Sounds Future Access Study

Economic Impact Assessment Technical Note

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This economics methodology was established by Stantec specifically for the Marlborough Sounds Future Access Project. It uses available data from a Community Residents and Business Survey to establish an indication of the relative impact and value for money of the different programme options in delivering future-focussed access to storm-affected areas. Results have been used to inform the community engagement.

1.1 Introduction

1.1.1 This technical note sets out the methodology for performing an economic impact assessment of the project options proposed in the Sound Future Access Programme Business Case (PBC). It then goes onto demonstrating the value for money assessment results of applying that methodology.

1.1.2 The approach is as follows:

- **Methodology:** The methodology is framed under the guidance of the Waka Kotahi Monetised Benefits and Costs Manual (MBCM) upon which the key benefits categories are identified, and the corresponding monetisation procedures are determined and applied.

- **Study Area Assessment:** This approach, at a high-level, has enabled an assessment of the potential economic impact of each option by zones (or Study Areas). The focus of this assessment will be to demonstrate the economic viability of candidate intervention options in each Study Area. This allowed a calculation of value for money across each intervention at Study Area level before determining the preferred combination of interventions to inform Pathway Options.

- **Pathways Assessment:** Following the Study Area assessment and its results, a series of Pathway Options are determined. This allowed for a comprehensive and robust final decision on a 'Preferred Pathway Option' to be grounded on an in-depth and balanced assessment of all the identified impacts.

1.1.3 The overarching rationale (and process) of benefits assessment methodology is shown as follows:

- The disastrous storm events happened in 2021 and 2022 caused serious damage to the local road network in the Marlborough district. As a result, the storm events not only extended travel time and incurred extra travel costs but also led significant difficulties for the local community to access manifold social and economic opportunities and huge loss in the local productivity.

- A survey named "the Sounds Future Access Survey" were implemented in Feb 2023 to understand the financial and nonfinancial losses experienced by the residents and businesses located in five areas in the Marlborough district, including French Pass, Kenepuru, Pelorus, Port Underwood, and Queen Charlotte Drive. The survey was designed to allow survey respondents to state the changes in life they experienced before and after the storm events. This was achieved by covering various key aspects and topics that are closely related to peoples' daily life, including travel and traffic, income level, education, (physical and mental) health, and (residential and business) property. In this case, the survey data which are then feed into benefit assessment are stated preference data.

- The transport interventions proposed in the Sounds Future Access Study aims to recover the local transport network and improve its resilience in the face of future unexpected disruptive events, which are therefore anticipated to bring the local community's life back to the pre-storm level.

- Given the strong dependence of local community's life on the local road network, the economic benefits generated by each transport intervention could be estimated based on its ability to alleviate the changes in life experienced by the local residents and businesses (i.e., stated extra travel time, stated decreases in business turnover, stated property value loss). It is noteworthy that the benefits discussed here are not income growth or property/land value uplift but values that could be restored or recovered (from the storm events) should the transport intervention be implemented. The transport interventions' ability to alleviate changes are gauged based on impact factors that are suggested based on a professional judgement of the potential impact that each intervention may have on the related study area / segment.

- In addition, considering the potential subjective bias in the stated preference survey data, three testing scenarios have been prepared to justify subjective bias and test how money for value assessment results respond to changes in benefits after controlling for subjective bias.

1.1.4 This technical note helps provide a quantitative and transparent assessment in the timescales available to progress the PBC.

1.2 Methodology Description

1.2.1 The Waka Kotahi Monetised Benefits and Costs Manual (MBCM) is the primary guideline directing the methodology conceptualisation, benefits identification and monetisation, and money for value assessment.

1.2.2 Two major benefit categories and five specific benefits are identified:

- Impact on network productivity and utilisation, reflecting the direct impacts on the local road transport network's efficiency.
  - Travel Time Savings (TTS)
  - Vehicle Operating Cost Savings (VOC)
- Wider Economic Benefits (WEBs). WEBs are additional to the conventional transport system benefits but must be calculated to ensure that impacts of transport activities on the distribution of economic activity generated by firms, households and workers are appropriately accounted for (Waka Kotahi NZ Transport Agency, 2021).
  - Impacts on household cost of living, including household income (inflow) and household expenditure (outflow).
  - Impacts on business cost of operating, including business turnover (inflow) and business spending (outflow).
  - Impacts on property value, covering both residential and business properties.

1.2.3 The primary source of data supporting the assessment and monetisation of the aforementioned benefits are responses to the Sound Future Access Survey. A total of 910 survey respondents who live or operate business in the Sound area participated in the survey in February 2023.

Quantitative Impacts

1.2.4 All the quantitative impacts captured in the survey are increments (and decrements) relative to the condition prior to the storm events in mid-2021 and 2022. For example, as shown by Table 0-1, the weekly travel time of personal trips in French Pass as of February 2023 is on average 100.31 mins (incremental (Δ) travel time) longer than it was in 2021. In addition, the average household income per annum (current) dropped by NZD$ 5,218 (decremental (Δ) household income) relative to the average income level before the storm events in mid-2021 and 2022.

Table 0-1 Summary statistics of survey responses in French Pass

Economic Statistics	Unit of Account (Dimension)	FRENCH PASS	
		Counts	Mean
Δ Travel Time (Personal Trips)	mins/hhd/week	108	100.31
Δ Travel Time (Business Trips)	mins/business/week	37	152.43
Δ Vehicle Operating Costs (Personal Trips)	$/hhd/p.a.	73	1235.42
Δ Vehicle Operating Costs (Business Trips)	$/business/p.a.	27	11814.81
Upper Annual Household Income	$	95	116,314.89
Δ Household Income	%	105	6%
Δ Household Spending	%	95	13%

Economic Statistics	Unit of Account (Dimension)	FRENCH PASS	
		Counts	Mean
Δ Household Income (reduction)	$/hhd/p.a.	80	5,218.71
Δ Household Spending (increases)	$/hhd/p.a.	75	14,858.55
Upper Annual Business Turnover	$	28	192,141.89
Δ Business Turnover	%	28	28%
Δ Business Spending	%	35	16%
Δ Business Turnover (reduction)	$/business/p.a.	23	64,021.45
Δ Business Spending (increase)	$/business/p.a.	26	34,615.23
Upper Residential Property Insurance Cap	$/property	117	919,657.13
Δ Residential Property Value-Road Deteriorate (reduction)	$/property	79	287,848.08
Δ Residential Property Value-Road Close (reduction)	$/property	85	437,831.13
Residential Relocation and resettlement costs	$/property	20	1,379,999.10
Upper Business Property Insurance Cap	$/property	18	1,199,999.00
Δ Business Property Value-Road Deteriorate (reduction)	$/property	25	669,679.94
Δ Business Property Value-Road Close (reduction)	$/property	24	1,054,374.79
Business Relocation and resettlement costs	$/property	5	1,519,999.20

Impact Factors

1.2.5 Those increments (and decrements) can be directly applied to gauge the extent to which the proposed options could improve the current situation. This can be achieved via multiplying the incremental values in one study area (i.e., changes in travel time) by the impact factor of the proposed intervention in this study area.

1.2.6 Impact factors are defined as the percentage of changes (the increments or decrements) that can be alleviated or recovered by the proposed intervention approaches that will be implemented at the identified road segments or marine hubs in the study areas. The impact factors are determined based on the level of improvements to road structure (e.g., lane width and lane numbers) or marine hubs (e.g., emergency ramp) and travel restrictions imposed on different vehicle classes (e.g., heavy truck/ trailer) and user groups (e.g., passengers/freight operators). A table summarising the impact factors of proposed intervention approaches are displayed in Appendix A . For example, the impact factor of road intervention approach Ai is 100%, meaning that the changes (increments or decrements, i.e., extra travel time and decreases in household income) are expected to be 100% recovered if approach Ai is taken.

Economic Parameters

1.2.7 Given that the dimension of economic parameters exported from the survey dataset is either per household or per business, the number of impacted properties by road segments or marine hubs is used as the basis for benefit monetisation. It is noteworthy that in each study area, after counting the total number of properties with access to road segments, the remaining properties without road access but with marine access are assumed to be equally distributed across the marine hubs in the study area.

1.2.8 In addition, due to the property counts provided didn't differentiate business properties from residential properties, it is assumed that the proportion of business to residential properties in each study area is

identical to the proportion of household survey respondents to business respondents. The property data is presented in Appendix B .

1.2.9 The benefit monetisation processes are shown by equation *(1)* to *(5):*

$$TTS_{i,m} = \Delta\mathrm{TT}_{i\_R} \times F \times P_{i\_R} \times VOT_P + \Delta\mathrm{TT}_{i\_B} \times F_m \times P_{i\_B} \times VOT_C \quad (1)$$

$$VOCB_{i,m} = \Delta\mathrm{VOC}_{i\_R} \times F \times P_{i\_R} + \Delta\mathrm{VOC}_{i\_B} \times F_m \times P_{i\_B} \quad (2)$$

$$WEB_{R\_i,m} = (\Delta I_{i\_R} + \Delta S_{i\_R}) \times F_m \times P_{i\_R} \quad (3)$$

$$WEB_{B\_i,m} = (\Delta I_{i\_B} + \Delta S_{i\_B}) \times F_m \times P_{i\_B} \quad (4)$$

$$WEB_{P\_i,m} = (\Delta V_{i\_R} \times P_{i\_R} + \Delta V_{i\_B} \times P_{i\_B}) \times F_m \quad (5)$$

Where:

$TTS_{i,m}$ is the expected travel time savings benefit generated by intervention approach m in study area i.

$\Delta\mathrm{TT}_{i\_R}$ and $\Delta\mathrm{TT}_{i\_B}$ are the reported changes in travel time for personal trips and business trips generated by intervention approach m in study area i, respectively.

F_m is the impact factor of road or marine intervention approach m proposed and will be implemented in study area i.

P_{i_R} and P_{i_B} are the number of residential and business properties in study area i, respectively.

VOT_P and VOT_C are the value of time parameter for personal and commercial trips, respectively.

$VOCB_i$ is the expected vehicle operating cost savings generated by intervention approach m in study area i.

$\Delta\mathrm{VOC}_{i\_R}$ and $\Delta\mathrm{VOC}_{i\_B}$ are the changes in vehicle operating costs reported by residents and business in study area i, respectively.

WEB_{R_i} is the wider economic benefits generated by intervention approach m in study area i, which are sourced from the impacts on household's cost of livings in study area i.

ΔI_{i_R} and ΔI_{i_B} are changes in household income and business turnover in study area i, respectively.

ΔS_{i_R} and ΔS_{i_B} are changes in household spending and business spending in study area i, respectively.

WEB_{B_i} is the wider economic benefits generated by intervention approach m in study area i, which are sourced from the impacts on business's cost of operating in study area i.

WEB_{P_i} is the wider economic benefits generated by intervention approach m in study area i , sourced from changes in property value in study area i.

ΔV_{i_R} and ΔV_{i_B} are changes in residential property value and business property value in study area i, respectively.

1.2.10 Three present values of benefits (PVB) are calculated as per equation *(6)*, *(7)* and *(8)*, respectively:

$$PVB_i = \left[\sum_{t=0}^{n} \frac{\sum_{i=1}^{x}(TTS_i + VOCB_i + WEB_{R_i} + WEB_{B_i})}{(1+r)^t} + \frac{WEB_{P_i}}{(1+r)^{30}}\right] \times T \quad (6)$$

$$PVTB_i = \left[\sum_{t=0}^{n} \frac{\sum_{i=1}^{x}(TTS_i + VOCB_i)}{(1+r)^t}\right] \times T \quad (7)$$

$$PVWEB_i = \left[\sum_{t=0}^{n} \frac{\sum_{i=1}^{x}(WEB_{R_i} + WEB_{B_i})}{(1+r)^t} + \frac{WEB_{P_i}}{(1+r)^{30}}\right] \times T \quad (8)$$

Where:

PVB_i is the present value of total economic benefits in study area i, incorporating both transport benefits and wider economic benefits.

$PVTB$ is the present value of transport economic benefits in study area i, including travel time savings and vehicle operating cost savings.

$PVWEB$ is the present value of wider economic benefits in study area i, including changes in household's cost of living, changes in business's cost of operating, and changes property value.

n represents the number of years considered in the analysis period. A 30-year analysis period is chosen for benefit assessment to ensure the consistency with cost estimates which were gauged based on a 30-year project lifecycle.

x is the number of study areas, which equals to 5.

r is the discount rate, where the choices of discount rate include 2%, 4%, 6%, and 8%.

T is a percentage representing a testing scenario, where the choices of value include 100% (core scenario), 50% (medium scenario), and 25% (low scenario).

1.2.11 Key considerations included in discounting benefits include that:

- Transport economic benefits and wider economic benefits are calculated separately to ensure that a Transport Benefit Cost Ratio (*TBCR*) and a Wider Economic BCR (*WEBCR*) can be calculated in addition to the overall Benefit Cost Ratio (*BCR*).
- All quantitative statistics and parameters used for the benefit calculation are sourced from the survey in which subjective biases are inherent. Sensitivity test scenario T, with choices of value of 25%, 50%, and 100%, is then engaged to justify subjective biases in survey data and to test how BCRs respond to changes in benefits after controlling for subjective biases.
- Changes in property values reported by survey respondents are deemed as a one-off value change happened at the end of the analysis period, covering the cumulative impacts on property values throughout the foreseeable future. As a result, the reported property value changes are regarded as future values incurred at the end of the 30th year and discounted back to the present point in time (year 2023) using a 30-year discount factor.

1.2.12 The programme-level money for value assessment, including the NPV and BCR calculations, is shown as equation *(9) to (12):*

$$NPV = PVB - PVC \quad (9)$$

$$BCR = \frac{PVB}{PVC} \quad (10)$$

$$TBCR = \frac{PVTB}{PVC} \quad (11)$$

$$WEBCR = \frac{PVWEB}{PVC} \quad (12)$$

1.3 Limitations

1.3.1 Subject to the lack of actual post-storm-events road traffic data and marine traffic data, the assessment of transport benefits (TTS and VOC) was not able to be undertaken following the conventional approaches prescribed by MBCM.

1.3.2 Regarding travel time savings benefits, the additional travel time experienced by the local road and barge users were sourced from the survey. The changes in travel time were then monetised using the latest value of time parameters in MBCM. The calculations of travel time savings benefits were based on the no. of household in each study area rather than road traffic volume because of the lack of the actual post-storm events road traffic data. In addition, gauging travel time related user benefits based on road traffic volumes overlooks users who chose marine transport services. In other words, road traffic count measures like Average Daily Traffic (ADT) only indicate the level of road usage, but the local transport system actually comprised two primary modes – that are road and marine.

1.3.3 Regarding the vehicle operating cost (VOC) savings, the additional travel costs incurred to the local residents and businesses were also sourced from the survey. In this case, the VOC categories of travel costs stated by survey respondents might be different from the VOC categories prescribed in MBCM.

1.3.4 In addition, the transport benefits generated by the proposed intervention options were calculated using impact factors, which are surrogate indicators of the level of impacts of different intervention options. No additional sensitivity testing was undertaken for impact factors. This is because the existing testing scenarios (core, medium, and high) have already demonstrated how BCRs are likely to respond. The range of BCRs yielded from the three testing scenarios could assist the preparation of Programme Business Case.

1.4 Industry Specifics Impacts

1.4.1 A series of engagement and consultation were organized with stakeholder representatives from a variety of mainstream industries in the Marlborough district. The objectives of stakeholder engagement are understanding industry-specific impacts of the storm events and consulting the key concerns and expectations in terms of the future local transport planning. The key insights drawn upon feedback from stakeholder representatives are summarized as follow.

- Forestry industry
  - The access to roads by logging trucks have been further restricted after the road network being seriously damaged by the storm events, resulting in extremely high transportation costs.
- Aquaculture industry
  - Freight access by truck to port hubs was compromised, leading to declined port throughput and extra transportation costs to export marine aquaculture produces (including mussels).

- Damages to aquacultural farming facilities constrained the volume of marine produces and also induced additional operating costs.
- Target interventions of improving transport facilities and port facilities are expected.

- Tourism industry
  - Due to the storm events, the damaged local road network took away access to accommodations, valued tourism destinations, and local activities. This led to huge impacts on tourism operators because of dropped tourists' volume, difficulties in carrying tourists, struggling in finding staff, and additional fuel costs.
  - There is a huge commercial demand on high-value tourism destinations in the Sounds area, where the roads are expected to be fixed.

- Farming industry
  - Damaged road network and limited access by trucks impose great challenges to the local farming community, resulting in more expensive raw materials needed by farming (for example, fertilizer), higher operational costs (for example, costs of getting vets and trades people in) and higher transportation costs to export produces (for example, livestock).
  - The financial cost of using the barge is considerably more than using trucks and is a very inefficient use of time. The lack of proper loading facilities made pick livestock and deliver to the barge quite difficult.
  - Reinstating the road to Class one and allowing for trucks and trailers are expected.

1.4.2 It should be noted that the industry-specific impacts informed by the stakeholder representatives were not quantitatively included in value for money assessment as this would risk double counting.

References

NZ Stats. (2014). New Zealand Household Travel Survey: Regional results (3-year moving average). https://nzdotstat.stats.govt.nz/wbos/Index.aspx?DataSetCode=TABLECODE7431#.

Waka Kotahi NZ Transport Agency. (2021). *Monetised Benefits And Costs Manual.* Waka Kotahi NZ Transport Agency.

Appendix A Impact factors for proposed intervention approach

	Approach Code (m)	Description	Impact Factors[1]	Justification
ROADS	Ai	Build back stronger (protect)	100%[2]	- No additional restrictions (from current) - Retain existing lane width and surface types - Upgrade stormwater pipelines across the whole route - Targeted Geotech for existing failures and improvements
	Aii	Build back as was	80%	- Additional restrictions on vehicle size/weight - Increasing number of one lane sections and unsealed sections - Upgrade stormwater pipelines across the whole route - Targeted Geotech for existing failures and improvements (less expensive due to reduced lane width)
	Bi	Build back with targeted improvements (accommodate)	60%	- No additional restrictions (from current) - Retain existing lane width and surface types - Targeted upgrades of stormwater pipelines - Essential Geotech to address existing failure
	Bii	Build back as was but with isolated one lane sections	40%	- Additional restrictions on vehicle size/weight - Increasing number of one lane sections and unsealed sections - Targeted upgrades of stormwater pipelines - Essential Geotech to address existing failure (less expensive due to reduced lane width)
	C	Build back with essential repairs only (accommodate/retreat)	20%	- Additional restrictions on vehicle size/weight - Increasing number of one lane sections and unsealed sections - Essential upgrades of stormwater pipelines to address existing failure - Essential Geotech to address existing failure
	D	Build back roads that provide access to marine hubs (retreat others)	10%	- Additional restrictions on vehicle size/weight - Increasing number of one lane sections and unsealed sections - Essential upgrades of stormwater pipelines to address existing failure - None Geotech – generally spokes get shorter as major Geotech issues happen

	Approach Code (m)	Description	Impact Factors	Justification
MARINE	X	Existing – maintain and protect (resilience)	10%	- Protect marine operations
	Yi	Existing – protect and upgrade facilities for pax	20%	- Protect marine operations - Allow for passenger marine services
	Yii	Existing – protect and upgrade facilities for freight	40%	- Protect and increase marine operations - Allow for freight marine services
	Yiii	Existing – protect and upgrade facilities for all users	60%	-Protect marine operations
	Zi	New – emergency ramp	100%	- Protect and increase marine operations - Allow for both passenger and freight marine services
	Zii	New – local marine hub	80%	- Protect and increase marine operations
	Ziii	New – arterial marine hub	100%	- Protect and increase marine operations

Notes:

[1] Impact factors are defined as the percentage of changes (the increments or decrements) that can be alleviated or recovered by the proposed intervention approaches that will be implemented at the identified road segments or marine hubs in the study areas. These impact factors have been suggested based on a professional judgement of the potential impact that each intervention may have on the related study area / segment. The “Justification” column provides details about the intervention approach (level of improvements and restrictions) to road segments or marine hubs in study areas. A series of testing scenarios (core, medium, and low) have been incorporated to ensure that a range of BCRs can be used to inform the investment decision.

[2] The impact factor of road intervention approach Ai is 100%, meaning that the extra travel time, extra vehicle operating costs, and losses in productivity (i.e., decreases in household income and property value) are expected to be 100% recovered if approach Ai is taken. This is because the intervention approach Ai is expected to bring the level of service of the targeted road segment back to the pre-storm levels, implying that the associated living condition and business activities will return to the pre-storm levels.

Note here:

Appendix B Number of properties by study area

	Segments	Property counts	Residential Properties	Business Properties	Total
FRENCH PASS	FP_R1	209	162	47	
	FP_R2	39	30	9	
	FP_R3, FP_R4	50	39	11	
	FP_R5, FP_R6	128	99	29	
	FP_R7	46	36	10	
	FP_R8	150	116	34	
	FP_M1	14	11	3	
	FP_M2	14	11	3	
	FP_M3	14	11	3	
	FP_M4	14	11	3	
	FP_M5	14	11	3	
	FP_M6	14	11	3	
	FP_M7	14	11	3	722
Queen Charlotte	QC_R1	178	146	32	
	QC_R2	241	197	44	
	QC_M1	81	67	15	500
KENEPURU	KP_R3	6	5	1	
	KP_R4, KP_R5	254	208	46	
	KP_R6a	50	41	9	
	KP_R6b	51	42	9	
	KP_R7	21	17	4	
	KP_R8a	45	37	8	
	KP_R8b	45	37	8	

	KP_R9, KP_10	68	56	12	
	KP_R11	126	103	23	
	KP_R12	143	117	26	
	KP_M1	81	67	15	
	KP_M2	81	67	15	
	KP_M3	81	67	15	
	KP_M4	81	67	15	
	KP_M5	81	67	15	
	KP_M6	81	67	15	1298
PELORUS	KP_R13	18	13	5	
	KP_R14	37	26	11	
	KP_M7	28	20	8	
	KP_M8	28	20	8	111
PORT UNDERWOOD	PU_R1	91	77	14	
	PU_R2	45	38	7	
	PU_R3	61	51	10	
	PU_R4	14	12	2	
	PU_M1	50	42	8	
	PU_M2	50	42	8	
	PU_M3	50	42	8	
	PU_M4	50	42	8	411