ECONOMIC AND FINANCIAL ANALYSIS

A. Macroeconomic Context

1. Fiji is a South Pacific nation of 110 inhabited islands with a land area of 18,300 square kilometers and a population of 860,000. The country is almost 3,000 kilometers away from major metropolitan markets, and service delivery costs are high because of its geographic dispersion. About 90% of the population lives on the three main islands of Viti Levu, Vanua Levu, and Taveuni. With about 650,000 visitors annually, tourism is the leading growth sector, accounting for about 37% of the economy. The manufacturing sector represents about 13% of the economy; the sugar, garments, and mineral water industries are significant. Sugar is the mainstay of the rural economy, with the industry employing about 3,000 people directly, and another 200,000 people depending on it for their livelihoods. Mining is growing in importance. The narrow economy is vulnerable to shocks. Four coups since 1987, numerous natural disasters (floods and cyclones), the global economic crisis, and price shocks have all negatively impacted growth.

2. The economy has rebounded since a contraction in 2009, with growth of 3.6% in 2013 and projected growth of 3.8% in 2014. Despite these recent gains, Fiji's longer-term growth performance has been low and volatile. Growth averaged 6.5% per annum in the decade following independence in 1970. However, growth from 1980 to 2013 has averaged only 1.7% per annum, and the economy contracted in 11 out of 33 years. This reflects underlying structural issues that have constrained growth, and internal political instability.

3. An efficient transport network is essential to improve access to economic opportunities and services for rural populations, and to improve trade. Poverty statistics show that overall poverty in Fiji declined slightly from 2003 (39.8%) to 2009 (35.2%). However, a 2008 household income and expenditure survey estimated poverty incidence of 19% in urban areas and 43% in rural areas, living below the basic needs poverty line of $43.43 per adult equivalent per week.[1] Rural communities in Fiji, which account for more than half of its population, are isolated from economic opportunities and social services by long distances from provincial and national centers, and the poor condition of rural transport infrastructure. In the 2014 *Doing Business* report, Fiji ranked 111 of 185 economies in the ease of trading across borders, which is a measure of the time and cost associated with the import or export of a standard shipment by sea transport.[2]

4. The government has estimated that about F$1.3 billion of capital expenditure and F$450 million of maintenance expenditure are required for road and rural maritime infrastructure over the next 5 years.[3] Sustaining these budget increases is dependent on contributions from concessional financing dedicated to the sector, and government support from general revenue sources. The proposed project will support the government's capacity to sustain these budgetary increases in the sector.

5. The project roads, bridges, and jetties will be nonrevenue earning, and constructed and operated by the Fiji Roads Authority (FRA). FRA is a noncommercial government agency which receives annual budget allocations from the Ministry of Finance. The financial analysis confirmed that the Ministry of Finance will have sufficient revenues to repay the loan and

[1] Fiji Bureau of Statistics. 2011. *Report on the 2008-2009 Household Income and Expenditure Survey for Fiji.* Suva.
[2] International Bank for Reconstruction and Development. 2014. *Doing Business: Fiji.* Washington, DC.
[3] Ministry of Finance. 2013. *2014 Budget Estimates.* Suva; Fiji Roads Authority. 2013. *Asset Management Plan 2013*. Suva.

provide sufficient budget allocations to FRA for the operation and maintenance of the project facilities.

B. Subproject Analysis

6. This economic analysis evaluates two sites for a sample subproject on the upper Sigatoka Valley Road, a 77-kilometer road that provides access through important market gardening areas to Queen's Road at Sigatoka. The analysis examined (i) options to repair the existing Narata Bridge or replace it with a new structure at the existing site; and (ii) options to replace the existing damaged Matewale Irish crossing adjacent to the existing site with a new Irish crossing or a new bridge. [4] Economic analysis was carried out in accordance with the Asian Development Bank (ADB) *Guidelines for the Economic Analysis of Projects*.[5]

7. Sigatoka Valley is in Nadroga-Navosa Province. The provincial center is Sigatoka, and the subcenter is Keiyasi. Most villages are along Sigatoka Valley Road. A number are situated in remote hilltop locations accessed by side roads. The total catchment population in the upper Sigatoka Valley is estimated to be about 7,500 people.[6] Agricultural produce is grown in the lower valley for the hotel industry, the domestic market in Suva, and export. The upper valley has nine schools. The main provincial hospital is in Sigatoka, and the upper valley has six medical facilities including a health center and five nursing stations.

8. Economic evaluation of road bridges is most often carried out as part of a wider analysis of road improvement, with the bridge works contributing part of the overall project benefits and project costs. Evaluating the economics of individual bridge repairs, upgrading, or replacement requires a more detailed inspection of the transport service function provided by the bridge in question (or other form of waterway crossing) and the effects of repair and replacement options. Further detail is in the Economic and Distributional Analysis.[7]

9. **Economic costs** for repair or replacement of transport infrastructure are those faced by Fiji Roads Authority and include land, construction, and operation and maintenance costs. All costs are exclusive of indirect taxes such as value-added tax and import and excise duty. The analysis assumes that multiple structures are constructed as part of a single contract package, resulting in economies of scale, except when a structure needs to be reinstated in an emergency following structural failure or flood washout. A shadow exchange rate factor of 0.986 was used to convert goods and services from financial to economic prices. A shadow wage rate factor of 0.860 was applied to local unskilled labor. These factors were applied to capital and maintenance costs and to elements of vehicle operating and passenger time costs.

10. **Economic benefits** arise principally from reductions in costs faced by road users—made up of vehicle operating costs, travel time, and perceived and actual safety risks. The analysis used built-up vehicle operating costs for the different classes of vehicle commonly surveyed in traffic counts in Fiji. Vehicle operating costs, traffic speed modeling, and economic evaluations were performed using a spreadsheet-based version of the World Bank's Highway

[4] An Irish crossing is a low-level submersible causeway raised above the bed of a watercourse, with culvert openings for passing the water flow under non-flood conditions. During a flood, the crossing is submerged and not usable. Irish crossings are a lower-cost option for vehicle access on low-traffic roads than a higher level and usually longer bridge structure.

[5] ADB. 1997. *Guidelines for the Economic Analysis of Projects*. Manila.

[6] Based on the 2007 population census and allowing for growth of 3.8% up to 2014.

[7] Economic and Distribution Analysis (accessible from the list of linked documents in Appendix 2).

Development and Management (HDM) vehicle operating cost and speed models in the World Bank open source software package, HDM4RUC.

11. Safety impacts were quantified by measuring the change in risk of fatal, serious, or minor crashes and the economic costs associated with each. These costs include medical and hospitalization costs, emergency services attendance, court and other administration costs, and damage costs to vehicles and other property. This analysis used the HDM4RUC model inbuilt estimate of fatal injury cost at 70 times the gross domestic product per capita and serious injury cost at 25% of the fatal injury cost.

12. Travel during paid work time is generally valued at the employer's cost of labor, while other non-work time is a lower value that individuals place on time spent traveling versus time spent on another activity, measured through their travel choices. Based on international research, non-work time is expressed as a percentage of the work time value. A value of 40% was used, consistent with previous road economic evaluation in Fiji. Two broad income groups were used to value working passenger time: (i) a low-income group who travel by bus or as passengers on trucks, and (ii) a high-income group who travel by private car.

13. An important benefit of bridge repair and replacement is the removal of periods of unplanned closure of the waterway crossing as a result of flooding. Where practical diversion routes exist, trips are longer and a higher road user cost is incurred. Travel demand is also suppressed, as users delay their travel until the reopening of a crossing. Where no practical diversion routes exist, road users need to reschedule or cancel their trip. Losses are specific to the circumstance of each trip, and could be very high if the need for travel is urgent (e.g., for medical reasons).

14. The subprojects also have a degree of unquantified social benefit. These include (i) improved reliability for short distance nonmotorized traffic; (ii) improved safety of two-lane bridges with footpaths for vehicles and pedestrians over narrow single-lane bridge decks; (iii) improved reliability of bridges in the valley, which may induce additional agricultural production; (iv) reduced damming effects upstream resulting from higher level structures, thereby cutting the costs of crop damage and flood damage to buildings adjacent to the river. For these reasons, a 10% economic internal rate of return (EIRR) threshold was applied for subproject acceptance, although a 12% discount rate was used in the discounted cash flow calculations.

15. **Narata Bridge.** Three scenarios were evaluated—a base case and two remedial options. The base case is where major maintenance is reactive to sustained damage to the existing structure, and does not prevent or avoid major closures that result from failure of structural components or foundation erosion. The base case estimates an annual probability of the bridge being washed out each year, as a function of the bridge surviving up to the previous year multiplied by the probability of loss for the current year. This annual probability is then multiplied by costs arising from (i) traffic disruptions, (ii) construction of a temporary crossing, and (iii) the full replacement cost of the bridge.

16. The first remedial option (option 1) costing F$810,000 would repair the bridge and install a parallel footbridge for pedestrians, replace missing end posts and guardrails, repair kerbs, paint steelwork to protect it from corrosion, repair the concrete deck, provide bracing to a damaged pier, and provide scour protection to abutments. The second remedial option (option 2) would completely replace the existing bridge with a longer two-lane single-span structure at a 1 meter (m) higher level, along with raising the level of the road approaches. Both

options include acquisition of a narrow strip of land, although the economic cost is small and included in the construction cost. The economic cost of option 2 is estimated at F$5.3 million.

17. Economic analysis results are summarized in Table 1. The highest road user costs are incurred under the base case, arising primarily from disruption costs during seasonal flood closure and the risk-adjusted disruption cost of bridge failure. For option 1, the seasonal flood closure costs remain although disruption from unexpected washout and reinstatement is avoided. Option 2 removes the flood closure and washout disruption costs together with other safety, speed change, and coincident traffic costs which are of smaller significance. The second option delivers higher road user savings as it greatly reduces the incidence of flood closures, and provides the full safety and operability benefits of a two-lane structure. While option 2 returns a lower EIRR than option 1, a two-lane bridge is more appropriate to the traffic function of Sigatoka Valley Road between the end of the sealed section at Narewa and the administrative subcenter of Keiyasi, and will complement future road upgrading to two-lane seal at a later date.

Table 1: Narata Bridge – Economic Summary

Option	**Agency Costs** (F$ million)	**Road User Costs** (F$ million)		
Base case – Reactive maintenance	3.46	1.15		
Option 1 – Bridge repairs	0.80	1.58		
Option 2 – Bridge replacement	4.94	-		
	Costs (F$ million)	**Benefits** (F$ million)	**NPV**[a] (F$ million)	**EIRR** (%)
Option 1 compared with base case	(2.66)	(0.42)	2.24	113.4%
Option 2 compared with base case	1.29	1.15	(0.14)	11.1%

( ) = negative, EIRR = economic internal rate of return, NPV = net present value.
[a] Costs are discounted at 12%.
Source: Asian Development Bank estimates.

18. **Sensitivity testing.** Option 1 is sensitive to the estimated annual probability of bridge loss resulting from progressive scouring of the abutments and piers in the base case. However, even if the probability of loss is reduced to zero, other deterioration of the structure will still result in an EIRR greater than 20%. Option 2 is more sensitive to the range of input assumptions. It is particularly sensitive to the number of flood closure days per year (which is eliminated by the higher level bridge, longer clear single span, and raised approaches). Results of the sensitivity analysis are in Table 2.

Table 2: Narata Bridge Replacement – Sensitivity and Switching Values

Scenario	**Increase / Decrease**	**EIRR**	**Switching Value (12% EIRR)**
Base Case		11.1%	
Sensitivity Tests			
Capital cost (F$5.3 million)	+25% / –25%	9.5% / 13.8%	–10%
Base traffic	+25% / –25%	13.0% / 9.3%	+12%
Normal traffic growth rate (base = 4%)	+1 % / –1 %	11.4% / 10.8%	+2.7 pp
Flood closure days/year (base = 2)	+ 1 / – 1	14.3% / 7.9%	+0.3 days

EIRR = economic internal rate of return, pp = percentage points.
Source: Asian Development Bank estimates.

19. **Matewale crossing.** Three scenarios were evaluated—a base case and two remedial options. Because of the condition of the crossing, continuing to repair the partially failed existing

crossing is not feasible. Therefore, the base case is represented by an approach to do nothing and replace the crossing when it fails. The first remedial option (option 1) is replacement of the existing deteriorated structure with a new low-level Irish crossing to an improved design in the existing location at a cost of F$2.0 million. The new crossing would be 22 m in length, with a deck elevation 0.5 m higher than the existing structure, providing improved performance and less flood outage compared with the existing design. The second option (option 2) is to construct a higher level bridge at or closely adjoining the existing site at a cost of F$5.6 million. The bridge would be 44 m in length, with a top deck elevation about 6 m above that of the existing crossing, and should be able to pass all but 100-year return period floods. Both options include the acquisition of a narrow strip of land, although the economic cost is small and included in the construction cost.

20. Economic analysis results are summarized in Table 3. Option 1 is the lowest cost remediation option, providing net savings to the transport agency through lower costs of a planned replacement in dry weather and as part of a contract package with other waterway crossings to give economies of scale (as opposed to the base case, which will require emergency reinstatement of the crossing on an ad-hoc basis). Road user savings also result from reduced flood closure, as the existing crossing is predicted to be out of service an estimated 5 to 10 times per year with outages of up to 1 week.

21. Option 2 gives an EIRR of 8.3% compared with the base case. A bridge is the strongly preferred solution of residents of the nearby Wema village, who reported three Irish crossings washed out at the same or adjacent sites since 1977. However, the relatively small population living above the Matewale crossing and limited traffic generation potential, coupled with the need to provide bridges at the lower crossings of the Kalekata and more importantly the Draiba (Namada River), make this option an uneconomic investment.

Table 3: Matewale Crossing – Economic Summary

Option	**Agency Costs** (F$ million)	**Road User Costs** (F$ million)		
Base case – Replace crossing upon failure	2.51	0.78		
Option 1 – Construct new Irish crossing	1.96	0.20		
Option 2 – Construct bridge at existing site	4.84	0.00		
	Costs (F$ million)	**Benefits** (F$ million)	**NPV**[a] (F$ million)	**EIRR** (%)
Option 1 compared with base case	(0.55)	1.05	1.59	v. large
Option 2 compared with base case	2.34	1.42	(0.92)	8.3%

( ) = negative, EIRR = economic internal rate of return, NPV = net present value.
[a] Costs are discounted at 12%.
Source: Asian Development Bank estimates.

22. **Sensitivity testing.** Sensitivity testing was carried out for option 2 compared with option 1. The results showed that high switching values were required for all main input parameters, including capital cost, base traffic, normal traffic growth rate, and flood closure days per year to obtain an EIRR greater than 12%. The results are in Table 4.

Table 4: Matewale Crossing, Bridge Replacement – Sensitivity and Switching Values

Scenario	Increase / Decrease	EIRR	Switching Value (12%)
Option 2 – Bridge vs. option 1 Irish crossing		2.8%	
Sensitivity tests			
Capital cost (F$5.6 million)	+25% / –25%	1.0% / 5.5%	–53%
Base traffic (50 vpd)	+25% / –25%	3.2% / 2.3%	+680%
Normal traffic growth rate (base = 4%)	+1 pp / –1 pp	3.1% / 2.5%	+15 pp
Flood closure days/year (base = 5)	+ 1d / – 1d	3.1% / 2.4%	39 days

EIRR = economic internal rate of return, pp = percentage points, vpd = vehicles per day.
Source: Asian Development Bank estimates.