CLIMATE CHANGE ASSESSMENT
November 2017

I. Basic Project Information

Project Title: Provincial Water Supply and Sanitation Project
Project Budget: $119.17 million
Location: Cambodia; Battambang, Kampong Cham, Siem Reap and Sihanoukville Provincial Towns
Sector: Water and other urban infrastructure and services.
Theme: Urban policy, institutional and capacity development - Urban sanitation - Urban water supply with cross-cutting themes of strengthening governance, promoting gender inclusiveness and equality, and improving resilience to natural hazards and the impact of climate change
Brief Description *(particularly highlighting aspects of the project that could be affected by weather/climate conditions)***:** Provincial Water Supply and Sanitation Project (PWSSP) will expand water supply and sanitation services and contribute to the Government's target of (i) 100 percent urban 24-hour water supply coverage for all town centers and 90 percent coverage for all suburbs by 2025 with improved water quality to national standards and services; and (ii) improved urban sanitation by focusing on the provision of septage management services and piped sewerage system development to complement the expansion of the water supplies in the towns and ongoing and /or planned Asian Development Bank (ADB) urban development projects. The impact of the Project is increased piped water supply and sanitation services coverage contributing to the Government's 2025 targets and resulting in improved urban environments and quality of life for the urban residents with an outcome of sustainable piped water supply and/or sanitation service provision in the towns of Battambang, Kampong Cham, Siem Reap, and Sihanoukville. The project has the following outputs: (i) Output 1: Improved piped water supply. The project will finance two water supply subprojects (Battambang and Kampong Cham), both new water treatment plants (WTPs) with a combined capacity of 61,600m^3/day and new distribution networks with a combined length of about 161 km. The expanded systems will be capable of serving an additional 209,000 people by 2022. (ii) Output 2: Improved sanitation. The Project will finance four wastewater subprojects, including (i) two new wastewater systems and improved septage management in Battambang and Sihanoukville, (ii) a new trunk sewer in Siem Reap, and (iii) septage management in Kampong Cham. In Battambang, the existing wastewater treatment plant (WWTP) will be decommissioned and a new WWTP of 11,600 m^3/day capacity will be constructed, together with 15.5 km of trunk sewers. In Sihanoukville the existing WWTP will be upgraded from a capacity of 6,900 m^3/day to 20,500m^3/day. In Kampong Cham, septage treatment and management facilities will be financed. In central Siem Reap, a 3.7km long trunk sewer will be constructed, using trenchless technology to limit disturbance to business and tourism activities in the town. A proposed Japan Fund for the Joint Crediting Mechanism (JFJCM) grant will provide support for the incremental cost and capacity development of a more advanced and energy efficient WWTP at Battambang, to reduce carbon emissions, while a proposed European Union grant will support (i) the free household connections and (ii) the solar-powered aerators needed for the Sihanoukville WWTP. (iii) Output 3: Improved institutional effectiveness. The project will include on-the-job training for the executing and implementing agencies in project management, implementation of urban water supply and sanitation projects, and O&M.

II. Summary of Climate Risk Screening and Assessment

A. Sensitivity of project component(s) to climate/weather conditions and sea level
The project is potentially sensitive to extremes of heavier and more intense rainfall events and consequent flooding, the converse situation of extended and deeper drought conditions and sea level rise

For periods of extended drought, the impacts are likely uncertainty over water supply and higher ambient temperatures leading to an increased per capita requirement for personal consumption, the reduced ability of the water resources to meet daily demand.

The heavier and more intense rainfall raises the risk of wash-out and damage to the urban infrastructure, the likelihood of flooding and inundation of raw water intakes and/or WTP and excessive sediment loading in source waters, compromising the capacity of the treatment plants. For the wastewater and sanitation infrastructure, there is the concomitant risk of the flooding and inundation of the WWTPs and septic tanks, and the surcharging of the sewerage networks leading to the discharge of untreated sewage.

Project component	*Sensitivity to climate/weather conditions and sea level*
1. *Water Supply* 2. *Construction of new waste water treatment lagoons* 3. *Pumping stations near the sea*	1. *Uncertainty in water supply due to drought* 2. *Low lying and flat sites may suffer flooding* 3. *May be exposed to sea level rise*

B. Climate Risk Screening

Initial climate risk screening was carried out using AWARE for Projects on (i) wastewater subprojects and (ii) water supply subprojects. Climate change risk was identified as high for wastewater subprojects on the basis of a high risk of sea level rise and flooding and medium risk of water availability. Climate change risk for water supply subprojects was identified as medium on the basis of high risk of flooding and medium risk of precipitation decrease, water availability and increased temperature (see Annex 1: Aware Climate Risk Screening Report).

Risk topic	Description of the risk
1. *Temperature increase* 2. *Rainfall increase* 3. *Droughts*	1. *Temperatures across Cambodia may increase by 4^{o}C under RCP 8.5 by 2050.* 2. *Rainfall during intense short duration precipitation may increase by 12%.* 3. *Severe droughts may occur as a 1 in 13-year event.*

Climate Risk Classification

Medium

The AWARE tool initially classified the climate risk to the project as high (see AWARE climate risk screening reports attached), in large part due to the potential impacts of sea level rise. However, the detailed climate risk and vulnerability assessment (CRVA) indicates that sea level rise is not a significant threat as the Sihanoukville WWTP, the only infrastructure investment in the only coastal town in the project, is located close to the sea but not immediately adjacent to it. This is the only infrastructure in a coastal town. Potential flooding was flagged as a potential issue by the AWARE tool, which was confirmed by the CRVA, which is why the project has a medium risk classification.

C. Climate risk assessment

A CRVA was undertaken, based on site visits and projections for four sites. The projects are based on RCP 8.5 for the years 2030 and 2050. Rainfall data on a daily basis for 25 years was obtained from the Ministry of Water Resources and Meteorology. Flood risks were assessed using the Flood Risk Management Interface (FRMI) developed by the Ministry of Public Works and Transport.

Projections show that the increase in intensity of rainfall during extreme weather events does not vary across the country. The 1 in 10-year event by 2030 under RCP 8.5 will experience a 4 % increase in 1-hour rainfall intensity and by 2050 under RCP 8.5 there will be a 7% increase in 1-hour rainfall intensity. The 1 in 100-

year event by 2030 under RCP 8.5 will experience a 7 % increase in 1-hour rainfall intensity and by 2050 under RCP 8.5 there will be a 12% increase in 1-hour rainfall intensity. The projected results show that by the year 2050, daily peak temperatures could reach 49.5^{o}C. This would be a 1 in 100-year event. A more common scenario would be daily peak temperatures reaching 47^{o}C which would be a 1 in 10-year event. The highest probability of a severe drought occurring is 7.5% by the year 2050 in Battambang, equating to a 1 in 13-year event. The highest probability of an extreme drought occurring is 4.29% by the year 2030 in Siem Reap, equating to a 1 in 23-year event.

The projected increases in intensity of drought events and increased temperature entail water supply risks, particularly for Battambang. The increases in hourly rainfall intensity entail risks of flooding of WWTPs and the networks that feed them.

III. Climate Risk Management Response within the Project

The total estimated adaptation cost for the project is approximately $1.7 million and the cost for GHG mitigating measures is $900,000.

The Battambang WWTP is located on an extremely flat site that is likely to be subjected to flooding. During detailed design, the intensity of rainfall used in the flood calculations, which will determine perimeter drainage design and bund height, should allow an increase of 12% on short duration rainfall intensity. The manholes and household connections will need to be to be raised above potential flood levels in low lying areas. Additionally, to cope with the increase in short duration rainfall intensity, the WWTP will need to have an increased height of bund around anaerobic ponds, which will cost approximately $20,000; increasing the bunds around the WWTP site is expected to cost $190,000; and the construction of bunded sludge drying beds is estimated at $100,000.

For the Battambang water supply subproject, water supply is influenced by upstream offtake for irrigation. At present, information on offtake quantities is not available as the major upstream irrigation dam is still undergoing commissioning trials, which may take 2 years to complete. The climate change adaptation response, given the existing information within the project, is to develop the Battambang provincial waterworks Water Safety Plan (WSP). The WSP will include drought response planning, awareness raising, early warning and appropriate management measures for the control of wastage and the marshalling and, if required, rationing of available supplies. The approximate cost for the assistance with WSP development is $10,000 with an annual reoccurring expenses of $3,000 relating to WSP monitoring and updating

The Kampong Cham septage treatment facility is on an elevated site that is unlikely to be flooded. Sludge drying beds are open to the weather and may be inundated with intense rainfall. Light weight free standing roofs over the sludge beds should be considered. The cost of site formation and preparation, based on an increase of 12% on short duration rainfall intensity, is assessed at $262,000, representing 5% of the cost of the WTP.

The Kampong Cham water supply site occupies a site adjacent to the existing WTP in an area that has moderate flooding risk. Designs for flood protection should allow an increase of 12% on short duration rainfall intensity. Similar to Battambang, the development of a comprehensive Kampong Cham provincial waterworks WSP is expected to cost approximately $10,000 for assistance with WSP development with an annual expense of $3,000 for expenses relating to WSP monitoring and updating.

For the Kampong Cham septage treatment subproject, there is the risk of climate change induced excessive rainfall causing local flooding and the inundation of anaerobic ponds at the septage treatment facility. The risk to the sludge drying beds is minimal as the sludge clearance will be undertaken in the dry season when weather conditions are stable. Also, the provision of a sludge dewatering container will minimise risks.

Approximately $90,000 is estimated for the bunds and site protection in the estimates of costs established by the preliminary engineering design for the septage treatment facility.

The Sihanoukville WWTP site is located close to the sea but not immediately adjacent to it. Sea level rise is not considered to be a threat at this site but flood risk should be taken into account when designing the pumping stations. The increased temperatures may stimulate the bacterial action in the lagoons. Temperature in excess of 40^{o}C may be encountered. This should be factored into the efficiency calculations of the additional surface aerators.

Although the ADB's AWARE tool suggested the potential risk of landslides in the Sihanoukville coastal zone, the geomorphology of the costal fringe of the town area would suggest that land slippage is highly unlikely. The Sihanoukville peninsula forms an extension of the foothills of the Cardamom Mountains, which extend along the whole of the shore of the Gulf of Thailand. Landforms are gently to steeply incised. The predominant rock type is sandstone, identified as the Upper Indosinian formation, of the upper Cretaceous period. This formation consists of a thick (of the order of 1000 metres) sequence of sandstone, shales, clay, marl and conglomerates.

With regard to climate change mitigation, the existing WWTP will be upgraded with the installation of 12 solar powered mixers/aerators to increase the capacity of the plant up to 250% to meet 2040 demands for the proposed new service areas. The mixers/aerators with hoses, freight and installation have an estimated cost of $900,000.

The replacement interceptor sewer at Siem Reap will be in an area classed has having a moderate risk of flooding. This may impact on the construction program. Other than that, no major climate change impacts are envisioned.