

## **G.5.7 Power Supply**

### **(1) General Considerations**

#### *1) Situation of EDC Power Supply System in Sihanoukville*

EDC projects that a transmission line will be extended from the national power grid in 2007 at earliest or 2008. At that time, it is anticipated the stable and sufficient power sources will be available from the national grid, as mentioned in the sub-clause I.2.8.1 (3).

According to EDC's proposition, a grid substation would be established at approximately 6 km northern place from the site of Sihanoukville Port Free Zone. This grid substation must be a main power source in Sihanoukville area.

#### *2) Outline of Power Supply to Sihanoukville Industrial Area No.4*

The SIA SITE-4 is expected to be developed in 2008 with the forecasted power demand of 11.6 MW.

Study Team proposes that a 66kV transmission line from the grid substation and a 66/22kV on-site substation should be established to receive the power fed from the 66kV transmission line.

The route of transmission line is shown in **Figure G-12**.

### **(2) Design Conditions and Criteria**

For design of electricity supply to the industrial area, Study Team postulates that the grid substation will be constructed at the place where **Figure G-12** indicates by the time the industrial area starts. Study Team proposes 66kV line voltage of the transmission, but this line voltage should be reviewed according to the design standards of the grid substation and transmission system to be set up in future.

Regarding the basic design conditions and criteria, the same matters stated in the sub-clause I.2.8.2 shall be supported.

### **(3) Specifications**

In this pre-feasibility study on the industrial area, the basic design on the following facilities is proposed in the subsequent clause.

- 1) Transmission line between the grid substation and on-site substation
- 2) On-site substation in the industrial area
- 3) Distribution facilities in the industrial area

In addition to these items, some works, such as increase of feeder bays and transformer capacity in grid substation, etc. may be necessary for EDC facilities.

#### *1) Transmission line between grid substation and on-site substation*

In consideration of the power demand and 12km transmission length, 66kV transmission line is proposed.

Two (2) circuits are proposed in order to secure the high reliability of power

supply.

The following design is proposed for the transmission line:

- (a) Line Voltage : 66 kV
- (b) No. of circuit : 2 circuits
- (c) Line Length : Approximately 12 km
- (d) Structure : Steel tower, or concrete pole
- (e) Insulator : Porcelain
- (f) Conductor : ASCR 200mm<sup>2</sup>

### 2) *On-site Substation*

An on-site substation shall be established to receive the power from the 66kV transmission line, and distribute it to consumers.

The basic design of the substation is summarized below:

- (a) Type : Outdoor conventional type
- (b) Capacity : 30 MVA
- (c) Arrangement and composition of switch gear:
  - 66kV and 22kV bus : Single bus
  - 22kV switchgears : In door cubicle type
  - Main transformer : 66/22kV, 15 MVA x 2 sets  
Outdoor type with on-load tap changer
  - Station transformer : 22/0.4kV, 400kVA x 1 set

### 3) *Distribution Facilities*

**Figure G-13** shows the route map of 22kV distribution line in the area. 22kV distribution lines are spread from the substation to the consumers.

The basic design of 22kV distribution network in the area is summarized below:

- (a) Line Voltage : 22 kV
- (b) Line length : Approximately 8.5 km
- (c) Cable type : Rated voltage 24kV (50Hz)  
240 mm<sup>2</sup> XLPE triplex cables, Al. conductor
- (d) Burying method : 0.8 m underearth by direct burying  
(Protection pipe shall be used when burying under the roads.)
- (e) Ring main unit : Outdoor cubicle type or indoor type  
(In case indoor type, small building shall be constructed.)  
Ring main unit will be installed at the borders of every two consumers.
- (f) Operation system : Manual Operation

(g) Street lighting system

- Transformer : 22/0.4kV, 50kVA, 2 stations
- Underground cable : 0.6/1.0 kV, XLPE 2 x 25 mm<sup>2</sup>  
Cable length: approx. 18 km
- Other accessory : Distribution board, watt-hour meter,  
switching timer, circuit breaker, etc.
- Station transformer in the substation will also used for power supply  
to street lighting.

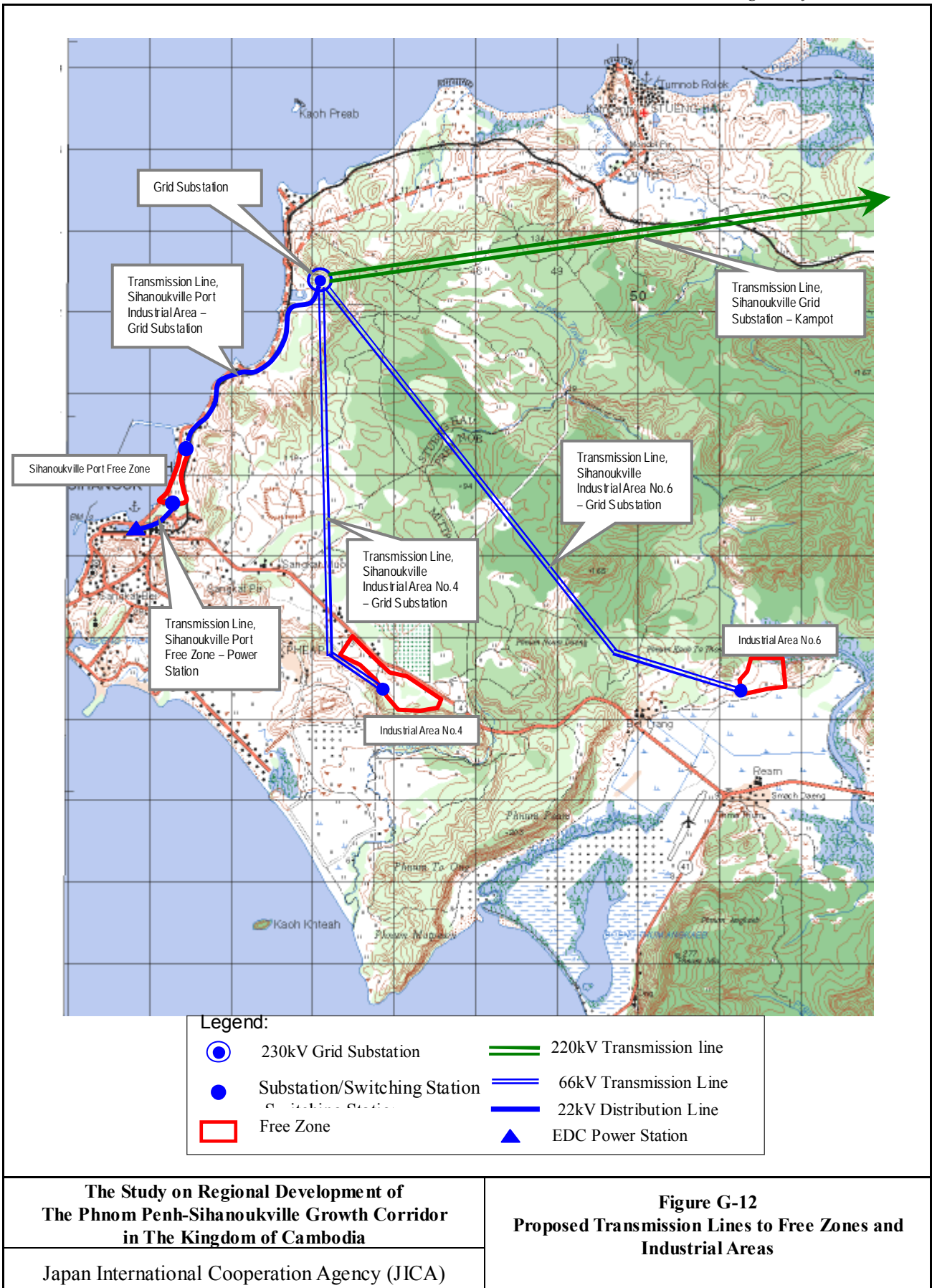
(h) EDC Design Standard shall be applied.

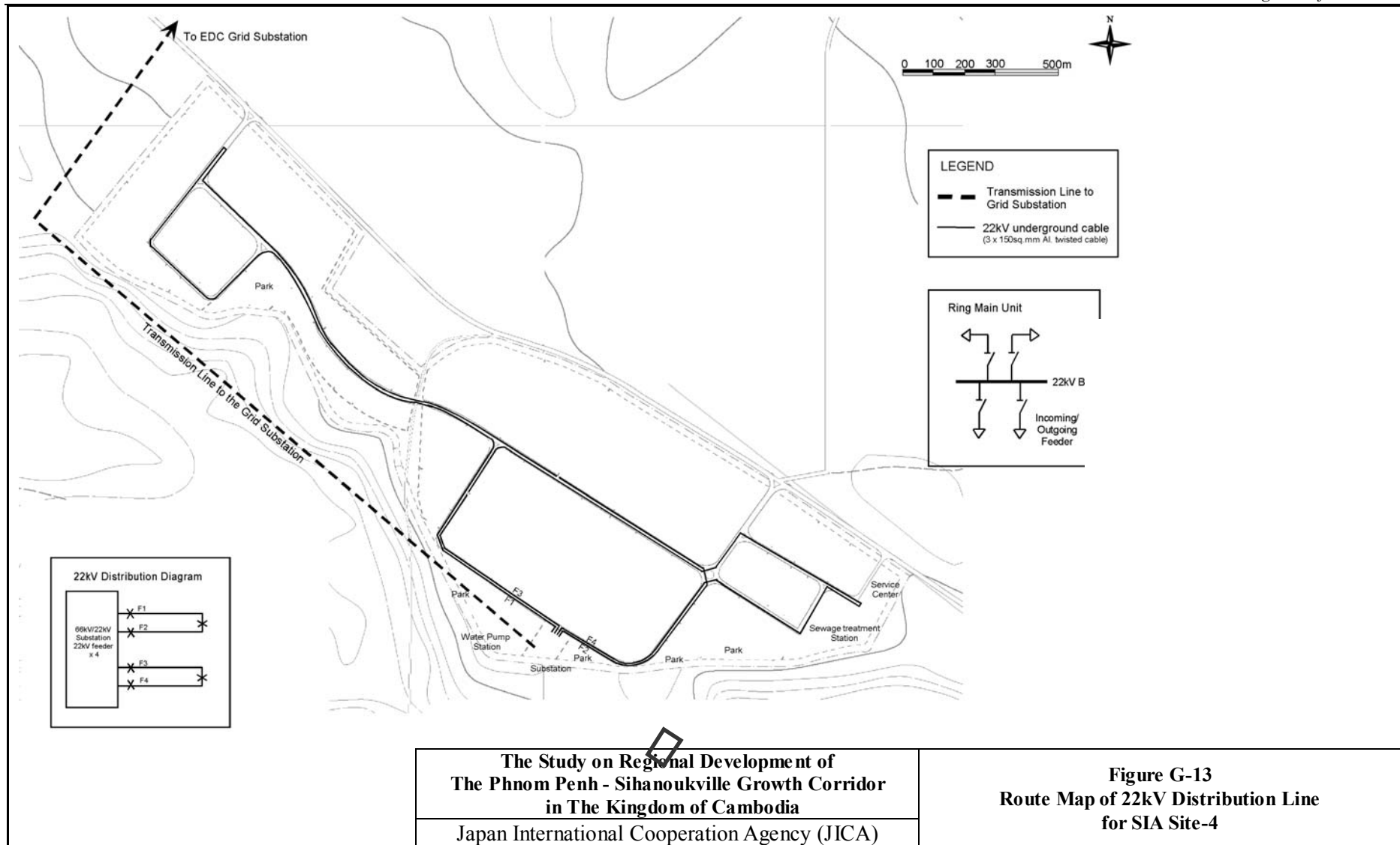
### **G.5.8 TELECOMMUNICATION**

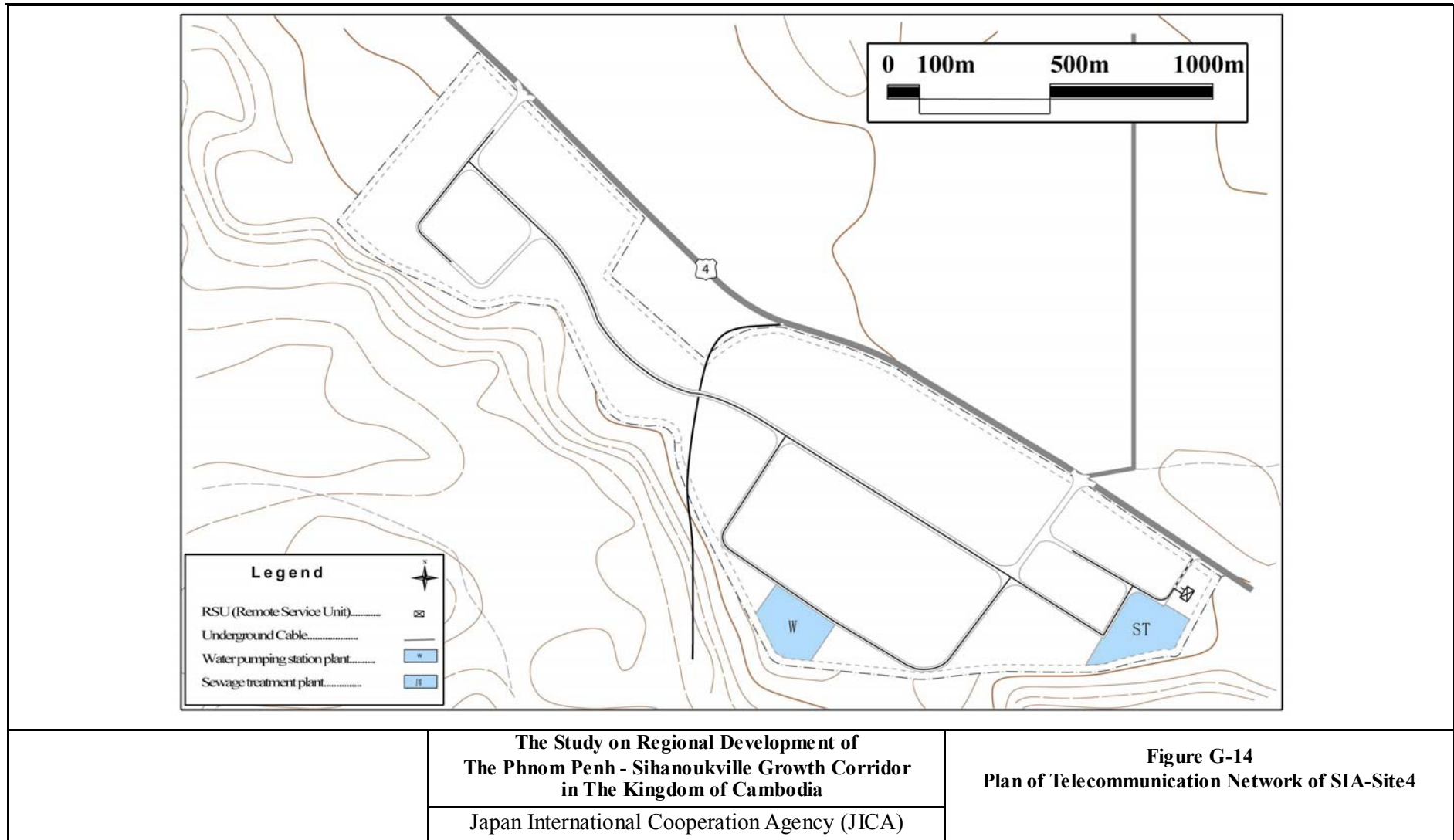
The demand of the tenanted industry in site 4 is projected as 320 lines in 2008. To cope with the demand, the RSU will be installed in the one-stop-service center and to connect to the newly established LS by OF.

At the network plan in the zone, since the companies tenanted in the site-4 will adopt the computerized shipping and accepting order for products, parts, and components, the enough capacity for data communication should be considered.

The network in the zone is shown as following the **Figure G-14**.







## G.6 PRE-FEASIBILITY STUDY OF SIHANOUKVILLE INDUSTRIAL AREA SITE -6

### G.6.1 Development Framework

#### (1) Prospective Investors by Category of Industry and Lot Size

The distribution plan of factory lot in the Sihanoukville Industrial area –Site-6 (SIA Site-6) can be designed as shown in **Table G-14**. 66 lots for the manufacturer and trader with the total lot area of 124 ha can be developed in the SIA Site-6.

**Table G-14 Planned Number of Investors by Category of Industry and Lot Size for the SIA Site-6-**

ISIC Code	The category of Industry	Planned Num of FDI Demand						Plot Demand (ha)	
		– 2500 m <sup>2</sup>	2500m <sup>2</sup>	5000m <sup>2</sup>	1 ha	2 ha	2ha–		Total
311-312	Food manufacture			1	2	2	3	8	18.5
321	Textiles		1		2	3	2	8	16.3
322	Wearing apparel except		1	1	3	2		7	7.8
332	Furniture and fixture					2		2	4.0
3412	Containers and boxes of paper		1	1			2	4	8.8
3522	Drugs and medicines			1	2	2		5	6.5
3523	Soap and cleaning preparations, perfumes,				1	3		4	7.0
355	Rubber products			1		2		3	4.5
361	Pottery, china and earth ware		1	1		1	1	4	6.8
383	Electrical machinery, apparatus, appliance			1	3	8	3	15	31.5
3901	Jewellery and related articles			1				1	0.5
3909	Toys and other manufacturing industries		1			2	2	5	12.3
	<b>Total</b>	0	5	8	13	27	13	66	124.3

Source: JST

#### (2) Development Demand

The development of the SIA Site-6 with the factory area of 110 ha, will induce approximately 17,000 job opportunities as shown in **Table G-15**. Approximately 12,500 m<sup>3</sup>/day water, 12.5 kW electricity, and 350 telephone lines will be necessary to provide the efficient infrastructure.

**Table G-15 Employment Infrastructure Demand for SIA Site-6**

ISIC Code	The category of Industry	Plot Demand (ha)	Num of Employee		Water Demand		Electricity Demand		Telephone Demand	
			Employee /ha	Employee	m <sup>3</sup> /ha	m <sup>3</sup> /day	W/m <sup>2</sup>	kW	line/factory	lines
311-312	Food manufacture	18.5	100	1900	300	5550	8	1480	5	40
321	Textiles	16.3	150	2400	100	1630	8	1300	5	40
322	Wearing apparel except footwear	7.8	500	3900	50	390	8	620	5	35
332	Furniture and fixture	4.0	50	200	40	160	8	320	5	10
3412	Containers and boxes of paper	8.8	70	600	50	440	8	700	5	20
3522	Drugs and medicines	6.5	100	700	100	650	10	650	5	25
3523	Soap and cleaning preparations, perfumes,	7.0	100	700	150	1050	10	700	5	20
355	Rubber products	4.5	100	500	150	680	10	450	5	15
361	Potterv, china and earth ware	6.8	100	700	50	340	8	540	5	20
383	Electrical machinery, apparatus, appliance	31.5	100	3200	40	1260	15	4370	5	75
3901	Jewellery and related articles	0.5	150	100	40	20	8	40	5	5
3909	Toys and other manufacturing industries	12.3	150	1700	20	240	8	980	5	25
	Utility/facility			100		10		360		20
	<b>Total</b>	<b>124.3</b>	<b>134</b>	<b>16.700</b>	<b>100</b>	<b>12.420</b>	<b>10</b>	<b>12.510</b>	<b>5</b>	<b>350</b>

Source: JST

## G.6.2 Land Use Plan

The development principles of the Sihanoukville Port Free Zone as explained in I.2.2 is applied to the SIA Site-6. Following is additional ideas for the SIA Site-6.

- Accessibility to the Route 4 and the Sihanoukville Airport is advantageous to attract FDI.
- The site development is planned to avoid the adverse environmental impact on the rice field spread in the downstream of the site

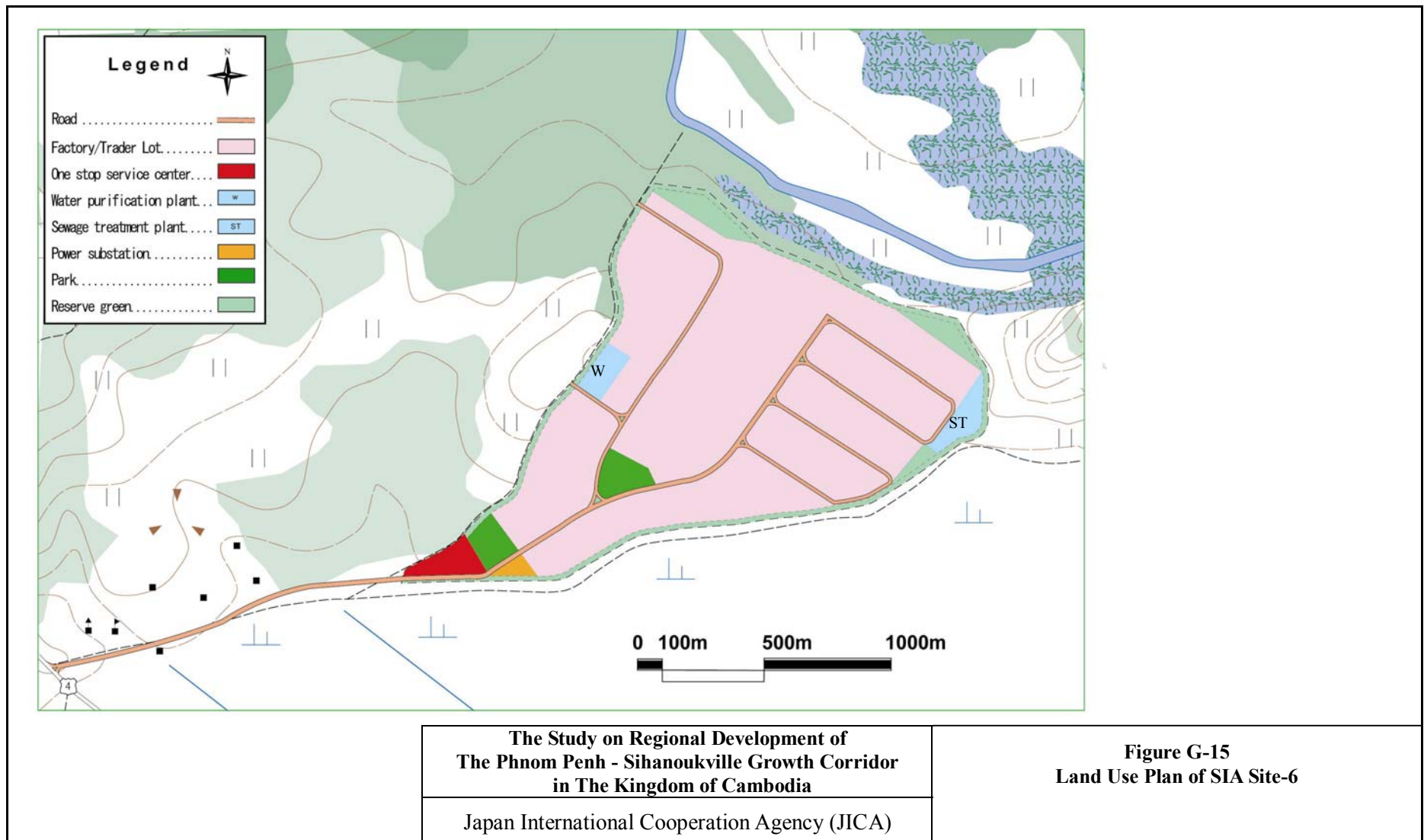
Land use plan of SIA Site-6- is summarized in **Table G-16** and illustrated in **Figure G-15**. 124 ha of the factory lot, 69.1% of the total area, can be provided, while the road, utilities and parks with the area of 13.9 ha, 11.4 ha and 27.5 ha will be necessary.

**Table G-16 Land Use Plan of SIA Site-6**

Item	ha	%	Remarks
1 Factory/trader lot	124.38	69.1%	
2 One stop service center	2.85	1.6%	
3 Road	13.88	7.7%	Roads of access, main/submain,
4 Utility	11.40	6.3%	Water pump station, power
5 Others	27.50	15.3%	Park ad reserve green
<b>Total</b>	<b>180.00</b>	<b>100.0%</b>	

Source: JST





### **G.6.3 Water Supply Facility**

#### **(1) Outline of Water Supply to Sihanoukville Industrial Area Site-6 (SIA Site-6)**

General conditions of water supply system and resources in Sihanoukville are described in before (see **Section G.5.3**).

As mentioned before (Table G-14), the average daily water demand for the proposed Industrial Area in the Sihanoukville (SIA Site-6) is estimated at 12,400 m<sup>3</sup>/day. Water supply for the SIA Site-6 needs new water source due to insufficient supply capacity of SWSA at present and future. Concerning the groundwater source, it will be necessary to drill more than 25 wells (assumed average yield of unit well as 500 m<sup>3</sup>/day in Sihanoukville area<sup>1</sup>) to meet the demand. In addition, distance of each well should be sparse more than 500m, and the area of well fields is required more than 22 km<sup>2</sup>. The cost of drilling deep wells, connection pipeline and operation cost will be high. Therefore, the water reservoir development will be required. Proposed reservoir in the Prek Toek Sap River is preliminary studied as shown in **Appendix G.10**.

Basic concept of the water supply for the SIA Site-6 is summarized as follows.

- Water source will be developed by construction of new reservoir at the Prek Toek Sap River.
- Construction cost of the new reservoir will be allocated with water supply system of Sihanoukville City (SWSA) and the user of SIA Site-6.

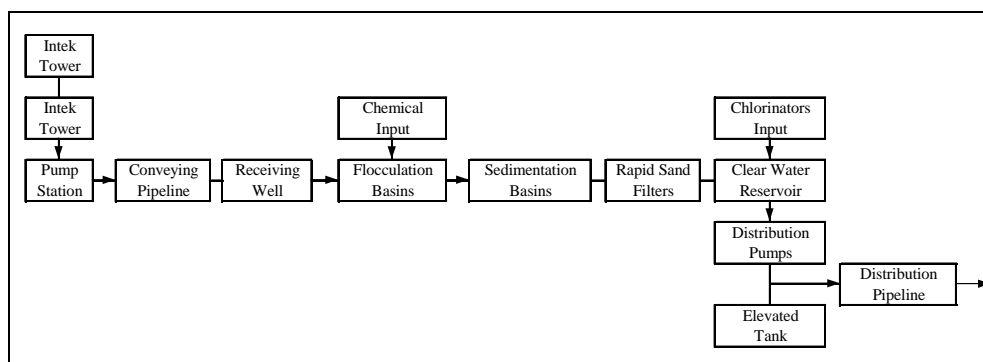
#### **(2) Design Conditions**

##### *1) Flow of Water Supply System*

Water supply facilities for the SIA Site-6 is comprised by reservoir in Prek Toek Sap River, intake facilities, pumps, connection pipelines, receiving wells, sand retention ponds, clear water reservoir, distribution pumps, elevated tanks and water distribution pipes. The flow of water supply system is shown in **Figure G-16**.

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<sup>1</sup> Source : Sihanoukville Water Supply Authority (SWSA), WB, 2002.



**Figure G-16 Flow of Water Supply System (Rapid Sand Filter Type)**

## 2) Design Discharge

The design flow rate for the SIA Site-6 is assumed below.

**Table G-17 Design Conditions of Water Supply Facilities for the SIA Site-6**

Items	Water Flow	Remarks
Daily average water demand	12,400 m <sup>3</sup> /day	
Daily average water consumption	14,900 m <sup>3</sup> /day	Unaccounted water ratio = 20%
Daily maximum water consumption	17,885 m <sup>3</sup> /day	Daily fluctuation factor = 1.2
Hourly maximum water consumption	1,863 m <sup>3</sup> /hr	Hourly fluctuation factor = 2.5

The capacity of distribution pumps and distribution pipes in the supply area is designed taking the consideration of the fire-fighting water (extinguishing water) of 1.0 to 1.5 m<sup>3</sup>/min in addition to the ordinary water consumption. Thus, the maximum water consumption (MWC) including the fire-fighting water is estimated at 32.6 m<sup>3</sup>/min.

$$\text{MWC} = 31.1 \text{ m}^3/\text{min} \text{ (or } 1,863 \text{ m}^3/\text{hr}) + 1.5 \text{ m}^3/\text{min} = 32.6 \text{ m}^3/\text{min}$$

## (3) Design Criteria

Design criteria for the water supply facilities in SIA Site-6 are used of same criteria for SIA-4 as described in the **Section G.5.3**.

## (4) Specifications

Location map of proposed Toek Sap Reservoir and the connecting pipeline to the site are shown in **Figure G-17**. The water distribution network in the SIA Site-6 is shown in **Figure G-18**.

Proposed water supply system for the SIA Site-6 is shown in the table below.

**Table G-18 Proposed Water Supply System for SIA Site-6**

<b>Items</b>	<b>Specifications</b>
1. Intake Facility	
Reservoir	Cost will be allocated by SWSA and SIA Storage Vol.(Gross) = 16.3 MCM, Daily Ave. Consumption = 80,000 m <sup>3</sup> /d, Earth Fill Type Dam, H=14 m, Dam Crest Length =646 m
Intake Tower	- (Same facility for SIA-4 will be used)
Intake Pipe	D 250 mm x L 20 m x 4 (additional)
Intake Pump	Pump 4.6 m <sup>3</sup> /min x H 20 m x 8 kW x 4 sets (including 1 standby)
Electric Power	- (Same facility for SIA-4 will be used)
2. Conveying Pipeline	
Conveying Pipe	DIP 500 mm Dia. x Total 5,300 m Length
3. Distribution Facility	
Receiving Well	H 3 m x W 2.71 m x L 2.71 m x 2 wells = V 44 m <sup>3</sup>
Flocculation Basin	W 7.9 m x L 7.9 m x D 2.0 m x 2 basins = V 248 m <sup>3</sup>
Sedimentation Basin	W 5.9 m x L 20.0 m x D 3.5 m x 2 basins = V 828 m <sup>3</sup> , Surface Load = 15 mm/min, Average Velocity = 0.30 m/min.
Rapid Sand Filter	W 5.0 m x L 12.0 m x D 0.7 m (+ freeboard 0.3 m) x 2 beds
Clear water reservoir	H 3 m x W 10 m x L 23.5 m x 2 ponds = V 1,411 m <sup>3</sup> (12 hours of daily maximum consumption)
Operation Building	W 10m x L 20 m x 1
Pump Station	5 m x 32 m = 158 m <sup>2</sup> x 1 house
Distribution Pump	4.6 m <sup>3</sup> /min x H 25 m x 10 kW x 9 pumps (including 1 standby)
Elevated Tank	Total Vol.=977 m <sup>3</sup> (30 minutes of maximum hourly Q) H = 15 m, Depth =4 m x Dia 12.8 m x 1 tank.
Transformer	1 set
Distribution Pipeline	PVC 100 - 150 mm Dia. x Total 2,186 m Length
	DIP 200 - 700 mm Dia. x Total 5,664 m Length

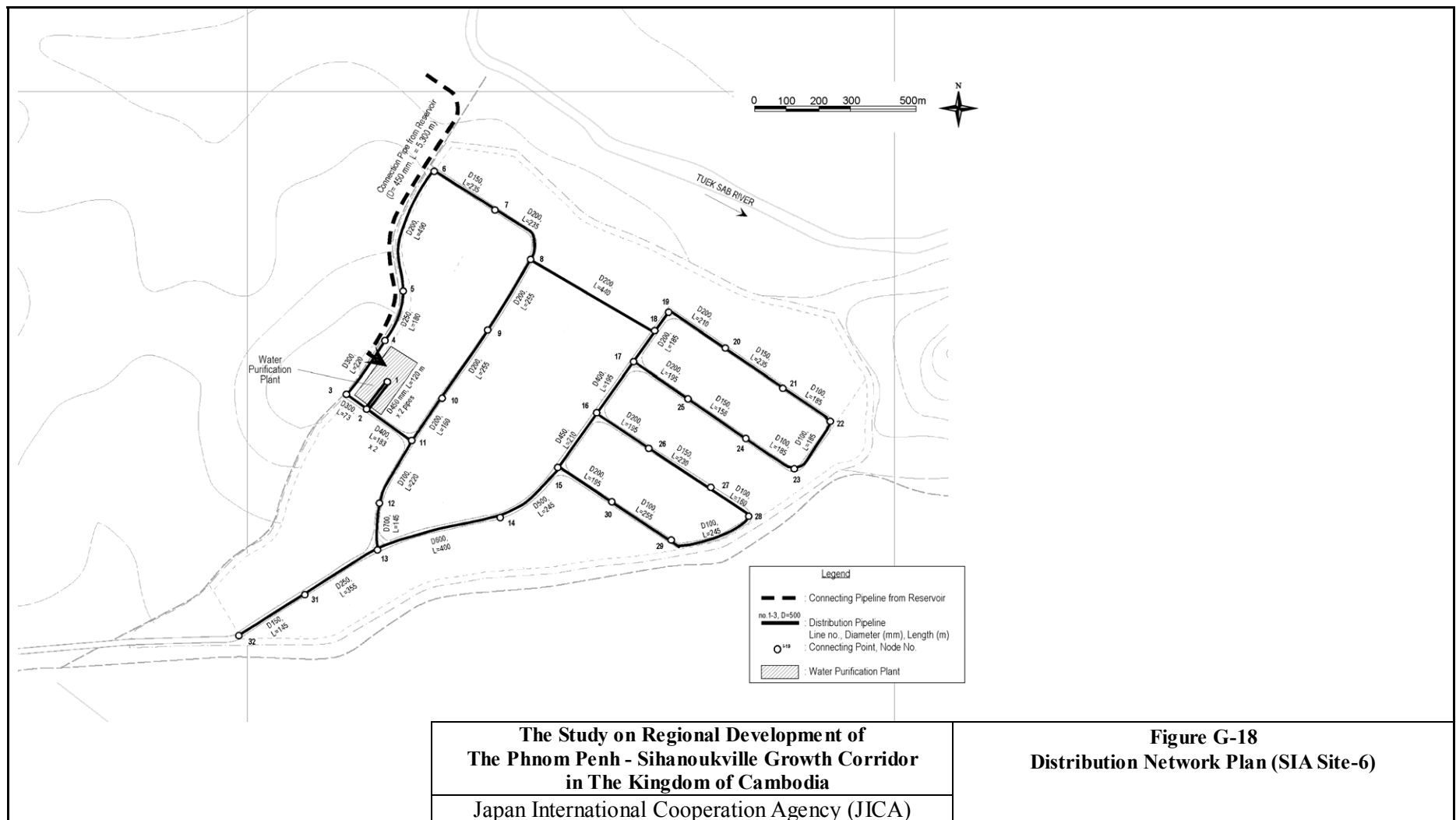


**The Study on Regional Development of  
The Phnom Penh-Sihanoukville Growth Corridor  
in The Kingdom of Cambodia**

Japan International Cooperation Agency (JICA)

**Figure G-17  
Proposed Toek Sap Reservoir and Connecting  
Pipeline (SIA Site-6)**





## **G.6.4 Drainage**

### **(1) General Conditions**

The total drainage area of the SIA Site-6 is 180 ha. The rainwater will be discharged into the Tuek Sab River, after being collected by the drainage.

### **(2) Design Conditions and Criteria**

The same conditions and criteria as the SPFZ-P described in the section I.2.5 have been applied.

### **(3) Specifications**

Stormwater channels, which are of open channel with opposite trapezoidal shape and of earth- constructed with stone lining, will be installed along the roads to collect and transport stormwater as shown in **Figure G.6.4-1**. The channels to be installed are described as follows:

- Stormwater Channels:	Small Size (3m Width)	Total length 290m
- Stormwater Channels:	Medium Size (4 - 6m Width)	Total length 4,870m
- Stormwater Channels:	Large Size (7 - 8m Width):	Total length 3,680m
		Overall length 8,840m

Stormwater will be discharged into the Tuek Sab River by gravity force through open channels.

## **G.6.5 Sewerage**

### **(1) General Considerations**

In the same manner as the SPFZ-P described in the section I.2.6, the total pollution load to be generated has been estimated at:

	<u>BOD (kg/day)</u>	<u>SS (kg/day)</u>
- Total pollution loads:	6,760	5,660

### **(2) Design Conditions**

The flowrate of wastewater to be generated from factories has been estimated in the same manner as the SPFZ-P described in the section I.2.6.

- Daily Average Flow:	(m <sup>3</sup> /day)	12,300
- Daily Maximum Flow:	(m <sup>3</sup> /day)	14,760
- Hourly Maximum Flow:	(m <sup>3</sup> /hr)	1,540

The quality of wastewater to be generated and treated wastewater has been set in the same manner as the SPFZ-P, as follows:

	<u>Incoming Wastewater</u>	<u>Treated Wastewater</u>
- pH:	5 - 9	5 - 9
- BOD: (mg/l)	550	less than 80
- SS: (mg/l)	460	less than 80

### (3) Design Criteria

The same criteria as the SPFZ-P described in the sector I.2.6 has been applied.

### (4) Specifications

#### 1) Sewers

Sewers of hume concrete pipe, which are embedded under the roads, are used to collect and transport wastewater by gravity force, and manholes and collection pipes will be attached to sewers at necessary locations. The major specifications of sewers are described as follows:

- Sewers:	Small Size (200 - 300mm Dia)	Total length 1,720m
- Sewers:	Medium Size (400 - 600mm Dia)	Total length 3,490m
- Sewers:	Large Size (700 - 1000mm Dia)	Total length 1,580m
		Overall length 6,790m

The layout of sewerage is shown in **Figure I.5.5-1**.

#### 2) Wastewater Treatment Plant (WWTP)

A WWTP employing the process of "Oxidation Ditch" will be constructed to purify wastewater to the level to meet the water quality set by the Cambodian Government. A sludge treatment system and other auxiliary facilities as described below will accompany the WWTP:

- Grit chamber:	1 unit	Reinforced concrete-constructed, square shape Attached by: Influent pump (3 units including 1 standby) Influent screen (1 unit)
- Oxidation ditch:	4 units	Reinforced concrete-constructed, 4 m Width x 82 m Length x 3.5 m Depth x 4 pass Attached by: Aeration Rooter (4 units)
- Settling basin:	4 units	Reinforced concrete, circular shape, 22m Dia x 4m Depth Attached by: Sludge return pump (6 units including 2 unit) Sludge collector (4 units)
- Sludge treatment system:	1 unit	Mechanical dehydration type  Attached by: Sludge thickener (2 unit) Sludge dehydrator (4 unit)
- Other appurtenances:		Chlorination basin (1 unit)  Operation and supervision building (1 unit) Power receiving and control boards (1 unit)

#### 3) Discharge of Treated Water

Treated water will be discharged into the Tuek Sab River by gravity force through a stormwater channel.

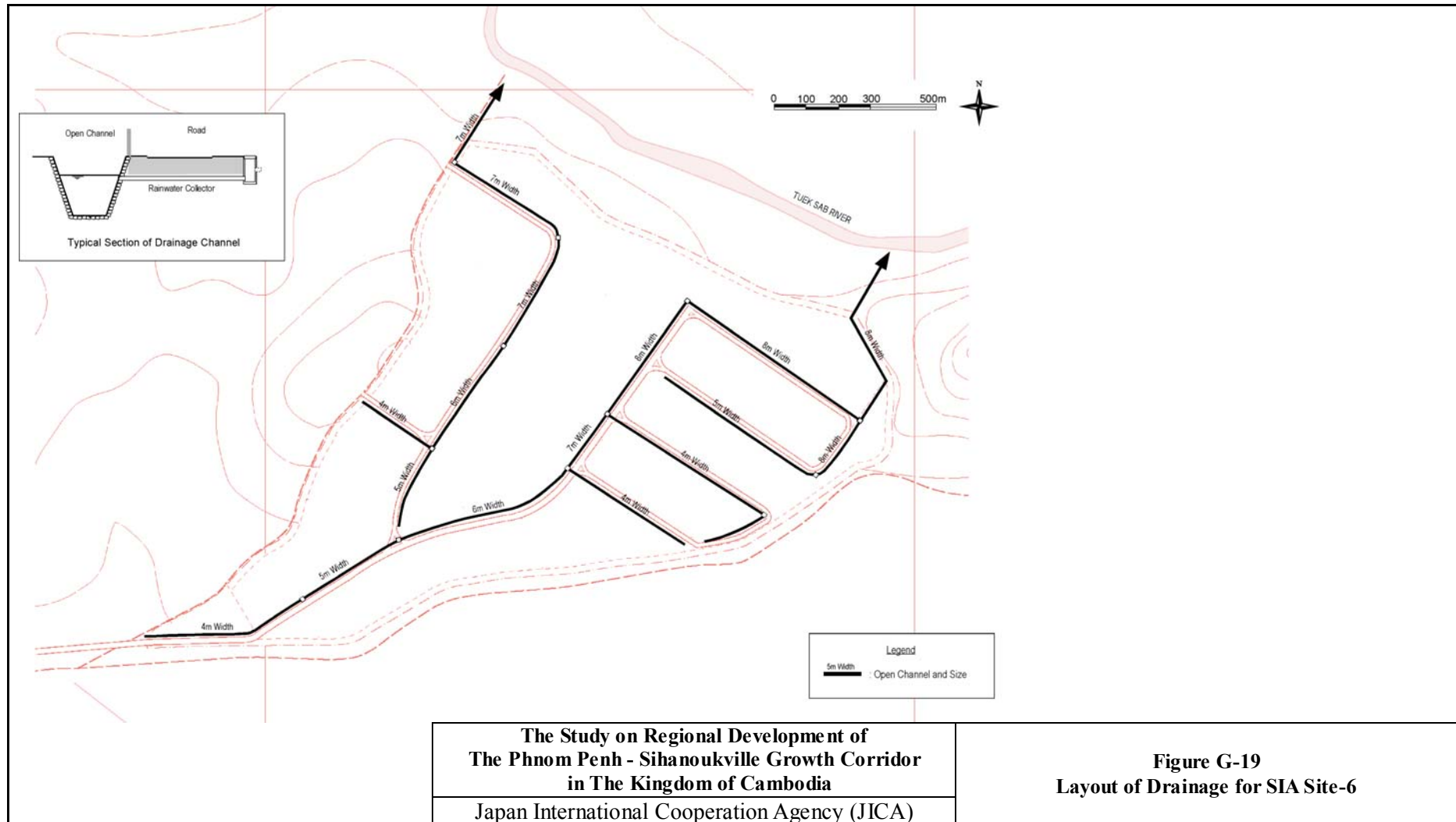


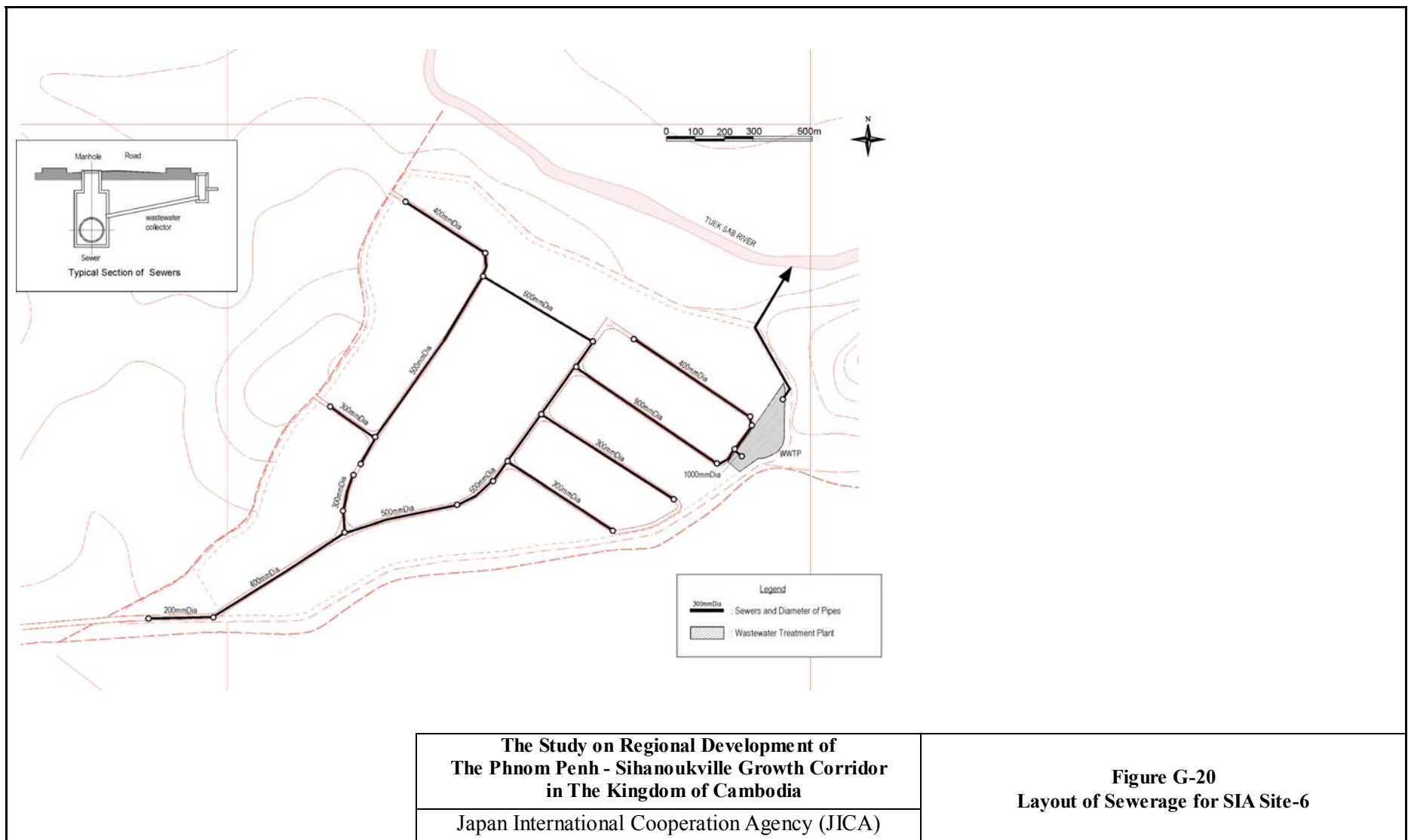
### **G.6.6 Solid Waste Management**

In the same manner as the SPFZ-P described in the section I.2.7, the solid waste amount to be discharged has been estimated as follows:

	<u>Units</u>	<u>Solid Waste Discharged from Factories</u>				<u>WWTP Sludge</u>
		<u>Combustible</u>	<u>Non-Combustible</u>	<u>Toxic Waste</u>	<u>Total</u>	
- Discharged Solid Waste:	(ton/day)	32.7	14.7	0.2	47.6	17.0

After being transported by sub-contractors of each factory, all solid waste to be discharged from the site except toxic waste will be disposed of at the existing public landfill, which will be renovated until due time.





## **G.6.7 Power Supply**

### **(1) General Considerations**

As mentioned in the sub-clause 1.3.7.1, the power will be available from the grid substation in Sihanoukville.

Study Team proposes that 66kV transmission line from the grid substation to the industrial area and 66/22kV on-site substation in the industrial area should be established as well as Sihanoukville Industrial Area No.4.

The route of transmission line is shown in **Figure I.3.7-1**.

### **(2) Design Conditions and Criteria**

The same manners as Area No.6 in the sub-clause I.3.8.2 are maintained.

### **(3) Specifications**

In this pre-feasibility study on the industrial area, the basic design on the following facilities is proposed in the subsequent clause.

- (a) Transmission line between the grid substation and on-site substation
- (b) On-site substation in the industrial area
- (c) Distribution facilities in the industrial area

In addition to these items, some works, such as increase of feeder bays and transformer capacity in grid substation, etc. may be necessary for EDC facilities.

#### *1) Transmission line between grid substation and on-site substation*

In consideration of the power demand, 12.5 MW and transmission length, 15km, 66kV transmission line is proposed.

Two (2) circuits are proposed in order to secure the high reliability of power supply.

The following design is proposed for the transmission line:

- (a) Line Voltage : 66 kV
- (b) No. of circuit : 2 circuits
- (c) Line Length : Approximately 15 km
- (d) Structure : Steel tower, or concrete pole
- (e) Insulator : Porcelain
- (f) Conductor : ASCR 200mm<sup>2</sup>

#### *2) On-site Substation*

An on-site power station shall be established to receive the power from the 66kV transmission line, and distribute it to consumers.

The basic design of the substation is summarized below:

- (a) Type : Outdoor conventional type
- (b) Capacity : 30 MVA

- (c) Arrangement and composition of switch gear:
  - 66kV and 22kV bus : Single bus
  - 22kV switchgears : In door cubicle type
  - Power transformer : 15 MVA x 2 sets  
Outdoor type with on-load tap changer
  - Station transformer : 22/0.4kV, 400kVA x 1 set

### 3) *Distribution Network*

**Figure G-21** shows the route map of 22kV distribution line in the area. 22kV distribution lines are spread from the substation to the consumers.

The basic design of 22kV distribution network in the area is summarized below:

- (a) Line Voltage : 22 kV
- (b) Line length : Approximately 10.2 km
- (d) Cable type : Rated voltage 24kV (50Hz)  
240 mm<sup>2</sup> XLPE triplex cables, Al. conductor
- (e) Burying method : 0.8 m underearth by direct burying (Protection pipe shall be used when burying under the roads.)
- (f) Ring main unit : Outdoor cubicle type or indoor type  
(In case indoor type, small building shall be constructed.)  
Ring main unit will be installed at the borders of every two consumers.
- (g) Operation system : Manual Operation
- (h) Street lighting system
  - Transformer : 22/0.4kV, 50kVA, 2 stations
  - Underground cable : 0.6/1.0 kV, XLPE 2 x 25 mm<sup>2</sup>  
Cable length: approx. 18 km
  - Other accessory : Distribution board, watt-hour meter, switching timer, circuit breaker, etc.
  - Station transformer in the substation will also used for power supply to street lighting.
- (i) EDC Design Standard shall be applied.

#### **G.6.8 Telecommunication**

The demand of the tenanted industry in site-6 is projected as 330 lines in 2008. To cope with the demand, the RSU will be installed and to connect to the newly established LS by OF.

The network in the site is shown as following **Figure G-22**.

