INTRODUCTION

The Veal Rinh market area and its surroundings consist of about 18 hectares located between the railway and National Road 4 Veal Rnh Commune, Prey Nob District. The area suffers from storm water flooding in the rainy season. The stretch of land between the road and the market area has the lowest elevation level. The current drainage system is poorly maintained and is too small to deal with the increasingly intense rainfall events that are likely to occur as a result of climate change. Therefore, floods occur inside and in front of the market in every time it rains.

Problem statement
The current storm water drainage system is too small for the market area’s surroundings, causing flooding and long-term damage to infrastructure in the area. Based on the climate change assessment in Cambodia, the prediction is that the total annual rainfall will drop until 2030 and afterwards will increase again. There will be a shorter and more intense rainfall events occurring causing severe problems arising from the design of the current drainage system. To cope with the increased amount of high intensity precipitation in a shorter period, the drainage system around the market requires a new design.

The poor solid waste management system in the market area and its surroundings, causes clogging of the drainage system. The drainage system around the market area is an open channel, it is easy for the people to throw garbage in to the channel. The existing drainage system is fully clogged with solid waste. This problem can further cause the stagnant water which can create the conditions for breeding bacteria, viruses or other micro-organisms. This can then lead to public health problems.

Resilience to natural hazards refers to the ability to protect lives, livelihoods and infrastructure from destruction and damage, and to the capability to restore areas after natural hazard has occurred. This investment seeks to improve the resilience of the affected communes to the vulnerability of increasingly intense rainfall events through the provision of:

- Improve storm water drainage system;
- Improved road layout and profile.
- Waste management education (provided under activities in Output 1.1, which are designed to support this activity)
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Location

The market area is located on National Road 4, close to the junction of National Roads 3&4 on the Sihanoukville side. This makes the area the entrance to Preah Sihanouk. Therefore the area is suited as a example space for resilient living and integrated urban water management.

The problem location is in open area between the main road and the market as shown in figure 1, this location has the lowest elevation levels. The precipitation in the market area and surroundings accumulates in the market area and is discharged by the open channel drainage and overland run-off. In the opposite site of the market, there is no drainage system. Rainwater runoff flows on surface to the discharging points.
Beneficiaries

The beneficiaries of this investment range from people who living in the area to the people who passing through the road in a safer manner than before. The benefits can be addressed in to different categories of beneficiaries:

- Local residents
- District population
- Traffic in and out of Prey Nob District
- Economy
Approximately 4,500 people depend on the market for their livelihood. These people are the direct beneficiaries of the investment. The area surrounding the market has 1,976 households, with a total population of 10,717. Many of these people also sell at the market (and all of them buy from it), so they are indirect beneficiaries (if not included in the 4500 sellers). Besides this group the Prey Nob district accounts as beneficiaries as well since this is the districts main shopping area. The total population of Prey Nob will be benefitting the improvement is 100,387 (in 2017). The market area itself has total 4500 sellers, whose daily income relies on the access to the market area. When flooded these 4500 sellers cannot make an income on these days. Given that the market area roughly floods 30 days a year. With a conservative estimate of US$10 income per shop per day, gives an approximate yearly loss of US$1,350,000 per year due to flooding.

Cambodia is known for high casualties in traffic with figures up to 15.1 fatalities in each 10,000 registered vehicles in 2008 (ADB, infrastructure project). The construction of a central median in the road will prevent head-to-head crashes and guides the crossing traffic to safe zones (road safety toolkit). The limitation of crossing points will reduce congestion of traffic, which will benefit the wide range transport traffic, from Sihanoukville harbour to Phnom Penh and vice versa.

The regeneration of the road layout will increase the liveability of the area in total, creating shade and preventing flooding are essential focus points in the design for this investment. Rainwater harvesting can contribute the water scarcity solutions and greenery will reduce the dust and dirt in the area.
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BUDGET

*Market area rehabilitation*

The cost for the improvement of the market area

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>QUANTITY</th>
<th>UNIT PRICE</th>
<th>COST</th>
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<tbody>
<tr>
<td>Culvert 1500 x 1500 mm</td>
<td>1060 m</td>
<td>200$/m</td>
<td>212,000</td>
</tr>
<tr>
<td>Traffic culvert 1500 x 1500 mm</td>
<td>100 m</td>
<td>2,500$/m</td>
<td>250,000</td>
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<tr>
<td>Labour</td>
<td>375 days</td>
<td>$15 per day</td>
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<tr>
<td>Labour skilled</td>
<td>125 days</td>
<td>$30 per day</td>
<td>3,750</td>
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<tr>
<td>Connection with existing drainage system of surrounding</td>
<td>20 points</td>
<td>250$/point</td>
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<tr>
<td>Trees</td>
<td>244 unit</td>
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<td>Excavation</td>
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<td>Lighting (Existing)</td>
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<td>75$/m²</td>
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<tr>
<td>Asphalt</td>
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<td>Excavator</td>
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<td>Garbage trap</td>
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<tr>
<td>Eco-Treatment</td>
<td>2 unit</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td><strong>$712,905</strong></td>
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</table>
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DATA COLLECTION

Inputs

Storm water design and the planning on road layout were suggested during the visit to the Veal Renh market together with the commune chief and the owner of the market. The community cleans the drainage system every two weeks, to remove the solid waste (plastics) to prevent the system from clogging. While visiting the site, there was still a significant amount of solid waste present in the drainage system, severely reducing its functionality. Below a summary on the site visit.

- The existing system has a diameter of 300-500 mm which is too small to deal with the increasing of rainfall intensity due to climate change. There are 2 discharging points in the opposite site of the market. The crossing pipe is also small, creating a bottleneck.
- The market building is designed with rainwater drainage into the sewer.
- Due to the low elevation at the front of market, the rainfall runoff from the surrounding area flows directly to this area or via open channel drainage.
- The commune chief suggested to apply the rectangular culvert instead of a circular pipe. This culvert can be open and should be cleaned frequently.
- System clogging with solid waste is one of main problems.
- There is no rainwater harvesting facility, all rainfall drains directly to drainage system. To retain the rainwater by installation of rainwater tanks, can be used for cleaning the market hall.

Consultations
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The Veal Renh market is owned by a private owner and is run cooperatively with the local government. Consultation has been carried out with the market owner and commune chief for the implementation and planning.

Site Records

- The owner and local government are aware of the small drainage system and want to redesign it to cope with climate change.
- The Veal Rinh market area is also aware of the problems caused by solid waste.
- At the discharging point opposite side of the market, there is a concern about land ownership issues. The discharging channel cannot be extended, only deepened. The system discharge directly to the rice field behind the housing area.
- The runoff from the surrounding area drained direct or discharges in the open channel and connects to the drainage system at the corner of the market. The runoff from this surrounding area has in fact no separated drainage route except via the market system. Therefore, causing the crossing pipe, underneath the road, a system bottle neck. New drainage system has to be able to deal with the runoff from the whole area (the market and its surroundings).
- In the market, there is no rainwater harvesting facility, all rainwater drains directly to the system.
- The road width is approximately 20 meters. The house to house cross section is between 45 – 50 meters. Both side of the road has low level, so that water can easily flood.
- There is no proper solid waste management system.
Figure 3  “Site Investigation”
IMPLEMENTATION

*Design*

The drainage design concern about the climate change, the increasing of rainfall intensity is taken into account. The catchment area is extend to covered whole area.

*Inputs*

- Catchment area: 187,905 m² (include market area and residential area both side of the road).
- Rainfall intensity based on climate adaptation: 200 l/s.ha
- This refers to the measurement record as following;
  - Maximum rainfall per month = 1,319.7 mm = 1.3197 m = 0.043 m/day
  - Assume rain fell only 15% of the time, in intense bursts rather than continuously. this gives a rainfall rate of:  0.043 m/day divided by 15% = 0.284 m/day = 11.83 mm/hr.
  - For the drainage design which has to deal with short peak intensity, assume rainfall burst (peak) in 10 minutes = 11.83 mm/hr x 60/10 = 70.98 mm/hr or circa 197.33 l/s.ha
  - Design concept is 2 main drainage systems along the road no.4 with 2 discharging points at the rice field side with eco-treatment.
  - Slope 5 permille (5:1000).

*Figure 4*  “Design catchment area”
The maximum flow from rainfall runoff is: 200 l/s.ha x 187,905 m² / 10,000 m² / 2 = 1,879.05 l/s

From the input, 4 culvert profiles have been analysed. Based on the calculation details below, the most suitable culvert size at laying 5 permille is 1.5 m X 1.5 m.

It is suggested to have a garbage trap at the location of crossing road culvert for both sides. This trap will help community to collect solid waste before discharging and to prevent the clogging problem. At both discharging points it is suggested to install a small eco-treatment facility like helophyte filter or wetland to treat the rainwater before discharge to the rice field.

The concept sketch design for the road no.4 in front of the Veal Renh market is shown in figure 8.

For rainwater harvesting, the investment will have a small water tank spreading over entirety of the market area, especially the vegetable and meat zones. The harvested rainwater can be used for cleaning the wet area. The water tank will be connected to the existing roof drain.

The drainage system of the surrounding/residential area is not included in this project as this would be prohibitively expensive and highly complex from an environmental and social safeguard point of view due to the ownership of the land and gaining the necessary consent from the communities.
Figure 6  "Calculation"

\[ Q = A \cdot v \]

\[ v = k_s \cdot R^{2/3} \cdot I^{1/2} \]

\[ k_s = 60 \text{ (beton)} \]

<p>| | | | | | |</p>
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<td>X</td>
<td>Width</td>
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<td>1.2</td>
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<tr>
<td>O</td>
<td>Wet length</td>
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<td>2542.73</td>
<td>2.31</td>
<td>2177.75</td>
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</table>
**Figure 7**  “Eco treatment/Helophyte filter”

**Figure 8**  “Concept street profile”
Community Engagement

The community is currently engaged by the removal of the solid waste from the drainage system twice weekly. The project should be proceeding with the full engagement of the community for the solid waste management. This is programmed into the project under the activities proposed under Output 1.1.

Capacity building on climate adaptation is also suggested, the market and the community around have to understand the changing of rainfall pattern and how to maintain their drainage system to have a best drainage efficiency. Training for communities on basic maintenance and use of the system is provided by the project under Output 1.3.

For further information about the consultative process undertaken in the formulation of this proposal, please see Part II, Section H of the proposal.

Construction

Construction of the market area road side and the storm water drainage system are two separate investments. These two investments are good practice examples that can be replicated throughout the country. This concept design combines the urban landscape and water works to adapt to climate
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change and promote a better living environment for the community. A large number of markets are prone to flood events in Cambodia. With increasing urbanisation and expanding paved surfaces, storm water floods likely to become more frequent and severe in the near future.

For the construction, it will require a local contractor who can do excavation works and laying of new drainage system. The culvert can be fabricated at factory and transport to the site for installation.

**Contractor Requirements**

Material:
- A concern is the quality of the culverts used for the drainage system. These culverts need to be easily maintainable. Therefore, the top should be possible to lift up.

Contractor:
- The contractor must have enough heavy machinery capacity for excavation works especially be able to do speed works crossing road no.4. The crossing must be done in short time, to minimize effect to the traffic. Good planning is essential.
- Contractor must have ability to do a detail design for the system.

**Key Risks & Safeguarding Issues**

§ Environmental (if applicable)
As in the existing system, the investment will have a discharging point in the rice field. The drainage system could bring the pollution to that point. The investment on two small Eco treatment is designed to alleviate this risk by treating polluted rainwater before discharge to a level where the water is suitable for animals to drink.

§ Social Safeguards (if applicable)
During the construction, temporary disruption could lead to a social conflict especially the access for the seller in the market and housing around. Care should be taken to ensure that there is a good planning for alternative access route. Consultation with sellers in the market and local residents will take place throughout the construction.

Also, the system requires a crossing on main road no.4. Care should be taken to ensure that there is minimal effect on the transport.

For the construction of drainage discharging, it might lead to temporary disturbance of land owner. It will be requiring the cooperation of land owner along the route. Consultation will take place throughout, with consent in place in advance.

§ Gender/Youth (if applicable)
No safeguarding issues identified
<table>
<thead>
<tr>
<th>ENVIRONMENTAL AND SOCIAL SAFEGUARD PRINCIPLE</th>
<th>RISK MITIGATION ACTIONS INCORPORATED IN THE DESIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Compliance with the law</strong></td>
<td>The project requires a good cooperative with land owner, market sellers, local people in surrounding and local government and transport system that might affect. A good execution planning is required and must be informed to the involved stakeholders before proceed. However, no legal issues are anticipated.</td>
</tr>
<tr>
<td><strong>Access and Equity</strong></td>
<td>The new drainage system and landscape works along the road will improve safety from flooding to all stakeholders in this area. All stakeholders will get benefit from this project. Every housing in this area can connect their rainwater pipe direct or indirect to the system. Proactive measures will be taken to ensure that people (and especially sellers, who are primarily women) can still access the market while the works are ongoing.</td>
</tr>
<tr>
<td><strong>Marginalised and Vulnerable Groups</strong></td>
<td>There are no anticipated issues regarding marginalized groups. The market will provide improved access for people with disabilities (who currently cannot easily access it).</td>
</tr>
<tr>
<td><strong>Human Rights</strong></td>
<td>There is no evidence to suggest that human rights will be violated. Rights issues concerning land, women, labour and indigenous people are addressed separately in this sheet.</td>
</tr>
</tbody>
</table>
### Gender Equity and Women's Empowerment

Projects/programmes supported by the Fund shall be designed and implemented in such a way that both women and men 1) have equal opportunities to participate as per the Fund gender policy; 2) receive comparable social and economic benefits; and 3) do not suffer disproportionate adverse effects during the development process.

There are no anticipated issues regarding gender equity.

The project is primarily designed to benefit women. It is estimated that 90% of the sellers in the market are women, so the incomes that will be safeguarded and increased as a result of the project will primarily be women’s.

Men and women will be given equal opportunity to provide their labour to the construction process, under the [People's Process](#) approach. Whenever women provide their labour, the project will ensure that they have access to separate bathrooms and hygienic products.

All labourers (male and female) employed under the project will be given a mandatory briefing on the prevention of sexual harassment and exploitation prior to commencing their work.

### Core Labour Rights

Projects/programmes supported by the Fund shall meet the core labour standards as identified by the International Labour Organization.

There are no specific risks to core labour rights resulting from this investment. However, the following safeguard provisions will be made.

Safety equipment will be required for workers on the site and provided for them.

This activity will draw upon unskilled labour from the community. All workers in the project will be informed of their rights to organise, including joining formal labour unions, in accordance with the law. Unskilled labourers will be paid $300 per month (assuming an 8-hour working day, 5 days per week, this is 50% higher than the national minimum wage).

All workers employed by the project (including under agreement of cooperation) will be aged 18 or over.)
**Indigenous People**

The Fund shall not support projects/programmes that are inconsistent with the rights and responsibilities set forth in the UN Declaration on the Rights of Indigenous Peoples and other applicable international instruments relating to indigenous peoples.

There is no evidence of indigenous people or undocumented migrants in the target area, and consequently there is no risk that the activities will affect indigenous people.

**Involuntary Resettlement**

Projects/programmes supported by the Fund shall be designed and implemented in a way that avoids or minimizes the need for involuntary resettlement. When limited involuntary resettlement is unavoidable, due process should be observed so that displaced persons shall be informed of their rights, consulted on their options, and offered technically, economically, and socially feasible resettlement alternatives or fair and adequate compensation.

There is no resettlement required. The sellers currently working in the market will not have to move during or after the works, though there may be brief and temporary disruption to access.

All works will be undertaken with full coordination and consent from the sellers currently working in the market.

**Protection of Natural Habitat**

The Fund shall not support projects/programmes that would involve unjustified conversion or degradation of critical natural habitats, including those that are (a) legally protected; (b) officially proposed for protection; (c) recognized by authoritative sources for their high conservation value, including as critical habitat; or (d) recognized as protected by traditional or indigenous local communities.

There are no sensitive natural habitats in the area, which is heavily urbanized.

**Conservation of Biological Diversity**

Projects/programmes supported by the Fund shall be designed and implemented in a way that avoids any significant or unjustified reduction or loss of biological diversity or the introduction of known invasive species.

There is no risk on biological diversity. The works are to be undertaken in a heavily urbanised area, beside a main road.

**Climate Change**
Projects/programmes supported by the Fund shall not result in any significant or unjustified increase in greenhouse gas emissions or other drivers of climate change.

The project will help the local to better understand and to deal with effects of climate change. The construction will not generate a significant amount of greenhouse gas. The benefit of a better drainage system and flood prevention and adaptation to climate change substantially outweighs and negligible emissions caused by the construction works.

**Pollution Prevention and Resource Efficiency**

Projects/programmes supported by the Fund shall be designed and implemented in a way that meets applicable international standards for maximizing energy efficiency and minimizing material resource use, the production of wastes, and the release of pollutants.

The waste and pollution at discharging point is taking account into the design. The eco-treatment system has been incorporated into the design to eliminate the possibility of polluted wastewater (which is the present situation), by using nature-based solutions to treat waste water to a level where it is safe for animals to drink.

**Public Health**

Projects/programmes supported by the Fund shall be designed and implemented in a way that avoids potentially significant negative impacts on public health.

The better drainage system will reduce the stagnant water. Disease from virus, bacteria and microorganism can be decreased as a result.

There are no hazardous materials being used in the construction work.

Specific safety provisions will be devised by the site manager as traffic will continue to pass the site as normal during the construction.

**Physical and Cultural Heritage**

Projects/programmes supported by the Fund shall be designed and implemented in a way that avoids the alteration, damage, or removal of any physical cultural resources, cultural sites, and sites with unique natural values recognized as such at the community, national or international level. Projects/programmes should also not permanently interfere with existing access and use of such physical and cultural resources.

The project will promote the better landscape design for living. There will be no effect to physical and culture heritage, and there are no points of physical or intangible cultural heritage in or around the market area.
Land and Soil Conservation

Projects/programmes supported by the Fund shall be designed and implemented in a way that promotes soil conservation and avoids degradation or conversion of productive lands or land that provides valuable ecosystem services.

There are no anticipated issues regarding land and soil conservation.