# ANNEX 5.3.1

# THE PROJECT AND ITS FESSIBILITY STUDY

**THE STUDY ON WATER SUPPLY SYSTEM**
**FOR SIEM REAP REGION IN CAMBODIA**

**FINAL REPORT**
**Vol. III SUPPORTING REPORT**

**ANNEX 5.3.1 THE PROJECT AND ITS FEASIBILITY STUDY**

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# ANNEX 5.3.1 THE PROJECT AND ITS FEASIBILITY STUDY

## 1. Introduction

Future water supply system, which will be constructed under the Stage 1 Project, is described in this Annex. Target year of the Stage 1 Project is year 2006. Basis of the facility planning is as shown on Table 1.1.

**Table 1.1 Basis of Facility Planning for the Stage 1 Project**

| Description | Figures in Year 2006 |
|---|---|
| Population in Service Area | 39,244 |
| Service Ratio | 65 % |
| Served Population | 25,508 |
| Domestic Water Demand (Daily Average) | 3,061 $m^3$/day |
| Tourism Water Demand (Daily Average) | 2,060 $m^3$/day |
| Special Water Demand (Daily Average) | 156 $m^3$/day |
| Total Water Demand (Daily Average) | 5,277 $m^3$/day |
| Peak Factor for Domestic/Special Water Demand | 1.2 |
| Peak Factor for Tourism Water Demand | 1.573 |
| Total Water Demand (Daily Maximum) | 8,352 $m^3$/day |
| Hourly Peak Factor | 1.2 |
| Number of Domestic Connection | 4,475 |
| Total Number of Connection | 4,797 |

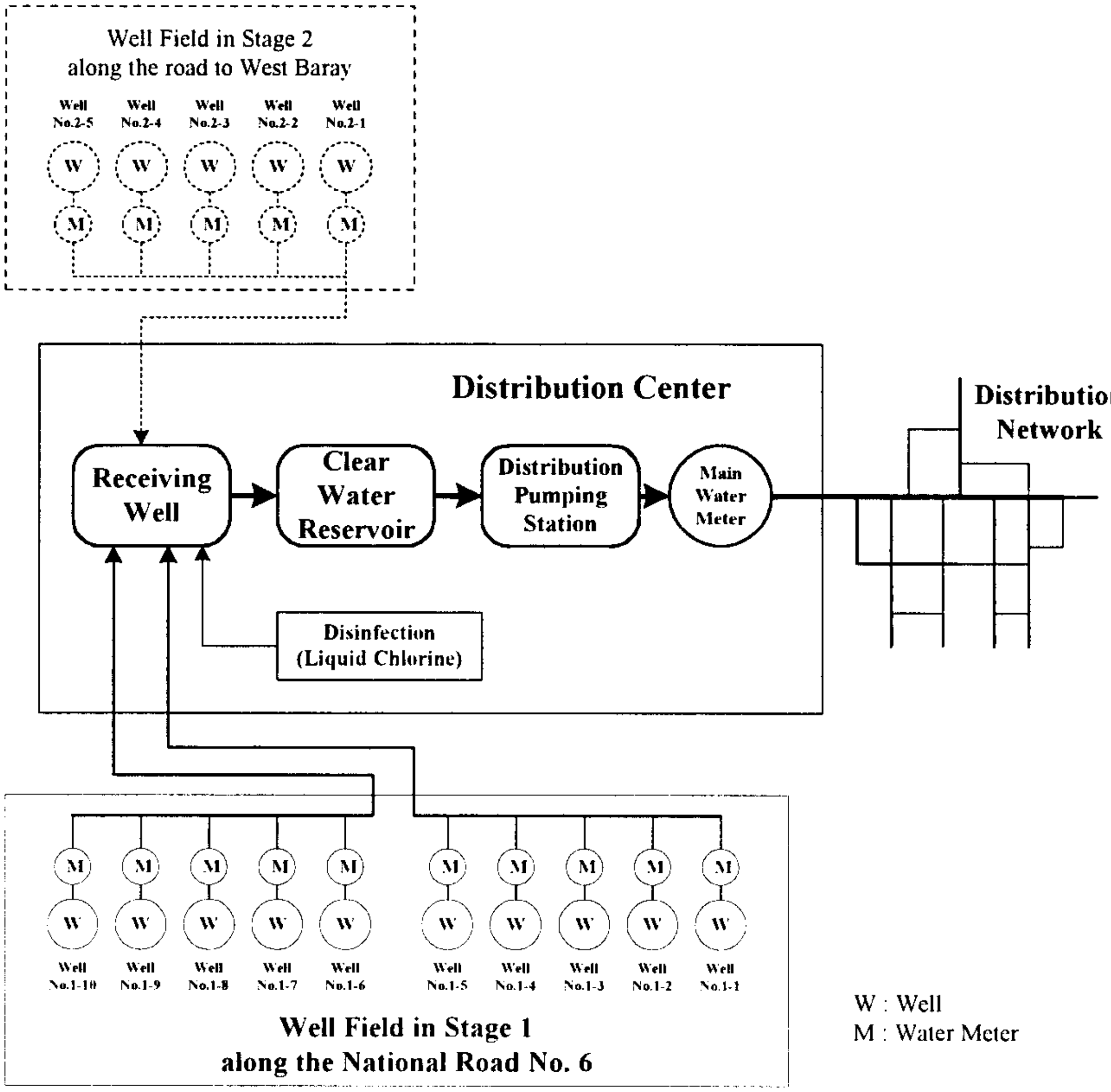
## 2. Future Water Supply Facilities

### 2.1 System Flow

Future water supply system flow which will use groundwater as its source is as shown on Figure 2.1.1.

Groundwater abstracted from each well will be sent to receiving well through connecting pipeline. Each five wells connected by one connecting pipeline and these five wells will form one unit. The water meter equipped on each well will measure quantity of groundwater abstraction. Liquid chlorine will be dosed for disinfection in the receiving well. Disinfected groundwater will be stored in the clear water reservoir to buffer hourly peak water demand. Water will be pumped to distribution network, after measurement by the main water meter. Method of water distribution is direct pumping and new/additional elevated tank will not be constructed.

Water production facilities such as wells, receiving well, clear water reservoir, and disinfection facilities were planned based on the Daily Maximum Water Demand. Distribution system such as distribution pumping station and distribution network were planned based on the Hourly Maximum Water Demand.




| The Study on Water Supply System for Siem Reap Region in Cambodia | Figure 2.1.1 Water Supply System Flow |
|---|---|
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## 2.2 Production Facilities

### 2.2.1 Well Field

10 wells to be constructed under the Stage 1 will be located along the National Road No. 6 with 400 m intervals. Additional 5 wells to be constructed under stage 2 will be located along the branch road from the National Road No. 6 to the West Baray Reservoir. Plan of the well field is shown on Figure 2.2.1

The specification of the wells is based on the groundwater simulation analysis and pumping test result. The well is designed to meet the drawdown depth requirement with safety clearance, well interference, and diameter of the submersible pump to be installed. The material for the casing and screen pipes is PVC, which is durable against corrosion by low pH groundwater.

<u>Detail Well Design</u>

The safe yield from each well is around 800 $m^3$/day considering a drawdown of 5 meter. This is also confirmed from the critical state of well as shown in Figure 2.2.2 and 2.2.3. First stage total demand of 8,000 $m^3$/day can be met by 10 wells. The groundwater simulation result in the Main Report Section 4.2.4 states that additional groundwater lowering may arise by the well interference effects caused by the steady operation of the total 15 well. The simulation result confirmed that with this modification there would be no impact on surrounding wells and Angkor heritage.

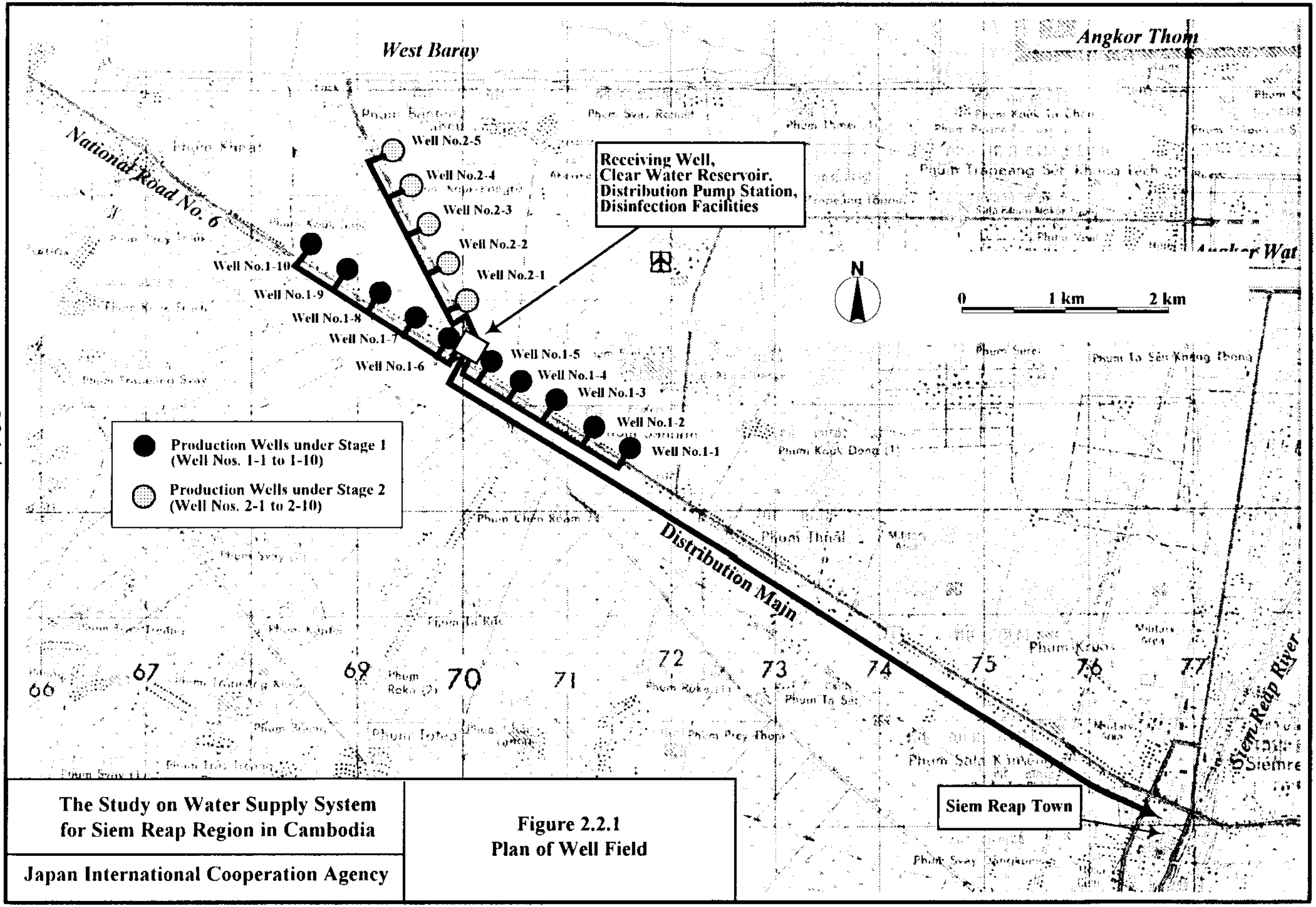


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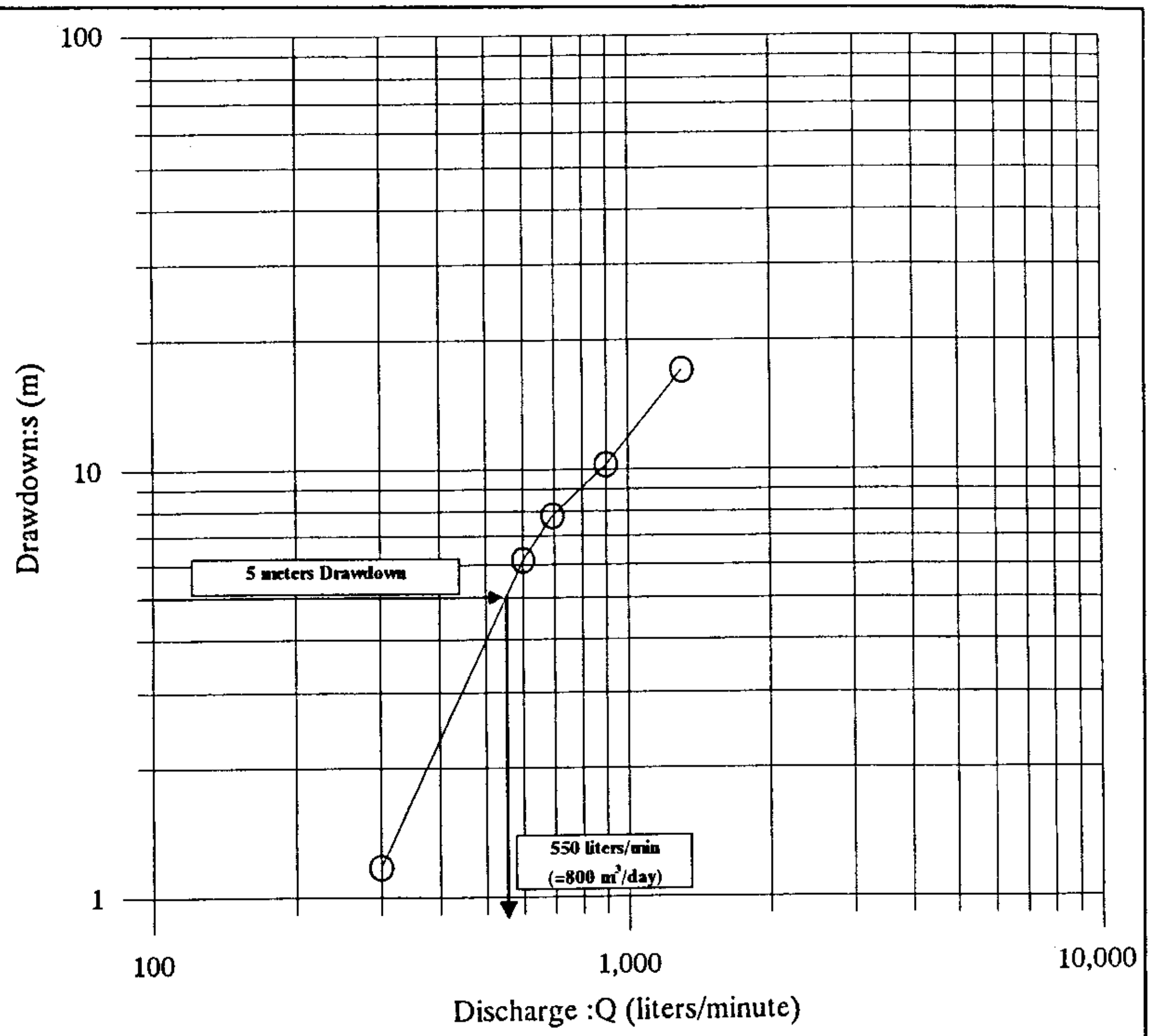
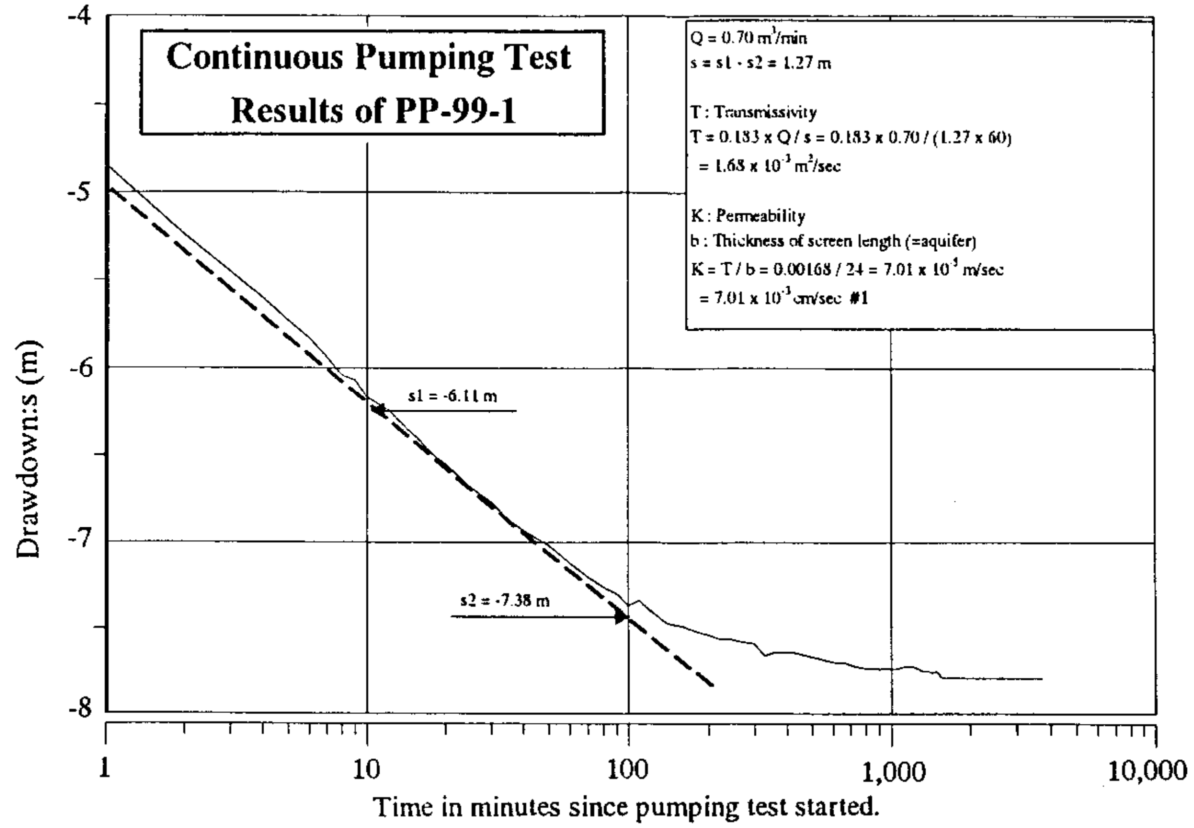
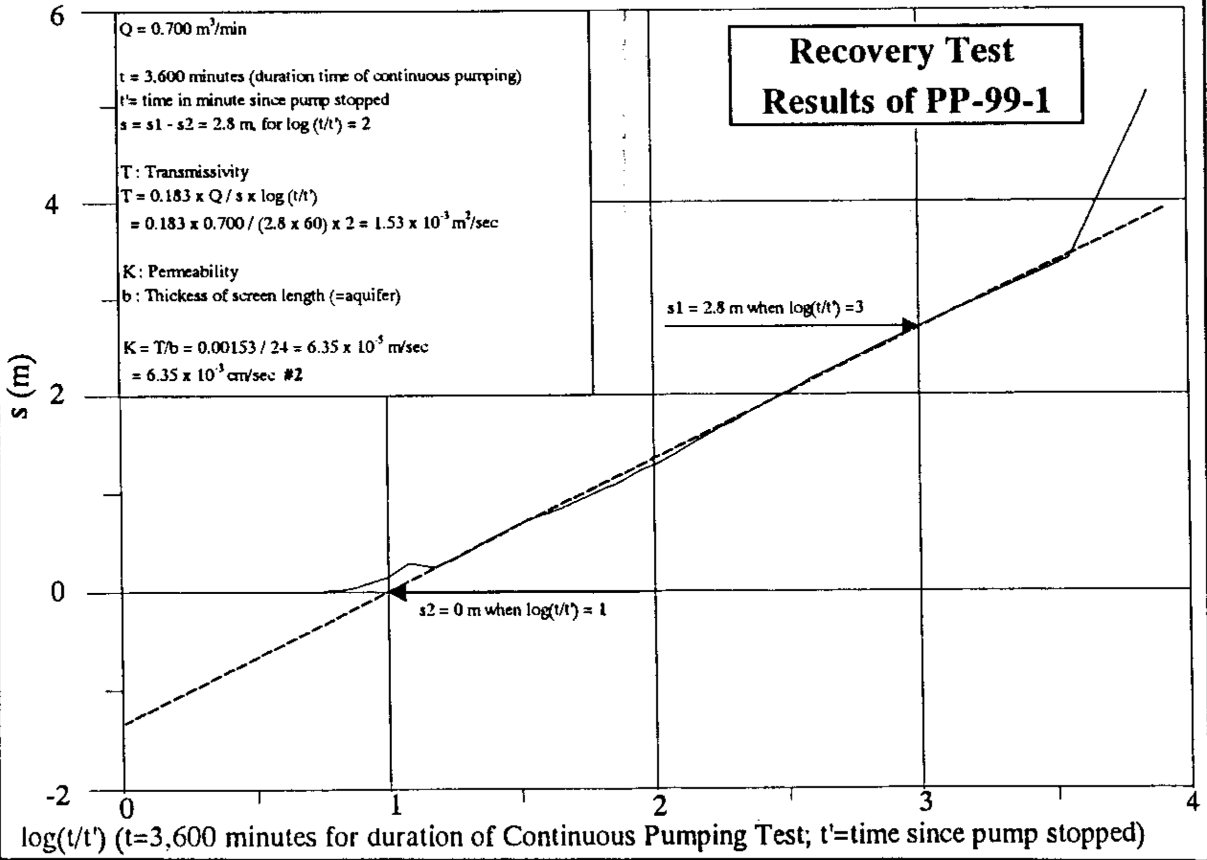
**Figure 2.2.1**
**Plan of Well Field**

| Item | Discharge | | | Drawdown | Remarks |
| --- | --- | --- | --- | --- | --- |
| | (liter/sec) | (liter/min) | ($m^3$/day) | (m) | |
| 1st Step | 5.0 | 300 | 432 | 1.17 | |
| 2nd Step | 10.0 | 600 | 864 | 6.14 | |
| 3rd Step | 11.6 | 700 | 1,000 | 7.79 | Continuous test |
| 4th Step | 15.0 | 900 | 1,300 | 10.24 | |
| 5th Step | 21.7 | 1,300 | 1,875 | 17.00 | Preliminary test |




**Step Drawdown Test Results of PP-99-1**




Note

Analyzed by Jacob Method

Permeability Coefficient $k = 7 \times 10^{-3}$ cm/sec in average from the above 2 data (**#1** and **#2**)

The data was used for the Groundwater simulation

| | |
| --- | --- |
| **The Study on Water Supply System for Siem Reap Region in Cambodia** | **Figure 2.2.2** **Pumping Test Results of PP-99-1** |
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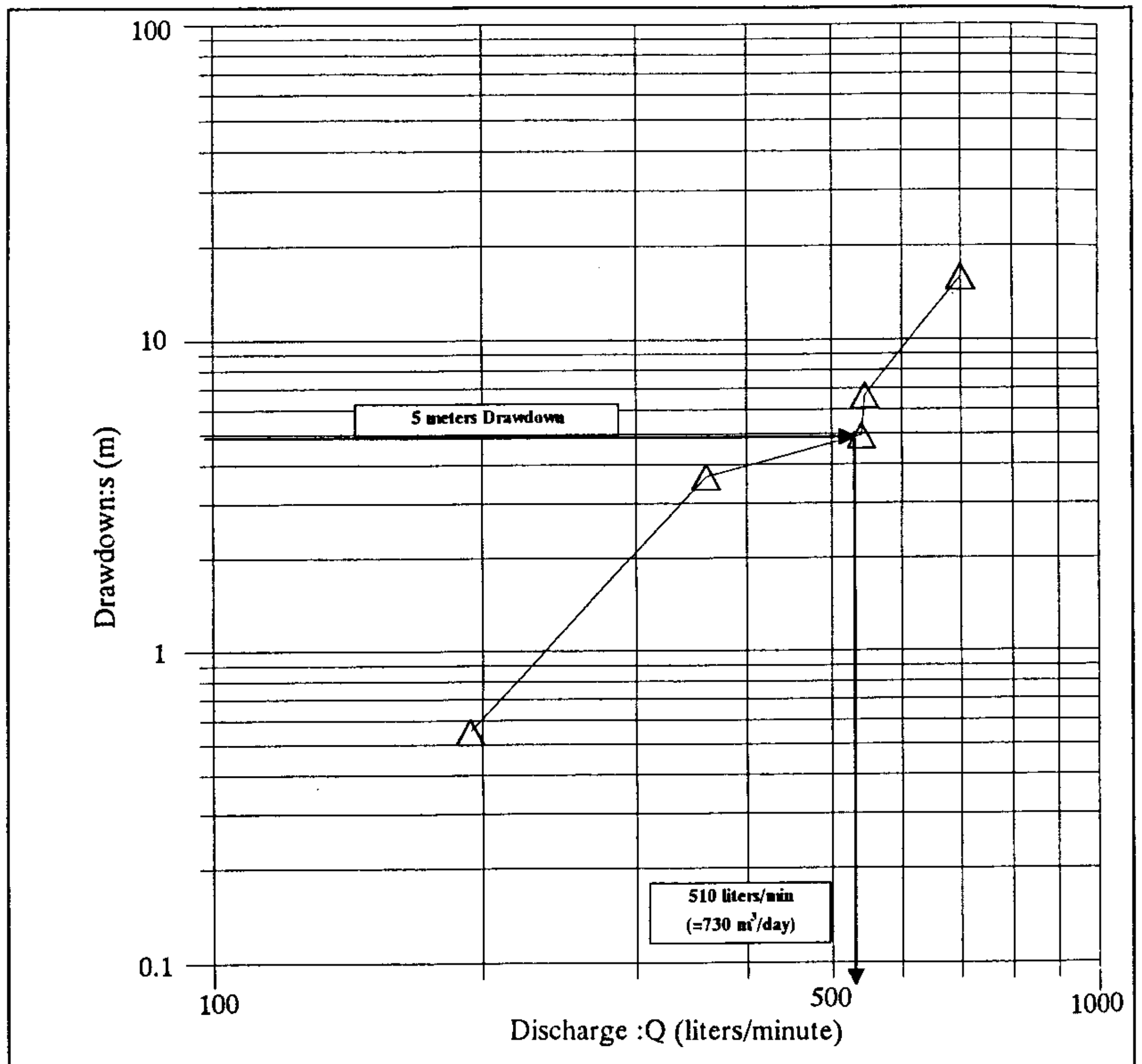
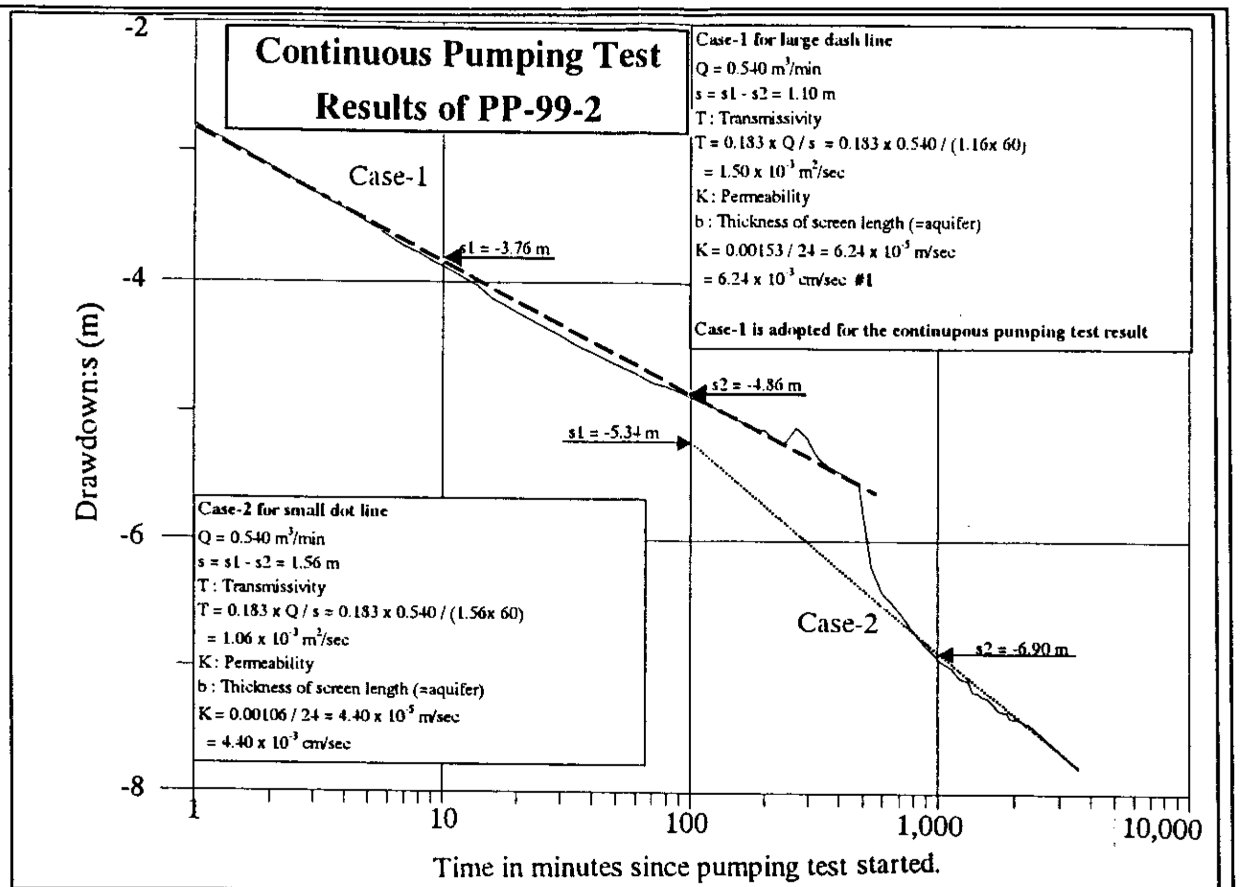
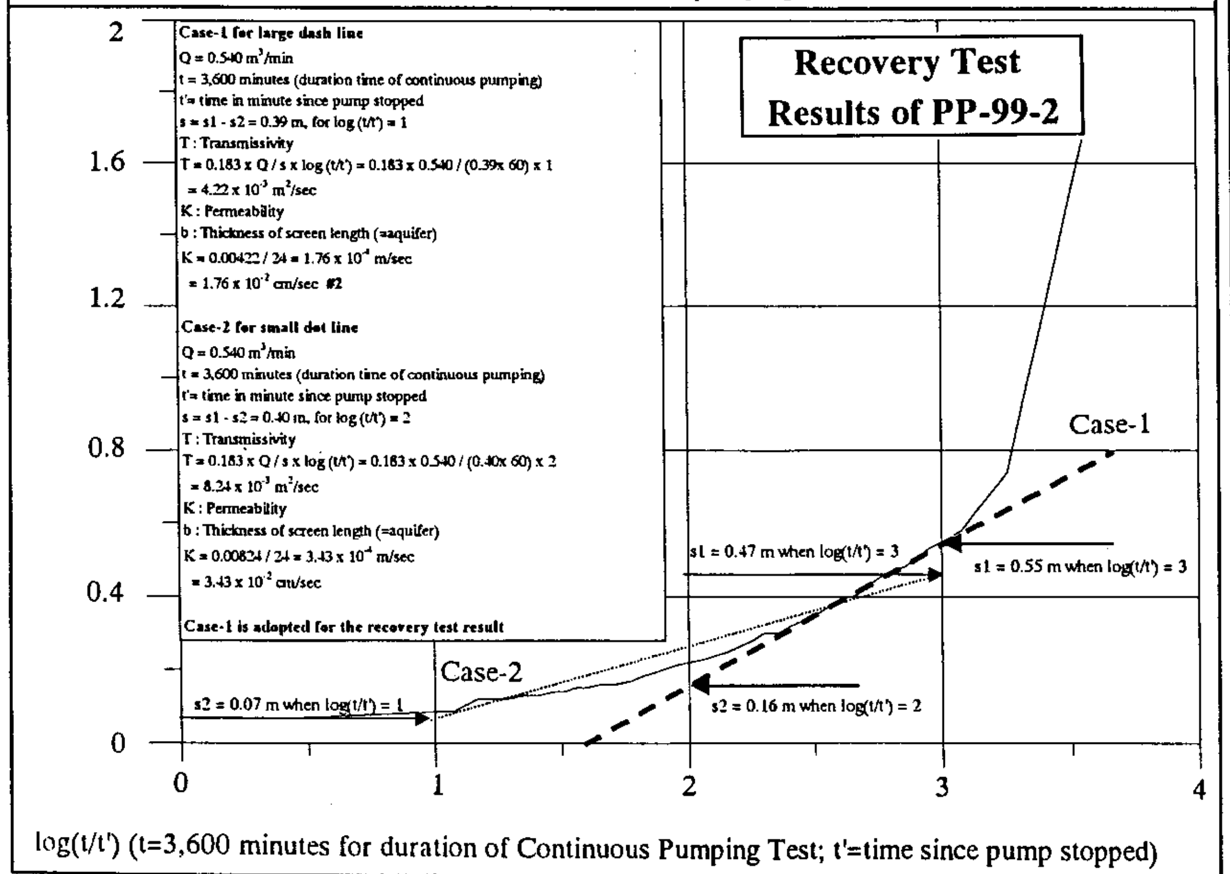
| Item | Discharge | | | Drawdown | Remarks |
|---|---|---|---|---|---|
| | (liter/sec) | (liter/min) | ($m^3$/day) | (m) | |
| 1st Step | 3.22 | 194 | 280 | 0.55 | |
| 2nd Step | 5.98 | 360 | 517 | 3.65 | |
| 3rd Step | 9.00 | 540 | 780 | 4.94 | Continuous test |
| 4th Step | 9.10 | 545 | 785 | 6.64 | |
| 5th Step | 11.70 | 700 | 1,011 | 15.88 | Preliminary test |




**Step Drawdown Test Results of PP-99-2**




Note

Analyzed by Jacob Method

Case-1 was adopted for simulation analysis, case-2 was judged that discharge was changed

Permeability Coefficient k = 1 x $10^{-2}$ cm/sec in average from the above 2 data (#1 and #2)

The data was used for the Groundwater simulation

| The Study on Water Supply System for Siem Reap Region in Cambodia | Figure 2.2.3 Pumping Test Results of PP-99-2 |
|---|---|
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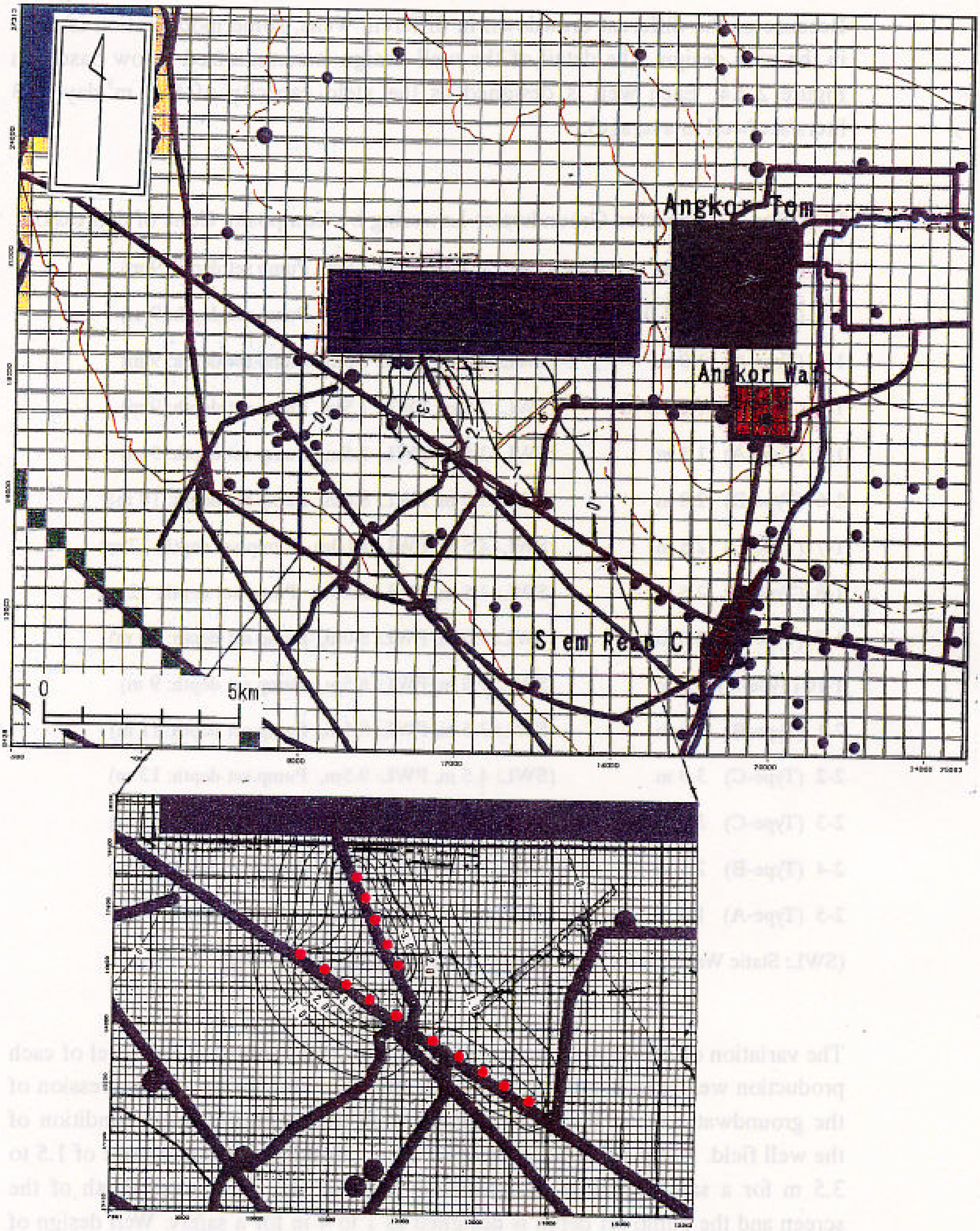
Because of the different drawdown in different wells, some modification is done in the well design. The detail of the well design is summarized below based on Figure 2.2.4. Each well is designed as the yield capacity of 800 $m^3$/day (9.3 liters/sec/well in average).

| Well Nos. | Expected Groundwater Lowering by Composite Cone of depression | |
|---|---|---|
| 1-1 (Type-A) | 0.5 m | (SWL: 1.5 m, PWL: 7.5m, Pump set depth: 9 m) |
| 1-2 (Type-A) | 0.5-1.0 m | (SWL: 2.0 m, PWL: 7.5m, Pump set depth: 9 m) |
| 1-3 (Type-A) | 1.0 m | (SWL: 2.0 m, PWL: 7.5m, Pump set depth: 9 m) |
| 1-4 (Type-A) | 1.0-1.5 m | (SWL: 2.5 m, PWL: 7.5m, Pump set depth: 9 m) |
| 1-5 (Type-A) | 1.5 m | (SWL: 2.5 m, PWL: 7.5m, Pump set depth: 9 m) |
| 1-6 (Type-B) | 2.0 m | (SWL: 3.0 m, PWL: 8.0m, Pump set depth: 10 m) |
| 1-7 (Type-C) | 2.5 m | (SWL: 4.5 m, PWL: 10.0m, Pump set depth: 12 m) |
| 1-8 (Type-C) | 2.5 m | (SWL: 4.5 m, PWL: 10.0m, Pump set depth: 12 m) |
| 1-9 (Type-B) | 2.0 m | (SWL: 3.0 m, PWL: 8.0m, Pump set depth: 10 m) |
| 1-10 (Type-A) | 0.5 m | (SWL: 1.5 m, PWL: 6.5m, Pump set depth: 9 m) |
| 2-1 (Type-B) | 2.0 m | (SWL: 3.5 m, PWL: 8.5m, Pump set depth: 11 m) |
| 2-2 (Type-C) | 3.0 m | (SWL: 4.5 m, PWL: 9.5m, Pump set depth: 13 m) |
| 2-3 (Type-C) | 3.0 m | (SWL: 4.5 m, PWL: 9.5m, Pump set depth: 13 m) |
| 2-4 (Type-B) | 2.5 m | (SWL: 3.5 m, PWL: 8.5m, Pump set depth: 10 m) |
| 2-5 (Type-A) | 1.0 m | (SWL: 1.5 m, PWL: 6.5m, Pump set depth: 9 m) |

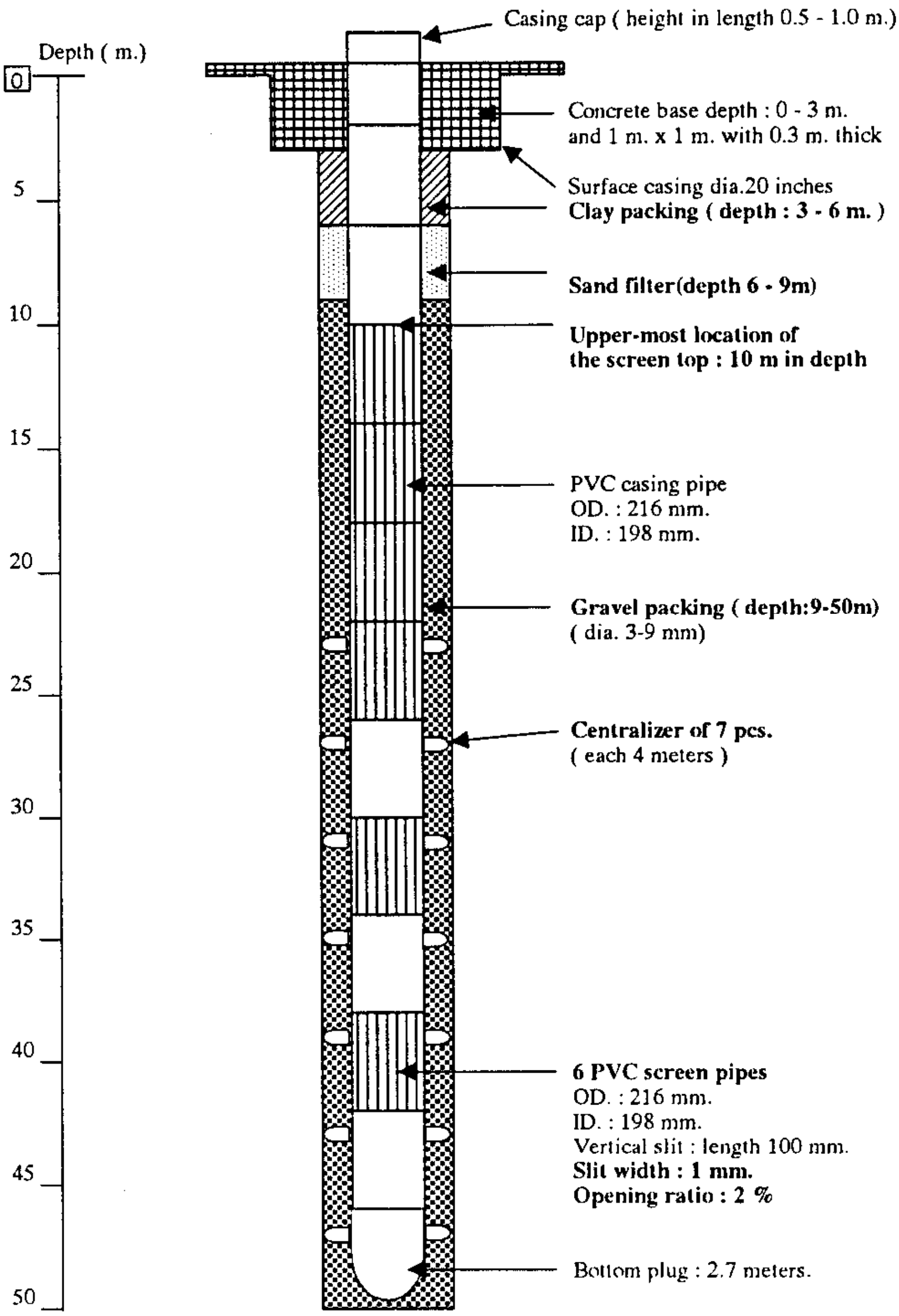
(SWL: Static Water Level, in the lowest PWL: Pumping Water Level)

The variation of drawdown, the static water level and dynamic water level of each production well is estimated based on the effects of composite cone depression of the groundwater table, the well alignment and the hydrogeological condition of the well field. Pump set depth is designed after considering the clearance of 1.5 to 3.5 m for a safety. Further the clearance between the upper-most depth of the screen and the pump set depth is designed as 1 to 4 m for a safety. Well design of Type-A, Type-B and Type-C are described in Figure 2.2.5, Figure 2.2.6 and Figure 2.2.7 respectively.




drawdowns in detail

| The Study on Water Supply System for Siem Reap Region in Cambodia | **Figure 2.2.4** |
|---|---|
| Japan International Cooperation Agency | **The Simulated Drawdown Contours in 5 Years** |



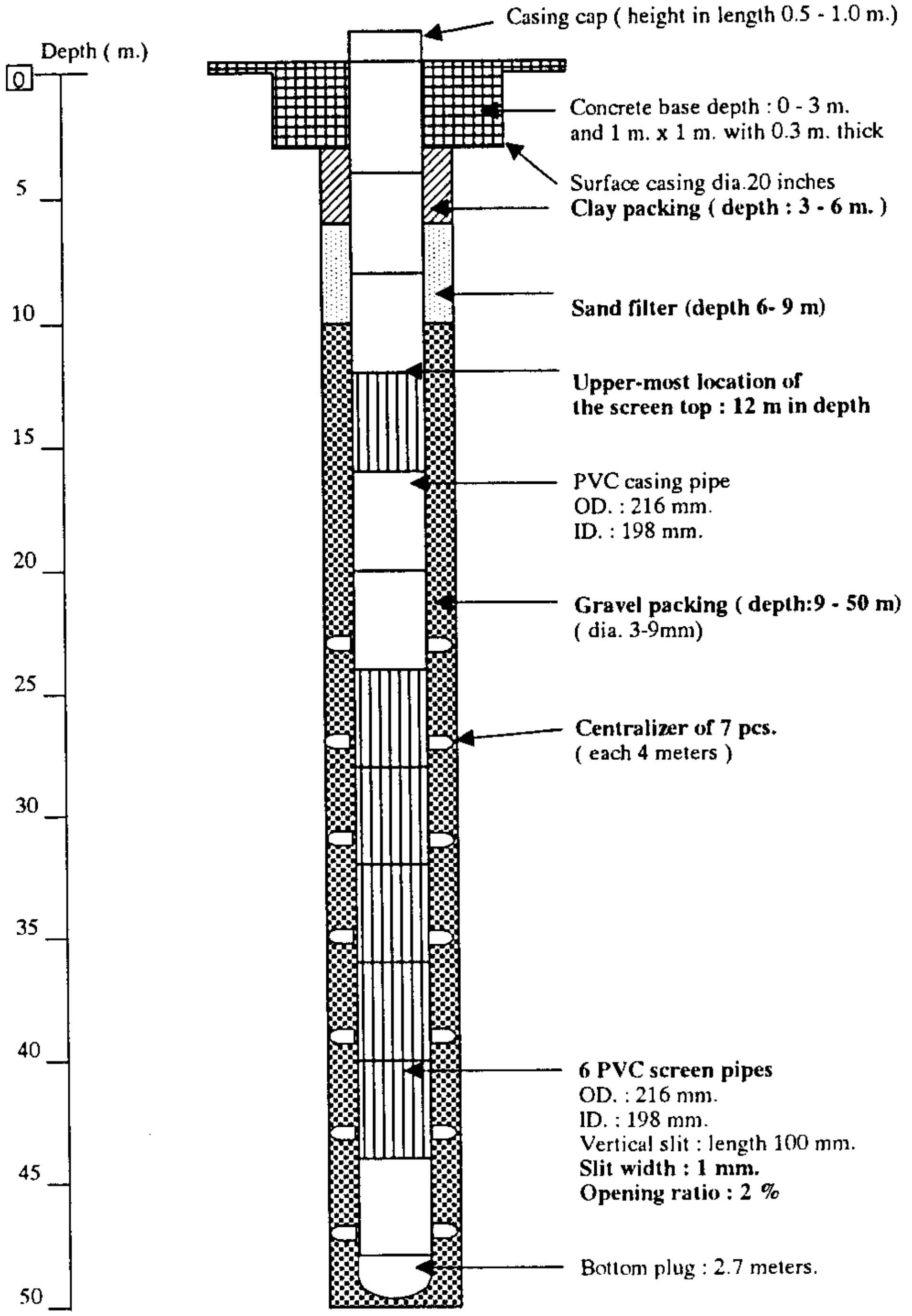

Note 1: Opening ratio of the Screen shall be approximately 2 %.
The size of slit in screen is 1.0 mm wide and 100 mm in length.

2: Gravel packing quantity is around 5.3 $m^3$ (200 bags).

3: Sand filter by using medium river sand for 7-9 m shall be put to purify shallow groundwater

4: This design shall be applied for the 6 wells in the stage-1(No.1-1, N0.1-2, N0.1-3 N0.1-4, N0.1-5 and N0.1-10), and the 1 well in the stage-2(N0.2-5)

| | |
|---|---|
| **The Study on Water Supply System for Siem Reap Region in Cambodia** | **Figure 2.2.5 Well Design Type-A** |
| **Japan International Cooperation Agency** | |




Note 1: Opening ratio of the Screen shall be approximately 2 %.
The size of slit in screen is 1.0mm wide and 100mm in length.

2: Gravel packing quantity is around 5.3 $m^3$ (200 bags).

3: Sand filter by using medium river sand for 7 - 9m shall be put to purify shallow groundwater

4: This design shall be applied for the 2 wells in the stage-1(No.1-6 and No.1-9), and the 2 wells in the stage-2(No.2-1 and No.2-4)

| The Study on Water Supply System for Siem Reap Region in Cambodia | **Figure 2.2.6** **Well Design Type-B** |
|---|---|
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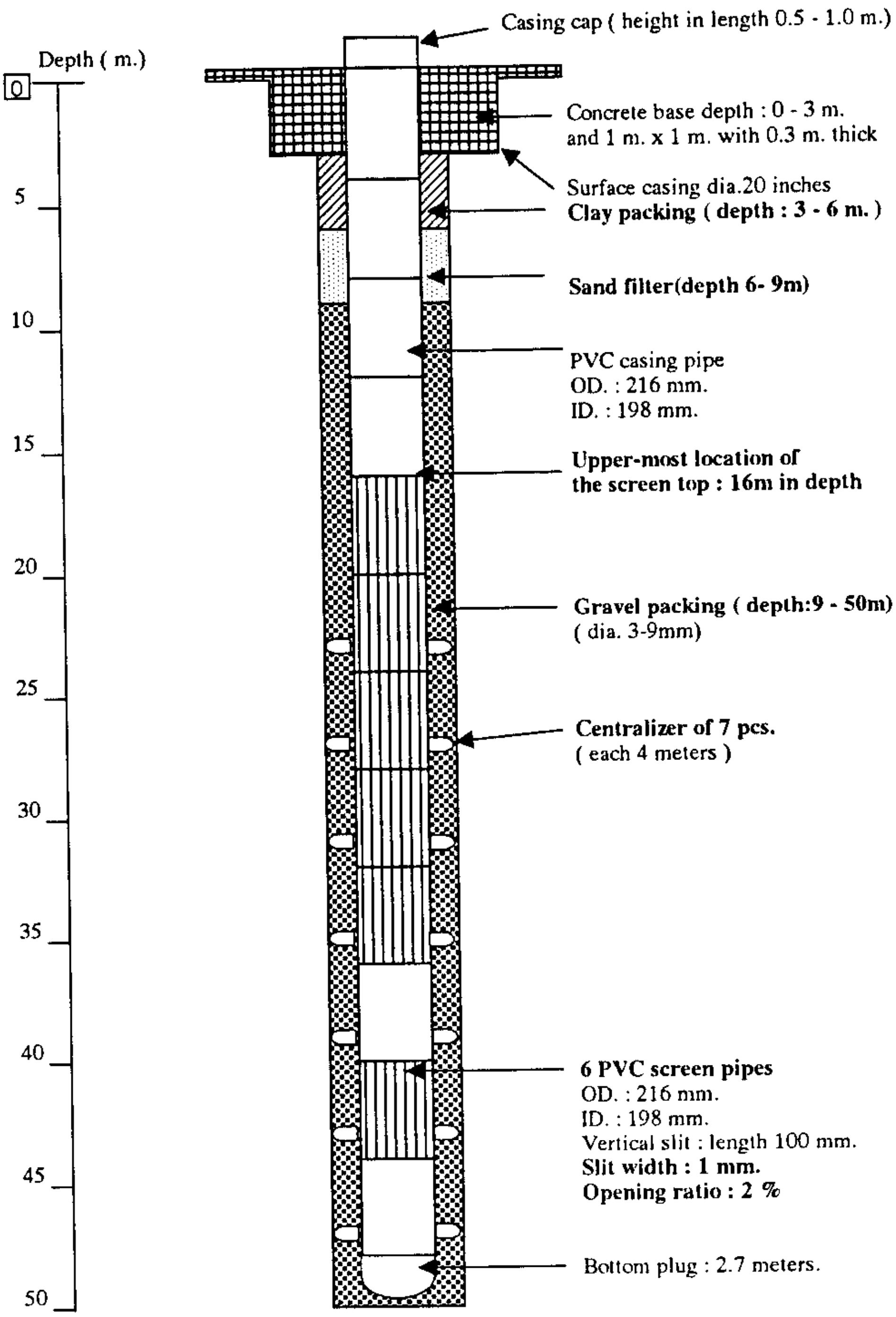


Note 1: Opening ratio of the Screen shall be approximately 2 %.
The size of slit in screen is 1.0mm wide and 100 mm in length.
2: Gravel packing quantity is around 5.3 m$^3$ (200 bags).
3: Sand filter by using medium river sand for 7 - 9m shall be put to purify shallow groundwater
4: This design shall be applied for the 2 wells in the stage-1(No.1-7 and No.1-8),
and the 2 wells in the stage-2(No.2-2 and No.2-3)

| The Study on Water Supply System for Siem Reap Region in Cambodia | Figure 2.2.7 Well Design Type-C |
|---|---|
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### 2.2.2 Well Connecting Pipe

Schematic plan of well connecting pipes is shown on Figure 2.2.8. Every five wells are connected by one connecting pipe of which diameter is 150 mm to 250 mm. Ductile Cast Iron Pipe (DIP) will be recommended for the material of the connecting pipe because of its reliability and easy installation work, especially in rainy season.

The results of hydraulic analysis of the well connecting pipe is shown on Table 2.2.1. Based on the results of the analysis, specifications of submergible pump in respective wells are decided.

***Water Level***
Receiving Well : HWL + 16.0 m

***Well Discharge***
800 m3/day/well
0.56 m3/min/well
9.259 l/sec/well

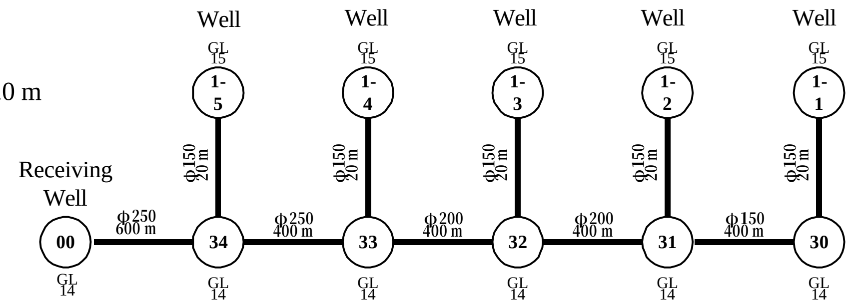


**Figure 2.2.8 (1/2) Schematic Plan of Well Connecting Pipe : Unit 1 (Well Number 1-1 to 1-5)**

***Water Level***
Receiving Well :
HWL + 16.0 m

***Well Discharge***
800 m3/day/well
0.56 m3/min/well
9.259 l/sec/well

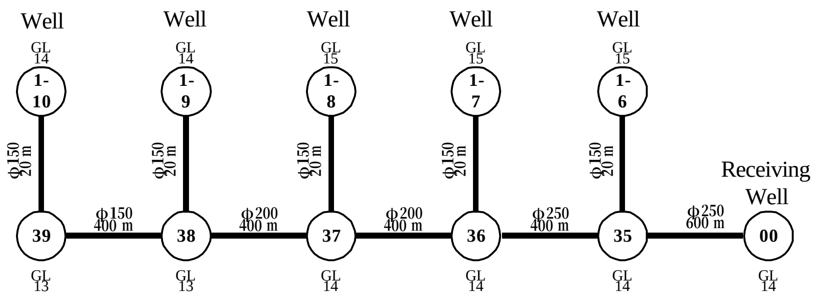


**Figure 2.2.8 (2/2) Schematic Plan of Well Connecting Pipe : Unit 2 (Well Number 1-6 to 1-10)**

**Table 2.2.1 (1/2) Results of Hydraulic Analysis on Well Connecting Pipe**

**Unit 1 (Well Number 1-1 to 1-5)**

| NODE NO | Type | Q l/sec | WL m | GL m | EH m |
|---|---|---|---|---|---|
| 0 | 1 | 46.295 | 16.00 | 14.00 | 2.00 |
| 11 | 0 | -9.259 | 25.26 | 15.00 | 10.26 |
| 12 | 0 | -9.259 | 23.91 | 15.00 | 8.91 |
| 13 | 0 | -9.259 | 22.71 | 15.00 | 7.71 |
| 14 | 0 | -9.259 | 20.16 | 15.00 | 5.16 |
| 15 | 0 | -9.259 | 18.70 | 15.00 | 3.70 |
| 30 | 0 | | 25.20 | 14.00 | 11.20 |
| 31 | 0 | | 23.85 | 14.00 | 9.85 |
| 32 | 0 | | 22.65 | 14.00 | 8.65 |
| 33 | 0 | | 20.11 | 14.00 | 6.11 |
| 34 | 0 | | 18.65 | 14.00 | 4.65 |

| PIPE NO(u) | NO(d) | Dia mm | Length m | C | Q l/sec | V m/sec | I o/oo |
|---|---|---|---|---|---|---|---|
| 11 | 30 | 150 | 20 | 120 | 9.26 | 0.52 | 2.70 |
| 12 | 31 | 150 | 20 | 120 | 9.26 | 0.52 | 2.70 |
| 13 | 32 | 150 | 20 | 120 | 9.26 | 0.52 | 2.70 |
| 14 | 33 | 150 | 20 | 120 | 9.26 | 0.52 | 2.70 |
| 15 | 34 | 150 | 20 | 120 | 9.26 | 0.52 | 2.70 |
| 30 | 31 | 150 | 500 | 120 | 9.26 | 0.52 | 2.70 |
| 31 | 32 | 200 | 500 | 120 | 18.52 | 0.59 | 2.40 |
| 32 | 33 | 200 | 500 | 120 | 27.78 | 0.88 | 5.09 |
| 33 | 34 | 250 | 500 | 120 | 37.04 | 0.75 | 2.92 |
| 34 | 0 | 250 | 600 | 120 | 46.30 | 0.94 | 4.41 |

**Table 2.2.1 (2/2) Results of Hydraulic Analysis on Well Connecting Pipe**

**Unit 2 (Well Number 1-6 to 1-10)**

| NODE NO | Type | Q l/sec | WL m | GL m | EH m |
|---|---|---|---|---|---|
| 0 | 1 | 46.295 | 16.00 | 14.00 | 2.00 |
| 16 | 0 | -9.259 | 18.70 | 15.00 | 3.70 |
| 17 | 0 | -9.259 | 20.16 | 15.00 | 5.16 |
| 18 | 0 | -9.259 | 22.71 | 15.00 | 7.71 |
| 19 | 0 | -9.259 | 23.91 | 14.00 | 9.91 |
| 110 | 0 | -9.259 | 25.26 | 14.00 | 11.26 |
| 35 | 0 | | 18.65 | 14.00 | 4.65 |
| 36 | 0 | | 20.11 | 14.00 | 6.11 |
| 37 | 0 | | 22.65 | 14.00 | 8.65 |
| 38 | 0 | | 23.85 | 13.00 | 10.85 |
| 39 | 0 | | 25.20 | 13.00 | 12.20 |

| PIPE NO(u) | NO(d) | Dia mm | Length m | C | Q l/sec | V m/sec | I o/oo |
|---|---|---|---|---|---|---|---|
| 16 | 35 | 150 | 20 | 120 | 9.26 | 0.52 | 2.70 |
| 17 | 36 | 150 | 20 | 120 | 9.26 | 0.52 | 2.70 |
| 18 | 37 | 150 | 20 | 120 | 9.26 | 0.52 | 2.70 |
| 19 | 38 | 150 | 20 | 120 | 9.26 | 0.52 | 2.70 |
| 110 | 39 | 150 | 20 | 120 | 9.26 | 0.52 | 2.70 |
| 39 | 38 | 150 | 500 | 120 | 9.26 | 0.52 | 2.70 |
| 38 | 37 | 200 | 500 | 120 | 18.52 | 0.59 | 2.40 |
| 37 | 36 | 200 | 500 | 120 | 27.78 | 0.88 | 5.09 |
| 36 | 35 | 250 | 500 | 120 | 37.04 | 0.75 | 2.92 |
| 35 | 0 | 250 | 600 | 120 | 46.29 | 0.94 | 4.41 |

Length of well connecting pipe is summarized as shown on Table 2.2.2.

**Table 2.2.2 Length of Well Connecting Pipe**

| Diameter (mm) | Unit 1 (Well No. 1-1 to 1-5) | Unit 2 (Well No. 1-6 to 1-10) | Total Length (m) |
|---|---|---|---|
| 250 | 1,000 | 1,000 | 2,000 |
| 200 | 800 | 800 | 1,600 |
| 150 | 500 | 500 | 1,000 |
| Total | 2,300 | 2,300 | 4,600 |

### 2.2.3 Well Submergible Pump

Specifications of well submergible pumps are designed from the head loss in the well connecting pipes and level of groundwater. Head loss in the well connecting pipes are already shown in Table 2.2.1 above. Static groundwater level and groundwater level draw down by continuous pumping are shown on Table 2.2.3 together with calculated total head required for each submergible pump.

From the calculated total head required, capacity of each submergible pump is obtained as shown on Table 2.2.4 and submergible pumps required is summarized in Table 2.2.5.

Number of operating pumps will increase year by year along with water demand increase. Table 2.2.6 shows the number of operating pumps in each year.

**Table 2.2.3 Total Head Required at Each Submergible Pump**

| Well Number | Abstraction ($m^3$/min) | Ground Level (m) (above sea) | Static Water Level (m) (above sea) | Draw down by Pumping (m) | Head Required at Well (m) (above sea) | Total Head Required (m) |
|---|---|---|---|---|---|---|
| 1-1 | 0.56 | 15 | 13.5 | 6.0 | 25.26 | 17.8 |
| 1-2 | 0.56 | 15 | 13.0 | 5.5 | 23.91 | 16.4 |
| 1-3 | 0.56 | 15 | 13.0 | 5.5 | 22.71 | 15.2 |
| 1-4 | 0.56 | 15 | 12.5 | 5.0 | 20.16 | 12.7 |
| 1-5 | 0.56 | 15 | 12.5 | 5.0 | 18.70 | 11.2 |
| 1-6 | 0.56 | 15 | 12.0 | 5.0 | 18.70 | 11.7 |
| 1-7 | 0.56 | 15 | 10.5 | 5.5 | 20.16 | 15.2 |
| 1-8 | 0.56 | 15 | 10.5 | 5.5 | 22.71 | 17.7 |
| 1-9 | 0.56 | 14 | 11.0 | 5.0 | 23.91 | 17.9 |
| 1-10 | 0.56 | 14 | 12.5 | 5.0 | 25.26 | 17.8 |

**Table 2.2.4 Capacity of Each Submergible Pump**

| Well Number | Abstraction ($m^3$/min) | Total Head Required (m) | Calculated Power Required (kW) | Standard Output (kW) |
|---|---|---|---|---|
| 1-1 | 0.56 | 17.8 | 3.1 | 3.7 |
| 1-2 | 0.56 | 16.4 | 2.8 | 3.7 |
| 1-3 | 0.56 | 15.2 | 2.6 | 3.7 |
| 1-4 | 0.56 | 12.7 | 2.2 | 2.2 |
| 1-5 | 0.56 | 11.2 | 1.9 | 2.2 |
| 1-6 | 0.56 | 11.7 | 2.0 | 2.2 |
| 1-7 | 0.56 | 15.2 | 2.6 | 3.7 |
| 1-8 | 0.56 | 17.7 | 3.1 | 3.7 |
| 1-9 | 0.56 | 17.9 | 3.1 | 3.7 |
| 1-10 | 0.56 | 17.8 | 3.1 | 3.7 |

**Table 2.2.5 Summary of Submergible Pumps Required under Stage 1**

| Submergible Pumps | Number of Pumps Required |
|---|---|
| Q 0.56 $m^3$/min x H11.2-12.2 x 2.2kW | 3 units |
| Q 0.56 $m^3$/min x H14.7-17.8 x 3.7kW | 7 units |

**Table 2.2.6 Number of Operating Pumps in Each Year**

| Year | Daily Maximum Water Demand | | Number of Operating Pumps |
|---|---|---|---|
| | $m^3$/day | $m^3$/min | |
| 2002 | 2,773 | 1.9 | 4 |
| 2003 | 4,217 | 2.9 | 6 |
| 2004 | 5,905 | 4.1 | 8 |
| 2005 | 7,308 | 5.1 | 10 |
| 2006 | 8,352 | 5.8 | 10 |

## 2.3 Distribution Center

### 2.3.1 Location and Plan of Distribution Center

Distribution Center will consist of receiving well, clear water reservoir, disinfection facilities, distribution pumping station and generators. The center will require about 1 ha land space to accommodate these facilities. Proposed location of the center was selected after consultation with local government and PDIME. Location will be at the side of the branch road to the West Baray Reservoir from the National Road No. 6. Distance from the center to the Road No. 6 is about 200 m. The center will be located at the middle of the proposed well field.

Figure 2.3.1 shows the layout of the Distribution Center. As shown in the figure, reserved space will be required for the expansion of clear water reservoir for the Stage 2.

According to the results of the water quality analysis of groundwater adjacent to the proposed well field, no iron removal facilities will be required. However, should iron concentration become high in future, it is recommended to remove iron by slow sand filtration. Iron will be oxidized and removed by the iron bacteria layer developed on the surface of the slow sand filters. To accommodate required slow sand filtration system, additional 0.5 ha land space might be required if iron concentration becomes high in future. Furthermore, replacement of submergible pumps in wells with higher pump head and reconstruction of the receiving well will be required.

It should be noted that these iron removal facilities and modification of the system flow are not included in Stage 1 Project.

### 2.3.2 Receiving Well

From the two units of wells under Stage 1, each unit consisting of five wells, groundwater will be conveyed to the receiving well. Purpose of the receiving well is to regulate the water flow and to dose and mix chlorine solution for disinfection.

Capacity of the receiving well is 42 $m^3$ (effective depth 3 m, area 14 $m^2$) and this is equivalent to 5 minutes of Stage 2 production capacity of 12,000 $m^3$/day. The receiving well with the capacity of the Stage 2 will be constructed under the Stage 1 because the size of the well is small and can not be constructed separately for each stage. Structures will be RC made and high water level of the receiving well will be +16.0 m.

Structure of the receiving well will be as shown on Figure 2.3.2. The receiving well will be equipped with over flow pipe and drain.

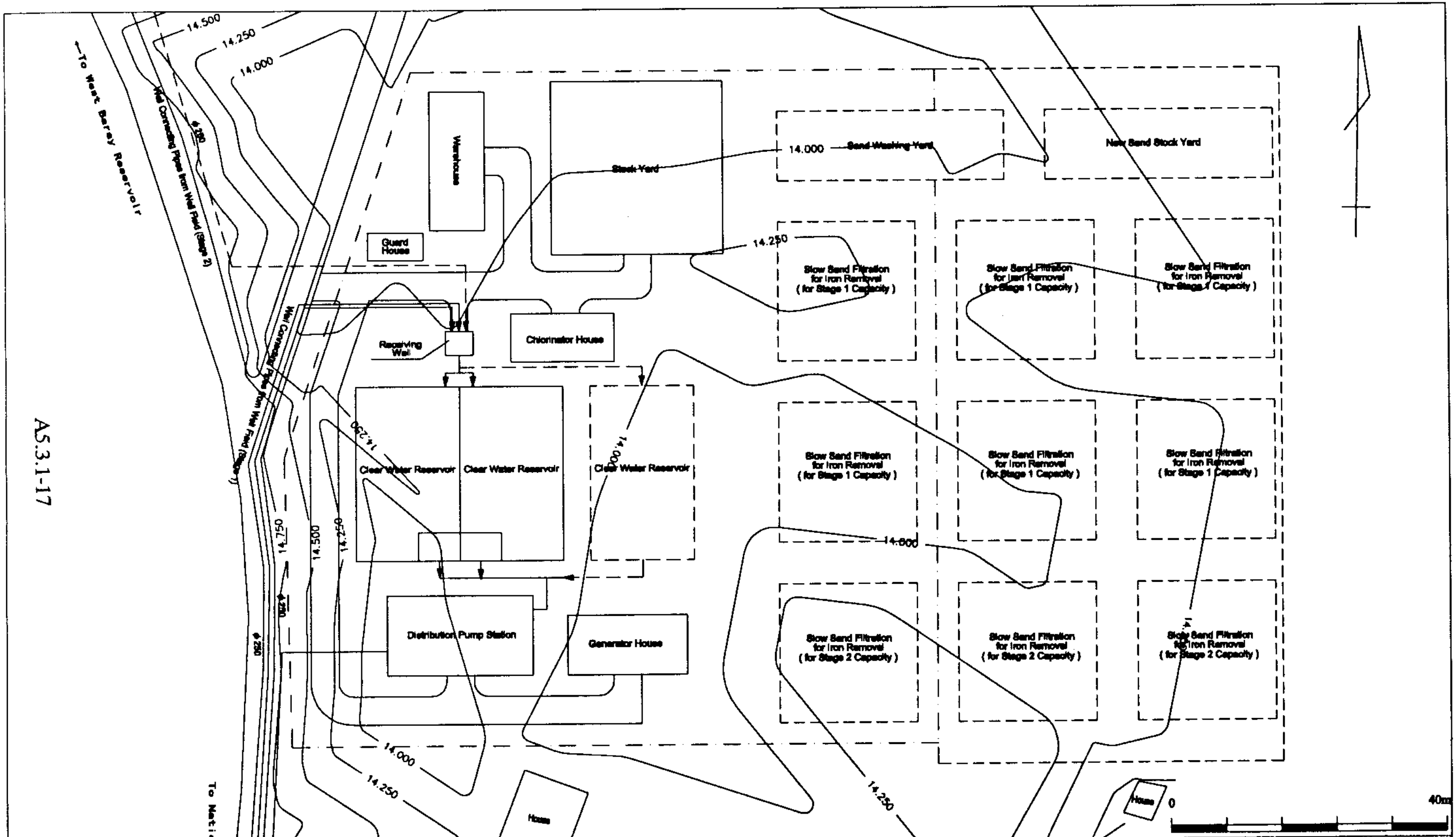


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**Figure 2.3.1 Layout of Proposed Distribution Center**

Lime solution feeder will also be equipped at the receiving well for pH control . Value of pH will be checked daily basis and if pH value is too low, lime solution will be dosed.

### 2.3.3 Disinfection Facilities

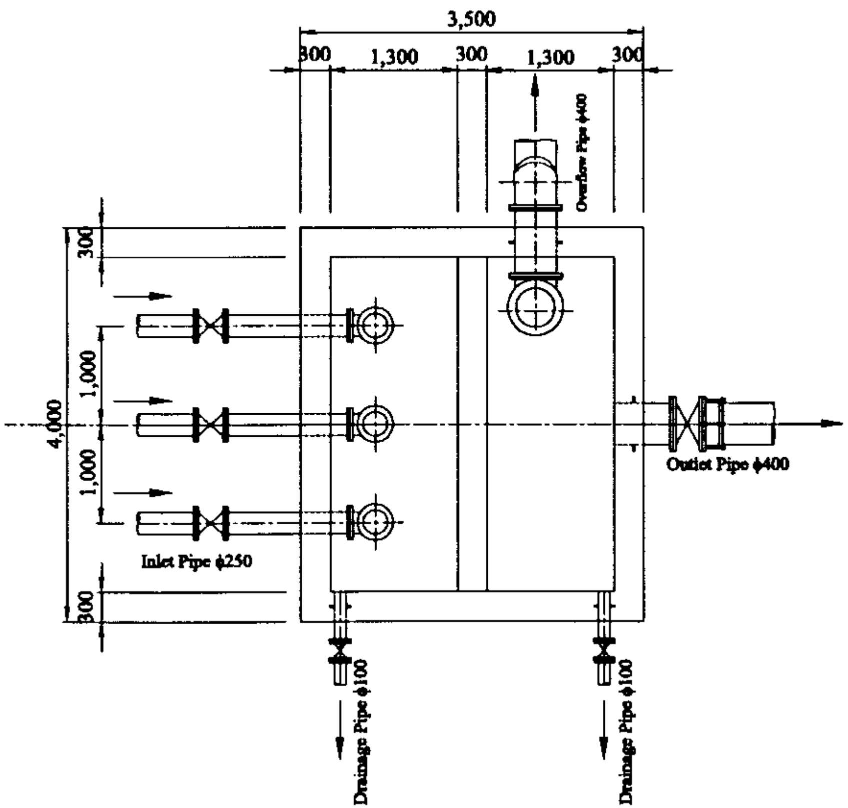
Chlorine gas will be fed by solution-feed chlorinators. Solution-feed chlorinators take gaseous chlorine evaporated in the container, measure it, and mix it with water to form a strong chlorine solution. The chlorine solution will be fed in the receiving well mentioned above.

Two sets of chlorinators will be installed in the Chlorinator House under Stage 1. The Chlorinator House will also have a space for storage of the gas cilliynders.

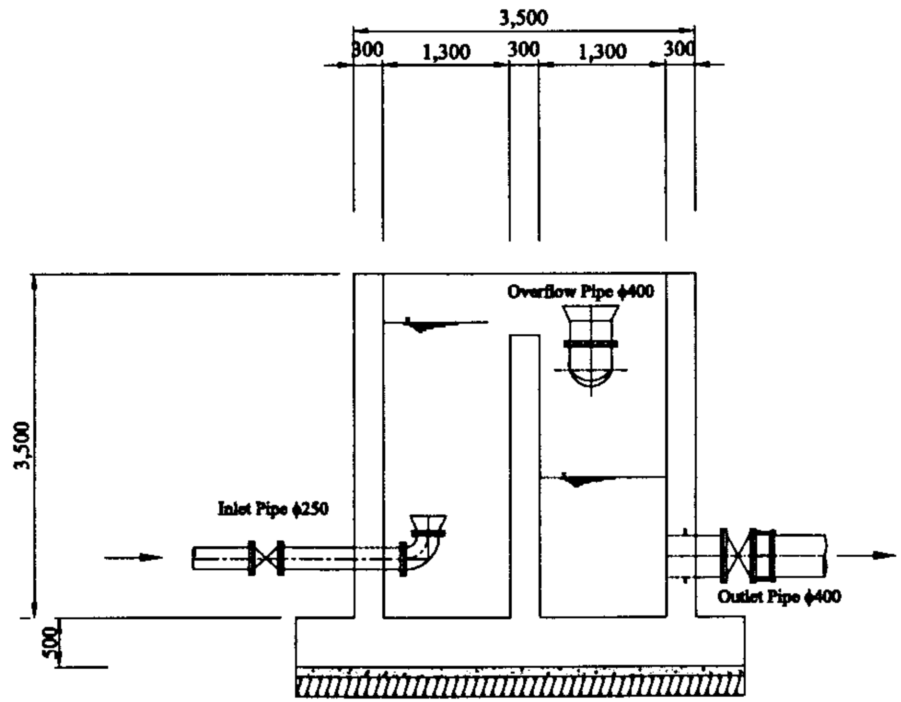
### 2.3.4 Clear Water Reservoir

Clear water reservoir will be constructed to balance the fluctuating demand from the distribution system against the output from the wells, and to act as a safeguard for the continuation of the supply should there be any breakdown at the source or on the main trunk distribution pipelines.

Detention time of the reservoir is about 8 hours. Reservoir volume is calculated from the detention time. The clear water reservoir will consist from three basins. Two of them will be constructed under Stage 1 and the other will be constructed under Stage 2. Structure of the reservoir will be RC made and dimension of the each basin will be W 15 m x L 25 m x Depth 3.5 m. In the reservoir, buffer walls will be installed to avoid dead water space and pump suction well will be constructed as part of the reservoir. Structure of the clear water reservoir is as shown on Figure 2.3.3.



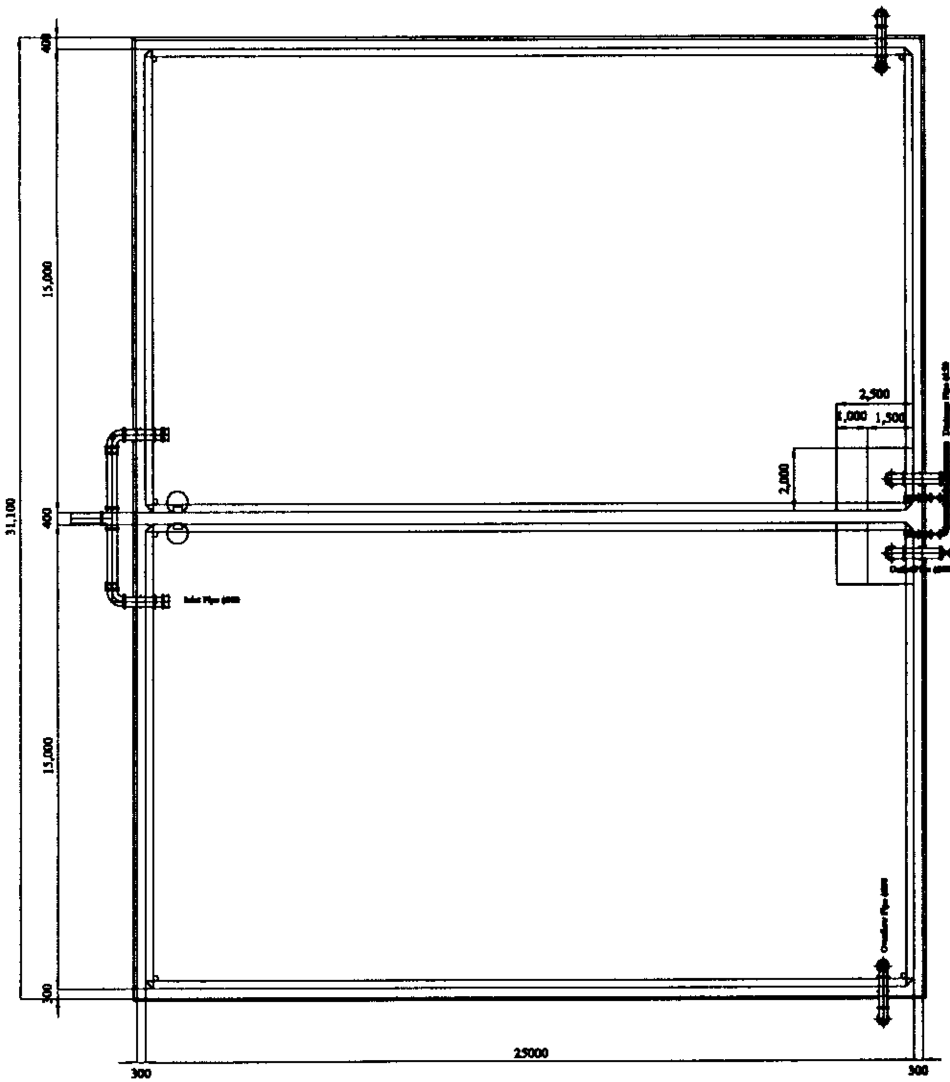

Plan




Section

0 4,000m

| The Study on Water Supply System for Siem Reap Region in Cambodia | Figure 2.3.2 Structure of Receiving Well |
|---|---|
| Japan International Cooperation Agency | |

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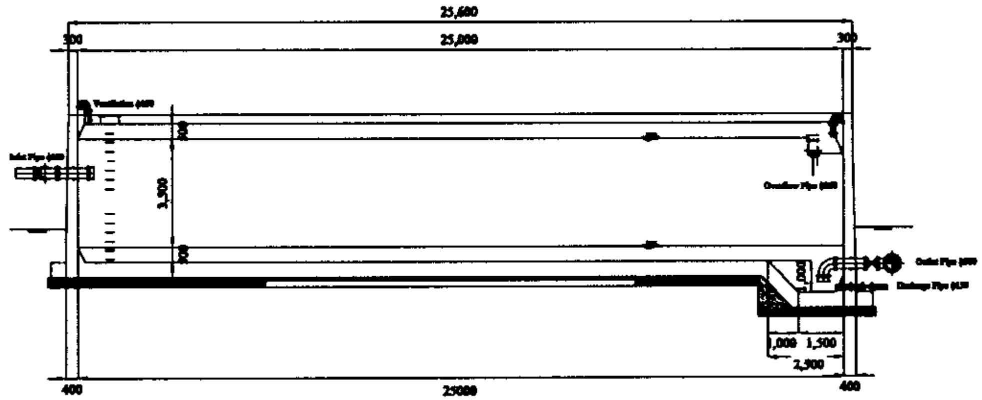


Section


| The Study on Water Supply System for Siem Reap Region in Cambodia | Figure 2.3.3 |
| --- | --- |
| Japan International Cooperation Agency | Structure of Clear Water Reservoir |

### 2.3.5 Distribution Pumping Station

Distribution pumping station will be constructed to store distribution pumps that will transmit water to distribution system in Siem Reap Town area through distribution trunk main.

Flow of transmitting water will be controlled by number of operating pumps. Therefore, capacity of each pump will be planned rather small. List of distribution pumps is shown on Table 2.3.1.

**Table 2.3.1 List of Distribution Pumps**

| Distribution Pumps | Number Required for Stage 1 |
|---|---|
| 1.0 $m^3$/min x H35 m, 11kW | 3 |
| 1.82 $m^3$/min x H35 m, 18.5kW | 4 |

Number of operating distribution pumps will be decided by quantity of hourly maximum water demand. Pump operation plan is as shown on Table 2.3.2. As shown on the Table, one stand-by for small and large pumps is available respectively.

**Table 2.3.2 Pump Operation Plan**

| Year | Hourly Max | | Distribution Pumps | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | l/sec | $m^3$/min | SP1 | SP2 | SP3 | LP1 | LP2 | LP3 | LP4 |
| 2002 | 38.51 | 2.31 | OP | | | OP | | | |
| 2003 | 57.43 | 3.45 | | | | OP | OP | | |
| 2004 | 79.56 | 4.77 | OP | OP | | OP | OP | | |
| 2005 | 98.35 | 5.90 | OP | | | OP | OP | OP | |
| 2006 | 112.4 | 6.74 | OP | OP | | OP | OP | OP | |

SP : Small Pump of which capacity is 1.0 $m^3$/min
LP : Large Pump of which capacity is 1.82 $m^3$/min
OP : Operating

### 2.3.6 Power Source

Own generator system is proposed to supply electricity for well pumps, distribution pumps and lighting etc. of new water supply system, considering the current situation that public electric supply in Siem Reap is not stable and reliable, and the capacity of the public supply will not be guaranteed for future power requirement. List of generators required for the new system is as shown on Table 2.3.3.

**Table 2.3.3 List of Generators Required**

| Generator | Number Required for Stage 1 |
|---|---|
| For Submergible Pumps (3P75kVA w/Fuel Tank) | 4 |
| For Distribution Pumps (3P150kVA w/Fuel Tank) | 4 |