

Complete Economic and Financial Analysis

I. Economic Analysis

A. Macroeconomic Context

1. After nearly 30 years of civil war and isolation, Cambodia turned a new page in its history by reuniting all parties—once bitter enemies—at the mediation table to broker peace. The Paris Peace Accord, signed on 23 October 1991, led to the national election in 1993 under the auspices of the United Nations Transitional Authority in Cambodia (UNTAC). With peace completely restored, the government set about rehabilitating the country's decimated socioeconomic infrastructure. Development efforts have so far involved: (i) the promotion of private investments to create a vibrant private sector as the backbone of the national economy; (ii) the building and upgrading of physical infrastructure through public sector investment and assistance from international organizations and development partners; and (iii) the reform of soft infrastructure, including the judicial system, to promote social justice and create an enabling business environment.

2. Owing to Cambodia's open economic policy and efforts to create an environment conducive to private sector development, Cambodia has enjoyed remarkable economic growth since 1993—making it one of the fastest growing economies in Asia. This impressive economic performance has been largely traced to the strong developments in the garment sector and improvements in tourism and construction. Steady growth in the agricultural sector has contributed significantly to overall socioeconomic growth since nearly 80 percent of the population live and work in rural areas. These four sectors which include garment, tourism, construction and agriculture employ the majority of the country's workforce and generate huge amounts of income for the poor. A robust economic growth coupled with public investments has enabled the country to improve infrastructure, develop human resources, and undertake many key government reforms.

3. Nonetheless, the wave of global financial crisis in late 2008 had hit Cambodia's industry very hard. The economy contracted and barely grew in 2009, before it started to expand again and grow by 5 % in 2010. Further adding to the economic difficulty was the destruction of tens of thousands of hectares of cultivated land during the extensive flooding in 2011. This calamity took its toll on Cambodia's economy and the people's wellbeing. Despite this, the country still achieved a 6.5% growth rate in 2012 and is expected to grow at about 7% in 2013. The share of agriculture declined from 45.3% in 1993 to 32.5% in 2011, while industry's share jumped from 12.6% to 26.5% for the same period. This indicates a structural shift from agriculture to industry—the garment industry, in particular—confirming the development transformation of Cambodia amid continuing risks include those associated with climate change.

B. Urban Sector Context

4. Cambodia has embarked on decentralization and deconcentration by holding its first local election in 2002—aiming to delegate powers and responsibilities to local government and promote local socioeconomic development. This reform is expected to strengthen democracy, service delivery, and livelihood for local people. In recent years, the provincial and municipal governments have come up with strategic development and investment rolling plans for boosting local development and reducing poverty.

5. The economic growth in recent years has been exceptional. However, the benefits have been unevenly shared among the rich and the poor. The 2009 poverty rate in Phnom Penh is nearly 13%, in other urban areas around 19%, and in the rural areas almost 25%.¹ The unequal development between rural and urban areas has prompted rapid movement of migrant workers seeking for jobs in the cities and abroad, leaving their families behind. Migration has been particularly driven by opportunities in education and jobs which are vastly concentrated in the capital city. The garment and tourism sectors are absorbing the most number of workers. The increasing number of habitants into the cities is exerting tremendous pressures on the urban social security and environment. It is also causing higher crime rate and human trafficking.

6. The Tonlé Sap is a combined lake and river system of major importance to Cambodia. It is the largest freshwater lake in Southeast Asia and is an ecological spot that was designated as a UNESCO biosphere in 1997. There are nine provinces along the Tonle Sap including Kampong Chhnang and Pursat. Kampong Chhnang Province, in central Cambodia, is located just west of the Tonle Sap River and is a noted port. Pursat Province is also located along the Tonle Sap River and lies 174 kilometers northwest of Phnom Penh. Both provinces, with their proximity to the capital city and the border towns of Thailand, have been attracting migrants especially in their capital towns, exacerbating pressures on their local governments to address infrastructure deficiencies. At present, the costs of public utilities in the two capital towns remain high, affecting businesses and the local residents, especially the poor. There is poor solid waste management because the dumpsites, along with the drainage and sewage systems, are not constructed or rehabilitated to meet the growing demand. Further, without proper dykes and embankment along Tonle Sap, both towns continue to be highly vulnerable to flooding, causing perennial damages to lives, properties, and businesses.

C. Economic Rationale for Government Intervention

7. Climate-induced changes to the Mekong River and its tributaries will adversely affect wetland ecosystems, such as the Tonle Sap. About 20% of the Mekong River's floodwaters are absorbed by the Tonle Sap, with 62% of the Tonle Sap's water originating from the Mekong River and 38% from the Tonle Sap basin. It is connected to the Mekong River by the 100-kilometer (km) long Tonle Sap River, which reverses its flow seasonally. The average water levels in the Tonle Sap may increase by 0.2 m and peak water levels may increase by up to 0.3 m by 2050; hence, flood durations may be estimated to be 9% longer under anticipated climate change conditions and thus, the probability of river floods is likely to increase.²

8. Urban areas are crucial to Cambodia's development and its integration into regional markets and global economies such as the Greater Mekong Subregion (GMS) and the Association of Southeast Asian Nations (ASEAN). Urban areas around the Tonle Sap like Kampong Chhnang (KCH) and Pursat are key economic growth centers and have direct and symbiotic relationships with their rural areas that are predominantly based on agriculture, fisheries and manufacture. Increased prosperity in urban areas and greater climate resilient infrastructure will strengthen rural-urban linkages.

¹ Cambodia's Poverty Profile 2011

² C.T. Hoanh, K. Jirayoot, G. Lacombe, V. Srineter. 2010. Impacts of climate change and development on Mekong flow regime. First assessment–2009. *MRC Technical Paper No. 29 (June)*. Mekong River Commission, Vientiane; and K. Västilä, M. Kumm, C. Sangmanee and S. Chinvanho. 2010. Modeling Climate Change Impacts on the Flood Pulse in the Lower Mekong Floodplains. *Journal of Water and Climate Change*. Vol.1, No.1: 67-86.

9. The Tonle Sap Urban Areas Development Framework (TSUADF) is an urban planning document, which guides sustainable growth and climate resilient infrastructure development of urban areas in the Tonle Sap. It seeks to protect the Tonle Sap ecosystems from environmental pollution and potential threats due to unregulated growth and urbanization through an agreed vision and approach. It identifies KCH and PST municipalities as first priority for further urban planning and investments due to its strategic importance (location and economic importance), climate change risk and environment protection needs, and synergies with ADB projects on agriculture and rural development.

10. KCH and PST government agencies listed poor environmental sanitation as their town's biggest infrastructure issue. Lack of climate resilient infrastructure, especially around the Tonle Sap, leaves residents vulnerable from flooding and climate-induced disasters. Limited solid waste collection and poor management is a major environmental issue in flood-prone areas of the Tonle Sap and health concern for communities. The embankment in KCH, for instance, is imperative for resident to have continued access to social services and economic activities in the town area (e.g., rice processing mills). Improved flood protection will assist farmers in the eastern part of the municipality increase agricultural production from two to three crops per year.³ The town drainage will improve and strengthen the stormwater drainage system to accommodate more intensive rainfall. It will support increased economic activities in the town (e.g., marble process and carvings), and facilitate residents' continued access to social services.⁴

11. Public works infrastructure and services (e.g., flood management and drainage) are areas where the private sector is not readily found due to the nature of the assets, potential for revenue and profit and type of public services. The net benefits generated from these services will spill over to a broader segment of society also help to justify some form of public subsidy for capital investments (e.g., drainage and sanitation). In addition, limited private sector participation in solid waste management (SWM) has resulted in the need for the government to take a greater role and ownership in collection and management services in order to avoid the potential of jeopardizing the towns' economic prospects and activities and their people's welfare. The project will explore private sector involvement; in cases where private sector interest is found, the project will help to strengthen the government's ability in developing and managing these contracts.

D. Economic Analysis of Subprojects

12. The economic analyses of the subprojects were conducted in accordance with ADB's *Guidelines for the Economic Analysis of Projects, Framework for the Economic and Financial Appraisal of Urban Development Sector Projects* and *Handbook for Integrating Risk Analysis in the Economic Analysis of Projects*.⁵

13. In each subproject, there was only one option that was technically viable.⁶ Benefits and costs were arrived at through comparison of the 'without project' and 'with project' conditions. Benefits and costs were estimated over each subproject's estimated economic life at constant 2015 price. An average exchange rate of KR4,115 per \$1.00 was used in the analysis. Annual benefits and costs for each subproject were evaluated for a period up to 2045, allowing for 5-year

³ Output 1 complements JICA's drainage project in KCH and GIZ's support for the development of urban master plan.

⁴ Output 2 complements the GMS Flood and Drought Risk Management and Mitigation Project, which provides support to the Dhamnak Chheukrom Irrigation System Rehabilitation (located about 40 km upstream).

⁵ ADB. 1994. *Framework for the Economic and Financial Appraisal of Urban Development Sector Projects*. Manila; and ADB. 1997. *Guidelines for the Economic Analysis of Projects*. Manila.

⁶ Technical feasibility reports available in Appendix 2, Supplementary Documents 27 to 30.

construction period starting in 2016, followed by a benefit period of 25 years. All costs were valued using the domestic price numeraire. Economic costs were derived from the technical team's financial estimates of capital and operation and maintenance (O&M) costs and adjusted for transfer payments and any other market distortions. Taxes and duties were excluded because they represent transfer payments. Traded goods, net of taxes and duties, were adjusted by the shadow exchange rate factor of 1.10 while a factor of 1.0 was applied for non-traded goods and skilled labor. The shadow wage rate factor of 0.75 was used for unskilled labor. These parameters are consistent with those used in recently approved ADB-financed projects in Cambodia.⁷ The economic value of land acquired was estimated based on its net economic benefit⁸ over the life of the project. Economic opportunity cost of capital (EOCC) of 12% was assumed for the analysis.

1. Drainage and Flood Protection

14. For the flood control subproject in KCH, the benefits were derived mainly from the following sources: (i) savings from household property damages avoided, and (ii) income from recovered agricultural and industrial land. In PST, a combined economic analysis was conducted due to the difficulty of explicitly delineating the areas to be benefited by the proposed drainage and river embankment subprojects, as both prevent flooding. The economic benefits were calculated by quantifying the following: (i) savings from household property damages avoided, and (ii) savings from the agricultural and commercial losses averted.

15. **KCH flood protection.** Town officials indicated that there were about 1,882 households heavily affected by annual flooding while there were about 1,255 households moderately affected. Town officials estimated the average annual costs of repairs and cleaning over the recent five year period at \$250 per household for those heavily affected and \$50 per household for those moderately affected, stated in economic price.

16. With the flood protection improvements, about 720 hectares (ha) of agricultural land and about 705 ha of industrial land would be recovered due to the subproject. The benefits from the recovered agricultural land were valued in terms of income from rice farming of the recovered agricultural land. Income from rice farming was calculated based on 3 crop harvests each year. Average yields per hectare were assumed at 4 tons in dry season, 4 tons in early wet season and 3.5 tons in wet season. The net economic revenues each year, calculated based on a rice crop budget model, were estimated at \$233 thousand in dry season, \$191 thousand in early wet season and \$212 thousand in wet season. Details of the model are shown in Supplementary Table 3a. The economic unit prices of output and inputs used in the model were based on a recently approved ADB project in Cambodia involving rice.⁹ Supplementary Table 3b shows the details of the economic prices of output and inputs used.

17. The benefits from the 705 ha recovered industrial land were estimated at \$4,935 thousand each year, quantified in terms of the prevailing average monthly lease fee estimated at \$583 per hectare, stated in economic price.

⁷ ADB. 2012. *Report and Recommendations of the President to the Board of Directors on a Proposed Loan to the Kingdom of Cambodia: GMS Southern Economic Corridor Towns Development Project*. Manila.

⁸ Rice crop budget model was used in the estimation of net economic benefit. Net economic benefits were \$778 each year for KCH and \$1,156 each year for PST over the life of the project.

⁹ ADB. 2013. *Report and Recommendations of the President to the Board of Directors on Proposed Loans and Administration of Grants and Loan to the Kingdom of Cambodia: Climate-Resilient Rice Commercialization Sector Development Program*. Manila.

18. **PST flood protection.** Town officials indicated that there were about 980 households heavily affected by annual flooding while there were about 245 households moderately affected. Town officials estimated the average annual costs of repairs and cleaning over the recent five year period at \$250 per household for those heavily affected and \$50 per household for those moderately affected, stated in economic price.

19. With the flood protection improvements, agricultural and commercial losses would be averted. Avoided agricultural losses were derived based on the following assumptions: (i) average yield per hectare at 3.5 tons of rice; (ii) 2,376 ha heavily affected with harvest completely destroyed; and (iii) 5,544 ha moderately affected with harvest reduced by about 50%. The avoided net economic losses each year, calculated based on a rice crop budget model, were estimated at \$701 thousand in the areas heavily affected and \$818 thousand in the areas moderately affected. Details of the model are shown in Supplementary Table 4a. The economic unit prices of output and inputs used were the same as in KCH.

20. Avoided commercial losses from the public market's temporary closure due to flooding were assumed at 10% of the projected annual net economic revenues of the various business establishments involved. Revenues of the various business establishments involved were estimated based on the data provided by town officials.

21. **Evaluation results.** The resulting base case EIRR of 18.22% for KCH and 16.88% for PST are higher than the ADB's 12% economic opportunity cost of capital (EOCC). This demonstrates the economic contribution of the proposed subprojects to the affected towns and communities. Sensitivity analysis conducted suggested that the EIRRs will be more vulnerable to changes in the anticipated benefits from the subprojects. Capital costs will have to increase by 33.3% to 40.2%, while benefits will require only a reduction of 25.2% to 35.7% for the EIRRs to drop to the EOCC (Table 1). These results, however, are most likely underestimated since the benefits from severe floods in addition to the annual flooding were not accounted for in the analysis as they are not easily quantifiable and to avoid double counting. The derivations of detailed economic costs for these two subprojects are shown in Supplementary Tables ST1 and ST2. The benefit estimations are presented in Supplementary Tables ST3 to ST4. The EIRR calculations and sensitivity analyses for the subprojects are shown in Supplementary Tables ST5 and ST6.

Table 1: Economic Evaluation of Drainage and Flood Protection Subprojects

Base Case/Sensitivity Scenarios	Kampong Chhnang Flood Protection	Pursat Drainage and River Embankment
Economic Cost (US\$ Thousand)	21,616	8,926
Net Present Value (US\$ Thousand)	9,257	2,953
Base Case EIRR (%)	18.22%	16.88%
Sensitivity Tests:		
Case 1: Capital Cost + 10%		
EIRR	16.67%	15.41%
Switching Value	40.2	33.3
Sensitivity Indicator	2.49	3.00
Case 2: O & M Cost + 10%		
EIRR	18.19%	16.61%
Switching Value	1,921	181
Sensitivity Indicator	0.05	0.55
Case 3: Benefits - 10%		
EIRR	16.48%	14.94%
Switching Value	35.7	25.2
Sensitivity Indicator	2.80	3.97
Case 4: Combination of Cases 1,2 & 3		
EIRR	15.00%	13.28%
NPV (US\$ Thousand)	4,712	813
% Drop in NPV	49.1	72.5
Case 5: Benefits delayed by one year		
EIRR	15.77%	14.35%
NPV (US\$ Thousand)	6,163	1,576
% Drop in NPV	33.4	46.6

EIRR=economic internal rate of return, NPV=net present value, O&M=operations and maintenance.
Source: Asian Development Bank.

2. Solid Waste Management

22. The economic benefits quantified for the solid waste management (SWM) subprojects in both towns were reduced health risks from poor SWM as measured through reduction in the Disability Adjusted Life Years (DALYs).¹⁰ It was observed that the lack of proper SWM in both project towns prompted many households to result in burning their trash—one of the major causes of outdoor pollution in developing countries. Likewise, residents indiscriminately dispose of their solid wastes anywhere such as public roads, drains, house yards, vacant land plots, Tonle Sap River and the banks, thus clogging the drainage systems and polluting the water.

23. The World Health Organization (WHO) estimated the total DALYs of Cambodia at 38,451 per 100,000 population.¹¹ The WHO also estimated that 10% of the total DALYs of Cambodia was water, sanitation and hygiene related¹² and 1.3% was attributable to outdoor air pollution¹³. The economic analysis assumes that 1% of the total DALYs in each town is due to poor SWM. As a result of the subprojects, the DALYs attributable to the poor SWM in each town are assumed to reduce by 75%.

¹⁰ A DALY is an indicator of life expectancy combining mortality and morbidity into one summary measure of population health to account for the number of years lived in less than optimum health. The approach was developed by Harvard University for the World Bank in 1990 for a study that provided a comprehensive assessment of mortality and disability from diseases, injuries and risk factors. The World Health Organization (WHO) adopted the method in 1996. DALY determination is continually revised by the WHO.

¹¹ World Health Organization. 2004. World Health Report. Geneva.

¹² WHO. 2007. Environmental Burden of Disease Series No. 15 (Water, Sanitation and Hygiene). Geneva.

¹³ WHO. 2004. Environmental Burden of Disease Series No. 5 (Outdoor Air Pollution). Geneva.

24. The approach of the WHO in calculating the annual economic value of a DALY to be equivalent to a country's gross national income (GNI) per capita was adopted.¹⁴ Cambodia's estimated GNI per capita in 2012 was \$2,690.¹⁵ The analysis conservatively assumes a GNI per capita growth of 2% per annum.

25. **Evaluation results.** The resulting base case EIRR of 16.64% for KCH and 14.50% for PST are higher than the ADB's 12% economic opportunity cost of capital (EOCC). This demonstrates the economic contribution of the proposed subprojects to the affected towns and communities. Sensitivity analysis conducted suggested that the EIRRs will be more vulnerable to changes in the anticipated benefits from the subprojects. Capital costs will have to increase by 12.7% to 27.1%, while benefits will require only a reduction of 10% to 13.8% for the EIRRs to drop to the EOCC (Table 2). The derivations of detailed economic costs for these two subprojects are shown in Supplementary Tables ST7 and ST8. The benefit estimations are presented in Supplementary Tables ST9 to ST10. The EIRR calculations and sensitivity analyses for the subprojects are shown in Supplementary Tables ST11 and ST12.

Table 2: Economic Evaluation of Solid Waste Management Subprojects

Base Case/Sensitivity Scenarios	Kampong Chhnang Solid Waste Management	Pursat Solid Waste Management
Economic Cost (US\$ Thousand)	1,564	2,354
Net Present Value (US\$ Thousand)	760	637
Base Case EIRR (%)	16.64%	14.50%
Sensitivity Tests:		
Case 1: Capital Cost + 10%		
EIRR	13.00%	13.58%
Switching Value	12.7	27.1
Sensitivity Indicator	7.86	3.69
Case 2: O & M Cost + 10%		
EIRR	13.04%	13.82%
Switching Value	12.9	36.8
Sensitivity Indicator	7.76	2.72
Case 3: Benefits - 10%		
EIRR	12.02%	12.69%
Switching Value	10.0	13.8
Sensitivity Indicator	9.96	7.25
Case 4: Combination of Cases 1,2 & 3		
EIRR	10.44%	11.10%
NPV (US\$ Thousand)	(290)	(235)
% Drop in NPV	138.2	137.0
Case 5: Benefits delayed by one year		
EIRR	12.30%	12.30%
NPV (US\$ Thousand)	57	81
% Drop in NPV	92.5	87.3

EIRR=economic internal rate of return, NPV=net present value, O&M=operations and maintenance.

Source: Asian Development Bank.

II. Financial Analysis

26. A financial analysis of the Integrated Urban Environment Management in the Tonle Sap Basin Project has been undertaken in accordance with ADB's *Guidelines on Financial Management and Analysis of Projects and Financial Due Diligence: A Methodology Note*. The analysis focused on the financial viability of two output of the project—the Kampong Chhnang

¹⁴ The WHO Commission of Macroeconomics and Health assumes that each DALY can be valued at one year of per capita GNI to arrive at a conservative estimate of the economic value of a DALY.

¹⁵ World Bank. 2012. World Development Indicators. Washington D.C.

and Pursat Urban Area Improvements. These two outputs included both revenue and non-revenue generating subprojects aimed at improving flood protection, drainage and solid waste management around the Tonle Sap Basin.

A. Financial Analysis for Revenue-Generating Subprojects

27. Financial internal rates of return (FIRRs) were prepared for the solid waste management subprojects in Kampong Chhnang and Pursat. Table 1 presents the major indicators of the financial viability of the proposed solid waste management subproject in Kampong Chhnang. The base case FIRR of 5.98% exceeded the weighted average cost of capital (WACC) which was calculated at 2.33%. Sensitivity tests indicated that on the average, the FIRR will be most susceptible to a 10% reduction in the projected revenues or user charges and fees to be collected and paralleled by 10% increase in capital and O & M costs.

Table 1: Financial Evaluation of Solid Waste Management in Kampong Chhnang

Base Case/Sensitivity Scenarios	FIRR (%)	NPV (\$'000) (at 2.33%)	Switching Value	Sensitivity Indicator
Base Case Scenario	5.98	2,998		
Sensitivity Tests:				
Case 1: 10% Increase in Investment Cost	5.70	2,849	202.36	0.49
Case 2: 10% Increase in O&M Costs	5.18	2,367	71.23	1.40
Case 3: 10% Decline in Revenues	4.81	1,919	48.95	2.04
Case 4: Combination of Cases 1, 2 and 3	3.75	1,139		
Case 4: Revenues Delayed by 1 Year	4.59	1,771		

FIRR=financial internal rate of return, NPV=net present value
Source: Asian Development Bank.

28. Table 2 summarizes the major indicators of the financial viability of the proposed solid waste management subproject in Pursat. The base case FIRR of 9.59% is greater than the WACC of 2.33%. The FIRR is also highly sensitive to reductions in revenues underscoring the need for project management to pay close attention to the effective and efficient collection of the targeted revenues and adhering to projected capital and O & M costs with the planned establishment of Utility.

Table 2: Financial Evaluation of Solid Waste Management in Pursat

Base Case/Sensitivity Scenarios	FIRR (%)	NPV (\$'000) (at 2.33%)	Switching Value	Sensitivity Indicator
Base Case Scenario	9.59%	9,757		
Sensitivity Tests:				
Case 1: 10% Increase in Investment Cost	8.00%	7,563	58.57	1.71
Case 2: 10% Increase in O&M Costs	9.04%	9,068	171.93	0.58
Case 3: 10% Decline in Revenues	8.45%	7,789	82.18	1.22
Case 4: Combination of Cases 1, 2 and 3	7.44%	6,796		
Case 4: Revenues Delayed by 1 Year	8.21%	7,689		

FIRR=financial internal rate of return, NPV=net present value
Source: Asian Development Bank.

29. In calculating the FIRR for both subprojects, two primary sources of revenues were considered. The first is garbage collection fees for the residential households. Currently, an average tariff of KR 4,000 or approximately \$1.0 per month is imposed for garbage to be collected from individual households. Average household size assumed is 5.16, consistent with the information presented in the resettlement plan. For the purpose of the analysis and in consideration of the affordable limits of the target households, this rate was increased by 5% to \$1.05 and maintained during the period 2019-2021, increasing by 5% every three (3) years thereafter. The estimated collection services was assumed at 5% based on current range of 3% to 10% of households being serviced by private entities in both towns. It was assumed that community awareness activities will increase the collection efficiency during the project implementation period, assumed to reach 20% by 2019 and increasing to 85% over the 30-year forecast period.

30. Under the project, Urban Services Units (USUs) will be established in Pursat and Kampong Chhnang and will be responsible for solid waste management, inclusive of the operation and maintenance of sanitary landfill and garbage collection. These entities will also manage for Pursat the town center drainage including the pumping station, wastewater stabilization ponds and the embankment, and the flood control river embankment works in Kampong Chhnang. In the event the proposed creation and training of these entities do not materialize, the Provincial Department of Public Works and Transport (PDPWT) will assume the responsibility for the town center drainage in Pursat, and together with the Provincial Department for Water Resources and Meteorology (PDWRAM) will cover the flood control—river embankment—in Kampong Chhnang.

31. The second major source of revenues considered was the collection charges on business firms which was estimated to range from \$75/year to \$500/year depending on the nature and size of the firm paying. For ease of collection, these charges will be linked to the annual approval and release of their business licenses. These charges were projected to increase by 8-10% per annum in order to mobilize revenues sufficient to cross subsidize the poorer households in the towns. Both charges are consistent with the polluter pays principle which encourages the imposition of taxes to parties directly responsible for producing the

pollution.¹⁶ The derivations of the WACC for these two subprojects are shown in Supplementary Tables ST13 and ST14. The financial revenues estimations are presented in Supplementary Tables ST15 to ST16. The FIRR calculations and sensitivity analyses for the subprojects are shown in Supplementary Tables ST17 and ST18.

B. Financial Sustainability Analysis

32. Financial projections for the towns of Kampong Chhnang and Pursat were also prepared to confirm that with a properly phased and executed collection of charges on drainage and/or flood protection services plus other user charges and fees, the PIUs in each town will be able to transition to become semi-autonomous USUs.

33. Supplementary Tables ST21 and ST22 present the results of the financial projections conducted for each PIU. Initially, particularly during the project implementation phase and about five years thereafter, the PIUs will be financially dependent on the government for their funding needs. This will include financing for both their capital and operating requirements. Simultaneously, they will be expected to mobilize their own revenues, starting modestly then gradually accelerating their efforts. With revenue generation commencing in 2019, both Pursat and the Kampong Chhnang will cease to require government subsidies within 10 years or in 2029-2030 as projected revenues will be sufficient to cover O& M and incremental administration for the SWM and drainage/flood control subprojects.

34. For the purpose of the projections undertaken, the revenues considered included the following: (i) solid waste management garbage collection fees and charges; (ii) drainage and/or flood control service charges; and (iii) other charges and fees on urban services which will be formulated and levied over the life of the project. The assumptions used to calculate the solid waste management and garbage collection fees and charges are discussed in para. 4.

35. Initial collection efficiency was assumed at 20% and gradually increasing to 85% towards the end of the 30-year period. Annual price indices were applied to the projected revenues and costs of O & M and incremental administration for the subprojects.

36. For the drainage and flood control service charges, each household will be levied a minimal fee of KR 1500 or \$0.38 per month beginning 2019, increasing by 5% every three years. Business entities will be charged higher within the range of \$50 to \$300 per annum depending on classification (capitalization and type of business operation).

37. Other fees and surcharges were estimated at 20-25% of revenues mobilized from SWM and drainage and/or flood protection services to augment funds for O & M expenditures. Community-led improvements will likewise help promote ecologically sustainable activities. Examples of charges which could be implemented or increased include steering fees on effluents, pollution and other hazardous wastes.

¹⁶ Tipping fees were also considered because they are typically associated with cost recovery mechanisms for landfill sites. However, a review of the literature and current practices of local governments suggested that charging tipping fees in developing countries like Thailand, Viet Nam, the Philippines, and potentially Cambodia, encouraged illegal dumping in order to avoid paying the tipping fees.

C. Affordability Analysis

38. Considering the household income of the bottom 3% and 6% of the residents in Kampong Chhnang and Pursat, respectively, the garbage collection tariff for households of KR 4,000 is approximately 1.2% of their average monthly income. For drainage and flood control services, the tariff of KR 1,500 (\$0.38) per month is approximately 0.45% of their monthly income. Jointly, the fees for SWM and drainage and flood control comprises about 1.65% of the household income.

Table ST1: Calculation of Economic Costs—Kampong Chnnang Flood Protection Subproject
(in constant 2015 prices, US\$'000)

INVESTMENT COSTS (Constants 2015 prices, in US\$ '000)

PROJECT COST ITEM	TOTAL FINANCIAL	FINANCIAL WITHOUT TAX	FINANCIAL COSTS EXCLUDING TAX								TOTAL ECONOMIC COSTS
			Unskilled Labor		Skilled Labor		Local Materials		Foreign Costs		
			%	Total	%	Total	%	Total	%	Total	
1 Site clearance works	290	264	15%	40	15%	40	30%	79	40%	105	264
2 Foundation works	2,593	2,357	10%	236	20%	471	30%	707	40%	943	2,393
3 Earth works	5,475	4,977	10%	498	20%	995	30%	1493	40%	1991	5,052
4 Concrete wall structures	6,111	5,555	10%	556	20%	1111	30%	1667	40%	2222	5,639
5 Geotextile	456	415	10%	41	20%	83	30%	124	40%	166	421
6 Gabion mattress	1,778	1,616	10%	162	20%	323	30%	485	40%	647	1,641
7 Amor rock	477	434	10%	43	20%	87	30%	130	40%	173	440
8 Grass slope protection	367	334	10%	33	20%	67	30%	100	40%	133	339
9 Toe trench work	19	17	10%	2	20%	3	30%	5	40%	7	18
10 Road base course	449	408	10%	41	20%	82	30%	122	40%	163	414
11 Road pavement	2,446	2,224	10%	222	20%	445	30%	667	40%	889	2,257
12 Sidewalk	185	168	10%	17	20%	34	30%	50	40%	67	171
13 Lighting and Safety	132	120	10%	12	20%	24	30%	36	40%	48	122
14 Tree Planting	127	115	10%	12	20%	23	30%	35	40%	46	117
13 Sluice gate	350	318	5%	16	25%	80	30%	95	40%	127	327
14 Manual Equipment for Maintenance	40	36	5%	2	25%	9	30%	11	40%	15	37
Subtotal Infrastructure Works	21,295	19,359	10%	1,931	20%	3,876	30%	5,808	40%	7,744	19,651
Total BASELINE COSTS	21,295	19,359	10%	1,931	20%	3,876	30%	5,808	40%	7,744	19,651
Physical Contingencies 10%	2,130	1,936	10%	193	20%	388	30%	581	40%	774	1,965
TOTAL DIRECT COST	23,425	21,295	10%	2,125	20%	4,264	30%	6,389	40%	8,518	21,616
Allocated costs	7,059										6,514
Costs inclusive of allocated costs											28,129
Land acquisition	46										6
TOTAL SUBPROJECT COST	30,529										28,136

RECURRENT COSTS (Constants 2015 prices, in US\$ '000)

PROJECT COST ITEM	TOTAL FINANCIAL	FINANCIAL WITHOUT TAX	FINANCIAL COSTS EXCLUDING TAX								TOTAL ECONOMIC COSTS
			Unskilled Labor		Skilled Labor		Local Materials		Foreign Costs		
			%	Total	%	Total	%	Total	%	Total	
1 Operation and Maintenance	150	130	10%	13	20%	26	20%	26	50%	65	134

SHADOW PRICING INDICES

Unskilled Labor Shadow Index	0.75
Skilled Labor Shadow Index	1.00
Local Materials Shadow Index	1.00
Foreign Exchange Cost Shadow Index	1.10

Table ST2: Calculation of Economic Costs—Pursat Drainage and Flood Protection Subproject
(in constant 2015 prices, US\$'000)

INVESTMENT COSTS (Constants 2015 prices, in US\$ '000)

PROJECT COST ITEM	TOTAL FINANCIAL	FINANCIAL WITHOUT TAX	FINANCIAL COSTS EXCLUDING TAX								TOTAL ECONOMIC COSTS
			Unskilled Labor		Skilled Labor		Local Materials		Foreign Costs		
			%	Total	%	Total	%	Total	%	Total	
A Embankment Protection											
1 Foundation works	24	22	10%	2	20%	4	30%	7	40%	9	22
2 Slope works	165	150	10%	15	20%	30	30%	45	40%	60	152
3 Apron works	8	7	10%	1	20%	1	30%	2	40%	3	7
4 Wall	1	1	10%	0	20%	0	30%	0	40%	0	1
5 Sidewalk	27	24	10%	2	20%	5	30%	7	40%	10	25
6 Gabion	263	239	10%	24	20%	48	30%	72	40%	96	243
7 Stone	146	132	10%	13	20%	26	30%	40	40%	53	134
8 Geotextile	13	12	10%	1	20%	2	30%	4	40%	5	12
9 Manual Equipment for Maintenance	40	36	10%	4	20%	7	30%	11	40%	15	37
Subtotal (A)	686	624	9%	59	19%	118	28%	176	38%	235	596
B Drainage System											
1 Site Infrastructure	7,468	6,789	10%	679	20%	1358	30%	2037	40%	2716	6,891
3 Overflow structures	180	164	10%	16	20%	33	30%	49	40%	65	166
4 Preliminary treatment	500	455	10%	45	20%	91	30%	136	40%	182	461
5 Manual Equipment for Maintenance	40										
Subtotal (B)	8,188	7,407	10%	741	20%	1,481	30%	2,222	40%	2,963	7,518
Subtotal Infrastructure Works (A+B)	8,874	8,031	10%	799	20%	1,599	30%	2,398	40%	3,198	8,115
Total BASELINE COSTS	8,874	8,031	10%	799	20%	1,599	30%	2,398	40%	3,198	8,115
Physical Contingencies 10%	887	803	10%	80	20%	160	30%	240	40%	320	811
TOTAL DIRECT COST	9,762	8,834	10%	879	20%	1,759	30%	2,638	40%	3,518	8,926
Allocated costs	2,948										2,696
Costs inclusive of allocated costs											11,622
Land acquisition	14										9
NPV of economic opportunity cost of land over the life of the project											9
TOTAL SUBPROJECT COST	12,724										11,631

RECURRENT COSTS (Constants 2015 prices, in US\$ '000)

PROJECT COST ITEM	TOTAL FINANCIAL	FINANCIAL WITHOUT TAX	FINANCIAL COSTS EXCLUDING TAX								TOTAL ECONOMIC COSTS
			Unskilled Labor		Skilled Labor		Local Materials		Foreign Costs		
			%	Total	%	Total	%	Total	%	Total	
1 Operation and Maintenance	496	431.30	0.10	43.13	0.20	86.26	0.20	86.26	0.50	215.65	444.24

SHADOW PRICING INDICES

Unskilled Labor Shadow Index	0.75
Skilled Labor Shadow Index	1.00
Local Materials Shadow Index	1.00
Foreign Exchange Cost Shadow Index	1.10

Table ST3: Estimation of Economic Benefits—Kampong Chhnang Flood Protection Subproject
(in constant 2015 prices, US\$'000)

A. Savings from Property Damages Avoided	Unit	Amount
Households heavily affected by flooding	HH/year	1,882
Households moderately affected by flooding	HH/year	1,255
Estimated cost of repairs/cleaning for heavy damage	\$/HH	250
Estimated cost of cleaning/repairs for moderate damage	\$/HH	50
Total cost of repairs/cleaning for heavily damaged houses	\$'000/year	471
Total cost of repairs/cleaning for moderately damaged houses	\$'000/year	63
Total Savings from Property Damages Avoided	\$'000/year	533
B. Net Revenue from Agriculture Land Recovered		
Total Agricultural Land to be Recovered	hectare	720
Net Revenue from Harvest:		
Dry Season	\$'000/year	233
Early Wet Season	\$'000/year	191
Wet Season	\$'000/year	212
Total Net Revenue from Agricultural Land Recovered	\$'000/year	637
C. Lease Income from Industrial Land Recovered		
Total Industrial Land to be Recovered	hectare	705
Average lease fee	\$/hectare/month	583
Total Additional Income from Industrial Land Recovered	\$'000/year	4,935
TOTAL ESTIMATED ECONOMIC BENEFITS	\$'000/year	6,105

**Table ST3a: Estimation of Economic Benefits (Rice Crop Budget Model)—Kampong Chhnang Flood Protection Subproject
(in constant 2015 prices, US\$'000)**

Dry Season (Mid December to Mid March)		Area	Ave. Yield	Produced	Econ. Price	Econ.Revenue
		(ha)	(tons/ha)	(tons/year)	(US\$/ton)	(US\$'000/year)
Paddy Rice Production Revenue		720	4.0	2,880	214	617
Paddy Rice Productions Costs			Econ. Price	Econ. Price	Econ. Price	Econ. Costs
Inputs		Unit	(KR/Unit)	(Riel '000/ha)	(US\$/ha)	(US\$'000/year)
Seed	kg/ha	125	2,000	250	62	45
Urea	kg/ha	150	2,064	310	77	55
DAP	kg/ha	150	2,688	403	100	72
Agro Chemicals	KR'000/ha	2	64,500	129	32	23
Land Preparation (mechanized)	KR'000/ha	1	320,000	320	79	57
Land Preparation (labor for transplant)	person days/ha	-	13,500	-	-	-
Harvesting (mechanized)	KR'000/ha	1	360,000	360	89	64
Harvesting (labor)	person days/ha	-	13,500	-	-	-
Other Labor	person days/ha	10	13,500	135	33	24
Bags for paddy	pieces/ha	40	2,000	80	20	14
Pumping from canal	hrs/ha	16	10,200	163	40	29
Total Production Costs						384
Net Revenue - Dry Season						233
Early Wet Season (April to early July)		Area	Ave. Yield	Produced	Econ. Price	Econ.Revenue
		(ha)	(tons/ha)	(tons/year)	(US\$/ton)	(US\$'000/year)
Paddy Rice Production Revenue		720	4.0	2,880	214	617
Paddy Rice Productions Costs			Econ. Price	Econ. Price	Econ. Price	Econ. Costs
Inputs		Unit	(KR/Unit)	(Riel '000/ha)	(US\$/ha)	(US\$'000/year)
Seed	kg/ha	125	2,000	250	62	45
Urea	kg/ha	150	2,064	310	77	55
DAP	kg/ha	150	2,688	403	100	72
Agro Chemicals	KR'000/ha	1	64,500	65	16	12
Land Preparation (mechanized)	KR'000/ha	1	320,000	320	79	57
Land Preparation (labor for transplant)	person days/ha	25	13,500	338	84	60
Harvesting (mechanized)	KR'000/ha	-	360,000	-	-	-
Harvesting (labor)	person days/ha	30	13,500	405	100	72
Other Labor	person days/ha	10	13,500	135	33	24
Bags for paddy	pieces/ha	40	2,000	80	20	14
Pumping from canal	hrs/ha	8	10,200	82	20	15
Total Production Costs						426
Net Revenue - Early Wet Season						191
Wet Season (Mid July to late November)		Area	Ave. Yield	Produced	Econ. Price	Econ.Revenue
		(ha)	(tons/ha)	(tons/year)	(US\$/ton)	(US\$'000/year)
Paddy Rice Production Revenue		720	3.5	2,520	214	540
Paddy Rice Productions Costs			Econ. Price	Econ. Price	Econ. Price	Econ. Costs
Inputs		Unit	(KR/Unit)	(Riel '000/ha)	(US\$/ha)	(US\$'000/year)
Seed	kg/ha	100	2,000	200	50	36
Urea	kg/ha	100	2,064	206	51	37
DAP	kg/ha	100	2,688	269	67	48
Agro Chemicals	KR'000/ha	1	64,500	65	16	12
Land Preparation (mechanized)	KR'000/ha	1	320,000	320	79	57
Land Preparation (labor for transplant)	person days/ha	-	13,500	-	-	-
Harvesting (mechanized)	KR'000/ha	1	360,000	360	89	64
Harvesting (labor)	person days/ha	-	13,500	-	-	-
Other Labor	person days/ha	15	13,500	203	50	36
Bags for paddy	pieces/ha	25	2,000	50	12	9
Pumping from canal	hrs/ha	16	10,200	163	40	29
Total Production Costs						328
Net Revenue - Wet Season						212
Total Annual Net Revenue (US\$'000/year)						637

**Table ST3b: Economic Prices of Output and Inputs Used in Rice Crop Budget Model—
Kampong Chhnang Flood Protection Subproject
(in constant 2015 prices, US\$'000)**

Rice paddy: (Export parity in 2013 currencies)^{a/}			
Thailand (current \$) ^{a/}	\$/t	540	
Thailand (constant 2005 \$) ^{a/}	\$/t	440	
Rice FOB Bangkok (constant 2013 \$)	\$/t	540	
Quality Adjustment ^{c/}	\$/t	432	
Freight, insurance, etc.	\$/t	20	
CIF Sihanoukville	\$/t	412	
CIF Sihanoukville in Riel ^{d/}	000 Riel/t	1,660	
Freight & handling Sihanoukville to project area	000 Riel/t	230	
Conversion to paddy ^{f/}	000 Riel/t	887	
Milling Charge net of bran and husks	000 Riel/t	0	
Handling and transport farm to mill ^{e/}	000 Riel/t	23	
Economic Farmgate Price per tonne	000 Riel/t	864	
Economic Farmgate Price per kg	Riel/kg	864	
Economic Variety adjusted Price per kg	Riel/kg	864	
Inputs			
Seed	Riel/kg	2,000	
Fertilizer			
Urea	Riel/kg	2,064	
DAP	Riel/kg	2,688	
Manure	Riel/kg	200	
Agro-Chemicals	Riel/ha	64,500	
Pump rental + fuel per hour	Rent/hr	10,200	
Bags for paddy harvest	Riel/each	2,000	
Mechanical land preparation	Riel/ha	320,000	
Combine harvester rent	Riel/ha	360,000	
Farm Labor	Riel/day	13,500	
<p>a/ WB Commodity Price Projections prepared January 15, 2013 for 2013-2020 and 2025.</p> <p>c/ Adjustment for Quality relative to the standard of Thai white rice, 5% broken. 20%</p> <p>e/ Standard Conversion Factor (SCF) --- applied on half the amount of handling, transportation and r 90%</p> <p>f/ Conversion factor of paddy to rice 62%</p> <p>g/ Varietal adjustment 0%</p>			

Source: ADB. 2013. Cambodia Climate Resilient Rice Commercialization Sector Development Program, Manila.

Table ST4: Estimation of Economic Benefits—Pursat Drainage and Flood Protection Subproject
(in constant 2015 prices, US\$'000)

A. Savings from Households Property Damages Avoided	Unit	Amount
Households heavily affected by flooding	HH/year	980
Households moderately affected by flooding	HH/year	245
Estimated cost of repairs/cleaning for heavy damage	\$/HH	250
Estimated cost of cleaning/repairs for moderate damage	\$/HH	50
Total cost of repairs/cleaning for heavily damaged houses	\$'000/year	245
Total cost of repairs/cleaning for moderately damaged houses	\$'000/year	12
Total Household Property Damages Avoided	\$'000/year	257
B. Savings from Agriculture Losses Avoided		
a. Total Rice Land Heavily Affected by Flooding (Harvest Completely Destroyed)	hectare	2,376
Agricultural Losses Avoided (a)	\$'000/year	701
b. Total Rice Land Moderately Affected by Flooding (Harvest Partially Affected and Reduced by 50%)	hectare	5,544
Agricultural Losses Avoided (b)	\$'000/year	818
Total Agricultural Losses Avoided	\$'000/year	1,519
C. Savings from Business Losses Avoided		
Estimated Business Losses (Public Market Temporary Closure due to Flooding)		
Textiles shops	\$/month	180
Hardware shops	\$/month	150
Electronic shops	\$/month	90
Jewelry shops	\$/month	150
Food & grocery stores	\$/month	240
Meat & fish shops	\$/month	90
Vegetable shops	\$/month	42
Total Business Losses Avoided	\$'000/year	942
TOTAL ESTIMATED ECONOMIC BENEFITS	\$'000/year	2,718

**Table ST4a: Estimation of Agricultural Losses Avoided (Rice Crop Budget Model)—
Pursat Flood Protection Subproject
(in constant 2015 prices, US\$'000)**

Harvest Completely Destroyed						
		Area (ha)	Ave. Yield (tons/ha)	Produced (tons/year)	Econ. Price (US\$/ton)	Econ.Revenue (US\$'000/year)
Paddy Rice Production Revenue		2,376	3.5	8,316	214	1,783
Paddy Rice Productions Costs						
Inputs	Unit	Quantity	Econ. Price (KR/Unit)	Econ. Price (Riel '000/ha)	Econ. Price (US\$/ha)	Econ. Costs (US\$'000/year)
Seed	kg/ha	100	2,000	200	50	118
Urea	kg/ha	100	2,064	206	51	122
DAP	kg/ha	100	2,688	269	67	158
Agro Chemicals	KR'000/ha	1	64,500	65	16	38
Land Preparation (mechanized)	KR'000/ha	1	320,000	320	79	189
Land Preparation (labor for transplant)	person days/ha	-	13,500	-	-	-
Harvesting (mechanized)	KR'000/ha	1	360,000	360	89	212
Harvesting (labor)	person days/ha	-	13,500	-	-	-
Other Labor	person days/ha	15	13,500	203	50	119
Bags for paddy	pieces/ha	25	2,000	50	12	29
Pumping from canal	hrs/ha	16	10,200	163	40	96
Total Production Costs						1,082
Avoided Losses						701
Harvest Partially Affected and Reduced by 50%						
		Area (ha)	Ave. Yield (tons/ha)	Produced (tons/year)	Econ. Price (US\$/ton)	Econ.Revenue (US\$'000/year)
Paddy Rice Production Revenue		5,544	3.5	19,404	214	4,160
Paddy Rice Productions Costs						
Inputs	Unit	Quantity	Econ. Price (KR/Unit)	Econ. Price (Riel '000/ha)	Econ. Price (US\$/ha)	Econ. Costs (US\$'000/year)
Seed	kg/ha	100	2,000	200	50	275
Urea	kg/ha	100	2,064	206	51	284
DAP	kg/ha	100	2,688	269	67	370
Agro Chemicals	KR'000/ha	1	64,500	65	16	89
Land Preparation (mechanized)	KR'000/ha	1	320,000	320	79	440
Land Preparation (labor for transplant)	person days/ha	-	13,500	-	-	-
Harvesting (mechanized)	KR'000/ha	1	360,000	360	89	495
Harvesting (labor)	person days/ha	-	13,500	-	-	-
Other Labor	person days/ha	15	13,500	203	50	279
Bags for paddy	pieces/ha	25	2,000	50	12	69
Pumping from canal	hrs/ha	16	10,200	163	40	225
Total Production Costs						2,525
Net Revenue						1,635
Avoided Losses	50%					818
Total Avoided Agricultural Losses (US\$'000/year)						1,519

**Table ST5: EIRR Calculation and Sensitivity Analysis—
Kampong Chhnang Flood Protection Subproject
(in constant 2015 prices, US\$'000)**

CALCULATION OF ECONOMIC INTERNAL RATE OF RETURN (EIRR)
Kampong Chhnang Flood Protection
(US\$'000)

Year	Economic Costs	Incremental O & M	Economic Benefits	Net Benefits
2015	-	-	-	-
2016	1,413	-	-	(1,413)
2017	4,219	-	-	(4,219)
2018	11,252	-	-	(11,252)
2019	8,439	-	-	(8,439)
2020	2,813	134	6,105	3,158
2021		134	6,105	5,971
2022		134	6,105	5,971
2023		134	6,105	5,971
2024		134	6,105	5,971
2025		134	6,105	5,971
2026		134	6,105	5,971
2027		134	6,105	5,971
2028		134	6,105	5,971
2029		134	6,105	5,971
2030		134	6,105	5,971
2031		134	6,105	5,971
2032		134	6,105	5,971
2033		134	6,105	5,971
2034		134	6,105	5,971
2035		134	6,105	5,971
2036		134	6,105	5,971
2037		134	6,105	5,971
2038		134	6,105	5,971
2039		134	6,105	5,971
2040		134	6,105	5,971
2041		134	6,105	5,971
2042		134	6,105	5,971
2043		134	6,105	5,971
2044		134	6,105	5,971
2045		134	6,105	5,971

EIRR = 18.22%

Sensitivity Analysis Scenarios

Case 1:	10% Increase in Capital Cost
Case 2:	10% Increase in O & M
Case 3:	10 % decrease in benefits
Case 4:	10 % increase in capital costs + O&M; 10 % decrease in benefits
Case 5:	delay in project benefits by one year

Year	NET BENEFITS (US\$ MILLION)					
	Base Case	Case 1	Case 2	Case 3	Case 4	Case 5
2015	-	-	-	-	-	-
2016	(1,413)	(1,554)	(1,413)	(1,413)	(1,554)	(1,413)
2017	(4,219)	(4,641)	(4,219)	(4,219)	(4,641)	(4,219)
2018	(11,252)	(12,377)	(11,252)	(11,252)	(12,377)	(11,252)
2019	(8,439)	(9,283)	(8,439)	(8,439)	(9,283)	(8,439)
2020	3,158	2,877	3,156	2,547	2,253	(2,947)
2021	5,971	5,971	5,957	5,360	5,347	5,971
2022	5,971	5,971	5,957	5,360	5,347	5,971
2023	5,971	5,971	5,957	5,360	5,347	5,971
2024	5,971	5,971	5,957	5,360	5,347	5,971
2025	5,971	5,971	5,957	5,360	5,347	5,971
2026	5,971	5,971	5,957	5,360	5,347	5,971
2027	5,971	5,971	5,957	5,360	5,347	5,971
2028	5,971	5,971	5,957	5,360	5,347	5,971
2029	5,971	5,971	5,957	5,360	5,347	5,971
2030	5,971	5,971	5,957	5,360	5,347	5,971
2031	5,971	5,971	5,957	5,360	5,347	5,971
2032	5,971	5,971	5,957	5,360	5,347	5,971
2033	5,971	5,971	5,957	5,360	5,347	5,971
2034	5,971	5,971	5,957	5,360	5,347	5,971
2035	5,971	5,971	5,957	5,360	5,347	5,971
2036	5,971	5,971	5,957	5,360	5,347	5,971
2037	5,971	5,971	5,957	5,360	5,347	5,971
2038	5,971	5,971	5,957	5,360	5,347	5,971
2039	5,971	5,971	5,957	5,360	5,347	5,971
2040	5,971	5,971	5,957	5,360	5,347	5,971
2041	5,971	5,971	5,957	5,360	5,347	5,971
2042	5,971	5,971	5,957	5,360	5,347	5,971
2043	5,971	5,971	5,957	5,360	5,347	5,971
2044	5,971	5,971	5,957	5,360	5,347	5,971
2045	5,971	5,971	5,957	5,360	5,347	5,971

EIRR	18.22%	16.67%	18.19%	16.48%	15.00%	15.77%
NPV	9,257	7,507	9,202	6,521	4,712	6,163
SV		40.23	1,921.37	35.70		
SI		2.49	0.05	2.80		

**Table ST6: EIRR Calculation and Sensitivity Analysis—
Pursat Drainage and Flood Protection Subproject
(in constant 2015 prices, US\$'000)**

CALCULATION OF ECONOMIC INTERNAL RATE OF RETURN (EIRR)
Pursat River Embankment Protection
(US\$'000)

Year	Economic Costs	Incremental O & M	Economic Benefits	Net Benefits
2015	-	-	-	-
2016	590	-	-	(590)
2017	1,743	-	-	(1,743)
2018	4,649	-	-	(4,649)
2019	3,487	-	-	(3,487)
2020	1,162	444	2,718	1,111
2021		444	2,718	2,274
2022		444	2,718	2,274
2023		444	2,718	2,274
2024		444	2,718	2,274
2025		444	2,718	2,274
2026		444	2,718	2,274
2027		444	2,718	2,274
2028		444	2,718	2,274
2029		444	2,718	2,274
2030		444	2,718	2,274
2031		444	2,718	2,274
2032		444	2,718	2,274
2033		444	2,718	2,274
2034		444	2,718	2,274
2035		444	2,718	2,274
2036		444	2,718	2,274
2037		444	2,718	2,274
2038		444	2,718	2,274
2039		444	2,718	2,274
2040		444	2,718	2,274
2041		444	2,718	2,274
2042		444	2,718	2,274
2043		444	2,718	2,274
2044		444	2,718	2,274
2045		444	2,718	2,274

EIRR = 16.88%

Sensitivity Analysis Scenarios

Case 1:	10% Increase in Capital Cost
Case 2:	10% Increase in O & M
Case 3:	10 % decrease in benefits
Case 4:	10 % increase in capital costs + O&M; 10 % decrease in benefits
Case 5:	delay in project benefits by one year

Year	NET BENEFITS (US\$ MILLION)					
	Base Case	Case 1	Case 2	Case 3	Case 4	Case 5
2015	-	-	-	-	-	-
2016	(590)	(649)	(590)	(590)	(649)	(590)
2017	(1,743)	(1,918)	(1,743)	(1,743)	(1,918)	(1,743)
2018	(4,649)	(5,114)	(4,649)	(4,649)	(5,114)	(4,649)
2019	(3,487)	(3,835)	(3,487)	(3,487)	(3,835)	(3,487)
2020	1,111	995	1,107	840	679	(1,606)
2021	2,274	2,274	2,229	2,002	1,957	2,274
2022	2,274	2,274	2,229	2,002	1,957	2,274
2023	2,274	2,274	2,229	2,002	1,957	2,274
2024	2,274	2,274	2,229	2,002	1,957	2,274
2025	2,274	2,274	2,229	2,002	1,957	2,274
2026	2,274	2,274	2,229	2,002	1,957	2,274
2027	2,274	2,274	2,229	2,002	1,957	2,274
2028	2,274	2,274	2,229	2,002	1,957	2,274
2029	2,274	2,274	2,229	2,002	1,957	2,274
2030	2,274	2,274	2,229	2,002	1,957	2,274
2031	2,274	2,274	2,229	2,002	1,957	2,274
2032	2,274	2,274	2,229	2,002	1,957	2,274
2033	2,274	2,274	2,229	2,002	1,957	2,274
2034	2,274	2,274	2,229	2,002	1,957	2,274
2035	2,274	2,274	2,229	2,002	1,957	2,274
2036	2,274	2,274	2,229	2,002	1,957	2,274
2037	2,274	2,274	2,229	2,002	1,957	2,274
2038	2,274	2,274	2,229	2,002	1,957	2,274
2039	2,274	2,274	2,229	2,002	1,957	2,274
2040	2,274	2,274	2,229	2,002	1,957	2,274
2041	2,274	2,274	2,229	2,002	1,957	2,274
2042	2,274	2,274	2,229	2,002	1,957	2,274
2043	2,274	2,274	2,229	2,002	1,957	2,274
2044	2,274	2,274	2,229	2,002	1,957	2,274
2045	2,274	2,274	2,229	2,002	1,957	2,274

EIRR	16.88%	15.41%	16.61%	14.94%	13.28%	14.35%
NPV	2,953	2,230	2,774	1,735	813	1,576
SV		33.29	180.58	25.17		
SI		3.00	0.55	3.97		

**Table ST7: Calculation of Economic Costs—Kampong Chhnang
Solid Waste Management Subproject
(in constant 2015 prices, US\$'000)**

INVESTMENT COSTS (Constants 2015 prices, in US\$ '000)

PROJECT COST ITEM	TOTAL FINANCIAL	FINANCIAL WITHOUT TAX	FINANCIAL COSTS EXCLUDING TAX								TOTAL ECONOMIC COSTS
			Unskilled Labor		Skilled Labor		Local Materials		Foreign Costs		
			%	Total	%	Total	%	Total	%	Total	
1 Landfill construction cost	480	436	10%	44	20%	87	30%	131	40%	175	443
2 Landfill operating equipment	482	438	0%	0	0%	0	0%	0	100%	438	482
3 Waste collection fleet equipment	497	452	0%	0	0%	0	0%	0	100%	452	497
Subtotal Infrastructure Works	1,459	1,326	3%	44	7%	87	10%	131	80%	1,065	1,422
Total BASELINE COSTS	1,459	1,326	3%	44	7%	87	10%	131	80%	1,065	1,422
Physical Contingencies 10%	146	133	3%	4	7%	9	10%	13	80%	106	142
TOTAL SUBPROJECT COST	1,605	1,459	3%	48	7%	96	10%	144	80%	1,171	1,564
Allocated costs		480									468
Final adjusted costs inclusive of allocated costs											2,031

RECURRENT COSTS (Constants 2015 prices, in US\$ '000)

PROJECT COST ITEM	TOTAL FINANCIAL	FINANCIAL WITHOUT TAX	FINANCIAL COSTS EXCLUDING TAX								TOTAL ECONOMIC COSTS
			Unskilled Labor		Skilled Labor		Local Materials		Foreign Costs		
			%	Total	%	Total	%	Total	%	Total	
1 Operation and Maintenance	344	299	10%	30	20%	60	20%	60	50%	150	308

SHADOW PRICING INDICES

Unskilled Labor Shadow Index	0.75
Skilled Labor Shadow Index	1.00
Local Materials Shadow Index	1.00
Foreign Exchange Cost Shadow Index	1.10

**Table ST8: Calculation of Economic Costs—Pursat
Solid Waste Management Subproject
(in constant 2015 prices, US\$'000)**

INVESTMENT COSTS (Constant 2015 prices, in US\$ '000)

PROJECT COST ITEM	TOTAL FINANCIAL	FINANCIAL WITHOUT TAX	FINANCIAL COSTS EXCLUDING TAX								TOTAL ECONOMIC COSTS
			Unskilled Labor		Skilled Labor		Local Materials		Foreign Costs		
			%	Total	%	Total	%	Total	%	Total	
1 Landfill construction cost	1,137	1,034	10%	103	20%	207	30%	310	40%	413	1,049
2 Landfill operating equipment	482	438	0%	0	0%	0	0%	0	100%	438	482
3 Waste collection fleet equipment	609	554	0%	0	0%	0	0%	0	100%	554	609
Subtotal Infrastructure Works	2,228	2,025	5%	103	10%	207	15%	310	69%	1,405	2,140
Total BASELINE COSTS	2,228	2,025	5%	103	10%	207	15%	310	69%	1,405	2,140
Physical Contingencies 10%	223	203	5%	10	10%	21	15%	31	69%	141	214
TOTAL SUBPROJECT COST	2,451	2,228	5%	114	10%	227	15%	341	69%	1,546	2,354
Allocated costs		733									705
Final adjusted costs inclusive of allocated costs											3,059

RECURRENT COSTS (Constants 2015 prices, in US\$ '000)

PROJECT COST ITEM	TOTAL FINANCIAL	FINANCIAL WITHOUT TAX	FINANCIAL COSTS EXCLUDING TAX								TOTAL ECONOMIC COSTS
			Unskilled Labor		Skilled Labor		Local Materials		Foreign Costs		
			%	Total	%	Total	%	Total	%	Total	
1 Operation and Maintenance	490	426	10%	43	20%	85	20%	85	50%	213	439

SHADOW PRICING INDICES

Unskilled Labor Shadow Index	0.75
Skilled Labor Shadow Index	1.00
Local Materials Shadow Index	1.00
Foreign Exchange Cost Shadow Index	1.10

**Table ST9: Estimation of Economic Benefits—Kampong Chhnang
Solid Waste Management Subproject
(in constant 2015 prices, US\$'000)**

Benefits from Reduced Outdoor Pollution (Measured in DALY)							
	2019	2020	2026	2031	2035	2040	2045
DALYs in Cambodia (per 100,000 population) due to SWM mismanagement	385	385	385	385	385	385	385
Population in Kampong Chhnang (persons)	59,200	60,300	71,600	81,900	86,200	91,100	95,700
DALYs in KC due to SWM mismanagement	228	232	275	315	331	350	368
Economic value of DALY in Cambodia (\$ thousand/DALY)	3.029	3.090	3.480	3.842	4.159	4.592	5.069
Economic value of DALYs in KC (\$ thousand) due to SWM mismanagement	690	716	958	1,210	1,378	1,608	1,865
Savings in DALY due to subproject (%)	75.00%	75.00%	75.00%	75.00%	75.00%	75.00%	75.00%
Savings in DALY due to subproject (\$ thousand)	517	537	719	907	1,034	1,206	1,399
Estimated Economic Health Benefits (per annum)	517	537	719	907	1,034	1,206	1,399

**Table ST10: Estimation of Economic Benefits—Pursat
Solid Waste Management Subproject
(in constant 2015 prices, US\$'000)**

Benefits from Reduced Ground and Outdoor Pollution (Measured in DALY)						
	2020	2025	2030	2035	2040	2045
DALYs in Cambodia (per 100,000 population) due to SWM mismanagement	385	385	385	385	385	385
Population in Kampong Chhnang (persons)	83,600	94,600	107,000	122,200	133,000	141,200
DALYs in KC due to SWM mismanagement	321	364	411	470	511	543
Economic value of DALY in Cambodia (\$ thousand/DALY)	3.090	3.412	3.767	4.242	4.683	5.171
Economic value of DALYs in KC (\$ thousand) due to SWM mismanagement	993	1,241	1,550	1,993	2,395	2,807
Savings in DALY due to subproject (%)	75.00%	75.00%	75.00%	75.00%	75.00%	75.00%
Savings in DALY due to subproject (\$ thousand)	745	931	1,162	1,495	1,796	2,106
Estimated Economic Health Benefits (per annum)	745	931	1,162	1,495	1,796	2,106

**Table ST11: EIRR Calculation and Sensitivity Analysis—
Kampong Chhnang Solid Waste Management Subproject
(in constant 2015 prices, US\$'000)**

CALCULATION OF ECONOMIC INTERNAL RATE OF RETURN (EIRR)
Kampong Chhnang Solid Waste Management Subproject
(US\$'000)

Year	Economic Costs	Incremental O & M	Economic Benefits	Net Benefits
2015	-	-	-	-
2016	203	-	-	(203)
2017	914	-	-	(914)
2018	711	-	-	(711)
2019	203	308	517	6
2020	-	308	537	229
2021	-	308	567	259
2022	-	308	597	289
2023	-	308	629	321
2024	-	308	661	353
2025	-	308	694	386
2026	-	308	719	410
2027	-	308	744	436
2028	-	308	771	462
2029	-	308	798	490
2030	-	308	878	570
2031	-	308	907	599
2032	-	308	938	630
2033	-	308	968	660
2034	-	308	1,001	692
2035	-	308	1,034	726
2036	-	308	1,068	760
2037	-	308	1,099	791
2038	-	308	1,135	827
2039	-	308	1,171	863
2040	-	308	1,207	899
2041	-	308	1,244	935
2042	-	308	1,280	972
2043	-	308	1,319	1,011
2044	-	308	1,360	1,052
2045	-	308	1,400	1,092

EIRR = 16.64%

Sensitivity Analysis Scenarios

Case 1:	10% Increase in Capital Cost
Case 2:	10% Increase in O & M
Case 3:	10 % decrease in benefits
Case 4:	10 % increase in capital costs + O&M; 10 % decrease in benefits
Case 5:	delay in project benefits by one year

Year	NET BENEFITS (US\$ MILLION)					
	Base Case	Case 1	Case 2	Case 3	Case 4	Case 5
2015	-	-	-	-	-	-
2016	(203)	(223)	(203)	(203)	(223)	(203)
2017	(914)	(1,006)	(914)	(914)	(1,006)	(914)
2018	(711)	(782)	(711)	(711)	(782)	(711)
2019	6	(526)	(536)	(505.91)	(557)	(511)
2020	229	209	206	157	127	(79)
2021	259	229	198	175	145	209
2022	289	259	228	202	172	229
2023	321	289	258	229	198	259
2024	353	321	290	258	227	289
2025	386	353	322	287	256	321
2026	410	386	355	316	285	353
2027	436	410	380	339	308	386
2028	462	436	405	362	331	410
2029	490	462	432	385	355	436
2030	570	490	459	410	379	462
2031	599	570	539	482	451	490
2032	630	599	569	509	478	570
2033	660	630	599	536	505	599
2034	692	660	629	563	533	630
2035	726	692	662	592	562	660
2036	760	726	695	622	591	692
2037	791	760	729	653	622	726
2038	827	791	760	681	650	760
2039	863	827	796	713	683	791
2040	899	863	832	745	715	827
2041	935	899	868	778	748	863
2042	972	935	905	811	780	899
2043	1,011	972	941	844	813	935
2044	1,052	1,011	980	879	848	972
2045	1,092	1,052	1,021	916	885	1,011

EIRR	16.64%	13.00%	13.04%	12.02%	10.44%	12.30%
NPV	760	192	188	3	(290)	57
SV		12.73	12.88	10.04		
SI		7.86	7.76	9.96		

**Table ST12: EIRR Calculation and Sensitivity Analysis—
Pursat Solid Waste Management Subproject
(in constant 2015 prices, US\$'000)**

CALCULATION OF ECONOMIC INTERNAL RATE OF RETURN (EIRR)
Pursat Solid Waste Management Subproject
(US\$'000)

Year	Economic Costs	Incremental O & M	Economic Benefits	Net Benefits
2015	-	-	-	-
2016	306	-	-	(306)
2017	1,376	-	-	(1,376)
2018	1,071	-	-	(1,071)
2019	306	-	-	(306)
2020	-	439	745	306
2021	-	439	779	340
2022	-	439	815	376
2023	-	439	852	413
2024	-	439	890	451
2025	-	439	931	492
2026	-	439	973	535
2027	-	439	1,017	579
2028	-	439	1,064	625
2029	-	439	1,112	673
2030	-	439	1,162	723
2031	-	439	1,214	775
2032	-	439	1,269	830
2033	-	439	1,324	886
2034	-	439	1,380	941
2035	-	439	1,438	999
2036	-	439	1,495	1,056
2037	-	439	1,555	1,116
2038	-	439	1,614	1,175
2039	-	439	1,675	1,236
2040	-	439	1,735	1,296
2041	-	439	1,796	1,357
2042	-	439	1,858	1,420
2043	-	439	1,919	1,481
2044	-	439	1,981	1,542
2045	-	439	2,044	1,605

EIRR = 14.50%

Sensitivity Analysis Scenarios

Case 1:	10% Increase in Capital Cost
Case 2:	10% Increase in O & M
Case 3:	10 % decrease in benefits
Case 4:	10 % increase in capital costs + O&M; 10 % decrease in benefits
Case 5:	delay in project benefits by one year

Year	NET BENEFITS (US\$ MILLION)					
	Base Case	Case 1	Case 2	Case 3	Case 4	Case 5
2015	-	-	-	-	-	-
2016	(306)	(336)	(306)	(306)	(336)	(306)
2017	(1,376)	(1,514)	(1,376)	(1,376)	(1,514)	(1,376)
2018	(1,071)	(1,178)	(1,071)	(1,071)	(1,178)	(1,071)
2019	(306)	(336)	(306)	(306)	(336)	(306)
2020	306	306	302	232	188	(439)
2021	340	340	296	262	218	306
2022	376	376	332	295	251	340
2023	413	413	369	328	284	376
2024	451	451	408	362	318	413
2025	492	492	448	399	355	451
2026	535	535	491	437	393	492
2027	579	579	535	477	433	535
2028	625	625	581	519	475	579
2029	673	673	629	562	518	625
2030	723	723	680	607	563	673
2031	775	775	732	654	610	723
2032	830	830	786	703	659	775
2033	886	886	842	753	709	830
2034	941	941	898	803	760	886
2035	999	999	955	855	811	941
2036	1,056	1,056	1,012	906	863	999
2037	1,116	1,116	1,072	960	916	1,056
2038	1,175	1,175	1,131	1,014	970	1,116
2039	1,236	1,236	1,192	1,068	1,024	1,175
2040	1,296	1,296	1,252	1,122	1,078	1,236
2041	1,357	1,357	1,314	1,178	1,134	1,296
2042	1,420	1,420	1,376	1,234	1,190	1,357
2043	1,481	1,481	1,437	1,289	1,245	1,420
2044	1,542	1,542	1,498	1,344	1,300	1,481
2045	1,605	1,605	1,561	1,401	1,357	1,542

EIRR	14.50%	13.58%	13.82%	12.69%	11.10%	12.30%
NPV	637	429	460	169	(235)	81
SV		27.11	36.80	13.80		
SI		3.69	2.72	7.25		

**Table ST 13: Derivation of WACC—
Kampong Chhnang Solid Waste Management Subproject
(in constant 2015 prices, US\$'000)**

Item	Financing Component		
	ADB Loan	Government Funds	Total
A. Amount (US\$'000)	1,444.50	160.50	1,605
B. Weight	90.00%	10.00%	100%
C. Nominal Cost ^a	1.50	10.00	
D. Tax Rate	0.00%	0.00%	
E. Tax Adjusted Nominal Cost	1.50	10.00	
F. Inflation Rate	1.80%	3.50%	
G. Real Cost	1.48%	9.96%	
H. Weighted Component of WACC	1.33%	1.00%	2.33%
Weighted Average Cost of Capital (Real)	2.33%		

ADB= Asian Development Bank, WACC = weighted average cost of capital.

a In the absence of a bond market in Cambodia, the nominal cost of funds is based on the latest recorded 5-year bond yield of its neighboring Viet Nam plus a premium for project associated risks.

**Table ST 14: Derivation of WACC—
Kampong Chhnang Solid Waste Management Subproject
(in constant 2015 prices, US\$'000)**

Item	Financing Component		
	ADB Loan	Government Funds	Total
A. Amount (US\$'000)	2,205.90	245.10	2,451
B. Weight	90.00%	10.00%	100%
C. Nominal Cost ^a	1.50	10.00	
D. Tax Rate	0.00%	0.00%	
E. Tax Adjusted Nominal Cost	1.50	10.00	
F. Inflation Rate	1.80%	3.50%	
G. Real Cost	1.48%	9.96%	
H. Weighted Component of WACC	1.33%	1.00%	2.33%
Weighted Average Cost of Capital (Real)	2.33%		

ADB= Asian Development Bank, WACC = weighted average cost of capital.

a In the absence of a bond market in Cambodia, the nominal cost of funds is based on the latest recorded 5-year bond yield of its neighboring Viet Nam plus a premium for project associated risks.

**Table ST15: Estimation of Financial Revenues—
Kampong Chhnang Solid Waste Management Subproject
(in constant 2015 prices, US\$'000)**

Forecast Item	Unit	2019	2020	2025	2030	2035	2040	2041	2042	2043	2044	2045
Projected Population	people	59,200	60,300	70,500	80,800	86,200	91,100	92,000	92,900	93,800	94,800	95,700
Estimated Households	total households	11,473	11,686	13,663	15,659	16,705	17,655	17,829	18,004	18,178	18,372	18,547
Garbage Collection & Disposal Fees /	\$/month	1.05	1.05	1.16	1.22	1.34	1.34	1.34	1.34	1.34	1.34	1.34
Estimated Garbage Collection Revenues												
Without Project	\$/month	602	632	807	1,030	1,315	1,678	1,762	1,850	1,943	2,040	2,142
With Project	\$/month	2,409	3,068	9,490	13,324	17,909	20,110	20,309	20,508	20,706	20,927	21,127
Incremental Garbage Collection Revenues (\$/year)		21,684	29,222	104,194	147,520	199,131	221,189	222,560	223,895	225,164	226,650	227,818
Business Garbage Collection & Disposal Charges /2												
Large Businesses	\$/year	300	330	531	855	1378	2221	2443	2687	2956	3252	3577
Medium Sized Businesses	\$/year	200	220	354	570	919	1480	1628	1791	1970	2167	2384
Small Businesses	\$/year	100	110	177	287	463	746	821	903	993	1092	1201
No of Large Businesses		30	31	36	41	46	51	52	53	54	55	56
No of Medium usinesses		150	155	180	209	242	280	288	297	306	315	324
No of Small Businesses		220	231	295	377	482	615	646	678	712	748	785
Estimated Incremental Revenues (\$/year)		58,800	67,199	129,830	251,564	486,635	940,582	1,073,229	1,225,349	1,398,758	1,596,599	1,821,235
Total Revenues		80,484	96,421	234,023	399,084	685,766	1,161,771	1,295,790	1,449,244	1,623,922	1,823,249	2,049,053

Notes:

1. Current garbage collection fee for residential households is KR3,000-KR5,000 per month.
2. Payable upon renewal of business licenses.
3. Average Household size is 5.16 based on Resettlement Plan as of April 16, 2014.

**Table ST16: Estimation of Financial Revenues—
Pursat Solid Waste Management Subproject
(in constant 2015 prices, US\$'000)**

Forecast Item	Unit	2019	2020	2025	2030	2035	2040	2041	2042	2043	2044	2045
Projected Population	people	83,600	85,700	97,000	109,600	122,200	133,000	134,900	136,600	138,200	139,800	141,200
Estimated Households	total households	16,202	16,609	18,798	21,240	23,682	25,775	26,143	26,473	26,783	27,093	27,364
Garbage Collection Fee Rate /1	\$/month	1.05	1.05	1.16	1.22	1.34	1.48	1.48	1.48	1.55	1.55	1.55
Estimated Garbage Collection Revenues												
Without Project	\$/month	851	893	1,140	1,455	1,857	2,370	2,488	2,613	2,743	2,880	3,024
With Project	\$/month	3,402	4,360	13,057	18,072	25,389	32,369	32,831	33,246	35,317	35,726	36,083
Incremental Garbage Collection Revenues (\$/year)		30,622	41,601	143,001	199,408	282,386	359,993	364,117	367,597	390,883	394,142	396,702
Business Environmental Charge /2												
Large Businesses	\$/year	500	540	793	1164	1711	2514	2715	2932	3167	3420	3694
Medium Sized Businesses	\$/year	300	324	476	699	1026	1508	1629	1759	1900	2052	2216
Small Businesses	\$/year	75	81	119	175	257	378	408	441	476	514	555
No of Large Businesses		48	49	54	59	64	69	70	71	72	73	74
No of Medium usinesses		360	371	430	499	578	670	690	711	732	754	777
No of Small Businesses		560	588	750	957	1221	1558	1636	1718	1804	1894	1989
Estimated Incremental Revenues (\$/year)		169,800	189,529	327,827	568,205	984,949	1,713,858	1,914,799	2,140,695	2,391,658	2,673,032	2,988,694
Total Revenues		200,422	231,130	470,828	767,612	1,267,335	2,073,851	2,278,917	2,508,293	2,782,540	3,067,174	3,385,395

Notes:

1. Current garbage collection fee for residential households is KR3,000-KR5,000 per month.
2. Payable upon renewal of business licenses.

**Table ST17: Calculation of FIRR and Sensitivity Analysis—
Kampong Chhnang Solid Waste Management Subproject
(in constant 2015 prices, US\$'000)**

Year	Incremental Costs		Incremental Revenues Net of Taxes	Net Revenues
	Investment Costs	O&M Costs		
2015	-	-	-	0.00
2016	160.44	-	-	(160.44)
2017	721.99	-	-	(721.99)
2018	561.55	-	-	(561.55)
2019	160.44	348	80.48	(428.11)
2020	-	348	96.42	(251.73)
2021	-	348	114.54	(233.61)
2022	-	348	137.01	(211.14)
2023	-	348	159.37	(188.78)
2024	-	348	192.56	(155.59)
2025	-	348	234.02	(114.12)
2026	-	348	272.74	(75.41)
2027	-	348	295.55	(52.60)
2028	-	348	328.08	(20.06)
2029	-	348	357.00	8.85
2030	-	348	399.08	50.94
2031	-	348	468.44	120.29
2032	-	348	510.74	162.59
2033	-	348	558.95	210.80
2034	-	348	623.67	275.52
2035	-	348	685.77	337.62
2036	-	348	769.21	421.07
2037	-	348	848.35	500.20
2038	-	348	939.90	591.75
2039	-	348	1,043.86	695.72
2040	-	348	1,161.77	813.62
2041	-	348	1,295.79	947.64
2042	-	348	1,449.24	1,101.10
2043	-	348	1,623.92	1,275.77
2044	-	348	1,823.25	1,475.10
2045	-	348	2,049.05	1,700.90

(289)

FIRR = 5.98%

Year	Net Incremental Revenues (US\$'000)					
	Base Case	Case 1	Case 2	Case 3	Case 4	Case 5
2015	0	0	0	0	0	0
2016	(160)	(176)	(160)	(160)	(176)	(160)
2017	(722)	(794)	(722)	(722)	(794)	(722)
2018	(562)	(618)	(562)	(562)	(618)	(562)
2019	(428)	(444)	(463)	(436)	(487)	(509)
2020	(252)	(252)	(287)	(261)	(296)	(268)
2021	(234)	(234)	(268)	(245)	(280)	(252)
2022	(211)	(211)	(246)	(225)	(260)	(234)
2023	(189)	(189)	(224)	(205)	(240)	(211)
2024	(156)	(156)	(190)	(175)	(210)	(189)
2025	(114)	(114)	(149)	(138)	(172)	(156)
2026	(75)	(75)	(110)	(103)	(137)	(114)
2027	(53)	(53)	(87)	(82)	(117)	(75)
2028	(20)	(20)	(55)	(53)	(88)	(53)
2029	9	9	(26)	(27)	(62)	(20)
2030	51	51	16	11	(24)	9
2031	120	120	85	73	39	51
2032	163	163	128	112	77	120
2033	211	211	176	155	120	163
2034	276	276	241	213	178	211
2035	338	338	303	269	234	276
2036	421	421	386	344	309	338
2037	500	500	465	415	381	421
2038	592	592	557	498	463	500
2039	696	696	661	591	557	592
2040	814	814	779	697	663	696
2041	948	948	913	818	783	814
2042	1,101	1,101	1,066	956	921	948
2043	1,276	1,276	1,241	1,113	1,079	1,101
2044	1,475	1,475	1,440	1,293	1,258	1,276
2045	1,701	1,701	1,666	1,496	1,461	1,475

FIRR	5.98%	5.70%	5.18%	4.81%	3.75%	4.59%
NPV	2,998	2,849	2,367	1,919	1,139	1,771
SV		202.36	71.23	48.95		
SI		0.49	1.40	2.04		

Sensitivity Analysis Scenarios

Case 1:	10% Increase in investment cost
Case 2:	10% Increase in O&M costs
Case 3:	10 % decrease in revenues
Case 4:	10 % increase in capital costs + O&M and 10 % decrease in revenues
Case 5:	Delay in project revenues by one year

**Table ST18: Calculation of FIRR and Sensitivity Analysis—
Pursat Solid Waste Management Subproject
(in constant 2015 prices, US\$'000)**

Year	Incremental Costs		Incremental Revenues Net of Taxes	Net Revenues
	Investment Costs	O&M Costs		
2015	-	-	-	0.00
2016	245	-	-	(245.11)
2017	1,103	-	-	(1,103.00)
2018	1,708	-	-	(1,707.60)
2019	245	-	200	(44.69)
2020	-	400	231	(168.47)
2021	-	400	264	(135.30)
2022	-	400	305	(95.06)
2023	-	400	345	(54.32)
2024	-	400	402	2.13
2025	-	400	471	71.23
2026	-	400	539	139.63
2027	-	400	585	185.63
2028	-	400	646	246.75
2029	-	400	704	303.99
2030	-	400	768	368.01
2031	-	400	883	483.17
2032	-	400	961	561.65
2033	-	400	1,048	648.89
2034	-	400	1,160	759.97
2035	-	400	1,267	867.74
2036	-	400	1,407	1,007.21
2037	-	400	1,557	1,157.45
2038	-	400	1,705	1,305.78
2039	-	400	1,870	1,470.86
2040	-	400	2,074	1,674.25
2041	-	400	2,279	1,879.32
2042	-	400	2,508	2,108.69
2043	-	400	2,783	2,382.94
2044	-	400	3,067	2,667.57
2045	-	400	3,385	2,985.80
FIRR = 9.59%				

Year	Net Incremental Revenues (US\$'000)					
	Base Case	Case 1	Case 2	Case 3	Case 4	Case 5
2015	0	0	0	0	0	0
2016	(245)	(270)	(245)	(245)	(270)	(245)
2017	(1,103)	(1,213)	(1,103)	(1,103)	(1,213)	(1,103)
2018	(1,708)	(1,878)	(1,708)	(1,708)	(1,878)	(1,708)
2019	(45)	(69)	(45)	(65)	(89)	(245)
2020	(168)	(199)	(208)	(192)	(232)	(199)
2021	(135)	(168)	(175)	(162)	(202)	(168)
2022	(95)	(135)	(135)	(126)	(165)	(135)
2023	(54)	(95)	(94)	(89)	(129)	(95)
2024	2	(54)	(38)	(38)	(78)	(54)
2025	71	2	31	24	(16)	2
2026	140	71	100	86	46	71
2027	186	140	146	127	87	140
2028	247	186	207	182	142	186
2029	304	247	264	234	194	247
2030	368	304	328	291	251	304
2031	483	368	443	395	355	368
2032	562	483	522	466	426	483
2033	649	562	609	544	504	562
2034	760	649	720	644	604	649
2035	868	760	828	741	701	760
2036	1,007	868	967	867	827	868
2037	1,157	1,007	1,117	1,002	962	1,007
2038	1,306	1,157	1,266	1,135	1,095	1,157
2039	1,471	1,306	1,431	1,284	1,244	1,306
2040	1,674	1,471	1,634	1,467	1,427	1,471
2041	1,879	1,674	1,839	1,651	1,611	1,674
2042	2,109	1,879	2,069	1,858	1,818	1,879
2043	2,383	2,109	2,343	2,105	2,065	2,109
2044	2,668	2,383	2,628	2,361	2,321	2,383
2045	2,986	2,668	2,946	2,647	2,607	2,668
FIRR	9.59%	8.00%	9.04%	8.45%	7.44%	8.21%
NPV	9,757	7,563	9,068	7,789	6,796	7,689
SV		58.57	171.93	82.18		
SI		1.71	0.58	1.22		

Sensitivity Analysis Scenarios

Case 1:	10% Increase in investment cost
Case 2:	10% Increase in O&M costs
Case 3:	10 % decrease in revenues
Case 4:	10 % increase in capital costs + O&M and 10 % decrease in revenues
Case 5:	Delay in project revenues by one year

**Table ST19: CALCULATION OF FINANCIAL REVENUES
Kampong Chhnang Flood Protection
(Constant 2015 Prices -- US\$'000)**

Forecast Item	Unit	2019	2020	2025	2030	2035	2040	2041	2042	2043	2044	2045
Projected Population	people	59,200	60,300	70,500	80,800	86,200	91,100	92,000	92,900	93,800	94,800	95,700
Estimated Households	total households	11,473	11,686	13,663	15,659	16,705	17,655	17,829	18,004	18,178	18,372	18,547
Flood Protection Fees	\$/month	0.38	0.38	0.46	0.51	0.61	0.74	0.74	0.74	0.81	0.81	0.81
Estimated Flood Protection Revenues												
Without Project	\$/month	0	0	0	0	0	0	0	0	0	0	0
With Project	\$/month	872	1,110	3,769	6,732	8,690	11,113	11,222	11,332	12,586	12,720	12,842
Incremental Collection Revenues (\$/year)		10,463	13,322	45,232	80,784	104,278	133,352	134,666	135,988	151,033	152,645	154,099
Business Flood Protection Charges /2												
Large Businesses	\$/year	300	330	531	855	1378	2221	2443	2687	2956	3252	3577
Medium Sized Businesses	\$/year	200	220	354	570	919	1480	1628	1791	1970	2167	2384
Small Businesses	\$/year	100	110	177	287	463	746	821	903	993	1092	1201
No of Large Businesses		30	31	36	41	46	51	52	53	54	55	56
No of Medium usinesses		150	155	180	209	242	280	288	297	306	315	324
No of Small Businesses		220	231	295	377	482	615	646	678	712	748	785
Estimated Incremental Revenues (\$/year)		58,800	67,199	129,830	251,564	486,635	940,582	1,073,229	1,225,349	1,398,758	1,596,599	1,821,235
Total Revenues		69,263	80,521	175,062	332,348	590,914	1,073,934	1,207,896	1,361,337	1,549,791	1,749,244	1,975,333

Notes:

- Proposed drainage charges for residentia households is KR1,5000 or \$0.38 per month.
- Payable upon renewal of business licenses.

Table ST20: CALCULATION OF FINANCIAL REVENUES
Pursat Solid Waste Management Subproject
(Constant 2015 Prices -- US\$'000)

Forecast Item	Unit	2019	2020	2025	2030	2035	2040	2041	2042	2043	2044	2045
Projected Population	people	83,600	85,700	97,000	109,600	122,200	133,000	134,900	136,600	138,200	139,800	141,200
Estimated Households	total households	16,202	16,609	18,798	21,240	23,682	25,775	26,143	26,473	26,783	27,093	27,364
Drainage/Flood Protection Fee	\$/month	0.38	0.38	0.41	0.43	0.48	0.53	0.53	0.53	0.55	0.55	0.55
Estimated Garbage Collection Revenues												
Without Project	\$/month	0	0	0	0	0	0	0	0	0	0	0
With Project	\$/month	1,215	1,557	4,663	6,454	9,067	11,560	11,725	11,873	12,613	12,759	12,887
Incremental Garbage Collection Revenues (\$/year)		14,582	18,685	55,957	77,452	108,810	138,725	140,706	142,482	151,358	153,110	154,641
Business Environmental Charge /2												
Large Businesses	\$/year	200	216	318	467	686	1008	1089	1176	1270	1372	1482
Medium Sized Businesses	\$/year	150	162	238	350	514	755	815	880	950	1026	1108
Small Businesses	\$/year	50	54	79	116	171	252	272	294	318	343	370
No of Large Businesses		48	49	54	59	64	69	70	71	72	73	74
No of Medium usinesses		360	371	430	499	578	670	690	711	732	754	777
No of Small Businesses		560	588	750	957	1221	1558	1636	1718	1804	1894	1989
Estimated Incremental Revenues (\$/year)		88,800	99,263	172,837	302,114	528,908	928,756	1,039,073	1,163,759	1,303,145	1,458,438	1,632,921
Total Revenues		103,382	117,948	228,794	379,566	637,718	1,067,482	1,179,779	1,306,241	1,454,503	1,611,548	1,787,562

Notes:

1. Proposed drainage/flood protection fee for residentia households is KR1,500 per month.
2. Payable upon renewal of business licenses.

**Table ST21: Income and Expenditure Projections for Kampong Chhnang Project Implementation Unit
(KR Thousand, in current prices for financial years ending 31 December)**

Item	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
A. Sources of Funds																
1. Own Source Revenues																
Solid Waste Collection Fees	0	0	0	0	101	124	151	185	222	275	341	410	463	534	606	702
Drainage and Flood Protection Charges	0	0	0	0	41	50	61	79	94	111	139	167	194	233	269	311
Other Urban Service Fees	0	0	0	0	8	30	37	46	56	67	83	102	121	70	161	183
Subtotal (Recurrent Revenues)	0	0	0	0	150	204	249	310	371	452	564	679	778	837	1,036	1,196
2. Support for Infrastructure Subprojects																
ADB and PPCR Loan and Grant Proceeds Passed on as Grants	0	1,330	4,359	10,481	7,800	2,655	0	0	0	0	0	0	0	0	157	286
Subtotal (Support for Infrastructure Subprojects)	0	1,330	4,359	10,481	7,800	2,655	0	0	0	0	0	0	0	0	157	286
3. Other Government Grants and Subsidies	184	191	197	204	61	263	419	381	343	289	203	114	43	13	0	0
Total Sources of Funds	184	1,521	4,556	10,685	8,011	3,122	668	691	715	741	766	793	821	850	1,193	1,482
B. Uses of Funds																
1. Infrastructure Operations and Maintenance																
Subproject Flood Protection	0	0	0	0	0	0	184	191	198	204	212	219	227	235	243	251
Subproject Solid Waste Management	0	0	0	0	0	248	257	266	275	285	295	305	316	327	338	350
Subtotal (Infrastructure Operations and Maintenance)	0	0	0	0	0	248	441	457	473	489	507	524	543	562	581	602
2. Administration and Overheads																
Incremental Administration	184	191	197	204	211	219	226	234	242	251	260	269	278	288	298	308
Subtotal (Administration and Overheads)	184	191	197	204	211	219	226	234	242	251	260	269	278	288	298	308
3. Investment																
Subproject Flood Protection	0	1,165	3,598	9,875	7,623	2,655	0	0	0	0	0	0	0	0	157	0
Subproject Solid Waste Management	0	165	761	606	178	0	0	0	0	0	0	0	0	0	0	0
Subtotal (Investment)	0	1,330	4,359	10,481	7,800	2,655	0	0	0	0	0	0	0	0	157	286
4. Other Investments	0	0	0	0	0	0	0	0	0	0	0	0	0	0	156	287
Total Uses of Funds	184	1,521	4,556	10,685	8,011	3,122	668	691	715	740	766	793	821	849	1,192	1,483
D. Indicators																
1. Price Index	1.00	1.04	1.07	1.11	1.15	1.19	1.23	1.27	1.32	1.36	1.41	1.46	1.51	1.56	1.62	1.68
2. Own Source Revenue																
Collection Efficiency	20%	25%	30%	35%	40%	50%	60%	70%	70%	70%	70%	70%	80%	80%	80%	80%
Real Growth in Income						30%	18%	19%	15%	16%	18%	14%	10%	5%	15%	9%
As a Share of Total Income					2%	7%	37%	45%	52%	61%	74%	86%	95%	98%	87%	81%
As a Share of Direct Cost of Services and Maintenance						82%	56%	68%	79%	92%	111%	130%	143%	149%	178%	199%
3. Expenditure																
Real Growth in Recurrent Expenditure		3%	3%	3%	3%	46%	24%	3%	3%	2%	2%	2%	2%	2%	2%	2%

**Table ST22: Income and Expenditure Projections for Pursat Project Implementation Unit
(KR Thousand, in current prices for financial years ending 31 December)**

Item	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
A. Sources of Funds																
1. Own Source Revenues																
Solid Waste Collection Fees	0	0	0	0	200	239	283	338	396	477	579	686	771	881	992	1,121
Drainage and Flood Protection Charges	0	0	0	0	103	122	143	169	198	235	281	331	375	429	487	554
Other Urban Service Fees	0	0	0	0	26	81	96	113	134	158	190	227	265	300	342	387
Subtotal (Recurrent Revenues)	0	0	0	0	330	442	522	620	728	869	1,050	1,244	1,411	1,610	1,821	2,062
2. Support for Infrastructure Subprojects																
ADB and PPCR Loan and Grant Proceeds Passed on as Grants	0	739	2,666	4,945	3,374	1,077	0	0	0	0	0	0	0	0	0	0
Subtotal (Support for Infrastructure Subprojects)	0	739	2,666	4,945	3,374	1,077	0	0	0	0	0	0	0	0	0	0
3. Other Government Grants and Subsidies	156	161	167	173	0	218	763	709	649	556	425	283	170	25	0	0
Total Sources of Funds	156	901	2,833	5,118	3,704	1,737	1,285	1,330	1,377	1,425	1,475	1,527	1,580	1,635	1,821	2,062
B. Uses of Funds																
1. Infrastructure Operations and Maintenance																
Subproject Flood Protection and Embankment	0	0	0	0	0	0	602	623	645	668	691	715	740	766	793	821
Subproject Solid Waste Management	0	0	0	0	0	475	491	508	526	545	564	583	604	625	647	669
Subtotal (Infrastructure Operations and Maintenance)	0	0	0	0	0	475	1,094	1,132	1,171	1,212	1,255	1,299	1,344	1,391	1,440	1,490
2. Administration and Overheads																
Incremental Administration	156	161	167	173	179	185	192	198	205	213	220	228	236	244	253	261
Subtotal (Administration and Overheads)	156	161	167	173	179	185	192	198	205	213	220	228	236	244	253	261
3. Investment																
Subproject Flood Protection and Embankment	0	487	1,504	4,018	3,102	1,077	0	0	0	0	0	0	0	0	0	0
Subproject Solid Waste Management	0	252	1,163	928	272	0	0	0	0	0	0	0	0	0	0	0
Subtotal (Investment)	0	739	2,666	4,945	3,374	1,077	0	0	0	0	0	0	0	0	0	0
4. Other Investments	0	0	0	0	151	0	0	0	0	0	0	0	0	0	128	310
Total Uses of Funds	156	901	2,833	5,118	3,704	1,737	1,285	1,330	1,377	1,425	1,475	1,527	1,580	1,635	1,821	2,062
D. Indicators																
1. Price Index	1.00	1.04	1.07	1.11	1.15	1.19	1.23	1.27	1.32	1.36	1.41	1.46	1.51	1.56	1.62	1.68
2. Own Source Revenue																
Collection Efficiency	20%	25%	30%	35%	40%	50%	60%	70%	70%	70%	70%	70%	80%	80%	80%	80%
Real Growth in Income						29%	15%	15%	13%	14%	15%	13%	9%	9%	8%	8%
As a Share of Total Income					9%	25%	41%	47%	53%	61%	71%	81%	89%	98%	100%	100%
As a Share of Direct Cost of Services and Maintenance						93%	48%	55%	62%	72%	84%	96%	105%	116%	126%	138%
3. Expenditure																
Real Growth in Recurrent Expenditure		3%	3%	3%	3%	61%	40%	3%	3%	2%	2%	2%	2%	2%	2%	2%