

2.3.2.4 Culvert Design

1) Basic Plan

- All existing culverts were planned to be reconstructed.
- Additional culverts were planned to be provided in the flood section and its adjacent area where the drainage is poor at present. These locations are as follows:
 - five additional culverts in the flood section from Km 303+300 to Km 305+400
 - two additional culverts in the poor drainage section from Km 306+000 to Km 306+900
 - one additional culvert in the flood section from Km 309+500 to Km 310+700

2) Type and Size of Culverts

- Pipe culverts were used as much as possible, as they are more economical and easier in construction than box culverts and height from the ground to road surface is not so high.
- Box culverts were used at locations where bigger discharge capacity is required.
- Diameter of pipe culvert was determined to be 1.2m for easier maintenance, except for the pipe culverts which are used for an irrigation purpose and their diameters are purposely small. For such pipe culverts, the same diameter was used as the existing one.

3) Location of Additional Culverts

Additional culverts were located at the locations with the following conditions:

- The ground elevation is relatively low to the adjacent area.
- A waterway was made as a result of construction of an intersecting road by a side-borrow method.
- No problem is expected at the outlet side, for example, there is a pond at downstream side.

4) Slope Protection Work Adjacent to Culverts

Slope protection work with grouted riprap of 20m in length is provided at adjacent section of culvert which is located where road elevation is lower than 14.5m.

5) Schedule of Culverts

The schedule of culverts is shown in Table 2.3-22.

TABLE 2.3-22 SCHEDULE OF CULVERTS

Location	Existing			Proposed			Reasons of Additional Installation
	Type	Size	Invert Elevation	Type	Size	Invert Elevation	
Km 298+315	Pipe	φ 0.4	12.65	Pipe	φ 1.2	12.65	
Km 298+490	Pipe	φ 0.2	13.60	Pipe	φ 0.2	13.60	
Km 303+283	Box	4.0x1.6	11.98	Box *	4.0x1.8	11.70	
Km 303+425	-	-	-	Pipe *	φ 1.2	12.00	Flood Section
Km 303+564	-	-	-	Pipe *	2 x φ 1.2	12.00	Flood Section
Km 304+095	Box	2.0x1.1	12.26	Box *	2.0 x 1.8	11.45	
Km 304+280	-	-	-	Pipe *	φ 1.2	12.00	Flood Section
Km 304+540	Box	2.0x1.1	12.76	Box *	2.0 x 1.8	12.00	
Km 304+820	-	-	-	Pipe *	2 x φ 1.2	12.20	Flood Section, request of residents
Km 305+100	-	-	-	Pipe *	φ 1.2	12.50	Flood Section, request of residents
Km 305+413	Box	2.0x1.1	13.16	Pipe *	2 x φ 1.2	12.85	
Km 305+846	Box	2.0x1.2	13.46	Pipe	3 x φ 1.2	13.10	
Km 306+250	-	-	-	Pipe	φ 1.2	13.20	Poor drainage, request of residents
Km 306+525	-	-	-	Pipe	φ 1.2	13.20	Poor drainage, request of residents
Km 306+927	Box	4.0x0.9	13.99	Pipe	3 x φ 1.2	13.70	
Km 307+304	Box	2.0x1.6	13.40	Pipe	2 x φ 1.2	13.50	
Km 307+606	Box	2.1x1.0	13.90	Pipe	2 x φ 1.2	13.70	
Km 308+262	Box	2.0x0.8	14.32	Pipe	2 x φ 1.2	13.90	
Km 309+057	Pipe	φ 0.5	14.30	Pipe	2 x φ 1.2	14.15	
Km 309+525	-	-	-	Pipe	2 x φ 1.2	14.00	Flood Section
Km 309+910	Box	2.0x1.0	14.00	Pipe	2 x φ 1.2	14.00	
Km 310+309	Box	2 Cell x 3.0 x 1.1	14.27	Box	2 Cell x 3.0 x 1.5	13.90	
Km 310+688	Pipe	φ 1.0	14.00	Box	3.0 x 1.5	13.90	
Km 311+348	Box	3.0x1.5	13.90	Box	3.0 x 1.5	13.90	
Km 312+298	Box	2.0x1.2	13.80	Box	2.0 x 1.5	13.80	
Km 313+196	Box	2 Cell x 4.0 x 1.2	13.60	Box	2 Cell x 4.0 x 1.2	13.70	
Km 314+800	Pipe	φ 1.0	13.90	Pipe	φ 1.2	13.40	
Km 315+140	Box	2.0 x 1.8	13.00	Box	2.0 x 1.8	13.00	
Km 315+367	Pipe	φ 1.0	13.75	Pipe	φ 1.2	13.60	

Note: * Slope protection work to be provided for 20m (for both inlet and outlet sides).

2.3.2.5 Road Surface Drainage Design

1) Basic Plan

The basic plan for road surface drainage is as follows:

Rural Section	(Km 298+125 – Km 310+700) :	Natural drain
Urban Section-1	(Km 310+700 – Km 313+725) :	Side ditch with cover
Urban Sections-2 & 3	(Km 313+800 – Km 314+715) :	Catch basin and pipe
Urban Section-4	(Km 314+775 – Km 315+625) :	Natural drain

Road surface drainage system is shown in Figure 2.3-5.

2) Formula and Design Variables

Storm water run-off was calculated by the rational formula.

$$Q = \frac{1}{3.6 \times 10^6} \times C \times I \times a$$

Where:

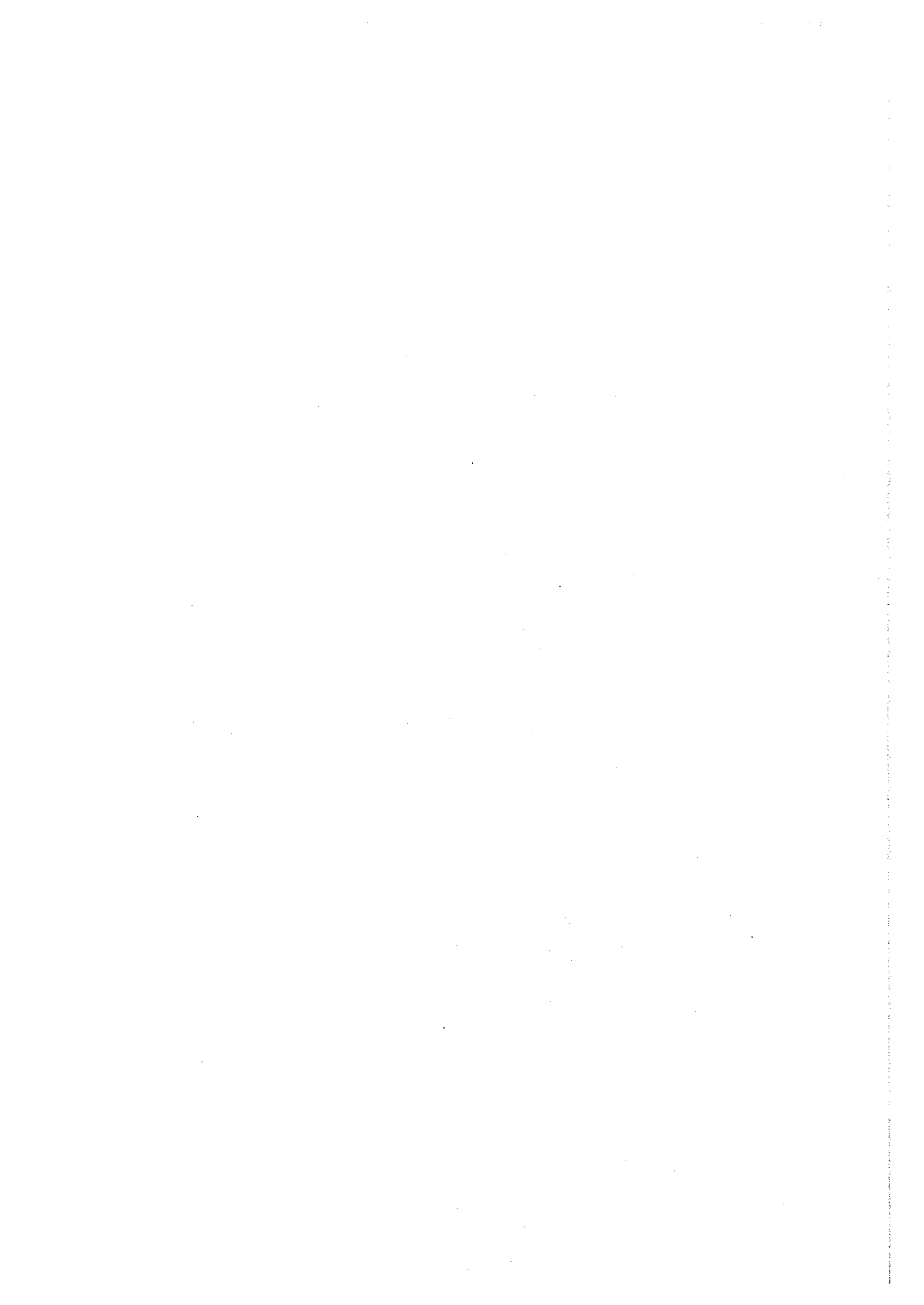
- Q : Run-off (m³/sec)
- C : Run-off coefficient
- I : Intensity of rainfall for a duration of the time of concentration (mm/hour)
- a : Catchment area (m²)

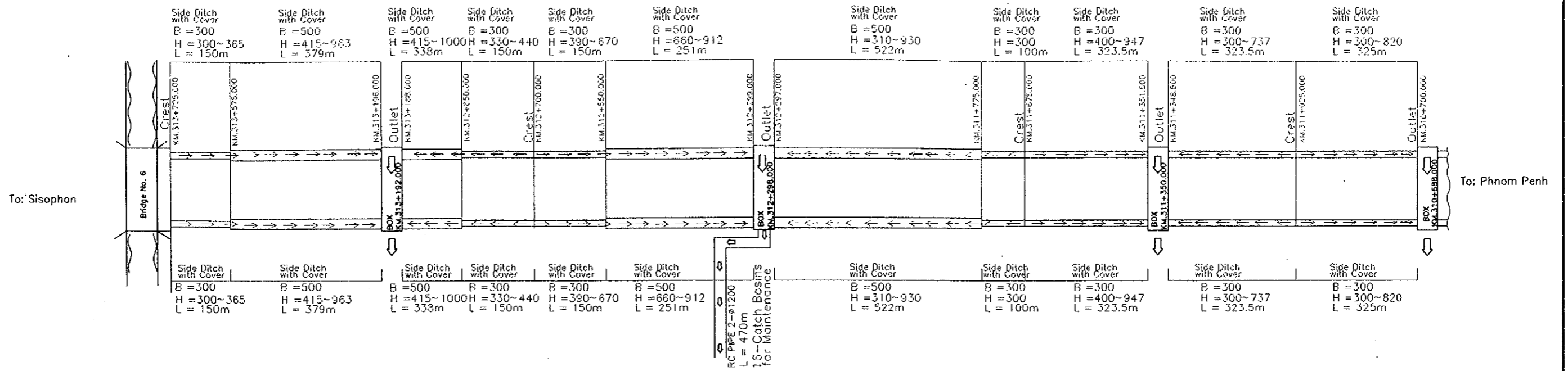
Discharge area and mean velocity were computed by the following formula:

$$Q = A \cdot V$$
$$V = \frac{1}{n} \times R^{2/3} \times i^{1/2}$$

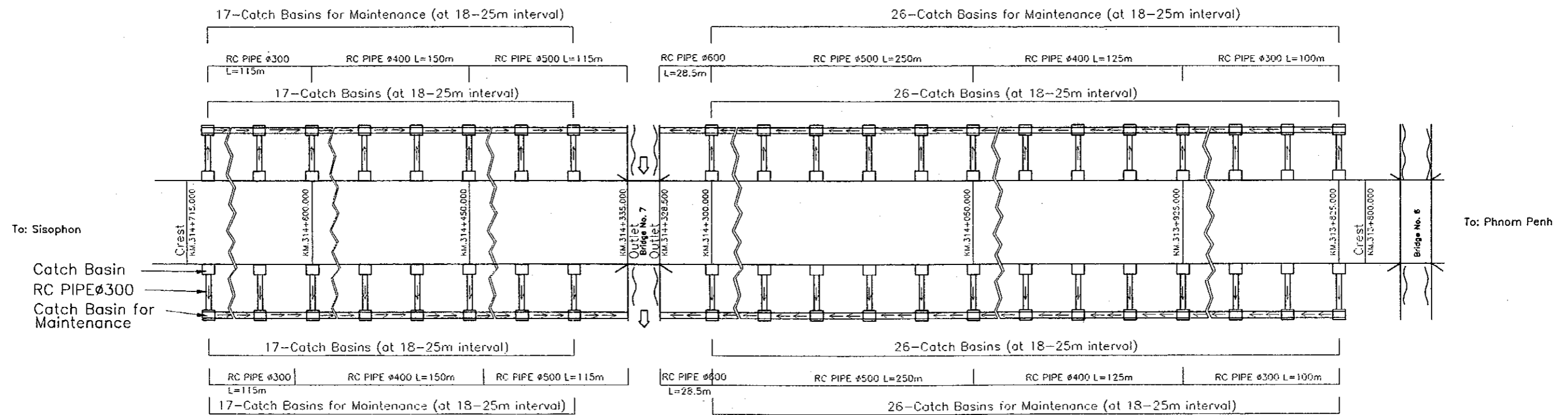
Where:

- A : Cross-sectional area of flowing water (m²)
- V : Mean velocity (m / sec)
- n : Roughness coefficient
- R : Hydraulic radius (m)
R = A/P (P = wetted perimeter length)
- i : Hydraulic gradient





Urban Section-1



Urban Section-2&3

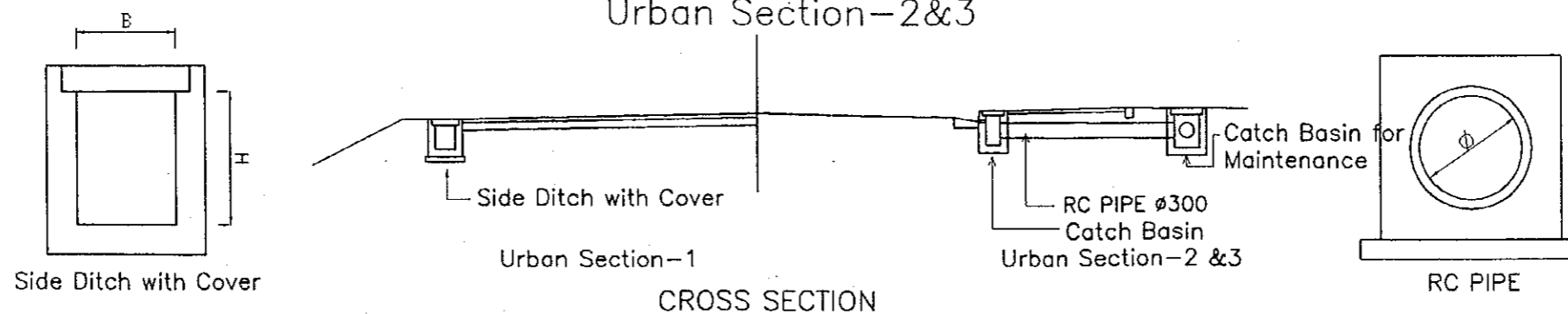
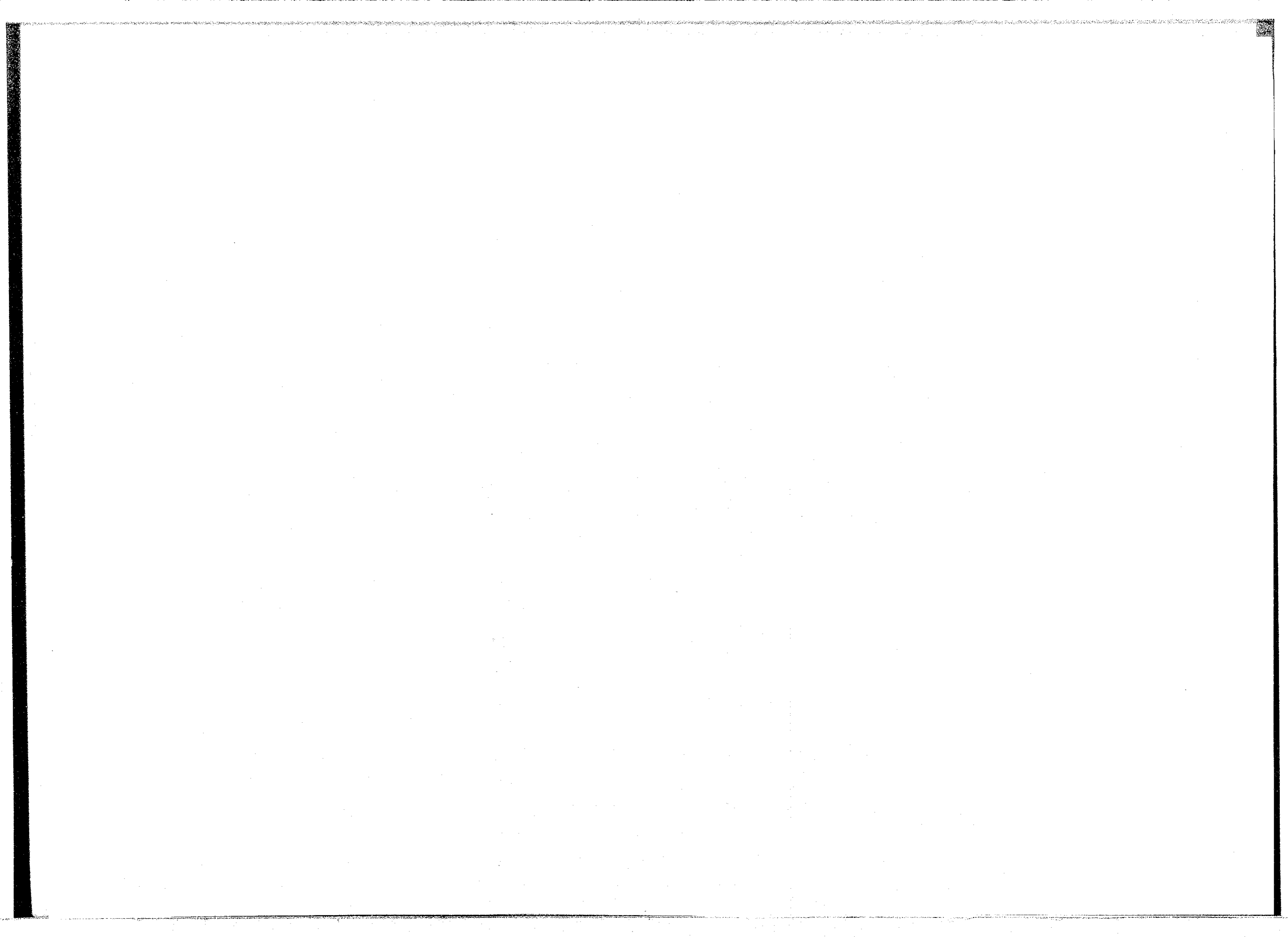
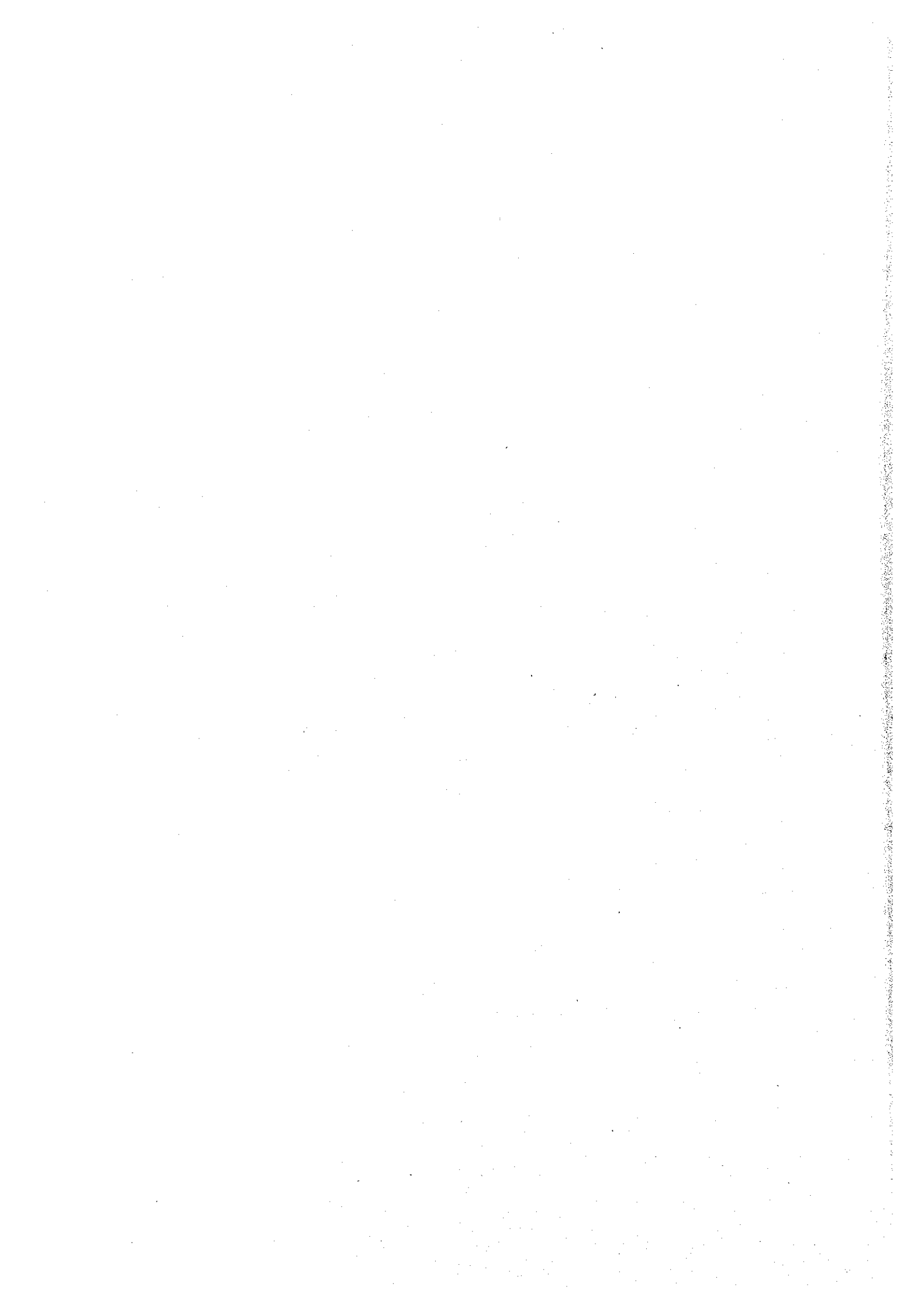


FIGURE 2.3-5 ROAD SURFACE DRAINAGE SYSTEM





Design variables were assumed as follows:

Run-off coefficient C	:	0.9 (Pavement) 0.6 (Ground surface other than pavement)
Intensity of rainfall I	:	120 mm/hr (return period = 3 years, time of concentration = 10 minutes)
Width of catchment		
• Urban Section-1 (Km 310+700 – Km 313+675)		Pavement=6.5m, Ground surface=0m
• Urban Section-1 (Km 311+675 – Km 313+725)		Pavement=9.5m, Ground surface=20.5m
• Urban Section-2 & 3 (Km 313+800 – Km 314+715)		Pavement=7.5m, Ground surface=2.5m
Roughness Coefficient n	:	0.015 (Urban Section-1, Side ditch) 0.013 (Urban Section-2 & 3, Pipe)

3) Hydraulic Analysis : Urban Section-1

Estimated run-off and hydraulic analysis results are shown in Table 2.3-23 and Table 2.3-24, respectively.

4) Hydraulic Analysis : Urban Sections-2 & 3

Estimated run-off and hydraulic analysis results are shown in Table 2.3-25 and Table 2.3-26, respectively.

TABLE 2.3-23 ESTIMATED RUN-OFF (URBAN SECTION-1)

Chainage	Distance from Crest(m)	Width of Catchment, Pavement(m)	Width of Catchment, Ground Surface(m)	Run-off (m ³ /s)	Remarks
310+700	325	6.5	0	0.05833	Outlet
+725	300	6.5	0	0.05200	
+775	250	6.5	0	0.04333	
+825	200	6.5	0	0.03467	
+875	150	6.5	0	0.02600	
+925	100	6.5	0	0.01733	
+975	50	6.5	0	0.00867	
311+025	0	-	-	-	Crest
+075	50	6.5	0	0.00867	
+125	100	6.5	0	0.01733	
+175	150	6.5	0	0.02600	
+225	200	6.5	0	0.03467	
+275	250	6.5	0	0.04333	
+325	300	6.5	0	0.05200	
311+348.5	323.5	6.5	0	0.05607	Outlet
311+351.5	323.5	6.5	0	0.05607	Outlet
+375	300	6.5	0	0.05200	
+425	250	6.5	0	0.04333	
+475	200	6.5	0	0.03467	
+525	150	6.5	0	0.02600	
+575	100	6.5	0	0.01733	
+625	50	6.5	0	0.00867	
+675	0	-	-	-	Crest

Chainage	Distance from Crest(m)	Width of Catchment, Pavement(m)	Width of Catchment, Ground Surface(m)	Run-off (m ³ /s)	Remarks
311+675	0	-	-	-	Crest
311+700	25	9.5	20.5	0.01488	
+750	75	9.5	20.5	0.04463	
+775	100	9.5	20.5	0.05950	
+800	125	9.5	20.5	0.07438	
+850	175	9.5	20.5	0.10413	
+900	225	9.5	20.5	0.13388	
+950	275	9.5	20.5	0.16363	
312+000	325	9.5	20.5	0.19338	
+050	375	9.5	20.5	0.22313	
+100	425	9.5	20.5	0.25288	
+150	475	9.5	20.5	0.28263	
+200	525	9.5	20.5	0.31238	
+250	575	9.5	20.5	0.34213	
312+297	597	9.5	20.5	0.35522	Outlet
312+299	401	9.5	20.5	0.23860	Outlet
+350	350	9.5	20.5	0.20825	
+400	300	9.5	20.5	0.17850	
+450	250	9.5	20.5	0.14875	
+500	200	9.5	20.5	0.11900	
+550	150	9.5	20.5	0.08925	
+600	100	9.5	20.5	0.05950	
+650	50	9.5	20.5	0.02975	
+700	0	-	-	-	Crest
+750	50	9.5	20.5	0.02975	
+800	100	9.5	20.5	0.05950	
+850	150	9.5	20.5	0.08925	
+900	200	9.5	20.5	0.11900	
+950	250	9.5	20.5	0.14875	
313+000	300	9.5	20.5	0.17850	
+050	350	9.5	20.5	0.20825	
+100	400	9.5	20.5	0.23800	
+150	450	9.5	20.5	0.26775	
313+188	488	9.5	20.5	0.29036	Outlet
313+196	529	9.5	20.5	0.31476	Outlet
+225	500	9.5	20.5	0.29750	
+275	450	9.5	20.5	0.26775	
+325	400	9.5	20.5	0.23800	
+375	350	9.5	20.5	0.20825	
+425	300	9.5	20.5	0.17850	
+475	250	9.5	20.5	0.14875	
+525	200	9.5	20.5	0.11900	
+575	150	9.5	20.5	0.08925	
+625	100	9.5	20.5	0.05950	
+675	50	9.5	20.5	0.02975	
+725	0	-	-	-	Crest

TABLE 2.3-24 HYDRAULIC ANALYSIS (Urban Section-1)

Chainage	Distance from Crest (m)	Width of side Ditch (m)	Roughness Coefficient	Hydraulic Gradient	Run-off (m3/sec)	Mean Velocity (m/sec)	Water Depth (m)	Cross-Sectional Area of Flowing Water (m2)	Hydraulic Radius (m)	Elevation of Top of Side Ditch (m)	Elevation of Bottom of Side Ditch (m)	Effective Height of Side Ditch (m)	Remarks
310+700	325	0.300	0.015	0.00200	0.05633	0.639	0.294	0.088	0.099	15.930	14.970	0.800	Outlet
+725	300	0.300	0.015	0.00200	0.05200	0.630	0.275	0.083	0.097	15.940	15.020	0.760	
+775	250	0.300	0.015	0.00200	0.04333	0.607	0.238	0.071	0.092	15.960	15.120	0.680	
+825	200	0.300	0.015	0.00200	0.03467	0.579	0.200	0.060	0.086	15.980	15.220	0.600	
+875	150	0.300	0.015	0.00200	0.02600	0.542	0.160	0.048	0.077	16.000	15.320	0.520	
+925	100	0.300	0.015	0.00200	0.01733	0.488	0.118	0.036	0.066	16.020	15.420	0.440	
+975	50	0.300	0.015	0.00200	0.00867	0.399	0.073	0.022	0.049	16.040	15.520	0.360	
311+025	0	0.300	0.015	0.00200	0.00000	-	-	-	-	16.060	15.620	0.280	Crest
+075	50	0.300	0.015	0.00200	0.00867	0.399	0.073	0.022	0.049	16.080	15.520	0.400	
+125	100	0.300	0.015	0.00200	0.01733	0.488	0.118	0.036	0.066	16.038	15.420	0.458	
+175	150	0.300	0.015	0.00200	0.02600	0.542	0.160	0.048	0.077	15.996	15.320	0.516	
+225	200	0.300	0.015	0.00200	0.03467	0.579	0.200	0.060	0.086	15.955	15.220	0.575	
+275	250	0.300	0.015	0.00200	0.04333	0.607	0.238	0.071	0.092	15.913	15.120	0.633	
+325	300	0.300	0.015	0.00200	0.05200	0.630	0.275	0.083	0.097	15.871	15.020	0.691	
311+348.5	324	0.300	0.015	0.00200	0.05607	0.639	0.293	0.088	0.099	15.850	14.973	0.717	Outlet
311+351.5	324	0.300	0.015	0.00200	0.05607	0.639	0.293	0.088	0.099	15.850	14.763	0.927	Outlet
+375	300	0.300	0.015	0.00200	0.05200	0.630	0.275	0.083	0.097	15.850	14.810	0.880	
+425	250	0.300	0.015	0.00200	0.04333	0.607	0.238	0.071	0.092	15.850	14.910	0.780	
+475	200	0.300	0.015	0.00200	0.03467	0.579	0.200	0.060	0.086	15.850	15.010	0.680	
+525	150	0.300	0.015	0.00200	0.02600	0.542	0.160	0.048	0.077	15.850	15.110	0.580	
+575	100	0.300	0.015	0.00200	0.01733	0.488	0.118	0.036	0.066	15.850	15.210	0.480	
+625	50	0.300	0.015	0.00200	0.00867	0.399	0.073	0.022	0.049	15.850	15.310	0.380	
+675	0	0.300	0.015	0.00200	0.00000	-	-	-	-	15.850	15.410	0.280	Crest
311+700	25	0.300	0.015	0.00180	0.01488	0.450	0.110	0.033	0.064	15.400	14.960	0.280	
+750	75	0.300	0.015	0.00180	0.04463	0.586	0.254	0.076	0.094	15.310	14.870	0.280	
+775	100	0.500	0.015	0.00180	0.05950	0.637	0.187	0.093	0.107	15.280	14.825	0.245	
+800	125	0.500	0.015	0.00180	0.07438	0.677	0.220	0.110	0.117	15.260	14.780	0.270	
+850	175	0.500	0.015	0.00180	0.10413	0.736	0.283	0.141	0.133	15.230	14.690	0.330	
+900	225	0.500	0.015	0.00180	0.13388	0.780	0.343	0.172	0.145	15.200	14.600	0.390	
+950	275	0.500	0.015	0.00180	0.16363	0.813	0.402	0.201	0.154	15.200	14.510	0.480	
312+000	325	0.500	0.015	0.00180	0.19338	0.840	0.460	0.230	0.162	15.200	14.420	0.570	
+050	375	0.500	0.015	0.00180	0.22313	0.863	0.517	0.259	0.169	15.240	14.330	0.700	
+100	425	0.500	0.015	0.00180	0.25288	0.882	0.573	0.287	0.174	15.280	14.240	0.830	
+150	475	0.500	0.015	0.00180	0.28263	0.898	0.629	0.315	0.179	15.220	14.150	0.860	
+200	525	0.500	0.015	0.00180	0.31238	0.912	0.685	0.342	0.183	15.150	14.060	0.880	
+250	575	0.500	0.015	0.00180	0.34213	0.925	0.740	0.370	0.187	15.070	13.970	0.890	
312+297	597	0.500	0.015	0.00180	0.35522	0.929	0.764	0.382	0.188	15.000	13.930	0.860	Outlet
312+299	401	0.500	0.015	0.00200	0.23860	0.912	0.523	0.262	0.169	15.000	13.918	0.872	Outlet
+350	350	0.500	0.015	0.00200	0.20825	0.890	0.468	0.234	0.163	15.000	14.020	0.770	
+400	300	0.500	0.015	0.00200	0.17850	0.863	0.414	0.207	0.156	15.000	14.120	0.670	
+450	250	0.500	0.015	0.00200	0.14875	0.831	0.358	0.179	0.147	15.050	14.220	0.620	
+500	200	0.500	0.015	0.00200	0.11900	0.791	0.301	0.151	0.137	15.160	14.320	0.630	
+550	150	0.300	0.015	0.00200	0.08925	0.690	0.431	0.129	0.111	15.200	14.420	0.620	
+600	100	0.300	0.015	0.00200	0.05950	0.646	0.307	0.092	0.101	15.180	14.520	0.500	
+650	50	0.300	0.015	0.00200	0.02975	0.559	0.177	0.053	0.081	15.150	14.620	0.370	
+700	0	0.300	0.015	0.00200	0.00000	-	-	-	-	15.160	14.720	0.280	Crest
+750	50	0.300	0.015	0.00200	0.02975	0.559	0.177	0.053	0.081	15.180	14.620	0.400	
+800	100	0.300	0.015	0.00200	0.05950	0.646	0.307	0.092	0.101	15.100	14.520	0.420	
+850	150	0.500	0.015	0.00200	0.08925	0.737	0.242	0.121	0.123	15.000	14.420	0.370	
+900	200	0.500	0.015	0.00200	0.11900	0.791	0.301	0.151	0.137	14.970	14.320	0.440	
+950	250	0.500	0.015	0.00200	0.14875	0.831	0.358	0.179	0.147	14.920	14.220	0.490	
313+000	300	0.500	0.015	0.00200	0.17850	0.863	0.414	0.207	0.156	14.900	14.120	0.570	
+050	350	0.500	0.015	0.00200	0.20825	0.890	0.468	0.234	0.163	14.870	14.020	0.640	
+100	400	0.500	0.015	0.00200	0.23800	0.912	0.522	0.261	0.169	14.910	13.920	0.780	
+150	450	0.500	0.015	0.00200	0.26775	0.930	0.576	0.288	0.174	14.990	13.820	0.960	
313+188	488	0.500	0.015	0.00200	0.29036	0.943	0.616	0.308	0.178	14.860	13.744	0.906	Outlet
313+196	529	0.500	0.015	0.00200	0.31476	0.955	0.659	0.330	0.181	14.900	13.767	0.923	Outlet
+225	500	0.500	0.015	0.00200	0.29750	0.946	0.629	0.314	0.179	14.890	13.825	0.855	
+275	450	0.500	0.015	0.00200	0.26775	0.930	0.576	0.288	0.174	14.880	13.925	0.745	
+325	400	0.500	0.015	0.00200	0.23800	0.912	0.522	0.261	0.169	14.870	14.025	0.635	
+375	350	0.500	0.015	0.00200	0.20825	0.890	0.468	0.234	0.163	14.900	14.125	0.565	
+425	300	0.500	0.015	0.00200	0.17850	0.863	0.414	0.207	0.156	14.940	14.225	0.505	
+475	250	0.500	0.015	0.00200	0.14875	0.831	0.358	0.179	0.147	14.960	14.325	0.425	
+525	200	0.500	0.015	0.00200	0.11900	0.791	0.301	0.151	0.137	15.010	14.425	0.375	
+575	150	0.500	0.015	0.00200	0.08925	0.737	0.242	0.121	0.123	15.030	14.525	0.345	
+625	100	0.300	0.015	0.00200	0.05950	0.662	0.180	0.090	0.105	15.070	14.625	0.285	
+675	50	0.300	0.015	0.00340	0.02975	0.662	0.180	0.090	0.105	15.240	14.800	0.280	
+725	0	0.300	0.015	0.00340	0.00000	-	-	-	-	15.440	14.970	0.280	Crest

TABLE 2.3-25 ESTIMATED RUN-OFF (URBAN SECTIONS-2 & 3)

Chainage	Distance from Crest(m)	Width of Catchment, Pavement(m)	Width of Catchment, Ground Surface(m)	Run-off (m ³ /s)	Remarks
313+800	0	-	-	-	Crest
313+825	25	7.5	2.5	0.00604	
+850	50	7.5	2.5	0.01208	
+875	75	7.5	2.5	0.01813	
+900	100	7.5	2.5	0.02417	
+925	125	7.5	2.5	0.03021	
+950	150	7.5	2.5	0.03625	
+975	175	7.5	2.5	0.04229	
314+000	200	7.5	2.5	0.04833	
+025	225	7.5	2.5	0.05438	
+050	250	7.5	2.5	0.06042	
+075	275	7.5	2.5	0.06646	
+100	300	7.5	2.5	0.07250	
+125	325	7.5	2.5	0.07854	
+150	350	7.5	2.5	0.08458	
+175	375	7.5	2.5	0.09063	
+200	400	7.5	2.5	0.09667	
+225	425	7.5	2.5	0.10271	
+250	450	7.5	2.5	0.10875	
+275	475	7.5	2.5	0.11479	
+300	500	7.5	2.5	0.12083	
+325	525	7.5	2.5	0.12688	
+328.5	528.5	7.5	2.5	0.12772	Outlet
+335	380	7.5	2.5	0.09183	Outlet
+350	365	7.5	2.5	0.08821	
+375	340	7.5	2.5	0.08217	
+400	315	7.5	2.5	0.07613	
+425	290	7.5	2.5	0.07008	
+250	265	7.5	2.5	0.06404	
+475	240	7.5	2.5	0.05800	
+500	215	7.5	2.5	0.05196	
+525	190	7.5	2.5	0.04592	
+550	165	7.5	2.5	0.03988	
+575	140	7.5	2.5	0.03383	
+600	115	7.5	2.5	0.02779	
+625	90	7.5	2.5	0.02175	
+650	65	7.5	2.5	0.01571	
+675	40	7.5	2.5	0.00967	
+700	15	7.5	2.5	0.00363	
+715	0	-	-	-	Crest

TABLE 2.3-26 HYDRAULIC ANALYSIS (URBAN SECTION-2 & 3)

Chainage	Distance from Crest (m)	Pipe Diameter (m)	Roughness Coefficient	Hydraulic Gradient	Run-off (m ³ /sec)	Mean Velocity (m/sec)	Water Depth (m)	Cross-Sectional Area of Flowing Water (m ²)	Hydraulic Radius (m)	Remarks
313+800	0	-	-	-	-	-	-	-	-	Crest
313+825	25	0.300	0.013	0.0013	0.00604	0.370	0.085	0.0163	0.049	
+850	50	0.300	0.013	0.0013	0.01208	0.448	0.122	0.0270	0.065	
+875	75	0.300	0.013	0.0013	0.01813	0.498	0.154	0.0364	0.076	
+900	100	0.300	0.013	0.0013	0.02417	0.532	0.184	0.0454	0.084	
+925	125	0.400	0.013	0.0013	0.03021	0.565	0.177	0.0535	0.092	
+950	150	0.400	0.013	0.0013	0.03625	0.592	0.196	0.0612	0.099	
+975	175	0.400	0.013	0.0013	0.04229	0.615	0.215	0.0688	0.104	
314+000	200	0.400	0.013	0.0013	0.04833	0.635	0.233	0.0762	0.109	
+025	225	0.400	0.013	0.0013	0.05438	0.651	0.252	0.0835	0.114	
+050	250	0.400	0.013	0.0013	0.06042	0.664	0.272	0.0909	0.117	
+075	275	0.500	0.013	0.0013	0.06646	0.689	0.247	0.0964	0.124	
+100	300	0.500	0.013	0.0013	0.07250	0.704	0.260	0.1030	0.128	
+125	325	0.500	0.013	0.0013	0.07854	0.718	0.272	0.1094	0.132	
+150	350	0.500	0.013	0.0013	0.08458	0.731	0.285	0.1158	0.135	
+175	375	0.500	0.013	0.0013	0.09063	0.742	0.298	0.1221	0.138	
+200	400	0.500	0.013	0.0013	0.09667	0.752	0.311	0.1285	0.141	
+225	425	0.500	0.013	0.0013	0.10271	0.762	0.324	0.1348	0.144	
+250	450	0.500	0.013	0.0013	0.10875	0.770	0.338	0.1412	0.146	
+275	475	0.500	0.013	0.0013	0.11479	0.777	0.352	0.1477	0.148	
+300	500	0.600	0.013	0.0013	0.12083	0.800	0.316	0.1510	0.155	
+325	525	0.600	0.013	0.0013	0.12688	0.809	0.326	0.1567	0.158	
+328.5	528.5	0.600	0.013	0.0013	0.12772	0.811	0.327	0.1575	0.158	Outlet
+335	380	0.500	0.013	0.0015	0.09183	0.787	0.287	0.1167	0.136	Outlet
+350	365	0.500	0.013	0.0015	0.08821	0.779	0.280	0.1132	0.134	
+375	340	0.500	0.013	0.0015	0.08217	0.766	0.268	0.1072	0.131	
+400	315	0.500	0.013	0.0015	0.07613	0.752	0.256	0.1012	0.127	
+425	290	0.500	0.013	0.0015	0.07008	0.737	0.244	0.0951	0.123	
+450	265	0.400	0.013	0.0015	0.06404	0.712	0.269	0.0899	0.117	
+475	240	0.400	0.013	0.0015	0.05800	0.698	0.251	0.0831	0.114	
+500	215	0.400	0.013	0.0015	0.05196	0.682	0.234	0.0762	0.110	
+525	190	0.400	0.013	0.0015	0.04592	0.662	0.216	0.0693	0.105	
+550	165	0.400	0.013	0.0015	0.03988	0.640	0.199	0.0623	0.100	
+575	140	0.400	0.013	0.0015	0.03383	0.614	0.181	0.0551	0.094	
+600	115	0.300	0.013	0.0015	0.02779	0.580	0.192	0.0479	0.086	
+625	90	0.300	0.013	0.0015	0.02175	0.549	0.164	0.0396	0.079	
+650	65	0.300	0.013	0.0015	0.01571	0.506	0.136	0.0310	0.070	
+675	40	0.300	0.013	0.0015	0.00967	0.444	0.104	0.0218	0.058	
+700	15	0.300	0.013	0.0015	0.00363	0.335	0.063	0.0108	0.038	
+715	0	-	-	-	-	-	-	-	-	Crest

2.3.2.6 Other Road Facility Design

1) Slope Protection Work

Slope protection works with grouted riprap were planned at the sections where culverts are installed and road elevation is lower than 14.50 m. Length of slope protection work at each section is 20 m on both inlet and outlet sides (refer to 2.3.2.4).

2) Traffic Regulatory Signs

The following traffic regulatory signs were planned:

Speed Limit : Four locations on each direction at the beginning or end of the Project, at the boundary of Siem Reap City and at two locations in the urban section.

Truck No Entry : One location on each direction before truck ban section.

Pedestrian Crossing Ahead : Seven locations before pedestrian crossings.

3) Road Markings

Road markings include road centerlines, carriageway outside lines, and pedestrian crossings. Pedestrian crossings were planned before and after five major intersections in the urban section and two pedestrian crossings in front of the public market.

4) Guardrail

Guardrails were planned to be provided at bridge approaches and at sections where box culverts are installed in the urban section. Specific locations are as follows:

- Approaches of Stung Bridge : 4 m each on both sides (embankment height less than 4 m)
- Approaches of Lo Lum Bridge : 4 m each on both sides (embankment height less than 4 m)
- Approaches of Kaek Bridge : 12 m each on both sides (embankment height 4 m or more)
- Over box culvert (Km 310+688) : 10 m
- Over box culvert (Km 312+298) : 15 m
- Over box culvert (Km 313+196) : 19 m

2.3.2.7 Major Construction Quantities

Major construction quantities are shown in Table 2.3-27.

TABLE 2.3-27 MAJOR CONSTRUCTION QUANTITIES

	Item	Quantity	Remarks
Earthwork	Removal of top soil	34,500 m ³	
	Removal of exist. pavement	3,230 m ³	
	Borrow soil	21,300 m ³	
	Embankment	52,600 m ³	
	Slope finishing	37,200 m ²	
Pavement	Surface course	37,100 m ²	AC t = 80mm
	Surface course	93,800 m ²	AC t = 70mm
	Surface course	8,580 m ²	AC t = 50mm
	Surface course	54,000 m ²	AC t = 30mm
	Base course	193,000 m ²	Mechanically stabilized material
	Subbase course	206,600 m ²	Crusher-run
Drainage Facilities	Pipe culvert	410 m	φ 1,200mm, φ 200mm
	Box culvert	2,770 m ³	Reinforced concrete
	Side ditch with cover	5,870 m	B = 0.3~0.5m, H = 0.3~1.0m
	RC pipe	470 m	2 x φ 1,200mm
	Gutter	1,820 m	
	Catch Basin	188 each	
	RC pipe	1,910 m	φ 600mm, φ 500mm, φ 400mm, φ 300mm
Bridge	Pile	204 each	400mm x 400mm Precast RC
	Substructure	1,120 m ³	Reinforced concrete
	Superstructure	592 m ³	Reinforced concrete
	Riverbank protection	1 set	Concrete block, grouted riprap
	Approach slab	177 m ³	Reinforced concrete
	Shoe, Expansion joint	1 set	Rubber shore, Rubber joint
Other Facilities	Edge block	5,880 m	Concrete block
	Guardrail	168 m	
	Road marking	45,900 m	Road centerline, edge line
	Traffic sign board	23 each	

CHAPTER 3 IMPLEMENTATION PLAN

3.1 Implementation Plan

3.1.1 Implementation Conditions

The following are the basic conditions for implementing this project:

- This project, if approved, will be implemented in accordance with the provisions of Japan's Grant Aid Program after the signing of the Exchange of Notes between the Governments of Japan (GOJ) and the Kingdom of Cambodia.
- The Ministry of Public Works and Transport (MPWT) is the responsible agency for implementing the project.
- The detailed design, tenders and construction supervision of the road project will be undertaken by a Japanese consulting firm in accordance with a contract between the MPWT and the consultant.
- The construction of the road will be undertaken by the successful Japanese tenderer in awarding the contract with the MPWT.

3.1.2 Implementation Concept

The following are the main concepts in the implementation plan:

- The construction will be undertaken by the Japanese contractor under its direct management, employing labors and leasing available equipment from local subcontractors.
- Materials and equipment necessary for the project will be procured in Cambodia as far as available. Items unavailable locally will be procured from Japan or third countries. Third countries will be selected based on their cost, quality and required delivery time.
- The construction method and schedule of the project will be planned reflecting local conditions of climate, topography, geology, transportation and others.
- Easy and low cost methods of construction will be adopted for the project as much as possible.
- Organization for construction and supervision of the project will be proposed upon standardization and specification for the project as well as construction supervision
- Detours for vehicles and pedestrians will be provided during construction when necessary.
- Environment-friendly construction methods will be proposed.

3.1.3 Utilization of RCC Equipment and Execution of OJT

In the past Japan's Grant Aid project, the equipment of the Road Construction Center (RCC) was utilized and OJT for equipment operation and maintenance was exercised to MPWT staff including RCC staff. As a result, their technical ability was improved and now the RCC equipment is actively being utilized mainly for urgent rehabilitation works.

Likewise in this Project, it is highly recommended to utilize the RCC equipment as much as possible and exercise OJT.

3.1.4 Safeguard Measures

- Regarding the search of mines and unexploded ordnance in the construction area, CMAC has conducted the level one survey services including:
 - Gathering information of the threat of mines and UXO,
 - Conducting a spot check to determine and delineate the perimeter of mined location, and
 - Searching data records in data base,and reported that there are no reports or records of the casualty and no mines or UXOs were found while conducting a spot check.
- When mine or unexploded ordnance is still discovered during construction, it will be removed by the Royal Government of Cambodia.
- Guard and communication system will be established at and between project sites and the project office.

3.1.5 Construction Plan

Major work items and their construction method are as follows:

- 1) Preparation Works
 - Site offices, logging houses, plant facilities and material storage yards will be set up on the sites supplied by the Royal Government of Cambodia. Generators will be equipped for power supply and cellular phones will be used for telecommunication.
 - Survey control points will be set up to develop the road alignment and chainages.
 - Utilities will be removed or relocated by the Royal Government of Cambodia.
 - A quarry will be selected and the road between the project site and the quarry will be repaired to make it passable if necessary. Phnom Liep Quarry which is about 70 km distant from the site was selected as a possible candidate based on the aggregate material source investigation. If the said quarry is selected, the required works are as follows:

Aggregate hauling road repair works:

- Construction of temporary bridges for 4 river crossings. (Bridge length : 15m, 18m, 10m and 15m)
- Leveling of 7 m wide and 47 km long laterite surface road including scarification of the road surface by a bulldozer and its compaction by macadam rollers.

2) Earthwork

- Top soil will be removed and bench cut will be carried out on existing road slopes prior to widening the embankment and rising the road.
- The borrow material for the embankment will be purchased from the roadside farms. The most of the roadside soil is laterite which can be used for embankment.
- In finishing the embankment slope, top soil containing grass seeds (about 5 cm thick) will be placed to protect the slope from erosion.
- Earthwork including subgrade work will be completed before the rainy season starts.

3) Temporary work for bridge construction

- Since the bridges will be reconstructed at the same locations as the existing bridges, detour will be provided prior to the demolition of existing bridges. Detour will be 7 m wide and 10 cm thick crusher-run surfaced road. Temporary bridges will be constructed where the river is deeper than 2 m.
- For construction of substructures, steel sheet pile cofferdams and temporary platform will be installed where river is deeper than 2m, while embankment cofferdam will be installed where river is shallow.
- Temporary work for bridge construction is summarized in Table 3.1-1.

TABLE 3.1-1 TEMPORARY WORK FOR BRIDGE CONSTRUCTION

Bridge Name	Stung	Lo Lum	Kaek
Detour Location	13 m upstream from exist. bridge	13 m upstream from exist. bridge	40 m upstream from exist. bridge
Detour Work	Fill section (46m) Bridge (24m)	Fill section (46m) Bridge (24m)	Fill section (106m)
Cofferdam	Steel sheet pile	Steel sheet pile	Fill cofferdam
Platform	Install	Install	No need

4) Bridge works

- Foundation and substructures will be constructed in dry seasons. The filled detour will be removed and the detour bridge or new bridge will be opened for the traffic in the rainy seasons.
- The foundation piles made of precast reinforced concrete will be fabricated at the sites.
- The superstructure is made of in-situ reinforced concrete which will be placed on the timber pile supported forms.

- 5) Drainage
 - Catch basins, concrete pipes and gutters are made of precast concrete. The pipe culverts will be covered with in-situ reinforced concrete since the top soil covers are less than 50 cm. Side ditches with precast concrete covers are made of in-situ plain concrete since the height and the width of the ditches are variable.
 - In construction of culverts, at least one lane will be maintained for the traffic by providing detour or by constructing the culverts half by half alternately.

- 6) Pavement
 - In the subgrade preparation, severely deteriorated existing pavement will be removed and compacted. Pot holes will be filled with subbase course material after removal of loosened existing base.
 - Pavement structure is composed of crusher-run subbase course, mechanically stabilized base course and hot mixed asphalt concrete.
 - Pavement work will be done half by half to always open one lane for traffic.

- 7) Sidewalk
 - Where drainage pipes are installed under existing sidewalks, the sidewalks will be restore with existing tiles or new ones similar to the existing after installing pipes.
 - Where new construction of sidewalks are proposed, color sidewalk blocks fitting the landscape will be placed.

- 8) Other road facilities
 - Guardrails will be installed.
 - Road centerlines, edge lines, cross walks will be marked on the pavement.
 - Traffic sign boards will be installed.

3.1.6 Considerations on the implementation

The following points will be considered in the implementation of the project:

- 1) Safeguard measures
Refer to 3.1.4.

- 2) Traffic control and safety control during construction
 - Not to interrupt the traffic during construction, detours and traffic control will be provided by the contractor.
 - To secure traffic safety, warning signs and lights, guard fences and traffic control persons will be arranged at the construction sites.

- 3) Environment-friendly construction method
 - Concrete mixing plant, rock crushing plant and asphalt mixing plant which cause noise and dust will be located apart from resident areas.

- Noise and dust free construction method will be taken as much as possible in the urban area.
 - Demolished materials of bridges and pavement will be disposed properly (to be buried in borrow pits).
 - Sewage from the construction plants will be drained after treated.
- 4) Maximum utilization of RCC Equipment and Execution of OJT
Refer to 3.1.3.
- 5) Control of overloaded vehicles
- Overloading which causes damages on the road structures will be controlled by weighing of vehicles in the Project site. When an overloaded truck is found and it is connected with the construction of the Project, an immediate action to decrease the load will be taken and decisive measures to prevent the recurrence will be taken. If the overloaded truck is being operated for other construction work, it will be reported to the responsible persons (person in charge of construction and implementing agency's representative) and the police for appropriate measures to be taken.
- 6) Resettlement and land acquisition
- The Resettlement Action Plan (RAP) has been formulated including the project section. Resettlement and land acquisition for the project will be undertaken by the Government of the Kingdom of Cambodia before the construction in accordance with the RAP.
- 7) Preservation of archaeological antiquities
- Excavation work in the Baray section will be carried out at the presence of APSARA staff.
 - Construction work in other sections will be carried out also with full attention to archaeological antiquities. When something antique is found, the contractor will immediately inform APSARA thereof. It will be left in the hands of APSARA to dig out and carry out the finding.

3.1.7 Scope of Works

Undertakings of both governments, Japan and the Kingdom of the Cambodia, are listed in Table 3.1-2.

TABLE 3.1-2 UNDERTAKINGS OF BOTH GOVERNMENTS

Item	Item	Undertaken by		Remarks
		Japan	Cambodia	
Procurement of Materials and Equipment and Repair of Transportation Road	Procurement	◎		
	Customs Clearance		◎	
	Repair of Inland Transport Road		◎	
	Repair of Aggregate Transport Road	◎		
Investigation and removal of Mines & UXO			◎	
Preparation Work	Acquisition of Lots		◎	Lots for site office, storage yards, plants and work shops
	Other works than the above	◎		
Removal / Relocation of Existing Facilities			◎	Houses, Stores, Power Poles, Telephone Cables
Road Construction		◎		
In case of discovery of archaeological antiques	Report	◎		
	Digging and carrying out		◎	

3.1.8 Consultant Supervision Plan

A Japanese consulting firm will supervise the implementation of the project on behalf of the Government of Cambodia. The works to be undertaken by the consultant are as follows:

1) Detailed Design

The major works in the detailed design to be carried out by the consultant are as follows:

- Supplementary site survey
- Detailed design of the road and related structures

- Preparation of drawings and specifications
- Construction planning and cost estimation
- Preparation of tender documents

The necessary time for the detailed design is 3 months.

2) Assistance in Tendering

This task includes the following items:

- Tender publication
- Pre-qualification
- Tendering
- Tender evaluation
- Contract facilitation

The necessary time for assistance in tendering is 3 months.

3) Construction Supervision

The main work items to be executed by the consultant are as follows:

- Inspection and approval of site surveys
- Inspection and approval of construction planning
- Quality control
- Progress control
- Measurement of work
- Inspection of safety aspects
- Final inspection and turnover

The construction period is 17 months. To successfully carry out supervision, a resident engineer of the consultant is required to be stationed on the site during the entire construction period. Additionally, a pavement engineer is required to supervise for about one month at the beginning of the pavement work.

3.1.9 Procurement Plan

1) Construction Materials

Common items of construction materials are available in Cambodia. Cement, reinforcing steel bars, play woods and rolled steel bars are imported by local suppliers and they are constantly available in the local market. Aggregate, lumbers, concrete pipes are produced by local suppliers.

Principles on procurement of construction materials are as follows:

- Locally available materials will be procured as far as their quality, price and quantity are acceptable.
- Imported materials which are constantly available in the local market will be procured as local items.

- Materials which are not available in the local market will be procured from Japan or third countries. Countries of the material source will be decided comparing quality, price and other points of the materials.

Procurement plan of the major construction materials is shown in Table 3.1-3.

TABLE 3.1-3 MATERIAL PROCUREMENT PLAN

	Procured from			Remarks
	Cambodia	Japan	Third Country	
Crushed stones	⊙			
Sand	⊙			
Straight asphalt	⊙			Imported
Asphalt Emulsion	⊙			Imported
Sidewalk block	⊙			
Edge block	⊙			
Play wood	⊙			Imported
Lumber	⊙			
Cement	⊙			Imported
Reinforcing steel bar	⊙			Imported
Rubber bearing		⊙		
Anchor bar & cap		⊙		
Expansion joint		⊙		
Bridge name plate		⊙		
Concrete pipes	⊙			
Side ditches with covers	⊙			
Gutter	⊙			
Catch basins	⊙			
Road marking paint	⊙			Imported
Beads	⊙			Imported
Traffic sign boards	⊙			
Guard rail		⊙		
Rolled steel bars	⊙			Imported
Sand bag	⊙			
Steel sheet pile		⊙		
Form tie	⊙			Imported
Support pipes	⊙			Imported
Square pipes	⊙			Imported
Form coating oil	⊙			Imported
Scaffolding frame	⊙			Imported

2) Equipment

There is no equipment lease firm in Cambodia. However, equipment owned by local contractors is available to be leased. The models of the equipment are old and common types only.

The equipment owned by the Road Construction Center (RCC) of which equipment was procured by the Japan's Grant Aid has been experienced to be leased to a road construction project under Japan's Grant Aid. Likewise the equipment is available to be leased to this project.

Principles on procurement of construction equipment are as follows:

- Equipment commonly owned by local contractors will be leased from them.
- Equipment of RCC will be utilized as much as possible.
- Equipment which are not available in Cambodia and equipment which will seriously affect the construction schedule if broken down will be procured from Japan or third countries.

Vehicles made in Thailand cannot be procured since right-hand-drive vehicles are prohibited to operate in Cambodia.

Procurement plan of the major equipment is shown in Table 3.1-4.

TABLE 3.1-4 EQUIPMENT PROCUREMENT PLAN

Equipment	Capacity	Procured from				Remarks
		Cambodia (Lease)	RCC (Lease)	Third Country	Japan	
Bulldozer	21t	⊙	⊙			
Backhoe excavator	0.6t	⊙	⊙			
Dump truck	10t	⊙	⊙		⊙	
Wheel loader	12t	⊙	⊙			
Macadam roller	10t	⊙	⊙			
Tire roller	8-20t				⊙	
Vibration roller	10t	⊙	⊙			
Asphalt finisher					⊙	
Motor grader	3.7m	⊙	⊙			
Water tank truck	8t	⊙	⊙			
Hand guided roller	1t	⊙				
Crane mounted truck	4t				⊙	
Diesel hammer	3.5t	⊙				
Concrete breaker		⊙				
Air compressor	3m3	⊙				
Agitator truck	3m3	⊙			⊙	
Concrete vibrator					⊙	
Generator	30KVA	⊙				
Tamper					⊙	
Truck crane	15t	⊙			⊙	
Wheel crane	50t				⊙	
Line marker & mixer				⊙		
Vibro-hammer	46kV				⊙	
Asphalt plant		⊙				
Concrete plant		⊙				
Vehicle weigh measure					⊙	

3.1.10 Implementation Schedule

The Implementation schedule of this Project is proposed as shown in Table 3.1-5.

TABLE 3.1-5 IMPLEMENTATION SCHEDULE

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
D / D	Site Survey	—																	
	Detailed Design	—	—																
	Approval on D/D			—											(Total 3.0 months)				
	Preparation Works	—																	
	Temporary Works	—	—															Cleaning	
	Earth Work			—	—														
Road	Pave-ment					—	—												
	Subbase					—	—												
	Base					—	—												
	Surface					—	—												
	Sidewalk										—	—	—	—	—	—	—	Sidewalk	
	Foundation																	Drain	
Bridge	Substructure																		
	Superstructure																		
	Riverbank Protection																		
Drainage	Box Culverts																		
	Pipe culverts																		
	Side Ditches																		
	Basins & Pipes																		
Other Facilities	Road Marking																		
	Traffic Signs																		
	Project Monument																		
																			(Total 17.0 months)

C O N S T R U C T I O N

3.1.11 Obligations of the Kingdom of Cambodia

The following necessary measures should be taken by the Royal Government of Cambodia on condition that the grant aid by the Government of Japan is extended to the project:

- To provide data and information necessary for the project.
- To secure the land necessary for the execution for the project, such as the right of way, the land for temporary offices, working areas, storage yards, plant facilities and others.
- To clear the sites prior to the commencement of the construction including removal of the UXO (Unexploded Ordinance) and the mines.
- To make passable all roads and bridges leading to the project sites before the commencement of inland transportation of materials and equipment.
- To remove existing obstacles such as houses, stores, etc. in the right of way.
- To relocate existing utilities such as power poles, power cables, etc. outside the road structures to be constructed.
- To bear commissions to the Japanese foreign exchange bank for its banking services based upon the Banking Arrangement, namely the advising commission of the "Authorization to Pay" and payment commission.
- To ensure prompt unloading, tax exemption, customs clearance at the port of disembarkation in the Kingdom of Cambodia and prompt internal transportation of the materials and equipment for the project purchased under the grant aid.
- To exempt Japanese nationals engaged in the project from customs duties, internal taxes and other fiscal levies which may be imposed in the Kingdom of Cambodia with respect to the supply of the products and services under the verified contracts.
- To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into the Kingdom of Cambodia and stay therein for the performance of their work.
- To provide necessary permission, licenses and other authorizations for implementing the project, if necessary.
- To maintain and use properly and effectively the facilities constructed under the project.
- To coordinate and solve any issues related to the project which may be raised from third parties or inhabitants in the project area during implementation of the project.
- To dig out and carry out the archaeological antiquities which may be discovered at the construction site.
- To bear all the expenses, other than those covered by the Japanese grant aid, necessary for the project.

3.2 Project Cost Estimation

Project cost born by the Kingdom of Cambodia is estimated at US\$ 159,400.
(Refer to Appendix 5)

3.3 Maintenance Plan of the Project Road

Maintenance of the road facilities to be constructed under this project will be carried out by Public Works and Transport Service of Siem Reap Province.

Maintenance activities are composed of routine inspection, periodic cleaning and repair when necessary. A maintenance plan for the road facilities to be constructed under this project was proposed as shown in the Table 3.3-1. Timing, staff, equipment and cost required in each maintenance activity are explained in the plan.

Table 3.3-1 MAINTENANCE PLAN FOR THE PROJECT ROAD

(Total road length :17.5 Km)

1. Routine Inspection						
Facility	Inspection Item	Interval	Number of Staff	Equipment/Material	Quantity	budget (US\$/year)
Ditches	Presence of mud, sand, obstacles, etc.	4 times/year (5 days/time)	2 persons	Measuring tape, Scoop, Hammer Chain hoists, Measuring tape	40preson*day/year	1,000
Catch basin and Pipes Pavement	Presence of mud, sand, obstacles, etc. Crack, deformation, potholes, etc. Collapse, erosion, etc.					
Embankment slopes	Surface of deck, abutment, pier, river condition	4 times/year (5 days/time)	2 persons	Pick-up truck	20units*day/year	400
Bridges	Presence of mud, sand, obstacles, etc.					
Culverts	Stain, discolor					
Road marking	Damage, deformation, stain, discolor					
Sign boards					Sub-total	1,400
2. Clearing						
Facility	Cleaning Item	Interval	Number of Staff	Equipment/Material	Quantity	budget (US\$)
Ditches	Removal of deposit of mud, sand, obstacle	2 times/year (20 days/time)	10 persons	Scoops, Steel bars, Brooms Chain hoists, Tool set	400preson*day/year	4,000
Catch basins and Pipes Pavement	ditto ditto					
Embankment slopes	Cutting grass	2 times/year (20 days/time)	10 persons	Pick-up truck	80units*day/year	1,600
Bridges	Removal of deposit of mud, sand, obstacle					
Culverts	ditto					
Road marking	ditto					
Sign boards	ditto				Sub-total	5,600
3. Repair						
Facility	Repair item	Interval	Number of Staff	Equipment/Material	Quantity	budget (US\$)
Ditches	Repair of covers	1 times/year (20 days/time)	4 persons	Chain hoist, Plate tamper Precast covers, Asphalt emulsion Crusher-run	80preson*day/year	1,200
Catch basin and Pipes Pavement	ditto Sealing of cracks, potholes					
Embankment slopes	Embankment	1 times/year (20 days/time)	4 persons	Pick-up truck	20units*day/year	400
Bridges	Repair of river protections					
Culverts	ditto					
Road marking	Repainting				Materials	2,000
Sign boards	Repainting				Sub-total	3,600
					Grand total :	10,600

CHAPTER 4 PROJECT EVALUATION AND RECOMMENDATION

4.1 Project Effect

Population of Siem Reap Province is estimated at about 695,500 in 1998, of which about 119,500 live in the provincial town (Siem Reap City). The population within the influence area of the Project is estimated at about 177,000 (entire population of Siem Reap City plus 10% of the population in the other area of the province), which are considered as direct beneficiaries of the Project.

National Road Route 6, being the only primary road in the region on the north of Tonle Sap River/Tonle Sap Lake, is one of the most important roads in the country's road network. The Project section is of distinguished importance, connecting Siem Reap City, the focus of the region's economy and base town for tourism with Roluos, the historical town. However, existing road and bridges are seriously damaged, being one of the factors of checking the sound regional development.

The major direct effects of the Project are as follows:

Reduction of Travel Time

- Travel time will be significantly reduced by improvement of pavement and reconstruction of bridges.

Improvement of Riding Comfort and Traffic Safety

- Riding comfort and traffic safety will be improved by eliminating potholes and road surface deformation.
- Traffic safety will be improved as 2-wheel vehicles can be separated from other vehicles.

Increase of Transport Capacity and Reliability

- Highway capacity will be increased by providing the sufficient lane width and space for 2-wheel vehicles, resulting in the increase of transport capacity and reliability.

Savings in Transport Cost

- Vehicle operating cost will be reduced by improvement of running conditions (smoothed surface and increased highway capacity).
- Loss and damages of goods during transportation will be decreased.

Savings in Road Maintenance Cost

- Road maintenance cost will be reduced by provision of pavement with less possibility of local surface damage, improvement of road surface drainage condition, and construction of bridge with little maintenance requirement.

Decrease of Flood

- Flood in the urban section will be decreased by installation of road surface drainage system.

Promotion of Tourism Industry

- Improvement of accessibility to the cultural heritages in Roluos will contribute to increase of tourists and development of tourism industry.

Improvement of Inhabitants' Convenience

- Accessibility to public facilities such as school, hospital, etc. will be improved.
- Arrival of emergency vehicles such as ambulance, police patrol car, fire engine, etc. to the scene will be quickened.

Environmental Improvement

- Dust due to passage of vehicles will be reduced by paving the road surface including shoulder.
- Water pollution will be lessened by preventing the surface soil from washing out and muddy water from flowing out.

4.2 Recommendation

As well as the above direct effects will be expected, the Project will contribute to the enhancement of the quality of inhabitants' life, acceleration of industrial development and activation of socio-economic activities. It is therefore concluded to be appropriate to implement the Project under Japan's Grant Aid.

The system, personnel and budget of the Royal Government of Cambodia for implementation of the Project are considered to be well arranged and no problem is expected.

To realize and sustain the project effects at maximum, the Royal Government of Cambodia should do the following:

- To carry out routine inspection/maintenance and repair works as necessary to well maintain the road.
- To secure the budget for the above.
- To control overloaded vehicles as they cause damages of road and shorten the pavement performance period.
- To formulate the project for improvement of the western 95.5 km section of National Road Route 6, aiming at the early completion of improvement of the entire section of the road.

APPENDIX 1

MEMBER LIST OF THE STUDY TEAM

MEMBER LIST OF THE STUDY TEAM

1. Field Survey

Mr. Takahiro MORITA	Leader	Second Project Study Division, Grant Aid Project Study Department, JICA
Mr. Kunihiko SAWANO	Chief Consultant / Road Development Planner	Katahira & Engineers International
Mr. Mitsuo KIUCHI	Road Designer	Katahira & Engineers International
Mr. Eiji TAKEMORI	Natural Condition Surveyor	Katahira & Engineers International
Mr. Soemu OSHITA	Construction Planner/ Cost Estimator	Katahira & Engineers International
Mr. Nobutugu CHIDA	Bridge Planner/ Bridge Designer	Katahira & Engineers International

2. Explanation on Draft Report

Mr. Shinichi MASUDA	Leader	Assistant Resident Representative, Cambodia Office, JICA
Mr. Kunihiko SAWANO	Chief Consultant / Road Development Planner	Katahira & Engineers International
Mr. Soemu OSHITA	Construction Planner/ Cost Estimator	Katahira & Engineers International

APPENDIX 2

STUDY SCHEDULE

STUDY SCHEDULE

1. Field Survey (April 4 to May 19, 1999)

(1/3)

No.	Date		Activities
1	Apr. 4	Sun	• Tokyo to Bangkok (TG641)
2	Apr. 5	Mon	• Bangkok to Phnom Penh (TG696) • Courtesy call on JICA Cambodia Office and Embassy of Japan • Courtesy call and discussion with Ministry of Public Works and Transport (MPWT)
3	Apr. 6	Tue	• Discussion with Senior Minister of APSARA • Discussion with MPWT • Visit to Obayashi Corp. Office • Phnom Penh to Siem Reap (VJ370)
4	Apr. 7	Wed	• Discussion with Governor of Siem Reap Province • Discussion with Siem Reap Police Commissioner • Site survey (with Chief Service of Public Works and Transport Service of Siem Reap)
5	Apr. 8	Thu	• Discussion with Senior Minister and Siem Reap Representative of APSARA (Mr. Morita) • Site survey (Mr. Sawano, Mr. Kiuchi, Mr. Takemori, Mr. Oshita, Mr. Chida) • Siem Reap to Phnom Penh (VJ371) (Mr. Morita, Mr. Sawano, Mr. Kiuchi, Mr. Oshita)
6	Apr. 9	Fri	• Discussion on Draft Minutes of Discussions with MPWT (Mr. Morita, Mr. Sawano, Mr. Kiuchi) • Visit to Mekong River Commission (Mr. Sawano, Mr. Kiuchi) • Data collection (Mr. Oshita) • Site survey (Mr. Takemori, Mr. Chida)
7	Apr. 10	Sat	• Signing of Minutes of Discussions, visit to a quarry (Mr. Morita, Mr. Sawano, Mr. Kiuchi, Mr. Oshita) • Site survey (Mr. Takemori, Mr. Chida)
8	Apr. 11	Sun	• Data collection, Internal meeting among the study team members • Siem Reap to Phnom Penh (VJ361) (Mr. Chida)

No.	Date		Activities
9	Apr. 12	Mon	<ul style="list-style-type: none"> • Visit to CDC, RCC (Mr. Morita, Mr. Sawano, Mr. Kiuchi) • Data correction (Mr. Oshita) • Site survey (Mr. Takemori)
10	Apr. 13	Tue	<ul style="list-style-type: none"> • Report to Embassy of Japan and JICA Cambodia Office (Mr. Morita, Mr. Sawano, Mr. Kiuchi) • Phnom Penh to Bangkok (TG699) (Mr. Morita) • Discussion with MPWT, CDC, Mekong River commission (Mr. Sawano, Mr. Kiuchi) • Data correction (Mr. Oshita, Mr. Chida) • Site survey (Mr. Takemori)
11	Apr. 14	Wed	<ul style="list-style-type: none"> • Bangkok to Tokyo (TG640) (Mr. Morita) • Phnom Penh to Siem Reap (VJ390) (Mr. Sawano, Mr. Kiuchi, Mr. Oshita, Mr. Chida) • Site survey (Mr. Takemori)
12	Apr. 15	Thu	<ul style="list-style-type: none"> • Site survey
15	Apr. 18	Sun	
16	Apr. 19	Mon	<ul style="list-style-type: none"> • Visit to Siem Reap Provincial Government, Public Works and Transport Service of Siem Reap, Water Supply Authority, Telephone Company, APSARA (Mr. Sawano, Mr. Kiuchi) • Material and equipment procurement condition survey (Mr. Oshita, Mr. Chida) • Siem Reap to Phnom Penh (VJ361) (Mr. Sawano, Mr. Kiuchi, Mr. Oshita, Mr. Chida) • Site survey (Mr. Takemori)
17	Apr. 20	Tue	<ul style="list-style-type: none"> • Discussion with MPWT and data collection (Mr. Sawano, Mr. Kiuchi, Mr. Oshita, Mr. Chida) • Site survey (Mr. Takemori)
23	Apr. 26	Mon	
24	Apr. 27	Tue	<ul style="list-style-type: none"> • Discussion with MPWT and data collection (Mr. Sawano, Mr. Kiuchi, Mr. Chida) • Phnom Penh to Siem Reap (VJ320) (Mr. Oshita) • Site survey (Mr. Takemori)
25	Apr. 28	Wed	<ul style="list-style-type: none"> • Discussion with MPWT, data collection and report to JICA Cambodia Office (Mr. Sawano, Mr. Kiuchi, Mr. Chida) • Site survey (Mr. Takemori, Mr. Oshita)

No.	Date		Activities
26	Apr. 29	Thu	<ul style="list-style-type: none"> • Data collection (Mr. Sawano, Mr. Kiuchi, Mr. Chida) • Siem Reap to Phnom Penh (VJ371) (Mr. Oshita) • Site survey (Mr. Takemori)
27	Apr. 30	Fri	<ul style="list-style-type: none"> • Data collection (Mr. Sawano, Mr. Kiuchi, Mr. Oshita, Mr. Chida) • Site survey (Mr. Takemori)
28	May 1	Sat	<ul style="list-style-type: none"> • Phnom Penh to Bangkok (TG699) (Mr. Sawano, Mr. Kiuchi, Mr. Chida) • Data collection (Mr. Oshita) • Site survey (Mr. Takemori)
29	May 2	Sun	<ul style="list-style-type: none"> • Bangkok to Tokyo (JL708) (Mr. Sawano, Mr. Kiuchi, Mr. Chida) • Data collection (Mr. Oshita) • Site survey (Mr. Takemori)
30	May 3	Mon	<ul style="list-style-type: none"> • Phnom Penh to Bangkok (TG699) (Mr. Oshita) • Site survey (Mr. Takemori)
31	May 4	Tue	<ul style="list-style-type: none"> • Bangkok to Tokyo (TG772) (Mr. Oshita) • Site survey (Mr. Takemori)
32	May 5	Wed	<ul style="list-style-type: none"> • Site survey (Mr. Takemori)
35	May 8	Sat	
36	May 9	Sun	<ul style="list-style-type: none"> • Siem Reap to Phnom Penh (VJ345) (Mr. Takemori)
37	May 10	Mon	<ul style="list-style-type: none"> • Geotechnical survey (Mr. Takemori)
44	May 17	Mon	
45	May 18	Tue	<ul style="list-style-type: none"> • Phnom Penh to Bangkok (TG699) (Mr. Takemori)
46	May 19	Wed	<ul style="list-style-type: none"> • Bangkok to Tokyo (TG772) (Mr. Takemori)

2. Explanation on Draft Report (Aug. 1 to Aug. 11, 1999)

No.	Date		Activities
1	Aug. 1	Sun	• Tokyo to Bangkok (JL717/TG641) (Mr. Sawano, Mr. Oshita)
2	Aug. 2	Mon	• Bangkok to Phnom Penh (TG696) • Courtesy call on JICA Cambodia Office and Embassy of Japan • Courtesy call and discussion with MPWT
3	Aug. 3	Tue	• Discussion with Senior Minister of ASPARA • Visit to EDC • Visit to RCC • Phnom Penh to Siem Reap (VJ370) (Mr. Oshita)
4	Aug. 4	Wed	• Phnom Penh to Siem Reap(VJ320) (Mr. Masuda, Mr. Sawano) • Visit to Public Works and Transport Service of Siem Reap) • Site survey • Visit to APSARA
5	Aug. 5	Thu	• Visita to Public Works and Transport Service of Siem Reap) • Visit to CAMINTEL • Visit to JSA • Visit to APSARA • Siem Reap to Phnom Penh (VJ341)
6	Aug. 6	Fri	• Discussion on Draft Minutes of Discussions with MPWT
7	Aug. 7	Sat	• Data collection, Internal meeting among the study team members
8	Aug. 8	Sun	• Data collection, Internal meeting among the study team members
9	Aug. 9	Mon	• Signing of Minutes of Discussions • Discussion with MPWT • Visit to ADB • Visit to APSARA
10	Aug. 10	Tue	• Report to Embassy of Japan and JICA Cambodia Office • Visit to CDC • Phnom Penh to Bangkok (TG699) (Mr. Sawano, Mr. Oshita)
11	Aug. 11	Wed	• Bangkok to Tokyo (JL718) (Mr. Sawano, Mr. Oshita)

APPENDIX 3

LIST OF PARTIES CONCERNED IN THE KINGDOM OF CAMBODIA

LIST OF PARTIES CONCERNED IN THE KINGDOM OF CAMBODIA

Ministry of Public Works and Transport

H.E. KHY TAINGLIM	Minister
H.E. TRAM IV TEK	Secretary of State
Mr. TAN HAY SIEN	General Director of Public Works
Mr. TAUCH CHANKOSAL	Director of Heavy Equipment Center
Dr. YIT BUNNA	Director of Public Works Research Center
Mr. VA SIM SORYA	Director of Planning Department
Ms. ING CHHEANG LY	Director of Finance Department
Mr. KHUN SOKHA	Deputy Director of Public Work Research Center
Mr. IPPEI NAKAMURA	JICA Expert
Mr. KAZUO MURAKAMI	JICA Expert
Mr. TAKASHI WATANABE	JICA Expert
Mr. TETSUO HAGIWARA	JICA Expert

Governor of Siem Reap Province

HEMr. CHAP NHALYVOUD

Public Works & Transport Service of Siem Reap Province

Mr. SOK SUNLIN Chief Service

Authority for the Protection and Management of Angkor and the Region of Siem Reap

H.E. VANN MOLYVANN	Senior Minister
Mr. ANG CHOULEAN	Council of Ministers

Council for Development of Cambodia

Mr. CHHIENG YANARA	Deputy Secretary General
Ms. HENG SOKUN	Deputy Director, Bilateral Aid Coordination Dept.
Ms. MICHIKO UMEZAKI	JICA Expert

Ministry of Water Resources & Meteorology

Mr. TE NAVUTH	Deputy Director, Department of Hydrology
Ms. SETH VANNARETH	Deputy Director, Department of Meteorology
Mr. HIROSHI OKUDAIRA	JICA Expert

Ministry of Interior

Col. SORT NADY Siem Reap Police Commissioner

Asian Development Bank

Mr. NIDA OUK Project Implementation / Programs Officer

World Bank

Mr. ALAIN LABEAU Sr. Transportation Specialist

Groupe Agence Francaise de Developpement

Ms. GENEVIEVE JAVALOYES Directrice, Agence de Phnom Penh

United Nations Educational, Scientific and Cultural Organization

Mr. TERUO JINNAI Culture Programme Specialist

Mekong River Commission

Mr. YASUNOBU MATOBA Chief Executive Officer

Mr. SHOSHIRO HORIGOME Senior Project Officer (Hydropower)

Mr. TAKAO MASUMOTO Senior Project Officer (Hydrologist)

APPENDIX 4

MINUTES OF DISCUSSIONS

1. Field Survey

Minutes of Discussions
on
the Basic Design Study
on
the Project for the Improvement of National Highway Route 6
Siem Reap Section
in
the Kingdom of Cambodia

In response to the request from the Government of the Kingdom of Cambodia, the Government of Japan has decided to conduct a basic design study on the Project for the Improvement of National Highway Route 6 Siem Reap Section (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent to the Kingdom of Cambodia a basic design study team (hereinafter referred to as "the Team"), which is headed by Mr. Takahiro MORITA, Second Project Study Division, Grant Aid Project Study Department, JICA, and is scheduled to stay in the country from April 5 to April 13, 1999.

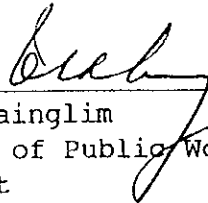
The Team held discussions with the concerned officials of the Government of the Kingdom of Cambodia, and conducted a field survey at the project site.

In the course of the discussions and field survey, both parties have confirmed the main items of the Project as described on the attached sheets. The Team will proceed to further works and prepare the Basic Design Study Report.

Phnom-Penh, April 10, 1999

森田隆博

Mr. Takahiro MORITA
Leader
Basic Design Study Team
JICA



Mr. Khy Tainglim
Minister of Public Works and
Transport

ATTACHMENT

1. OBJECTIVE

The objective of the Project is to improve National Highway Route 6 Siem Reap Section to cope with socio-economic demands of the country.

2. PROJECT SITE

The site of the Project is shown in Annex-1.

3. RESPONSIBLE ORGANIZATION AND IMPLEMENTING AGENCY

- (1) Responsible Organization : Ministry of Public Works and Transport (MPWT)
- (2) Implementing Agency : Heavy Equipment Center, MPWT

The organization chart is shown in Annex-2.

4. ITEMS REQUESTED BY THE GOVERNMENT OF THE KINGDOM OF CAMBODIA

After the series of discussions, the following were finally requested by the Government of the Kingdom of Cambodia.

Improvement of the deteriorated road condition on National Highway Route 6 Siem Reap Section including 5 bridges, from Roluos to Siem Reap (approximately 18km).

However, the final component of the Project and the inclusion of the rehabilitation of the bridges will be decided after further study.

5. JAPAN'S GRANT AID SYSTEM

The Government of the Kingdom of Cambodia has understood the system of Japan's Grant Aid explained by the Team as described in Annex-3.

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6. NECESSARY MEASURES TO BE TAKEN BY THE GOVERNMENT OF THE KINGDOM OF CAMBODIA

- (1) The Government of the Kingdom of Cambodia will take necessary measures described in Annex-4 for smooth implementation of the Project, on condition that Grant Aid assistance by the Government of Japan is extended to the Project.
- (2) Concerning the item 3 in Annex-4, the Government of the Kingdom of Cambodia will remove all UXOs and mines in accordance with the results of the UXO and mine search conducted by the authority concerning the UXO and mine. The search and removal work by the Government of the Kingdom of Cambodia will be completed prior to the commencement of the detail design of the Project.
- (3) Concerning the item 3 in Annex-4, the Government of the Kingdom of Cambodia will relocate all public utilities such as electric posts, telephone wire posts and water pipes prior to the commencement of the construction of the Project.
- (4) Concerning the item 3 in Annex-4, the Government of the Kingdom of Cambodia will implement the Resettlement Action Plan (RAP) to clear the sites prior to the commencement of the construction of the Project.

7. FURTHER SCHEDULE OF THE STUDY

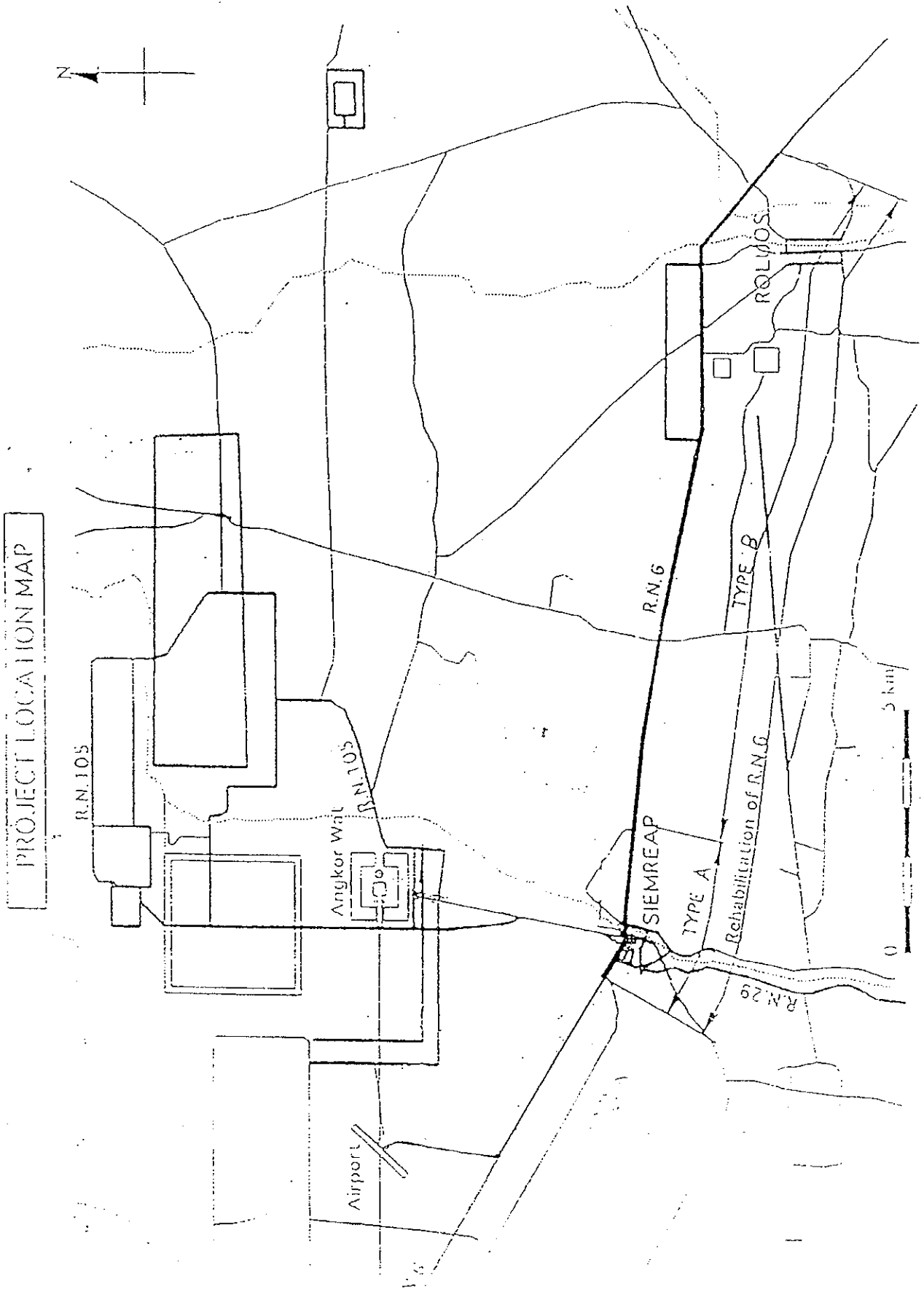
- (1) The Team will proceed to further studies in the Kingdom of Cambodia until May 3, 1999.
- (2) Based on the results of the Field Survey, JICA will prepare a draft Basic Design report and dispatch a team in July, 1999 in order to consult the Government of the Kingdom of Cambodia on the outline of the Draft Basic Design.

8. OTHER RELEVANT ISSUES

- (1) The Government of the Kingdom of Cambodia will take necessary measures to coordinate between the Government of Japan and the World Bank/the Asian Development Bank (ADB).
- (2) The Government of the Kingdom of Cambodia confirmed that restoring one historical bridge which is a part of the National Highway Route 6 in Roluos will be implemented under the World Bank Road Rehabilitation Project.

(3) The Government of the Kingdom of Cambodia agreed to take responsibility of the treatment of any artifacts discovered during the implementation of the Project in coordination with the Japanese side.

(4) The Government of the Kingdom of Cambodia will take all possible measures to secure the safety of the concerned people during the study and implementation of the Project.



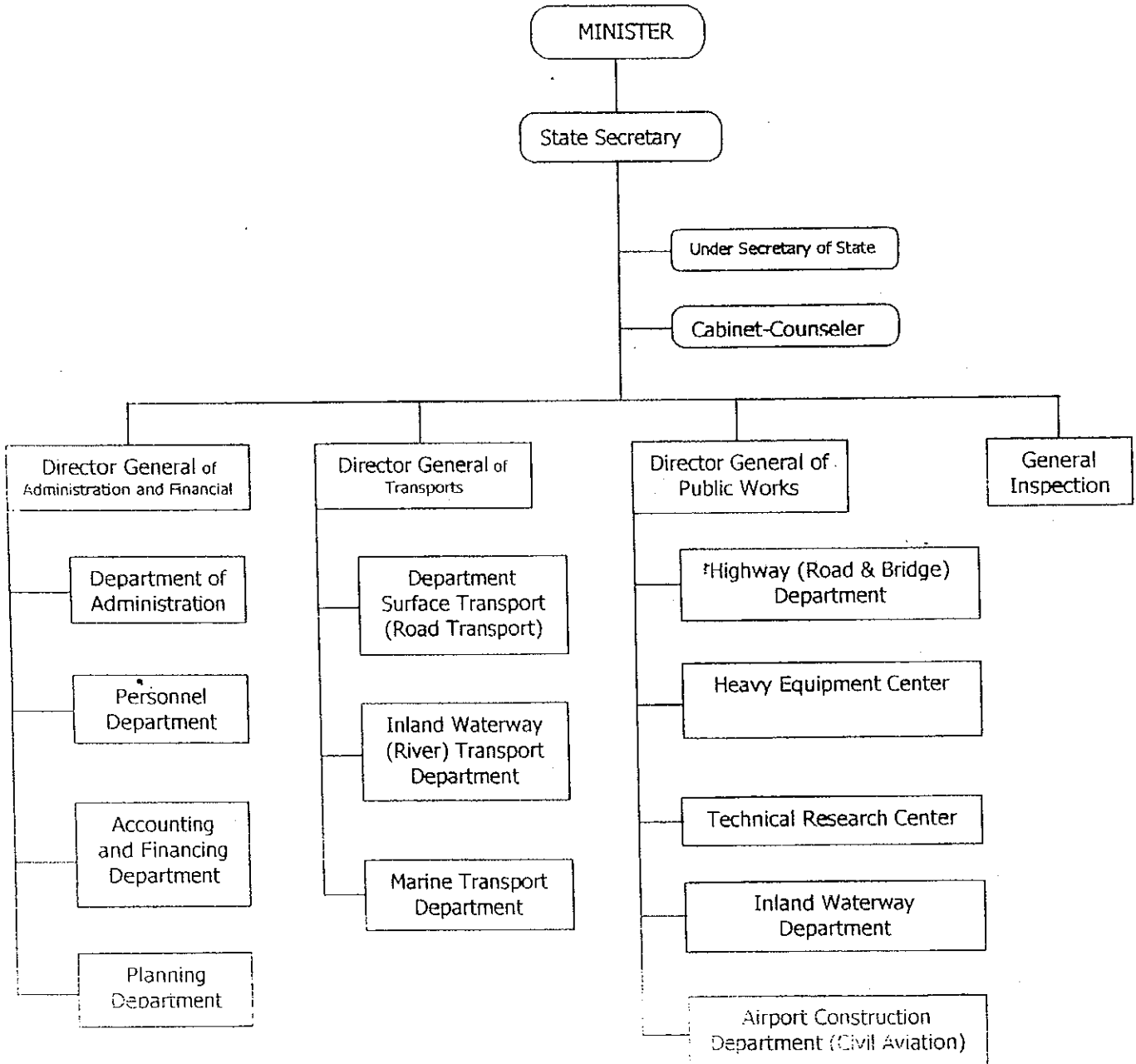
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KINGDOM OF CAMBODIA
NATION RELIGION KING

MINISTRY OF PUBLIC WORKS
AND TRANSPORT



JAPAN'S GRANT AID SCHEME

1. Grant Aid Procedures

1) Japan's Grant Aid Program is executed through the following procedures.

- Application (Request made by a recipient country)
- Study (Basic Design Study conducted by JICA)
- Appraisal & Approval (Appraisal by the Government of Japan and Approval by Cabinet)
- Determination of Implementation (The Notes exchanged between the Governments of Japan and the Implementation recipient country)

2) Firstly, the application or request for a Grant Aid project submitted by a recipient country is examined by the Government of Japan (the Ministry of Foreign Affairs) to determine whether or not it is eligible for Grant Aid. If the request is deemed appropriate, the Government of Japan assigns JICA (Japan International Cooperation Agency) to conduct a study on the request.

Secondly, JICA conducts the study (Basic Design Study), using (a) Japanese consulting firm(s).

Thirdly, the Government of Japan appraises the project to see whether or not it is suitable for Japan's Grant Aid Program, based on the Basic Design Study report prepared by JICA, and the results are then submitted to the Cabinet for approval.

Fourthly, the project, once approved by the Cabinet, becomes official with the Exchange of Notes signed by the Governments of Japan and the recipient country.

Finally, for the implementation of the project, JICA assists the recipient country in such matters as preparing tenders, contracts and so on.

2. Basic Design Study

1) Contents of the study

The aim of the Basic Design Study (hereafter referred to as "the Study"), conducted by JICA on a requested project (hereafter referred to as "the Project") is to provide a basic document necessary for the appraisal of the Project by the Government of Japan. The contents of the Study are as follows :

- a) Confirmation of the background, objectives, and benefits of the

Project and also institutional capacity of agencies concerned of the recipient country necessary for the Project's implementation.

- b) Evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from a technical, social and economic point of view.
- c) Confirmation of items agreed on by both parties concerning the basic concept of the Project.
- d) Preparation of a basic design of the Project.
- e) Estimation of costs of the Project.

The contents of the original request are not necessarily approved in their initial form as the contents of the Grant Aid project. The Basic Design of the Project is confirmed considering the guidelines of the Japan's Grant Aid Scheme.

The Government of Japan requests the Government of the recipient country to take whatever measures are necessary to ensure its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization in the recipient country actually implementing the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country through the Minutes of Discussions.

2) Selection of Consultants

For smooth implementation of the Study, JICA uses (a) registered consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms. The firm(s) selected carry(ies) out a Basic Design Study and write(s) a report, based upon terms of reference set by JICA. The consulting firm(s) used for the Study is(are) recommended by JICA to the recipient country to also work on the Project's implementation after the Exchange of Notes, in order to maintain technical consistency.

3. Japan's Grant Aid Scheme

1) What is Grant Aid?

The Grant Aid Program provides a recipient country with non-reimbursable funds to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for economic and social development of the country under principles in accordance with the relevant laws and regulations of Japan. Grant Aid is not supplied through the donation of materials as such.

2) Exchange of Notes (E/N)

Japan's Grant Aid is extended in accordance with the Notes

exchanged by the two Governments concerned, in which the objectives of the Project, period of execution, conditions and amount of the Grant Aid, etc., are confirmed.

- 3) "The period of the Grant Aid" means the one fiscal year which the Cabinet approves the Project for. Within the fiscal year, all procedures such as exchanging of the Notes, concluding contracts with (a) consulting firm(s) and (a) contractor(s) and final payment to them must be completed. However, in case of delays in delivery, installation or construction due to unforeseen factors such as weather, the period of the Grant Aid can be further extended for a maximum of one fiscal year at most by mutual agreement between the two Governments.
- 4) Under the Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased.

When the two Governments deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country.

However, the prime contractors, namely, consulting constructing and procurement firms, are limited to "Japanese nationals". (The term "Japanese nationals" means persons of Japanese nationality or Japanese corporations controlled by persons of Japanese nationality.)

5) Necessity of "Verification"

The Government of recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by the Government of Japan. This "Verification" is deemed necessary to secure accountability to Japanese taxpayers.

6) Undertakings required of the Government of the Recipient Country

In the implementation of the Grant Aid Project, the recipient country is required to undertake such necessary measures as the following:

- (1) To secure land necessary for the sites of the Project and to clear, level and reclaim the land prior to commencement of the construction.
- (2) To provide facilities for the distribution of electricity, water supply and drainage and other incidental facilities in and around the sites.
- (3) To secure buildings prior to the procurement in case the installation of the equipment.
- (4) To ensure all the expenses and prompt excursion for unloading, customs clearance at the port of disembarkation and internal transportation of the products purchased under the Grant Aid.

(5) To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the Verified Contracts.

(6) To accord Japanese nationals whose services may be required in connection with the supply of the products and services under the Verified contracts, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work.

7) "Proper Use"

The recipient country is required to maintain and use the facilities constructed and the equipment purchased under the Grant Aid properly and effectively and to assign staff necessary for this operation and maintenance as well as to bear all the expenses other than those covered by the Grant Aid.

8) "Re-export"

The products purchased under the Grant Aid should not be re-exported from the recipient country.

9) Banking Arrangements (B/A)

a) The Government of the recipient country or its designated authority should open an account in the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"). The Government of Japan will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.

b) The payments will be made when payment requests are presented by the Bank to the Government of Japan under an Authorization to Pay (A/P) issued by the Government of the recipient country or its designated authority.

NECESSARY MEASURES TO BE TAKEN BY THE GOVERNMENT OF THE KINGDOM
OF CAMBODIA

The following necessary measures should be taken by the Government of the Kingdom of Cambodia on condition that the Grant Aid by the Government of Japan is extended to the Project:

1. To provide data and information necessary for the Project.
2. To secure the land necessary for the execution of the Project, such as the Right of Way, land for bridges, temporary offices, working areas, storage yards and others.
3. To clear the sites prior to the commencement of the construction including removal of the UXO (Unexploded Ordnance) and the mines, if required.
4. To make passable all roads and bridges leading to the Project sites before the commencement of inland transportation of materials and equipment.
5. To bear commissions to the Japanese foreign exchange bank for its banking services based upon the Banking Arrangement, namely the advising commission of the "Authorization to Pay" and payment commission.
6. To ensure prompt unloading, tax exemption, customs clearance at the port of disembarkation in the Kingdom of Cambodia and prompt internal transportation of the materials and equipment for the Project purchased under the Grant Aid.
7. To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the Verified Contracts.
8. To accord Japanese Nationals whose services may be required in connection with the supply of products and the services under the verified contract such facilities as may be necessary for their entry into the Kingdom of Cambodia and stay therein for the performance of their work.

9. To provide necessary permissions, licenses and other authorizations for implementing the Project, if necessary.
10. To maintain and use properly and effectively the facilities constructed under the Project.
11. To coordinate and solve any issues related to the Project which may be raised from third parties or inhabitants in the Project area during implementation of the Project.

2. Explanatio on Draft Report

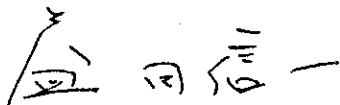
Minutes of Discussions
on
the Basic Design Study
on
the Project for the Improvement of National Highway Route 6
Siem Reap Section
in
the Kingdom of Cambodia
(Explanation on Draft Report)

In April 1999, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched a Basic Design Study team on the Project for the Improvement of National Highway Route 6 Siem Reap Section (hereinafter referred to as "the Project") , to the Kingdom of Cambodia, and through discussions and field survey in the Kingdom of Cambodia, and technical examination of the results in Japan, has prepared the Draft Report on the study.

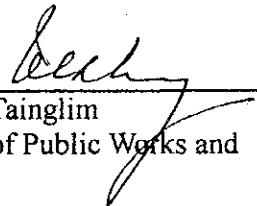
In order to explain and to consult the Royal Government of Cambodia on the components of the Draft Report, JICA sent to the Kingdom of Cambodia the Draft Report Explanation Team (hereinafter referred to as "the Team"), which is headed by Mr. Shinichi MASUDA, Assistant Resident Representative, JICA Cambodia Office from August 2 to 10, 1999.

As a result of discussions, both parties confirmed the main items described on the attached sheets.

Phnom Penh, August 9, 1999



Mr. Shinichi MASUDA
Leader
Draft Report Explanation Team
Japan International Cooperation Agency



Mr. Khy Tainglim
Minister of Public Works and
Transport

ATTACHMENT

1. COMPONENTS OF THE DRAFT REPORT

The Royal Government of Cambodia agreed and accepted in principle the components of the Draft Report explained by the Team.

2. PROJECT SITE

The site of the Project is shown in Annex-1.

Beginning point : KM 298+125

End point : KM 315+625

3. JAPAN'S GRANT AID SYSTEM

The Kingdom of Cambodia side understands the Japan's Grant Aid Scheme and the necessary measures to be taken by the Royal Government of Cambodia as explained by the Team and described in Annex-3 and Annex-4 of the Minutes of Discussions signed by both parties on April 10, 1999.

4. FURTHER SCHEDULE OF THE STUDY

Based on the results of discussions of the Draft Report, JICA will complete the final report and send it to the Royal Government of Cambodia by the end of October, 1999.

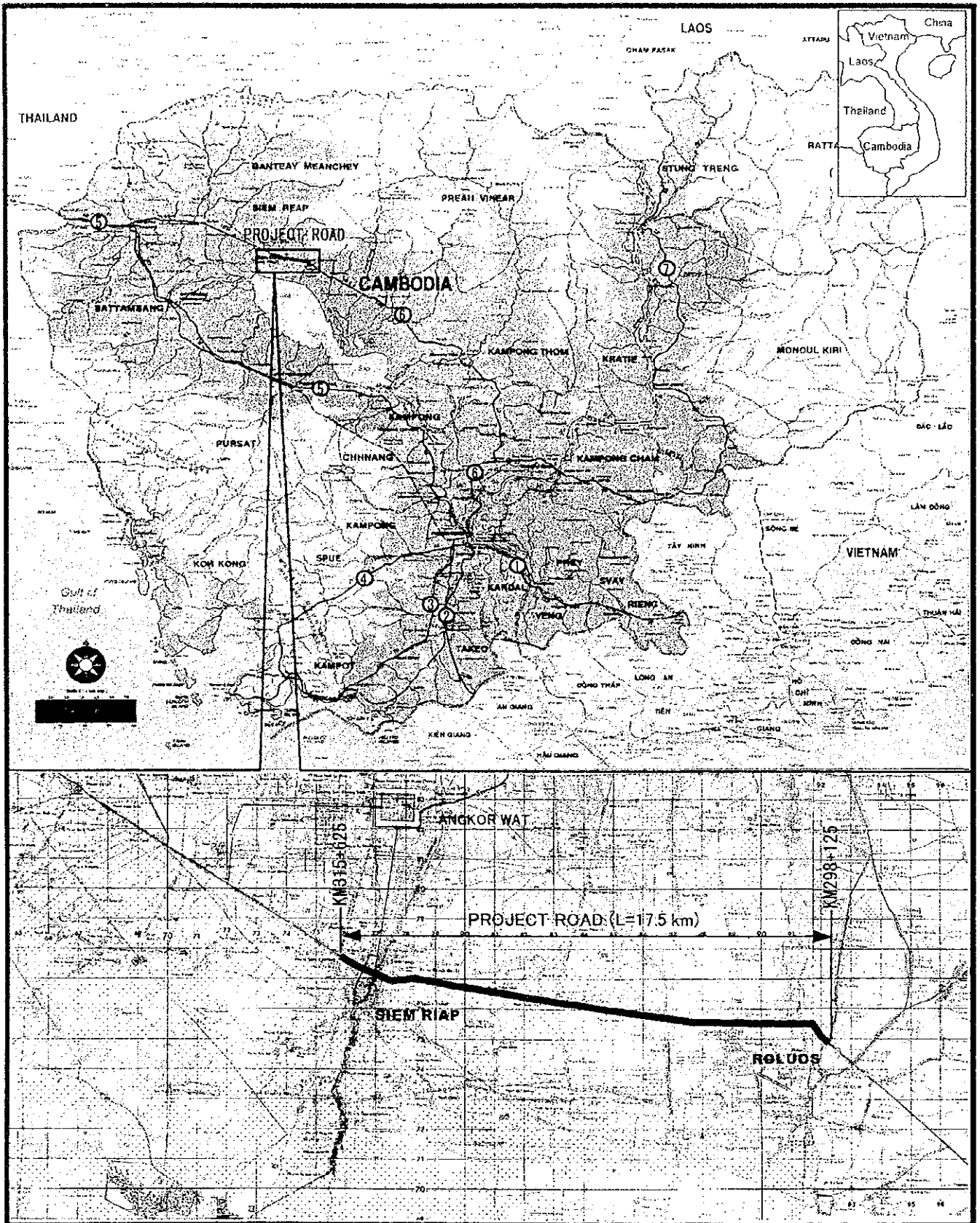
5. OTHER RELEVANT ISSUES

- (1) The Royal Government of Cambodia will take all possible measures to secure the safety of the concerned people during the implementation of the Project.
- (2) The Royal Government of Cambodia will remove all UXOs and mines in accordance with the results of the UXO and mine search to be conducted for the area shown in Annex-2. The search and removal work by the Royal Government of Cambodia will be completed prior to the commencement of the detailed design and construction of the Project, respectively.
- (3) The Royal Government of Cambodia confirmed that rehabilitation of the section from KM297+275 to KM298+125 of the National Highway Route 6 in Roluos including the ancient bridge will be implemented under the World Bank Road Rehabilitation Project.
- (4) The Ministry of Public Works and Transport will take necessary measures to coordinate between the Government of Japan and the World Bank/the Asian Development Bank (ADB).
- (5) The Royal Government of Cambodia will relocate all public utilities, which could hinder during the implementation of the Project, such as electric posts, telephone

wire posts and water pipes prior to the commencement of the construction of the Project.

- (6) The Royal Government of Cambodia will rehabilitate the irrigation canal along the Project Road in the west of Phsar gne Street.
- (7) The Ministry of Public Works and Transport will implement the Resettlement Action Plan (RAP) to clear the sites prior to the commencement of the construction of the Project.
- (8) The Ministry of Public Works and Transport will conduct necessary survey and establish a protocol to protect cultural heritages in the Project site. In case that any artifacts are discovered during the implementation of the Project, the Ministry of Public Works and Transport will take responsibility of the treatment thereof under the guidance of APSARA.
- (9) The Ministry of Public Works and Transport will take necessary measures to utilize equipment of RCC and to exercise OJT during the implementation of the Project.

hat 7/2

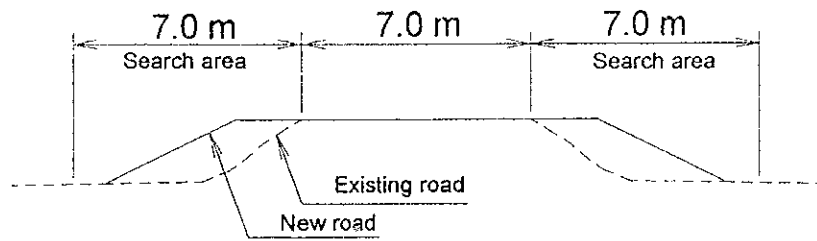


PROJECT SITE

lat
pr

Area for UXO and Mine Search

1. Roadway



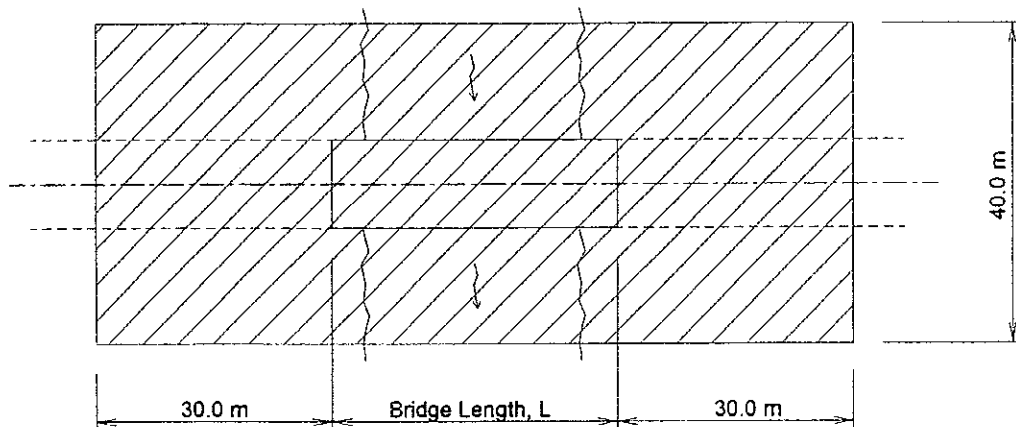
ROAD CROSS SECTION

Area for Search

Section : KM298+125 to KM311+675 (Length = 13,550-bridge section length
= 13,550 - 278 = 13,272 m)

Area : $13,272 \times 7.0 \times 2 = 185,808 \text{ m}^2$

2. Bridge



PLAN OF A BRIDGE SITE

Bridge	L (m)	Area (m ²)
Stung	36.0	$(60.0+36.0) \times 40.0 = 3,840 \text{ m}^2$
Lo Lum	36.0	$(60.0+36.0) \times 40.0 = 3,840 \text{ m}^2$
Kaek	26.0	$(60.0+26.0) \times 40.0 = 3,440 \text{ m}^2$
		Total 11,120 m ²

3. Total Area

$185,808 + 11,120 = 196,928 \text{ m}^2$

Signature

APPENDIX 5

COST ESTIMATION BORNE BY THE KINGDOM OF CAMBODIA

COST ESTIMATION BORNE BY THE KINGDOM OF COMBODIA

1. Investigation of mines and UXO

Investigation area : 18.6ha
Unit price : US\$ 8,000/ha
Amount : US\$148,800

2. Acquisition of lots for site office, storage yards, plants and workshops

Lot area : 10,000m²
Unit price : US\$0.5 (for 17 months)
Amount : US\$5,000

3. Removal of power poles

No of poles to be relocated: 87 each
Unit price : US\$ 30
Amount : US\$2,600

4. Relocation of telephone lines and removal of telephone poles

No of poles to be removed and their lines are to be relocated : 75 each
Unit price : US\$ 40.
Amount : US\$3,000

4. Total Amount : US\$ 159,400

APPENDIX 6

TRAFFIC VOLUME DATA

TRAFFIC VOLUME DATA

1. Survey Station : (Roluos)

12-hour Traffic Volume (6:00~18:00)

Date	Direction (To)	Car/Van	Pick-up	Bus	Truck (2-Axl)	Truck (3-Axl)	Semi-Trailer	Trailer	Bi-cycle	Motor-cycle	Total
Apr.21 (Wed)	Phnom Penh	178	24	2	5	1	13	0	923	944	2,090
	Sisophone	40	114	7	36	9	0	5	819	814	1,844
	Total	218	138	9	41	10	13	5	1,742	1,758	3,934
Apr.22 (Thr)	Phnom Penh	194	19	1	23	8	14	0	2,185	2,020	4,464
	Sisophone	129	30	2	39	11	0	1	1,467	1,425	3,104
	Total	323	49	3	62	19	14	1	3,652	3,445	7,568
Apr.23 (Fri)	Phnom Penh	174	16	0	18	11	4	0	2,265	2,260	4,748
	Sisophone	134	15	0	27	20	0	7	1,805	1,640	3,648
	Total	308	31	0	45	31	4	7	4,070	3,900	8,396
Apr.24 (Sat)	Phnom Penh	209	9	5	17	13	15	0	2,610	2,485	5,363
	Sisophone	126	12	0	28	13	0	1	1,655	1,520	3,355
	Total	335	21	5	45	26	15	1	4,265	4,005	8,718
Apr.25 (Sun)	Phnom Penh	193	6	4	9	18	6	0	2,455	2,680	5,371
	Sisophone	126	18	0	14	8	10	0	2,045	1,550	3,771
	Total	319	24	4	23	26	16	0	4,500	4,230	9,142
Apr.26 (Mon)	Phnom Penh	114	19	3	18	8	4	8	1,790	1,925	3,889
	Sisophone	173	10	4	17	14	6	0	2,480	2,575	5,279
	Total	287	29	7	35	22	10	8	4,270	4,500	9,168
Apr.27 (Tue)	Phnom Penh	178	13	0	16	25	0	0	2,540	2,495	5,267
	Sisophone	126	11	1	28	9	2	0	1,655	1,530	3,362
	Total	304	24	1	44	34	2	0	4,195	4,025	8,629
Average	Phnom Penh	177	15	2	15	12	8	1	2,110	2,116	4,456
	Sisophone	122	30	2	27	12	3	2	1,704	1,579	3,481
	Total	299	45	4	42	24	11	3	3,814	3,695	7,937

2. Survey Station : (Siem Reap)

12-hour Traffic Volume (6:00~18:00)

Date	Direction (To)	Car/ Van	Pick-up	Bus	Truck (2-Axl)	Truck (3-Axl)	Semi-Trailer	Trailer	Bi-cycle	Motor-cycle	Total
Apr. 21 (Wed)	Phnom Penh	435	420	39	109	30	46	0	2,200	8,435	11,714
	Sisophone	447	463	14	122	6	63	4	2,135	10,725	13,979
	Total	882	883	53	231	36	109	4	4,335	19,160	25,693
Apr. 22 (Thr)	Phnom Penh	391	399	22	179	63	23	9	2,135	7,995	11,216
	Sisophone	461	498	9	190	2	114	10	2,020	10,085	13,389
	Total	852	897	31	369	65	137	19	4,155	18,080	24,605
Apr. 23 (Fri)	Phnom Penh	381	359	11	183	97	1	2	2,175	8,763	11,972
	Sisophone	393	422	4	186	5	115	3	2,075	11,140	14,343
	Total	774	781	15	369	102	116	5	4,250	19,903	26,315
Apr. 24 (Sat)	Phnom Penh	390	382	3	161	79	8	0	2,485	9,480	12,988
	Sisophone	489	492	6	257	19	112	1	2,150	10,570	14,096
	Total	879	874	9	418	98	120	1	4,635	20,050	27,084
Apr. 25 (Sun)	Phnom Penh	362	334	16	209	89	2	6	4,140	11,140	16,298
	Sisophone	447	437	8	259	5	95	13	2,440	11,750	15,454
	Total	809	771	24	468	94	97	19	6,580	22,890	31,752
Apr. 26 (Mon)	Phnom Penh	416	373	9	175	89	0	7	2,699	21,532	25,300
	Sisophone	430	437	10	214	0	122	16	2,670	11,495	15,394
	Total	846	810	19	389	89	122	23	5,369	33,027	40,694
Apr. 27 (Tue)	Phnom Penh	387	367	14	195	54	0	4	2,487	9,078	12,586
	Sisophone	471	449	15	213	13	112	11	2,140	11,640	15,064
	Total	858	816	29	408	67	112	15	4,627	20,718	27,650
Average	Phnom Penh	395	376	16	173	72	11	4	2,617	10,917	14,581
	Sisophone	448	457	10	206	7	105	8	2,233	11,058	14,532
	Total	843	833	26	379	79	116	12	4,850	21,975	29,113

3. Survey Station : (Approx. 400m away from Phsar gne st. to the airport)

12-hour Traffic Volume (6:00~18:00)

Date	Direction (To)	Car/ Van	Pick-up	Bus	Truck (2-Axl)	Truck (3-Axl)	Semi-Trailer	Trailer	Bi-cycle	Motor-cycle	Total
July 12 (Mon)	Phnom Penh	442	210	74	18	89	11	1	1,022	1,236	3,103
	Sisophone	243	287	97	20	31	6	6	842	1,191	2,723
	Total	685	497	171	38	120	17	7	1,864	2,427	5,826
July 13 (Tue)	Phnom Penh	486	176	47	29	72	6	2	952	1,506	3,276
	Sisophone	317	314	126	34	27	11	2	1,392	1,138	3,361
	Total	803	490	173	63	99	17	4	2,344	2,644	6,637
Average	Phnom Penh	464	193	60	24	80	9	2	987	1,371	3,190
	Sisophone	280	301	112	27	29	8	4	1,117	2,329	3,042
	Total	744	494	172	51	109	17	6	2,104	2,535	6,232

APPENDIX 7

CBR TEST RESULTS

CBR TEST RESULTS

Sample No.	Location	Soil Description	Natural Moisture Content (%)	CBR (%)	In-situ CBR (%)
1	296+800	Brown sandy clay	5.2	11.7	25
2	297+670	- "-	4.1	6.8	12
3	298+590	Yellowish brown sandy clay	8.8	6.3	17
4	299+420	Brown fine sand	4.0	7.5	26
5	300+200	- "-	4.6	13.1	20
6	301+010	- "-	3.2	7.6	21
7	301+770	Brown sandy silt	4.1	13.9	24
8	302+630	- "-	4.8	7.9	12
9	297+450	Dark gray silty clay	9.5	6.0	23
10	304+310	Yellowish-gray sandy clay	9.4	6.1	18
11	305+190	Gray fine sand with clay	5.2	10.0	23
12	306+040	Brown fine sand	7.3	13.1	16
13	306+040	- "-	5.8	7.0	10
14	307+770	Brown sandy clay	10.0	6.2	9
15	308+600	Brown fine sand	8.2	8.1	8
16	309+440	- "-	4.6	7.4	27
17	310+290	- "-	3.1	8.3	29
18	311+140	Yellowish gray sandy clay	8.3	8.2	26
19	311+970	Light brown fine sand with clay	6.1	13.4	25
20	312+790	Reddish brown fine sand	7.9	11.5	31
21	313+610	Gray sandy clay with stone	8.5	8.3	28
22	314+210	Orange fine sand	3.6	8.6	22
23	314+790	Reddish brown sandy clay	9.9	8.1	24

APPENDIX 8

RAINFALL IN SIEM REAP

RAINFALL IN SIEM REAP

Hydrological Data

Monthly Rainfall in Siem Reap (1981 - 1998)

Latitude : 103° - 51'

Longitude : 13° - 22'

Altitude : 15m

mm

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1981	50.0	24.0	176.0	81.1	237.0	169.2	180.3	130.6	185.0	129.7	179.0	19.0	1,560.9
1982	0.0	0.0	42.8	48.8	74.9	208.7	192	217	224.1	175.2	42.0	0.0	1,225.4
1983	0.0	0.0	17.0	0.0	228.8	210.0	87.0	251.0	324.0	367.0	101.0	0.0	1,585.8
1984	0.0	0.0	5.0	36.0	170.0	144.0	124.0	182.0	115.0	302.0	4.0	0.0	1,082.0
1985	0.0	0.0	129.0	75.0	294.0	226.0	130.0	109.0	112.0	113.0	40.0	0.0	1,228.0
1986	0.0	0.0	0.0	93.0	240.0	146.0	133.3	460.5	279.1	376.2	13.8	31.0	1,772.9
1987	0.0	0.0	17.5	60.0	138.2	169.2	129.8	138.0	313.9	176.0	104.5	0.0	1,247.1
1988	0.0	0.0	0.9	73.8	135.7	268.3	100.0	243.6	286.9	190.5	28.5	0.0	1,328.2
Rain Days	0	1	2	13	24	22	20	25	21	22	8	1	159
1989	0.5	0.0	50.7	44.2	204.3	169.6	236.8	255.0	283.4	236.6	81.6	0.0	1,562.7
Rain Days	1	0	8	7	18	18	23	22	25	20	10	0	152
1990	15.0	0.0	28.3	117.9	112.7	329.6	64.8	94.0	304.8	187.2	47.9	0.0	1,302.2
Rain Days	2	1	9	9	18	26	18	19	24	23	9	2	160
1991	0.0	0.1	50.0	71.0	49.3	249.3	240.1	306.1	426.9	250.6	0.0	0.0	1,643.4
Rain Days	0	1	2	5	17	22	21	27	25	25	5	1	151
1992	63.7	0.0	0.0	4.0	56.0	159.3	197.8	354.4	120.1	174.7	9.7	18.1	1,157.8
Rain Days	4	2	0	3	16	24	19	29	20	20	6	6	149
1993	3.7	0.0	17.2	30.5	43.7	340.2	172.9	199.6	280.4	408.9	12.2	15.1	1,524.4
Rain Days	3	0	10	4	12	19	17	26	19	23	6	3	142
1994	0.0	0.6	66.3	8.7	102.3	237.9	179.8	257.9	282.7	34.8	8.3	0.5	1,179.8
Rain Days	0	2	9	4	17	22	23	21	17	10	4	1	130
1995	0.0	0.0	22.0	28.5	178.2	221.6	240.7	230.0	512.1	301.9	13.3	18.1	1,766.4
Rain Days	0	0	3	6	15	15	18	13	26	15	4	3	118
1996	0.0	7.4	0.1	67.7	186.1	285.7	104.1	156.5	264.3	235.8	149.5	5.4	1,462.6
Rain Days	0	1	1	6	21	23	17	14	26	19	14	3	145
1997	0.0	20.7	10.5	132.4	149.4	147.4	384.7	193.2	355.2	135.2	21.8	0.8	1,551.3
Rain Days	0	6	5	10	14	17	24	18	18	21	8	1	142
1998	0.0	1.3	0.0	18.2	92.3	145.1	180.8	259.0	298.8	106.5	209.7	16.1	1,327.8
Rain Days	0	2	0	6	13	24	19	21	26	17	13	4	145

1981 - 1998

Average of Rainfall :

1,417mm

Monthly Rainfall in Kompong Cham (1989 - 1998)

Latitude : 105° - 27'

(-) No rain

Longitude : 12° - 00'

(*) No information

Altitude : 14m

mm

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1989	5.8	0.5	118.4	75.2	211.0	170.2	279.1	318.7	209.4	342.0	83.4	0.0	1,813.7
1990	*	*	*	*	*	*	*	*	76.9	203.1	73.6	0.4	354.0
1991	-	-	-	61.1	196.1	110.8	288.6	204.5	164.4	188.5	0.0	4.0	1,218.0
1992	26.0	0.0	0.0	14.9	103.7	283.8	190.7	268.8	339.7	218.4	48.0	13.9	1,507.9
1993	30.0	0.0	80.8	19.1	213.0	165.5	317.2	103.0	243.3	334.8	47.3	10.3	1,564.3
1994	0.0	0.0	81.3	166.6	178.7	423.1	118.1	102.3	288.5	147.9	0.0	32.2	1,538.7
1995	-	-	114.6	14.3	241.7	181.4	181.1	115.1	458.5	288.9	38.9	1.5	1,636.0
1996	62.6	8.5	1.8	45.7	328.7	228.5	151.4	202.1	421.0	481.0	112.1	8.8	2,052.2
1997	-	27.4	3.0	194.8	152.3	132.1	195.1	117.7	145.8	264.3	23.2	-	1,255.7
1998	-	-	0.0	33.6	192.0	187.3	57.6	239.1	391.2	114.8	157.7	35.4	1,408.7

Average of Rainfall : 1,434.9

Monthly Rainfall in Kandal (1989 - 1998)

Latitude :

(-) No rain

Longitude :

(*) No information

Altitude :

mm

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1989	29.2	-	152.5	19.2	143.4	37.2	167.9	156.6	425.4	333.3	118.0	-	1,582.7
1990	-	-	-	31.0	41.0	103.3	178.4	228.2	244.2	166.5	39.8	-	1,032.4
1991	-	-	-	43.5	82.2	172.8	129.9	184.2	204.2	158.2	3.0	-	978.0
1992	-	-	-	-	200.8	107.9	199.2	114.7	146.2	72.3	-	-	841.1
1993	6.4	-	127.3	109.5	94.7	200.2	191.0	105.8	134.6	370.2	95.8	-	1,435.5
1994	-	-	154.2	0.9	140.2	54.8	178.2	220.7	559.3	210.2	-	-	1,518.5
1995	-	-	29.5	30.4	115.7	293.5	115.4	116.7	193.8	481.4	4.7	0.0	1,381.1
1996	-	-	0.0	109.3	280.2	122.0	108.7	174.2	208.5	260.0	202.9	1.8	1,467.6
1997	0.0	1.2	0.0	32.0	137.9	86.1	190.4	179.7	110.7	430.7	26.6	-	1,195.3
1998	-	-	-	76.5	68.0	141.1	144.2	171.7	206.1	159.0	217.9	19.8	1,204.3

Average of Rainfall : 1,263.7

Monthly Rainfall in Pochentong Phnom Penh Air Port (1989 - 1998)

Latitude : 104° - 50'

(-) No rain

Longitude : 11° - 33'

(*) No information

Altitude : 10m

mm

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1989	15.0	-	54.0	63.2	183.5	38.4	86.6	162.4	398.7	328.6	107.3	-	1,437.7
1990	-	-	-	26.2	227.1	63.8	166.8	174.6	246.6	98.3	138.7	-	1,142.1
1991	-	-	-	83.4	53.4	304.5	284.3	193.7	120.2	210.2	2.2	1.7	1,253.6
1992	3.1	2.5	0.6	35.0	93.4	113.9	219.5	198.4	216.5	197.2	10.9	3.8	1,094.8
1993	-	-	-	-	47.5	55.1	170.1	312.2	174.1	203.1	155.4	3.2	1,120.7
1994	0.4	-	164.2	61.1	157.7	106.1	96.5	154.3	332.9	126.9	5.6	17.9	1,223.6
1995	-	-	18.0	94.3	234.6	146.8	156.4	208.9	277.1	243.6	22.4	11.2	1,413.3
1996	14.6	-	5.2	112.2	173.0	146.2	99.8	150.3	343.3	213.3	345.8	14.3	1,618.0
1997	-	26.1	7.4	20.0	107.6	135.0	213.4	119.8	337.6	337.5	89.8	6.0	1,400.2
1998	-	-	-	74.2	25.2	225.9	217.2	180.0	247.6	219.4	269.7	25.1	1,484.3

Average of Rainfall : 1,318.8

Siem Riap Daly Rainfall in 1998

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	0	0	0	0	0	0.3	8.4	5.8	18.0	0	3.0	0	35.5
2	0	0	0	0	0	7.2	14.8	0	2.2	0	40.3	13.4	77.9
3	0	0	0	0	0	7.6	2.2	0	0.1	0	0	0	9.9
4	0	0	0	0	0.5	0	26.5	47.2	12.2	0	0	0.1	86.5
5	0	0	0	0	0	2.0	4.0	1.8	0.2	0	0	0	8.0
6	0	0	0	0	0	7.0	2.6	4.4	0	2.8	0	0	16.8
7	0	0	0	0	0	1.9	1.8	100.6	13.3	19.0	0	0	136.6
8	0	0	0	0	0	7.1	4.0	2.8	0	24.7	0.0	0	38.6
9	0	0	0	0	0	24.4	33.7	5.3	0	1.8	12.0	0	77.2
10	0	0	0	0	0	2.7	0.1	18.3	2.8	0.1	0	0	24.0
11	0	1.3	0	0	2.0	0	33.8	0.2	44.6	7.2	0	0	89.1
12	0	0	0	0	12.8	0.5	3.6	7.2	0	6.5	0	0	30.6
13	0	0	0	0	0	5.0	3.4	9.3	18.2	0.1	0	0	36.0
14	0	0	0	0	0	0	0	0	3.6	7.6	0.7	0	11.9
15	0	0	0	0	6.4	7.4	0	0	28.4	12.8	37.2	0	92.2
16	0	0	0	0	0	8.2	0	1.2	2.2	0	0.3	0	11.9
17	0	0	0	6.6	0.6	1.2	0	27.6	2.0	14.0	0	0	52.0
18	0	0	0	0	0	0.2	0	1.2	14.6	0.1	0	0	16.1
19	0	0	0	1.4	0	0	0	0.5	12.4	9.0	0	0	23.3
20	0	0	0	10.2	0	15.0	0	4.3	0.2	0	75.0	0	104.7
21	0	0	0	0	6.2	0.8	0	5.6	9.6	0.3	11.9	0	34.4
22	0	0	0	0	0	0	0	3.8	0.2	0	12.6	0	16.6
23	0	0	0	0	0.3	0	13.8	0	4.6	0	0.4	2.6	21.7
24	0	0	0	0	26.5	0	0	0	20.4	0.1	0	0	47.0
25	0	0	0	0	12.4	12.2	5.0	0	11.0	0	0	0	40.6
26	0	0	0	0	2.0	8.0	0	0	44.6	0	15.8	0	70.4
27	0	0	0	0	0	6.2	0	2.4	3.2	0	0.3	0	12.1
28	0	0	0	0	0	0.8	8.4	9.0	5.4	0.3	0	0	23.9
29	0	0	0	0	5.0	0.6	1.1	0.5	15.0	0.1	0.1	0	22.4
30	0	0	0	0	2.2	18.8	8.4	0	9.8	0	0	0	39.2
31	0	0	0	0	15.4	0	5.2	0	0	0	0	0	20.6
Total	0	1.3	0	18.2	92.3	145.1	180.8	259	298.8	106.5	209.6	16.1	1,327.7

Siem Riap Daly Rainfall in 1997

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	0	0	0	15.5	0	14.5	0	35.8	0.1	0.1	0	0	66.0
2	0	0	5.4	0	5.0	17.0	0	75.5	2.0	0	0	0	104.9
3	0	0.3	0	0	0	16.0	0	0	0	27.0	1.4	0	44.7
4	0	0.4	0	2.8	0	18.3	7.0	0.4	0	24.0	0	0	52.9
5	0	0	0	0	0.6	0	0	2.0	0.6	0.5	0	0	3.7
6	0	0	0	0	0	0.4	0	8.2	0	0	0	0	8.6
7	0	0	0	0	0	0	1.2	0	0	1.9	0	0.8	3.9
8	0	0	0	3.8	0	0.8	0.3	0.9	0	2.8	0	0	8.6
9	0	0	0	0	5.0	2.4	0	0	0	6.0	0	0	13.4
10	0	0	0	20.0	0	0.8	127.0	0	0	2.4	0	0	150.2
11	0	0.4	0	0	0	0	3.4	0	0.3	1.0	0.3	0	5.4
12	0	15.0	0	0	0	0	40.8	0	0	0.1	0.2	0	56.1
13	0	0	0	0	0	0	0.7	0	0	0	0	0	0.7
14	0	0	0	0.2	3.4	0	6	0	0	2.2	13.2	0	25.0
15	0	0	0	0	0	0	0	3.7	55.2	10.0	0	0	68.9
16	0	0	0	0	9.4	0	1.2	5.1	1.2	38.2	0	0	55.1
17	0	4.6	0	0	0.6	0	0.6	0	9.2	0.2	6.0	0	21.2
18	0	0	0	0	0	0	0.2	0	3.2	1.0	0.5	0	4.9
19	0	0	0	0	0	0	35.2	0	6.8	0.2	0	0	42.2
20	0	0	0	0	0	3.2	12.2	0	63.8	0.2	0	0	79.4
21	0	0	0	0.9	7.0	21.0	22.8	0.4	6.8	2.4	0	0	61.3
22	0	0	0	6.0	17.2	4.5	25.1	15.2	7.7	0	0	0	75.7
23	0	0	0	0	25.3	0	9.0	2.0	3.0	0	0	0	39.3
24	0	0	0	0	0	5.4	3.8	1.6	0	2.6	0	0	13.4
25	0	0	0	83.2	57.4	1.8	1.8	0.8	29.0	0	0	0	173.8
26	0	0	0	0	0	26.5	11.2	0.4	160.4	0	0	0	198.5
27	0	0	0.4	0	0	7.2	4.0	0	5.0	0	0	0	16.6
28	0	0	0	0	0	7.2	50.0	6.2	0.9	12.4	0.2	0	76.9
29	0	0	3.2	0	0	0	12.4	12.0	0	0	0	0	27.6
30	0	0	0.6	0	6.0	0.6	4.0	23.0	0	0	0	0	34.2
31	0	0	0.9	0	12.6	0	4.8	0	0	0	0	0	18.3
Total	0	20.7	10.5	132.4	149.5	147.4	384.7	193.2	355.2	135.2	21.8	0.8	1,551.4

Siem Riap Daly Rainfall in 1996

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	0	0	0	0	6.5	1.2	0	6.8	6.0	24.8	2.3	2.0	49.6
2	0	0	0	0	0	4.8	0	1.0	12.4	1.0	35.0	2.0	56.2
3	0	0	0	0	2.6	0	0	0	14.6	0.4	10.6	0	28.2
4	0	0	0	0	3.7	0	0	1.2	45.2	11.1	1.2	1.4	63.8
5	0	0	0	34.6	0	10.8	0	26.0	8.2	0	2.4	0	82
6	0	0	0	0	1.2	26.4	0	13.4	17.2	31.8	27.6	0	117.6
7	0	0	0	0.6	0	2.7	0	0	0.1	0	0.2	0	3.6
8	0	0	0	0	4.6	5.2	0	1.6	6.2	0	0	0	17.6
9	0	0	0	0	25.1	25.6	0	0	0	14.2	8.2	0	73.1
10	0	0	0	0	0	4.4	0	0	0	0	0	0	4.4
11	0	0	0.1	0	0	0	7.2	0	0	0	0	0	7.3
12	0	0	0	0	33.6	2.4	1.2	0	0.6	18.2	0	0	56
13	0	0	0	0	5	43.8	0	1.6	1.6	4.1	10.4	0	66.5
14	0	0	0	17.9	0.4	6.6	0	0	0.6	0	13.8	0	39.3
15	0	0	0	0	0	36.2	5.0	0	0.3	0	0	0	41.5
16	0	0	0	0	0	32.0	0.6	0	5.2	14.0	0	0	51.8
17	0	0	0	0	3.8	0	0	16.2	0.2	0.1	7.0	0	27.3
18	0	5.4	0	0	2.3	8.0	8.2	0	1.4	14.1	0	0	39.4
19	0	2.0	0	0	17.2	0	6	0	2.0	1.4	0	0	28.6
20	0	0	0	1.0	54.1	6.2	14.6	0	0	0	0	0	75.9
21	0	0	0	12.4	0.6	0.1	12.2	3.2	4.0	0	0	0	32.5
22	0	0	0	0	4.8	6.8	8.0	21.6	0.3	3.6	0	0	45.1
23	0	0	0	0	15.2	1.0	4.6	23.4	4.8	3.2	0	0	52.2
24	0	0	0	0	0.3	20.0	0	17.4	0.3	3.4	0	0	41.4
25	0	0	0	0	0	20.0	16.0	12.6	8.8	46.2	3.8	0	107.4
26	0	0	0	0	0.6	1.2	14.2	10.5	3.6	0	0	0	30.1
27	0	0	0	0	2.5	5.1	0.6	0	17.7	0	0	0	25.9
28	0	0	0	0	0	0	2.0	0	7.8	0	0	0	9.8
29	0	0	0	0	2.0	0	3.4	0	42.0	5.0	24.2	0	76.6
30	0	0	0	1.2	0	15.2	0.1	0	53.2	22.2	2.8	0	94.7
31	0	0	0	0	0	0	0.2	0	0	17	0	0	17.2
Total	0	7.4	0.1	67.7	186.1	285.7	104.1	156.5	264.3	235.8	149.5	5.4	1,462.6

Siem Riap Daly Rainfall in 1995

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	0	0	0	15.5	0	5.0	5.5	0	11.6	0	2.6	0	40.2
2	0	0	0	0	0	4.0	0	0	19.2	24.0	0.5	0	47.7
3	0	0	0	0	0	0	4.3	0	0	0	0	0	4.3
4	0	0	0	0	20.6	0	0.5	80.0	0	4.0	0	0	105.1
5	0	0	0	0	0	0	0	0	1.2	66.3	0	0	67.5
6	0	0	0	1.0	0	0	0	2.6	5.2	8.9	0	0	17.7
7	0	0	0	0	0	16.4	0	2.3	0	54.5	0	0	73.2
8	0	0	0	0	6	0	6.8	40.0	0	39.4	0.6	0	92.8
9	0	0	0	0	2.3	5.2	0	0	5.0	17.0	0	0	29.5
10	0	0	0	0	0	4.6	32.6	0	13.7	21.4	9.6	0	81.9
11	0	0	0	0	35.4	12.3	21.1	0	22.7	0	0	0	91.5
12	0	0	0	0	0	0	0	0	26.2	10.0	0	0	36.2
13	0	0	0	0	11.2	0	0	1.0	0	0	0	0	12.2
14	0	0	0	0	0.8	0	0	0	36.4	0	0	4.3	41.5
15	0	0	0	0	0.2	0	8.4	0	4.7	0	0	0.4	13.7
16	0	0	0	0	0	0	10.6	0	10.2	3.8	0	0	24.6
17	0	0	0	0	0	0	20.0	0	33.8	0	0	0	53.8
18	0	0	0	0	0	0	14.8	0	20.2	0	0	13.4	48.4
19	0	0	0	0	0	0	0	0	14.2	0	0	0	14.2
20	0	0	0	0	0	2.4	0	5.2	27.8	7.0	0	0	42.4
21	0	0	0	0	0	0	0	21.9	4.6	2.2	0	0	28.7
22	0	0	0	0	13.2	0	0	0	90.8	0	0	0	104.0
23	0	0	0	0	0	45.6	12.2	0	31.5	0	0	0	89.3
24	0	0	0	0	0	0	33	20.6	25.5	0	0	0	79.1
25	0	0	22.0	0	0	18.0	11.0	29.1	26.7	0	0	0	106.8
26	0	0	0	4.2	2.6	8.4	0.2	0	0	20.6	0	0	36.0
27	0	0	0	7.8	40.0	0	0	16.1	0	0	0	0	63.9
28	0	0	0	0	3.3	0	1.0	11.2	4.4	13.4	0	0	33.3
29	0	0	0	0	1.4	47.8	0	0	67.0	9.4	0	0	125.6
30	0	0	0	0	2.2	51.9	43.2	0	9.5	0	0	0	106.8
31	0	0	0	0	39.0	0	15.5	0	0	0	0	0	54.5
Total	0	0	22	28.5	178.2	221.6	240.7	230.0	512.1	301.9	13.3	18.1	1766.4

Siem Riap Daly Rainfall in 1994

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	0	0	0	0	0	0	0	0	1.1	2.0	0	0	3.1
2	0	0	0	0	0	4	11.5	20.0	0	7.2	0	0	42.7
3	0	0	0	0	0	0	39.9	8.9	25.0	0	0	0	73.8
4	0	0	0	0	0	0	5.0	3.7	0	0	0	0	8.7
5	0	0	0	0	0	0	0	2.2	3.8	0	0	0	6
6	0	0	0	0.0	4.5	0	2.6	0	0	4.3	0	0.5	11.9
7	0	0	0	0	0.7	2.9	0.9	0	17.8	0	0	0	22.3
8	0	0	0	0	0	3.9	4.5	0	0	2.1	0	0	10.5
9	0	0	0	0	0.3	0	0	0	3.3	0	0	0	3.6
10	0	0	0	0	23.0	1.2	13.8	11.8	80.6	0	0	0	130.4
11	0	0	0	0	21.4	4.6	19.4	0	5.0	0	0	0	50.4
12	0	0	0	0	9.0	13.2	4.0	0	0	2.8	0	0	29.0
13	0	0.6	5.4	1.6	0	10.0	3.9	0	24.3	0	0	0	45.8
14	0	0	2.8	0	0	0.8	0	0	0	0	0	0	3.6
15	0	0	0	0.3	0	19.4	0	0	0.2	0	0	0	19.9
16	0	0	0	0	0	0	20.8	5.2	11.9	0	0	0	37.9
17	0	0	13.3	0	2.2	0.6	4.0	4.0	32.1	1.2	3.2	0	60.6
18	0	0	0	6.0	14.8	5.7	3.6	0.4	0.2	0	0	0	30.7
19	0	0	1.5	0	9.1	6.8	3.2	31.6	0	2.4	0	0	54.6
20	0	0	2.6	0.8	0	15.0	0	0	0	12.8	0	0	31.2
21	0	0	0	0	6.2	5.4	0	0.2	0	0	0.2	0	12.0
22	0	0	25.3	0	6.5	0.8	1.2	3.6	0	0	4.4	0	41.8
23	0	0	15.4	0	0	14.8	0	69.8	12.2	0	0.5	0	112.7
24	0	0	0	0	0	2.8	0	29.4	0.5	0	0	0	32.7
25	0	0	0.0	0	0	27.0	0	15.1	0	0	0	0	42.1
26	0	0	0	0	0	3.4	20.0	1.4	0	0	0	0	24.8
27	0	0	0	0	0	0	0	3.4	7.2	0	0	0	10.6
28	0	0	0	0	0	32.8	1.4	7.8	60.3	0	0	0	102.3
29	0	0	0	0	3.8	62.8	1.7	14.8	0	0	0	0	83.1
30	0	0	0	0	0	0	0	23	1.0	0	0	0	24.0
31	0	0	0	0	0.8	0	16.2	0	0	0	0	0	17.0
Total	0	0.6	66.3	8.7	102.3	237.9	179.8	257.9	282.7	34.8	8.3	0.5	1179.8

Siem Riap Daly Rainfall in 1993

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	0	0	0	0	0	0	0	0	3.2	22.4	0	0	25.6
2	0	0	0	0	0	0	0	10.0	0.2	0.4	0	0	10.6
3	0	0	0	0	0	0	1.6	14.9	15.2	3.0	0	5.2	39.9
4	0	0	0	0	0	0	0	5.5	21.7	0	0	0	27.2
5	0	0	0	0	0	0	0.2	36.6	0	0	0	0	36.8
6	0	0	0	0	0	1.4	33.2	2.2	0	2.0	0	0	38.8
7	0	0	0	19.3	0	20.3	0	1.6	15.0	1.2	0	0	57.4
8	0	0	0	1.8	0	1.4	0	9.2	11.8	0	0	0	24.2
9	0	0	0	0	0	51.7	0	0	9.8	1.0	2.2	7.8	72.5
10	0	0	0	0	0	35.1	43.3	4.0	0	22.4	0	0	104.8
11	0	0	0	0	0	1.1	25.4	1.0	3.4	0	1.0	0	31.9
12	0	0	0	0	0.2	3.9	5.7	0	0	20.7	5.2	0	35.7
13	0	0	0	0	0	0	50.0	11.0	28.6	0.6	0	0	90.2
14	0	0	0	0	0	0	0.9	1.7	0.5	0.4	0	2.1	5.6
15	0	0	0	9.4	0	0	0.6	3.0	4.2	0	0	0	17.2
16	0	0	1.2	0	0	0	0	8.0	0	0.8	0	0	10.0
17	0	0	10.6	0	0	0	0	0	0	12.8	0	0	23.4
18	0	0	0	0.0	0	4.1	0	13.6	52.4	20.0	2.6	0	92.7
19	0	0	0	0	0.2	0	0	12.4	19.4	88.4	0	0	120.4
20	0	0	5.4	0	0	3.8	0	10.8	12.0	1.2	0	0	33.2
21	0	0	0	0	0.6	0	0	31.8	0	50.4	1.2	0	84.0
22	0	0	0	0	0	12.5	0	0.8	0	2.0	0	0	15.3
23	0	0	0	0	0.7	99.1	0	10.0	0	11.6	0	0	121.4
24	0	0	0	0	19.5	48.8	0	0	3.0	61.0	0	0	132.3
25	0	0	0	0	0	35.2	2.2	0	0	0	0	0	37.4
26	3.7	0	0	0	0	0.6	0	0	0	64.3	0	0	68.6
27	0	0	0	0	22.0	0.8	0	0	1	13.5	0	0	37.3
28	0	0	0	0	0.5	1.6	5.8	2.0	5.2	0	0	0	15.1
29	0	0	0	0	0	8.4	4.0	2.6	0	8.8	0	0	23.8
30	0	0	0	0	0	10.4	0	4.1	73.8	0	0	0	88.3
31	0	0	0	0	0	0	0	2.8	0	0	0	0	2.8
Total	3.7	0	17.2	30.5	43.7	340.2	172.9	199.6	280.4	408.9	12.2	15.1	1521.6

Siem Riap Daly Rainfall in 1992

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	0	0	0	0	11	0.5	0	0	0	4.8	0	0	16.3
2	9.2	0	0	0	0	0	0	3.5	0	0	0	0	12.7
3	0	0	0	0	0	0	0.9	5.0	0	52.7	0	0	58.6
4	0	0	0	0	2.6	6.8	0.3	88.0	0	0	0	0	97.7
5	11.1	0	0	0	0.3	0.5	4.5	0	0	4.8	0	0	21.2
6	0	0	0	0	0	0	0	10.8	4.1	0.7	0	0	15.6
7	0	0	0	0	0	0	0	5.0	2.8	0	0	0	7.8
8	43.4	0	0	0	0	0	0	0	3.2	0	1.0	0	47.6
9	0	0	0	0	0	15.6	15.2	0	0	2.2	0	0	33.0
10	0	0	0	0	0	0	0	0	0	3.7	0	0	3.7
11	0	0	0	0	2.6	11.5	0	16.3	0	4.7	0	0	35.1
12	0	0	0	0	0.2	1.3	0	12.3	0	13.4	0	0	27.2
13	0	0	0	0	0	0.3	11.5	4.0	3.8	0.2	0	0	19.8
14	0	0	0	0	0	0	3.7	4.2	5.5	0	0	4.3	17.7
15	0	0	0	0	0	5.4	0	4.6	0	1.0	0	0.4	11.4
16	0	0	0	0	0.5	0	0	9.9	0.5	8.5	0	0	19.4
17	0	0	0	0	0	0.5	12.4	2.5	0	0.5	0	0	15.9
18	0	0	0	4.0	0	27.8	2.4	5.5	20.3	30	0	13.4	103.4
19	0	0	0	0	0	2.2	0	18.5	17.5	0	0	0	38.2
20	0	0	0	0	0	6.0	0	0.9	5.2	0	0	0	12.1
21	0	0	0	0	0	18.2	0.4	34.9	24.2	0	8.7	0	86.4
22	0	0	0	0	0	7.0	6.0	30.9	1.5	0	0	0	45.4
23	0	0	0	0	10.5	0	0	30.5	6.0	0	0	0	47.0
24	0	0	0	0	13.5	0	9.4	1.3	1.6	0	0	0	25.8
25	0	0	0	0	0	0	7.2	8.4	3.3	22.2	0	0	41.1
26	0	0	0	0	0	32.8	17.2	2.6	4.1	1.5	0	0	58.2
27	0	0	0	0	0.0	2.8	8.4	46.5	1.0	0	0	0	58.7
28	0	0	0	0	0	2.1	1.4	4.3	7.9	0	0	0	15.7
29	0	0	0	0	0.8	0	94.6	1.7	0.5	2.1	0	0	99.7
30	0	0	0	0	14	18	0	0.7	7.1	20.5	0	0	60.3
31	0	0	0	0	0	0	2.3	1.6	0	1.2	0	0	5.1
Total	63.7	0	0	4	56	159.3	197.8	354.4	120.1	174.7	9.7	18.1	1157.8

Siem Riap Daly Rainfall in 1991

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	0	0	0	0	0	15.6	0	1.4	0	0	0	0	17
2	0	0	0	0	0	0	27.5	0	0	0	0	0	27.5
3	0	0	0	0	0	0	1.5	0	74.4	17.6	0	0	93.5
4	0	0	0	0	1.9	30.0	0	6	36.3	7.5	0	0	81.7
5	0	0	0	0	0	0	0	38.6	30.5	39.8	0	0	108.9
6	0	0	0	0	0	8.0	0	85.6	7.8	12.7	0	0	114.1
7	0	0	0	0	0	26.0	0	1.4	0	0.8	0	0	28.2
8	0	0	0	0	0	14.0	14.5	17.1	1.5	13.3	0	0	60.4
9	0	0	0	0	0	7.7	0	0	0.2	25.3	0	0	33.2
10	0	0	0	0	0	55.5	6.5	0	0	0	0	0	62
11	0	0	0	0	0	14.0	53.5	0	5.8	0	0	0	73.3
12	0	0	0	0	0	5.1	51.1	41.5	0.3	0	0	0	98
13	0	0	0	0	0	30.4	0	1.6	0	13.3	0	0	45.3
14	0	0	0	0	0	5.8	12.6	2.6	37.0	0	0	0	58
15	0	0	0	0	0	0	1.8	3.0	10.0	0	0	0	14.8
16	0	0	0	0	0	1.8	0	0	12.7	0	0	0	14.5
17	0	0	0	0	0	4.6	0	0	17.1	61.0	0	0	82.7
18	0	0	0	0	0	0	0	0	0	1.2	0	0	1.2
19	0	0	0	0	0	0	0	0	78.5	10.6	0	0	89.1
20	0	0	0	0	0	0	0	0	0	12.8	0	0	12.8
21	0	0	0	0	0.3	1.3	0	6.3	21.5	13.5	0	0	42.9
22	0	0.1	0	0	0	0.9	0	0.5	0	1.5	0	0	3
23	0	0	0	0	0	0	6.5	0.1	30.0	10.8	0	0	47.4
24	0	0	0	62.0	0	0.4	5.6	0	21.0	0	0	0	89
25	0	0	0	9.0	0	0	0.5	0	1.0	8.9	0	0	19.4
26	0	0	0	0	3	0	0	0	0	0	0	0	3
27	0	0	0	0	33.1	0	4.2	14.3	0	0	0	0	51.6
28	0	0	0	0	8.5	17.6	3.4	39.0	0	0	0	0	66.5
29	0	0	0	0	4.5	6	6.4	47.1	40.8	0	0	0	104.8
30	0	0	0	0	0	4.7	33.2	0	0.5	0	0	0	38.4
31	0	0	50.0	0	0	0	11.3	0	0	0	0	0	61.3
Total	0	0.1	50.0	71.0	49.3	249.4	240.1	306.1	426.9	250.6	0	0	1643.5

Siem Riap Daly Rainfall in 1990

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	0	0	0	0	0	0.2	1.7	0	0	10.0	5.2	0	17.1
2	0	0	0	0	0	0	0.1	0.4	0	17.5	0	0	18.0
3	0	0	0	0	0	0	0	1.0	0	87.5	9.0	0	97.5
4	0	0	0	0	0	28.6	0	0	24.0	64.8	0	0	117.4
5	0	0	0.9	18.1	0	0.4	2.8	3.0	0	14.5	0	0	39.7
6	0	0	0	0	0	1.5	2.0	2.0	0	10.2	0	0	15.7
7	0	0	0	0	0	2.0	0	0	0	0	0	0	2.0
8	0	0	0	0	0	0	0	0	1.7	7.4	0	0	9.1
9	0	0	7.0	0	0	50.4	1.0	0	27.5	4.3	2.0	0	92.2
10	0	0	0	0	0	26.9	0	0	0	0	5.0	0	31.9
11	0	0	0	0	6.1	4.0	0	0	2.3	0	3.6	0	16.0
12	0	0	0	0	0	5.5	1.0	0	10.0	0	0	0	16.5
13	0	0	0	0	0	0	0.4	17.7	9.0	0	21.6	0	48.7
14	0	0	0	6.2	0	0	0	15.0	27.5	3.0	2.6	0	54.3
15	0	0	10.8	0	0	0.6	0	6.0	8.7	0	0	0	26.1
16	0	0	9.6	5.3	0	19.9	0	3.5	7.6	0	0	0	45.9
17	0	0	0	0	0	9.2	0.8	3.0	0	0	0	0	13.0
18	0	0	0	0	0	8.6	0	0	6.0	0.9	0	0	15.5
19	0	0	0	0	0	3.0	0	19.5	19.0	0	0	0	41.5
20	15.0	0	0	0	0	0.2	5.9	13.3	9.0	2.0	0	0	45.4
21	0	0	0	0	0.4	53.9	27.7	0	0	0	7.4	0	89.4
22	0	0	0	0	0.5	0	5.5	0	0	3.5	0.5	0	10.0
23	0	0	0	0	3.4	0	14.6	0	0.5	1.3	0	0	19.8
24	0	0	0	0	13.2	0.6	0	0	0	0	0	0	13.8
25	0	0	0	33.8	58.4	9.0	0	0	42.0	0	0	0	143.2
26	0	0	0	0	0.3	0.8	0	0	0	5.2	0	0	6.3
27	0	0	0	0	15.2	0	0	10.0	5.0	13.0	0	0	43.2
28	0	0	0	0	3.5	84.0	0	1.0	0	0	0	0	88.5
29	0	0	0	0	0	9.0	0	0	0	3.0	0	0	12.0
30	0	0	0	54.5	1.4	2.2	0	0	0	32.1	0	0	90.2
31	0	0	0	0	10.3	9.0	0	0	0	3.0	0	0	22.3
Total	15.0	0	28.3	117.9	112.7	329.6	64.8	94.0	304.8	187.2	47.9	0	1302.2

Siem Riap Daly Rainfall in 1989

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	0	0	0	0	0	31.0	0	7.7	4.6	0	0	0	43.3
2	0	0	0	0	0	0	8.6	5.3	0.8	61.2	0	0	75.9
3	0	0	0	0	0	0	0	7.1	1.8	5.3	14.0	0	28.2
4	0	0	0	0	0	25.3	0.2	64.0	6.5	0	0	0	96.0
5	0	0	0	0	0	5.6	16.4	19.6	0	0	0	0	41.6
6	0	0	0	0	15.0	0	0	0.7	0.1	23.0	5.2	0	44.0
7	0	0	0	0	3.7	0	0	0	0.6	0.5	0	0	4.8
8	0	0	0	0	0	0	0	0	23.9	4.9	0.5	0	29.3
9	0	0	0	25.7	0	7.8	0	0	0.6	5.5	2.1	0	41.7
10	0	0	0	0	0	0	4.4	0.7	50.0	0	29.4	0	84.5
11	0	0	0	11.5	4.5	1.5	22.5	22.2	0	0	0.6	0	62.8
12	0	0	0	0	32.8	0	46.7	0	7.6	0	0	0	87.1
13	0	0	0	0	10.0	0	0	5.2	2.3	0	0	0	17.5
14	0	0	0	0	0	6.5	1.2	1.6	0	9.8	0	0	19.1
15	0	0	0	0	12.7	1.8	16.9	2.3	0	0	0	0	33.7
16	0	0	35.8	0	0	4.0	0	0	0	0.1	0	0	39.9
17	0.5	0	9.7	0	0	0.8	0	0	0	7.0	0	0	18.0
18	0	0	0.6	0	9.0	0	1.0	17.0	0	4.0	0	0	31.6
19	0	0	0	0	7.2	0	2.9	8.0	2.8	29.3	0	0	44.2
20	0	0	0	0	0	0	0	18.4	85.2	14.5	0	0	116.1
21	0	0	4.6	0	0	0	0.9	4.1	2.7	0	42.0	0	54.3
22	0	0	0	0	0	0	6.0	0.9	1.1	0	0	0	8.0
23	0	0	0	0	1.9	0	14.7	22.0	0.2	0	0	0	38.8
24	0	0	0	0	5.6	22.8	8.1	53.0	0	22.2	0	0	111.7
25	0	0	0	0	2.0	0	7.3	2.5	1.7	0	0	0	13.5
26	0	0	0	4.6	49.4	44.9	13.0	0	0.6	0	0	0	112.5
27	0	0	0	2.4	50.9	17.6	3.6	0	15.1	17.6	0	0	107.2
28	0	0	0	0	1.4	0	20.0	0	27.2	13.4	1.8	0	63.8
29	0	0	0	0	4.2	0	0	0	42.1	0	0	0	46.3
30	0	0	0	0	0	0	0	0	2.4	0	0	0	2.4
31	0	0	0	0	0	0	35.3	0	0	9.6	0	0	44.9
Total	0.5	0	50.7	44.2	204.3	169.6	236.8	255.0	283.4	236.6	81.6	0.0	1562.7

Siem Riap Daly Rainfall in 1988

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	0	0	0	0	25.8	1.6	0	48.3	0	2.7	0	0	78.4
2	0	0	0	0	31.3	2.3	0	23.1	0	0	0	0	56.7
3	0	0	0	0	6.5	11.4	0	8.3	0	0	0	0	26.2
4	0	0	0.9	0	0	15.9	0	0	0	1.2	0	0	18.0
5	0	0	0	0	1.3	54.6	0	0	0	18.0	0	0	73.9
6	0	0	0	0	0.5	7.5	0	0	0	2.4	0	0	10.4
7	0	0	0	0	0	9.6	1.6	0	0	0	3.7	0	14.9
8	0	0	0	0	0	0	0	19.2	2.1	4.8	4.4	0	30.5
9	0	0	0	0	0	0	0	48.2	0	0	3.4	0	51.6
10	0	0	0	0	0	0	0	0	77.5	8.6	0	0	86.1
11	0	0	0	2.4	0.9	16.8	0	41.2	6.5	4.3	0	0	72.1
12	0	0	0	0	2.3	37.5	22.1	0	0	10.7	0	0	72.6
13	0	0	0	13.7	13.5	15.6	0.5	0	0	18.7	0	0	62.0
14	0	0	0	3.8	0	0.7	2.5	0.1	0	0	0	0	7.1
15	0	0	0	6.7	0	14.9	2.8	0.1	0	0	0	0	24.5
16	0	0	0	17	0.1	0.9	10.8	0	1.7	85.7	0	0	116.2
17	0	0	0	0	0	0	3.0	2.4	17.6	1.9	0	0	24.9
18	0	0	0	14.2	0	6.2	3.2	1.9	10.8	0	10.9	0	47.2
19	0	0	0	0	0.1	11.8	0	0	82.0	23.1	0.2	0	117.2
20	0	0	0	0	16.4	0	0	5.1	0	0.3	0	0	21.8
21	0	0	0	0	0	0.2	28.0	0	0	1.5	0.0	0	29.7
22	0	0	0	0	0	0	2.1	10.5	0.7	0	0	0	13.3
23	0	0	0	0	0	0	0	1.0	0	0	0	0	1.0
24	0	0	0	6.6	0	0	0	2.7	6.6	0	1.8	0	17.7
25	0	0	0	0	4.9	0	0	27.2	6.7	0.6	0	0	39.4
26	0	0	0	5.4	7.3	0	0.9	4.1	23.8	6.0	0	0	47.5
27	0	0	0	0	3.5	0	3.4	0	4.8	0	4.1	0	15.8
28	0	0	0	0	3.4	25.8	4.0	0	32.9	0	0	0	66.1
29	0	0	0	4.0	6.4	0.6	0	0	0.7	0	0	0	11.7
30	0	0	0	0	9.3	34.4	15.1	0.2	12.5	0	0	0	71.5
31	0	0	0	0	2.2	0	0	0	0	0	0	0	2.2
Total	0	0	0.9	73.8	135.7	268.3	100.0	243.6	286.9	190.5	28.5	0.0	1328.2