue the commencement order to the contractors;
(d) provide recommendation to Executing Agency for acceptance of the Contractor Performance security, advance payment security and required insurances;
(e) review and approve the proposals submitted by the contractors which include work program, method statements, material sources, manpower and equipment deployment. In light of Section 3.03 of Guidelines for the Employment of Consultants under Japanese ODA Loans (April 2012), the Consultant shall pay attention, in particular, to whether such proposals will meet the safety requirements set forth in the applicable laws and regulations, the specifications or other parts of the contract;
(f) explain and/or adjust ambiguities and/or discrepancies in the Contract Documents and issue any necessary clarifications or instructions;
(g) review, verify and further detail the design of the works, approve the contractors' working drawings and, if necessary, issue further drawings and/or give instructions to the Contractor;
(h) liaise with the appropriate authorities to ensure that all the affected utility services are promptly relocated.
(i) carry out field inspections on the contractor's setting out to ensure that the works are carried out in accordance with drawings and other design details.
(j) regularly monitor physical and financial progress against the milestones as per the contract so as to ensure completion of contract in time;
(k) supervise the works so that all the contractual requirements will be met by the contractors,

including those in relation to i) quality of the works, ii) safety and iii) protection of the environment. In light of Section 3.03 of Guidelines for the Employment of Consultants under Japanese ODA Loans (April 2012), the Consultant shall confirm that an accident prevention officer proposed by contractor is duly assigned at the project site and that construction works are carried out according to the requirements set forth in the applicable laws and regulations, the specifications or other parts of the contract ;

(l) supervise field tests, sampling and laboratory test to be carried out by the contractors;

(m) inspect the construction method, equipment to be used, workmanship at the site, and attend shop inspection and manufacturing tests in accordance with the specifications;

(n) survey and measure the work output performed by the contractors and issue payment certificates such as interim payment certificates and final payment certificate as specified in the contract;

(o) coordinate the works among different contractors employed for the Project;

(p) modify the designs, technical specifications and drawings, relevant calculations and cost estimates as may be necessary in accordance with the actual site conditions, and issue variation orders (including necessary actions in relation to the works performed by other contractors working for other projects, if any);

(q) carry out timely reporting to Executing Agency for any inconsistency in executing the works and suggesting appropriate corrective measures to be applied;

(r) inspect, verify and determine claims issued by Executing Agency in accordance with the civil works contract;

(s) perform the inspection of the works and to issue certificates such as the Taking-Over Certificate, Performance Certificate as specified in the civil works contract,;

(t) supervise testing and commissioning;

(u) provide periodic and/or continuous inspection services during defects liability period (Defect Notification Period defined in FIDIC Conditions of Contract) and if any defects are noted, instruct the contractor to rectify;

(v) check and certify as-built drawings submitted by the contractors; and prepare and submit reports to Executing Agency, which are detailed in Chapter 6 in relation to the implementation of the Project.

(Note)

The Consultant's supervision duties as set out above shall include those on the procurement of equipment to be used for the project.

(4) Safety Measures

The Consultant shall:

(a) when preparing or reviewing bidding documents for procurement of work and those for

procurement of supply and installation of plant, make sure to meet the requirements for safety measures.

(b) review the safety plans submitted by the bidders from the point of view of securing the safety during the construction. (Refer to Paragraph (2), Section 4.02 Scope of the Project and of the Consulting Services of the Guidelines for the Employment of Consultants under Japanese ODA Loans, April 2012).

(c) review the Program (the program stipulated in the relevant clause of the Standard Bidding Documents under Japanese ODA Loans (Procurement of Works) 2012) submitted by the contractors from the point of view of securing the safety during the construction and require them to submit further details, if necessary.

(d) during the supervision of the construction work, confirm that an accident prevention officer proposed by the contractor is duly assigned at the project site and that the construction work is carried out according to the safety plan as well as the safety measures prescribed in the Program. If consultants recognize any questions regarding the safety measures in general including the ones mentioned above, the consultants shall require the contractors to make appropriate improvements.

(5) Facilitation of Implementation of Environmental and Social Management and Monitoring Plan (ESMMP)

The Consultant shall:

(a) update ESMMP as appropriate; incorporate necessary technical specifications with design and contract documentation;

(b) assist Executing Agency in dissemination and explanation of additionally confirmed and identified environmental issues to public including holding public consultations if necessary;

(c) during the preparation of bidding documents, clearly identify environmental responsibilities as explained in the ESMMP;

(d) assist Executing Agency to review the Contractor's Environmental and Social Management and Monitoring Plan (the Contractor's ESMMP) prepared by the selected Contractor in accordance with ESMMP, relevant plans and JICA Environmental Guidelines

(e) assist Executing Agency to implement the measures identified in the ESMMP

(f) assist Executing Agency to monitor the Contractor's mitigation activities addressed in the Contractor's ESMMP

(g) review of ESMMP it if required so.

(h) monitor the effectiveness of ESMMP and negative impacts on environment caused by the construction works and provide technical advice, including a feasible solution, so that

Executing Agency can improve situation when necessary;

(i) assist Executing Agency in monitoring the compliance with the requirements under ESMMP and EMoP and JICA Environmental Guidelines;

(j) assist Executing Agency in preparation of the answer to the request from JICA's advisory committee for environmental and social considerations if necessary

(k) assist Executing Agency in the capacity building of Executing Agency staff on environmental management through on-the-job training on environmental assessment techniques, mitigation measure planning, supervision and monitoring, and reporting.

(l) at the completion of construction works, (a) undertake final environmental monitoring and evaluation against the set indicators and (b) prepare an evaluation report.

(6) Technical Transfer

The Consultant shall carry out the technology transfer as an important aspect in design, supervision works. The Consultant shall provide the opportunity to the Executing Agency officers and staffs to be involved in the working team of the Consultant during the design, contract administration and supervision works for their capacity building wherever possible. If requested by Executing Agency, the Consultant shall brief and demonstrate the survey and design procedure, the construction supervision and contract management process and procedures. The consultant shall assist Executing Agency and its staff to build their capacity as a part of on the job training under the Project.

The consultant shall also provide the assistance for overseas training to NPNL for their efficient and effective operation and maintenance of the Water Supply System in coordination with the Capacity Development Project for Improvement of Management Ability of Water Supply Authority (August 2012-August 2017).

(7) Defect liability period

When defect would be found during defect liability period, the Consultant shall survey and decide whether they are defects in the works (i.e. works that are not in accordance with the contract), or whether they are issues caused by maintenance. If the Consultant considers that they are defects, the Consultant issue instructions to the contractor to make good the defects within a reasonable time. The Consultant issue certificate to the contractor after confirmation of rectification.

Chapter 4. Expected Time Schedule

The total duration of consulting services will be 66 months including 12 months of defects liability period. The implementation schedule expected is as shown in Table 4.1.

Table 4.1 : Implementation Schedule Expected

Key Activities	Date	Duration in Months
Commencement of Consulting Services	1 July 2016	12
Completion of detail design, preparation of drawings and tender documents	30 June 2017	
Tender process including prequalification	Package 1 From 1 April 2017 to 30 June 2018 Package 2 From 1 April 2017 to 31 October 2018	15 (Package 1) 19 (Package 2)
Commencement of Construction works	Package 1 1 July 2018 Package 2 1 November 2018	30 (Package 1) 24 (Package 2)
End of Construction works	Package 1 31 December 2020 Package 2 31 October 2020	
Defect Liability Period	1 January 2021 to 31December 2021	12
Termination of Consulting Services	31 December 2021	-

Chapter5. Staffing (Expertise required)

15 of Professional (A) consultants, International Specialist, and 8 of Professional (B) consultants, Local Specialist, are expected to be assigned, over 54 month' duration of consulting services, for a total of 181 man-months for Professional (A) and 223 man-months for Professional (B) consultants. Total consulting input is minimum 404 man-months. A detailed schedule of consulting services and a distribution of man-months is shown in **Attachment 1**.

(1) Qualification of key Team Members

The qualification of key Team Members is shown in Table 5.1.

Table 5.1 : Qualification of key Team Members

Designation	Qualification
Professional (A) International Specialist	
Team Leader	Qualification • Licensed or Registered Civil Engineer or related field • Graduate (B.Sc.) in Civil Engineering or related field Experience • Should have at least 15 years' experience in urban water supply and water related projects. • Should have at least five international urban water supply project including planning, process design, detail design, construction supervision, monitoring and/or commissioning. • Should have at least three Japanese ODA projects including detail design and/or construction supervision in water supply and water related projects. • Should have at least 2 water supply projects in Laos
Civil Engineer	Qualification • Licensed or Registered Civil Engineer or related field • Graduate (B.Sc.) in Civil Engineering or related field Experience • Should have at least 10 years' experience in urban water supply and water related projects. • Should have at least three international urban water supply projects including process design, detailed design, construction supervision, monitoring and/or Commissioning. • Should have at least three Japanese ODA projects including detail design and/or construction supervision in water supply and water related projects. • Should have at least 2 water supply projects in Laos
Pipeline Engineer	Qualification • Licensed or Registered Civil Engineer or related field • Graduate (B.Sc.) in Civil Engineering or related field

Designation	Qualification
	Experience • Should have at least 7 years' experience urban water supply and water related projects including detailed design , water conveyance system and distribution network analysis. • Should have at least two international urban water supply and water related projects. • Should have at least three Japanese ODA projects. • Should have at least one project in Laos
Mechanical Engineer	Qualification • Licensed or Registered Mechanical Engineer • Graduate (B.Sc.) in Mechanical Engineering and/or related field Experience • Should have at least 15 years' experience in plan/design engineering of mechanical works and piping in water/waste water treatment plant and pump system and water hammer analysis • Should have at least one urban water supply project • Should have at least three Japanese ODA projects including detail design and/or construction supervision in water supply and/or water related projects.
Electrical Engineer	Qualification • Licensed or Registered Electrical Engineer • Graduate (B.Sc.) in Electrical Engineering and/or related field Experience • Should have at least 15 years' experience in plan/design engineering of electrical works in water/wastewater treatment plant and water related projects • Should have at least one urban water supply project with instrumentation of SCADA system • Should have at least three Japanese ODA projects including detail design and/or construction supervision in water supply and/or water related projects.
Professional (B) Local Specialist	
Deputy Team Leader	Qualification • Licensed or Registered Civil Engineer or related field • Graduate (B.Sc.) in Civil Engineering or related field Experience • More than 15 years in water supply projects in similar area

Non-key Team Members are followings, and similar qualifications of above are required for non-key Team Members.

- Architect (A)
- Cost Estimator /Construction Planner (A & B)
- Document/Contract Specialist (A)

・Spec Writer (A)
・Environmental Specialist (A & B)
・Topographical and Geotechnical Survey Specialist (A & B)
・Operation and Maintenance Specialist (A)
・NRW Specialist (A)
・Finance Specialist (A)
・Procurement Specialist (Private Consignment) (A)
・Civil Engineer (B)
・Water Supply Engineer (B)
・Mechanical Engineer (B)
・Electrical Engineer (B)

Consultant may propose other experts and supporting staffs required to accomplish the tasks outlined in the ToR. It is the Consultant's responsibility to select the optimum team and to propose the professionals which he believes best meets the needs of Executing Agency.

(2) Scope of works for the respective personnel

Detailed information on the major tasks and duties of each member in the phase of pre-construction and construction is shown in **Attachment 2**.

Chapter6. Reporting

Within the scope of consulting services, the Consultant shall prepare and submit reports and documents to Executing Agency as shown in Table 6.1. The Consultant shall provide electronic copy of each of these reports. The contents to be included in each report are shown attachment 3 as a sample.

Table 6.1 : Report Submission

Category	**Type of** Report	Timing	**No.** of **Copies**
Consultancy Services	Inception Report	Within 1 month after commencement of the services	10
	Monthly Progress Report	Every month	10
	Quarterly Progress Report	Every quarter	10
	Project Completion Report (for submission to JICA)	At the end of Services	10
Detail Design	Project Description Report	Within 2 months after Commencement of the Services	10
	Draft Design Report	Within 10 months after Commencement of the Services	10
	Cost Estimate Report	As per the Project Program for each Packages	10
	Final Design Report	As per the Project Program for each Packages	10
Tender Assistance	Pre-Qualification Document	As per the Project Program for each Packages	10
	Bidding Document	As per the Project Program for each Packages	10
	Pre-Qualification Evaluation Report	At appropriate timing	10
	Bid Evaluation Report	At appropriate timing	10
Construction Supervision	Quarterly Progress Report	Every month	10
	Quality Control Report	Every month	10
	O & M Manuals	At appropriate timing in accordance with the Inception Report	10
	Completion Report	At the end of the Construction Supervision	10
Environment and Social Safeguard	Environmental Monitoring Report	Every quarter	10
Other Report	Technical Report	As required or upon request	As required

Chapter7. Obligations of the Executing Agency

A certain range of arrangements and services will be provided by Executing Agency to the Consultant for smooth implementation of the Consulting Services. In this context, Executing Agency will:

(1) Reports and data

Make available to the Consultant existing reports and data related to the Project as required.

(2) Office space

Provide an office space in Vientiane Capital with necessary equipment, furniture and utility. However, the Consultant's requirement for office space, including necessary equipment, furniture and utilities, should be clearly stated in the proposal with its rental cost for the case where Executing Agency would be unable to provide such facilities;

(3) Cooperation and counterpart staff

Appoint counterpart officials, agent and representative as may be necessary for effective implementation of the Consulting Services;

(4) Assistance and exemption

Use its best efforts to ensure that the assistance and exemption, as described in the Standard Request for Proposal issued by JICA, will be provided to the Consultant, in relation to:

- work permit and such other documents;
- entry and exit visas, residence permits, exchange permits and such other documents;
- clearance through customs;
- instructions and information to officials, agent and representatives of the GOL;
- exemption from any requirement for registration to practice their profession;
- privilege pursuant to the applicable law in Lao P.D.R.
- tax issues

Attachment 1 :Sample of Manning Schedule for the Consulting Services

To be proposed by the Proposer

Attachment 2: Sample of Major Tasks and Duties

No	Position	I or L	Major Tasks and Duties
A-1	Team Leader	I (Pro-A)	Pre-Construction Stage: • General coordination • Supervises the Consultant's services • Assumes direct responsibility for day-to-day consulting services • Represents the Consultant's Team in all matters relating to the performance of services Construction Stage: • Assist Executing Agency in contract administration • General coordination • Supervises the Consultant's services • Assumes direct responsibility for day-to-day consulting services • Represents the Consultant's Team in all matters relating to the performance of services
A-2	Civil Engineer	I (Pro-A)	Pre-Construction Stage • Review structural design • Prepare the basic design and detail design of intake facilities, expansion of WTP, reservoirs and elevated tank • Direct the local engineers in charge of the detail design of intake facilities, expansion of WTP, reservoirs and elevated tank • Prepare technical specifications • Prepare Bill of Quantities Construction Stage • Coordinate and supervise contractors' civil works for intake facilities, expansion of WTP, reservoirs and elevated tank • Review and approve shop drawings/ construction drawings for civil works submitted by the Contractor. • Review and approve test reports for materials submitted by the Contractors • Inspect the Contractors' works
A-3	Pipeline Engineer	I (Pro-A)	Pre-Construction Stage • Review hydraulic analysis • Review structural designs • Prepare the basic design and detailed design of transmission and distribution pipelines • Direct the local engineers attending the detailed designs of transmission and distribution pipelines • Prepare Technical Specifications • Prepare Bills of Quantities • Direct the local pipeline engineers Construction Stage • Coordinate and supervise the contractor's works • Review and approve shop drawings submitted by the contractors
A-4	Mechanical Engineer	I (Pro-A)	Pre-Construction Stage • Review existing designs • Prepare the basic design of mechanical equipment for the intake, water treatment plant and water transmission and distribution facilities • Direct the local mechanical engineers attending the detailed designs

No	Position	I or L	Major Tasks and Duties
			of mechanical works for the intake, water treatment plant and water transmission and distribution facilities • Prepare Specifications for mechanical works • Prepare Bill of Quantities for mechanical works <u>Construction Stage</u> • Check the shop drawings submitted by the contractors • Assess the substitution of products proposed by the contractors • Supervise the installation work of mechanical equipment • Attend the factory inspection together with Executing Agency engineer, if requested • Attend the trial operation of mechanical equipment

No	Position	I or L	Major Tasks and Duties
A-5	Electrical Engineer	I (Pro-A)	Pre-Construction Stage • Review existing designs • Prepare the basic design of electrical equipment for the intake, water treatment plant and transmission and distribution facilities • Direct the local electrical engineers attending the detailed designs of the intake, water treatment plant and transmission and distribution facilities • Prepare Specifications for electrical works • Prepare Bill of Quantities for electrical works Construction Stage • Check the shop drawings submitted by the contractors • Assess the substitution of products proposed by the contractors • Supervise the installation work of electrical equipment • Attend the factory inspection together with Executing Agency engineer, if requested • Attend the trial operation of mechanical equipment
A-6	Architect	I (Pro-A)	Pre-Construction Stage • Prepare architectural design of buildings • Prepare drawings for buildings • Prepare Specifications for building works • Prepare Bill of Quantities for building works
A-7	Cost Estimator /Construction Planner	I (Pro-A)	Pre-Construction Stage • Prepare the Engineer's Cost Estimates for the Project and each packages • Assist the Civil and Pipeline Engineer for each component in finalizing Bill of Quantities
A-8	Contract Specialist	I (Pro-A)	Pre-Construction Stage • Prepare Bidding Documents and Evaluation Criteria • Assist Executing Agency in conducting bidding process • Coordinate consultant's bid evaluation and prepare bid evaluation reports • Assist Team Leader in presentation to and discussion with Executing Agency as well as liaison with JICA on the bid evaluation
A-9	Spec Writer	I (Pro-A)	Pre-Construction Stage • Prepare Bidding Documents • Assist all Professional (A) Engineers to Prepare Bidding Documents
A-10	Environmental Specialist	I (Pro-A)	Pre-Construction Stage/ Construction Stage • Prepare environmental monitoring plan to be carried out by Executing Agency • Assist Executing Agency in initial set-up of environmental monitoring plan • Guide and assist Executing Agency's initial set-up of action plan • Assist Executing Agency in carrying out these actions. • Monitor the effect of these campaign programs and improve programs if necessary.
A-11	Topographical and Geotechnical Survey Specialist	I (Pro-A)	Pre-Construction Stage • Assist the Civil Engineer and Pipeline Engineer for site surveys and natural condition surveys • Supervise all the surveys to be outsourced to obtain necessary data for detail design

No	Position	I or L	Major Tasks and Duties
A-12	Operation and Maintenance Specialist	I (Pro-A)	Construction Stage • Review the progress of activities related to O&M based on long-term plan developed by NPNL. • Advise how to review the plan based on the progress
A-13	NRW Specialist	I (Pro-A)	Construction Stage • Review the progress of activities related to NRW reduction activities based on long-term plan developed by NPNL. • Advise how to review the plan based on the progress
A-14	Finance Specialist	I (Pro-A)	Construction Stage • Review the progress of activities related to finance based on long-term plan developed by NPNL. • Advise how to review the plan based on the progress
A-15	Procurement Specialist (Private Consignment)	I (Pro-A)	Construction Stage • Advise for introduction of outsourcing based on water works practices in other countries • Provide necessary advices on the contracts/agreements with a private company for outsourcing
B-1	Deputy Team Leader	L (Pro-B)	Pre-Construction Stage/ Construction Stage • Assist Team Leader in carrying out all tasks and duties of Team Leader • Represent the Consultant's team during absence of the Team Leader • Perform specific issues/aspects delegated by Team Leader • Manage local experts and coordinate among foreign and local experts in addition to client and related Governmental Agencies.
B-2	Civil Engineer	L (Pro-B)	Pre-Construction Stage • Assist Professional (A) Civil Engineer in carrying out site survey/investigation and collecting local data and information related to civil works for Intake Facility, Expansion of WTP and Reservoir/Elevated Tank • Assist Professional (A) Civil Engineer in carrying out detailed design of civil structure and buildings • Prepare drawings for these facilities • Assist Professional (A) Civil Engineer in carrying out Preparation of Bill of Quantities Construction Stage • Assist Professional (A) Civil Engineer in carrying out day-to-day supervision of the contractors' works for Intake Facility, Expansion of WTP and Reservoir/Elevated Tank construction
B-3	Pipeline Engineer	L (Pro-B)	Pre-Construction Stage • Assist Professional (A) Pipeline Engineer in carrying out the pipeline route survey/investigation and collecting local data and information related to Conveyance and Transmission and Distribution Pipelines • Assist Professional (A) Pipeline Engineer in carrying out detailed design of Transmission and Distribution Pipelines • Prepare drawings for these pipelines • Assist Professional (A) Pipeline Engineer in carrying out Preparation of Bill of Quantities Construction Stage • Assist Professional (A) Pipeline Engineer in carrying out day-to-day supervision of the contractors' works for Pipelines
B-4	Mechanical Engineer	L (Pro-B)	Pre-Construction Stage • Assist Professional (A) Mechanical Engineer in detailed design of mechanical works

No	Position	I or L	Major Tasks and Duties
			Construction Stage • Assist Professional (A) Mechanical Engineer in carrying out day-to-day supervision of the contractors' mechanical works
B-5	Electrical Engineer	L (Pro-B)	Pre-Construction Stage • Assist Professional (A) Electrical Engineer in detailed design of electrical works Construction Stage • Assist Professional (A) Electrical Engineer in carrying out day-to-day supervision of the contractors' electrical works
B-6	Cost Estimator /Construction Planner	L (Pro-B)	Pre-Construction Stage • Assist Professional (A) Engineers in collecting local cost data and information, and estimating local components of works
B-7	Environmental Specialist	L (Pro-B)	Pre-Construction Stage/ Construction Stage • Assist duties and works to be carried out by Professional (A) Environment Specialist
B-8	Topographical and Geotechnical Survey Specialist	L (Pro-B)	Pre-Construction Stage • Assist duties and works to be carried out by Professional (A) Topographical and Geotechnical Survey Specialist

Attachment 3: Sample of Contents to be included in each reports

(1) For Consultancy Services

- **Inception Report**: presents the methodologies, schedule, organization, etc.
- **Monthly Progress Report**: describes briefly and concisely all activities and progress for the previous month by the 10th day of each month. Problems encountered or anticipated will be clearly stated, together with actions to be taken or recommendations on remedial measures for correction. Also indicates the work to be performed during the coming month.
- **Quarterly Progress Report**: presents the progress status of the Project.
- **Project Completion Report**: presents all the activities of the Project

(2) For Detail Design

- **Project Description Report**: presents the design criteria and standards and also the basic design with approximate project costs for the Client consideration and decision.
- **Draft Design Report**: presents detailed engineering design.
- **Cost Estimate Report**: presents detailed cost estimate.
- **Final Design Report**: presents final documents of detailed design and cost estimate and bid plan through the incorporation of comments on the Draft Design Report provided by the Consultant.

(3) For Tender Assistance

- **Pre-Qualification Document**: presents the pre-qualification documents and its evaluation criteria.
- **Bidding Document**: presents the bidding documents and bid evaluation criteria.
- **Pre-Qualification Evaluation Report**: presents the results of the evaluation with recommendation on the selection of the qualified applicants.
- **Bid Evaluation Report**: presents the results of technical evaluation with recommendation on technically responsive bidders then also the results of the tenders with recommendation on the successful bidder for award of contract.

(4) For Construction Supervision

- **Quarterly Progress Report**: presents the progress status of the Project. It shall be submitted at every 3 months.
- **O & M Manuals**: contains technical procedures for the appropriate operation and maintenance of all project facilities.
- **Completion Report**: comprises outline of all facilities completed and construction records from the commencement through completion, together with key data and records.

(5) For Environment and Social Safeguard

- **Environmental Monitoring Report**: presents the environmental impacts and implementation of environmental mitigation measures during and after the construction

stage. Environmental monitoring forms shall be filled and attached to the Report.

A.11 Schedule for Selection of Consultants

Schedule for selection of consultants is shown below.

■ Selection of consultants : 12.0 Months

Breakdown of above 12.0 months is shown below.

- Preparation of Request for Proposal (RFP) & Short-list and Approval by authority concerned :2.0Months
- JICA Concurrence for RFP & Short-list* : 0.5Months
- Issuance of RFP to Short-listed Consultants : 0.5Months
- Proposal Submission by Consultants : 1.5Months
- Evaluation of Technical Proposal, Approval by authority concerned : 2.5Months
- JICA Concurrence for Evaluation of Technical Proposal : 0.5Months
- Opening Financial Proposals, Evaluation, Approval by authority concerned : 1.0Month
- JICA Concurrence for Evaluation of Proposals : 0.5Months
- Contract Negotiation, Approval by authority concerned : 2.0Months
- Signing of Contract : 0.5Months
- JICA Concurrence for Signed Contract : 0.5Months

Table A.11.1 Schedule for Selection of Consultants

No	Item	Months												Total
		1	2	3	4	5	6	7	8	9	10	11	12	
1	Preparation of Request for Proposal (RFP) & Short-list and Approval by authority concerned	■	■	■										2.0
2	JICA Concurrence for RFP & Short-list			■										0.5
3	Issuance of RFP to Short-listed Consultants			■										0.5
4	Proposal Submission by Consultants				■	■								1.5
5	Evaluation of Techinical Proposal, Approval by authority concerned					■	■	■	■					2.5
6	JICA Concurrence for Evaluation of Technical Proposal								■					0.5
7	Opening Financial Proposals, Evaluation, Approval by authority concerned								■	■				1.0
8	JICA Concurrence for Evaluation of Proposals									■				0.5
9	Contract Negotiation, Approval by authority concerned										■	■		2.0
10	Signing of Contract												■	0.5
11	JICA Concurrence for Signed Contract												■	0.5

* Short-list will be prepared in accordance with Article 15 (3) “Short list” of PART III: Consultants’ or Experts’ Service in Implementing Rules and Regulation on Decree of Government Procurement of Good, Works, Maintenance and Services (2004), prepared by Procurement Monitoring Office (PrMO) of Ministry of Finance. The following sentences are abstracted from the related Articles.

Implementing Rules and Regulation of Good, Works, Maintenance and Services No. 063/MOF, Dated 12 March 2004

Article 15: Use of Consultants or Experts

(3) Short list: The short list of up to six (6) firms and not less than three (3) is compiled from different sources of information but must include a review of the responses to a notification published in a Lao language newspaper and an English newspaper, domestic and international consultants registered to do business in Lao PDR; consultants identified by associations of consulting firms or by international organizations and financial institutions. In selecting consulting firms and experts for the short list, the procuring entity or project owner will have regard to the objective section criteria enumerated in Article 17.

Article 17: Selection of Criteria

Eligible Bidders:

1. Individuals, firms and enterprises established in Lao PDR which are in conformity with the provisions of the law and have fulfilled their obligations with regard to the payment of duties and taxes. State Operating Enterprise will be permitted to bid if it is legally and financially autonomous and operates under commercial law is not a dependent agency of the project entity.
2. International enterprises not registered in Lao PDR can bid if they are established in conformity with the law in their country of origin and have fulfilled its obligation with regard to the payment of duties and taxes. If they are awarded a contract, they will be required to implement the contract in accordance with the Rule of Tax Registration and Management of Tax Payers of the Ministry of Finance No. 2349/MOF, dated 30 December 2003.
3. In the case of a Joint Venture (JV):
   (a) All parties to the JV shall be jointly and severally liable; and
   (b) A JV shall nominate a representative who shall have the authority to conduct all businesses for and on behalf of any and all parties of JV during the bidding process and, in the event the JV is awarded the contract, during the contract execution.

A.12 Considerations for Procurement Method

(1) Procurement Situation in Lao P.D.R.

The following materials and construction methods need to be imported for the project. Other materials such as cement, stone, brick, sand, timber, plywood, concrete block, fence, gabion mesh, wire nail, gasoline, diesel, lubricant, scaffolding and various small items are available in Lao PDR.

- Imported Materials
  - Mechanical equipment (various pumps, motor, flow meter, various valves and flexible joint .etc)
  - Electrical equipment
  - Pipe materials (Ductile Iron Pipe)
  - Steel (for temporary works)

- Imported Construction Method
  - Pipe jacking method (for construction of intake pipe)
  - Method of non-suspension water (for the expansion of WTP during operating existing WTP)

(2) Contract Package

Contract package is shown in Table A.12.1.

Table A.12.1 Contract Packages for the Phase 1 Project

Package	Scope	Component	ICB/LCB
Package 1	- Intake (G) - Raw water pipeline (G) - Chinaimo WTP (G) - Chinaimo WTP (E) - Laboratory equipment - Salakham Reservoir (G) - Transmission Pipeline (G) - Distribution Pipeline (G)	Procurement and construction of following facilities - Intake Civil (160,000m^3/day) - Pipe jacking at intake pipe - Raw water pipeline (225m) - Chinaimo WTP Civil and Building (40,000m^3/day) - Method of non-suspension water - Chinaimo WTP Mechanical and Electrical Equipment such as Chemical feed system (excluding pump equipment) - Equipment for laboratory in Chinaimo WTP - Salakham Reservoir Civil (5,100 m^3+2000m^3) - Transmission pipeline (6,700m) - Distribution pipeline (42,689m)	ICB
Package 2	- Intake pump (E) - Transmission and distribution pump (E) - Salakham pump (E) - Monitoring System	Procurement and installation of following facilities - Intake pump and related facilities (120,000 m^3/day) - Transmission and distribution pump and related facilities (120,000 m^3/day) - Salakham high lift pump and related facilities (37,000 m^3/day) - Monitoring System	ICB

(G) means “General” works including civil, pipeline and building works.
(E) means “Equipment” works including mechanical and electrical works.
Source: JST

(3) Bidding Method and Contract Condition

It is assessed that the design bid build (DBB) is appropriate for both package 1 and 2 to adopt the conventional treatment method for expansion of Chinaimo WTP considering following reasons.

- There are three alternative treatment methods (1.Conventional method, 2.Upflow clarifier, 3.Ceramic filtration) considered for expansion of Chinaimo WTP. Among the three methods, “2.Upflow clarifier” and “3.Ceramic filtration” are not able to treat high raw water turbidity effectively and economically.

- In contrast, “1.Conventional method” has proven its good performance against high raw water turbidity for a long period of time.

- Adopting different treatment process from existing process may cause complexity of operation and increase burden to the plant operators.

(4) Selection of Consultant

There are two (2) methods for consultant selection as shown in Table A.12.2.

Table A.12.2 Methods of Consultant Selection

Method	Detail	Remarks
1. Submission of Expression of Interest (EOI)	Project owner announces the project information to assemble bidders of consulting companies through newspaper and so forth.	− It is expected free competition. − It takes times for procedure. − It is difficult to evaluate all the bidders correctly.
2. Decision of candidates by project owner	Project owner decides the candidates of bidders by themselves.	− Project owner generally consult fund owner to nominate candidates. − It is expected to nominate suitable candidates for the project.

Source: JST

It is appropriate to adopt method of "2.Decision of candidates by project owner" from the following reasons.

- There is a possibility that consultant company with little experience applies for the bidding in case of the method of "1. Submission Expression of interest (EOI)". It seems difficult for Executing Agency to evaluate the bidders correctly among the a lot of bidders since the experience of implementing International Competitive Bidding for consultant selection is not so much in Lao P.D.R.

- It is expected to be able to nominate suitable candidates for the project by adopting the method of "2. Decision of candidates by project owner".

In case of " 2.Decision of candidates by project owner", shortlist for consultant will be decided by project owner considering the consultation with fund owner.

(5) Selection of Contractor

The both package 1 and package 2 are tendered by International Competitive Bidding (ICB). The bidding will be implemented with Pre-Qualification (PQ).

A.13 Action Plan for Project Implementation

The selection of consultants and contractors includes many processes, and several related organizations and agencies. The process for selection of consultant and related organization is shown in Table A.13.1,with responsible organizations. The process for selection of contractor is shown in Table A.13.2.

Table A.13.1 Process for Selection of Consultants with Related and Responsible Organization

Content	Term (Month)	Responsible Organization / Section			
		DPWT-VC	NPNL	MPWT	JICA
Preparation of RFP & Short-list	2.0	Do	Do		
Approval of RFP and Short-list				C	
Concurrence for RFP & Short-list	0.5				C
Issuance of RFP to Short-listed Consultants	0.5	Do	Do		
Proposal Submission by Consultants	1.5	Bidders (Consultant)			
Evaluation of Technical Proposal	2.5	Do	Do		
Approval of Evaluation of Technical Proposal				C	
Concurrence for Evaluation of Technical Proposal	0.5				C
Opening Financial Proposals, Evaluation	1.0	Do	Do		
Approval of Evaluation of Financial Proposal				C	
Concurrence for Evaluation of Proposals	0.5				C
Contract Negotiation	2.0	Do	Do		
Approval of Contract Negotiation				C	
Signing of Contract	0.5	Do	Do		
Concurrence for Signed Contract	0.5				C
Total	**12.0**				

Note; “Do” means the implementing or preparing organization, “C” means authority for approval or concurrence and “A” means advisory agency or organization.
Source: JST

Table A.13.2 Process for Selection of Contractors with Related and Responsible Organization

Content	Term(Month)		Responsible Organization / Section				
	Package1	Package2	DPWT-VC	NPNL	MPWT	JICA	Consultant
Preparation of PQ Documents	4.0*	4.0*	Do	Do			Do
Approval of PQ Documents					C		
Concurrence for PQ Documents						C	
Issuance of PQ Documents			Do	Do			
PQ Submission by Contractor			Bidders (Contractor)				
Evaluation of PQ			Do	Do			A
Approval of PQ					C		
Concurrence of PQ Result						C	
Preparation of Tender Documents	3.0*	3.0*	Do	Do			Do
Approval of Tender Documents					C		
Concurrence for Tender Documents						C	
Tender Period	3.0	3.0	Do	Do			
Tender Evaluation	2.0	6.0	Do	Do			A
Approval of Tender Evaluation					C		
Concurrence for Tender Evaluation	1.0	1				C	
Contract Negotiation	2.0	2.0	Do	Do			
Approval of Contract Negotiation					C		
Signing of Contract			Do	Do			
Concurrence for Signed Contract	1.0	1.0				C	
Open of Letter of Credit and Issuance of Letter of Commitment	1.0	1.0	Do	Do	A		
Total	15.0	19.0					

Note; "Do" means the implementing or preparing organization, "C" means authority for approval or concurrence and "A" means advisory agency or organization.
* Procedures of PQ (4 months) and Tender (3 months) related words are overlapping for two (2) months.
Source: JST

A.14 Organizations of MPWT, DPWT, and NPNL

Organization charts of MPWT, DPWT, and NPNL are shown in the following.

Ministry of Public Works and Transport

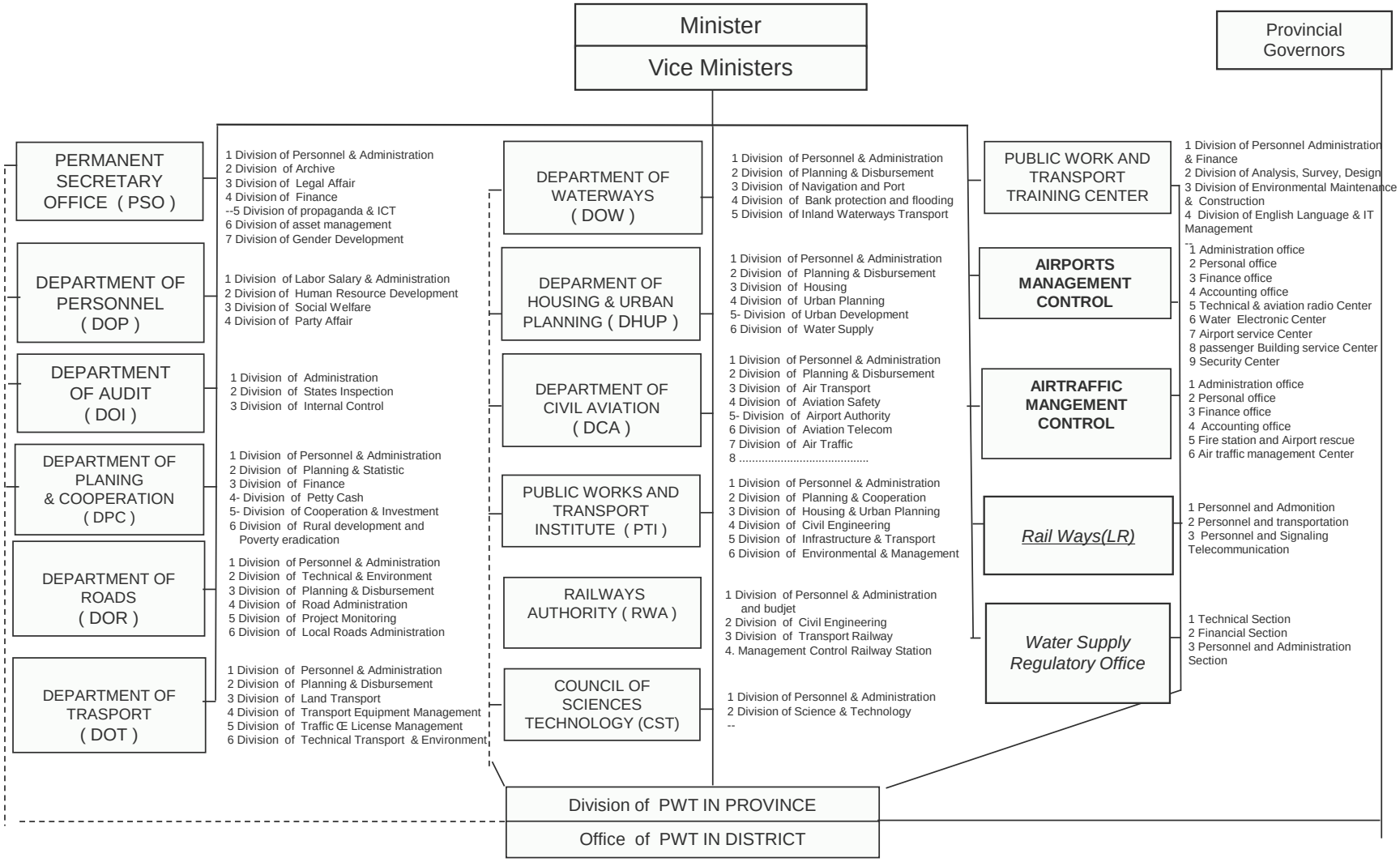


Figure A.14.1 Organization Chart of MPWT

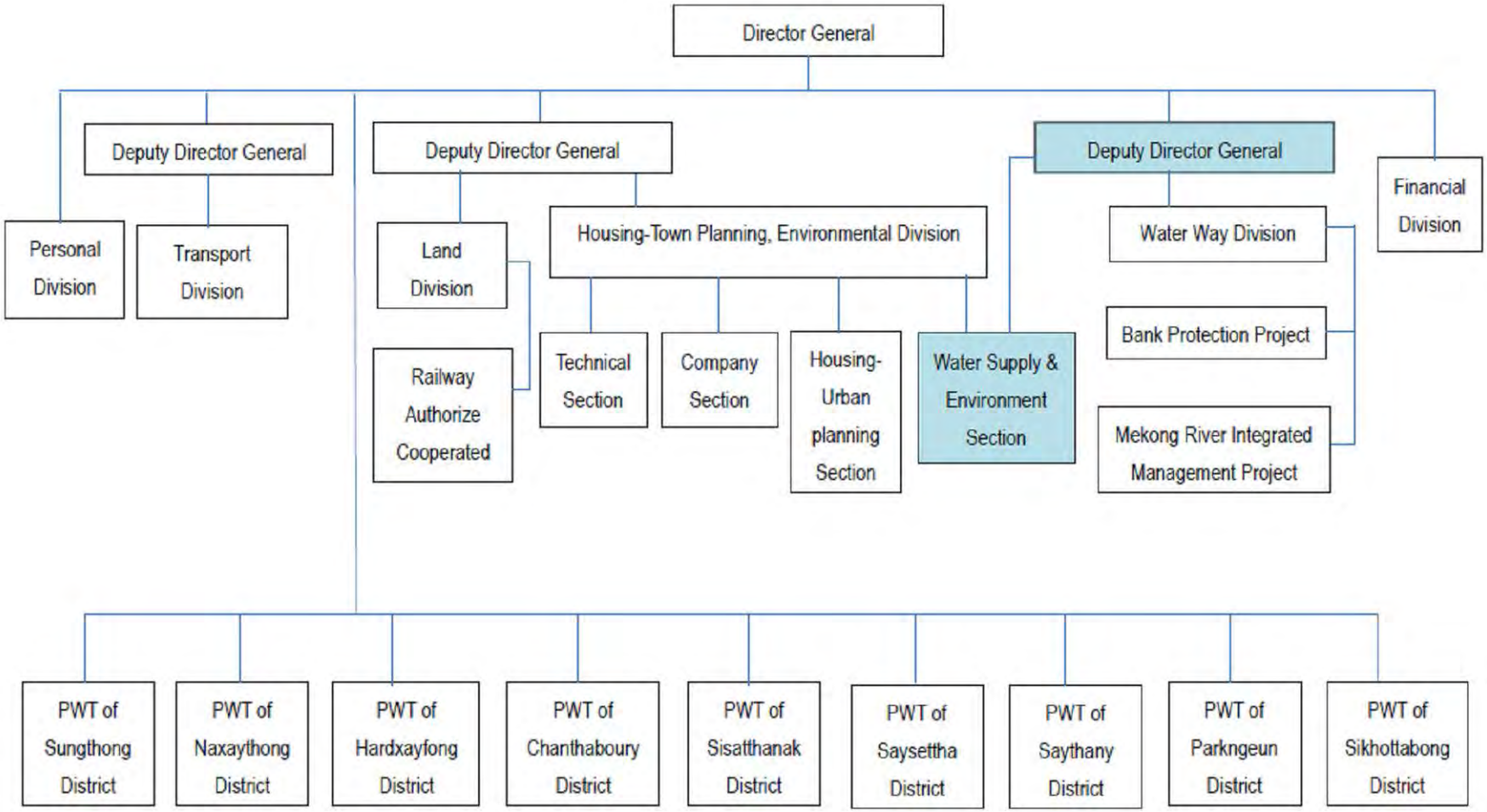


Figure A.14.2 Organization Chart of DPWT-Vientiane Capital

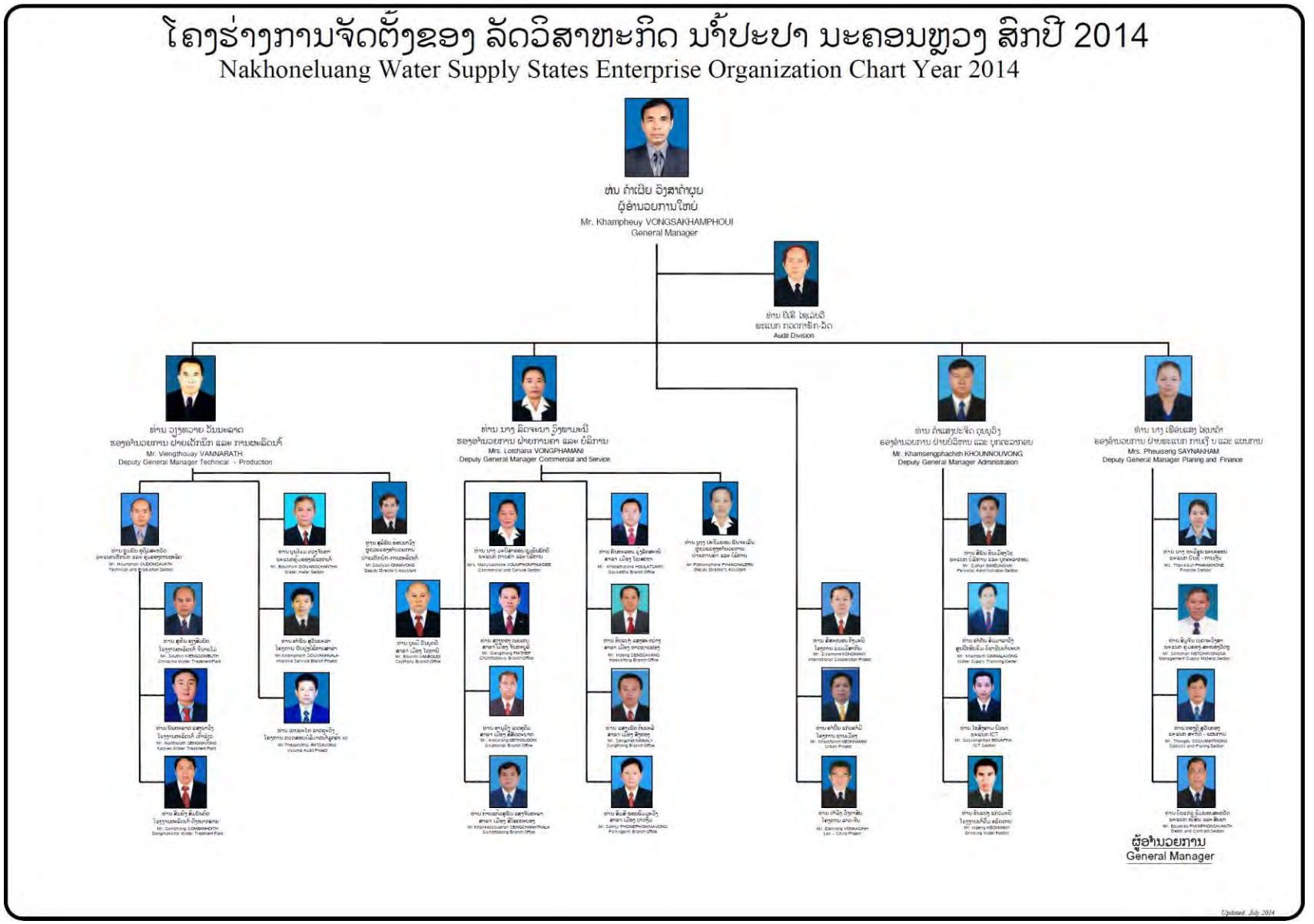


Figure A.14.3 Organization Chart of NPNL

A.15 EIA Screening

IEE Screening Format (Draft)

Name of Proposed Project:
Project Executing Organization, Project Proponent or Investment Company:
Name, Address, Organization, and Contact Point of a Responsible Officer:

(In the case that the project executing organization is DHUP, MPWT)
Name: Mr.Khantaby Thaiphachanh
Address: Lane-Xang Ave,Vientiane
Organization: Director General, Department of Housing and Urban Planning, Ministry of Public Works and Transport
Tel: +856-21-412284
Fax: +856-21-412282
E-Mail: khamthavy@mpwt.laopdr.org
Date:
Signature:

(In the case that the project executing organization is DPWT, Vientiane Capital)
Mr.Detsongkham Thamnavong
Address: Sethathirath Road, Kaoyoth Village, Sisattanak District
Organization: Director General, Department of Public Works and Transport, Vientiane Capital
Tel: +856-21-212629
Fax: +856-21-412282
E-Mail: dedtmv@yahoo.com
Date:
Signature:

Check Items

Please write “to be advised (TBA)” when the details of a project are yet to be determined.

Question 1: Address of project site
- Chinaimo Water Treatment Plant and related facilities (Intake, Raw Transmission Pipeline) located in Sisatthanak District
- Treated Water Transmission Pipeline from Chinaimo Water Treatment Plant to Salakham Water Elevated Tank located in Hadxaifong District

- Distribution Pipeline located within the public road in the District of Sisatthanak, Hadxaifong, Xaysetha and Chanthabouly in Vientiane Capital.

Question 2: Scale and contents of the project (approximate area, facilities area, production, electricity generated, etc.)

2-1. Project profile (scale and contents)

Project scale and contents are summarized in Table below.

Component	Location	Proposed Facilities	Detail of the Structures
Expansion of Chinaimo Water Treatment Plant	Premises of the Chinaimo Water Treatment Plant	2 Water Treatment Plants	28m W x95m L x3m H 40,000m^3 treatment capacity per day
		Electric Power Receiving and Distribution System	10m W x5m L x7m H
		Reservoir for treated water	36m Wx61m L x6.7m H with 9,800m^3 Capacity
		Chemical Feeding Building	15m W x 35m L x 8m H
		Chloration Building	15m W x 25m L x8m H
Expansion and Development of Water Intake Facilities, Water Transmission Facilities and Water Supply Facilities	Premises of the Intake for the Chinaimo Water Treatment Plant	Intake	16mW x 21m L x 10m H
		Administration Building (moved from the Chinaimo Water Treatment Plant)	11m W x 20.5m L x 10m H
		Electric Power Receiving and Distribution System (Divided from the Chinaimo Water Treatment Plant)	10m Wx5m Lx7m H
	Under Public Road	Raw Water Transmission Pipeline connecting Intake and Water Treatment Plant	0.13km with 1,400 mm diameter
	Under Public Road	Treated Water Transmission Pipeline	6 km with 900mm diameter
	Premises of the Salakham Elevated Tank	Elevated Tank	32m H with 21m diameter 2,000m^3 Capacity
		Reservoir	3.5 Depth with 34m diameter 5,200m^3 Capacity
Expansion and Development of Water Distribution Facilities	Under Public Road	Distribution Pipeline	150km with pipe size ranges from 1,200mm to 100mm

2-2. How was the necessity of the project confirmed?

Is the project consistent with the higher program/policy?

√YES: Please describe the higher program/policy.

According to the GOL's 1999 policy statement (PM Decision No. 37), the sector target is stipulated as providing 24-hour access to safe drinking water for 80% of the urban population by 2020. To achieve this goal, the GOL has progressively developed water supplies in Vientiane and the provincial centers. The Project is formed in line with this policy.

□NO

2-3. Did the proponent consider alternatives before this request?

√YES: Please describe outline of the alternatives

Intake Location

Among three alternatives 1)without project (use existing intake with expanding water intake), 2)same type of intake to be constructed using land adjacent to the existing Chinaimo intake and 3)construct in the premises of existing Chinaimo Intake, alternative 3) was selected as the most feasible option.

Water Treatment Plant Location

Among three alternatives 1)without project (use existing water treatment plant), 2)same type of water treatment plant to be constructed using land adjacent to the existing Chinaimo water treatment plant and 3)construct in the premises of existing Chinaimo water treatment plant, alternative 3) was selected as the most feasible option.

Water Elevated Tank Location

Among three alternatives, 1)alternative 1: demolish Phone Kheng Water Elevated Tank and rebuilt new elevated tank with larger capacity, 2)alternative 2: construct new water elevated tank and 3)alternative 3: construct in the premises of existing water elevated tank in Salakham and expand the reservoir capacity in the Chinaimo Water Treatment Plant, alternative 3) was selected as the most feasible option.

□NO

2-4. Did the proponent implement meetings with the related stakeholders before this request?

√Implemented □Not implemented

If implemented, please mark the following stakeholders.

√Administrative body

√Local residents

□NGO

□Others（ ）

Question 3:

Is the project a new one or an ongoing one? In the case of an ongoing project, have you received strong complaints or other comments from local residents?

√New ☐Ongoing (with complaints) ☐Ongoing (without complaints)

☐Other （ ）

Question 4:

Is an Environmental Impact Assessment (EIA), including an Initial Environmental Examination (IEE) required for the project according to a law or guidelines of a host country? If yes, is EIA implemented or planned? If necessary, please fill in the reason why ~~EIA~~ IEE is required.

☐Necessity (√Implemented □Ongoing/planning)

Reason why ~~EIA~~ IEE is required:

Based on the legislations (No.29/NA December 2012 Environmental Protection Law, No.8056, No.8056 MONRE December 2013 Ministerial Agreement on the Environment and Promulgation of List of Investment Projects and Activities Requiring for Conducting Environmental and Social Impact Assessment and No.8029 MONRE December 2013 Ministerial Instruction on the Process of Initial Environmental Examination, IEE is required for obtain environmental compliance certificate.

Based on the)

☐Not necessary

☐Other (please explain)

Question 5:

In the case that steps were taken for an EIA, was the EIA approved by the relevant laws of the host country? If yes, please note the date of approval and the competent authority.

√Approved without a supplementary condition	☐Approved with a supplementary condition	☐Under appraisal IEE report was submitted to DONRE December 2014 and it has been under review process for approval.

(Date of approval: 17 February 2015 Competent authority: Department of Natural Resources and Environment, Vientiane Capital)

☐Under implementation

☐Appraisal process not yet started

☐Other ( )

Question 6:

If the project requires a certificate regarding the environment and society other than an EIA, please indicate the title of said certificate. Was it approved?

☐Already certified

Title of the certificate: ( )

☐Requires a certificate but not yet approved

√Not required

☐Other

Question 7:

Are any of the following areas present either inside or surrounding the project site?

☐Yes √No

If yes, please mark the corresponding items.

☐National parks, protection areas designated by the government (coastline, wetlands, reserved area for ethnic or indigenous people, cultural heritage)

☐Primeval forests, tropical natural forests

☐Ecologically important habitats (coral reefs, mangrove wetlands, tidal flats, etc.)

☐Habitats of endangered species for which protection is required under local laws and/or international treaties

☐Areas that run the risk of a large scale increase in soil salinity or soil erosion

☐Remarkable desertification areas

☐Areas with special values from an archaeological, historical, and/or cultural points of view

☐Habitats of minorities, indigenous people, or nomadic people with a traditional lifestyle, or areas with special social value

Question 8:

Does the project include any of the following items?

☐Yes √No

If yes, please mark the appropriate items.

☐Involuntary resettlement (scale: households persons)

☐Groundwater pumping (scale: m3/year)

☐Land reclamation, land development, and/or land-clearing (scale: hectors)

☐Logging (scale: hectors)

Question 9:

Please mark related adverse environmental and social impacts, and describe their outlines.

√Air pollution √Water pollution

☐Soil pollution
√Waste
√Noise and vibrations
☐Ground subsidence
√Offensive odors
☐Geographical features
☐Bottom sediment
☐Biota and ecosystems
☐Water usage
√Accidents
☐Global warming

☐Involuntary resettlement
☐Local economies, such as employment, livelihood, etc.
☐Land use and utilization of local resources
☐Social institutions such as social infrastructure and local decision-making institutions
√Existing social infrastructures and services
☐Poor, indigenous, or ethnic people
☐Misdistribution of benefits and damages
☐Local conflicts of interest
☐Gender
☐Children's rights
☐Cultural heritage
√Infectious diseases such as HIV/AIDS
☐Other ( )

Outline of related impact:

The main negative impact include temporary and site specific pollution such as air pollution, water pollution, waste generation, noise and vibration, accidents due to construction activities in the construction phase. The impacts could be avoided or minimized in applying countermeasures. During operation phase, offensive odor would be created due to improper management of chloride at water treatment plant. However, with mitigation measures such as provide proper instruction and carry out regular monitoring, it will be avoided.

Question 10:

In the case of a loan project such as a two-step loan or a sector loan, can sub-projects be specified at the present time?

☐Yes ☐No

Not applicable for this project

Question 11:

Regarding information disclosure and meetings with stakeholders, if JICA's environmental and social considerations are required, does the proponent agree to information disclosure and meetings with stakeholders through these guidelines?

√Yes ☐No

A.16 EIA Check List

EIA Checklist: Water Supply（1）

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a) Y (b) Y (c) Y (d) N	(a) According to the legal requirement in Lao PDR, the project needs to conduct an initial environmental examination (IEE) for obtaining an environmental compliance certificate. The IEE was drafted and submitted to Department of Natural Resources and Environment, Vientiane Capital for approval in December 2014 for review. (b) (c) TheIEE is appproved by authorities (Department of Natural Resources and Environment, Vientiane Capital: DONRE) on 17 February, 2015. (d) No other environmental permit required.
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a) Y (b) Y	(a) In line with the legal requirement in Lao PDR, stakeholders meeting at two different levels, village/district level and district/Vientiane Capital level in the project area needs to be conducted for the project. One stakeholder meeting at village/district level was conducted on 11 December 2014 for all villages and districts located in the project area to disseminate the content of project and the result of the drafted IEE. Understanding on the project was obtained from all participants at the meeting. The meeting for district/Vientiane Capital level was held on 17 January 2015 in order to obtain the approfal of the drafted IEE report. (b) The information and opinions from the stakeholders meeting at village/district level as well as the meeting at disstrict/Vientiane Capital were reflected to the project design.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) Alternatives on the design of intake, water treatment plant, elevated tank and distribution line were examined in order to avoid negative impacts on society and natural environment in the project area.

EIA Checklist: Water Supply（2）

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
2 Pollution Control	(1) Air Quality	(a) Is there a possibility that chlorine from chlorine storage facilities and chlorine injection facilities will cause air pollution? Are any mitigating measures taken? (b) Do chlorine concentrations within the working environments comply with the country's occupational health and safety standards?	(a) Y (b) Y	(a) (b) In carrying out the regular monitoring of the storage facilities and training for proper management, air pollution from the storage facilities are to be avoided.
	(2) Water Quality	(a) Do pollutants, such as SS, BOD, COD contained in effluents discharged by the facility operations comply with the country's effluent standards?	(a) Y	(a) Together with effluents from existing facilities, the water quality from the water treatment plant will be sampled regularity in order to comply with the country's standards.
	(3) Wastes	(a) Are wastes, such as sludge generated by the facility operations properly treated and disposed in accordance with the country's regulations?	(a) Y	(a) There is no regulation yet to be set on the sludge treatment. However, the sludge from the water treatment plant will be diluted with water together with the sludege generated from the existing Chinaimo water treatment plant and discharge to the Mekong river through drainage.
	(4) Noise and Vibration	(a) Do noise and vibrations generated from the facilities, such as pumping stations comply with the country's standards?	(a) Y	(a) The facilities to be constructed are located in the premises of existing facilities which are not located residential areas. Accordingly, noise and vibration from these facilities are not considered to give negative impacts.
	(5) Subsidence	(a) In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence?	(a) N	(a) No plan to extract ground water.
3 Natural Environment	(1) Protected Areas	(a) Is the project site or discharge area located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a) N	(a) There is no protected area located in the proposed location of facilities.
3 Natural Environment	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site or discharge area encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic	(a) N (b) N (c) - (d) -	(a) No primeval forest, tropical rain forests or ecologically valuable habitats confirmed in the project area. (b) No protected habitats of endangered species confirmed in the project area. (c) Not applicable (d) The amount of water taken from the Mekong river for intake is not significant amount. Thus, no negative impact is anticipated.
	(3) Hydrology	(a) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect surface water and groundwater flows?	(a) N	(a) The amount of water taken from the Mekong river for intake is not significant amount. Thus, no negative impact is anticipated.

EIA Checklist: Water Supply（3）

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Is the compensations going to be paid prior to the resettlement? (e) Is the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?	(a) N (b) - (c) - (d) - (e) (f) - (g) - (h) - (i) - (j)-	(a)(b)(c)(d)(e)(f)(g)(h)(i)(j) There will be no resettlement or land acquisition. The proposed facilities will be constructed in the government land.

EIA Checklist: Water Supply（4）

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
4 Social Environment	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (b) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect the existing water uses and water area uses?	(a) N (b) N	(a) (b) No negative impact is anticipated. On the contrary, the expansion of water supply coverage in the project area will contribute to increase living standard.
	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N	(a) No local archeological, historical, cultural or religious heritage confirmed in the proposed facility locations.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) No adverse impact is anticipated. Because the proposed facilities will be located either in the premises of existing facilities or under public road.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a) - (b) N	(a)(b) The project will not give negative impacts on the ethnic minorities.
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local	(a) N (b) Y (c) Y (d) Y	(a) There is no violation of laws or ordinances on the working conditions due to the project. (b)(c) (d)Safety for individuals involved in the project will be considered by conducting regular monitoring and providing instructions.

EIA Checklist: Water Supply（5）

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts? (d) If the construction activities might cause traffic congestion, are adequate measures considered to reduce such impacts?	(a) Y (b) - (c) Y (d) Y	(a) Environmental and social management and monitoirng plan (ESMMP) has been developed as a part of IEE. Negative impacted resulting from construction activities including air pollution, water pollution, noise will be minimized in applying mitigation measures addressed in the ESMMP. (b) No negative impact is anticipated. (c) In line with the ESMMP, the grievance committee will be formed prior to the commencement of construction. Any complain will be dealt with the grievance committee via environmental and social staff assigned in the project management unit (or project implementation unit) (d) In the congested traffic area, it is required in the ESMMP that the Contractor shall assign a staff for dealing with smooth traffic flow.
5 Others	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a) Y (b) Y (c) Y (d) Y	(a) (b) (c)The environmental and social management and monitoring plan (ESMMP)has been developed as a part of IEE. In the ESMMP, mitigation measures and monitoring items, implementation frequencies of the mitigation measures and the monitoring, institutional responsibility for implementing mitigation measures and monitoring the mitigation activities and the budget for monitoring activities are addressed. Dust , water quality, waste, noise, disturbance to locals along the road, traffic, health and safety of workers and locals will be managed daily by the Contractors and monitored monthly by the environmental and social staff in the project management unit (or project implementation unit) in inspecting the construction sites and reviewing the result of water quality and noise level from the construction sites. (d) The result of site inspection and the result of water quality and noise level will be report to Department of Natural Resources and Environment, Vientiane Capital quarterly.
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Dam and River Projects checklist should also be checked.	(a) -	(a) Not applicable
	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) -	(a) Not applicable

1) Regarding the term “Country’s Standards” mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are required to be made.
In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan's experience).
2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which the project is located.

A.17 FIRR and EIRR Calculation, Financial Plan of NPNL

A.17.1 FIRR Calculation

Table A.17.1 Cost and Benefit Stream of Proposed Water Supply Project

Phase 1 only

Assumptions:

Existing Chinaimo WTP stops operation by the year 2020 without rehabilitation work planned by this Project. Therefore, production volume of this project is set at maximum 120,000m^3/day.

Following is shown in real term, therefore, water tariff must be raised regularly for inflation adjustment.

Tariff must be raised at **0.00** % in the year 2019 from that of the year 2018.

(Unit: million JPY)

Year		Cost				Revenue	Balance	Collection efficiency	Bill Amount (million JPY)
		Const-ruction *1	Replace-ment	O&M	Total	Total			
-4	2015	0.00	0.00	0.00	0.00	0.00	0.00	**99.6%**	0.00
-3	2016	156.00	0.00	0.00	156.00	0.00	-156.00	99.6%	0.00
-2	2017	266.00	0.00	0.00	266.00	0.00	-266.00	99.7%	0.00
-1	2018	1,436.00	0.00	0.00	1,436.00	0.00	-1,436.00	99.8%	0.00
0	2019	3,287.00	0.00	0.00	3,287.00	0.00	-3,287.00	99.8%	0.00
1	2020	3,138.00	0.00	16.97	3,154.97	88.12	-3,066.85	**99.9%**	88.21
2	2021	418.00	0.00	217.99	635.99	1,139.64	503.65	99.9%	1,140.78
3	2022	0.00	0.00	229.91	229.91	1,221.79	991.88	99.9%	1,223.01
4	2023	0.00	0.00	241.98	241.98	1,303.93	1,061.95	99.9%	1,305.24
5	2024	0.00	0.00	253.90	253.90	1,386.07	1,132.17	99.9%	1,387.46
6	2025	0.00	0.00	265.82	265.82	1,468.22	1,202.40	99.9%	1,469.69
7	2026	0.00	0.00	265.82	265.82	1,391.88	1,126.06	99.9%	1,393.28
8	2027	0.00	0.00	265.82	265.82	1,404.37	1,138.55	**99.9%**	1,405.77
9	2028	0.00	0.00	265.82	265.82	1,417.04	1,151.22	99.9%	1,418.46
10	2029	0.00	0.00	265.82	265.82	1,429.91	1,164.09	99.9%	1,431.34
11	2030	0.00	0.00	265.82	265.82	1,443.08	1,177.26	99.9%	1,444.52
12	2031	0.00	6.20	177.21	183.41	951.28	767.87	99.9%	952.23
13	2032	0.00	6.20	177.21	183.41	951.28	767.87	99.9%	952.23
14	2033	0.00	6.20	177.21	183.41	951.28	767.87	99.9%	952.23
15	2034	0.00	6.20	177.21	183.41	951.28	767.87	99.9%	952.23
16	2035	0.00	832.20	177.21	1,009.41	951.28	-58.13	99.9%	952.23
17	2036	0.00	6.20	177.21	183.41	951.28	767.87	99.9%	952.23
18	2037	0.00	6.20	177.21	183.41	951.28	767.87	**99.9%**	952.23
19	2038	0.00	6.20	177.21	183.41	951.28	767.87	99.9%	952.23
20	2039	0.00	6.20	177.21	183.41	951.28	767.87	99.9%	952.23
21	2040	0.00	832.20	177.21	1,009.41	951.28	-58.13	99.9%	952.23
22	2041	0.00	6.20	177.21	183.41	951.28	767.87	99.9%	952.23
23	2042	0.00	6.20	177.21	183.41	951.28	767.87	99.9%	952.23
24	2043	0.00	6.20	177.21	183.41	951.28	767.87	99.9%	952.23
25	2044	0.00	6.20	177.21	183.41	951.28	767.87	99.9%	952.23
26	2045	0.00	6.20	177.21	183.41	951.28	767.87	99.9%	952.23
27	2046	0.00	6.20	177.21	183.41	951.28	767.87	99.9%	952.23
28	2047	0.00	6.20	88.60	94.80	935.12	840.32	99.9%	936.06
29	2048	0.00	6.20	88.60	94.80	935.12	840.32	99.9%	936.06
30	2049	0.00	6.20	88.60	94.80	935.12	840.32	**99.9%**	936.06

FIRR: 9.29% NPV: 4,774 million JPY B/C: 1.45

Note: *1; Construction cost excludes the 'Price escalation', 'Interest during construction' and adjusted the 'Contingency' also.

Source: prepared by JST

Table A.17.2 Construction Cost, Replacement Cost and O&M Cost

Construction cost

Unit: million JPY

Year		Total cost
-4	2015	0.00
-3	2016	156.00
-2	2017	266.00
-1	2018	1,436.00
0	2019	3,287.00
1	2020	3,138.00
2	2021	418.00
3	2022	
4	2023	
5	2024	
6	2025	
7	2026	
8	2027	
9	2028	
10	2029	
11	2030	
12	2031	
13	2032	
	Total	8,701.00

Replacement cost

Unit: million JPY

Year		Total cost
-4	2015	
-3	2016	
-2	2017	
-1	2018	
0	2019	
1	2020	
2	2021	
3	2022	
4	2023	
5	2024	
6	2025	
7	2026	
8	2027	
9	2028	
10	2029	
11	2030	
12	2031	6.2
13	2032	6.2
14	2033	6.2
15	2034	6.2
16	2035	832.2
17	2036	6.2
18	2037	6.2
19	2038	6.2
20	2039	6.2
21	2040	832.2
22	2041	6.2
23	2042	6.2
24	2043	6.2
25	2044	6.2
26	2045	6.2
27	2046	6.2
28	2047	6.2
29	2048	6.2
30	2049	6.2
31	2050	6.2

O&M cost

Year		Total cost (million LAK)	Total cost (million JPY)
-4	2015		
-3	2016		
-2	2017		
-1	2018		
0	2019		
1	2020*1	1,139.00	16.97
2	2021	14,630.00	217.99
3	2022	15,430.00	229.91
4	2023	16,240.00	241.98
5	2024	17,040.00	253.90
6	2025	17,840.00	265.82
7	2026	17,840.00	265.82
8	2027	17,840.00	265.82
9	2028	17,840.00	265.82
10	2029	17,840.00	265.82
11	2030	17,840.00	265.82
12	2031	11,893.00	177.21
13	2032	11,893.00	177.21
14	2033	11,893.00	177.21
15	2034	11,893.00	177.21
16	2035	11,893.00	177.21
17	2036	11,893.00	177.21
18	2037	11,893.00	177.21
19	2038	11,893.00	177.21
20	2039	11,893.00	177.21
21	2040	11,893.00	177.21
22	2041	11,893.00	177.21
23	2042	11,893.00	177.21
24	2043	11,893.00	177.21
25	2044	11,893.00	177.21
26	2045	11,893.00	177.21
27	2046	11,893.00	177.21
28	2047	5,946.42	88.60
29	2048	5,946.42	88.60
30	2049	5,946.42	88.60
31	2050	5,946.42	88.60

Note: *1; O&M costs of the year 2020 is assumed for 1 month.

Table A.17.3 Financial Revenue Stream of Proposed Water Supply Project

Phase 1 only — Tariff must be raised at: 0.00 % — in the year 2019

	Year	Project water supply volume (m3/day)				Unit price of water (Kip/m3)			Bill Amount (million JPY)				Initial connection charge	Meter rent charge	Total
		Household	Government	Commercial	Total	Household	Government	Commercial	Household	Government	Commercial	Total			
-4	2015	0	0	0	0				0.00	0.00	0.00	0.00	0.00	0.00	0.00
-3	2016	0	0	0	0	1,893	2,538	3,089	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-2	2017	0	0	0	0	1,969	2,665	3,244	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-1	2018	0	0	0	0	2,081	2,665	3,244	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0	2019	0	0	0	0	2,081	2,665	3,244	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	2020 *1	50,308	10,457	11,434	72,200	2,081	2,665	3,244	47.45	12.63	16.81	76.89	8.62	2.70	88.21
2	2021	54,639	11,358	12,419	78,416	2,081	2,665	3,244	618.38	164.61	219.10	1,002.09	103.45	35.24	1,140.78
3	2022	58,971	12,258	13,403	84,632	2,081	2,665	3,244	667.40	177.66	236.46	1,081.52	103.45	38.03	1,223.01
4	2023	63,302	13,158	14,387	90,847	2,081	2,665	3,244	716.42	190.71	253.83	1,160.96	103.45	40.82	1,305.24
5	2024	67,633	14,059	15,372	97,063	2,081	2,665	3,244	765.44	203.76	271.19	1,240.39	103.45	43.62	1,387.46
6	2025	71,964	14,959	16,356	103,279	2,081	2,665	3,244	814.45	216.81	288.56	1,319.82	103.45	46.41	1,469.69
7	2026	72,595	15,090	16,499	104,184	2,081	2,665	3,244	821.60	218.71	291.08	1,331.39	15.07	46.82	1,393.28
8	2027	73,238	15,224	16,645	105,107	2,081	2,665	3,244	828.87	220.65	293.66	1,343.18	15.36	47.23	1,405.77
9	2028	73,892	15,360	16,794	106,046	2,081	2,665	3,244	836.27	222.62	296.29	1,355.18	15.62	47.65	1,418.46
10	2029	74,557	15,498	16,945	107,000	2,081	2,665	3,244	843.80	224.62	298.95	1,367.37	15.88	48.08	1,431.34
11	2030	75,235	15,639	17,099	107,973	2,081	2,665	3,244	851.47	226.67	301.67	1,379.81	16.19	48.52	1,444.52
12	2031	50,157	10,426	11,400	71,983	2,081	2,665	3,244	567.65	151.11	201.12	919.89	0.00	32.35	952.23
13	2032	50,157	10,426	11,400	71,983	2,081	2,665	3,244	567.65	151.11	201.12	919.89	0.00	32.35	952.23
14	2033	50,157	10,426	11,400	71,983	2,081	2,665	3,244	567.65	151.11	201.12	919.89	0.00	32.35	952.23
15	2034	50,157	10,426	11,400	71,983	2,081	2,665	3,244	567.65	151.11	201.12	919.89	0.00	32.35	952.23
16	2035	50,157	10,426	11,400	71,983	2,081	2,665	3,244	567.65	151.11	201.12	919.89	0.00	32.35	952.23
17	2036	50,157	10,426	11,400	71,983	2,081	2,665	3,244	567.65	151.11	201.12	919.89	0.00	32.35	952.23
18	2037	50,157	10,426	11,400	71,983	2,081	2,665	3,244	567.65	151.11	201.12	919.89	0.00	32.35	952.23
19	2038	50,157	10,426	11,400	71,983	2,081	2,665	3,244	567.65	151.11	201.12	919.89	0.00	32.35	952.23
20	2039	50,157	10,426	11,400	71,983	2,081	2,665	3,244	567.65	151.11	201.12	919.89	0.00	32.35	952.23
21	2040	50,157	10,426	11,400	71,983	2,081	2,665	3,244	567.65	151.11	201.12	919.89	0.00	32.35	952.23
22	2041	50,157	10,426	11,400	71,983	2,081	2,665	3,244	567.65	151.11	201.12	919.89	0.00	32.35	952.23
23	2042	50,157	10,426	11,400	71,983	2,081	2,665	3,244	567.65	151.11	201.12	919.89	0.00	32.35	952.23
24	2043	50,157	10,426	11,400	71,983	2,081	2,665	3,244	567.65	151.11	201.12	919.89	0.00	32.35	952.23
25	2044	50,157	10,426	11,400	71,983	2,081	2,665	3,244	567.65	151.11	201.12	919.89	0.00	32.35	952.23
26	2045	50,157	10,426	11,400	71,983	2,081	2,665	3,244	567.65	151.11	201.12	919.89	0.00	32.35	952.23
27	2046	50,157	10,426	11,400	71,983	2,081	2,665	3,244	567.65	151.11	201.12	919.89	0.00	32.35	952.23
28	2047	25,078	5,213	5,700	35,991	2,081	2,665	3,244	567.65	151.11	201.12	919.89	0.00	16.17	936.06
29	2048	25,078	5,213	5,700	35,991	2,081	2,665	3,244	567.65	151.11	201.12	919.89	0.00	16.17	936.06
30	2049	25,078	5,213	5,700	35,991	2,081	2,665	3,244	567.65	151.11	201.12	919.89	0.00	16.17	936.06
31	2050	25,078	5,213	5,700	35,991	2,081	2,665	3,244	567.65	151.11	201.12	919.89	0.00	16.17	936.06

	Year	Project water supply volume (m3/day)			
		Phase I			
		Household	Government	Commercial	Total
-4	2015				
-3	2016	0	0	0	0
-2	2017	0	0	0	0
-1	2018	0	0	0	0
0	2019	45,977	9,557	10,450	65,984
1	2020	50,308	10,457	11,434	72,200
2	2021	54,639	11,358	12,419	78,416
3	2022	58,971	12,258	13,403	84,632
4	2023	63,302	13,158	14,387	90,847
5	2024	67,633	14,059	15,372	97,063
6	2025	71,964	14,959	16,356	103,279
7	2026	72,595	15,090	16,499	104,184
8	2027	73,238	15,224	16,645	105,107
9	2028	73,892	15,360	16,794	106,046
10	2029	74,557	15,498	16,945	107,000
11	2030	75,235	15,639	17,099	107,973
12	2031	50,157	10,426	11,400	71,983
13	2032	50,157	10,426	11,400	71,983
14	2033	50,157	10,426	11,400	71,983
15	2034	50,157	10,426	11,400	71,983
16	2035	50,157	10,426	11,400	71,983
17	2036	50,157	10,426	11,400	71,983
18	2037	50,157	10,426	11,400	71,983
19	2038	50,157	10,426	11,400	71,983
20	2039	50,157	10,426	11,400	71,983
21	2040	50,157	10,426	11,400	71,983
22	2041	50,157	10,426	11,400	71,983
23	2042	50,157	10,426	11,400	71,983
24	2043	50,157	10,426	11,400	71,983
25	2044	50,157	10,426	11,400	71,983
26	2045	50,157	10,426	11,400	71,983
27	2046	50,157	10,426	11,400	71,983
28	2047	25,078	5,213	5,700	35,991
29	2048	25,078	5,213	5,700	35,991
30	2049	25,078	5,213	5,700	35,991
31	2050	25,078	5,213	5,700	35,991

Note: *1; Water supply volume of the year 2020 is assumed for 1 month.

Table A.17.4 Unit Price of Water and Actual Water Consumption Volume

Estimation of Unit Price of Water

Average Consumption Volume:		Household
	0.245	m^3/capita/day
	5.21	persons/HH
	30.4	days/month
	38.8	**m^3/month/HH**

Category 1: Household	2016	2017	2018
1-10 m^3/month total bill	13,790	14,340	15,600
11-30 m^3/month total bill	38,200	39,720	41,700
31-38.8 m^3/month total bill	21,472	22,334	23,452
Total bill (38.8m^3)	73,462	76,394	80,752
Unit price of water (LAK/m3)	1,893	1,969	2,081

Water Tariff Table

Category	Type of User	Change of Unit price (LAK/m^3) of each year				
		2014	2015	2016	2017	2018
		-	3%	3%	4%	5%
1	Category 1: Household					
	1-10 m^3/month	1,300	1,339	1,379	1,434	1,560
	11-30 m^3/month	1,800	1,854	1,910	1,986	2,085
	31-50 m^3/month	2,300	2,369	2,440	2,538	2,665
	51m^3/month and more	2,800	2,884	2,970	3,089	3,244
2	Category 2: Governmental, embassy, and international organization	2,300	2,369	2,440	2,538	2,665
3	Category 3: Business industry & commercial	2,800	2,884	2,971	3,089	3,244

Actual Water Consumption

1 month in 2014					
Customer number	%	Water consumption vol.	%		
103,201	1	4,507,374	1		
Domestic					
22,981		90,447			
37,873		760,936			
19,644		769,551		Ave. water	
16,737		1,533,772		consumption vol.	
97,235	**94.2%**	**3,154,706**	**70.0%**	32.44	m3/customer
Governmental					
410		1,210			
422		8,372		Ave. water	
320		12,584		consumption vol.	
1,222		623,996			
2,374	**2.3%**	**646,162**	**14.3%**	272.18	m3/customer
Commercial					
551		1,504			
514		10,489		Ave. water	
413		16,755		consumption vol.	
2,114		677,758			
3,592	**3.5%**	**706,506**	**15.7%**	196.69	m3/customer

Table A.17.5 Weighted Average Cost of Capital

No.	Items	Public	NPNL		Total
		Grant	Sub-loan	Own Fund	
1	% of total financing	0%	100%		100%
			93%	7%	
2	Nominal interest rate or expected capital income	-	1.7%	13.7%	-
3	Corporate income tax	-	0.25%	0%	-
4	Nominal cost *1	-	1.7%	13.7%	-
5	Inflation rate	-	5.6%	5.6%	-
6	Real cost *3	-	-3.7%	7.7%	
7	Weighted real cost (No.1 x No.6)	-	**-3.44%**	**0.54%**	**-3.16%**
8	Applied Minimum Rate Test (MRT)	-	-	-	**4.00%**

Source: JICA Survey Team

Notes: *1; For ODA 2 step loan, nominal cost is calculated as follows;

Nominal cost = Nominal interest rate x (1 - Corporate income tax)

*2; Real cost = (1 + Nominal cost)/(1 + Inflation rate) - 0

Estimation of Nominal interest rate for Sub-loan of JICA loan

Interest rate from JICA to MOF	0.70%
Sub-loan interest rate from MOF to NPNL	+0.5% to +1%
foreign lending interest rate	1.70%
Nominal Interest rate	1.70%

Tax on NPNL

Tax items	%	formula	cases
Tax for Profit	24.0%	x Profit	
	0.25%	x water revenue	in case of loss
Tax after Profit Tax	60.0%	x Profit after tax	
	0.0%		in case of loss
	Total		

A.17.2 EIRR Calculation

Table A.17.6 Cost and Benefit Stream of Proposed Water Supply Project

	Phase 1	only					
							(Unit: million JPY)
Year		Cost				Benefit	Balance
		Const-ruction	Replace-ment	O&M	Total	Total	
-4	2015	0.00	0.00	0.00	0.00	0.00	0.00
-3	2016	154.06	0.00	0.00	154.06	0.00	-154.06
-2	2017	262.26	0.00	0.00	262.26	0.00	-262.26
-1	2018	1,418.57	0.00	0.00	1,418.57	0.00	-1,418.57
0	2019	3,255.34	0.00	0.00	3,255.34	0.00	-3,255.34
1	2020	3,106.17	0.00	16.12	3,122.29	209.32	-2,912.97
2	2021	413.35	0.00	207.09	620.44	2,728.13	2,107.69
3	2022	0.00	0.00	218.41	218.41	2,944.43	2,726.02
4	2023	0.00	0.00	229.88	229.88	3,160.69	2,930.81
5	2024	0.00	0.00	241.20	241.20	3,376.92	3,135.72
6	2025	0.00	0.00	252.53	252.53	3,593.18	3,340.65
7	2026	0.00	0.00	252.53	252.53	3,624.68	3,372.15
8	2027	0.00	0.00	252.53	252.53	3,656.78	3,404.25
9	2028	0.00	0.00	252.53	252.53	3,689.44	3,436.91
10	2029	0.00	0.00	252.53	252.53	3,722.64	3,470.11
11	2030	0.00	0.00	252.53	252.53	3,756.48	3,503.95
12	2031	0.00	6.20	168.35	174.55	2,504.35	2,329.80
13	2032	0.00	6.20	168.35	174.55	2,504.35	2,329.80
14	2033	0.00	6.20	168.35	174.55	2,504.35	2,329.80
15	2034	0.00	6.20	168.35	174.55	2,504.35	2,329.80
16	2035	0.00	832.20	168.35	1,000.55	2,504.35	1,503.80
17	2036	0.00	6.20	168.35	174.55	2,504.35	2,329.80
18	2037	0.00	6.20	168.35	174.55	2,504.35	2,329.80
19	2038	0.00	6.20	168.35	174.55	2,504.35	2,329.80
20	2039	0.00	6.20	168.35	174.55	2,504.35	2,329.80
21	2040	0.00	832.20	168.35	1,000.55	2,504.35	1,503.80
22	2041	0.00	6.20	168.35	174.55	2,504.35	2,329.80
23	2042	0.00	6.20	168.35	174.55	2,504.35	2,329.80
24	2043	0.00	6.20	168.35	174.55	2,504.35	2,329.80
25	2044	0.00	6.20	168.35	174.55	2,504.35	2,329.80
26	2045	0.00	6.20	168.35	174.55	2,504.35	2,329.80
27	2046	0.00	6.20	168.35	174.55	2,504.35	2,329.80
28	2047	0.00	6.20	84.17	90.37	1,259.71	1,169.34
29	2048	0.00	6.20	84.17	90.37	1,259.71	1,169.34
30	2049	0.00	6.20	84.17	90.37	1,259.71	1,169.34
	EIRR:	27.30%	NPV:	6,707	million JPY	B/C:	2.15

Table A.17.7 Economic Costs of Construction, Replacement and O&M

Construction cost

(Unit: FC; million JPY, LC; million LAK)

	Year	Foreign cost (FC)	Local cost (LC)	SCF	Converted LC (LC)	Total Economic Cost (FC)
-4	2015	0	0	0.95	0	0.00
-3	2016	111	3,031	0.95	2,890	154.06
-2	2017	185	5,438	0.95	5,185	262.26
-1	2018	1,071	24,463	0.95	23,327	1,418.57
0	2019	2,589	46,899	0.95	44,721	3,255.34
1	2020	2,441	46,816	0.95	44,642	3,106.17
2	2021	323	6,359	0.95	6,064	413.35
3	2022			0.95	0	0.00
4	2023			0.95	0	0.00
5	2024			0.95	0	0.00
6	2025			0.95	0	0.00
7	2026			0.95	0	0.00
8	2027			0.95	0	0.00
9	2028			0.95	0	0.00
10	2029			0.95	0	0.00
11	2030			0.95	0	0.00
12	2031			0.95	0	0.00
	Total	6,720	133,006	0.95	126,829	8,609.75

Note: SCF is Standard Conversion Factor. It is set at 0.95 which is often used by other projects.

Replacement Cost

(Unit: FC; million JPY, LC; million LAK)

	Year	Foreign cost (FC)	Local cost (LC)	SCF	Converted LC (LC)	Total Economic Cost (FC)
-4	2015			0.95	0.00	0.00
-3	2016			0.95	0.00	0.00
-2	2017			0.95	0.00	0.00
-1	2018			0.95	0.00	0.00
0	2019			0.95	0.00	0.00
1	2020			0.95	0.00	0.00
2	2021			0.95	0.00	0.00
3	2022			0.95	0.00	0.00
4	2023			0.95	0.00	0.00
5	2024			0.95	0.00	0.00
6	2025			0.95	0.00	0.00
7	2026			0.95	0.00	0.00
8	2027			0.95	0.00	0.00
9	2028			0.95	0.00	0.00
10	2029			0.95	0.00	0.00
11	2030			0.95	0.00	0.00
12	2031	6.2		0.95	0.00	6.20
13	2032	6.2		0.95	0.00	6.20
14	2033	6.2		0.95	0.00	6.20
15	2034	6.2		0.95	0.00	6.20
16	2035	832.2		0.95	0.00	832.20
17	2036	6.2		0.95	0.00	6.20
18	2037	6.2		0.95	0.00	6.20
19	2038	6.2		0.95	0.00	6.20
20	2039	6.2		0.95	0.00	6.20
21	2040	832.2		0.95	0.00	832.20
22	2041	6.2		0.95	0.00	6.20
23	2042	6.2		0.95	0.00	6.20
24	2043	6.2		0.95	0.00	6.20
25	2044	6.2		0.95	0.00	6.20
26	2045	6.2		0.95	0.00	6.20
27	2046	6.2		0.95	0.00	6.20
28	2047	6.2		0.95	0.00	6.20
29	2048	6.2		0.95	0.00	6.20
30	2049	6.2		0.95	0.00	6.20

Annual Operation and Maintenance Cost

(Unit: FC; million JPY, LC; million LAK)

	Year	Foreign cost (FC)	Local cost (LC)	SCF	Converted LC (LC)	Total Economic Cost (FC)
-4	2015			0.95	0.00	0.00
-3	2016			0.95	0.00	0.00
-2	2017			0.95	0.00	0.00
-1	2018			0.95	0.00	0.00
0	2019			0.95	0.00	0.00
1	2020 *1		1,139	0.95	1,082.05	16.12
2	2021		14,630	0.95	13,898.50	207.09
3	2022		15,430	0.95	14,658.50	218.41
4	2023		16,240	0.95	15,428.00	229.88
5	2024		17,040	0.95	16,188.00	241.20
6	2025		17,840	0.95	16,948.00	252.53
7	2026		17,840	0.95	16,948.00	252.53
8	2027		17,840	0.95	16,948.00	252.53
9	2028		17,840	0.95	16,948.00	252.53
10	2029		17,840	0.95	16,948.00	252.53
11	2030		17,840	0.95	16,948.00	252.53
12	2031		11,893	0.95	11,298.35	168.35
13	2032		11,893	0.95	11,298.35	168.35
14	2033		11,893	0.95	11,298.35	168.35
15	2034		11,893	0.95	11,298.35	168.35
16	2035		11,893	0.95	11,298.35	168.35
17	2036		11,893	0.95	11,298.35	168.35
18	2037		11,893	0.95	11,298.35	168.35
19	2038		11,893	0.95	11,298.35	168.35
20	2039		11,893	0.95	11,298.35	168.35
21	2040		11,893	0.95	11,298.35	168.35
22	2041		11,893	0.95	11,298.35	168.35
23	2042		11,893	0.95	11,298.35	168.35
24	2043		11,893	0.95	11,298.35	168.35
25	2044		11,893	0.95	11,298.35	168.35
26	2045		11,893	0.95	11,298.35	168.35
27	2046		11,893	0.95	11,298.35	168.35
28	2047		5,946	0.95	5,648.70	84.17
29	2048		5,946	0.95	5,648.70	84.17
30	2049		5,946	0.95	5,648.70	84.17

Note: *1; O&M costs of the year 2020 is assumed for 1 month.

Table A.17.8 Economic Benefit Stream of Proposed Water Supply Project

Phase 1 only

	Year	Water supply by the project			Benefit (million JPY)				
		Domestic (m^3/day)	Non domestic (m^3/day)	Total (m^3/day)	Alternative water supply			Saving water tank cost	Grand Total
					Domestic	Non domestic	Total		
-4	2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-3	2016	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-2	2017	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-1	2018	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0	2019	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	2020*1	50,308	21,892	72,200	176.15	31.91	208.06	1.26	209.32
2	2021	54,639	23,776	78,415	2,295.81	415.85	2,711.66	16.47	2,728.13
3	2022	58,971	25,661	84,632	2,477.83	448.82	2,926.65	17.78	2,944.43
4	2023	63,302	27,546	90,848	2,659.81	481.79	3,141.60	19.09	3,160.69
5	2024	67,633	29,430	97,063	2,841.79	514.74	3,356.53	20.39	3,376.92
6	2025	71,964	31,315	103,279	3,023.77	547.71	3,571.48	21.70	3,593.18
7	2026	72,595	31,589	104,184	3,050.29	552.50	3,602.79	21.89	3,624.68
8	2027	73,238	31,869	105,107	3,077.30	557.40	3,634.70	22.08	3,656.78
9	2028	73,892	32,154	106,046	3,104.78	562.38	3,667.16	22.28	3,689.44
10	2029	74,557	32,443	107,000	3,132.72	567.44	3,700.16	22.48	3,722.64
11	2030	75,235	32,738	107,973	3,161.21	572.59	3,733.80	22.68	3,756.48
12	2031	50,157	21,826	71,983	2,107.49	381.74	2,489.23	15.12	2,504.35
13	2032	50,157	21,826	71,983	2,107.49	381.74	2,489.23	15.12	2,504.35
14	2033	50,157	21,826	71,983	2,107.49	381.74	2,489.23	15.12	2,504.35
15	2034	50,157	21,826	71,983	2,107.49	381.74	2,489.23	15.12	2,504.35
16	2035	50,157	21,826	71,983	2,107.49	381.74	2,489.23	15.12	2,504.35
17	2036	50,157	21,826	71,983	2,107.49	381.74	2,489.23	15.12	2,504.35
18	2037	50,157	21,826	71,983	2,107.49	381.74	2,489.23	15.12	2,504.35
19	2038	50,157	21,826	71,983	2,107.49	381.74	2,489.23	15.12	2,504.35
20	2039	50,157	21,826	71,983	2,107.49	381.74	2,489.23	15.12	2,504.35
21	2040	50,157	21,826	71,983	2,107.49	381.74	2,489.23	15.12	2,504.35
22	2041	50,157	21,826	71,983	2,107.49	381.74	2,489.23	15.12	2,504.35
23	2042	50,157	21,826	71,983	2,107.49	381.74	2,489.23	15.12	2,504.35
24	2043	50,157	21,826	71,983	2,107.49	381.74	2,489.23	15.12	2,504.35
25	2044	50,157	21,826	71,983	2,107.49	381.74	2,489.23	15.12	2,504.35
26	2045	50,157	21,826	71,983	2,107.49	381.74	2,489.23	15.12	2,504.35
27	2046	50,157	21,826	71,983	2,107.49	381.74	2,489.23	15.12	2,504.35
28	2047	25,078	10,913	35,991	1,053.72	190.87	1,244.59	15.12	1,259.71
29	2048	25,078	10,913	35,991	1,053.72	190.87	1,244.59	15.12	1,259.71
30	2049	25,078	10,913	35,991	1,053.72	190.87	1,244.59	15.12	1,259.71

Note: *1; Water supply volume of the year 2020 is assumed for 1 month.

	Year	Project water supply volume (m3/day)			
		Phase 1			
		Household	Commer-cial	Industry	Total
-4	2015				
-3	2016	0.00	0.00	0.00	0.00
-2	2017	0.00	0.00	0.00	0.00
-1	2018	0.00	0.00	0.00	0.00
0	2019	0.00	0.00	0.00	0.00
1	2020	50,308	10,457	11,434	72,200
2	2021	54,639	11,358	12,419	78,416
3	2022	58,971	12,258	13,403	84,632
4	2023	63,302	13,158	14,387	90,847
5	2024	67,633	14,059	15,372	97,063
6	2025	71,964	14,959	16,356	103,279
7	2026	72,595	15,090	16,499	104,184
8	2027	73,238	15,224	16,645	105,107
9	2028	73,892	15,360	16,794	106,046
10	2029	74,557	15,498	16,945	107,000
11	2030	75,235	15,639	17,099	107,973
12	2031	50,157	10,426	11,400	71,983
13	2032	50,157	10,426	11,400	71,983
14	2033	50,157	10,426	11,400	71,983
15	2034	50,157	10,426	11,400	71,983
16	2035	50,157	10,426	11,400	71,983
17	2036	50,157	10,426	11,400	71,983
18	2037	50,157	10,426	11,400	71,983
19	2038	50,157	10,426	11,400	71,983
20	2039	50,157	10,426	11,400	71,983
21	2040	50,157	10,426	11,400	71,983
22	2041	50,157	10,426	11,400	71,983
23	2042	50,157	10,426	11,400	71,983
24	2043	50,157	10,426	11,400	71,983
25	2044	50,157	10,426	11,400	71,983
26	2045	50,157	10,426	11,400	71,983
27	2046	50,157	10,426	11,400	71,983
28	2047	25,078	5,213	5,700	35,991
29	2048	25,078	5,213	5,700	35,991
30	2049	25,078	5,213	5,700	35,991

Exchange rate:	0.0149	JPY/LAK	67.11	LAK/JPY
	120.4	JPY/USD	8,094.6	LAK/USD

Item	Unit cost for water acquisition		SCF	Converted LC	FC	
Domestic	8,132.70	LAK/m3	0.95	7,726.0	115.12	JPY/m3
Non Domestic	3,384.80	LAK/m3	0.95	3,216.0	47.92	JPY/m3

Scenario and Assumptions for Calculation of Economic Benefit of Water Supply Project

Exchange rate:	0.0149	JPY/LAK	67.11	LAK/JPY
	120.4	JPY/USD	8,094.6	LAK/USD

1 Economic Benefit originated from saving alternative water acquisition costs

1.1 Domestic User

Assumed without the Project case, public water supply system will not be able to cover the increasing water demand. Therefore, increased amount of water demand shall be satisfied with alternative water supply systems (Open well with pump or without pump, or Deep well with pump).

For simplification, it is assumed in our analysis that 1 unit of Open well without pump is shared by 4 household. It is assumed that the other well with pump are owned by each household. Average number of water supply facilities for each household is as follows;

Number of wells for each household

Type of Water Supply	Number of Facilities / Household
Open well without pump	0.25
Open well with pump	1.00
Deep well with pump	1.00

Combining the above data and the Annual Cost of Construction, Operation, & Maintenance of each Alternative Water Supply System, annual cost for each well per household are calculated as follows;

Type of Wells	Number of Facilities / Household	Annual cost for Construction, O&M	Annual cost for water supply / household
Open well without pump	0.25	1,541,480 LAK/year	385,370 LAK/year
Open well with pump	1.00	3,556,902 LAK/year	3,556,902 LAK/year
Deep well with pump	1.00	6,956,691 LAK/year	6,956,691 LAK/year

Share of each Type of Wells are shown below based on the results of Socio-economic survey (Interview survey). Weighted average annual cost for well/household can be calculated by utilizing the share data as follows;

Type of Wells	Share	Annual cost for water supply / household	Weighted average annual cost for well/household
Open well without pump	4.3 %	385,370 LAK/year	4,290,872 LAK/year
Open well with pump	70.1 %	3,556,902 LAK/year	
Deep well with pump	25.6 %	6,956,691 LAK/year	
Total	100.0 %		

As a result, cost for alternative water acquisition methods other than public water supply shall be listed in the following table.

Method of Water Acquisition	Weighted average cost for water acquisition (LAK/household per year)	Average size of household (persons/household)	Domestic Water Consumption (liter/capita per day)	Unit Cost for water acquisition (LAK/m3)
Well	4,290,872	5.90	245	**8,132.7**

1.2 Non Domestic User

Assumed without the Project case, public water supply system will not be able to cover the increasing water demand. Therefore, increased amount of water demand shall be satisfied with alternative water supply systems. For simplification, and based on the result of Socio-economic survey (Interview survey), non domestic users are assumed to utilize Open well with pump or Deep well with pump, in order to satisfy their scarcity of water, without the Project case in our analysis.

From the existing data of NPNL, average water consumption volume per customer for non-domestic is as follows;

	Water consumption vol.	Customer number	Average water consumption vol.
Non-Domestic	1,352,668 m^3/month	5,966 customers	2,721.00 m3/year per customer

Share of each Type of Wells and Annual cost for wells are shown below based on the results of Socio-economic survey (Interview survey). Annual cost for well including construction cost and O&M costs are also calculated and shown below. Weighted average annual cost for well/household can be calculated by utilizing these data as follows;

Type of Wells	Share	Annual cost for well / unit	Weighted average annual cost for well/unit
Open well with pump	53.3 %	6,916,326 LAK/year	9,210,147 LAK/year
Deep well with pump	46.7 %	11,828,148 LAK/year	
Total	100.0 %		

Annual unit cost for non-domestic is as follows;

Type of Water Supply	Annual cost for construction, O&M	Average water consumption vol. (m3/year per customer)	Unit Cost for water acquisition (LAK/m3)
Well with pump	9,210,147	2,721.0	**3,384.8**

2 Economic Benefit originated from solving water supply stoppage

According to the Socio-economic survey (Interview survey), 25.6% of the household in Vientiane Capital store water in the residential area. After the completion of the project, because of the expansion of water supply, water storage tank will be decreased. It is economic benefit by solving water supply stoppage. For simplicity, it is asumed that total number of water tank will be fewer at 50% in the water supply area of the project.

Facility	No. of HH customer in service area	Existing rate of utilizing water tank	Total number of water tank in service area	Reduction of water tank	Saved number of water tank
Water tank (2025)	49,785	25.6 %	12,745	50%	6,372

Annual cost for water tank (construction, O&M) per household is calculated as follows. In this analysis, it is assumed that the water tank shall be usable for 15 years on average.

Type of Water Supply	Annual cost of facilities (LAK/year per customer)
Water Tank	228,527

Economic benefit from solving water supply stoppage shall be originated from the completion of the project, and the amount shall be estimated as follows;

Year	No. of HH customer in service area	No. of water tank to be saved	Total Benefit of Saving Water Tanks (LAK/year)
2020 *1	34,803	4,455	84,840,649
2021	37,800	4,838	1,105,613,626
2022	40,796	5,222	1,193,367,994
2023	43,792	5,605	1,280,893,835
2024	46,789	5,989	1,368,648,203
2025	49,785	6,372	1,456,174,044
2026	50,221	6,428	1,468,971,556
2027	50,666	6,485	1,481,997,595
2028	51,119	6,543	1,495,252,161
2029	51,579	6,602	1,508,735,254
2030	52,048	6,662	1,522,446,874
2031	34,699	4,441	1,014,888,407
2032	34,699	4,441	1,014,888,407
2033	34,699	4,441	1,014,888,407
2034	34,699	4,441	1,014,888,407

Note; *1; Benefits of the year 2020 are assumed for 1 month.

Annual Cost of Construction, Operation, & Maintenance of Alternative Water Supply System

		Interest rate								Interest rate		Economic period		Capital Recovery Factor	Annualized construction cost		Present Value				Annualized construction cost	O&M cost /year	**Annual Construction + O&M cost**	
CRF*	**=**	**r**	**/(**	**1**	**-**	**1**	**/(**	**1**	**+**	**r**	**)**	**^**	**n**	**)**		**Pn**	**=**	**So**	**x**	**CRF**				
*; Capital Recovery Factor																							Unit: LAK	
	1	**Annual Cost**				**Open Well without Pump**								**Domestic**										
		13.7%	/(	1	-	1	/(	1	+	13.7%	)	^	15	) = 0.16037		**Water tank**		0	x	0.16037	=	0	0	**0**
		13.7%	/(	1	-	1	/(	1	+	13.7%	)	^	10	) = 0.18947		**Pump**		0	x	0.18947	=	0		**0**
		13.7%	/(	1	-	1	/(	1	+	13.7%	)	^	10	) = 0.18947		**Generator**		0	x	0.18947	=	0	0	**0**
		13.7%	/(	1	-	1	/(	1	+	13.7%	)	^	15	) = 0.16037		**Well**		4,000,000	x	0.16037	=	641,480	900,000	**1,541,480**
																Total		4,000,000						
																Annual cost for Construction, O&M								
																Tube well with Pump & Water Tank							**1,541,480**	**LAK/year**
	2	**Annual Cost**				**Open Well with Pump**								**Domestic**										
		13.7%	/(	1	-	1	/(	1	+	13.7%	)	^	15	) = 0.16037		**Water tank**		1,500,000	x	0.16037	=	240,555	0	**240,555**
		13.7%	/(	1	-	1	/(	1	+	13.7%	)	^	10	) = 0.18947		**Pump**		1,500,000	x	0.18947	=	284,205		**284,205**
		13.7%	/(	1	-	1	/(	1	+	13.7%	)	^	10	) = 0.18947		**Generator**		4,900,000	x	0.18947	=	928,403	0	**928,403**
		13.7%	/(	1	-	1	/(	1	+	13.7%	)	^	15	) = 0.16037		**Well**		4,700,000	x	0.16037	=	753,739	1,350,000	**2,103,739**
																		12,600,000						
																Annual cost for Construction, O&M								
																Tube well with Pump & Water Tank							**3,556,902**	**LAK/year**
	3	**Annual Cost**				**Open Well with Pump**								**Non-Domestic**										
		13.7%	/(	1	-	1	/(	1	+	13.7%	)	^	15	) = 0.16037		**Water tank**		2,500,000	x	0.16037	=	400,925	0	**400,925**
		13.7%	/(	1	-	1	/(	1	+	13.7%	)	^	10	) = 0.18947		**Pump**		2,500,000	x	0.18947	=	473,675		**473,675**
		13.7%	/(	1	-	1	/(	1	+	13.7%	)	^	10	) = 0.18947		**Generator**		7,500,000	x	0.18947	=	1,421,025	0	**1,421,025**
		13.7%	/(	1	-	1	/(	1	+	13.7%	)	^	15	) = 0.16037		**Well**		7,300,000	x	0.16037	=	1,170,701	3,450,000	**4,620,701**
																		19,800,000						
																Annual cost for Construction, O&M								
																Tube well with Pump & Water Tank							**6,916,326**	**LAK/year**

	4	**Annual Cost** **Deep Well with Pump**	**Domestic**										
		13.7% /(1 - 1 /(1 + 13.7%) ^ 15)	=	0.16037	**Water tank**	1,500,000	x	0.16037	=	240,555	0	**240,555**	
		13.7% /(1 - 1 /(1 + 13.7%) ^ 10)	=	0.18947	**Pump**	2,000,000	x	0.18947	=	378,940	0	**378,940**	
		13.7% /(1 - 1 /(1 + 13.7%) ^ 10)	=	0.18947	**Generator**	4,900,000	x	0.18947	=	928,403	0	**928,403**	
		13.7% /(1 - 1 /(1 + 13.7%) ^ 20)	=	0.14838	**Well**	15,560,000	x	0.14838	=	2,308,793	3,100,000	**5,408,793**	
						23,960,000							
					Annual cost for Construction, O&M								
					Tube well with Pump & Water Tank							**6,956,691**	**LAK/year**
	5	**Annual Cost** **Deep Well with Pump**	**Non-Domestic**										
		13.7% /(1 - 1 /(1 + 13.7%) ^ 15)	=	0.16037	**Water tank**	4,500,000	x	0.16037	=	721,665	0	**721,665**	
		13.7% /(1 - 1 /(1 + 13.7%) ^ 10)	=	0.18947	**Pump**	4,000,000	x	0.18947	=	757,880		**757,880**	
		13.7% /(1 - 1 /(1 + 13.7%) ^ 10)	=	0.18947	**Generator**	7,500,000	x	0.18947	=	1,421,025	0	**1,421,025**	
		13.7% /(1 - 1 /(1 + 13.7%) ^ 20)	=	0.14838	**Well**	23,100,000	x	0.14838	=	3,427,578	5,500,000	**8,927,578**	
						39,100,000							
					Annual cost for Construction, O&M of Water tank								
					Tube well with Pump & Water Tank							**11,828,148**	**LAK/year**
	6	**Annual Cost** **Water Tank**	**Domestic**										
		13.7% /(1 - 1 /(1 + 13.7%) ^ 15)	=	0.16037	**Water tank**	1,500,000	x	0.16037	=	240,555	0	**240,555**	**LAK/year**
Notes:	*1;	Average interest rate of those between the year 2009 and 2013.											

Construction and O&M Costs for each Wells

Open Well without Pump			For Domestic
Construction cost			
1	Survey	LAK	200,000.00
2	Mobilization cost	LAK	300,000.00
3	Open well digging cost	LAK	1,500,000.00
4	Reinforcement of inside well wall (cement /brick)	LAK	1,500,000.00
5	Pump	LAK	Not applicable
6	Piping to tank	LAK	Not applicable
7	Water tank	LAK	Not applicable
8	Piping in yard	LAK	Not applicable
9	Generator	LAK	Not applicable
10	Others	LAK	500,000.00
	TOTAL	LAK	4,000,000.00
O&M cost			
1	Removal of blockage	LAK/ year	800,000.00
2	Electricity	LAK/ year	Not applicable
3	Repair costs	LAK/ year	100,000.00
	TOTAL O&M COSTS	LAK/ year	900,000.00

Open Well with Pump			For Domestic
Construction cost			
1	Survey	LAK	250,000.00
2	Mobilization cost	LAK	300,000.00
3	Open well digging cost	LAK	1,500,000.00
4	Reinforcement of inside well wall (cement /brick)	LAK	1,500,000.00
5	Pump	LAK	1,500,000.00
6	Piping to tank	LAK	300,000.00
7	Water tank	LAK	1,500,000.00
8	Piping in yard	LAK	350,000.00
9	Generator	LAK	4,900,000.00
10	Others	LAK	500,000.00
	TOTAL	LAK	12,600,000.00
	TOTAL without Pump	LAK	11,100,000.00
O&M cost			
1	Removal of blockage	LAK/ year	800,000.00
2	Electricity	LAK/ year	250,000.00
3	Repair costs	LAK/ year	300,000.00
	TOTAL O&M COSTS	LAK/ year	1,350,000.00

Open Well with Pump			For Non-Domestic
Construction cost			
1	Survey	LAK	450,000.00
2	Mobilization cost	LAK	550,000.00
3	Open well digging cost	LAK	2,200,000.00
4	Reinforcement of inside well wall (cement /brick)	LAK	2,000,000.00
5	Pump	LAK	2,500,000.00
6	Piping to tank	LAK	650,000.00
7	Water tank	LAK	2,500,000.00
8	Piping in yard	LAK	800,000.00
9	Generator	LAK	7,500,000.00
10	Others	LAK	650,000.00
	TOTAL	LAK	19,800,000.00
	TOTAL without Pump	LAK	17,300,000.00
O&M cost			
1	Removal of blockage	LAK/ year	1,500,000.00
2	Electricity	LAK/ year	1,500,000.00
3	Repair costs	LAK/ year	450,000.00
	TOTAL O&M COSTS	LAK/ year	3,450,000.00

Deep Well with Pump			For Domestic
Construction cost			
1	Survey	LAK	500,000.00
2	Mobilization cost	LAK	1,000,000.00
3	Drilling cost	LAK	7,000,000.00
4	Flushing cost	LAK	2,000,000.00
5	Casing cost	LAK	2,000,000.00
6	Galvanized pipe cost	LAK	260,000.00
7	Well cap	LAK	800,000.00
8	Pump	LAK	2,000,000.00
9	Water tank	LAK	1,500,000.00
10	Electricity panel	LAK	Not applicable
11	Generator	LAK	4,900,000.00
12	Filter	LAK	1,000,000.00
13	Others (if any)	LAK	1,000,000.00
	TOTAL	LAK	23,960,000.00
	TOTAL without Pump	LAK	21,960,000.00
O&M cost			
1	Removal of blockage	LAK/ year	2,500,000.00
2	Electricity	LAK/ year	250,000.00
3	Repair costs	LAK/ year	350,000.00
	TOTAL O&M COSTS	LAK/ year	3,100,000.00

Deep Well with Pump			For Non-Domestic	
Construction cost				
1	Survey	LAK	2,000,000.00	
2	Mobilization cost	LAK	2,000,000.00	
3	Drilling cost	LAK	7,000,000.00	
4	Flushing cost	LAK	2,000,000.00	
5	Casing cost	LAK	2,000,000.00	
6	Galvanized pipe cost	LAK	800,000.00	50 m
7	Well cap	LAK	800,000.00	
8	Pump	LAK	4,000,000.00	
9	Water tank	LAK	4,500,000.00	
10	Electricity panel	LAK	4,500,000.00	
11	Generator	LAK	7,500,000.00	
12	Filter	LAK	1,000,000.00	
13	Others (if any)	LAK	1,000,000.00	
	TOTAL	LAK	39,100,000.00	
	TOTAL without Pump	LAK	35,100,000.00	
O&M cost				
1	Removal of blockage	LAK/ year	3,500,000.00	
2	Electricity	LAK/ year	1,500,000.00	
3	Repair costs	LAK/ year	500,000.00	
	TOTAL O&M COSTS	LAK/ year	5,500,000.00	

A.17.3 Financial Plan of NPNL

Financial Plan of NPNL

Tariff raise (in addition to inflation adjustment): 0.0% in the year 2020, 2025, 2030, 2035, and 2040

1. Income Statement Projection for NPNL

Unit: million LAK

			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
No.	**Items**	**Year**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**
1	**Income**		110,938	117,364	127,982	139,138	152,404	168,778	177,054	185,421	197,123	208,825	220,526	232,228	243,929	255,381	266,833	278,286
1.1	Water revenue		107,423	113,656	124,081	135,044	148,117	164,298	172,381	180,476	191,906	203,336	214,765	226,195	237,625	248,806	259,987	271,169
1.2	Other income		3,515	3,708	3,901	4,094	4,287	4,480	4,673	4,945	5,217	5,489	5,761	6,033	6,304	6,575	6,846	7,117
2	**Expenditure**		114,094	114,721	137,486	151,367	164,306	176,829	198,736	225,583	230,802	243,027	245,740	248,591	251,562	259,447	260,287	261,258
2.1	O&M costs		90,286	91,707	99,080	109,771	120,424	130,660	150,281	157,323	161,396	172,475	174,043	175,748	177,573	184,312	184,007	183,832
	Bulk water purchase		10,841	10,841	10,841	14,158	17,438	20,302	32,550	35,603	35,687	42,777	40,355	38,071	35,916	40,660	38,358	36,187
	Staff salary [*1]		25,877	27,297	28,718	30,139	31,560	32,981	34,402	36,407	38,412	40,417	42,422	44,427	46,423	48,419	50,415	52,411
	Electricity [*2]		15,464	15,464	17,183	18,901	20,619	22,337	24,056	24,628	25,201	25,774	26,347	26,919	27,492	27,492	27,492	27,492
	Procurement, repair, outsourcing, etc [*2]		38,105	38,105	42,339	46,572	50,806	55,040	59,274	60,685	62,096	63,508	64,919	66,330	67,742	67,742	67,742	67,742
2.2	Depreciation cost		23,808	23,015	38,406	41,596	43,882	46,168	48,455	68,260	69,406	70,551	71,697	72,843	73,989	75,135	76,280	77,426
3	**Operating income**		-3,156	2,643	-9,504	-12,228	-11,902	-8,051	-21,682	-40,162	-33,679	-34,202	-25,214	-16,363	-7,633	-4,066	6,546	17,028
	Non operating income [*3]		2,568	2,645	2,724	2,806	2,890	2,977	3,066	3,158	3,253	3,351	3,451	3,555	3,661	3,771	3,884	4,001
	Non operating cost [*4]		3,883	6,502	17,395	20,604	23,831	27,059	30,286	31,522	31,923	32,336	32,748	33,161	33,573	33,079	32,599	32,161
4	**Net Profit / Loss before tax**		**-4,471**	**-1,214**	**-24,174**	**-30,027**	**-32,843**	**-32,132**	**-48,901**	**-68,526**	**-62,349**	**-63,187**	**-54,511**	**-45,969**	**-37,545**	**-33,374**	**-22,168**	**-11,132**
	Tax for Profit [*5]		241	293	320	348	381	422	443	464	493	522	551	581	610	638	667	696
5	**Net Profit / after Profit tax**		**-4,712**	**-1,508**	**-24,494**	**-30,374**	**-33,224**	**-32,554**	**-49,344**	**-68,989**	**-62,842**	**-63,709**	**-55,062**	**-46,549**	**-38,155**	**-34,012**	**-22,835**	**-11,828**
	Tax after Profit Tax [*5]		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	**Net Profit / Loss after tax**		**-4,712**	**-1,508**	**-24,494**	**-30,374**	**-33,224**	**-32,554**	**-49,344**	**-68,989**	**-62,842**	**-63,709**	**-55,062**	**-46,549**	**-38,155**	**-34,012**	**-22,835**	**-11,828**

2. Cash Flow Statement Projection for NPNL

Unit: million LAK

			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
No.	**Items**	**Year**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**
1	**Cash Flows from Operating Activities**																	
	(Loss) / profit after tax		-4,712	-1,508	-24,494	-30,374	-33,224	-32,554	-49,344	-68,989	-62,842	-63,709	-55,062	-46,549	-38,155	-34,012	-22,835	-11,828
	Adjustment for:																	
	Depreciation		23,808	23,015	38,406	41,596	43,882	46,168	48,455	68,260	69,406	70,551	71,697	72,843	73,989	75,135	76,280	77,426
	Net cash flows from operating activities		**19,096**	**21,507**	**13,912**	**11,221**	**10,658**	**13,614**	**-889**	**-730**	**6,563**	**6,842**	**16,635**	**26,294**	**35,834**	**41,122**	**53,445**	**65,598**
2	**Cash Flows from Investing Activities**																	
	Purchase of property, plant, and equipment			30,109	600,234	185,234	185,234	185,234	185,234	68,442	43,098	43,098	43,098	43,098	43,098	43,098	43,098	43,098
	Net cash flows used in investing activities		**0**	**30,109**	**600,234**	**185,234**	**185,234**	**185,234**	**185,234**	**68,442**	**43,098**	**43,098**	**43,098**	**43,098**	**43,098**	**43,098**	**43,098**	**43,098**
3	**Cash Flows from Financing Activities**																	
	Long-term loan borrowing			28,608	611,556	174,139	174,139	174,139	173,881	45,223	20,626	20,626	20,626	20,626	-29,104	-29,104	-26,275	-26,275
	Increase of long-term liabilities		66,208	94,816	706,372	880,511	1,054,649	1,228,788	1,402,669	1,447,892	1,468,518	1,489,144	1,509,770	1,530,396	1,501,292	1,472,187	1,445,913	1,419,638
	Net cash flows used in financing activities		**0**	**28,608**	**611,556**	**174,139**	**174,139**	**174,139**	**173,881**	**45,223**	**20,626**	**20,626**	**20,626**	**20,626**	**-29,104**	**-29,104**	**-26,275**	**-26,275**
	Net cash flows financing minus investing activities			-1,501	11,322	-11,095	-11,095	-11,095	-11,353	-23,219	-22,472	-22,472	-22,472	-22,472	-72,202	-72,202	-69,373	-69,373
4	**Net increase / (decrease) in cash**		19,096	20,006	25,234	126	-437	2,519	-12,242	-23,949	-15,908	-15,630	-5,837	3,822	-36,368	-31,080	-15,928	-3,774
	Cash at the beginning of the year		1,429	20,526	40,532	65,766	65,892	65,454	67,973	55,731	31,782	15,874	244	-5,593	-1,771	-38,139	-69,219	-85,147
5	**Cash at the end of the year**		**20,526**	**40,532**	**65,766**	**65,892**	**65,454**	**67,973**	**55,731**	**31,782**	**15,874**	**244**	**-5,593**	**-1,771**	**-38,139**	**-69,219**	**-85,147**	**-88,921**

No.	**Items**	**Year**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**
	Necessary tariff raise (%)		as scheduled	as scheduled	as scheduled	as scheduled	as scheduled	as scheduled	0.0%	**0.0%**	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Note:
*1; Staff salary is assumed to increase with the same rate as production capacity increase.
*2; Electricity and Procurement, repair, outsourcing, cost are assumed to increase with the same rate as production capacity of NPNL's WTPs.
*3; Non operating income is assumed to increase at additional 3% per year
*4; Non operating cost includes interest payments.
*5; Tax rate for NPNL is as follows;

Tax on NPNL

Tax items	%	formula	cases
Tax for Profit	24.0%	x Profit	
	0.25%	x water revenue	in case of loss
Tax after Profit Tax	60.0%	x Profit after tax	
	0.0%		in case of loss
	Total		

Financial Plan of NPNL

1. Income Statement Projection for NPNL

			16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
No.	**Items**	**Year**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**
1	**Income**		289,738	300,990	303,800	303,800	303,800	303,800	303,800	303,800	303,800	303,800	303,800	303,800	303,800	303,800	303,800
1.1	Water revenue		282,350	293,531	296,341	296,341	296,341	296,341	296,341	296,341	296,341	296,341	296,341	296,341	296,341	296,341	296,341
1.2	Other income		7,388	7,459	7,459	7,459	7,459	7,459	7,459	7,459	7,459	7,459	7,459	7,459	7,459	7,459	7,459
2	**Expenditure**		268,041	272,821	277,474	273,942	270,564	267,333	261,160	256,798	250,783	244,889	239,109	233,437	229,007	224,674	220,431
2.1	O&M costs		189,469	193,103	198,550	195,811	193,227	190,789	188,490	188,002	185,860	183,839	181,933	180,135	178,438	176,838	175,328
	Bulk water purchase		39,828	42,942	48,388	45,649	43,065	40,628	38,328	37,840	35,698	33,678	31,771	29,973	28,276	26,676	25,166
	Staff salary[*1]		54,407	54,928	54,928	54,928	54,928	54,928	54,928	54,928	54,928	54,928	54,928	54,928	54,928	54,928	54,928
	Electricity[*2]		27,492	27,492	27,492	27,492	27,492	27,492	27,492	27,492	27,492	27,492	27,492	27,492	27,492	27,492	27,492
	Procurement, repair, outsourcing, etc[*2]		67,742	67,742	67,742	67,742	67,742	67,742	67,742	67,742	67,742	67,742	67,742	67,742	67,742	67,742	67,742
2.2	Depreciation cost		78,572	79,718	78,924	78,131	77,337	76,543	72,670	68,796	64,923	61,049	57,176	53,302	50,569	47,836	45,103
3	**Operating income**		21,697	28,169	26,326	29,859	33,236	36,467	42,641	47,002	53,017	58,911	64,691	70,363	74,793	79,126	83,369
	Non operating income[*3]		4,121	4,244	4,372	4,503	4,638	4,777	4,921	5,068	5,220	5,377	5,538	5,704	5,875	6,052	6,233
	Non operating cost[*4]		31,723	31,285	29,985	28,254	26,565	24,890	24,332	22,657	20,982	19,306	17,631	17,073	15,339	13,605	11,871
4	**Net Profit / Loss before tax**		**-5,905**	**1,128**	**713**	**6,107**	**11,309**	**16,355**	**23,229**	**29,413**	**37,256**	**44,982**	**52,598**	**58,994**	**65,329**	**71,572**	**77,731**
	Tax for Profit[*5]		724	271	171	1,466	2,714	3,925	5,575	7,059	8,941	10,796	12,623	14,159	15,679	17,177	18,655
5	**Net Profit / after Profit tax**		**-6,630**	**858**	**542**	**4,642**	**8,595**	**12,429**	**17,654**	**22,354**	**28,314**	**34,186**	**39,974**	**44,835**	**49,650**	**54,395**	**59,075**
	Tax after Profit Tax[*5]		0	515	325	2,785	5,157	7,458	10,592	13,412	16,989	20,512	23,985	26,901	29,790	32,637	35,445
6	**Net Profit / Loss after tax**		**-6,630**	**343**	**217**	**1,857**	**3,438**	**4,972**	**7,062**	**8,942**	**11,326**	**13,674**	**15,990**	**17,934**	**19,860**	**21,758**	**23,630**

2. Cash Flow Statement Projection for NPNL

			16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
No.	**Items**	**Year**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**
1	**Cash Flows from Operating Activities**																
	(Loss) / profit after tax		-6,630	343	217	1,857	3,438	4,972	7,062	8,942	11,326	13,674	15,990	17,934	19,860	21,758	23,630
	Adjustment for:																
	Depreciation		78,572	79,718	78,924	78,131	77,337	76,543	72,670	68,796	64,923	61,049	57,176	53,302	50,569	47,836	45,103
	Net cash flows from operating activities		**71,942**	**80,061**	**79,141**	**79,987**	**80,775**	**81,515**	**79,731**	**77,738**	**76,249**	**74,724**	**73,166**	**71,236**	**70,429**	**69,594**	**68,733**
2	**Cash Flows from Investing Activities**																
	Purchase of property, plant, and equipment		43,098	43,098	416	416	416	416	55,852	416	416	416	416	55,852	416	416	416
	Net cash flows used in investing activities		**43,098**	**43,098**	**416**	**416**	**416**	**416**	**55,852**	**416**	**416**	**416**	**416**	**55,852**	**416**	**416**	**416**
3	**Cash Flows from Financing Activities**																
	Long-term loan borrowing		-26,275	-26,275	-90,922	-89,484	-88,137	-88,137	-32,285	-88,137	-88,137	-88,137	-88,137	-35,225	-91,077	-91,077	-91,077
	Increase of long-term liabilities		1,393,363	1,367,089	1,276,167	1,186,683	1,098,545	1,010,408	978,123	889,986	801,849	713,712	625,574	590,350	499,273	408,196	317,119
	Net cash flows used in financing activities		**-26,275**	**-26,275**	**-90,922**	**-89,484**	**-88,137**	**-88,137**	**-32,285**	**-88,137**	**-88,137**	**-88,137**	**-88,137**	**-35,225**	**-91,077**	**-91,077**	**-91,077**
	Net cash flows financing minus investing activities		-69,373	-69,373	-91,338	-89,900	-88,553	-88,553	-88,137	-88,553	-88,553	-88,553	-88,553	-91,077	-91,493	-91,493	
4	**Net increase / (decrease) in cash**		2,570	10,688	-12,197	-9,913	-7,778	-7,038	-8,406	-10,815	-12,305	-13,829	-15,388	-19,840	-21,064	-21,899	-22,759
	Cash at the beginning of the year		-88,921	-86,352	-75,664	-87,861	-97,774	-105,552	-112,590	-120,996	-131,811	-144,116	-157,945	-173,333	-193,173	-214,237	-236,135
5	**Cash at the end of the year**		**-86,352**	**-75,664**	**-87,861**	**-97,774**	**-105,552**	**-112,590**	**-120,996**	**-131,811**	**-144,116**	**-157,945**	**-173,333**	**-193,173**	**-214,237**	**-236,135**	**-258,895**

No.	**Items**	**Year**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**
	Necessary tariff raise (%)		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Note: *1; Staff salary is assumed to increase with the same rate as production capacity increase.

*2; Electricity and Procurement, repair, outsourcing, cost are assumed to increase with the same rate as production capacity of NPNL's WTPs.

*3; Non operating income is assumed to increase at additional 3% per year

*4; Non operating cost includes interest payments.

*5; Tax rate for NPNL is as follows;

Financial Plan of NPNL

Tariff raise (in addition to inflation adjustment): 3.5% in the year 2020, 2025, 2030, 2035, and 2040

1. Income Statement Projection for NPNL

Unit: million LAK

			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
No.	**Items**	**Year**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**
1	**Income**		110,938	117,364	127,982	139,138	152,404	168,778	177,054	191,738	203,840	215,941	228,043	240,145	260,854	273,102	285,351	297,600
1.1	Water revenue		107,423	113,656	124,081	135,044	148,117	164,298	172,381	186,793	198,623	210,452	222,282	234,112	254,550	266,527	278,505	290,483
1.2	Other income		3,515	3,708	3,901	4,094	4,287	4,480	4,673	4,945	5,217	5,489	5,761	6,033	6,304	6,575	6,846	7,117
2	**Expenditure**		114,094	114,721	137,486	151,367	164,306	176,829	198,736	225,583	230,802	243,027	245,740	248,591	251,562	259,447	260,287	261,258
2.1	O&M costs		90,286	91,707	99,080	109,771	120,424	130,660	150,281	157,323	161,396	172,475	174,043	175,748	177,573	184,312	184,007	183,832
	Bulk water purchase		10,841	10,841	10,841	14,158	17,438	20,302	32,550	35,603	35,687	42,777	40,355	38,071	35,916	40,660	38,358	36,187
	Staff salary[*1]		25,877	27,297	28,718	30,139	31,560	32,981	34,402	36,407	38,412	40,417	42,422	44,427	46,423	48,419	50,415	52,411
	Electricity[*2]		15,464	15,464	17,183	18,901	20,619	22,337	24,056	24,628	25,201	25,774	26,347	26,919	27,492	27,492	27,492	27,492
	Procurement, repair, outsourcing, etc[*2]		38,105	38,105	42,339	46,572	50,806	55,040	59,274	60,685	62,096	63,508	64,919	66,330	67,742	67,742	67,742	67,742
2.2	Depreciation cost		23,808	23,015	38,406	41,596	43,882	46,168	48,455	68,260	69,406	70,551	71,697	72,843	73,989	75,135	76,280	77,426
3	**Operating income**		-3,156	2,643	-9,504	-12,228	-11,902	-8,051	-21,682	-33,845	-26,962	-27,085	-17,697	-8,446	9,292	13,655	25,064	36,342
	Non operating income[*3]		2,568	2,645	2,724	2,806	2,890	2,977	3,066	3,158	3,253	3,351	3,451	3,555	3,661	3,771	3,884	4,001
	Non operating cost[*4]		3,883	6,502	17,395	20,604	23,831	27,059	30,286	31,522	31,923	32,336	32,748	33,161	33,573	33,079	32,599	32,161
4	**Net Profit / Loss before tax**		**-4,471**	**-1,214**	**-24,174**	**-30,027**	**-32,843**	**-32,132**	**-48,901**	**-62,209**	**-55,633**	**-56,070**	**-46,994**	**-38,052**	**-20,620**	**-15,652**	**-3,651**	**8,182**
	Tax for Profit[*5]		241	293	320	348	381	422	443	479	510	540	570	600	652	683	713	1,964
5	**Net Profit / after Profit tax**		**-4,712**	**-1,508**	**-24,494**	**-30,374**	**-33,224**	**-32,554**	**-49,344**	**-62,688**	**-56,142**	**-56,610**	**-47,564**	**-38,652**	**-21,272**	**-16,335**	**-4,364**	**6,218**
	Tax after Profit Tax[*5]		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3,731
6	**Net Profit / Loss after tax**		**-4,712**	**-1,508**	**-24,494**	**-30,374**	**-33,224**	**-32,554**	**-49,344**	**-62,688**	**-56,142**	**-56,610**	**-47,564**	**-38,652**	**-21,272**	**-16,335**	**-4,364**	**2,487**

2. Cash Flow Statement Projection for NPNL

Unit: million LAK

			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
No.	**Items**	**Year**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**
1	**Cash Flows from Operating Activities**																	
	(Loss) / profit after tax		-4,712	-1,508	-24,494	-30,374	-33,224	-32,554	-49,344	-62,688	-56,142	-56,610	-47,564	-38,652	-21,272	-16,335	-4,364	2,487
	Adjustment for:																	
	Depreciation		23,808	23,015	38,406	41,596	43,882	46,168	48,455	68,260	69,406	70,551	71,697	72,843	73,989	75,135	76,280	77,426
	Net cash flows from operating activities		**19,096**	**21,507**	**13,912**	**11,221**	**10,658**	**13,614**	**-889**	**5,571**	**13,263**	**13,941**	**24,133**	**34,191**	**52,717**	**58,799**	**71,916**	**79,913**
2	**Cash Flows from Investing Activities**																	
	Purchase of property, plant, and equipment			30,109	600,234	185,234	185,234	185,234	185,234	68,442	43,098	43,098	43,098	43,098	43,098	43,098	43,098	43,098
	Net cash flows used in investing activities		**0**	**30,109**	**600,234**	**185,234**	**185,234**	**185,234**	**185,234**	**68,442**	**43,098**	**43,098**	**43,098**	**43,098**	**43,098**	**43,098**	**43,098**	**43,098**
3	**Cash Flows from Financing Activities**																	
	Long-term loan borrowing			28,608	611,556	174,139	174,139	174,139	173,881	45,223	20,626	20,626	20,626	20,626	-29,104	-29,104	-26,275	-26,275
	Increase of long-term liabilities		66,208	94,816	706,372	880,511	1,054,649	1,228,788	1,402,669	1,447,892	1,468,518	1,489,144	1,509,770	1,530,396	1,501,292	1,472,187	1,445,913	1,419,638
	Net cash flows used in financing activities		**0**	**28,608**	**611,556**	**174,139**	**174,139**	**174,139**	**173,881**	**45,223**	**20,626**	**20,626**	**20,626**	**20,626**	**-29,104**	**-29,104**	**-26,275**	**-26,275**
	Net cash flows financing minus investing activities			-1,501	11,322	-11,095	-11,095	-11,095	-11,353	-23,219	-22,472	-22,472	-22,472	-22,472	-72,202	-72,202	-69,373	-69,373
4	**Net increase / (decrease) in cash**		19,096	20,006	25,234	126	-437	2,519	-12,242	-17,648	-9,209	-8,531	1,661	11,719	-19,486	-13,403	2,544	10,541
	Cash at the beginning of the year		1,429	20,526	40,532	65,766	65,892	65,454	67,973	55,731	38,083	28,875	20,344	22,005	33,724	14,238	835	3,379
5	**Cash at the end of the year**		**20,526**	**40,532**	**65,766**	**65,892**	**65,454**	**67,973**	**55,731**	**38,083**	**28,875**	**20,344**	**22,005**	**33,724**	**14,238**	**835**	**3,379**	**13,919**

No.	**Items**	**Year**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**
	Necessary tariff raise (%)		as scheduled	as scheduled	as scheduled	as scheduled	as scheduled	as scheduled	0.0%	**3.5%**	0.0%	0.0%	0.0%	0.0%	3.5%	0.0%	0.0%	0.0%

Note: *1; Staff salary is assumed to increase with the same rate as production capacity increase.

*2; Electricity and Procurement, repair, outsourcing, cost are assumed to increase with the same rate as production capacity of NPNL's WTPs.

*3; Non operating income is assumed to increase at additional 3% per year

*4; Non operating cost includes interest payments.

*5; Tax rate for NPNL is as follows;

Tax on NPNL

Tax items	%	formula	cases
Tax for Profit	24.0%	x Profit	
	0.25%	x water revenue	in case of loss
Tax after Profit Tax	60.0%	x Profit after tax	
	0.0%		in case of loss
	Total		

Financial Plan of NPNL

1. Income Statement Projection		**for NPNL**															
			16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
No.	**Items**	**Year**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**
1	**Income**		309,848	332,902	336,018	336,018	336,018	336,018	347,517	347,517	347,517	347,517	347,517	359,419	359,419	359,419	359,419
1.1	Water revenue		302,460	325,443	328,559	328,559	328,559	328,559	340,058	340,058	340,058	340,058	340,058	351,960	351,960	351,960	351,960
1.2	Other income		7,388	7,459	7,459	7,459	7,459	7,459	7,459	7,459	7,459	7,459	7,459	7,459	7,459	7,459	7,459
2	**Expenditure**		268,041	272,821	277,474	273,942	270,564	267,333	261,160	256,798	250,783	244,889	239,109	233,437	229,007	224,674	220,431
2.1	O&M costs		189,469	193,103	198,550	195,811	193,227	190,789	188,490	188,002	185,860	183,839	181,933	180,135	178,438	176,838	175,328
	Bulk water purchase		39,828	42,942	48,388	45,649	43,065	40,628	38,328	37,840	35,698	33,678	31,771	29,973	28,276	26,676	25,166
	Staff salary[*1]		54,407	54,928	54,928	54,928	54,928	54,928	54,928	54,928	54,928	54,928	54,928	54,928	54,928	54,928	54,928
	Electricity[*2]		27,492	27,492	27,492	27,492	27,492	27,492	27,492	27,492	27,492	27,492	27,492	27,492	27,492	27,492	27,492
	Procurement, repair, outsourcing, etc[*2]		67,742	67,742	67,742	67,742	67,742	67,742	67,742	67,742	67,742	67,742	67,742	67,742	67,742	67,742	67,742
2.2	Depreciation cost		78,572	79,718	78,924	78,131	77,337	76,543	72,670	68,796	64,923	61,049	57,176	53,302	50,569	47,836	45,103
3	**Operating income**		41,807	60,081	58,544	62,076	65,454	68,685	86,358	90,719	96,734	102,628	108,408	125,982	130,412	134,745	138,988
	Non operating income[*3]		4,121	4,244	4,372	4,503	4,638	4,777	4,921	5,068	5,220	5,377	5,538	5,704	5,875	6,052	6,233
	Non operating cost[*4]		31,723	31,285	29,985	28,254	26,565	24,890	24,332	22,657	20,982	19,306	17,631	17,073	15,339	13,605	11,871
4	**Net Profit / Loss before tax**		**14,205**	**33,040**	**32,930**	**38,325**	**43,527**	**48,572**	**66,946**	**73,130**	**80,973**	**88,699**	**96,315**	**114,613**	**120,948**	**127,192**	**133,350**
	Tax for Profit[*5]		3,409	7,930	7,903	9,198	10,446	11,657	16,067	17,551	19,433	21,288	23,116	27,507	29,027	30,526	32,004
5	**Net Profit / after Profit tax**		**10,796**	**25,111**	**25,027**	**29,127**	**33,080**	**36,915**	**50,879**	**55,579**	**61,539**	**67,411**	**73,199**	**87,106**	**91,920**	**96,666**	**101,346**
	Tax after Profit Tax[*5]		6,477	15,066	15,016	17,476	19,848	22,149	30,527	33,347	36,924	40,447	43,920	52,264	55,152	57,999	60,808
6	**Net Profit / Loss after tax**		**4,318**	**10,044**	**10,011**	**11,651**	**13,232**	**14,766**	**20,352**	**22,232**	**24,616**	**26,964**	**29,280**	**34,842**	**36,768**	**38,666**	**40,538**

2. Cash Flow Statement Projection		**for NPNL**															
			16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
No.	**Items**	**Year**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**
1	**Cash Flows from Operating Activities**																
	(Loss) / profit after tax		4,318	10,044	10,011	11,651	13,232	14,766	20,352	22,232	24,616	26,964	29,280	34,842	36,768	38,666	40,538
	Adjustment for:																
	Depreciation		78,572	79,718	78,924	78,131	77,337	76,543	72,670	68,796	64,923	61,049	57,176	53,302	50,569	47,836	45,103
	Net cash flows from operating activities		**82,890**	**89,762**	**88,935**	**89,781**	**90,569**	**91,309**	**93,021**	**91,028**	**89,539**	**88,014**	**86,456**	**88,145**	**87,337**	**86,502**	**85,642**
2	**Cash Flows from Investing Activities**																
	Purchase of property, plant, and equipment		43,098	43,098	416	416	416	416	55,852	416	416	416	416	55,852	416	416	416
	Net cash flows used in investing activities		**43,098**	**43,098**	**416**	**416**	**416**	**416**	**55,852**	**416**	**416**	**416**	**416**	**55,852**	**416**	**416**	**416**
3	**Cash Flows from Financing Activities**																
	Long-term loan borrowing		-26,275	-26,275	-90,922	-89,484	-88,137	-88,137	-32,285	-88,137	-88,137	-88,137	-88,137	-35,225	-91,077	-91,077	-91,077
	Increase of long-term liabilities		1,393,363	1,367,089	1,276,167	1,186,683	1,098,545	1,010,408	978,123	889,986	801,849	713,712	625,574	590,350	499,273	408,196	317,119
	Net cash flows used in financing activities		**-26,275**	**-26,275**	**-90,922**	**-89,484**	**-88,137**	**-88,137**	**-32,285**	**-88,137**	**-88,137**	**-88,137**	**-88,137**	**-35,225**	**-91,077**	**-91,077**	**-91,077**
	Net cash flows financing minus investing activities		-69,373	-69,373	-91,338	-89,900	-88,553	-88,553	-88,137	-88,553	-88,553	-88,553	-88,553	-91,077	-91,493	-91,493	
4	**Net increase / (decrease) in cash**		13,518	20,389	-2,403	-119	2,016	2,756	4,884	2,475	985	-539	-2,098	-2,932	-4,155	-4,990	-5,851
	Cash at the beginning of the year		13,919	27,437	47,826	45,424	45,305	47,320	50,076	54,961	57,435	58,421	57,881	55,784	52,851	48,696	43,706
5	**Cash at the end of the year**		**27,437**	**47,826**	**45,424**	**45,305**	**47,320**	**50,076**	**54,961**	**57,435**	**58,421**	**57,881**	**55,784**	**52,851**	**48,696**	**43,706**	**37,855**

No.	**Items**	**Year**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**
	Necessary tariff raise (%)		0.0%	3.5%	0.0%	0.0%	0.0%	0.0%	3.5%	0.0%	0.0%	0.0%	0.0%	3.5%	0.0%	0.0%	0.0%

Note: *1; Staff salary is assumed to increase with the same rate as production capacity increase.

*2; Electricity and Procurement, repair, outsourcing, cost are assumed to increase with the same rate as production capacity of NPNL's WTPs.

*3; Non operating income is assumed to increase at additional 3% per year

*4; Non operating cost includes interest payments.

*5; Tax rate for NPNL is as follows;

A.18 Basis for Quantitative Effects

Calculations for Quantitative Effects are shown below.

1. Served Population in Chinaimo Service Area												
	At 2013, Total population in villages of Chinaimo water supply area		252,666	see attached sheets								
	At 2013, Served population in villages of Chinaimo water supply area	person	230,000	as 91%	coverage of total population in villages of Chinaimo water supply area in 2013							
					(Same as coverage in service area in urban Vienatiane Capital in 2013							
					of SUPPORTING REPORT, A6)							
	At 2023, Total population in villages of Chinaimo water supply area		313,929	see attached sheets								
	At 2023, Served population in villages of Chinaimo water supply area	person	295,000	as 94%	coverage of total population in villages of Chinaimo water supply area in 2023							
					(Same as service ratio in urban Vientiane Capital in 2023							
					of SUPPORTING REPORT, A6)							
	Increased served population in Chinaimo service area	person	65,000									
2. Amount of Water Supply from Chinaimo WTP												
(1)	At 2013, it is actual record obtained from NPNL	m^3/day	93,272	at 2013 as day average								
(2)	At 2023, it is gradually increase the served population and,											
	calculated as 93,272+(109,100-93,272) x (2023-2021)/(2024-2021)	m^3/day	103,800	at 2023 as day average								
	calculated as day avarage, 103,800 x 110%	m^3/day	114,200	at 2023 as day maximum								
(3)	At 2024, it is expected the day average											
	calculated as day max., 120,000 / 110% x 100%	m^3/day	109,100	at 2024 as day average								
	At 2024, it is expected as the max. design capacity	m^3/day	120,000	at 2024 as day maximum								
3. Rate of Facility Utilization in Chinaimo WTP												
				Production	Design							
(1)	At 2013, % = water production amount, 93,272 / design capacity, 80,000 x 100			(m^3/day)	(m^3/day)							
		%	116.6	93,272	80,000	at 2013						
(2)	At 2023, % = water production amount, 103,800 / design capacity, 120,000 x 100											
		%	86.5	103,800	120,000	at 2023 as day average						
		%	95.2	114,200	120,000	at 2023 as day maximum						

Calculation Sheets for Total Population in Villages of Chinaimo Water Supply Area							Total	252,666		309,131	4,798	313,929
								Current Chinaimo Supply Area		Existing Service (in 2013)	Future Expansion (up to 2020)	Total at
1. CHANTHABURY DISTRICTS								2013		2023	2023	2023
NO	CODE VILLAGE	NAME OF VILLAGE	YEAR 2013 AMOUNT	YEAR 2013 FEMAIL	YEAR 2013 HOUSEHOLD	REMARK				1.5%growth	3.0%growth	
1	001	NONG PING	2,737	1,437	582			-		-	-	-
2	002	BOR NA NGUA	1,830	936	339			-		-	-	-
3	003	HUAY HONG	5,857	2,961	1,190			-		-	-	-
4	004	PHON SA WANG	5,388	3,333	656			-		-	-	-
5	005	NONG THA NEUA	4,600	2,320	900			-		-	-	-
6	006	NONGTHA TAI	2,379	1,187	401			-		-	-	-
7	007	DORN DAENG	3,092	1,664	577			-		-	-	-
8	008	PHON TONG SA VATH	4,041	2,090	676			4,041		4,690	-	4,690
9	009	DONG PA LAEB	2,603	1,301	454			-		3,021	-	3,021
10	010	PHON TONG CHOMMANY	4,239	2,105	813			4,239		4,920	-	4,920
11	011	HONGXAENG	1,153	602	181			1,153		1,338	-	1,338
12	012	HONG KAI KEO	1,364	688	233			1,364		1,583	-	1,583
13	013	THONG SANG NANG	2,584	1,317	398			2,584		2,999	-	2,999
14	014	SAVANG	1,972	1,075	356			1,972		2,289	-	2,289
15	015	HONGKHA	2,819	1,422	445	Existing Service Area in 2013		-		3,272	-	3,272
16	016	THONG TOUM	1,488	737	230			1,488		1,727	-	1,727
17	017	DONG MIENG	1,955	1,010	298			1,955		2,269	-	2,269
18	018	SI DAM DUAN	1,526	796	251			1,526		1,771	-	1,771
19	019	SI BOUN HEUANG	2,265	1,371	345			2,265		2,629	-	2,629
20	020	KHUALUANG	2,778	1,495	454			-		3,224	-	3,224
21	021	SISAWATH	3,494	1,841	578			3,494		4,055	-	4,055
22	022	THONG KHAN KHAM	2,900	1,191	450			2,900		3,366	-	3,366
23	023	SI HORM	1,355	577	238			-		1,573	-	1,573
24	024	ANOU	1,072	642	128			1,072		1,244	-	1,244
25	025	SAILOM	1,137	572	154			1,137		1,320	-	1,320
26	026	HATSADY	1,427	703	247			1,427		1,656	-	1,656
27	027	HAI SOK	897	489	200			897		1,041	-	1,041
28	028	VATCHAN	731	328	116			731		848	-	848
29	029	MIXAY	639	299	108			639		742	-	742
30	030	XIENG GNUEN	1,556	713	256			-		1,806	-	1,806
TOTAL CHANTHABOULY DISTRICTS			71,878	37,202	12,254			34,884		53,383	0	53,383

2. SIKHODTHABONG DISTRICT								Current		Existing	Expansion	Total
NO	CODE VILLAGE	NAME OF VILLAGE	YEAR 2013			REMARK		2013		2023	2023	2023
			AMOUNT	FEMAIL	HOUSEHOLD					1.5%growth	3.0%growth	
1	001	NAKHAM	1,459	726	264			-		1,693	-	1,693
2	002	AOUBMOUNG	1,211	637	249			-		1,405	-	1,405
3	003	NONGPANAI	1,088	586	211			-		1,263	-	1,263
4	004	VATTAI NOYTHA	905	479	147			-		1,050	-	1,050
5	005	VATTAI NOY TONG	1,007	500	200			-		1,169	-	1,169
6	006	NONGSANOKHAM	1,113	578	237			-		1,292	-	1,292
7	007	VATTAI GNAI THONG	745	378	142			-		865	-	865
8	008	VATTAI GNAI THA	745	386	145			-		865	-	865
9	009	AKATH	1,926	996	376			-		-	-	-
10	010	MEUANGVATHONG	1,385	737	235			-		-	-	-
11	011	MEUANGVATHA	596	301	135			-		-	-	-
12	012	SIKAITHA	1,109	599	205			-		-	-	-
13	013	SIKAITHONG	1,161	588	199	Existing Service Area in 2013		-		-	-	-
14	014	GNAPHA	1,655	824	314			-		-	-	-
15	015	SIBOUNHEUANG THA	1,278	665	240			-		-	-	-
16	016	SIBOUNHEUANG TONG	1,196	612	204			-		-	-	-
17	017	SIXOMXUEN	1,391	700	250			-		-	-	-
18	018	NONSAVANG	670	346	114			-		-	-	-
19	019	KAOLIOW	2,123	1,042	405			-		-	-	-
20	020	DANKHAM	1,106	546	195			-		-	-	-
21	021	NONKHILEK	2,295	1,176	417			-		-	-	-
22	022	NONKEO	4,413	2,212	899			-		-	-	-
23	023	PHONESAWATH NEUA	3,735	1,918	665			-		-	-	-
24	024	PONESOMBOUN	1,691	839	300			-		-	-	-
25	025	TARDTHONG	2,780	1,364	529			-		-	-	-
26	026	NONGDA	2,732	1,319	523			-		-	-	-
27	027	MAI	1,527	787	288	Future Expansion up to 2020		-		-	-	-
28	028	HUAYHORM	1,923	772	383			-		-	-	-
29	029	ARNGGNAI	876	420	160			-		-	-	-
30	030	PHONSI	809	338	177			-		-	-	-
31	031	NAHAE	944	446	170			-		-	-	-
32	032	VIENGSAWAN	1,521	749	294			-		-	-	-
33	033	THONGPONG	1,927	985	343			-		-	-	-
34	034	NALAO	4,800	2,372	910			-		-	-	-
35	035	NONGNIOW	2,820	1,431	466			-		-	-	-
36	036	NONGTEANG TAI	4,685	2,194	812			-		-	-	-
37	037	NONGTAENG NEUA	1,833	941	358			-		-	-	-
38	038	VIENGKHAM	3,322	1,760	648			-		-	-	-
39	039	CHAMPA	3,198	1,602	589			-		-	-	-
40	040	DONGNASOK TAI	546	277	100			-		-	-	-
41	041	DONGNASOK NEUA	3,133	1,562	563			-		-	-	-
42	042	PARKTHANG	2,245	1,172	425			-		-	-	-
43	043	DONGNATHONG	2,828	1,422	530			-		-	-	-
44	044	LAKHIN	1,201	591	237	Existing Service Area in 2013		-		-	-	-
45	045	NONGBUEK TAI	1,366	668	253			-		-	-	-
46	046	NONGBUEK NEUA	1,435	723	282			-		-	-	-
47	047	DONGKALAO	1,283	652	249			-		-	-	-
48	048	XAMKETH	681	334	133			-		-	-	-
49	049	KHOUNTHATHONG	1,914	876	366			-		2,221	-	2,221
50	050	KHOUNTHA THA	622	319	108			-		722	-	722
51	051	SITAN NEUA	730	370	148			-		847	-	847
52	052	NONGDUANG NEUA	704	361	150			-		817	-	817
53	053	NONGDUANG	1,428	721	270			-		1,657	-	1,657
54	054	NONGDUANG THONG	1,297	710	242			-		1,505	-	1,505
55	055	PHONSAVATH TAI	1,627	788	297			-		-	-	-
56	056	NONGBUATHONG TAI	1,250	672	242			-		1,451	-	1,451
57	057	NONGBOUATHONG NEUA	1,580	958	293			-		1,834	-	1,834
58	058	PHONEKHAM	3,053	1,568	573			-		3,543	-	3,543
59	059	CHANSAVANG	1,935	1,008	409			-		-	-	-
60	060	DONXINGXOU	6,539	3,331	1,370			-		-	-	-
TOTAL SIKORDTHABONG DISTRICT			109,097	54,934	20,638			0		24,199	0	24,199

3. XAISETTA DISTRICT								Current		Existing	Expansion	Total
NO	CODE VILLAGE	NAME OF VILLAGE	YEAR 2013			REMARK		2013		2023	2023	2023
			AMONT	FEMAIL	HOUSEHOLD					1.5%growth	3.0%growth	
1	001	CHOMMANY	20,633	11,017	2,923			-		-	-	-
2	002	PHONPHANAO	3,112	1,671	633			-		-	-	-
3	003	PHONKHENG	2,201	1,189	417			2,201		2,554	-	2,554
4	004	NONGSANGTHOR	1,442	774	303			1,442		1,673	-	1,673
5	005	PHONSA ARTH	1,321	692	260			1,321		1,533	-	1,533
6	006	THATLUANG NEUA	1,497	808	285			1,497		1,737	-	1,737
7	007	NONGBORN	1,730	919	347			1,730		2,008	-	2,008
8	008	PHONXAI	1,949	1,039	446			1,949		2,262	-	2,262
9	009	NAXAI	1,785	949	356			1,785		2,072	-	2,072
10	010	FAI	1,167	600	210			1,167		1,354	-	1,354
11	011	VIENGCHALEAN	2,580	1,312	529			-		-	-	-
12	012	THATLUANG KANG	1,528	798	304			1,528		1,773	-	1,773
13	013	THATLUANG TAI	2,171	1,141	425			2,171		2,520	-	2,520
14	014	HONGKAE	2,255	1,206	450			2,255		2,617	-	2,617
15	015	SISANGVORN	1,015	548	217			1,015		1,178	-	1,178
16	016	SAPHANGMOR	2,174	1,134	425			2,174		2,523	-	2,523
17	017	PHONTHAN	3,182	1,675	639			3,182		3,693	-	3,693
18	018	HONGSUPHARB	2,881	1,470	627	Existing Service Area in 2013		2,881		3,344	-	3,344
19	019	NONSAWAN	1,230	633	241			1,230		1,427	-	1,427
20	020	NONGNIENG	1,984	1,025	403			-		-	-	-
21	021	NONSAVANG	1,521	789	342			1,521		1,765	-	1,765
22	022	AMORN	1,961	1,000	411			1,961		2,276	-	2,276
23	023	SENGSAVANG	3,650	1,843	772			3,650		4,236	-	4,236
24	024	XOK KHAM	3,286	1,668	682			3,286		3,814	-	3,814
25	025	VANGXAI	1,809	919	365			1,809		2,099	-	2,099
26	026	NONSAVANG	2,559	1,333	517			2,559		2,970	-	2,970
27	027	HUAKHUA	1,401	728	267			1,401		1,626	-	1,626
28	028	NONKOR NUEA	2,147	1,114	460			2,147		2,492	-	2,492
29	029	KHAMSAVATH	3,404	1,575	742			3,404		3,950	-	3,950
30	030	NONWAI	2,436	1,245	569			2,436		2,827	-	2,827
31	031	MEUANG NOY	2,540	1,277	620			2,540		2,948	-	2,948
32	032	XIENGDA	2,756	1,746	562			2,756		3,198	-	3,198
33	033	KHAMNGOY	2,257	1,146	493			2,257		2,619	-	2,619
34	034	NASANGPHAI	1,651	838	379			1,651		1,916	-	1,916
35	035	SOMSANGA	1,611	824	379			1,611		1,870	-	1,870
36	036	HAIKHAM	1,234	658	279			1,234		1,432	-	1,432
37	037	NAKHUAY KANG	882	451	188			-		-	-	-
38	038	NAKHUAY TAI	1,843	840	372	Future Expansion up to 2020		-		-	-	-
39	039	XOK GNAI	1,702	877	402			-		-	-	-
40	040	XOK NOY	2,111	1,061	474			-		-	-	-
41	041	XAM KHE	1,369	712	282			1,369		1,589	-	1,589
42	042	PHONTHONG	900	477	195			-		-	-	-
43	043	NABIEN	628	325	155			-		-	-	-
44	044	DOUNG	1,198	600	238	Existing Service Area in 2013		-		-	-	-
45	045	NAHAI	614	309	148			-		-	-	-
46	046	NANO	1,357	663	297			-		-	-	-
47	047	CHOMSI	384	188	90			-		-	-	-
48	048	NONKHOR TAI	1,843	964	397			1,843		2,139	-	2,139
TOTAL SAISETTA DISTRICT			108,891	56,770	21,517			68,963		80,034	0	80,034

4. SISATHANAK DISTRICT								Current		Existing	Expansion	Total
NO	CODE VILLAGE	NAME OF VILLAGE	YEAR 2013			REMARK		2013		2023	2023	2023
			AMOUNT	FEMAIL	HOUSEHOLD					1.5%growth	3.0%growth	
1	001	PHIAVAT	877	489	147			877		1,018	-	1,018
2	002	KAOGNORD	1,107	585	185			1,107		1,285	-	1,285
3	003	SIMEUANG	1,781	925	270			1,781		2,067	-	2,067
4	004	NONGCHAN	676	343	117			676		785	-	785
5	005	DONGPALANTHA	1,264	651	216			1,264		1,467	-	1,467
6	006	DONGPALANTHONG	1,564	766	253			1,564		1,815	-	1,815
7	007	PHONSINUAN	2,322	1,190	296			2,322		2,695	-	2,695
8	008	SAPHANTHONG	4,312	2,261	590			4,312		5,004	-	5,004
9	009	TONGPHANTHONG	3,717	2,155	530			3,717		4,314	-	4,314
10	010	THATKAO	958	505	138			958		1,112	-	1,112
11	011	PHAPHO	1,038	571	148			1,038		1,205	-	1,205
12	012	PHAXAI	1,204	673	157			1,204		1,397	-	1,397
13	013	PHONSAWAN NEUA	2,425	1,304	357			2,425		2,814	-	2,814
14	014	PHONSAWANTAI	1,349	754	165			1,349		1,566	-	1,566
15	015	BUENGKHANORNG	3,176	1,654	417			3,176		3,686	-	3,686
16	016	SOKPALUANG	1,139	552	168			1,139		1,322	-	1,322
17	017	VATNAK	2,610	1,348	392			2,610		3,029	-	3,029
18	018	SAPHANTHONG TAI	2,909	1,469	369	Existing		2,909		3,376	-	3,376
19	019	THAPHALANXAI	2,584	1,252	356	Service Area		2,584		2,999	-	2,999
20	020	PHANMAN	999	520	129	in 2013		999		1,159	-	1,159
21	021	THONGKANG	3,014	1,533	430			3,014		3,498	-	3,498
22	022	PHONPAPAO	6,147	3,276	876			6,147		7,134	-	7,134
23	023	DONKOY	5,348	2,799	833			5,348		6,207	-	6,207
24	024	DONKOKKHOUM	3,094	1,664	447			3,094		3,591	-	3,591
25	025	DONPAMAI	1,179	674	164			1,179		1,368	-	1,368
26	026	VAT SOB	724	388	102			724		840	-	840
27	027	PHO XAI	793	423	102			793		920	-	920
28	028	SUAN MORN	1,334	664	207			1,334		1,548	-	1,548
29	029	SANG WEUG	1,879	981	256			1,879		2,181	-	2,181
30	030	DONGSAWAT	4,063	2,118	614			4,063		4,715	-	4,715
31	031	CHOMPHET NEUA	2,733	1,476	387			2,733		3,172	-	3,172
32	032	HAI SOK	1,414	722	216			1,414		1,641	-	1,641
33	033	CHOM CHAEUA	1,189	608	148			1,189		1,380	-	1,380
34	034	KHOK NIN	715	361	82			715		830	-	830
35	035	CHOMPHET TAI	3,283	1,673	447			3,283		3,810	-	3,810
36	036	XAISATHAN	956	500	142			956		1,109	-	1,109
37	037	PHONSAWANG	2,213	1,200	343			2,213		2,568	-	2,568
		TOTAL SISATHANAK DISTRICT	78,089	41,027	11,196			78,089		90,627	0	90,627

5. NAXAITHONG DISTRICT								Current		Existing	Expansion	Total
NO	CODE VILLAGE	NAME OF VILLAGE	YEAR 2013			REMARK		2013		2023	2023	2023
			AMOUNT	FEMAIL	HOUSEHOLD					1.5%growth	3.0%growth	
1	001	NASIOW	3,280	1,664	600			-		-	-	-
2	002	XAIMOUNGKHOHOUN	841	433	169			-		-	-	-
3	003	SIKEUTH	2,747	1,433	528			-		-	-	-
4	004	PHANG HAENG	2,016	1,088	349			-		-	-	-
5	005	NALIEN	947	479	113			-		-	-	-
6	006	PAK HAED	2,270	1,194	413	Existing		-		-	-	-
7	007	PHONSAWAN	1,032	519	200	Service Area		-		-	-	-
8	008	PHONKEO	943	492	161	in 2013		-		-	-	-
9	009	DONG XIENGDY	1,115	588	243			-		-	-	-
10	010	NAXAI TAI	1,197	591	224			-		-	-	-
11	011	NAXAI KANG	1,017	529	170			-		-	-	-
12	012	NAXAI NEUA	1,239	590	208			-		-	-	-
13	014	NONG GNAO	1,076	619	182			-		-	-	-
14	013	NA KHOUN	2,857	1,328	510			-		-	-	-
15	015	DONG BORNG	1,573	818	290			-		-	-	-
16	016	HUA XANG	1,132	390	227			-		-	-	-
17	017	DAN XY	1,201	626	205			-		-	-	-
18	018	HUA KHUA	1,728	885	330			-		-	-	-
19	019	NAXORN	1,039	446	136			-		-	-	-
20	020	NA GNANG	1,895	933	332			-		-	-	-
21	021	NONGKHANKHOU	665	338	135			-		-	-	-
22	022	NAM KIENG	2,309	1,119	467			-		-	-	-
23	023	NA XAB	1,136	557	222			-		-	-	-
24	024	ELAI TAI	1,285	670	214			-		-	-	-
25	025	ELAI NEUA	1,817	947	338			-		-	-	-
26	026	SONG KHUA KANG SAEN	660	329	115			-		-	-	-
27	027	CHAEN SAWANG	484	249	80			-		-	-	-
28	028	HUAY NAMYEN	2,498	1,284	447			-		-	-	-
29	029	SISAWATH	434	214	85			-		-	-	-
30	030	ARING NAMHOUM	1,554	817	337			-		-	-	-
31	031	NA THORN	1,340	723	250			-		-	-	-
32	032	SONG PEUAY TAI	997	502	168			-		-	-	-
33	033	SONG PEUAY NEUA	1,068	546	197	Future		-		-	-	-
34	034	NAM HOUM	792	457	142	Expansion up		-		-	-	-
35	035	PEUK	1,081	558	191	to 2020		-		-	-	-
36	036	HOUMBAENG	1,171	555	237			-		-	-	-
37	037	PHONKHAM	1,338	704	246			-		-	-	-
38	038	HUANA	523	255	91			-		-	-	-
39	039	NANATH	1,083	509	214			-		-	-	-
40	040	PHONMUANG	1,592	799	281			-		-	-	-
41	041	HONG NGUA	1,291	678	287			-		-	-	-
42	042	SAE DIN	1,376	691	259			-		-	-	-
43	043	THAM	1,019	518	202			-		-	-	-
44	044	NA KHA	1,090	568	258			-		-	-	-
45	045	NA NGA	1,269	612	225			-		-	-	-
46	046	SIMLAY	1,398	728	262			-		-	-	-
47	047	PHOXAI	1,195	622	181			-		-	-	-
48	048	PHOSY	639	310	115			-		-	-	-
49	049	PHONTHONG	1,077	567	176			-		-	-	-
50	050	BOUA	811	409	137			-		-	-	-
51	051	NONGSA	1,758	901	341			-		-	-	-
52	052	PHATTANA	1,676	853	265			-		-	-	-
53	053	NADY	740	386	137			-		-	-	-
54	054	DONGLUANG	1,481	741	276			-		-	-	-
TOTAL NAXAITHONG DISTRICT			71,792	36,361	13,168			0		0	0	0

6. XAYTHANY DISTRICT								Current		Existing	Expansion	Total
NO	CODE VILLAGE	NAME OF VILLAGE	YEAR 2013			REMARK		2013		2023	2023	2023
			AMOUNT	FEMAIL	HOUSEHOLD					1.5%growth	3.0%growth	
1	009	THASAWANG	1,362	693	238			-		-	-	-
2	017	THANGON	2,522	1,309	444			-		-	-	-
3	018	NA	1,446	722	231			-		-	-	-
4	019	PHOUKHAM	1,740	852	270			-		-	-	-
5	024	NON SA ATH	5,482	3,497	970			-		-	-	-
6	025	DONGMARKAI	2,101	1,029	476			-		-	-	-
7	026	DANXANG	3,347	1,740	626			-		-	-	-
8	027	DONTIOW	2,696	1,370	506			-		-	-	-
9	028	XAISAWANG	2,669	2,660	546			-		-	-	-
10	029	DON NOUN	3,718	1,874	738			-		-	-	-
11	031	NA KHAE	1,534	747	315			-		-	-	-
12	032	SAPHANG MEUK	2,289	1,194	418			-		-	-	-
13	033	XANGKHOU	2,934	1,582	534			-		-	-	-
14	034	PHA KHAO	4,382	2,245	779			-		-	-	-
15	035	SIVILAY	3,654	1,890	672			-		-	-	-
16	036	KHAM HOUNG	4,873	2,560	905	Existing		-		-	-	-
17	037	NONG VIENGKHAM	2,157	1,145	430	Service Area		-		-	-	-
18	039	DONGDOK	3,475	1,788	653	in 2013		-		-	-	-
19	040	TAN MIXAI	4,473	2,354	764			-		-	-	-
20	041	NONGPHAGNAS	7,853	4,111	1,498			-		-	-	-
21	042	NATHOM	2,437	1,297	450			-		-	-	-
22	046	DONGSANGHIN	1,722	903	351			-		-	-	-
23	047	PHOKHAM	1,279	707	244			-		-	-	-
24	051	NALORM	820	483	141			-		-	-	-
25	053	NAMON	498	256	94			-		-	-	-
26	054	DONGBANG	1,033	477	181			-		-	-	-
27	084	KHOKSIVILAY	1,454	726	307			-		-	-	-
28	085	XAISOMBOUN	3,269	1,627	613			-		-	-	-
29	086	KHOKSAATH	1,543	791	288			-		-	-	-
30	088	NONTHONG	439	235	89			-		-	-	-
31	101	NASALA	2,982	1,511	441			-		-	-	-
32	102	SAINAMNGEUN	2,033	1,055	380			-		-	-	-
33	103	NON BORLEK	3,089	1,560	512			-		-	-	-
34	008	HAI	1,809	924	361			-		-	-	-
35	010	VEUNKHAM	1,670	851	379			-		-	-	-
36	011	CHALEAHXAI	2,390	1,267	440			-		-	-	-
37	012	NONGKHENG	1,290	636	274			-		-	-	-
38	013	NONGNO	1,221	574	195			-		-	-	-
39	014	PHONNGAM	1,169	710	198			-		-	-	-
40	015	PHONXAI	4,483	2,311	594			-		-	-	-
41	016	SAMSA ATH	914	461	168			-		-	-	-
42	022	OUDOMPHOUAN	4,501	2,398	684			-		-	-	-
43	023	LATHKHOUY	3,114	1,597	589			-		-	-	-
44	038	HUAYDAENMEUNG	773	387	168			-		-	-	-
45	043	VIENG KEO	1,288	652	216			-		-	-	-
46	044	NONSENGCHAN	1,288	710	260			-		-	-	-
47	045	HUAYTEUY	812	403	165			-		-	-	-
48	048	KHOKNOY	730	348	137			-		-	-	-
49	049	KHOK GNAI	654	344	111			-		-	-	-
50	050	SAPHANGKHANONG	604	291	119			-		-	-	-
51	052	NONG BUA	444	214	92			-		-	-	-
52	055	NONTAE	940	452	163	Future		-		-	-	-
53	056	PHONTHONG	619	320	87	Expansion up		-		-	-	-
54	059	THADORKKHAM	493	369	74	to 2020		-		-	-	-
55	061	PHONNGAM 2	1,123	606	138			-		-	-	-
56	062	PHONNGAM 1	933	474	150			-		-	-	-
57	063	THADINDAENG NEUA	1,892	961	337			-		-	-	-
58	064	THADINDAENG TAI	1,837	942	247			-		-	-	-
59	065	NAPORK	1,777	924	268			-		-	-	-
60	066	PAKSARDKAO	709	365	156			-		-	-	-
61	067	PAKSARDMAI	1,364	698	253			-		-	-	-
62	071	PALAI	462	231	72			-		-	-	-
63	073	NAKHAO	1,754	888	311			-		-	-	-
64	087	THANAK	970	515	202			-		-	-	-
65	089	HUAXIENG	2,401	1,224	509			-		-	-	-
66	092	PAILORM	2,042	1,040	347			-		-	-	-
67	094	SOMSAWAN	3,539	1,788	707			-		-	-	-
68	095	KOKSAWAN	629	324	124			-		-	-	-
69	096	PHONSAWAN	572	281	110			-		-	-	-
70	097	DORNLOUM	660	324	131			-		-	-	-
71	098	NAPHASOUK	1,107	539	185			-		-	-	-
72	099	BOR LEK	3,058	1,520	520			-		-	-	-
TOTAL Xaythany DISTRICT			145,340	76,853	26,345			0		0	0	0

7. HATXAIFONG DISTRICT								Current		Existing	Expansion	Total
NO	CODE VILLAGE	NAME OF VILLAGE	YEAR 2013			REMARK		2013		2023	2023	2023
			AMOUNT	FEMAIL	HOUSEHOLD					1.5%growth	3.0%growth	
1	001	THANA	1,259	637	259			1,259		1,461	-	1,461
2	002	DONDU	2,293	1,185	451			2,293		2,661	-	2,661
3	003	BOR - OH	700	372	136			700		812	-	812
4	004	PHAO	1,004	459	200			1,004		1,165	-	1,165
5	005	KHANG	875	464	172			875		1,015	-	1,015
6	006	SOMHHONG	681	346	140			681		790	-	790
7	007	KAENGGNAGE	1,169	594	216			1,169		1,357	-	1,357
8	008	DONPHAXAI	832	413	179			832		966	-	966
9	009	NATAM	791	389	160			791		918	-	918
10	010	KAENGPAYANG	1,039	526	203			1,039		1,206	-	1,206
11	011	HATDORKKEO	683	346	145	Existing		683		793	-	793
12	012	HUA HA	1,215	619	247	Service Area		1,215		1,410	-	1,410
13	013	HATHKHANXA	1,336	708	263	in 2013		1,336		1,550	-	1,550
14	014	DONKEUTH	533	265	140			533		619	-	619
15	015	PHONGEUN	1,509	726	267			1,509		1,751	-	1,751
16	016	PHOSY	911	465	188			911		1,057	-	1,057
17	017	SAWANG	931	518	196			931		1,080	-	1,080
18	018	PAFANG	921	479	189			921		1,069	-	1,069
19	019	CHOMTHONG	1,072	570	236			1,072		1,244	-	1,244
20	020	HORN TAI	1,302	682	269			1,302		1,511	-	1,511
21	021	CHIEMPANG	1,128	552	258			1,128		1,309	-	1,309
22	022	THINPHIA	1,635	813	352			1,635		1,897	-	1,897
23	023	THA KHAEK	954	467	201			954		1,107	-	1,107
24	024	XAIFONG NEUA	1,042	544	227	Future		-		-	1,400	1,400
25	025	XAIFONG TAI	1,025	520	205	Expansion up		-		-	1,378	1,378
26	026	KHOKXAI	1,503	755	334	to 2020		-		-	2,020	2,020
27	027	SITHAN TAI	1,511	802	356			-		-	-	-
28	028	HATXAI KHAO	2,983	1,512	596			2,983		3,462	-	3,462
29	029	SOMVANG NEUA	2,478	1,272	456			2,478		2,876	-	2,876
30	030	SOMVANG TAI	1,383	694	283			1,383		1,605	-	1,605
31	031	NONG HAI	4,180	2,098	822			4,180		4,851	-	4,851
32	032	SOMSANOUK	2,638	1,380	502			2,638		3,062	-	3,062
33	033	NONGWAENG	2,881	1,491	568			2,881		3,344	-	3,344
34	034	SALAKHAM NEUA	1,453	806	283			1,453		1,686	-	1,686
35	035	NA HAI	3,341	1,671	641			3,341		3,877	-	3,877
36	036	DONG KHAMXANG	3,056	1,547	650	Existing		3,056		3,547	-	3,547
37	037	NAHAI	1,579	823	318	Service Area		1,579		-	-	-
38	038	NONG HEO	2,687	1,369	547	in 2013		2,687		-	-	-
39	039	DONGPHPSY	2,734	1,389	506			2,734		-	-	-
40	040	THANALAENG	2,003	1,020	361			2,003		-	-	-
41	041	THAMOUANG	2,093	1,121	412			2,093		-	-	-
42	042	DONGPHONHAE	1,136	595	220			1,136		-	-	-
43	043	PAWA	856	439	180			856		-	-	-
44	044	THADEUA	2,310	1,167	447			2,310		-	-	-
45	045	THINTOM	1,870	948	384			1,870		-	-	-
46	046	KHAMCHALEAN	432	247	96			-		-	-	-
47	047	NONGPAEN NEUA	505	252	110			-		-	-	-
48	048	XIENG KHUAN	2,263	1,121	454			-		-	-	-
49	049	NONGPAEN TAI	443	234	90			-		-	-	-
50	050	THAPA	1,801	899	358			-		-	-	-
51	051	PAKPENG	345	178	68	Future		-		-	-	-
52	052	NONGPHONG	2,500	1,239	513	Expansion up		-		-	-	-
53	053	THINTHAEN	820	407	162	to 2020		-		-	-	-
54	054	KHUAYDAENG	1,855	938	344			-		-	-	-
55	055	SIMMANO NEUA	1,306	651	246			-		-	-	-
56	056	SIMMANO TAI	1,060	685	243			-		-	-	-
57	057	NALONG	1,523	760	312			-		-	-	-
58	058	DON FAI	996	495	230	Existing		996		-	-	-
59	059	SALAKHAM TAI	1,760	920	337	Service Area		1,760		2,043	-	2,043
60	060	DONGPHONLAO	1,540	696	289	in 2013		1,540		1,787	-	1,787
TOTAL HATXAIFONG DISTRICT			90,664	46,280	18,217			70,730		60,888	4,798	65,686