3 Technical Program Design

To develop sustainable and green cities requires the use of decision support systems that can take into account the impact of climate change and enable better flood management. GrEEEn cities should be planned on the basis of appropriate urban design principles and those of green infrastructure and low impact development. This chapter describes each of these aspects and shows how they have been taken into account in the design of the Program, and the subsequent selection of subprojects.

3.1 Climate Change, Flood Management and Decision Support Systems (DSS) Principles

3.1.1 Introduction

Viet Nam is one of the most disaster-prone countries in the world. Because of its geographic location and topography, this water-rich country suffers from storms, floods, landslides, salt-water intrusion, forest fires and, occasionally, earthquakes. Disasters triggered by storms and floods are, by far, the most destructive. Furthermore, a significant number of its people has always lived in low-lying, flood prone areas where paddy fields, aquaculture and fisheries have flourished. Thus, several wide-scale inundation and destructive flooding events annually affect a large percentage of the country's total land area—up to 59%, and its population—up to 71%, according to estimates from the World Bank (Châu, 2014 [17]). In 2004, the losses in the country attributed to water-related disasters amounted to VND 2,209 billion (Zoleta-Nantes, 2007).

Viet Nam has a general tropical monsoon climate, fairly humid—average humidity of 84%—and with average annual rainfall rates of approximately 1,830 mm. Three main sub-climates may be distinguished: (i) in the northern and inland region, subtropical, with dry winters and humid summers; (ii) in the central and south-eastern region, monsoonal with abundant rainfall and high temperatures; and (iii) in the south-western region, a third sub-climate characterized by two seasons well defined by its rainfall regime—wet and dry periods—and by relatively high temperatures.

In Southeast Asia, two monsoon circulation systems prevail during the year, influencing a very large area—north-east winds and southwest winds. As a result, four seasons can be defined in Viet Nam (**Table 3-1**). Tropical storm annual frequency in Viet Nam is up to seven events, compared to 11 in the highly active East Sea. The stormy season lasts from June to December, with a minimum frequency of 0.3 storms/month on average, and a maximum of 1.4 storms/month in September.

Disaster prevention and mitigation are far from new in the country and, to date, major efforts have been undertaken by the Vietnamese authorities over flood management—in many cases with the support of multilateral banks and other international donors. However, attention has been traditionally focused on implementing structural flood mitigation measures—mainly river and sea dikes, and a reasonable balance with non-structural measures has still not been achieved. Among the latter type of measures, implementation of early warning systems (EWS) and decision support systems (DSS) applied to flood management have been promoted in the last decade (Booij, 2003; Van Diep, 2007; Nam et al., 2009; Saavedra et al., 2009; Van Lai et al., 2009; Ranzi et al., 2012), mainly within the framework of foreign research and development initiatives. Since a lot of data is needed for intensive model calibration and validation, these tools have only recently been used in an operational manner by the Vietnamese authorities.

Undoubtedly, climate change poses serious threats and challenges to urban areas and may have quite negative impacts. New projections show annual temperature increases ranging from 0.8 ºC to 3.4ºC by 2050—a trend that continues throughout the century; more frequent heat waves[18]; sea level rises from 100 mm to 400 mm—lesser in the north coast, eventually accentuated by short-term extreme events, such as storm surges; and changes in drought frequency and rainfall amounts because of extreme

[17] References quoted in the chapter are fully described in the "references" section of **Appendix 5**.

[18] A heatwave is defined as more than five consecutive days of extreme temperatures.

events, although there is not a strong consensus on this issue.

The expected impacts of climate change, combined with industrialization and rapid urbanization, mean that the future of many cities—as well as rural regions into which they are expanding—will be subjected to severe environmental deterioration and increased vulnerability to disasters, should proper actions not be taken. In response, Vietnamese authorities developed, in October 2012, a national strategy to tackle climate change.

Table 3-1. Description of the Four Weather Seasons Existing in Viet Nam

Season	Main features
December to March	• Winter (NE) monsoon occurs as a result of high pressures over the northern areas of Asia, with a strong pressure gradient towards the East Sea, producing winds coming from the north. • Precipitation at this time is mainly caused by disturbances of the polar front, and its intensity is enhanced by the orographic effect.
April to May	• First inter-monsoon period, characterized by the decline of the strong pressure gradient. • The weather during these months is conditioned by the Inter-Tropical Convergence Zone (ITCZ), with weak winds and high variability. • Weak rainfall in most of the country, except in the mountainous regions—because its origin is mainly orographic.
June to September	• Summer (SW) monsoon. Its first effects may be visible in mid-May, depending on the "El Niño" Southern Oscillation (ENSO) phenomenon. • It is the rainiest season in the region.
October to November	• Second inter-monsoon period, caused by a weakening of the summer monsoon and cooling of the Asian continent. • The typical synoptic situation is similar to the first inter-monsoon season, and related meteorological phenomena are again associated with the ICTZ. • Tropical cyclones remain active and reach the country during these months because of high temperatures existing in the East Sea.

Source: PPTA Consultants.

The GrEEEn Operational Framework promoted by SEUW-SERD (ADB) proposes the integration of environmental management—including flood management—into urban planning to improve liveability and resilience in cities. However, in Viet Nam—and in other countries of Southeast Asia—such integration is far from being considered a common practice (Tran & Shaw, 2007), and water management still retains very strong linkages with agricultural development, despite of the accelerated industrialization experienced in the country.

Within this framework, general principles and recommendations to be considered for climate change, flood management and decision support systems (DSS) are presented in the following paragraphs.

3.1.2 Climate Change Principles

Taking into account the driving force of industrialization, rural-urban migration and the rapid increase in city-populations, it is evident that most of the climate change problems that will arise are conditioned by how urban planning and management are addressed today[19]. Accordingly, mitigation measures must focus on better urban management, and on reducing emissions to environment, without leaving out measures for reducing industry emissions or improving the carbon balance in rural areas.

The Government of Viet Nam (GoV) is aware of the challenges posed to the country by climate change. Since the early 1990s, GoV has increased the country's capacity to assess climate projections, and has established a strategy for adaptation to climate change and mitigation of their impacts. Such a strategy is consistent with the sustainable development goals pursued by GoV. These are described in the National

[19] In fact, this is a global trend, since, according to the World Bank (WB), it is estimated that in 2030 around 60% of the worldwide population will live in urban areas, while it is expected that in developing countries, urban population reach 50% as early as in 2020.

Action Plan on Climate Change over the Period 2012-2020, approved on October 5th 2012 by the Prime Minister—Decision No. 1474/QD-TTg.

The main objectives for accomplishment by 2020, include:

- To strengthen capacity on climate monitoring and early warnings.
- To ensure food and water security.
- To proactively respond to disasters; to prevent the flooding of big cities; to strengthen security of river and sea dikes, and reservoirs.
- To adjust plans, planning standards, and guidelines on construction techniques in areas frequently affected by natural disasters in accordance with the conditions of climate change and sea level rise.
- To reduce greenhouse gas emissions and to develop a low carbon economy.
- To raise awareness, and to develop human resources—qualified staff in climate change response.

However, improving urban resilience is not necessarily tied to climate change, although this phenomenon must be considered when planning resilience-related actions. There is a close relationship between environment and climate change in managing natural hazards, and improving the adaptation capacity of cities to reduce future impacts, which will not always be associated to climate, but derived from geological risks, pollution or other phenomena.

In general, climate change resilience means climate change mitigation and adaptation measures. Supporting the policies developed by GoV, some general principles and recommendations that need to be considered when effectively implementing the GrEEEn Operational Framework in Vietnamese secondary cities relate to mitigation and adaptation:

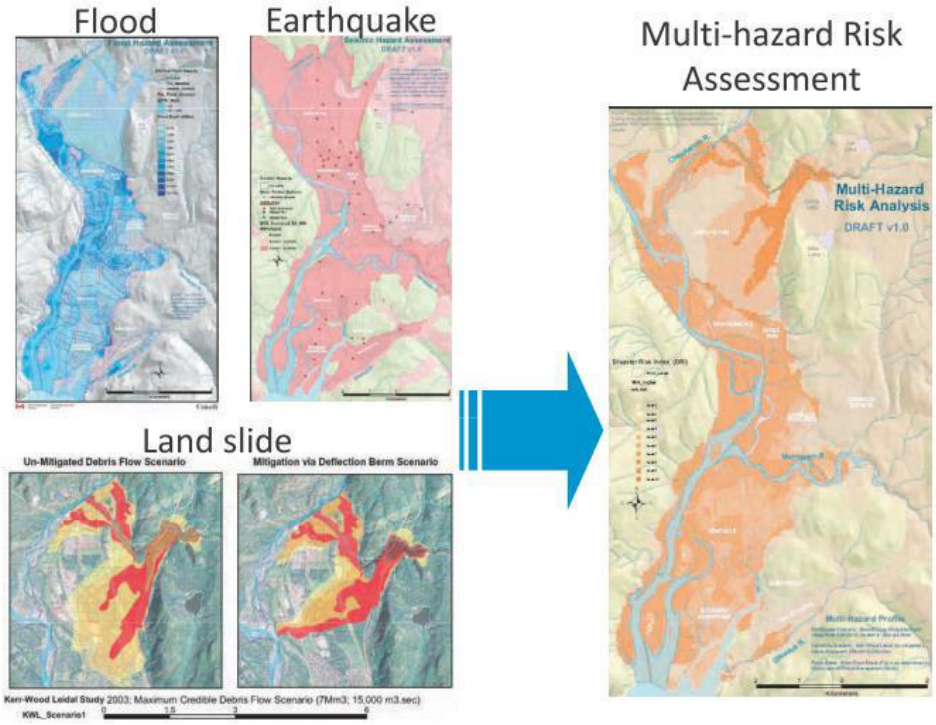
Mitigation-related measures:

- *Traffic management and public transportation.* Viet Nam suffers from slow and hindered traffic flows, caused by the disorderly use of slow vehicles—bicycles, mopeds, animal-powered transport, etc.—and the use of hard shoulders on roads for small goods sales. To better manage long distance traffic, specific lanes dividing fast and slow traffic are proposed. This could improve goods transportation, which could enhance development, even for the most remote cities, such as Ha Giang. Furthermore, public transport should be encouraged, since its use is currently negligible, and leads to the extensive use of private vehicles. The strategy for urban transport should focus on reducing the use of cars in favour of bicycles and low-emission mopeds, which are familiar to the Vietnamese.
- *Emission reduction*. It could be possible that some secondary cities—which may serve as an example to other similar urban centers—obtain a Low Emissions City Certificate or even aspire to be the the first zero-emission city in Southeast Asia. However, to accomplish this, the use of renewable energies must be encouraged[20], energy efficiency regulations must be implemented, and measures for CO_2 capture must be adopted along with creating new green spaces—for instance, greenery combined with organic waste recycling.
- *Energy efficiency.* Beside the current adoption of low-consumption lighting, building standards should be revised to decrease future enegery consumption through the lower use of air conditioning. It is expected that economic growth will motivate an increase in the use of air conditioners and, consequently, an increase in CO_2 emissions, as well as in "heat-island" effects, unless counter measures are taken in advance. Other energy efficiency measures proposed are the use of gray-water—through green filter technologies—for garden watering.
- *Climate change education and awareness*. It is important that the general public see the fight against climate change as an opportunity to improve the urban environment and their quality of life.

[20] For instance, there is a growing share from hydropower generation in energy production in Ha Giang, whilst it does not seem that Hue takes full advantage on the potentialities of hydropower generation in the Huong River Basin.

Education and awareness programs should be implemented, and addressed towards different population segments—based on age and levels of dedication, from basic education to job training.

Figure 3-1. Example of an Overlay Map for Risk Assessment: Multi-Risk Assessment Maps Quickly and Easily Communicate Where Land is Suitable for Specific Types of Uses, Thus Being of Great Help in Urban Planning Processes.



Source: Pathways Group at Natural Resources, Canada (after Suzuki, 2010).

Adaptation measures

- *Drought and heat wave risks.* The effects of droughts and heat waves on the health of population may become more severe, because of urban "heat-island" effects, and the lack of proper infrastructure. An increase in shaded and green areas, which are known to soften extreme temperatures, must be promoted, as well as an increase in urban albedo, to reduce street heating. Furthermore, measures to improve water resources management in extraordinary scenarios, such as water scarcity and droughts, and related infrastructure must also be adopted.
- *Sea level rise*. Monitoring local water levels is required, protecting coastal water bodies—wetlands, lakes, etc.—and promoting mangrove swamps to strengthen those areas against the impacts of heavy storms.
- *Urban planning.* Climate change adaptation and mitigation measures must be properly incorporated into urban planning processes. City planners and managers need to acquire knowledge on how to plan and implement resilience improvement measures. Often, a climate change department is established within a city governmental, rather than having such staff spread among other specialised or more generic offices.
- *Natural hazards management*. Integral natural hazard management plans must be promoted, including multi-risk maps, which graphically represent how each potential risk affects specific areas—floods, winds, landslides, etc. (**Figure 3-1**). The most affected population and/or urban assets, wether private or publicly owned, must be identified, and action protocols defined—communication improvements, resilience infrastructure planning, warning systems, population broadcast systems, and evacuation shelters or areas.

- *Communication and risk awareness*. It is essential that communication with the public be improved to convey operative measures to face natural hazards—heat waves, droughts, floods, etc.—with enhanced resilience. The general public must be educated and made aware of how to correctly react during a climate-induced, disaster event. Moreover, the capacity of key public administration staff to understand and manage climate change should be improved through proper training activities, including courses, and workshops.

Climate change also must be taken into account in the detailed engineering design of urban assets, in particular, hydraulic infrastructure. Existing national standards are far from being fixed. Consequently, decisions on how climate change must be taken into account in the design calculations often have been neglected by local consultants. Accordingly, it is advised to conduct awareness raising campaigns among these professionals, or even prepare relevant practical guidelines.

Vietnamese authorities have developed and reported climate projections five times—in 1994, 1998, 2007, 2009 and 2014. The latest climate change scenario and impact assessment studies include[21]:

- MONRE 2009: Climate Change, Sea Level Rise Scenarios for Viet Nam.
- ISPONRE 2009: Viet Nam Assessment Report on Climate Change.
- IMHEN 2010a: Impacts of Climate Change on Water Resources and Adaptation Measures.
- IMHEN 2010b: Sea Level Rise – Scenarios and Possible Risk Reduction in Viet Nam.
- MONRE 2010: Viet Nam's Second Communication to the United Nations Framework Convention on Climate Change (UNFCCC).
- MONRE 2012: Climate Change, Sea Level Rise Scenarios for Viet Nam.
- IMHEN 2014: High-resolution climate projections for Viet Nam.

However, official climate scenarios are not available with appropriate detail in all provinces. IMHEN provides climate projections to GoV but there are no updated official, public projections for use by local administrations. Major efforts have focused on the most heavily populated areas at risk—Mekong Delta, Red River Delta and Central Coastal areas[22]. Nevertheless, significant efforts need to be carried out to ensure the effective use of official projections by local administrations in developing their planning policies, and in urban infrastructure design through updated guidelines on construction techniques.

It appears that several infrastructure investments proposed over the last few years—for instance, in the Integrated Flood Management Plan of the Huong River Basin, Vinh Phuc Province—incorporate climate change into the design calculations—for instance, through increase of rainfall and/or sea level rise in 2020, 2050 and 2100—taking as a standard reference the results published by MONRE (2010) in its 2nd Communication to the UNFCCC. These results were generated under the assumptions of the IPCC 3rd emission scenarios (IPCC AR3), and the models and scenarios considered (A2 and B2) are somewhat outdated. IPCC AR5 results obtained by IMHEN in collaboration with the Commonwealth Scientific and Industrial Research Organisation (CSIRO), have not been officially published. The most likely climate projections are considered to be those corresponding to the so-called Representative Concentration Pathways[23] (RCPs) 4.5 and 8.5, which are fairly analogue to scenarios A1B and A2 from IPCC AR3.

Hence, it is suggested that an average of the (official) IPCC AR3 climate projections published by MONRE (2010), and the unofficial IPCC AR5 ones is adopted in the design calculations for the

[21] MONRE: Ministry of Natural Resources and Environment; ISPONRE: Institute of Strategy and Policy on Natural Resources and Environment; IMHEN: Institute of Meteorology, Hydrology and Environment.

[22] For this reason, among the three cities surveyed under the PPTA, only Hue has future detailed projections and has developed early warning mechanisms.

[23] These pathways describe four possible climate futures, all of which are considered possible depending on how much greenhouse gases are emitted in the years to come. They are named RCP 2.6, 4.5, 6 and 8.5, after a possible range of radiative forcing values in the year 2100 relative to pre-industrial values (+2.6, +4.5, +6.0, and +8.5 W/m^2, respectively).

investments considered in this Program. For the three Program cities—Ha Giang, Hue and Vinh Yen, some practical guidance is provided in **Appendix 5**—see "Preliminary Analysis of Climate Change Impacts in Ha-Giang, Hue and Vinh Yen. Furthermore, since average rainfall is one of the most critical and basic parameters to be considered in the design of city assets, practical recommendations are shown in **Table 3-2** on increases in average rainfall for each city. These increments are estimated on a year 2050 horizon, taking into account the rainiest season.

Table 3-2. Increment on Average Rainfall to be Considereed in Design Calculations, in Order to Consider Climate Change Impacts

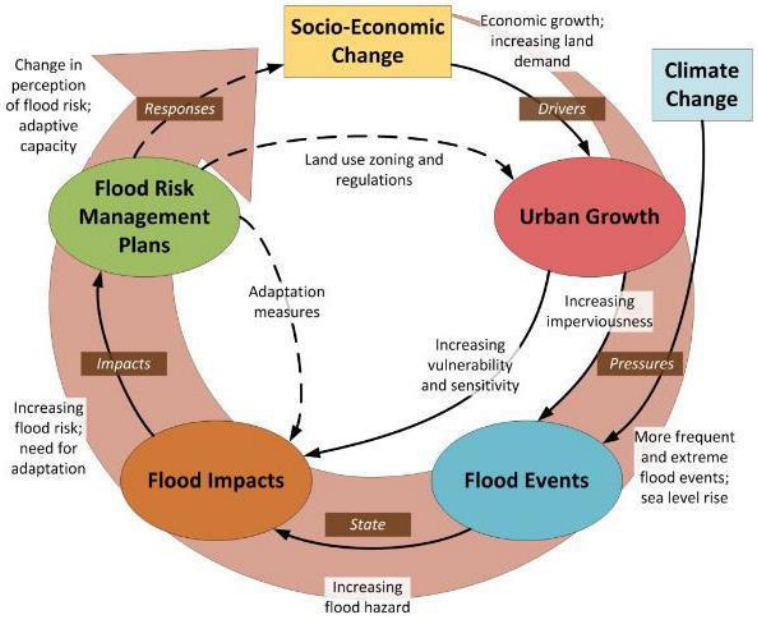
City	Province	Increment on average rainfall	Remarks
Ha Giang	Ha Giang	10%	Average increment based on RCP 4.5 for the South West Monsoon Season (SWMS)
Hue	Thua Thien Hue	6%	Average increment based on RCP 4.5 for the Second Inter-Monsoon Season (SIMS)
Vinh Yen	Vinh Phuc	8%	Average increment based on RCP 4.5 for the South West Monsoon Season (SWMS)

Source: PPTA Consultants.

3.1.3 Flood Management Principles

From an academic standpoint, the complex and dynamic interplay between economic and urban growth at a regional level, climate change and resilience of urban systems to flood events has been properly addressed in a joint effort from European and Asian entities within the 4-year Collaborative Research on Flood Resilience in Urban areas (CORFU) project, funded by the European Commission (EC)'s 7th Framework Programme (FP7). Such analysis has been synthesised in the so-called Drivers-Pressure-State-Impacts-Responses (DPSIR) logical framework. **Figure 3-2** shows the *drivers* to be the social and economic developments, such as population change, which lead to environmental *pressures.* These pressures lead to changes in the urban system (*state*), which lead in turn to *impacts* on society and the environment. These impacts can be mitigated through planned *responses*, which may result in renewed socio-economic change (Kurzbach et al., 2013).

Figure 3-2. Drivers-Pressure-State-Impacts-Responses (DPSIR) Logical Framework



Source: EC's FP7-funded CORFU project (Kurzbach et al., 2013).

Under the DPSIR approach, the flood management objective—as it is understood in this PPTA—is to prevent, control and mitigate the negative impacts of floods, in a sustainable manner and integrate these into urban development. This implies three concepts: (i) the flood management itself in its four phases—prevention and mitigation, preparedness, response and recovery[24]; (ii) respect for the environment and sustainability; and (iii) flood management as a coordinated part of urban management.

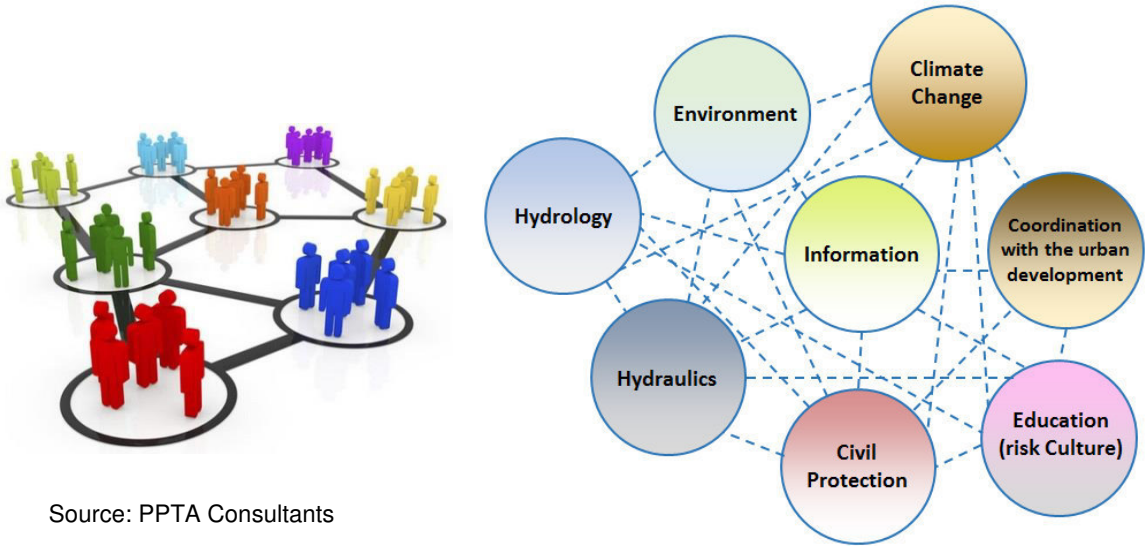
Targeting the implementation of the GrEEEn Cities approach, an understanding of how the river and drainage systems work is necessary (**Figure 3-3**), not only from a hydraulic standpoint on a urban scale, but also from a hydrological standpoint on an basin scale, both in the current situation and under future scenarios which consider climate change and urban development trends. It is essential to access secondary data / information available from the GoV—data, studies, projects, maps, records of historical events and any other document which may be useful—on climate, hydrology, geomorphology, floods, river hydraulics and risk assessment. However, this not only must take into account these technical aspects but also consider other relevant factors, such as city development—in particular land use planning and infrastructure, the environment, civil protection, information and raising risk awareness, among others (**Figure 3-4**).

Figure 3-3. A Rational Understanding of Flood Management Requires Considering Both a Hydrological Standpoint (Basin Scale, Left) and A Hydraulic One (urban scale, right). The Case Shown Corresponds to Hue City, Located in the Huong (Perfume) River Basin.

Source: PPTA Consultants.

[24] As defined, for instance, by the United States Federal Emergency Management Agency (FEMA).

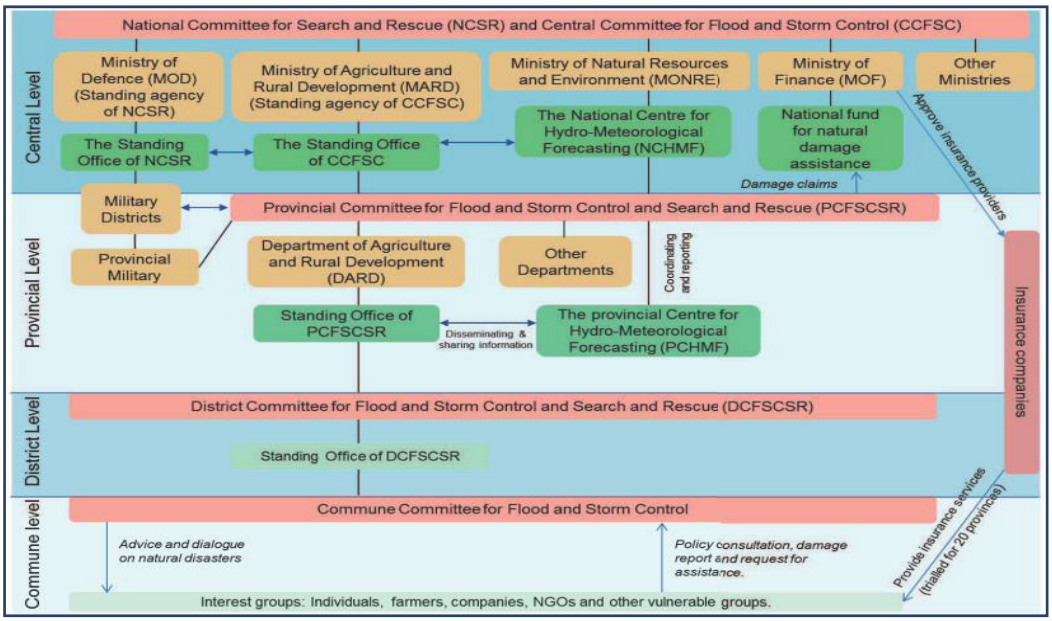
Figure 3-4. A Multidisciplinary Approach Is Required to Properly Integrate Flood Management into Urban Planning Processes, According to the GrEEEn Cities philosophy.



Source: PPTA Consultants

Measures already implemented or planned by the Vietnamese authorities may be complemented, when possible, with alternative and additional ones. It is crucial to access any available information—data, studies, projects, records of historical events, etc.—on floods and hydraulic dysfunctions in a city. No less important is to capitalise on the experience of not only local, but also regional and national stakeholders involved in flood management. The term "stakeholders" must be understood in its broader sense to include not only public authorities, which in Viet Nam are organized according to a fairly complex institutional architecture (Châu, 2014)—as shown in **Figure 3-5**—but also civil society and the private sector. Local stakeholders cope directly with a flood event; regional stakeholders often undertake flood management in a province, region or basin-integrated manner; and national stakeholders are in charge of legislation, strategies, standards, and other institutional mechanisms.

Figure 3-5. Institutional Framework for Flood Management in Viet Nam: Central, Provincial, District and Commune Level.



Source: Châu (2014).

The motivating reasons for capitalising on the experience of key stakeholders are simple, since they:

- Are the ones who suffer the impacts and consequences of floods.
- Are, by far, the ones who best know the territory, its characteristics, behaviour and response.
- Have already done a lot of work on the topic.
- Have gained invaluable experience from the successful and less successful measures undertaken in the past, and developed rational and practical design criteria adapted to existing data and information constraints.

The proposed measures for flood management should adopt the following principles:

- *Flood management must be based on a holistic view at a basin level.* Quite often, many of the problems posed by a river flowing nearby to an urban area can be corrected or mitigated by upstream interventions, such as reforestation, erosion control, etc, while others demand a good understanding of the global hydrological/hydraulic phenomena occurring in the basin to assess the effectiveness of protection measures—for instance, preservation of natural flood buffers.
- Viet Nam has traditionally relied on a flood control approach, strongly focused on structural measures to prevent particular flood events—for instance, a 20-year flood. However, the flood risk management approach has meant a paradigm shift (Châu, 2014), since the emphasis is placed on reducing damage rather than responding to particular flood events that are becoming increasingly difficult to predict—even more, bearing in mind the hydrometeorological data shortages found in the country. Accordingly, *a proper balance must be achieved between structural measures and non-structural measures.* This includes early warning systems (EWS)—more or less sophisticated depending on the type of flood—and decision support systems (DSS)—models, tools or even risk maps—enabling flood risk managers to enhance their reaction and response capacity, make future cost-benefit analysis, and optimize decision-making.
- An important body of flood management legislation, consisting of laws, ordinances, decrees, decisions and regulations, has been passed in Viet Nam since its independence in 1945, Châu (2014). This has created a legal framework for flood and storm control initially, and natural disaster management currently. However, *several gaps and shortcomings still persist,* such as fragmentation, overlapping and repetition within legal documents; insufficient emphasis on multi-hazard disaster risk management; and a centralised institutional framework that disincentives a proactive role of local governments with regard to flood management and planning, because of hierarchical top-down approach (Châu, 2014). These shortcomings should be properly overcome. Governance of the flood management chain, including urban planning activities, should be improved, supplementing the current top-down approach by combining it with a bottom-up approach, and clarifying the roles and responsibilities of key stakeholders[25].
- *Land use in potentially flood-prone areas must be properly identified*. The delimitation of these areas, based on water velocities, water depths and, consequently, associated risk levels, must be understood as a powerful tool available to relevant public authorities. This would enable urban growth and development to be compatible with the constraints imposed by flood management.
- *For each flood risk-prone area, preparedness, mitigation, response and recovery plans should be established and approved by appropriate authorities.* These plans should clearly define what should or can be done, as well as how, and for whom, for each level of flood disaster, before, during and post-disaster (Châu, 2014; Kirsch-Wood, 2015).

[25] For instance, Châu (2014) points out the overlap posed by the Law of Dykes (2006)—specifically dealing with dykes from a flood-protection structural measures—and by the Ordinance on the Management of Irrigation and Drainage Structures (2001), which considers dykes as irrigation and drainage infrastructures. Confusion is generated since dykes are run by flood and storm control divisions, but are also managed by companies responsible for irrigation and drainage infrastructure.

In addition, practical criteria and general recommendations are set out below. These should be taken into account in the detailed engineering designs of proposed measures or subprojects[26]:

- Calculations required to design urban infrastructure, and designs must satisfy Vietnamese standards and regulations. These are sanctioned by practice; in particular, TCVN 7957:2008 Drainage and Sewerage (External Networks and Facilities); TCVN 8419:2010, concerning the design of river bank flood protection structures; technical standards for the design of sea dykes, prepared by the Ministry of Agriculture and Rural Development (MARD) and approved under Decision 1613/QD-BNN-MOST, July 9, 2012; national standards TCVN-9901-2014, on technical requirements for sea dyke design; flood control standard 4116/BNN-TCTL; and dike level standards QPTL-A6-77 No 344/QP/KT—which establishes the design frequency, or return period, based on the protected population—number of inhabitants, the extension of potentially flooded areas (ha) and the mean flood water depth in the considered region—among others. And, calculations must also take into account eventual climate change impacts. In particular, climate change must be properly considered by increasing design rainfall and their intensities in percentages—or applying multiplier factors—under the most likely climate scenarios[27]. Reasonable guidance is provided in section 3.1.2. Likewise, in coastal regions, it must be considered how an eventual sea level rise, because of climate change, may affect river interventions.
- The implementation of a particular structural measure cannot lead to worsening existing hydrologic and hydraulic conditions—for instance, river narrowing, increase in water surface levels, etc, or generate relevant negative impacts downstream—in particular, in terms of flooding and/or erosion.
- Final engineering designs must always consider the most accurate knowledge on soil conditions, water velocities and its erosion power, as well as material resistance.
- When proposing structural measures, apart from a proper design of infrastructure and civil works, special attention must be paid to operation and maintenance (O&M) issues, and their associated costs, which often are a significant part of the total investment cost.
- As far as possible, green infrastructure and low impact development (LID) principles must be incorporated in detailed engineering designs. Such an approach strongly contributes to minimizing water surface runoff close to its origin, thus helping to achieve efficient storm water management. If possible, data from hydrology-based urban simulation models must be considered for properly dimensioning such infrastructure. Otherwise, commonly accepted criteria, at an international level, should be used.
- River embankment toes and structures located along the banks must be properly protected. The design must take into account the maximum—general, local and transient—erosion level. Foundations must be stable, and will not be eroded during the life of the infrastructure while all backfill must be properly and sufficiently compacted.
- Where a road development intercepts one or more river beds, bridges must be designed to ensure an allowance sufficiently above the flood water level. Should the bridge have piles, these must be protected against general, local and transient erosion. Bridge abutments must also be reinforced and protected. Foundation types must also be selected based on existing site characteristics and constraints.
- Dredging works in water bodies—lakes, river stretches, etc.—must be carried out with extreme care to prevent undesirable negative impacts on the shores.
- Cross-sections of river embankments must be reasonably uniform, without abrupt changes over short distances. These cross-sections will be built with berms for maintenance purposes when necessary, but avoid an unnecessary complex construction process. Availability of local materials, such as

[26] When necessary, these practical criteria and general recommendations are particularized for each city considered in the Program.

[27] For instance, in the case of stormwater drainages, if design rainfalls are not slightly increased to take into account the climate change impacts, these infrastructures will be underdimensioned (the design flows will be simply too low) and, accordingly, their lifespan will be significantly reduced.

stone, wood, or bamboo, must be weighed against long distance transportation of other technically more suitable materials—which may be the case of riprap protection. Reference documents, such as the "Guideline for Small-Scale and Low-Cost Riverbank Erosion Protection Works" (JICA, 2012) should be taken into account.

- Stormwater drainage cross-sections must ensure reasonably smooth transitions—that is, avoiding abrupt geometrical changes. And there should be an adequate disposition of manholes to facilitate O&M. Special attention must be paid to clogging issues—for instance, due to inadequate waste management practices—and to hydraulic capacity constraints imposed by high water levels in their outlets associated with river overflows.
- Special attention must be paid to the environmental and landscape integration of the proposed measures. Thus, "soft" solutions will be preferred instead of "hard" solutions, if existing constraints do not represent an impediment.
- When subprojects funded by different entities—for instance, other multilateral development banks, foreign cooperation agencies and international donors—coexist in an area, coordination mechanisms must be set up, since these interventions may overlap in an inefficient way and/or significantly affect each other with unexpected results.

3.1.4 Decision Support System (DSS) Principles

DSS should be a key element of city planning. They are essential tools for developing the capacity of city planners and managers to simplify the process of analysis, assessment and decision-making. Although they may represent a high initial investment, they do yield undeniable benefits[28]. Suzuki et al. (2010) show that these tools are:

- *Transparent.* Easy to understand and adjust, as opposed to to complex "black-box" computer models, which often turn to be ineffective and inappropriate.
- *Scalable.* Easily adaptable to the level of effort required, the level of knowledge and skill of the user and the amount and quality of data involved; and they are able to accommodate a larger scope or more precise inputs, as conditions change.
- *Modular.* Models work best when they are limited to specific tasks, instead of using overly general and all-inclusive tools. However, they must also be flexible enough to work on their own or in combination with other tools. The ability to amend key assumptions make them easier to adapt to real-world complexities, and to changing user needs.
- *Web-friendly.* They can take full advantage of the Internet, which means that they are easier to update, and can be used for data and results exchange. It is easier to train people, and stakeholders participation is significantly enhanced.

For flood management, the use of DSS tools is to enhance preparedness planning, response and recovery to flood situations. A DSS should stress on prediction and monitoring, as well as on emergency response and public involvement. It needs to be practical and well designed so as to provide the decision makers with adequate resources to prepare reliable assessments and avoid raising false alarms. To set up the DSS, updated, accurate and user-friendly databases need to be developed. Applications and documents which can be of assistance in the monitoring and administration of floods are also needed. The design of a specific DSS for a particular city, must consider:

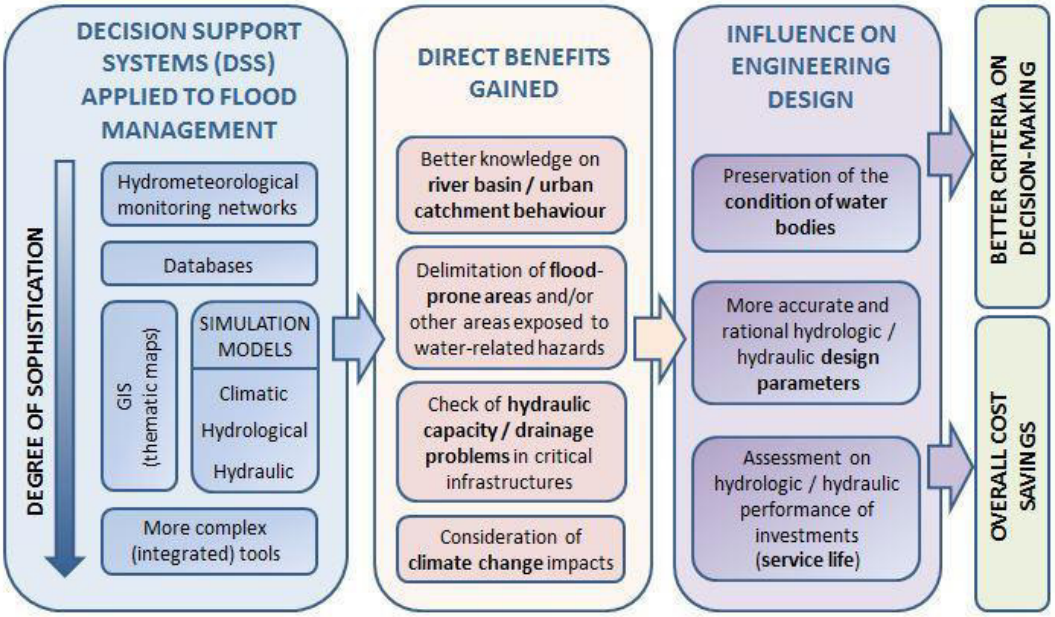
- The nature of the flooding problem.
- The amount and quality of data available.
- The administrative organization in charge of data collection and decision making.
- Rational expectations on the outcome, based on the above items.

[28] The concept of DSS is broad: it includes templates, checklists, diagrams, maps and specialized software applications, addressed to several purposes and supporting the planning process at different times and in various ways. However, this section exclusively focusses on DSS applied to flood management.

In flood management, a DSS can be incorporated into something as relatively simple as a GIS-based, or not, thematic map—for example, risk maps or network schemes—or more complex tools such as hydrological and/or hydraulic models of a basin, a river stretch or a drainage system; or even more sophisticated ones, such as basin-based early warning or operational systems, which are typically fed with the outcomes of climate prediction models and remote data acquisition.

Figure 3-6 shows a DSS applied to flood management in emergent and fast-growing developing countries such as Viet Nam, the basic level is the exploitation and enhancing of hydro-meteorological monitoring networks as well as the collection and storage of relevant data in appropriate databases. This should be complemented with other data sources, such as the quantification of flood impacts by civil protection bodies and local authorities[29]. A further step is the production of thematic maps—such as flood risk maps—to be incorporated into the urban planning process, which may or not be based on a GIS environment (**Figure 3-7)** and also capitalise on the amount of valuable information in hands of local people—social or community mapping. These maps will be significantly more useful in so far as they are enriched with climatic, hydrological and/or hydraulic simulation model outputs, which will enable the reproduction different feasible scenarios (**Figure 3-8**).

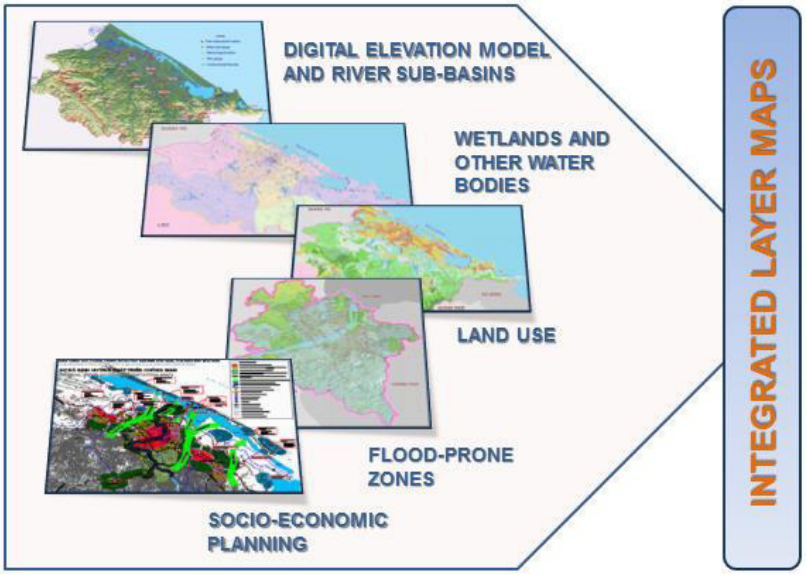
Figure 3-6. Integration of DSS Applied to Flood Management with Engineering Design for Improving the Cities' Overall Resilience to Flood (and Other Water-Related) Disasters.



Source: PPTA Consultants.

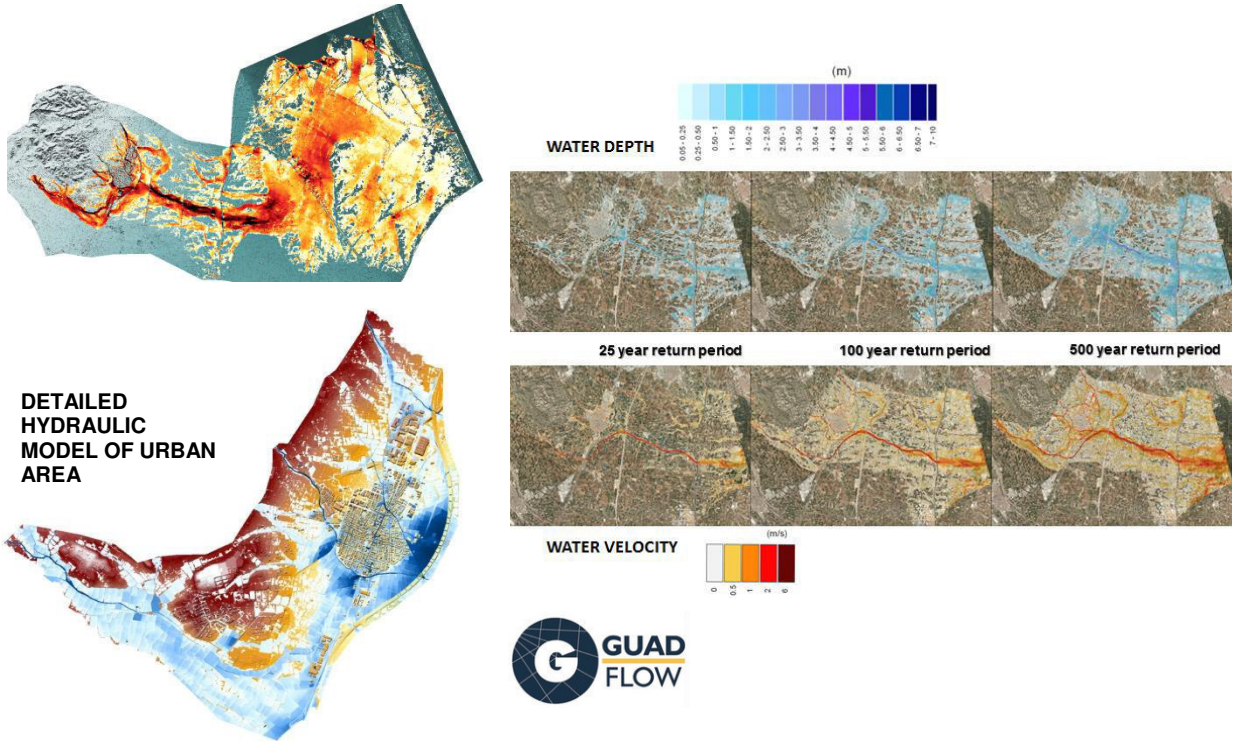
[29] To some degree and despite several shortages, the three secondary cities considered in the Program have access to this level.

Figure 3-7. Layering Data: Several Layers of Information can be Visually Integrated into a Geographical Information System (GIS), which Provides Very Useful Guidance in Strategic Decision-Making Processes Concerning Flood Management.



Source: PPTA Consultants, based on Suzuki et al. (2010).

Figure 3-8. Bi-Dimensional Hydraulic Model (GUAD-2D) Used for Studying (Flash) Flood Impacts Over a Strongly Urbanized Municipality, Located in an Extremely Flat Area—where rice fields are developed with poorly defined river beds and near a coastal freshwater.



Source: Martínez-Bravo et al. (2011).

Accurate and rational simulation model outputs rely heavily on the amount and quality of hydro-meteorological data, as well as on their validation with historical events. Significant efforts must be made in validation if reliable outputs are desired, although it must be recognised that even the simplest models can provide very useful guidance for practical purposes. As the quality, amount and representation of hydro-meteorological data increases, more complex simulation models can be built. Consequently, higher level tools could be developed as part of an integrated DSS.

Currently, even in those Vietnamese cities reasonably equipped with some kind of forecasting and monitoring systems and EWS, there is still a strong demand on technology to improve weather forecasting, real-time acquisition of data, or data processing and dissemination of warnings to support a well-organized emergency response network[30]. **Figure 3-9** shows how data, information, extracted knowledge and water governance are linked. DSS is intimately related to knowledge generation. Regardless of the degree of sophistication of the already existing or to be implemented DSS in the Vietnamese cities, direct benefits will be gained through their use; these are:

- A better knowledge of the river basin/urban catchment behaviour, which proves to be critical for successfully integrating flood management into urban development—for instance, by establishing restrictions on land use.
- Flood-prone areas and/or other areas exposed to water-related hazards can be defined, paving the way for minimising potential flood impacts—for example, promoting self-protection plans for key activities, among other good practices.
- Existing hydraulic capacity and/or drainage problems in critical infrastructure can be checked for different return periods.
- Climate change impacts can be taken into account, through the simulation of pre-set and well established likely climate scenarios—see section 3.1.1.

Figure 3-9. Links between data, information, knowledge and governance. (AHIS: Automated Hydrologic Information System; DWH: Data Warehouse; DSS: Decision Support System).

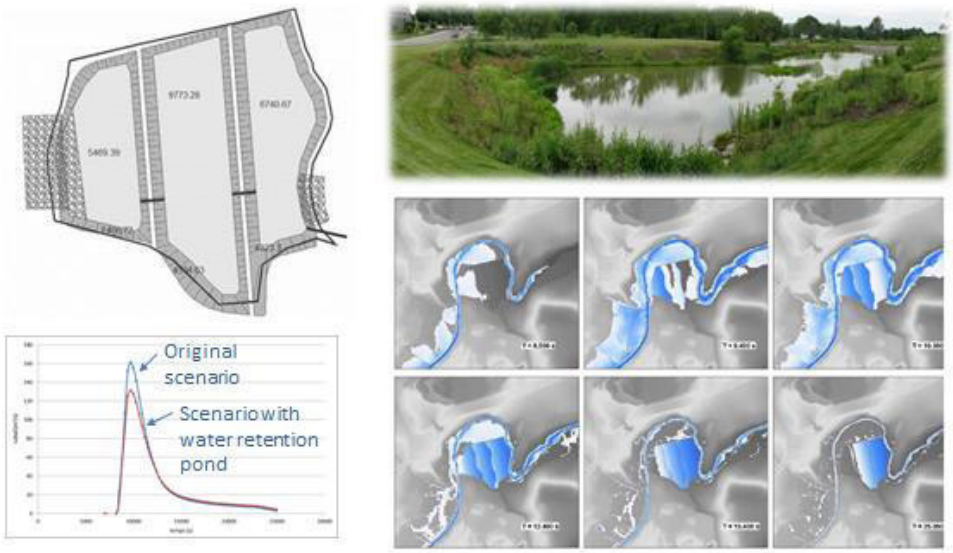
Source: PPTA Consultants.

Undoubtedly, knowledge gained with the use of DSS when applied to detailed engineering designs can influence how the cities' investments are planned in a more decisive manner, the better the available tools are (**Figure 3-10**). Such increased knowledge enables the preservation of the condition of affected water bodies, or, at least, minimize impacts derived from potential disruptions. It also provides more accurate and rational hydrologic and/or hydraulic design parameters closely suited to local conditions

[30] For instance, despite of significant progresses achieved during the last few years, this is the case of Hue, as shown by Porter (2014).

instead of defering to national and/or regional "traditional" and necessarily conservative standards. And it provides a more rational assessment of the hydrologic and/or hydraulic performance of the assets throughout their service lives, determining operation and maintenance constraints and requirements. These tools provide better criteria on decision-making processes and translate into overall cost savings not only in the infrastructure's implementation phase, but also for operation and maintenance within a climate-evolving context.

Figure 3-10. Pre-design of a Water Retention Pond (Green Infrastructure) Based on DSS tools.



Source: PPTA Consultants

3.2 Urban Design Principles

3.2.1 Generic Urban Design Sustainability Principles

The following urban design principles contribute to sustainable urban development, liveability, sense of place and 'green' city planning:

- *Promote higher densities, mixed uses and a variety of facilities.* The pursuit of high-density mixed-use development, especially in central urban areas, would help to avoid urban sprawl, and maintain city cohesion and compactness of built form.
- *Focus on inner urban areas and urban renewal.* Sustainable urban planning and urban design should focus on the development of inner urban 'brown field' sites, infill development and urban renewal, and the reuse of old buildings.
- *Incorporate natural environment into design.* The natural environment and ecological systems should be incorporated into designs for urban character, recreational and landscape planning. Development proposals must be sensitive to the natural context.
- *Integrate utility planning into urban design.* Utility and infrastructure subproject planning should be integrated into strategic urban design and planning approaches. Riverside embankments should accommodate landscaped pedestrian routes.
- *Use the natural environment as part of green infrastructure.* Combine 'green infrastructure' planning with natural environmental processes.
- *Adopt energy efficient technology into building design.* New development should include energy efficient technologies into building design.
- *Encourage pedestrian activity, public transport use and cycling:* Planning and urban design for cities should encourage walking, cycling and public transport use. Mixed uses, a variety of facilities and higher density development will help to achieve this.

- *Design for a hierarchy of functions and activities.* There should be a focus on a hierarchy of functions for parks, roads and pathways. There needs to be appropriate road and pavement widths, together with planting for specific road functions and traffic capacity needs. This should incorporate traffic calming measures for certain areas.
- *Promote a sense of place and liveability.* It is important to promote a sense of place, through urban design quality, for each of the cities and their component parts, to improve liveability and the quality of life for residents.
- *Reduce management and maintenance costs.* Efforts to reduce landscape/streetscape maintenance and management costs is often linked to the use of higher quality materials, good design and the integration of the natural environment into design approaches.

3.2.2 Ha Giang

Review of Ha Giang's Urban Master Plan

Ha Giang is a Class 3 city. Its current Master Plan (MP) was prepared in 2008 with a planning timescale to 2025, and envisaged a doubling of the development area to 1,600 hectares. The population would increase from 54,000 to 100,000 by 2025. The Provincial Department of Construction has recently decided to update Ha Giang's 2008 MP to extend the timescale to 2035. This would increase the total development area of the city to about 3,000 hectares with population levels of 300,000 by 2050.

Comments

The following comments arise from a review of the Master Plan for Ha Giang (2008-2025) and its prospective replacement (2015-2035):

- The increase in development area and population size for Ha Giang would be ambitious and would completely change the character of the city.
- It is unclear how this ambitious population increase would be realised by market conditions and demand for the proposed residential and commercial floorspace.
- Development control must be strict and avoid urban sprawl, which would otherwise spread along the proposed distributor and bypass roads.
- The new expansion areas are proposed in attractive natural landscapes and would significantly affect ethnic minority communities. It would also have an impact on the attractiveness of central Ha Giang as a regional tourism base.
- The new development areas would stimulate the need for greater private car use.

Ha Giang's City Centre Urban Design Character

The urban form of Ha Giang is linear and follows the river valleys. The city centre is compact and easy to walk around, and the River Lo provides an attractive natural corridor through the city with the forested limestone mountain backdrop providing additional scenic character. Buildings rarely rise above five storeys in height. There are a number of redevelopment opportunities in central Ha Giang that offer the potential to improve city centre facilities and to strengthen urban design character. Broad city centre roads are predominantly tree-lined. However, pavements are taken up by haphazard street furniture, tree planting, overspill from cafes and stalls, impromptu bike parking and also the hazard of low hanging wiring. This means that whilst some pavements have generous widths of more than three metres, they are still mostly unusable for pedestrian access.

Riverside pedestrian access is limited to central areas and represents a missed opportunity for other riverside routes. These new routes could form a strategic pedestrian network around the city and link the centre with more rural suburban environments along the riverside. The proposed riverside improvements provide scope for this. However, pedestrian routes that have been constructed along river embankments have been designed with little landscape provision. There are two city centre bridge crossings aver the River Lo. The northern iron bridge—Cau Yen Bien—appears to be the oldest. Between that and the PPC headquarters on the west bank of this river is the principal riverside park and main square. This park

extends for roughly 150m and occupies the space between the riverside edge and the main road, Nguyen Trai. Open space provision in Ha Giang is estimated to be 11m^2–12m^2 per person, which would exceed the standard for Ha Giang's Class 3 urban category of 10m^2 per person. Nevertheless, there seems to be a problem with the maintenance of parks.

Recommendations for Urban Design and Environmental Improvements in Ha Giang City Centre

The following are recommendations for urban design, landscape and environmental improvements for Ha Giang's central area:

- *Supporting the city centre.* The city's proposed development areas could threaten the viability of the centre and the potential to keep its urban core functions. To counter this, opportunities for redevelopment and infill schemes should be pursued that would achieve higher population densities and improved central area facilities.
- *Public transport services.* There should be some public transport services in Ha Giang, even if this initially starts as a limited shuttle bus service—perhaps with electric vehicles.
- *Central area traffic calming.* Traffic calming measures should be implemented for quieter residential streets in the city centre.
- *Network of parks and pedestrian routes.* Riverside areas, especially along Lo River, should have linear parks, boardwalks, passive and active recreational facilities, themed park areas, sculptures and water features. There should be indoor facilities, including 'winter gardens' that would enable the parks to be used in cooler weather. There needs to be a change in landscape treatment of routes from urban, and more formal hard-wearing treatment, towards rural, and more natural design.
- *Revitalisation of the central park and main square.* The main square and gardens in front of the PPC building should form a first phase of central area landscape improvements with more imaginative design. A sketch ideas plan has been prepared and is included in **Appendix 3**, **the Urban Design Report**.
- *Pavement widening and upgrade.* The generous road widths within the centre would allow for an additional one metre of pavement widening on either side, which would still typically leave at least 7.5m road carriageways. Street narrowing and pavement widening schemes need to be accompanied by regulated semi-public and public areas. This could allow some overspill from building frontages but leave a good width of pavement for pedestrians.
- *Street furniture improvements.* Street furniture comprising traffic lights, street lighting, directional signage, seating and rubbish bins all need to be rationalised and properly sited. Electricity and telephone wiring should be placed underground, not only to reduce pavement clutter but also for protective reasons during extreme weather conditions.

Outline Proposals for Ha Giang Centre Streetscape Improvements

Outline sketch ideas are shown for environmental and streetscape improvements to central Ha Giang in *Figure 3.5.1* of **Appendix 3**. These should be implemented in conjunction with the development and infill of city centre sites, preferably for higher density mixed use facilities that would support the viability of the central part of the city and increase its population levels and liveability.

Next Steps

It is proposed that the following key projects be pursued:

- Central Ha Giang Urban Design Action Plan.
- Strategic Plan for Riverside Linear Parks.
- Review of the New Development Areas.

These are described in more detail in **Appendix 3**, *Section 3.6,* and an Urban Design Strategy for Ha Giang is shown as *Figure 3.3.1* of the same appendix.

3.2.3 Vinh Yen

Review of Vinh Phuc Master Plan

Vinh Yen is designated as a Class 2 city. It has experienced significant change since transforming itself from an agricultural area to an industrial city. The Master Plan (MP) for Vinh Phuc Province City covers Vinh Yen City, Phuc Yenh and Huong Canh urban areas. It was prepared in June 2011 with a plan period to 2030 and a Vision for 2050. The plan sets out ambitious new development proposals for Vinh Phuc City. The scale of development has probably not been equalled in northern Vietnam. The Vinh Phuc City development area would cover 318kms^2. The population would increase from the current 153,000 for Vinh Yen on 50.8kms^2 to a projected Vinh Phuc City population of roughly 400,000 by 2030 and one million by 2050.

The MP proposes a 'spirit pivot' corridor of about 100m width that would create a major north-south route through the city. This would include a major dual carriageway road with a light rail transit line along the central reservation. The spirit pivot would extend from the Hanoi-Lao Cai Expressway toll gate in the north, through central Vinh Yen and southwards across the middle of Dam Vac Lake to the bypass of the National Highway 2. A bus rapid transit line would run east-west along a major road central reservation through the city centre. The MP is being implemented by the Overseas Development Assistance (ODA) Board, which was set up by the Provincial People's Committee. It is understood that future MP implementation would be undertaken by a PMU established by the provincial Department of Planning and Investment, perhaps evolving from the current ODA set-up. The GoV would finance infrastructure to pump-prime private sector development.

Comments

The following comments arise from a review of the Master Plan for Vinh Phuc (2011-2030):

- *Ambitious development task.* The proposed increase in development area and population for Vinh Phuc would be ambitious. It would completely change the character, and perhaps viability, of Vinh Yen city centre.
- *Need for strict market-based phasing approach to development.* It is not clear how the population increase would be realised under current market conditions and given national population growth rates of about 1% per annum. It is strongly recommended that if this plan is to be implemented it should be undertaken with a tight phasing plan that extends progressively from the city centre outwards, and that this expansion is closely followed by demand realities.
- *Strengthen Vinh Yen centre.* The new development areas would spur the need for greater private car use. This may affect the viability of Vinh Yen centre if new out-of-centre shopping facilities were to be built.
- *Project implementation approach.* It's uncertain how a PMU operation could properly implement the demanding task required for the development of Vinh Phuc City. A more realistic approach may require establishing an urban development corporation-type of entity utilising a public-private sector partnership approach.

Review of Vinh Yen GCAP

The Green Cities Action Plan (GCAP) for Vinh Yen was produced in November 2014. It states that '*Vinh Yen city's vision is to become an eco-business satellite city in metropolitan Hanoi*'. The principal focus of environmental improvements would be on enhancing the quality of Dam Vac Lake and its shoreline. The GCAP has concluded that planting over the years has reduced, and that there is a strong case for more 'green' areas. The plan estimates that there is 10m^2 of landscaped areas per capita, and that the city intends to increase that to 15m^2 per capita. In 2013 the total area of accessible open space in Vinh Yen City was 47 hectares, representing an average of 4.8m^2 per person, which is lower than the standard for a Class 3 city of 5m^2 to 7m^2 per person.

Comments. The GCAP makes no mention of the MP for Vinh Phuc and the scale of development proposed, or its effect on urban sustainability principles. There is also little mention of landscape planning or urban design, and in particular the prospects for a network of landscaped routes, which could connect the different parts of the new city. Most of the focus is on tree planting and expanding 'green' areas.

Whilst the subprojects are described, they are not framed within an urban design, landscape or recreational strategy that would define the functions and types of spaces relevant to different parts of the plan.

Vinh Yen's Urban Design Character (City Centre)

Boulevards that have already been built in Vinh Phuc and Vinh Yen exhibit much mature tree planting, low bushes and flowers. The parks, lakes and boulevard landscape all help to create a new garden city feel for Vinh Phuc. The built form would be predominantly low rise and expansive with broad road connections and roundabouts that effectively encourage the need for greater car use. This would be a contrast to Vinh Yen City's more tightly packed urban environment with its narrower tree-lined network of streets. Existing uses in Vinh Yen have more of a mixed-use and fine grain character than envisaged for Vinh Phuc City, where single use and broad zoning areas would prevail.

Dam Vac Lake is expected to function as a major leisure and recreational resource for Vinh Phuc City. Much of the central area has been planned around Vinh Yen City centre and the many lakes and ponds, where Dam Vac Lake (180 hectares) forms the principal water body. The new city centre would focus on the large Theatre Square, with its tree-lined avenues, parks and the centrepiece modern theatre building. Whilst there is a wealth of planting and parks, together with lakes, that present Vinh Phuc as a potential garden city, there is little functional structure for this, and what parks would serve which areas and what activities they would include. Much of the existing landscape exhibits sameness, as do the roads, with little urban design differentiation between one area and another.

Recommendations for Urban Design and Environmental Improvements in Vinh Yen's Central Area

The following are recommendations for urban design, landscape and environmental improvements for Vinh Yenh/Vinh Phuc's central area:

- *Supporting Vinh Yen city centre.* Vinh Phuc's rapid development expansion could undermine the viability of the city centre and the potential for it to maintain its urban core functions. To support the city centre, opportunities for redevelopment and infill should be pursued that increase densities and improve commercial facilities.
- *Streetscape improvements for central Vinh Yen.* Road widths in central Vinh Yen could allow for pavement widening depending on the traffic needs and function of specific roads. For some neighbourhood areas, as well as commercial streets, there should be traffic calming measures. These should be undertaken as part of an overall traffic management plan for central Vinh Yen.
- *Public transport services.* There needs to be public transport services provided early in Vinh Yen and Vinh Phuc, perhaps in the form of minibus services—or electric shuttle buses.
- *Differentiation of parks, routes and leisure areas.* Whilst there is a generous amount of landscape provision and planting, one issue appears to be the need for a clear differentiation in function between different routes and parks, and how they might accommodate a variety of activities and themed facilities.
- *Management and maintenance.* The extensive area of landscaping and vast number of trees currently planted and proposed throughout Vinh Phuc City will place a heavy management and maintenance burden on PPC and CPC budgets.

Conceptual ideas for Vinh Yen Subproject (Dam Vac Lake Area B)

A concept plan is presented for extensive parkland in Area B on the southern shore of Dam Vac Lake—*Figure 4.6.1* of **Appendix 3**. This shows a variety of character areas to include the lakeside embankment and wetlands, nature forest, mangrove forest, tree groves and meadowland. Much of the area would be for a wetlands environment that would include a small 'water bird' lake with the intention of encouraging wading birds, wetlands flora and fauna.

Next Steps

It is proposed that the following key projects be pursued:

- Vinh Yen City Centre Urban Design Action Plan.
- Master Plan for Area B on Dam Vac Lake.

These are described in more detail in **Appendix 3**, Section 4.7.

3.2.4 Hue

Review of Hue Master Plan

Hue is designated as a grade 1 city and had a population of 343,000 in 2011. Greater Hue had a population of 437,000 in 2011, and that for Thua Thien Hue Province was 1.1million. The city population is anticipated to increase to 410,000 in 2030, although Hue's demographic growth has been modest in recent years. The Hue City Master Plan (MP) was prepared in 2014 and had a plan period up to 2030 with a vision to 2050. The preparation of the new MP focused on the need to accommodate population growth; proposals for the conservation of heritage attractions; the expansion of infrastructure provision with the city's recent grade I status; and, the need to mitigate the effects of climate change. The MP covers all of Thua Thien Hue Province. Six growth options were reviewed during the MP preparation process and one was selected as the preferred development option. This focused on the need for 'compact' urban development for Hue as a cultural, educational and tourism centre. Inner urban, or 'brown field', sites would be the focus of development in conjunction with self-sufficient centres that would reduce the need for cars. The MP concludes that it should build on '*public transport-centred intensive urban renovation and development'*. The key proposals in the MP were:

- Citadel Area improvements would focus on tourism infrastructure investment.
- The Northern Huong So area would include mostly industrial development.
- The Southern Huong River area would focus on administrative and private offices, housing and tourism facilities in the major An Van Duong development area.
- The central city area would focus on tourism development.
- There would be an emphasis on the handicraft industry in suburban areas.

In terms of its open space and landscape planning, the MP proposed:

- Open space within the urban area would be conserved.
- Natural environmental areas would be retained.
- There would be strategic open space corridors of about two to three kilometres.
- Parks would be implemented according to different functions.

Comments on Hue MP

The MP generally follows a sustainable approach to development and proposals seek to increase the population of the urban centre, and improve the facilities there. The following are additional suggestions for improvements:

- *Redevelopment areas.* Part of Thuy Bieu has been outlined for 'redevelopment'. This area is largely undeveloped, mostly forested and is where some of the UNESCO WHS Nguyen heritage sites are. It should be retained as a landscape conservation area. Similarly, proposed redevelopment in Gia Hoi should be undertaken on a limited low rise and site infill basis, since the area provides a setting on the eastern edge of the Citadel.
- *Realigned new railway line.* The justification for relocating the existing railway line to the west of the current alignment should be comprehensively reviewed.
- *An Van Duong Development Area.* This is a significant new development area on the northeastern edge of the city centre. Proposals for An Van Duong are based on a plan prepared by local consultants in 2005. The road layout, upon which a number of the Hue subprojects are based, has not been justified by traffic needs assessments. The negative effect of this new area on city centre activities could be significant.

Review of Hue GCAP

The Green Cities Action Plan (GCAP) for Hue was produced in November 2014 and covered the Province of Thua Thien Hue. The stated vision is that: '*Hue city aspires to become a highly sustainable, world-class tourist destination*'. There are environmentally supportive projects in the GCAP that are

grouped into three: improving the urban environment; enhancing the tourism experience; and developing sustainable transportation.

Comments

There is little mention of landscape planning or urban design in the GCAP, and in particular the prospects for a network of landscaped linkages. The GCAP focus is on tree planting and expanding 'green' areas as measured against national standards. However, proposals should be more directly related to the MP and framed within a citywide urban design, landscape and recreational strategy. This should define the functions and types of spaces relevant to different parts of the city. Although 'green' space may increase, it's important to make it usable and for it to function properly within the urban structure, and to be equally accessible to tourists and local residents.

Hue Central Area Urban Design Character

The Huong River is the principal natural feature in central Hue with the Citadel/Imperial City and other Nguyen Dynasty visitor attractions the main tourism draw. The riverfront is lined with broad and attractive linear parks. The French Quarter has particularly attractive and broad tree-lined streets. Le Loi along the southern riverbank edge is the grandest and best known of them. Roads in the central area are invariably lined by mature trees with canopies that provide cover across the carriageways. At the north eastern end of Le Loi is the main tourist area with hotels, bars and restaurants that are gathered principally around three narrow and busy streets. In the Citadel area there are formal gardens around the walls. Neighbourhood streets in the Citadel are typically narrow and lined with mature trees. Urban areas are low rise but densely packed with lakes that provide some open space relief together with parks alongside the many canals within the Citadel walls. This distribution of tree planting, gardens and water bodies continues westwards beyond the Citadel to the royal tombs south of the bend of the Huong River. Individual residential gardens are also a distinctive feature of the Citadel area. In the outer and more recently built areas of Hue, streets broaden into wide avenues with less mature planting. The character changes to a more expansive, and less intimate, spatial sense of place than exists in the French Quarter.

Recommendations for Urban Design Improvements in Hue's Central Area

The following are recommendations for urban design, landscape and environmental improvements for Hue's central area:

- *Parkland maintenance.* Linear parks follow both sides of the Huong riverbank and form attractive and popular stretches of parkland in the centre of the city. However, there are signs that maintenance of these parks is becoming problematic.
- *Strategic routes and linkages.* There is an opportunity to strengthen pedestrian/cycling routes throughout the Citadel area that would link with key visitor attractions. The electric shuttle bus service should be extended to connect with the French Quarter and be made available for public use.
- *Create forest park in Thuy Bieu.* Thuy Bieu has an extensive forested area with lakes of heritage significance. This area should be conserved as a parkland setting for the UNESCO WHS-designated tombs. Trekking routes should link the key attractions.
- *Traffic calming measures.* For some areas there should be streetscape improvements to reduce traffic speeds. These could include raised 'pedestrian table crossings' at key road junctions, the use of one-way streets, or a change of road surface material.
- *Support for Citadel residential gardens.* There should be financial support for the rehabilitation and conservation of the many house gardens in the Citadel area.

Sketch Concept Ideas for Hue Subproject—Thuan Thanh Ward

Sketch concept ideas are presented for streetscape improvements in the Thuan Thanh ward of the Citadel as *Figure 5.6.1* of **Appendix 3**. However, urban design and streetscape improvements for roads in the Citadel should be undertaken as part of an overall strategy and improvement plan that would address landscape/streetscape, pedestrian access, street furniture, drainage/utility provision and traffic

management requirements—including traffic calming measures and one-way streets. Proposals for Thuan Thanh also include a Citadel wall ecological linear park.

Next Steps

It is proposed that the following key projects be pursued:

- Citadel Urban Design Action Plan.
- Central Hue Urban Design Action Plan.
- Review of the An Van Duong Development Areas.

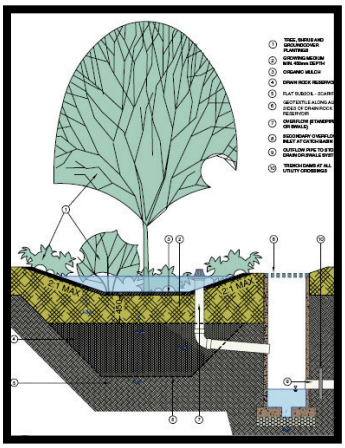
These are described in more detail as *Section 5.7 of* ***Appendix 3****,* together with a Context Plan for Recommended Hue Projects as *Figure 5.7.*1 of same appendix.

3.2.5 Best Practice Urban Design Guidance

A best practice urban design manual should be prepared. The document would identify effective climate resilience approaches, especially practical examples of best practice that could be applied to urban areas throughout Vietnam. It would be circulated to government authorities and agencies throughout the country, as well as to consultancies and civil society organisations. From the urban design/urban planning perspective, guidance would incorporate the principles and content covered here. The document would focus on illustrative and user-friendly content. This recommendation is covered in more detail in *Section 6* of **Appendix 3**.

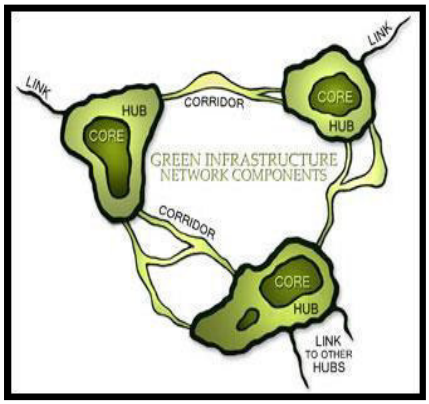
3.3 Green Infrastructure Principles

3.3.1 Subproject Greening



The Program should focus on key areas of green infrastructure and flood mitigation. Green infrastructure principles will support the integration of green facilities and of low impact development technologies, into the planning and design of the proposed investments into the cities. These will be presented in the feasibility studies, detailed engineering designs and the subproject costs. Flood mitigation will assess measures to prevent, control and manage negative impacts of flooding. It will include a technical assessment of climate, hydrology, geomorphology, floods, river hydraulics and related risks. Other relevant factors include city development plans, environment, civil protection, information, education, and communication to raise risk awareness.

Concepts of green infrastructure (GI), and what is meant by a green project, green and low impact development (LID) are discussed in this section. It shows the provinces and cities how to improve their infrastructure designs to include such features, and what to evaluate a technical proposal against when considering LID and GI. Concepts in this section should be incorporated into design briefs for consultants when preparing subproject feasibility studies. Further details of what is meant by green infrastructure are contained in **Appendix 2.**



3.3.2 Green Infrastructure

Infrastructure is the foundation upon which community growth depend ("Infrastructure" 2010). Davies et al., (2006[31]) define green infrastructure as the network of multifunctional open spaces—parks, gardens, open countryside, woodlands, street trees, green corridors and water ways—which make up the physical environment within and between urban zones—cities, towns, and

[31] Davies, C, McGloin, C, MacFarlane, R & Roe, M 2006, *Green infrastructure planning guide project: final report.*

villages, for example. Concepts of GI originating in Europe tend to see it as the network of green corridors and hubs, which contribute to preserving faunal and floral biodiversity. (Murphy, 2009[32]). In contrast, the United States Environmental Protection Agency's (USEPA) concept of GI is that of an approach that communities can choose to maintain healthy waters, and achieve multiple environmental benefits through sustainable practices. In this context, GI employs vegetation and soil to manage rainwater where it falls, rather than having gray storm water infrastructure, where pipes dispose rainwater (USEPA, 2009a[33]). This concept also involves designing green and integrating low impact development techniques (Weinstein, 2008[34]). A third concept of GI unites both in such a way that the natural environment becomes the driver in designing infrastructure.

Providing a systems approach to planning and development which recognizes the value of ecosystem services, the novel understanding of GI under this new paradigm—as a network of ecosystems and associated features providing a wide variety of functions and benefits, seeks to improve and holistically integrate ecosystem services within a constructed environment (Kimmel et al., 2013[35]).

The North American concept of GI originated in the US in the 1990s. Initially, it referred to planning for land development that ensured the low impact of storm water management on the environment. Various global organizations have expanded this definition to include the engineering of systems to have less impact on the environment and to be more efficient in the use of resources. Today, the concept is more extensive and integrates the European concept of hubs and links.

In Europe, as early as 1996, the concept of sustainability assisted local authorities and practitioners in designing urban infrastructure. In the 1990s, the European Science Foundation proposed the concept of best practices in Sustainable Urban Infrastructure (SUI). In Asia, the concept of GI involves the introduction of parks and gardens into existing, large cities. Depending on the demographics and the age of existing urban infrastructure and housing, the concept is different. In Singapore, it has been extended to, for example, recycling water due to shortages in supply.

In summary, there are two routes to define GI: (i) Concept E, the European concept of hubs and links. Green infrastructure is defined as the interconnected network of waterways, wetlands, woodlands, wildlife habitats, and other natural areas—The Conservation Fund, 2013[36]; (ii) Concept A, the USEPA concept of underlying infrastructure to be designed with respect for the environment. There is a need to integrate the two, which connects both concepts, such that natural environment becomes the driver in the design of infrastructure. Table 3-3 defines the terms related to each concept.

Table 3-3. Concept Definitions

Concept "A"		Concept "E"	
Black water	Water from toilet, urinal, kitchen, dishes washing machine.	Hubs	Anchor green infrastructure networks and provide an origin or destination for wildlife and ecological processes moving to or through it.
Greywater	Untreated wastewater water from bathtubs, showers, lavatories and clothes washing machine.	Greenbelt	Protected natural land or working land that serve as a framework for development while preserving ecosystem.
Reclaimed rainwater	Water treated to domestic	Greenway	Protected corridor of land managed for

[32] Murphy, P 2009, 'Green infrastructure for Europe? View from the commission', *Proceedings of the European commission workshop, 25–26 March 2009,* Brussels.

[33] USEPA 2009a, *Managing wet weather with green infrastructure*, United States Environmental Protection Agency, Washington DC.

[34] Weinstein N 2008, *LID observations*, Low Impact Development Center, May1st 2008.

[35] Kimmel, C., Robertson, D., Hull, R.B., Mortimer, M., Wernstedt, K. 2013. Greening the Grey: An Institutional Analysis of Green Infrastructure for Sustainable Development in the US. Arlington, VA: Center for Leadership in Global Sustainability, Virginia Tech. Retrieved January 22nd, 2015 from http://cligs.vt.edu/wp-content/uploads/2014/01/CLiGS-NARC_GI2013_final.pdf.

[36] Conservation Fund, (2013), Green Infrastructure, Retrieved from: http://www.conservationfund.org/our-conservation-strategy/focus-areas/green-infrastructure/

Concept "A"		Concept "E"	
	wastewater tertiary standards.		resource
Harvested rainwater	Stormwater that is conveyed from a building roof or parking lot. It has to be treated before usage.	Ecobelt	Linear woody buffer that can ease the zone of tension between urban and rural land use.
Rain garden	Reservoir with flowers or graminess that can facilitate rainwater infiltration or retention.	Conservation corridors	Linear protected areas such as river and stream corridor that serves as biological conduits for wildlife.
Bioswales	Bioswales are landscaping element used to catch and filter stormwater runoff. They are also used to drain the roads.	Wetlands	Natural or constructed wet area having herbaceous vegetation that can treat wastewater; for MDDEP any piece of land having 300mm of wet organic soil is a wetland.
Bioretention	Bio retention is an open depression. Bioretention utilizes soils and both woody and herbaceous plants to remove pollutants from storm water runoff.	Filter Marsh	Constructed wetlands designed to filter vertically or horizontal water through a filtering media as sand.

Source: PPTA Consultants

3.3.3 Green Project

A green project is a sustainable project. It may refer to a single action, such as installing solar panels on a building. Conversely, a green development project refers to a multi-action implementation in a large scale agglomeration. To certify green projects, the United States Green Building Council (USGBC) developed a registration approach known as Leadership in Energy and Environmental Design (LEED). The aim of this approach is to focus more holistically on buildings as a source of multiple environmental effects. For example, buildings offer impressive opportunities for pollution abatement (Enkvist, Naucler & Rosander 2007[37]). Promoting green buildings conserves energy and water, reduces greenhouse gas emissions, and provides state of the art, modern facilities for office and residential use (Tolley & Shaikh 2010[38]).

3.3.4 Green Development

Green development is a broader concept. It involves green space management that conserves natural ecosystem functions and provides associated benefits to ecosystems, including the human population (Benedict & McMahon 2002[39]). Such development includes the construction or conservation of hubs and links. Hubs can include green hubs, such as forests or lakes, or functional hubs with housing, commercial, or institutional functions. Roads and pedestrian alleys are urban links—they may or may not be green. Conservation corridors, greenways, and greenbelts provide links between green hubs. Green development needs GI, and green links are essential to preserve green hubs.

> "*In Australia, the concept of Water Sensitive Urban Design (WSUD) [another GI approach] is based on formulating development plans that incorporate an integrated approach to the management of the urban water cycle. In relation to storm water management, WSUD involves a proactive process recognizing the opportunities for urban design, landscape architecture, and storm water management infrastructure to be intrinsically linked" (Wong 2006[40]).*

[37] Enkvist, A, Nauclér, T & Rosander, J 2007, *A cost curve for greenhouse gas reduction*, February 2007, The McKinsey Quarterly,

[38] Tolley, GS & Shaikh, SL 2010, 'The greening of buildings', in I Parry & F Day (eds), *Issues of the day: 100 commentaries on climate, energy, the environment, transportation and public health policy*, RFF Press, Resources for the Future.

[39] Benedict, M & McMahon, E 2002, *Green infrastructure: smart conservation for the 21st century*, Sprawl Watch Clearing House, Washington DC.

[40] Wong, THF 2006, 'An overview of water sensitive urban design practices in Australia', *Water Practice & Technology*, vol. 1, no. 1, pp. 1–8.

There has been increasing public and government interest in establishing green technologies in project development because of their demonstrated environmental benefits (Barlow 2011). Many cities in the US and Canada have adopted a green policy. Large cities like New York, Boston, Toronto, and Vancouver have developed environmental guidelines to promote green buildings. Despite the increasing acceptance of green development concepts around the world, there have been very few examples of green development.

One of the major barriers to an increase in the implementation of green projects and green development is the absence of suitable frameworks under which to initiate such projects. Of those that exist, some, such as LID and LEED do not cover wastewater treatment, water filtration, water supply or water balance. Therefore, it is recommedned that an integrated framework is adopted that includes all components of water management in GI in an integrated manner.

3.3.5 Low Impact Development (LID)

LID is a low cost, effective alternative to stormwater control technology. It combines resource conservation, a hydrologically functional site design with pollution prevention measures to reduce developmental impacts to better replicate natural watershed hydrology and water quality. Through a variety of small-scale site design techniques, low-impact development controls runoff discharge, volume, frequency and quality to mimic development runoff conditions. (LIDC, 2011a).

The LID concept is different from conventional treatment—pipe and pond stormwater management site design. It uses hydrologic functions, such as infiltration, frequency and volume of discharges, and groundwater recharge can be maintained with the use of reduced impervious surfaces, functional grading, open channel sections, disconnection of hydrologic flow paths, and the use of bioretention/filtration landscape areas. LID also incorporates multifunctional site design elements into the stormwater management plan. Alternative stormwater management practices, such as on-lot microstorage, functional landscaping, open drainage swales, reduced imperviousness, flatter grades, increased runoff travel time, and depression storage can be integrated into a multifunctional site design. (LIDC, 2011a[41]).

There are many features to consider in the layout of a LID, with those typically selected and arranged according to topography and landscape. The following can be incorporated into designs:

- *Rain Gardens* enhance local water quality by allowing water to be filtered naturally by soil instead of being piped untreated into large bodies of water (LIDC, 2011b[42]; http://highbridge.org/government/environmental-commission/environmental-committee-initiatives/rain-gardens/). A rain garden is used to capture and infiltrate water during rainfall and direct it to the groundwater. It must be dug down, or planted in a slight depression, to catch the runoff in a shallow basin. Ideally, a rain garden is planted with a variety of native grasses, and other herbaceous or woody plants that are adapted to the soil and local climate. (The Native Plant Society of New Jersey, 2005[43]). Beyond their environmental use, rain gardens provide attractive landscaping and a natural habitat for birds, bees, and butterflies, while encouraging environmental stewardship and community pride (LIDC, 2011b).


Source WAA

[41] Low Impact Development Center (LIDC). (2011a). Home; About; Retrieved from http://www.lowimpactdevelopment.org

[42] Low Impact Development Center (LIDC). (2011b). Impact Development Center's sizing tool explained. Retrieved from http://www.lid-stormwater.net/bioretention/bio_sizing.htm

[43] The Native Society Plant Society of New Jersey, 2005, Rain Garden Manual for New Jersey, Office of Continuing Professional Education, Cook College 102 Ryders Lane New Brunswick, NJ 08901-8519, www.npsnj.org

- *Street storage* refers to the technology of temporarily storing storm water—in densely populated urban areas—on the surface—on and off-street—and, as needed, below the surface, close to the source (Carr, Esposito, & Walsh, 2001[44]). The use of street storage and catchment basins reduces the rate of runoff entering storm sewer systems, reducing the required minimum size of water mains conveying storm water pipes (LIDC, 2011b).

- *Bioretention* is an alternative to runoff treatment, acting on storm water before it is discharged into waterways (Hsieh & Davis, 2003[45]). A landscaped island containing a curb inlet drains a large area or street, channeling rainwater through a small pipe into a municipal storm drain system. Bioretention consists of porous media layers that can remove pollutants by infiltrating runoff through mechanisms that include adsorption, precipitation, and filtration (Hsieh & Davis, 2003).

- *Permeable pavement systems* restore soil infiltration functions in the urban landscape. These systems are mainly porous pavement systems in parking areas (LIDC). Permeable pavements offer one solution to the problem of increased storm water runoff and the decreased stream water quality associated with automobile usage (Brattebo & Booth, 2003[46]; doi:10.1016/S0043-1354(03)00410-X). Permeable pavements with reservoir structures consisting of concrete paving stones offer the possibility for decentralized, sustainable storm water management and source control in urban areas (ascelibrary.org/doi/pdf/10.1061/40644(2002)40). Runoff from streets and parking areas with low traffic densities can be infiltrated to support groundwater recharge and to reduce hydraulic stress in sewer systems. Infiltration can help to return the urban water cycle to its natural condition, increasing the level of groundwater (Dierkes et al., 2002[47]).

- *Green roofs*—roofs with a vegetated surface and substrate—provide ecosystem services in urban areas, including improved storm water management, better regulation of building temperatures, reduced urban heat island effects, and increased urban wildlife habitat (Oberndofer et al., 2007[48]). The use of vegetation on a rooftop as an alternative to traditional roofing materials is an increasingly utilized GI practice. The vegetation and growing media perform a number of functions that improve environmental performance, including absorption of rainfall, reduction of roof temperatures, improvement in ambient air quality, and the provision of urban habitat (Carter & Keeler, 2007[49]).

[44] Carr, R., Esposito, C., and Walesh, S. (2001). "Street-Surface Storage for Control of Combined Sewer Surcharge." J. Water Resour. Plann. Manage. 127, special issue: mini-symposium on urban drainage, 162–167.

[45] Hsieh C.H., Davis A.P., 2003. Multiple-event study of bioretention for treatment of urban storm water runoff, Diffuse Pollution Conference Dublin 2003.

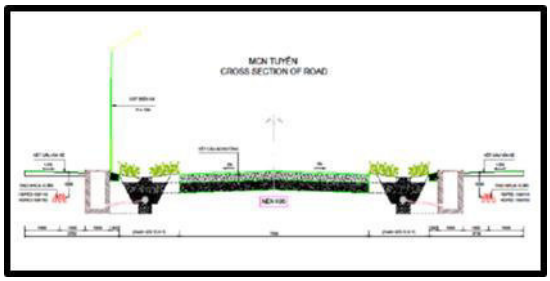
[46] Brattebo, B. O., & Booth, D. B. (2003). Long-term stormwater quantity and quality performance of permeable pavement systems. Seattle, WA: University of Washington, Department of Civil and Environmental Engineering, Center for Water and Watershed Studies.

[47] Dierkes C., Kuhlmann L., Kandasamy J., Angelis G., 2012, Pollution Retention Capability and Maintenance of Permeable Pavements, Global Solutions for Urban Drainage: pp. 1-13. doi: 10.1061/40644(2002)40 American Society of Civil Engineers, Ninth International Conference on Urban Drainage (9ICUD), Lloyd Center Doubletree Hotel, Portland, Oregon, United States, September 8-13, 2002.

[48] Oberndorfer E., Lundholm J., Bass B., Coffman R.R., Doshi H., 2007, Green Roofs as Urban Ecosystems: Ecological Structures, Functions, and Services, Architectural Science Publications and Research , Architectural Science, http://digitalcommons.ryerson.ca/arch/1

[49] Carter T., Keeler A. (2007), Life-cycle cost–benefit analysis of extensive vegetated roof systems, Journal of Environmental Management 87 (2008) 350–363 351, Elsevier Ltd. doi:10.1016/j.jenvman.2007.01.024

- *Bioretention swales* are broad ditches with gentle slopes. Swales are vegetated open channels designed to accept sheet flow runoff and convey it in a broad shallow flow. Swales are used to reduce storm water volume through infiltration, improve water quality through vegetative and soil filtration, and reduce flow velocity by increasing channel roughness (Lukes & Kloss, 2009[50]). Bioretention swales can take many forms. Generally, they can be contained in approximately one percent of the land area draining into them. Since bioretention swales are linear, they work well along impermeable surfaces such as roads and sidewalks (Wahl, 2009[51]).



- *Rainwater harvesting*, which involves the collection of rainwater from impervious surfaces and storing it for later use, is a technique that has been used for millennia. Although, rainwater harvesting has not been widely employed in industrialized societies, which rely primarily on centralized water distribution systems. But with the increasing recognition of the need to address the problems of limited water resources and storm water pollution, and the emergence of green building design, the role of rainwater harvesting in water supply is being reassessed (Kloss, 2009[52]). Rainwater harvesting systems typically divert and store runoff from residential and commercial roofs. Often referred to as “clean” runoff. Roof runoff contains pollutants—metals and hydrocarbons from roofing materials, nutrients from atmospheric deposition, and bacteria from bird droppings. However, this runoff contains lower concentrations of, or is missing many of the toxins present in runoff from other impervious surfaces. Installing a rainwater collection system requires diverting roof downspouts to cisterns or rain barrels to capture and store the runoff. From the storage container, a dual plumbing system is needed to make use of the water indoors, and/or a connection to the outdoor irrigation system can be installed (Kloss, 2009).

[50] Lukes, R. & Kloss, C. (2009). Managing wet weather with green infrastructure, municipal handbook, Green Streets. US EPA. Retrieved from http://water.epa.gov

[51] Wahl S. 2009, Stormwater Best Management Practices a First Guide for Landscape Architects, http://epsilon.slu.se/.

[52] Kloss, G. (2009). Managing wet weather with green infrastructure, Municipal Handbook, Rainwater Harvesting Policies. US EPA. Retrieved from http://www.dep.wv.gov

4 Subproject Screening, Assessment, Selection and Prioritization—Ha Giang, Hue and Vinh Yen

This chapter examines the subprojects proposed by the provinces/cities for financing under the Program. It starts with a description of the selection and screening process that was used to establish the initial lists. The methodology used to prioritize the subprojects by city, and the principles used to determine the final list of subprojects follows. The principle is that the total costs of subprojects for each city should match the financial resource envelope determined on the basis on provincial borrowing capacities and available resources from the ADB and UCCRFT. Subproject prioritization was undertaken, and this means that subprojects higher up in the ranking have been included in the Program, while those further down may be added later as more resources become available. Following the prioritization exercise are individual subproject appraisals covering technical assessments, social and environmental safeguards, poverty, gender and social aspects, and financial and economic analyses.

4.1 Selection and Screening Process and Criteria

The selection and assessment of subprojects for inclusion into the Program within the three cities—Ha Giang, Hue, and Vinh Yen—is described in this section. It starts with selection and screening process adopted, which followed the assessment undertaken by the Cities Development Initiative for Asia (CDIA) within each city. Despite the clear prioritization of subprojects from this work, each city added subprojects and deleted some as funding was secured from elsewhere. Revised lists were submitted to consultants for the Interim Report. These subprojects were changed again stemming from the Interim Report Workshop and the ADB mission. Rules of engagement were later established wherein road subprojects should not exceed 20% of the total program cost within each city. Specific funding guidelines were also given that OCR funds could only be used for direct revenue generating subprojects; land acquisition and resettlement should be financed by counterpart funds; ADF funding would be divided between the three cities at US$40 million each; and OCR funding would be split between Hue and Vinh Yen equally at US$25 million each. Cities revised their list of subprojects once again. These were then subjected to further evaluation to ensure that urban design, green infrastructure and low impact development features, and the results of the decision support systems work were included in the designs, and that subprojects were integrated into area specific interventions.

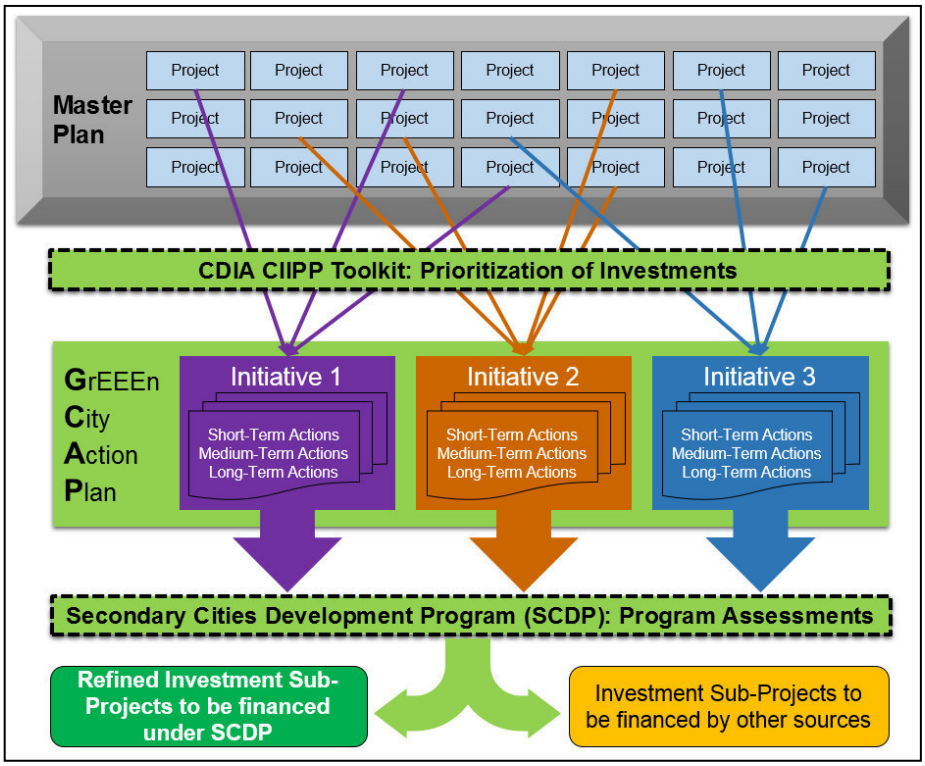
Initial assessments of subprojects was undertaken by the consultants, based on the lists made available at the time—Ha Giang, as submitted on April 8, 2015; Hue on May 4, 2015; and Vinh Yen on April 3, 2015. The assessments covered technical aspects, social safeguards, environmental aspects, poverty, gender, and social features, and financial and economic analyses. Summaries of these assessments are in Volume 3—Subproject Data Sheets.

The process of identifying, evaluating, and prioritizing investment subprojects for SCDP follows a number of steps as shown by **Figure 4-1**.

The ranking of subprojects (**Figure 4-2**) was based on:

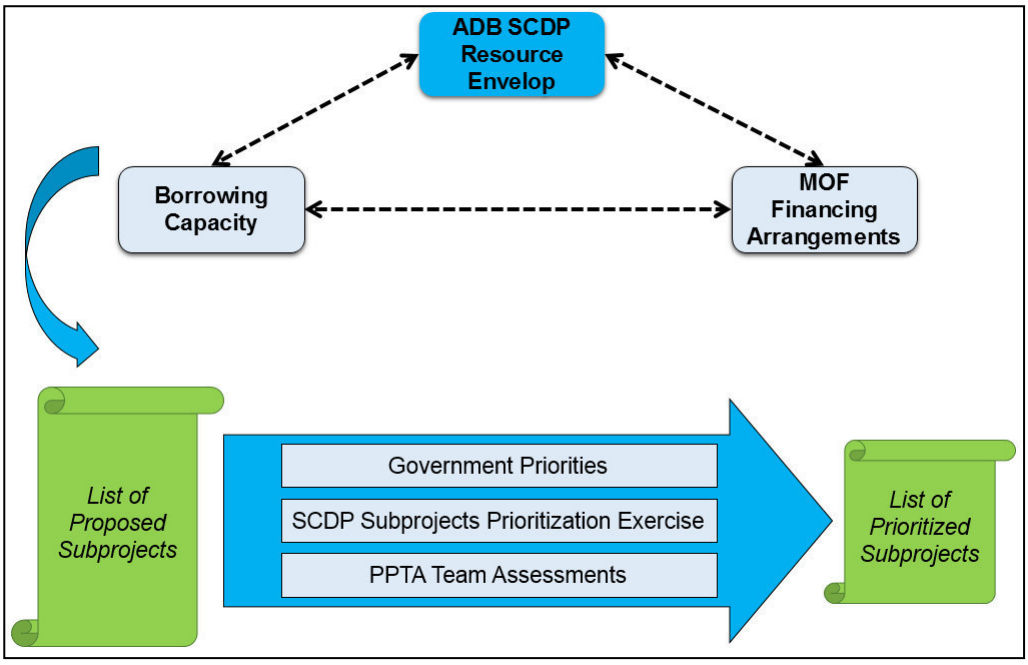
- The priorities of the governments in each Program city.
- The scores of a prioritization exercise.
- Assessments by the PPTA consultants.

Figure 4-1. From Planning to Investment



Source: PPTA Consultants.

Figure 4-2.Subproject Prioritization Process



Source: PPTA Consultants

4.1.1 Initial Subproject Identification

Subprojects that were initially identified by the cities supported the long-term objectives for infrastructure investments as provided in each province's socio-economic development master plan. They also were consistent with those included in each city's spatial master plan. In 2014, Hue, Vinh Yen and Ha Giang cities used the City Infrastructure Investment Programming and Prioritization (CIIPP) Toolkit. This was developed by CDIA to assist cities and municipalities undertake more structured planning, prioritization, and programming of urban infrastructure. The exercise was undertaken in parallel with the preparation of the GCAP for Hue and Vinh Yen. Results were taken into account in the preparation of the initiatives and actions for both GCAPs, and the formulation of the investment programs for each city. This took place prior to the engagement of this PPTA team. For Ha Giang the GCAP and investment program was prepared under this PPTA.

Box 2: CDIA City Infrastructure Investment Programming and Prioritization (CIIPP) Toolkit:

The toolkit was developed to assist cities and municipalities throughout Asia to move from strategies to bankable investment projects by doing a better and more structured job in urban infrastructure planning, prioritization and programming. The toolkit has three components:

- *Analysis of the Investment Budget*—determine the financial envelope of the city to undertake strategic infrastructure projects
- *Prioritize Projects*—using a rational approach and a pre-determined set of indicators
- *Program Projects*—in a 5-year investment plan matching the fiscal space of the municipality.

The approach towards prioritizing projects was dopted in the three cities. It used qualitative and quantitative data, and required input from key officials and agencies within the city administration, during a participatory workshop.

Source: Project Programming and Prioritisation Toolkit. User Manual. From wish list to short list: Prioritising Urban Infrastructure Projects for Local Development. CDIA. 2009.

The GCAPs translated the list of prioritized investment subprojects and capacity development activities into feasible actions. CDIA's CIIPP Toolkit application in the Program cities supported the provincial and city governments to reduce their 'wish lists' to 'short lists' by assessing each subproject and applying weights for different prioritization criteria—purpose or demand for the subproject, public response, environmental and socio-economic impacts in relation to green cities, and their feasibility—in the screening exercise. Each criteria was weighted, and this was slightly different in Hue in comparison to the other two cities (**Table 4-1**).

Table 4-1. Weighting Criteria Used to Prioritize Subprojects, CDIA

City	Purpose (%)	Public Response (%)	Environment (%)	Socio-Economic (%)	Feasibility (%)
Ha Giang	10	10	35	30	15
Hue	15	10	30	30	15
Vinh Yen	10	10	35	30	15

Source: Internal project documents. CDIA. 2014

The Program cities provided a final list of prioritized subprojects for financing, which reflected the GCAP and CIIPP Toolkit results, but incorporated changes on account of some subprojects having already secured financing. Some new ones were also added. Since the GrEEEn Cities approach[53] guided the Program cities, the eventual list of investment subprojects did not change much from interim prioritizations. Nevertheless, some changes were discussed and agreed with the EAs to: (i) strengthen the Program's impact, outcome, and outputs; (ii) adjust intended subprojects vis-à-vis financial resources available in this Program; and (iii) align the planned investments with the institutional, economic, safeguards, as well as financial and procurement capacities of the EAs. The PPTA Team conducted site visits and held consultations in the three cities to verify previous assessments, discuss investments, and identify options to refine subprojects through GrEEEn guidelines, and recommendations for infrastructure planning and urban design.

[53] S. C. Sandhu and R. Naik Singru. 2014. *Enabling GrEEEn Cities: An Operational Framework for Integrated Urban Development in Southeast Asia*. ADB Southeast Asia Working Paper Series No. 9, November 2014. Manila.

Also, the selection of subprojects was dependent upon the resource envelop available for financing, which determined the scale of the Program, and the subprojects for inclusion based upon a ranking of importance in relation to goals and objectives. The financial envelope for the Program was determined based upon the borrowing capacities of each province, the draft financing arrangements to be adopted by the Ministry of Finance (MOF) regarding central transfers to provinces for funding investment projects (**Chapter 9**), and the amount of money set aside by ADB and UCCRTF for the Program.

4.1.2 Subproject Ranking Process

A further subproject evaluation was undertaken, using criteria developed by the consultants. Each subproject was rated according to the perceived accomplishment—scoring—against nine criteria, expressed as questions:

Scoring: 0=not at all // 1=neutral // 2=somewhat // 3=significantly

(i) To what extent does the subproject support the vision of the GCAP?
(ii) To what extent does the subproject support a smart and competitive city?
(iii) To what extent does the subproject support an environmentally sustainable and resilient city?
(iv) To what extent does the subproject support a socially inclusive city?
(v) To what extent will the subproject have the potential for direct revenue generation/cost recovery?
(vi) To what extent does the subprojects have the potential for private sector involvement?
(vii) To what extent does the subproject have a sustainable operations and maintenance plan (system and finance)?

Scoring: 0=none // -1=very little // -2=some // -3=significant

(viii) To what extent will the subproject require relocation of people and businesses?
(ix) To what extent will the subproject require land acquisition?

Scores were totalled for each subproject enabling a ranking from the highest to lowest to be undertaken. A subproject would be included or excluded according to its position on the ranking, and the available resources. This was undertaken with the concerned city and provincial officials, the private sector and civil society during workshops held in each city. The PPTA consultants involved key stakeholders—government, private sector, and civil society—score subprojects under the first four criteria—GCAP vision and the 3Es. Criteria (v)-(vii)—revenue generation/cost recovery, private sector involvement, and O&M plan—were scored by the technical staff of the government, and the local feasibility study consultants[54]. The last two criteria—relocation and land acquisition were scored by the PPTA consultants according to subproject technical details and ADB's guidelines in its Safeguard Policy.[55] Nevertheless, the scores in these two criteria were discussed with participants. Further consultations between PPTA consultants, Program cities, and their local consultants enabled the incorporation of green recommendations into the subproject designs. The results of this process are summarized for each of the Program cities separately. **Appendix 6** detailes the results of the exercise.

4.1.3 Final Selection

Based on the results and discussions of the subprojects prioritization exercise with each city government, the private sector, and civil society, further consultations were held during the ADB interim mission in July 2015. These meetings brought together the government's priorities; the results from the stakeholder prioritization exercise; and the PPTA consultant team's assessments of the subprojects. The consultations helped to revisit the rationale and purpose of the SCDP as a "Green Cities" program, and to correspondingly prioritize and select subprojects that meet the criteria for green infrastructure with positive economic, environmental, and social impacts. ADB, PPTA consultants' team, and the Program

[54] This was undertaken since it was assumed that the knowledge of each subproject by other participants would not suffice to make a sufficiently informed judgment on these technical criteria.

[55] The rationale was that criteria (vi) and (vii) are technical not subjective to individual judgments, but are scored based on ADB. *Safeguard Policy Statement*. Manila. 2009.

cities discussed which kind of subprojects—scale, scope, and technical complexity—would be most suitable for the Program.

Further consultations were undertaken, and the list of subprojects was amended again by the cities to take into account revised guidelines of ADB and the PPTA team, which involved:

- Maximum ADB loan amounts—US$40 million ADF for each city, and US$25 million OCR each for Hue and Vinh Yen.
- OCR could only be used for direct revenue generating subprojects.
- Land acquisition and resettlement should be financed by local counterpart funds.
- The investment requirements for road subprojects should be less than 15%-20% of program cost for each city.

Revised subproject lists were provided by each city that responded to the above criteria. These were further reviewed by the PPTA consultants' team and the staff of the Program cities, and their local consultants worked on further improvements to the proposed designs of subprojects. This ensured the inclusion of green infrastructure, low impact development and urban design features, and refocusing investments on integrated area development. Additional results from the economic, financial, environmental, and social analysis, including safeguards, poverty, gender and social impacts and land acquisition and resettlement requirements informed about each subproject's viability. Accordingly, the Program cities arrived at their final list of prioritized subprojects.

4.1.4 Spatial Rationale for Subprojects

The selected subprojects were grouped according to broader spatial areas within each city that would be improved under the Program. Each subproject was seen as part of larger spatially integrated scheme. These are identified below for each city.

Ha Giang

The subprojects will improve the southern gateway to the city, upgrade drainage of the inner city and enhance drainage and access in the north east:

- Improving access in south and gateway to the city. The upgrading of National Road 2 will complement the new southern ring road and Lo Rover bridge. With green features, this component will improve the appearance of the southern gateway into the city. It will encourage new development in the south east and improve access to the inner urban area.
    - *Upgrading of National Road Number 2* to improve access, strengthen the road network in the south of the city and improve appearance of the southern entrance to the city—*Ha Giang subproject 8.*
    - *Southern Ring Road Improvement* to enhance connectivity, divert traffic from the city and improve mobility and road safety—*Ha Giang subproject 9.*
    - *Bridge from National Highway Number 2 to the Southern Ring Road*—River Lo bridge as the third crossing of the river to improve access and reduce travel times—*Ha Giang subproject 10.*
    - *Western Embankment of Lo River* to stabilize river and stream banks to adapt to climate change and recue environmental pollution through creating a green landscape—*Ha Giang subproject 4.*
    - *Southern Embankment of Me Stream*, southern side—*Ha Giang subproject 6.*
    - *Improvement to Existing Landfill*—properly engineered sanitary landfill to cover needs for ten years, includes a new cell and leachate treatment—*Ha Giang subproject 7.*
- Drainage improvements in the inner city to clean and rehabilitate the primary storm water drainage system, discourage encroachment and provide public open space.
    - *Drainage Improvements of Inner City Wards*—Minh Khai, Tran Phu, and Nguyen Train wards—*Ha Giang subprojects 1 and 2.*
- Drainage improvements and better access for the peri-urban areas in the north east of the city which is to encourage mixed use development, mainly for leisure activities. Subprojects comprise integrated embankment and road improvements to reduce flooding and improve access and mobility of the

north-eastern peri-urban areas along with primary storm water drainage improvements that would discourage encroachment and dumping.

- *Embankment and Roads on both sides of Mien River—Ha Giang subproject 5.*
- *Drainage for T1, T2, T3 and T4* primary drains—streams—in Quang Trung ward—*Ha Giang subproject 3.*

Hue

The subprojects target the integrated development and greening of three areas:

- Improvement of the environment in the Citadel and surrounding areas. They are designed to improve drainage and reduce flooding and provide a more green environment for residents and tourists.
  - *Dredging and Embankment of Ke Van River—Hue subproject 1.*
  - *Drainage and Pavements in Four Inner City Wards* in the Citadel area—Thuan Thanh, Thuan Loc, Tay Loc and Thuan Hoa—*Hue subproject 2*
  - *Dredging and Embankment, Six Lakes in the Citadel*—Xa Tac, Phong Trach, Mung, Huu Bao, Tien Bao and Vuong—*Hue subproject 3*
  - *Dredging and embankment of Lap River,* Kim Long ward—*Hue subproject 5*
  - *Dredging and embankment of An Hoa River—Hue subproject 7*
  - *Improvement of Citadel Canal—Hue subproject 8.*
  - *Rehabilitation/Embankment of Dong Ba River* (from Ba Ben to Bai Dau bridge)—*Hue subproject 11.*
- Greening, drainage and improving access within the new development area in the east of the city. The subprojects will encourage further development of this new part of the city which will include new public administrative buildings, housing and commercial activities. Subprojects will contain green elements and low impact development along with appropriate urban design features at the outset.
  - *Eco-Channel of the An Van Duong Development Area—Hue subproject 6.*
  - *Park and Square in the Administrative Area,* An Van Duong—*Hue subproject 10.*
  - *Section of Central Road, including Bridge, in New Development Area of An Van Duong,* connecting Areas A and B, including a bridge over the Nhu Y River)—*Hue subproject 14.*
  - *Vy Da Bridge and Access Roads—Hue subproject 17.*
  - *Park with Trees, Sidewalks, Drainage, Lighting in An Van Duong*, within the central ecological axis in the New Development Area of An Van Duong—*Hue subproject 9.*
  - *Rehabilitation/ Embankment of An Cuu River,* the remaining 2 km—*Hue subproject 12.*
  - *Rehabilitation/Embankment of Nhu Y River,* along Han Mac Tu road, from Vy Da bridge to Van Duong—*Hue subproject 13.*
- Promotion of tourism infrastructure in the south western part of the city. Subprojects will improve access to tourist sites and historic monuments, temples, garden houses and fruit farms. Landscaping will be improved, cycle paths added, along with street lightning.
  - *Bui Thi Xuan Road—Hue subproject 15.*
  - *Huyen Tran Cong Chua Road—Hue subproject 16.*
- Water supply for proposed solid waste management facility to serve the whole city, and enable improved water supply for villages to the south west of the city.
  - *Water Supply to Phu Son Solid Waste Treatment Facility, Huong Thuy Town* and neighbouring villages—*Hue subproject 4*.

Vinh Yen

The subprojects involve improvements around the Dam Vac Lake, and essential infrastructure to support the development of the proposed University village in the north of the city:

- Improvement of Dam Vac Lake and its surrounding areas. Dam Vac Lake is the heart and main green hub of the city. The aim is to improve the quality of water, the lake's carrying capacity, and improve the environmental of the surrounding areas including the quality of water that flows into the lake. This involves improving wastewater management and sanitation, financing household connections and greening of the surrounding areas. It also involves building the first public park of the city.
  - *Dredging and Landscape Protection, Dam Vac Lake—Vinh Yen subproject 1.*
  - *Green Park Development near Dam Van Lake,* conservation and development of green trees and parks in the city—*Vinh Yen subproject 5.*
  - *Tertiary Wastewater Sewers*—household connections and sanitation improvements. Focus initially on connections in Ngo Quyen, Dong Da, Lien Bao and Khai Quang wards—*Vinh Yen subprojects 3 and 4.*
  - *Wastewater Collection and Treatment, Western Part of City*—Dong Tam, Hoi Hop and Tich Son wards and Dinh Trung and Tranh Tru communes—*Vinh Yen subproject 2.*
- Development of infrastructure for the proposed University site. The new university village is located in the north of the city and the subproject involves improving access to the area. The proposed road will provide the structure and overall framework for the development of the area, and will open up significant areas of land for development. The exhibition/linkage center with its green development training facilities should be able to integrate with the new universities and colleges and local business.
  - *Infrastructure to University Area*, to Improve access to and within the area—the main arterial road, and a section of the ring road number 2 of the city—*Vinh Yen subproject 6.*
  - *Exhibition/Linkage Center for Business Support*—promotion of low carbon development and educational and training linkages to university—*Vinh Yen subproject 7.*

4.2 Costs Estimates of Subprojects

Some 31 subprojects have been identified by the cities—10 in Ha Giang, 15 in Hue and 6 in Vinh Yen. The total cost of the Program on the basis of these subprojects is about $222.89 million (VND5,172 billion)—Ha Giang $45.49 million (VND1,006 billion), Hue $93.77 million (VND2,2311 billion), and Vinh Yen $83.63 (VND1,935 billion). **Tables 6-2**, **6-3**, and **6-4** list the subprojects and their cost estimates for Ha Giang, Hue and Vinh Yen, respectively.

The major subprojects in Ha Giang are principally drainage and embankments, of which six—drainage for Tran Phu and Nguyen Trai Wards; Minh Khai Ward; T1, T2, T3, T4 in Quang Trung Ward; embankments of Lo River, Mien River, Me stream—all have a base cost of over VND400 billion, and represent some 63% of the total base cost. The other subprojects, costing more than VND200 billion, are the improvement of the National Road No.2, Southern Ring and bridge.

Table 4-2. Program Cost for Ha Giang City

Item		VND million	$ million
Base Costs			
1	Drainage for Tran Phu and Nguyen Trai Wards	37,653	1.71
2	Drainage for Minh Khai Ward	40,893	1.86
3	Drainage for T1,T2,T3,T4 in Quang Trung Ward	7,546	0.34
4	West Embankment of Lo River	51,863	2.36
5	Embankment and Roads on each side of Mien River	241,579	10.98
6	Southern Embankment of Me Stream	24,571	1.12
7	Improvement of Existing Landfill	19,404	0.88
8	Upgrading of National Road No.2	41,796	1.90
9	Southern Ring Road Improvement	86,585	3.94
10	Bridge from National Road No.2 to Southern Ring Road	88,084	4.00
	Subtotal (Base Costs)	**639,974**	**29.09**
Detailed Engineering Design and Supervision (DEDS)		44,798	2.04

Item		VND million	$ million
Land Acquisition and Resettlement (LAR)		32,629	1.48
Contingencies			
1	Physical	72,565	3.30
2	Price	123,420	5.61
	Subtotal (Contingencies)	195,985	8.91
Taxes		87,452	3.97
Interest During Construction		5,480	0.25
	TOTAL COST	**1,006,318**	**45.74**

Source: PPTA Consultants.

Major subprojects in Hue are more varied than those in Ha Giang, and include dredging and embankment improvements in various locations; parks, roads and a bridge; and provision of water supply to Phuson Son solid waste management facility and adjacent villages; all costing over VND1,151 billion.

Table 4-3. Program Cost for Hue City[56]

Item		VND million	$ million
Base Costs			
1	Dredging and Embankment of Ke Van River	48,750	2.22
2	Dredging and Embankment of Lakes in Citadel	62,694	2.85
3	Dredging and Embankment of Lap River, Kim Long Ward	34,061	1.55
4	Eco-Channel of the An Duong Development Area	122,732	5.58
5	Dredging and Embankment of An Hoa River	74,800	3.40
6	Improvement of the Citadel Canal/Moat	70,395	3.20
7	Rehabilitation/Embankments of Dong Ba, An Cu, Nhu Y Rivers	28,443	1.29
8	Drainage and pavements in Four Inner City Wards of Citadel	195,500	8.89
9	Water Supply System to Phu Son Solid Waste Management Facility and Villages	18,820	0.86
10	Park, Paths, Drainage, and Lighting in An Van Duong Development Area	142,828	6.49
11	Park and Square in the Administrative Area, An Van Duong	116,111	5.28
12	Section of Central Road in An Van Duong Development Area including Bridge	64,937	2.95
13	Bui Thi Xuan Road	70,348	3.20
14	Huyen Tran Cong Chua Road	42,648	1.94
15	Vy da Bridge and Access Roads	58,090	2.64
	Subtotal (Base Costs)	**1,151,157**	**52.33**
Detailed Engineering Design and Supervision (DEDS)		80,581	3.66
Land Acquisition and Resettlement (LAR)		216,978	9.86
Contingencies			
1	Physical	145,002	6.59
2	Price	306,298	13.92
	Subtotal (Contingencies)	451,300	20.51
Taxes		162,832	7.40
Financing Charges		88,076	4.00
	TOTAL COST	**2,150,924**	**97.77**

Source: PPTA Consultants.

In Vinh Yen, 38% of the total base cost is attributed to wastewater management—collection, treatment and tertiary sewers. An access road to the proposed University Village costing VND254 billion is being proposed. Other subprojects costing more than VND100 billion are dredging and landscape conservation of Van Dam Lake, a green park development and construction of an exhibition linkage center for business support.

[56] Based on the subproject list submitted on May 13, 2015 as approved by the PPC.

Table 4-4. Program Cost for Vinh Yen City

Item		VND million	$ million
Base Costs			
1	Dredging and Landscape Protection of Dam Vac Lake	209,234	9.51
2	Collection and Wastewater Treatment in West Vinh Yen	308,017	14.00
3	Tertiary Wastewater Sewers	119,796	5.45
4	Green Park Development near Dam Vac Lake	186,444	8.47
5	Infrastructure for University Area	254,178	11.55
6	Exhibition/Linkage Center for Business Support	53,591	2.44
	Subtotal (Base Costs)	**1,131,260**	**51.42**
Detailed Engineering Design and Supervision (DEDS)		79,188	3.60
Land Acquisition and Resettlement (LAR)		64,013	2.91
Contingencies			
1	Physical	127,446	5.79
2	Price	277,525	12.61
	Subtotal (Contingencies)	404,971	18.41
Taxes		160,180	7.28
Financing Charges		95,141	4.32
	TOTAL COST	**1,934,753**	**87.94**

Source: PPTA Consultants.

4.3 Subproject Technical Assessments

All subprojects selected by the respective PPCs were subjected to detailed technical evaluations that covered climate change, flood management and decision support systems; technical engineering aspects including green infrastructure and low impact development; and the incorporation of urban design features. Each assessment is described below.

4.3.1 Climate Change, Flood Management and Decision Support System (DSS)

Introduction

The practical implementation of the GrEEEn Operational Framework in the three Program cities requires an urban profiling as well as a diagnostic assessment. However, in relation to flood management, a vast amount of input data was initially required from the Vietnamese authorities to undertake a through assessment (**Table 4-5**), as reflected in the Memorandum of Understanding (MoU) between GoV and ADB, and drafted during the Program's Inception Mission (March 9-17, 2015).

Table 4-5. Input Data Initially Required From the Vietnamese Authorities, Regarding Climate Change, Flood Management and DSS Topics and, It's Availability Constraints

Required Input Data	Availability	Remarks
Climate Change Action Plans, if available	Yes	—
Disaster Management Plans, if available	Yes	—
High resolution digital model for hydrological studies: for instance, grid size of 30 m x 30 m	—	NASA has recently released its SRTM-2 Dataset (grid 30 m x 30 m), freely available
High resolution digital model for hydraulic studies: for instance, grid size of 2 m x 2 m	—	—
General maps for the basins corresponding to the rivers crossing the 3 cities (for instance, 1:25,000 scale)	Yes	—
Detailed maps of the 3 cities (1:1,000 — 1:2,000 scale).	—	Only on scale 1:5,000
Aerial photographs (in particular, the historical ones).	—	—

Required Input Data	Availability	Remarks
Stocktaking of drainage systems for the three cities (pipelines, retention ponds or similar structures, gutters; drawings defining the network and characteristics of pipelines, as well as discharge points). Problems found.	Yes	—
Thematic maps (vegetation cover, land use, geology, infrastructures, slopes, etc).	—	Only on large scale
Data from weather observatories located in the areas of study and surrounding areas. It would be interesting to access to data from all the weather observatories existing in Viet Nam, if possible. Otherwise, to data from weather observatories located, at least, in a radius of 20 km of the studied areas.	Yes	Daily discharge and rainfall; monthly relative humidity, evaporation and wind
Historical data series of temperature, relative humidity and rainfall (at least, from weather observatories close to each one of the cities). Wind data series, when available, would be useful as well.	Yes	—
Evapotranspiration monthly data within the basins.	—	Data could be generated with a model.
Sample hyetographs of selected extreme rainfall events.	Yes	Hourly data
Discharge data series (including historical ones) of gauge stations along the rivers crossing the three cities.	Yes	Hourly data
Tidal data in Hue City.	—	Data only available from Da Nang
Meteorological record of historical events producing personal and material damages in the area, such as floods, droughts, heat waves and typhoons. Dates of these past extraordinary harmful events, adding possible press/photo coverage.	Yes	—
Specifically concerning data on historical floods: synoptic process trigerring floods, (rainfall) hyetographs, precipitation intensity data (intensity-duration-frequency curves or similar), flood hydrographs, delimitation of flooded areas, stocktaking (and evaluation) of impacts (damages) and human losses, if any.	—	Incomplete information
Geomorphology, solid transport, erosion and sedimentation studies.	—	N/A
Structural measures (embankments, bypasses, dykes, dams, etc) and non-structural measures (reforestation, urban zoning, early warning systems, etc) carried out and foreseen in order to reduce flood impacts (considering the whole river basins).	—	N/A
Stocktaking of infrastructures having influence on the hydraulic system performance (bridges, weirs, reservoirs, etc).	—	N/A
Hazard maps/risk maps of the cities.	Yes	Incomplete information
Earlier hydrologic and hydraulic studies and projects.	Yes	Incomplete information
Urban development and demographic evolution of the cities.	—	N/A

Source: Memorandum of Understanding (MoU) signed between the Government of Viet Nam (GoV) and the Asian Development Bank (ADB), within the framework of the Program.

Unfortunately, much of this data was unavailable—for instance, scarcity of hydro-meteorological data, amongst others. Nevertheless, significant efforts were made to overcome these difficulties and the assessment was undertaken using the most appropriate information available.

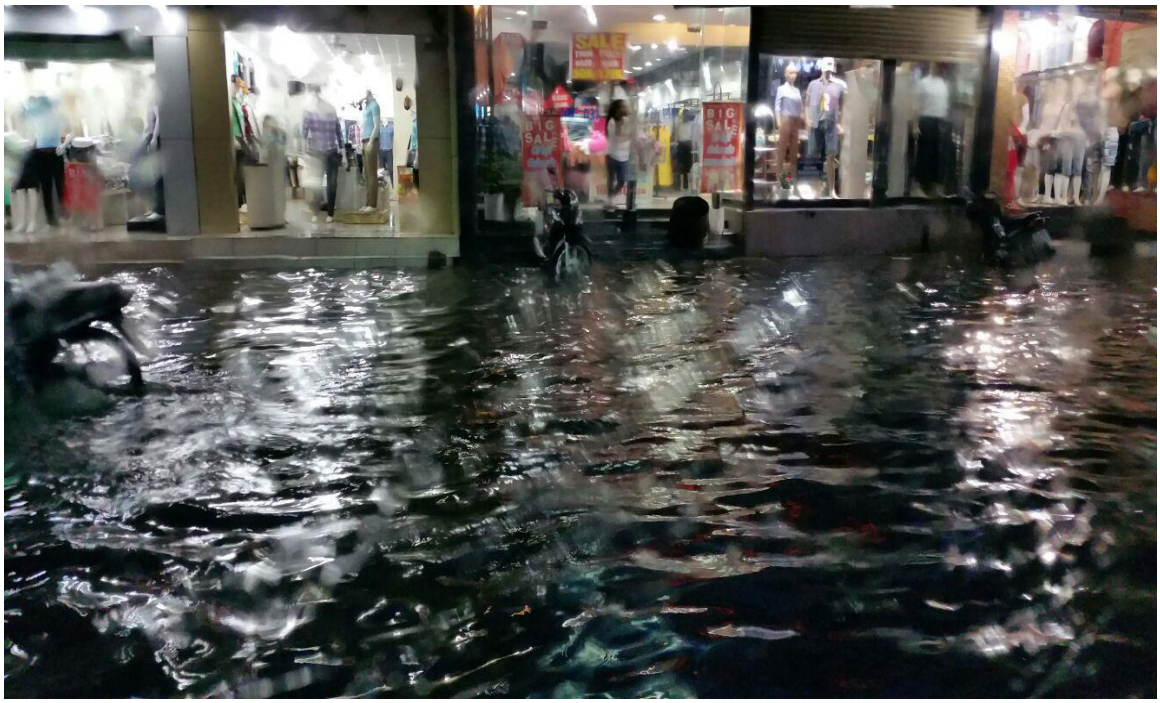
The methodology adopted was structured in three stages:

- **Situational awareness.** To understand how the water system—the river and the urban drainage network—work both on a hydrological scale—basin—and on a hydraulic scale—the city. This knowledge required the current situation, and the most likely future scenario taking into account climate change and urban development trends. It was crucial to access available information—data, studies, projects, records of historical events, etc.—on floods and hydraulic dysfunctions in the city

(**Figure 4-3**). Meetings were held with key stakeholders and local authorities to collect data and discuss technical issues, not only in the three cities but also in Hanoi. For reference, a list of people met and the agencies visited is included in **Appendix 1**. Furthermore, specific field visits were conducted in each of the three cities, with the support of local authorities. For completeness purposes, a summary text on these visits and a photographic report are contained in **Appendix 5.**

- **Diagnosis.** The information gathered in the field was processed and analysed, and a diagnosis was carried out adopting a multidisciplinary approach. Key technical aspects—including hydrology, hydraulics, climate change, historical floods and damages, structural and non-structural measures, and DSS—were taken into account. Several other aspects judged relevant were also considered, depending on available information and/or comments provided by key stakeholders and local authorities. This covered environmental integration and sustainability, coordination with and integration into the urban development and capacity building, among others.
- **Analysis of measures and considerations on DSS.** Based on the diagnosis, key aspects were analysed from a flood protection approach and included: relevant measures implemented, planned but not implemented yet, and those proposed by the local Department of Planning and Investment (DPI), ODA offices and/or included in each city's GCAP. Improvements and, where necessary, alternative measures were proposed. The overall strategy aims to achieve a reasonable balance between structural and non-structural measures. Best international practices were taken into account and special attention was paid to how Green Infrastructure (GI) and Low Impact Development (LID) techniques could be successfully incorporated into the existing and planned urban environment. This focussed on their role in improving the hydrological performance of urbanized catchments and, consequently, reducing water-related risks. Guidance for the DSS is given in each case. A DSS is a tool that supports and helps to optimise decision-making. As outlined in section 3.1.3, in flood management this ranges from relatively simple tools such as GIS-based, or not, thematic maps—for example, risk maps, and network schemes—to more complex ones, such as hydrological and/or hydraulic models of a basin, of a river stretch, of a drainage system, or even more sophisticated ones, such as basin-based early warning or operational systems.

Figure 4-3. Urban Flooding in Hue (picture taken on August 27th 2015)



Source: PPTA Consultants.

Figure 4-4. Field Visit Carried Out in Vinh Yen City, to Achieve Better Understanding of the Complex Hydrological/Hydraulic System, and Clarification of Technical Questions With Local Authorities and Key Stakeholders.

Source: PPTA Consultants.

The outputs from the analysis are an essential step that lays the foundation to: (i) properly design and build flood protection infrastructure and other urban assets—making them more resilient; (ii) allocate sufficient resources for their management; (iii) help identify overall infrastructure deficits in the city; and (iv) develop long-range plans to address these deficits. An additional objective can be achieved using DSS—to improve communication with the public on infrastructure spending. In fact, these are just some of the key benefits resulting from building an asset management culture (Jamer, 2015).

The most relevant outputs from applying the described methodology to each city are summarized in the following subsections, and additional material is included in **Appendix 5**.

Ha Giang Screening

From a flood management standpoint, the key features of Ha Giang Province are its trans-boundary nature —since it shares a 207 km border with the People's Republic of China (PRC)—and its location in the mountainous headwaters of the Lô-Gam River Basin, a left bank tributary of the transnational Red River. In particular, the Lô River's source is in the Chinese Yunnan Province, while almost two thirds of its length are in Viet Nam's Ha Giang Province.

Figure 4-5. Field Visit Carried Out in Ha Giang City: (A) the TA Specialists Acquire A Holistic View of the Hydrologic and Hydraulic Environment; (B) Local Dwellers Showing the Extent of Water Levels During the Last Flood Event, Occurred in 2014.

Source: PPTA Consultants.

The provincial capital, Ha Giang City is some 20 kms from the Chinese border, in the mountainous and forested sub-basin of the Lô River Basin—approximately 8,300 km^2, according to Le et al., 2010. Sediment transport processes are important, since more than 80% of the total annual rainfall—estimated on average to be 2,430 mm—falls with sufficient energy to produce soil detachment. The urban area has developed along several watercourses, in narrow and steep river valleys with forest-covered slopes prone to landslides and riverbank stability problems. The Lô River itself—since 2007 regulated upstream by the large dam of Malutang, in PRC—is the main waterway dividing the town. Most of urban development of Ha Giang City has been on its left bank; while the northern part of the city has developed along its main tributary, the Mien River. The latter river has recently been impacted by the construction of a system of five hydropower plants—four of which are operating. Other minor watercourses are the Me Stream, a right bank tributary of the Lô River, located in the southern part of city, and partly obstructed by a causeway-spillway—the Chang Spillway; the Nam Thau Stream, a left bank tributary of the Mien River, located in the eastern part of the city; and the Tien Stream, a small tributary of the Lô River, upstream of the Mien River and Lô River junction.

Major floods are historically associated with strong currents created by a particular combination of high rainfall and narrow and steep river valleys. Besides river overflows—because of flows and possibly water releases from the dams upstream, both in Viet Nam and in PRC—flooding is mainly caused by a limited urban drainage capacity to convey water generated in the surrounding hills as a result of heavy rains for 2-3 days. The inner city has a combined sewer system—storm water and wastewater, which is reported to be in reasonable good condition. However, rapid urbanization has resulted in streams being partly encroached by households and solid waste dumped into them, blocking drainage and forming stagnant polluted waters. There are some low spots within the urban area, which flood repeatedly. Economic losses in the two most recent floods were estimated at VND 5 billion in 2013, and VND 24.5 billion in 2014.

To address the problems of flood protection and drainage, the following initiatives have been implemented and/or are proposed:

- *Building a separate wastewater system* for the central area of the city—Phase 1: 2015—and the new urban areas—Phase 2: 2025, improving drainage in several wards, among others. Since various

financing sources have been tapped, the original package has been broken down into smaller subprojects. Some of these are currently funded by the Danish International Development Agency (DANIDA) focussing on the Nguyen Trai, Tran Phu and Minh Khai wards.

- *Embankments in several reaches of the Lô River network.* Embankment works in the Mien River, along the north side—from the River Tien confluence to Phung Hung Bridge—are completed, but the south side has not been improved. In the lower reach of the Me Stream—near the Chuang village bridge—a large concrete-based embankment is also under construction. Currently, more than 8 km of new embankments seem to be planned: a western embankment of the Lô River—from Goc Gao to new Me Bridge; embankments on both sides of Mien River—from the confluence of Tien Stream to Bridge 3/2; southern embankment of Me Stream—from old Me Bridge to Chang Spillway; and embankment of Nam Thau Stream, from Quyet Thang to the confluence of the Mien River.

Some of the above interventions have been proposed for funding under the Program. Those related to flood management and urban drainage are shown as **Table 4-6**.

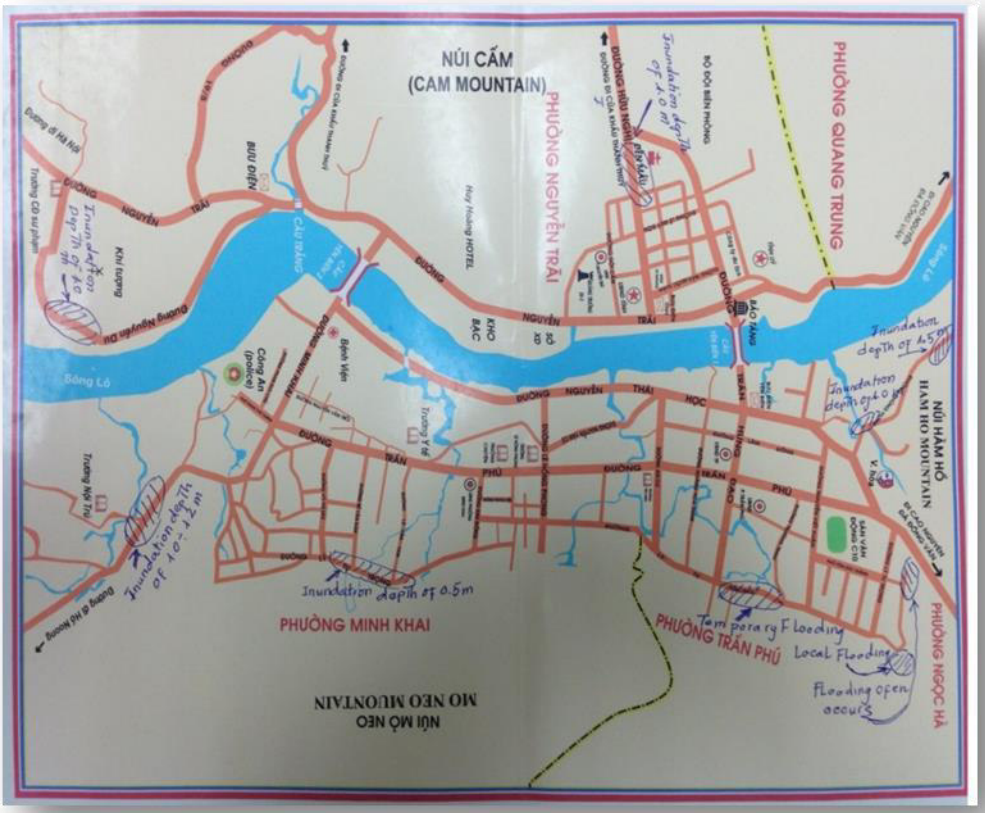
Table 4-6. Proposed Subprojects Which May Have Some Impact on Improving Flood Management and Urban Drainage in Ha Giang

Proposed Subproject	Key Topic
Drainage of Tran Phu and Nguyen Trai wards	Urban drainage
Drainage of Minh Khai ward	Urban drainage
Drainage of T1, T2, T3 and T4 for Quang Trung ward	Urban drainage
Western embankment of the Lô River—from Goc Gao to the new Me Bridge	Flood protection
Embankment on both sides of Mien River—from River Tien confluence to Bridge 3/2	Flood protection
Southern Embankment of Me Stream—from Old Me Bridge to Chang Spillway	Flood Protection

Source: PPTA Consultants.

On a river basin scale, flood management in Ha Giang is conditioned by upstream operation of PRC dams on the Lô River, while other planned, or already completed small hydropower plants in the Mien River, will also influence flood events. Improvement of the existing coordination mechanisms between Vietnamese and PRC authorities for data interchange and sharing is essential; in particular, those relating to hydrology and dam management—outflows from the PRC Malutang dam—in the upper Lô River Basin.

Figure 4-6. Map Showing the Location of Several Flooded Areas in Ha Giang City during the Event of September 2014, Prepared By Local Authorities. Flood Water Depths Were Estimated.



Source: PPTA Consultants.

Some comments and recommendations can be drawn from the assessment of these structural measures designed by local consultants. Actually, most of them have been included in the technical/engineering assessment (see **Volume 3**), where greener alternatives are proposed taking into account flood risk, climate change and environmental aspects.

- Calculations must take into account not only the Viet Namese technical standards for the design of dykes in non-coastal areas—TCVN-9901-2014, among others or the technical standards for design of urban drainage[57]—TCVN 7957:2008 Drainage and Sewerage - External Networks and Facilities, when required, but also the climate change impacts—mainly, through the rainfall and intensity increase according to the most likely future scenarios.
- Historical hydraulic data series in the area are available from the Ha Giang river gauge station: water level, 1960-1986, and 1994-2015; no data is available from 1987 to 1993, and discharge, 1960-1972. A Gumbel statistical distribution may be reasonably fit to the annual maximum water level data. These data seem to be quite uniform, and the Consultants understand that this is because of: (i) malfunction of the river gauge station—a study carried out by Dai Viet Consultant on Ha Giang river system embankments points out that, according to historical water level observations, Ha Giang station tends to underestimate water levels; and (ii) upstream regulation —PRC Malutang Dam[58] from 2005 to present, and Vietnamese small hydropower plants in the Mien River, from 2011 to present.

[57] In fact, during the field visit in Ha Giang City, some calculations and assessments on hydrology for dimensioning drainage networks using the Vietnamese Design Standard TCVN 7957:2008 were provided by local authorities.

[58] From 2007 to present, the Chinese Government has built a series of cascading reservoirs in the upper Lô River Basin, but more seem to be planned in the coming years; these facilities affect the flow regime downstream, especially during the rainy season.

Some care is advised when using these data in the detailed engineering designs, since there seems to be some inconsistencies.

- Hydraulic calculations for dimensioning urban drainage in Ha Giang city—which are drained by gravity—must take into account how high water levels in the rivers influence the hydraulic performance and effectiveness of the drainage system downstream.
- The future of the Chang causeway and spillway on the Me Stream should be reviewed. It is an obstacle, which enables flow to overtop the river course and flood settlements on the right bank. It would be advisable to consider relocating the spillway—used for diverting water for irrigation purposes—to an upstream location, outside the urban area. Since neither vehicle traffic nor pedestrians would use it, the spillway elevation could be lowered. Moreover, a diaphanous pedestrian bridge could be built where the spillway is currently located. This would prevent obstruction and flooding.
- Most of the proposed embankment designs use concrete. Alternative green solutions combined with rip-rap, using native trees and shrubs as well as earthen berms are feasible, if properly designed. The river is not an internal boundary within the city but a connecting part of it. Pathways or recreation areas could be developed along the watercourses. On the outskirts of town, environmentally and landscape friendly levees, including temporary floodwater storage and spreading areas—if necessary—could be considered.
- At the outlet of Quang Trung T3 drainage channel, there is a multi-storey building currently under construction, on the right bank of the Mien River. This building will be prone to flooding up to its third storey.

Additional non-structural measures—in particular, regarding DSS—should be implemented to improve environmental management and increase resilience to floods and other climate-induced phenomena. **Table 4-7** shows suggested measures, and includes practical recommendations to be considered.

Table 4-7. Non-Structural Measures to Improve Basin Management and Properly Address Flood Problesm Existing in Ha Giang

Tools		Comments and Suggestions
Decision Support Systems (DSS)	Data acquisition network	▪ A monitoring network for measuring flow discharges in the Ha Giang river sub-basin should be implemented, considering both river branches: the Mien River—having several small hydropower plants—and the Lô River just downstream the PRC border. In the latter case, a water level-measuring gauge should be sufficient.
	Hazard and risk maps	▪ Flood-prone areas—hazard mapping—must be identified depending on water levels, since it does is not feasible currently to calculate them with different return period peak discharges. A number of flood maps should be prepared for the range of water levels observed in historical events at 0.5m intervals. Each flood map should be associated with a related map of water velocities. The technology behind these maps, based on the use of GIS and 2D hydrodynamic models, is readily available. In terms of data for these maps, existing cartography is still deficient, and no detailed Digital Elevation Model (DEM) was available during the visit to the city. Hence, a new one could be built with data included in the CAD drawings used in the city. Using the mentioned information, a first computed version of flood maps will be approximate and will be updated in the future as cartographic information improves. Ha Giang could use these maps as a tool for disseminating flood alerts and take decisions aimed at minimizing damages. ▪ A desirable further step would be to prepare flood and landslide risk maps, combining hazard maps with vulnerable assets.
	Hydrological and hydraulic	▪ Implementation of a hydrological and hydraulic model for the Ha Giang river sub-basin —that is, considering both the Vietnamese and PRC

Tools		Comments and Suggestions
	models	territory. Although the model performance would be limited in case the PRC authorities do not provide rain and flow data, it would still be useful to estimate the hydrological response of the basin in natural flow regime conditions. Furthermore, the model would help in mid-long term to have a rough idea on the way the PRC dams are managed in dry and flood seasons.
	Reservoir management tools	▪ The operation and the releases of Malutang Dam, in PRC, conditions the flows Ha Giang receives. Only the reservoir managers can make decisions and alert downstream users of upcoming events. Problems are similar in the case of the Mien River, but here there are no big dams; some river regulation results from the operation of small hydropower plants.
	Short-term weather forecasts/early warning systems (EWS)	▪ Development of early warning procedures in case local meteorological events may not generate significant increases in main river water levels, but could induce flash floods in small streams and cause landslides.
Capacity building and public awareness		▪ Capacity building and institutional strengthening of local government staff in climate change and environmental risk management, as well as DSS tools. ▪ Actions aimed to increase public awareness and improve education on disaster risk management.
Other tools		▪ It is recommended that a Storm Water Management Master Plan—and a Waste Water Management Master Plan—be prepared to address the problem holistically, rather than adopting partial solutions. ▪ Because of the trans-boundary nature of the Lô River Basin, cooperation agreements between PRC and Viet Nam would be advisable to exchange and share data concerning hydrology and dam management—in particular, outflows from the PRC Malutang dam, preferably with the supervision of an independent international institution.

Source: PPTA Consultants.

Hue Screening

Thua Thien-Hue is recognised to be the most flood prone province in Viet Nam. Here, the main basin is that of the Perfume (Huong) River, some 2,830 km^2 in area, with mountainous headwaters, average rainfalls of 3,000-4,000 mm/year and a steep topography. The Perfume River drains to the Tam Giang coastal lagoon—a water body 60-70 km long, 2-8 km wide and with a surface area of 220,000 ha—and ends in the Bac Bo Gulf through the Thuan An Mouth estuary[59]. This eases the conveyance and accumulation of water throughout the plains, where drainage is limited because of the presence of the Tam Giang coastal lagoon.

The city of Hue, the economic, political and cultural centre of the province, and former capital of the country, is located in the lower part of the Perfume River Basin, on a flat plain, 10 km away from the coast, and amid a system of interconnected rivers, streams, canals and lakes. The main waterway is the Perfume River itself, which crosses the town before draining into the Tam Giang lagoon. Other river branches and perimeter canals within the city are:

- The Bach Yen River and the Lap River, river branches that connect the Perfume River with the three perimeter canals of the Citadel, the main asset of Hue[60].

[59] Nonetheless, a second outlet lies 40 km southeast.

[60] The city has been recognised by UNESCO as a world cultural heritage site.

- The three perimeter canals themselves—Ke Van River in the SW, An Hòa River in the NW, and the Dong Ba River in the NE—that, in turn, flow back from the Citadel to the Perfume River.
- The Nga Ha canal, crossing the Citadel.
- The An Cuu River and the Nhu Y River, located on the right side of the Perfume River, opposite the Citadel.

Furthermore, a complex system of inner lakes and ponds lies within the Citadel, some with water retention capacity in the event of a flood.

Because of its geographic location and topography, Hue suffers from storms, floods, salt-water intrusion and droughts. In the low flow season, long periods of hot weather may result in the Perfume River ceasing to flow. Disasters triggered by storms and floods, some three to five times a year, are by far the most destructive. There are several causes of flooding: high water from the river basins, sea level rise—sea surge, local accumulation of rain, or a combination of all. The determinants are: (i) the basin configuration, where three main rivers—Huu Trach River, Ta Trach River and Bô River—with mountainous headwaters and roughly the same basin size, converge on a flat plain—the perfect flood prone scenario; (ii) a complex drainage network of rivers, streams, and canals; and (iii) very heavy rains—monsoons and typhoons trigger rainy events of very high intensities. The Tam Giang lagoon is an aggravating factor, since in case of a flood, it acts as a reservoir that hampers the outflow. This can worsen when combined with a sea level rise.

Figure 4-7. The TA Specialists In Climate Change, Flood Protection And DSS During A Field Visit to Thuan An Beach, In The Coastal Bar, Where A Dune Breach Occurred During The Flood Event From 1st to 6th November 1999.

Source: PPTA Consultants.

The most severe flood event occurred from November 1st to 6th 1999, when there was a 978 mm rainfall in 24 hours, and a water level of 5.81 m was recorded at Kim Long gauging station[61], 2 km upstream of Hue City. In the last 40 years, at least four other recorded events also surpassed a water level of 4.50 m

[61] This station has been traditionally used as a flood warning system, based on three threshold water levels (1.0, 2.0 and 3.5 m): floods up to 3 m are considered small floods; above this water level, there are medium floods (3-4 m) and large floods (> 4m).

at this station. Moreover, most parts of the city are flooded once the water level reaches 3 m at Kim Long station. Flooding is more frequent in the southern parts of the city, although there are also some flood-prone areas in the north, particularly those surrounding the Citadel—Phu Cat, Phu Heep and Huong So.

Initiatives related to flood protection and drainage include:

- Regulation of the Perfume River Basin through construction of dams: upstream of Hue, there are three, one in each main sub-basin—Huu Trach River, Ta Trach River and Bô River. Downstream Hue, and just upstream of the Tam Giang lagoon, is an additional barrage—Thao Long—with 130 automated sluice gates to prevent saline intrusion. These gates are opened when floods occur.
- River erosion protection works were planned in several reaches of the riverbank, over a total length of 75.4 km (Hung & Le Dien, 2012). Some have already been completed and surveillance is carried out from time to time.
- National funds were allocated in 2009 for upgrading coastal dikes from Quang Ninh to Quang—Decision No. 1002/QD-TTg, in particular in Thua Thien-Hue Province.
- In 2011, under the sponsorship of JICA, Thua Thien-Hue Province developed an Integrated Flood Management Plan (IFMP) of the Perfume River Basin to 2020, including flood hazard maps, a GIS database and flood simulation models. The IFMP is currently being reviewed. Among the set of structural and non-structural measures proposed in the IFMP (**Table 4-8**), some are still to be implemented or remain outstanding because of funding constraints.

Table 4-8. Set of Structural and Non-Structural Measures Proposed in the Thua Thien-Hue Province's Integrated Flood Management Plan (IFMP)

Type	Proposed Measure
Structural measures	Strengthening organizational capacities of Committee for Flood and Storm Control (CFSC) at provincial, district and commune levels.
	Formulation and revision of disaster risk management plans.
	Enhancement of flood and storm warning and forecasting capacity.
	Public awareness raising.
	Forestation and protection of forests.
	Strengthening of information and communication systems.
	Housing construction guidelines and land use regulations.
	Enhancement of flood emergency response and recovery.
Non-structural measures	Raising local roads submerged in extreme floods.
	Repairing and upgrading flood mitigation works—dikes, culverts, pump stations, dredging, riverbanks, coastal erosion, etc.
	Construction of auxiliary facilities—shelters, rescue centers, etc.

Source: JICA (2011).

- The updated Hue City's Master Plan to 2030 and Vision to 2050—funded in 2013 by KOICA—considers the creation of green strips along the main rivers and within urban areas. With lengths ranging from 2-3 km and widths spanning from 0.5-1 km, these areas are meant to strengthen flood retention and prevention. Restrictions to large-scale residential developments in flood-prone areas were also considered.
- Simple existing flood warning systems—based on Kim Long gauging station—have migrated to more sophisticated ones in the last few years. Currently, DSS based on semi-distributed hydrological models, coupled with probabilistic numerical weather prediction models, are being used for flood forecasting in the most flood-prone river basins in Viet Nam, including the Perfume River Basin. The National Centre for Hydro-Meteorological Forecasting (NCHMF) increases the frequency of hydro-meteorological data collection—from six to three hours, or even hourly—in the event of a risk meteorological situation, and a detailed follow-up is carried out. Information is provided to

regional/local authorities, which for Thua Thien-Hue Province, is the Department of Agriculture and Rural Development (DARD)—in charge of risk management at the province level—and the Provincial and City Committee for Flood and Storm Control (CFSC).

- Additional capacity building actions oriented towards implementing Community-Based Disaster Risk Management (CBDRM), mainly funded by Japan International Cooperation Agency (JICA).

Other interventions at a city level addressing local problems have been proposed, including: (i) dredging and embankment improvement of some of the minor river branches and perimeter canals; (ii) rehabilitation of the Citadel's inner lakes; and (iii) drainage improvement in some wards inside the Citadel. Some of these addressing flood management and urban drainage problems have been proposed for the Program (**Table 4-9**), along with other measures not directly related, which could potentially be affected by them—for instance, road developments crossing watercourses, which may improve evacuation routes during a flood event.

Table 4-9. Proposed Subprojects Which May Have Some Impact on Improving Flood Management and Urban Drainage in Hue.

Proposed Subproject	Key Topic
Dredging and embankment of Ke Van River	Flood protection
Drainage and pavements of four inner city wards in the Citadel	Urban drainage
Dredging and embankment of six lakes in the Citadel	Flood protection/pollution control
Dredging and embankment of Lap River, Kim Long Ward	Flood protection
Eco-channel of the An Van Duong Development Area	Urban drainage
Dredging and embankment of An Hoa River	Flood protection
Improvement of the Citadel Canal (Moat)	Flood protection
Rehabilitation / embankment of Dong Ba River	Flood protection
Rehabilitation / embankment of An Cuu River	Flood protection
Rehabilitation / embankment of Nhu Y River	Flood protection

Source: PPTA Consultants.

Key recommendations stemming from the review are:

- Calculations must take into account not only the Vietnamese technical standards—for example, design of sea dykes, Decision 1613/QD-BNN-MOST, July 9, 2012; and TCVN-9901-2014, or TCVN 7957:2008 Drainage and Sewerage–External Networks and Facilities—as required, but also the impacts of climate change—mainly, rainfall and intensity increase and sea level rise.
- Dredging of river branches and perimeter canals will improve water quality and drainage, but will not improve flood protection significantly. The dredging and the consequent drop in bed elevations will not diminish velocities—or decrease water levels, but could be a negative stability factor for embankments or structures in contact with the river.
- As far as possible, embankments should avoid concrete, and be made of rip-rap, masonry or other alternative, environmentally friendly, river bank structures.
- The water table is close to ground level in Hue and the surrounding areas. Any rise may quickly affect the drainage system. Moreover, any green infrastructure aimed at retaining and/or infiltrating water must be carefully studied.
- Bridge designs must ensure sufficient freeboard above the flood water level, and it must ensure the protection of piles against erosion—general, local and transient.
- Proper attention must be given to canal and drainage maintenance.

- The consultants preparing detailed engineering designs must properly assess and take into account the maintenance requirements and costs required to operate the hydraulic infrastructures, and the flood control and management systems.

Figure 4-8. Hydrometeorological DSS Used in the Thua Thien-Hue Disaster Management Coordination Center (DMC), Inaugurated in November 2014 and Sponsored by the United States Pacific Command & United States Embassy.

Source: PPTA Consultants.

But, protecting Hue city from extraordinary events requires a more comprehensive set of solutions which should be properly analysed in a study, but is beyond the scope of this PPTA. This is because the Perfume River hydrological-hydraulic system—basin-rivers-canals-lagoon-sea—is highly complex (Tuan et al., 2006). An overall approach on a basin scale is necessary to address the flood problems in the city. Only through such a study can all factors and elements within the basin affecting the city be taken into account. Local solutions reducing flood risk in a specific area might sometimes trigger other problems downstream, when they do not assess the interrelationship with the rest of the basin. Measures implemented upstream can alleviate flooding impacts and effects downstream—for example, reforestation of the headwaters areas.

Massive and expensive structural measures could possibly solve the problem in the future—flood gates closing the lagoon openings and preserving water levels inland, together with flood retention at the upstream reservoirs; non-structural measures; and particularly an enhanced DSS based on flood hazard and risk maps, a real-time data acquisition network, short-term weather forecasting and reservoir management tools. These are a more realistic and affordable approach to help address the problem.

In particular, both reforestation and improvement of basin management must be undertaken, since they can help mitigate the effects of a flood event. *Reforestation* of the mountainous areas upstream of the reservoirs increases the rainfall retention capacity, whereas reforestation of the coastal strip with mangles will help protect it against coastal erosion, and the lagoon and the city against typhoons and storm surges. The *improvement of basin management*, requires the optimal operation of the three large-

scale reservoirs—Ta Trach, Binh Dien and Huong Dien—since they have a flood control volume of 530 Hm^3. This must be achieved combining experience and technological advancements. Providing the basin flood managers with a set of appropriate tools, is essential (**Table 4-10**).

Table 4-10. Non-Structural Measures To Improve Basin Management And Properly Address Flood Problems Existing in Hue.

Tools		Comments and Suggestions
Decision Support Systems (DSS)	Data acquisition network	▪ The network of hydrometeorological and gauge stations transmitting real time hydrologic data has to be optimised and completed—in particular, upstream of the reservoirs—and will become one of the pillars of an enhanced DSS because it will be the input to other advanced decision tools, notably a reservoir management system. The real time network will provide information to decision makers, which will be used to trigger alarms, and help officials declare warnings and take measures on evacuations or road closures ahead of time. The network must be *sustainable*, that is, designed and duly maintained to keep operating after floods and typhoons.
	Hazard and risk maps	▪ Improvement of hazard and risk maps with more complete and detailed information[62], considering likely climate change effects and different scenarios of reservoir management and flooding events. Reliable flood hazard maps are able to show which areas will inundate for any specific water level in the city. A number of flood maps should be constructed for the whole range of water levels observed in historical events at 0.5 m intervals. Each flood map should be associated with an associated map of water velocities. The technology behind these maps, based on the use of GIS and 2D hydrodynamic models, is readily available.
	Hydrological and hydraulic models	▪ Develop hydrological and hydraulic models enabling on-line monitoring of what happens in the basin, or to simulate, off-line, different scenarios.
	Short-term weather forecasts/early warning systems (EWS)	▪ The opportunity of raising alarms will improve with the advent of a short-term weather forecasting unit relying on the data transmitted by the weather authorities. If weather forecast bulletins were available on a regular basis, an advanced flood early warning system could be built by linking data into the hydrological simulation results on hydraulic infrastructure management. It will take time to achieve this, but first steps could be taken towards its overall design.
	Reservoir management tools	▪ Reservoir operation rules for all of the year apart from the flood season—which were already approved in 2014. Hydrology data—hydrographs—for different probabilities, together with dam-reservoir characteristics can be used to determine, through a conventional modelling study, the optimal dam operational rules which minimize dam releases and flow entering the flat area surrounding Hue. In practice, results can either be translated into graphs or built within a computer application. Where water levels and upstream discharges are available, the application could run on real time.
Capacity building		▪ Capacity building of the flood management staff at province, district and city levels, to improve expertise in hydrology and hydraulics, databases, software use, management and decision making. Sufficient equipment should be provided.

[62] Flood managers have already hazard and risk maps, which they use for decision-making and spatial planning.

Tools	Comments and Suggestions
Other tools	▪ Improvement of the communication system. ▪ Flood management staff need more equipment—computers, software, etc. ▪ Ensuring funds are released for maintenance of hydraulic infrastructure and management and control systems.

Source: PPTA Consultants.

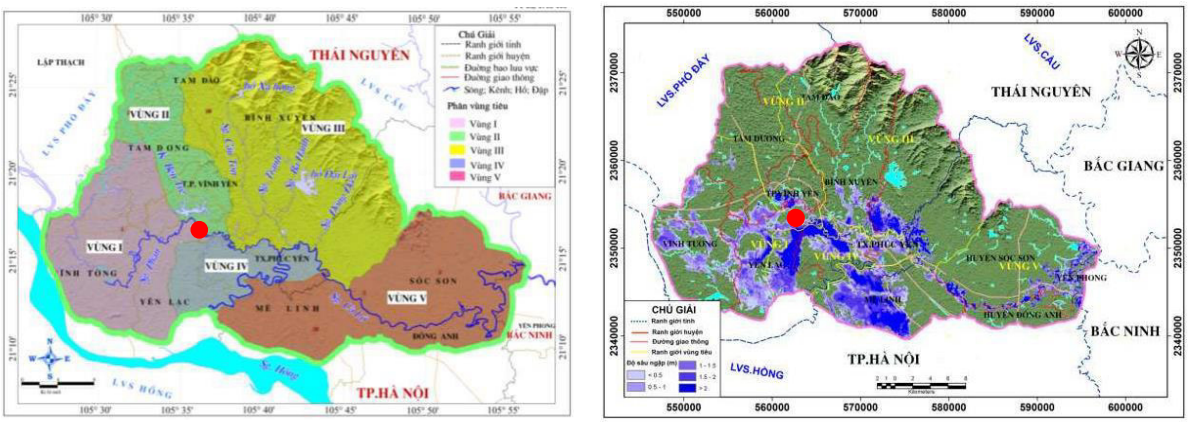
Some of the required tools probably exist, at least partially, but they need to be better organised and implemented. And the improvement of the basin management in Hue could be considered for a future loan (Porter, 2014). It is suggested that the preparation of the Terms of Reference for the improvement of the flood risk management in the Huong River Basin be one task of the overall capacity building component proposed for the implementation of the Program.

Vinh Yen Screening

Vinh Phuc Province is located in the industrial belt of the Northern Economic Region of Viet Nam. This water-rich zone, on the fertile alluvial soils of the Red River Delta, has a terrain gradually falling from the mountains in the northwest—Tam Dao—to the plains in the southwest and south. It has a total mean annual rainfall of 1,514 mm, almost 75% of which is during the rainy season, from May to September.

Vinh Yen City, the economic, political and cultural centre of Vinh Phuc province, is located on the transition between the mild-sloped terrain and the flat part of the province, with heights ranging from 10 to 50 m above mean sea level. Although two big rivers cross the province near Vinh Yen—the Red River and one of its main tributaries, the Lô River, the city is located in the Phan-Cà Lô River Basin—1,229 km^2, an independent and highly meandering system of small rivers which drain into the larger Cau River. The sub-basin affecting the city of Vinh Yen—number II in **Figure 4-9**—has an estimated area of 111 km^2. The city itself is embraced and bisected by several watercourses, canals and lakes: (i) The Phan River, which surrounds the city in the west and the south, and merges with the Cà Lô River, some 19 km downstream of Vinh Yen; (ii) The Cà Lô River river drains an area of 881 km^2, fed by streams in Tao Dao and Soc Don mountains, and flows 86 km to the east, until it reaches the Cau River; (iii) Cau Ton River, Trahn Dong River and Ba Hanh River, three watercourses draining from the Tam Dao Mountains, which are interconnected and flow through two branches, both to the Phan River and to the Cà Lô River; and (iv) Ben Tre Canal, a 12 km main irrigation channel draining to Dam Vac Lake, that is a large and non-stagnant water body located in the southern part of the city, with an area of 160 ha and a 14 km perimeter; it is also fed by the Khai Quang stream through the Khai Quang Lake.

Figure 4-9. The Phan-Cà Lô River Basin, where Vinh Yen (red dot) is located, is a complex hydrological and hydraulic system, highly prone to flooding (left); a simulation of a flooding event occurred in 2008 (right).



Source: Nguyet Minh (2014).

The configuration defines a complex and dense irrigation and drainage area. Dam Vac Lake, which faces pollution because of uncontrolled sewage discharges[63], is the main asset of the city. In the past it was partly used for irrigation, but now Vinh Phuc PPC is to take advantage of its ecological and landscape values, and are investing to exploit its tourism potential through several initiatives, a major urban development on the lake waterfront, among them.

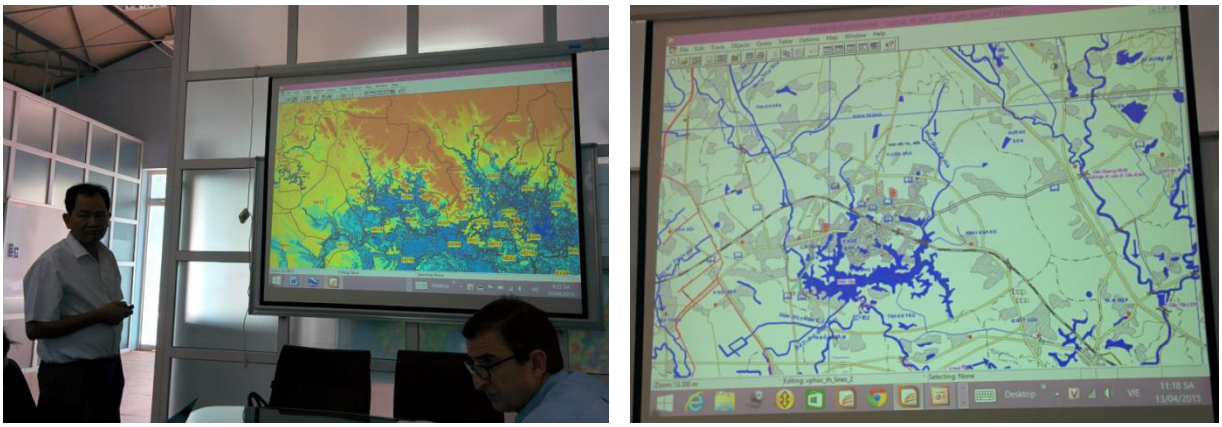
The combination of a flat topography and a dense hydraulic network entails downstream boundary conditions—the water level in the main rivers—affecting upstream river reaches, causing severe drainage problems, reverse flows and flooding. This poses serious challenges for flood management. Several areas, south and southeast of the city, are prone to flooding. According to local authorities, the normal water level of the Dam Vac Lake should be 7.5 m above mean sea level, and it overflows when it reaches 8.5-9 m, flooding some neighbouring areas. In the last 45 years, the lake's water level has exceeded 8.5 m. six times, and 9 m. four times. Data on historical floods and their impacts in Vinh Yen and the surrounding areas are relatively scarce, although the flood event of November 2008, when the whole Vinh Phuc Province and others in Central Viet Nam were affected, was an exception.

In the last few years, initiatives related to flood protection and drainage have been promoted; the most relevant ones are:

- The Dam Vac Lake originally had an area of some 400 ha. Today, because of anthropic pressures—landfilling, it has shrunk to 160 ha in the dry season, and 180 ha in the rainy season, taking into account flooded perimeter areas. Government wishes to preserve the surface water, while preventing the lake perimeter from being flooded. A levelled lake perimeter is under construction and will increase the water level overflow threshold, slightly reducing the frequency of flooding. The lake has a non-controlled outlet to the Phan River. But, this will be regulated in the future using a dike and a sluice gate that is currently under construction.
- In 1914, the French built a channel from the upper end of the Ben Tre Canal to the Phan River, upstream of Vinh Yen City, which enables the diversion and delay of water flows when necessary, since the distance to the city is much longer through the Phan River—more than 50 km—than through the Ben Tre Canal—12 km. When the Dam Vac Lake water level reaches 8 m or in the event of a flood, the diversion is activated.
- The Phan-Cà Lô Basin has a number of dikes from the Pho Day River and the Red River.
- The Plan for Red-Thai Binh Rivers flood prevention and control—approved by Decision No. 92/2007/QD-TTg, establishes design criteria—including flood flows and associated water levels—and proposes measures including dike strengthening and upgrading, flood diversion, dam operation or emergency response organization, amongst others. Vinh Phuc Province is one of the areas covered by this plan. Within this framework, the Viet Nam Institute of Irrigation (VII) drew up a flood prevention plan, 2008-2015, in 2010 for river dikes in the province.

[63] The city drainage comprises two separate networks (wastewater and stormwater). However, about 30% of the population is not connected to the sewage system, hence polluting the lake.

Figure 4-10. Examples of Decision Support Systems (DSS) Tools Used in Vinh Yen: Thematic Maps and GIS for Determining Flood-Prone Areas (Left); Schematic Model of Dam Vac Lake, local rivers and main hydraulic infrastructures (right).



Source: PPTA Consultants.

The Master Plan of Vinh Phuc Urban Area until 2030 and Vision to 2050 (Vinh Phuc PPC, 2011) includes several measures related to flood protection, including:

- Use of the Sau Vo Lakes, south of Vinh Yen, to retain water during rainy periods, helping to manage floods. From these lakes, water would be pumped to the Red River (see **Appendix 5**).
- Rehabilitation of Phan River, Cà Lô River, and a branch of Cà Lô River in the urban region.
- Separate sewers in all new urban developments.
- Implementation of green infrastructure and low impact development principles in the inter-urban space. This covers the temporary water storage in the Sau Vo Lakes, and the provison of green areas to reduce rainfall runoff, and for their leisure values.

More recently, the World Bank (WB) has supporting some initiatives to address basin-wide drainage problems. The WB-funded *Vinh Phuc Flood Risk and Water Management Project (P152460)* is focused, amongst others, on supporting structural measures for flood control and river rehabilitation, flooding and emergency response systems, and capacity building in integrated river basin management. In particular, Component flood risk management—will fund:

- The construction and rehabilitation of retention lakes to increase capacity, including the Sau Vo Lakes.
- The construction of three drainage pumping station groups to divert water from the Phan-Cà Lô River Basin in the western and southern surroundings of Vinh Yen to other basins, in:
  - Kim Xa (1 and 2), with capacity of 45 m^3/s each, and an outlet sluice gate to Pho Day River, in the west.
  - Ngu Kien (45 m^3/s), an outlet sluice gate, and 2 km of an outlet canal to Red River, in the south.
  - Nguyet Duc (75 m^3/s), a 7.5 km inlet canal connecting to Sau Vo Lake, an outlet sluice gate, and 2 km of an outlet canal to Red River, in the south.
- Dredging 18 km of the Phan River lower section to improve flow capacity.
- The construction of two flood control gates and related embankment works in Cáu Ham Rông—in the river branch connecting the Cau Ton River and the Trahn Dong River to the Phan River—and Cáu Sat—downstream the Phan River and Cà Lô River junction. These are meant to prevent reverse flows from affecting upstream Phan River and Vinh Yen City (see **Appendix 5**).

Furthermore, other measures are proposed by the local authorities for flood control and drainage focused on Vinh Yen city, which complement those funded by the WB. These include (**Table 4-11**) the dredging of 35 ha out of the total 160 ha, and landscape conservation of Dam Vac Lake. Two other subprojects concern environmental sanitation, and will help reduce pollutant loads currently being discharged into the Dam Vac Lake.

Table 4-11. Proposed Subprojects Which May Have Some Impact on Improving Flood Management and Urban Drainage in Vinh Yen

Proposed Subproject	Key Topic
Dredging and landscape protection of Dam Vac Lake	Flood protection
Wastewater collection and treatment in west Vinh Yen	Pollution control
Tertiary wastewater sewers	Pollution control

Source: PPTA Consultants.

On a basin scale, the future implementation of the proposed structural and non-structural measures will improve the overall basin flood management, hence reducing flooding and damages. On an urban scale, Vinh Yen flooding problems are unique since the Dam Vac Lake is the focal feature of the city. During floods, the city needs not only to maintain a reasonable level at the lake, but also reduce the flooded areas to a minimum. To achieve this double objective, the city relies on essential structural measures aimed at deverting flood waters, which would normally feed the city lake to the Phan River, through a gated canal. Several sluice gates also are in operation, which prevent back-flows from neighbouring streams, thus reducing the base water levels and improving the drainage of flood waters. But other needed structural measures are not in operation, and although there are plans to construct a dike, which would increase the operational level, and dredge the lake and the Phan River, no sluice gates are being designed for managing the water levels in the lake. The regulation of the Dam Vac Lake outlet would guarantee a 7.5 m fixed water level.

Key findings and practical recommendations are given below which should be taken into account during detailed engineering design:

- A levelled lake perimeter, which is under construction, will increase the water level overflow threshold, slightly reducing the lake overflow frequency. Thus, the lake operation leeway will depend on the difference between the existing water level and the levelled perimeter edge—outflow threshold, that is, from 7.5 m to 8.5-9 m—meaning roughly 1.6 to 2.4 Hm^3. In the event of a flood, this volume could be increased, lowering the lake water level in advance from the ordinary 7.5 m fixed value.
- Lake dredging alone is inefficient from a flood management standpoint. It is an environmental issue. Furthermore, dredging could affect the stability of dikes. Hence, the reinforcement of the embankment toes should be addressed.
- The lake management approach must consider the lake as a reservoir—volume in, discharge out and water level evolution. The Dam Vac lake outlet must be designed to enable management operations.
- The construction and completion of the city sewage system will improve water quality and reduce the presence of water hyacinths in Dam Vac lake.

In addition to above structural measures, other non-structural measures are required. In particular, enhanced DSS tools would positively help the authorities tackle the flooding problem and alleviate damages. These non-structural measures are outlined as **Table 4-12**.

Table 4-12. Non-Structural Measures yo Improve Basin Management and Properly Address Flood Problems Existing in Vinh Yen

Tools		Comments and Suggestions
Decision Support Systems (DSS)	Data acquisition network	▪ Even at the scale of the Phan-Cà Lô River Basin, Nguyet Minh (2014) points out that the existing hydro-meteorological network is insufficient for flood warning purposes, and restoration and construction of new gauging stations would be desirable, along with the allocation of appropriate funds to operate and maintain them.
	Hazard and risk maps	▪ Flood hazard maps have been produced by local authorities (see **Appendix 5**) based on water levels in Dam Vac lake. However, flood risk maps—considering in addition assets and their

Tools		Comments and Suggestions
		vulnerability—would be advisable, especially considering the proposed urban development surrounding the lake. Reliable flood hazard maps are able to show which areas will be flooded for any specific water level in the city. A number of flood maps should be constructed for the range of water levels observed in historical events at 0.5 m intervals. Each flood map should be associated with a corresponding one of water velocities. The technology behind these maps, based on the use of GIS is readily available. The preparation of these maps with existing cartography is dubious, since no detailed Digital Elevation Model (DEM) is available. The GIS layers used for managing the hydraulic system saved in MapInfo files can act as a first source of information. The layers allow the delineation of the extent of flooding by using the contour lines, since flow velocities are negligible in the city. This information can be taken as a first version of detailed flood hazard maps. The information lacks detail but coukld be refined as new cartographic data becomes available.
	Hydrological and hydraulic models	▪ Large-scale, hydrological and hydraulic, DSS have been implemented in the Red River Basin (Van Diep et al., 2007; Ranzi et al., 2012), and are used for flood forecasting and warning, but they do not appear to cover the Phan-Cà Lô River Basin in sufficient detail. Although some relatively detailed hydrological and hydraulic models have been implemented recently for this sub-basin (Nguyet Minh, 2014), further models are required.
	Short-term weather forecasts/early warning systems (EWS)	▪ Pedicting flood events will improve once a short term weather forecasting system based on real time data—from real time monitoring gauges or issued by weather authorities—is in operation. Under these circumstances, an advanced flood early warning system could be built by linking data into the hydrological simulations results needed for sluice gate system management. The development of such a system would be a long-term objective.
	Reservoir management tools	▪ The Dam Vac Lake acts as a natural reservoir. Its capacity equals the volume that can be stored in the natural terrain. The volume can be computed using flood hazard maps. Hydrological data—hydrographs in the river sources feeding the lake and the neighbouring streams—for different probabilities together with sluice gates or natural lake outlet characteristics can be used to foresee the effect of control on lake levels through a conventional reservoir model. Results can help decide when to divert upstream flows to the Phan River and how to operate the gates to control the release of water in the lake. Such a study should be undertaken as soon as a subproject on sluice gates is added. The hydrological data needed for this—precipitation and river discharge in upstream water sources—are not available. The hydrometric network should be extended to include the needed gauges as soon as possible.
Capacity building and public awareness		▪ To respond to the challenges posed by evolving environmental conditions and climate change, city and provincial departments must be strengthened and their capacity building needs addressed. This is crucial for ensuring an effective implementation of the GCAP. ▪ Furthermore, the involvement of local communities in disaster risk management should be encouraged through the adoption of the CBDRM model, which has proven successful in other

Tools	Comments and Suggestions
	Vietnamese cities.
Other tools	▪ It is recommended also to draft a Storm Water Management Master Plan—and a Waste Water Management Master Plan—to address the problem from a holistic approach, instead of adopting partial solutions.

Source: PPTA Consultants.

4.3.2 Subproject Technical Engineering Aspects

This section summarises the technical assessments of the subprojects while more details are contained in a separate volume, titled **Subproject Data Sheets (Volume 3).**

Ha Giang Subprojects

At initial evaluation, Ha Giang subprojects included three drainage projects, four embankment rehabilitation projects, five roads subprojects for rehabilitation, one major city redevelopment scheme, one bridge, solid waste landfill improvements and a water supply component. The final list was cut down to ten.

Drainage. Three subprojects are included to improve city drainage for wards of Tran Phu and Nguyen Trai; for areas T1, T2, T3 and T4 in Quang Trung Ward; and Minh Khai ward. A network of 14 streams flow from the surrounding mountains to Lo River and Mien River. They constitute a green link between the surrounding mountains and the Lo and the Mien Rivers. The streams are combined sewers collecting storm water and wastewater, and have been encroached by houses, resulting in reduced width and flow capacity, and increasing flood frequency. Solid waste is dumped in the stream. The Program subproject involves cleaning and rehabilitating the primary storm drainage system and providing open space for the community. An ongoing DANIDA-financed project involves the construction of a separate waste water collection and disposal system. It aims to collect and treat 80% of wastewater of the city, and is planned for completion in 2020. A new wastewater treatment plant (WWTP) will be built. The original subproject had a storm-water drainage component but this was dropped because of limited funds.

Embankment rehabilitation. This covers the western embankment of Lo River—from Goc Gao to new Me Bridge; embankment and roads for two sides of the Mien River—from Suoi Tien-Bridge 3/2; southern embankment of Me Stream—part from old Me bridge to Chang spillway; and the embankment of Nam Thau Stream—from Quyet Thang to Mien River. Embankment designs originally had a vertical or slope masonry and concrete construction. But a fully reinforced concrete embankment may not be necessary. Greener solutions were suggested for embankments on the inner meander—riprap protection, reinforced structural terraces with trees and vegetation—less concrete. The embankment slope, material and shape should be adapted to water velocity. Walls should include a natural finish. Masonry material should be used instead of concrete to allow for terraces and vegetation. Solid waste dumping should be discouraged through the provision of landscaped areas, linear paths or roads. The runoff drainage solution from roads and upstream should be improved to reduce landslide risks. And the embankment improvements should be integrated with the improved road subprojects, bridge, and the proposed green belt to protect the quality of the Lo River and connect green hubs. Three embankment projects have been prioritized—western embankment of Lo River, section of Goc Gao to new Me Bridge; embankment and roads on both sides of Mien River, section from Suoi Tien to Bridge 3/2; and the southern embankment of Me Stream, from old Me bridge to Chang spillway.

Roads. These subprojects included the upgrading and expansion of National Road No.2—from Km 286+300 to the new Me Bridge; southern ring road; Phung Hung road—from Tien Stream – bridge 3/2; road from Phong Quang bridge to the Ha Phuong water park; upgrading and expansion of Xuan Thuy road; upgrading of road from Quyet Thang to Son Ha; upgrading of La Van Cau Road; and a bridge—connecting National Road No.2 to the southern ring road. Improvements to National Road No. 2, the bridge and the southern ring road could be combined into one subproject, along with improvements to the south embankment of the Lo River, including the proposed linear park—green belt. This would provide the opportunity for greening, and improve access to a nearby bus station making an attractive entrance to the city in the south. The consultants suggested a review of road widths, with a view to downsizing,

improving landscaping, and introducing low impact development (LID) features into the design. The demand for the upgrading of Xuan Thuy and La Van Cau roads should be reassessed, and depending on the intended function, roadside pavements, lighting, and tree planting on either side may be considered. Upgrading of the city centre roads involves road resurfacing, pavement improvements, street lighting and landscaping of some 59 separate sub-components, covering 25kms of road. A comprehensive approach to upgrading is needed—roads, streetscape improvements, rationalisation of street furniture and some tree planting, drainage improvements with rain gardens and retention, and pavement widening only when required. Only three of these road subprojects have been included under the Program—upgrading of National Road No 2; southern ring road; and the River Lo bridge.

Solid waste management. This involves the expansion of the solid waste landfill site located in a scenic area on the south eastern edge of the city. One cell is closed and has been covered with topsoil and vegetation. There is no ground water monitoring. The existing operating cell is seven years old and half full, and has a polyethylene impermeable curtain that stops leachate infiltration. There is no monitoring of the membrane, and it is damaged. The area of the expanded landfill is planned to be five hectares—from its current two hectares—and one more cell will be added. Monitoring results of the nearby river downstream show that its water quality does not comply with environmental standards. The review of the subproject indicates that, as proposed, it needs to be revised considerably to ensure environmental sustainability. Nevertheless, this subproject has been included in the final list.

Water supply. The current system includes one water intake, two filtration plants, two deep wells, 22.7 km of primary pipes—100 to 300 mm diameter—and 103.3 km of secondary pipes—less than 100 mm diameter. The main filtration plant was built in 2004; capacity is 6,000 m3/day. A second filtration plant was built in 1998 with a capacity of 1,500 m3/day. Two wells are in operation at peak time and each supplies 620 m3/day to the network, but they should be decommissioned since there is no disinfection, and are too accessible to contamination. Total production capacity is 8,120 m3/day including the wells. Excluding unaccounted water, average consumption in 2014 was 95 liters per day. The mean production of the plants and wells was 8,583 m3/day compared to a maximum capacity of 8,120 m3/day for the two plants. A new plant is required and could be proposed under the Program. It should be designed to reach maximum capacity on the peak day of the year—presently 1.5 times the average or 8,917 m3/day. The life of the WTP should be designed for 20 years with a capacity of 12,000 m3/day. The subproject has been removed from the Program and will be proposed for funding from other sources.

Further descriptions of the proposed subprojects, and the recommended green elements for inclusion are shown as **Table 4-13**:

Table 4-13. Ha Giang Subproject Assessment Synthesis

Subproject	Description	Recommended Sustainability and Green Elements
Drainage for Tran Phu and Nguyen Trai Wards	Involves the cleaning and rehabilitation of the primary storm drainage system—streams—in the two wards. It will prevent encroachment, the disposal of refuse, and will increase flow capacity, thus eliminating flooding and reducing pollution.	These streams form a green link between the mountain and the Lo River. This an important green element of the Program enabling a green corridor to connect hubs, the mountain and rivers. All are naturally vegetated by trees on each side. An ongoing project financed by DANIDA is supporting the construction of a separate wastewater collection system. But because of limited funds, storm drainage component was dropped.
	This is a green subproject that should improve drainage and reduce flooding. It should be implemented as designed.	
Drainage for Minh Khai Ward	Involves cleaning and rehabilitating the primary storm drainage system to increase flow capacity, eliminate flooding and reduce pollution	In 2014, there was flooding to a height of 60 cm. The system constitutes a green link between the mountains and the Lo River which is naturally vegetated on each side. This an important element of the wastewater program and can become a green corridor connecting to hubs, mountains and rivers.

Subproject	Description	Recommended Sustainability and Green Elements
	This is a green subproject that should improve drainage and reduce flooding. It should be implemented as designed.	
Drainage of T1, T2, T3 and T4 within Quang Trung Ward	Involves cleaning and rehabilitating the primary storm drainage system in Quang Trung ward to help prevent encroachment and the dumping of garbage. It increases flow capacity of the narrow channels eliminates flooding and reduces pollution.	These drainage streams form a green link between the mountains and the Mien River which is naturally vegetated on each side. This is an important element of the program—a green corridor connecting to hubs, mountains and rivers.
	This is a green subproject that should improve drainage and reduce flooding. It should be implemented as designed.	
Western Embankment of Lo River.	Involves the improvement of the embankments along National Road No.2 along the River Lo's western bank for 950 m. The proposed embankments have a 1.5 to 2 slope and are proposed to be reinforced conventional concrete plates for the underwater part and two vegetated terraces for the top.	Greener solutions are suggested on inner meander—riprap protection and reinforced structural terraces with trees and vegetation. This should be part of a conservation corridor along the river.
	The subproject needs to be improved, by using less concrete; adapting the embankment slope, material and shape should to match water velocity; and by providing a more natural finish to the walls. It should be included but with the suggested green features added.	
Embankment and Roads on each side of Mien River	Covers improvements of 4.5 kms of embankment on each side of Mien river, from Phung Hung Bridge to bridge and the construction of the new Phung Hung road	The embankment associated with this road is a green belt and could be a linear park at the entrance to the city.
	The embankment improvements should be integrated with the nearby improved road, bridge, and green belt to ensure river quality and connect green hubs on both sides. The final design should consider soil conditions, water velocity, and material resistance. The subproject should be included under the Program.	
Southern Embankment of Me Stream	Embankment works along the eastern edge of Me River are proposed from the old Me Bridge to the River Lo confluence to meet the western embankment works of the above subproject—1.61kms. The scheme should involve a linear park/landscape, pedestrian route along the embankment that incorporates existing trees in the northern section.	This project should enable the preservation of a green corridor along the river.
	This landscape pedestrian route/linear park should integrate existing trees, and add some others where needed, lighting and seating—with occasional shelters—along a corridor width of 5-10m The emphasis would be on design for a natural environment. The subproject should be implemented, but with improvement that incorporate the linear park.	
Improvement of Existing Landfill	The existing landfill area is planned to be increased from its current two hectares to five hectares. One more cell (2 ha) will be added. When full the existing cell will be covered with topsoil and planted with trees to match the surrounding natural forested environment. The existing leachate treatment plant would be upgraded with biological—aerated—treatment. A new service shed and building will also be built.	The existing site does not include leachate collection and efficiency treatment. The monitoring results in the downstream river show that the treatment is partly efficient but does not comply with environmental standards yet, the stream is polluted as domestic wastewater—Coliforms 17 900mg/l, COD 363mg/l, BOD5 190mg/l, source: DONRE Runoff water from surrounding hills goes to a conventional drainage system around the operating cell and discharges downstream. No monitoring of water quality is undertaken.

Subproject	Description	Recommended Sustainability and Green Elements
	The landfill is located in a scenic area on the south eastern edge of the city. The subproject needs improvement and better monitoring; but is recommended for implementation subject to additional features to reduce potential adverse environmental impacts.	
Upgrading of National Road No.2.	This includes 1.23 kms of dual carriageway road within a 25m corridor. Includes two 7.5m carriageways, separated by a 2m planted median strip and 4.5m pavement area on either side.	The road should include low impact development drainage—bioretention swales, vegetation and trees. This road is the main entrance to the city, and should incorporate green features and become a welcoming entrance to the city
	The subproject should be implemented but with improvements—more green.	
Southern Ring Road	This is proposed as a by-pass road on the south eastern side of the city and will be built from the River Lo Bridge, and National Highway No 2 to the southern edge of the city centre. The total length of proposed section is 2.936 km	The design should be revised to include low impact development, drainage—bios wales—and vegetation, trees. For better safety, clear marking of a cycling lane on carriageway should be included.
	The proposed new ring road should be included in the Program.	
Bridge from National Road Number 2 to the Southern Ring Road.	The bridge would be the third crossing of the River Lo in Ha Giang. It will have a width of 18m and a length of 150m and would connect National Highway No.2 with the new Southern Ring Road	Pedestrians and bicycles should be included, in the designs of the carriage way. The bridge links the two banks of the river.
	The bridge should include pedestrian and bicycle lanes, and enlarged to accommodate them. The separation of lanes should be marked and enforced—pedestrians, bicycle, motorbikes, and cars-trucks-buses. The subproject should be included but with improvement.	

Source: PPTA Consultants

Hue Subprojects

The initial evaluation Hue subprojects included dredging and embankment improvements—Ke Van river and Xa Tac lake, a drainage component in four wards of the Citadel, nine road subprojects, bus and truck stations, and solid waste management improvements. The two dredging subprojects were justified by the need to remove sludge from the Ke Van River and Xa Tac Lake. But in both cases, the proposed embankment design required improvement to include more green features. The drainage proposals for the Citadel area should involve interlinked channels with a connection to a storm water gravity pumping station. Surface retention measures should help to drain the streets during strong rains. The subproject should include the rehabilitation of the roads, but expansion of the width of streets should be minimised.

All the road designs were over dimensioned, and required a more through technical assessment and justification through appropriate traffic studies and modelling. Rehabilitation of the roads in the commercial and tourist areas, should consider measures for pedestrians, and limits should be placed on their widening. The bus and truck stations require appropriate demand studies, including traffic projections and an assessment of public transport needs to better size the facilities. The proposed solid waste management subproject satisfied the criteria for green city investments and is supportive of the Program objectives.

After the first assessment, in July, Hue PMU prepared a new list of projects. They dropped 11 subprojects and submitted a list of 12 new ones. These were submitted to a new assessment, and the introduction of green features was promoted, although it is still an issue in design. A description of the proposed subprojects identified in the final list, and the recommended green elements for inclusion are shown as **Table 4-14**.

Table 4-14. Hue Subproject Assessment Synthesis

Subproject	Description	Recommended Sustainability and Green Elements
Dredging and Embankment of Ke Van River	This subproject aims to improve Ke Van River hydraulics and environment. Ke Van River is a manmade canal, and derives its water from the Huong River. The subproject has two components—dredging the canal, which will improve flow and environment quality of the Huong River; and strengthening the embankment on the east side of the river to reduce erosion from stormwater.	Greener solutions were proposed. Typical cross-section with various green features was recommended to satisfy green cities environmental objectives.
	The subproject should be included under the Program with improvements and the inclusion of a continuous green corridor along the river.	
Drainage and Pavement in Four Inner City Wards of Citadel	Involves upgrading and rehabilitating primary drainage systems to improve flood drainage capacity, and increase water conveyance. Rehabilitation of streets to improve traffic flow in the citadel and improving the landscape and lighting.	Low impact development features were introduces in the design. A close network with a central pumping station is added to the subproject to control flood occurrence.
	The subproject is recommended, with improved design as agreed with PMU; it should also retain the narrow streets to reduce vehicular traffic flow.	
Dredging and embankment of Lakes in Citadel	The subproject will improve the condition of the lakes; it has three components—lake dredging, lake embankment and drainage improvements.	Green objectives are to restore the lakes, intercept wastewater, prevent erosion by constructing embankments and improve landscaping.
	The subproject should be included, but with an improved design. The original subproject proposal has been improved and includes a one-meter wide path around all lakes for access and maintenance. However, the paths are not considered as a linear greenbelt since no landscaping or lighting has been included. This should be rectified.	
Water Supply System to Phu Son Solid Waste Management Facility and Villages	Involves providing water supply to a proposed solid waste recycling plant that will be built on a 40 ha site in Huong Binh commune, and the nearby villages.	This subproject will support recycling of solid waste, and will bring water to surrounding villages.
	This project should be implemented as designed, but could be included in ADB's water supply investments with the Hue WACO.	
Dredging and Embankment of Lap river , Kim Long Ward	Aims to improve Lap River hydraulics and environment. It has two components—dredging the river to improve flow from the Huong River and its environment quality; and strengthening the embankments on both sides of the river.	It will improve the green corridor along the river. A greenbelt has been added to the original design, and shoreline landscaping has been included to improve the embankment
	The subproject should be included under the Program, with the improved design as presented by PMU and summarised above.	
Eco-Channel at the An Van Duong Development Area	Involves the construction of a green area in An Van Duong. This proposed canal would link the An Cuu River in the south to a tributary of the Nhu Y River in the north. It would run, in a dog-leg alignment for 1.7kms, through the southeaster part	The subproject provides an opportunity to demonstrate green infrastructure and low impact development features.

Subproject	Description	Recommended Sustainability and Green Elements
	of the planned An Van Duong Development Area.	
	The linear park landscaping design is not well developed, and a landscape architect should be involved in the final design to introduce greener features and infrastructure. The project should be implemented with an improved landscape design.	
Dredging and Embankment of An Hoa River	The subproject has three components—dredging the river to improve flow from the Huong River and its environment quality; strengthening the embankment on both sides of the river to reduce erosion from storm water; and the construction of boardwalk—3 meters wide.	The subproject aims to improve An Hoa River hydraulics and environment. A green corridor should be included and green infrastructure features should be added.
	This project should be included but with an improved design.	
Improvement of the Citadel Canal/Moat	The subproject has two components—dredging the canal up to 2 meters deep for 8.5 km; and repairing the embankment of both sides of the canal to reduce erosion from storm water.	It aims to improve the environment of the moat around the citadel. It can be seen as an eco belt around the citadel that should be preserved
	This project should be included as designed	
Park, Paths, Drainage, and Lighting in An Van Duong Development Area	Involves landscaping along roads in new developments of An Van Duong. Two major roads have been built, but only the carriageways have been constructed. Involves integrating the sidewalks, traffic signs, landscaping, drainage, lighting, parking, and developing a linear park within the median of the existing road sections	Provides a good opportunity to introduce low impact development features. The revised basic design has integrated some green features, including bioretention swales for stormwater drainage. They have also integrated LED lighting.
	The subproject is recommended only with an improved design. The landscaping design is in a conceptual design phase and road traffic safety and safety of park users should be considered at final design stage.	
Park and Square in Administration Area, An Van Duong	The construction of a public square in the new An Van Duong Development Area. The development has an area of 17.23 ha and is located in the A zone of the area. It is the green component of the scheme.	Provides an excellent opportunity to demonstrate green infrastructure features and low impact development. However this needs to be incorporated into the design.
	The conceptual design shows large surface area of roads, official buildings and uniform landscaping of straight rows of trees. No green features or techniques have been demonstrated in the subproject documents. The subproject requires a revised conceptual design before it can be included in the Program.	
Rehabilitation/ Embankment of Dong Ba River	This involves improving Dong Ba River with new landscaping, since the embankment has been built on both sides. It has two components—construction of boardwalk along the embankment, about 3 meters wide, and 640m length; upgrading of lateral roads along the embankment, and the construction of a drainage system.	The scheme should include a green corridor along the river with low impact development components.
	This subproject should be included only after a new design has been prepared incorporating low impact development features.	

Subproject	Description	Recommended Sustainability and Green Elements
Rehabilitation/Embankment of An Cuu River	Involves embankment works along part of the northern bank of An Cuu River in the Cung An Dinh area, between An Cuu Bridge and Nhu Y tributary. The repair work to existing walls would apply to 119m of the north bank with a further 457m of new embankment strengthening works. The retaining walls would be in stone with a low parapet. The subproject also includes landscaping of two linear parks—200m in length and up to 25m wide,	This subproject aims to improve the environment of the An Cuu River. A boardwalk with vegetation would improve the quality of design and become a green corridor.
	This subproject should be included only after a new design has been prepared incorporating low impact development features.	
Rehabilitation/Embankment of Nhu Y River	Involves structuring the embankment of the east side of the river to reduce erosion from storm water. The objective is to complete the rehabilitation of the embankment of river.	This sub-project aims to improve Nhu Y River hydraulics and environment. A new green corridor along the river would improve the embankment
	The embankment design has been slightly modified to include a lighter slope and vegetation. No green drainage has been integrated and the boardwalk is narrow and pretty nude. Additional vegetation, landscaping and seating would be more welcoming for pedestrians. The subproject can be included, but with an improved design.	
Section of Central Road in An Van Duong Development Area including Bridge	The subproject involves constructing a road to connect two parts of the city. Part of this 100m-wide road was built in 2014—one section in Master plan Area A and one in Master plan Area B.	The design needs to introduce a conservation corridor, and low impact development.
	Redesigning the landscape and footpath along the central of median should be considered. Pedestrian crossings need to be carefully designed. The road dimensions, speed limit and access should be designed according to standards of an urban road. No proper justification is given for the current highway design. This subproject needs redesigning to be included in the Program.	
Bui Thi Xuan Road	Involves increasing the width of an existing rural road from 3.5 meters to 10.5 meters, and building a small bridge—25 meters long. The road will connect Huyen Tran Cong Chua Street to Luong Quan Street—2,994 m.	This area has many historic monuments, and the road will improve access to them and traditional garden houses protected by the provincial government. Landscaping will include trees and lighting. The road cross section has been reduced from 19.5m to 13.5m by reducing the driveway from 10.5m to 7.5m and the sidewalk from 4.5m to 3.0m. Some bio-swale drainage has also been added. A secured bicycle path has also been added on one side.
	The subproject should be included as per the improved design.	
Huyen Tarn Chua Cong Road	The subproject is to connect Bui Thi Xuan Street to Vong Canh Hill—4.17kms—by upgrading an existing road. This would improve the link between Bui Thi Xuan Street and Vong Canh Hill. Road widening increases width from about 3.5m to two carriageways of 5m each plus pavements of 3m on either side—total	This road will improve access to two important monuments located at Lang Tu Duc temple. The objective is to develop tourism, accessing garden houses, and connecting to the south to National Highway No.49A. The existing greenways should be preserved

Subproject	Description	Recommended Sustainability and Green Elements
	corridor of 16m.	
	The subproject should be included according to the improved design.	
Vy Da Bridge and Access Road	Upgrading Vy Da Bridge and its approaches on Pham Van Dong street. The bridge across the Nhu Y River will be reconstructed, and there will be improvements and widening of the approach road—Nguyen Sinh Cung Street--on the north side up to an existing major junctionwith Nguyen Phan Chanh	The subproject incorporates a renovated park constructed halfway between Pham Van Dong and Nguyen Phan Chanh. The approaches to the bridge should include low impact development features. Pedestrian crossings should be considered when combining with traffic lights at intersections
	This subproject should be included according to its improved design.	

Source: PPTA Consultants

Vinh Yen Subprojects

The initial evaluation of the subprojects of Vinh Yen included Dam Vac Lake and park improvements, sanitation improvement, road developments, institutional strengthening, and an industrial logistics center. From the original list of 18 infrastructure subprojects, seven were selected for inclusion in the Program.

The *Dam Vac lake improvements* involve dredging, construction of an embankment on one side and along the river discharge—Pham River—and the development of a park adjacent to lake. Although the subproject is generally acceptable, it has been modified to improve its green features.

The *sanitation* component covers two subprojects—the completion of secondary and tertiary wastewater sewers in four wards currently connected to a new wastewater treatment plant; and the construction a wastewater collection network in three wards with connections to a new wastewater treatment plant to be built under the subproject. All combined storm water and wastewater systems flow to Dam Vac Lake. Proper collection of wastewater and its treatment it is essential to maintain water quality in Dam Vac Lake—the main green hub of the city.

The *road development* subproject involves a new road around the proposed university village. It has been downsized from its original design and green features, incorporated, such as bioretention swales. The road subproject included is now just one lane of the arterial road.

A description of the proposed subprojects, and the recommended green elements for inclusion are shown as **Table 4-15**.

Table 4-15. Vinh Yen Subproject Assessment Synthesis

Subproject	Description	Recommended Sustainability and Green Elements
Dredging and Landscaping Protection of Dam Vac Lake	This includes dredging the lake—removing 50cm of sediments, and dredging a deeper portion along its center line to make a canal towards the lake outlet to Phan river. Phan River will be dredged and two new embankments will be built from the lake outfall along the National Highway #2. The subproject also includes dredging and embankment works of a western branch of Phan River.	This green infrastructure investment—for the main green hub—is designed to improve flood control, and improve surface water quality. The lake is used to promote tourism development and recreation activities. It is a major environmental area of the city.
	Dam Vac lake is the heart and the main green hub of Vinh Yen City. It should go ahead but with an improved design.	
Collection and Wastewater	The city's drainage, wastewater collection and treatment system subproject,	The proposed plant will treat wastewater from the three wards, and discharge into the Phan

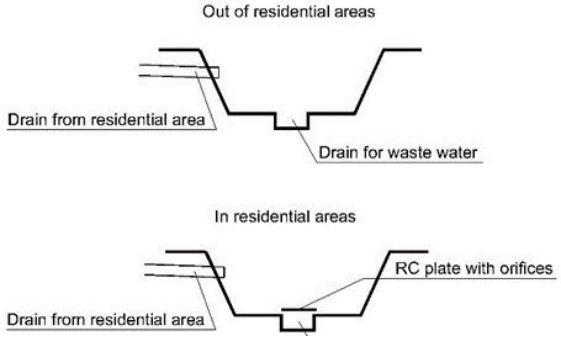
Subproject	Description	Recommended Sustainability and Green Elements
Treatment in West Vinh Yen	includes three components which are included in the Program: • Component 1: Wastewater collection in three wards—Dong Tam, Hoi Hop, and Tich Son—with nine pumping stations and one pressure pipe to the Wastewater Treatment Plant. • Component 2: Secondary and Tertiary collection sewers • Component 3: Wastewater treatment plant	River—1,500 m from the wastewater treatment plant. Treatment will be environmentally sustainable—a combined system including an aerated lagoon has been proposed and accepted. The subproject will improve water quality of Dam Vac Lake by intercepting wastewater for treatment downstream.
	This subproject should be included according to an improved design with a combined treatment system.	
Tertiary Wastewater Sewers	Involves the construction of the tertiary sewer network, some secondary pipes, and household connections in four wards—Dong Da, Ngo Quyen, Khai Quang, and Lien Bao. Proposed for funding under a JICA subproject, but was cancelled because of a lack of funds.	A crucial investment to improve lake and river quality. Dam Vac Lake is the main green hub of the city.
	This subproject should be included as designed	
Green Park Development near Dam Vac Lake	Involves the construction of a green area in Zone B—44.12 ha—located in the south, close to Dam Vac lake. It will be the first public park of the city.	The subproject is a green hub and requires a strong theme, including its wetland features—two wetlands are proposed in the park.
	This subproject should be included according to the improved design as presented by local consultant, and the recommendations of the urban designer's concept sketch.	
Infrastructure for University Area	This is an arterial road of the new University area proposed in north of the city. It will be 5.498km length, total width 50m, including storm ditches, sidewalks, median, and lighting. Investment will be into two phases: Phase 1 will construct one lane, width 25m and is included in the Program; Phase 2 will complete the second lane—cross section 50m but is not included in the Program.	This is a green element connecting two hubs—the lake and forest. The road should be designed with bioretention swales to drain storm water. In should include a greenway along its length.
	Phase 1 of the scheme should be included, as per the improved design	
Exhibition/Linkage Center for Business Support	An exhibition center for supporting industrial production with total area of 1.5 ha. It is proposed to be located in Huong Canh Town of Binh Xuyen District, and will showcase goods services available locally. It is also a business incubator for green technology industries.	The subproject is proposed to link industrial activities in the green city program, and should feature green infrastructure components.
	The design of this complex requires revision to include far more green features.	

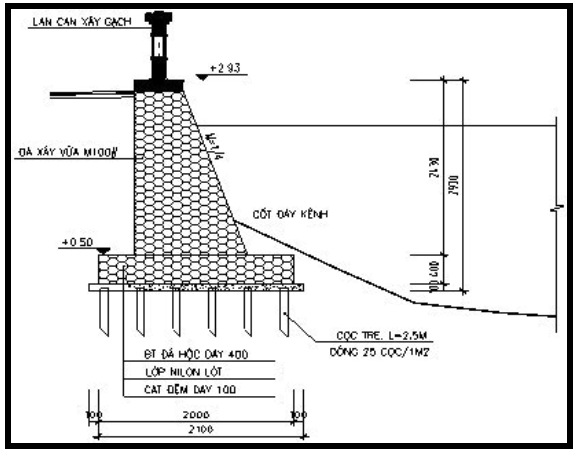
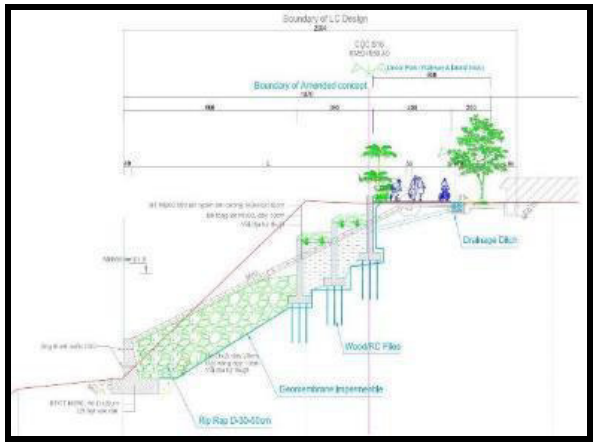
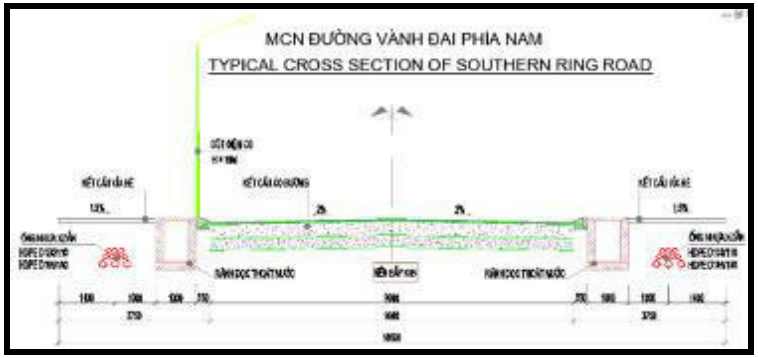
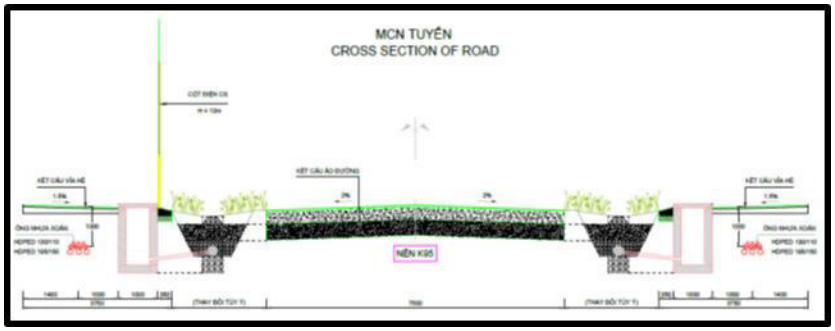
Source: PPTA Consultants

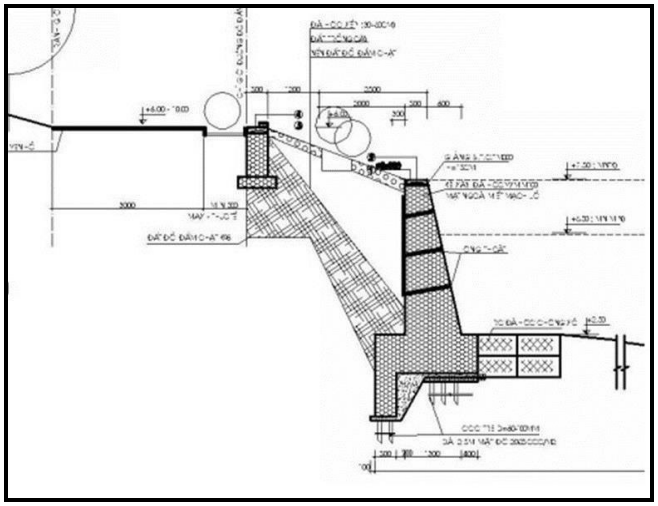
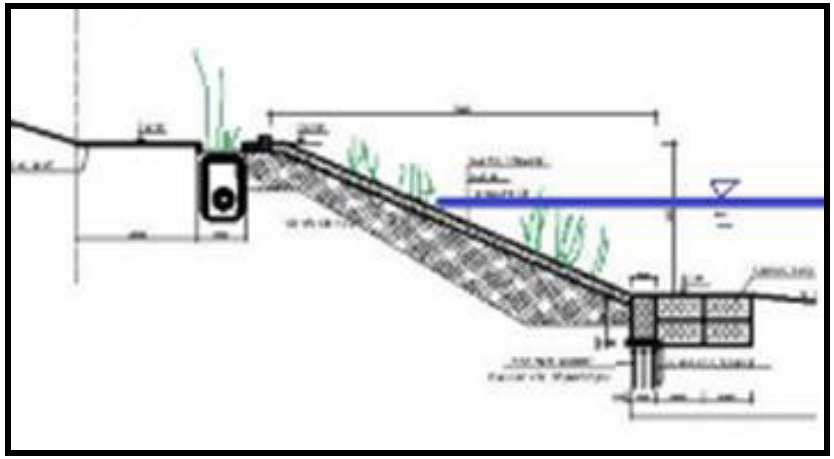
Recommended Design Improvements to Incoporate Green Infrastructure Features

As shown in **Tables 4-13, 4-14** and **4-15** the consultants have made a number of recommendations on improving specific designs to make them more in conformity with green infrastructere principles for each city. Selected recommended designs are shown as **Figure 4-11**.

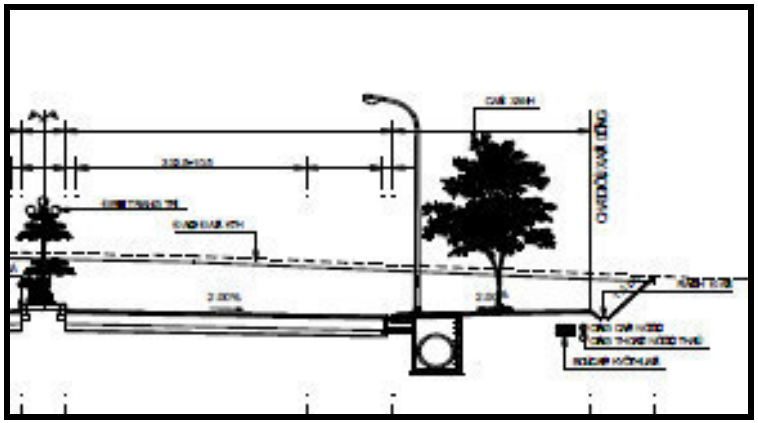
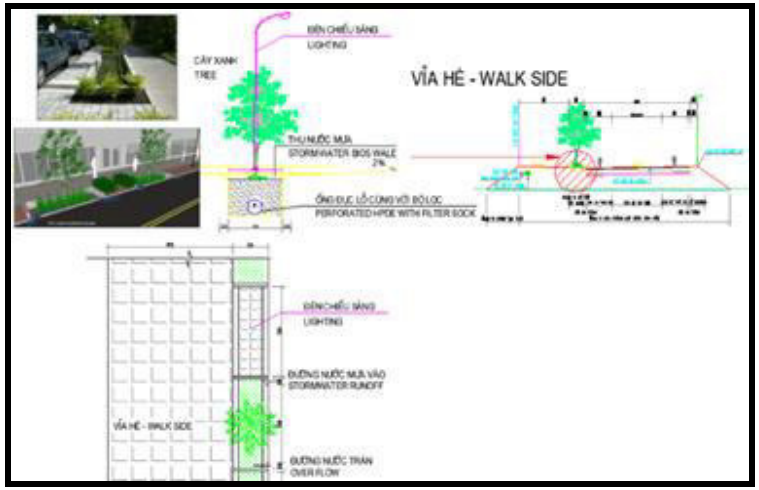
Figure 4-11. Sample designs towards green infrastructure features

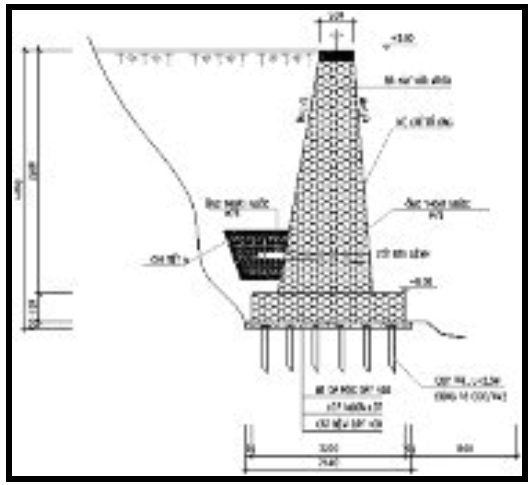
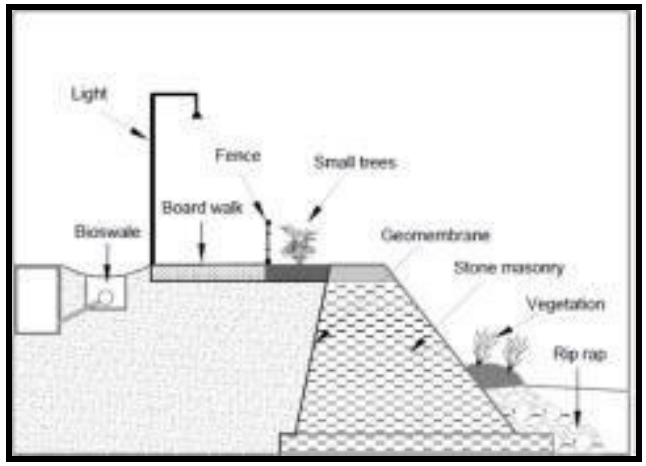
From Original Design or Situation →	To Green Infrastructure Features
Ha Giang	
Drainage	
	 It will also include the green corridors along the ditches.

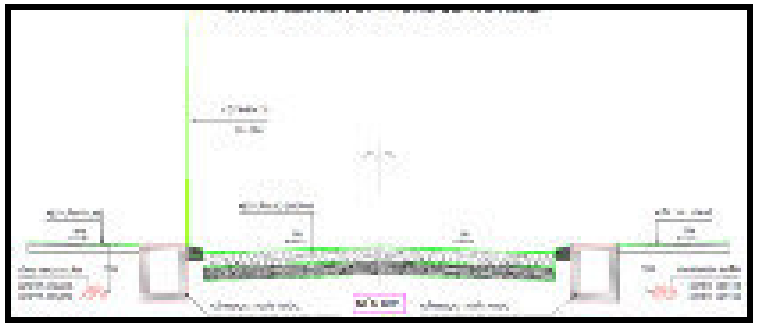
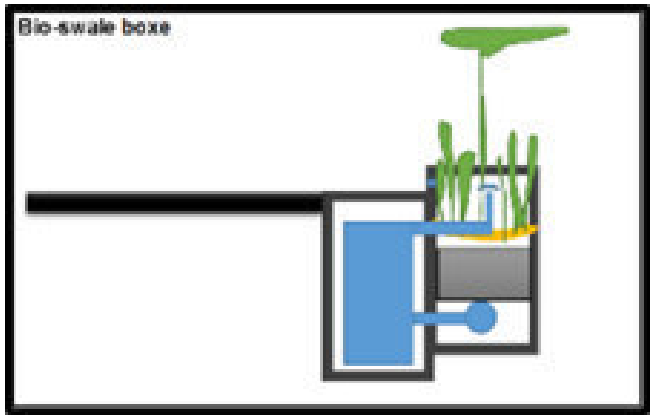
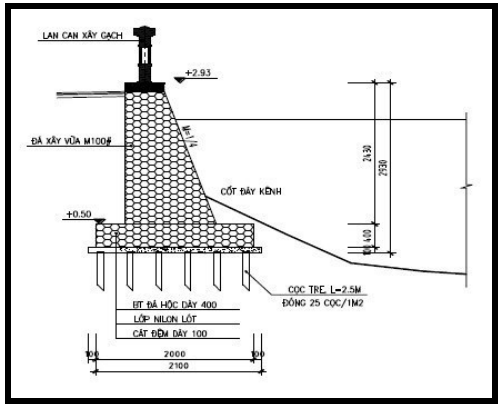
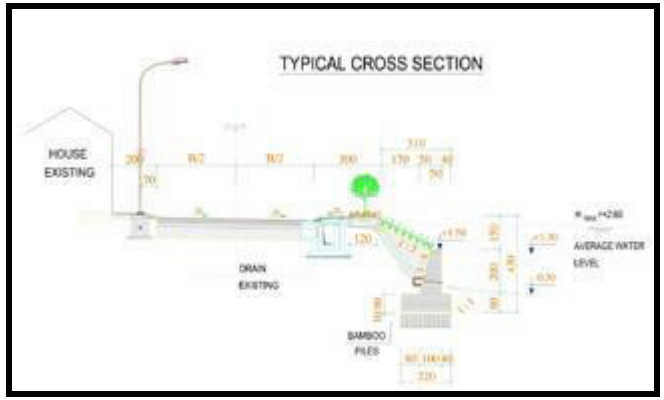
From Original Design or Situation	To Green Infrastructure Features
River Embankment	
	
Road	
	

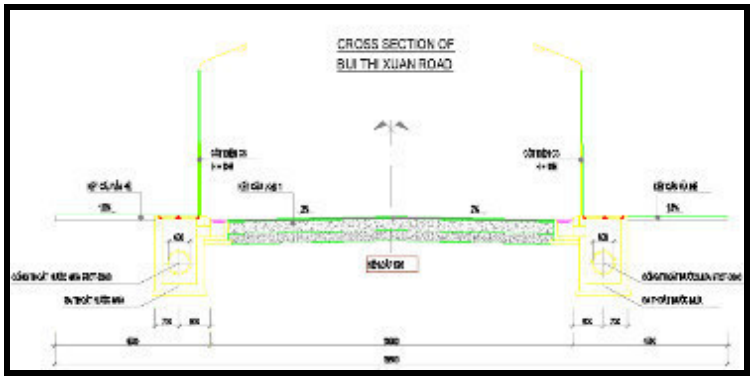
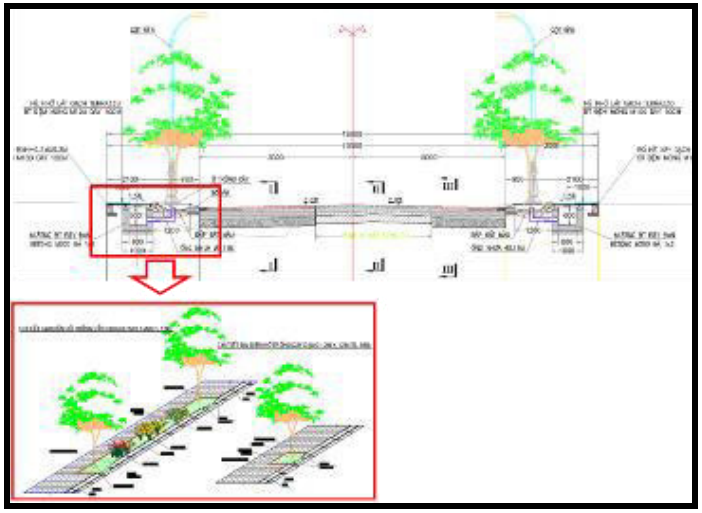
From Original Design or Situation	To Green Infrastructure Features
Vinh Yen	
Embankment	
	

From Original Design or Situation	To Green Infrastructure Features
Park	
	

From Original Design or Situation	To Green Infrastructure Features
Road	
	

From Original Design or Situation	To Green Infrastructure Features
Hue	
Embankment	
	

From Original Design or Situation	To Green Infrastructure Features
Road in Citadel	
	
Lake embankment in Citadel	
	

From Original Design or Situation	To Green Infrastructure Features
Rural Road	
	

4.3.3 Urban Design

This section assess the subprojects according to key urban design principles. This enabled the incorporation of such principles in the redesign of the subprojects where necessary.

Ha Giang Subprojects

Ten subprojects were assessed. **Table 4-16** presents the recommendations.

Table 4-16. Urban Design Recommendations for Ha Giang Subprojects

Subprojects	Urban Design Recommendations
Drainage for Tran Phu and Nguyen Trai Wards	Not relevant for UD
Upgrading of National Road No. 2	Pavements (3.75m wide) on either side of the road carriageway should include semi-mature tree planting at 7-8m intervals and tall lighting columns (9m high) for road traffic purposes. Lighting columns for traffic would probably be at spacing of 20m-25m whilst that for pavements would be at 7m-8m intervals, and possibly ground or low-level lighting. Directional signs should be affixed to lighting columns to avoid clutter. The existing city gateway entrance should be relocated to the southern most point of the upgraded road section.
Southern Ring Road (SRR) Improvement.	There should be a linear park/landscape pedestrian route along the eastern bank of the River Lo and into the southern edge of the city centre. This should be separate from the SRR and aligned alongside the riverbank. There could be a pavement (3.75m) on one side of the SRR—western riverbank side—that would be connected by steps to the riverbank linear park. This pavement area should have tree planting and lighting columns—for traffic and pedestrians—to the same standard as for National Road No.2. The riverside linear park needs to be designed as a natural route that would take advantage of the existing forested environment alongside this part of the eastern riverbank. The route should incorporate existing trees, with supplementary planting where necessary, lighting and seating, with occasional shelters, along a corridor width of 5-10m on the eastern River Lo bank. This could include level changes depending on flood limitations with the use of boardwalk sections close to the river. The emphasis would be on design for a natural environment.
Bridge from National Road No. 2 to Southern Ring Road	There should be 2.5m wide pavements on either side of the bridge with lighting for traffic and pedestrians. Pedestrian lighting could be set at a low level into the bridge wall. Pedestrian links/steps would be needed to the proposed linear park/pedestrian route along the east bank of the River Lo as part of the new SRR subproject.
Drainage for Minh Khai Ward.	Not relevant for UD
Western Embankment of the Lo River	There should be a landscape pedestrian route along the top of the embankment up to the Me Bridge with a connection onto the bridge crossing. The route should include a 3m wide pathway within a landscape corridor of up to 10m width, with tree and shrub planting, and set within an existing natural environment according to an informal design style. The pathway should preferably be of packed gravel with lighting and seating and occasional shelters.
Embankment and roads on both sides of Mien River	The Bridge 3/2 area is scenic and there is potential for extending trekking routes along River Nam Thau towards hills on the eastern edge of the city. There could, in the short to medium term, be a continuous riverside pedestrian route and linear park along the Lo, Mien and Nam Thau riverbanks from the city centre area to the eastern city edge. This landscape pedestrian route/linear park should incorporate existing trees, with some supplementary planting where necessary, and lighting and seating, with occasional shelters, along a corridor width of 5-10m. It would take up part of the embankment top as well as some natural landscape alongside. This pathway route could include level changes depending on flooding limitations together with boardwalk sections. The emphasis would be on a design for a natural, not urban environment, with appropriate materials.

Subprojects	Urban Design Recommendations
Southern Embankment of Me Stream	There should be a linear park/landscape pedestrian route along the top of the embankment that could incorporate some attractive existing tree growth in the northern section of the route. This landscape pedestrian route/linear park should integrate existing trees, some supplementary planting where necessary, lighting and seating, with occasional shelters, along a corridor width of 5-10m. It would take up part of the embankment top and some natural landscape alongside. This pathway route could include level changes depending on flood levels and incorporate boardwalk sections. The emphasis would be on design for a natural, not urban environment, with materials to suit.
Improvements to Existing Landfill	When completed/full the landfill should be covered with topsoil and planted with trees to blend in with the surrounding natural forested environment. Pathway routes should be provided through the landscaped landfill area to adjoining hillside forests, and from local communities, to turn this into a passive recreational area. Seating, directional signage and shelters should be included. A concept plan needs to be prepared for the landfill area with the local community. Pathway routes should be 2.0-2.5m width and in concrete or packed gravel. There would need to be ground lighting or medium height lighting standards—3.0 or 4m high, seating, shelters and directional signs.
Drainage for T1, T2, T3 and T4 of Quang Trung Ward.	Not relevant for UD

Source: PPTA Consultants

Vinh Yen

Eight subprojects have been assessed. **Table 4-17** presents the recommendations.

Table 4-17. Urban Design Recommendation for Vinh Yen Subprojects

Subprojects	Urban Design Recommendations
Dredging and Landscape Protection of Dam Vac Lake.	The lakeside edge pedestrian route should connect with the golf course, and proposed routes along the River Phan. It should include a pathway, cycling and jogging tracks within a linear park corridor of trees, bushes, small gardens and groves of trees. The landscape and spatial treatment would be in a natural and in an informal design style with the incorporation of existing trees and vegetation. The paths for jogging, cycling and walking should be differentiated by a change of materials, that could include packed gravel for walking, tarmac surface for cycling and softer synthetic surfaces for jogging connecting exercise stations along the route. Seating, shelters and pavilions should be provided, and low and medium height lighting. This would be accommodated within a linear park corridor width of at least 10-15m. This subproject should be closely integrated with that for Area B (see SP2).
Green Park Development near Dam Vac Lake	This is a large area for a park and should incorporate different themed areas. Much of the area, especially along the lakeside edge would be a wetlands environment that include a small lake. This could be one distinct element of the park to attract wading birds and wetlands flora and fauna. A network of boardwalks, with interpretative material and bird hides, could extend from the lakeside linear park into this area with connections to River Phan and proposed low-lying, manmade hills in the southern part of the area. These hills could be planted with trees and gardens with one for a picnic areas and the another as the beginning of the botanical garden focused on indigenous plants, which could, if successful expand into other areas. There should be a network of walking routes with cycling and jogging tracks alongside the River Phan connecting the lakeside linear park. A concept plan has been prepared (see *Figure 4.6.1 – Sketch Concept Plan for Dam Vac Lake Area B, in Appendix 3*) but would need to be worked up in more detail prior to the preparation of working drawings.
Infrastructure to University Area	The cross-sections for the retained road show minimal landscape provision. There is no detail of the land uses/facilities that would gain access or benefit from the road. There is little doubt that the subproject roads would open up speculative development land in the north of Vinh Phuc to the Hanoi-Lao Cai Expressway. However, the degree of environmental sustainability or 'green' credentials of this subproject have yet to be established. More information would be needed to properly assess it, especially in terms of staging and how it relates to the phasing of other Master Plan areas.

Subprojects	Urban Design Recommendations
Tertiary Wastewater Sewers	Not relevant for UD
Waste Water Collection and Treatment System	Not relevant for UD
Exhibition/Linkage Centre for Business Support	Not relevant for UD

Source: PPTA Consultants

Hue

Some 37 subprojects were assessed although many of which are drainage and streetscape improvement works for roads in the Citadel and have been grouped. Urban design recommendations are shown as **Table 4-18**.

Table 4-18. Urban Design Recommendation for Hue Subprojects

Subprojects	Urban Design Recommendations
Dredging and Embankment of Ke Van River.	The west side has a broad strip, about 10m wide along almost the entire length of the Ke Van River bank to the An Hoa River bridge. This should be used as a linear park with tree planting, seating, shaded canopies and lighting. On the other side, the embankment works should include a 3-5m wide basic riverside pathway, lighting, tree planting and at least two pedestrian bridge crossings to the west bank linear park. Available land on this eastern bank is limited and boardwalks extending out over the water may be needed for pedestrian access. There is significant existing tree growth that should be retained.
Drainage and Pavements of Four Inner City Wards of the Citadel	Urban design and streetscape improvements for roads in these four wards should be undertaken as part of an overall strategy and improvement plan that addresses landscape/streetscape, pedestrian access, street furniture, drainage/utility provision and traffic needs—including traffic calming measures and one-way streets. This should also include a comprehensive network of pedestrian and cycling routes throughout the Citadel area that would increase visitor attractiveness. The character of these streets should be retained, which would mean no road widening or property demolition. Road carriageway widths should be no more than 5.5m and, for some streets, could be 4m wide. Narrower streets could be part pedestrianised allowing vehicles for access only. Tree planting is broadly sufficient, although some supplementary planting may be needed for shade. Electricity and telephone line should be placed underground. A one-way system is in place for some streets, although this should be reviewed as part of a comprehensive approach to traffic management for the Citadel.
Dredging and Embankment Works for Six Citadel Lakes	Urban design and streetscape improvements for these lakes should be undertaken as part of an overall Citadel area strategy and improvement plan that addresses landscape/streetscape, pedestrian access, street furniture, drainage/utility provision and traffic needs, including traffic calming measures and one-way streets. This should also include the need to incorporate a comprehensive network of pedestrian and cycling routes that would increase visitor attractiveness. It is proposed to undertake engineering strengthening of the embankments with stone foundations, bamboo piling and stone and mortar facing. A fountain/aerator has been suggested to improve water conditions. There should be roadside pavement and lighting improvements along the lakes' edges. Trees should be retained along the lakeside edges and lighting provided.
Water Supply System for Landfill Area, Phu Son, Huong Thuy Town.	Not relevant for UD
Dredging and Embankment Works for Lap River, Kim Long Ward	This would open up an attractive secondary route along the river, which is currently overgrown and unusable. Mature and semi-mature trees on both banks should be retained. The narrow road along its southern embankment should be retained in its current form, although it could be made into a one-way street if traffic increases. The south bank should be the focus for a tree-lined riverside route, perhaps 3-4m wide,

Subprojects	Urban Design Recommendations
	with some supplementary planting, seating, shelters, lighting and perhaps some limited parking spaces. The emphasis should be on natural and informal landscape incorporating existing trees. This could be replicated on the north side of the river depending on available land. One or two pedestrian bridge crossings should be provided to connect both banks.
Eco-channel of An Van Duong Development Area.	This is one of many schemes in the An Van Duong area with broad landscaped avenues and boulevards. There are linear parks throughout the development area of 60m or more in width along canals or major roads. The key issue is the danger of a surfeit of linear parks. There seems to be little consideration as to how these areas of parkland would be used, who would use them and what linkage function they would play or indeed if they would be used at all. The broad eco-channel (33.5m) would also connect two narrow river tributaries at either end and this raises the issue of the sheer scale of the water route itself. The need for land acquisition along the eastern side must be questioned given that there is plenty of available land along the western side without existing properties. There is also the issue of the maintenance and management of the extensive landscape for these linear parks.
Dredging and Embankment for An Hoa River.	A linear park along the outer bank of the Ke Van River has been proposed as part of the urban design recommendations up to the An Hoa River bridge. This theme should be continued along the An Hoa River where available land allows. In the case of An Hoa there appears to be limited land available with the riverside forming the back of private properties. There is substantial mature tree growth. Where there is insufficient land, a 3-5m width boardwalk extending out over the river could be provided along either bank. Land acquisition should be avoided for the purpose of creating a boardwalk/footpath route. Mature and semi-mature trees should be retained and will most likely provide a screen alongside private houses. The pathway/boardwalk needs to include shaded seating areas and lighting. A cycle route should also be considered.
Improvements of Citadel Canal/Moat.	Existing tree planting and grass banks along either side of the moat edge would be retained. The embankment walls on both sides should be strengthened since they are in poor condition along much of the moat length. Grass embankments on the inner part of the moat, close to the Citadel walls, will be kept as they are, including existing lighting. There are sufficient opportunities, within and around the Citadel for walks and landscape improvements. Also, there is scope on the outer bank of the canal/moat to incorporate walkways set amongst trees between the canal and adjoining roads. This could be done as part of level change design following that near the main southern Citadel entrance.
Park, Paths, Drainage and Lighting in An Van Duong Development Area.	The layout and roads for the An Van Duong area has been based on the work undertaken in 2005 and needs to be reviewed by assessing traffic generation forecasts/modelling and property market demands. Highway standards appear unjustified in terms of capacity and traffic generation needs. The proposed road extension appears to be speculative and it is questionable as to why this infrastructure would be required now and well before the earlier phases of An Van Duong are even near to completion. Some 65m width of the 75m-wide median strip would be landscaped as a linear park. For the successful use of an urban linear park there would need to be a number of attractions throughout its length, and especially at either end of it. It should have retail, leisure and recreational attractions along it, including some indoor facilities. The function and implementation of this subproject should follow that for a similar grand route from the Xuan Phu, and new administrative centre, roundabout to Ba Trieu Road, which is the most likely proposition for a 'festival' linear park complete with shopping, entertainment and leisure attractions, as well as the possibility for a central busway or LRT route.
Park and Square in Administrative Part Area, An Van Duong.	The proposed landscape appears to provide a setting for the administrative centre with much of it apparently for trees to provide shading for significant areas of surface car parking. The circus core would be central park, probably for public access, together with a large pool and water fountain feature. Whilst many trees are proposed, how many would be part of a public park. The layout design appears to be more of an administrative centre with a landscape setting, rather than any new park of any significance. The notion that all government buildings be relocated to this site is questionable for urban sustainability reasons. This scheme could help to undermine the viability of central Hue, to erode the notion of high-density multi-functional mixed uses and also to encourage urban sprawl. The scheme as presented appears to be grandiose and land-hungry. However, if the plan is to proceed, it is recommended that car parking

Subprojects	Urban Design Recommendations
	should be placed underground beneath administrative building structures, and that densities be increased with the remainder of the site utilised for a mix of medium to high density retail and residential uses set within informal parkland that would extend through the site.
Embankment and Roads for the Dong Ba River	Lighting should be included along the riverside walkways. The northern section of landscaped pathway narrows principally because of land restrictions and the need to negotiate around existing housing areas. There should be a pedestrian 20 m wide bridge crossing of the Dong Ba between the two existing road bridges. There is a substantial amount of electricity wiring and this should be placed alongside the bridge structure as part of the subproject. Mature and semi-mature trees should be retained. To the north of the Phu Hau road bridge where the Dong Ba River meets the Huong River is some vacant land on both sides. There is scope here for creating a small neighbourhood park—on both sides—at this scenic confluence location, perhaps with a connecting pedestrian bridge.
Embankment and Roads for the An Cuu River	There would be a 3m wide road with 2m wide pavements one either side together with tree planting and lighting. At certain riverside points there should be small park areas as part of an overall riverside route that would include seating and canopies/shelters. Lighting and supplementary tree planting would be needed along the riverside embankment.
Embankment and Roads for the Nhu Y River	Along some parts of Han Mac Tu Road up to An Van Duong, especially at the eastern end there are opportunities for creating broader riverside landscape areas to include small parks for which tree planting, shaded seating areas and lighting would be needed.
Section of Central Road in An Van Duong Development Areas, including Bridge	The layout and roads provision for the An Van Duong area has been based on the work undertaken in 2005 and needs to be updated through traffic generation forecasts and modelling. The proposed road extension appears to be speculative.
Bui Thi Xuan Road.	The road widening may be needed for its eastern half to serve existing residential properties and allow traffic to pass comfortably. This could be accomplished with a 7.5m carriageway. A 3m-wide pavement could be provided on one side only, and include a dedicated cycling lane. Significant tree planting already exists along the length of the road but lighting would be needed. The widening of the road at the western end is debatable, since the land is almost entirely in agricultural use. This part of the Thuy Bieu peninsular area should be conserved for its recreational and landscape value and to maintain a riverside setting for the Nguyen Imperial tombs further south.
Huyen Tran Cong Chua Road.	The proposed road standards are questioned in terms of traffic needs. Road widths could be reduced to 7m with a pavement on one side only and provision for a dedicated cycling lane. This would be important to reduce property acquisition needs. Significant tree planting already exists along the length of the road but lighting would be needed.
Vy Da Bridge and Access Roads.	The existing road is wide—10.5m-12m—along its length. The traffic justification for widening to the standards proposed needs to be supported by traffic projections, and assessed against the costs of land acquisition. It is understood that there may be some congestion pinch-points for this road section where double parking sometimes occurs. Indented parking bays could be incorporated into pavement widths and road carriageways reduced. There should be some tree planting with semi-mature trees along the pavements, between parking bays that would complement the proposed tree and shrub planting along the median strip. Lighting columns for pedestrians and traffic would be needed. The need for dedicated bicycle lanes alongside the carriageway should be assessed. The open space at the Nguyen Phan Chanh junction has recently been provided with semi-mature tree planting, pavements, lighting and central grass lawn. Given this, the proposed redesign should probably be avoided. Thus, existing planting should be allowed to grow to maturity and consideration given to supplementary landscape needs thereafter.

Source: PPTA Consultants

4.4 Social Safeguards Assessment

Social safeguard assessments for the proposed subprojects are related to: (i) the need for land acquisition and compensation required for some subprojects; and (ii) the need to ensure an appropriate and inclusive approach with local communities, including Indigenous People (IP).

Resettlement is inclusive when there is equitable access, for all relocated population, including the poorest and the vulnerable, to urban infrastructure, land, housing, social services and livelihood opportunities. Inclusive resettlement is in particular, built through a participatory planning and decision-making process shared between various levels of government, relocated communities and civil society. But resettlement is not only about rebuilding houses for all those affected, but also about reviving livelihoods and rebuilding the community and the environment. Inclusive resettlement has to be sustainable, resilient and affordable.

- ***Sustainable.*** Resettlement will be sustainable if it maintains the community structure, preserves social networks and allows relocated households (HH) to continue their livelihood or to create opportunities for a new livelihood. Sustainability is also built through a pro-active community, government and civil society that maximize the potential of the community/city's available resources for its development. Assessing the needs and vulnerabilities of affected populations with particular attention to livelihood is essential during resettlement planning.
- ***Resilient.*** Resilience could be in specific cases an alternative to resettlement. The question to relocate or not to relocate should be asked in the case of people living in disaster prone areas. These people are often the most vulnerable and have site specific livelihoods. Relocation may impoverish them. Building safe and resistant houses and infrastructure, and training the population on how to build resiliency against future disasters may be a more sustainable option.
- ***Affordable.*** Land, housing and urban services should be affordable to all relocated households. Adequate compensation and assistance, and an appropriate financial mechanism should be proposed to allow the poor and vulnerable to have access to land, housing and services.

Subproject screening was based on (i) a review of existing studies regarding land acquisition; (ii) visits to each of the subprojects; (iii) discussions with relevant agencies; and (iv) focus group discussions conducted for some of the subprojects. **Appendix 7** includes a summary of focus group discussions and details the subprojects' impacts regarding land acquisition and resettlement. Feasibility studies have been prepared by national consultants in all three cities. Each PMU also hired a consultant to conduct preliminary surveys on land acquisition and resettlement for each of the subprojects. The data prepared on the extent and costs of land acquisition and resettlement are preliminary, and not based on detailed survey or inventory of losses. In addition to the identification of land acquisition and resettlement impacts, social risks were assessed for each subproject, and mitigation measures to ensure sustainability, resilience and affordability are proposed. Measures to involve citizens' participation in the implementation and the monitoring of some subprojects have also been proposed.

4.4.1 Subprojects in Ha Giang City

Ten subprojects are proposed in Ha Giang City, which have impacts on land acquisition and resettlement. It is estimated that 529 HH will be affected, most of them marginally; 27 HH will have to be relocated. In Ha Giang City there are indigenous people (IP) communities. However, these IP groups are urbanized and integrated into the urban mainstream way of life. Furthermore, IP communities will not be specifically targeted through the proposed subprojects, and no differential impacts are expected.

Consultation in the form of focus groups discussions (FGD) was conducted for proposed subprojects with the most significant land acquisition impacts—Southern Ring Road and upgrading of the road from Quyet Thang to Son Ha[64]. This was to identify concerns of affected households (AH) to better prepare resettlement/compensation plans. The main findings were:

- *Information/approach.* People are generally aware of the proposed subprojects in their wards. HH want to know where the subproject will be implemented and the exact design—who is affected, and

[64] This project was included in the first list proposed by Ha Gang City but was later removed from this list

to what extent, etc. In all FGDs it was confirmed that there is no need for a specific approach with IP group since they are fully integrated and all speak Vietnamese. IP communities want to be treated as the Kinh group.

- *Compensation*. HH are aware of new rates issued by PPC; they are also aware of the existing land transactions in their areas. HH consider that PPC rates are lower than market ones. They expect the Program to provide fair compensation, satisfying market rates. For the Southern Ring Road, some HH have already been partially compensated and experienced some land use restrictions—cannot cultivate some areas. HH request a clarification of the situation and an assessment of the impacts they have already experienced.
- *Income restoration*. Especially for the Southern Ring Road, HH are concerned by the potential loss of income and request restoration measures for loss of productive land and fish ponds. These need to be discussed with the AH.
- *Relocation.* HH are not aware of the location of relocation sites. They want to be relocated as close as possible to their former home or be allowd to make their own arrangements.
- *Vulnerable HH*. No potential vulnerable HH were identified in both subprojects.

Table 4-19, outlines the social benefits, impacts on land acquisition and resettlement, and the proposed measures to be adopted.

Table 4-19. Social Benefits, Impacts on Land Acquisition and Resettlement and Proposed Measures for Subprojects in Ha Giang City

Proposed Subprojects	Social Benefits	Potential social/ resettlement impacts	Social Risks	Mitigation measures
Drainage for Tran Phu and Nguyen Trai Wards	- Reduction of flooding and improved drainage and sanitation conditions for potentially: 6,700 HH for Tran Phu and Nguyen Trai wards; 3,500 HH for Minh Khai ward and 1,400 HH for Quang Trung ward. - Equity of access to services strengthened. - Strengthening natural hazard resilience against floods; citizens will be better able to cope with flooding.	- Limited impacts on land acquisition—1,546m^2 - 817m^2 agriculture, 729 m^2 residential - Estimated 155 HH marginally affected—land, houses, secondary structures, etc.; - 233 m^2 of main structure affected (92 HH); - Land acquisition costs: US$ 62,474	- No specific risks anticipated	- Compensation at replacement cost for the loss of land and non-land assets and an assistance package. - Involve citizens in maintaining the cleanliness of the drainage system through community programs. - Development of awareness program to prevent dumping of solid wastes into the ditches and drainage system. - A Water and Sanitation Committee (WSC) should be established to ensure community participation and responsive management of the subproject. As indicated in the GCAP, a community scorecard to monitor activities in the four urban wards should be implemented by the WSC to ensure citizens' monitoring
Drainage for Minh Khai Ward		- Very limited impacts on land acquisition (280 m^2); 21 HH marginally affected. - 9 HH have main structure affected (178 m^2). - Land acquisition costs: US$ 37,023.		
Drainage of T1, T2, T3 and T4 for Quang Trung Ward		- Very limited impacts on land acquisition (281 m^2). - 8 HH marginally affected; no main structure affected. - Land acquisition costs: US$ 12,261.		
Western Embankment of Lo River	- Facilitate the evacuation of people in the event of a natural disaster. - Strengthening natural hazard resilience against floods; citizens will be better able to cope with flooding. - Proposed green belt along the embankment—Lo River, Mien River expansion of scenic trekking routes along the river, with permanent pedestrian path—Mien River—linear	- No impact on land acquisition—public forest land. - Land may be allocated to HH for forestry production—plantation of acacia. - No land acquisition costs: compensation for trees to be assessed.	- Risks related to loss of timber trees which may lead to impoverishment.	- Compensation at replacement cost for the loss of land and non-land assets. - For trees on public land, compensation for trees at market rates to owners of trees regardless of tenure status. - Income restoration measures to be discussed with owners of trees—i.e. allocation of other forest areas—to be discussed. - Income restoration measures to be
Embankment and roads on both sides of		Embankment of Mien River	- Risks related to relocation and loss	

Proposed Subprojects	Social Benefits	Potential social/ resettlement impacts	Social Risks	Mitigation measures
Mien River	park/landscape pedestrian route along the top of the embankment with supplementary planting, lighting and seating, with occasional shelters (Me stream) will ensure public access to the rivers/stream banks for the neighbouring communities and all Ha Giang citizens, and will contribute to make the City more inclusive.	- Limited impacts on land acquisition—1,211 m^2 of agriculture land 54 HH marginally affected. - Land acquisition costs: US$ 19,717. Phung Hung Road - Significant impacts on land acquisition, 11,537 m^2 of agriculture land and 7,919 m2 of residential land affected; - 2,136 m^2 (71 HH) of main structure affected; 15 HH to be relocated - Land acquisition costs: US$ 568,660	of productive land which may lead to impoverishment.	discussed with severely affected HH through loss of productive land—provision of input or equipment, training etc.—to be discussed with farmers. - Development of awareness program to prevent dumping of solid waste into the Lo and Mien rivers and Me Stream, should also be considered. This will contribute to enhanced citizen participation for environmental protection. - As proposed in the design for Me stream, levees should be included to protect houses and properties without a full embankment from flooding (around 20 HH); it will make local residents better able to cope with flooding. - Proposed green belts, linear parks, pedestrian paths to be included in the final design to make the city more inclusive. - Relocation option to be proposed to the 15 HH affected by Phung Hung road so that they are relocated in a serviced resettlement site.
Southern Embank-ment of Me Stream		- Limited impacts on land acquisition—1,938 m2: 1,418 m^2 agriculture, 520 m^2 of residential affected along small stream - 39 HH marginally affected; 3 HH severely affected—losing more than 10% of their productive land; No main structure affected. - Land acquisition costs: US$ 31,099.	- Risks related to loss of productive land which may lead to impoverishment	
Improvement of Existing Landfill	- Contribute to a better environment and will improve community health. It will serve the total Ha Giang City population.	- No land acquisition (25.5 ha of public land); however land may be allocated to 12 HH for forestry production—plantation of acacia. - 2 HH (120 m2) not affected by land acquisition but need to be removed due to environmental conditions—close to current and future landfill. - Two informal waste pickers present at the current landfill site.	- Risks related to relocation and loss of timber trees which may lead to impoverishment - Risks for vulnerable population—informal waste pickers.	- Compensation at replacement cost for loss of land and non-land assets and assistance package. - For trees on public land, compensation for trees at market rates to owners of trees regardless of tenure status. - Income restoration measures to be discussed with owners of trees—allocation of other forest areas—to be discussed. - Income restoration measures for informal

Proposed Subprojects	Social Benefits	Potential social/ resettlement impacts	Social Risks	Mitigation measures
		- Land acquisition costs: US$ 7,822.		waste pickers—to be hired in waste separation at new landfill site etc.—to be discussed. - Public information campaign to encourage waste separation at source and to increase awareness for related practices should be considered. This will enhance citizens knowledge and participation in environmental protection.
Upgrading and expansion of National Road No.2	- Improved mobility of people, goods and services `will benefit to the whole population. - Proposed pedestrian and cycling paths will improve accessibility and safety for pedestrians, cyclists and for residents along the road. This will contribute to make the city more inclusive for all road users.	- Limited impacts on land acquisition—35 HH lose 1,400 m^2 of residential land and 1,200 m^2 of houses; 4 HH to be relocated. - Secondary structures affected—fences; no main houses affected. - Land acquisition costs: US$ 234,701	- Risks related to safety and relocation; - Presence of vulnerable groups including IP to be assessed	- Compensation at replacement cost for loss of land and non-land assets, and an assistance package. - Proposed pedestrian and cycling paths to be included in the final design to make the city more inclusive and to ensure users safety. - Relocation option to be proposed to the 4 HH in a serviced RS.
Southern Ring Road Improvement	- Improved mobility of people, goods and services will benefit to the whole population - Proposed linear park along the Lo River, which includes pedestrian and cycling paths, will improve accessibility and safety for pedestrians and cyclists. This will contribute to make the city more inclusive for all road users. - The proposed design for the bridge should include a pedestrian lane and a bicycle lane to link both banks both linear parks and green belts. It will improve accessibility and safety for pedestrians and cyclists, and will contribute to make the city more inclusive for all road users.	- Significant impact on land acquisition—46,250 m^2: 44,553 m^2 agriculture, 1,697 m^2 residential; public forestry land also affected; - Some land acquisition already has taken place and some HH experience limitation of land use—couldn't cultivate or build houses. - Estimated 99 HH affected, 60 HH severely affected—losing more than 10% of their productive land; 8 HH to be relocated; relocation close to affected area needed. - Full design of interchange between bridge and NH2 not available. - Land acquisition costs: US$ 674,236.	- Need for income restoration, for severely affected farmers, to be assessed to avoid impoverishment. - Presence of HH already affected my be suffering from land use restrictions; - Risks related to relocation and loss of productive land which may lead to impoverishment;	- Conduct due diligence for HH whose land was already acquired. - Compensation at replacement cost for loss of land and non-land assets, and assistance package. - Income restoration measures to be discussed with HH severely affected through loss of productive land—provision of input or equipment, training etc.—to be discussed with farmers. - Assistance to famers during the - Relocation option to be proposed to the 8 HH—self-relocation or relocation in a serviced RS close to their existing location.

Proposed Subprojects	Social Benefits	Potential social/ resettlement impacts	Social Risks	Mitigation measures
Bridge from National Road No. 2 to Southern Ring Road		- No impact on land acquisition: public land on right bank and part of affected land already acquired on the left bank. - No land acquisition costs.	- Presence of vulnerable groups including IP to be assessed; number of vulnerable HH and IP communities to be assessed.	

Source: PPTA Consultants

4.4.2 Subprojects in Vinh Yen City

Six subprojects are proposed in Vinh Yen City, and will have impacts on land acquisition and resettlement. It is estimated that 714 HH will be affected, most of them marginally; 15 HH will have to be relocated.

Focus groups discussions were conducted for the two subprojects with the most resettlement impacts—sewerage and waste water treatment system, and the access road to University City. The main results are.

- *Information.* People are aware of the subprojects, since they were presented as part of the master plan in 2011. Preliminary surveys were also conducted for the access roads to the university. Waste water is identified as a major environmental and health problem. Ponds in Hoi Hop ward are contaminated with wastewater. People, however, requested detailed information on land acquisition as soon as possible.
- *Anticipated impacts.* HH living in villages along the access roads in the university area anticipate limited impacts on land acquisition based on preliminary surveys conducted. Farmers in the university area have on average 1, 4 sao—around 500 m^2—of agriculture land in plots at different locations and are used mainly for rice cultivation. Even if some plots are affected by the university subproject many will retain other productive land. For the WWTP, plots are larger, and will be totally affected by its development. The main source of income is from agriculture in both areas.
- *Compensation.* Compensation at market rates has been given in both areas; sales have occurred and HH are aware of market rates. HH expect compensation will be at market rates.
- *Income restoration.* Only rice fields and fish ponds are affected in the proposed WWTP area. Children are not willing to continue agriculture production. HH are not interested by training since it is identified as inefficient. HH prefer additional cash. The younger generation are also not interested in cultivating the land in the university area. Therefore, income restoration programs should be focused on non-farm activities. HH in the university area are interested to diversify their incomes through providing services to students or to the university—catering, rooms for rent etc.

Table 4-20, outlines the social benefits, impacts on land acquisition and resettlement and the proposed measures to be adopted.

Table 4-20. Social Benefits, Impacts on Land Acquisition and Resettlement and Proposed Measures for Subprojects in Vinh Yen City

Proposed Subprojects	Social Benefits	Potential social/ resettlement impacts	Social Risks	Mitigation measures
Dredging and Landscape Protection of Dam Vac Lake	- The proposed subproject will build an embankment and path around the lake. Dam Vac Lake banks are becoming more privately owned, and the investment will ensure that public access is maintained for all citizens. It will make the city more inclusive and will contribute to equity.	- Significant impacts on land acquisition 22,000 m2 of agriculture land—30 HH—and 1,000 m2 of residential land—25 HH—affected; - No main structure affected and no HH will have to relocate. - Land acquisition costs US$202,000.	- Need to keep public access to Dam Vac Lake for citizens to ensure equity and inclusiveness for all. Risks related to loss of productive land which may lead to impoverishment	- Compensation at replacement cost for the loss of land and non-land assets and an assistance package. - Income restoration measures to be discussed with HH severely affected through loss of productive land—provision of input or equipment, training etc.—to be discussed with farmers - Maintain public access to the Dam Vac Lake. - Dam Vac Lake Protection Committee will be created to ensure community participation and a responsive management of the subproject. As indicated in the GCAP, a community scorecard to monitor activities of the Dam Vac Lake should be implemented by the Protection Committee to ensure citizens monitoring. - Measures to promote access for disabled persons should also be developed to enhance inclusiveness.
Green Park Development near Van Dam Lake	- The proposed green area will become the first public park of the city. It will benefit all Vinh Yen citizens who will will have access to new green areas. A playground will be developed in the park for children to use. The park may become a community gathering place which will help make the city more inclusive.	- Significant impacts on land acquisition—440,000 m2 of land including 160,000 m2 of public land, 100,000 m2 of wetland and the remaining is mainly fallow land not cultivated (125 HH); paddy and fish production are however present; 1,000 m2 of residential land (15 HH) will also be affected; - No main structure affected and no HH will have to relocate; - Land acquisition costs: US$ 1,615,000. - Positive impacts to citizens and	Risks related to relocation and loss of productive land which may lead to impoverishment	- Compensation at replacement cost for the loss of land and non-land assets and an assistance package; - Income restoration measures to be discussed with HH severely affected through loss of productive land—provision of input or equipment, training etc.—to be discussed with farmers - Measures to promote access for disabled persons should be included to enhance inclusiveness.

Proposed Subprojects	Social Benefits	Potential social/ resettlement impacts	Social Risks	Mitigation measures
		neighbourhood community.		
Infrastructure to University Area	- The planned University City will improve education level of the population of Vinh Yen, and make the population more qualified for service jobs. - Existing villages will be served by new infrastructures—water supply, roads, and bus lines—which will increase access to services for this area; this will improve overall access to public services and mobility and will contribute to equity.	- Significant impacts on land acquisition,15.9 ha of agriculture land—280 HH—and 0.6 ha of residential land—38 HH—will need to be acquired; 15 HH will need to be relocated; - Estimated 400 HH affected. - Several villages included in the whole university project. Information on the scope of land acquisition and impacts on villages were not fully available; - Land acquisition costs: US$ 1,680,000.	- Need confirmation that villages will not be affected and will be integrated in the whole subproject design. Risks related to relocation and loss of productive land which may lead to impoverishment	- Villages within the whole university area should be protected as far as possible and integrated in the university design. - Compensation at replacement cost for the loss of land and non-land assets and an assistance package. - Income restoration measures to be discussed with HH severely affected through loss of productive land—provision of input or equipment, training etc.—to be discussed with farmers; - Alternative livelihoods for villagers losing agriculture land should be developed—services delivered by villagers to university/students such as catering, entertainment, accommodation etc.; - Assistance to famers during the transition period - Relocation option to be proposed to the relocated HH—self-relocation or relocation in a serviced RS close to their existing location;
Tertiary Wastewater Sewers	- The proposed investment will improve sanitary conditions for 30,876 inhabitants and will improve access to services for a large part of the citizens leading to better equity regarding public services. - A related sanitation credit program is a key financial enabler, for this subproject, to ensure equity for poor and low-income households.	- Limited impacts on land acquisition as most of the land affected is public land; 5,200 m2 of garden land will be affected; 120 HH marginally affected—secondary structures, fences, trees, etc. - Land acquisition costs: US$ 71,400	- No specific risks anticipated	- Compensation at replacement cost for the loss of land and non-land assets; - Involve citizens in maintaining the cleanliness of the drainage system through community programs; - Development of awareness program to prevent dumping of solid wastes into the ditches and drainage system;
Wastewater Collection and Treatment in West Vinh Yen	- The subproject will benefit to 10,000 households and covers the three remaining wards—Tich Son, Dong Tam, Hoi Hop—not included in the	- Moderate impacts on land acquisition; 6 ha (1 HH) of agriculture land affected for the WWTP; 1,800 m2 (9HH) for the 7		- Compensation at replacement cost for the loss of land and non-land assets. - Income restoration measures to be discussed with HH severely affected

Proposed Subprojects	Social Benefits	Potential social/ resettlement impacts	Social Risks	Mitigation measures
	JICA project; this will ensure the same access to sanitation for all citizens of Vinh Yen City.	pumping stations and 6,000 m2 for the pipeline network (9 HH). All 19 HH affected cultivate public land. - Part of the 6 ha of land are public land allocated to farmers; - Land acquisition costs: US$71,4000		through loss of productive land—provision of input or equipment, training etc.—to be discussed with farmers. - Assistance to famers during the transition period. - Development of awareness program to prevent dumping of solid waste into the ditches and drainage system.
Exhibition/Linkage Center for Business Support	- The subproject will contribute to the development of new local enterprises and industries which will generate additional local employment resulting in increases in household incomes.	- Moderate impacts on land acquisition, 2.1 ha of agriculture land affected—105 HH—along NH 2A; area under urbanization. - Land acquisition costs: US$71,600.	- Risks related to loss of productive land which may lead to impoverishment	- Compensation at replacement cost for the loss of land and non-land assets, and an assistance package. - Income restoration measures to be discussed with HH severely affected through loss of productive land—provision of input or equipment, training etc.—to be discussed with farmers. - Assistance to famers during the transition period.

Source: PPTA Consultants

4.4.3 Subprojects in Hue City

Seventeen subprojects are proposed in Hue City which will have significant impacts on land acquisition and resettlement. Some of these—roads and channels—will require considerable land acquisition and the relocation of many HH with significant resettlement costs. It is estimated that 1,049 HH will be affected and 204 HH will have to be relocated. Measures to reduce land acquisition and resettlement need to be implemented.

Table 4-21, outlines the social benefits, impacts on land acquisition and resettlement and the proposed measures to be adopted.

Table 4-21. Social Benefits, Impacts on Land Acquisition and Resettlement and Proposed Measures for Subprojects Hue City

Proposed Subprojects	Social Benefits	Potential social/ resettlement impacts	Social Risks	Mitigation measures
Dredging and Embankment of Ke Van River	- The subproject by improving flow to the Huong River and also its environment quality will improve living conditions of the people living along the river—around 500 HH. - Proposed linear park along the west side of the River and pathway on the East site will benefit to the neighbouring community. - Structuring the embankment of east side of the river to reduce erosion from storm water will benefit HHs located along the banks.	- Limited land acquisition along the River due to clearance that already took place in some sections in 2011; large number of houses affected—80—but partially affected—trees, fences and small structures; no HH will have to relocate. - Tenure status of some houses on the each side of the River to be checked—possible encroachment on public land. - Costs of land acquisition around US$ 346,000	- Risks related to impacts on potential vulnerable HH—illegal encroachers, landless.	- Compensation at replacement cost for the loss of land and non-land assets, and an assistance package. - Provide compensation for non-land assets in case of illegal encroachment. - Development of awareness program to prevent dumping of solid wastes into the canals should also be considered. This will contribute to enhance citizen participation for environmental protection. - Due diligence on land acquisition conducted in 2011 may be necessary;
Drainage and Pavements in Four Inner City Wards of the Citadel	- Proposed subproject will reduce flooding in these two wards and will improve drainage and sanitation conditions for potentially 12,800 HH. Equity of access to services will be strengthen. - Roads should not be totally cleared to avoid impacts on the community encroachment of structures and keep the heritage Citadel character—trees, and architecture.	- The subproject proposes to clear the existing RoW; a significant number of HH encroached on public land—fence, part of house. - Due to the density of population within the Citadel, this will have significant impacts on structures; it is estimated that 100 HH will be affected through loss of structures; no HH will have to relocate. - Residential land acquisition—9,267 m^2—will also be necessary. - Along some streets, vendors located around existing markets will be temporarily displaced. Measures to minimize impacts to be discussed with vendors an community. - Costs of land acquisition around	- Encroachers may not be fully compensated for their structures even if they built them a long time ago. - Risks on the loss of income for street vendors.	- Review design to reduce clearance of structures; clearance of structures should be done only when necessary for the purpose of drainage and not systematically to clear the RoW so as to keep the character of these small roads with high potential for eco-tourism. - Ensure compensation at replacement costs for land and structures in case of land acquisition. - Provide compensation for non-land assets in case of illegal encroachment. - Conduct meaningful consultation with residents due to the severe impacts on existing HH. - Assess impacts on local vendors during construction. A Sanitation, Drainage and Protection Committee (SDPC) should be created to ensure community participation and a responsive management of the subproject. As indicated in the GCAP a community

Proposed Subprojects	Social Benefits	Potential social/ resettlement impacts	Social Risks	Mitigation measures
		US$ 1.14 Million.		scorecard to monitor activities in the 4 wards should be implemented to ensure citizens monitoring
Dredging and Embankment for Six Lakes in the Citadel	- Prevention of water pollution through proper drainage will lead to a cleaner environment, which in turn contributes to improved health of people—densely populated areas around the lakes. - Embankments will contribute to protection of properties—reduction of erosion; landscaping will benefit the neighbouring community and increase tourism attraction of the Citadel.	- The subproject will have limited impacts on land acquisition and resettlement—10 HH expected to be affected through loss of secondary structures; some illegal encroachment may have occurred. - HH will be affected through loss of income—cultivation of vegetables on the lakes. - Costs of land acquisition, US$ 92,464.	- Risks related to loss of source of income—cultivation of vegetables on the lakes—which may lead to impoverishment. - Risks related to impacts on potential vulnerable HH—illegal encroachers, landles.	- Compensation at replacement cost for the loss of land and non-land assets, and an assistance package. - Provide compensation for non-land assets in case of illegal encroachment. - Design specific income restoration measures—a credit program—for HH cultivating vegetables on the lakes; conduct meaningful consultation with affected farmers to design such measures. - Development of awareness program to prevent dumping of solid waste into the lakes should also be considered. This will contribute to enhance citizen participation for environmental protection.
Water Supply System to Phu Son Solid Waste Treatment Facility and Villages	- This subproject will contribute to a better environment and will improve community health. It will serve the total Hue City population. - Phu Son is a mountainous commune with no water supply for the residents. People are using water from deep wells with limited amount, very poor quality—high iron content, salted—and minimal treatment. Water borne diseases occur frequently. - This subproject will strengthen equality of access to services in remote areas.	- None or very limited impact on land acquisition is expected as the land used for the pipelines and other equipment are generally under existing public assets—mainly roads. - Costs of land acquisition, US$ 4,623.	- No specific risks anticipated.	- Public information campaign to encourage waste separation at source and to increase awareness for related practices should be considered. This will enhance citizens' knowledge and participation in environmental protection.
Dredging and Embankment of Lap River, Kim Long Ward	- The subproject, by improving flow to the Huong River and also its environment quality, will improve living conditions of the people living along the river—around 250 HHs.	- Mainly public land (forest) along the river which limits impacts on land acquisition; no structures located between the roads and the river on either side; some HH	- Risks related to loss of source of income—forest products—which may lead to	- Ensure compensation at replacement costs for the land and structures, and an assistance package in case of land acquisition. - Provide compensation for non-land

Proposed Subprojects	Social Benefits	Potential social/ resettlement impacts	Social Risks	Mitigation measures
	- Proposed walkway along the River will benefit to the neighbouring community. - It will also strengthen natural hazard resilience against floods, and the citizens will be better able to cope with flooding.	however have encroached on public land and have built structures on the banks; forest area may be used by HH living nearby as a source of livelihood. - Costs of land acquisition, US$ 46,232.	impoverishment; - Risks related to impacts on potential vulnerable HH—illegal encroachers, landless.	assets in case of illegal encroachment. - Assess if forest is used as source of livelihood by HH living nearby, and provide restoration measures in consultation with forest users. - Development of awareness program to prevent dumping of solid waste into the river should also be considered. This will contribute to enhance citizen participation for environmental protection.
Eco Channel of the An Van Duong Development Area	- Potential to develop an eco-tourism corridor, which will benefit to the whole population if green features are included. - Design needs improvement to reduce the scale of land acquisition.	- Significant land acquisition is anticipated with high costs; the eco-channel corridor would be between 114 m and 135.5 m wide; 148,936 m2 of agriculture land—110 HH, and 3,500 m2 of residential land—52 HH—will be acquired. - A community along the east side of the channel will be affected. 42 houses will be affected and 38 HH will need to be relocated. - The need for land acquisition along the eastern side must be questioned given that there is plenty of available land along the western side without existing properties. - Costs of land acquisition around US$ 1.4 M.	- Community structure may be disrupted due to the subproject. - Risks related to relocation, which may lead to social disruption; - Risks related to loss of productive land which may lead to impoverishment.	- The design needs to be reviewed to reduce the scale of land acquisition. - In case of relocation of the community, meaningful consultation needs to be conducted to develop options for resettlement. - Compensation at replacement cost for the loss of land and non-land assets, and an assistance package. - Income restoration measures to be discussed with HH severely affected through loss of productive land—provision of input or equipment, training etc.—to be discussed with farmers. - Assistance to farmers during the transition period.
Dredging and embankment of An Hoa River	- The subproject, by improving flow to the Huong River and also its environmental quality, will improve living conditions of the people living along the river—around 700 HH. - Structuring the embankment will	- Banks of the River are densely populated; a large number of HH are expected to be partially affected; none or few are expected to require relocation; expected; no data on land	- Risks related to impacts on potential vulnerable HH—illegal encroachers, landless.	- Land acquisition should be avoided for the purpose of creating a boardwalk and footpath route. - Compensation at replacement cost for the loss of land and non-land assets, and an assistance package.

Proposed Subprojects	Social Benefits	Potential social/ resettlement impacts	Social Risks	Mitigation measures
	reduce erosion from storm water; it will benefit HH located along the banks.	acquisition was available. - Additional land acquisition may be necessary for the linear parks. - Tenure status of some houses to be checked—possible encroachment on public land; - Costs of land acquisition, US$ 354,000.		- Provide compensation for non-land assets in case of illegal occupants. - Development of awareness program to prevent dumping of solid waste into the river should also be considered. This will contribute to enhance citizen participation for environmental protection.
Improvement of the Citadel Canal/Moat	- The subproject by improving land drainage, environmental sanitation, river water quality, and enabling a better riverbank environment, will benefit the whole community.	- No land acquisition will be necessary. On the Citadel side the moats banks are on public and protected land; on the other side, communities are living along the moat but are separated by a road, which limits the impacts on properties. - No cost for land acquisition.	- No specific risks anticipated.	- Compensation at replacement cost for the loss of land and non-land assets, and an assistance package. - Development of awareness program to prevent dumping of solid waste into the river should also be considered. This will contribute to enhance citizen participation for environmental protection.
Park, paths, Drainage and Lighting in An Van Duong Development Area Park and Square in Administration Area, An Van Duong	- These subprojects are aimed at improving landscaping and greening the area and will benefit the neighbouring communities. - No land acquisition is expected.	- Land acquisition for the large roads—100 m wide—and for the park has already been completed.	- No specific risks anticipated.	None
Rehabilitation/ Embankment of Dong Ba River	- The subproject by improving land drainage, environmental sanitation, river water quality, and enabling a better riverbank environment, will benefit the whole community. - Proposed pathway will benefit the neighbouring community.	- Limited land acquisition is anticipated; 250 m2 of agriculture land—5 HH, and 30 m2 of residential land—5 HH—will be acquired; 5 HH affected through loss of structures; no HH to be relocated; - Most of the land needed for the subproject has already been acquired. The width of the acquired land is 6.0m from the embankment. Only on the right bank of the river in the section	- Risks related to impacts on potential vulnerable HH—illegal encroachers, landless.	- Compensation at replacement cost for the loss of land and non-land assets; - Provide compensation for non-land assets in case of illegal occupation. - Development of awareness program to prevent dumping of solid waste into the river should also be considered. This will contribute to enhance citizen participation for environmental protection.

Proposed Subprojects	Social Benefits	Potential social/ resettlement impacts	Social Risks	Mitigation measures
		K+475 to K+578 is the land area limited due to its proximity to a residential area—the distance from the embankment to existing houses is only 3.5m—and the land up to 6.0m from the embankment should be acquired, but the amount of land to be acquired is limited—estimated at about 300m2—and not one house will be removed. - Tenure status of some houses to be checked—possible encroachment on public land; - Costs of land acquisition around US$ 424,000.		
Rehabilitation/ Embankment of An Cuu River	- The subproject, by improving land drainage, environmental sanitation, river water quality, and enabling a better riverbank environment, will benefit the whole community. - Proposed linear will benefit to the neighbouring community.	- Land has already been cleared along part of the proposed subproject, therefore no land acquisition will be neccesary. - Tenure status of some houses to be checked—possible encroachment on public land. - Costs of land acquisition, US$ 23,000.	- Risks related to impacts on potential vulnerable HH—illegal encroachers, landless.	- Compensation at replacement cost for the loss of land and non-land assets, and an assistance package. - Provide compensation for non-land assets in case of illegal occupation. - Development of awareness program to prevent dumping of solid waste into the river should also be considered. This will contribute to enhance citizen participation for environmental protection.
Rehabilitation/ Embankment of Nhu Y River	- The subproject by improving land drainage, environmental sanitation, river water quality, and enabling a better riverbank environment, will benefit the whole community. - Fishermen's community to be protected as much as possible.	- A densely populated area, with mainly fishermen, will be affected by the subproject, and 3,145 m^2 of residential land—37 HH—will be acquired. - 37 houses will be affected and 16 HH will need to be relocated. - Fishermen have built temporary houses on the river bank or over the river for fishing; fishing is their main source of income, but is	- Fishermen's community to be affected by the subproject; income of fishermen to be affected, especially during the construction period. Community may also be vulnerable—they rely on fishing in the river, which is illegal.	- Compensation at replacement cost for the loss of land and non-land assets and an assistance package. - Assess impacts on fishermen during RP preparation, and determine if fishermen can keep temporary houses after construction of the embankment, or if they will have to be relocated. - Conduct meaningful consultation with fishermen to identify income restoration measures if they have to move.

Proposed Subprojects	Social Benefits	Potential social/ resettlement impacts	Social Risks	Mitigation measures
		however an illegal activity. - Costs of land acquisition around 323,625.	- This subproject may be an opportunity to relocate the community to provide better sanitation and social services if new sources of income are provided.	- Assist fishermen during the transition period. - Development of awareness program to prevent dumping of solid waste into the river should also be considered. This will contribute to enhance citizen participation for environmental protection.
Section of Central in An Van Duong Development Area, including Bridge	- The proposed road, a 100 m wide, will pass through villages on both sides of the river causing serious disruption of existing communities—relocation of around 60 houses. - If the road is downsized as an urban boulevard with pedestrian and cycling paths, and connection to existing road network, it may improve accessibility to the city center and improve safety for all road users.	- Significant impacts on land acquisition and land acquisition due to RoW—100 m. 18,797 m2 of agriculture land—75 HH, and 3,828 m2 of residential land—300 HH—will be acquired. - Road will go through a populated residential area along the Nhu Y River; number of houses affected—100—and 40 HH to be relocated. - The whole community may also be temporarily relocated while new resettlement sites will be prepared along the main roads; HH will be temporarily relocated and will return to their former locations once the RS completed. - High costs of land acquisition, US$ 1.436 Million.	- Serious risk of disruption of existing community. - Risks related to relocation—40 HH—which may lead to social disruption. - Risks of delay of construction of RS may put the temporarily relocated HH, pending construction of RS, in a precarious situation.	- Current design to be reviewed to reduce impacts on the existing community. - Detailed impact assessment needed to evaluate this subproject with its serious social risks. - Meaningful consultation needs to be conducted to develop options for relocation. - Assistance for temporary relocation to cover the period until RS is ready and fully serviced. - Compensation at replacement cost for the loss of land and non-land assets, and an assistance package. - Income restoration measures to be discussed with HH severely affected through loss of productive land—provision of input or equipment, training etc.—to be discussed with farmers.
Bui Thi Xuan Road	- The road upgrading intends to provide better connections to the historic monuments, and other tourist attractions in the area. - Sidewalks and lighting may improve safety for residents along the road. Bicycle lanes shared with pedestrians on the 3m wide sidewalks are proposed; they could be used by both	- The design was revised with the reduction of the RoW from 19.5m to 13.5m by reducing the driveway from 10.5m to 7.5m, and the sidewalk from 4.5m to 3.0m. - Even with the RoW reduction, the subproject will have significant impacts on land acquisition:	- Community structure to be affected by the enlargement of the road. - Risks related to relocation—40 HH—which may lead to social disruption.	- Road width should be reduced to 7m with pavement on one side only, and provision made for a dedicated cycling lane. - If the subproject is implemented, in addition to compensation at replacement costs, the issue of relocation of HH will be critical. - Resettlement sites should be developed close to the existing location to maintain

Proposed Subprojects	Social Benefits	Potential social/ resettlement impacts	Social Risks	Mitigation measures
	residents and tourists, and will contribute to develop eco-tourism activities in the area.	11,000 m2 of agriculture land—25 HH, and 11,849 m2 of residential land—75 HH—will be acquired; 40 HH will need to be relocated due to road upgrading on 3,0 km through a densely populated area; current Bui Thi Xuan road is narrow in some areas. - High cost of land acquisition, US$ 2.436 Million.		the community structure, to preserve the social networks, and to allow relocated HH to continue their livelihood or to create opportunities for new livelihoods.
Huyen Tran Cong Chua Road	- This subproject aims to bring more tourists in Thuy Bieu commune—South-West of Hue City—by enlarging a rural road up to 16 meters—2 lanes with sidewalks—passing through a rural area but not densely populated; moderate impacts on land acquisition are anticipated. - Bicycle lanes shared with pedestrians on the 3m wide sidewalk are proposed; these could be used by both residents and tourists, and will contribute to develop eco-tourism activities.	- Road widening would increase from 3.5m to two carriageways of 5m each, together with pavements of 3m on either side—total corridor of 16m. This would require significant land acquisition 2,628 m2 of agriculture land—30 HH, and 4,887 m2 of residential land—95 HH—will be acquired; 95 houses affected and 30 HH will need to be relocated. - Presence of cemeteries along the road likely to be affected. - High cost of land acquisition, US$ 1.043 Million.	- Community structure to be affected by the enlargement of the road. - Risks related to relocation—30 HH—which may lead to social disruption.	- Impacts on the widening and traffic—more tourist buses—on the existing community to be assessed. - Road widths could be reduced to 7m with a pavement on one side only and provision for a dedicated cycling lane to reduce land acquisition. - If the subproject is implemented, in addition to compensation and replacement costs, an assistance package, the issue of relocation of HH will be critical. Resettlement sites should be developed close to the existing location to maintain the community structure, to preserve the social networks, and to allow relocated HH to continue their livelihood or to create opportunities for new livelihoods.
Vy Da Bridge and approaches	- The subproject will contribute to improved public safety, the enhancement of the liability of the city, and qualitative improvement of life in Hue.	- The approach roads are located in a densely populated urban area close to the city center. - Widening the bridge from 14m to 30.0m, and the two approaches from 20m-26m to 36.0 m will result in significant land acquisition: 4,200 m2 of agriculture land—40 HH, and	- Risks related to relocation—40 HH—which may lead to social disruption.	- The proposed widening includes provision for large pavements should be downsized to reduce the costs of land acquisition. - Compensation at replacement cost for the loss of land and non-land assets, and an assistance package. - Resettlement sites should be developed close to the existing homes to maintain

Proposed Subprojects	Social Benefits	Potential social/ resettlement impacts	Social Risks	Mitigation measures
		3,500 m2 of residential land—55 HH—will be acquired. The 55 houses affected and 40 HH will need to be relocated. - Land acquisition costs, US$ 2.431 Million.		current livelihoods.

Source: PPTA Consultants

4.5 Environmental Assessment

The Program will rely on the country's environmental safeguard system. Environmental impact assessments (EIAs) of subprojects are carried out by the Project Management Units (PMUs) through their EIA Consultants. No parallel EIA or initial environmental examination (IEE) has been prepared by the Program Preparation Technical Assistance (PPTA) Team. The status of EIA undertaking by the three participating cities at the time of the preparation of this report is: (i) each city is preparing one EIA report (EIAR) covering all of its proposed subprojects; (ii) the revision of draft EIARs for the Ha Giang is now underway, since the EIA consultant has received latest data on subprojects from the FS consultant; (iii) Vinh Yen subprojects is pending receipt by EIA consultants of the revised feasibility study reports; and (iv) the EIA consultant for Hue has yet to be engaged.

The Safeguard Policy Statement (SPS) of the Asian Development Bank (ADB), excludes Category A projects under a results-based lending (RBL) program. Hence, the PPTA Team carried out rapid environmental assessments (REAs) to determine the environmental categories of the subprojects. The REA findings are presented in this section and detailed as **Appendix 8**. The REAs have been shared with the EIA consultants of Ha Giang and Vinh Yen, and the PMU of Hue.

4.5.1 Environmental Benefits, Positive Impacts and Green Features

When completed, the subprojects will bring about environmental benefits and positive impacts, and will contribute to green growth. (**Table 4-22**).

4.5.2 Potential Issues, Concerns, Impacts and Mitigation Measures

Relative to Siting, Planning and Design

The screening process revealed any combination of the following siting issues/concerns in the main influence areas of all subprojects: (i) dense population and heavy development activities; (ii) losses associated to land or right-of-way acquisition; (iii) presence of utility lines; (iv) presence of trees and vegetation; (v) presence of surface water bodies, either crossed over, adjacent or close to subproject sites; (vi) vulnerability of sites to flooding during heavy rains; and (vii) potential presence of graves. In Hue, dredging, embankment, channel improvement, drainage and pavement works are proposed in, and around, the Citadel. (**Table 4-23**)

Relative to design, the salient concerns would be the inadequate consideration or incorporation in the respective designs of the above siting concerns, the sensitivity of infrastructure to climate change impacts as shown in **Table 4-24**, vulnerability of the cities to earthquakes and other natural hazards, and the following:

- Capability of the operator to maintain and repair the completed infrastructure.
- Sensitivity of groundwater and soil around the wastewater treatment plant and sanitary landfill.
- Provisions for groundwater monitoring wells at strategic locations near the wastewater treatment plant and sanitary landfill sites.
- Closure plan to restore—or at least mitigate the disturbance to and blend with—the landscape at the sanitary landfill site.
- The protection of slopes created from road subprojects that require cutting of hills.
- Demand for, availability of and sources of raw aggregates for construction.

During Program preparation, measures have been taken to minimize the above concerns:

- The REA findings have been shared with the EIA Consultants to ensure adequate considerations are made in the assessment, and appropriate measures relative to design are provided in the EMP.
- The basic subproject designs, carried out by local consultants, have been technically assessed by the PPTA team, who proposed greener alternatives, when possible, taking into account flood risk, climate change and environmental aspects. Moreover, non-structural measures have also been proposed for future implementation. Their aim is to optimize performance, durability and sustainability of the designed infrastructure in a more effectively resilient and low impact way. Some of these measures are related to decision support system tools and capacity building so as to improve management and operations.

Table 4-22. Environmental Benefits, Positive Impacts and Green Features

Subproject Type	Benefit/s	Positive Impact/s	Green Feature/s
Drainage, eco-channel, canal rehabilitation or improvement	• Improved stormwater management • Improved stream, river, lake, channel, and canal flow capacity	• Improved environmental sanitation • Flooding alleviated • Improved water quality of water bodies • Reduced risks of human contact with sewage overflowing from sewers during flooding	• Supports disaster risk management • Contributes to the livability of, and improved quality of life in the cities
Dredging of rivers and lakes	• Improved river channel capacity and its ability to convey water. • Improved storage capacity of lakes.	• Flooding alleviated or land drainage improved • Improved environmental sanitation • Improved water quality of the rivers and lakes and eventually, improved fish and aquatic habitat	• Supports disaster risk management • Restores natural resource efficiency and quality • Contributes to the livability of, and improved quality of life in the cities
Embankments	• Stabilized banks of lake and rivers	• Bank erosion alleviated • Improved water quality of the rivers and lakes, and eventually, improved fish and aquatic habitat	• Supports disaster risk management • Restores natural resource efficiency and quality • Contributes to the livability of, and improved quality of life in the cities
Parks, greening and trees; tree planting on sidewalks	• Enhanced cityscape, more vegetated areas and trees in the cities	• City becomes more conducive to habitation by birds, insects, etc; and physical activities or exercise, e.g., walking, running, biking, amd promoting public health • Improved release of O_2, capture of suspended particles, GHG absorption, CO_2 storage, noise absorption, thus, enhancing ambient air quality • Reduced heat stress • Increased rain capture, water storage and increased soil absorption of rainwater, alleviating flooding in the cities.	• Contributes to reduced GHG emissions • Supports disaster risk management • Fosters urban biodiversity • Contributes to livability of, and improved quality of life
Exhibition/linkage center for business support	• Facilitated growth in green production	• Less depletion of natural resources with the creation of products that can be partially or fully re-used or reclaimed • Minimized emissions; hence, reduced waste for disposal and reduced pollution	• Supports resource conservation • Contributes to the improvement of the quality of environment • Contributes to livability of, and improved quality of life

Subproject Type	Benefit/s	Positive Impact/s	Green Feature/s
Roads and bridges	• Improved mobility and access • Improved road surfaces	• Reduced travel time • Improved public safety on roads • Improved access of people in: communes and new urban areas to services and jobs in the city center; and the city center to recreational and tourism services outside.	• Supports energy conservation • Contributes to reduced GHG emissions • Contributes to livability of, and improved quality of life in the cities
Sanitary landfill	• Improved solid waste disposal	• Improved environmental sanitation • Air, water and land pollution mitigated.	• Controls and manages GHG emissions • Contributes to livability of, and improved quality of life in Ha Giang and Hue
Sewerage system, wastewater treatment and tertiary wastewater sewers	• Improved municipal wastewater management	• Improved environmental sanitation • Reduced risks of human contact with sewage from combined sewers during flooding	• Contributes to livability of and improved quality of life in Vinh Yen
Water supply system extension	• Increased coverage of reliable supply of potable water to about 450 households in three villages • Water supply for future solid waste facility.	• Improved health and sanitation	• Contributes to improved quality of life in the three villages currently without potable water supply

Source: PPTA Consultants

Table 4-23. Issues/Concerns Relative to Siting

Issues/Concerns	Ha Giang	Hue	Vinh Yen
Socio-Economic			
Population density	• Subject to drainage works - the densely populated sections of Minh Khai, Tran Phu and Nguyen Trai Wards	• Sites of works in and around the Citadel; other dredging and embankment works; and some road and bridge works – in city center	• Sites of wastewater collection system works - densely populated sections in the city
Development activities	• Subject to drainage works – city center wards of Minh Khai and Tran Phu.	• Sites of works in and around the Citadel; other dredging and embankment works; and some road and bridge works – in city center	• Sites of wastewater collection system works – in city center
Other socio-economic concerns	• Losses and physical relocation associated with land or right-of-way acquisition • Existing water supply mains and tertiary water supply pipes in or crossing or close to footprints of drainage works	• Losses associated with land or right-of-way acquisition • Existing utility lines and power supply poles in drainage, pavement and road works • Railway crossing Ke Van River and An Hoa River	• Losses associated with land or right-of-way acquisition • Existing utility lines and/or power supply poles in or crossing, or close to, sections of road works and sites for wastewater collection and treatment

Issues/Concerns	Ha Giang	Hue	Vinh Yen
	• Narrow alleys and traffic flows on main roads in the main influence area of drainage works • Traffic flow on the National Road Number 2 • Power supply poles in, or adjacent to, the proposed works at the National Road Number 2 • Rice fields adjacent to subproject footprints.		works • Rice growing, duck raising and/or aquaculture activities adjacent to subproject footprints.
Physical Cultural			
Cultural heritage	None	• Improvement of Citadel Canal located in the buffer area of the Citadel[1] • The Royal River, zoned as a world heritage property inside the Citadel[1] – drainage and pavement rehabilitation will include works at eight locations—discharging points—along the riverbank. The Royal River is the main receiving water body of combined storm and wastewater collected by the existing drainage system in the Citadel. Drainage improvements will improve the quality of life of residents in the Citadel.	None
Other physical cultural resources	• Potential graves in, or close to road works' footprints	• Potential graves in, or close to road works' footprints	• Potential graves in, or close to road works' footprints
Biological			
Presence of trees and other vegetation	• Presence of trees and other vegetation - in, or adjacent to almost all subproject footprints	• Presence of trees and other vegetation – in, or adjacent to, almost all subproject footprints	• Presence of trees and other vegetation – in the alignment of road works and wastewater treatment plant site
Physical			
Proximity to wetlands—including water resource/s	• Lo River, Mien River and Me Stream - subject to embankment works • Lo River – to be crossed by bridge works road works along the east bank of its southern section	• Rivers and lakes - sites of dredging, embankment and bridge works.	• Dam Vac Lake and Phan River - sites of dredging works. Vac Swamp is one of the five marshes and swamps that are among the 68 wetland sites of biodiversity and environmental values existing in the country.[2]
	• Mien River – both sides subject to road works	None	• Road and wastewater collection system works will either cross, or be adjacent or

Issues/Concerns	Ha Giang	Hue	Vinh Yen
	• Drainage streams - subject to cleaning and rehabilitation works		close to, streams and/or ponds.
Vulnerabilities, Climate Change, Disaster Risks			
Vulnerability to flooding	• Sites for, and main influence area of drainage and some road works - vulnerable to flooding during heavy rains. • Flooding in the city is mainly caused by overflows of rivers. Causes are any one or combination of increase in flows particularly during heavy rains, water releases from upstream dams and/or limited or reduced capacity of urban drains.	• Citadel – subject to recurrent flooding • Sites for, and main influence areas of dredging, embankment, drainage, pavement and canal improvement works–vulnerable to flooding • Hue City is some 18 km from the East Sea, also affected by sea level rise via tidal Perfume River. City is located in the lower part of Perfume River basin. Heavy rains and high waters from river basins also cause flooding.	• Sites for, and/or main influence area of wastewater collection, wastewater treatment plant and road works - vulnerable to flooding during heavy rains • Vinh Yen City is located in the Phan-Ca Lo River Basin, which is a highly meandering system of small rivers, with several lakes, ponds and canals, rendering the City highly prone to flooding. Rivers overflow when water level rises 8/9 m.
Seismicity	• City - within “least to moderate” seismicity zone [3]	• City - within “least” seismicity zone [3]	• City - within “moderate” seismicity zone [3]
Landslides	• Subproject sites are not in, or close to, highlands that are prone to landslides	None	None
Other hazards	• Whirlwinds and ice rain experienced in the city.	None	None
Climate change	• Changes in temperature, precipitation, or extreme events patterns–could affect the sustainability of proposed subprojects.	• Changes in temperature, precipitation, or extreme events patterns – could affect the sustainability of proposed subprojects.	• Changes in temperature, precipitation, or extreme events patterns – could affect the sustainability of proposed subprojects.

[1] The Monument and Site Protective Zoning Map – Citadel of Hue, Hue Monuments Conservation Center, dated 2011 and obtained from http://whc.unesco.org/.
[2] Vac Swamp is not among the 8 Ramsar sites in Viet Nam (as of 15 June 2015) and not among the 16 wetlands recognized by the GoV (per Appendix D: Wetland Sites of Biodiversity and Environmental Value in Viet Nam in the Overview of Wetlands Status in Viet Nam Following 15 Years of Ramsar Convention Implementation, Viet Nam Environmental Protection Agency, 2005.
[3] Based on Earthquake Hazard/Earthquake Risk Assessment in Vietnam, Seismic Risk Management Asia Pacific Region, Dec 2003.

Source: PPTA Consultants

Table 4-24. Sensitivity of Program Infrastructure to Climate Change Impacts*

Subproject Type	Increased temperature	Increased very hot days	Decrease in rainfall	Increase in precipitation	Increased frequency & intensity of storms	Increased intensity of extreme wind
Bridge	√	√		√	√	√
Drainage		√	√	√	√	√
Embankment				√	√	√
Road	√	√		√	√	
Sanitary landfill	√	√		√	√	√
Wastewater collection and treatment			√	√	√	√
Water supply extension (potential tanks)	√	√	√	√	√	√

Source: PPTA Consultants

Notes:

* **Appendix 8** gives sample impacts of climate-induced changes on the above infrastructures.

√ = Subproject type is sensitive to particular climate change impact.

During Construction

Local air pollution from dust, gas emissions and noise, surface water resources problems and associated impacts on aquatic ecosystems, removal of trees and vegetation, impacts on the sustainability of urban services, traffic and road blocking, blocked accesses, temporary local flooding, accidental damage to existing utility lines and community and workers' health and safety hazards are the temporary issues, concerns and impacts during construction. These are reversible that can be mitigated through simple or uncomplicated measures, integral to socially and environmentally responsible construction practices. Impacts relative to the extraction of natural aggregates may be mitigated by obliging contractors to obtain aggregates only from quarries that are still operating within the allowed extraction threshold according to their environmental clearances and permits to operate.

Dust during construction, impacts will come from earthworks, quarrying for aggregates, rock crushing, transport of fine aggregates and residual soils, movements of construction vehicles over unpaved roads, unloading or loading of fine aggregates and residual soils, and dry exposed areas. Gas emissions and fumes will be generated by the movement and operation of construction vehicles and equipment, asphalt processing, burning of waste, use of hazardous substances, such as those emitting volatile organic compounds (VOCs). Noise will be generated from the operation of equipment and movement of vehicles, especially those that are run by diesel, are poorly maintained, and have inefficient mufflers. Construction activities, such as drilling, excavation, breaking of pavements, unloading of aggregates, concrete mixing, and rock crushing, among others, will also emit noise. Vibration will be caused by the aforementioned activities and intensity will depend on the sensitivity of the ground conditions of the site.

Water resources at, near to or downstream of the subproject sites will be exposed to impacts from: (i) sedimentation or siltation caused by indiscriminate earthworks; (ii) improper management of dredged materials, waste and hazardous substances; (iii) irresponsible stockpiling of aggregates; (iv) leaks or accidental spills of materials, particularly hazardous substances and waste; and (v) poor sanitation practices of workers. Polluted surface waters will be detrimental to aquatic biodiversity.

Dredging activities will temporarily change the natural flow of a river or lake. Often, such a change in water flow destroys aquatic habitats. Dredging of river beds or lakes will destroy existing aquatic habitats, and life in the dredging influence area.

Removal of trees and vegetation will be inevitable in most works. Planning must ensure that no indiscriminate removal will occur. Prior to the removal of trees in the urban area, the following must be obtained: (i) the approval of the City People's Committee in Ha Giang and Hue; and (ii) an agreement among the Provincial People's Committee (PPC) and Urban Environment Company (URENCO) of Vinh Phuc, and the PMU of Vinh Yen.

The following will potentially impact on the sustainability of urban services:

- Inadequate management of waste, silt and aggregate stockpiles will mean that these materials will reach the drainage system; thus, compromising their effectiveness.
- Indiscriminate dumping of waste generated during construction will strain the capacities of URENCO/HEPCO in waste collection services, in keeping the cities clean.
- Volumes of solid waste will be deposited into the cities' disposal sites.
- Accidental damages to utility lines during construction will cause the disruption of services.

The existing traffic volumes in the three cities are generally low; at peak hours, moderate. The volume of vehicle movements generated from, and the likely closure of some roads and lanes leading to, the construction activities will cause traffic build-up and choke points.

- In Ha Giang, at intersections—some three-way—closest to drainage and road works in populated areas.
- In Hue, in the vicinities of the: (i) citadel affected by the drainage, dredging and embankment works; and (ii) road improvement or expansion works at or near to the city center.
- In Vinh Yen, in the vicinities of the wards for the works on tertiary wastewater sewers and sewerage system.

Road and access blocking during construction will cause public inconvenience and disruption of socio-economic activities, and pose safety hazards. During the rainy season, the impact will be worse, especially when local flooding occurs. When surface drainage is impeded by construction activities and stockpiles, and when existing drainage systems are clogged with construction debris and sediments, local flooding is inevitable during the rainy season.

Existing utility lines at or adjacent to work sites are exposed to accidental damage. Deferred repair of damages will cause: (i) inconvenience to affected households and socio-economic activities; (ii) disruption of socio-economic activities; and/or (iii) contamination of water supply.

During construction, public health and safety will be exposed to hazards and risks associated with dust, gas emissions, noise, vibration, poorly managed waste and hazardous substances, disruption of urban services, traffic, road and access blocking, open excavations, potential transmittable diseases from the construction workforce, potential fires and explosions, among others.

The health and safety of construction workers will be exposed to dust, gas emissions, noise, vibration, wastes and hazardous substances, movement and operation of construction equipment, open excavations, potential fires and explosions, and the weather, among others. The possibility of finding unexploded ordinance (UXO) also poses risks to workers' safety.

Measures to keep construction impacts in subproject sites to the minimum or acceptable levels are mostly good engineering and construction practices, commonly used at construction sites in urban settings. These are known to contractors, and can easily be instituted without difficulty. Some of these are shown in **Table 4-25**. The effective conduct of the following are additional, but crucial mitigation measures: (i) including the EMP, which is prepared based on the approved EIAR, in the bidding document package; (ii) construction management by the contractor; (iii) EMP implementation by the contractor; (iv) construction supervision and close monitoring of EMP implementation by the PMU; (v) observance of a Program grievance redress mechanism by all concerned parties; and (vi) community participation in the monitoring of EMP implementation.

Table 4-25. Environmental Codes of Practice during Construction

Issues/Concerns/ Impacts	Some Mitigation Measures
All issues, concerns and impacts	The Contractor shall implement the EMP, addressing, as minimum, the requirements of the EMP that will be prepared after EIAR approval, and based on the Environmental Management and Monitoring Programs featured in the approved EIAR.
Air pollution:	The Contractor shall: • Be responsible for complying with QCVN 05:2013/BTNMT, on ambient air quality.
(i) Dust	• Prepare and implement a dust control plan to minimize dust generation, ensuring: (i) dust is not causing a nuisance to the surrounding communities; and (ii) the working environment is safe. • Include in the dust control plan such measures as: (i) segmentation of works; (ii) watering of dry exposed surfaces, stockpiles of fine aggregates and soil at least twice a day, or as necessary; (iii) locating stockpiles against prevailing wind directions and providing wind barriers around stockpiles; (iv) for trucks to have tarpaulin cover on aggregate and waste loads and maintaining a minimum of 2' freeboard; and (v) minimizing drop heights and spraying water when loading or unloading dry aggregates.
(ii) Gas emissions	• Enforce all construction-associated vehicles to comply with GoV's regulations on vehicle emission standards, and ensure they have valid "certificates of conformity from inspection of quality, technical safety and environmental protection" following Decision No. 35/2005/QD-BGTVT. • Apply and use clean technology, such as: (i) asphalt processing at lower temperature; (ii) recycled asphalt, if feasible or would not impact on the service life and technical qualities of the structures; (iii) technologies and machinery with pollution control devices; (iv) low VOC emitting materials; and (v) clean-fueled equipment. • Limit equipment idling to five minutes. • Prohibit waste burning; dispose waste at the designated disposal site/s promptly. • Enforce rules on workers to wear provided protective nose masks.
Noise and vibration	The Contractor shall: • Be responsible for complying with QCVN 26:2010/BTNMT, on permitted maximum noise levels in public and residential areas, and QCVN 27:2010/BTNMT, on permitted maximum levels of vibration from construction and industrial activities in public and residential areas. • Set up noise barriers, e.g., temporary fences, enclosures around generator sets. • Restrict noisy and vibrating operations within the prescribed time period for daytime noise and vibration according to respective standards. • Use only equipment that emits least noise and vibration, e.g., electrically powered equipment, hydraulic tools with efficient mufflers and silencers. • Enforce turning off of equipment when not use.
Water resources problems	The Contractor shall: • Be responsible for complying with QCVN 08:2008/BTNMT, on surface water quality. • Prepare and implement the following plans with measures not limited to those below: - Eco-friendly wastewater, solid and hazardous waste management plans: (i) providing adequate sanitation facilities and water supply, adequately managing wastewater from sites and workers' camps; (ii) enforcing proper sanitation practices upon workers and suppliers; (iii) minimizing waste generation through reuse and recycling; (iv) adequate handling and storage and prompt disposal of solid and hazardous waste; (v) restricting maintenance of vehicles and equipment on site; and (vi) enforcing on workers rules to implement environmental sanitation. - Drainage and sediment control plan: (i) silt fences, barrier nets, stilling humps, etc.; (ii) stockpiling on flat grounds, and away from, not obstructing, main surface drainage routes; (iii) maintaining drainage system; and (iv) minimizing the necessary disturbance of slopes and protecting disturbed slopes. • Using less hazardous substances and storing no more such substances on site than needed in the short period.
Removal of trees and vegetation	The Contractor shall: • Prepare and implement a Vegetation Clearance and Restoration Management Plan, to include such measures as: (i) obtaining the necessary approval from the CPC; (ii) avoiding unnecessary removal of trees and vegetation; (iii) providing temporary fences or markers to guide vehicle movements and parking; and (iv) replacing or restoring removed trees and

Issues/Concerns/ Impacts	Some Mitigation Measures
	damaged vegetation in coordination with the concerned CPC.
Traffic and road blocking	The Contractor shall: • Prepare and implement a traffic management scheme, coordinated with local traffic authorities and affected communities, with such measures as: (i) posting notices on road closure, traffic rerouting plan at strategic places, at a minimum one week before effectivity; (ii) posting traffic (flag) persons during all working hours; (iii) spreading the schedule for materials delivery in non-peak hours; and (iv) enforcing proper vehicle and equipment parking within agreed areas.
Blocked accesses	The Contractor shall: • During IEC, prior to mobilization, inform communities regarding work phasing and schedules, anticipated access blocking, provisions for safe access for blocked properties, etc. • Provide safe accesses to blocked properties, e.g., steel planks of adequate grade, width and length, and if necessary, with guide rails.
Accidental damage to utility and service infrastructure	The Contractor shall: • During mobilization coordinate with relevant utility companies for the exact locations and set contact arrangements in case of damage/s. • In case of accidental damage, advise the concerned utility company and/or the PMU, at once. • Give at least one week prior notice on planned service interruption due to relocation of existing utility lines and/or for interconnection and streamlining.
Community health and safety	The Contractor shall: • Prepare and implement a community safety plan in coordination with the affected wards and communes that includes: (i) the grievance redress mechanism; (ii) measures to mitigate access blocking, local flooding, accidental damage to existing utility and service infrastructure and its impact; (iii) structural measures to restrict the public from accessing the main influence area of subproject; and (iv) emergency response plan and system. • Have a well-trained, well-equipped emergency response team. • In collaboration with the PMU, conduct adequate social preparation on construction activities, associated health and safety risks, and grievance redress mechanism, at least one month before award of Contract.
Workers' health and safety hazards	The Contractor shall: • Be responsible for complying with Labor Code. • Orient workers prior to mobilization on occupational health and safety hazard, and strict observance of safety measures, including the procedures to follow when encountering chance find of UXO. • Strictly enforce rules on workers' use of personal protective equipment. • Provide safe accommodation with reliable potable water supply and adequate sanitation facilities. • Conduct regular drills on emergency situations and emergency response.
Restoration of affected areas	The Contractor shall: • Restore the borrow pits that will no longer be in use, disposal areas, site facilities areas, workers' camps, stockpiles areas, working platforms and any areas temporarily occupied during construction of the subproject works. • Start revegetation at the earliest opportunity: (i) use the appropriate local species of vegetation; and (ii) plant trees and grass on exposed land, and on disturbed slopes to prevent erosion and collapse. • Re-profile spoil heaps and excavated slopes. • Remove all contaminated soil, and haul and bury in designated disposal areas. • Restore all access roads and bridges damaged by subproject activities.

Source: PPTA Consultants

During Operation

During the operation, the main potential environmental impacts relate to the operation of the sanitary landfill sites and the wastewater treatment plant, and of other works, but to a lesser extent. Anticipated or potential impacts and concerns include, among others:

- From sanitary landfill operations in Ha Giang: (i) dust, gas emissions and odor; (ii) water resource problems from inadequate management and treatment of leachate and gas; (iii) influx of insects, rodents and pests; (iv) workers' health and safety hazards; and (v) health and safety hazards of few households residing along, and road users of the main road leading to the landfills.
- From the operation of the wastewater treatment plant in Vinh Yen: (i) local air pollution due to gas emissions and odor; (ii) water resource problems such as contamination from substandard effluent discharge and eutrophication of nearby river/stream; (iii) water and soil contamination from potential overflow of ponds and spread of untreated wastewater during extreme weather events; (iv) waste and sludge disposal; (v) community and workers' health and safety hazards and risks, as well as nuisance, associated with odor, gas emissions, ground water pollution, and vectors; and (v) workers' health and safety hazards from exposure to chemicals used in operations, contact with raw sewage or wastewater during repair, maintenance and emergency response works.
- From completed roads, in sections passing through existing residential and developed areas, among others: (i) safety hazards; (ii) disruptions in the existing way of life, and social patterns and activities enjoyed by the residents; (iii) nuisance and health hazards from increasing traffic, noise, vibration, air emissions; and (iv) potentially, local flooding if drainage in surrounding areas is impeded because of a new road's higher elevation.
- From completed roads, in sections passing through agricultural lands, and possibly land used for aquaculture, among others: (i) safety hazards of rice farmers and/or owners of fishponds; and (ii) severed farm units, which could mean potential disruption in irrigation services and drainage patterns, and potential access constraints.
- For water supply extension: (i) unsustained reliability of supply because of inadequate consideration in design of decrease in precipitation or drought; and (ii) delivery of unsafe water due to the delay in repairs of broken pipes.
- Completed works unable to sustain their effectiveness over their life because of inadequate consideration and incorporation of the following in designs: (i) considerations of growth; (ii) incorporation of increasing precipitation and temperature, hazards and risks arising from climate change, as well as seismicity in the Program cities; and/or (iii) crossing streams and sustaining their hydrology.
- Unsustained effectiveness of services of all completed works and because of insufficient operation and maintenance (O&M) budgets and/or lack of O&M capacity.

The magnitude of impacts arising from the operation of completed works will depend on the degree of environmental considerations made from the start of subproject development through to operation. Some basic non-structural mitigation measures are as follows: (i) appropriate incorporation in designs the recommendations arising from the analyses applying DSS and from the technical assessment that recommend green facilities and low impact development technologies; (ii) effective supervision of detailed design and construction, and performance monitoring by the PMU; (iii) quality construction by the contractors; (iv) sufficient provisions in the annual budget for operation, maintenance and repair, as well as for emergency response; (v) undertaking the recommended environmental effects monitoring during operation; (vi) prompt action to raised issues, concerns and grievances; (vii) operators to engage and designate a staff to oversee EMP implementation and prepare the required environmental monitoring reports; and (viii) conduct of engineering investigation after every natural hazard, and take prompt action on damages. Some specific measures are shown as **Table 4-26**.

Table 4-26. Environmental Codes of Practice during Operation

Issues, Concerns and Impacts	Some Mitigation Measures
All issues, concerns and impacts	The operators of all completed subprojects shall implement the EMP, addressing at a minimum, the requirements that will be prepared after EIAR approval and based on the Environmental Management and Monitoring Programs featured in the approved EIAR. **The operators of the sanitary landfill and wastewater treatment plant (WWTP)** shall formulate and implement their respective Operations Manual that incorporates mitigation and monitoring measures, addressing, at a minimum, the requirements of the EMP—as stated above.
Air pollution from dust, gas, odor and/or noise	**The operators of the sanitary landfill and wastewater treatment plant (WWTP) shall:** ▪ Be responsible for complying with QCVN 05:2013/BTNMT, on ambient air quality, and QCVN 26:2010/BTNMT, on permitted maximum noise level in public and residential areas. ▪ Conduct air and noise monitoring, as prescribed in the EMP. ▪ Maintain equipment promptly and keep the premises clean. ▪ Have densely treed perimeter buffer area to mitigate noise and odor. **The operator of the sanitary landfill shall:** ▪ Mitigate dust: (i) water access road, internal roads, soil cover stockpile during the dry season; (ii) enforce maximum speed for collection trucks—say, 40 kph—on access and internal roads. ▪ Mitigate gas emissions: (i) daily cover the active waste cell; (ii) make provisions for gas management and monitoring wells; (iii) recover recyclable materials that will emit volatile organics; (iv) flaring or more appropriate method for treating the gas collected; (v) install gas alarm system; (vi) provide effective bottom and side liners of active cells; and (vii) final capping of completed cells. **The operator of the WWTP shall:** ▪ Promptly maintain ponds and the entire facility. ▪ Implement proper storage and prompt disposal of sludge at the designated disposal area.
Water resource Problems	**The operators of the sanitary landfill and WWTP shall:** ▪ Be responsible for complying with QCVN 08:2008/BTNMT, on surface water quality; QCVN 09:2008/BTNMT, on ground water quality; QCVN 25:2009/BTNMT, on the quality of wastewater from solid waste landfill sites; and QCVN 14:2008/BTNMT, on domestic wastewater quality. ▪ Conduct effluent, surface water and groundwater quality monitoring as prescribed in the EMP. ▪ Collect rain water to augment water supply for operations. ▪ Implement proper storage and prompt disposal of sludge at the designated landfill.
Pests and vectors	**The operators of the sanitary landfill and wastewater treatment plant (WWTP) shall:** ▪ Keep premises clean. ▪ Implement fumigation, especially during the warm and hot season. ▪ Install or use fly traps. ▪ Use insect-repellant trees and shrubs to green the site, e.g., neem, eucalyptus, citronella, etc. **The operator of the sanitary landfill shall:** ▪ Apply daily cover, or as prescribed.
Overflow of WWTP and leachate treatment facility	**The operators of the sanitary landfill and WWTP shall:** ▪ Prepare and implement contingency measures, e.g., pump and spilling basin.
Community health and safety	**The operators of the sanitary landfill and WWTP shall:** ▪ Maintain a treed perimeter buffer area or strip, and strictly disallow unauthorized entry. ▪ Observe the grievance redress mechanism.
Workers' health and safety hazards	**The operators of the sanitary landfill and WWTP shall:** ▪ Be responsible for complying with the Labor Code. ▪ Provide protective wear and enforce their use while on the premises.

Issues, Concerns and Impacts	Some Mitigation Measures
	▪ Enforce observance of proper sanitation and hygiene practices. ▪ Orient workers prior to mobilization, on occupational health and safety hazards, and strict observance of safety measures. ▪ Set up a well-trained, well-equipped emergency response team and conduct regular drills.
Unsustained effectiveness of operations from insufficient O&M capacity	The operators of the sanitary landfill and WWTP) shall: ▪ Prepare an O&M Manual that incorporates a continuing capacity building program and budgets the financial requirements for effective O&M, including environmental mitigation, monitoring and reporting.
Unable to cope during seismic and extreme weather events	The operators of the sanitary landfill and WWTP shall: ▪ After every seismic or extreme weather event, conduct due diligence of the structural and operational integrity of facilities and implement the necessary corrective actions without delay.

Source: PPTA Consultants

During Decommissioning of the Sanitary Landfill

During decommissioning of sanitary landfill operations, gas generation, gas migration, leachate generation impacting on water resources, and damage/s during seismic or extreme weather event are the salient concerns. Mitigation measures include, among others: (i) conduct of appropriate environmental monitoring for gas, effluent from the leachate treatment facility, and ground and surface water quality; (ii) restricting access to the site by unauthorized persons; and (iii) prompt due diligence of the structural integrity of the sanitary landfill after a natural hazard.

4.5.3 Findings and Conclusions

The subprojects under the Program are not among the ADB prohibited investment activities listed in Appendix 5 of the SPS. Based on the REA, the subprojects are not environmentally critical.

All subprojects are outside "environmentally sensitive" areas, except for the drainage and pavement rehabilitation works in Hue. These include eight discharging points along the banks of the Royal River inside the Citadel. The Royal River, which is zoned as a *world heritage property,* is the main receiving water body for the storm and wastewater collected by the existing drainage system in the Citadel. The development inside the Citadel is impacted by recurrent flooding, affecting more than 650,000 residents. The subproject is necessary to improve the quality of life in the Citadel, and improve the quality of the Royal River. Impacts during construction can be mitigated by contractors without difficulty. With close monitoring of constructor's environmental performance, it is expected that impacts will not threaten the quality of the waters in, and the physical conditions of the banks of the Royal River.

For other subprojects, the most sensitive sites are the rivers and lakes that: (i) will be dredged and/or whose banks will be stabilized with embankments; (ii) will be crossed by bridge and road works; or (iii) are along road works. Preventive and mitigation measures must be taken to ensure least impacts on the relevant rivers and lakes. Proper approvals will be obtained from the PPC for the works in the buffer area of the Citadel.

The basic subproject designs have been technically assessed by the PPTA team, and greener alternatives have been proposed, where possible, taking into account flood risk, climate change and environmental aspects. Non-structural measures have also been proposed. The aim is to optimize performance, durability and sustainability of the designed infrastructure in a more effective, resilient and low impact way. Some of these are related to decision support system tools and capacity building so as to improve management and operations.

The few adverse impacts of high significance during construction will be temporary and short-term—most likely to occur only during the peak construction period. The extent of adverse impacts is expected to be local, confined within the subprojects' immediate and/or main areas of influence, sources of aggregates, waste disposal sites, and the routes to and from these sites. These will not be sufficient to threaten or

weaken the surrounding resources. With mitigation measures in place, and ensuring that the bulk of works are completed—or at least almost complete—prior to the onset of the rainy season, the potential adverse impacts during construction would be more site-specific.

The conscientious implementation of the EMP will mitigate the impacts and lower their residual significance to, at least, "moderate" levels. Simple or uncomplicated mitigation measures, integral to socially and environmentally responsible construction practices, are commonly used at construction sites in urban settings and are known to contractors. Hence, mitigation measures would not be difficult to design and institute.

Direct impacts during operation will mainly come from those of the sanitary landfill and wastewater treatment plant. Their operations are expected to be guided by respective operations manuals. If complemented with a continued capacity building program on operations and maintenance, the direct impacts are not expected to have long-term, persistent, permanent or irreversible adverse impact on human health and safety, air quality, water quality, soil quality, and the biological environment.

The Program will bring the following benefits to respective cities: (i) improved lake storage and river or channel capacities and their flows through the dredging works in Hue and Vinh Yen; (ii) improved stormwater management because of drainage works in Ha Giang and Hue; (iii) stabilized banks of rivers and lakes as a result of embankment works in Hue and Ha Giang; (iv) enhanced cityscape because of the public park in Vinh Yen; (v) improved mobility and access between city centers and suburban, new urban expansion and service areas in the three cities; (vii) improved solid waste management in Ha Giang; (viii) improved municipal wastewater management in Vinh Yen; and (ix) extended water supply coverage to three villages outside Hue.

The green features of the Program include: (i) support to disaster risk management; (ii) restoration of natural resource efficiency and quality; (iii) support to resource conservation; (iv) fostering urban biodiversity; (v) support to energy conservation; (vi) control, management and contribution to the reduction, of GHG emissions; and (vii) contribution to the livability of, and improved quality of life in the cities.

Based on these findings, it is concluded that the Program is a Category B undertaking and contributes to the realization of the respective green city vision of the three cities.

During detailed engineering design should change/s in scale, technological processes in construction or operation, or location of any subproject warrant a remake of the EIAR under the safeguard system of the GoV, it is advised that the concerned subproject/s be re-screened using the ADB process to verify if the Program's B category is retained. The PMUs shall ensure that the recommended structural and non-structural measures arising from the technical assessment of the basic subproject designs are appropriately considered and incorporated.

4.6 Poverty, Gender, and Social Assessment

This section summarises the findings of the poverty, gender and social assessment; more details are provided as **Appendix 9.**

4.6.1 Poverty Profile

The cities of Ha Giang, Hue, and Vinh Yen are experiencing rapid urban growth. Urbanization is propelled by the shift from agriculture to industry and services, and rural to urban migration. All three cities serve as the political, economic, social and cultural centers of their respective provinces. However, they are struggling to cope with the increasing demand for infrastructure and services for the growing population. **Table 4-27** shows brief profiles of the three cities.

Table 4-27. Profiles of Ha Giang, Hue and Vinh Yen Cities, 2014

	Hue City	Vinh Yen City	Ha Giang City
Land area	71.70 km2	50.81 km2	135.33 km2
Population	348,279	102,502	53,661
Number of Men	169,682 (48.72%)	52,207 (50.09%)	25,765 (49.05%)
Number of Women	178,597 (51.28%)	50,295(49.91%)	26,768 (50.95%)

Source: PPTA Consultants

Poverty rates vary among regions of Viet Nam, where the North East Mountain Region, in which Ha Giang province is located, had one with the highest poverty rates at 33.5% in 2012—based on the Gneral Statistics Office (GSO) – World Bank (WB) figures. This is higher than the overall poverty rate of Viet Nam. The poverty rate in the North Central Coast region, which includes Hue, is 21.2% which was slightly higher than that of the country. The Red River Delta, where Vinh Yen is located, had a poverty rate of 7.4% in 2012. Using MOLISA's poverty rate figures, in 2013, the poverty incidence for the province of Ha Giang was at 26.95%, Thua Thien Hue at 6.42%, and Vinh Phuc at 4.93% **(Table 4-28)**.

Table 4-28. Poverty Estimates by Region, 2010 and 2012

	GSO-WB Poverty Rate		MOLISA Poverty Rate		
	2010	2012	2010		2013
	Incidence (%)	Incidence (%)	Incidence (%)	% to total	Incidence (%)
Viet Nam	20.7	17.2	14.2	100	
Urban	6.0	5.4	6.9	14	
Rural	27.0	22.1	17.4	86	
Region					
North Central Coast (Thua Thien Hue)	28.4	21.2	24.0	20	6.42*
North Eastern Mountains (Ha Giang)	37.7	33.5	24.2	20	26.95*
Red River Delta (Vinh Phuc)	11.4	7.4	8.4	13	4.93*

*Figures for the respective provinces of Thua Hien Hue, Ha Giang, and Vinh Phuc only.
Source: World Bank, 2010 and PPTA Consultants

The average monthly income per capita in Vinh Phuc is the highest of the three Program provinces at VND 1.9 million (US$ 89), followed by Hue at VND 1.7 million (US$ 83), and Ha Giang at VND 850,000 (US$ 40). Incomes of households in Vinh Phuc and Hue are mainly from formal employment in private and public organizations; whereas the Ha Giang population is largely dependent on agriculture, forestry, and fishery (**Table 4-29**).

Table 4-29. Monthly Income Per Capita per Province, 2012

	VND '000s		
Province	Ha Giang	Thua Thien Hue	Vinh Phuc
Total	850.3	1,747.1	1,866.8
Salary or Wage	273.7	833.7	783.5
Agriculture, Forestry and Fishery	440.4	220.5	373.3
Non-Agriculture, Forestry and Fishery	76.4	496.4	516.7
Others	59.8	196.5	193.4

Source: General Statistics Office (GSO), Viet Nam Household Living Standards Survey 2012

Ha Giang City

In 2013, Ha Giang Province had a poverty rate of 29.95%. Poverty is mostly concentrated in the mountainous districts. The province has achieved progress in lowering its poverty rate from 35% in 2011 to 29.95%, in 2013. In 2014, the poverty rate of Ha Giang City was 0.48%, and the percent of households under the close poor category was 1.59% (Ha Giang PC). Four out of the city's eight wards/communes have a high incidence of poverty—Quang Trung ward, and the three rural communes of Ngoc Duong, Phuong Do and Phuong Tien. Poverty rates in these areas ranged from 1.4% to 2.7% in 2013. The number of near-poor households has decreased overall—from 5.4% in 2011 to 2.5% in 2013, but still remained slightly higher in the four wards with the worst poverty in Phuong Tien commune.

Hue City

The poverty rate of the city in 2013 was 3.1%, which was significantly lower than the poverty rate for the province at 6.42%, and also lower than the national urban average of 3.9%. The wards with highest poverty rates were Huong So and Phu Hau, with around 7% poor households, and 6% to 10% near poor households. These high poverty rates are mainly because of the number of poor households relocated there from danger and hazard prone areas during the past years. In the Citadel area, the level of poverty is similar to the average of the whole city—about 3% to 4%. Nevertheless, pockets of poor households exist, especially in Phu Binh, Vy Da, and Kim Long wards.

Vinh Yen City

In 2012, the poverty rate of Vinh Yen City was 3.4%, significantly lower than that for Vinh Phuc Province at 25.1%, and the national urban poverty average of 3.9%. Poor households are mainly located in rural communes, comprising about 5.4% of the total population, or some 1,250 households. In 2012, the poverty rates in the city-center urban wards of Dong Da, Ngo Quyen, Tich Son and Lien Bao, were significantly lower—0.6% to 1.6%, than in Vinh Yen City as a whole. Dong Tam ward, Dinh Trung and Thanh Tru communes, located in the rural areas of the city, had higher poverty rates at 4.5%, 4.1% and 9.4%, respectively during the same year.

4.6.2 Gender Profile

There is almost an equal percentage of males and females in the three cities (**Table 4-30**). There is a slightly higher percentage of female population in Hue City (51.28%) and Ha Giang City (50.95%). In Vinh Yen, the percentage of women was 49.91% in 2014. The ratio of literate women for the three cities is high, ranging from 96% to 98%.

Table 4-30. Profiles of Ha Giang, Hue and Vinh Yen Cities, 2014

	Hue City	Vinh Yen City	Ha Giang City
Population	348,279	102,502	53,661
Number of Men	169,682 (48.72%)	52,207 (50.09%)	25,765 (49.05%)
Number of Women	178,597 (51.28%)	50,295(49.91%)	26,768 (50.95%)
Total number of Female headed HHs	n/a	6.6% (3,625 out of 23,951 households)	1,054
Female in labor force (from 15 to 55 years old)		48.77% (16,957 females out of 34,767 persons)	49.9% (16,594 females our of 33,220 persons)
Percentage of females in city government leadership	10% (5 out of 43 leaders)	31% (23 out of 74 leaders)	6.39%
Percentage of females in commune leadership	25% (84 out of 331 leaders)	19.1% (17 out of 89 leaders)	n/a
Migrated females in 2013		2.32% (456 out of 19,683 people)	51.66% (436 out of 844 cases)
Ratio of literate women	98%	98%	96%

Source: PPTA Consultants

Ha Giang City

There are 13,285 women who are 18 years of age and above in the city, and some 1,054 women-headed households, of whom 26 are considered poor. The number of women working as staff and officers in the city and commune people's committees represent about 71% of the total of 1,462. At the city level, the percentage of female staff members is high, some 76%, while at the commune level—the commune peoples' committees, Fatherland Front, Women's Union, and Youth Union—female staff account for 36% of the total. (**Table 4-31**)

Table 4-31. Staffing Profile of Ha Giang City, City and Commune Levels, 2015.

Department/Agency		Number of staff				
		Female	Male	Total	% women	% women leaders
I	**City Level**					
	DOLISA	5	3	8	63%	33% (1 out of 3)
	DONRE	10	18	28	36%	
	Women's Union (City Division)	6	0	6	100%	100%
	City Administration	21	10	31	68%	
	Fatherland Front	3	4	7	43%	25% (1 out of 4)
	Youth Union	5	1	6	83%	67% (2 out of 3)
	PMU	6	3	9	67%	33% (1 out of 3)
	Water Supply and Drainage Joint Stock Company	39	71	110	35%	75% (3 out of 4)
	Education Department (Teachers)	869	201	1070	81%	
	Subtotal	**964**	**311**	**1275**	**76%**	
II	**Commune Level**	68	119	187	36%	
	Total	**1032**	**430**	**1462**	**71%**	

Source: Department of Domestic Affairs and Section of Labor, Invalids, and Social Affairs, CPC Ha Giang, August 2015

Vinh Yen City

In 2015, the female labor force participation rate of the city is 48.77%. The percentage of women leaders, at the city level is 31%, while at the commune level it is 19%. About 6.6% or 3,625 households are headed by women. Of the total migrants in 2014, about 2.32% are women. **Table 4-32** shows the detailed staffing at the city and commune levels, by gender.

Table 4-32. Staffing Profile of Vinh Yen City, City and Commune Levels, 2015.

Department/Agency		Number of staff				
		Female	Male	Total	% women	% women leaders
I	**City Level**					
	City leaders for Population Council and City People Committees	23	51	74	31.3	31.3%
	City government staff	66	83	149	44%	-
	Leaders of Population Council and CPC	1	5	6	16.7%	16.7%
	Administration Unit of CPC AND Population council	6	7	13	46%	50%
	Section for Domestic Affairs	6	2	8	75%	50%
	Planning and Financial Unit	7	1	8	87%	100%
	Urban Management Unit	3	9	12	25%	8%
	Inspection Unit	0	5	5	0	0
	Justice Unit	2	3	5	40%	66.6%
	Economics Unit	1	4	5	20%	0
	Education Unit (not including teachers)	5	2	7	71%	66.6%

Department/Agency		Number of staff				
		Female	Male	Total	% women	% women leaders
	DOLISA	6	4	10	60%	50%
	DONRE	9	9	18	50%	11%
	Cultural and Informatics Unit	3	3	6	50%	50%
	Health Unit	1	2	3	33.3%	0
	Other Units/Branches 1/	26	36	62	41%	33%
	Women's Union	7	0	7	100%	100%
	Fatherland Front	4	3	7	57.1%	33.3%
	Youth Union	7	2	9	77.7%	66,6%
	PMU	4	14	18	22%	5%
	Health Center	1	2	3	33%	0
	Subtotal	188	247	435	43.22%	35.15%
II	**Commune Level**					
	Leadership	17	72	89	19.1%	19.1%
	Staff	57	132	189	30%	-
	Subtotal	74	204	278	26.6%	
	Total	262	451	713	36.75%	

Source: Department of Domestic Affairs and Section of Labor, Invalids, and Social Affairs, CPC Vinh Yen, August 2015

1/ City Television and Radio Broadcasting Extension Center; Center for Population and Family Planning; and Security Safe Guard Team

Hue City

The female labor force participation rate of the city currently is at 49%. About 60.32% of the staff and officers in the city and commune people's committees are women. Some 23.46% are women holding leadership roles at the city government level, while 25% are women leaders at the commune level (**Table 4-33**).

Table 4-33. Staffing Profile of Hue City, City and Commune Levels, 2015.

Department/Agency		Number of staff				
		Female	Male	Total	% women	% women leaders
I	**City Level**					
	All Units of CPC	57	126	183	31,14%	10.4% (5/48 leaders)
	Education Branch 1/	2,863	625	3,488	82.08%	67% (141/210 leaders)
	Other Units/Branches 2/	136	329	465	29%	4% (6/138 leaders)
	DOLISA at city level 3/	7	7	14	50%	0
	Women's Union (City Division)	6	0	6	100%	3 (100%)
	Elderly Association	2	1	3	67%	33% (1/3)
	PMU 3/	1	6	7	14%	0%
	DPI	18	43	61	29%	20% (6/30 leaders)
	Water Supply and Drainage Joint-Stock Company	No info	No info	606		1 leader (0.17%)
	Urban Management Unit	3	22	25	13%	0
	Subtotal	**3,093**	**1,159**	**4,858**	**63.67%**	**23.46%**
II	**COMMUNE LEVEL**					
	Leadership	84	247	331	25%	25%
	Staff	137	168	305	44%	-

Department/Agency		Number of staff				
		Female	Male	Total	% women	% women leaders
	Subtotal	221	415	636	34%	12.5%
	TOTAL	3,314	1,574	5,494	60.32%	21.63%

Source: Domestic Affairs, CPC Hue, August 2015
Notes:
1/ Primary, secondary schools and kindergarten
2/ Center for Culture-Informatics-Sport, City Television and Radio Broadcasting, Extension Center, Center For Population and Family Planning, Security Safe Guard Team

4.6.3 Social Benefits and Impacts—Subprojects

Social benefits and impacts were assessed from a review of subproject proposals and feasibility studies prepared by the cities, through site visits, and initial consultations with the city and commune representatives. **Appendix 9** presents a more detailed table on the findings of the social assessment. For each major category of subproject, social benefits and impacts are summarised as **Table 4-34**.

Table 4-34. Potential Benefits, Negative Social Impacts and Risks per Subprojects Category

Subproject Category	Social Benefits	Negative Social Impacts/Risks
Drainage improvement and pavement works	• Reduced flooding and improved drainage and sanitation conditions of nearby households	Impact on properties—land and structures—and livelihood/small business—commercial establishments
Upgrading and expansion of roads and bridges	• Improved mobility of people, goods and services	Impact on properties—land and structures—and livelihood/small business—commercial establishments
Embankment improvements	• Less riverbank erosion and more protection of residential properties • Improved accessibility of pedestrians; Landscaped riverbanks are public open space and recreational areas	Impact on properties—land and structures—and livelihood/small business—commercial establishments
Solid waste management facility/sanitary landfill	• Improved health and sanitation conditions of nearby households	Partial or full loss of assets and displacement—largely for waste pickers
Water system improvement	• Increased access of household to clean water supply • Indirect improvement in health and sanitation conditions in the households—decrease in water-borne diseases	Water tariffs may not be affordable for poor households
Dredging and landscape protection, green park development	• More open spaces for leisure and recreation • Indirectly encourages tourism-related businesses and jobs	• Impact on properties—land and structures—and livelihood/small business—commercial establishments • Destruction of fishing grounds,[65] and impact on deep wells in Dam Vac Lake[66] • Restrictions on lake access for small-scale fishing for subsistence, and other water uses—washing, vegetable pickers of lotus and watercress, etc.

[65] Impact of the Dam Vac Lake dredging on the fishing grounds of residents. There are of two types of fish/crustaceans—local names: tep dau and trai—being harvested by locals for food in Thanh Tru commune.

[66] There are existing drill wells in Dam Vac Lake which are being used as a water source by the Water and Sanitation Company No. 1 for potable water supply.

Subproject Category	Social Benefits	Negative Social Impacts/Risks
		• Possible encroachment and improper waste disposal within Dam Vac lake and green park areas
Wastewater collection and treatment and tertiary wastewater sewers	• Improved sanitary conditions for residents; • Reduced incidence of water-borne and vector-borne diseases	Low interest and capacity of households to connect to the proposed wastewater collection system
Exhibition/linkage center for business support	New local enterprises established and additional employment opportunities created resulting in improved household incomes	Impact on properties—land and structures—and livelihood/small business—commercial establishments

Source: PPTA Consultants

Social Benefits

Improved access of households to basic urban services and infrastructure is one of the key benefits of the Program, which is in line with the main thrust of the GoV in achieving poverty reduction. Living conditions and the quality of life of the urban residents, especially the poor, will be improved. Local enterprises, especially those related to tourism and education services, will have the opportunity to grow, consequently bringing in additional employment and increasing household incomes. The Program will encourage citizen participation in preparation, implementation, and monitoring of subprojects. The participation of the mass organizations, especially the Women's Union (WU), in the information, education and communications (IEC) campaigns related to the Program will encourage more accountability in implementation.

Estimates of the number of households that will benefit and will be affected by the subprojects are shown as **Table 4-35**. This is based on the preliminary assessments prepared by the cities. The total number of beneficiaries for all subprojects in the three cities is 126,914 households; while the total number of adversely affected households, mostly because of resettlement, is 2,240 households. This is broken down as follows: (i) household beneficiaries in Ha Giang City are 14,600, in Hue, 87,000, and in Vinh Yen, 25,314; and (ii) there are 529 adversly affected households in Ha Giang, 769 in Hue, and 942 in Vinh Yen.

Table 4-35. Estimated Number of Beneficiaries and Affected Households per Subproject

	Subprojects	Est. Target number of HHs beneficiaries/direct impact*	Est. Affected HHs*
I	**HA GIANG CITY**		
1	Drainage for Tran Phu and Nguyen Trai Wards	1,600	155
2	Drainage for Minh Khai Ward	1,000	21
3	Drainge of T1, T2, T3 and T4 in Quang Trung Ward	1,000	8
4	Western Embankment of Lo River	100	0
5	Embankment and Roads on each side of Mien River	100	160
6	Southern Embankment of Me Stream	20	39
7	Improvement of Existing Landfill	14,600	12
8	Upgrading of National Road No.2		35
9	Southern Ring Road Improvement		99
10	Bridge from National Road.No.2 to Southern Ring Road		0
	Subtotal	**14,600 b/**	**529**
II	**VINH YEN CITY**		
1	Dredging and Landscape Protection of Dam Vac Lake	5,000	55
2	Collection and Wastewater Treatment in West Vinh Yen	10,000	19
3	Tertiary Wastewater Sewers	10,800	120
4	Green Park Development near Dam Vac Lake	25,314	135

	Subprojects	Est. Target number of HHs beneficiaries/direct impact*	Est. Affected HHs*
5	Infrastructure for University Area	6,000	613
6	Exhibition/Linkage Center for Business Support		105
	Subtotal	**25,314 c/**	**942**
III	**HUE CITY**		
1	Dredging and Embankment of Ke Van River	1,000	80
2	Drainage and Pavements in Four Inner City Wards of Citadel	13,000	100
3	Dredging and Embankment of Lakes in Citadel	1,000	10
4	Water Supply System to Phu Son Solid Waste Management Facility and Villages	1,000	0
5	Dredging and Embankment of Lap River, Kim Long Ward	800	0
6	Eco-Channel of the An Van Duong Development Area	200	162
7	Dredging and Embankment of An Hoa River	800	0
8	Improvement of the Citadel Canal/Moat	500	0
9	Park, Paths, Drainage, and Lighting in An Van Duong Development Area	30,000	0
10	Park and Square in the Administrative Area, An Van Duong	30,000	0
11	Rehabilitation/Embankment of Dong Ba River	1,000	5
12	Rehabilitation/Embankment of An Cuu River	1,000	0
13	Rehabilitation/Embankment of Nhu Y River	1,000	37
14	Section of Central Road in An Van Duong Development Area including Bridge		375
15	Bui Thi Xuan Road		80
16	Huyen Tran Cong Chua Road		125
17	Vy Da Bridge and Access Roads		75
	Subtotal	**87,000 d/**	**769**
	TOTAL	**126,914**	**2,240**

a/ Only initial estimates based on review of draft project proposals, resettlement cost estimates, site visits, and consultations. For further validation during preparation of feasibility studies is necessary.

b/ Total household population in Ha Giang City.

c/ Total household population in Vinh Yen City

d/ Total household population in Hue City.

Source: PPTA Consultants

Potential Negative Social Impacts and Risks

The following significant, adverse social impacts and risks of the Program have been identified:

- *Land acquisition and resettlement.* The resettlement impacts vary from minimal to significant depending on the scope and type of subproject—partial or full loss of assets such as structures, land, and other improvements. There are certain gaps between the GoV's Land Law and ADB Resettlement policy which may pose more adverse impacts on the affected households, including (i) no compensation for land attached assets which have been illegally occupied; (ii) no specific measures for poor and vulnerable groups—women-headed households, persons with disabilities, and ethnic minorities; and (iii) no requirement to undertake a survey or census, or gender analysis related to resettlement impacts.
- *Low paying capacity of poor households for sewerage connections.* Particular to the tertiary waste water connection in Vinh Yen, the poor households may not be able to afford the connection fees.
- *Low level of involvement of mass organizations, especially women's union, in infrastructure-related subprojects.* The mass organizations—Fatherland Front, Women's Unions (WUs), Youth Unions, elderly associations, etc.--have little or no experience in the design, operations, and maintenance of green urban infrastructure and services.

- *Accessibility of women, elderly, children, persons with disabilities (PWDs), ethnic minorities, small-scale subsistence fishermen/vegetable pickers, and other vulnerable groups.* Local policies related to the design or preparation of infrastructure projects do not include provisions to ensure accessibility or address specific needs of some vulnerable sectors. There is a potential risk that the physical design or features of the proposed infrastructure do not meet the needs of some vulnerable groups, such as accessibility of persons with disabilities, access to the lake for small scale fishing or vegetable harvesting, separate toilets for men and women, among others.
- *Encroachment along drainage networks, river and lake embankments.* There is a possible risk of encroachment by residents or informal settlers after these are improved. In Dam Vac Lake, there is a potential risk that private businesses would encroach the lake area for large scale aquaculture or development for commercial uses.
- *Traffic, dust, noise and water pollution, groundwater contamination, safety risks, and other construction impacts***.** The construction or rehabilitation of existing drainage networks, internal roads and new roads, and bridges, may result in traffic, dust, noise and other construction impacts which may vary from minimal to significant. Mobility, health and safety of the people, and operations and income of commercial establishments and other businesses will be affected.
- *Risk of communicable diseases/HIV AIDs***.** There is a slow rise of HIV/AIDs cases in three cities, mostly attributed to infected needles through drug use and from sex workers.[67] There is a potential risk that HIV/AIDs and other communicable diseases may increase due to the influx of people to the cities, particularly laborers or construction workers, migrants from rural areas, and also tourists.

Gender Issues

In the design and implementation of urban infrastructure, gender considerations are not taken into account in feasibility study preparation or proposals, except for those funded by donor agencies. A rapid assessment on gender mainstreaming in the subprojects of the three cities has shown that there is little or no gender analysis—identification of gender issues, gender impacts—in the proposals or in the preparation of resettlement plans. Hence, there is little or no specific gender design features, targets or indicators in the design of the infrastructure subprojects[68], nor is there a gender action plan.

Gender issues to be addressed were identified through consultations and workshops with commune representatives; these were: (i) access of women to services and opportunities to be provided the Program; (ii) affordability of the services and the payment terms for loans among the poor women-headed households; and (iii) equal participation of women in the decision-making activities of the Program at the commune and city levels.

The women, being mainly responsible for household tasks, especially those related to sanitation, health, hygiene, should be consulted on appropriate design features needed for the tertiary wastewater connections. A concern on the capacity of the poor households, especially women-headed households without stable source of income, to pay for the wastewater connection was also raised. Although women participants do attend community meetings, there are generally more male leaders or officers at the commune, and also at the city levels who lead in the decision-making. Some women usually find it difficult to attend and contribute to community meetings due to household duties. More men are usually invited to be part of the community monitoring group which leads the monitoring of local infrastructure subprojects. Men are regarded to be more knowledgeable on the design and construction of small infrastructure subprojects, than women.

In general, the PMUs, WUs, and other key agencies to be involved in Program implementation require capacity building support on gender matters—basic principles, local legislation, ADB gender policies, and gender mainstreaming in subprojects.

[67] As of June 2015, the recorded cases of HIV/AIDs in three cities are as follows: 537 cases in Ha Giang, 506 cases in Hue, and 348 cases in Vinh Yen (Source: Center for HIV/AIDs Preventive Health Care).

[68] Rapid Survey on Capacity Assessment of Hue, Ha Giang, and Vinh Yen Cities on Gender Mainstreaming in Infrastructure Projects, SCDP TA Team, August 2015.

4.6.4 Mitigating Measures for Adverse Social and Gender Impacts

Social mitigation and gender action plans were prepared for each city—**Appendix 9** contains the detailed plans. These were drafted to address the potential negative social impacts and risks of the subprojects, and to achieve poverty reduction and gender targets under the Program. The critical activities and monitoring indicators proposed under the social and gender plans are summarised as **Table 4-36**.

Table 4-36. Summary Social Mitigation and Gender Action Plan for Ha Giang, Hue, and Vinh Yen Cities

Project Phase	Mitigating Measures/ Next Steps	Monitoring Indicators
I. Feasibility Study Stage	• PMU to conduct regular consultations with affected communes—with at least 50% women participants • Establish a Community Monitoring Group per affected Commune—at least 30% women members • Establish the Dam Vac Lake Environmental Protection Committee, with at least 30% women members—Vinh Yen.	• Number of consultations conducted and number of men and women participants in the meetings • Community Monitoring Group per commune established—at least 30% women members • Issuance of City Resolution for the creation of the Dam Vac Lake Environmental Protection Committee (Vinh Yen)
	Preparation of Land Acquisition and Resettlement Plan (LARP)/ Compensation Plan to include (i) conduct of socioeconomic survey; (ii) conduct of detailed measurement and inventory of losses survey; (iii) community consultations; and (iv) gender assessment	• Number of consultations conducted and number of men and women participants in the meetings • LARP report with details of the livelihood support programs for affected households
	• Preparation of Environmental Management Plan • Preparation of detailed engineering designs incorporating measures to avoid identified construction impacts	• Number of consultations conducted related to engineering design solutions • Detailed Environmental Management Plan • Detailed engineering designs that mitigate negative impacts during construction
	• Designation of Social and Gender Focal Person at PMU • At least 20% of ODA/PMU staff are women	• List of capacity building activities for PMU and community partners—commune leaders, WUs, etc. • Social and Gender Focal person assigned
	Prepare a feasibility study on the proposed loan fund for household sewer connections and sanitation to include (i) conduct of socioeconomic survey, (ii) willingness to pay survey, and (iii) consultations with communes and Women's Unions	• Number of consultations conducted and number of men and women participants in the meetings • Detailed feasibility study for the Loan Fund for Household Sanitation
II. Procurement and Detailed Engineering Design Stage	Consultations with representatives from Elderly Association, Youth Association, and PWDs groups on specific design requirements	Final detailed engineering design standards and performance indicators incorporating specific low impact design of facilities/amenities for men, women, elderly and PWDs in subprojects (refer to **Table 4-37**.
	Implementation of LARP/Compensation Plan and livelihood support programs	• Number of HHs provided due and timely compensation • Number of HHs provided with livelihood support • Number of consultations conducted, with 50% women participants

Project Phase	Mitigating Measures/ Next Steps	Monitoring Indicators
	• Update feasibility study for the loan fund for household sanitation with establishment of a savings group for poor households to improve loan payment capacities • Establish savings group for poor households to improve loan payment capacities • Conduct IEC activities on proper hygiene and sanitation practices	• List of eligible poor households for the loan fund program—number of men and women headed households • Establishment of a savings group per commune—at least 30% women • Number of IEC activities on sanitation and hygiene practices • Number of men and women participants on IEC activities on sanitation and hygiene
III. Construction Stage	Conduct capacity building activities on: Program planning, implementation, monitoring and evaluation tools/skills; gender equality policies and gender mainstreaming in subprojects; national and local safeguards policies on social and gender, environment, resettlement; household socioeconomic survey and census tools, resettlement and detailed measurement survey, willingness to pay survey; and loan and savings mechanisms for household wastewater connections/sanitation	• Number and types of capacity building activities conducted • Number of training participants, with at least 50% women participants
	• Implementation of Environmental Management Plan • Regular monitoring of construction activities	• Number of site inspections conducted • Number of meetings conducted with PMU, contractor, and community monitoring group • Traffic rerouting schemes implemented • Proper signage and barricades for safety installed
	• Engagement of the Community Monitoring Group during construction • Implementation of the Communications strategy, and Stakeholders Participation Plan	• Number/types of IEC materials and tools used to disseminate information on the Program • Number of community meetings conducted • Number of participants in meetings—at least 50% should be women • Number and type of IEC materials and tools used to disseminate Program information • Number and type of complaints and grievances recorded and resolved
IV. Operations and Maintenance Stage	• Continuing activities of the community monitoring group, as necessary • Quarterly or six monthly site inspections regarding encroachment • Implementation of the Communications strategy and Stakeholders Participation Plan	• Number of site inspections conducted • Number of meetings conducted with PMU, contractor, and community monitoring group • Number and type of complaints and grievances recorded and resolved
	Conduct IEC/awareness raising activities at commune level on: • 3Rs—reduce, reuse, recycle, waste segregation and disposal • Proper sanitation and hygiene practices • Climate change and disaster risk reduction • Loan fund and savings mechanisms for household	• Number and types of IEC/awareness raising activities conducted • Number of participants—at least 50% should be women • About 50% of residents per concerned commune have attended the consultations after subproject construction

Project Phase	Mitigating Measures/ Next Steps	Monitoring Indicators
	sanitation	
	Continue activities under the resettlement plan, especially livelihood support programs	• Number of HHs provided with livelihood support
	Implement loan program and savings program for household wastewater connections	• Number of borrower beneficiaries—at least 30% should be women • Number of savings groups established per commune—at least 30% should be women members

Source: PPTA Consultants

Design features to ensure accessibility and affordability of services

Further consultations with affected communes will be undertaken during subproject feasibility by national consultants. Low impact design features will be identified and incorporated in the detailed engineering plans to ensure vulnerable groups—women, children, elderly, and persons with disabilities—have access to or can afford the new services. **Table 4-38** summarises the required design features.

Table 4-37. Summary of Proposed Design Features for Subprojects

Proposed Design Features		
Ha Giang	**Hue**	**Vinh Yen**
For roads, pavements, and river embankments: • Access ramps for disabled persons on river embankments and roads • Separate toilets for men and women • Landscaped areas with benches and tables • Children's play areas • Exercise areas for the elderly • Lighting fixtures • Small platforms or open areas for social activities and public performances Wastewater improvements: • Feasibility study for a loan fund and savings program to finance household wastewater connections and improved sanitation	For roads, pavements, and river embankments: • Lighting fixtures • Trees/landscaped areas • Low-impact and green design of pavements and walking paths; design to follow existing street patterns of the Citadel • Pavements with access ramps and tactile paving for disabled persons • Parking spaces • Proper street signage • Separate toilets for men and women • Open spaces for social and cultural activities, sports and recreation • Access stairs along river embankments • Areas for children's playground • Chairs/benches	For Green and park developments: • Public taps for potable water • Access ramps and pavements for disabled persons • Separate toilets for men and women • Chairs/benches • Playgrounds for children • Resting spaces and covered areas with chairs and benches • Canteens and restaurants for tourists • Kiosks for small enterprises—souvenir items, food items, etc. • Open spaces for public performances, dancing, exercise and sex • Vehicle and motorbike parking spaces For Dam Vac Lake dredging and landscaping protection: • Preservation of breeding areas in Dam Vac Lake for indigenous fish and mollusc species • Designate areas for recreational and subsistence fishing; restrictions on large scale commercial aquaculture activities and prevention of further encroachment • Construction methods to avoid impact on fishing grounds and wells—for water supply source For tertiary wastewater sewers: • Design features to avoid groundwater pollution, water logging, and emission of foul odors

Source: PPTA Consultants

Training or capacity building activities proposed for the PMU, DOLISA, community monitoring group, women's unions, Fatherland Front, youth unions, commune people's committees, and other partner organizations are set out below:

- Project planning, implementation, monitoring and evaluation tools and skills.
- Gender equality policies and gender mainstreaming in subprojects.
- IEC tools—planning, implementation, monitoring and evaluation, communication skills and public speaking skills.
- National and local safeguards policies on social and gender, environment, and resettlement.
- National and local procurement policies and procedures.
- Financial management procedures.
- Construction supervision and monitoring.
- Household data collection—household socioeconomic survey and census tools, resettlement or detailed measurement surveys and willingness to pay surveys.
- Climate change and disaster risk reduction.

Gender Action Plans

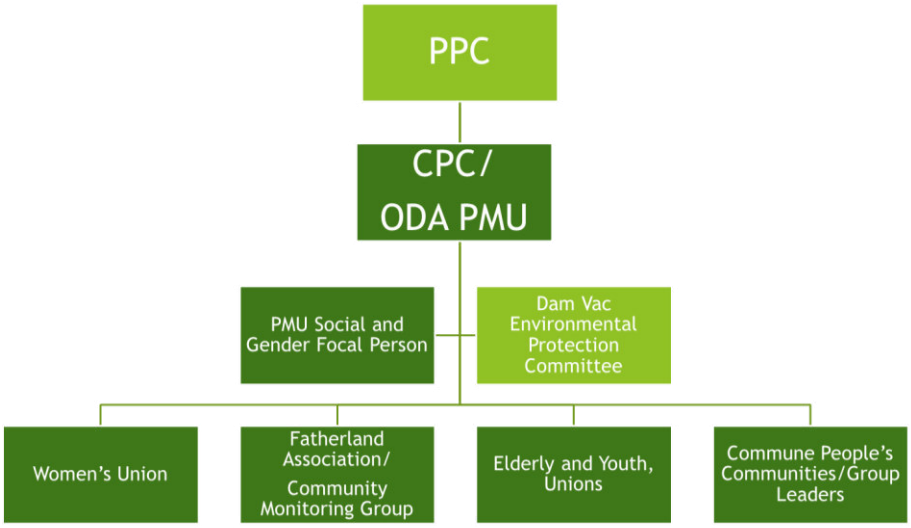
Gender Action Plans (GAP) were prepared for each city which outline the strategies to address the key gender concerns on the access to services and opportunities to be provided by the Program; affordable limits of the poor, especially women-headed households, and equal participation of women in the decision-making activities from planning to implementation of local infrastructure projects. Specific gender targets were also identified in the GAPs and include:

- Designation of social and gender focal person within the PMUs to supervise and monitor the implementation of the social and gender plans prepared under this Program.
- Assignment of at least 20% to 30% women as PMU staff—Ha Giang and Hue at 30%, Vinh Yen at 20%.
- Engagement of a national gender specialist who will provide technical advisory support to the PMU in integrating gender in the preparation and implementation of subprojects for each city.
- Integration of gender assessment, and finalization of gender action plans in the subsequent feasibility studies or subproject proposals.

4.6.5 Implementation Arrangements, Monitoring and Budget

The PMU will have a designated social and gender focal person who will supervise the preparation, implementation, monitoring and evaluation of social and gender plans. The implementation and monitoring of the social and gender plans will be in close collaboration with the commune people's committees, resident group leaders, WUs, Fatherland Front, elderly association, youth unions, community monitoring group, NGOs, and private sector groups. **Figure 4-12** outlines the proposed structure of the social and gender aspects and functions within the PMUs. An indicative total budget of US$ 500,000 is programmed for the implementation of the activities detailed in the social mitigation and gender plans for the Program.

Figure 4-12 Proposed Implementation Arrangement for Social and Gender Plan



Source: PPTA Consultants

4.7 Financial Assessment

The financial analysis undertaken for the subprojects is in accordance with guidelines of the Asian Development Bank (ADB)[69] and the Socialist Republic of Viet Nam[70]. All subprojects in the Program are considered non-revenue generating thus, the financial internal rate of return (FIRR) was not calculated. The tariffs collected for the revenue generating components—solid waste management, wastewater, water supply—currently do not fully cover costs for operation and maintenance (O&M), but are recommended to be adjusted over time to meet these requirements. Any funding gap for meeting full O&M costs will be covered by the executing agencies, which are the provincial governments of Ha Giang, Thua Thien Hue and Vinh Phuc.

Financial analysis was conducted for the three provincial governments covering the subproject sites to confirm the sustainability of the investments. The analysis focused on their capacity as end borrowers to service Program debts and to operate and maintain the subprojects. Details are shown as **Appendix 10**.

ADB loan funds will be channeled to the provincial governments of Ha Giang, Thua Thien Hue and Vinh Phuc through the Ministry of Finance. The provincial governments, have no direct financial benefit from the subprojects or from discharging its responsibilities as Program executing agencies. Thus, the financial analysis was conducted to ensure that their financial capacity will be adequate to meet its potential financial demands to achieve subproject sustainability.

4.7.1 Financial Sustainability Analysis – Ha Giang

Financial sustainability analyses were carried out by combining the costs of all ten subprojects which include drainage for Tran Phu and Nguyen Trai Wards; Minh Khai Ward; T1, T2, T3, T4 in Quang Trung Ward; embankment of Lo River, Mien River, Me stream; improvement of the National Road No.2, Southern Ring Road and Bridge; and landfill improvement. From the technical study, total subprojects' cost was estimated at VND 1,006 billion or $45.74 million equivalent. Of this, VND93.0 billion will be on-lent by the MoF to the Province.

While the City Government of Ha Giang will be implementing the subprojects, the Provincial Government will provide needed funds for debt service and O&M after construction. The Provincial Government's

[69] ADB. 2005. *Financial Management and Analysis of Projects.* Manila; and ADB. 2009. *Financial Due Diligence: A Methodology Note*. Manila.

[70] *An Introduction to Financial Analysis of ADB-Financed Investment Projects in Viet Nam.* This document is downloadable from http://www.adb.org/projects/operations/financial-management-resources.

financial statements for the last four years (2011–2014) were reviewed to assess historical fiscal performance, capital structure, and generation of internal funds to support subproject implementation. A parallel analysis of the Province's borrowing capacity was undertaken to ensure that the loan amount is within its borrowing capacity—section 9.3 has the details. Projections were prepared to assess the Provincial Government's likely financial performance for a period of operations after commissioning.

Like all local governments in Viet Nam, Ha Giang Province has its own fiscal revenues to support its administrative functions. But it also receives annual budgetary subsidies from Central Government. Based on financial information provided, the overall fiscal income of Ha Giang includes domestic income, revenues from imports and exports, transfer payments from Central Government through tax-sharing arrangements, general transfers, and allocated funds. **Table 4-38** shows Ha Giang's fiscal and non-fiscal income during 2011–2014, and projections to 2030.

Analyzing historical trends and through discussions with local officials, a projection of possible operations for the next 13 years was undertaken, covering eight years after construction. The financial forecasts assume that revenues and expenditures after 2014 will increase at the average growth rate experienced from 2011 to 2014. Ha Giang has experienced robust economic development during the last decade. According to historical data, total revenue grew by about 22% from 2011 to 2014, while expenditures grew by 27% in the same period.

Table 4-38. Actual and Projected of Net Income of Ha Giang Provincial Government, 2010-2030 (VND million)

Items	2010	2011	2012	2013	2014	2015	2020	2025	2030
						-Projection----------->>			
Total Revenues	**17,021,408**	**8,001,601**	**9,960,338**	**9,621,743**	**9,779,494**	**10,193,537**	**12,550,200**	**15,806,918**	**20,172,231**
Domestic revenues	8,001,601	589,387	746,705	896,954	1,084,022	1,374,000	1,825,000	2,939,181	4,733,580
% Annual Increase	-	-	26.7%	20.1%	20.9%	26.8%	9.9%	10.0%	10.0%
Revenues from Import-Export	4,222,873	531,495	367,481	256,365	181,512	180,000	220,200	255,272	295,930
% Annual Increase		-	-30.9%	-30.2%	-29.2%	-0.8%	3.0%	3.0%	3.0%
Income from resource transference	4,007,195	665,899	944,059	418,117	368,569	536,645			
% Annual Increase		-	41.8%	-55.7%	-11.9%				
Other Revenues	789,739	6,214,820	7,902,093	8,050,307	8,145,391	8,102,892	10,505,000	12,612,465	15,142,721
% Annual Increase		-	27.1%	1.9%	1.2%	-0.5%	1.6%	3.7%	3.7%
Total Expenditures	**11,822,655**	**7,374,206**	**9,569,697**	**9,328,728**	**9,391,404**	**10,074,327**	**12,543,570**	**15,748,413**	**19,930,602**
Capital Expenditures	3,182,577	1,906,633	2,983,455	2,262,457	2,123,791	2,675,568	4,504,894	6,318,347	8,861,808
% Annual Increase		-	56.5%	-24.2%	-6.1%	26.0%	10.0%	7.0%	7.0%
Loan Repayment	217,860	152,318	51,465	70,250	107,830	151,000	30,000	30,000	30,000
Recurrent expenditures	2,590,715	4,027,954	5,713,311	6,110,836	6,450,452	6,816,559	7,827,176	9,218,566	10,857,294
% Annual Increase		-	41.8%	7.0%	5.6%	5.7%	-0.8%	3.3%	3.3%
Expenditures from resource transference	5,443,568	944,059	418,117	368,569	535,601	250,000			
Other expenses	387,935	343,242	403,348	516,616	173,730	181,200	181,500	181,500	181,500
	17,021,408	8,001,601	9,960,338	9,621,743	9,779,494				
Surplus	**5,198,753**	**627,395**	**390,641**	**293,015**	**388,090**	**119,210**	**6,630**	**58,506**	**241,629**
% Surplus to Total Revenues		-	7.8%	3.9%	3.0%	4.0%	0.0%	0.3%	1.0%
% Annual Growth of Surplus		-	-38%	-25%	32%	-69%	-213%	42%	28%
Annual Average Growth Rate of Surplus						-20%	-185.26%	54.89%	

Source: Province of Ha Giang Financial Statements, 2011-2014.

If allocated funds and the proceeds of state subsidies are excluded, the government will still have available funds for Program purposes. By 2022, total revenues would be increased to VND13,744 billion, while projected expenditures would be VND13,726 billion. Annual funds required for O&M for all subprojects in 2023 are estimated to be VND11,755 million. This represents 0.5% of provincial domestic revenues, and 42.1% of surplus projected for this period.

The total subprojects' cost from all sources amounts to VND1,006 billion during the 2017–2022 construction period. Portion of the AFD loan will be provided to the province at 90% on-grant while the remaining 10% will be on-loan. Anticipated debt service obligations and operating expenses for 2023–2030 were calculated and included in the financial statements to determine the impact of the subprojects to the province's financial standing.

Table 4-39. Estimated Financial Impact of the Program – Ha Giang (VND million)

Items	2023	2024	2025	2026	2027	2028	2029	2030
Total Revenues	**14,392,684**	**15,079,417**	**15,806,918**	**16,578,229**	**17,396,656**	**18,265,796**	**19,189,567**	**20,172,231**
Total Expenditures	**14,364,746**	**15,038,281**	**15,748,413**	**16,497,351**	**17,287,450**	**18,121,216**	**19,001,319**	**19,930,602**
Surplus	**27,938**	**41,136**	**58,506**	**80,878**	**109,206**	**144,580**	**188,247**	**241,629**
% Surplus to Total Revenues	0.1%	0.2%	0.3%	0.4%	0.5%	0.6%	0.8%	1.0%
% Annual Growth of Surplus	54%	47%	42%	38%	35%	32%	30%	28%
Impact Of Project								
Debt Service	7,022	6,918	6,815	6,712	6,609	6,505	6,402	6,299
Operation & Maintenance	11,755	11,755	11,755	11,755	11,755	11,755	11,755	11,755
Total	**18,777**	**18,673**	**18,570**	**18,467**	**18,364**	**18,260**	**18,157**	**18,054**
Surplus after Project	**9,162**	**22,463**	**39,936**	**62,411**	**90,842**	**126,320**	**170,090**	**223,575**
Debt Service /Domestic Revenue	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%
Debt Service /Surplus	25.1%	16.8%	11.6%	8.3%	6.1%	4.5%	3.4%	2.6%
Project O&M/Domestic Revenue	0.5%	0.4%	0.4%	0.4%	0.3%	0.3%	0.3%	0.2%
Project O&M/Surplus	42.1%	28.6%	20.1%	14.5%	10.8%	8.1%	6.2%	4.9%

Source: PPTA Consultant's estimates.

Based on the above scenario, repayment is expected to be within the projected capacity of the province. Based on Ha Giang's projected income in 2023, the liability for the Program only amounts to 0.8% of domestic income. The position thereafter is expected to continue to improve with total debt service decreasing over time. (**Table 4-39**)

4.7.2 Financial Sustainability Analysis – Than Thien Hue

Financial sustainability analyses were carried out by combining the costs of all subprojects which include dredging and embankment improvements; parks, roads and bridge; and provision of water supply to the solid waste management facility and adjacent villages. From the technical study, total subproject cost was estimated at VND 2,231 billion or $101.39 million equivalent. Of this, VND1,093 billion will be on-lent by the MoF to the Province. The Provincial Government will provide needed funds for debt service and O&M after construction. The Provincial Government's financial statements of the last four years (2011–2014) were reviewed to assess historical fiscal performance, capital structure, and generation of internal funds to support Program implementation. Projections were prepared to assess the provincial government's likely financial performance for a period of operations after commissioning.

Thua Thien Hue Province has its own fiscal revenues to support its administrative functions. But it also receives annual budgetary subsidies from Central Government. Based on financial information provided, the overall fiscal income of the province includes domestic income, revenues from imports and exports, transfer payments from Central Government through tax-sharing arrangements, general transfers, and allocated funds. Analyzing historical trends and through discussions with local officials, a projection of possible operations for the next 15 years was undertaken. The financial forecasts assume that revenues and expenditures after 2014 will increase at the average growth rate experienced from 2010 to 2014. **Table 4-40** shows the province's fiscal and non-fiscal income during 2011–2014, and a projection up to 2030.

Table 4-40. Actual and Projected of Net Income of Thua Thien Hue Provincial Government 2011–2030 (VND million)

Items	2011	2012	2013	2014	2015	2020	2025	2030
					---------->	r e c a		
Total Revenues	**9,625,760**	**14,645,206**	**14,207,314**	**7,472,061**	**7,540,734**	**9,839,000**	**14,495,463**	**21,298,591**
% Annual Increase	-	52.1%	-3.0%	-47.4%	0.9%	8.5%	8.0%	8.0%
Domestic revenues	3,159,757	3,885,296	3,728,136	3,768,636	4,118,445	6,755,000	9,250,778	12,651,651
% Annual Increase	-	23.0%	-4.0%	1.1%	9.3%	11.0%	11.0%	11.0%
Revenues from Import-Export	241,110	412,030	410,538	520,000	390,000	628,000	1,011,201	1,628,230
% Annual Increase	-	70.9%	-0.4%	26.7%	-25.0%	10.0%	10.0%	10.0%
Income from resource transference	1,361,560	1,748,784	2,768,402	-	-	-	-	-
Other Revenues	4,863,333	8,599,096	7,300,238	3,183,425	3,032,157	2,018,000	2,119,926	2,227,000
% Annual Increase	-	76.8%	-15.1%	-56.4%	-4.8%	1.1%	1.0%	1.0%
Total Expenditures	**8,972,482**	**13,977,021**	**13,581,924**	**6,900,061**	**7,058,812**	**8,793,001**	**12,971,306**	**19,371,697**
Capital Expenditures	2,078,755	3,030,434	1,983,926	1,448,400	1,466,900	901,000	1,018,727	1,151,837
% Annual Increase	-	45.8%	-34.5%	-27.0%	1.3%	2.6%	2.5%	2.5%
Loan Repayment	3,000.00	3,000.00	44,375	-	-	-	-	-
Recurrent expenditures	2,884,296	4,164,990	4,833,269	4,580,197	4,888,157	7,180,000	11,047,320	16,997,671
Expenditures from resource transference	1,762,634	2,740,685	2,181,345					
Other expenses	2,243,797	4,037,912	4,539,009	871,464	703,755	712,000	905,258	1,222,188
Surplus	**653,278**	**668,185**	**625,390**	**572,000**	**481,922**	**1,045,999**	**1,524,157**	**1,926,894**
% Surplus to Total Revenues	**40.5%**	**6.8%**	**4.6%**	**4.4%**	**7.7%**	**10.4%**	**10.7%**	**9.4%**
% Annual Growth of Surplus	**-92%**	**2%**	**-6%**	**-9%**	**-16%**	**10.6%**	**6%**	**4%**
Annual Average Growth Rate of Surplus					**-24%**	**17.51%**	**7.84%**	

Source: Province of Hue Financial Statements, 2011-2014.

If allocated funds and the proceeds of state subsidies are excluded, the government will still have available funds for Program purposes. By 2023, the first year of repayment of the ADB loan, annual debt service represents 0.9% of projected revenues, and 8.3% of its projected surplus. Annual funds required for O&M of the subprojects in 2023 are estimated to be VND17,013 million. This represents 0.1% of domestic revenues and 1.3% of surplus projected for the period.

The total project cost from all sources amounts to VND2,231 billion during the 2017–2022 construction period. 70% of the AFD loan will be provided to the province on-grant while the remaining 30% will be on-loan. Anticipated debt service obligations and operating expenses from 2023 to 2030 were calculated and included in the financial statements to determine the impact of the subprojects on the province's financial standing. (**Table 4-41**)

Table 4-41. Estimated Financial Impact of the Program–Thua Thien Hue (VND million)

Items	2023	2024	2025	2026	2027	2028	2029	2030
Total Revenues	**12,427,523**	**13,421,725**	**14,495,463**	**15,655,100**	**16,907,508**	**18,260,109**	**19,720,918**	**21,298,591**
Total Expenditures	**11,071,038**	**11,981,677**	**12,971,306**	**14,046,907**	**15,216,088**	**16,487,131**	**17,869,058**	**19,371,697**
Surplus	**1,356,485**	**1,440,048**	**1,524,157**	**1,608,193**	**1,691,420**	**1,772,978**	**1,851,859**	**1,926,894**
% Surplus to Total Revenues	**11.1%**	**10.9%**	**10.7%**	**10.5%**	**10.3%**	**10.0%**	**9.7%**	**9.4%**
% Annual Growth of Surplus	**6%**	**6%**	**6%**	**6%**	**5%**	**5%**	**4%**	**4%**
Annual Average Growth Rate of Surplus			**7.84%**					
Impact Of Project								
Debt Service	112,350	110,329	108,309	106,288	104,268	102,247	100,227	98,206
Operation & Maintenance	17,013	17,013	17,013	17,013	17,013	17,013	17,013	17,013
Total	**129,363**	**127,342**	**125,322**	**123,301**	**121,281**	**119,260**	**117,240**	**115,219**
Surplus after Project	**1,227,122**	**1,312,706**	**1,398,836**	**1,484,892**	**1,570,140**	**1,653,718**	**1,734,620**	**1,811,675**
Debt Service /Total Revenue	0.9%	0.8%	0.7%	0.7%	0.6%	0.6%	0.5%	0.5%
Debt Service /Surplus	8.3%	7.7%	7.1%	6.6%	6.2%	5.8%	5.4%	5.1%
Project O&M/Total Revenue	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Project O&M/Surplus	1.3%	1.2%	1.1%	1.1%	1.0%	1.0%	0.9%	0.9%

Source: PPTA Consultant's estimates.

Based on the above scenario, repayment is expected to be within the projected capacity of the province. Based on the projected income in 2023, the Program's liability amounts to 1.0% of domestic income and 9.6% of surplus. The position thereafter is expected to improve with total debt service declining over time.

4.7.3 Finacial Sustainability Analysis—Vinh Phuc

Financial sustainability analyses were carried out by combining the costs of all subprojects which include principally wastewater management—collection, treatment and tertiary sewers; access road to the proposed University Village; dredging and landscape conservation of Van Dam Lake; a city park and construction of an exhibition linkage center for business support. Total subproject cost has been estimated to be VND 1,935 billion or $97.94 million equivalent. Of this, VND1,188 billion will be on-lent by the MoF to the province. The Provincial Government of Vinh Phuc will provide needed funds for debt service and O&M after construction. The Provincial Government's financial statements of the last four years (2011–2014) were reviewed to assess historical fiscal performance, capital structure, and generation of internal funds to support Program implementation. Projections were prepared to assess the provincial government's likely financial performance for a period of operations after commissioning.

Vinh Phuc Province has its own fiscal revenues to support its administrative functions. But it also receives annual budgetary subsidies from Central Government. Based on financial information provided, the overall fiscal income of Vinh Phuc includes domestic income, revenues from import and export, transfer payments from Central Government through tax-sharing arrangements, general transfers, and allocated funds. **Table 4-42** shows Vinh Phuc's fiscal and non-fiscal income during 2011–2014, and projections to 2030.