Supporting Report – 13

Financial/Economical Analysis

Phnom Penh Water Supply Authority

FIRR & SENSITIVITY ANALYSIS

Million Riels

Stated at 2005 Constant Price	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Base Case:														
Project Costs	-	18,442	92,978	104,765	16,747	2,230	43,626	178,558	204,875	29,144	20,640	3,276	6,551	104,791
Incremental O&M					3,057	4,546	6,670	8,386	10,098	11,806	13,502	15,805	18,019	20,218
Total Incremental Costs	-	18,442	92,978	104,765	19,804	6,777	50,296	186,944	214,973	40,951	34,142	19,081	24,570	125,009
Incremental Revenue					3,899	7,887	12,587	16,990	21,350	25,668	29,947	35,823	41,275	46,690
Net Cash Inflow (Outflow) - Base Case	-	(18,442)	(92,978)	(104,765)	(15,905)	1,111	(37,709)	(169,954)	(193,623)	(15,282)	(4,196)	16,742	16,705	(78,319)
Sensitivity Tests:														
10% Increase in Project Costs	-	(20,286)	(102,275)	(115,242)	(17,580)	888	(42,071)	(187,810)	(214,111)	(18,197)	(6,260)	16,414	16,050	(88,798)
10% Increase in O&M Costs	-	(18,442)	(92,978)	(104,765)	(16,211)	656	(38,376)	(170,793)	(194,633)	(16,463)	(5,546)	15,161	14,903	(80,341)
10% Decrease in Revenue	-	(18,442)	(92,978)	(104,765)	(16,295)	322	(38,967)	(171,653)	(195,758)	(17,849)	(7,190)	13,160	12,577	(82,988)

	NPV @ WACC	FIRR (%)	SI	% Change
Base Case	184,284	5.19%		
10% Increase in Project Costs	115,576	4.64%	1.18	10%
10% Increase in O&M Costs	135,896	4.85%	0.70	10%
10% Decrease in Revenue	48,760	4.22%	2.29	10%

Phnom Penh Water Supply Authority

FIRR & SENSITIVITY ANALYSIS

Million Riels

Stated at 2005 Constant Price	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base Case:														
Project Costs	93,786	8,818	-	-	-	-	-	-	-	13,749	-	-	-	-
Incremental O&M	22,464	24,664	27,282	29,397	31,606	33,910	36,253	38,838	41,358	43,973	46,589	48,760	50,171	50,413
Total Incremental Costs	116,251	33,481	27,282	29,397	31,606	33,910	36,253	38,838	41,358	57,722	46,589	48,760	50,171	50,413
Incremental Revenue	52,071	57,417	63,919	70,825	78,045	85,601	93,517	101,816	110,527	119,675	129,162	138,891	145,669	148,566
Net Cash Inflow (Outflow) - Base Case	(64,180)	23,935	36,636	41,428	46,440	51,691	57,264	62,979	69,169	61,953	82,572	90,131	95,498	98,153
Sensitivity Tests:														
10% Increase in Project Costs	(73,559)	23,054	36,636	41,428	46,440	51,691	57,264	62,979	69,169	60,578	82,572	90,131	95,498	98,153
10% Increase in O&M Costs	(66,426)	21,469	33,908	38,488	43,279	48,300	53,639	59,095	65,033	57,556	77,914	85,254	90,481	93,111
10% Decrease in Revenue	(69,387)	18,194	30,244	34,345	38,635	43,131	47,913	52,797	58,116	49,986	69,656	76,241	80,931	83,296

	NPV @ WACC	FIRR (%)	SI	% Change
Base Case	184,284	5.19%		
10% Increase in Project Costs	115,576	4.64%	1.18	10%
10% Increase in O&M Costs	135,896	4.85%	0.70	10%
10% Decrease in Revenue	48,760	4.22%	2.29	10%

Phnom Penh Water Supply Authority

FIRR & SENSITIVITY ANALYSIS

Million Riels

Stated at 2005 Constant Price	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Base Case:													
Project Costs	-	-	-	-	-	16,720	-	-	-	-	-	-	-
Incremental O&M	50,685	50,989	51,198	51,397	51,585	51,764	52,052	52,213	52,365	52,506	52,639	52,762	52,876
Total Incremental Costs	50,685	50,989	51,198	51,397	51,585	68,484	52,052	52,213	52,365	52,506	52,639	52,762	52,876
Incremental Revenue	151,910	155,268	158,640	162,029	165,435	168,859	172,302	175,766	179,253	182,762	186,295	189,853	193,438
Net Cash Inflow (Outflow) - Base Case	101,225	104,279	107,442	110,632	113,849	100,375	120,250	123,553	126,888	130,255	133,656	137,091	140,562
Sensitivity Tests:													
10% Increase in Project Costs	101,225	104,279	107,442	110,632	113,849	98,703	120,250	123,553	126,888	130,255	133,656	137,091	140,562
10% Increase in O&M Costs	96,156	99,180	102,323	105,492	108,691	95,198	115,045	118,332	121,652	125,004	128,392	131,815	135,274
10% Decrease in Revenue	86,034	88,752	91,578	94,429	97,306	83,489	103,020	105,977	108,963	111,979	115,026	118,106	121,218

	NPV @ WACC	FIRR (%)	SI	% Change
Base Case	184,284	5.19%		
10% Increase in Project Costs	115,576	4.64%	1.18	10%
10% Increase in O&M Costs	135,896	4.85%	0.70	10%
10% Decrease in Revenue	48,760	4.22%	2.29	10%

Phnom Penh Water Supply Authority

FIRR AND SENSITIVITY ANALYSIS

Particulars	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Loan Interest Rate at 8.5%														
Weighted Average Cost of Capital	3.84%													
Rate of Return on Revenues	21.4%	23.8%	18.9%	8.7%	7.9%	10.4%	6.3%	11.9%	16.1%	19.7%	23.8%	25.8%	29.3%	32.9%
Rate of Return on Total Assets	2.4%	3.0%	2.4%	1.1%	1.1%	1.6%	0.7%	1.5%	2.2%	2.9%	3.9%	4.5%	5.7%	7.3%
Loan Interest Rate at 1%														
Weighted Average Cost of Capital	0.35%													
Rate of Return on Revenues	21.4%	25.5%	25.4%	21.7%	21.3%	24.8%	19.6%	24.2%	27.4%	30.1%	33.5%	35.0%	38.1%	41.1%
Rate of Return on Total Assets	2.4%	3.2%	3.3%	2.7%	2.9%	3.8%	2.1%	3.0%	3.7%	4.4%	5.5%	6.1%	7.4%	9.0%
Favorable Difference														
Weighted Average Cost of Capital	-3.49%													
Rate of Return on Revenues	0.0%	1.7%	6.5%	13.0%	13.4%	14.4%	13.3%	12.3%	11.3%	10.5%	9.7%	9.3%	8.8%	8.1%
Rate of Return on Total Assets	0.0%	0.2%	0.8%	1.6%	1.9%	2.2%	1.5%	1.5%	1.5%	1.5%	1.6%	1.6%	1.7%	1.8%

Analysis and Conclusion:

1. With reduced interest rate, the WACC will reduce by 3.49%.
2. The lower interest rate is reflected on higher rates of return (on revenues and total assets).
3. The impact of lower interest is highest in 2010, the last year of loan withdrawal and loan balance is at the highest.
4. The impact of lower interest starts to lower in 2011 when repayment of loan starts.

Phnom Penh Water Supply Authority

FIRR AND SENSITIVITY ANALYSIS

Particulars	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Loan Interest Rate at 8.5%												
Weighted Average Cost of Capital												
Rate of Return on Revenues	34.9%	37.2%	40.2%	43.1%	45.7%	48.0%	51.1%	51.7%	54.8%	57.9%	60.4%	63.2%
Rate of Return on Total Assets	8.1%	9.3%	10.8%	12.6%	14.1%	15.3%	17.7%	16.6%	19.0%	21.7%	23.6%	26.8%
Loan Interest Rate at 1%												
Weighted Average Cost of Capital												
Rate of Return on Revenues	42.5%	44.6%	47.3%	50.0%	52.4%	54.5%	57.3%	57.7%	60.7%	63.5%	65.9%	68.6%
Rate of Return on Total Assets	9.9%	11.2%	12.8%	14.6%	16.1%	17.4%	19.8%	18.5%	21.0%	23.8%	25.7%	29.1%
Favorable Difference												
Weighted Average Cost of Capital												
Rate of Return on Revenues	7.6%	7.4%	7.1%	6.9%	6.7%	6.5%	6.2%	6.0%	5.8%	5.6%	5.5%	5.4%
Rate of Return on Total Assets	1.8%	1.8%	1.9%	2.0%	2.1%	2.1%	2.2%	1.9%	2.0%	2.1%	2.1%	2.3%

Analysis and Conclusion:

1. With reduced interest rate, the WACC will reduce by 3.49%.
2. The lower interest rate is reflected on higher rates of return (on revenues and total assets).
3. The impact of lower interest is highest in 2010, the last year of loan withdrawal and loan balance is at the highest.
4. The impact of lower interest starts to lower in 2011 when repayment of loan starts.

Phnom Penh Water Supply Authority

EIRR & SENSITIVITY ANALYSIS

Million Riels

Stated at 2005 Constant Price	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Resource Costs:														
Investment Costs	-	16,356	82,460	92,915	14,853	1,978	38,691	158,361	181,701	25,848	18,305	2,905	5,810	92,938
Incremental O&M	-	-	-	-	3,018	4,487	6,583	8,277	9,967	11,653	13,327	15,600	17,785	19,956
Total Resource Costs	-	16,356	82,460	92,915	17,870	6,465	45,275	166,638	191,668	37,501	31,632	18,505	23,595	112,894
Gross Benefits:														
Resource Cost Savings					3,612	7,421	12,175	16,940	21,713	26,494	31,282	38,227	45,186	52,157
Additional Water Supply					2,340	4,803	7,853	10,893	13,924	16,948	19,964	24,298	28,618	32,925
Water Collection Time Savings					1,271	2,546	4,315	6,084	7,852	9,621	11,390	14,031	16,672	19,313
Total Gross Benefits	-	-	-	-	7,224	14,770	24,343	33,916	43,490	53,063	62,636	76,556	90,475	104,395
Net Cash Inflow (Outflow) - Base Case	-	(16,356)	(82,460)	(92,915)	(10,646)	8,304	(20,931)	(132,721)	(148,178)	15,562	31,004	58,051	66,880	(8,499)
Sensitivity Tests:														
10% Increase in Investment Costs	-	(17,992)	(90,707)	(102,207)	(12,132)	8,107	(24,801)	(148,557)	(166,348)	12,978	29,173	57,760	66,299	(17,792)
10% Increase in O&M Costs	-	(16,356)	(82,460)	(92,915)	(10,948)	7,856	(21,590)	(133,549)	(149,175)	14,397	29,671	56,491	65,102	(10,494)
10% Decrease in Benefits	-	(16,356)	(82,460)	(92,915)	(11,369)	6,827	(23,366)	(136,113)	(152,527)	10,256	24,740	50,395	57,833	(18,938)

	NPV @ EOCC	EIRR (%)	SI	% Change
Base Case	184,046	13.31%		
10% Increase in Investment Costs	145,351	12.45%	0.69	10%
10% Increase in O&M Costs	170,967	13.09%	0.17	10%
10% Decrease in Benefits	113,867	12.13%	0.97	10%

Phnom Penh Water Supply Authority

EIRR & SENSITIVITY ANALYSIS

Million Riels

Stated at 2005 Constant Price	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Resource Costs:														
Investment Costs	83,178	7,820	-	-	-	-	-	-	-	12,194	-	-	-	-
Incremental O&M	22,173	24,343	26,928	29,016	31,195	33,470	35,782	38,334	40,821	43,402	45,984	48,127	49,519	49,759
Total Resource Costs	105,350	32,164	26,928	29,016	31,195	33,470	35,782	38,334	40,821	55,596	45,984	48,127	49,519	49,759
Gross Benefits:														
Resource Cost Savings	59,138	66,128	72,102	78,256	84,594	91,120	97,838	104,750	111,861	119,174	126,691	134,415	137,223	135,619
Additional Water Supply	37,222	41,511	46,248	51,301	56,688	62,432	68,554	75,078	82,030	89,436	97,325	105,727	110,857	112,460
Water Collection Time Savings	21,954	24,595	27,058	29,642	32,351	35,194	38,175	41,302	44,583	48,024	51,191	53,164	54,738	54,738
Total Gross Benefits	118,315	132,234	145,408	159,198	173,634	188,746	204,567	221,131	238,474	256,634	275,207	293,306	302,817	302,817
Net Cash Inflow (Outflow) - Base Case	12,964	100,070	118,480	130,183	142,438	155,276	168,785	182,797	197,653	201,038	229,222	245,178	253,298	253,059
Sensitivity Tests:														
10% Increase in Investment Costs	4,646	99,288	118,480	130,183	142,438	155,276	168,785	182,797	197,653	199,819	229,222	245,178	253,298	253,059
10% Increase in O&M Costs	10,747	97,636	115,787	127,281	139,319	151,929	165,207	178,964	193,571	196,698	224,624	240,365	248,346	248,083
10% Decrease in Benefits	1,133	86,847	103,939	114,263	125,075	136,401	148,328	160,684	173,806	175,375	201,702	215,848	223,016	222,777

	NPV @ EOCC	EIRR (%)	SI	% Change
Base Case	184,046	13.31%		
10% Increase in Investment Costs	145,351	12.45%	0.69	10%
10% Increase in O&M Costs	170,967	13.09%	0.17	10%
10% Decrease in Benefits	113,867	12.13%	0.97	10%

Phnom Penh Water Supply Authority

EIRR & SENSITIVITY ANALYSIS

Million Riels

Stated at 2005 Constant Price	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Resource Costs:													
Investment Costs	-	-	-	-	-	14,829	-	-	-	-	-	-	-
Incremental O&M	50,027	50,327	50,533	50,730	50,916	51,092	51,376	51,535	51,685	51,825	51,956	52,077	52,189
Total Resource Costs	50,027	50,327	50,533	50,730	50,916	65,921	51,376	51,535	51,685	51,825	51,956	52,077	52,189
Gross Benefits:													
Resource Cost Savings	133,992	132,342	130,667	128,969	127,246	125,498	123,725	121,926	120,101	118,249	116,371	114,466	112,533
Additional Water Supply	114,087	115,738	117,412	119,110	120,833	122,581	124,355	126,154	127,979	129,830	131,708	133,613	135,546
Water Collection Time Savings	54,738	54,738	54,738	54,738	54,738	54,738	54,738	54,738	54,738	54,738	54,738	54,738	54,738
Total Gross Benefits	302,817	302,817	302,817	302,817	302,817	302,817	302,817	302,817	302,817	302,817	302,817	302,817	302,817
Net Cash Inflow (Outflow) - Base Case	252,790	252,490	252,284	252,088	251,901	236,896	251,441	251,282	251,132	250,992	250,862	250,740	250,628
Sensitivity Tests:													
10% Increase in Investment Costs	252,790	252,490	252,284	252,088	251,901	235,413	251,441	251,282	251,132	250,992	250,862	250,740	250,628
10% Increase in O&M Costs	247,787	247,457	247,230	247,015	246,810	231,787	246,303	246,128	245,964	245,810	245,666	245,532	245,409
10% Decrease in Benefits	222,508	222,208	222,002	221,806	221,620	206,615	221,159	221,000	220,851	220,711	220,580	220,458	220,346

	NPV @ EOCC	EIRR (%)	SI	% Change
Base Case	184,046	13.31%		
10% Increase in Investment Costs	145,351	12.45%	0.69	10%
10% Increase in O&M Costs	170,967	13.09%	0.17	10%
10% Decrease in Benefits	113,867	12.13%	0.97	10%

Peri-Urban WS EIRR and Sensitivity Analysis - Master Plan

EIRR AND SENSITIVITY ANALYSIS

Stated at 2005 Constant Price ('000 Riels)	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Resource Costs:														
Investment Costs	-	1,227,438	-	9,083,044	9,083,044	9,083,044	7,161,247	5,844,842	5,844,842	5,844,842	5,844,842	8,080,829	9,341,272	8,212,665
O&M Costs	-	-	-	133,177	266,354	399,531	493,046	586,561	680,075	773,590	867,105	996,211	1,125,317	1,254,423
Total Resource Costs	-	1,227,438	-	9,216,221	9,349,398	9,482,575	7,654,293	6,431,402	6,524,917	6,618,432	6,711,946	9,077,040	10,466,589	9,467,088
Gross Benefits:														
Resource Cost Savings	-	-	-	877,643	1,755,285	2,632,928	3,249,194	3,865,460	4,481,726	5,097,992	5,714,258	6,565,073	7,415,888	8,266,703
Water Collection Time Savings	-	-	-	835,850	1,671,700	2,507,550	3,094,470	3,681,390	4,268,310	4,855,230	5,442,150	6,252,450	7,062,750	7,873,050
Total Gross Benefits	-	-	-	1,713,493	3,426,985	5,140,478	6,343,664	7,546,850	8,750,036	9,953,222	11,156,408	12,817,523	14,478,638	16,139,753
Net Cash Inflow (Outflow) - Base Case	-	(1,227,438)	-	(7,502,729)	(5,922,413)	(4,342,098)	(1,310,630)	1,115,447	2,225,119	3,334,790	4,444,461	3,740,483	4,012,048	6,672,665
Sensitivity Tests:														
10% Increase in Investment Costs	-	(1,350,182)	-	(8,411,033)	(6,830,718)	(5,250,402)	(2,026,754)	530,963	1,640,634	2,750,306	3,859,977	2,932,400	3,077,921	5,851,398
10% Increase in O&M Costs	-	(1,227,438)	-	(7,516,046)	(5,949,049)	(4,382,051)	(1,359,934)	1,056,791	2,157,111	3,257,431	4,357,751	3,640,862	3,899,517	6,547,222
10% Decrease in Benefits	-	(1,227,438)	-	(7,674,078)	(6,265,112)	(4,856,145)	(1,944,996)	360,762	1,350,115	2,339,468	3,328,820	2,458,731	2,564,185	5,058,689

	NPV @ EOC(	EIRR (%)	SI	% Change
Base Case	31,682,222	20.12%		
10% Increase in Investment Costs	27,332,176	17.94%	1.21	10%
10% Increase in O&M Costs	31,048,639	19.91%	0.10	10%
10% Decrease in Benefits	23,530,371	17.52%	1.48	10%

EIRR AND SENSITIVITY ANALYSIS

Stated at 2005 Constant Price ('000 Riels)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Resource Costs:													
Investment Costs	8,212,665	8,065,375	447,958	447,958	447,958	447,958	619,328	1,196,111	1,109,612	1,109,612	996,727	343,323	343,323
O&M Costs	1,383,529	1,512,635	1,512,635	1,512,635	1,512,635	1,512,635	1,512,635	1,512,635	1,512,635	1,512,635	1,512,635	1,512,635	1,512,635
Total Resource Costs	9,596,194	9,578,010	1,960,594	1,960,594	1,960,594	1,960,594	2,131,964	2,708,746	2,622,248	2,622,248	2,509,362	1,855,958	1,855,958
Gross Benefits:													
Resource Cost Savings	9,117,518	9,968,333	9,968,333	9,968,333	9,968,333	9,968,333	9,968,333	9,968,333	9,968,333	9,968,333	9,968,333	9,968,333	9,968,333
Water Collection Time Savings	8,683,350	9,493,650	9,493,650	9,493,650	9,493,650	9,493,650	9,493,650	9,493,650	9,493,650	9,493,650	9,493,650	9,493,650	9,493,650
Total Gross Benefits	17,800,868	19,461,983	19,461,983	19,461,983	19,461,983	19,461,983	19,461,983	19,461,983	19,461,983	19,461,983	19,461,983	19,461,983	19,461,983
Net Cash Inflow (Outflow) - Base Case	8,204,673	9,883,972	17,501,389	17,501,389	17,501,389	17,501,389	17,330,019	16,753,237	16,839,735	16,839,735	16,952,620	17,606,024	17,606,024
Sensitivity Tests:													
10% Increase in Investment Costs	7,383,407	9,077,435	17,456,593	17,456,593	17,456,593	17,456,593	17,268,086	16,633,626	16,728,774	16,728,774	16,852,948	17,571,692	17,571,692
10% Increase in O&M Costs	8,066,321	9,732,708	17,350,125	17,350,125	17,350,125	17,350,125	17,178,755	16,601,973	16,688,471	16,688,471	16,801,357	17,454,761	17,454,761
10% Decrease in Benefits	6,424,587	7,937,774	15,555,190	15,555,190	15,555,190	15,555,190	15,383,821	14,807,038	14,893,537	14,893,537	15,006,422	15,659,826	15,659,826

	NPV @ EOCC	EIRR (%)	SI	% Change
Base Case	31,682,222	20.12%	-	0%
10% Increase in Investment Costs	27,332,176	17.94%	1.21	10%
10% Increase in O&M Costs	31,048,639	19.91%	0.10	10%
10% Decrease in Benefits	23,530,371	17.52%	1.48	10%

EIRR AND SENSITIVITY ANALYSIS

Stated at 2005 Constant Price ('000 Riels)	2032	2033	2034	2035	2036	2037	2038	2039	2040
Resource Costs:									
Investment Costs	343,323	343,323	474,664	916,719	850,425	850,425	763,908	263,128	263,128
O&M Costs	1,512,635	1,512,635	1,512,635	1,512,635	1,512,635	1,512,635	1,512,635	1,512,635	1,512,635
Total Resource Costs	1,855,958	1,855,958	1,987,299	2,429,355	2,363,061	2,363,061	2,276,544	1,775,764	1,775,764
Gross Benefits:									
Resource Cost Savings	9,968,333	9,968,333	9,968,333	9,968,333	9,968,333	9,968,333	9,968,333	9,968,333	9,968,333
Water Collection Time Savings	9,493,650	9,493,650	9,493,650	9,493,650	9,493,650	9,493,650	9,493,650	9,493,650	9,493,650
Total Gross Benefits	19,461,983	19,461,983	19,461,983	19,461,983	19,461,983	19,461,983	19,461,983	19,461,983	19,461,983
Net Cash Inflow (Outflow) - Base Case	17,606,024	17,606,024	17,474,684	17,032,628	17,098,922	17,098,922	17,185,439	17,686,219	17,686,219
Sensitivity Tests:									
10% Increase in Investment Costs	17,571,692	17,571,692	17,427,217	16,940,956	17,013,879	17,013,879	17,109,048	17,659,906	17,659,906
10% Increase in O&M Costs	17,454,761	17,454,761	17,323,420	16,881,364	16,947,658	16,947,658	17,034,175	17,534,955	17,534,955
10% Decrease in Benefits	15,659,826	15,659,826	15,528,485	15,086,430	15,152,724	15,152,724	15,239,241	15,740,020	15,740,020

	NPV @ EOCC	EIRR (%)	SI	% Change
Base Case	31,682,222	20.12%	-	0%
10% Increase in Investment Costs	27,332,176	17.94%	1.21	10%
10% Increase in O&M Costs	31,048,639	19.91%	0.10	10%
10% Decrease in Benefits	23,530,371	17.52%	1.48	10%

Phnom Penh Water Supply Authority

FIRR & SENSITIVITY ANALYSIS

Million Riels

Stated at 2005 Constant Price	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Base Case:														
Project Costs	-	18,442	92,978	104,765	16,747	2,230	-	-	-	-	-	-	-	8,549
Incremental O&M					3,057	4,546	6,670	8,386	10,098	11,806	13,502	15,805	18,019	20,218
Total Incremental Costs	-	18,442	92,978	104,765	19,804	6,777	6,670	8,386	10,098	11,806	13,502	15,805	18,019	28,767
Incremental Revenue					3,899	7,887	12,587	16,990	21,350	25,668	29,947	35,823	41,275	46,690
Net Cash Inflow (Outflow) - Base Case	-	(18,442)	(92,978)	(104,765)	(15,905)	1,111	5,918	8,604	11,251	13,862	16,444	20,017	23,256	17,923
Sensitivity Tests:														
10% Increase in Project Costs	-	(20,286)	(102,275)	(115,242)	(17,580)	888	5,918	8,604	11,251	13,862	16,444	20,017	23,256	17,068
10% Increase in O&M Costs	-	(18,442)	(92,978)	(104,765)	(16,211)	656	5,251	7,765	10,242	12,681	15,094	18,437	21,454	15,901
10% Decrease in Revenue	-	(18,442)	(92,978)	(104,765)	(16,295)	322	4,659	6,905	9,117	11,295	13,450	16,435	19,128	13,254

	NPV @ WACC	FIRR (%)	SI	% Change
Base Case	108,337	6.73%		
10% Increase in Project Costs	86,848	6.03%	1.16	10%
10% Increase in O&M Costs	83,162	6.13%	0.99	10%
10% Decrease in Revenue	50,839	5.31%	2.68	10%

Phnom Penh Water Supply Authority

FIRR & SENSITIVITY ANALYSIS

Million Riels

Stated at 2005 Constant Price	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base Case:														
Project Costs	-	-	-	-	-	-	-	-	-	9,850	-	-	-	-
Incremental O&M	21,881	22,294	22,665	23,022	23,390	23,765	24,087	24,554	24,856	25,146	25,468	25,737	25,995	26,243
Total Incremental Costs	21,881	22,294	22,665	23,022	23,390	23,765	24,087	24,554	24,856	34,996	25,468	25,737	25,995	26,243
Incremental Revenue	50,506	50,992	52,130	53,236	54,309	55,351	56,362	57,344	58,298	59,223	60,122	60,995	61,842	62,664
Net Cash Inflow (Outflow) - Base Case	28,626	28,698	29,466	30,213	30,919	31,586	32,275	32,790	33,442	24,228	34,654	35,258	35,847	36,422
Sensitivity Tests:														
10% Increase in Project Costs	28,626	28,698	29,466	30,213	30,919	31,586	32,275	32,790	33,442	23,243	34,654	35,258	35,847	36,422
10% Increase in O&M Costs	26,438	26,468	27,199	27,911	28,580	29,209	29,867	30,334	30,956	21,713	32,108	32,684	33,247	33,797
10% Decrease in Revenue	23,575	23,599	24,253	24,890	25,488	26,050	26,639	27,055	27,612	18,305	28,642	29,159	29,663	30,155

	NPV @ WACC	FIRR (%)	SI	% Change
Base Case	108,337	6.73%		
10% Increase in Project Costs	86,848	6.03%	1.16	10%
10% Increase in O&M Costs	83,162	6.13%	0.99	10%
10% Decrease in Revenue	50,839	5.31%	2.68	10%

Phnom Penh Water Supply Authority

FIRR & SENSITIVITY ANALYSIS

Million Riels

Stated at 2005 Constant Price	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Base Case:													
Project Costs	-	-	-	-	-	11,987	-	-	-	-	-	-	-
Incremental O&M	26,525	26,839	27,059	27,270	27,471	27,663	27,931	28,106	28,272	28,430	28,579	28,719	28,851
Total Incremental Costs	26,525	26,839	27,059	27,270	27,471	39,649	27,931	28,106	28,272	28,430	28,579	28,719	28,851
Incremental Revenue	63,463	64,238	64,991	65,721	66,431	67,120	67,788	68,437	69,068	69,680	70,274	70,851	71,411
Net Cash Inflow (Outflow) - Base Case	36,938	37,399	37,931	38,452	38,960	27,470	39,857	40,331	40,795	41,250	41,695	42,131	42,560
Sensitivity Tests:													
10% Increase in Project Costs	36,938	37,399	37,931	38,452	38,960	26,272	39,857	40,331	40,795	41,250	41,695	42,131	42,560
10% Increase in O&M Costs	34,285	34,715	35,225	35,725	36,213	24,704	37,064	37,521	37,968	38,407	38,837	39,260	39,674
10% Decrease in Revenue	30,592	30,975	31,432	31,879	32,317	20,758	33,079	33,488	33,889	34,282	34,668	35,046	35,418

	NPV @ WACC	FIRR (%)	SI	% Change
Base Case	108,337	6.73%		
10% Increase in Project Costs	86,848	6.03%	1.16	10%
10% Increase in O&M Costs	83,162	6.13%	0.99	10%
10% Decrease in Revenue	50,839	5.31%	2.68	10%

Phnom Penh Water Supply Authority

EIRR & SENSITIVITY ANALYSIS

Million Riels

Stated at 2005 Constant Price	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Resource Costs:														
Investment Costs	-	16,360	82,479	92,936	14,856	1,978	-	-	-	-	-	-	-	7,584
Incremental O&M	-	-	-	-	3,018	4,487	6,583	8,277	9,967	11,653	13,327	15,600	17,785	19,956
Total Resource Costs	-	16,360	82,479	92,936	17,874	6,466	6,583	8,277	9,967	11,653	13,327	15,600	17,785	27,540
Gross Benefits:														
Resource Cost Savings					3,612	7,421	12,175	16,940	21,713	26,494	31,282	38,227	45,186	52,157
Additional Water Supply					2,340	4,803	7,853	10,893	13,924	16,948	19,964	24,298	28,618	32,925
Water Collection Time Savings					1,271	2,546	4,315	6,084	7,852	9,621	11,390	14,031	16,672	19,313
Total Gross Benefits	-	-	-	-	7,224	14,770	24,343	33,916	43,490	53,063	62,636	76,556	90,475	104,395
Net Cash Inflow (Outflow) - Base Case	-	(16,360)	(82,479)	(92,936)	(10,650)	8,304	17,760	25,639	33,523	41,410	49,309	60,956	72,690	76,855
Sensitivity Tests:														
10% Increase in Investment Costs	-	(17,996)	(90,727)	(102,230)	(12,135)	8,106	17,760	25,639	33,523	41,410	49,309	60,956	72,690	76,097
10% Increase in O&M Costs	-	(16,360)	(82,479)	(92,936)	(10,952)	7,855	17,102	24,812	32,526	40,245	47,977	59,396	70,912	74,860
10% Decrease in Benefits	-	(16,360)	(82,479)	(92,936)	(11,372)	6,827	15,326	22,248	29,174	36,104	43,046	53,300	63,643	66,416

	NPV @ EOCC	EIRR (%)	SI	% Change
Base Case	178,359	17.55%		
10% Increase in Investment Costs	163,140	16.52%	0.63	10%
10% Increase in O&M Costs	169,323	17.24%	0.18	10%
10% Decrease in Benefits	136,268	16.08%	0.92	10%

Phnom Penh Water Supply Authority

EIRR & SENSITIVITY ANALYSIS

Million Riels

Stated at 2005 Constant Price	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Resource Costs:														
Investment Costs	-	-	-	-	-	-	-	-	-	8,738	-	-	-	-
Incremental O&M	21,597	22,005	22,371	22,724	23,086	23,457	23,774	24,236	24,533	24,819	25,137	25,402	25,657	25,902
Total Resource Costs	21,597	22,005	22,371	22,724	23,086	23,457	23,774	24,236	24,533	33,557	25,137	25,402	25,657	25,902
Gross Benefits:														
Resource Cost Savings	57,005	57,005	57,005	57,005	57,005	57,005	57,005	57,005	57,005	57,005	57,005	57,005	57,005	57,005
Additional Water Supply	35,949	35,949	35,949	35,949	35,949	35,949	35,949	35,949	35,949	35,949	35,949	35,949	35,949	35,949
Water Collection Time Savings	21,057	21,057	21,057	21,057	21,057	21,057	21,057	21,057	21,057	21,057	21,057	21,057	21,057	21,057
Total Gross Benefits	114,011	114,011	114,011	114,011	114,011	114,011	114,011	114,011	114,011	114,011	114,011	114,011	114,011	114,011
Net Cash Inflow (Outflow) - Base Case	92,414	92,006	91,640	91,288	90,925	90,554	90,237	89,775	89,478	80,454	88,874	88,609	88,354	88,109
Sensitivity Tests:														
10% Increase in Investment Costs	92,414	92,006	91,640	91,288	90,925	90,554	90,237	89,775	89,478	79,580	88,874	88,609	88,354	88,109
10% Increase in O&M Costs	90,255	89,806	89,403	89,015	88,616	88,209	87,860	87,352	87,025	77,972	86,360	86,068	85,788	85,519
10% Decrease in Benefits	81,013	80,605	80,239	79,886	79,524	79,153	78,836	78,374	78,077	69,053	77,473	77,207	76,953	76,708

	NPV @ EOCC	EIRR (%)	SI	% Change
Base Case	178,359	17.55%		
10% Increase in Investment Costs	163,140	16.52%	0.63	10%
10% Increase in O&M Costs	169,323	17.24%	0.18	10%
10% Decrease in Benefits	136,268	16.08%	0.92	10%

Phnom Penh Water Supply Authority

EIRR & SENSITIVITY ANALYSIS

Million Riels

Stated at 2005 Constant Price	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Resource Costs:													
Investment Costs	-	-	-	-	-	10,633	-	-	-	-	-	-	-
Incremental O&M	26,181	26,491	26,708	26,916	27,114	27,304	27,568	27,741	27,905	28,061	28,208	28,347	28,477
Total Resource Costs	26,181	26,491	26,708	26,916	27,114	37,937	27,568	27,741	27,905	28,061	28,208	28,347	28,477
Gross Benefits:													
Resource Cost Savings	57,005	57,005	57,005	57,005	57,005	57,005	57,005	57,005	57,005	57,005	57,005	57,005	57,005
Additional Water Supply	35,949	35,949	35,949	35,949	35,949	35,949	35,949	35,949	35,949	35,949	35,949	35,949	35,949
Water Collection Time Savings	21,057	21,057	21,057	21,057	21,057	21,057	21,057	21,057	21,057	21,057	21,057	21,057	21,057
Total Gross Benefits	114,011	114,011	114,011	114,011	114,011	114,011	114,011	114,011	114,011	114,011	114,011	114,011	114,011
Net Cash Inflow (Outflow) - Base Case	87,831	87,521	87,303	87,095	86,897	76,074	86,443	86,270	86,106	85,950	85,803	85,665	85,534
Sensitivity Tests:													
10% Increase in Investment Costs	87,831	87,521	87,303	87,095	86,897	75,011	86,443	86,270	86,106	85,950	85,803	85,665	85,534
10% Increase in O&M Costs	85,212	84,871	84,632	84,404	84,185	73,344	83,686	83,496	83,315	83,144	82,982	82,830	82,687
10% Decrease in Benefits	76,429	76,119	75,902	75,694	75,496	64,673	75,042	74,869	74,705	74,549	74,402	74,263	74,133

	NPV @ EOCC	EIRR (%)	SI	% Change
Base Case	178,359	17.55%		
10% Increase in Investment Costs	163,140	16.52%	0.63	10%
10% Increase in O&M Costs	169,323	17.24%	0.18	10%
10% Decrease in Benefits	136,268	16.08%	0.92	10%

Peri-Urban WS EIRR and Sensitivity Analysis - Priority Projects

EIRR AND SENSITIVITY ANALYSIS

Stated at 2005 Constant Price ('000 Riels)	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Resource Costs:														
Investment Costs	-	1,227,719	-	9,085,123	9,085,123	9,085,123	-	-	-	-	-	-	696,299	696,299
O&M Costs	-	-	-	133,177	266,354	399,531	399,531	399,531	399,531	399,531	399,531	399,531	399,531	399,531
Total Resource Costs	-	1,227,719	-	9,218,300	9,351,477	9,484,654	399,531	399,531	399,531	399,531	399,531	399,531	1,095,830	1,095,830
Gross Benefits:														
Resource Cost Savings	-	-	-	877,643	1,755,285	2,632,928	2,632,928	2,632,928	2,632,928	2,632,928	2,632,928	2,632,928	2,632,928	2,632,928
Water Collection Time Savings	-	-	-	835,850	1,671,700	2,507,550	2,507,550	2,507,550	2,507,550	2,507,550	2,507,550	2,507,550	2,507,550	2,507,550
Total Gross Benefits	-	-	-	1,713,493	3,426,985	5,140,478	5,140,478	5,140,478	5,140,478	5,140,478	5,140,478	5,140,478	5,140,478	5,140,478
Net Cash Inflow (Outflow) - Base Case	-	(1,227,719)	-	(7,504,808)	(5,924,492)	(4,344,177)	4,740,946	4,740,946	4,740,946	4,740,946	4,740,946	4,740,946	4,044,647	4,044,647
Sensitivity Tests:														
10% Increase in Investment Costs	-	(1,350,491)	-	(8,413,320)	(6,833,004)	(5,252,689)	4,740,946	4,740,946	4,740,946	4,740,946	4,740,946	4,740,946	3,975,017	3,975,017
10% Increase in O&M Costs	-	(1,227,719)	-	(7,518,125)	(5,951,128)	(4,384,130)	4,700,993	4,700,993	4,700,993	4,700,993	4,700,993	4,700,993	4,004,694	4,004,694
10% Decrease in Benefits	-	(1,227,719)	-	(7,676,157)	(6,267,191)	(4,858,224)	4,226,899	4,226,899	4,226,899	4,226,899	4,226,899	4,226,899	3,530,600	3,530,600

	NPV @ EOC(	EIRR (%)	SI	% Change
Base Case	9,781,074	18.37%		
10% Increase in Investment Costs	7,909,029	16.18%	1.36	10%
10% Increase in O&M Costs	9,540,884	18.17%	0.11	10%
10% Decrease in Benefits	6,690,733	15.76%	1.66	10%

Peri-Urban WS EIRR and Sensitivity Analysis - Priority Projects

EIRR AND SENSITIVITY ANALYSI

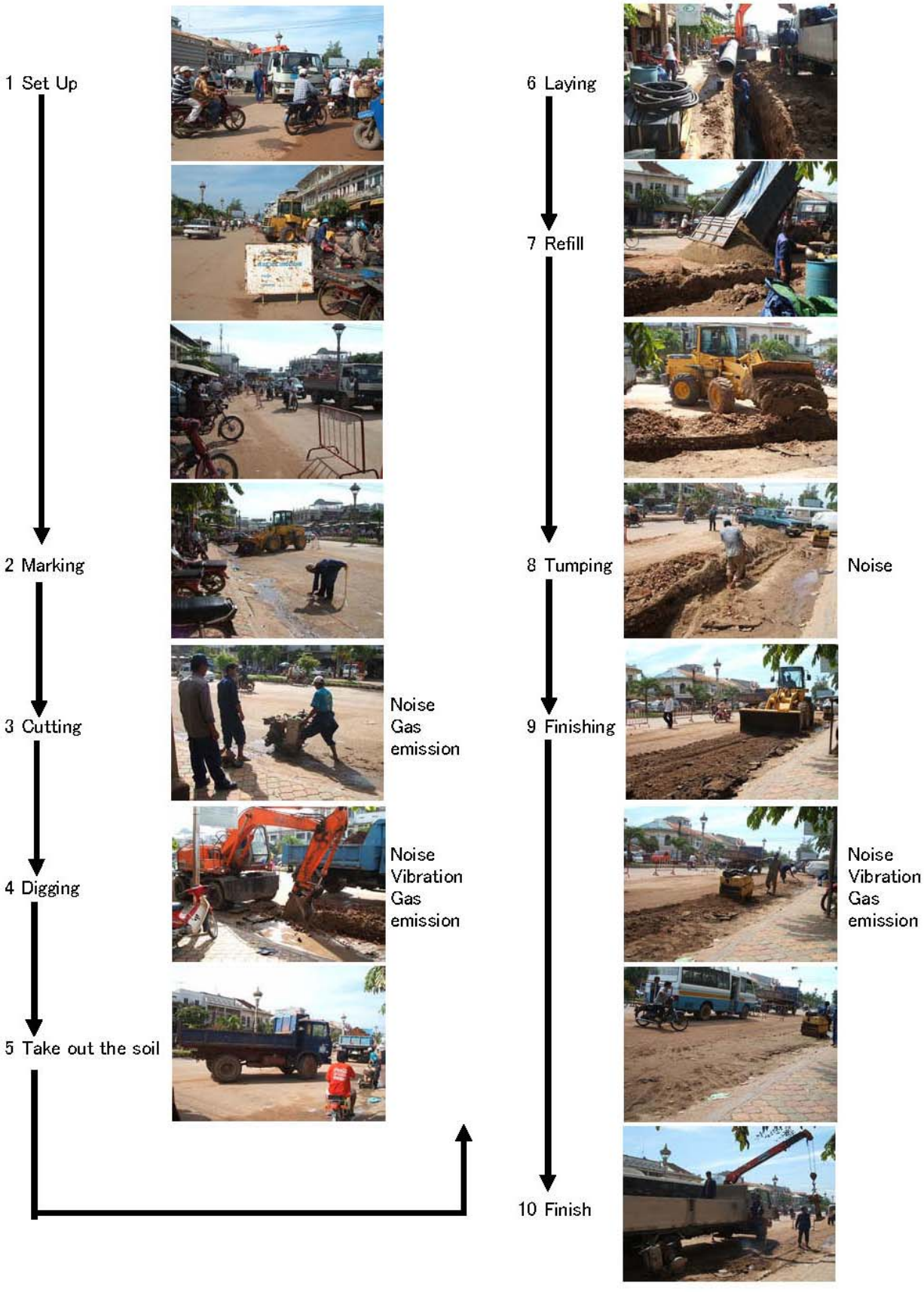
Stated at 2005 Constant Price ('000 Riels)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Resource Costs:												
Investment Costs	696,299	-	-	-	-	-	-	533,655	533,655	533,655	-	-
O&M Costs	399,531	399,531	399,531	399,531	399,531	399,531	399,531	399,531	399,531	399,531	399,531	399,531
Total Resource Costs	1,095,830	399,531	399,531	399,531	399,531	399,531	399,531	933,186	933,186	933,186	399,531	399,531
Gross Benefits:												
Resource Cost Savings	2,632,928	2,632,928	2,632,928	2,632,928	2,632,928	2,632,928	2,632,928	2,632,928	2,632,928	2,632,928	2,632,928	2,632,928
Water Collection Time Savings	2,507,550	2,507,550	2,507,550	2,507,550	2,507,550	2,507,550	2,507,550	2,507,550	2,507,550	2,507,550	2,507,550	2,507,550
Total Gross Benefits	5,140,478	5,140,478	5,140,478	5,140,478	5,140,478	5,140,478	5,140,478	5,140,478	5,140,478	5,140,478	5,140,478	5,140,478
Net Cash Inflow (Outflow) - Base Case	4,044,647	4,740,946	4,740,946	4,740,946	4,740,946	4,740,946	4,740,946	4,207,291	4,207,291	4,207,291	4,740,946	4,740,946
Sensitivity Tests:												
10% Increase in Investment Costs	3,975,017	4,740,946	4,740,946	4,740,946	4,740,946	4,740,946	4,740,946	4,153,926	4,153,926	4,153,926	4,740,946	4,740,946
10% Increase in O&M Costs	4,004,694	4,700,993	4,700,993	4,700,993	4,700,993	4,700,993	4,700,993	4,167,338	4,167,338	4,167,338	4,700,993	4,700,993
10% Decrease in Benefits	3,530,600	4,226,899	4,226,899	4,226,899	4,226,899	4,226,899	4,226,899	3,693,243	3,693,243	3,693,243	4,226,899	4,226,899

	NPV @ EOCC	EIRR (%)	SI	% Change
Base Case	9,781,074	18.37%	-	0%
10% Increase in Investment Costs	7,909,029	16.18%	1.36	10%
10% Increase in O&M Costs	9,540,884	18.17%	0.11	10%
10% Decrease in Benefits	6,690,733	15.76%	1.66	10%

Supporting Report – 14

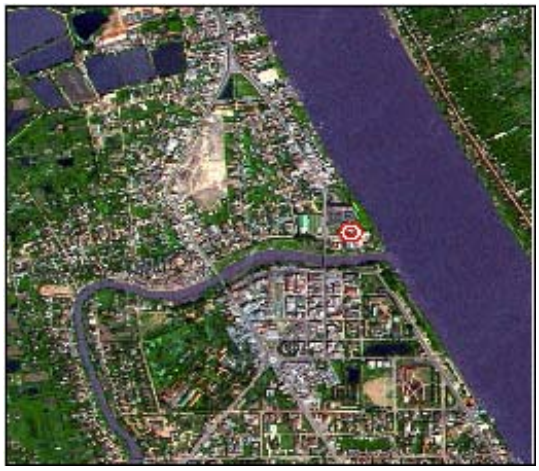
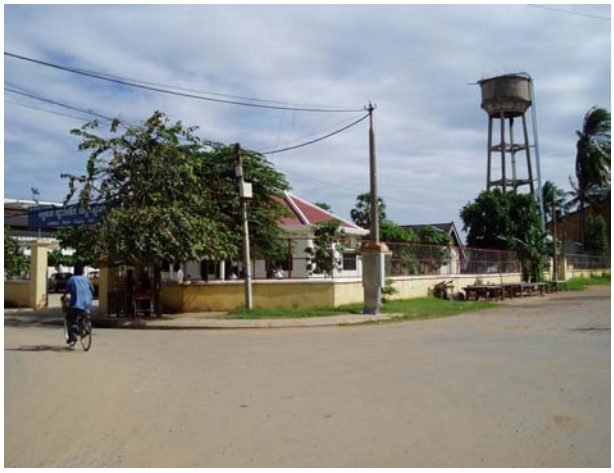
Environmental Impact Assessment

Supporting Report 14.1 Pipe laying procedures

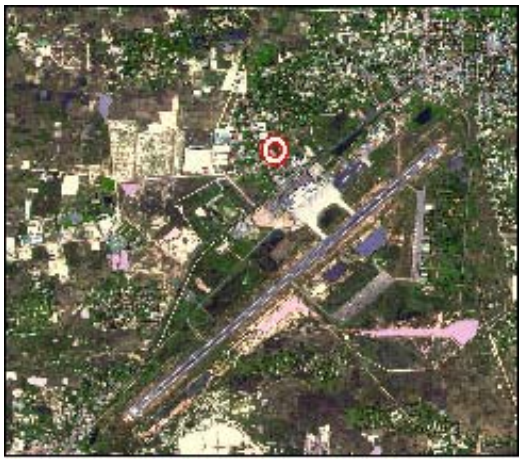


Supporting Report 14.2 Photos of Around the Water Tower and Booster Pump Project Sites

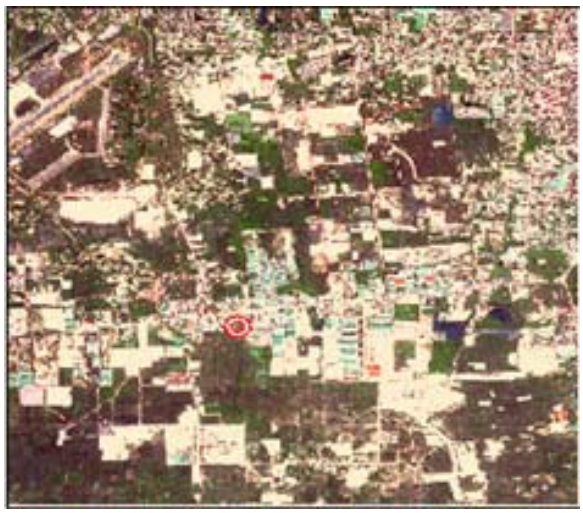
(1) Ta Khmau

	
Location map of Ta Khmau Water Tower	Present facilities in Ta Khmau Waterworks

(2) Airport (Airport North)

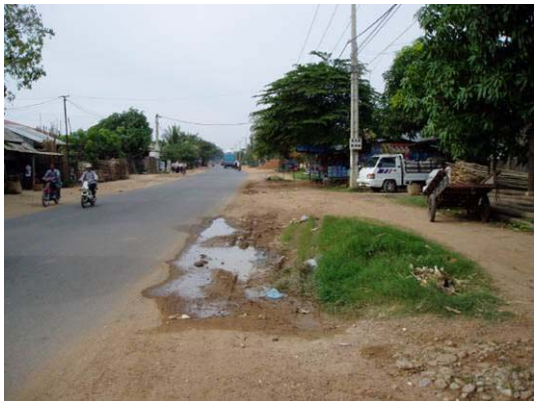
	
Location map of Airport Water Tower	On going construction of the Water Tower

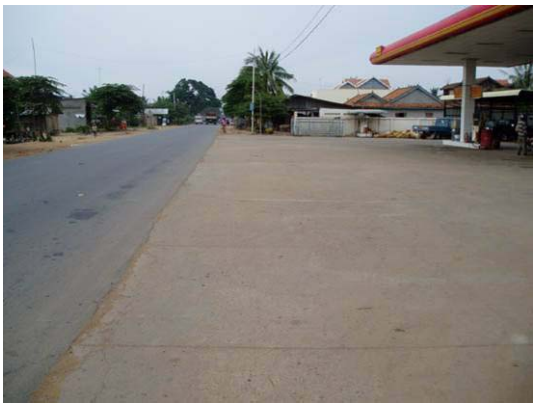
(3) Airport South

	
Location map of Chaom Chau Water Tower	On going construction of the Water Tower

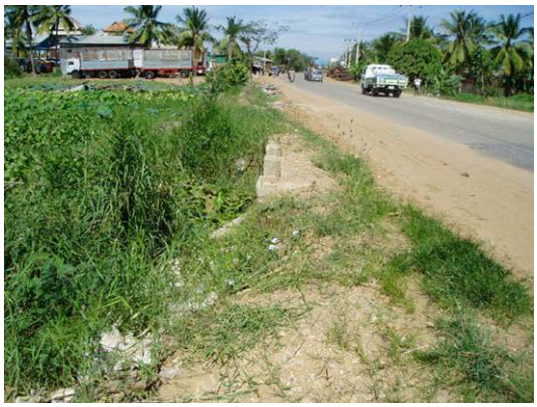
Supporting Report 14.3 Typical Images from the Target Areas for Pipeline Construction

Prek Leap

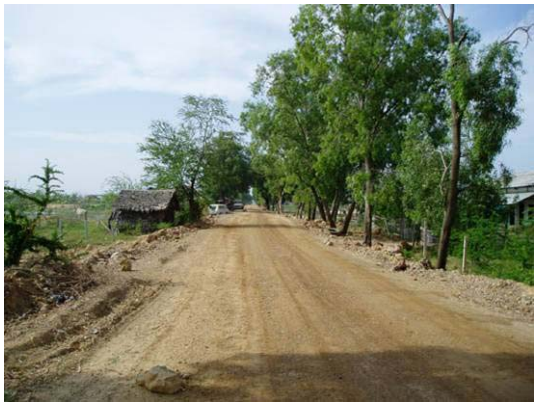




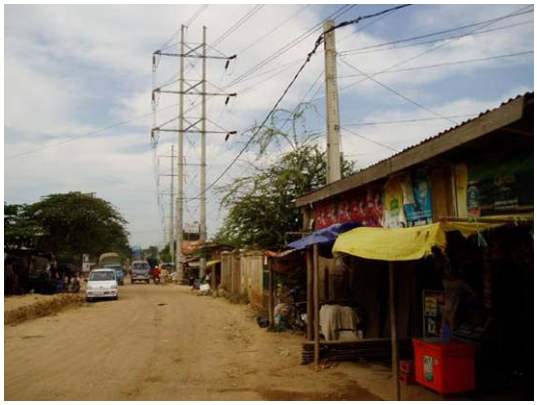
Ruessei Kaev



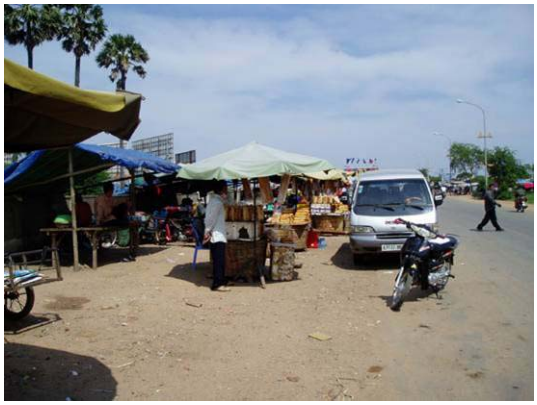
Svay Pak

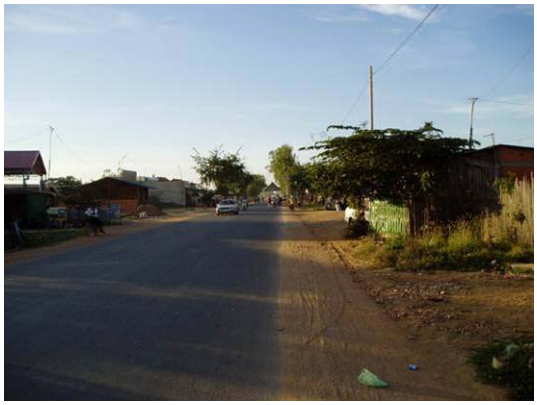


Phnom Penh Thmei

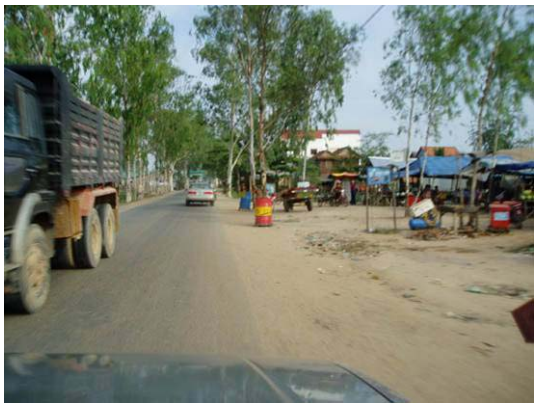


Prey Pring Choeung (Chaom Chau)

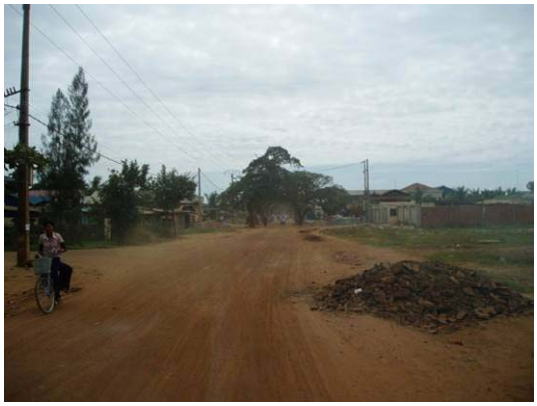




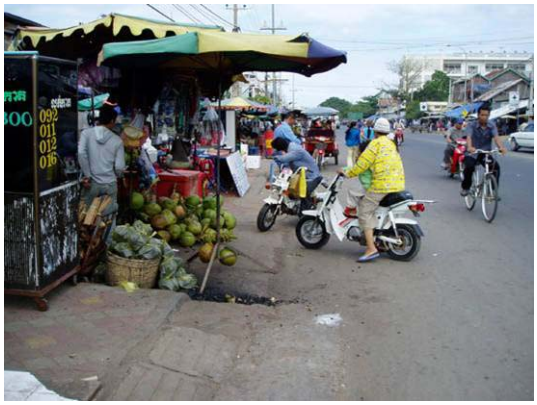
Samraong Krom



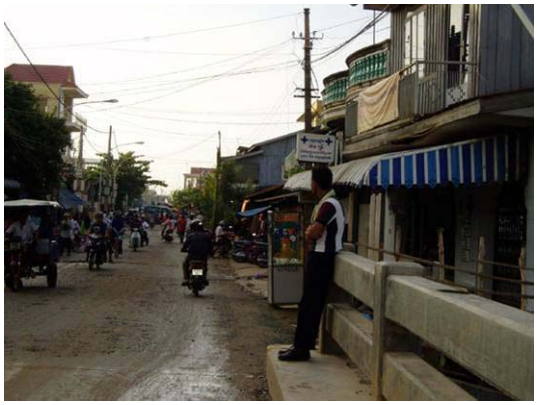
Dangkao

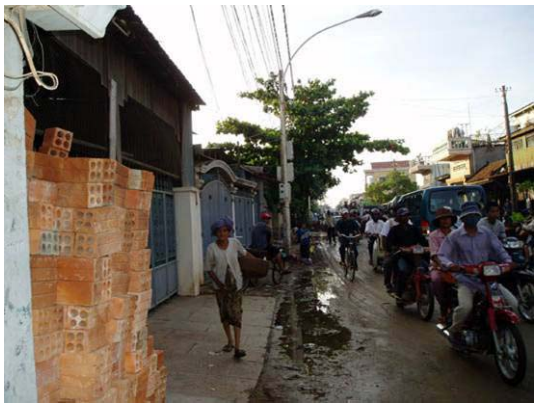


Ta Khmau

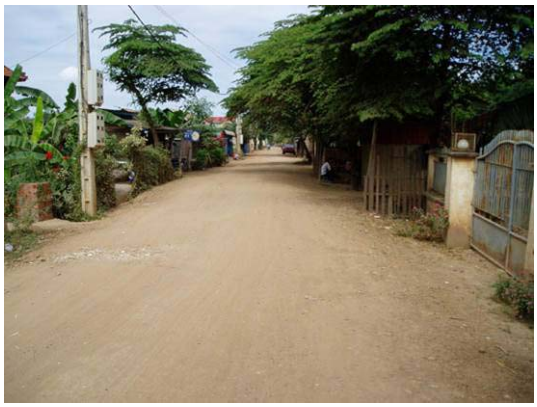


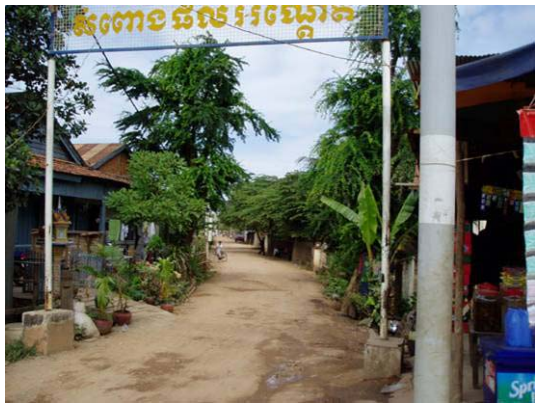
Prek Pra





Kien Svay (Chbar Ampov 1+2)





Supporting Report 14.4 Cambodian Environmental Standards

1. Water Quality Standards

No : 27 ANRK.BK SUB-DECREE on WATER POLLUTION CONTRL

(1) Water Quality Standard in public water areas for bio-diversity conservation (River)

No	Parameter	Unit	Standard Value
1	pH	mg/l	6.5 – 8.5
2	BOD_5	mg/l	1 – 10
3	Suspended Solid	mg/l	25 – 100
4	Dissolved Oxygen	mg/l	2.0 - 7.5
5	Coliform	MPN/100ml	< 5000

(2) Effluent standard for pollution sources discharging wastewater to public water areas or sewer

Nº	Parameters	Unit	Allowable limits for pollutant substance discharging to	
			Protected public water area	Public water area and sewer
1	Temperature	^0C	< 45	< 45
2	pH		6 – 9	5 - 9
3	BOD_5 (5 days at 200 C)	mg/l	< 30	< 80
4	COD	mg/l	< 50	< 100
5	Total Suspended Solids	mg/l	< 50	< 80
6	Total Dissolved Solids	mg/l	< 1000	< 2000
7	Grease and Oil	mg/l	< 5.0	< 15
8	Detergents	mg/l	< 5.0	< 15
9	Phenols	mg/l	< 0.1	< 1.2
10	Nitrate (NO_3)	mg/l	< 10	< 20
11	Chlorine (free)	mg/l	< 1.0	< 2.0
12	Chloride (ion)	mg/l	< 500	< 700
13	Sulphate (as SO_4)	mg/l	< 300	< 500
14	Sulphide (as Sulphur)	mg/l	< 0.2	< 1.0
15	Phosphate (PO_4)	mg/l	< 3.0	< 6.0
16	Cyanide (CN)	mg/l	< 0.2	< 1.5
17	Barium (Ba)	mg/l	< 4.0	< 7.0
18	Arsenic (As)	mg/l	< 0.10	< 1.0
19	Tin (Sn)	mg/l	< 2.0	< 8.0
20	Iron (Fe)	mg/l	< 1.0	< 20
21	Boron (B)	mg/l	< 1.0	< 5.0
22	Manganese (Mn)	mg/l	< 1.0	< 5.0
23	Cadmium (Cd)	mg/l	< 0.1	< 0.5
24	Chromium (Cr)$^{+3}$	mg/l	< 0.2	< 1.0
25	Chromium (Cr)$^{+6}$	mg/l	< 0.05	< 0.5
26	Copper (Cu)	mg/l	< 0.2	< 1.0
27	Lead (Pb)	mg/l	< 0.1	< 1.0
28	Mercury (Hg)	mg/l	< 0.002	< 0.05
29	Nickel (Ni)	mg/l	< 0.2	< 1.0
30	Selenium (Se)	mg/l	< 0.05	< 0.5
31	Silver (Ag)	mg/l	< 0.1	< 0.5
32	Zinc (Zn)	mg/l	< 1.0	< 3.0
33	Molybdenum (Mo)	mg/l	< 0.1	< 1.0

Nº	Parameters	Unit	Allowable limits for pollutant substance discharging to	
			Protected public water area	Public water area and sewer
34	Ammonia (NH_3)	mg/l	< 5.0	< 7.0
35	DO	mg/l	>2.0	>1.0
36	Polychlorinated Byphemyl	mg/l	<0.003	<0.003
37	Calcium	mg/l	<150	<200
38	Magnesium	mg/l	<150	<200
39	Carbon tetrachloride	mg/l	<3	<3
40	Hexachloro benzene	mg/l	<2	<2
41	DTT	mg/l	<1.3	<1.3
42	Endrin	mg/l	<0.01	<0.01
43	Dieldrin	mg/l	<0.01	<0.01
44	Aldrin	mg/l	<0.01	<0.01
45	Isodrin	mg/l	<0.01	<0.01
46	Perchloro ethylene	mg/l	<2.5	<2.5
47	Hexachloro butadiene	mg/l	<3	<3
48	Chloroform	mg/l	<1	<1
49	1,2 Dichloro ethylene	mg/l	<2.5	<2.5
50	Trichloro ethylene	mg/l	<1	<1
51	Trichloro benzene	mg/l	<2	<2
52	Hexaxhloro cyclohexene	mg/l	<2	<2

Remark: The Ministry of Environment and the Ministry of Agriculture, Forestry and Fishery shall collaborate to set up the standard of pesticides which discharged from pollution sources.

(3) Water Quality Standard in public water areas for public health protection

No	Parameter	Unit	Standard Value
1	Carbon tetrachloride	µg/l	< 12
2	Hexachloro-benzene	µg/l	< 0.03
3	DDT	µg/l	< 10
4	Endrin	µg/l	< 0.01
5	Diedrin	µg/l	< 0.01
6	Aldrin	µg/l	< 0.005
7	Isodrin	µg/l	< 0.005
8	Perchloroethylene	µg/l	< 10
9	Hexachlorobutadiene	µg/l	< 0.1
10	Chloroform	µg/l	< 12
11	1,2 Trichloroethylene	µg/l	< 10
12	Trichloroethylene	µg/l	< 10
13	Trichlorobenzene	µg/l	< 0.4
14	Hexachloroethylene	µg/l	< 0.05
15	Benzene	µg/l	< 10
16	Tetrachloroethylene	µg/l	< 10
17	Cadmium	µg/l	< 1
18	Total mercury	µg/l	< 0.5
19	Organic mercury	µg/l	0
20	Lead	µg/l	< 10
21	Chromium, valent 6	µg/l	< 50
22	Arsenic	µg/l	< 10
23	Selenium	µg/l	< 10
24	Polychlorobiohenyl	µg/l	0
25	Cyanide	µg/l	< 0.005

(4) Type of pollution sources required having a permission from Ministry of Environment before discharging or transporting their wastewater

Nº	Type of pollution sources	Category
1	Canned food and meat manufacturing	I
2	Canned vegetable and fruit manufacturing	I
3	Aquatic production processing	I
4	Frozen manufacturing	I
5	Flour manufacturing	I
6	Sugar manufacturing	I
7	Pure drinking water manufacturing	I
8	Brick manufacturing	I
9	Soft drink manufacturing and brewery	I
10	Wine and alcohol manufacturing	I
11	Feed mill manufacturing	I
12	Oil and fat manufacturing	I
13	Yeast manufacturing	I
14	Cake and sweet manufacturing	I
15	Cigarette manufacturing	I
16	Garment manufacturing without chemical washing	I
17	Hotel	I
18	Restaurant	I
19	Animal farm	I
20	Slaughter – house	I
21	Garage and car cleaning	I
22	Business center	I
23	Hospital and clinic	I
24	Plastic manufacturing	I
25	Sewage treatment plant	I
26	Gelatin and Glue manufacturing	I
27	Natural resin manufacturing	I
28	Glass manufacturing	I
29	Cement manufacturing	I
30	Macadam quarrying	I
31	Gravel quarrying	I
32	Wood processing	I
33	Fertilizer manufacturing	I
34	Mixed concrete manufacturing	I
	Category II omitted.	

Category I are subject to the prior permit from the Ministry of Environment when the amount of their effluent exceed ten cubic meter per day (10 M3 /day) but not including the amount of water volume used for cooling the engine.

Category II shall be necessarily required to apply for the permission from the Ministry of Environment.

2. Air Pollution

(1) Maximum allowable standard of pollution substance for immobile sources in ambient air

No	Parameters	Maximum level of discharge
1	Particulate in smoke of :	
	Incinerator	0.4g/m3
	Heating metal	400mg/m3
	Bad stone , Lime , cement manufacturing	400mg/m3
	Asphalt concrete plant	500mg/m3
	Other sources	
2	Dust :	
	Containing silica (Sio2)	100mg/m3
	Containing asbestos	27ug/m3
	Chemical inorganic substance	
3	Aluminum Al	(dust)300mg/m3 ;(Al)50mg/m3
4	Ammonia NH3	100mg/m3
5	Antimony Sb	25mg/m3
6	Arsenic As	20ug/m3
7	Berylium Be	10mg/m3
8	Chloride Cl	20mg/m3
9	Hydrogen chloride HCl	200mg/m3
11	Hydrogen sulfide H2S	2mg/m3
12	Cadmium Cd	1mg/m3
13	Copper Cu	(dust)300mg/m3; (Cu)20mg/m3
14	Lead Pb	(dust)100mg/m3 ; (Cu)20mg/m3
15	Zinc Zn	30mg/m3
16	Mercury Hg	0.1mg/m3
17	Carbon monoxide CO	1000mg/m3
18	Sulfur dioxide SO2	500mg/m3
19	Nitrogen oxide NOx (all category)	1000mg/m3
20	Nitrogen oxide NOx (emittedHNO3 product)	2000mg/m3
21	Sulfuric Acid H2SO4	35mg/m3
22	Acetic Acid HNO3	70mg/m3
23	Sulfur trioxide SO3	35mg/m3
24	Phosphoric Acid H3PO4	3mg/m3
	Chemical organic substance	
	(omitted)	

Remark: This standard is applied to control of pollution substance for immobile sources to atmosphere.

(2) Gas emission standard of mobile sources

Nº	Kind of Vehicle	Kind of fuel	Level of emission				
			CO(%)		HC(ppm)		Dark fume %
			A	B	A	B	-
1	Motorcycle contain 2chapter combustion	Petrol	4.5	4	10000	3000	-
2	Motorcycle contain 4 chapter combustion	Petrol	4.5	4	10000	2400	-
3	**All kind of vehicles**	**Petrol**	**4.5**	**4**	**10000**	**800**	**-**
4	**All kind of vehicles**	**Diesel**	**-**	**-**	**-**	**-**	**50**

Remark: This Standard applied to control of noise emission of mobile sources into atmosphere.
A : Refer to all kind of vehicles used over 5 years as from year produce.
B : Refer to all kind of vehicles are new importation in first 5 years as from year produced.

(3) Sulfur, lead, Benzene, and Aromatic Hydrocarbons standard permitted to fuel and other combustion substances

Nº	Combustion Substance	Sulfur (S)	Lead (Pb)	Benzene	Aromatic Hydrocarbons
1	Fuel Oil	1.0%			
2	Diesel	0.2%			
3	Petrol	-	0.15g/l	3.5%	50%
4	Coal	1.5%			

Remark: This standard applied to control of Sulfur, lead, Benzene, and Aromatic Hydrocarbons that permitted to fuel and coal

3. Noise

(1) Vehicle of noise in public and residential area maximum permitted noise level

Nº	Category of vehicle	Maximum noise level permitted (dB(A))
1	Motorcycles, cylinder capacity (CC) of the engine does not exceed 125cm3	85
2	Motorcycles, CC of the engine exceeds 125cm	90
3	Motorize tricycles	90
4	Cars, taxi, passenger vehicle for the carriage of not more than 12 passengers	80
5	Passenger vehicle constructed for carriage of more than 12 passengers	85
6	**Truck permitted maximum weight does not exceed 3.5 tones**	**85**
7	**Truck permitted maximum weight does not exceed 3.5 tones**	**88**
8	**Truck engine is more than 150 KW**	**89**
9	**Tractor or any other truck not elsewhere classified of described in this column of the table**	**91**

Remark: This standard is applied to control of noise emission standard for all kind of vehicle when operating on the public road.

(2) Maximum permitted noise level in public and residential area (dB(A))

Nº	Area	Period of time		
		From 6h AM to 18h	From 18h to 22h	From 22h to 6hAM
1	Quiet areas - Hospitals - Libraries - School - Kindergarten	45	40	35
2	Residential area: - Hotels - Administration offices - House	60	50	45
3	Commercial and service areas and mix	70	65	50
4	Small industrial factories intermingling in residential areas	75	70	50

Remark: This standard is applied to control of noise level of any source of activity that emitted noise into the public and residential areas.

Supporting Report 14.5 Results of Field Study of the Target Villages for Well Construction Project

Dangkor District					
N	**Village**	**Well Mngmt**	**Groundwater quality**	**Water shortage**	**Observed Relative Significance of Water Shortage**
1	Toul Key	Possible to form committee for well management (2)	Not good according to some family who have hand pump well with depth only 20-30m 2	Using water from ponds during rainy season. Lack of water source during dry season. Buy water. 3	B
2	Koppluk	There is committee for well management exist for PRDWS-JCFC	Good from PRDWS-JCFC wells	2 wells provided by PRDWS-JCFC	C
3	Prey Ro Ngeang	Use to have committee for well management 2	Not so good from private hand pump wells with depth of 20-30m. 2	Using water from ponds, dug well and hand pump well. Lack of water.	B
5	Phleung Chhea Roteh Lech	There is committee for well management	Not so good from private hand pump wells with depth of 20-30m.	Lack of water for drinking.	A
6	Phleung Chhea Roteh Keut	Use to have committee for well management.	Not so good from private hand pump wells with depth of 20-30m.	Lack of water for drinking	A
7	Kork Khasch	Use to have committee but not so good in term of collective activity	Not so good from private hand pump wells with depth of 20-30m. Not good for drinking.	Lack of water for drinking.	B
8	Prey Key	No existing committee for well management, but there is possibility to create.	Not so good from private hand pump wells with depth of 20-30m. Not good for drinking.	Lack of water for drinking.	B
9	Sre Nhor	No existing committee for well management, but there is possibility to create.	Not so good from private hand pump wells with depth of 20-30m. Not good for drinking.	Lack of water for drinking. Buy water for drinking.	A
10	Khleh Samday	There is committee for well management exist for PRDWS-JCFC	Not so good from private hand pump wells with depth of 20-30m, but good from PRDWS-JCFC well.	Shortage of water. Wait long queue to use PRDWS-JCFC well. Some house to far from this well location.	B
11	Prey Key A (Kor)	No existing committee for well management, but there is possibility to create.	Not good for drinking purpose.	Only 1-2 hand pump well with depth of 20-30 m. Majority use water from hand dug wells. Lack of water for drinking	A
12	Prey Key B (Kha)	There is committee for well management exist for PRDWS-JCFC	Good from PRDWS-JCFC wells.	Still need to wait long queue to use PRDWS-JCFC well. Some house to far from this well location.	B

Dangkor District					
N	**Village**	**Well Mngmt**	**Groundwater quality**	**Water shortage**	**Observed Relative Significance of Water Shortage**
13	Tram Daok	There is committee for well management exist for PRDWS-JCFC	Good from PRDWS-JCFC wells.	Fairly enough water for use in the village	C
14	Trapaing Sala	No existing committee for well management, but there is possibility to create.	Not so good from private hand pump wells with depth of 20-30m. Not good for drinking.	Lack of water for drinking. Buy water for drinking.	A
15	Prey Veng Lech	No existing committee for well management, but there is possibility to create.	Not good from hand pump and hand dug wells with depth less than 30m. not good for drinking	Shortage of water, especially for drinking purpose	A
16	Kam Rieng	No existing committee for well management, but there is possibility to create.	Not good from hand pump and hand dug wells with depth less than 30m. not good for drinking	Shortage of water, especially for drinking purpose	A
17	Rol Chrouk	No existing committee for well management, but there is possibility to create.	Not good from hand pump and hand dug wells with depth less than 30m. not good for drinking	Have hand pump wells for most of the family. Some families can not afford to build.	B
18	Serey Day Dos	No existing committee for well management, but there is possibility to create.	Water quality in the river not good for drinking purpose.	No water in the river in dry season. Contractors drill wells in the bed of river to get ground water to sell to villagers. Still shortage.	B
19	Toul Sambour	No existing committee for well management, but there is possibility to create.	Not good from hand pump and hand dug wells with depth less than 30m. not good for drinking	There are two common wells in the village, but not enough compare to area of the village.	B
20	Prey Sa Keut	There is committee for well management exist for PRDWS-JCFC	Good from PRDWS-JCFC wells.	Still need to wait long queue to use PRDWS-JCFC well. Some house to far from this well location.	B
21	Anlong Kong	There is committee for well management exist for PRDWS-JCFC	Good from PRDWS-JCFC wells.	Still need to wait long queue to use PRDWS-JCFC well. Some house to far from this well location.	B
22	Piem	There is committee for well management exist for PRDWS-JCFC	Good from PRDWS-JCFC wells.	Still need to wait long queue to use PRDWS-JCFC well. Some house to far from this well location.	B
23	Kraing Svay	There is committee for well management exist for PRDWS-JCFC	Before the water quality was good from PRDWS-JCFC well, but now not so good.	Still need to wait long queue to use PRDWS-JCFC well. Some house to far from this well location.	B

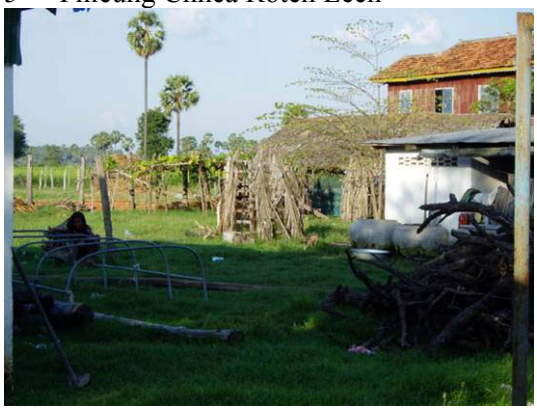
Dangkor District					
N	**Village**	**Well Mngmt**	**Groundwater quality**	**Water shortage**	**Observed Relative Significance of Water Shortage**
24	Kraing Pong Ro	There is committee for well management exist for PRDWS-JCFC	Good from PRDWS-JCFC wells.	Still need to wait long queue to use PRDWS-JCFC well. Some house to far from this well location.	B
25	Teuk Thla	No existing committee for well management, but there is possibility to create.	Not good for drinking purpose	Most houses have hand pump well, but lack of water for drinking purpose.	B
26	Prey Sampor	No existing committee for well management, but there is possibility to create.	Not good for drinking purpose	Almost all houses have hand dug well. but lack of water for drinking purpose.	B
27	Prateah Lang	There is committee for well management exist for PRDWS-JCFC	Good from PRDWS-JCFC wells.	There are three PRDWS-JCFC wells in the village, fairly enough for use in the village	C
28	Phea	There is committee for well management exist for PRDWS-JCFC	Good from PRDWS-JCFC wells.	Still need to wait long queue to use PRDWS-JCFC well. Some house to far from this well location.	B
29	Ang	There is committee for well management exist for PRDWS-JCFC	Good from PRDWS-JCFC wells.	There is one PRDWS-JCFC well in the school, houses nearby can use. Almost all houses use hand dug wells. Lack of water for drinking.	A
30	Taing Roneam	No existing committee for well management, but there is possibility to create.	Not good for drinking purpose	Almost all houses have hand pump or hand dug well, but lack of water for drinking purpose.	B
31	Kok Khsach	No existing committee for well management, but there is possibility to create.	Fairly good, but still not really good for drinking purpose	There one common well in the village and almost all houses have hand pump or hand dug well.	C
32	Kok Meas	No existing committee for well management, but there is possibility to create.	Not good for drinking purpose	Use water from ponds and hand dug wells. There water shortage. few hand pump wells.	A
33	Kraing Tapho	There is committee for well management exist for PRDWS-JCFC	Water quality from PRDWS-JCFC wells not so good, there is smell.	Two PRDWS-JCFC wells in the village	C

Ta Khmau District					
N	**Village**	**Well Mngmt**	**Groundwater quality**	**Water shortage**	**Observed Relative Significance of Water Shortage**
34	Preaek Kat	No existing committee for well management, but there is possibility to create.	Not good for drinking purpose, especially in dry season.	Almost all houses have hand pump, but lack of water for drinking purpose.	B
35	Preaek Long	No existing committee for well management, but there is possibility to create.	Not good for drinking purpose, especially in dry season.	Almost all houses have hand pump, but lack of water for drinking purpose. There is one common well provided by LWS.	B
36	Preaek Reang	No existing committee for well management, but there is possibility to create.	Not good for drinking purpose, especially in dry season.	Almost all houses have hand pump, but lack of water for drinking purpose.	B
37	Krabau	No existing committee for well management, but there is possibility to create.	Not good for drinking purpose, especially in dry season.	Almost all houses have hand pump, but lack of water for drinking purpose.	B

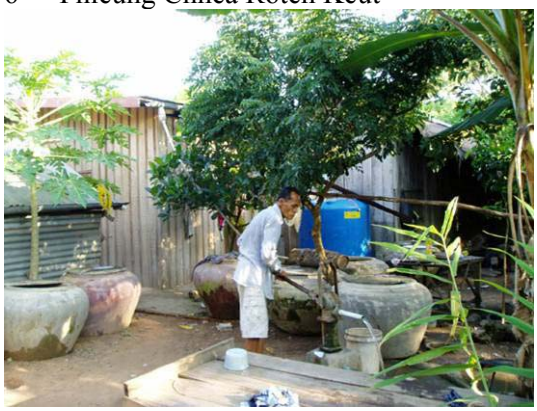
Kien Svay District					
N	**Village**	**Well Mngmt**	**Groundwater quality**	**Water shortage**	**Observed Relative Significance of Water Shortage**
38	Mitakpheap	No existing committee for well management, but there is possibility to create.	Not so good for drinking purpose	Use hand pump well and pipe water supply by private contractor.	C
39	Tuol Ta Chan	No existing committee for well management, but there is possibility to create.	Not so good for drinking purpose	Use hand pump well and pipe water supply by private contractor.	C
40	Chong Preaek	No existing committee for well management, but there is possibility to create.	Not so good for drinking purpose	Use hand pump well and pipe water supply by private contractor.	C
41	Roboah Angkanh	No existing committee for well management, but there is possibility to create.	Not so good for drinking purpose	Most of the houses have hand pump well, but still lack of water for drinking purpose.	B
42	Campuh K'aek	No existing committee for well management, but there is possibility to create.	Not so good for drinking purpose	Most of the houses have hand pump well, but still lack of water for drinking purpose.	B
43	Kaoh Krabei	No existing committee for well management, but there is possibility to create.	Not so good for drinking purpose	Use hand pump well and pipe water supply by private contractor.	C

Supporting Report 14.6 Typical Images from the Target Villages for Well Construction Project

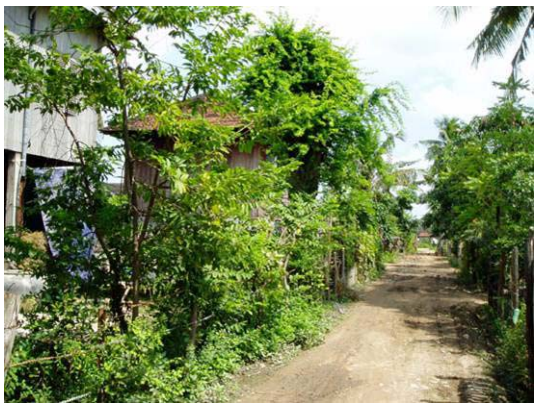
5 Phleung Chhea Roteh Lech



6 Phleung Chhea Roteh Keut

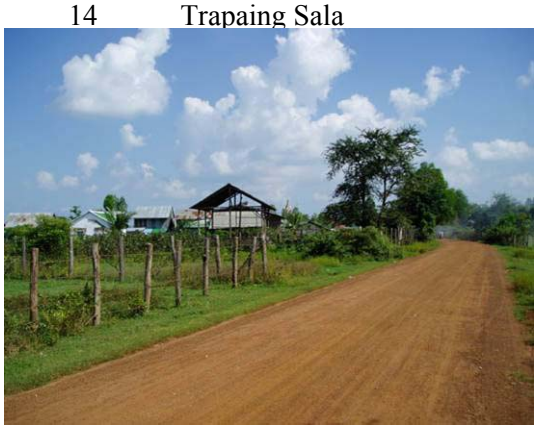


9 Sre Nhor

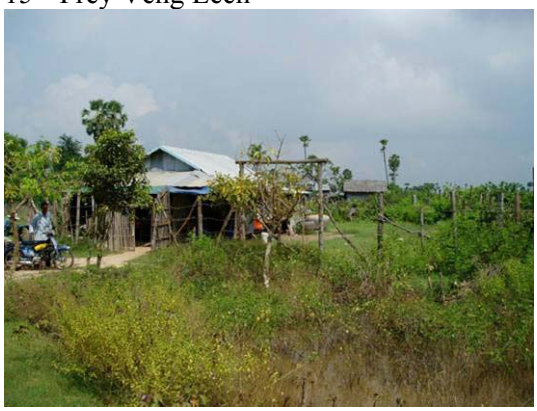


11 Prey Key A (Kor)

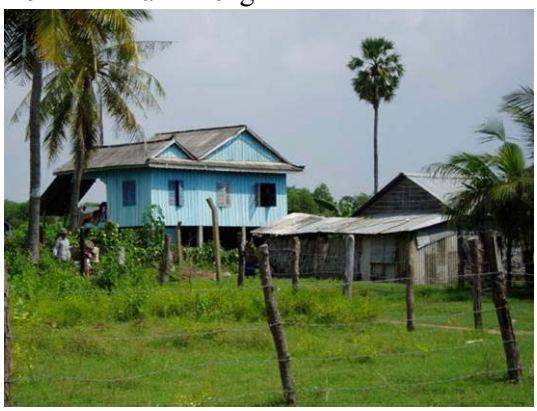
14 Trapaing Sala



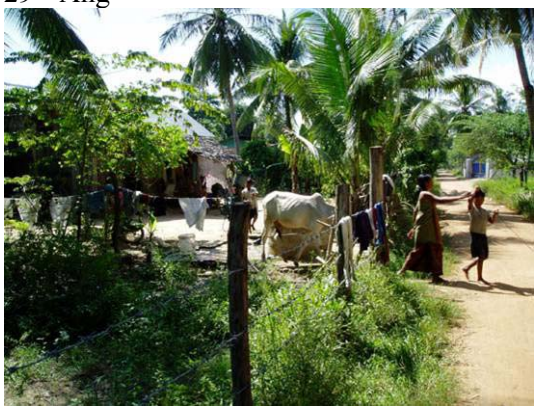
15 Prey Veng Lech



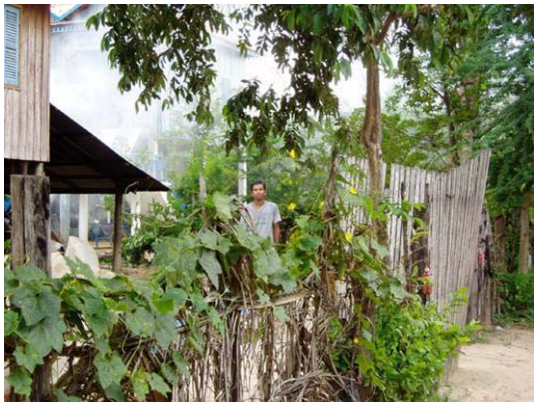
16 Kam Rieng

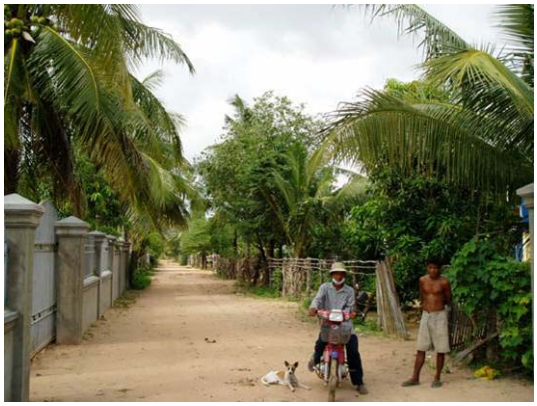


29 Ang



32 Kok Meas





Supporting Report 14.7 Attendants at 1st Seminar on the Master Plan Study

Attendants from Local Offices		
Name	**Institution**	**Position**
Mung Samon	Kean Svey	Deputy Governer District
Vong Meng	Ang Snol	Deputy Governer
Long Yan	Kandal Province	Vice Chief Dept.
Chun	Preak Pnove	Officer
Soum Riththy	Toul Kork District	Deputy Governer
Try Narin	7 Makara District	Deputy Governer
Nou Sakorn	Takmao District	Deputy Governer
Ek Koneoun	Daun Penh	Deputy Governer
Kong Tithea	Russey Keo	Vice President
Mean Channy	Ponnear Lour	Deputy Governer District
Sim Soulong	Dong Kor District	Deputy Governer
Nou Dim	Kandal Province	Secretary-ganeral
Mom Sandap	Phnom Penh Municipality , Planning(BAU)	Director
Chiek Ang	Phnom Penh Environment Dept	Dept. DOE
Ieng Aunny	Phnom Penh Municipality	Deputy Chief of Cabinet
Moung Sophear	Phnom Penh Municipality	Head of office

Attendants from National Offices		
Name	**Institution**	**Position**
Sok Sokontea	Department of Health	Vice Chief
Choun Nearin	Ministry of Planning	Deputy Director
Sok Theary	Ministry of Planning	Officer
Mao Saray	Ministry of Rural Development	Director Dept.
Dim Kimhon	Council for the Development of Cambodia	Officer
Harumi Okawa	Council for the Development of Cambodia	JICA Expert
Keo Sovannarith	DD.W.S	DGD
Sor Syvutha	Ministry of Public Works and Transportation	E.n
Tan Sokchea	Ministry of Industry, Mining and Energy	Chief of Office
Meng Saktheara	Ministry of Industry, Mining and Energy	Deputy Director

Attendants from International Offices		
Name	**Institution**	**Position**
Bun Veasna	World Bank	Officer
Nida Ouk	ADB	Org. Officer

Attendants from PPWSA		
Name	**Institution**	**Position**
Long Naro	PPWSA	DGD
Sem Donmeng	PPWSA	DGD
Chea Visot	PPWSA	Asist. GD
Sim Khenglin	PPWSA	Dir. Commercial Dept.
Ros Kimleang	PPWSA	Dir. Accounting & Finance
Khut Vuthiarith	PPWSA	Director Dept.
Chea Satephoat	PPWSA	Office Manager
Lim Songkri	PPWSA	Office Manager
Lagh Phatana	PPWSA	Office Manager
Chou Phalla	PPWSA	Manager
Roeun Nary	PPWSA	Chief of officer
Ma Noravin	PPWSA	Cheif of Tech. Project
Som Sovann	PPWSA	PTD
Lea Youleng	PPWSA	PMU
Oeur Luxe	PPWSA	Adm.
Goun Chantrea	PPWSA	Officer
Ros Deth	PPWSA	
Lim Sokkom	PPWSA	
Heng Sophanara	PPWSA	
Meach Sorin	PPWSA	
Churn Tean	PPWSA	

Attendants fron JICA and related organizations		
Name	**Institution**	**Position**
Itsu Adachi	JICA Tokyo	Group Director
Tomohiro Ono	JICA Cambodia	A.R.R
Yamamoto Keiko	JICA	JICA Expert, Chief Advisor of Project
Kazuya Kubota	JICA	JICA Expert
Hiroshi Sasayama	JICA	JICA Expert
Yariuchi Mina	JICA Water Supply Project	Coordinator
Kazumasa Mori	Kitakyushu City W.W	Director General
Takayama	Kitakyushu City W.W	
Yoshihiko Sato	JICA Study Team	Team Leader
Wilfrido Barreiro	JICA Study Team	CB. Specialist
Stetten Guillaume	JICA Study Team	NJS
Chank Chhuong	STC	Interpreter

Supporting Report 14.8 Attendants at 2nd Seminar on the Master Plan Study

No	Name	Intitution	Position
1	Sen Piseth	Phnom Penh Munitipal Health Dept.	Deputy
2	Nget Kem	Phnom Penh Municipality	
3	Takeak Roukphoan	Toul Kork district	Deputy Governer
4	Hem Sodak	Chamkar Morn district	Official
5	Jon Socheat	Takmao City	Vice Chief district
6	Kut Kunly	Preak Pnov districtClean water	Represatative of Company
7	Enk Kundoeun	Doun Penh district	

No	Name	Intitution	Position
8	Enk Sonchan	PPWSA	General Director
9	Long Naro	PPWSA	Deputy Director
10	Meach Sarin	PPWSA	MD
11	Heng Sophanarath	PPWSA	AD. Chief
12	Noun Sophorn	PPWSA	Vice Chief
13	Chorn Tean	PPWSA	Director of customer service
14	To Chheng	PPWSA	Director of Income dept.
15	Goeun Chantrea	PPWSA	Director of Finance dept.
16	Samreth Sovithia	PPWSA	Director of Planning&Technical Dept.
17	Ros Kimleang	PPWSA	Director Accountant & Finance Dept.
18	Khut Vuthiarith	PPWSA	Director of Production&Distribution
19	Sim Khenglin	PPWSA	Director of Commerce dept.
20	Cher Visorth	PPWSA	AcGD
21	Leah Vathana	PPWSA	Accountant
22	Ros Deth	PPWSA	Production
23	Ou Khunavath	PPWSA	Design & Project
24	Lim longkry	PPWSA	Distribution

No	Name	Intitution	Position
25	Ung Vuthy	Ministry of Enviroment, EIA dept. ,	Directir dept.
26	Khoy Khim	Min. Industry, Mining, Energy	Officer
27	Pou Manith	Min.Public Work&Transportation	Civil Engineer
28	Sen Bonem	Ministry of Land Management and Urban C	Vice Director
29	Choun Mearin	Ministry of Planning	Deputy Director
30	Seng Eamhor	Ministry of Rural Development	Chief of Planning
31	Veth Bunthoeun	Ministry of Economic & Fiance	Deputy Director
32	Sachiko Nishioka	Cambodian Development Council/CRDB	Advisor
33	Dim Kimhon	Cambodian Development Council	Asia Dept.

No	Name	Intitution	Position
34	Kubota Kazuya	JICA	Jica expert
35	Yariuchi Mina	JICA	Capacity Building Project
36	Meng Chamvibol	JICA	Jica staff
37	Stetten Guillaume	Njs Consutant Co., Ltd	Jica study team
38	T. Matsushita	Njs Consutant Co., Ltd	Jica study team
39	Chito Sun	Njs Consutant Co., Ltd	Jica study team
40	Peter Ide	Njs Consutant Co., Ltd	Jica study team
41	Willie Barreiro	Njs Consutant Co., Ltd	Jica study team
42	Taing Sophanara	SAWAC(Local Consultant)	Local consultant pipe engineer
43	Ly Saroeun	PPWSA Consultants	Director
44	Michard Jear	PPWSA Consultants	Safege
45	Gargnol	PPWSA Consultants	Safege
46	Galzin Pal	PPWSA Consultants	Safege