

Inputs register

Caribbean coastal resilience programme

Sample output, edited for publication. Every input with its value, unit, status and source, settled and signed before the run.

Signed judgements

Line	Input	Value	Unit	Status	Note	Source
	Capital cost	35	US\$ million	Signed	accepted at the case's value at the inputs sign-off · the source beside it grounds this input, not this figure	[1] Busch mangrove-cost synthesis / TNC-UCSC reef CBA / Narayan et al.
	Protection Effectiveness	0.20	fraction	Signed	accepted at the case's value at the inputs sign-off · the source beside it grounds this input, not this figure	[2] Marine Policy / The Nature Conservancy (Mapping Ocean Wealth)
	Baseline Tourism Jobs	11,000	FTE	Signed	accepted at the case's value at the inputs sign-off · the source beside it grounds this input, not this figure	[3] World Travel & Tourism Council (Grenada factsheet)
	Visitor Days Per Year	600,000	visitor-days per year	Signed	accepted at the case's value at the inputs sign-off · the source beside it grounds this input, not this figure	[3] World Travel & Tourism Council (Grenada factsheet)
	Construction Leakage	0.45	fraction	Signed	accepted at the case's value at the inputs sign-off · the source beside it grounds this input, not this figure	[4] International Monetary Fund
	Operational Leakage	0.08	fraction	Signed	accepted at the case's value at the inputs sign-off · the source beside it grounds this input, not this figure	[5] Treasury Board of Canada Secretariat
	Operational Displacement	0.05	fraction	Signed	accepted at the case's value at the inputs sign-off · the source beside it grounds this input, not this figure	[6] World Bank
	Construction Displacement	0.10	fraction	Signed	accepted at the case's value at the inputs sign-off · the source beside it grounds this input, not this figure	[7] Innovation, Science and Economic Development Canada
	Annual Tourism Revenue	260,000,000	US\$ per year	Signed	accepted at the case's value at the inputs sign-off · the source beside it grounds this input, not this figure	[3] World Travel & Tourism Council (Grenada factsheet)
	Insurance Premium	10,000,000	US\$ per year	Signed	accepted at the case's value at the inputs sign-off · the source beside it grounds this input, not this figure	[8] International Monetary Fund / CCRIF SPC

Evidence, sourced and verified

Line	Input	Value	Unit	Status	Note	Source
1.3a	Sea surge: Sea surge risk reduction (share)	0.22	fraction	Checked, review found a different value	the research agent found a different value; the case's own figure is the one in force	[9] Cell Reports Sustainability / UC Santa Cruz / The Nature Conservancy
1.3a	Sea surge: Sea surge damage growth multiple (baseline pathway)	1.40	ratio	Checked, values agree	the trajectory ramps over 2025→2100 (75 yr) and is held flat after, which is the trajectory's own span and not the run's horizon	[10] PLOS One / World Bank
1.3a	Sea surge: Sea surge damage growth multiple (mid pathway)	1.80	ratio	Checked, values agree	the trajectory ramps over 2025→2100 (75 yr) and is held flat after, which is the trajectory's own span and not the run's horizon	[10] PLOS One / World Bank
1.3a	Sea surge: Sea surge damage growth multiple (high pathway)	2.45	ratio	Checked, values agree	the trajectory ramps over 2025→2100 (75 yr) and is held flat after, which is the trajectory's own span and not the run's horizon	[10] PLOS One / World Bank
1.3a	Coastal erosion: Coastal erosion risk reduction (share)	0.10	fraction	Checked, values agree		[11] US Geological Survey / UC Santa Cruz
1.3a	Coastal erosion: Coastal erosion damage growth multiple (baseline pathway)	1.40	ratio	Checked, values agree	the trajectory ramps over 2025→2100 (75 yr) and is held flat after, which is the trajectory's own span and not the run's horizon	[10] PLOS One / World Bank
1.3a	Coastal erosion: Coastal erosion damage growth multiple (mid pathway)	1.80	ratio	Checked, values agree	the trajectory ramps over 2025→2100 (75 yr) and is held flat after, which is the trajectory's own span and not the run's horizon	[10] PLOS One / World Bank
1.3a	Coastal erosion: Coastal erosion damage growth multiple (high pathway)	2.45	ratio	Checked, values agree	the trajectory ramps over 2025→2100 (75 yr) and is held flat after, which is the trajectory's own span and not the run's horizon	[10] PLOS One / World Bank
1.2a	Per visit surplus	66	US\$ per visit	Checked, values agree		[12] Ocean & Coastal Management
1.2a	Beach visitor decline endpoint (mid pathway)	0.38	fraction	Checked, values agree	the trajectory ramps over 2025→2100 (75 yr) and is held flat after, which is the trajectory's own span and not the run's horizon	[13] Ocean & Coastal Management, Vol. 225, Article 106207
1.2a	Endpoint revenue loss (share) (mid pathway)	0.38	fraction	Checked, values agree	the trajectory ramps over 2025→2100 (75 yr) and is held flat after, which is the trajectory's own span and not the run's horizon	[13] Ocean & Coastal Management, Vol. 225, Article 106207
1.2a	Beach visitor decline endpoint (high pathway)	0.47	fraction	Checked, values agree	the trajectory ramps over 2025→2100 (75 yr) and is held flat after, which is the trajectory's own span and not the run's horizon	[13] Ocean & Coastal Management, Vol. 225, Article 106207

1.2a	Endpoint revenue loss (share) (high pathway)	0.47	fraction	Checked, values agree	the trajectory ramps over 2025→2100 (75 yr) and is held flat after, which is the trajectory's own span and not the run's horizon	[13] Ocean & Coastal Management, Vol. 225, Article 106207
1.1a	Operational wage	9,783	US\$ per FTE per year	Checked, values agree		[14] International Labour Organization / STATIN / ECCB
1.1a	Income multiplier	1.75	ratio	Checked, values agree		[15] Annals of Tourism Research (Pratt 2015); Wanhill (1994)
1.1a	Fte per million usd	13.8	FTE-years per US\$ million	Checked, values agree		[4] International Monetary Fund
1.1a	Construction wage	15,556	US\$ per FTE per year	Checked, review found a different value	the research agent found a different value; the case's own figure is the one in force	[14] International Labour Organization / STATIN / ECCB
1.1a	Decline endpoint (share) (mid pathway)	0.38	fraction	Checked, values agree	the trajectory ramps over 75 yr and is held flat after, which is the trajectory's own span and not the run's horizon	[13] Ocean & Coastal Management, Vol. 225, Article 106207
1.1a	Decline endpoint (share) (high pathway)	0.47	fraction	Checked, values agree	the trajectory ramps over 75 yr and is held flat after, which is the trajectory's own span and not the run's horizon	[13] Ocean & Coastal Management, Vol. 225, Article 106207
1.1b	Second dividend ratio	1.0	ratio	Checked, values agree		[16] World Resources Institute
1.1b	Premium friction factor	0.70	fraction	Checked, values agree		[17] Roper (industry commentary) / Climate Finance Lab (CILRIF 2024)

Scope

Line	Input	Value	Unit	Status	Note	Source
	Discount rate	0.035	annual rate (fraction)	Signed	the case's own figure, accepted at the scoping sign-off	
	Time horizon	30	years	Signed	the case's own figure, accepted at the scoping sign-off	
	Exposure base	1,800,000,000	US\$	Signed	the case's own figure, accepted at the scoping sign-off	

Action magnitude	0.22	fraction	Signed	the case's own figure, accepted at the scoping sign-off
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Action costs

Line	Input	Value	Unit	Status	Note	Source
	partial restoration programme; island mangrove restoration (~800 ha) + limited reef (~5 km) (partial) · CAPEX year 0	8,000,000	US\$	In force	year-0 build spend; 800 ha mangrove @ ~\$8k–\$45k/ha + 5 km reef @ ~\$1.3M/km + hybrid defence (bottom-up)	[1] Busch mangrove-cost synthesis / TNC-UCSC reef CBA / Narayan et al.
	partial restoration programme; island mangrove restoration (~800 ha) + limited reef (~5 km) (partial) · CAPEX year 1	6,000,000	US\$	In force	year-1 build spend (bottom-up)	[1] Busch mangrove-cost synthesis / TNC-UCSC reef CBA / Narayan et al.
	partial restoration programme; island mangrove restoration (~800 ha) + limited reef (~5 km) (partial) · CAPEX year 2	4,000,000	US\$	In force	year-2 build spend (bottom-up)	[1] Busch mangrove-cost synthesis / TNC-UCSC reef CBA / Narayan et al.
	partial restoration programme; island mangrove restoration (~800 ha) + limited reef (~5 km) (partial) · O&M per year	180,000	US\$	In force	from year 3 to the horizon. ~1%/yr of implementation cost (restoration maintenance fraction, real-anchored)	[18] Busch (jonahbusch.com synthesis) / restoration cost literature
	planned restoration programme; island mangrove (~1,500 ha) + reef (~10 km) + partial hybrid defence (planned) · CAPEX year 0	15,000,000	US\$	In force	year-0 build spend; 1500 ha mangrove @ ~\$8k–\$45k/ha + 10 km reef @ ~\$1.3M/km + hybrid defence (bottom-up)	[1] Busch mangrove-cost synthesis / TNC-UCSC reef CBA / Narayan et al.
	planned restoration programme; island mangrove (~1,500 ha) + reef (~10 km) + partial hybrid defence (planned) · CAPEX year 1	12,000,000	US\$	In force	year-1 build spend (bottom-up)	[1] Busch mangrove-cost synthesis / TNC-UCSC reef CBA / Narayan et al.
	planned restoration programme; island mangrove (~1,500 ha) + reef (~10 km) + partial hybrid defence (planned) · CAPEX year 2	8,000,000	US\$	In force	year-2 build spend (bottom-up)	[1] Busch mangrove-cost synthesis / TNC-UCSC reef CBA / Narayan et al.
	planned restoration programme; island mangrove (~1,500 ha) + reef (~10 km) +	350,000	US\$	In force	from year 3 to the horizon. ~1%/yr of implementation cost (restoration maintenance fraction, real-anchored)	[18] Busch (jonahbusch.com synthesis) / restoration cost

partial hybrid defence (planned) · O&M per year					literature
ambitious restoration programme; island mangrove (~2,500 ha) + reef (~18 km) + extended hybrid defence (ambitious) · CAPEX year 0	24,000,000	US\$	In force	year-0 build spend; 2500 ha mangrove @ ~\$8k–\$45k/ha + 18 km reef @ ~\$1.3M/km + hybrid defence (bottom-up)	[1] Busch mangrove-cost synthesis / TNC-UCSC reef CBA / Narayan et al.
ambitious restoration programme; island mangrove (~2,500 ha) + reef (~18 km) + extended hybrid defence (ambitious) · CAPEX year 1	20,000,000	US\$	In force	year-1 build spend (bottom-up)	[1] Busch mangrove-cost synthesis / TNC-UCSC reef CBA / Narayan et al.
ambitious restoration programme; island mangrove (~2,500 ha) + reef (~18 km) + extended hybrid defence (ambitious) · CAPEX year 2	14,000,000	US\$	In force	year-2 build spend (bottom-up)	[1] Busch mangrove-cost synthesis / TNC-UCSC reef CBA / Narayan et al.
ambitious restoration programme; island mangrove (~2,500 ha) + reef (~18 km) + extended hybrid defence (ambitious) · O&M per year	580,000	US\$	In force	from year 3 to the horizon. ~1%/yr of implementation cost (restoration maintenance fraction, real-anchored)	[18] Busch (jonahbusch.com synthesis) / restoration cost literature

Kinds of value

Line	Input	Value	Unit	Status	Note	Source
	Employment and economic activity	Valued		The case author's judgement	Employment: construction jobs created + tourism jobs protected along the decline trajectory.	
	Induced economic effects (TDR second dividend)	Valued		The case author's judgement	Induced effects (TDR second dividend); resilience action unlocks it; Indicative confidence.	
	Recreation, tourism and amenity	Valued		The case author's judgement	Recreation/amenity: beach consumer-surplus public value protected (destination revenue carried as market expression).	
	Avoided damage cost (hazard protection)	Valued		The case author's judgement	Avoided damage (sea surge + erosion) is the primary quantified public value gain of the resilience action.	
	Future resource use and stranded resource risk	Held in words		The case author's judgement	Option value: qualitative; future adaptive value of the restored ecosystem.	
	Existence and bequest value	Held in words		The case author's judgement	Existence/bequest: qualitative; biodiversity and intergenerational value of coastal ecosystems.	

Sources

Ref	Citation	Publisher	Link	Licence
[1]	Restoration programme scale for a medium coastal zone, built bottom-up from the unit costs (mangrove ~\$8k–\$45k/ha eroded/open-coast; reef ~\$1.3M/km; hybrid defence \$10–23M/km) and documented Caribbean programme sizes (tens-to-low-hundreds of \$M, e.g. Mesoamerican Reef Fund ~\$60M).	Busch mangrove-cost synthesis / TNC-UCSC reef CBA / Narayan et al.	https://www.wacaprogram.org/article/managing-mangroves-cost-effective-coastline-protection-ghana	Published cost syntheses + programme records, cited under fair use for the bottom-up CAPEX derivation. Composite programme totals grounded, not invented.
[2]	Spalding, M. et al. (2017), Mapping the global value and distribution of coral reef tourism, Marine Policy 82:104-113 (TNC / Mapping Ocean Wealth). Reef-adjacent tourism set at ~10% of coastal tourism expenditure; where tourism occurs near reefs, well over 20% of value is attributed directly to reef presence; up to ~40% of coastal non-urban arrivals fall within 30 km of reefs.	Marine Policy / The Nature Conservancy (Mapping Ocean Wealth)	https://doi.org/10.1016/j.marpol.2017.05.014	Peer-reviewed article, cited under fair use as a reference anchor for the ecosystem-dependent SHARE of coastal tourism value. Anchors a user-adjustable case default, not a value read directly into the account.
[3]	Grenada Travel & Tourism Economic Impact (WTTC 2023, 2022 data): direct tourism GDP XCD 694.2mn (~USD \$257M at the 2.70 XCD/USD peg, 21.5% of GDP); 11,283 direct tourism jobs (21.1% of employment); ~200k stopover arrivals. A representative small developed Eastern Caribbean tourism island.	World Travel & Tourism Council (Grenada factsheet)	https://researchhub.wttc.org/product/factsheet-grenada-travel-tourism-economic-impact	WTTC published country factsheet, cited with attribution. Grounds the composite single-island tourism figures (revenue, jobs, visitor scale).
[4]	Moszoro, M. (2021), The Direct Employment Impact of Public Investment, IMF Working Paper WP/21/131; construction employment coefficient 10.4–17.2 direct FTE-years per USD \$1M CAPEX (emerging-market economies; central ~13.8).	International Monetary Fund	https://www.imf.org/en/Publications/WP/Issues/2021/05/06/The-Direct-Employment-Impact-of-Public-Investment-50276	IMF Working Paper, cited under fair use for the employment coefficient.
[5]	Treasury Board of Canada Secretariat (2007), Canadian Cost-Benefit Analysis Guide: Regulatory Proposals; the additionality framework (deadweight, displacement, leakage, substitution) applied to employment welfare effects; opportunity cost of labour lower where unemployment is elevated.	Treasury Board of Canada Secretariat	https://www.tbs-sct.canada.ca/rtrap-parfa/analys/analys-eng.pdf	Government of Canada publication (Crown copyright; non-commercial reproduction permitted with attribution). Methodology source; grounds the additionality FRAMEWORK, not case-specific rates. URL to be spot-verified at the user's pack review.
[6]	World Bank, Tourism and Competitiveness brief; international tourism demand is exogenous to the domestic economy ("tourism's tradable yet place-based nature ... means countries can capture foreign exchange and fiscal revenues while strengthening domestic firms"): grounds LOW displacement for operational tourism employment in SIDS.	World Bank	https://www.worldbank.org/en/topic/competitiveness/brief/tourism-and-competitiveness	World Bank web publication (CC BY 3.0 IGO for worldbank.org content). Qualitative mechanism source; no numeric extract. URL to be spot-verified at the user's pack review.
[7]	Industry Canada / ISED (2015), Canada Small Business Financing Program cost-benefit analysis; applied 50% as a construction leakage/displacement mid-point in Canadian government CBA practice; the practice anchor the skill cites for construction-phase additionality.	Innovation, Science and Economic Development Canada	https://ised-isde.canada.ca/site/csbfp-evaluation	Government of Canada publication (Crown copyright; non-commercial reproduction permitted with attribution). Practice-anchor source. URL to be spot-verified at the user's pack review.

[8]	IMF, "Gone with the Wind: Assessing Hurricane Costs in the Caribbean" (2017) + CCRIF SPC payout records: Caribbean hurricane damage averages ~1.6% of GDP/yr (2.5% accounting for under-recording); Grenada Ivan (2004) ~\$800M/200% GDP, Beryl (2024) \$219M/16.5% GDP; CCRIF Beryl payout to Grenada US\$44M.	International Monetary Fund / CCRIF SPC	https://www.imf.org/en/Blogs/Articles/2017/02/07/gone-with-the-wind-assessing-hurricane-costs-in-the-caribbean	IMF blog + CCRIF public payout records, cited under fair use. Grounds the island's average-annual-loss (AAL) and the coastal insurance scale.
[9]	Narayan, S. et al. (2025), mangrove storm-surge property-damage valuation using Moody's RMS catastrophe-risk models (UC Santa Cruz CCCR + East Carolina University); with TNC, Methodology for Coastal Resilience Benefits from Restoration and Protection of Mangroves and Tidal Marshes, Verra-validated, April 2026.	Cell Reports Sustainability / UC Santa Cruz / The Nature Conservancy	https://news.ucsc.edu/2025/10/mangroves-property-protection/	Peer-reviewed article + Verra-validated methodology; cited under fair use for method and calibration. Underlying catastrophe-risk model data not redistributed. Figures used as benefit-transfer anchors, not reproduced datasets.
[10]	Reguero et al. (PLOS One 2015), "Effects of Climate Change on Exposure to Coastal Flooding in Latin America and the Caribbean"; World Bank "360° Resilience" (2021); across 18 Caribbean countries, sea-level rise increases expected annual damage (EAD) ~30% by 2050 / 80% by 2100 under RCP4.5, and ~40% by 2050 / 145% by 2100 under RCP8.5.	PLOS One / World Bank	https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0133409	PLOS One (CC BY) + World Bank report (open access), cited with attribution. Grounds the climate axis's expected-damage GROWTH trajectory per RCP.
[11]	Storlazzi, Reguero, Beck et al., USGS/UC Santa Cruz/NOAA; coral-reef coastal-protection valuation; US Virgin Islands ecological restoration scenario.	US Geological Survey / UC Santa Cruz	https://www.usgs.gov/publications/quantifying-coastal-hazard-risk-reduction-benefits-coral-reef-restoration-us-virgin	US Government work (USGS); public domain in the US; cited with attribution. Figures used as benefit-transfer anchors.
[12]	Schuhmann, P.W. et al. (2016), Visitor preferences and WTP for coastal attributes in Barbados; Barbados coastal/marine WTP ~USD \$36–52/visit (~2008 USD).	Ocean & Coastal Management	https://doi.org/10.1016/j.ocecoaman.2016.10.003	Peer-reviewed article, cited under fair use for the per-visit consumer- surplus transfer. CPI adjustment to price year documented at point of use.
[13]	Spencer, N., Strobl, E. & Campbell, A. (2022), Sea level rise under climate change: implications for beach tourism in the Caribbean; 30 Caribbean islands; direct tourism revenue loss 38% (RCP4.5) / 47% (RCP8.5) by 2100 (sandy-beach loss 53%/59%).	Ocean & Coastal Management, Vol. 225, Article 106207	https://doi.org/10.1016/j.ocecoaman.2022.106207	Peer-reviewed article, cited under fair use. Cumulative-2100 endpoints; used to parameterise a trajectory, never applied as an annual rate.
[14]	ILO ILOSTAT country profiles + national statistical offices; Caribbean economy-wide average annual wages (Jamaica ~USD \$12,229/yr, STATIN LFS 2024; Saint Lucia ~USD \$15,556/yr, CSO/ECCB 2023); ILO human-capital (HCT) ≥20% discount for tourism-sector wage premia.	International Labour Organization / STATIN / ECCB	https://ilostat.ilo.org/data/country-profiles/	ILOSTAT data; free to use with attribution (ILO open-data terms). National-statistics figures cited with attribution.
[15]	Pratt, S. (2015), input-output analysis of 7 SIDS; accommodation/restaurants income multiplier (central 0.75); Wanhill (1994), 18 island economies, tourism income multiplier range.	Annals of Tourism Research (Pratt 2015); Wanhill (1994)	https://doi.org/10.1016/j.annals.2015.08.005	Peer-reviewed articles, cited under fair use for the multiplier transfer. SIDS-specific; High match on the multiplier dimension only.
[16]	WRI Adaptation Triple Dividend (AdapTDR) 2025; portfolio analysis of 320 adaptation investments; second + third dividends average ~2× the first, second ≈ third (second-dividend ratio ≈ 1.0, range 0.5–2.0).	World Resources Institute	https://www.wri.org/research/triple-dividend-resilience	WRI research report, cited under fair use. Portfolio-average ratio used as an Indicative transfer; not a project-level parameter.

[17]	Roper (2025), indicative coastal-resilience insurance-premium reduction (60% loss reduction → premiums \$50M→\$30M, 40% cut); general market friction ~0.70 pass-through.	Roper (industry commentary) / Climate Finance Lab (CILRIF 2024)	https://www.climatefinancelab.org/	Indicative industry example, cited under fair use for the friction convention. Not a validated transfer rate; supplementary cross-check only.
[18]	Bosire/Busch global mangrove-restoration cost synthesis; global median ~USD \$8,143/ha (range \$27–\$253,300/ha); maintenance ~1%/yr of implementation cost. Higher (~\$23k–\$45k/ha) on richer economies, eroded sites, open coasts.	Busch (jonahbusch.com synthesis) / restoration cost literature	https://www.jonahbusch.com/cost-restoring-mangroves	Published cost synthesis, cited under fair use for grounding the CAPEX profile. Unit costs used bottom-up; verified at point of use.