

Chiles Ltd

Project: **Ōtaki to North Levin
Detailed Business Case
Phase 1 Multi Criteria Analysis**

Report: **Acoustics assessment**

Client: Stantec (for Waka Kotahi)

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1. Introduction

Waka Kotahi is undertaking a Detailed Business Case (DBC) for a new highway from Ōtaki to North Levin (O2NL). The DBC is based on the new highway being generally within a 300 metre wide corridor previously identified through an Indicative Business Case (IBC) prepared in 2018. A Multi Criteria Analysis (MCA) is now being made to refine the emerging preferred highway alignments, interchange locations and forms, and local road configurations. Phase 1 of the MCA is being undertaken by technical specialists, which will then be updated and reviewed in Phase 2 following consultation with the community.

Chiles Ltd (Stephen Chiles) has been engaged to make an acoustics assessment for the Phase 1 MCA. The assessment is to address potential noise and vibration effects from both construction and operation of the highway. In practice, the operational (road-traffic) noise is the controlling factor and can generally serve as a proxy for the other acoustics aspects. Therefore, the following assessment has been made for operational noise. The assessment has been cognisant of construction noise and vibration and operational vibration, but these have not directly affected any of the ratings.

The Phase 1 MCA comprises three separate components:

- Phase 1a – alignment options
- Phase 1b – interchange options
- Phase 1c – local road connection options

2. Methodology

During the IBC, nine options for potential highway corridors were assessed for operational noise by consideration of numbers of houses and other sensitive receivers ("Protected Premises and Facilities", PPFs) within 250m of each corridor. The ranking of options was based on both the number of PPFs affected and also the likely noise exposure and changes in noise exposure of PPFs.

For the emerging preferred alignments now under consideration, this assessment is focussed on how options might influence adverse noise effects at the most affected PPFs nearest to the highway. For alignment options a quantitative assessment has been made considering the number of nearby PPFs and the distance of these PPFs from each section of the highway. This has been overlain with a qualitative evaluation to arrive at a score, including consideration of potential effects in the wider area and from other road features. For the interchange and local road connection options the assessment has been made solely on a qualitative basis.

Dr Chiles made a site visit on 19 May 2020 during which the corridor and relationship to PPFs was inspected from public roads.

For each aspect, the options that have been assessed are:

- Phase 1a - the corridor is split into 10 zones labelled A to L (omitting I and J) and in each zone there are between two and four alignment options, each labelled as a colour.
- Phase 1b - there are six potential locations for interchanges and two or three interchange form options at each location.
- Phase 1c - there are sixteen locations where local road access is required and between one and four options for connections at each location.

Consistent with other assessments and the MCA instructions, for the alignment and interchange options scores have been based on the following scale:

Score	Description
1	The option presents few difficulties on the basis of the criterion being evaluated and may provide significant benefits in terms of the attribute.
2	The option presents only minor aspects of difficulty on the basis of the criterion being evaluated, and may provide some benefits in terms of the criterion.
3	The option presents some aspects of reasonable difficulty in terms of the criterion being evaluated and problems cannot be completely avoided. There are few apparent benefits in terms of the criterion.
4	The option includes clear aspects of difficulty in terms of the criterion being evaluated, and very limited perceived benefits.
5	The option includes significant difficulties or problems in terms of the criterion being evaluated and no apparent benefits.

For the local road connection options, a simplified three-point scale has been used: 1 (minor impacts), 2 (moderate impacts) and 3 (significant negative impacts).

3. Information

This assessment has relied on the following information:

- Malcolm Hunt Associates, Preliminary Traffic Noise Review Report, March 2019 (IBC, App D)
- Stantec, Technical specialists briefing, 4 May 2020
- Stantec, Interchange options review, 8 May 2020
- Stantec, Initial alignment review, 12 May 2020
- Stantec, MCA 1a Expressway alignment options, 12 May 2020
- Stantec, GIS alignment and building information including building types, 14 May 2020
- Stantec, GIS query of buildings near alignment options, 18 May 2020
- Site visit, Dr Chiles, 19 May 2020
- Stantec, Local access roads long list options report, 25 May 2020
- Stantec, MCA 1b Interchange Options, 27 May 2020
- Stantec, GIS interchange indicative layouts, 27 May 2020

The following information was not available for this assessment:

- Confirmation of which PPFs will be acquired/removed as part of the works (other than those within the earthworks footprint)
- Confirmation of predicted traffic volumes and turning movements (volumes for the main alignment from the March 2019 Preliminary Traffic Noise Review Report have been assumed)
- Details of unexercised resource consents for future PPFs and details of where future PPFs could be built as permitted activities

4. Alignments

Criteria

Consistent with the approach taken for the IBC, reference has been made to criteria and guidance set out in NZS 6806¹. Since NZS 6806 was published in 2010, a number of Boards of Inquiry have considered assessments made for state highway projects applying the standard. The Boards determined that broader assessment of noise effects is required additional to application of NZS 6806, and in some instances additional mitigation is necessary beyond that determined by NZS 6806. This assessment is cognisant of those decisions and has sought to address the issues they raised.

The most stringent criterion in NZS 6806 is 57 dB $L_{Aeq(24h)}$ outside a PPF. Below this level road-traffic noise may still be audible and may still change the amenity of an area but should generally be at a reasonable level. If external levels do not exceed 57 dB $L_{Aeq(24h)}$ then internal levels should generally be below 40 dB $L_{Aeq(24h)}$ even with windows ajar for ventilation.

From the IBC, a level of 57 dB $L_{Aeq(24h)}$ should generally be achieved beyond 75m of the highway in zones A to F and beyond 50m of the highway in zones G to L. The change in distance is due to lower assumed traffic volumes in zones G to L compared to zones A to F. Both distances are based on a porous asphalt road surface. The IBC was based on a traffic speed of 100 km/h, but these distances remain valid for the design speed of the road of 110km/h.

The number of PPFs (identified by Stantec as dwellings) has been counted:

- Within 75m of the nearest edge of an alignment option in zones A to F
- Within 50m of the nearest edge of an alignment option in zones G to L

To check for potential unintended consequences of using a single distance threshold the number of PPFs has also been counted in the next 25m:

- Between 75m and 100m of the nearest edge of an alignment option in zones A to F
- Between 50m and 75m of the nearest edge of an alignment option in zones G to L

Where PPFs are within the earthworks boundary or very close to it these have been excluded from the count. Some other PPFs may also be acquired/removed but these remain in the PPF totals at this stage. When PPFs are removed from the total it reflects improved noise outcomes as people are no longer exposed to road-traffic noise. There may be associated negative social and property effects from removing PPFs but those are not considered in this noise assessment.

MCA scores have generally been assigned as set out below:

Score	Criteria
1	n/a - all of the options have adverse noise effects and none provide significant benefits
2	Options with no houses within 75m (south) or 50m (north)
3	Options with at least one house within 75m (south) or 50m (north)
4	Options with at least five houses within 75m (south) or 50m (north)
5	n/a - none of the options should cause significant difficulties

¹ Standards New Zealand NZS 6806:2010 Acoustics - Road-traffic noise - New and altered roads

Results

Zone	Option	PPFs <75m	PPFs 75-100m	MCA 1a score
A	Green	2	5	3
	White	4	2	3
B	Cyan	5	3	4
	Green	5	5	4
	White	6	2	4
C	Green	5	0	4
	Purple	2	0	3
	White	1	1	3
D	Cyan	4	2	3
	Blue	3	2	3
E	Cyan	3	1	3
	Green	1	4	3
F	Orange	3	3	3
	Purple	10	4	4
	White	1	6	3
		PPFs <50m	PPFs 50-75m	
G	Cyan	0	1	2
	Purple	0	0	2
	White	1	0	3
H	Cyan	1	1	3
	Purple	2	2	3
K	Cyan	5	1	4
	Blue	4	3	3
	Yellow	3	1	3
L	Black	3	4	3
	Green	3	3	3
	Orange	3	4	3
	Purple	3	2	3

Discussion

The methodology adopted allowed for a qualitative adjustment to scores determined on the basis of the PPF counts. Consideration could also be given to the secondary PPF count in the additional 25m band. However, on review of the scores assigned based on the primary PPF counts within 75m/50m they have been considered appropriate without further adjustment.

The scores show relatively little differentiation between options in terms of noise effects. This is an accurate reflection of the fact that all options have adverse noise effects, generally to a similar overall degree. As such, noise effects would generally not be expected to be a significant factor in the alignment selection.

The PPF counts are significantly affected by PPFs that have been assumed to be removed because they are under or very close to earthworks. The results could also be affected by removal of other PPFs due to loss of access and/or loss of a large proportion of the associated land parcel.

Zones B and F are highlighted as areas where further consideration of noise effects may be warranted:

- In Zone B all options have scored the same, but with numerous PPFs on both sides slight adjustments to the alignments could alter this outcome. Further development of options could be warranted in this area.
- In Zone F all options disrupt a residential cluster. The purple alignment remains closest to the most remaining PPFs and has the worst score indicating it is not preferred in terms of noise. However, all alignments in this area could benefit from further development to maximise separation from remaining PPFs.

The above scores were circulated prior to the Phase 1a MCA workshop held on 25 May 2020, where the methodology and results were presented. There were no questions or issues raised at the workshop that resulted in changes to the pre-workshop scores.

This assessment has not included consideration of potential noise effects, from different alignment options, on future activities that may occur in the proposed Gladstone Green development in Zone G. The differential effects of alignment options will depend on the extent to which the master-planning of the proposed development is adapted to respond to a highway noise environment.

5. Interchanges

Criteria

There is a single interchange design for each form/location on a generic alignment. The actual interchange designs would move and alter depending on the selected alignment. At this stage the indicative interchange designs have not been optimised and therefore allow for some turning movements that might not be required and might extend over a wider footprint than essential.

Given the status of the indicative interchange designs, it would be inappropriate to measure distances to PPFs from specific interchange elements in the same manner as the alignment options. The same considerations apply in terms of noise exposure at nearby PPFs as for the alignment options, but this has been accounted for on a qualitative basis from an overview of PPFs in the vicinity.

A key issue with interchange options is the potential for disturbing noise characteristics to be generated by vehicles braking and accelerating. This is often associated with roundabouts, particularly when all vehicles in the main highway traffic flow have to decelerate from 100/110 km/h to a safe speed to navigate the roundabout, before accelerating again.

The noise effects of the interchanges are not directly related to the footprint size, as effects depend on the resulting relationship to PPFs and the nature of vehicle movements within the interchange. Therefore, footprint size has not been directly considered.

A secondary consideration in the assessment of interchanges is consequential traffic changes, and associated noise effects, on local road connections.

Considering the above, the main factors in the qualitative assessment and assignment of MCA scores are set out below:

Score	Criteria
1	No interchange. Free-flowing highway traffic no closer to any PPFs with no additional braking/accelerating.
2	Interchange remote from PPFs and minor consequential effects on local roads.
3	Few PPFs affected, or maintenance of free-flowing highway traffic
4	Numerous PPFs affected by significant braking/acceleration noise of secondary traffic flows
5	Numerous nearby PPFs affected by significant braking/acceleration noise of the main highway traffic flow

Results

Interchange	Location	Form	Comments	MCA 1b score
Manakau	South	Roundabout	All highway traffic braking/accelerating Numerous PPFs in the vicinity Potential braking/accelerating at existing SH1	5
	South	Service	Ramps/local traffic braking/accelerating Numerous PPFs in the vicinity Potential braking/accelerating at existing SH1	4
	North	Roundabout	Reasonable separation from houses Potential braking/accelerating at existing SH1	3
	North	Service	Reasonable separation from houses Potential braking/accelerating at existing SH1	3
	None	-	All highway traffic free-flowing	1
Kimberley / Tararua	Kimberley	Roundabout	All highway traffic braking/accelerating Numerous PPFs in the vicinity	5
	Kimberley	Service	Ramps/local traffic braking/accelerating Multiple roundabouts including existing SH57 Numerous PPFs in the vicinity	5
	Tararua	Roundabout	All highway traffic braking/accelerating PPFs in the vicinity	5
	Tararua	Service	Ramps/local traffic braking/accelerating PPFs in the vicinity Potential braking/accelerating at existing SH1	4
SH1 / SH57	-	Bifurcation	Free-flowing highway traffic Northbound merge close to PPFs PPFs in the vicinity Effects on local road traffic Tight north/south bend to be removed	3
	-	Roundabout	All highway traffic braking/accelerating PPFs in the vicinity	5
	-	Service	Ramps/local traffic braking/accelerating including all SH57 traffic PPFs in the vicinity	4
North Levin	-	Roundabout	All highway traffic braking/accelerating PPFs in the vicinity	5
	-	Service (bifurcation)	Traffic braking/accelerating at merge/bends PPFs in the vicinity	4

Discussion

The high "4" and "5" scores assigned to various options reflects the severity of noise issues that could be associated with the interchanges. Operational noise should be a key factor in further development of the interchanges.

Further consideration/development may be warranted in the following areas:

- The noise effects are related to traffic speeds/behaviour and road environmental design. The scoring could potentially be modified (reduced) if the characteristics of some of the local roads (such as existing SH1/SH57) were to be changed to low speed environments. Road environmental design will be required to encourage gradual braking and acceleration for all interchanges.
- While the scoring does not indicate a particular difference, there is likely to be more scope to mitigate adverse noise effects for the Tararua Road location option than the Kimberley Road location option.
- At Tararua Road the options are currently threaded between existing PPFs, having significant potential noise impacts on them all. Consideration should be given to moving the interchange closer to (and removing) PPFs on one side so that effects can be reduced at PPFs on the other side.
- The SH1 / SH57 roundabout option is located in the middle of various PPFs, having significant potential noise impacts on them all. Consideration should be given to moving the roundabout closer to (and removing) some PPFs so that it is further from the other PPFs.
- The North Levin interchange may have significantly less traffic than other interchanges but currently appears to have similar geometric standards applied. An alternative approach with lower speeds could reduce potential noise effects.

The above scores were circulated prior to the Phase 1b/1c MCA workshop held on 3 June 2020, where the methodology and results were presented. There were no questions or issues raised at the workshop that resulted in changes to the pre-workshop scores.

6. Local road connections

Criteria

There should generally be minor operational noise issues associated with local road connection options due to low traffic volumes and speeds. A qualitative assessment has been made of options to identify any areas where there may be significantly increased traffic (and corresponding noise) or where there are likely to be significant braking/accelerating noise characteristics introduced, such as due to roundabouts.

No differentiation has been made between options with the highway on an underpass or overpass as insufficient detail is available to understand the resulting relationship with PPFs. It has been assumed that the highway and local roads would not have steep gradients that would give rise to significant braking or acceleration when travelling over bridges.

MCA scores have generally been assigned as set out below:

Score	Description	Criteria
1	Minor impacts/issues	
2	Moderate impacts/issues	Moderate increased traffic flow or effects Moderate braking/accelerating likely near PPFs
3	Significant impacts/issues	Significantly increased traffic flow by PPFs Significant braking/accelerating likely near PPFs

Results

Option	Comments	MCA 1c score
A1	Two houses on Taylors Road are affected and the sharp bend is likely to give rise to noticeable braking/accelerating sounds. There will be an effect from a return of some of the traffic in Ōtaki on the existing SH1 that will otherwise be removed by PP2O.	3
A2	82 SH1 is affected. There will be an effect from a return of some of the traffic in Ōtaki on the existing SH1 that will otherwise be removed by PP2O.	2
A3	82 SH1 is affected. There will be an effect from a return of some of the traffic in Ōtaki on the existing SH1 that will otherwise be removed by PP2O.	2
B1		1
B2		1
B3	The gradients and bends on Honi Taipua Street near houses are likely to cause distinct vehicle noise characteristics.	2
C1		1
C2		1
C3		1
C4	It is assumed there would be minimal motorised vehicle traffic on the new links.	1
D1		1
D2		1
E1		1
E2		1
EQ		1

F1		1
F2		1
F3		1
G1		1
G2		1
G3		1
H1		1
H2		1
H3	Potential issues with intersection on existing SH57 and on Kimberley Road connecting the new link near houses with vehicles braking/accelerating.	3
I1	Potential issues on Tararua Road with multiple roundabouts near houses giving rise to vehicles braking/accelerating.	2
J1	Potential issues with roundabouts on existing SH57 and connecting the new link near houses with vehicles braking/accelerating.	3
J2	Potential issues with roundabouts on existing SH57 and connecting the new link near houses with vehicles braking/accelerating.	3
J3		1
J4	Potential issues on Tararua Road with roundabout near houses giving rise to vehicles braking/accelerating.	2
K1		1
K2		1
L1		1
L2		1
N1		1
N2		1
N3		1
P1	Potential issue with noise from braking/accelerating at roundabout - primarily related to the interchange rather than local road connection.	3
P2	Potential issue with noise from braking/accelerating at roundabouts.	3
Q1		1

Discussion

There are three locations identified above where further consideration of noise impacts of local road connections is warranted.

The above scores were circulated prior to the Phase 1b/1c MCA workshop held on 3 June 2020, where the methodology and results were presented. There were no questions or issues raised at the workshop that resulted in changes to the pre-workshop scores.