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

### G.5.3    Water Supply Facility

### (1)    General Conditions

#### 1)    *Water Resources Potential*

Mean annual rainfall at the Sihanoukville is approximately 3,400 mm/year. However, water supply potential in the Sihanoukville is very limited.    The river flow is almost dried up in the dry season, while the groundwater potential is not high in the Sihanoukville province.    The shallow well yields only 58 m$^3$/day[5] in average, while deep well yields from 480 m$^3$/day to 720 m$^3$/day[6].

#### 2)    *Present Water Supply System in Sihanoukville*

Presently the center of the Sihanoukville municipality is served by the piped water supply system.    The Sihanoukville Water Supply Authority (SWSA) under the Water Supply Office of Department of Industry, Mines and Energy operates the system.

The plant capacity of the water supply system in the Sihanoukville is only 3,000 m$^3$/day and the service ratio is reported at only 13% (1,400 households) of the population in the service area in 2002.    Presently the typical dry-season yield of the lake is approximately 2,200 m$^3$/day, which is inadequate to serve the water demand of the Sihanoukville.

The expansion project (funded by World Bank) is on going to make the capacity 6,000 m$^3$/day (service ratio of 50% for 4,000 households) by increasing capacity of existing reservoir "Lake Boeng Prek Tup" and development of additional 3 wells.

#### 3)    *Updating of Water Demand forecast in Sihanoukville*

In this study, future water demand of the Sihanoukville City is estimated by using updated data/information.    As the future water demand in the Sihanoukville City at 2020 level is projected at 86,000 m$^3$/day in this Study.    It is included the water demand for 2-sites of proposed industrial area (IA).    There will be a substantial imbalance between the water supply capacity and the demand.    Water sources are not sufficient to supply water to the large demands without the development of the reservoir in this area.

#### 4)    *Review of Alternative Water Supply Sources*

In 1994, the potential alternatives of the long-term water for Sihanoukville was studied by Fraser Thomas.    The ten alternatives of long-term sources were considered as shown in **Table G-11**.    Location of the ten-(10) alternative sources are indicated in **Figure G-4**.

---

[5]        Source : UNICEF & Ministry of Rural Development.
[6]        Source : Sihanoukville Water Supply Authority (SWSA), WB, 2002.

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

**Table G-11    Alternative Long-term Water Supply Sources for Sihanoukville Comparative Attributes (from Fraser Thomas, 1994)**

| No. | Name | Source | Location | Capacity | Quality | Notes |
|-----|------|--------|----------|----------|---------|-------|
| 1 | Lake Boeng Prek Tup (increased capacity) | Lake | Sihanoukville area | X | F | Present supply lake |
| 2 | Oil Refinery Lake | Lake | Stung Hav District | X | F | Inadequate for future demand |
| 3 | Groundwater | GW | Sihanoukville area | F | O | Inadequate for future demand |
| 4 | Phum Riem (Groundwater Reserves) | GW | Prey Nob District | X | O | Inadequate for future demand |
| 5 | Phum Riem (Lake Boeng Thom Angkep | Lake | Prey Nob District | X | X | Inadequate for future demand |
| 6 | Sokha Lake | Lake | Sihanoukville area | X | X | Poor quality |
| 7 | Groundwater further afield | GW | Prey Nob District | X | O | Inadequate for future demand |
| 8 | Lower Prek Toek Sap | River | Prey Nob District | O | X | Brackish water |
| 9 | Upper Prek Toek Sap | River | Prey Nob District | O | O | Need reservoir |
| 10 | Other rivers | River | Stung Hav District | O | O | Long distance |

Source : Fraser Thomas (1994)

The study by Fraser Thomas confirmed that the upper reaches of the Prek Toek Sap River is the only resource in consideration of the estimated dry season yield.

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

Nippon Koei/ IDCJ/ KRI International

(Source : Fraser Thomas, 1994)

1 : Lake Boeng Prek Tup (increased capacity)
2 : Oil Refinery Lake - Stung Hav District
3 : Groundwater - Sihanoukville area
4 : Phum Riem - Groundwater Reserves
5 : Phum Riem - Lake Boeng Thom Angkep

6 : Lake at "Sokha"
7 : Groundwater further afield
8 : Prek Toek Sap - Lower reaches
9 : Prek Toek Sap - Upper reaches
10 : Other rivers

| The Study on Regional Development of The Phnom Penh-Sihanoukville Growth Corridor in The Kingdom of Cambodia | Figure G-4 Alternative Water Resource Locations |
|---|---|
| Japan International Cooperation Agency (JICA) | |

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

5)    *Flow of Prek Toek Sap River*

An automatic rain gauge, water level and staff gauges were installed at around 200m upstream of the Kbal Chay waterfall in the Prek Toek Sap River by the Department of Water Resources and Meteorology, Sihanokville on 16 February, 2001.   Catchment area of the Kbal Chay water level station is at 52.5 km$^2$.   The location map is shown in **Figure G-5**.
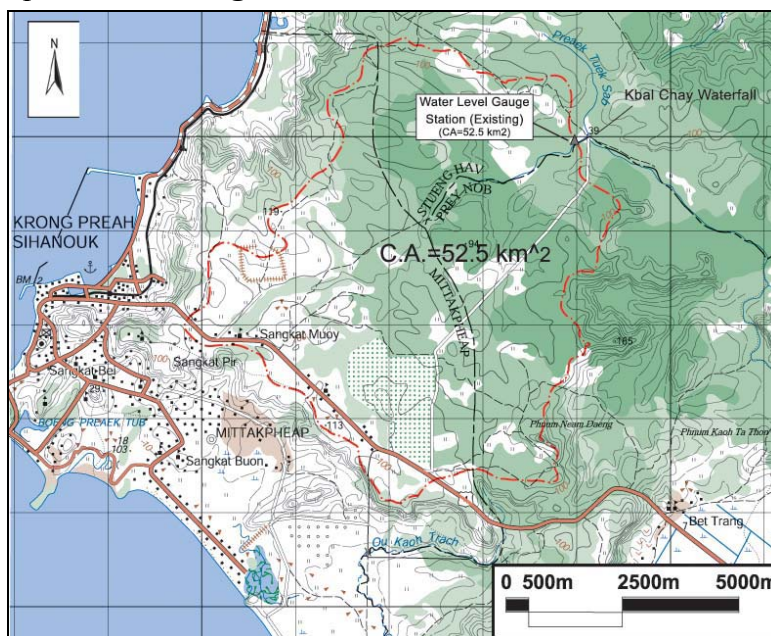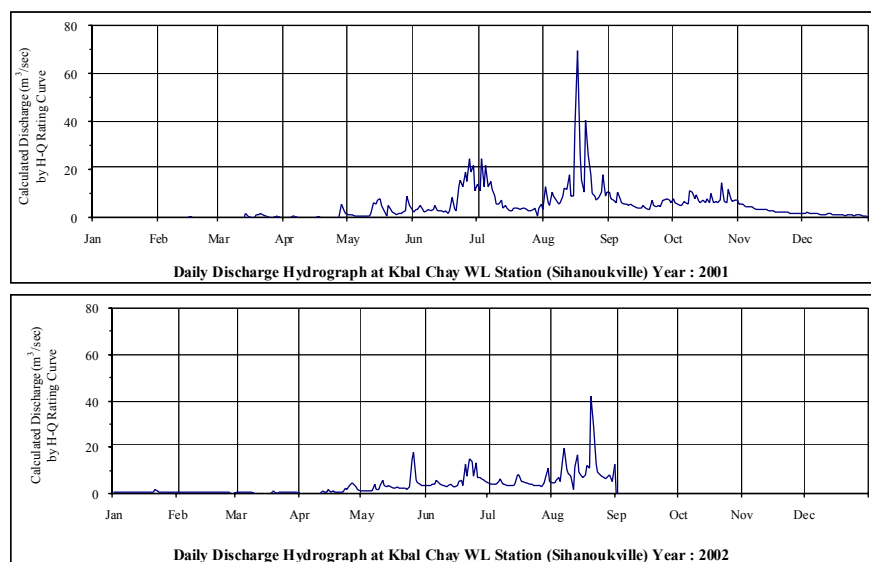


**Figure G-5    Location Map of Kbal Chay W.L. Station (Prek Toek Sap River)**

Using the daily gauge height record and the rating curve, the daily discharge is calculated as shown in **Figure G-6**.



Source :  JICA Study Team
Daily gauge height data from Department of Water Resources and Meteorology, Sihanoukville

**Figure G-6    Daily Discharge Hydrograph at Kbal Chay W.L. Station (2001-2002)**

During the observed period from February 2001 to August 2002, a minimum discharge was observed at 0.11 m$^3$/sec in 17 February, 2001, while a maximum daily mean discharge was observed at 69.6 m$^3$/sec in 17 August, 2001.

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

The river discharge during the dry season in the Sihanoukville area is quite limited. As described above, future water demand in the Sihanoukville City will reach to 86,000 $m^3$/day (= 0.99 $m^3$/sec). It is not available to use this river without any reservoir (dam) for the water supply in Sihanoukville City. Therefore, it is strongly requested to make a reservoir in the Prek Toek Spa River for the water supply in the Sihanoukville as soon as possible.

*6) Outline of Water Supply to Sihanoukville Industrial Area Site-4 (SIA-4)*

As mentioned before, the average daily water demand for the SIA Site-4 is estimated at 9,500 $m^3$/day. Water supply for the SIA Site-4 should develope new water source due to insufficient supply capacity of SWSA at present and future. Considering that the water supply by groundwater source, it is necessary to drill more than 20 wells (assumed average yield of unit well as 500 $m^3$/day in Sihanoukville area[7]). In addition, distance of each well should be sparse more than 500m and the area of well fields is required more than 17 $km^2$. Also the cost of drilling deep wells, connection pipeline and operation cost will be high. Therefore, the water source 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-4 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-4.

### (2) Design Conditions

*1) Flow of Water Supply System*

Water supply facilities for the SIA SITE-4 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-7**.
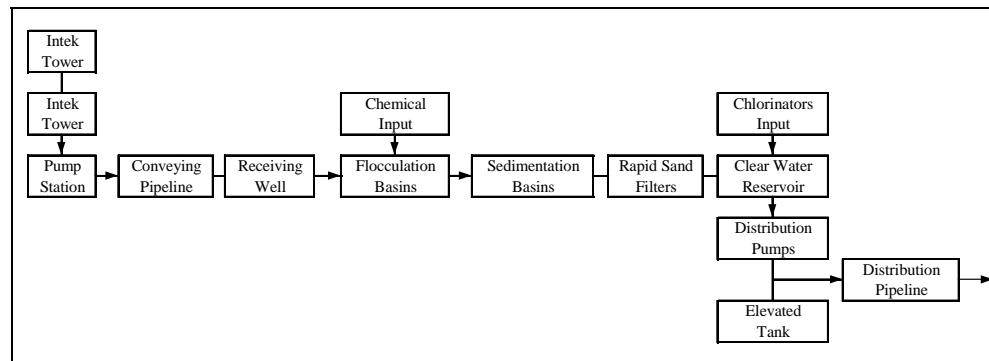


**Figure G-7    Flow of Water Supply System (Rapid Sand Filter Type)**

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

*2) Design Discharge*

The design flow rate for the SIA SITE-4 is assumed below.

**Table G-12 Design Conditions of Water Supply Facilities for the SIA Site-4**

| Items | Water Flow | Remarks |
|---|---|---|
| Daily average water demand | 9,500 m³/day | |
| Daily average water consumption | 11,400 m³/day | Unaccounted water ratio = 20% |
| Daily maximum water consumption | 13,680 m³/day | Daily fluctuation factor = 1.2 |
| Hourly maximum water consumption | 1,425 m³/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 m³/min in addition to the ordinary water consumption. Thus, the maximum water consumption (MWC) including the fire-fighting water is estimated at 25.3 m³/min.

**MWC**= 23.8 m³/min (or 1,425 m³/hr) + 1.5 m³/min = 25.3 m³/min (or 0.54 m³/sec)

## (3) Design Criteria

The water supply facilities are designed in accordance with the following criteria:

*1) Intake Facilities*

Intake facilities will be installed at the proposed reservoir in Prek Toek Sap River. Intake water will be located at upstream of dam. Intake facilities consist following facilities:

- Reservoir : earth-fill type dam, include main dam embankment, spillway, inlet and outlet, operation, operation house
- Intake tower : RC made, including screen, intake gates, intake pipe
- Intake pipe : design intake discharge = daily maximum water consumption, steel pipe
- Intake pump : include submergible pumps, pump pit & screen, patrol boat
- Intake capacity : daily maximum water consumption x 110%
- Intake pump station : RC made
- Electric Power : electric line from EDC

*2) Conveying Pipeline*

- Design discharge : daily maximum water consumption x 110%
- Materials of pipe : Ductile Crest Iron Pipe with internal mortar lining (DIP) is recommended for the material of connecting pipe because of its reliability

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

and easy installation work specially in the rainy season.

*3)    Receiving Well*

Purpose of the receiving well is to regulate the water flow or pressure and to dose and mix chlorine solution for disinfection in general.

- Effective depth         :    3.0 - 5.0 m
- No. of basin             :    2 basins
- Detention time          :    more than 15 minutes of daily maximum water consumption
- Appurtenances         :    perfect over flow weir, inlet valves and chemical dosing popes are required.

*4)    Flocculation Basins*

- Basin type               :    Up-Down Baffled Cannel Maixing
- No. of basin             :    2 basins
- Detention time          :    20 - 40 minutes of daily maximum water consumption
- Appurtenances         :    washing pipes, drain gates

*5)    Sedimentation Basins*

- Basin type               :    Horizontal Flow Sedimentation
- No. of basin             :    at least 2 basins
- Size of basin             :    $L = W \times 3 \sim 8$ times
- Effective depth         :    $D = 3 \sim 4$ m
- Free board               :    0.3 m
- Surface load             :    15 - 30 mm/min.
- Average velocity       :    less than 0.4 m/min.
- Appurtenances         :    drain valves, washing pipelines, outlet troughs

*6)    Rapid Sand Filters*

- No. of bed               :    at least 2 beds. surface area <= 150 m2 /bed
- Size of basin             :    Rectangle (W<L), max
- Depth of sand           :    $D = 0.6 - 0.7$ m
- Free board               :    0.3 m
- Filtration Speed        :    around 120 - 150 m/day
- Appurtenances         :    surface wash and back wash system, pipe gallery

*7)    Clear Water Reservoir*

Clear water reservoir will be constructed to regulate the fluctuating demand of the

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

distribution system.

- No. of reservoir : at least 2 reservoirs, RC made.
- Detention time : about 12 hours of the daily maximum water consumption
- Effective depth : D = 3 ~ 6 m
- Appurtenances : inlet and outlet pipes, ventilators, level meter

*8)  Operation Building*

- Size : W 10 m x L 20 m
- Structure : RC made

*9)  Chemical Building*

- Size : W 7 m x L 15 m x 2 Stories
- Structure : RC made

*10)  Distribution Pump*

Distribution pumping station will be constructed to install distribution pumps that will transmit water to distribution system in the SIA SITE-4 area through distribution pipeline networks.

*11)  Elevated Tank*

In general, elevated tank is used in the area considering that there is no high elevated site for the clear water reservoir in the planned area.  The elevated tank will also be constructed to correspond to the fluctuating pressure of the distribution pipeline and demand of the distribution system.  Capacity of the elevated tank will be design to be about 30 minute of the hourly maximum water consumption, if it is used with pump and other clear water reservoir.  Structure of the reservoir will be RC.

*12)  Supplied Water Pressure of Distribution Pipe*

The minimum residual water pressure of 15 m is applicable at the ground level (= 1.5 kg/cm$^2$ = 0.15 MPa) of supply point.  The maximum pressure is designed less than 50-m head (0.50 MPa).  Design velocity is planned less than 1.6 m/s.

*13)  Hydraulic design of distribution pipes*

The *Hazen-Williams' Formula* is applicable for hydraulic analysis of distribution pipes to check of the supplied water pressure.

$$I = 10.666 \times C^{1.85} \times D^{-4.87} \times Q^{1.85}$$

$$H = I \times L$$

where, $I$ : Hydraulic gradient [-]
$C$ : Roughness coefficient of pipes, 110 [-]
$D$ : Inner diameter of pipe [m]
$Q$ : Water flow rate [m$^3$/sec]
$H$ : Head loss of pipes [m]
$L$ : Length of pipe [m]

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

*14)   Hydraulic Analysis for Loop-wise Pipe Networks*

The *Hardy-Cross Method* is applicable for the analysis of loop-wise pipe networks. Therefore, the water flow distribution, which satisfies the following equations, is selected at each node point.

$$\sum Q_{\inf\,low} = \sum Q_{outflow} \text{ , and}$$

$$\sum \Delta H_{clockwise\_direction} = \sum \Delta H_{anti-clockwise\_direction}$$

where,    Q        :        Water flow rate [m3/sec]
          $\Delta H$        :        Head loss of pipes [m]

*15)   Materials of Distribution Pipe*

- Over 200 mm of nominal diameter   :   Ductile Crest Iron Pipe with internal mortar lining (DIP)

- Below 150 mm of nominal diameter   :   Hard polyvinyl-chloride (PVC) pipe for water works (VP)

- Minimum diameter                   :   Nominal 50 mm

*16)   Fire-fighting Hydrant*

The 4-inch-diameter hydrants are installed by the 200m interval.

*17)   Earth Covering of Pipes*

Water distribution pipes are embedded at 1.2 m below the ground level in principle.   Pipes will be laid underground along the roads.

*18)   Appurtenances*

- Lot connecting piping :   To be installed around the boundaries of industry lots with water meter and stop valve.

- Other accessories      :   Air-valves, drain-valves and stop-valves to be installed at appropriate places.

**(4)   Specifications**

Location map of proposed Toek Sap Reservoir and the connecting pipeline to the site are shown in **Figure G-8**.   The water distribution network in the SIA SITE-4 is shown in **Figure G-9**

Proposed water supply system for the SIA Site-4 is shown in the table below.

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

**Table G-13    Proposed Water Supply System for SIA Site-4**
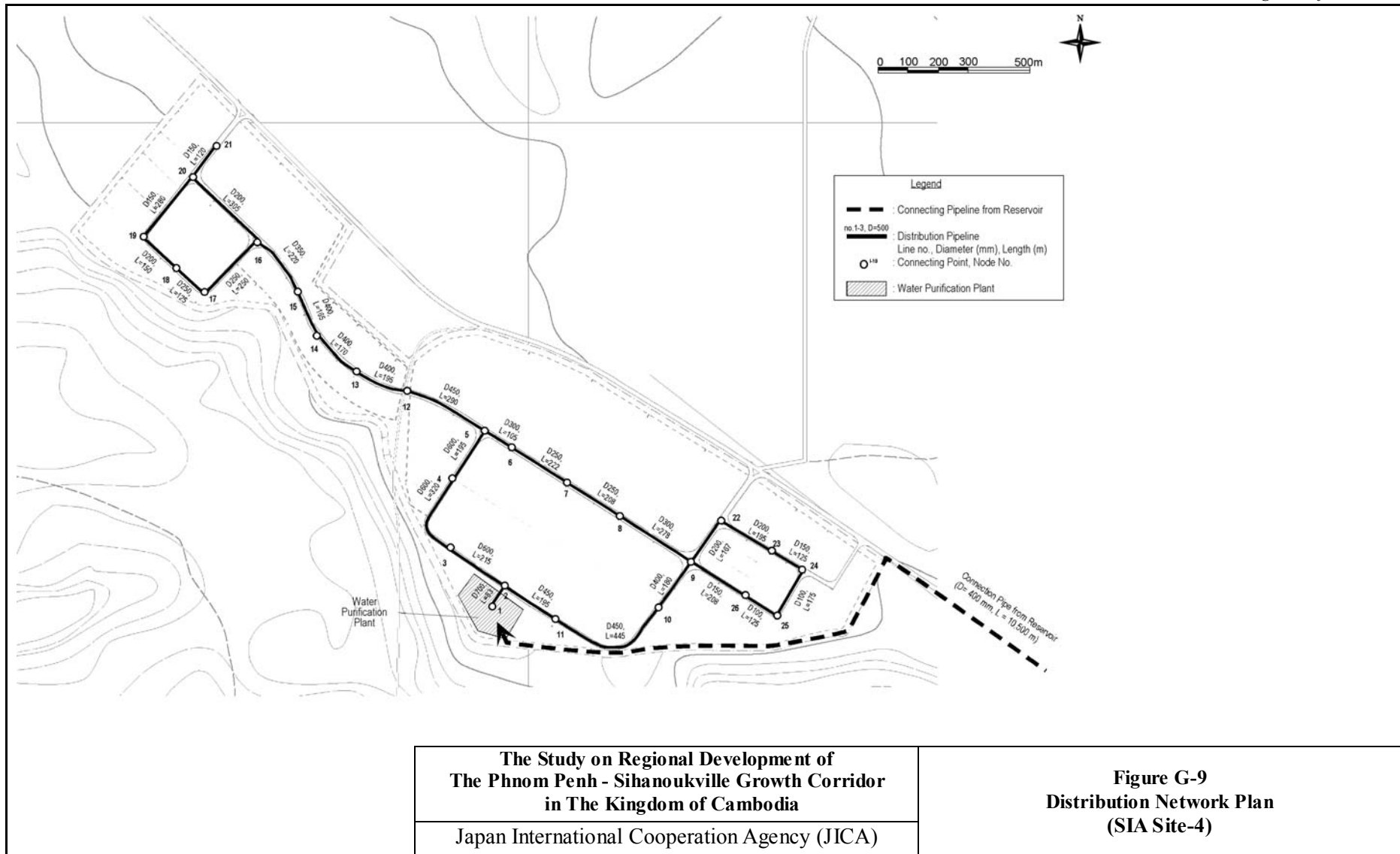
| Items | Specifications |
|---|---|
| **1. Intake Facility** | |
| Reservoir | Cost will be allocated by SWSA and SIA |
| | Storage Vol.(Gross) = 16.3 MCM, Daily Ave. Consumption = 80,000 $m^3$/d, Earth Fill Type Dam, H=14 m, Dam Crest Length =646 m |
| Intake Tower | D 3.0m x H 15 m, RC made. Including screen, intake gates, intake pipe |
| Intake Pipe | D 250 mm x L 20 m x 4 |
| Intake Pump | Pump 4.6 $m^3$/min x H 20 m x 8 kW x 4 sets (including 1 standby) |
| | Include Gates and Screen |
| Electric Power | 22kV Distribution Line x 15,000 m + 1 Transformers |
| **2. Conveying Pipeline** | |
| Pump | 5.0 $m^3$/min x H 40 m x 15 kW x 4 sets (including 1 standby) x 2 sites |
| Pump House | 6 m x 12 m x 2 sites (include intake pump house), RC made. |
| Electric Power | 22kV Distribution Line (same line for intake) + 2 Transformers |
| Conveying Pipe | DIP 500 mm Dia. x Total 10,500 m Length |
| **3. Distribution Facility** | |
| Receiving Well | H 3 m x W 2.35 m x L 2.35 m x 2 wells = V 33 $m^3$ |
| Flocculation Basin | W 6.9 m x L 6.9 m x D 2.0 m x 2 basins = V 190 $m^3$ |
| Sedimentation Basin | W 6.0 m x L 15.0 m x D 3.5 m x 2 basins = V 633 $m^3$, Surface Load = 15 mm/min, Average Velocity = 0.23 m/min. |
| Rapid Sand Filter | W 4.6 m x L 10.0 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 $m^3$ |
| | (12 hours of daily maximum consumption) |
| Operation Building | W 10m x L 20 m x 1 |
| Pump Station | 5 m x 25 m = 123 $m^2$ x 1 house |
| Distribution Pump | 4.6 $m^3$/min x H 25 m x 10 kW x 7 pumps (including 1 standby) |
| Elevated Tank | Total Vol.=758 $m^3$ (30 minutes of maximum hourly Q) |
| | H = 15 m, Depth =4 m x Dia 11.3 m x 1 tank. |
| Transformer | 1 set |
| Distribution Pipeline | PVC 100 - 150 mm Dia. x Total 1,033 m Length |
| | DIP 200 - 700 mm Dia. x Total 4,678 m Length |
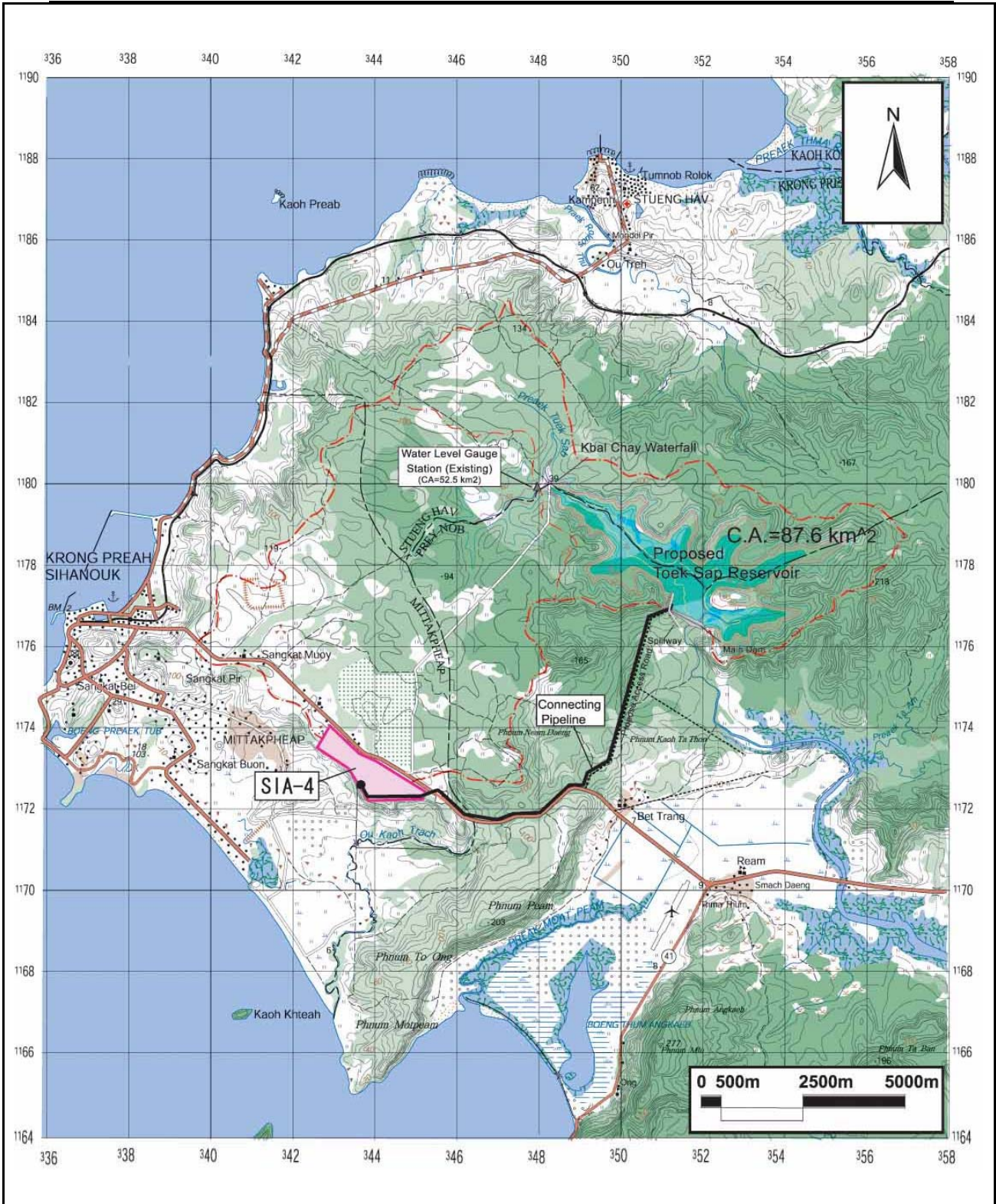
*The Study on Regional Development*
*of the Phnom Penh-Sihanoukville Growth Corridor*
*in The Kingdom of Cambodia*

| The Study on Regional Development of The Phnom Penh-Sihanoukville Growth Corridor in The Kingdom of Cambodia | Figure G-8 Proposed Toek Sap Reservoir and Connecting Pipeline (SIA Site-4) |
|---|---|
| Japan International Cooperation Agency (JICA) | |

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

| The Study on Regional Development of The Phnom Penh - Sihanoukville Growth Corridor in The Kingdom of Cambodia | Figure G-9 Distribution Network Plan (SIA Site-4) |
|---|---|
| Japan International Cooperation Agency (JICA) | |

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

## G.5.4 Drainage

### (1) General Considerations

The total drainage area of the site is 158 ha.   The rainwater will be discharged into the Ou Kaoh Trach 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-10.   The channels are described as follows:

| | | |
|---|---|---|
| - Stormwater Channels: | Small Size (3m Width) | Total length 1,050m |
| - Stormwater Channels: | Medium Size (4 - 6 m Width) | Total length 6,260m |
| - Stormwater Channels: | Large Size (7 - 9m Width): | Total length 3,630m |
| | | Overall length 10,940m |

Stormwater will be discharged into the Ou Kaoh Trach River by gravity force through an open channel.

## G.5.5 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 from the site has been estimated at:

| | BOD (kg/day) | SS (kg/day) |
|---|---|---|
| - Total pollution loads: | 4,800 | 4,140 |

### (2) Design Conditions

The flow of wastewater has been estimated in the same manner as the SPFZ-P described in the section I.2.6, as follows:

| | | |
|---|---|---|
| - Daily Average Flow: | ($m^3$/day) | 9,410 |
| - Daily Maximum Flow: | ($m^3$/day) | 11,290 |
| - Hourly Maximum Flow: | ($m^3$/hr) | 1,180 |

The quality of wastewater to be generated and treated wastewater has been set in the same manner as the SPFZ-P described in the section I.2.6, as follows:

| | | Incoming Wastewater | Treated Wastewater |
|---|---|---|---|
| - pH: | | 5 - 9 | 5 - 9 |
| - BOD: | (mg/l) | 510 | less than 80 |
| - SS: | (mg/l) | 440 | less than 80 |

### (3) Design Criteria

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

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

**(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 1,260m
    - Sewers:          Medium Size (400 - 600mm Dia)       Total length 2,310m
    - Sewers:          Large Size (700 - 1000mm Dia)       Total length 3,180m
                                                           Overall length 6,750m

The layout of sewerage is shown in Figure G-10.

*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 (i unit) |
| - Oxidation ditch: | 4 units | Reinforced concrete-constructed, |
| | | 4 m Width x 65 m Length x 3.5 m Depth x 4 pass |
| | | Attached by:      Aeration Roater (4 units) |
| - Settling basin: | 4 units | Reinforced concrete, circular shape, |
| | | 20m 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 Ou Kaoh Trach River through a stormwater channel by gravity force.

**G.5.6    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:

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

| | Units | Solid Waste Discharged From Factories | | | | WWTP Sludge |
|---|---|---|---|---|---|---|
| | | Combustible | Non-Combustible | Toxic Waste | Total | |
| - Discharged Solid Waste: | (ton/day) | 26.2 | 13.8 | 0.2 | 40.2 | 12.4 |

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

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



| The Study on Regional Development of The Phnom Penh - Sihanoukville Growth Corridor in The Kingdom of Cambodia | Figure G-10 Layout of Drainage for SIA-site 4 |
|---|---|
| Japan International Cooperation Agency (JICA) | |

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

| The Study on Regional Development of The Phnom Penh - Sihanoukville Growth Corridor in The Kingdom of Cambodia | Figure G-11 Layout of Sewerage for SIA-site 4 |
|---|---|
| Japan International Cooperation Agency (JICA) | |