



Contract 5364

Influence of Procurement and Delivery Models on Pavement Performance

Prepared for

Waka Kotahi

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Document Control

Version	Amendments over previous Version	Review by:	Approved by:	Date
Rev 9	<i>Recommendations shown within the Executive Summary have been re-referenced to align with the 'Required Responses' approach used by the Pavement Delivery System Review (PDSR) Steering Group.</i>	IMcN	<i>Discussed and agreed with C. MacKay at SG Meeting 28.07.22</i>	28.07.22



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1. Executive Summary

Overview

In 2017 Waka Kotahi started to specify the pavement design on D&C Contracts & Alliances as it does on Construct only contracts. This was in response to significant early pavement failures across multiple projects. It was Waka Kotahi's experience that contractors generally did not offer innovative designs but rather low quality and high-risk designs to maximise commercial advantage.

In Jan 2020 an independent review of State Highway Pavement Delivery concluded (amongst other things) that client specified pavement design was not utilising full "industry expertise" that is available to influence and optimise pavement design.

A pavement Delivery System Review Steering Group was created to develop and deliver a programme of improvement initiatives to address the findings of the Jan 2020 report. One of the workstreams under this Steering Group is the Influence of Procurement & Delivery Models on Pavement Performance. This work stream is based on and extends the scoping document entitled "Workstream Procurement" that was subsequently prepared by Waka Kotahi.

The scope of this review will include an assessment of the procurement of both Capital and Network Outcomes contracts.

This review finds substantial agreement with the outcomes of both the Highway Pavement Delivery Review Paper as well as Waka Kotahi's Workstream procurement document in particular:

1. For price competitive procurement models, that the focus of tenderers is on the lowest cost pavement design that meets the requirements of the specifications, and not necessarily, or primarily, on delivering a robust design that achieves the 25 year design life objective.
2. That this aggressive commercial focus increases the risk of poor long term pavement performance.

Following the review of the reference papers referred to above, the author provides initial recommendations improvements of the current procurement models that may improve the performance outcomes of contractor-lead pavement designs.

These initial recommendations are subsequently tested against the opinions of Waka Kotahi, contractor and designer personnel. Interviews with these personnel concluded that the personnel interviewed largely supported the current approach of a Principal prescribed design, subject to key criteria. It is acknowledged that the sample interviewed from the supplier industry was small, and that a wider survey of the market may reveal differing opinions.

Modified recommendations emanating from these interviews, including the criteria on which these recommendations are based, are described in sections 10 and 11.5, and summarised below.



Recommendation 10.1 Pavement Design Standards (Required Response WS3.1)

That Waka Kotahi consults collaboratively with the industry in continuing the development of appropriate standards, specifications and guidelines, for the design, construction and maintenance of road pavements. All new specifications and guidance materials should include online training resources.

Recommendation 10.2 Principal's Prescribed Pavement Designs (Required Response WS3.2)

That Waka Kotahi provides Principal prescribed pavement designs for new and rehabilitation projects subject to the following criteria:

- a) That industry concerns in respect of the pavement design standards are discussed and considered through collaborative consultation with the industry, as per Recommendation 10.1. (WS3.1)
- b) That the pavement designs be carried out by independent Principal appointed pavement designers.
- c) That design responsibility be retained by the independent Principal appointed pavement designers.
- d) Provision of a separate construction prequalification category for pavement construction, potentially to be included within a surfacing category.

Recommendation 10.3 Contractor's Pavement Design Alternative (Required Response WS3.3)

The Steering Group is reluctant to encourage tenderers to nominate alternative pavements during tendering. Instead, it has recommended that the Principal remains open to considering innovative pavement ideas that should be raised outside the tendering and award of any contract.

Recommendation 10.4 Scheduling Pavement Design and Construction as a Provisional Sum (Required Response WS3.4)

That for contractor-led procurement models, excluding Principal prescribed design, pavement design and construction be:

- a) Scheduled as a Provisional Sum
- b) Designed and priced in conjunction with the Principal, Principal's Agent, and an Independent Estimator following contract award.

Recommendation 10.5 Non Price Attributes (Required Response WS3.5)

That, for contractor led pavement dominant project designs, Non-Price Attributes place a higher threshold on pavement design and construction expertise through:

- a) Provision of a separate construction prequalification category for pavement construction, potentially to be included within a surfacing category.
- b) Consideration of a prequalification requirement for demonstrated consultant experience in the effective supervision of pavement construction.
- c) Greater weighting of NPA scoring of Relevant Skills required for pavement design and construction.
- d) Greater interrogation of the tenderers' proposed pavement design and construction personnel at the interactive meetings, and that these, and other aspects of the interactive meetings be included in the NPA scoring.
- e) Tender requirements that place a greater obligation on contractors and designers to resource their projects with personnel nominated in the tender proposals (refer to Recommendation 10.6 / WS3.6).

Recommendation 10.6 Retention of Tenderers' Nominated Personnel (Required Response WS3.6)

That the Principal recognises the challenges for contractors in employing and retaining suitably experienced personnel, and that procurement procedures require the following:

- a) That tender proposals outline the contractors' intended employee development programmes on the contract and how, when and by whom, the nominated personnel will be replaced through the development programme. This proposal will be scored as an integral part of Relevant Skills.
- b) That the accuracy with which the contractor adheres to the approved contractors' staff development programme, is scored in the PACE assessment of contracts for consideration in subsequent tenders.
- c) Retention of the current measures for financial penalties in the event of non-compliance with agreed resourcing commitments.

Recommendation 10.7 Training

That an industry-wide training initiative for pavement construction be established, under the auspices of CCNZ, and in consultation with Waka Kotahi. *This recommendation is the subject of a separate workstream initiated by the Steering Group relating to Industry Capability (Workstream 6).*



With specific reference to the Network Outcomes Contracts, the opinion of Waka Kotahi, contractors and designers active in the NOC industry is that current pavement performance issues are not a consequence of the procurement model or methods; rather, that these performance issues are instead related to contract management and contract delivery, including:

- i) Budgetary, or funding constraints.
- ii) Levels of skills and competency in the industry.
- iii) Constructability constraints, impacting on quality, that relate to working under live traffic, weather and traffic safety

The interviews carried out in this review represent a small sample of opinions with the NOC industry. It is recommended that representative opinions be canvassed from the industry through formal industry workshops. Key issues to be canvassed should include:

- a) Whether, and how, the current NOC procurement model may be improved in order to enhance the performance outcomes of pavement maintenance delivery within the NOCs.
- b) The status of skill levels in the industry, and the potential need for a programme of industry-wide training.
- c) Greater collaboration between Waka Kotahi project personnel and suppliers in the selection of optimal pavement design solutions given the fact that budgets will always remain a constraint on expenditure.
- d) Extension of the concept of an independent pavement design reviewer. This may include a formal process for considering broader outcomes associated with the optimisation of budget constraints and pavement design life.
- e) Assessment of the overall condition of the State highway network, and the funding levels that will be required to address the potential shortfall in the required levels of service.



2. Terms of Reference

The purpose of this commission is to develop a report detailing a review of the influence of various procurement & delivery models on Pavement Performance as per the scoping document entitled “Workstream Procurement”.

The report will, in addition, recommend improvements to the current procurement models with the view to accommodating both Waka Kotahi’s long term pavement performance objectives, as well as industry participation in contractor led pavement designs.

The commission has been carried out in accordance with the Methodology in Appendix A that has been agreed with Waka Kotahi, with two notable exceptions:

- i) While web-based research was carried, this did not reveal previous relevant consideration of the subject of this review; neither did interviews with personnel from Major Road Projects Victoria.
- ii) Attempts were made to interview Waka Kotahi Procurement personnel prior to preparing this report. Unfortunately this was not possible in the timeframe required.

References in this report to the “author” means Andy Wright Project Services in respect of this commission and report.

3. Author’s Relevant Experience

The author has worked as a supplier to Waka Kotahi in the procurement and delivery of capital and maintenance contracts since 1993. He was formerly employed by Fulton Hogan and HEB Construction in the major projects divisions of both contracting companies, where he was tasked with actively participating in the procurement and delivery of major roading projects. Of relevance is that these projects included contractor led designs in the D&C, ECI, Competitive Alliance, Pure Alliance, and PPP procurement models, and also included a number of traditional Lump Sum or Measure and Value contracts.



4. Author’s Views of Procurement Influences on Pavement Performance

The Workstream Procurement scoping document provided for this review tabulates a summary of eleven differentiators (drivers, incentives and risks) considered to be associated with, or influenced by, the four key procurement models utilised by Waka Kotahi. These procurement models are:

- Competitive Alliance (CA)
- Traditional - construct only
- Design and Construct (D&C)
- Early Contractor Involvement and Pure Alliance, considered together (ECI/A)

Of the eleven differentiators, nine are considered to be directly influenced by the form of the procurement model used. Commentary on these differentiators is provided below.

a) Risk ownership

The scoping document describes the allocation of Risk Ownership (of the pavement design) as follows:

Competitive Alliance	Traditional Construct only	Design and Construct	ECI / Pure Alliance
<i>Shared</i>	<i>Client</i>	<i>Contractor</i>	<i>Shared</i>

The author agrees that this risk allocation largely reflects the allocation of risk ownership in as it manifests in practice.

In a Traditional Construct only contract, the pavement design, including all design assumptions, are prescribed for the Contractor, who is entitled to payment for all work carried out in delivering the constructed design in accordance with a specification and a schedule of rates. Any design risks that subsequently require an increase in construction costs, may entitle the contractor to a variation.

In the case of the Alliance models under consideration, pavement risks are identified and priced into the TOC. Savings or cost increases during the PAA phase (Project Alliance Agreement ie design and construction) are shared. However, in a Competitive Alliance tender, the Contractor is more likely to under-estimate the total pavement design, and potentially underestimate the construction cost, including risk, than in a Pure Alliance. This arises from the commercial cost pressures of the Competitive Alliance model where tenderers compete largely on price. While non-price attributes ultimately influence the selection of the preferred tenderer, the distribution of relative NPA scores is generally not known to tenderers at the time of pricing. It is the author’s experience that tenderers will therefore ignore any potential advantage that they may subsequently gain through NPA scoring, and focus on providing the most competitive pricing for their tender submission. For this reason, while the risk is shared, the magnitude of this risk is substantially higher in a Competitive Alliance, for both the NOP and the Principal.

For a D&C contract, all design and construction risk (other than design traffic loadings) is assigned to the Contractor. In the experience of the author, the Contractor will manage this risk by engaging an experienced and reputable pavement designer to provide a pavement design that conforms with the

PRs, but does not exceed these required design standards. As discussed in other parts of this section, the highly price competitive nature of this model places commercial pressure on the designer and constructor (tender team) to focus on the lowest possible tender price, while still meeting the minimum standards prescribed by the PRs. This commercial pressure may potentially compromise judgements made in respect of design factors of safety and long term performance.

b) Type of project suitable procurement

This differentiator answers the question whether the procurement model is suitable for the type of project being tendered. The scoping document assesses this project suitability as follows:

Competitive Alliance	Traditional Construct only	Design and Construct	ECI / Pure Alliance
<i>Projects of high scale, with high risk, high innovation potential</i>	<i>Projects of small to medium scale, with low risk or low innovation potential</i>	<i>Projects of medium to high scale, with high risk, high innovation potential</i>	<i>Projects with high scale, with high risk, high innovation potential</i>

The author generally agrees that this assessment of suitability but provides the following commentary, particularly in respect of pavement procurement.

The assessment of scale is considered to be appropriate due to the higher costs of tendering associated with all but Traditional Construct contracts. The high cost of tendering an Alliance or D&C contract would attract little interest from the market if the project was small in scale.

It should be expected that innovation will:

- provide higher value in respect of pavement performance
- provide overall whole of life cost savings

However, innovation may potentially increase performance risk due to the many variables and uncertainties that affect long term pavement performance, such as environmental factors, variable subgrade conditions, quality of pavement materials, and construction methodology and effort. Procurement models that provide for equitable sharing of this increased risk, such as Alliance and ECI models, are well suited to manage this increased risk, as the risk is more robustly assessed and priced into the tender price or TOC.

As suggested in the previous section, the mitigation or sharing of (increased) risk in a Competitive Alliance is not as effective as with a pure Alliance due to the competitive pressures on the tender price or TOC. This exposes the Principal to a higher risk of a potential cost overrun.

The Competitive Alliance and D&C models offers little or no incentive for adding value through innovation where this added value would increase the capital or tender price. Tendering authorities have suggested that added value which has increased costs would be recognised in the scoring of the NPAs or in the tangible price adjustment. Contractors are generally of the view that the recognition by the tender evaluation team of this added value is almost always less than the addition cost of

providing the added value. Consequently, innovation in a Competitive Alliance or D&C focuses largely on cost reduction, which in turn tends to result in increased risks, particularly as this relates to pavement durability and performance.

The author is therefore of the view that project components, such as pavement design and construction, that are subject to many variable risks or uncertainties, are not well suited to procurement by way of a D&C model in the form that existed prior to the introduction of Principal prescribed pavement designs in 2017. However, in section 10, the author suggests improvements to the previous models that may provide greater confidence in long term pavement performance.

c) Competitive pricing tender

The scoping document assesses the degree of price competition for each of the procurement models as follows:

Competitive Alliance	Traditional Construct only	Design and Construct	ECI / Pure Alliance
<i>Medium due to shortlisting</i>	<i>High</i>	<i>Medium due to shortlisting</i>	<i>Low as price is negotiated</i>

The author agrees with this assessment of competitive pricing as it relates to Traditional, ECI and pure Alliances. However, further commentary on the assessment of competitive pricing for Competitive Alliances and D&C contracts follows below.

The perception of a medium degree of competitive pricing may be a reasonable assumption as this relates to the limitation on the numbers of tenderers that may be shortlisted to participate in the tender process. Generally, this shortlisting limits the number of tenderers to two for Competitive Alliances and three for D&C tenders.

The number of large contractors in New Zealand, who have the capacity to tender for and deliver the large contracts procured through Competitive Alliances and D&C contracts, is small, approximately 5 or 6. Interest from overseas contractors tends introduce their participation in the form of joint ventures with local contractors. Where local contractors joint venture with each other, this further reduces the number of tender participants.

However, it is the experience of the author that price competition amongst the shortlisted tenderers is very aggressive. Most tenderers would carry out a robust “Go / No Go” analysis prior to committing to a large tender process that would likely require a sunk cost of well in excess of \$1M to \$2M, with their chances of success being around 33%. The subsequent payment made to tenderers for the intellectual property rights to the designs is generally insufficient to cover the tenderers’ tendering costs.

Having made the decision to tender, and to incur this large tender cost ‘at risk’, tenderers will carefully plan and implement a tender strategy that overwhelmingly focuses on lowest tender price, and also on non-price attributes. Lowest tender price cannot realistically be achieved without lowest cost. Lowest cost cannot realistically be achieved without minimising the amount of work to be carried out in delivering the contract. The latter has two significant consequences:

- i. Designers are encouraged by the tender team to develop the slimmest (least cost) designs possible, while still meeting the PRs.
A designer will not knowingly design to a standard below that set by the PRs. This ethical approach aligns with expected professional standards of both the designer and the contractor, with the contract requirement for a peer review, and with the contract requirement for the designer to sign both the Design and Construction Review Producer Statements. However, in respect of a pavement design, this approach has the potential to reduce the factors of safety required to account for the number of variables in both the design assumptions, materials and in the actual construction methodology, timing and effort.
- ii. Contractors may back themselves to construct the required works with production efficiencies and managed risk levels that may exceed their own benchmark standards. This phenomenon may manifest in a number of ways:
 - Staffing levels may be unduly reduced.
 - Peak or near peak production rates may be used instead of more likely average rates.
 - While a thorough risk assessment may be carried out by the tenderer, the pricing review may conclude that the contractor will manage the risk in a manner that eliminates it (the risk). An example may be the identification of the cost of potential rework, as a risk. A bullish view would be that the contract management will be good enough to avoid all rework. Words often used in a tender price review are “we will back ourselves to effectively manage this risk”. This approach is often unrealistic, resulting in additional unbudgeted costs.

A reputable contractor should not allow cost overruns to detract from their values of delivering a robust construction outcome. Never the less, this will result in a more aggressive focus on cost savings. This commercial pressure on tender pricing therefore remains a risk for the mutual success of the project. Commercial pressures impacting on the design may be of greater concern, as appropriate pricing and construction cannot address any slim or overly optimised design where the design factors of safety may potentially have been compromised.

It is the view of the author that highly price competitive procurement models such as Competitive Alliances and D&C contracts potentially have substantial influence on pavement performance outcomes as a direct result of:

- the very high commercial pressures inherent in these models
- design review checks and balances where a track record of inadequate pavement performance suggests that the reviews have not identified potential design issues or risks, and that improvements in the review processes should be considered – this issue is discussed further in section 10.

d) Design/construction interface

The scoping document assesses the level of designer and constructor interface and coordination for each of the procurement models as follows:



Competitive Alliance	Traditional Construct only	Design and Construct	ECI / Pure Alliance
<i>Very high</i>	<i>Low – detailed design completed in a separate phase</i>	<i>High, but initial specimen design completed prior to appointing constructor</i>	<i>Very high</i>

The author agrees with this assessment of the level of designer and constructor interface and coordination for each of the procurement models.

In the case of the D&C model, the Specimen design is not particularly relevant to the tender and detailed designs prepared and constructed by the designer / constructor team. The Specimen design is prepared based on limited data, is generally conservative, and is used primarily demonstrate feasibility and to determine a cost estimate for the Principal’s team. Additional geotech testing is carried out during the tender and detailed design phases to more fully inform the pavement design, which will provide the data on which to innovate and optimise the design. Usually, therefore, the final (detailed or construction) design is often relatively different to the Specimen design.

Experience has shown that the level of interface for Competitive Alliance, D&C, ECI and pure Alliances is much the same across these models. In conclusion, it is unlikely that the levels of interaction in these models have any (different) influences on pavement performance outcomes.

e) Procurement costs and tendering complexity

The scoping document assesses the procurement costs and tendering complexity for each of the procurement models as follows:

Competitive Alliance	Traditional Construct only	Design and Construct	ECI / Pure Alliance
<i>High</i>	<i>Low</i>	<i>Medium</i>	<i>High</i>

The author provides the following opinion in respect of procurement costs and tendering complexity:

- Competitive Alliance - agrees that these are high for both the Tenderer and the Principal.
- Traditional Construct only – agrees that these are low for both the Tenderer and the Principal.
- D&C – it is considered that these are high for both the Tenderer and the Principal, and not necessarily any different to a Competitive Alliance.
- ECI / Pure Alliance – agrees that complexity is high. For this model the Principal would reimburse much of the tenderer’s tender costs and therefore tenderer’s procurement costs are considered to be low to medium.

It is unlikely that tendering complexity has much influence on pavement performance outcomes due to the sophistication of the designer and constructor teams selected to participate in the respective tenders.

For models having high tenderer costs, such as D&C and Competitive Alliance Models, there is commercial pressure to limit the amount of expenditure on the tender, as the total amount generally

exceeds \$1M or \$2M after reimbursement of intellectual property rights for the tenderers’ designs. While the pavement design costs are not high relative to other components, the costs of sufficient geotechnical investigations required to provide a higher level of understanding of subgrade conditions, may be high. While the Principal provides for some further geotechnical investigations during the tender, these are often limited in nature. This may reduce confidence in the tender pavement design, and increase the risk of this design. A risk contingency would generally be allowed in the tender pricing for design investigations and development during the subsequent detailed design phase. This contingency would be assessed under the commercial pressures of the competitive tender, and the sufficiency of this contingency is never assured.

As mentioned, during the detailed design stage, there is opportunity for further investigations. These would be funded by the successful tenderer from funds allocated in the tender price that has been developed under commercial pressure, as described above. These funds, including the risk contingency for further investigations and pavement design development, may be limited.

These limitations arising from high procurement or tendering costs and the commercial pressures of Competitive Alliance and D&C models have the potential to impact on the robustness of the pavement design factors of safety, and hence the pavement performance outcomes.

f) Scope change

The scoping document assesses the ease with which scope changes may be evaluated for each of the procurement models as follows:

Competitive Alliance	Traditional Construct only	Design and Construct	ECI / Pure Alliance
<i>Difficult. No schedule of rates on which to base a variation.</i>	<i>Easy. Variation based on schedule of rates.</i>	<i>Difficult. No schedule of rates on which to base a variation.</i>	<i>Difficult. No schedule of rates on which to base a variation.</i>

It is unlikely that this factor has much, if any influence on ultimate pavement performance. Nevertheless, the author offers the following commentary.

The author generally agrees with this assessment. However, the difficulties in assessing scope changes for Competitive Alliance, D&C, ECI and pure Alliances, as described, exist due to the non-prescriptive manner in which the pricing schedule is requested in the Request for Tender. This issue may be readily resolved by requiring tenderers to submit a fully detailed schedule of quantities and rates with their tenders.

g) Alignment of goals

The scoping document assesses the level of designer and constructor interface and coordination for each of the procurement models as follows:



Competitive Alliance	Traditional Construct only	Design and Construct	ECI / Pure Alliance
<i>High due to shared risks</i>	<i>Low. Contractor and consultant protecting their own commercial interests.</i>	<i>Low. Contractor and consultant protecting their own commercial interests.</i>	<i>High due to shared risks</i>

The author agrees with this assessment, although, as described earlier, the commercial pressures inherent in a Competitive Alliance tend to reduce the extent of risk sharing and alignment of goals in this model.

While the alignment of goals in a Traditional contract is low, this factor should not impact to any noticeable extent on pavement performance outcomes.

As mentioned previously, commercial pressure in a D&C contract is generally very high, even extreme. Therefore, while the Principal would seek a pavement design that is robust, has a higher factor of safety to performance risks, and is arguably conservative, these goals conflict with the tenderer’s commercial pressures during the tender and construction phases. This conflict may lead to misalignment of goals as evidenced by a number of disagreements and disputes in respect of pavement performance that have resulted following D&C contracts.

This misalignment of goals, and in some contracts the resulting less than desirable pavement performance, is considered to result from the commercial pressures inherent in a D&C procurement model.

This phenomenon may similarly apply to Competitive Alliances, albeit to a lesser degree.

h) Whole-of-life focus through supply chain

The scoping document assesses the whole-of-life focus for each of the procurement models as follows:

Competitive Alliance	Traditional Construct only	Design and Construct	ECI / Pure Alliance
<i>High due to shared risks</i>	<i>Low</i>	<i>Low - tendency to design to minimum standards</i>	<i>High due to shared risks. Tendency for a conservative design.</i>

The author generally agrees with this assessment. However, it is suggested that in a Competitive Alliance the true benefits of risk sharing are diluted by the highly commercial focus in preparing the TOC design and price.

As mentioned elsewhere in this report, substantial pressure is brought to bear on designing to the lowest standard considered to be permitted by the PRs. Insufficient, if any, consideration is given to modelling more costly alternative designs that may potentially have lower whole of life costs. This is due to insufficient recognition in tender evaluations of the capital and whole of life value of such pavement designs.



In summary, the whole of life considerations and outcomes are influenced by the selection of procurement model.

i) Procurement period

The scoping document assesses the length of the procurement period for each of the procurement models as follows:

Competitive Alliance	Traditional Construct only	Design and Construct	ECI / Pure Alliance
<i>Long</i>	<i>Short</i>	<i>Medium</i>	<i>Medium</i>

The author generally agrees with this assessment, although, in practice, there may be little difference in the overall procurement periods for the Competitive Alliance, D&C, ECI and pure Alliances.

It may be argued that the longer the tender periods, the more robust would be the pavement designs. In the experience and opinion of the author, for procurement periods of 12 weeks or longer, the lengths of these various procurement periods have (relatively) little influence on the robustness of the pavement designs and pavement performance outcomes. There are higher priorities for tenderers that influence the robustness and outcome of pavement designers in contractor-led procurement models.

5. Commentary on the State Highway Pavement Delivery Review Paper

The Review of State Highway Pavement Delivery for the New Zealand Transport Agency, January 2020, by Lindsay Crossen, Mark Cruden and Tony Fisher, has reference.

The following extracts from that document have relevance to the assessment of procurement model influences in subsequent sections of the author’s report.

Section	Extract	Author’s Commentary
Executive Summary, 4 th para	<i>Important criteria should articulate..... factors of safety to ensure reliability.</i>	These extracts align with the author’s experience that highly competitive procurement models have the potential to compromise factors of safety as these relate to design, construction and long term pavement performance and reliability.
Executive Summary, 5 th para	<i>Tensions have developed where the designs have been optimised during procurement (influenced by commercial / funding aspects) resulting in Factors of Safety being compromised.</i>	
Executive Summary, 6 th para	<i>Pavement design is based on mechanistic / empirical analysis which is sensitive to compromise due to potential variability in both aggregate qualities and construction methodology.</i>	Further to the commentary above, overly “optimised” pavement designs may fail to account for the aggregated effect of all risks that may impact on pavement performance.
Executive Summary, 7 th para	<i>Construction continuously provides challenge and variability to full achievement of design aspirations. Moving forward, it is critical that procurement and construction aspire to quality outputs to meet design and reliability expectations, corresponding to relevant factors of safety.</i>	This is further emphasis of the variable factors that contribute to pavement performance, and the importance of preserving appropriate factors of safety that take account of the many factors and risks inherent in pavement design, construction and performance.
Executive Summary, 7 th para	<i>Innovation and value for money considerations should focus on productivity and quality, rather than refinement and alternative designs.</i>	This extract supports the author’s view expressed elsewhere in this report for a truly independent review of pavement designs, particularly in highly competitive procurement models.
Design is Risk Based, page 13, 1 st para	<i>Generally, there was confidence expressed by pavement designers that the Guides supported by professional geotechnical and physical analysis, can provide the Reliability expectations. The consensus, however, was levels of risk manipulated by commercial and funding factors caused serious tensions and thus compromised potential Reliability. Procurement tensions and Value for Money challenges have tended to minimise pavements without appreciation of the elevations in risk.</i>	These extracts align with the author’s experience that highly competitive procurement models have the potential to compromise factors of safety as these relate to design, construction and long term pavement performance and reliability.
Design is Risk Based, page 13, 3 rd para	<i>The review concludes that design life and durability performance are highly problematic due to a complex matrix of risk factors</i>	This is further emphasis of the variable factors that contribute to pavement performance, and the importance of preserving appropriate factors of safety that take account of the many factors and risks inherent in pavement design, construction and performance.

<p>Design is Risk Based, page 14, Findings, item 5</p>	<p><i>Procurement drivers (vfm and commercial tensions) have trended to minimise pavements with potential change in Reliability risk not being appreciated.</i></p>	<p>This aligns with the author’s experience that highly competitive procurement models have the potential to compromise factors of safety as these relate to reliability of pavement performance.</p>
<p>Procurement Evolution, page 16, item 2</p>	<p><i>Generally, outcomes have delivered some innovation in the form of modified pavement types, but mostly resulted in minimisation of pavement for commercial reasons.</i></p>	<p>This aligns with the author’s experience that commercial drivers and closely / marginally achieving the PRs and MRs, are the prime focus of tenderers in highly competitive forms of procurement. This is regarded as a necessity in order to win these, often large scale, contracts. This focus does not necessarily consider all risk factors inherent in long term pavement performance.</p>
<p>Constructability Considerations, page 17, 1st para</p>	<p><i>Post procurement, any adjustment to pavement designs Will again require pavement expert overview before construction Changes should be designer led but Principal awareness is essential</i></p>	<p>The author agrees with this view. In fact, the author proposes that changes to the design are formally approved or accepted by the Principal. This is particularly important in the event that the pavement design is further “optimised” or ‘minimised” from what was accepted in the tender.</p>
<p>Constructability Considerations, page 17, Findings, item 1</p>	<p><i>Materials, methodology and construction capability for pavements – to successfully build a high quality design, these require better scrutiny and qualification in the procurement.</i></p>	<p>The author agrees with this view. This procurement requirement should be based largely on demonstrable evidence of effective QA planning and processes implemented on previous projects, but with emphasis on further improvements intended in the contract being procured. This would safeguard potential “empty promises” where tenderers merely state what the TET wishes to hear without a clear commitment to delivery of their undertakings, and to which they would be held accountable.</p>
<p>Constructability Considerations, page 17, Findings, item 2</p>	<p><i>Quality Assurance planning and processes for pavements should be a scored attribute for procurement.</i></p>	
<p>Technical Requirements, page 23, Findings, item 2</p>	<p><i>Refinement of pavement designs sometimes increases pressure to make marginal materials work.</i></p> <p><i>Clarification: In this context the term “marginal” is clarified to mean pavement materials for which the properties lie outside of the standard TNZ materials specifications for premium aggregates. Despite this lower material standard, such materials may nevertheless be potentially suitable for bespoke specification in specific pavement designs, particularly for more lightly trafficked roads. The Steering Group prefers the use of the term “alternative” materials. This terminology is used interchangeably in subsequent sections of this report.</i></p>	<p>This supports the author’s views that highly competitive procurement models drive tenderers’ focus on refinement or optimisation of pavement designs, and that one outcome is increased “pressure to make marginal material work”.</p>

<p>Risk, page 24, 1st and 2nd paras</p>	<p><i>Delivery of pavements ... is non exact engineering. This is due to the variability in subgrades, pavement materials, empirical mechanistic design philosophies, construction methods, site environmental factors and dynamic loading inflicted by heavy motor vehicles.</i></p> <p><i>Risk can only be managed by reducing the probability of failure; by accurately characterising materials, adopting lower risk pavement designs and a focussed attention on quality of the construction process.</i></p>	<p>These paragraphs acknowledge the many risk factors that contribute to successful (or unsuccessful) pavement performance. Reducing the risk of failure by (et al) adopting lower risk pavement designs, does not necessarily align with, and likely conflicts with, the commercial pressures in competitive tenders to minimise the pavement design to the extent possible within the requirements of the PRs or MRs.</p>
<p>Headline Risks for Pavement Delivery, page 25, item g</p>	<p><i>During procurement, expert challenge to design modifications related to resources, and/or VfM refinements.</i></p>	<p>It is the author’s view that all stages of the design, from tender design in procurement, to detailed design post award, should be subject to (independent) expert challenge to provide a measure of mitigation of the temptation to minimise pavement design. This challenge should extend to a full risk assessment that is carried through all stages from tender design, through detailed design and all approvals, to construction methodology statements and ITPs.</p>
<p>Industry Leadership, page 26, Findings item 4</p>	<p><i>Since mandating that NZTA designers will provide full pavement designs for capital projects, significant robustness in strength in pavement layers has been added and construction variations remain significantindustry expertise should still be engaged for design in conjunction with robust longer term performance requirements ...</i></p>	<p>The author agrees with this view. However, a change from the pre 2017 approach is needed to ensure that the Principal is protected, at all stages of the design and delivery, through greater level of independent review and challenge. This will ensure that pavement delivery is not compromised by an undue focus on pavement optimisation or minimisation.</p>
<p>Asset Condition, page 27, 1st para and 1st bullet point</p>	<p><i>Many stakeholders interviewed highlighted that:</i></p> <ul style="list-style-type: none"> • <i>pavements both new and rehabilitated, are being built too light</i> 	<p>It is assumed that this finding refers to pavements designed and constructed pre-2017, following which Principal prescribed pavement designs are been characterised as having significant robustness. The view of “light pavement” would align with the concept of commercial pressures in highly competitive procurement models putting pressure on pavement designs.</p>

<p>Pavement Aggregate Resources, page 28, 3rd para</p>	<p><i>.... pavements have been engineered to be built using well specified all-purpose aggregates.</i></p>	<p>Given these challenges in providing consistent, high quality aggregates for pavement construction, it is important that this materials risk be identified and addressed at all stages of the pavement procurement, design and delivery. It is important that adequate attention be given to identification of the source and quality of the material to be considered at all these stages of the delivery process. Greater attention should be given to this performance risk at all stages of the design development and construction.</p>
<p>Pavement Aggregate Resources, page 28, Findings item 2</p>	<p><i>Quarry aggregates have considerable rock variability and grading characteristics which challenge suppliers and contractors to achieve satisfactory pavements.</i></p>	
<p>Quality and Risk Transparency, page 28, 1st and 2nd paras</p>	<p><i>This review advocates Quality Right should also be fully employed as an assurance tool for the pre-design, design and procurement phases where optimisation and risk judgements are made. this report highlights a clear need for an effective end to end risk evaluation / mitigation system Such a system would be a powerful tool to assure well designed and built reliable pavements.</i></p>	<p>It is the author fully supports this view ie for a full risk assessment that is carried through all stages from tender design, through detailed design and all approvals, to construction methodology statements, ITPs and producer statements.</p>
<p>Summary of Review, Design Parameters and Guidelines, page 29, 2nd para</p>	<p><i>The NZ Guide should be corrected to:</i></p> <ul style="list-style-type: none"> • <i>Better articulate pavement performance (including measurement over time) relative to prescribed Design Life of 25 years and the associated anticipated pavement maintenance regime that will typically apply over the design life term.</i> • <i>Better define performance expectations for different pavement categories</i> • <i>Review and update risk profiles of current subgrade, pavement and surfacing compositions.</i> • <i>Better define guidance around drainage and subgrade improvements.</i> 	<p>From participation in contractor led design projects, the author fully supports this suggested update to enhance the focus on long term performance expectations, risk profiles of subgrade, pavement and surfacing compositions, and enhanced drainage (top down and bottom up). This focus should be actively carried through all stages of the design and approvals, as referred to above.</p>



<p>Summary of Review, Design Parameters and Guidelines, page 29, 1st para</p>	<p><i>Tensions have developed where designs have been optimised during procurement (influenced by commercial / funding aspects) resulting in Factors of Safety being reduced.</i></p>	<p>Commentary has been provided above in support of these statements.</p>
<p>Summary of Review, Procurement and Construction Practices, page 30, 1st para</p>	<p><i>Investment constraints, and commercial / value for money performance orientated contracts, have driven optimisation of design. This has included minimisation of pavement thickness</i></p>	
<p>Summary of Review, Quality Right, page 30, 2nd para</p>	<p><i>Quality Right appears to be limited in extent to the construction phase of delivery. It is highly desirable that Quality Right be extended to be an effective assurance system, complemented by an effective risk mitigation evaluation, for end to end evaluation.</i></p>	

6. Proposed Improvements to Capital Project Procurement Models:

Initial Recommendations

In this section, the author identifies the issues in respect of pavement design and construction that, in his opinion, are inherent in contractor-led procurement models for capital works projects.

From these opinions, initial recommendations are made to address these issues. It is intended that these initial recommendations will be tested in sections 8 and 9 against the views of Waka Kotahi, contractor and designer personnel involved in the procurement and delivery of major capital projects.

Final recommendations will be made in section 10 following these interviews.

i) Risk management through all stages of design development, approvals and construction

The process for the thorough identification, documentation and accounting for the many risks associated with staged pavement design development and subsequent construction should be reviewed. These risks include traffic loadings, environmental factors, variable subgrade conditions, pavement drainage, quality and consistency of pavement materials, and construction methodology and effort - all of which contribute to ultimate pavement performance.

An assessment of these risks is undoubtedly carried out by pavement designers. What is not always clear is the extent to which these risks and design assumptions have been:

- addressed and communicated in the various design stages of pavement design development, review and approval and, in particular
- formally communicated to the construction teams for inclusion in their construction management plans, quality plans and inspection and test plans.

It is not suggested that this risk communication is not being carried out in practice. What is suggested is that some teams are more robust in doing so, while others are less robust or thorough in this discipline. The latter has the potential for the construction and MSQA teams to overlook these risks and their management in subsequent stages of design development, review and construction. This may impact on long term pavement performance.

Recommendation 1: That PRs and MRs mandate the documentation of all design risks and assumptions at each stage of the design and construction chain including the manner in which these risks have been addressed in the design and construction planning.

These stages are, et al, tender design (or Certificate A at procurement), detailed design, design review, construction team briefing, construction management plans, quality and inspection and test plans, and in the final producer statements. Both the designer and constructor, through the provision of their respective producer statements, should confirm that the identified design and construction risks have been effectively addressed at Practical Completion.

ii) Procurement non-price attributes may not effectively identify the preferred tenderer

As a separate matter to quality pavement design, the following are prerequisites for quality pavement construction:

- contractor experience and capability in pavement construction, in respect of the contracting company, as well as the pavement construction personnel
- a high level of understanding of the pavement construction methodology and effective management of pavement construction quality and risks

These prerequisites are generally articulated in the tender non-price attributes (NPAs). However, a low score of these requirements will not necessarily exclude a tenderer from preferred tenderer status, and eventual contract award, as their scoring of other attributes may be sufficient to include them for further consideration.

It is inconceivable that a contract that includes pavement construction as a critical element, may be awarded to a contractor who may not have the expertise required to assure a quality construction and acceptable long term performance. It is not considered acceptable to merely construct a pavement, without these underlying assurances.

Recommendation 2: That procurement protocols provide for the following:

- a) A PASS / FAIL threshold be implemented that disqualifies a tenderer who is unable to provide the required assurances of delivering a quality and reliable pavement, and / or
- b) In the event that a tenderer, with an unacceptably low score for pavement expertise, track record and construction methodology, is identified as the preferred tenderer, that the tenderer be given the opportunity to satisfactorily address these deficiencies prior to tender award, failing which the tenderer may be excluded from further consideration.

A further consideration of NPA submissions is the fact that the highest possible overall score is crucial to winning a tender. The proposal that best conveys what the Tender Evaluation Team requires, is most likely to score highly. For this reason, NPA proposals are seldom, if ever written, by construction personnel. These are more often written by specialist attribute writers who provide a marketing or sales approach to key themes and messages, both technical and non-technical. It is widely accepted by contractors that the “best story wins”, not necessarily the best team.

In the opinion of the author, the single most important factor in a tender proposal is the capability of the construction personnel. A contracting business with an average track record offering a highly experienced and skilled team, may potentially be a more suitable option than a contractor with a good track record but offering a less experienced or ‘B’ team.

Recommendation 3: That procurement requirements provide for:

- a) greater emphasis on the capabilities of construction team individuals
- b) reference checks for key construction personnel
- c) greater emphasis and recognition for the outcome of tender interactives, and pre-award meetings at which individuals are interviewed in respect of their experience, capability and understanding of the construction requirements, particularly as this relates to quality pavement construction and other critical elements of the contract. Any overstatement of the capability of key individuals within the NPA proposal are likely to be revealed during these interviews.

The tender evaluation process should provide for a substantial inclusion in the scoring for the interviews of key construction personnel.

iii) Review of pavement designs

Current procurement protocols require design reviews by independent reviewers, who are selected and reimbursed by the tenderer or contractor. Despite this requirement, pavement design and construction pre-2017 did not always achieve expected performance standards. It may be prudent to reassess how an independent reviewer is appointed and reimbursed.

A further consideration is that once the PRs and MRs have been approved for procurement purposes, the opinion of the Principal, in respect of the pavement design and associated risks, is effectively excluded, other than potentially through the the departures process. Upon contract award, further input from the Principal is difficult to achieve, as the management of the pavement design process by the Engineer to Contract is governed by the contract.

It is considered therefore, that procurement and contract processes of the PRs and MRs may not adequately provide the Principal with:

- A truly independent review of the robustness of the pavement design in terms of its factor of safety and ability/reliability to meet the required 25 year design life. These prescribed processes may not necessarily achieve the Principal's long term (whole of life) pavement performance objectives.
- The opportunity to effectively challenge the offered pavement design in a manner that safeguards against minimalistic and high risk pavement designs.

It is acknowledged that:

- The supplier market has substantial experience and expertise to offer in respect of contractor-led pavement designs
- The pre-2017 approach did not generally deliver the Principal's pavement performance objectives in contractor-led pavement designs

- A return to pre-2017 procurement and contract requirements is unacceptable without changes that effectively address the pre-2017 shortcomings in respect of pavement performance

Recommendation 4: That PRs and MRs provide for the following pavement design review protocols:

- a) That a single, independent Pavement Review Team be appointed by the Principal, and nominated in the RFT. This team will provide consistency of review across all pavement design submissions, and will be reimbursed for their services through a 50:50 cost share arrangement between the Principal and the tenderer (or contractor) – as has been the case for the reimbursement of independent Safety Audit Teams.
- b) The Pavement Review Team will be selected from the Principal’s Independent Professional Advisor (IPA) panel, and may include a representative from the Principal’s National Office Pavement Team. The latter requirement will ensure that the Principal “has a voice” in the pavement design review in order to assure the achievement of the Principal’s long term pavement performance objectives.
- c) This independent review will be carried out at all stages of design development including Certificate A (tender design), Detailed Design, and at any subsequent stage during construction should any conditions require a modification to the pavement design.

This recommendation has particular significance for pavement designs using alternative lower quality materials, where the performance risk may potentially be elevated.

The following criteria will be fundamental in order for this recommendation to be successfully implemented:

- i) The Principal must ensure that the pavement PRs or MRs are adequate for their intended purpose ie to achieve the 25 year performance objective. Expert industry opinion should be canvassed in this regard.
- ii) The most critical review will be of the Certificate A tender design, as this would reduce the likelihood of changes required by the reviews carried out subsequent to contract award.
- iii) The recommended reviews may be carried out against the standards specified in the PRs and MRs only. Any deviation from these specified standards in the post award reviews may entitle the Contractor to a variation.
- iv) The Engineer to Contract will make the contractual decision regarding the compliance, or otherwise, of the pavement design with the specification.

In addition to the above recommendations, there are particular issues that relate specifically to price competitive procurement models such as Competitive Alliances and D&Cs. These are as follows:

v) Appropriate recognition of value

Procurement models do not adequately recognise and reward tenderers for added value in innovative or lower-risk pavement designs, particularly when these designs may increase construction costs and tender prices.

The following paragraph taken from section 4b is relevant:

“The Competitive Alliance and D&C models offers little or no incentive for adding value through innovation where this added value would increase the capital or tender price. Tendering authorities have suggested that added value that has increased costs would be recognised in the scoring of the NPAs or in the tangible price adjustment. The author is unaware of many contractors that would agree with this view. Contractors are generally of the view that the recognition by the tender evaluation team of this added value is almost always less than the addition cost of providing the value. Consequently, innovation in a Competitive Alliance or D&C focuses largely on cost reduction, which in turn tends to result in increased risks, particularly as this relates to pavement durability and performance.”

Recommendation 5: That the tender evaluation protocols provide for:

- a) Independent valuation, by an Independent Estimator, of higher cost innovations or features of value offered by tenderers in price competitive models.
- b) That these independent valuations be used in the determination of a Tangible Cost Adjustment factor.

vi) Overly aggressive commercial pricing behaviours

These models drive aggressive commercial pricing behaviours which potentially result in the following:

- Tension, and at times conflict, between the commercial drivers of the competitive procurement models, and the reliability of the pavement design and construction, and its long term performance.
- Slim or marginal designs that minimise the design to the extent permitted by the PRs and MRs, where factors of safety that should account for the many design and construction assumptions, variables and aggregated risks, may be compromised.
- A focus on innovation generally results in a focus on lowest capital cost instead of lowest whole of life value. This may drive a focus on using alternative materials without fully addressing the long term performance risks associated with this approach.
- Overly optimistic view of production rates that subsequently apply pressure on the construction teams to achieve budget and deliver a quality outcome.

When considered together, these issues have the potential to impact on the long term pavement performance outcomes expected by the Principal.

Recommendation 6: That Waka Kotahi:

- a) Limit the use of Competitive Alliances and D&C models, particularly where the project includes a substantial or sensitive pavement component.
- b) Move to lower risk competitive models that provide for greater recognition of value, greater co-operation between owner and non-owner participants, and reduce the potential for overly aggressive competitive pricing.

The author observes that this recommendation is largely currently being exercised by Waka Kotahi through the use of the Hybrid Alliance model. This model is in the early stages on implementation with no hybrid alliance contract having been completed to date.

vii) Materials Selection

The specification of open graded or 'bony' mixes for pavement construction in Traditional contracts may present workability challenges during construction.

There are greater issues associated with the design and construction of pavements using alternative lower quality materials. This risk is discussed in greater detail in section 12.

Recommendation 7: That specifications for pavement materials include:

- a) In the case of Traditional contracts, that designers of such specific mixes take particular care to ensure that they understand the potential 'workability' constraints of the specified mixes. The inclusion of trial construction sections may be considered, where deemed necessary, to confirm this workability characteristic of this material, with provision in the contract to vary the mix, as and if required, to improve workability and adequate compaction.
- b) In the case of other procurement models, that the PRs or MRs require a minimum level of testing during the tender period to document how the risk of alternative materials has been addressed in the tender submission.
- c) During the post-award Detailed Design phase, that a high level of material testing and documentation be carried out, including the manner in which design assumptions will be confirmed, and the long term performance of the alternative materials may be assured. This may include the requirement for a trial pavement to be constructed. Waka Kotahi should investigate the feasibility of investment in accelerated pavement testing equipment.

viii) Defects Liability Period

A number of historical disputes relating to underperforming pavements have extended well beyond the typically 12 to 24 months defects liability period (DLP). On some contracts, the pavements performance issues have not manifested until after the expiry of the DLP. While the Principal retains some right of challenge for a total period of 7 years under the contracts' Professional Indemnity insurance provisions, the ability to successful make this challenge has been difficult to achieve in most cases.

Recommendation 8: That Waka Kotahi consider extending the DLP for projects involving substantial or sensitive pavement structures, as follows:

- a) An extension of the DLP for pavements only, as a separable portion, for a period of 5 to 7 years after Practical Completion. This period may be determined by the scale and risk levels of the proposed pavement.
- b) The amount of the bond applicable to this separable portion may be set as a percentage of the pavement value. This could be 25% or of this order.

It is acknowledged that more stringent bonding requirements will add cost to the delivery model. However, this slightly increased project cost may add value as effective longer term "insurance" of pavement performance and the potential costs of remedial works.

This approach is supported by the approach taken by Major Road Projects Victoria as reported in the last paragraph of section 7 below.

It has been argued that the indisputable determination of the cause of pavement failure is often complex or not absolutely clear, and more often than not disputed between Principals and Contractors. While a longer DLP may not clarify the causes of failure, it will almost certainly factor into the risk profile that a tenderer is prepared to take, in respect of defects liability, when they carry out and offer a tender design. In other words, the greater the potential liability exposure, the greater the probability of design robustness, and the lower the design risk taken by the tenderer.

7. Interview with Major Road Projects Victoria

It is understood that Major Road Projects Victoria (MRPV) have moved away from price competitive models for the procurement of their major roading projects. The author interviewed Danny Benjamin, Delivery Director, Major Road Projects Victoria, on 19 October 2021. Details of this interview are included in Appendix B. Key messages from the interview are given below:

- i. MRPV do not favour price competitive D&C models. They do not believe that these provide a fixed price outcome, generally resulting in a 20% price increase from tender offer (even excluding legitimate scope increases).
- ii. MRPV believe that this is because the D&C model overly emphasises competitive pressures as tenderers generally have the best chance of winning the tender through lowest price. This increases the Principal's commercial risks through subsequent claims by Contractors to meet budget or required profitability.
- iii. In the opinion of MRPV, this state of affairs ie MRPV's negative experience, is driven by the price competitive nature of the D&C model.
- iv. MRPV have therefore developed, and are implementing, the PDA (Programme Delivery Approach) model as a response to the pressures mentioned above. The key objective of this approach is to remove the negative commercial friction inherent in the D&C model and replace this with the incentivised target cost approach of the PDA model. This removes the need to "push the envelope" with respect to slim designs and marginal pricing.

An extract from the Program Delivery Approach Summary Paper provided by Danny Benjamin is provided below that substantiates the decision by MRPV to adopt this approach:

The Program Delivery Approach (PDA) has been conceived to respond to the issues currently facing the State and the construction industry with the following key objectives:

- a. **Market:** create a more sustainable contractor market, with the capacity and capability across all tiers to support the State in delivering its program of infrastructure projects;
- b. **Efficiency:** Improve the efficiency of project procurement in the roads sector, saving time and minimising State and contractor costs, enhancing development and delivery outcomes by streamlining processes, operating in parallel throughout the development phase and integrated planning improving project delivery; and
- c. **Outcomes and Value:** Improve project outcomes, contractor performance and optimise value, through a more collaborative approach to procurement and delivery, and by better incentivising contractor performance, both financially and via future opportunities.

It appears that the PDA closely resembles a pure Alliance in respect of pricing, risk allocation and collaboration.

Interestingly, a further extract from the PDA concludes:

Under a program approach the State will require the contractor to provide contractual warranties (fit for purpose and design) which extends beyond the defects liability period.

This supports the recommendation in section 6 for consideration of an extended DLP for the pavement component of the contract works.

8. Interviews with Waka Kotahi Personnel (Capital Projects)

8.1 Project Personnel

Notes of the interviews with Waka Kotahi (WK) personnel are referenced in the Appendices. The opinions of Waka Kotahi personnel in respect of the projects' pavement performance issues, are shown below. The opinions of Contractors in respect of pavement performance issues are also shown.

Project, Personnel	Procurement Model	WK's Opinion	Contractor's Opinion
SH1 McKays to Peka Peka Graham Taylor	Pure Alliance <i>Appendix C</i>	<i>Failures attributed to design methodology ie early application of OGPA without trafficking the chipseal membrane.</i>	<i>Contractor declined to be interviewed due to pending insurance claim.</i>
WEX: Te Rapa Bypass Jo Wilton & Peter Murphy	Competitive Alliance <i>Appendix D</i>	<i>Rutting, potentially due to brown rock subbase consolidating under traffic loading followed by cracked seal, water ingress and potholing.</i>	<i>The MRs required a prime coat, 2 coat seal followed by OGPA. This did not provide adequate waterproofing of the underlying pavement structure.</i>
WEX: Cambridge Section Raj Rajagopal	D&C <i>Appendix E</i>	<i>Pavement issues were localised. A review of these pavement performance issues has been commissioned by WK.</i>	<i>The Contractor has not been interviewed due to pending outcomes of the current review process.</i>
Atiamuri Bridge Replacement and Bypass Jo Wilton	ECI <i>Appendix F</i>	<i>No pavement performance issues</i>	<i>No pavement performance issues</i>
WEX: Ngaruawahia Bypass Jo Wilton	D&C <i>Appendix G</i>	<i>The contract has not performed well. Issues were widespread. Pavement issues included, SIL, subgrade, basecourse & drainage.</i>	<i>The PRs drove a low cost high risk pavement. An example is the waterproofing capacity of the surfacing provided in response to the PRs.</i>
Taupo Eastern Arterial Jo Wilton	D&C <i>Appendix H</i>	<i>Extensive pavement failures are believed to be due to a slim pavement structure with insitu pumice subbase.</i>	<i>The Contractor was not interviewed.</i>

SH73 Mingha Bluff to Rough Creek Chris Collins	M&V Appendix I	<i>Extensive QA issues were experienced during the contract. This specification has been successfully used on other contracts.</i>	<i>The Contractor attributed to the poor workability of the specified material.</i>
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The support, or otherwise of Waka Kotahi and supplier personnel in respect of the initial recommendations in section 6, are tabulated below. Further details of their responses are provided in the appendices.

Recommendation		Jo Wilton	Graham Taylor	R Raja-gopal	Chris Collins	Fulton Hogan	Fletcher Beca	HEB Bartley
1	PRs and MRs mandate the documentation of all design risks and assumptions at each stage of the design and construction chain	✓	✓	✓	n/a	✓	✓	✓
2	Tenderer be given the opportunity to satisfactorily address these perceived pavement construction deficiencies prior to tender award, failing which the tenderer is excluded from the tender.	Note 1	✓	Note 6 ✓	n/a	✓	✓	✓
3	Greater emphasis on the capabilities of construction team individuals including reference checks, tender interactives, and pre-award meetings.	✓	✓	✓	✓	✓	✓	✓
4	PRs and MRs provide for a truly independent review of the pavement design - reviewers appointed by WK	Note 2	✓	Note 7	n/a	✓	✓	✓
5	Independent valuation, by an Independent Estimator, of higher cost pavement alternatives offered by tenderers in price competitive models	✓	✓	✓	✓	✓	✓	✓
6	Use procurement models that reduce the potential for overly aggressive competitive pricing of pavements.	Note 3	✓	✓	n/a	✓	✓	✓
7	Specifications require the construction of trial pavements for unusual pavement designs or use of alternative lower quality materials	✓	✓	Note 8	Note 9	✓	✓	✓
8	Extension of the Defects Liability Period	Note 4	Note 5	✓	Note 10	Note 11	Note 12	Note 13

Amplification of interview responses are provide in the following notes:

Note 1: A number of tier 1 contractors have experienced pavement performance issues. This recommendation would potentially disqualify a large number of these contractors, who are considered to be highly competent. Further, tenderers would not put up a poor project for tender evaluation. More detail would be needed of how this recommendation would be implemented, as it may be difficult to implement.

Note 2: Unsure that this can practically be implemented. Waka Kotahi personnel have differing views regarding pavement designs. A caution was expressed with regard to risk transfer if Waka Kotahi review, approve or accept the design.

Note 3: Price competitive models have their place. The TET need to challenge low prices in detail, including assessments of “sustainable tenders”.

Note 4: Response not received.

Note 5: Does not believe this is necessary.

Note 6: It would be preferable to increase the weighting on the pavement design and construction so that this is elevated in importance and priority in the tender evaluation.

Note 7: The Project Manager does not believe that Waka Kotahi needs to review the design at the construction stage. He believes that the PRs must be reviewed by Waka Kotahi’s subject matter experts before it goes to tender.

Note 8: The Project manager did not express a clear preference either way.

Note 9: The response suggested that trial pavements are not relevant in a Traditional Contract. The author believes it may be relevant depending on the manner in which the material specifications differ from TNZ material specifications.

Note 10: Suggested that longer DLPs can be difficult to manage over long periods, and often difficult to determine liability in the event of an issue. Not good to be on books for a long time. Staff changes make this difficult to manage.

Note 11: Fulton Hogan do not favour this recommendation for the Principal’s prescribed design, and would prefer to “get the right pavement design at the start”. However, they would support an extended DLP for an alternative pavement design.

Note 12: Fletcher Construction does not support this recommendation as this becomes a staff resourcing and management issue. The duration would be very drawn out, potentially causing confusion with the responsibilities of the NOC contractor. Beca supports the view of a longer DLP.

Note 13: Not sure how much influence this would have as the tender approach does not consider the impact of the DLP.

8.2 Interview with Geoff Griffiths

The purpose of the interview was to understand the Canterbury experience with foamed bitumen stabilised (fbs) pavements and how the performance of these pavements may potentially be related to the choice of procurement model. Notes of the interview are included in Appendix J.

Geoff Griffiths of Waka Kotahi's Christchurch office has specific experience in the use of fbs.

Key notes from this interview are:

- a) The Canterbury RONS projects in 2010, Waka Kotahi's Christchurch office took the decision to use fbs on its key RONS projects, including:
 - Christchurch Southern Motorway Stage 1 – CSM1 (D&C)
 - Christchurch Southern Motorway Stage 2 – CSM2 (Traditional LS)
 - Western Belfast Bypass (Traditional Measure and Value)
- b) The pavement designs were Principal provided, and not Contractor led, for the following reasons:
 - There was a lack of confidence in the pavement construction expertise – this concern remains today.
 - NZTA did not wish to take the risks inherent in a contractor-led design. They wanted a low risk pavement and high level of confidence in reliability.
 - They wanted to reduce the number of variables that may contribute to poor performance.
- c) Post-construction performance has been good.
- d) Geoff is not in favour of a contractor-led pavement design as a result of the issues that have been experienced with this approach.
- e) Pavement designs should not target cost savings as a key objective. Supplying less pavement for less cost is not innovation.
- f) Geoff agrees with the recommendation for a truly independent reviewer with greater Principal input to the acceptance of the design (as for the RSA process).
- g) He agrees with the concept of an extended DLP period for contractor designed pavements.

Geoff suggested that another approach would be to allow for two pavement design options in a contractor led project:

Design Option 1: A Principal's design with a standard DLP period, or

Design Option 2: An alternative contractor's design with an extended DLP.

The author believes there is substantial merit in this suggestion, particularly if other recommendations such as independent pavement design review, are included as a requirement for an alternative pavement design. This approach will form the basis of the final recommendations in this report.

8.3 Interview with David Alabaster, Principal Pavements Engineer, Waka Kotahi

Key outcomes of this interview, as referenced in appendix K, are:

- a) Dave is of the opinion that price competitive procurement models allows designers to make judgements of the design input criteria, and this can result in “skinny” pavement designs.
- b) Accelerated pavement testing is feasible in order to avoid long term pavement failures.
- c) The CAPTIF test track is not suited to any of the procurement models as the timeframes from tendering to construction are too short. Most designs would take a year (or more) to test at 25 year design life. CAPTIF is more suited to longer term research.
- d) Dave recommends the use of the Dynatest HVS simulator, costing US\$3M in 2014. He is strongly in favour of Waka Kotahi making this investment for the benefit of their future pavements.
- e) He supports the approach taken on Christchurch Southern Motorway Stage 2 for the appointment of a “Clerk of Works” to oversee pavement construction.

8.4 Summary of Key Outcomes from the Interview of Waka Kotahi Personnel

The key outcomes from the interview of Waka Kotahi personnel may be summarised as follows:

- a) There was universal alignment among interviewees with the view that price competitive procurement models, such as D&C and Competitive Alliances, contribute to poor pavement performance as a result of the aggressive focus on lowest cost pavement. Further, that the current D&C model should not be used for the pavement component of a project.
- b) There was general, albeit not universal agreement among interviewees with the initial recommendations of section 6.
- c) There was universal alignment among interviewees with the view that a Principal’s provided pavement design offers greater certainty in long term pavement performance, and this should be the approach adopted by Waka Kotahi for the procurement of their major projects.
- d) A common response was related to the inadequate standard and number of pavement construction skills within the industry.

The views of the interviewees will be taken into account in the final recommendations of this report presented in section 10.

9. Interviews with Contractor and Designer Personnel (Capital Projects)

9.1 Summary of Key Outcomes from the Interview of Contractor and Designer Personnel

The key outcomes from the interview of Contractor and Designer personnel may be summarised as follows:

- a) There was universal alignment among interviewees with the view that price competitive procurement models, such as D&C and Competitive Alliances, contribute to poor pavement performance, and that the current D&C model should not be used for the pavement component of a project.
- b) There was general agreement among interviewees with the initial recommendations of section 6. There was mixed support for an extended defects liability period for the pavement component of the project.
- c) There was common preference among interviewees for a Principal prescribed design that would address the “race to the bottom” behaviours associated with these aggressively competitive procurement models. However, there is a strong view that the standards set by the Principal’s prescribed design in respect of waterproofing of the pavement, are inadequate and that this is a major contributing factor to the poor performance of pavements.
- d) There was concern about the inadequate standard and number of pavement construction skills within the industry

The views of the interviewees will be taken into account in the final recommendations of this report presented in section 10.

The section below expands on the views above provided by Contractor and Designer interviewees.

9.2 Expanded Responses from Contractor and Designer Personnel

Some contractors made the point that the views expressed in the interviews were their personal opinions, and not necessarily those of their company. Nevertheless, these views are considered to be highly relevant to this review. Key aspects of these reviews are expanded below.

a) Price Competitive procurement models contribute to poor pavement performance

Excerpts from the interview notes are testimony to this universal view:

- “Price competitive models create “a race to the bottom” and “that this focus on low price may impact on pavement design risk”
- “The pavement design is carried out “down to the wire”, but still meeting the PRs”
- “Pavement designs may meet the PRs in theory but the designs are “bare minimum” and relatively high risk options”
- “Ability to innovate in pavement design is limited. The focus is on reducing cost”
- “There is a “massive amount of commercial pressure on design”
- “Commercial pressures in price competitive models potentially impact on the application of engineering judgement in the pavement design this can lead to slimline design”

Clearly these behaviours are likely to impact on the robustness of the pavement design, and increase the risk of pavement performance achieving expected standards.

Interestingly, Fulton Hogan commented that this “race to the bottom” is often similarly reflected in Hybrid Alliances when the affordability thresholds are set too low. This has a similar negative impact on pavement design as in the case of D&Cs and Competitive Alliances. Fulton Hogan suggested that this concern may be addressed by providing a separate threshold for pavement design and construction in hybrid Alliance models.

The author believes that this matter is worthy of consideration by Waka Kotahi, in the event that competitive pavement designs models continue to be used.

b) Standards set by the Principal’s prescribed pavement design

Fulton Hogan reflected the common sentiment of the contractors and designers that were interviewed:

- That Principal prescribed designs do not adequately address all design risks and set too low a standard, particularly in respect of waterproofing the pavement structure. OGPA over a two coat chip seal is no longer considered sufficient.
- That the current requirement for Principal prescribed designs is for the contractor to provide the PS1 Design Producer Statement, even though they have not carried out the design, and further, that they believe the Principal prescribed designs are, in some cases, inadequate. Contractor and designers are unwilling to accept this responsibility.

Their common view to address the competitive pavement design challenges was to retain the Principal’s prescribed pavement design. However, in their view, the following issues would need to be addressed, as preconditions:

- Firstly, that the standards of the prescribed design be addressed and agreed with the industry
- Secondly, that the liability for the pavement design must remain with the Principal’s designer, not with the contractor.

Contractors’ preference is for the Principal to engage an independent pavement designer who will be responsible for the design producer statements, as is the case for a Traditional contract. The Contractor’s liability would be clearly demarcated as pavement construction only.

A refinement of this approach would be to provide for the option of an alternative pavement design where the Contractor considers that such an option may add value. This reflects the approach suggested by Geoff Griffiths of Waka Kotahi in section 8.2.

c) Mixed support for an extended defects liability period

From the interviews, there are mixed views in respect of this recommendation.

Matt Zame of Fletcher Construction does not support this recommendation as, in his view, this becomes a staff resourcing and management issue. He believes that a longer, drawn out DLP, would potentially causing confusion with the responsibilities of the NOC contractor. The author does not share this view.

Interestingly, John Hallett of Beca, Fletcher Construction's pavement designer for Ngaruawahi, supports the view of a longer DLP. He believes that a longer DLP would encourage tenderers to be more circumspect about offering "minimum" pavements. He believes that having a longer term responsibility would be a good approach for longer term commitment by Contractors to pavement performance. Thresholds, or performance criteria, would need to be set for failures which trigger the Contractor's responsibility.

Fulton Hogan do not favour this recommendation for the Principal's prescribed design, and would prefer to "get the right pavement design at the start". However, they would support an extended DLP for an alternative pavement design.

d) Inadequate standard and number of pavement construction skills within the industry

Matt Zame of Fletcher Construction emphasised this issue:

"The industry has an overall shortage of resources. Lack of continuity of work makes it difficult to maintain resource expertise. This makes it difficult to keep people on projects as they look for projects that suit them best. Loyalty is less of a focus nowadays."

Fulton Hogan similarly expressed reservations about the standard of skills in the industry, in particular with smaller contractors.

Similar views were expressed during the interviews of the NOC contractors – refer to section 11.

10. Proposed Improvements to Capital Project Procurement Models:

Final Recommendations

The following final recommendations are based on the initial recommendations in section 6, but are modified to take account of the opinions expressed in sections 8 and 9 by Waka Kotahi, contractors and designers.

10.1 Pavement Design Standards

Contractors and designers have serious concerns about the design standards provided in the Principal's prescribed pavement designs. Where these concerns are valid or not, it is important that these concerns be addressed in order to achieve alignment between Waka Kotahi and the supplier industry.

Recommendation 10.1 (Refer Executive Summary)

That Waka Kotahi consults collaboratively with the industry to develop appropriate standards, specifications and guidelines , for the design, construction and maintenance of road pavements.

10.2 Principal's Prescribed Pavement Designs

Waka Kotahi, contractor and designers personnel interviewed were unanimous in their views and preferences for the retention of Principal's prescribed pavement designs. However, contractor and designers prefaced this support as described in the recommendation below.

Recommendation 10.2 (Refer Executive Summary)

That Waka Kotahi provides Principal prescribed pavement designs for new and rehabilitation projects subject to the following criteria:

- a) That industry concerns in respect of the pavement design standards are discussed and considered through collaborative consultation with the industry.
- b) That the pavement designs be carried out by independent Principal appointed pavement designers.
- c) That design responsibility be retained by the independent Principal appointed pavement designers.

10.3 Contractor's Pavement Design Alternative

Waka Kotahi, contractor and designers personnel interviewed recommended that Contractors be afforded the opportunity to offer innovation and value through an Alternative Pavement Design. This

alternative design would be subject to more stringent criteria than has previously been the practice. Such criteria would include:

- a) Design standards be discussed and considered with the industry as per recommendation 10.1.
- b) Acceptance of the tendered Alternative Pavement Design be at the discretion of the Principal. This discretion would be exercised prior to the acceptance of the tender.
- c) Pavement design risks and assumptions be mandated for documentation, and follow up, at each stage in the design and construction.
- d) Independent pavement design reviewers be appointed by the Principal.
- e) The valuation of the commercial aspects of the Alternative Pavement Design be supported by construction specialists in the determination of a Tangible Cost Adjustment factor.
- f) Consideration be given to the extension of the Defects Liability Period for the pavement design and construction.
- g) Consideration be given to the requirement for the construction of a trial pavement section, if required by the Principal, and particularly where alternative lower quality materials have been proposed.

In addition, the Principal should consider carrying out more accelerated pavement testing for new pavement innovations as and when they are identified, for the greater good of the industry.

However, members of the Steering Group had a strong preference that alternative pavement designs be considered outside of tenders.

The Steering Group is reluctant to encourage tenderers to nominate alternative pavements during tendering. Instead, it has recommended that the Principal remains open to considering innovative pavement ideas that are raised prior to, during tendering or after award of any contract.

10.4 Scheduling Pavement Design and Construction as a Provisional Sum

It has been suggested that, for contractor-led procurement models, including D&C and Competitive Alliances, the pavement design and construction components be removed from competitive tendering.

Recommendation 10.4 (Refer Executive Summary)

That for contractor-led procurement models, pavement design and construction be:

- a) Scheduled as a Provisional Sum
- b) Designed and priced in conjunction with the Principal, Principal's Agent, and Independent Estimator following contract award.

10.5 Non Price Attributes (NPAs)

Waka Kotahi, contractor and designers personnel interviewed agreed that greater emphasis be required in the NPAs of the expertise expected for the successful pavement design and construction in a contractor-led procurement model.

Recommendation 10.5 (Refer Executive Summary)

That, for contractor led designs, Non-Price Attributes place a higher threshold on pavement design and construction expertise through:

- a) Provision of a separate construction prequalification category for pavement construction, potentially including surfacing.
- b) Consideration of a prequalification requirement for demonstrated consultant experience in the effective supervision of pavement construction.
- c) Greater weighting of NPA scoring of Relevant Skills required for pavement design and construction. This may include a Pass / Fail threshold as high as 60-65% for key personnel such as the Pavements Construction Manager / Engineer.
- d) Greater interrogation of the tenderers' proposed pavement design and construction personnel at the interactive meetings, and that these, and other aspects of the interactive meetings be included in the NPA scoring.
- e) Tender requirements that place a greater obligation on contractors and designers to resource their projects with personnel nominated in the tender proposals (refer to Recommendation 10.6).

10.6 Retention of Tenderers' Nominated Personnel

Waka Kotahi personnel expressed concern about the challenges in ensuring that tenderers' nominated personnel remain committed to the contract for an acceptable period of time. Contractors attributed this, at least in part, to the shortage of skilled and competent personnel.

Recommendation 10.6 (Refer Executive Summary)

That the Principal recognises the challenges for contractors in employing and retaining suitably experienced personnel, and that procurement procedures require the following:

- a) That tender proposals outline the contractors' intended employee development programmes on the contract and how, when and by whom, the nominated personnel will be replaced through the development programme. This proposal will be scored as an integral part of Relevant Skills.
- b) That the accuracy with which the contractor adheres to the approved contractors' staff development programme, is scored in the PACE assessment of contracts for consideration in subsequent tenders.
- c) Retention of the current measures for financial penalties in the event of non-compliance with agreed resourcing commitments.

10.7 Training

Waka Kotahi, contractor and designers personnel expressed a common concern about the available competent skills within the construction industry, specifically but not exclusively, as this related to pavement construction. This concern is similarly reflected in section 11 in respect of the Network Outcomes Contracts.

Recommendation 10.7 (Refer Executive Summary)

That an industry-wide training initiative for pavement construction be established, under the auspices of CCNZ, and in consultation with Waka Kotahi.

11. Procurement Influences on Pavement Performance of the Network Outcomes Contracts

11.1 Interview with Mike Manion, Lead Advisor Contract Performance, Maintenance and Operations, Waka Kotahi

The author interviewed Mike Manion, Lead Advisor Contract Performance, Maintenance and Operations, Waka Kotahi on 15 November 2021. Details of this interview are included in Appendix P.

Key outcomes from the interview are:

1. The procurement model is Measure and Value (with some Lump Sums) and the method of Supplier selection is the Price Quality Method (PQM).
2. The extent of pavement underperformance on the Network Outcomes Contracts (NOCs) is relatively substantial across the country.
3. In Mike's view this is not a consequence of the procurement model or methods; rather, these performance issues are instead related to contract management and contract delivery, which are currently being assessed for improvement.
4. These issues relating to pavement performance include:
 - Quality of available quarry materials
 - Testing inconsistencies
 - Site specific constraints that impact of timing of the rehabilitation works eg weather, traffic flow requirements and temporary traffic management plans, with the comment that working on pavements under live traffic can detract from best practice construction techniques
 - Inadequacies in the site investigation and Failure Mode Assessment processes leading to potentially inappropriate designs
 - Historically insufficient contract supervision, which is currently being addressed
5. Of relevance to the contractor-led pavement design processes of Waka Kotahi's major capital projects is the degree of participation by the Principal in the design review and approval process.
6. This pavement design and construction process for the NOCs may be summarised as follows:

- a. The contractor identifies the underperforming sections of pavement and programmes for their treatment/rehabilitation in their forward works programme.
- b. The Contractor submits a design report in which they propose at least 3 pavement designs (treatments) for consideration by Waka Kotahi, including a whole of life economic assessment.
- c. The design proposals are considered and a final design option is approved by Waka Kotahi.
- d. The final (detailed) design is carried out by the contractor's designer
- e. This is reviewed and approved by Waka Kotahi.
- f. The design is implemented by the Contractor.
- g. Pavement performance is monitored for 5 years post construction which is the Defects Liability Period for that section of rehabilitation.
- h. Financial penalties are subsequently applied to the Contractor for non-conformance against specified performance standards.

A major difference between the contractors' pavement design proposal (or concept pavement design) in the NOC and capital projects is the selection in the NOCs of a pavement design from 5 design options, pre-selected by the Principal and specified in the contract. Notwithstanding this contract requirement, the contractor has the ability to propose a design that may be more innovative by virtue of adding greater value through costs savings of reliability of design. This provision is best described by the relevant extract from clause 5.3.2 Pavement Rehabilitation Design:

"If, in the interest of innovation, the Contractor wishes to use a design that deviates from the Principal's Guide to Pavement Structural Design and the Principal's Guide to Pavement Evaluation and Treatment Design (on which the prescribed design are based), the Contractor shall be required to provide empirical or analytical documentation, to the satisfaction of the Principal, to demonstrate that the design can reasonably be expected to meet the design life requirement agreed. The Contractor is expected to use the Principal's specifications for materials and construction that are proven to achieve the outcomes, and, where alternatives are proposed, sufficient empirical or analytical evidence is required for the Principal to approve. Ultimately, the approval of alternative designs is at the Principal's discretion."

Based on this interview with Mike Manion:

- i) It is suggested that the NOC procurement model itself has little or no influence on pavement performance outcomes, and that some improvements to the contract management, investigations, quality assurance, and testing are being considered to improve performance outcomes.
- ii) It is recommended that the greater Principal participation in the review and approval of pavement designs for the NOCs be considered for implementation in capital projects, albeit with some modifications to suit the specific requirements of the latter.
- iii) The extended Defects Liability Period as applied in the NOCs for pavement design and construction, be considered for application to capital projects.

Further discussion was held with Mike Manion on 15th December 2021. This discussion followed interviews with NOC contractors and designers and focussed on the impact of NOC funding levels on pavement performance, as suggested by the latter. Mike's views are noted below:

- a) As discussed before, Mike's view is that there are no issues with the procurement model itself, but rather with delivery.
- b) Mike agrees with the view of contractors and designer that funding levels play a role in the effective delivery of pavement maintenance and performance:
 - The contractor generally suggests a 25 year design life, but this is often above the budget originally set with input from the Contractor.
 - Waka Kotahi has to be pragmatic to meet budget.
 - Waka Kotahi does not have the budget to construct a 25 year rehabilitation option across the network. Further, this may result in overly conservative designs across the network.
 - Mike questioned the need for a 25 year design life as a lesser design life may at times offer a more optimal WOL / NPV. A lesser design would allow a wider maintenance coverage of the network than a 25 year design life throughout.

Further views on the performance of the NOCs, specifically pavement performance, are provided below.

11.2 Interview with Peter Connors, Lead Advisor, Asset Quality Maintenance, Waka Kotahi

The author interviewed Peter Connors, Lead Advisor, Asset Quality Maintenance, Waka Kotahi on 14 December 2021. Details of this interview are included in Appendix Q.

Key outcomes from the interview are the following views expressed by Peter:

- a) The key issue relating to poor pavement performance on the NOC contracts is poor delivery, as a result of a lack of sufficient capability within the maintenance industry.
- b) Of significance to this review, is the exponential increase in maintenance costs, and the impact this has on affordable funding.
- c) Funding is based on the Contractor's 3 year forward works programme. Each year the Contractor's Annual Plan is used to update the funding for the subsequent year. However, due to overall funding constraints, the requested funds or budgets are not always made available.
- d) The optimal Nett Present Value or optimal whole of life design is not necessarily a 25 year design life, as has been suggested by some designers. However, he agrees that due to budget constraints, Waka Kotahi cannot always approve the optimal WOL design solution.

11.3 Interview with Higgins Contractors

Higgins are the contractor for the East Waikato, Bay of Plenty (East and) Hawkes Bay NOC contracts. The author interviewed the following personnel from Higgins Contractors on 21st December 2021:

- Dale Nichols (NOC Contract Manager) - 6 years on the Hawkes Bay NOC
- Brian Jones (NOC Asset Manager)
- Thorsten Frobels (Pavement Design Manager)

Details of this interview are included in Appendix Q.

Key outcomes from the interview are the following individuals' views:

- a) While there are some performance issues on their NOC contracts, this is not considered to be widespread.
- b) The industry is under immense pressure and needs change and improvements. Specifically, the NOC contracts face three key challenges in respect of pavement performance, these being:
 - Industry capability
 - Constraints of working under live traffic
 - Adequate budgets that effectively target the requirements of the network.
- c) In respect of industry capability:
 - Skill level in the industry is an issue, especially with operators on critical plant such as graders, rollers, pavers and stabilisers
 - These inadequate skill levels often result in quality issues.
- d) In respect of the constraints of working under live traffic:
 - These present significant constraints to achieving quality "every time".
 - Weather and demands of the public for reduced delays mean that the contractor sometimes needs to seal before they are ready to do so, to avoid being caught out by rain and incurring public frustration.
 - These constructability constraints or risks are not generally considered in the pavement design. If they did it would increase the cost of the treatment solution.
 - As an example, cement stabilisation is particularly prone to these risks, whereas a foamed bitumen stabilised base would be more forgiving when experiencing inclement weather. But this would not be achievable with the constraints of the budget.
 - These constraints have been exacerbated by recent Health and Safety requirements for safety zones between the workface and motorists. This puts heavy bypassing traffic in fixed wheel paths that can lead to pavement deterioration. The use of a drag broom and/or the ability to move traffic laterally is often not possible under the new H&S requirements.

e) In respect of budget constraints:

- Austroads Guidelines and the NZ Supplement require pavement renewals to be designed for a 25 year design life. However, in some cases funding constraints require a reduced design life, often to acceptance of a 10 or 15 year design life.
- For some years insufficient funding has been made available for effective pavement maintenance to maintain the level of service of the network.
- Waka Kotahi Managers are therefore compelled to do what they can with the available budgets, such as:
 - Selecting a lower design life
 - Cutting back on other maintenance requirements such as drainage
 - Deferring rehabilitation – ‘holding the pavement’ by means of repairs until funding is available for a longer term treatment such as rehabilitation / renewal.
 - Reducing the number of reseals i.e. waterproofing of the pavement, meaning that the seal life is pushed too far.
- These measures add risk to pavement performance. Recently, this increased risk has been accepted by Waka Kotahi network managers and, together with a reduction in design life, the risk has been transferred to Waka Kotahi.
- The overall condition of the network is deteriorating and there may be a bow wave of performance issues requiring heavy maintenance (rehabilitation).

f) The Higgins’ personnel suggested the following solutions:

- Industry-wide training initiatives with leadership from Waka Kotahi (government) to address the skills crisis, and opening of the borders to skilled workers by Immigration NZ (central government).
- Closer working between suppliers and Waka Kotahi to identify and address pavement performance risks. The introduction of Rob Damhuis as an independent pavement design reviewer is welcomed and has led to some positive outcomes.
- Acknowledgement of the funding challenges, and improvement in funding levels.

11.4 Interview with John Hallett, Pavement Designer, Beca Consultants

The author interviewed John Hallett, Pavement Designer, Beca Consultants on 13 December 2021. Beca are consultants to Higgins Contractors for the East Waikato, Bay of Plenty (East and) Hawkes Bay NOC contracts.

Key opinions expressed in this interview are:

- a) John does not believe that the current NOC procurement model has any influence on pavement performance, as standard rehabilitation treatments are priced.
- b) The issue of pavement performance is driven by funding levels that are set too low to meet the network requirements.
- c) Heavy traffic has increased significantly and pavement stock has been consumed. Some sections are inadequate for current traffic. More than one rehabilitated section has reached the end of its useful life.
- d) Performance issues manifest during the 5 year Defects Liability Period when measured against the performance criteria set for a longer pavement design life than has been selected under funding constraints.
- e) John supports the concept of an independent pavement design reviewer, as has been implemented in the Waikato by the involvement of Rob Damhuis.

11.5 Recommendations for Improvements on the NOC Contracts

While the interviews carried out in respect of the NOC contracts have revealed reasonable alignment of opinions relating to pavement design and performance, these represent a very small sample of opinions with the industry.

The outcome of the interviews revealed that contributing factors to pavement performance issues include:

- i) Budgetary, or funding constraints.
- ii) Levels of skills and competency in the industry.
- iii) Constructability constraints, impacting on quality, that relate to working under live traffic, weather and traffic safety

The issues identified are of significance. For this reason, it is recommended that representative opinions be canvassed from all sectors of the NOC industry. This may be achieved through industry workshops. Key issues to be canvassed should include:



- a) Whether, and how, the current NOC procurement model may be improved in order to enhance the performance outcomes of pavement maintenance delivery within the NOCs.
- b) The status of skill levels in the industry, and the potential need for a programme of industry-wide training.
- c) Greater collaboration between Waka Kotahi project personnel and suppliers in the selection of optimal pavement design solutions given the fact that budgets will always remain a constraint on expenditure.
- d) Extension of the concept of an independent pavement design reviewer such as Rob Damhuis. This may include a formal process for considering broader outcomes associated with the optimisation of budget constraints and pavement design life.
- e) Assessment of the overall condition of the State highway network, and the funding levels that will be required to address the potential shortfall in the required levels of service.

12. Materials Selection

As a general rule, lower or alternative quality pavement materials attract a higher risk in respect of pavement performance in comparison to premium quality aggregates. However, the latter is increasingly becoming of shorter supply. This often drives contractor-led pavement designs to use alternative materials as a means to achieve design innovation and / or reduced construction cost.

The author is unaware that material selection is a significant issue for Traditional contracts where premium aggregates are generally specified as a low risk approach to pavement design. However, he is aware of workability of open graded material being contested by the contractor for the SH73 Mingha Bluff contract. It is accepted that open graded or 'bony' mixes specified for particular environmental reasons (high rainfall or frost heave), are more difficult to level and compact.

While the technical assessment is beyond the scope of this review, the following considerations are suggested in respect of project specific specifications for premium quality aggregates:

- Designers of such specific mixes should take particular care to ensure that they understand the potential 'workability' constraints of the specified mixes.
- Tender selection criteria need to take account of expertise and experience of tenderers in their ability to construct pavements using these specifications.
- The inclusion of trial construction sections may be considered, where deemed necessary, to confirm the workability characteristics of this material, with provision in the contract to vary the mix, as and if required to improve workability and adequate compaction.

There are further issues associated with the design and construction of pavements using alternative lower quality materials. Extensive testing from the sources of such materials should be required in order to confirm the consistency and expected performance of these materials. In addition, construction trials using these materials would provide higher level of confidence in their performance, albeit that the most effective or compelling trials would be of a longer term nature under design traffic loadings. During the procurement of major projects, there is generally insufficient time and / or contractor funding to carry out such extensive, or effective testing.

There is greater opportunity to confirm the characteristics of the alternative material, and arguably performance through trial sections, after contract award and during the detailed design stage.

There is a view amongst the various interviewees that Waka Kotahi should consider research into accelerated pavement performance testing that may be carried out prior to the finalising of pavement designs on major contracts where the pavement design is provided by the Contractor. It is acknowledged that:

- such testing would be extremely valuable in predicting the long term performance of these pavement designs
- current test methods such as the Heavy Vehicle Simulator require a substantial investment in equipment



- there may be logistical constraints in the availability and transport of such equipment to meet the contractors' design and constructions programmes

The view expressed by a number of interviewees was that further research is needed on the use of alternative materials in pavement construction.

13. Interview Waka Kotahi Procurement

Attempts were made to arrange an interview with Waka Kotahi Procurement. Unfortunately this was not possible in the timeframe required for preparing this report.



14. Conclusion

At the commencement of this review, there was an expectation that the supplier industry had advocated for a return to contractor-led pavement designs for major projects, as had been the practice prior to 2017. The initial recommendations considered by this report focussed on procurement improvements in respect of such contractor-led procurement models.

In testing these initial recommendations against the views of Waka Kotahi, contractor and designer personnel, it was clear that the personnel interviewed were not in favour of this pre-2017 approach. Instead, they substantially supported the current approach of a Principal prescribed design, subject to key criteria. It is acknowledged that the sample interviewed from the supplier industry was small, and that a wider survey of the market may reveal differing opinions.

Modified recommendations emanating from these interviews, including the criteria on which these recommendations are based, are provided in sections 10 and 11.5.

Appendix A

Methodology For Carrying Out This Review

The following methodology for this review was agreed with Waka Kotahi:

1	Review supplied documents.
2	Prepare Methodology. Discussion with, and approval by Waka Kotahi of this Methodology.
3	Discuss with Mike Mannion (WK Lead Advisor Contract Performance, Maintenance and Operations) how best to include the NOC contracts in this assessment.
4	Carry out a theoretical assessment of the influence of the various procurement models on the risk to pavement performance. This will be based on my own experience as a Contractor, in the tendering of the various procurement models.
5	Research overseas experience or publications that may be relevant to this assessment.
6	<p>Prepare a draft report on the influence of the various procurement models on the risk to pavement performance. This will be tested in later stages against:</p> <ul style="list-style-type: none"> • the views of WK Project Managers, and selected contractors and design consultants • actual contract outcomes including pavement performance <p>This draft report should propose improvements to the current procurement models with a view to providing greater opportunity for contractor design and innovation, as well as clear procedures and requirements for addressing WK's long term pavement performance risk.</p>
7	WK to confirm reference projects and Project Managers / contact details.
8	<p>Interview WK Project Managers to objectively define the relationship between contract outcomes and procurement model. This should specifically include the pavement performance experienced on the reference projects so that the risk associated with the procurement of those projects may be assessed in context eg:</p> <ul style="list-style-type: none"> • what was the contract end cost versus the tendered costs • what was the sequence of variations and were they due to scope creep, cost over-runs or rework • did the overall contract perform well; if not what were the issues and were they localised or widespread (including but not limited to pavements) • what were the commercial arrangements (e.g. with which party were the key roles & responsibilities; how were decisions made; who was consulted in decision-making; what commercial tensions existed) • what were the delivery issues encountered (e.g. design constructability; sourcing compliant materials difficult or unexpected time delays) • how readily and positively have the various contractors responded in addressing the delivery performance issues (including but not limited to any pavement issues) <p>This understanding is key to the influence of the procurement model on the various performance outcomes.</p> <p>Discuss with the PMs how these design, delivery and performance issues may have been influenced by the original contract procurement.</p>

	<p>Discuss with Geoff Griffiths the foam bitumen pavements across three different contract models and all with different outcomes/issues including Western Belfast.</p> <p>Obtain Contractor and pavement designer contact details for future interviews.</p> <p>Write up key outcomes of WK interviews for appendices to report.</p>
9	<p>Interview selected Contractor and pavement designers (with WK PMs?) to understand their views of the influence that procurement may have had in the subsequent pavement issues. Canvas the WK and contractor of their views of the procurement improvements proposed.</p> <p>Write up key outcomes of interviews for appendices to report.</p>
10	<p>Interview WK Procurement regarding the risks and influences of the various procurement options and proposed improvements</p>
11	<p>Prepare and submit draft Report.</p>
12	<p>Review of draft report by Steering Group. Potentially meet with the Steering Group.</p>
13	<p>Update and finalise report to take account of Steering Group feedback.</p>

The following reference projects will be included in the review:

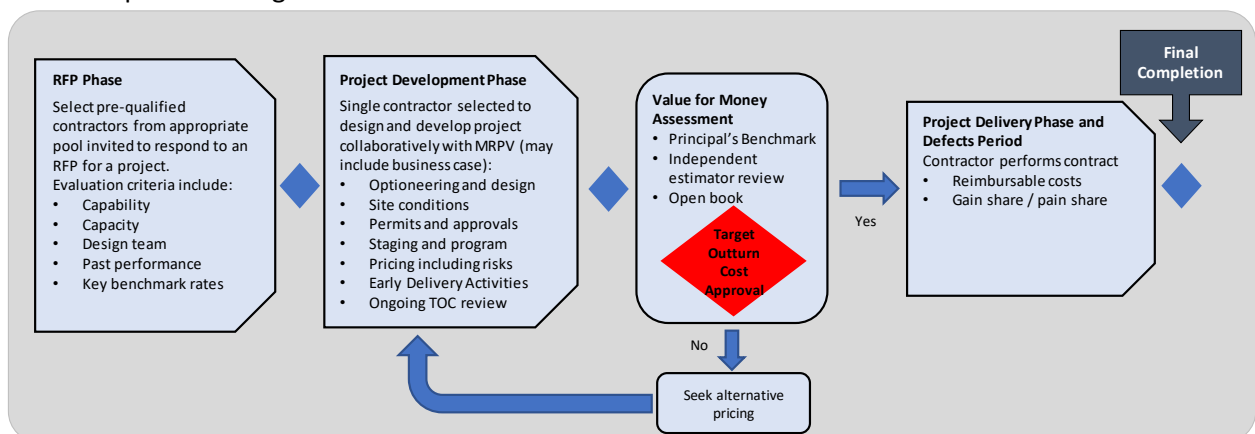
	Project / Completion	Procurement model / Reason for Selection	Waka Kotahi Personnel
1	Taupo Eastern Arterial	D&C. Slim pavement design. Pavement failures post construction.	Jo Wilton
2	Waikato Expressway: Ngaruawahia Bypass	D&C. Pavement failures post construction.	Jo Wilton
3	Waikato Expressway: Te Rapa Bypass	Competitive Alliance. Pavement failures post construction.	Peter Murphy Jo Wilton
4	Waikato Expressway: Cambridge Bypass	D&C. Granular pavement. Various trial sections instructed by WK. Some post construction pavement failures.	Raj Rajagopal
5	Hawkes Bay NOC	NOC. Project Proposed by Waka Kotahi.	Mike Manion
6	McKay's to Peka Peka	Pure Alliance. Pavement failures post construction.	Graham Taylor
7	SH1 Atiamuri Realignment	ECl. FBS pavement. Not aware of any major failures – WK to confirm.	Jo Wilton
8	SH73: Mingha Bluff to Rough Creek	Traditional contract. Granular pavement. Issues with workability.	Chris Collins

Appendix B

Notes from Interview with Danny Benjamin, Delivery Director, Major Road Projects Victoria

on 19 October 2021

1. Major Road Projects Victoria (MRPV) have not experienced the same level of pavement performance issues as in New Zealand.
2. MRPV do not favour price competitive D&C models. They do not believe that these provide a fixed price outcome, generally resulting in a 20% price increase from tender offer (even excluding legitimate scope increases).
3. MRPV believe that this is because the D&C model overly emphasises competitive pressures as tenderers generally have the best chance of winning the tender through lowest price. This increases the Principal's commercial risks through subsequent claims by Contractors to meet budget or required profitability.
4. In the opinion of MRPV, this state of affairs ie MRPV's negative experience, is driven by the price competitive nature of the D&C model.
5. MRPV have therefore developed, and are implementing, the PDA (Programme Delivery Approach) model as a response to the pressures mentioned above. The key objective of this approach is to remove the negative commercial friction inherent in the D&C model and replace this with the incentivised target cost approach of the PDA model. This removes the need to "push the envelope" with respect to slim designs and marginal pricing.
6. This approach targets all infrastructure components of a project, not only pavements.
7. The PDA is essentially a hybrid between a D&C and a pure Alliance where the D&C has been modified to include painshare / gainshare criteria.
8. The stages of the PDA comprise:
 - a. a Request for Proposal Phase;
 - b. a Project Development Phase;
 - c. a Value for Money assessment; and
 - d. a Project Delivery Phase.
9. MRPV depicts this staged model as follows:



10. Key features of the PDA model include:

- a. Panels for contractors and designers based on the size of projects and the capability of contractors / designers.
- b. Contractors and design consultants offer separate proposals based on criteria set by MRPV for each contract.
- c. MRPV selects their preferred contractor and designer.
- d. The Contractor is required to engage the designer directly as a subcontractor. There is room for debate if the contractor has valid objections to the choice of designer.
- e. The contractual relationship is between the Principal and the Contractor, and does not include the designer “at the top table”.
- f. MRPV and the contractor (including their designer) work collaboratively to design and develop the project design.
- g. The Contractor develops a TOC that is reviewed by an Independent Estimator on an openbook basis during the Value for Money phase.
- h. Should the TOC not demonstrate value for money, the State retains the discretion to:
 - i. continue to work with the contractor to improve the value for money offering; or
 - ii. appoint an alternative Panel Member from the relevant Construction Panel to prepare an alternative Delivery Phase Offer; or
 - iii. reserve then right to run an external tender process utilizing the information gathered during the prior process.
- i. Off-site overheads and profit are set at 10% by the Principal.
- j. When the TOC has been assessed as representing value for money and has been approved by MRPV, the project moves into the Delivery Phase where reimbursement is based on actual costs, plus painshare / gainshare and off-site overheads and profit where the profit component is at risk through the painshare / gainshare. Also included is a Performance Adjustment based on KRA's.
- k. Independent “Tiger Teams” are appointed to work with the Principal and Contractor to lift performance, particularly capabilities of project staff. These staff are particularly those of the Principal who may not always have the necessary understanding of project commercial matters, or construction risks as these may impact on the project outcomes. Danny believe this has been a “gamechanger” for MRPV.

11. The PDA targets improved performance outcomes for all components of the project, not only pavements.

12. MRPV experience to date with the PDA:

- a. 23 projects underway
- b. 8 at TOC stage
- c. 15 in construction – none yet completed and outcomes appear to be positive

13. Danny understands that Queensland Main Roads and New South Wales are reviewing collaborative contracting and the PDA.

Appendix C

Notes from the Interview with Graham Taylor, Waka Kotahi, McKays to Peka Peka on 22 November 2021

- What was the contract end cost versus the tendered costs

Response: \$24.7M increase due to pavement failures, shared 56% WK, 46% NOPs.

- What was the sequence of variations and were they due to scope creep, cost over-runs or rework

Response: The key variations were as a result of rework due to failure of the basecourse layer. Failures seem to be attributed to the design methodology (ie early application of OGPA without trafficking the underlying chipseal membrane).

- Did the overall contract perform well; if not what were the issues and were they localised or widespread (including but not limited to pavements)

Response: The above was the only real issue

- What were the commercial arrangements (e.g. with which party were the key roles & responsibilities; how were decisions made; who was consulted in decision-making; what commercial tensions existed) –

Response: The PAB decided to use a local quarry material and to modify this with cement, (not supported by WK pavement specialists). However the failure modes were as described above, and were not necessarily due to local modified materials.

- What were the delivery issues encountered (e.g. design constructability; sourcing compliant materials difficult or unexpected time delays)

Response: These are described above.

- How readily and positively have the various contractors responded in addressing the delivery performance issues (including but not limited to any pavement issues)

Response: The Contractor responded very well. They had material problems with the asphalt plant which took time to resolve. But the end result was a good outcome. Remedial works were recommended by the specialist pavements group, and approved by the PAB. These were completed using structural AC. NOPs payments have been agreed.

Discuss with the PMs how these design, delivery and performance issues may have been influenced by the original contract procurement.

Response: The project was a Pure Alliance. Graham was involved towards the end. Neil Walker, PAB member, recalls the decision to use a modified local basecourse was due to the shortage of premium aggregate in Wellington.

Recommendations

i) Risk management through all stages of design development, approvals and construction

Recommendation 1: That PRs and MRs mandate the documentation of all design risks and assumptions at each stage of the design and construction chain including the manner in which these risks have been addressed in the design and construction planning.

These stages are, et al, tender design (or Cert A at procurement), detailed design, design review, construction team briefing, construction management plans, quality and inspection and test plans, and in the final producer statements. Both the designer and constructor, through the provision of their respective producer statements, should confirm that the identified design and construction risks have been effectively addressed at Practical Completion.

*Response: Graham agrees with this suggested approach and that this is applicable to all procurement models. He sees less capability in the industry.
Graham also suggests the use of independent QA testing and monitoring (this is the subject of a separate review).*

ii) Procurement non-price attributes may not effectively identify the preferred tenderer

Recommendation 2: That procurement protocols provide for the following:

- a) A PASS / FAIL threshold be implemented that disqualifies a tenderer who is unable to provide the required assurances of delivering a quality and reliable pavement, and / or
- b) In the event that a tenderer, with an unacceptably low score for pavement expertise, track record and construction methodology, is identified as the preferred tenderer, that the tenderer be given the opportunity to satisfactorily address these deficiencies prior to tender award, failing which the tenderer is excluded from further consideration.

Recommendation 3: That procurement requirements provide for:

- a) greater emphasis on the capabilities of construction team individuals
- b) reference checks for key construction personnel
- c) greater emphasis and recognition for the outcome of tender interactive, and pre-award meetings at which individuals are interviewed in respect of their experience, capability and understanding of the construction requirements, particularly as this relates to quality pavement construction and other critical elements of the contract. Any overstatement or capability or understanding of key individuals within the NPAs proposal are likely to be revealed during these interviews.

The tender evaluation process should provide for a substantial inclusion in the scoring for the interviews of key construction personnel.

Response: Graham agrees with these recommendations and that the capabilities of key individual's is crucial, and that reference checks should be carried out for these individuals. He has experience of unsuitable candidates on one project being accepted on another, which did not lead to a good outcome on the latter project.

iii) Review of pavement designs

Recommendation 4: That PRs and MRs provide for the following pavement design review protocols:

- a) That a single, independent Pavement Review Team be appointed by the Principal, and nominated in the RFT. This team will provide consistency of review across all pavement design submissions, and will be reimbursed for their services through a 50:50 cost share arrangement between the Principal and the tenderer (or contractor) – as has been the case for the reimbursement of independent Safety Audit Teams.
- b) The Pavement Review Team will be selected from the Principal's Independent Professional Advisor (IPA) panel, and may include a representative from the Principal's National Office Pavement Team. The latter requirement will ensure that the Principal "has a voice" in the pavement design review in order to assure the achievement of the Principal's long term pavement performance objectives.
- c) This independent review will be carried out at all stages of design development including Certificate A (tender design), Detailed Design, and at any subsequent stage during construction should any conditions require a modification to the pavement design.

Response: Graham agrees with these recommendations and would like to see an independent reviewer and Waka Kotahi participate in the pavement design review, in much the same manner that a Road Safety Audit Team operates. Graham suggests the use of a Pavement Design Philosophy Statement that captures risks and assumptions. He agrees that this approach is particularly relevant to higher risk pavements using marginal materials.

This is consistent with the approach on the current national Weighright projects. The pavement design is carried out by Bartley Consultants, with the challenge and review of the design report carried out by WSP and Dave Alabaster (Waka Kotahi's pavement specialist).

iv) Appropriate recognition of value

Recommendation 5: That the tender evaluation protocols provide for:

- a) Independent valuation, by an Independent Estimator, of higher cost innovations or features of value offered by tenderers in price competitive models.
- b) That these independent valuations be used in the determination of a Tangible Cost Adjustment factor.

Response: Graham agrees with this recommendation.

v) Overly aggressive commercial pricing behaviours

Recommendation 6: That Waka Kotahi:

- a) Limit the use of Competitive Alliances and D&C models, particularly where the project includes a substantial or sensitive pavement component.
- b) Move to lower risk competitive models that provide for greater recognition of value, greater co-operation between owner and non-owner participants, and reduce the potential for overly aggressive competitive pricing.

Response: Graham agrees with this recommendation.

vi) Materials Selection

The specification of open graded or 'bony' mixes for pavement construction in Traditional contracts may present workability challenges during construction.

There are greater issues associated with the design and construction of pavements using alternative lower quality materials. This risk is discussed in greater detail in section 6.

Response: Graham agrees, especially as this relates to the use of a trial section on contracts. He emphasised that the risks in using marginal materials are especially high with high traffic and HCV loading. His further recommendations are:

- Consider the use of the CAPTIF pavement test track to prove pavement life
- Engage independent QA monitoring

vii) Defects Liability Period

Recommendation 8: That Waka Kotahi consider extending the DLP for projects involving substantial or sensitive pavement structures, as follows:

- a) An extension of the DLP for pavements only, as a separable portion, for a period of 5 to 7 years after Practical Completion. This period may be determined by the scale and risk levels of the proposed pavement.
- b) The amount of the bond applicable to this separable portion may be set as a percentage of the pavement value. This could be 25% or of this order.

Response:

Graham draws a parallel to vertical construction where 6 year guarantees have recently been put in place. The cost of pavements is very high compared to most vertical construction and could be expected to substantially increase bid prices. Given the suggested approach of an independent pavement designer with the principal consultant/contractor and Waka Kotahi participating in review/challenge of the pavement design, plus the appointment of independent QA, there is hardly the need for an extended DLP.

Appendix D

Notes from the Interview with Jo Wilton and Peter Murphy, Waka Kotahi, Waikato Expressway:

Te Rapa Bypass on 22 November 2021

- What was the contract end cost versus the tendered costs

Response: Tendered \$112M with final cost \$150M due to additional scope. A further \$27.5M was allocated due to pavement performance issues. The remedial work is currently underway but is not yet complete. Spent \$8M (shared 50% with FH) to date with a further circa \$10M to come.

Performance issues are rutting. Investigations could not identify or agree reasons for rutting. Could potentially be brown rock subbase consolidating under traffic loading initially in slow lane, followed by cracked seal, water ingress and potholing. Other theory is OGPA caused hydraulic pressures in pavement casing pavement failures – this is not support by WK pavement experts.

There were some QA issues in meeting the B2 spec. See later.

- What was the sequence of variations and were they due to scope creep, cost over-runs or rework

These are explained above.

- Did the overall contract perform well; if not what were the issues and were they localised or widespread (including but not limited to pavements)

Response: Pavements did not appear to be an issue during the contact. Pavement design was carried out in-house by FH. There is a question whether the review was carried out independently. It was later identified that B2 QA had not been achieved and that surfacing had been completed. Failures were widespread. There were no other major issues, other than some geotech issues resulting in a dip in the road– there has been no need to address this. There was also a slip which has been remediated, but a crack has again opened – relatively minor.

- What were the commercial arrangements (e.g. with which party were the key roles & responsibilities; how were decisions made; who was consulted in decision-making; what commercial tensions existed)

Response: The NOP had very good commercial controls in place. Pavements did not appear to be an issue during the contact. Later identified that B2 QA had not been achieved and surfacing completed. There was little active decision making regarding pavements during the contract. Commercial tensions arose from the Competitive Alliance model with pressures to meet budget.

- What were the delivery issues encountered (e.g. design constructability; sourcing compliant materials difficult or unexpected time delays)

Response: See above. In hindsight brown rock did not seem to have appropriate designer and QA overview from the NOP design team. The project suffered from a lack of transparency about respective roles and responsibilities.

- How readily and positively have the various contractors responded in addressing the delivery performance issues (including but not limited to any pavement issues)

Response: The initial reaction from Contractor was resistance to accepting responsibility. They later became more agreeable to identify causes of issues, and to carry out temporary repairs. Responsibility or costs cannot be agreed at this stage. Repairs have been remediated, with AC in ruts and a “whisper” seal over.

- How these design, delivery and performance issues may have been influenced by the original contract procurement.

Response: A view was expressed of a “race to the bottom” with the Competitive Alliance in respect of pricing. Specifications (MRs) allowed this to happen ie in hindsight these did not include a minimum pavement structure or adequate checks and balances (such as clarity regarding independent reviews and QA requirements, and minimum pavement structures).

Recommendations

i) Risk management through all stages of design development, approvals and construction

Recommendation 1: That PRs and MRs mandate the documentation of all design risks and assumptions at each stage of the design and construction chain including the manner in which these risks have been addressed in the design and construction planning.

These stages are, et al, tender design (or Cert A at procurement), detailed design, design review, construction team briefing, construction management plans, quality and inspection and test plans, and in the final producer statements. Both the designer and constructor, through the provision of their respective producer statements, should confirm that the identified design and construction risks have been effectively addressed at Practical Completion.

Response: This recommendation was agreed. Designers are often not located in the Waikato, and do not see first-hand what is being built. Contractors, and designers on site do not understand what the design assumptions and risks are.

On the WEX Hamilton Section, Waka Kotahi had a person on site for QA checking– almost like a Clerk of Works. This worked well.

ii) Procurement non-price attributes may not effectively identify the preferred tenderer

Recommendation 2: That procurement protocols provide for the following:

- a) A PASS / FAIL threshold be implemented that disqualifies a tenderer who is unable to provide the required assurances of delivering a quality and reliable pavement, and / or
- b) In the event that a tenderer, with an unacceptably low score for pavement expertise, track record and construction methodology, is identified as the preferred tenderer, that the tenderer be given the opportunity to satisfactorily address these deficiencies prior to tender award, failing which the tenderer is excluded from further consideration.

Response: The issue is that even with low NPAs, the lowest price could dominate. Almost all tier 1 contractors have had pavement issues. This recommendation would potentially disqualify them all. Further, tenderers would not put up a poor project. More detail would be needed of how this recommendation would be implemented, as it may be difficult to implement. It was noted that it generally takes years to resolve pavement failure issues – it not a quick fix.

Recommendation 3: That procurement requirements provide for:

- a) greater emphasis on the capabilities of construction team individuals
- b) reference checks for key construction personnel
- c) greater emphasis and recognition for the outcome of tender interactive, and pre-award meetings at which individuals are interviewed in respect of their experience, capability and understanding of the construction requirements, particularly as this relates to quality pavement construction and other critical elements of the contract. Any overstatement or capability or understanding of key individuals within the NPAs proposal are likely to be revealed during these interviews.

The tender evaluation process should provide for a substantial inclusion in the coring for the interviews of key construction personnel.

Response:

Recommendation a) was agreed, and this should include the individuals responsible for the designs and verification reviews.

It was pointed out that reference checks are carried out by Waka Kotahi and that this may not be widely known.

Recommendation c) was agreed. The tenderers' proposals should be challenged to ensure that they are practical and realistic.

iii) Review of pavement designs

Recommendation 4: That PRs and MRs provide for the following pavement design review protocols:

- a) That a single, independent Pavement Review Team be appointed by the Principal, and nominated in the RFT. This team will provide consistency of review across all pavement design submissions, and will be reimbursed for their services through a 50:50 cost share arrangement between the Principal and the tenderer (or contractor) – as has been the case for the reimbursement of independent Safety Audit Teams.
- b) The Pavement Review Team will be selected from the Principal’s Independent Professional Advisor (IPA) panel, and may include a representative from the Principal’s National Office Pavement Team. The latter requirement will ensure that the Principal “has a voice” in the pavement design review in order to assure the achievement of the Principal’s long term pavement performance objectives.
- c) This independent review will be carried out at all stages of design development including Certificate A (tender design), Detailed Design, and at any subsequent stage during construction should any conditions require a modification to the pavement design.

Response: Peter Murphy and Jo Wilton were not sure that this can practically be implemented. Waka Kotahi personnel have differing views regarding pavement designs. A caution was expressed with regard to risk transfer if Waka Kotahi review, approve or accept the design.

Further response: It was suggested that another approach could be for Waka Kotahi to propose a Principal’s design (ie a “level playing field”) and that tenderers be permitted to vary this design if they can demonstrate valid technical reasons for doing so. This would be carried out in a partnering relationship with Waka Kotahi. Details of such an approach would need to be worked out eg when is this change permitted (before or after contract award as the outcome may affect pricing).

iv) Appropriate recognition of value

Recommendation 5: That the tender evaluation protocols provide for:

Independent valuation, by an Independent Estimator, of higher cost innovations or features of value offered by tenderers in price competitive models.

That these independent valuations be used in the determination of a Tangible Cost Adjustment factor.

Response: This recommendation was agreed.

v) Overly aggressive commercial pricing behaviours

Recommendation 6: That Waka Kotahi:

- a) Limit the use of Competitive Alliances and D&C models, particularly where the project includes a substantial or sensitive pavement component.
- b) Move to lower risk competitive models that provide for greater recognition of value, greater co-operation between owner and non-owner participants, and reduce the potential for overly aggressive competitive pricing.

Response: Price competitive models have their place. The TET need to challenge low prices in detail, including assessments in respect of “sustainable tenders”.

There is a preference to include worthwhile bonus payments across all WK contracts.

This could encourage more aggressive behaviours to win the tenders, in which case a reduction in payments may be made for non-compliance – will this work?

vi) Materials Selection

Recommendation 7: That specifications for pavement materials include:

- a) In the case of Traditional contracts, that designers of such specific mixes take particular care to ensure that they understand the potential ‘workability’ constraints of the specified mixes. The inclusion of trial construction sections may be considered, where deemed necessary, to confirm this workability characteristic of this material, with provision in the contract to vary the mix, as and if required, to improve workability and adequate compaction.
- b) In the case of other procurement models that the PRs or MRs require a minimum level of testing during the tender period to document how the risk of alternative materials has been addressed in the tender submission
- c) During the Detailed Design phase, that a high level of material testing and documentation be carried out, including the manner in which the long term performance of the alternative materials may be assured. The use of the CAPTIF test track may be mandated for improved modelling of the performance of alternative materials.

Response: These agreed, particularly the use of the CAPTIF test track. However, Waka Kotahi should champion research on the use of alternative materials.

Further response: In addition to pavements, other price competitive issues that have been experienced include ground improvements.



vii) Defects Liability Period

Recommendation 8: That Waka Kotahi consider extending the DLP for projects involving substantial or sensitive pavement structures, as follows:

- a) An extension of the DLP for pavements only, as a separable portion, for a period of 5 to 7 years after Practical Completion. This period may be determined by the scale and risk levels of the proposed pavement.
- b) The amount of the bond applicable to this separable portion may be set as a percentage of the pavement value. This could be 25% or of this order.

Response 8: Peter and Jo to respond.

Appendix E

Notes from the Interview with Raj Rajagopal, Waka Kotahi, Waikato Expressway Cambridge Section on 29 November 2021

- What was the contract end cost versus the tendered costs

Response: Tendered \$136,389,894 with final cost to be confirmed.

- What was the sequence of variations and were they due to scope creep, cost over-runs or rework

Response: Most of the variations were driven by better outcomes for the project with both savings in time and costs. Variations due to pavement works were related to the improvement of the SIL with brown rock due to the softness of the ground at certain locations (unforeseen ground conditions). There were pavement performance issues after the completion of the contract. These were regarded as variations and paid by Waka Kotahi. Additional pavement works were instructed by Waka Kotahi that were in excess of the PRs.

- Did the overall contract perform well; if not what were the issues and were they localised or widespread (including but not limited to pavements)

Response: Overall the project went smoothly with the only technical issues being pavement specifications and performance. These pavement issues were localised and not widespread, believed to be mainly due to the nature of the cross drainage below the road and potential impact on the subgrade. This was driven by the very flat nature of the terrain. Also, there were trial areas that remained untreated as requested by Waka Kotahi's pavement expert which have subsequently shown failures.

- What were the commercial arrangements (e.g. with which party were the key roles & responsibilities; how were decisions made; who was consulted in decision-making; what commercial tensions existed)

Response: The commercial arrangement was a D&C LS contract. HEB was responsible for making commercial decisions including pavement structure and surfacings as this related to the pavement design and construction. There was however the introduction of "eOGPA" which was made mandatory by National Office and was thus a variation to the Contract.

- What were the delivery issues encountered (e.g. design constructability; sourcing compliant materials difficult or unexpected time delays)

Response: Locating suitable materials for fills was an issue. The contractor had to import more fill material than they had expected due to the nature of the insitu soils. Quality of materials used was not consistent with the expected outcomes ie materials may have met the specifications but not the objectives for the final product. There was a difference of opinion between Waka Kotahi's pavement expert and HEB's pavement designer.

- How readily and positively have the various contractors responded in addressing the delivery performance issues (including but not limited to any pavement issues)

Response: Contractor performed well other than the pavement performance issues. The Contractor responded well to addressing the pavement issues discussed during construction. Issues encountered post construction are currently under negotiation.

- How these design, delivery and performance issues may have been influenced by the original contract procurement.

Response: This was a very competitive D&C with a high weighting on price. The tender went through the Unsustainable Tender Committee (UTC) who agreed that the contract be awarded to HEB. Raj believes that the crux of the problem with more complex contracts' procurement strategies is that the NZS3910 and NZS3916 conditions of contract are not geared for complex projects. He believes that this is more likely the reason why the form of procurement model itself cannot deliver the outcomes of the project effectively. Besides, he believes, the contractual process for determining the cause of failures is not clearly provided in the CoC and therefore there is ambiguity, or lack of clarity. Is to the Contractors' advantage to indulge in protracted dispute resolution negotiations with Waka Kotahi rather than the Engineer to the Contract (EtC).

Raj added that the D&C form should not be used because the construction industry in New Zealand is not mature enough to self-regulate and therefore they produce 'minimum upon minimum quality outcomes' which create long-term performance issues. Contractors are unable to give "best for project" outcomes as they price the tenders too low to allow for some genuine innovations. Most "innovations" are effectively cost cutting exercises. Anything positive ends up as a Variation.

He believes that should Waka Kotahi proceed with D&Cs then a minimum of 5 years DLP should be included in the contract, besides setting better timeframes for the delivery of documentations such as test results that have an implication on proceeding with the next stage of the works This would allow failures to be addressed in a timely manner.

Recommendations

i) Risk management through all stages of design development, approvals and construction

Recommendation 1: That PRs and MRs mandate the documentation of all design risks and assumptions at each stage of the design and construction chain including the manner in which these risks have been addressed in the design and construction planning.

These stages are, et al, tender design (or Cert A at procurement), detailed design, design review, construction team briefing, construction management plans, quality and inspection and test plans, and in the final producer statements. Both the designer and constructor, through the provision of their respective producer statements, should confirm that the identified design and construction risks have been effectively addressed at Practical Completion.

Response: Raj agreed. More time should be spent getting the design as accurate or robust as possible and to give the contractor enough time to investigate and design (in a D&C). Often the Contractor doesn't have sufficient time to price the contract accurately due to site access issues (land acquisition delays) or short tender periods.

Jo and Peter: Designers are often not located in the Waikato, and do not see first-hand what is being built. Contractors, and designers on site do not understand what the design assumptions and risks are.

ii) Procurement non-price attributes may not effectively identify the preferred tenderer

Recommendation 2: That procurement protocols provide for the following:

- a) A PASS / FAIL threshold be implemented that disqualifies a tenderer who is unable to provide the required assurances of delivering a quality and reliable pavement, and / or
- b) In the event that a tenderer, with an unacceptably low score for pavement expertise, track record and construction methodology, is identified as the preferred tenderer, that the tenderer be given the opportunity to satisfactorily address these deficiencies prior to tender award, failing which the tenderer is excluded from further consideration.

Response: It would be preferable to increase the weighting on the pavement design and construction so that this is elevated in importance and priority in the tender evaluation and tender pricing.

Recommendation 3: That procurement requirements provide for:

- a) greater emphasis on the capabilities of construction team individuals
- b) reference checks for key construction personnel
- c) greater emphasis and recognition for the outcome of tender interactive, and pre-award meetings at which individuals are interviewed in respect of their experience, capability and understanding of the construction requirements, particularly as this relates to quality pavement construction and other critical elements of the contract. Any overstatement or capability or understanding of key individuals within the NPAs proposal are likely to be revealed during these interviews.

The tender evaluation process should provide for a substantial inclusion in the coring for the interviews of key construction personnel.

Response:

Recommendations a) and c) were agreed.

Regarding recommendation b) reference checks on individuals are carried out by the TET.

The nominated key individuals for the contract should not be replaced until at least until the end of the first season of construction.

iii) Review of pavement designs

Recommendation 4: That PRs and MRs provide for the following pavement design review protocols:

- a) That a single, independent Pavement Review Team be appointed by the Principal, and nominated in the RFT. This team will provide consistency of review across all pavement design submissions, and will be reimbursed for their services through a 50:50 cost share arrangement between the Principal and the tenderer (or contractor) – as has been the case for the reimbursement of independent Safety Audit Teams.
- b) The Pavement Review Team will be selected from the Principal’s Independent Professional Advisor (IPA) panel, and may include a representative from the Principal’s National Office Pavement Team. The latter requirement will ensure that the Principal “has a voice” in the pavement design review in order to assure the achievement of the Principal’s long term pavement performance objectives.
- c) This independent review will be carried out at all stages of design development including Certificate A (tender design), Detailed Design, and at any subsequent stage during construction should any conditions require a modification to the pavement design.

Response: This approach to independent review (Cat 1) is being implemented on the Awakino Tunnel Bypass and the review is being 100% paid for by Waka Kotahi. This is a D&C with amended review requirements required by Waka Kotahi – a condition of the PRs for the Cat 1 review.

Raj does not believe that Waka Kotahi needs to review the design at the construction stage. He believes that the PRs must be reviewed by Waka Kotahi’s subject matter experts before it goes to tender and their review should be responded to by the Principal’s designer. This outcome becomes part of the PRs.

He recommends that designers need to carefully consider subgrade strength requirements.

iv) Appropriate recognition of value

Recommendation 5: That the tender evaluation protocols provide for:

- a) Independent valuation, by an Independent Estimator, of higher cost innovations or features of value offered by tenderers in price competitive models.
- b) That these independent valuations be used in the determination of a Tangible Cost Adjustment factor.

Response: This recommendation was agreed.

v) Overly aggressive commercial pricing behaviours

Recommendation 6: That Waka Kotahi:

- a) Limit the use of Competitive Alliances and D&C models, particularly where the project includes a substantial or sensitive pavement component.
- b) Move to lower risk competitive models that provide for greater recognition of value, greater co-operation between owner and non-owner participants, and reduce the potential for overly aggressive competitive pricing.

Response: Price competitive models have their place. The TET need to challenge low prices in detail, including assessments in respect of “sustainable tenders”.

There is a preference to include worthwhile bonus payments across all WK contracts by determining measurable KPIs including quality.

This may encourage more aggressive behaviours to win the tenders, in which case a reduction in payments may be made for non-compliance.

Raj added that the D&C form should not be used because the construction industry in New Zealand is not mature enough to self-regulate and therefore they produce ‘minimum upon minimum quality outcomes’ which create long-term performance issues. Contractors are unable to give “best for project” outcomes as they price the tenders too low to allow for some genuine innovations. Most “innovations” are effectively cost cutting exercises. Anything positive ends up as a Variation.

vi) Materials Selection

Recommendation 7: That specifications for pavement materials include:

- a) In the case of Traditional contracts, that designers of such specific mixes take particular care to ensure that they understand the potential 'workability' constraints of the specified mixes. The inclusion of trial construction sections may be considered, where deemed necessary, to confirm this workability characteristic of this material, with provision in the contract to vary the mix, as and if required, to improve workability and adequate compaction.
- b) In the case of other procurement models that the PRs or MRs require a minimum level of testing during the tender period to document how the risk of alternative materials has been addressed in the tender submission
- c) During the Detailed Design phase, that a high level of material testing and documentation be carried out, including the manner in which the long term performance of the alternative materials may be assured. The use of the CAPTIF test track may be mandated for improved modelling of the performance of such materials.

Response: Raj believes that there is a shortage of premium quality pavement materials in New Zealand, and therefore the pavement needs to be designed with that in mind. He does not believe that designers adequately take account of the poorer quality of materials in the design. This may drive the need for the use of AC/deeper pavements although the traffic volumes may be lower than normally required for AC.

Raj is unsure of the effective use of the CAPTIF test track. It should be complimented with some outdoor testing as well to study performance under actual conditions.

vii) Defects Liability Period

Recommendation 8: That Waka Kotahi consider extending the DLP for projects involving substantial or sensitive pavement structures, as follows:

- a) An extension of the DLP for pavements only, as a separable portion, for a period of 5 to 7 years after Practical Completion. This period may be determined by the scale and risk levels of the proposed pavement.
- b) The amount of the bond applicable to this separable portion may be set as a percentage of the pavement value. This could be 25% or of this order.

Response 8: Raj agreed strongly with this recommendation as this will encourage contractors to design and construct pavements that meet long term performance objectives.

Appendix F

Notes from the Interview with Jo Wilton, Waka Kotahi, Atiamuri Bridge Replacement and Bypass on 6 December 2021

- What was the contract end cost versus the tendered costs

Response: Information to be provided.

- What was the sequence of variations and were they due to scope creep, cost over-runs or rework

Response: There was a large insurance claim for the collapse of a sediment pond. There was also an EOT for consents not being in place at the start of the project. This was a WK issue not of the contractor's making ie a Principal delay – the project should not have been tendered before consents were in place. There were no other significant variations.

- Did the overall contract perform well; if not what were the issues and were they localised or widespread (including but not limited to pavements)

Response: The contract performed well after the EOT for delay to consenting was resolved.

- What were the commercial arrangements (e.g. with which party were the key roles & responsibilities; how were decisions made; who was consulted in decision-making; what commercial tensions existed)

Response: The contract was with HEB, Designer was BBO, Principal's Agent was Resolve Group. Bond validated the price. Commercial pressures were satisfactorily resolved and mitigated. These were not an issue.

- What were the delivery issues encountered (e.g. design constructability; sourcing compliant materials difficult or unexpected time delays)

Response: Time delays are covered above. No issues with design constructability, or compliant materials. Minor issues with coordinating dam water control from the upstream storage dam, impacting on construction of substructure.

- How readily and positively have the various contractors responded in addressing the delivery performance issues (including but not limited to any pavement issues)

Response: There have been no pavement issues – it is performing well. BBO were careful to ensure that pavement design was thoroughly designed and reviewed.

- How these design, delivery and performance issues may have been influenced by the original contract procurement.

Response: While Jo Wilton was not the Project Manager at the time, she is not aware of any design, delivery or performance issues. The contract was well delivered and is still performing well today after 7 years in service. The ECI proved to be a good model for the procurement of this project.

Recommendations

Please refer to the notes relating to the Te Rapa Bypass where Jo Wilton provided her comments on the proposed recommendations.

Appendix G

Notes from the Interview with Jo Wilton, Waka Kotahi, Waikato Expressway Ngaruawahia Bypass

Section on 6 December 2021

- What was the contract end cost versus the tendered costs

Response: Information to be provided.

- What was the sequence of variations and were they due to scope creep, cost over-runs or rework

Response: These were pavement mainly related. To repair the pavement WK reached a 40:60 commercial agreement with Fletcher and 100% WK responsibility for betterment. The designer has not been party to negotiations and settlement.

- Did the overall contract perform well; if not what were the issues and were they localised or widespread (including but not limited to pavements)

Response: The contract has not performed well. Issues were widespread. Issues were pavements generally but included subsoils, subgrade (SIL), basecourse, drainage, swales and one of the bridges.

- What were the commercial arrangements (e.g. with which party were the key roles & responsibilities; how were decisions made; who was consulted in decision-making; what commercial tensions existed)

Response: D&C contract was with Fletchers. Higgins were the pavement subcontractor. The designer was with Parsons Brinkerhoff, with Beca as pavement design subconsultants. BBO was the Principal's Advisor. Commercial tensions were high. PB had no Hamilton office – the design was carried out remotely, staff were green (not specialists). WSP bought out PB, and design records cannot be located. There did not appear to be a PMB, or it may not have been effective. Concerns were raised about the pavement throughout construction. The design did not achieve the design parameters / objectives.

- What were the delivery issues encountered (e.g. design constructability; sourcing compliant materials difficult or unexpected time delays)

Response: A trial pavement was required to prove the design assumptions. However, lessons from the trial pavement were not transferred to the pavement construction. PC granted this year (2021) about 8 years after completion. The Contractor has been maintaining the pavement during this extended period.

- How readily and positively have the various contractors responded in addressing the delivery performance issues (including but not limited to any pavement issues)

Response: The Contractor did not respond well to addressing the remedial works. Delays to repairs increased the ultimate cost of the repairs. Note above - 8 years post completion to achieve PC. Subsequent change in Fletcher staff helped to resolve this issue ie Matt Zame.

- How these design, delivery and performance issues may have been influenced by the original contract procurement.

Response: This D&C resulted in a drive to the bottom for the lowest price to provide the lowest price possible. The PRs did not have robust specifications and no performance criteria, or criteria for quality of materials.

Together these impacted the quality of the pavement designed and constructed.



Recommendations

Please refer to the notes relating to the Te Rapa Bypass where Jo Wilton provided her comments on the proposed recommendations.

Appendix H

Notes from the Interview with Jo Wilton, Waka Kotahi, Taupo Eastern Arterial on 6 December 2021

- What was the contract end cost versus the tendered costs

Response: Waka Kotahi had this contract delivered by TDC. Final cost was paid by Taupo DC. The final costs are also difficult to separate from the complexities of the second contract that was entered into, initially for betterment works, but actually included additional pavement remedial costs. Waka Kotahi did not have influence over the outcome of the contract. There should have been a feedback loop to Waka Kotahi.

- What was the sequence of variations and were they due to scope creep, cost over-runs or rework

Response: There was rework because standards in the contract were not to Waka Kotahi standards, but to Taupo DC standards. There were cost overruns in respect of pavement repairs but there has also been subsequent betterment. A second M&V contract was awarded to repair some pavement issues and including betterment. The cost of this contract blew out – remedial pavement design could not achieve desired performance objectives and substantial TM costs were incurred (due to a day rate used).

- Did the overall contract perform well; if not what were the issues and were they localised or widespread (including but not limited to pavements)

Response: There were pavement issues but otherwise the contract went well. The second contract did not go well due to substantial time and cost issues. The pavement issues were generally limited to the left hand heavy vehicle lane.

- What were the commercial arrangements (e.g. with which party were the key roles & responsibilities; how were decisions made; who was consulted in decision-making; what commercial tensions existed)

Response: The original D&C was awarded by Waka Kotahi and then managed by TDC. This arrangement was not well structured in terms of closely involving Waka Kotahi. This included the handover to Waka Kotahi.

- What were the delivery issues encountered (e.g. design constructability; sourcing compliant materials difficult or unexpected time delays)

Response: It is understood that subbase was insitu pumice with around 180mm M4 basecourse. There were no delays of significance in the first contract. In the second contract there have been Covid delays, and pavement setout issues that impacted on quantities and caused contract delays. These delays resulted in substantial additional temporary traffic management costs.

- How readily and positively have the various contractors responded in addressing the delivery performance issues (including but not limited to any pavement issues)

Response: The issues manifested in the second contract that including pavement remedial works. In this second contract the contractor did not respond well. There were suspension and delay claims. The Contractor's local branch was and is aggressive with claims.



- How these design, delivery and performance issues may have been influenced by the original contract procurement.

Response: Waka Kotahi had little influence on the outcome of the contract that was managed by the local authority.

The D&C contract was a concern in respect of the pavement design and construction. This resulted in a much reduced pavement thickness than had been anticipated.

The second contract was not established in a thorough manner in terms of adding in the pavement repairs from the outset. The implications were not carefully established and understood when the contract was awarded.

Recommendations

Please refer to the notes relating to the Te Rapa Bypass where Jo Wilton provided her comments on the proposed recommendations.

Appendix I

Notes from the Interview with Chris Collins, Waka Kotahi, SH73 Mingha Bluff to Rough Creek on 24 November 2021

- What was the contract end cost versus the tendered costs

*Response: Hawkins were not lowest tender in NPA or price. They were 2nd or 3rd lowest but NPAs got then to preferred status.
Tender price was \$18.1M and final contract price was \$23M.*
- What was the sequence of variations and were they due to scope creep, cost over-runs or rework

Response: There was no scope creep on the contract. The main reasons for the cost increases were quantity variations due to unsuitable soils, and settlement of the final contract dispute.
- Did the overall contract perform well; if not what were the issues and were they localised or widespread (including but not limited to pavements)

Response: The contract did not perform well. There was a conflict of personalities between the MSQA team and the contractor's team, who had no experience in NZ conditions, were very adversarial from their overseas background, inexperienced staff, and no one from tender bid turned up or stayed more than a few months. The main contractor tried to shift blame and responsibility onto their subcontractor. The Contractor was of the view that the material specification for pavements resulted in difficulties in workability. However the same material was used extensively elsewhere and on Arthur's Pass. The low fines M4 material for Alpine conditions has been used by experienced contractors over many years without problems. The contract issues were not limited to pavements but throughout the contract.
- What were the commercial arrangements (e.g. with which party were the key roles & responsibilities; how were decisions made; who was consulted in decision-making; what commercial tensions existed)

Response: This was a Traditional M&V contract designed by WSP with traditional roles and responsibilities. Decisions made through the Engineer to Contract, with pavement decisions made by WSP in dealing with Contractor queries. There were a large number of claims, many of which were disputed by the Engineer and this led to conflicts and was to go to arbitration, but was settled at the last minute.
- What were the delivery issues encountered (e.g. design constructability; sourcing compliant materials difficult or unexpected time delays)

Response: Discussed above, no real issues with sourcing compliant pavement materials, however it was on the coarse side of the grading specification resulting it being harder to lay. This was exacerbated by the main contractor merely acting in a project management role, and actual work carried out through various subcontractors. The pavement material met specification requirements, but was not easy to lay, being on the coarse side of the grading envelope. They could not rework the material, with it becoming increasingly difficult to work. Wind rain and cold were difficult working conditions but not impossible. Other experienced contractors managed under these conditions.
- How readily and positively did the contractor respond in addressing the delivery performance issues (including but not limited to any pavement issues)

Response: The contractor was not proactive, always suggesting it was the designer's problem – they took no responsibility.

- How these design, delivery and performance issues may have been influenced by the original contract procurement.

Response: The traditional contract in itself should not have any influence on the pavement performance outcome as the contractor has no influence on the design – other than selecting the source of material to meet the specification. The Waka Kotahi procurement procedures did/could not preclude the appointment of the contractor. The preferred contractor based on NPAs could not be selected due to the lower bid prices of the other tenderers.

A key determinant of the poor overall outcome was the fact that the team proposed by the tender were unavailable or spent little time on site and were changed during construction. Hawkins' team was made up largely with staff from overseas who did not have the experience required in the project conditions or materials / environmental conditions of the alpine environment.

Recommendations

i) Risk management through all stages of design development, approvals and construction

Recommendation 1: That PRs and MRs mandate the documentation of all design risks and assumptions at each stage of the design and construction chain including the manner in which these risks have been addressed in the design and construction planning.

These stages are, et al, tender design (or Cert A at procurement), detailed design, design review, construction team briefing, construction management plans, quality and inspection and test plans, and in the final producer statements. Both the designer and constructor, through the provision of their respective producer statements, should confirm that the identified design and construction risks have been effectively addressed at Practical Completion.

Response: This is relevant to this contract as low fines pavement materials are more difficult to lay. Possibly this issue could have been covered in the tender ie provide advance notice of this risk.

When coarse grading of the material selected by the contractor became evident, it was suggested that this be changed to a slightly higher fines content, but this was rejected by the contractor, requesting a variation.

ii) Procurement non-price attributes may not effectively identify the preferred tenderer

Recommendation 2: That procurement protocols provide for the following:

- a) A PASS / FAIL threshold be implemented that disqualifies a tenderer who is unable to provide the required assurances of delivering a quality and reliable pavement, and / or
- b) In the event that a tenderer, with an unacceptably low score for pavement expertise, track record and construction methodology, is identified as the preferred tenderer, that the tenderer be given the opportunity to satisfactorily address these deficiencies prior to tender award, failing which the tenderer is excluded from further consideration.

Response: In this case the preferred tenderer based on NPAs did not win the tender. The price differential dominated the contractor selection.

Recommendation 3: That procurement requirements provide for:

- a) greater emphasis on the capabilities of construction team individuals
- b) reference checks for key construction personnel
- c) greater emphasis and recognition for the outcome of tender interactive, and pre-award meetings at which individuals are interviewed in respect of their experience, capability and understanding of the construction requirements, particularly as this relates to quality pavement construction and other critical elements of the contract. Any overstatement or capability or understanding of key individuals within the NPAs proposal are likely to be revealed during these interviews.

The tender evaluation process should provide for a substantial inclusion in the coring for the interviews of key construction personnel.

Response:

- a) this is covered reasonably well in the NPA requirements*
- b) reference checks are carried out at tender but not necessarily for the replacement personnel*
- c) agreed – this project has particular risks that could have been discussed prior to tender – was done with the nominated personnel but these personnel were subsequently not available to deliver the contract.*

iii) Review of pavement designs

Recommendation 4: That PRs and MRs provide for the following pavement design review protocols:

- a) That a single, independent Pavement Review Team be appointed by the Principal, and nominated in the RFT. This team will provide consistency of review across all pavement design submissions, and will be reimbursed for their services through a 50:50 cost share arrangement between the Principal and the tenderer (or contractor) – as has been the case for the reimbursement of independent Safety Audit Teams.
- b) The Pavement Review Team will be selected from the Principal’s Independent Professional Advisor (IPA) panel, and may include a representative from the Principal’s National Office Pavement Team. The latter requirement will ensure that the Principal “has a voice” in the pavement design review in order to assure the achievement of the Principal’s long term pavement performance objectives.
- c) This independent review will be carried out at all stages of design development including Certificate A (tender design), Detailed Design, and at any subsequent stage during construction should any conditions require a modification to the pavement design.

Response: This is not relevant to a traditional contract.

iv) Appropriate recognition of value

Recommendation 5: That the tender evaluation protocols provide for:

- a) Independent valuation, by an Independent Estimator, of higher cost innovations or features of value offered by tenderers in price competitive models.
- b) That these independent valuations be used in the determination of a Tangible Cost Adjustment factor.

Response: Agreed, but not appropriate for a traditional contract.

v) Overly aggressive commercial pricing behaviours

Recommendation 6: That Waka Kotahi:

- c) Limit the use of Competitive Alliances and D&C models, particularly where the project includes a substantial or sensitive pavement component.
- d) Move to lower risk competitive models that provide for greater recognition of value, greater co-operation between owner and non-owner participants, and reduce the potential for overly aggressive competitive pricing.

Response: This is less prevalent on traditional contracts where there is little opportunity to vary the design or the specified materials. Further it is not always the lowest tender price that wins.

vi) Materials Selection

Recommendation 7: That specifications for pavement materials include:

- a) In the case of Traditional contracts, that designers of such specific mixes take particular care to ensure that they understand the potential 'workability' constraints of the specified mixes. The inclusion of trial construction sections may be considered, where deemed necessary, to confirm this workability characteristic of this material, with provision in the contract to vary the mix, as and if required, to improve workability and adequate compaction.
- b) In the case of other procurement models that the PRs or MRs require a minimum level of testing during the tender period to document how the risk of alternative materials has been addressed in the tender submission.
- c) During the Detailed Design phase, that a high level of material testing and documentation be carried out, including the manner in which the long term performance of such materials may be assured. The use of the CAPTIV test track may be mandated for improved modelling of the performance of alternative materials.

Response:

- a) In the case of this contract, the materials issues were not relevant. These materials/specifications are tried, tested and proven over many years.*
- b) Not relevant to a Traditional Contract*

vii) Defects Liability Period

Recommendation 8: That Waka Kotahi consider extending the DLP for projects involving substantial or sensitive pavement structures, as follows:

- a) An extension of the DLP for pavements only, as a separable portion, for a period of 5 to 7 years after Practical Completion. This period may be determined by the scale and risk levels of the proposed pavement.
- b) The amount of the bond applicable to this separable portion may be set as a percentage of the pavement value. This could be 25% or of this order.



Response: This is not relevant to traditional but longer DLPs can be difficult to manage over long periods, and to determine liability. Not good to be on books for a long time. Staff changes make this difficult to manage.

Appendix J

Notes from the Interview with Geoff Griffiths, Waka Kotahi on 24 November 2021

Purpose of the Interview

To understand the Canterbury experience with foamed bitumen stabilised (fbs) pavements and how the performance of these pavements may potentially be related to the choice of procurement model.

Geoff Griffiths of Waka Kotahi's Christchurch office has specific experience in the use of fbs.

Notes taken during the interview

- a) A decade or more ago there was evidence of performance issues in unbound granular pavements. Geoff's view was that a key factor may have been the decline in pavement construction expertise within the industry. (Post meeting note: Another factor may have been the use of granular pavements for increasing traffic loadings that may have surpassed the capacity of such pavements.) Agreed by Geoff, for most highways and obviously motorways, traffic volumes exceed unbound granular pavement options. He was using the example of the spate of failures being experienced at the time in pavements, including traditional unbound pavements, as evidence of the decline in experience and skills in the industry.
- b) The Canterbury RONS projects in 2010, Waka Kotahi's Christchurch office took the decision to use fbs on its key RONS projects, including:
 - Christchurch Southern Motorway Stage 1 – CSM1 (D&C)
 - Christchurch Southern Motorway Stage 2 – CSM2 (Traditional LS)
 - Western Belfast Bypass (Traditional Measure and Value)
- c) The pavement designs were Principal provided, and not Contractor led. For CSM1, WK allowed alternatives to be provided at time of tender, with a conforming tender, but these were not accepted.
- d) The reasons behind this decision were:
 - There was a lack of confidence in the pavement construction expertise
 - NZTA did not wish to take the risks inherent in a contractor-led design. They wanted a low risk pavement and high level of confidence in reliability.
 - They wanted to reduce the number of variables that may contribute to poor pavement performance. The reduced variables also aided in the analysis of any post construction failures to determine cause.
- e) The pavements for CSM1 and the Western Belfast Bypass were well constructed and post-construction performance has been good.
- f) However, there were substantial issues during the construction of the CSM2 pavements:
 - The contract was underbid
 - There was insufficient experience and expertise on site

- The first km of fbs pavement was poorly constructed and had to be reconstructed. No post construction performance issues to date under the guidance of a Waka Kotahi appointed overseer. Geoff puts this down to the fact that WK essentially supplied the expertise in an overseer to supervise the works and instruct the contractor on construction techniques.
- g) Geoff has no issues with fbs as a product, but has concern about the level of construction expertise available (within certain supplier organisations).
- h) In his view the performance or lack of performance of a fbs pavement is not influenced by the procurement model. Could it be that in a competitive D&C even a fbs pavement could be minimalised in depth and binder content in order to reduce costs? This is a potential outcome that would have to be guarded against. Supplying less pavement for less cost is not innovation. Waka Kotahi should ensure designs are conservative, and not target cost savings as a key objective.
- i) Fbs performance can be affected by a lack of fines in the aggregate. Again, this is unlikely to be influenced by the procurement model. The grading for an fbs pavement has a higher proportion of fines and is therefore slightly different to a typical M/4 grading. There also need to be good control of this grading to ensure optimal benefits from the fbs process. One of the main reasons observed in problems with fbs is excessive working of the basecourse post stabilisation, there needs to be a good methodology and sufficient, experienced resource to trim, compact and finish the surface in a timely manner.
- j) Geoff is not in favour of a contractor-led design as a result of the issues that have been experienced with this approach.
- k) Geoff provided the following opinion regarding proposed recommendations:
 - a) He agreed with the recommendation for a truly independent reviewer with greater Principal input to the acceptance of the design (as for the RSA process). He doesn't believe Waka Kotahi recognises the extent of expertise available within the organisation and further does not always give their own internal advise the weighting it should when assessed against supplier proposals and performance claims.
 - b) He agreed with the suggestion of an extended DLP period for contractor designed pavements
- l) Geoff suggested that another approach would be to allow for two pavement design options in a contractor led project:
 - A Principal's design with a standard DLP period of say 1 or 2 years, or
 - An alternative contractor's design with an extended DLP.

Geoff:

"I've never said we shouldn't consider tender alternative designs but I would like to see all contracts have a default Principal's pavement design and essentially the tenderer have to make the case why an alternative should be accepted. This should be based around performance and long term risk. The extended DLP with any Contractor's design just recognises the additional risk inherent in acceptance of an alternative bearing in mind in the bulk of cases the alternative is being put forward to gain a commercial advantage."



Appendix K

Notes from the Interview with David Alabaster, Principal Pavements Engineer, Waka Kotahi on 30th November 2021

1. Dave is of the opinion that price competitive procurement models allows designers to make judgements of the design input criteria, and this can result in “skinny” pavement designs.
2. Accelerated pavement testing is feasible in order to avoid long term pavement failures.
3. The CAPTIF test track is not suited to any of the procurement models as the timeframes from tendering to construction are too short. Most designs would take a year (or more) to test at 25 year design life. CAPTIF is more suited to longer term research.
4. Dave recommends the use of the Dynatest HVS simulator, costing US\$3M in 2014. He is strongly in favour of Waka Kotahi making this investment for the benefit of their future pavements.
5. He supports the approach taken on CSM2 for the appointment of a “Clerk of Works” to oversee pavement construction.

Appendix L

Notes from the Interview with Matt Zame of Fletcher Construction, Waikato Expressway: Ngaruawahia Bypass, on 9th December 2021

1. What is the Contractor's view of the influence that procurement may have had on pavement performance?

Response:

D&C was a focus on lowest price by means of the bare minimum approach to the PRs. This procurement model drives lowest price.

PRs were asking for a high risk low cost pavement. This puts the performance of the pavement at risk.

An example is the waterproofing capacity of the surfacing provided in response to the PRs.

Minimum requirements of the PRs (spec), combined together, raise the risk of poor pavement performance.

Ability to innovate in pavement design is limited. Focus is on reducing cost.

This procurement model drives lowest price.

2. Canvas the WK and contractor of their views of the procurement improvements proposed.

i) Risk management through all stages of design development, approvals and construction

Recommendation 1: That PRs and MRs mandate the documentation of all design risks and assumptions at each stage of the design and construction chain including the manner in which these risks have been addressed in the design and construction planning.

These stages are, et al, tender design (or Cert A at procurement), detailed design, design review, construction team briefing, construction management plans, quality and inspection and test plans, and in the final producer statements. Both the designer and constructor, through the provision of their respective producer statements, should confirm that the identified design and construction risks have been effectively addressed at Practical Completion.

Contractor's Response:

There is a need to document these risks and assumptions all at stages of the project development to convey this information and requirements to the construction team. The best way to manage this is for the designer to collaborate in the development of the design and the specifications. This communication between designer and constructor must continue through design to construction, including documentation of risks and assumptions.

Trial pavements are important to validate design assumptions. Be prepared to make design changes, if possible, within the constraints of the contract.

ii) Procurement non-price attributes may not effectively identify the preferred tenderer

Recommendation 2: That procurement protocols provide for the following:

- a) A PASS / FAIL threshold be implemented that disqualifies a tenderer who is unable to provide the required assurances of delivering a quality and reliable pavement, and / or
- b) In the event that a tenderer, with an unacceptably low score for pavement expertise, track record and construction methodology, is identified as the preferred tenderer, that the tenderer be given the opportunity to satisfactorily address these deficiencies prior to tender award, failing which the tenderer is excluded from further consideration.

Contractor's Response:

Writing non-price attributes is a sales game.

Some attributes need to be rated highly technically to ensure that the right skills and expertise is procured. Pavements is one of them. An experienced earthworks team is another. The TET should test these areas as hard as possible during the tender and prior to contract award. Much of what is asked for in the NPAs is a given, but the skills and expertise must be absolutely confirmed to ensure that a quality pavement is designed and constructed.

Waka Kotahi should have better conversations before going to tender about their expectations. Get advice from contractors on what Contractors see as key issues. Make sure the selected tenderer has the required expertise to deliver what is required.

Industry has an overall shortage of resources. Lack of continuity or work makes it difficult to maintain resource expertise. Makes it difficult to keep people on projects as they look for projects that suit them best. Loyalty is less of a focus nowadays.

Recommendation 3: That procurement requirements provide for:

- a) greater emphasis on the capabilities of construction team individuals
- b) reference checks for key construction personnel
- c) greater emphasis and recognition for the outcome of tender interactive, and pre-award meetings at which individuals are interviewed in respect of their experience, capability and understanding of the construction requirements, particularly as this relates to quality pavement construction and other critical elements of the contract. Any overstatement or capability or understanding of key individuals within the NPAs proposal are likely to be revealed during these interviews.

The tender evaluation process should provide for a substantial inclusion in the scoring for the interviews of key construction personnel.

Contractor's Response:

Recommendations a) and b) are happening to a greater or lesser degree. Driving lowest price leads to the bare minimum of resources and this add to the construction risk.

We need more resources and need to train people coming through the system. There are costs attached to on-the-job training and mentoring.

c) The TET could be more creative in how individuals are interviewed to ensure that they have the skills – technical plus non-technical. This could include asking questions or posing scenarios that are very focussed on construction needs to ensure the high quality construction of the pavement.

iii) Review of pavement designs

Recommendation 4: That PRs and MRs provide for the following pavement design review protocols:

a) That a single, independent Pavement Review Team be appointed by the Principal, and nominated in the RFT. This team will provide consistency of review across all pavement design submissions, and will be reimbursed for their services through a 50:50 cost share arrangement between the Principal and the tenderer (or contractor) – as has been the case for the reimbursement of independent Safety Audit Teams.

b) The Pavement Review Team will be selected from the Principal's Independent Professional Advisor (IPA) panel, and may include a representative from the Principal's National Office Pavement Team. The latter requirement will ensure that the Principal "has a voice" in the pavement design review in order to assure the achievement of the Principal's long term pavement performance objectives.

c) This independent review will be carried out at all stages of design development including Certificate A (tender design), Detailed Design, and at any subsequent stage during construction should any conditions require a modification to the pavement design.

Contractor's Response:

This approach is agreed as long as the Contractor has the ability to object in genuine cases of (lack of) competence or conflict of interest of the independent appointee.

An independent review must be carried out before tender prices are locked in (as with the RSA). As with the RSA, the contractor needs certainty that what has been design and priced will carry through to construction. Safeguards required.

iv) Appropriate recognition of value

Recommendation 5: That the tender evaluation protocols provide for:

- a) Independent valuation, by an Independent Estimator, of higher cost innovations or features of value offered by tenderers in price competitive models.
- b) That these independent valuations be used in the determination of a Tangible Cost Adjustment factor.

Contractor's Response:

Value is not always conveyed on paper (ie in the documented submission). WOL outcomes must be more carefully considered. Collaborative discussions are needed to attempt to reach agreement on the cost and value of the proposed offer. There should be an opportunity for the tenderer to be interviewed and to discuss the implications of the innovation or alternative. This be better inform both the TET and the tenderer of the expectations and implications of the alternative offer.

Value engineering improvements must be shared post award.

v) Overly aggressive commercial pricing behaviours

Recommendation 6: That Waka Kotahi:

- a) Substantially limit the use of Competitive Alliances and D&C models, particularly where the project includes a substantial or sensitive pavement component.
- b) Move to lower risk competitive models that provide for greater recognition of value, greater co-operation between owner and non-owner participants, and reduce the potential for overly aggressive competitive pricing.

Contractor's Response:

Agrees with the above recommendations.

Agrees with these behaviours leading to perverse outcomes. The Principal's budget needs to be set at the right level with risk including for contingencies. Low affordability threshold (or budgets) also drive these perverse behaviours.

Matt would prefer to limit D&C to smaller scale projects with limited complexity eg a bridge replacement, but not for large complex projects

Matt is comfortable with the Principal taking the risk for a Principal prescribed design, and for the contractor to take construct (only) risk. He would prefer that the pavement is scheduled as a PS with subsequent design development carried out collaboratively in order to reduce the risks inherent in price competitive pavement design and construction.

vi) Materials Selection

Recommendation 7: That specifications for pavement materials include:

- a) In the case of Traditional contracts, that designers of such specific mixes take particular care to ensure that they understand the potential 'workability' constraints of the specified mixes. The inclusion of trial construction sections may be considered, where deemed necessary, to confirm this workability characteristic of this material, with provision in the contract to vary the mix, as and if required, to improve workability and adequate compaction.
- b) In the case of other procurement models that the PRs or MRs require a minimum level of testing during the tender period to document how the risk of alternative materials has been addressed in the tender submission
- c) During the Detailed Design phase, that a high level of material testing and documentation be carried out, including the manner in which the long term performance of such materials may be assured. The use of the CAPTIV test track may be mandated for improved modelling of the performance of alternative materials.

Contractor's Response:

Matt agrees with these recommendations and the use of trial sections. Timing to be up front in the programme. This should be mandated and not optional.

vii) Defects Liability Period

Recommendation 8: That Waka Kotahi consider extending the DLP for projects involving substantial or sensitive pavement structures, as follows:

- a) An extension of the DLP for pavements only, as a separable portion, for a period of 5 to 7 years after Practical Completion. This period may be determined by the scale and risk levels of the proposed pavement.
- b) The amount of the bond applicable to this separable portion may be set as a percentage of the pavement value. This could be 25% or of this order.

Contractor's response:

Matt does not support this recommendation as this becomes a staff resourcing and management issue. The duration would be very drawn out, potentially causing confusion with the responsibilities of the NOC contractor.

Appendix M

Notes from the Interview with John Hallett of Beca, Waikato Expressway: Ngaruawahia Bypass, on 13th December 2021

1. What is the Designer's view of the influence that procurement may have had on pavement performance?

Response:

As a designer John supports the response from Matt ie the Ngaruawahia D&C was very price competitive and the pavement design was carried out only to meet the minimum requirements, no more – the design was carried out “down to the wire” but still meeting the PRs. Meeting the PRs does not necessarily guarantee long term pavement performance. The Austroads guidelines and PRs did not address the waterproofing requirements.

It is a very competitive environment in capital contracts where the lowest bidder normally wins and tendered rates are often inappropriate.

The pavement designs may meet the PRs in theory but are “bare minimum” and relatively high risk options.

Innovation could mean low costs and increased risk.

2. Canvas the WK and contractor of their views of the procurement improvements proposed.

i) Risk management through all stages of design development, approvals and construction

Recommendation 1: That PRs and MRs mandate the documentation of all design risks and assumptions at each stage of the design and construction chain including the manner in which these risks have been addressed in the design and construction planning.

These stages are, et al, tender design (or Cert A at procurement), detailed design, design review, construction team briefing, construction management plans, quality and inspection and test plans, and in the final producer statements. Both the designer and constructor, through the provision of their respective producer statements, should confirm that the identified design and construction risks have been effectively addressed at Practical Completion.

Designer's Response:

Formal documentation of pavement design risks and assumptions was not a contract requirement on Ngaruawahia – it should have been a requirement, so John supports this recommendation that these be mandated as a contract requirement.

The Austroads guidelines and PRs did not address the waterproofing requirements. This performance risk should have been documented.

ii) Procurement non-price attributes may not effectively identify the preferred tenderer

Recommendation 2: That procurement protocols provide for the following:

- a) A PASS / FAIL threshold be implemented that disqualifies a tenderer who is unable to provide the required assurances of delivering a quality and reliable pavement, and / or
- b) In the event that a tenderer, with an unacceptably low score for pavement expertise, track record and construction methodology, is identified as the preferred tenderer, that the tenderer be given the opportunity to satisfactorily address these deficiencies prior to tender award, failing which the tenderer is excluded from further consideration.

Designer's Response:

Capital projects do not take sufficient account of the value of non-price attributes. This is a very competitive environment where the lowest bidder normally wins and tendered rates are often inappropriate.

The NOC contracts are a good example where greater value is placed in the non-price attributes.

Recommendation 3: That procurement requirements provide for:

- a) greater emphasis on the capabilities of construction team individuals
- b) reference checks for key construction personnel
- c) greater emphasis and recognition for the outcome of tender interactive, and pre-award meetings at which individuals are interviewed in respect of their experience, capability and understanding of the construction requirements, particularly as this relates to quality pavement construction and other critical elements of the contract. Any overstatement or capability or understanding of key individuals within the NPAs proposal are likely to be revealed during these interviews.

The tender evaluation process should provide for a substantial inclusion in the scoring for the interviews of key construction personnel.

Designer's Response:

Refer to previous response and reference to the NOC contracts.

iii) Review of pavement designs

Recommendation 4: That PRs and MRs provide for the following pavement design review protocols:

- a) That a single, independent Pavement Review Team be appointed by the Principal, and nominated in the RFT. This team will provide consistency of review across all pavement design submissions, and will be reimbursed for their services through a 50:50 cost share arrangement between the Principal and the tenderer (or contractor) – as has been the case for the reimbursement of independent Safety Audit Teams.
- b) The Pavement Review Team will be selected from the Principal's Independent Professional Advisor (IPA) panel, and may include a representative from the Principal's National Office Pavement Team. The latter requirement will ensure that the Principal "has a voice" in the pavement design review in order to assure the achievement of the Principal's long term pavement performance objectives.
- c) This independent review will be carried out at all stages of design development including Certificate A (tender design), Detailed Design, and at any subsequent stage during construction should any conditions require a modification to the pavement design.

Designer's Response:

John supports this replication of the approach to independent reviewers taken by for the Road Safety Audits. However, the review however must focus on whether the design meets the PRs or not ie one cannot expect the design to provide more than PRs. The onus is therefore on ensuring that the PRs are appropriate – this is fundamental!

John believes that the PRs and / or the prescribed Principal's pavement designs still do not reflect the appropriate waterproofing requirement of the pavement ie the prescribed designs do not always achieve the specified performance standards.

Why be so prescriptive and then require designer to take design responsibility for standards set by the Principal – there is concern about responsibility for the Principal's design.

John would prefer to go back to the old model where Waka Kotahi would specify the pavement design carried out by an independent designer – provide this as the prescribed Principal's design.

iv) Appropriate recognition of value

Recommendation 5: That the tender evaluation protocols provide for:

- a) Independent valuation, by an Independent Estimator, of higher cost innovations or features of value offered by tenderers in price competitive models.
- b) That these independent valuations be used in the determination of a Tangible Cost Adjustment factor.

Designer's Response:

John agrees with these recommendations.

v) Overly aggressive commercial pricing behaviours

Recommendation 6: That Waka Kotahi:

- a) Limit the use of Competitive Alliances and D&C models, particularly where the project includes a substantial or sensitive pavement component.
- b) Move to lower risk competitive models that provide for greater recognition of value, greater co-operation between owner and non-owner participants, and reduce the potential for overly aggressive competitive pricing.

Designer's Response:

John agrees with these recommendations - too much price tension drives the wrong behaviour. Refer to discussions above.

Consider an alternative approach to competitive pavement design though either:

- a) Waka Kotahi specifies the pavement design that has been carried out by an independent designer who would retain design responsibility.
- b) provide a Provisional Sum for a collaborative approach to pavement design in the competitive environment.

vi) Materials Selection

Recommendation 7: That specifications for pavement materials include:

- a) In the case of Traditional contracts, that designers of such specific mixes take particular care to ensure that they understand the potential 'workability' constraints of the specified mixes. The inclusion of trial construction sections may be considered, where deemed necessary, to confirm this workability characteristic of this material, with provision in the contract to vary the mix, as and if required, to improve workability and adequate compaction.
- b) In the case of other procurement models that the PRs or MRs require a minimum level of testing during the tender period to document how the risk of alternative materials has been addressed in the tender submission
- c) During the Detailed Design phase, that a high level of material testing and documentation be carried out, including the manner in which the long term performance of such materials may be assured. The use of the CAPTIF test track may be mandated for improved modelling of the performance of alternative materials.

Designer's Response:

For a) if designer moves outside of the standard Waka Kotahi specifications, pavement trials should be included as a contract requirement. There should be provision to subsequently modify the specification, if required. HILAB is a good example where grading was changed after trials.

In the case of marginal materials these need to be well specified and tested for consistency.

CAPTIF is not appropriate in this context. Even HVS is more of a research tool but could be used to validate the pavement design and expected performance. However, this testing must be carried out prior to the detailed design phase.

vii) Defects Liability Period

Recommendation 8: That Waka Kotahi consider extending the DLP for projects involving substantial or sensitive pavement structures, as follows:

- a) An extension of the DLP for pavements only, as a separable portion, for a period of 5 to 7 years after Practical Completion. This period may be determined by the scale and risk levels of the proposed pavement.
- b) The amount of the bond applicable to this separable portion may be set as a percentage of the pavement value. This could be 25% or of this order.



Designer's Response:

John agrees with the view that a longer DLP would encourage tenderers to be more circumspect about "minimum" pavements. Capital costs may increase but WOL costs will improve.

John believes that having a maintenance responsibility is a good approach for longer term commitment by Contractors to pavement performance. This would not need to include minor failures such as potholes. Thresholds for failures may be set which trigger the Contractor's responsibility.

Appendix N

Notes from the Interview with Andrew Johnson and Dr Bryan Pidwerbesky of Fulton Hogan, Waikato Expressway: Te Rapa Bypass, on 6th December 2021

1. What is the Contractor's view of the influence that procurement may have had on pavement performance?

FH's Response:

FH agrees that commercial pressures in price competitive models potentially impact on the application of engineering judgement in the pavement design. This can lead to slimline design in some cases in respect to treatment selections ie pavement configuration.

FH believes that Waka Kotahi is not specifying a high enough standard in their Principal's prescribed pavement designs ie the base level for the prescribed design is too low. MRs for surfacing do not provide adequate waterproofing in wet environments. Australia has this right ie 40-50mm dense AC below surfacing. This was included on Alliances such as the Northern Gateway and Causeway. OGPA over 2 coat chip seal is no longer considered sufficient. FH said that they have offered this enhanced waterproofing mechanism in their most high profile projects, as a response to their considered risk profile.

On Te Rapa the MRs required a prime coat, 2 coat seal membrane followed by OGPA. FH designed the underlying pavement structure but the surfacing was Principal prescribed.

SIL considerations have improved in recent years. Bryan pointed to the importance of designs that account for site-specific rainfall.

2. Canvas the contractor on their views of the procurement improvements proposed.

i) Risk management through all stages of design development, approvals and construction

Recommendation 1: That PRs and MRs mandate the documentation of all design risks and assumptions at each stage of the design and construction chain including the manner in which these risks have been addressed in the design and construction planning.

These stages are, et al, tender design (or Cat A at procurement), detailed design, design review, construction team briefing, construction management plans, quality and inspection and test plans, and in the final producer statements. Both the designer and constructor, through the provision of their respective producer statements, should confirm that the identified design and construction risks have been effectively addressed at Practical Completion.

FH's Response:

Bryan agrees with all these recommendations. The designer should be on-site regularly during construction. He pointed out that the specialist pavement designer cannot always get to site throughout the construction phase. Instead these are often generalists instead of pavement specialists that understand pavement assumption, risks and construction issues.

ii) Procurement non-price attributes may not effectively identify the preferred tenderer

Recommendation 2: That procurement protocols provide for the following:

- a) A PASS / FAIL threshold be implemented that disqualifies a tenderer who is unable to provide the required assurances of delivering a quality and reliable pavement, and / or
- b) In the event **that** a tenderer, with an unacceptably low score for pavement expertise, track record and construction methodology, is identified as the preferred tenderer, that the tenderer be given the opportunity to satisfactorily address these deficiencies prior to tender award, failing which the tenderer is excluded from further consideration.

FH's Response:

Some contractors have little experience in pavement construction. Waka Kotahi needs to have a mechanism for selecting experienced contractors, not those with little or no experience.

Pavements need to have a different way of scoring the pavement D&C submission as this is the most high profile aspect of the project, to both road users and the Principal.

Recommendation 3: That procurement requirements provide for:

- a) greater emphasis on the capabilities of construction team individuals
- b) reference checks for key construction personnel
- c) greater emphasis and recognition for the outcome of tender interactive, and pre-award meetings at which individuals are interviewed in respect of their experience, capability and understanding of the construction requirements, particularly as this relates to quality pavement construction and other critical elements of the contract. Any overstatement or capability or understanding of key individuals within the NPAs proposal are likely to be revealed during these interviews.

The tender evaluation process should provide for a substantial inclusion in the scoring for the interviews of key construction personnel.

FH's Response:

Agreed. This is done in many cases.

iii) Review of pavement designs

Recommendation 4: That PRs and MRs provide for the following pavement design review protocols:

- a) That a single, independent Pavement Review Team be appointed by the Principal, and nominated in the RFT. This team will provide consistency of review across all pavement design submissions, and will be reimbursed for their services through a 50:50 cost share arrangement between the Principal and the tenderer (or contractor) – as has been the case for the reimbursement of independent Safety Audit Teams.
- b) The Pavement Review Team will be selected from the Principal's Independent Professional Advisor (IPA) panel, and may include a representative from the Principal's National Office Pavement Team. The latter requirement will ensure that the Principal "has a voice" in the pavement design review in order to assure the achievement of the Principal's long term pavement performance objectives.
- c) This independent review will be carried out at all stages of design development including Certificate A (tender design), Detailed Design, and at any subsequent stage during construction should any conditions require a modification to the pavement design.

FH's Response:

FH would accept the IPA reviewer approach, but with ability to challenge the selection eg in cases of conflict of interest and capability.

FH would prefer the work with a Principal's specified pavement design and have the option to consider an offer of an alternative design where this may offer value. They have two concerns that would have to be resolved:

Firstly, their concern that Principal prescribed designs do not adequately address all design risks and set too low a standard.

Secondly, the current requirement for Principal prescribed designs is for the contractor to provide the PS1 Design Producer Statement, even though they have not carried out the design, and further, that they believe the Principal prescribed designs are, in some cases, inadequate.

iv) Appropriate recognition of value

Recommendation 5: That the tender evaluation protocols provide for:

- a) Independent valuation, by an Independent Estimator, of higher cost innovations or features of value offered by tenderers in price competitive models.
- b) That these independent valuations be used in the determination of a Tangible Cost Adjustment factor.

FHs Response: FH agrees with these recommendations.

v) Overly aggressive commercial pricing behaviours

Recommendation 6: That Waka Kotahi:

- a) Substantially limit the use of Competitive Alliances and D&C models, particularly where the project includes a substantial or sensitive pavement component.
- b) Move to lower risk competitive models that provide for greater recognition of value, greater co-operation between owner and non-owner participants, and reduce the potential for overly aggressive competitive pricing.

FH's Response:

FH agrees with the fact that price competitive models create "a race to the bottom" and that this may impact on pavement design risk by more inexperienced designers.

In respect of Alliances, FH is concerned that affordability thresholds are set too low, creating a similar "race to the bottom" by tenderers trying to reduce costs simply in order to meet the affordability threshold. This has a similar impact on pavement design as in the case of D&Cs and Competitive Alliances. This issue is compounded by low pavement design standards set by the MRs, resulting in increased risk for the long term pavement performance.

Bryan suggested that this concern may be addressed by providing a separate threshold for pavement design and construction in hybrid Alliance models.

vi) Materials Selection

Recommendation 7: That specifications for pavement materials include:

- a) In the case of Traditional contracts, that designers of such specific mixes take particular care to ensure that they understand the potential ‘workability’ constraints of the specified mixes. The inclusion of trial construction sections may be considered, where deemed necessary, to confirm this workability characteristic of this material, with provision in the contract to vary the mix, as and if required, to improve workability and adequate compaction.
- b) In the case of other procurement models that the PRs or MRs require a minimum level of testing during the tender period to document how the risk of alternative materials has been addressed in the tender submission.
- c) During the Detailed Design phase, that a high level of material testing and documentation be carried out, including the manner in which the long term performance of such materials may be assured. The use of the CAPTIF test track may be mandated for improved modelling of the performance of alternative materials.

FH’s Response:

- a) FH suggested a method spec is appropriate for the use of “boney” material designed for reduce frost susceptibility of aggregates in colder climates – however designers may have liability concerns. Bryan agreed that designers need to take account of workability issues in unusual or site specific designs. Tender selection criteria need to take account of expertise and experience of tenderers in their ability to construct pavements using this specification. Trial pavements are an option but must be constructed using material in the final specification.
- b) With respect to alternative materials, the B3 specification has a good methodology for using these materials. The issue is therefore not the materials themselves but rather the design risks inherent in the design. In a contractor led design it must be clear that the risk lies with the Contractor/designer, in particular as it relates to the elevated risks of using such materials.
- c) Bryan agrees with Dave Alabaster that CAPTIF is not suitable for assessing long term pavement performance in a contractor-led pavement design. He has concerns about the logistics. Timing is the issue in a contract situation as CAPTIF takes too long to achieve results in the tight timeframes required in a capital project.

vii) Defects Liability Period

Recommendation 8: That Waka Kotahi consider extending the DLP for projects involving substantial or sensitive pavement structures, as follows:

- a) An extension of the DLP for pavements only, as a separable portion, for a period of 5 to 7 years after Practical Completion. This period may be determined by the scale and risk levels of the proposed pavement.
- b) The amount of the bond applicable to this separable portion may be set as a percentage of the pavement value. This could be 25% or of this order.

FH's Response:

This could apply to alternatives offered to Principal prescribed pavement designs. Key is to address Contractor's concerns relating to standards set by these designs (ie being too low) and well as the liability implications in respect of the PS1 Design Review.

It was noted that for the current Penlink hybrid Alliance, the DLP has been increased to 36 months.

The challenge in further extension to 5 or 7 years is that may impact on the bonding capacity of smaller contractors where a bond in lieu of retentions is provided.

While PI cover is up to 7 years, this deals with negligence and is hard to apply or enforce for the contentious issues relating to underperforming pavements.

The best approach would be to "get the right pavement design at the start".

Appendix O

Notes from the Interview with Shane Wilton of HEB Construction, Atiamuri Bridge Replacement and Bypass, on 8th December 2021

Attended by: HEB Construction (Shane Wilton),
Bartley Consultants BCL (Andrew Deakin)
Waka Kotahi (Jo Wilton)

1. What is the Contractor's view of the influence that procurement may have had on pavement performance?

Response:

HEB: This was an ECI with HEB as head contractor, BBO as head designer and BCL pavement designer. SP 1 was for design and pricing. Pricing was reviewed by Bond CM. Price met Waka Kotahi's budget threshold, and SP2 for construction proceeded. HEB self-performed pavement construction with Highway Stabilisers performing the fbs.

There was no undue commercial pressures other than meeting Waka Kotahi's budget threshold and scrutiny of Bond CM's pricing review.

Cannot recall who carried out the technical peer review of the pavement.

The good quality (performance) outcome is a result of both design and construction. ECI was a suitable procurement model without aggressive commercial pressures other than external review.

BCL: There was early recognition that fbs would be a suitable pavement design option as the subgrades needed pavement resilience.

The pavement design was cost effective, with good CBR subgrade results from the insitu pumice.

2. Canvas Waka Kotahi and contractor views of the procurement improvements proposed.

i) Risk management through all stages of design development, approvals and construction

Recommendation 1: That PRs and MRs mandate the documentation of all design risks and assumptions at each stage of the design and construction chain including the manner in which these risks have been addressed in the design and construction planning.

These stages are, et al, tender design (or Cert A at procurement), detailed design, design review, construction team briefing, construction management plans, quality and inspection and test plans, and in the final producer statements. Both the designer and constructor, through the provision of their respective producer statements, should confirm that the identified design and construction risks have been effectively addressed at Practical Completion.

Response:

HEB: Risk allocation must be clear. Shane's view is that the better the designer and constructor communication the better, including understanding of all risks. He is supportive for mandating the approach to risk management.

BCL: Agrees with these recommendations as this matter needs further robustness. This is an area that could be improved. Treatment selection is subjective.

Needs a lot more robustness around the risk assessment. PRs are seen as the risk level Principal is willing to take and this sets the Contractor's risk level/s. These can result in a "skinny" pavement and this can lead to difficult discussions when performance outcomes are not as expected.

Andrew noted that Waka Kotahi can expect different reactions from the industry in this regard (to the standard of PRs) moving forward. Andrew believes this could result in AC pavements (generally) being accepted as suitable by designers. This reaction would put the performance risk with the Principal.

There have been learnings over past 10 years. Insurers driving some of this approach.

If Atiamuri was done again the pavement would be more robust / expensive. Suggested that this would apply nationally to other projects.

Andy W: Assume these comments applied to more heavily loaded, extreme conditions, and not all pavements across the board. Horses for courses.

ii) Procurement non-price attributes may not effectively identify the preferred tenderer

Recommendation 2: That procurement protocols provide for the following:

- a) A PASS / FAIL threshold be implemented that disqualifies a tenderer who is unable to provide the required assurances of delivering a quality and reliable pavement, and / or
- b) In the event that a tenderer, with an unacceptably low score for pavement expertise, track record and construction methodology, is identified as the preferred tenderer, that the tenderer be given the opportunity to satisfactorily address these deficiencies prior to tender award, failing which the tenderer is excluded from further consideration.

Response:

HEB: In respect of Atiamuri, the success of the project was in the attention to detail. Much information was communicated between the designer and contractor. There was no commercial pressure to “race to the bottom”.

BCL: Important to the expertise of the personnel involved. Ensure that tender documentation provides for this threshold. Contractors have A and Z teams. Some designer expertise sits remotely. Tenderers can present something that looks good on paper (ie better than it really is). The committed expertise must work on the project. Expertise has been lost/stretched. Simple mistakes are made. Other commitments may mean pressure to seal in winter, for example. Resourcing is an issue. The contractor needs access to suitably qualified designers on site. There is a finite number of skilled people. Must have support from suitably experience people. Not rely on generalists for oversight of pavement construction.

WK: This issue is variable in practice. It could be mandated, but not sure how to ensure it actually happens ie that the right resources do the work. The challenge as always is to ensure that nominated people actually do the work. Agree that resourcing is an issue. Consider a way to practically make this work.

Recommendation 3: That procurement requirements provide for:

- a) greater emphasis on the capabilities of construction team individuals
- b) reference checks for key construction personnel
- c) greater emphasis and recognition for the outcome of tender interactive, and pre-award meetings at which individuals are interviewed in respect of their experience, capability and understanding of the construction requirements, particularly as this relates to quality pavement construction and other critical elements of the contract. Any overstatement or capability or understanding of key individuals within the NPAs proposal are likely to be revealed during these interviews.

The tender evaluation process should provide for a substantial inclusion in the scoring for the interviews of key construction personnel.

General response:

Waka Kotahi believe that recommendations a) and b) carried out in tender evaluations.

Attribute scoring normally focus is on what is submitted. However, the assessment of key personnel can be influenced by the interactives.

iii) Review of pavement designs

Recommendation 4: That PRs and MRs provide for the following pavement design review protocols:

- a) That a single, independent Pavement Review Team be appointed by the Principal, and nominated in the RFT. This team will provide consistency of review across all pavement design submissions, and will be reimbursed for their services through a 50:50 cost share arrangement between the Principal and the tenderer (or contractor) – as has been the case for the reimbursement of independent Safety Audit Teams.
- b) The Pavement Review Team will be selected from the Principal’s Independent Professional Advisor (IPA) panel, and may include a representative from the Principal’s National Office Pavement Team. The latter requirement will ensure that the Principal “has a voice” in the pavement design review in order to assure the achievement of the Principal’s long term pavement performance objectives.
- c) This independent review will be carried out at all stages of design development including Certificate A (tender design), Detailed Design, and at any subsequent stage during construction should any conditions require a modification to the pavement design.

Response:

BCL: Andrew agrees with these recommendations. Commercial pressures in the peer review may result in suggestions for consideration, instead of more strongly worded responses. This is a dilution of the review. Design reviewers must say what they really think and believe.

Principal’s design may be conservative. Learnings from waterproofing issues, particularly for alternative materials.

WK: Recently peer reviewers are appointed by WK. Jo agreed that truly internal reviews are far more direct in their responses. Consider each party appointing a peer reviewer. Jo advised that the Waka Kotahi National office is involved in setting the PRs. However, they may not agree with the outcome that is produced from the PRs and may then want to change these.

HEB: Shane suggested that a Principal’s prescribed design could be provided to mitigate any issues with peer reviews.

General response: A more collaborative approach to the pavement design was suggested as a way to address the performance issues experienced.

iv) Appropriate recognition of value

Recommendation 5: That the tender evaluation protocols provide for:

- a) Independent valuation, by an Independent Estimator, of higher cost innovations or features of value offered by tenderers in price competitive models.
- b) That these independent valuations be used in the determination of a Tangible Cost Adjustment factor.

Response:

BCL: There seems to be a lack of recognition of what the maintenance regime may be for the proposed pavement designs. Lightly modified (low capital cost) pavements will require a higher level of maintenance. This does not mean that the initial design and construction are inadequate. WOL costing must be robust.

WK: NPV attached to pavement costs need to be reviewed for robustness. The current approach does not sufficiently value future costs, but instead focusses on initial capital cost.

v) Overly aggressive commercial pricing behaviours

Recommendation 6: That Waka Kotahi:

- c) Limit the use of Competitive Alliances and D&C models, particularly where the project includes a substantial or sensitive pavement component.
- d) Move to lower risk competitive models that provide for greater recognition of value, greater co-operation between owner and non-owner participants, and reduce the potential for overly aggressive competitive pricing.

Response:

BCL: Agrees that there is a “massive amount of commercial pressure on design”. Expensive options are discarded without careful consideration of risks of the various options. The focus is on the lowest price option.

Often the tender team is different to the construction team. One team is responsible for winning – the success story. The next team for construction struggles deliver the contract for the tender price. Pavements are the last component to be built, often left with the remaining budget.

HEB: There is huge competitive/commercial pressure on the tender, effectively a “race to the bottom”. These models do not drive the right behaviours.

General response: A more collaborative approach to the pavement design was suggested as a way to address these excessive commercial pressures and resulting unsatisfactory outcomes.

vi) Materials Selection

Recommendation 7: That specifications for pavement materials include:

- c) In the case of Traditional contracts, that designers of such specific mixes take particular care to ensure that they understand the potential ‘workability’ constraints of the specified mixes. The inclusion of trial construction sections may be considered, where deemed necessary, to confirm this workability characteristic of this material, with provision in the contract to vary the mix, as and if required, to improve workability and adequate compaction.
- d) In the case of other procurement models that the PRs or MRs require a minimum level of testing during the tender period to document how the risk of alternative materials has been addressed in the tender submission
- e) During the Detailed Design phase, that a high level of material testing and documentation be carried out, including the manner in which the long term performance of such materials may be assured. The use of the CAPTIF test track may be mandated for improved modelling of the performance of alternative materials.

Response:

BCL: There is some information available around the country, particularly on smaller regional projects. However, it is difficult to transfer the results to a large project.

Trial pavements are common sense and good practice, especially for “out of the norm designs” and are supported but should not be constructed as a part of the main alignment.

The issues with the particular South Island project should have been addressed through the tender evaluation phase to ensure that the desired outcomes could be delivered by the Contractor.

Testing of trial pavements is a good consideration. Concerns about the timing challenges of HSV testing could be addressed by early construction and testing of trial pavements ie a contract requirement for early programming (in much the same manner as for trial embankments for geotech verification).

WK: Further trials and investigations are needed to understand the response of marginal quality materials. Designers need to understand the conditions in each region.

vii) Defects Liability Period

Recommendation 8: That Waka Kotahi consider extending the DLP for projects involving substantial or sensitive pavement structures, as follows:

- f) An extension of the DLP for pavements only, as a separable portion, for a period of 5 to 7 years after Practical Completion. This period may be determined by the scale and risk levels of the proposed pavement.
- g) The amount of the bond applicable to this separable portion may be set as a percentage of the pavement value. This could be 25% or of this order.

Response:

WK: All contracts currently have DLPs of 24 months and 5 years for landscaping. There would be difficulties in managing DLPs for extended periods.

HEB: Not sure how much influence this would have as the tender approach does not consider the impact of the DLP.

BCL: Designers' PI insurance extends for 6 years after construction. Who would have responsibility is a small pothole 5 years after construction? How would future reseals be addressed?

Andy W: Future second coat seals are often the responsibility of the main contractor, who often contract the local maintenance contractor to carry out remedial works within the DLP.

Appendix P

Notes from the Interview with Mike Manion, Lead Advisor Contract Performance, Maintenance and Operations, Waka Kotahi on 15 November 2021

1. The extent of the issue relating to non-compliance of pavement performance may be reflected in the many tens of millions of dollars currently under review in the Post Design Assessment Report (PDCAR) process. This is the result of the differences between the NOC performance outcomes and the pavement and surfacing renewals work delivered by the NOC contractors.
2. The NOC contract requires the following process for the contractors' design and construction of pavements treatments:
 - a. The contractor identifies the underperforming sections of pavement and programmes for their treatment/rehabilitation in their forward works programme.
 - b. The Contractor submits a design report in which they propose at least 3 pavement designs (treatments) for consideration by Waka Kotahi, including a whole of life economic assessment.
 - c. The design proposals are considered and a final design option is approved by Waka Kotahi.
 - d. The final (detailed) design is carried out by the contractor's designer
 - e. This is reviewed and approved by Waka Kotahi.
 - f. The design is implemented by the Contractor.
 - g. Pavement performance is monitored for 5 years post construction which is the Defects Liability Period for that section of rehabilitation.
 - h. Financial penalties are applied to the Contractor for non-conformance with specified performance standards.
3. NOC contracts are procured using Waka Kotahi's Price Quality (PQM) model. Post interview note after review of a typical RFT – the procurement model is a Measure and Value (with some Lump Sums) and the method of Supplier selection is the Price Quality Method (PQM).
4. In Mike's view there is no issue with the procurement model or methods. He believes the performance issues are instead related to contract management and contract delivery, which are currently being assessed for improvement.
5. Specific issues include:
 - a. Quality of available quarry materials
 - b. Testing inconsistencies
 - c. Site specific constraints that impact of timing of the rehabilitation works eg weather, traffic flow requirements and temporary traffic management plans, with the comment that working on pavements while they are still in operation, can detract from best practice construction techniques
 - d. Inadequacies in the site investigation and Failure Mode Assessment processes leading to potentially inappropriate designs
 - e. Historically insufficient contract supervision, which is currently being addressed

Following the interview, Mike Manion provided various relevant documents that outlined the NOC approach to pavement design and construction including samples of tender request and contract documents.



A further discussion was held on 15th December 2021. Key discussions are noted below:

- a) As discussed before there are no issues with the procurement model itself, rather with delivery.
- b) Andy mentioned feedback he has had regarding the role of funding in this matter. Mike agrees that there are certainly issues with funding:
 - The contractor generally suggests a 25 year design life, but this is often above the budget originally set with input from the Contractor.
 - Waka Kotahi has to be pragmatic to meet budget.
 - It does not have the budget to construct a 25 year rehabilitation option across the network. In fact, this may result in overly conservative designs from a network wide perspective.
 - Mike questions the need for a 25 year design life as a lesser design life may at times offer a more optimal WOL / NPV. A lesser design would allow a wider maintenance coverage of the network than a 25 year design life throughout.

Appendix Q

Notes from the Interview with Peter Connors, Asset Quality Maintenance, Waka Kotahi

on 14th November 2021

Purpose of the Interview

To expand on the information provided by Mike Manion and John Hallett in respect of the influence of the NOC procurement model on pavement performance outcomes.

Notes taken during the interview

- b) Peter's role was formerly the Christchurch Asset Manager. He is currently the Lead Advisor, Asset Quality Maintenance.
- c) Low pricing by tenderers is not a major issue. In so far as there were generally appropriate rates for renewals, (generally smaller item in schedules) issue still exists that on underbid contracts the appropriate maintenance interventions weren't being carried out under the LS leading to some perverse outcomes in both the treatment and timeliness of intervention.
- d) Of significance though, is the exponential increase in maintenance costs and the impact this has on affordable funding.
- e) The key issue relating to poor pavement performance on the NOC contracts is poor delivery as a result of a lack of sufficient capability within the maintenance industry.
- f) This is exacerbated or driven by the change in the way maintenance contract are procured:
 - Before the NOC's there were specialist crews (other than the main suppliers) who carried out pavement renewals only and unfortunately some became losers in the NOC tendering process
 - Since then these maintenance works are aggregated to 22 NOC contracts which effectively preclude the participation of a large number of smaller, often very capable, smaller contractors.
 - While the NOC contracts may require a certain percentage of the contract works to be subcontracted to smaller subcontractors, this tends to be only for the less specialist works such as vegetation maintenance etc, and not for the specialised pavement rehabilitation type works.(this is not the case everywhere and often this renewal work is subcontracted however to new players not as capable as those smaller players that preceded them)
 - Another real issue is the low volume of renewals /rehab (as little as 1%) in some years, has led to a paucity of skills nationally, not enough across the supply chain to keep this skill set fully utilised
- g) Funding:
 - Andy W raised John Hallett's concern that in many cases the Contractor's design was unaffordable in terms of the budget, and contractor's designers were pressured to reduce the standard of the design. John's view was that generally the optimal WOL solution was a 25 year design life.



- Peter responded that the optimal NPV, WOL design was not necessarily for a 25 year design life, but agrees that due to budget constraints, Waka Kotahi does not always approve the optimal WOL design solution.
- In respect of flexible pavements, pavement treatments are preceded by pavement repairs. The current Lump Sum approach to pavement repairs does not work well in practice as there is a tendency for the contractor to limit the amount of work required to carry out all the required repairs ie repairs are not fully carried out. Waka Kotahi are reviewing this approach to potentially a M&V scheduling approach.
- Also the industry lacks the skills in some case to identify a pavement's failure mode subsequently leading to poor treatment selection
- Funding is based on the Contractor's 3 year forward works programme. Each year the Contractor's Annual Plan is used to update the funding for the subsequent year.
- However, due to overall funding constraints, the requested funds / budget are not always made available.
- Further, contractor's applications for funding are not always correct or accurate, leading to further request for additional funds.
- Budget management becomes tricky, additional expenditure in one areas leads to cut-backs in other areas.

Appendix R
Notes from the Interview with John Hallett, NOC Pavement Designer, Beca
on 13th November 2021

Introduction

John is the pavement designer for 3 NOCs namely, East Waikato, Hawkes Bay and Bay of Plenty (East)

1. What is the Designer's view of the influence that procurement may have had on pavement performance?

Response:

Beca are involved in the East Waikato, Bay of Plenty (East and) Hawkes Bay NOC contracts. The following discussion relates mainly to the BOP (East and) Hawkes Bay contracts. For the East Waikato contract, the Waka Kotahi staff have a better understanding of pavement conditions and appropriate designs.

John does not believe that NOC procurement has any influence on pavement performance. Standard rehabilitation treatments are priced.

The forward work programme identifies the treatment length. The three year programme is prepared by the Contractor. This is largely based on the 7 year programme prepared by Waka Kotahi and included in the tender documents.

For budget purposes, the contractor agrees the treatment (design) with Waka Kotahi's RAPT team of "asset integrators". At this early stage the treatment is agreed without any investigations.

After testing has been carried out, a formal design is prepared by the Contractor. This design is required to achieve a 25 year design life and a whole of life (NPV) assessment is carried out. If design does not meet the budget, the designer is pressured to accept a lower design to meet the budget. This means that the lesser design will not provide the required 25 year design life.

Performance issues manifest during 5 year DLP when measured against the performance criteria set for a 25 year pavement design. In practice what is happening is that contractors negotiate relaxed performance requirements to align with the lower life design.

This issue is driven by the funding levels that are set too low to meet the network requirements. This does not always allow the 25 year designs to be selected and constructed. There seems to be pressure on WK regional staff to keep costs below low budgets despite network pavement rehabilitation requirements.

Heavy traffic has increased significantly and pavement stock are worn out (consumed). Some sections are totally inadequate for current traffic. More than one rehabilitated section has reached the end of its useful life.

In summary the whole of life NPV economic evaluation may show an optimal 25 year design but a lower design life is selected due to funding constraints. This leads to cheaper treatments being selected for the BOP (East) and Hawkes Bay NOC contracts. This approach is often guided by Waka Kotahi personnel. There is some evidence of this approach on the South Island. This was happening with the hybrid contracts where budget pressures dictated lower design standards.

For East Waikato, Waka Kotahi do not wish to select a shorter life design, and choose to maintain the pavements at current levels until funding is available for rehabilitating to a 25 year design life. This is a rational approach. Waka Kotahi staff here more experienced and senior. This contract is being well managed.

2. Canvas the WK and contractor of their views of the procurement improvements proposed.

i) Risk management through all stages of design development, approvals and construction

Recommendation 1: That PRs and MRs mandate the documentation of all design risks and assumptions at each stage of the design and construction chain including the manner in which these risks have been addressed in the design and construction planning.

These stages are, et al, tender design (or Cert A at procurement), detailed design, design review, construction team briefing, construction management plans, quality and inspection and test plans, and in the final producer statements. Both the designer and constructor, through the provision of their respective producer statements, should confirm that the identified design and construction risks have been effectively addressed at Practical Completion.

Designer's Response:

Does not apply to NOC contracts. Current NOCs set a min price so very low prices are avoided. Very high prices affect contract award adversely. WK saw the procurement issues and addressed these. Credit to WK. JH does not hear Contractor's complaining about low prices. JH believes Mike is right about model not impacting on pavement performance –rather an issue of funding driving low design levels.

ii) Procurement non-price attributes may not effectively identify the preferred tenderer

Recommendation 2: That procurement protocols provide for the following:

- a) A PASS / FAIL threshold be implemented that disqualifies a tenderer who is unable to provide the required assurances of delivering a quality and reliable pavement, and / or
- b) In the event that a tenderer, with an unacceptably low score for pavement expertise, track record and construction methodology, is identified as the preferred tenderer, that the tenderer be given the opportunity to satisfactorily address these deficiencies prior to tender award, failing which the tenderer is excluded from further consideration.

Designer's Response:

This is not an issue for the current NOC procurement model. Non-price attributes are taken account of appropriately.

Recommendation 3: That procurement requirements provide for:

- a) greater emphasis on the capabilities of construction team individuals
- b) reference checks for key construction personnel
- c) greater emphasis and recognition for the outcome of tender interactive, and pre-award meetings at which individuals are interviewed in respect of their experience, capability and understanding of the construction requirements, particularly as this relates to quality pavement construction and other critical elements of the contract. Any overstatement or capability or understanding of key individuals within the NPAs proposal are likely to be revealed during these interviews.

The tender evaluation process should provide for a substantial inclusion in the scoring for the interviews of key construction personnel.

Designer's Response:

Agrees that in general winning contracts has become a marketing exercise and there are weaknesses that are not always exposed. Therefore need to interrogate these at interactives and pre award meetings. Availability of key people also an issue. OK if replacement is good. Lack of experience in industry.

Opinion. Models encourage large contractors – corporate models. Staff don't feel loyalty in corporate organisations as much as in smaller companies.

iii) Review of pavement designs

Recommendation 4: That PRs and MRs provide for the following pavement design review protocols:

- a) That a single, independent Pavement Review Team be appointed by the Principal, and nominated in the RFT. This team will provide consistency of review across all pavement design submissions, and will be reimbursed for their services through a 50:50 cost share arrangement between the Principal and the tenderer (or contractor) – as has been the case for the reimbursement of independent Safety Audit Teams.
- b) The Pavement Review Team will be selected from the Principal’s Independent Professional Advisor (IPA) panel, and may include a representative from the Principal’s National Office Pavement Team. The latter requirement will ensure that the Principal “has a voice” in the pavement design review in order to assure the achievement of the Principal’s long term pavement performance objectives.
- c) This independent review will be carried out at all stages of design development including Certificate A (tender design), Detailed Design, and at any subsequent stage during construction should any conditions require a modification to the pavement design.

Designer’s Response:

In NOCs peer reviewers are done by WK – in addition to internal review. Was done in region, now WK employs a truly independent reviewer. Rob Damhuis is doing a good job but is discovering the issue of funding constraints.

iv) Appropriate recognition of value

Recommendation 5: That the tender evaluation protocols provide for:

- a) Independent valuation, by an Independent Estimator, of higher cost innovations or features of value offered by tenderers in price competitive models.
- b) That these independent valuations be used in the determination of a Tangible Cost Adjustment factor.

Designer’s Response:

These recommendations may apply to capital projects. The NOC contracts are different – pavement design options are encouraged.

v) Overly aggressive commercial pricing behaviours**Recommendation 6:** That Waka Kotahi:

- c) Limit the use of Competitive Alliances and D&C models, particularly where the project includes a substantial or sensitive pavement component.
- d) Move to lower risk competitive models that provide for greater recognition of value, greater co-operation between owner and non-owner participants, and reduce the potential for overly aggressive competitive pricing.

Designer's Response:

These recommendations are not applicable to the NOC contracts.

vi) Materials Selection**Recommendation 7:** That specifications for pavement materials include:

- c) In the case of Traditional contracts, that designers of such specific mixes take particular care to ensure that they understand the potential 'workability' constraints of the specified mixes. The inclusion of trial construction sections may be considered, where deemed necessary, to confirm this workability characteristic of this material, with provision in the contract to vary the mix, as and if required, to improve workability and adequate compaction.
- d) In the case of other procurement models that the PRs or MRs require a minimum level of testing during the tender period to document how the risk of alternative materials has been addressed in the tender submission
- e) During the Detailed Design phase, that a high level of material testing and documentation be carried out, including the manner in which the long term performance of such materials may be assured. The use of the CAPTIV test track may be mandated for improved modelling of the performance of alternative materials.

Designer's Response:

Generally NOCs are constrained by the materials available in the area that this often requires the use of locally available marginal materials. This increases pavement performance risk and does contribute to some of the premature failures. Alternatives are very expensive if materials are brought in from a distance.

Marginal materials may be acceptable for low traffic pavements. Some designs can and some cannot perform if modified with cement. Further research into the in service performance of different pavement types is required eg upside down pavements (stabilised subbase and unbound base) that reduces demand for premium aggregates.

It will become increasingly imperative to find a way to develop extraction of more premium aggregates – an issue at government level.

vii) Defects Liability Period

Recommendation 8: That Waka Kotahi consider extending the DLP for projects involving substantial or sensitive pavement structures, as follows:

- f) An extension of the DLP for pavements only, as a separable portion, for a period of 5 to 7 years after Practical Completion. This period may be determined by the scale and risk levels of the proposed pavement.
- g) The amount of the bond applicable to this separable portion may be set as a percentage of the pavement value. This could be 25% or of this order.

Designer's Response:

John agrees with WK view that a longer DLP would encourage tenderers to be more circumspect about "minimum" pavements. Capital costs may increase but WOL costs will improve.

John believes that having a maintenance responsibility is a good approach for longer term commitment by Contractors to pavement performance. This would not need to include minor failures such as potholes. Thresholds for failures may be set which trigger the Contractor's responsibility.



Appendix S
Notes from the Interview with Higgins Contractors, NOC Contractor
on 21st December 2021

Attended by: Dale Nichols (NOC Contract Manager) - 6 years on the Hawkes Bay NOC
Brian Jones (NOC Asset Manager)
Thorsten Frobel (Pavement Design Manager)
Andy Wright (Independent Consultant)

Overview

Andy explained the background to this interview. Thorsten responded:

- The opinions offered in this conversation do not necessarily represent those of Higgins as the agenda was only provided 24 hours prior to the meeting, and
- He hoped that a more formal and wide-ranging survey of Waka Kotahi's supply market would be sought to ensure that balanced company wide views are gathered.

Andy posed the following questions:

1. Is it Higgins' experience that there are many pavement performance issues on the Network?
2. If so, what does Higgins consider to be the causes of these performance issues?
3. How may these issues best be addressed?

Higgins' responses:

1. Yes, there are some instances of pavement performance issues.
2. The NOC contracts face three key challenges in respect of pavement performance, these being:
 - a) Industry capability
 - b) Constraints of working under live traffic
 - c) Adequate budgets that effectively target the requirements of the network.

a) Industry capability

- Skill level in the industry is an issue, especially with operators on critical plant such as graders, rollers, pavers, stabilisers ("drivers not operators").
- Retaining skills is challenging.
- These inadequate skill levels often result in quality issues.
- This issued needs to be addressed on an industry-wide basis, possibly led by CCNZ, with leadership from Waka Kotahi (government).
- Industry-wide training initiatives should be implemented.

b) Constraints of working under live traffic

- There are significant constraints to achieving quality “every time” by working on a live highway.
- These include weather and demands of the public for reduced delays meaning that the contractor sometimes needs to seal before they are ready to do so – to avoid being caught out by rain and incurring public frustration.
- These constructability constraints or risks are not generally considered in the pavement design. If they did it would increase the cost of the treatment solution.
- As an example, cement stabilisation is particularly prone to these risks, whereas a foamed bitumen stabilised base would be more forgiving when experiencing inclement weather. But this would cost more (initially) – see funding constraints below.
- These constraints have been exacerbated by recent H&S requirements for safety zones between the workface and motorists. This puts heavy bypassing traffic in fixed wheel paths that leads to pavement deterioration. For example, the use of a drag broom and/or the ability to move traffic laterally is often not possible under the new H&S requirements.

c) Adequate budgets that effectively target the requirements of the network.

- While there are some performance issues on their NOC contracts, this is not considered to be widespread.
- Austroads Guidelines and the NZ Supplement require pavement renewals to be designed for a 25 year design life. However, in some cases funding constraints require a reduced design life, often to acceptance of a 10 year design life.
- Sufficient funding is a constraint. For some years insufficient funding has been made available for effective pavement maintenance to maintain the level of service of the network.
- Waka Kotahi Managers are therefore compelled to do what they can with the available budget/s, such as:
 - Selecting a lower design life
 - Cutting back on other maintenance requirements such as drainage
 - Deferring rehabilitation – ‘holding the pavement’ by means of repairs until funding is available for a longer term treatment such as rehabilitation / renewal.
 - Reducing the number of reseals i.e. waterproofing of the pavement i.e. the seal life is pushed too far.
- These measures add risk to pavement performance. Recently, this increased risk has been accepted by Waka Kotahi network managers and, together with a reduction in design life, the risk has been transferred to Waka Kotahi.
- In particular, inadequate expenditure on waterproofing chip seals, and lack of pavement drainage improvements, add substantial risk to pavement performance.
- The overall condition of the network is deteriorating and they expect a bow wave of performance issues requiring heavy maintenance (rehabilitation).



3. Solutions

- In short, the industry is under immense pressure and needs change/improvements.
- Industry-wide training initiatives with leadership from Waka Kotahi (government) to address skills crisis and/or opening of borders to skilled workers by Immigration NZ (central government).
- Closer working between suppliers and Waka Kotahi to identify and address pavement performance risks. The introduction of Rob Damhuis as an independent pavement design reviewer is welcomed and has led to some positive outcomes. Further initiatives of this nature are recommended.
- Acknowledgement and improvement in funding levels. Fortunately, it seems that in future years, maintenance funding levels will increase.