Group Exercise (Feb 10)

Coastal Protection

Pacific Region Infrastructure Facility

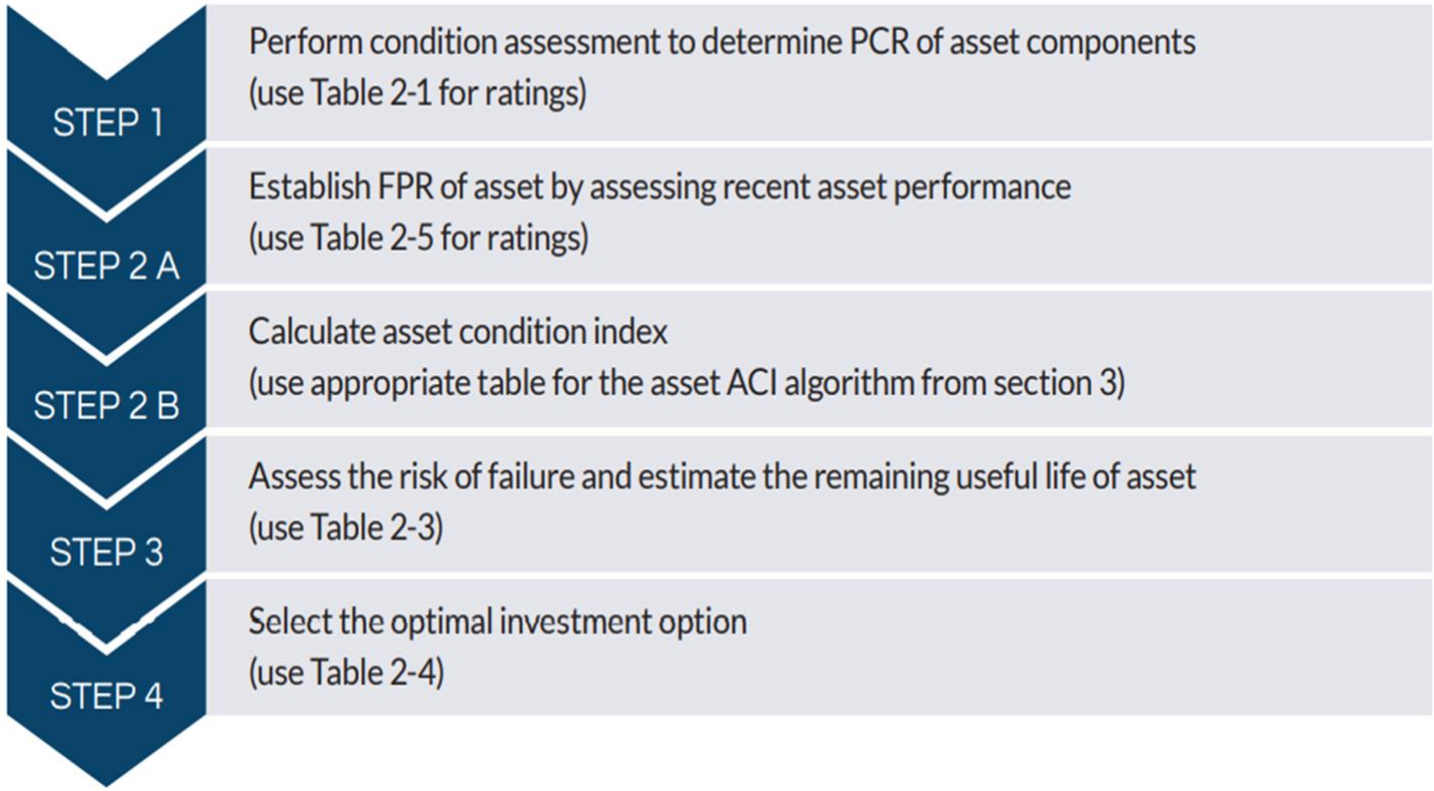
SPC Secretariat of the Pacific Community

Asset Condition Assessment For Seawall

- A 200 m long section of 4 m high steel reinforced concrete sea wall in Fiji is shown in Figure. It has developed a large structural crack, which is frequently topped during high ocean waves.
- Frequent flooding of the road behind the seawall has caused significant soil erosion and is impacting the safety of road traffic, behind the seawall during high tides.
- Calculate its asset condition index and develop an investment plan

Asset Condition Assessment of Seawall

Since we have information available on both physical condition and functional performance of the sea wall, to calculate condition assessment index and develop investment plan for this seawall, we will use the second approach which consists of the following steps, Figure 2-2 (Section 2):



Step 1

- Perform condition assessment to determine PCR of asset components (use Table 2-1, Section 2 for ratings)

To assess the condition of a seawall, we will use Table 2-1 from Section 2, to assign the physical condition ratings to seawall components (described in Section 3.6).

Table 2-1, Section 2

Asset Component Condition	Physical Condition Rating	Interpretation
Asset Component in brand new condition, with no wear, no damage, no deformation, no defects, no deterioration, no impairment	5	Excellent
Asset Component in "like new" condition, with minor wear and no damage, no defects, no deformation, no deterioration and no impairment	4	Good
Asset Component shows minor wear, minor deformation, minor damage, minor defects, minor deterioration, minor impairment, asset condition can be maintained through normal preventative maintenance	3	Fair
Asset Component with major deformation, degradation, deterioration, damage or defects and serious impairment in condition; however component condition can be restored through economically efficient rehabilitation/refurbishment of degraded/faulty components.	2	Poor
Asset Component with major degradation, deterioration, damage or defects and serious impairment in condition, and it is not possible to restore the component condition through economically efficient rehabilitation/refurbishment	1	Very Poor

Step 1

- Perform condition assessment to determine PCR of asset components (use Table 2-1 for ratings)

As described in Section 3.6, to calculate the asset condition index, sea walls are treated as a single component asset.

Let's visually assess condition of the sea wall

Step 1

- Perform condition assessment to determine PCR of asset components (use Table 2-1 for ratings)

Physical Condition Rating	Interpretation
5	Excellent
4	Good
3	Fair
2	Poor
1	Very poor

Based on the extent of structural damage,

- Which rating would you give to this sea wall?
- Please discuss within your group and assign a rating.

Step 2A

- Establish FPR of asset by assessing recent asset performance (use Table 2-5 for ratings)

To establish the Functional Performance Rating, we need recent performance assessment. Based on the initial description, we know high waves frequently top this seawall and there has been erosion of the road that this seawall is meant to protect, making the road unsafe during high tides. Use Table 2-5, Section 2 to assign a functional performance rating to this section of the seawall.

Table 2-5: Asset Functional Performance Ratings

Asset Functional Performance Rating	Condition Score	Interpretation
Asset's functional performance exceeds the upper limit of the desired service levels.	5	Excellent
Asset's functional performance meets the upper limit of the desired service levels.	4	Good
Asset's functional performance meets the lower limit of the service level requirements.	3	Fair
Asset's functional performance does not meet the lower limit of the service level requirements, however through refurbishment/renewal it is possible to restore the performance to acceptable level.	2	Poor
Asset's functional performance does not meet the lower limit of the service level requirements, and it is not possible to restore the performance to acceptable levels through renewal/refurbishment.	1	Very poor

Step 2B

• Calculate the Asset Condition Index

Now that we have assessed and assigned the physical condition rating and the functional performance rating to the seawall, we will input them into Table 3-16, Section 3 to calculate the Asset Condition Index. In the Excel worksheet, insert condition ratings in cells marked with "?" It will calculate the asset condition index

Table 3-16, Section 3

Condition Criteria	Weight	Condition Ratings	Maximum Score	Actual Score
Physical Condition	6	?	30	#VALUE!
Asset Functional Performance	2	?	10	#VALUE!
Total Score	8		40	#VALUE!
Asset Condition Assessment Index (ACI) = (Actual Score / Maximum Score) x 100				#VALUE!

Risk of Failure and Remaining Useful Life

Step 3

- Assess the risk of asset failure and remaining useful life Use Table 2-3 (Section 2) shown below

Based on the Asset Condition Index value calculated in the previous slide, find the correct row in the first column of the table and then move to column 3 in the same row to find the remaining useful and move to column 4 in the same row to find the risk of asset failure.

Table 2:3 (Section 2)

Asset Condition Index	Interpretation	Remaining Useful Life	Risk of Failure in Service
0 to 20	Very Poor	< 5% of TUL	Very High
21 to 40	Poor	<20% and ≥5% of TUL	High
41 to 60	Fair	<50% and ≥20% of TUL	Moderate
61 to 80	Good	<85% and ≥50% of TUL	Low
81 to 100	Excellent	≥85% of TUL	Very Low

Investment plan

Step 4

- Select the optimal investment plan Use Table 2-4 (Section 2) shown below

- Based on the Asset Condition Index value calculated in the previous slide, what is the recommended action?

Table 2-4 (Section 2)

Asset or Component Condition	Recommended Action for Investment Planning
ACI = 0 to 20	Plan Asset Replacement - with High Priority
ACI = 21 to 40	Plan Asset Replacement
ACI>40, but one or more component's Rating 2 or Less	Plan Renewal of Components with Condition Rating of 2 or Less
ACI >50 and all components with rating of 3 or higher	Only Scheduled Maintenance and inspectuibs are Required

Estimate of Investment Needs

Seawall Dimensions			Units
Length	L	200	m
Height	H	4	m
Area	A = L x H	800	m^2
Unit Costs for Seawall Construction(From Section 4)			
Unit cost seawall (Table 4-4)	C_{sw}	$6,000.00	USD/m^2
Price Adjustment Factor for Fiji (Table 4-2)	P_{af}	1	
Cost Estimate			
Estimated Cost of seawall construction	A x C_{sw} x P_{af}	$ 4,800,000	USD

4.6 Coastal Protection Structures

Because of the significant variations in design and capacity of bridges and culverts, it is not possible to develop The cost of constructing coastal protection structures can vary over a broad range depending upon tidal range, ground conditions, structure shape and design, slopes, local availability, and haulage and transport of materials. Table 8-8 shows indicative costs of coastal protection structures,[7] which would need to be refined when detailed designs are prepared.

Table 4-11: Indicative Unit Costs for Coastal Protection

Coastal Protection Type	Measurement Unit	Per-unit Price in $
Steel reinforced concrete seawall	m^2 wall area	$4,000 to $6,000
Rock masonry wall	m^2 wall area	$2,500 to $3,500
Rock Revetments	m^3 - volume of rock	$150 to $250
Beach nourishment	m^3 - volume of sand or gravel	$10 to $25

Note: m^2 = square meter, m^3 = cubic meter.

[7] Thomas Hudson, Kevin Keating, Angus Pettit. 2019. Cost Estimation For Coastal Protection – Summary of Evidence Report –SC080039/R7. Environmental Agency of the United Kingdom.
[8] Prices updated for inflation and currency correction in Gold Coast Water Unit Rates Review – 2008.

Group 3 Exercise Results

Visual Condition Assessment of a Seawall in Fiji

- A 200 m long section of 4 m high steel reinforced concrete sea wall in Fiji. It has developed a large structural crack, which is frequently topped during high ocean waves.

- Frequent flooding of the road behind the seawall has caused significant soil erosion and is impacting the safety of road traffic, behind the seawall during high tides.

Physical Condition Ratings	
Functional Performance Rating	
Asset Condition Index	
Remaining Useful Life	
Risk of Failure	
Estimated Investment	