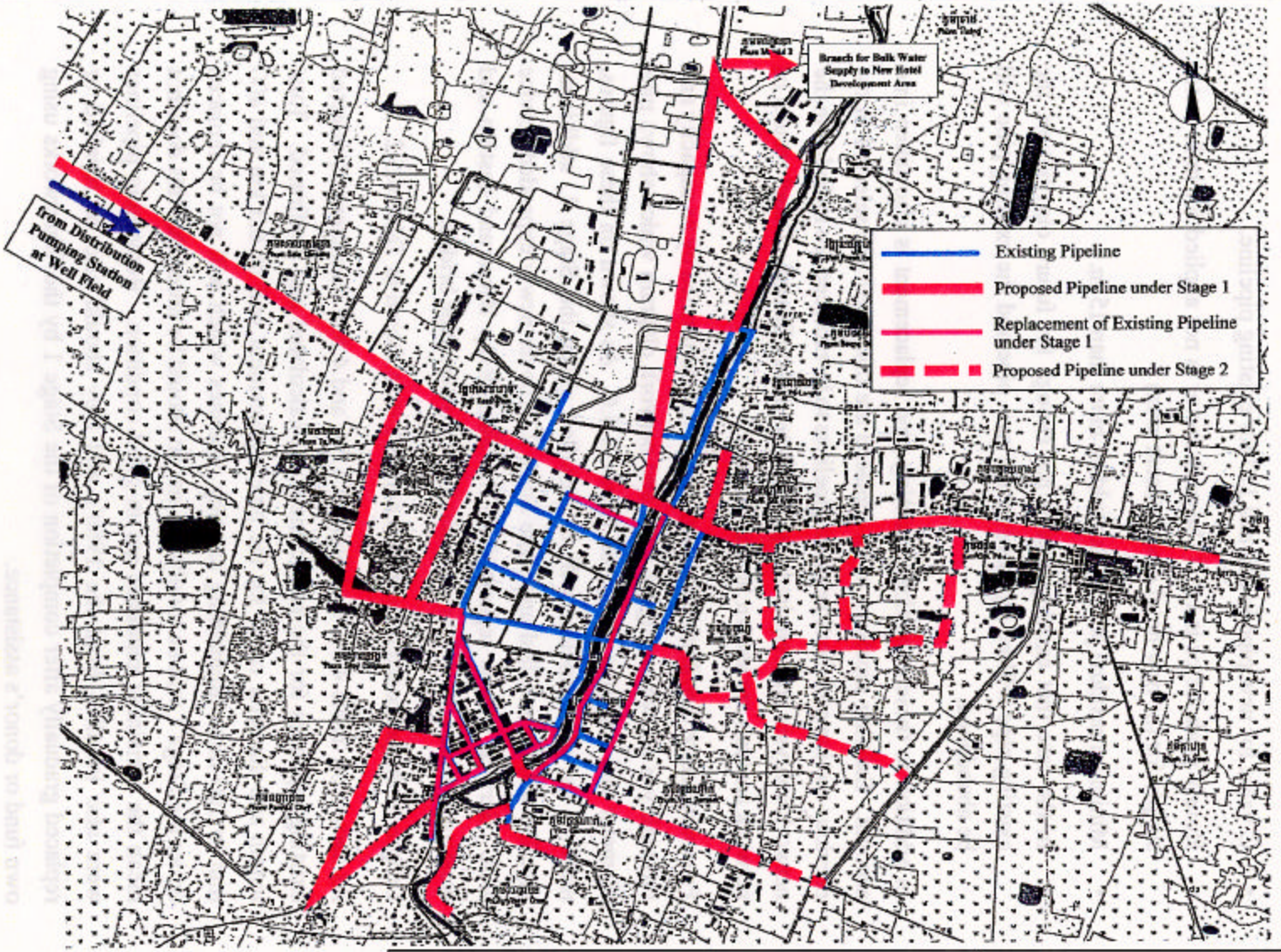

The Study on Water Supply System for Siem Reap Region in Cambodia

Japan International Cooperation Agency

Figure 4.5.5
Proposed Distribution Network

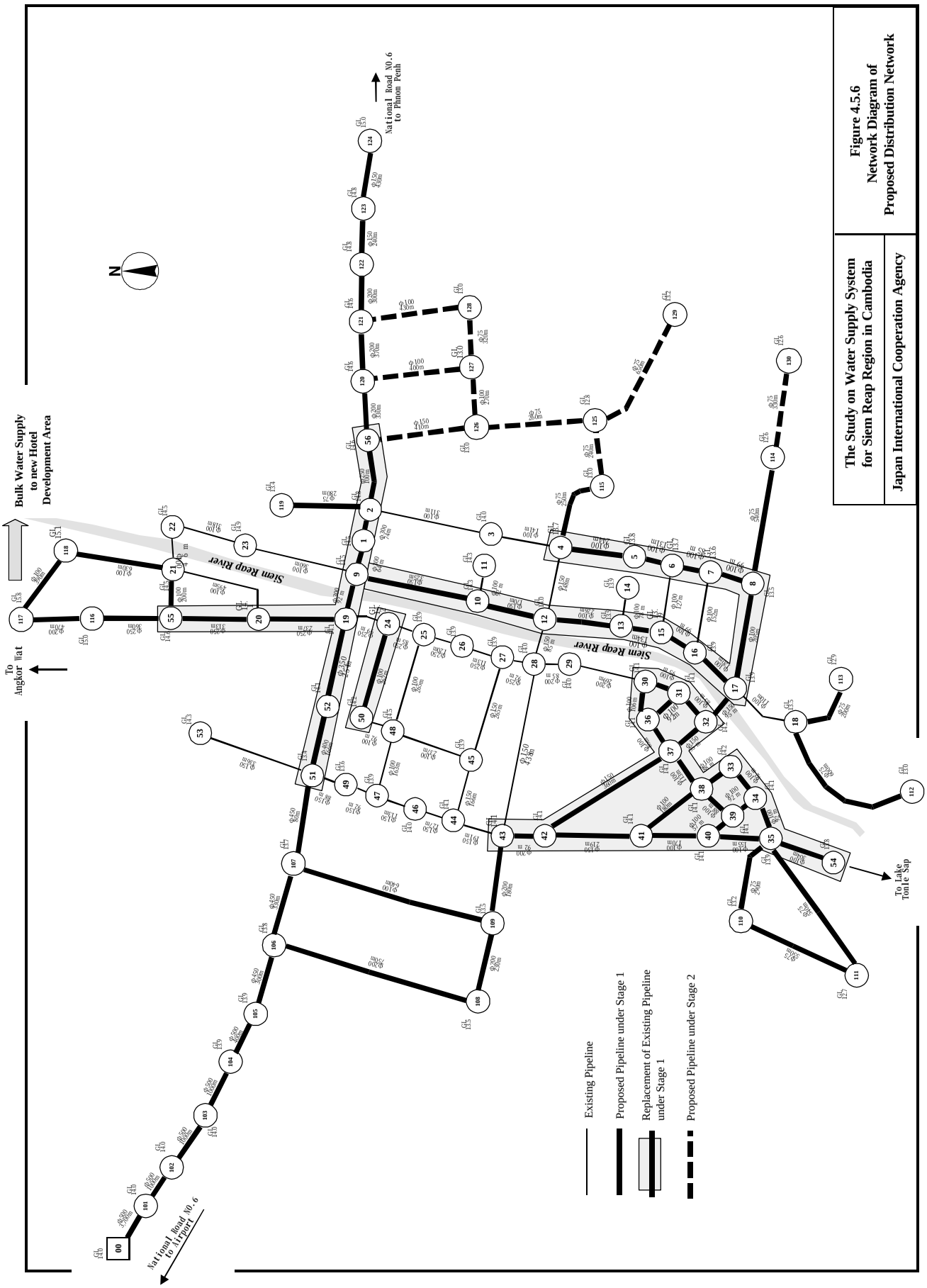
Bulk Water Supply to new Hotel Development Area
To Angkor Wat
National Road NO.6 to Phnom Penh
National Road NO.6 to Airport
To Lake Tonle Sap
Siem Reap River
Siem Reap River
N
Existing Pipeline
Proposed Pipeline under Stage 1
Replacement of Existing Pipeline under Stage 1
Proposed Pipeline under Stage 2
The Study on Water Supply System for Siem Reap Region in Cambodia
Japan International Cooperation Agency
Figure 4.5.6
Network Diagram of
Proposed Distribution Network

Table 4.5.2 Length of Distribution Pipeline by Diameter

Dia (mm)	Stage 1		State 2	Remaining Existing Pipelines (m)	Total (m)
	New Installation (m)	Replacement (m)	New Installation (m)		
500	7,450	-	-	-	7,450
450	710	-	-	-	710
400	-	166	-	-	166
350	-	254	-	-	254
300	-	230	-	-	230
250	360	900	-	509	1,769
200	2,630	92	-	354	3,076
150	765	1,169	410	1,964	4,308
100	1,860	3,499	1,100	3,005	9,464
75	3,250	-	1,800	-	5,050
Total	**17,025**	**6,310**	**3,310**	**5,832**	**32,477**

Pipe material should be considered separately for the trunk main of which diameter is more than 200 mm and secondary main of which diameter is less than 150 mm.

For the trunk main, DIP is recommended from the following advantages.

- Easy installation work comparing with Steel Pipe (SP) under rainy weather condition and high groundwater level
- Quick and easier installation even by unskilled labor using push-on or mechanical joint.
- Easier maintenance and repair comparing with SP.
- High resistance against corrosion comparing with SP.

Even though DIP has disadvantages such as its weight, heavier than SP, DIP is a recommendable pipe material because of its high reliability.

For the secondary main, PVC or PE is recommendable. Recently, Siem Reap Waterworks started to use PVC for repairing ACP line. In Phnom Penh, PE is prevailing as a material for the secondary main.

3) Service Mains

It is recommended that tapping for connection is allowed from distribution pipe of which diameter is smaller than 150 mm. It will require parallel pipe installation along with larger diameter, more than 200 mm, to install connection. Required length of service main will be calculated from the length of distribution trunk main more than 200 mm.

Total length of service main will be about 6,200 m and diameter will be 50 mm and 75 mm. Length of each diameter is assumed to be same and the

length will be 3,100 m each. Pipe material of the service main, PVC or PE is also recommendable.

4) House Connection

Future increase of house connection is estimated as shown on Table 4.5.3. Domestic house connection is calculated from future served population by dividing average family size 5.7. Number of connection for hotels and guest houses are estimated based on the room numbers required in future.

Table 4.5.3 Number Connections

Year	House Connection (Domestic)	Connection for Hotels	Connection for Guest Houses	Total Number of Connections	Incremental Connection
2002	1,640	21	83	1,744	1,354
2003	2,320	32	137	2,489	745
2004	3,067	43	204	3,314	826
2005	3,898	48	244	4,190	875
2006	4,475	50	272	4,797	607
2007	5,506	53	301	5,860	1,063
2008	6,276	56	330	6,662	803
2009	6,650	59	358	7,067	405
2010	6,994	61	387	7,442	375

Installation of new connection is recommended to be conducted by licensed plumber and contractor and details will be discussed in the following section.

4.5.4 Preliminary Cost Estimates

(1) Basis of Cost Estimates

Basis of the cost estimation is same as the basis discussed in the Section 4.3.

Price Level: Base year for the cost estimation is 1999 and all costs are shown in US$.

Unit Cost: Unit costs in this cost estimation are collected from government offices, local consultants and manufacturers. These information are also checked against costs used in recent similar project in Cambodia.

More detail information is described in Annex 4.5.2.

(2) Preliminary Cost Estimates

1) Construction Costs

A survey concerning unit costs of labor, materials, machines and equipment in Siem Reap Town and Phnom Penh is carried out. Based on the results of the survey, construction costs are preliminary estimated as shown on Table 4.5.4.

Table 4.5.4 Summary of Project Cost for Master Plan

(Unit: US$1,000)

	Description	Stage 1	Stage 2	Total
A	Construction Costs	11,242	1,963	13,205
	• Well Facilities(Deep Wells, Connecting Pipelines and Well House)	2,432	1,218	3,650
	• Disinfection, Reservoir, Power Facilities and Pumping Station	2,669	489	3,158
	• Pipelines (Distribution Mains, Service Mains, Rehabilitation of Existing Pipe)	6,141	256	6,397
B	Land Acquisition Cost	250	-	250
C	Administration Cost (2% of A)	225	40	265
D	Engineering Services (15% of A)	1,687	295	1,982
E	Physical Contingency (10% of A+C+D)	1,316	230	1,546
F	Price Contingency (10% of A to E)	1,472	253	1,725
	Total	**16,192**	**2,781**	**18,973**

2) Operation and Maintenance Costs

Operation and maintenance costs are calculated for the Stage 1 of which capacity is 8,000 m^3/day and for the Stage 2 of which capacity is 12,000 m^3/day. Estimated operation and maintenance costs in terms of costs per m^3 of production is as shown on Table 4.5.5.

Table 4.5.5 Unit Operation and Maintenance Cost

Description	Stage 1 (US$ per m^3)	Stage 2 (US$ per m^3)
Operation Cost	**0.089**	**0.078**
Power	0.062	0.056
Chemical	0.007	0.007
Personnel	0.019	0.016
Maintenance Cost	**0.046**	**0.036**
Total	***0.135***	***0.115***

3) Project Costs

For the implementation of the project, related costs will be required other than the construction costs shown above. Related costs will be land acquisition cost, administrative cost which will be required among Cambodian government, physical and price contingencies. These costs are estimated by assuming certain ratio to the construction cost except land acquisition cost. Project costs included the related costs are summarized in Table 4.5.4.

4.5.5 Implementation Schedule

To implement this project, stagewised implementation is recommended as described in the previous section. Project implementation is divided into two stages, Stage 1 and Stage 2. Scope of works in each stage are as follows.

Stage 1 System Capacity : 8,000 m^3/day

- Construction of 10 wells
- Installation of well connecting pipes
- Construction of receiving well
- Construction of clear water reservoir
- Installation of disinfection facilities
- Construction of distribution pumping station
- Installation of distribution pipelines
- Installation of service mains
- Installation of house connections

Stage 2 System Capacity 4,000 m^3/day

- Construction of 5 wells
- Installation of well connecting pipes
- Construction of clear water reservoir
- Installation of additional chlorinator

- Installation of additional distribution pumps
- Installation of distribution pipelines
- Installation of house connections

For the project implementation, following procedures will be required after the Master Plan and Feasibility Study, and time schedule will be as shown on Figure 4.5.7.

- Budgetary arrangement for detail design, construction works and engineering services concerned
- Detailed design
- Tendering
- Construction

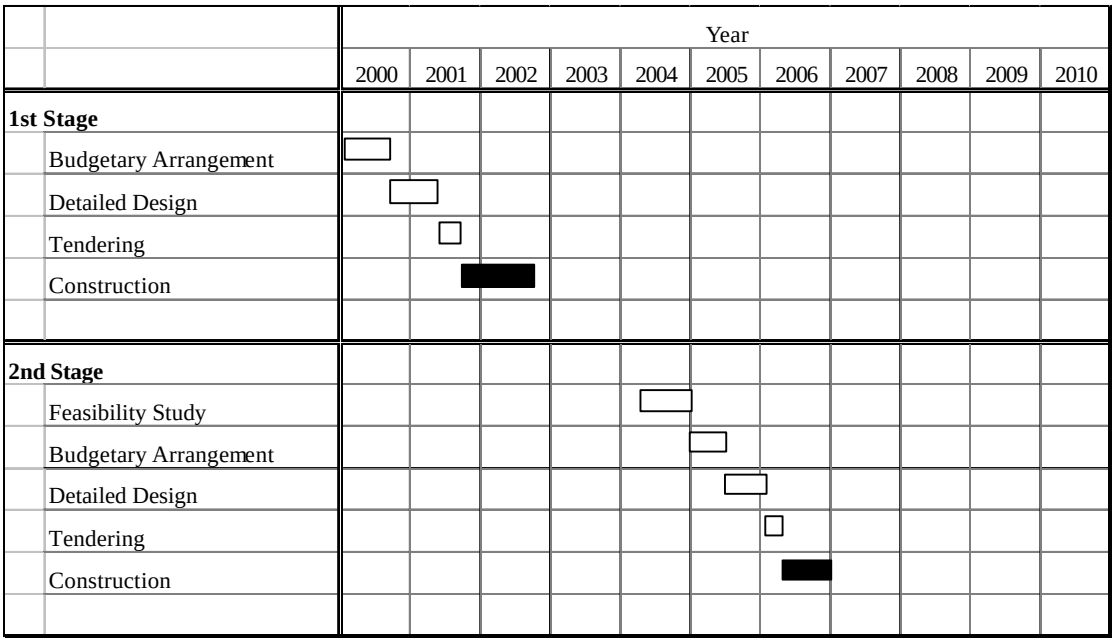

Figure 4.5.7 Implementation Schedule