CLIMATE CHANGE ASSESSMENT

I. BASIC PROJECT INFORMATION

Project Title:	Outer Islands Transport Infrastructure Investment Project (KOITIIP)
Project Cost ($ million)**:**	$42.0 million (ADB $12.00 million; World Bank $30.00 million)
Location:	Republic of Kiribati
Sector:	Transport
Theme:	Environmentally sustainable growth (global and regional transboundary environmental concerns; Disaster risk management); Inclusive economic growth (Pillar 2: Access to economic opportunities, including jobs, made more inclusive)
Brief Description:	Connectivity and accessibility to Kiribati's outer islands is challenging due to inadequate infrastructure (wharves, ramps, piers, and ports), boat channels, passages, and aids to navigation. Shipping points on the outer islands are inefficient, cumbersome, and unsafe. They exist only in the form of narrow channels cut through expansive reef flats, with docks on some islands. None of the outer islands have proper cargo-handling facilities and equipment. At most islands, vessels have no choice but to offload passengers and cargoes onto small outboard motorboats far from the shore. These boats then have to traverse across the reef flats to shore, which is often only possible during high tides. This type of operation contributes to prolonged and expensive shipping turnaround times. Current practices are also extremely risky in bad weather, with a number of fatalities, injuries and cargo losses reported.

II. SUMMARY OF CLIMATE CHANGE FINANCE

Project Financing		**Climate Finance**	
Source	**Amount** ($ million)	**Adaptation** ($ million)	**Mitigation** ($ million)
Asian Development Bank			
Special Funds resources (ADF grant)	$12.000	$4.35	$0.000
Cofinancing			
World Bank	$30.000	$7.128	$0.000

ADF = Asian Development Fund.
Source: Asian Development Bank.

III. SUMMARY OF CLIMATE RISK SCREENING AND ASSESSMENT

A. Sensitivity of Project Components to Climate or Weather Conditions and the Sea Level

Current Risks

Climatic conditions and the impacts of wind and waves have played a part in the growing strain on shipping operations. In particular, improved maritime infrastructure must account for the seasonal wave climate. As shown in the table below, several severe events have impacted Kiribati in the past 12 years alone, including two major ferry accidents due to rough seas, tropical cyclones (2015, 2016), extreme tides (2010, 2014, 2015), and large swells due to strong winds (2008). Many of these events occurred during the northern trade wind season (December–March), when waves have a larger height and longer period than in other months. Waves and swells that pose the main challenges are driven by the El Nino Southern Oscillation (ENSO), the South Pacific Convergence Zone (SPCZ), and distant tropical cyclonic activity.

Climate-induced disasters in Kiribati since 2008

Event	Date	Description
Swell	9 December 2008	Damage incurred to coastal infrastructure and buildings as a result of strong winds and destructive waves (1 fatality).
Ferry accident on high seas	13 July 2009	En route between Tarawa and the outlying island of Maiana, a ferry capsized in high seas, killing 33 people.
Extreme tide	29 January to 1 February 2010	Coastal inundation of near shore infrastructure.
Extreme tide and swell	28 February to 2 March 2014	Widespread damage was incurred across western Kiribati (Makin, Marakei and Onotoa). Households were damaged, and coastal residents were forced to move inland. Inundation and major damage to causeways and houses also experienced in Tarawa.
Extreme tide	10–13 August 2014	Considerable damage was inflicted on sea walls and causeways in South Tarawa.
Extreme tide	20–23 January 2015	Inundation and major damage to coastal infrastructure and buildings as a result of destructive waves (2 fatalities).
Tropical cyclone Pam and Tropical storm Bavi	March 2015	Coastal inundation and erosion causing damage to homes and infrastructure on many islands around western Kiribati. In Tarawa, the Nippon causeway was damaged and had to be closed. In the southern islands, residents were forced to evacuate their homes due to storm surge.
Tropical cyclone Pali and low-pressure system	9 January 2016	Major coastal inundation (4 fatalities).
Ferry accident in strong waves	18 January 2018	After leaving Nonouti, a ferry ran aground twice, causing structural damage. It later sank in open seas, killing 95 people.

Source: Government of Kiribati.

Aside from safety concerns, surface wind-wave driven processes can impact maritime infrastructure in many ways, including, coastal flooding during storm wave events; coastal erosion, both during episodic storm events and due to long-term changes in integrated wave climate; and reef morphology.

Projected Future Risks

In the future, confidence is very high that El Niño and La Niña events will continue to occur under climate change, but there is little consensus on whether climate change will cause El Nino and/or La Nina to change in intensity or frequency. The same uncertainty applies to the impact climate change will have on the position and timing of the SPCZ. Climate change may or may not influence ENSO and/or SPCZ. The great uncertainty about how climate change will affect these drivers raises the significant risk that the wave climate will worsen and combine with sea level rise to make Kiribati's current interisland shipping operations inoperable for longer periods every year.

In addition, while Kiribati is not in the cyclone belt, it is still affected by them. In March 2015, Tropical Cyclone Pam started some 1,200 kilometers to the south, but still caused significant storm tides, coastal flooding, erosion, and loss of houses and infrastructure.

The main factors determining the height of these waves are the intensity of the cyclone and its distance from Kiribati. Hence, should climate change affect the frequency, path, or intensity of tropical cyclones, this could have a major impact on swell waves, especially combined with sea level rise. There is little consensus on how climate change will affect tropical cyclones in the Pacific, but on a global scale, projections indicate there is likely to be an increase in the average maximum wind speed of typhoons by between 2% and 11%.

Implications for Planned Maritime Infrastructure

KOITIIP will improve maritime infrastructure in several ways, thereby helping Kiribati adapt to disaster risks and climate change and improving the currently unsafe practices in interisland transport.

Component 1: Safety of interisland navigation improved. KOITIIP will undertake hydrographic surveying and updating of all outdated nautical charts in Kiribati. With such surveying, the project can adequately assess and then mitigate the effects of disaster and climate change risks, such as sea level rise and extreme waves. Using various tools (e.g. singlebeam, multibeam, and sidescan sonar, tide gauges, sound velocity profilers), the survey work will be a key enabler for the project's infrastructure investments to ensure safer and smoother interisland navigation given the current and future wave climate. It will also provide valuable bathymetry information that can be used to better predict natural phenomena such as tides, ocean currents, and tsunami inundation, as well as for meteo-oceanographic forecasts.

Component 2: Resilience of outer island access infrastructure improved. This component will focus on designing and constructing maritime infrastructure that will address disaster risks and projected climate change to make sea transport safer and more efficient. Investments will include the following:

- Investments in aids to navigation in four selected islands;
- Construction of boat ramps, port terminals, and a range of maritime infrastructures (e.g. jetties, barges, dredging); and
- Rehabilitation works for causeways on prioritized outer islands.

Resilient design measures and construction materials will be used to enhance infrastructure resilience to current disaster risks (e.g. extreme waves and tides), as well as to climate change.

Component 3: Enabling environment strengthened. This output will focus on strengthening institutional capacity to design, implement and maintain transport sector investments. Capacity building will include contingency planning, extreme weather maritime management, and resilient operational and maintenance practices.

B. Climate/Disaster Risk Screening and Classification

Based on findings of the disaster and climate risk assessment (described below), the climate risk classification is **high**, As summarized in the table in the next section, causeways and road infrastructure, and to a lesser extent transport buildings and structures, were assessed as being most sensitive to disaster and climate change impacts, followed by boat ramps, jetties and navigation aid assets.

Two hazards in particular need to be considered in the project design. The first is high tides, extreme storms, overtopping and storm surge, which will increase with sea level rise, and the second is coastal erosion and sedimentation. Both these hazards can cause widespread infrastructure damage and loss. The design of investments must take into account these and other hazards; if so, damage can be recoverable by ongoing maintenance and repair.

C. Climate Risk and Adaptation Assessment

The Asian Development Bank has conducted an initial disaster and climate risk assessment (DCRA), which highlights the intention of the project to address disaster and climate change risks. This initial DCRA adopted a qualitative 'risk-based' approach for identifying the specific systematic disaster and climate risks to the project. The approach estimated the likelihood (or frequency) and consequence (or impacts) to define disaster and climate risks (e.g. high, medium, low), as shown in the table below. It then provided general recommendations about the design and construction of the proposed maritime transport infrastructure.

Sensitivity of Project Infrastructure to Disaster and Climate Risks

	Hazards	**Infrastructure Type**			
		Navigation aids	Boat ramps and jetties	Causeways and roads	Buildings and structures
Key Sensitivity Factors for Transport Infrastructure Assets	High temperatures and heatwaves	Negligible	Negligible	Low	Negligible
	Extreme precipitation (localized flooding and inundation)	Negligible	Negligible	Low	Low
	Extreme tides, storm surge, cyclones (flooding and overtopping)	Moderate	Moderate	Very High	Moderate
	Wind and wave climate (wave climate and significant heights)	Moderate	Moderate	Moderate	Low

	Coastal processes (erosion and sedimentation)	Moderate	Moderate	Very High	Moderate
	Oceanic conditions (temperature and acidification)	Negligible	Negligible	Negligible	Negligible

In summary, the DCRA recommended that engineering options should employ the best construction methods and materials for the situation and intended life span of the asset, including appropriate international standards and design codes pertaining to maritime transport infrastructure, and also that maintenance over the structure's life span should be feasible and affordable. In addition to engineering options, a range of non-engineering options were recommended that may reduce the impact of disaster and climate change impacts on coastal transport infrastructure. These include coastal mangrove plantings and sustainable reef management.

Following hydrographic surveys (described above), a more detailed DCRA will be developed in conjunction with the detailed design of maritime infrastructure to ensure that project-level disaster risks are fully assessed, DRR measures identified and costed, and best practices in building climate and disaster resilience are reflected in the final design.

D. Climate Risk Screening Tool and/or Procedure Used

Climate risk screening was not undertaken. Instead, the decision was to progress directly to the disaster and climate risk assessment described above.

IV. DISASTER RISK REDUCTION AND CLIMATE ADAPTATION WITHIN THE PROJECT

Component 1–Safe Interisland Navigation can be considered a "Type 2" adaptation activity, meaning that it is predicated on the need to address climate change risks. Thus, the adaptation finance for Component 1 equals the total ADB financing provided for that component ($3.5 million).

As earlier mentioned, detailed designs will be undertaken after completion of the hydrographic surveys. Therefore, it is difficult at this time to estimate the extent and nature of climate proofing ("Type 1" adaptation activities) that will need to be incorporated into project designs for Component 2–Resilient Outer Island Access Infrastructure. For the three sub-components, it is assumed that 10% of the project infrastructure costs (or $607,000) will be counted as climate change finance which is consistent with past maritime projects in the Pacific. For institutional strengthening (Component 3), another $243,000 is counted.

Additionally, the cost of disaster risk reduction (DRR) measures to enhance the disaster resilience of maritime infrastructure is estimated at $2.429 million.

Estimated Disaster Risk Reduction and Climate Change Adaptation Finance

DRR/CCA Activity	Target Disaster Risk	Target CC Risk	Estimated DRR Costs	Estimated CCA Costs	Justification
COMPONENT 1: Safe Interisland Navigation – $3.5 million for hydrographic surveying and updating of all outdated nautical charts in Kiribati.					
Various survey tools will assess the effects of the current and future climate and better predict natural phenomena, including natural disasters.	Extreme waves and tides	Sea level rise, and changes in wind and wave climate	$0 m	$3.50 m	Type 2 adaptation activity – predicated on the need to address climate risks, including climate change and variability.

COMPONENT 2: Resilient Outer Island Access Infrastructure					
Sub-component 2.1: Improvement of Ships-to-Shore Transfer – $930,000 for investments in aids to navigation in four selected islands.					
Investments will be made in aids to navigation in four selected islands. Marker heights will account for current and future wave climate and water levels and strengthened beacons will account for lagoon currents during high tides.	Extreme waves and tides	Sea level rise and changes in wind and wave climate	$186,000	$93,000	Incremental costs, calculated at 20% of the total estimated cost for DRR and 10% for CCA
Sub-component 2.2: Rehabilitation of Island Access Infrastructure – $4.67 million for constructing boat ramps, port terminals, and a range of maritime infrastructure (e.g. jetties, barges, dredging).					
Around concrete ramps, additional erosion protection will account for high risk of coastal erosion. Passenger terminals and multipurpose maritime facilities will be designed to withstand increased wind loads.	Extreme waves and tides, coastal erosion	Sea level rise, changes in wind and wave climate, and changes in coastal processes	$934,000	$467,000	Incremental costs, calculated at 20% of the total estimated cost for DRR and 10% for CCA
Sub-component 2.3: Rehabilitation of Island-Crossing Causeways – $470,000 for rehabilitating works for causeways on prioritized outer islands.					
Improvements to 11 causeways (on 3 islands) will address past damage due to wave lapping, overtopping, and submergence, and also better protect against future damage. Investments will include: structural repairs to revetments, installation of culverts, improvements to road surface and drainage, installation of coastal structures (e.g. groyne fields, breakwaters), provision of scour protection, and planting of mangroves.	Extreme waves and tides, coastal erosion	and changes in coastal processes	$94,000	$47,000	Incremental costs, calculated at 20% of the total estimated cost for DRR and 10% for CCA
COMPONENT 3: Strengthening the Enabling Environment - $2.43 million for building greater institutional capacity to design, implement and maintain transport sector investments.					
Capacity building will include contingency planning, extreme weather maritime management, and resilient operational and maintenance practices.	Extreme waves	Sea level rise, changes in wind and wave climate	$1.215 million	$243,000	Incremental costs, calculated at 50% of the total estimated cost for DRR and 10% for CCA
		TOTAL	**$2.429 million**	**$4.35 million**	

CC = climate change; CCA = climate change adaptation; DRR = disaster risk reduction.
Source: Asian Development Bank.