Premium Aggregate Resource Efficiency Discussion paper

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PURPOSE

The purpose of this document is to define the problem and to identify work required regarding the sustainable use of premium aggregate. It is intended that this work will input into the Ministry of Transport research strategy which outlines priorities for research within the transport sector.

SCOPE

This discussion paper focuses on premium aggregate grades for road construction and maintenance and also substitute materials (i.e. melter aggregate which is a by-product from steel manufacturing at Glenbrook). It focuses on supply and demand pressures and also the resource efficiency concept of reduce, reuse and recycle. Please note that although freight is an aspect of this work – it is not a focus i.e. this is not a freight study.

Out of scope:

- Lower grade aggregates
- Aggregate for non- transport construction purposes

SUMMARY

Premium aggregate grades – basecourse aggregate (M4) and sealing chip (M6) are fundamental inputs into the construction of roading infrastructure. Aggregate is a low cost and high volume product that represents the largest raw material used by volume for highways construction. In general there is no shortage of aggregate material with most aggregate being mined and produced locally. Aggregate is a finite resource that is not evenly spread across the country with premium aggregate grades only being supplied by about quarter of the active quarries in New Zealand. It is estimated that 10% of quarry production is for premium aggregate grades.

The price of aggregate is relatively low. Therefore, transportation costs can have a significant impact on its overall cost due to aggregate being a heavy product. Typically the cost of transporting aggregate to site can double after the first 30km of haul distance[1].

We are currently seeing substantial increases in distances between the quarry source of premium aggregate and where it is being used in construction with significant impacts on transportation costs. If this trend continues, it will have implications on the affordability of future transportation projects. This will be particularly acute where demand for road construction projects is highest such as in main urban areas. Increases in haulage distances will have negative impacts on communities which will

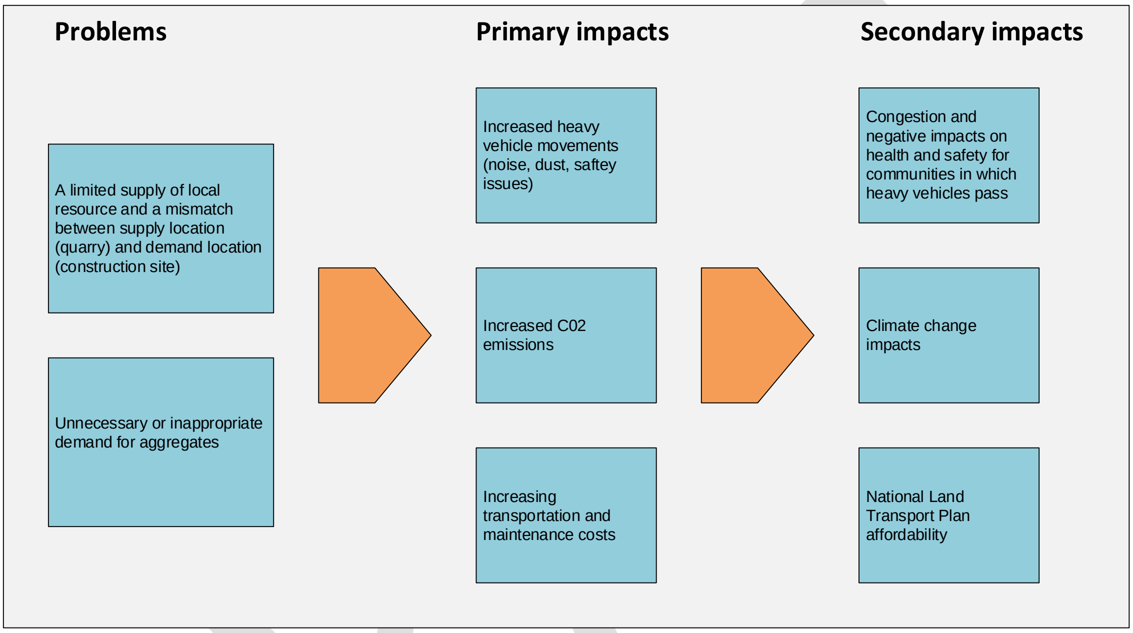
[1] Source: NZIER. 2013. 'Construction Industry Study – Implications for cost escalation in road building, maintenance and operation'. Report to the Ministry of Transport. Wellington: NZIER

have increased heavy traffic vehicle movements. There will also be impacts on fuel use, CO_2 emissions and increased maintenance costs.

There is currently no national picture or strategy in place for considering the ongoing demand and supply of premium aggregate. As the Transport Agency is only one user of premium aggregate material, data collected in the Road Assessment and Maintenance Management (RAMM) database does not provide a full picture of the demand for and supply of premium aggregate. It is likely that other sectors will be interested in these findings as premium aggregate is also a key raw material for building and housing. This discussion document will enable agreement around what the problem is and identify further research required.

A summary of the problems and impacts are provided in Figure 1 below.

Figure 1: Premium aggregate: problems and impacts



BACKGROUND

Aggregate supply and demand

Aggregate remains New Zealand's most mined mineral, at 27 million tonnes, this averages about 6 tonnes per head of population. Aggregate is widely used in roading, farming, commercial and residential construction.

MBIE classifies aggregate into five products. The quantities below are for 2012.

- Rock for reclamation and protection (147,000 tonnes – 1 percent)
- Rock, sand, and gravel for building (6,561,000 tonnes – 24 percent)
- Rock, sand and gravel for roading (15,432,000 tonnes – 56 percent)
- Rock, sand and gravel for fill (3,140,000 tonnes – 12 percent)
- Industrial sand (1,517,000 tonnes – 6 percent)

Figure 2: Aggregate production

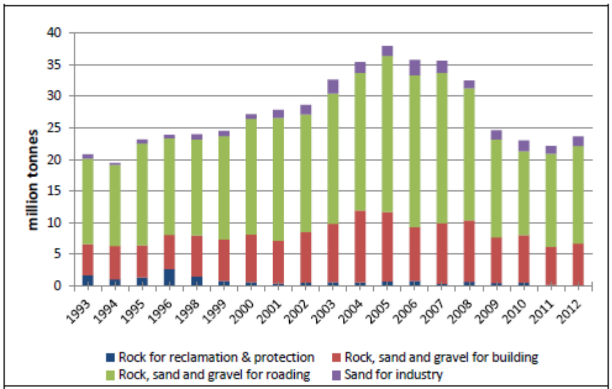


Figure 3.28
Aggregate production since 1993

Source: MBIE

Aggregate represents the largest raw material used by volume for highways construction. In 2015 New Zealand generated approximately 39 million tonnes of aggregates, of which 18 million tonnes were used for road construction[2]. State highway construction consumes between 28,000 and 39,000 tonnes of aggregate per km and 10,000 tonnes for local roads.[3]

Figure 3: Aggregate production by region

In 2012, production by region by type of aggregate was as follows:

Table 3.71
Aggregate Production by Region 2012 ('000 tonnes)

Region	Aggregate Type					
	Roading	Reclamation	Building	Fill	Sand	Total
Northland	1,082	0	263	338	4	1,688
Auckland	2,307	0	2,010	713	542	5,573
Waikato	3,499	35	1,101	685	378	5,697
Bay of Plenty	747	20	97	271	103	1,239
Gisborne	233	4	35	-	-	272
Hawke's Bay	262	-	352	19	64	696
Taranaki	170	21	105	64	63	423
Manawatu/ Wanganui	566	0	435	84	-	1,086
Wellington	653	4	306	251	213	1,427
TMN	590	22	345	38	20	1,015
West Coast	24	1	-	5	-	31
Canterbury	3,759	36	893	534	75	5,297
Otago	1,154	4	495	135	55	1,842
Southland	386	-	122	5	1	513
Total	**15,439**	**147**	**6,561**	**3,140**	**1,517**	**26,798**

Source: MBIE. Note that Roading total includes 7300t for the Chatham Islands. Excludes slag

The price of aggregate is relatively low and is in the range of about $30/tonne for high quality aggregate materials and $20/tonne for marginal materials. Surfacing aggregates are the highest quality aggregates used on the road – this is reflected in their cost, $40 to $60 per tonne[4].

Nationally New Zealand has a large supply of quality aggregate material however it is unevenly distributed – with its location determined by geological conditions. Greywacke is the source rock for close to 75% of aggregates produced in New Zealand[5]. There is an uneven distribution of quality aggregates throughout New Zealand and aggregate source properties and, therefore the engineering performance of aggregate varies significantly, even with similar geological sourced materials. The quality of aggregate material can also vary between rock faces within the same quarry. This makes it difficult to accurately calculate aggregate production potential.

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[2] Source: New Zealand petroleum and Minerals
[3] MoT (March 2014) National Freight Demand Study
[4] Source: Discussion with Mike Chilton (Technical Advisor) Aggregate & Quarry Association of NZ
[5] Source: University of Auckland presentation (2016)

New Zealand roads or 'pavements' usually consist of a:

- Surface layer (M6) – where the highest quality aggregate is used – chip seal.
- Basecourse layer (M4) which is just under the surface layer and provides the major structural component of the pavement. Premium aggregate is used on this layer and it distributes axle loads to protect the subgrade from high stresses.
- Sub-basecourse layer which is situated below the basecourse layer and above the subgrade. This layer is also load bearing but uses a lesser quality of aggregate compared to the basecourse layer.

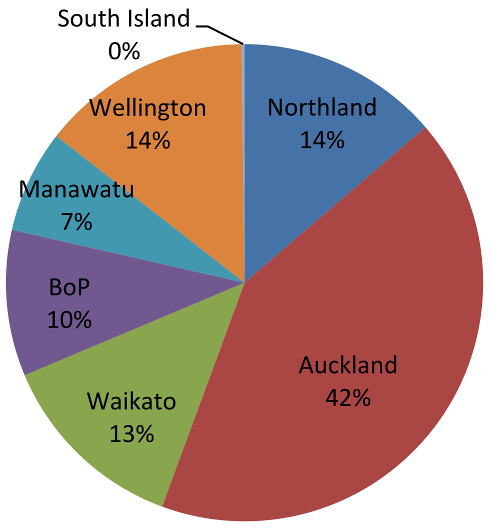
To give an indication of the quantities of premium aggregate being used it is estimated that premium aggregate grades represent about 10% of overall quarry production. On the 18km Mackay's to Peka Peka Expressway project 270,000 tonnes of basecourse was used. In addition to basecourse – chip seal is applied at a rate of approximately 10kg per square meter. If we conservatively presume that the expressway is 15 meters wide then a 1km stretch of road would use 150,000 kg (150 tonnes) and the expressway would use 2,700 tonnes[6] of chip seal. It is estimated that of the 1,000 active quarries in New Zealand – there are only 227 that produce M4 for state highways.

At present aggregates are almost entirely transported by road. The haulage and distribution of quarried aggregates contribute significantly to the number of heavy vehicles using the roading network and this represents a substantial part of the national freight task. In 2006-07 about 40 million tonnes of aggregates were moved out of a total freight task of about 230 million tonnes[7].

State highway forward work programme

The asset improvement project programme for 2016/17-2022 earmarks $9.1b for major (>$100m) and medium ($20m-$100m) asset improvement projects.

The graphic below summarises the proposed project costs by region. This does not include the East-West Link project for Auckland ($ tbc), Transmission Gully for Wellington (already underway) or the Christchurch Northern Arterial for the South Island (already underway).



The majority of funding (70%) over the next 5 years is earmarked for projects in the Northland, Auckland and Waikato regions. This highlights the importance of the discussion on premium

[6] Source: Discussion with Mike Chilton (Technical Advisor) Aggregate & Quarry Association of NZ

[7] MoT (March 2014) National Freight Demand Management Study

aggregate materials, as these are the principal regions already experiencing stress from resource shortages.

On average quarry products make up between 7%-15% of the total project costs (excluding cartage)[8]. In 2015/16 NZTA spent $1.8b on state highway improvement and maintenance projects which equates to between $126m-$252m being related to quarry materials (excluding transport costs).

WORK TO DATE

The Transport Agency tested our thinking with a group of technical experts in Auckland on 30 May 2017. The technical group agreed with the issues as outlined and the approach to include wider government in the discussion. On the 20th July a number of government departments were invited to a joint presentation by Auckland University and the Transport Agency. Comment received from these sessions is that it would be useful to cast other lenses over the issue other than resource efficiency such as economics.

KEY PROBLEMS

The key problems that surround the sustainable use/future proofing of premium aggregate are identified below. The key problems identified to date for premium aggregate, which are looked at in further detail, are:

- A limited supply of local resource and a mismatch between supply location (quarry) and demand location (construction site)
- Unnecessary or inappropriate demand for aggregates

Limited supply of local resource and a mismatch between supply location (quarry) and demand location (construction site)

There is increasing evidence to suggest that in our urban centres, and specifically Auckland, that locally produced premium aggregate resources are being depleted. Auckland already imports about 1/3 of its aggregate materials from Northland and Waikato over distances of 100km or more[9] and it is projected to have to increasingly rely on imported resources. The national freight demand management study 2006/7 estimated that 4.8 million tonnes were supplied from outside that region.[10]

Recently the Transmission Gully project in Wellington had to import RipRap material from Nelson, having exhausted supply from the closest quarry in Palmerston North. The trend we are seeing is likely to continue. Other regions, such as parts of Hawkes Bay and Taranaki, don't have sufficient local natural resources that meet NZTA specifications for premium aggregates and are also relying on sourcing premium aggregate materials from other parts of the country.

Urban encroachment has put additional pressure on aggregate supply. A number of potential aggregate sources have become inaccessible due to urban development. Local resource availability and sustainability are identified in many local government planning documents however there is no

[8] Based on estimates developed by Ian Bond (NZTA) in 2014
[9] Source: Discussion with Mike Chilton (Technical Advisor) Aggregate & Quarry Association of NZ
[10] Richard Paling Consulting (June 2010) Waikato aggregates distribution costs study

overarching national strategy around the protection of premium aggregate resources and the response to the issue from local government varies considerably.

The problem is exacerbated by the long lead time required to opening up new quarries, and requests to increase production, to meet RMA and other planning requirements (up to 10 years). There is also a Not In My Back Yard (NIMBY) effect to aggregate extraction as communities do not want quarries located near them, as they are generators of heavy vehicle movements and have a number of adverse environmental effects.

Unnecessary demand for aggregates

There are a number of instances where premium aggregate grades are being used unnecessarily which is having a negative effect on demand drivers.

Low traffic volume road specifications

Due to a lack of locally available specifications and in order to minimise risks, local roading authorities, road designers and engineers in many cases use NZTA specifications on non-highway projects. This is having the effect of premium aggregate materials being used when they are not necessarily needed. Please note that the Transport Agency is currently looking at preparing fit for purpose specifications for local roads.

NZ TRANSPORT AGENCY
WAKA KOTAHI

NZTA M6: 2011

SPECIFICATION FOR SEALING CHIP

1. SCOPE

This specification sets out the material requirements for five size grades of sealing chip for use on state highways and other heavily trafficked roadways.

2. TESTING GENERAL

International Accreditation New Zealand registered personnel shall perform all sampling and testing. Sampling must be performed in accordance with the methods detailed in NZS 4407 Part 2.

Recycled and marginal materials

The NZ Transport Agency allows the use of recycled materials in M/3, M/4, M/6 and M/10 (details provided on the Transport Agency website). There are well documented benefits to using recycled materials and a number of New Zealand case studies and research reports, as well as numerous international case studies to support this. Despite this there has only been very limited uptake of recycled materials in Agency projects. Currently this hovers around 1% or less of all mineral materials used in road construction and maintenance projects[11]. Compared internationally, NZ recycling figures can be considered to be very low.

New Zealand rates of recycled or marginal aggregate usage are very low compared to international rates. Historically New Zealand has been perceived as having an abundance of aggregate material available and as a result has not invested in recycling technology or mandating the use of recycled materials. There also seems to be a (perceived) risk of product variability in recycled material quality – which does not align with the research that has proven that recycled materials can be successfully used in pavement construction.

Marginal materials are considered aggregate grades that do not meet all specified requirements. A number of treatments can be applied to marginal materials to enable them to meet in- service performance requirements. The increased use of marginal materials would assist with the

[11] Source: CAA (2003)

sustainable use of premium aggregate grades. The University of Auckland is currently undertaking research into the treatment of marginal materials.

IMPACTS

The primary impacts of increased volumes of heavy traffic include:

- Increased vehicle movements
- Impacts on local communities from noise, poor air quality and dust etc
- Higher carbon foot prints through diesel emissions
- Having to transport aggregates a greater distance will increase the overall cost of aggregates (which includes both fuel use and driver related costs).
- Increased maintenance of roads

Secondary impacts include:

- Congestion
- Negative impacts on community health and safety
- Contribute to climate change impacts
- National Land Transport Programme affordability

INCREASING INTEREST

NZ Transport Agency Board

In August 2016 the NZ Transport Agency Board members requested information around what trends were being observed in the prices of inputs (aggregate and bitumen) to the state highway maintenance and construction activities. Based on discussions with bitumen suppliers no issues that would dramatically affect supply were identified, however the availability of premium aggregate that meets the performance criteria for road surface or pavement construction was identified as a potential issue. There is an increased recognition of the need to future proof finite natural resources being used in construction. There is also increased interest from economists as they have identified that increasing transportation costs could have a large impact on project cost – and what is affordable from the National Land Transport Fund.

Research

There are a number of research projects currently being undertaken in this space. This research is helping raise the profile of the optimal use of premium aggregates. Primary focus seems to be on aggregate inventories, improving the use of recycled and marginal materials and freight studies into the movement of aggregate. There is an opportunity to pull together what is currently known and look at the gaps such as the production potential of premium aggregates.

Currently the University of Auckland is undertaking research into the better utilisation of natural resource, including aggregate materials. This research includes the use of marginal and recycled materials and how they can be used more widely. The increased use of marginal materials would assist with the sustainable use of premium aggregate grades. Further detail is provided in Attachment 1. Economic theory would suggest that as we see price increases of virgin aggregate materials we will see increased use of alternative and substitute materials.

The Australian Road Research Board (ARRB) is leading the Austroads project on "Appropriate use of marginal and non-standard pavement materials in road construction and maintenance" (AAM2101). The main purpose of this project is to provide evidence of the effectiveness of using locally-available marginal and non-standard materials in place of materials which meet specified standards.

There are also a number of freight studies that have been undertaken including the Ministry of Transport National Freight Demand Study (March 2014). This study however states that 'most movements of aggregate are local and short distance.' What we are currently observing does not seem to have been widely considered before now.

Environment Waikato has undertaken a lot of work looking at the demand and supply of aggregate within the Waikato region and the opportunities around options for improving transportation (i.e. possibility of rail freight). A list of further research, including the use of recycled materials in the use of pavement construction, is included in Attachment 2.

POSSIBLE SOLUTIONS

Planning Controls

Local government have a difficult balancing act to play when looking at the requirement to have quarry resources close to where they are needed for construction and the adverse environmental and health effects on communities from quarrying activities. There is currently no overarching national strategy or plan which considers the protection of premium aggregate resources or provides guidance on how these considerations should be balanced.

An example of good practice may be considered to be the Tasman Regional Policy Statement. The Tasman Regional Policy Statement identifies the issue of accessibility of mineral resources and also sets out policies for addressing the issue. In addition to this the Tasman Resource Management Plan - Zone Rules for residential activities require that "a residential activity is set back at least 500 metres from any boundary of an existing quarry site".

Figure 4: Tasman Regional Policy Statement

Issue 6.9

ACCESSIBILITY OF MINERAL RESOURCES

Minerals are natural, physical resources present in the District. They are locationally fixed and non-renewable, and if they are to be extracted or protected, they must be extracted (and often processed) or protected where they occur. Minerals do not exist in isolation from other resources; they may underlie outstanding landscapes, significant ecosystems, or land of high productive value.

Unlike biological resources, minerals are not likely to be damaged or destroyed by other land use activities. The principal effect of other activities on minerals is on access to them.

While the physical constraint of landform influences the accessibility of minerals, accessibility is also affected by other constraints, such as land tenure; resource management and mining legislation; management plans and strategies prepared under other legislation; environmental standards for extraction and processing activities; land value, road access, and extraction and transport costs.

Addressed by Objective 6.7 and Policy 6.2.
Related issues are Issues 6.1, 6.2, 6.3, 6.4, 6.5, 6.6.

Objective 6.7

Avoidance, remedying or mitigation of the adverse effect of land uses on the accessibility of mineral resources.

REASONS:

The use, development or protection of surface features of land may constrain access to mineral resources, although the constraint may be economic rather than physical obstruction or degradation of the mineral resource itself.

Addresses Issue 6.9, achieved by Policy 6.2.
Related objectives are Objectives 6.1, 6.3.

The provision of national policy or guidance around the protection of quarry resources may go some way to future proof quarry resources.

Specifications

Due to the lack of locally available specifications and in order to minimise risks, local roading authorities, road designers and engineers in many cases are also using NZTA specifications on non-highway projects, resulting in the use of premium aggregate materials when they are not necessarily needed. The Transport Agency has recognised this need and is currently looking at preparing fit for purpose specifications for local roads.

TRANSIT NEW ZEALAND ARARAU AOTEAROA

TNZ M/4: 2006

SPECIFICATION FOR BASECOURSE AGGREGATE

1. SCOPE

This specification sets out requirements for basecourse aggregate for use on state highways and other heavily trafficked roadways.

2. GENERAL

All sampling and testing shall be performed by an IANZ Accredited laboratory for the performance of the relevant test as shown in Figure 1.

Recycled and marginal materials

Compared internationally, NZ recycling figures can be considered to be very low. There currently seems to be a (perceived) risk of product variability in recycled material quality. If the use of recycled content increased then it would go some way to the more sustainable use of premium aggregate resources and there would also be a number of other positive environmental benefits from the uptake of recycled content – such as a reduction in waste to landfill. The increased use of marginal materials would also contribute to reducing the demand for virgin premium aggregate. This would also have a number of positive environmental benefits.

Economic levers

Currently the price of aggregate is relatively low and there seems to be limited economic incentive to sustainably use premium aggregate resources or use recycled, marginal and substitute materials. If wider environmental and social costs were included in decision making then this may have an impact on how and when virgin aggregate materials are used.

There also seems to be market failure around the cost of sending waste to landfill. Again, if environmental and social costs and benefits were properly accounted for then this might result in less waste being sent to landfill.

Procurement

The Transport Agency contracts out all of its construction works. It is usual that the contractor then sub-contracts the supply of aggregate material – i.e. one step removed. It may be possible to include in contracts the use of marginal, recycled and alternative materials (including risk management).

Sustainability Rating Tools

Infrastructure sustainability rating systems essentially assess the environmental and social credentials of a given infrastructure project. Infrastructure providers worldwide are increasingly using infrastructure sustainability rating systems to provide a consistent method of assessing, achieving, comparing and communicating the positive environmental and social outcomes associated with infrastructure projects.

The Transport Agency currently uses the Greenroads (US based) rating system to assess the sustainability performance of high value state highway improvement projects (projects over $15 million) during design and construction. A certification level that is to be achieved by a contractor is specified within a contract. The Transport Agency currently uses the Greenroads tool to benchmark performance across the state highway network however it could use if to influence behaviour in regards to credits related to the use of aggregate such as reducing a projects need for the extraction of virgin materials.

Please note that the Agency is also currently piloting the Infrastructure Sustainability Council of Australia (NZ/OZ) tool on a small number of projects to investigate its use and to develop a working knowledge of this particular tool.

DATA AND MAPPING

The Transport Agency have had a number of internal conversations regarding the mapping of NZ premium aggregate grades (M4 and M6) to improve our understanding of where they are sourced and where they are used on a project and production potential. The below summarises our findings to date.

Road Asset and Maintenance Management Database

The Transport Agency requires all road assets and road maintenance projects on the State Highway Network, regardless of the type of project, to be recorded in the Road Assessment and Maintenance Management (RAMM) database. The data recorded includes the nature of the asset or maintenance carried out, the exact location on the State Highway network, the project features (e.g. recycled material use, surface material, etc.), as well as cost information. Although the RAMM database captures a lot of information it does not have detailed information on quarry production of premium aggregate grades (M4 and M6).

Currently M6 aggregate source and owner/producer information is collected in RAMM as the Transport Agency requires this information as part of its contracts to ensure that material being used is of an adequate standard, for example skid resistance. If the Transport Agency does not hold this information then the material cannot be used so this provides a strong incentive for producers to provide this information.

Maps have been generated that use RAMM data to show the quarries the Transport Agency uses and provides a RAMM code which is used to track source material (I have these on file). The Transport Agency also has 50 suppliers of M6 grade aggregate on an email database. This database could be used to contact suppliers and request information around the production potential of M6 and M4.

The data recorded by RAMM suggests that the Transport Agency uses only approximately 4% of the total roading aggregate material produced in 2015. This suggests that either a lot of premium aggregate is used for other non-NZTA roading purposes or that RAMM does not collect all of the aggregate material consumed by Agency projects. There seems to be some discrepancies between RAMM and other data bases such as New Zealand Petroleum and Minerals and MBIE data. These discrepancies need to be looked at in more detail.

Other data sources

Worksafe

WorkSafe New Zealand (WorkSafe) is the work health and safety regulator and monitors and enforces compliance with work health and safety legislation in New Zealand. Over the last 18 months WorkSafe have collected information on known quarry operators in New Zealand, building the largest data base of quarry operations in NZ. The Worksafe database includes information on quarry locations, ownership and production volumes where known.

Freeman Media

Freeman Media is a corporate information services provider who publishes a number of industry maps, including New Zealand quarry maps for the North and South Island. The Freeman Media maps record the name of each quarry (these are all the main commercial operating quarries that provide 99.5% of all production), its operator, as well as production volumes and rock types (where known). Included are aggregate, limestone and other industrial minerals quarries.

Please note that the above includes information sourced on the ground when working with quarry owners directly, however it is understood that the majority of above is based on Worksafe information.

New Zealand Petroleum and Minerals

NZP&M provides online maps using real-time data to show all current minerals permits and applications in New Zealand https://www.nzpam.govt.nz/

FUTURE RESEARCH AND NEXT STEPS

The above problems, impacts and solutions should be looked at in detail by engaging and collaborating with:

- Suppliers
- Representatives of user groups (e.g. MBIE, building industry etc.)
- Councils, local government representatives, Ministry for the Environment (i.e. RMA)
- Engagement with research providers and technical specialists

Future Research

The below identifies some initial ideas around future research. The below research can assist with the sustainable use or future proofing of premium aggregate and also the associated environmental and social adverse impacts from the increased transportation of premium aggregate.

Supply and demand

- Further analysis around the supply of premium aggregate (M4 and M6) by region, this includes establishing annual production estimates and linking them to quarry locations/regions. It would be useful to overlay the RAMM and Worksafe data currently held. Moving forward there would also be merit in the Transport Agency collecting and reporting production volumes and inputting this into the RAMM database.
- Further analysis around the future demand for premium aggregates, in particular by other non-transport users.
- Further analysis of the transportation costs of premium aggregate grades vs non-premium grades.

Recycled and alternative materials

- Investigate how we can encourage or mandate that use of recycled and marginal materials.
- Develop guidelines and standards to ensure substitute, marginal materials & recycled material quality are able to meet specifications.

Specifications

- Work with local transport authorities around fit for purpose specifications for aggregate materials (Please note that this work is currently underway)

National approach to planning

- Review the role of legislation and planning and identify any barriers
- Work with local governments around protecting suitable quarry sites from sterilisation (specifically near large urban areas such as Auckland, Wellington and Christchurch).
- Develop a strategic approach to resource use across the Transport Agency, local transport authorities and all of government.

Economic drivers

- Look into the lifecycle costs and impacts from the use of virgin and recycled aggregate options.

Next Steps

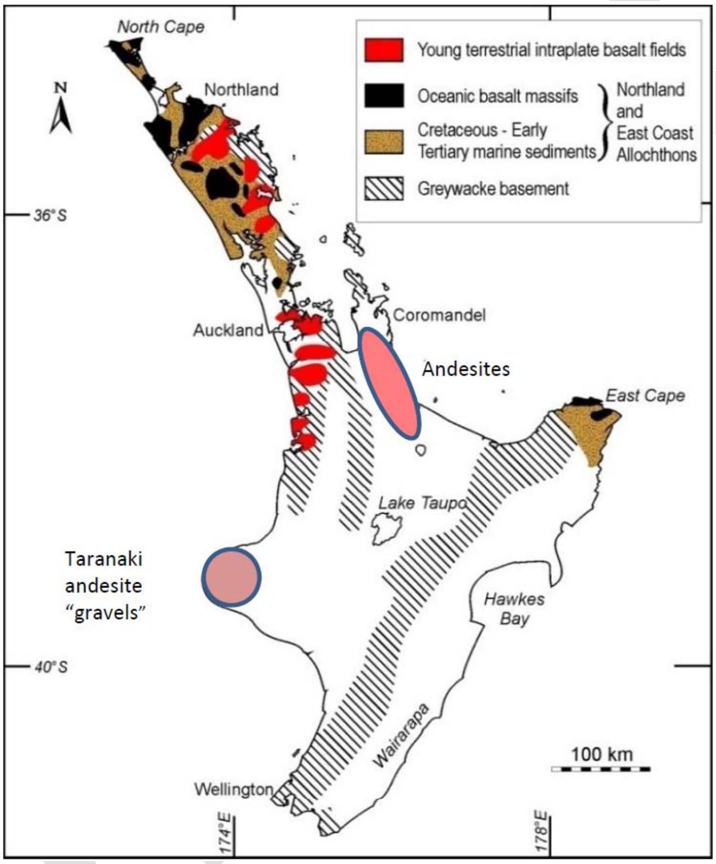
- Agreement around problems, impacts and future work required.
- Incorporate into the MOT research strategy
- Brief Transport Agency Board and Transport Minister on this work – or identify as a potential risk to delivery of future Government Policy statements on Land Transport?

ATTACHMENT 1: CURRENT RESEARCH

Auckland University research

Auckland University / MBIE Research Project

The aim of this project is to support better utilisation of natural resource, including aggregate materials. Auckland University have undertaken an inventory of geological aggregate availability in New Zealand (based on the NZ geological maps – led by Professor Philippa Black, see graphic below).



Source: Auckland University (2016)

The research project has three main research areas:

1. Natural resource use, incl. identifying economic opportunities for Maori
2. Marginal aggregates (geological availability and use)
3. Surface properties of aggregates (e.g. polishing or impacts from weathering)

Preliminary research findings:

- One of the outcomes recorded from the research project confirmed that "borrowing" of NZTA standards by councils and consultants for local or rural roading projects led to significant increase of premium aggregate use when not strictly required for the level of road constructed. This supports the notion to develop road classification for local roads or roads with lower traffic volume under the One Network Road Classification.

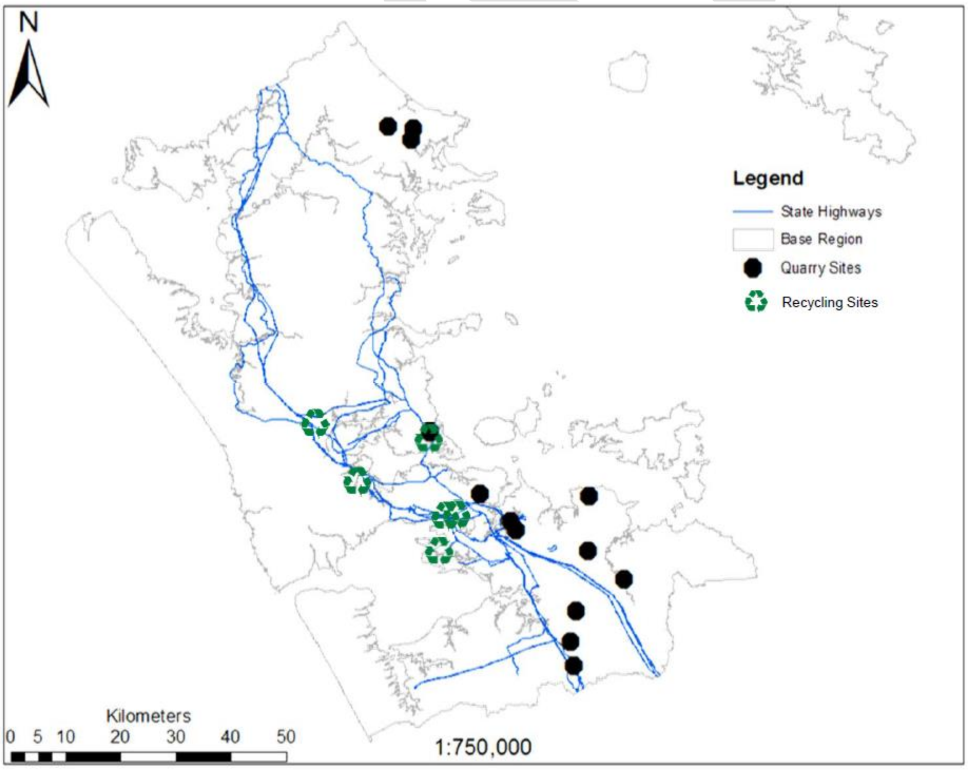
- The research project also looks into how weathering for material affects material properties and what treatment options are available to achieve higher levels of standards (i.e. remixing material at quarry or applying on site treatment at roading project, such as lime or cement stabilisation).
- Doug Wilson (Auckland University) confirmed that it was difficult to tell how much premium aggregate material was available from quarries, as a lot of it these are not currently fully developed or utilised.
- Often the quality within a quarry can also vary significantly, making it hard to predict premium materials availability
- A lot of quarries in NZ are only opened/re-opened when a project requires material from local sources (i.e. contractors own quarries and open them as needed). This means that many of these may be recorded as “closed” when in fact they can reopen if required.

Application of Recycled Aggregate in NZ’s pavements – Project Research

A second Auckland University research project aims to develop a better understanding of the availability of recycled aggregate material in the Auckland region and the costs and benefits compared to local virgin quarry material.

The project investigates the engineering qualities, durability and variability of recycled materials and undertakes an environmental assessment to understand potential risks.

Auckland University is working with eight local recycled material providers (see graphic below) to assess the quality of their products and develop a better understanding where recycled aggregate materials can be used in New Zealand pavement construction.



Source: Auckland University (2016)

Austroads research – Recycled Materials

Investigating opportunities to make roads more resource efficient Austroads completed the technical research report (PA-T287-14) "Economics of materials availability and recycling". This report shows that increasing the use of recycled materials to 15% would result in a 4% reduction in annual material costs ($24 million) across the whole state of Victoria.

Recycled materials are lighter (lower density), meaning less material is required to cover a given area (compared to quarried material with a higher density) and results in lower transport costs (reduced tonne-km). The Austroads report estimates that as a result the cost for an in-place pavement can be up to 25-30% cheaper.

Table 5.3: Average net benefit (or savings) of recycling 1 tonne of waste material

Waste material	Greenhouse gases (t CO2-e)	Cumulative energy demand (GJ fossil energy)	Water use (kL)
Asphalt	0.03	2.38	0.88
Brick	0.02	0.28	1.26
Concrete	0.02	0.35	1.28

Source: Department of Environment, Climate Change and Water NSW (2010).

Recycling and reuse of recycled aggregates can bring substantial environmental benefits. The magnitude of these gains depends on an efficient recycled aggregate collection and reuse supply chain. Taking into account lower transport costs and cheaper supply the reduction can be as high as 25-30%.

Using recycled materials also has significant environmental benefits, with Victoria alone, through the collection and reprocessing of 2 Mt of recycled aggregate resulting in 46.000 t CO2e avoided and 805.000 GJ less fuel used and 2.9 ML of less water used.

Further, the Australian Road Research Board (ARRB) is leading the Austroads project on "Appropriate use of marginal and non-standard pavement materials in road construction and maintenance" (AAM2101). The main purpose of this project is to provide evidence of the effectiveness of using locally-available marginal and non-standard materials in place of materials which meet specified standards.

The main outcome of the project will be an improved understanding and awareness of the use of fit-for-purpose pavement materials, including:

- recommendations regarding the need to amend current specifications or standards in the light of the findings of the work
- guidelines for the more effective management of available natural resources as part of a road agency's longer-term asset management planning

Both of the research projects described above are directly applicable to the issues identified in in this discussion paper. The findings of these reports are likely to provide learning's and potential pathways for New Zealand.

ATTACHMENT 2: REFERENCES/USEFUL DOCUMENTS

- Aggregate and Quarry Association of NZ – Discussions with Mike Chilton – Technical Advisor
- CAE (2003) Centre for Advanced Engineering information Bulletin Number 24, May 2003. Waste – Using More, Creating Less; Redirecting Construction Waste
- Greg Slaughter, Construction of New Zealand's First 100% Recycled Road http://www.wasteminz.org.nz/wp-content/uploads/Greg-Slaughter2.pdf

- New Zealand Petroleum and Minerals statistics https://www.nzpam.govt.nz/our-industry/nz-minerals/minerals-data/industry-statistics/.

- Ministry of Transport (March 2014) National Freight Demand Study

- Richard Paling Consulting (2010) Waikato Aggregates Distribution Costs Study: Stage 1 Analysis
- Regional Transport Committee Report (2010) Waikato Aggregates Distribution Costs Study: Stage 1 Analysis
- Philippa M. Black, Geologic Inventory of North Island Aggregate Resources: Influences on Engineering Materials Properties, Geology, School of the Environment, University of Auckland, 2009. From http://www.aqa.org.nz/resources/North%20Island%20Geological%20Inventory%202009.pdf

  http://rcaforum.org.nz/sites/public_files/images/161111-Item%204-Doug%20Wilson-Road%20Aggregates_Optimize.pdf

Published research reports

- NZ Transport Agency Research Report 219 Recycling of materials for more sustainable road construction
- NZ Transport Agency Research Report 306 Assessing the Environmental Effects of New and Recycled Materials in Road Construction
- NZ Transport Agency Research Report 308 Environmental impact of industrial by-products in road construction – A literature review
- NZ Transport Agency Research Report 309 Trials of the use of recycled hot mix and ground tyre rubber in hot mix asphalt
- NZ Transport Agency Research Report 345 Contaminant characterisation and toxicity of road sweepings and catchpit sediments: towards more sustainable reuse options
- NZ Transport Agency Research Report 351 The effect of adding recycled glass on the performance of basecourse aggregate
- NZ Transport Agency Research Report 406 Quantifying the benefits of waste minimisation
- Research Report 482 Fleet management commitment to fuel efficiency
- Research Report 558 Epoxy modified bitumen chip seals
- NZ Transport Agency Research Report 560 – Reduced bitumen application rates using bitumen emulsions

- Research Report 578 Removing barriers to the use of crumb rubber in roads
- Transit New Zealand Technical Memorandum: TNZ TM 6001 v1 – Use of Reclaimed Tyre Rubber in Asphalt (preliminary report)