

## ECONOMIC ANALYSIS – DONG HOI CITY

### A. Introduction

1. This economic analysis aims to assess the economic viability of the project through standard cost benefit analyses. The analysis has been undertaken separately for the sub-outputs that comprise the topics for each of the Feasibility Study Reports. The Dong Hoi Climate Change Adaptation Subproject comprises completion of the Dong Hoi main city wastewater collection system and development of the new urban area in Bao Ninh including a hydrodynamic study and dune restoration of the coastal area. The results of the Dong Hoi economic analysis are presented in this appendix for each suboutput and for the overall output.

### B. Subproject Rationale

2. Completion of the wastewater collection system in the main city area comprises establishment of tertiary sewers in seven central city wards and the associated connections to households as well as the completion of sewer extensions, pumping stations and related infrastructure. The sub-component builds on previous investments by the World Bank. The original World Bank project was approved in November 2006<sup>1</sup> for an amount of SDR83.9 million to finance investments in Nha Trang, Quy Nhon and Dong Hoi in (i) flood control, drainage and wastewater collection; (ii) wastewater treatment plants; (iii) solid waste management; (iv) resettlement; (v) household revolving fund and school sanitation program; and (vi) capacity building and project implementation. The total cost of the proposed investment in Dong Hoi was \$37.88 million, including the loan of \$28.18 million.

3. Project benefits identified included: (i) reduced flood damage; (ii) health benefits; (iii) savings in installation and desludging of septic tanks; (iv) savings in drainage maintenance; (v) increased tourism due to an improved environment for tourists and potential investors; (vi) improved financial positions of the service providers as tariffs are increased resulting in better management of service provision and the elimination of subsidies from the provincial governments, (vii) enhancement of the development potential of the cities especially the areas along canals and previously flooded areas; (viii) creation of new business opportunities such as restaurants, retail stores, and other entertainment activities; and (ix) land value appreciation in the area, the extent of which will largely depend on the new economic activities created by the proposed investments. Since it was not possible to quantify all of the benefits, only the first five were assessed.<sup>2</sup> The economic internal rate of return (EIRR) of the overall project was estimated at 18.5% with the Dong Hoi subproject having an EIRR of 14.6%.

4. Additional financing of SDR42.5 million was provided in February 2011 to complete the investments in the three cities.<sup>3</sup> The estimated cost of the Dong Hoi subproject increased by \$40.67 million from \$37.8 million at the original appraisal to \$78.54 million although there were no changes in the proposed investment packages. The revised EIRR for the overall project was 16.4% and the EIRR for Dong Hoi was estimated at 12.8%, a reduction of 1.8%. While the

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<sup>1</sup> World Bank, 2006. *Project Appraisal Document on a Proposed Credit in the Amount of SDR83.9 million to the Socialist Republic of Vietnam for a Coastal Cities Environmental Project*. Urban Development Sector Unit, East Asia and Pacific Region.

<sup>2</sup> *ibid.* Paragraphs 68 and 69.

<sup>3</sup> World Bank, 2011. *Project Paper on a Proposed Additional Credit in the Amount of SDR42.5 million to the Socialist Republic of Vietnam for a Coastal Cities Environmental Sanitation Project*. Vietnam Sustainable Development Unit, Sustainable Development Department, East Asia and Pacific Region.

investment envisaged under the proposed project will reduce the overall EIRR further it is considered critical to achieving the benefits of improved wastewater collection and treatment.

5. Development of Bao Ninh new urban area includes (i) construction and upgrading of vertical and horizontal roads to improve access and support the development of the new urban blocks; (ii) installation of gravity and pressurized flow pipes, and pumping stations for wastewater collection in Bao Ninh; and (iii) addition of stormwater collection and detention storage as required. The urban development, in particular the road system, will create several categories of land for urban development, designated as land for construction of resettlement houses, land for construction of household's houses, land for construction building houses, land for construction of commercial buildings (trading centers, restaurants, etc.). All land parcels are located along the west side of the upgraded road, along both sides of the 32-meter wide road and along the north side of the road linking to Nhat Le 2 bridge. In addition the subproject will include a hydrodynamic study of the coastal area and restoration of the sand dunes that have been degraded through recent urban development. This investment, which will be financed through a grant, is expected to result in more sustainable and climate change resilient development of the Bao Ninh area as well as provide a demonstration of climate change resilient development for other coastal cities in Viet Nam.

6. The subproject in Dong Hoi will assist the city both in achieving the envisaged benefits from the substantial investments that have already been made in wastewater collection and treatment infrastructure, and developing urban infrastructure in the Bao Nonh area as proposed in the city masterplan. Without the support of the project, and particularly the grant-aided hydrodynamic study and dune restoration, it is unlikely that Bao Ninh will be developed in a sustainable way, as can be observed in nearby locations that have been severely affected by typhoons and coastal erosion. With the assistance of the project, the Bao Ninh urban area is expected to provide an example of best practices for climate change resilient urban development in the coastal area that can be replicated elsewhere.

### C. Major Assumptions and Methodology

7. The economic analysis has been conducted using *Guidelines for the Economic Analysis of Projects*,<sup>4</sup> the *Workbook on Economic Evaluation of Environmental Impacts*,<sup>5</sup> and *Cost-Benefit Analysis for Development: A Practical Guide*<sup>6</sup> of the Asian Development Bank (ADB). The major assumptions of the analysis are:

- (i) economic analysis was carried out over 30 years starting in 2015 and including the 5-year implementation period;
- (ii) basic costs and prices are the same as those used in the financial analysis;
- (iii) financial costs and revenues are based on prevailing prices in mid-2013 and are expressed in constant 2013 terms;
- (iv) economic costs and benefits are valued in US dollars using the *world price level numeraire* in constant 2013 terms;
- (v) local currency costs are converted to US dollars using an exchange rate of VND20,800 per US\$1;
- (vi) economic costs and benefits for non-tradable inputs and outputs were derived by excluding taxes and duties and then adjusting their values by a standard conversion

<sup>4</sup> ADB. 1997. *Guidelines for Economic Analysis of Projects*. Manila.

<sup>5</sup> ADB. 2005. *Workbook on the Economic Evaluation of Environmental Impacts*. Manila.

<sup>6</sup> ADB. 2013. *Cost-Benefit Analysis for Development: A Practical Guide*. Manila.

factor (SCF) of 0.90 which is consistent with the SCF used in recent ADB projects for Viet Nam;<sup>7</sup>

- (vii) the economic value of agricultural land acquisition costs, as a part of land acquisition and resettlement costs, was estimated based on the expected economic value of the agricultural production forgone, while all other land acquisition and resettlement costs were treated as non-tradable and the financial value, excluding taxes, was assumed to reflect the actual economic value of the land;
- (viii) the proportion of costs for skilled and unskilled labor could not be separated from other non-tradable costs and a single conversion factor was therefore applied, implying a shadow wage rate factor (SWRF) based on an opportunity cost of labor (scarce or surplus) of 1.0 and a SCF of 0.9;<sup>8</sup> and
- (ix) the economic opportunity cost of capital is assumed to be 12%.

8. The analysis was undertaken through examination of the without- and with-project scenarios. Without-project there are expected to be few additional connections to the new wastewater treatment plant (WWTP), and land use in the Bao Ninh area is expected to continue in the current pattern with little economic activity. With-project the Dong Hoi main city communities are expected to benefit through (i) increased connections to the wastewater system which take advantage of the substantial investments that have already been incurred; (ii) avoided costs due to not having to construct or maintain septic tanks and (iii) improved health through reduction of wastewater borne diseases. The benefits for the Bao Ninh New Urban Area are expected to derive from a rapid increase in sustainable economic activity as the proposed infrastructure and dune restoration supports settlement, industrial activity and increased tourism. The difference in the with- and without-project benefits was assessed based (i) improved health and reduced costs for the wastewater connections in the main city; and (ii) the economic value of services to be provided to the Bao Ninh area, in particular water supply, wastewater collection and treatment, and the urban road network. In addition, benefits were recognized from improved urban drainage (which will have a positive impact on flood protection, improved flood protection through restoration and protection of the Bao Ninh sand dunes, and increased tourism numbers and expenditure. However, no information was available to permit the quantification of these benefits and consequently they were treated as non-quantifiable.

## **D. Economic Costs and Benefits**

### **1. Investment Costs**

9. The investment costs for the subproject were derived from the agreed financial cost of the Dong Hoi component of the overall project. Detailed costs by year were estimated using the Costabs program and are shown for the infrastructure investments in Table 1 and for project management and climate change in Table 2.

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<sup>7</sup> ADB. 2013. *Report and Recommendation of the President to the Board of Directors: Proposed Loan and Administration of Grant to the Socialist Republic of Viet Nam for the Central Mekong Delta Region Connectivity Project*. Manila; ADB. 2012. *Report and Recommendation of the President to the Board of Directors: Proposed Loan and Administration of Grant to the Socialist Republic of Viet Nam for the Greater Mekong Subregion Corridor Towns Development Project*. Manila; and ADB. 2012. *Report and Recommendation of the President to the Board of Directors: Proposed Loans, Grant, and Administration of Grant to the Lao People's Democratic Republic and Socialist Republic of Viet Nam for the Greater Mekong Subregion Flood and Drought Risk Management and Mitigation Project*. Manila.

<sup>8</sup> The shadow wage rate factor for unskilled labor in Viet Nam is 0.75 and for skilled labor is 1.0.

**Table 1: Financial Cost of Dong Hoi Subproject Investments by Year**

Item	Totals Including Contingencies (\$ '000) <sup>a</sup>						Total
	2016	2017	2018	2019	2020	2021	
<b>I. Investment Costs</b>							
<b>A. Dong Hoi Main City Wastewater Collection</b>							
<b>1. Civil Works</b>							
a. Tertiary sewers in central city wards	833	833	833	833	-	-	3,331
b. Sewer extensions, pump station & CSO	-	548	565	548	-	-	1,661
<b>Subtotal</b>	833	1,381	1,397	1,381	-	-	4,992
2. Pump Stations and CSO Alarms, CCTV	-	-	182	182	-	-	363
<b>Subtotal</b>	833	1,381	1,579	1,562	-	-	5,355
<b>B. Bao Ninh Urban Development</b>							
<b>1. Civil Works</b>							
a. North-South Road No. 2	-	2,251	2,319	2,251	-	-	6,822
b. East-West Road No. 1	-	368	379	368	-	-	1,114
c. East-West Road No. 2	-	326	336	326	-	-	988
d. East-West Road No. 3	-	419	432	419	-	-	1,270
e. East-West Road No. 4	-	1,199	1,235	1,199	-	-	3,633
f. Bao Ninh Stormwater	-	1,133	1,133	1,133	1,133	-	4,532
g. Wastewater	-	-	2,178	2,244	2,178	-	6,600
<b>Subtotal</b>	-	5,696	8,012	7,940	3,311	-	24,959
<b>C. Bao Ninh Hydrodynamic Study and Dune Restoration</b>							
<b>1. Dong Hoi Hydrodynamic Study</b>							
<b>a. Consultants</b>							
International Consultants	69	69	-	-	-	-	139
National Consultants	25	25	-	-	-	-	50
<b>Subtotal</b>	94	94	-	-	-	-	189
<b>b. Consultant Support</b>							
Miscellaneous administration and support	6	6	6	6	6	6	33
<b>Subtotal</b>	100	100	6	6	6	6	222
<b>2. Bao Ninh Dune Restoration</b>							
a. Topographic and Bathymetric Maps	178	-	-	-	-	-	178
<b>b. Sand fill and replanting</b>							
Sand fill	372	-	-	-	-	-	372
Replanting	14	-	-	-	-	-	14
Replanting	-	13	11	11	11	11	58
<b>Subtotal</b>	386	13	11	11	11	11	444
c. Training	6	6	6	-	-	-	17
<b>d. Consultants</b>							
International consultants	28	14	14	14	14	6	89
National consultants	11	8	6	3	3	3	33
<b>Subtotal</b>	39	22	19	17	17	8	122
e. Reports and communications	3	3	3	3	3	3	17
<b>Subtotal</b>	611	44	39	31	31	22	777
<b>Subtotal</b>	711	144	44	36	36	28	999
D. Land Acquisition and Resettlement	1,254	1,254	-	-	-	-	2,508
<b>E. Environmental Management</b>							
<b>1. Monitoring</b>							
Water and air quality sampling	-	1	1	1	1	1	3
Water quality analysis	-	2	2	2	2	2	11
Air quality analysis	-	3	3	3	3	3	13
<b>Subtotal</b>	-	5	5	5	5	5	26
<b>F. Management &amp; supervision costs</b>							
<b>1. Engineering and management overheads /a</b>							
Main city wastewater civil works	21	35	35	35	-	-	125
Main city wastewater pump stations	-	-	5	5	-	-	9
Bao Ninh	-	142	200	198	83	-	624
<b>Subtotal</b>	21	177	240	238	83	-	758
<b>2. Construction supervision /b</b>							
Main city wastewater civil works	21	35	35	35	-	-	125
Main city wastewater pump stations	-	-	5	5	-	-	9
Bao Ninh	-	142	200	198	83	-	624
<b>Subtotal</b>	21	177	240	238	83	-	758
<b>Subtotal</b>	42	354	480	475	166	-	1,516
<b>Total</b>	2,839	8,833	10,120	10,019	3,518	33	35,363

<sup>a</sup> Excludes price contingencies<sup>b</sup> 2.5% of total physical works<sup>c</sup> 2.5% of total physical works

Source: Dong Hoi Government estimates.

**Table 2: Financial Cost of Dong Hoi Project Management and Climate Change Support**

Item	Total Including Contingencies (\$ '000)						Total
	2016	2017	2018	2019	2020	2021	
<b>I. Investment Costs</b>							
<b>B. Overall Project Management - Dong Hoi</b>							
<b>1. International Consultants</b>							
Team Leader/Civil Engineer	50	66	33	33	17	33	231
Climate Change/Urban Planner	8	25	8	8	8	-	58
Financial Management	8	8	8	8	8	-	41
Environment Monitoring Specialist	8	8	8	8	8	8	50
Resettlement Specialist	8	8	8	8	8	8	50
Gender specialist	8	8	8	8	8	8	50
<b>Subtotal</b>	91	124	74	74	58	58	479
<b>2. Communications</b>							
Environmental awareness campaigns	4	4	4	4	4	4	23
<b>Subtotal</b>	95	128	78	78	62	62	501
<b>C. Project Management Unit: Dong Hoi</b>							
<b>1. National Consultants</b>							
Deputy Team Leader	17	33	33	25	25	17	149
Climate Change/Urban Planner	3	8	3	3	3	-	19
Financial Management Specialist	6	17	11	6	6	6	50
Environmental Monitoring Specialist	8	8	8	8	6	3	41
Resettlement Specialist	17	25	25	25	25	-	116
Gender Training Specialist	6	3	3	3	3	-	17
<b>Subtotal</b>	55	94	83	69	66	25	391
<b>2. Consultant Support</b>							
Office operation	28	28	28	28	28	28	165
Training	110	-	-	-	-	-	110
Equipment (hardware & software)	28	-	-	-	-	-	28
<b>Subtotal</b>	165	28	28	28	28	28	303
<b>3. Revolving funds</b>							
Dong Hoi Women's Association	200	-	-	-	-	-	200
<b>Subtotal</b>	420	121	110	96	94	52	893
<b>E. Detailed Engineering and Preparation</b>							
<b>1. Dong Hoi</b>							
Bao Ninh Detailed Planning	263	-	-	-	-	-	263
Dong Hoi Detailed design	525	-	-	-	-	-	525
<b>Subtotal</b>	788	-	-	-	-	-	788
<b>Total</b>	1,302	249	188	174	155	114	2,182

Source: Dong Hoi Government estimates.

10. The costs for the “main city wastewater collection” and “Bao Ninh urban area development” components were separated to permit estimation of the financial viability of the Bao Ninh urban development component. The total financial cost of the subproject, including physical contingencies, was estimated at \$37.54 million (Table 3). The financial cost of the main city wastewater collection component was estimated at \$5.97 million with the allocation by year at \$1.28 million, \$1.49 million, \$1.70 million and \$1.70 million respectively for the years 2016 to 2019. The financial cost of the Bao Ninh urban area development component was estimated at \$31.57 million with the allocation by year at \$2.87 million, \$7.59 million, \$8.62 million, \$8.52 million, \$3.67million and \$0.15 million respectively for the years 2016 to 2021.

**Table 3: Summary of Financial Costs by Component and Subproject**

Component/Subproject	Totals Including Contingencies (\$000s) <sup>a</sup>						Total
	2016	2017	2018	2019	2020	2021	
<b>A. Dong Hoi Urban Environment and Climate Change Adaptation</b>	2,839	8,833	10,120	10,019	3,518	33	35,363
Dong Hoi Wastewater	874	1,450	1,658	1,640	0	0	5,623
Bao Ninh Urban Development	1,965	7,384	8,462	8,378	3,518	33	29,740
<b>B. Project Management and Climate Change Support</b>	1,302	249	188	174	155	114	2,182
Dong Hoi Wastewater	401	41	31	29	0	0	347
Bao Ninh Urban Development	901	208	157	146	155	114	1,835
<b>Total PROJECT COSTS</b>	<b>4,141</b>	<b>9,082</b>	<b>10,308</b>	<b>10,193</b>	<b>3,673</b>	<b>147</b>	<b>37,544</b>

<sup>a</sup> Excluding price contingencies

Source: Summarized from Tables 1 and 2.

11. Economic costs for the each component and the overall subproject were derived from the financial costs using the Costabs program. The economic cost of infrastructure investments is shown in Table 4 and of project management and climate change support in Table 5. The combined summarized costs are shown in Table 6. The economic cost of the overall Dong Hoi subproject is estimated at \$33.60 million, including physical contingencies. As with the financial costs the economic costs for the “main city wastewater collection” and “Bao Ninh urban area development” components were separated out to permit separate estimation of the economic viability of each component. The economic cost of the main city wastewater collection component was estimated at \$5.26 million with the allocation by year at \$1.17 million, \$1.32 million, \$1.48 million and \$1.47 million respectively for the years 2016 to 2019. The economic cost of the Bao Ninh urban area development component was estimated at \$28.33 million with the allocation by year at \$2.77 million, \$6.88 million, \$7.63 million, \$7.55 million, \$3.25 million and \$0.13 million respectively for the years 2016 to 2021.

**Table 4: Economic Cost of Dong Hoi Subproject Investments by Year**

Item	Total Economic Cost Including Contingencies (\$ '000) <sup>a</sup>						Total
	2016	2017	2018	2019	2020	2021	
<b>I. Investment Costs</b>							
<b>A. Dong Hoi Main City Wastewater Collection</b>							
<b>1. Civil Works</b>							
a. Tertiary sewers in central city wards	732	732	732	732	-	-	2,928
b. Sewer extensions, pump station & CSO	-	482	496	482	-	-	1,460
<b>Subtotal</b>	732	1,214	1,228	1,214	-	-	4,388
2. Pump Stations and CSO Alarms, CCTV	-	-	150	150	-	-	299
<b>Subtotal</b>	732	1,214	1,378	1,363	-	-	4,687
<b>B. Bao Ninh Urban Development</b>							
<b>1. Civil Works</b>							
a. North-South Road No. 2	-	1,979	2,039	1,979	-	-	5,996
b. East-West Road No. 1	-	323	333	323	-	-	980
c. East-West Road No. 2	-	286	295	286	-	-	868
d. East-West Road No. 3	-	368	380	368	-	-	1,116
e. East-West Road No. 4	-	1,054	1,086	1,054	-	-	3,193
f. Bao Ninh Stormwater	-	996	996	996	996	-	3,984
g. Wastewater	-	-	1,914	1,972	1,914	-	5,801
<b>Subtotal</b>	-	5,007	7,043	6,979	2,910	-	21,939
<b>C. Bao Ninh Hydrodynamic Study and Dune Restoration</b>							
<b>1. Dong Hoi Hydrodynamic Study</b>							
<b>a. Consultants</b>							
International Consultants	69	69	-	-	-	-	138
National Consultants	25	25	-	-	-	-	50
<b>Subtotal</b>	94	94	-	-	-	-	187
<b>b. Consultant Support</b>							
Miscellaneous administration and support	6	6	6	6	6	6	33
<b>Subtotal</b>	99	99	6	6	6	6	220
<b>2. Bao Ninh Dune Restoration</b>							
a. Topographic and Bathymetric Maps	176	-	-	-	-	-	176
<b>b. Sand fill and replanting</b>							
Sand fill	331	-	-	-	-	-	331
Replanting	12	-	-	-	-	-	12
Replanting	-	12	10	10	10	10	51
<b>Subtotal</b>	343	12	10	10	10	10	395
c. Training	6	6	6	-	-	-	17
<b>d. Consultants</b>							
International consultants	28	14	14	14	14	6	88
National consultants	11	8	6	3	3	3	33
<b>Subtotal</b>	39	22	19	17	17	8	121
e. Reports and communications	3	3	3	3	3	3	17
<b>Subtotal</b>	566	42	37	29	29	21	725
<b>Subtotal</b>	665	141	43	35	35	26	945
D. Land Acquisition and Resettlement	1,254	1,254	-	-	-	-	2,508
<b>E. Environmental Management</b>							
<b>1. Monitoring</b>							
Water and air quality sampling	-	0	0	0	0	0	2
Water quality analysis	-	2	2	2	2	2	10
Air quality analysis	-	2	2	2	2	2	11
<b>Subtotal</b>	-	5	5	5	5	5	24
<b>F. Management &amp; supervision costs</b>							
<b>1. Engineering and management overheads /a</b>							
Main city wastewater civil works	21	35	35	35	-	-	125
Main city wastewater pump stations	-	-	5	5	-	-	9
Bao Ninh	-	142	200	198	83	-	624
<b>Subtotal</b>	21	177	240	238	83	-	758
<b>2. Construction supervision /b</b>							
Main city wastewater civil works	21	35	35	35	-	-	125
Main city wastewater pump stations	-	-	5	5	-	-	9
Bao Ninh	-	142	200	198	83	-	624
<b>Subtotal</b>	21	177	240	238	83	-	758
<b>Subtotal</b>	42	354	480	475	166	-	1,516
<b>Total</b>	2,693	7,974	8,948	8,857	3,115	31	31,618

<sup>a</sup> Excludes price contingencies<sup>b</sup> 2.5% of total physical works<sup>c</sup> 2.5% of total physical works

Source: Asian Development Bank estimates.

**Table 5: Economic Cost of Dong Hoi Project Management and Climate Change Support**

Item	Total Economic Cost Including Contingencies (\$ '000)						Total
	2016	2017	2018	2019	2020	2021	
<b>I. Investment Costs</b>							
<b>B. Overall Project Management - Dong Hoi</b>							
<b>1. International Consultants</b>							
Team Leader/Civil Engineer	45	59	30	30	15	30	208
Climate Change/Urban Planner	7	22	7	7	7	-	52
Financial Management	7	7	7	7	7	-	37
Environment Monitoring Specialist	7	7	7	7	7	7	45
Resettlement Specialist	7	7	7	7	7	7	45
Gender specialist	7	7	7	7	7	7	45
<b>Subtotal</b>	<b>82</b>	<b>111</b>	<b>67</b>	<b>67</b>	<b>52</b>	<b>52</b>	<b>431</b>
<b>2. Communications</b>							
Environmental awareness campaigns	3	3	3	3	3	3	19
<b>Subtotal</b>	<b>85</b>	<b>115</b>	<b>70</b>	<b>70</b>	<b>55</b>	<b>55</b>	<b>450</b>
<b>C. Project Management Unit: Dong Hoi</b>							
<b>1. National Consultants</b>							
Deputy Team Leader	15	30	30	22	22	15	135
Climate Change/Urban Planner	2	7	2	2	2	-	17
Financial Management Specialist	5	15	10	5	5	5	45
Environmental Monitoring Specialist	7	7	7	7	5	2	37
Resettlement Specialist	15	22	22	22	22	-	105
Gender Training Specialist	5	2	2	2	2	-	15
<b>Subtotal</b>	<b>50</b>	<b>85</b>	<b>75</b>	<b>62</b>	<b>60</b>	<b>22</b>	<b>355</b>
<b>2. Consultant Support</b>							
Office operation	24	24	24	24	24	24	142
Training	94	-	-	-	-	-	94
Equipment (hardware & software)	24	-	-	-	-	-	24
<b>Subtotal</b>	<b>142</b>	<b>24</b>	<b>24</b>	<b>24</b>	<b>24</b>	<b>24</b>	<b>260</b>
<b>3. Revolving funds</b>							
Dong Hoi Women's Association	200	-	-	-	-	-	200
<b>Subtotal</b>	<b>392</b>	<b>109</b>	<b>99</b>	<b>86</b>	<b>84</b>	<b>46</b>	<b>815</b>
<b>E. Detailed Engineering and Preparation</b>							
<b>1. Dong Hoi</b>							
Bao Ninh Detailed Planning	239	-	-	-	-	-	239
Dong Hoi Detailed design	477	-	-	-	-	-	477
<b>Subtotal</b>	<b>716</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>716</b>
<b>Total</b>	<b>1,192</b>	<b>223</b>	<b>169</b>	<b>156</b>	<b>139</b>	<b>101</b>	<b>1,981</b>

Source: Asian Development Bank estimates.

**Table 6: Summary of Economic Costs by Component and Subproject**

Component/Subproject	Total Economic Costs Including Contingencies (\$000s)						Total
	2016	2017	2018	2019	2020	2021	
<b>A. Dong Hoi Urban Environment and Climate Change Adaptation</b>	2,693	7,974	8,948	8,857	3,115	31	31,618
Dong Hoi Wastewater	774	1,283	1,457	1,441	0	0	4,955
Bao Ninh Urban Development	1,919	6,691	7,491	7,416	3,115	31	26,663
<b>C. Project Management and Climate Change Support</b>	1,192	223	169	156	139	101	1,981
Dong Hoi Wastewater	343	36	27	25	0	0	310
Bao Ninh Urban Development	850	187	141	131	139	101	1,670
<b>Total PROJECT COSTS</b>	<b>3,885</b>	<b>8,197</b>	<b>9,116</b>	<b>9,013</b>	<b>3,254</b>	<b>133</b>	<b>33,598</b>

Source: Summarized from Tables 4 and 5.



## 2. Operation and Maintenance Costs

12. Operation and maintenance (O&M) costs were estimated based on Circular 11/2012/TT-BXD dated 25 December, 2012 relating to the allocation of funds for O&M by type of construction work. For wastewater investments the O&M cost is expected to be around 1% of the investment cost and this is considered to be reasonable for the type of incremental investments to be supported by the project. With respect to Bao Ninh urban area, the circular indicates that industrial works should be allocated 0.6-0.1% of investment costs, civil construction works 0.08-0.1% and urban infrastructure works 0.18-0.25%. According to Decision 114/2010/ND-CP dated 6, December, 2010 on maintenance of construction works, maintenance should be applied every 5 years after construction works are completed. Since the Bao Ninh component is classified urban infrastructure works, the O&M costs are suggested to be a maximum of 0.25% of the investment cost every 5 years, equivalent to 0.05% annually. The consultant considered that such a small allocation to O&M will not maintain the infrastructure at the level required to achieve the proposed project life. Unless more is spent the infrastructure will rapidly deteriorate and the benefits will be lost. Therefore an allocation of 1% of the investment cost was used for the analyses.

## 3. Benefits

### a. Main city wastewater collection

13. The benefits quantified for the main city water collection component were limited to (i) improved health for the newly connected areas (4,635 households), particularly reduced incidences of illnesses resulting in lost working days;<sup>9</sup> (ii) saved cost of cleaning existing septic tanks and constructing new septic tanks; and (iii) reduced incidences of illnesses in the overall population due to improved monitoring of the wastewater collection system.

14. **Improved health in the newly connected areas.** Based on surveys conducted of the potential benefiting households, without project (that is without connections to the wastewater collection system) waterborne and water vector diseases were estimated at 2.3% and 16.3% of households respectively each year. With project the incidences of waterborne and water vector diseases are expected to reduce to 0.5% and 2.8% respectively. Thus the overall reduction in the incidence of diseases following the increased connection rate was estimated to be from 16.3% to 3.3%, and the unit cost of each type of disease was assumed to be the same. Based on data from the Prevention Medical Center of Dong Hoi City, the average cost of medication was estimated at VND150,000/day for 7 days with a total cost of VND2.07 billion. In addition, labor lost, valued at VND250,000/day in 2013 constant values, was estimated for the employed persons who were sick, 70% of sick persons, plus one carer for each sick person,<sup>10</sup> totaling 5,374 persons for 7 days. The annual cost per benefiting household was thus estimated at \$33.00 per year (equivalent to VND686,400) in 2013 values. Based on the reduction in the incidence of illnesses per household the annual cost per benefiting household with project was estimated at about \$7.00 (equivalent to VND145,600) in 2013, in constant 2013 values. In addition to the households who would directly benefit from the improved wastewater connections, it is expected that other community members, who visit these households or are affected by the poor environmental conditions, will benefit from the improved connections. This

<sup>9</sup> This is likely to be an underestimate of the benefits since other people visiting the non-connected households are likely to be exposed to these diseases.

<sup>10</sup> The estimate of one carer per sick persons is based on the common practice in the project area as reported by local people.

has been assumed to be 5% of the population and the benefits to them have been estimated by assuming the same reduction in disease incidence. The unit values without- and with-project were adjusted by year to reflect the expected annual increase in the real value of labor productivity of 3% and the total annual value of illnesses avoided was estimated based on the expected pattern of adoption of wastewater connections. The financial costs without- and with-project were converted to their economic values and the benefit from reduced incidence of diseases thus derived.

15. **Saved Cost of Cleaning Septic Tanks.** There were estimated to be about 17,500 septic tanks in Dong Hoi main city in 2012, which should be cleaned every 3 years. The number of new septic tanks being installed is currently about 50, but this number has declined due to the impact of a slowdown in development. With project, the number is expected to increase to about 125/year between 2015 and 2018 as the household connections are made. With the completion of the wastewater system and connections, there will be no need to construct new septic tanks, with a saving per new tank of about VND13.5 million. In addition, as households are connected, there will be a saving in the cost of cleaning, estimated at VND600,000 per cleaning. Both cost savings were aggregated to the annual values and converted to their economic values.

16. **Improved health of overall population.** In addition to the health improvements for the households that connect to the wastewater collection system, there are expected to be significant health benefits to the overall community from the improved monitoring and management of the WWTP system to be supported through the project. Data for the period 2010 to 2012 on the without-project health situation were provided by the Prevention Medical Center of Dong Hoi City. According to their records, the average number of incidences of water-borne diseases per year was 228 for dysentery, 497 for diarrhea, and 71 for dengue fever. This represents, on average, about 0.7% of the population. There were no reported cases of cholera or typhoid. The center also indicated that the number of cases known to the center represents about 40% of the total incidences of these diseases since many patients treat themselves rather than attending the center. The total number of persons affected by these illnesses was therefore estimated at 1,976/year. The costs incurred from these diseases were estimated in the same way as the costs of illnesses from lack of connections. With project the incidence of such diseases is expected to decrease by 50%.

#### **b. Bao Ninh Climate Change Adaptation**

17. Development of the Bao Ninh new urban area will convert an area of currently unused land, predominantly sandy fields into a new urban area with completed basic infrastructure including the road system, domestic and commercial water supply, wastewater collection, drainage, power transmission, communication lines, etc. The main benefits from the project will come from (i) the improved water supply, wastewater, drainage, flood management and transportation systems developed; (ii) the improved welfare of families that move to the new residential areas, including improved health; (iii) the greater aesthetic value of living and working in the new urban area; and (iv) reduced tidal damage in terms of both erosion and land loss. Quantification of these benefits is complex many cannot be measured using standard market approaches. An alternative would be a contingent valuation approach but since most of the beneficiaries are not currently resident in the area it is difficult to obtain a representative sample. Furthermore, the study resources were insufficient to conduct such a survey. The only alternative was to select those benefits that good be estimated with some degree of confidence from available information and to treat all other benefits as non-quantifiable. The specific benefits identified were health (in particular as it relates to improved wastewater management), water supply and urban roads. The build-up of benefits was assumed to occur over 6 years,

starting 2018 and reaching 100% in 2023. Given the large number of benefits were treated as non-quantifiable, the economic evaluation is considered to be extremely conservative.

18. **Population and Tourist Numbers.** Estimates of the population and tourist numbers were obtained from a recent zoning document for Bao Ninh, which indicates a total population of 12,670 by 2020 and 23,370 by 2035, including “frequent tourist visitors” of 1,000 in 2020 increasing to 2,000 in 2035.<sup>11</sup> Since the population was provided in persons rather than households, an average household size of 4 persons was assumed. The unit used for tourists was no provided preventing assessment of whether this is tourist years or a smaller unit: tourist years was assumed for the analysis. Given the relatively small value of the tourist benefits estimated, the unit was assumed to be tourist years. The population in 2014 was assumed to be 7,650, which is probably an overestimate. Values for intermediate years were then estimated using a constant growth rate.

19. **Health.** Per household health benefits were assumed to be the same as for the water connections for the main city water supply and were weighted in accordance with the expected population build-up. Health benefits for tourists were estimated *pro rata* from those for the households.

20. **Water Supply.** Estimation of the WTP for water supply was based on the assumption that all of the existing consumers in Bao Ninh were already consuming water so that the assessment of the economic value should be only for incremental WTP. For new consumers coming from elsewhere the economic value was estimated for all water consumption. The current water price for Dong Hoi, including Bao Ninh urban development area was set at VND15,000/m<sup>3</sup>, as defined in “Decision Number 01/2012/QB-UBND” dated 18/01/2012. Water consumption was assumed to be the same as in Hoi An, 150 lpcd for residents and 192.5 lpcd for tourists. Based on field discussions WTP for an improved water supply—reflecting the difference between the existing system in Bao Ninh, and the improved system in the developed Bao Ninh urban development area—was assessed at 10% of the current price. Financial values were converted to economic values using the SCF.

21. **Urban Roads.** Data for expected urban road use were obtained from a translation of the transportation section of the Dong Hoi Masterplan. Since data were provided in the form of a chart, rather than a table, the values had to be estimated and were thus subject to interpretative error in addition to projection errors. For the section of roads in Bao Ninh peninsula, the expected daily traffic volume in 2025 was estimated at 2,000 bicycles, 12,000 motorcycles, 4000 cars and 5,000 buses. Assumed trip lengths were 2 km for bicycles, 2 km for motorcycles, and 3 km for cars and buses. These values seem reasonable given the layout of the roads and observed current practices, albeit without quantified data. Existing (without-project) traffic is predominantly bicycles and motorcycles and this is unlikely to change significantly without the project. For the purpose of this analysis it is assumed that existing traffic is 10% of the total and benefits have thus been estimated for the incremental amount of 90% using the rule of 50% of the total VOC and labor costs. Labor costs were adjusted to reflect the expected increase in labor productivity.

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<sup>11</sup> In this analysis tourism benefits are limited to willingness-to-pay for improved water supply and the health benefits of improved wastewater collection and treatment. These are a minor part of the overall benefits.

## E. Financial Analysis of the Climate Change Adaptation Subproject

### 1. Base Case

22. Since the government is both the owner of the land and the investor, and will benefit from the revenue to be generated by the project, it was considered appropriate to estimate the financial internal rate of return (FIRR). The results of the base financial analysis are shown in Table 7. The FIRR is estimated at 19.6% with a financial net present value (FNPV) when discounted at the WACC, about 1%, of \$209.7 million. Using a discount rate of 12% reduces the FNPV to \$20.0 million.

**Table 7: Financial Evaluation of the Bao Ninh Climate Change Adaptation Component**  
(\$000)

Year	Investment Costs	O&M Costs	Total Cost	Benefits	Net Benefits
2016	2,866	-	2,866	-	(2,866)
2017	7,591	-	7,591	-	(7,591)
2018	8,620	-	8,620	-	(8,620)
2019	8,524	-	8,524	3,467	(4,184)
2020	3,673	-	3,673	3,880	207
2021	147	314	461	4,340	3,879
2022		314	314	4,830	4,515
2023		314	314	5,375	5,061
2024		314	314	5,983	5,668
2025		314	314	6,660	6,345
2026		314	314	7,414	7,100
2027		314	314	8,255	7,941
2028		314	314	9,192	8,878
2029		314	314	10,238	9,924
2030		314	314	11,406	11,092
2031		314	314	12,711	12,396
2032		314	314	12,946	12,632
2033		314	314	13,189	12,875
2034		314	314	13,441	13,127
2035		314	314	13,701	13,387
2036		314	314	13,971	13,656
2037		314	314	14,224	13,910
2038		314	314	14,485	14,171
2039		314	314	14,754	14,440
2040		314	314	15,032	14,718
2041		314	314	15,318	15,004
2042		314	314	15,612	15,298
2043		314	314	15,916	15,602
2044		314	314	16,229	15,915
2045		314	314	16,552	16,238
<b>FNPV (12%)</b>		1,398	23,720	43,207	20,042
<b>FIRR</b>					19.6%
<b>FNPV @ WACC</b>		6,584	37,053	245,885	209,671

FIRR = Financial Internal Rate of Return; FNPV = Financial Net Present Value; WACC = weighted average cost of capital

Note: Values in parentheses are negative.

Source: Asian Development Bank estimates.

## 2. Sensitivity Analysis

23. Sensitivity analyses were conducted including (i) a 10% cost increase; (ii) a 10% benefit decrease; (iii) a 10% cost increase combined with a 10% benefit decrease; (iv) a 1-year lag in benefits, and (v) a 50% increase in O&M costs. Switching values and sensitivity indexes were only estimated for the cost increase and benefit decrease analyses since the economic viability of the subproject is clearly not affected by an increase in O&M costs. The results (Table 8) indicate that the investment would remain financially viable, even using a discount rate of 12%, under the most adverse conditions—a 10% cost increase combined with a 10% benefit decrease—which would reduce the FIRR to 16.8%. A 50% increase in O&M costs would reduce the FIRR to 19.3%, a 0.3 percentage point reduction, indicating that the component is not sensitive to increased O&M costs. A 1-year benefit lag would reduce the FIRR to 17.7%, well above the cut-off point for financial viability. The switching values indicate that costs would have to increase by 84% or benefits decrease by 46% to reduce the FIRR to 12%, which confirms the robustness of the investment.

**Table 8: Summary of Financial Indicators and Sensitivity Analysis**

Scenario	FIRR (%)	FNPV @ 12% discount (\$ million)	FNPV @ WACC (\$ million)	Switching Value (%)	Sensitivity Index
Base case	19.6	20.0	209.7		
10% cost increase	18.3	17.7	206.0	84.5	1.2
10% benefit decrease	18.1	15.7	185.0	45.8	2.2
10% cost increase + 10% benefit decrease	16.8	13.3	181.3		
1-year benefit lag	17.7	15.8	196.9		
50% increase in O&M Cost	19.3	19.2	206.2		

FIRR = Financial Internal Rate of Return; FNPV = Financial Net Present Value; O&M = operation and maintenance; WACC = weighted average cost of capital.

Source: Asian Development Bank estimates.

## F. Economic Analysis

### 1. Base Case

#### a. Main city wastewater collection

24. The results of the base economic analysis for the main city wastewater collection component are shown in Table 9. The EIRR is estimated at 11.0% and the ENPV at negative \$0.31 million, indicating the component is economically non-viable. However, there are non-quantifiable benefits in terms of the improved environment, which would improve the attractiveness of the main city to tourism, and the component should be considered together with the overall investment in wastewater collection and treatment financed by the World Bank. While it was not possible to conduct an aggregate analysis including this investment since the earlier data was not available, it seems unlikely that the additional investment proposed under the project would affect its economic viability.

**Table 9: Economic Evaluation of the Main City Wastewater Collection Component**  
(\$000s)

Year	Economic Costs			Economic benefits			Total	Net Benefits
	Investment	O& M	Total	Health	Septic Tanks	Improved monitoring		
2016	1,116	0	1,116	70	77	0	147	-969
2017	1,319	11	1,330	103	122	0	225	-1,105
2018	1,484	25	1,509	137	123	89	349	-1,160
2019	1,467	40	1,507	173	124	184	481	-1,026
2020		55	55	179	48	287	514	458
2021		55	55	184	48	298	531	475
2022		55	55	190	48	311	548	493
2023		55	55	196	48	324	567	512
2024		55	55	202	48	337	587	532
2025		55	55	208	48	352	608	552
2026		55	55	215	48	367	629	574
2027		55	55	220	48	375	643	588
2028		55	55	225	48	384	657	602
2029		55	55	231	48	393	672	617
2030		55	55	236	48	403	687	632
2031		55	55	242	48	412	703	647
2032		55	55	248	48	422	719	663
2033		55	55	254	48	433	735	680
2034		55	55	261	48	443	752	697
2035		55	55	267	48	454	769	714
2036		55	55	274	48	465	787	732
2037		55	55	281	48	477	806	751
2038		55	55	288	48	489	825	770
2039		55	55	295	48	501	845	790
2040		55	55	303	48	514	865	810
2041		55	55	311	48	527	886	831
2042		55	55	319	48	540	907	852
2043		55	55	327	48	554	929	874
2044		55	55	336	48	568	952	897
2045		55	55	345	48	583	976	921
<b>ENPV (12%)</b>	4,037	329	4,366	1,455	574	2,026	4,054	-311
<b>EIRR</b>								11.0%

EIRR = economic internal rate of return; ENPV = economic net present value.

Note: Values in parentheses are negative.

Source: Asian Development Bank estimates.

## b. Bao Ninh Urban Climate Change Adaptation Component

25. **Bao Ninh Urban Climate Change Adaptation Component.** The results of the base economic analysis of the Bao Ninh Climate Change Adaptation Development Component are shown in Table 10. The EIRR is estimated at 19.4% and the ENPV at \$17.8 million, indicating the subproject is economically viable.

**Table 10: Economic Evaluation of the Bao Ninh Climate Change Adaptation Component**  
(\$000)

Year	Investment Costs	O&M Costs	Total Cost	Benefits	Net Benefits
2016	2,769	-	2,769	-	(2,769)
2017	6,878	-	6,878	-	(6,878)
2018	7,632	-	7,632	-	(7,632)
2019	7,546	-	7,546	3,141	(4,405)
2020	3,254	-	3,254	3,517	263
2021	133	283	415	3,936	3,521
2022		283	283	4,380	4,097
2023		283	283	4,874	4,591
2024		283	283	5,424	5,141
2025		283	283	6,037	5,754
2026		283	283	6,720	6,437
2027		283	283	7,480	7,197
2028		283	283	8,327	8,044
2029		283	283	9,273	8,990
2030		283	283	10,328	10,045
2031		283	283	11,507	11,224
2032		283	283	11,723	11,440
2033		283	283	11,947	11,664
2034		283	283	12,179	11,896
2035		283	283	12,419	12,136
2036		283	283	12,667	12,384
2037		283	283	12,899	12,616
2038		283	283	13,138	12,855
2039		283	283	13,384	13,101
2040		283	283	13,637	13,355
2041		283	283	13,899	13,616
2042		283	283	14,169	13,886
2043		283	283	14,446	14,164
2044		283	283	14,733	14,450
2045		283	283	15,028	14,745
<b>ENPV (12%)</b>	20,097	1,258	21,356	39,162	17,806
<b>EIRR</b>					19.4%

EIRR = economic internal rate of return; ENPV = economic net present value.

Note: Values in parentheses are negative.

Source: Asian Development Bank estimates.

### c. Overall Dong Hoi Component

26. The economic viability of the overall Dong Hoi subproject was assessed by combining the results of the economic analyses of the two components. The aggregate results are presented in Table 11. The EIRR of the overall subproject is estimated at 18.4% and the ENPV at \$17.5 million, indicating the overall subproject is economically viable.

**Table 11: Economic Evaluation of the Overall Dong Hoi Subproject**  
(\$000s)

Year	Costs			Benefits			Net Benefits
	Investment Costs	O&M Costs	Total Cost	Bao Ninh	Waste water	Total Benefits	
2016	3,885	-	3,885	-	147	147	(3,738)
2017	8,197	11	8,209	-	225	225	(7,984)
2018	9,116	25	9,141	-	349	349	(8,792)
2019	9,013	40	9,053	3,141	481	3,622	(5,431)
2020	3,254	55	3,309	3,517	514	4,031	722
2021	133	338	470	3,936	531	4,466	3,996
2022		338	338	4,380	548	4,928	4,590
2023		338	338	4,874	567	5,441	5,103
2024		338	338	5,424	587	6,011	5,673
2025		338	338	6,037	608	6,644	6,306
2026		338	338	6,720	629	7,349	7,011
2027		338	338	7,480	643	8,123	7,785
2028		338	338	8,327	657	8,985	8,647
2029		338	338	9,273	672	9,945	9,607
2030		338	338	10,328	687	11,015	10,677
2031		338	338	11,507	703	12,209	11,871
2032		338	338	11,723	719	12,442	12,104
2033		338	338	11,947	735	12,682	12,344
2034		338	338	12,179	752	12,931	12,593
2035		338	338	12,419	769	13,188	12,850
2036		338	338	12,667	787	13,455	13,117
2037		338	338	12,899	806	13,705	13,367
2038		338	338	13,138	825	13,963	13,625
2039		338	338	13,384	845	14,228	13,891
2040		338	338	13,637	865	14,502	14,165
2041		338	338	13,899	886	14,785	14,447
2042		338	338	14,169	907	15,076	14,738
2043		338	338	14,446	929	15,376	15,038
2044		338	338	14,733	952	15,685	15,347
2045		338	338	15,028	976	16,004	15,666
<b>ENPV (12%)</b>	24,134	1,587	25,721	39,162	4,054	43,217	17,495
<b>EIRR</b>							18.4%

EIRR = economic internal rate of return; ENPV = economic net present value.

Note: Values in parentheses are negative.

Source: Asian Development Bank estimates.

## 2. Sensitivity Analysis

27. Sensitivity analyses were conducted for each of the components as well as the overall subproject, including (i) a 10% cost increase; (ii) a 10% benefit decrease; (iii) a 10% cost increase combined with a 10% benefit decrease; (iv) a 1-year lag in benefits, and (v) a 50% increase in O&M costs. Switching values and sensitivity indexes were only estimated for the cost increase and benefit decrease analyses since the economic viability of the subproject is clearly not affected by an increase in O&M costs. The results of the sensitivity analyses for each of the components as well as the overall subproject are summarized in Table 12. They indicate



that the subproject would remain economically viable under the most adverse conditions—a 10% cost increase combined with a 10% benefit decrease—which would reduce the EIRR to 15.7%. A 50% increase in O&M costs would reduce the EIRR 18.1%, a 0.3 percentage point decline, indicating that the subproject is not sensitive to increased O&M costs. A 1-year benefit lag would reduce the EIRR to 16.2%, well above the cut-off point for economic viability. The switching values indicate that project cost would have to increase by 68% or benefits decrease by 40% to affect the economic viability of the subproject. Sensitivity indexes confirm the robustness of the subproject.

**Table 12: Summary of Economic Indicators and Sensitivity Analysis**

Scenario	EIRR (%)	ENPV (\$million)	Switching Value (%)	Sensitivity Index
<b>Wastewater Component</b>				
Base case	11.0	(0.31)		
10% cost increase	9.7	(0.75)	7.1	14.0
10% benefit decrease	9.6	(0.72)	7.7	13.0
10% cost increase + 10% benefit decrease	8.4	(1.15)		
1-year benefit lag	9.6	(0.77)		
50% increase in Operation and Maintenance Cost	10.4	(0.48)		
<b>Bao Ninh Climate Change Adaptation Component</b>				
Base case	19.4	17.81		
10% cost increase	18.3	16.18	109.2	51.4
10% benefit decrease	18.2	14.34	0.9	1.9
10% cost increase + 10% benefit decrease	16.9	12.21		
1-year benefit lag	17.7	14.47		
50% increase in Operation and Maintenance Cost	19.1	17.18		
<b>Overall Subproject</b>				
Base case	18.4	17.50		
10% cost increase	17.1	14.92	68.0	1.5
10% benefit decrease	16.9	13.17	40.5	2.5
10% cost increase + 10% benefit decrease	15.7	10.60		
1-year benefit lag	16.2	12.39		
50% increase in Operation and Maintenance Cost	18.1	16.70		

EIRR = economic internal rate of return; ENPV = economic net present value.

Note: Values in parentheses are negative.

Source: Asian Development Bank estimates.

## G. Benefit Distribution and Poverty Impact Analysis

28. Given the relatively low reported incidence of poverty in the subproject area, it was not considered appropriate to estimate a formal poverty impact ratio. However, it is clear that the project will have significant impacts on the poorer sectors of the community since these will benefit the most from improved sanitation with the connections to the main city wastewater system, and the cost savings associated with the shift from use of septic tanks. They are also expected to benefit from job creation during construction of the new urban area and in the increased employment following establishment of commercial enterprises in this area.