



The Economic Contribution and Impact of Pakiri Sand Extraction

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Prepared for

McCallum Bros Ltd. and Kaipara Ltd.

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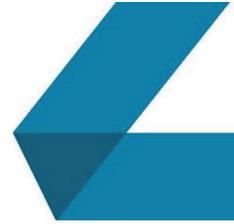
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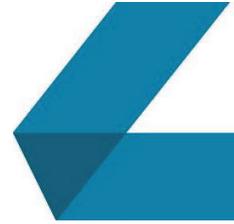
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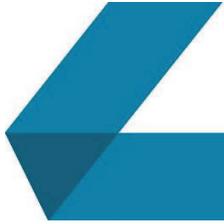
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Executive Summary

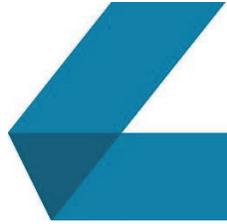
Since its invention by the Romans, concrete has been used as a key component in the design and building of many built forms. Vital to the production of ready-mix concrete is aggregate and sand. Sand, which is the focus of this report provides structure to the concrete and acts as a binding agent, as well as being used in landscaping, industrial and turf applications. Critically, access to suitably located sand of sufficient quality and quantity is a vital component of the existing built economy and any future economic growth. To achieve the urban and economic growth expectations of a rapidly growing Auckland region, now and into the future, consideration needs to be made that enables sustained access to key aggregate and sand resources.

The nature of sand is such that it needs to be transported over relatively short distances in order to be cost effective and to minimise wider environmental and social costs to society. This means that the spatial distribution of sand extraction sites is key to the economic viability of future development. Further, the quality of the sand product is a key determinant in the end product that it may be used for – most notably ready-mix concrete. Currently, sand sources that are located appropriately and of sufficient quality for use in concrete are limited in and near the Auckland Region.

The key sand providers within the Auckland sand market include; Winstone Aggregates, Atlas, Kaipara Ltd and McCallum Bros Ltd. The first two of these extract at the Taporapora Sand Banks and dispatch from Helensville, while McCallum Bros Ltd extracts from their own licence and that held by Kaipara Ltd in the Mangawhai Pakiri Embayment and barge directly to the Ports of Auckland. Other inland or river operations exist in the northern Waikato or Northland, though quality issues and transport distances restrict and limit the suitability of these sources for ready-mix concrete in the Auckland Region.

The operation at the Mangawhai Pakiri Embayment is held under three consents owned by Kaipara Ltd and McCallum Bros Ltd with both resources having previously been deemed to be sustainable by the Environment Court (Decision No. A066/2006 and Decision No. A 1/2003). The current consents enable extraction of up to 406,800 tonnes of sand annually until they expire in 2020 and 2023. Furthermore, this resource is the largest single supplier of sand within the Auckland region, with 325,000 out of an estimated total 750,000 tonnes sold in 2018. Ensuring that this resource is available into the future is key to ensuring the long term economic and urban growth of Auckland. Importantly, the ability for sands extracted at the Mangawhai Pakiri Embayment to be barged directly to the Ports of Auckland saves on transport and environmental costs that are associated with the alternatives.

The demand for sand in the Auckland Region is driven by a rapidly growing population that has culminated in a significant housing shortage with residential growth demand for new housing and the associated infrastructure needs, as well as from expansion within the wider economy. This is driven both from residential growth and wider growth pressures including export demand and from increases in demand for Auckland products from other parts of New Zealand. Auckland's growth is currently being planned for by Auckland Council in the form of The Auckland Plan, which incorporates the Auckland Unitary Plan, the Infrastructure Supply Strategy, and the Future Urban Land Supply Strategy. Key to implementing these



plans is sufficient and continued supply of ready-mix concrete (and therefore sand). They have been used as guiding documents to estimate the likely future demand for sand for concrete using population growth, economic development, and urban expansion projections.

Two scenarios of future growth have been analysed based on sand per capita usage in the Auckland region. First, a medium residential growth future to 2043 and an average sand demand per capita (based on the last 5 years) are combined to generate an estimated growth path. Under these assumptions, it is anticipated that annual demand for sand in Auckland will reach just over 1,000,000 tonnes, which is a 36% increase on 2018 sales. A second growth scenario has been developed based on a higher annual growth rate of 2.5% to 2043, to reflect aspirations for continued economic growth over and above growth associated with that of population increases. Under these assumptions, it is expected that Auckland's annual sand demand will reach approximately 1.2 million tonnes (61% above 2018 levels).

The operation at Pakiri is positioned to continue servicing a significant portion of this demand into the future, assuming consent for further extraction is issued for 2020 onwards. Based on the ability to transport the sand product via barge instead of road transport, the Pakiri operation would likely save the Auckland economy between \$6.6M and \$8.2M annually based on current prices (or between \$132 million and \$165 million over 20 years). This is built on the operating and environmental costs associated with the principle alternatives at Helensville. As well as this cost saving, the Pakiri operation is less constrained operationally, helps to reduce CO₂ emissions, and ensures that sand supply is spread strategically across multiple locations in the Auckland region. Combined, these make the consents at the Mangawhai Pakiri Embayment an essential component of Auckland's current and future economic infrastructure.



1 Introduction

There has been and will continue to be significant growth in demand for sand from within the Auckland economy. Sand is used in multiple applications within Auckland including concrete, industrial, turf and landscape applications. However, the majority of the volume utilised is as a key component within ready-mix concrete, with between 350 and 450 kilograms of sand used in each cubic metre of concrete. Concrete is used in many built forms to meet the needs of urban expansion, including for residential, business, and road construction. Given the importance of concrete for the region's economy, Auckland's built future is effectively based upon sustainable sources of sand.

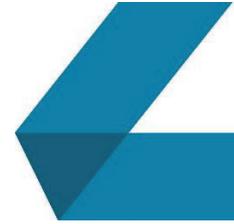
Sand extracted from the Mangawhai Pakiri embayment is a key component of this supply. Reliance upon these sands extends further than Auckland, into Waikato, the Bay of Plenty and beyond.

Because of its role in concrete, much of New Zealand's productive growth is reliant on sand in one form or another. This means that the impact of sand extends significantly further than just the construction sector. Economic growth is in part related to urban development and expansion, meaning that the ability to cater for future growth in population and economic output is heavily reliant on and directly linked to the availability of sand.

Achieving the GDP growth and export performance aims set by Auckland Council as well as catering for sustained household growth requires continued sustained access to sand of appropriate quality in an appropriate location, provided to market at a cost-effective price.

Currently there exist a number of sand extraction sites within Northland, Auckland and the Waikato that have served to provide sand to ready-mix concrete plants within in the upper North Island over recent years. The majority of the consented sand extraction sites are located within the Auckland Region. Collectively the Auckland extraction activities are permitted to provide some 1.49million tonnes (67%) of the total 2.20million tonnes available in the upper North Island annually. One of the key areas servicing the Auckland Region is the resource located in the Mangawhai Pakiri embayment, where there are three consents held by either Kaipara Ltd or McCallum Bros. Ltd. All licences are operated by McCallum Bros. Ltd (MBL), who have been operating extraction vessels in the area since the 1940's. Currently the site offers a good source of high-quality sand, able to be transported in a cost effective and efficient manner to key transport hubs and growth sites within Auckland. McCallum Bros. and Kaipara Ltd's existing resource consents are set to expire in September of 2020 and February 2023 respectively.

Under these resource consents, up to 406,000 tonnes are able to be extracted annually. Although this consent is a relatively minor portion of the total consented in Auckland (27% of 1.49M tonnes consented in Auckland), current sales estimates place the operation as the top supplier of sand in the Auckland Region at around 325,000 tonnes annually. Included in this is a volume of 45,000 tonnes of sand sold into industrial, turf and landscape applications in the Auckland region where other sands could be used in the same application. The volume of sand sold from the Pakiri area represents 43% of the total sand market



and is by far the single largest market share by supply from any one area. This is significant because it implies that extraction operations at Pakiri are more economically and environmentally efficient than the alternatives – which is reflected in the volume they supply.

A key set of issues considered under the Resource Management Act as being relevant to granting that particular consent, are those relating to the economic effects of the consent. In this instance those economic effects are associated with the avoided costs of transportation and improved efficiencies associated with the physical source properties of the product. In this study, the focus is on the amount of growth anticipated in the Auckland market for sand, the likely sources for that sand as well as the costs associated with alternative sources of sand to highlight the effect of Pakiri's existing consent and the expiry of that consent. In determining the granting of future consents, consenting authorities must consider Pakiri in context, as a regionally and nationally significant sand source.

The current consents are located in the Mangawhai-Pakiri Embayment, one of the few locations where sand of sufficient quality and quantity can be sourced within the Auckland area. The key difference between the Pakiri sand supply and the alternatives is that the sand is barged into central Auckland at significantly less environmental and economic cost than trucking the sand from the alternatives.

1.1 Sand Market

Globally, some 50 billion tonnes of sand are extracted for use in construction, primarily to make concrete. The vast majority of sand for concrete needs to be sourced from either the sea, from rivers, or from relict river or dune deposits because the grains do not have all their edges eroded away, meaning that the sand binds better with cement to make stronger concrete. Sand that is wind eroded, such as that found in deserts, has a much rounder profile, meaning it is not good for making concrete. In the New Zealand context, the choices are narrower. Due to the continued eruptions from the silica rich andesitic volcanoes of the central north island, the river sands north of Taupo have high levels of alkali reactive minerals. This makes them less desirable for concrete manufacture and civil construction.

For the Auckland market there are three source typologies for sand;

- Land based, either relict dune or river alluvial deposits
- River based, in this case the Waikato River
- Marine sourced, Pakiri or Kaipara Harbour

Land or river-based sands are mostly sourced from the Waikato and Bay of Plenty, therefore they have high levels of reactive minerals from the Taupo Volcanoes and are less desirable for civil construction projects. In the Auckland market the majority of these sands are used for landscape purposes, domestic retail and for sports fields or where transport and distance makes marine sands not financially viable. As with other low value, high volume or weight resources, sand prices are extremely sensitive to transportation distances. Although two large land-based sand resources do exist in the northern Waikato these are already heavily allocated, meaning that the next closest location is from sources close to Cambridge. This additional distance means that Auckland-based users of land-based sand are turning more to the sands sourced from the west coast resource and from the Pakiri embayment. There is a relict dune deposit of sand in the Northland region which is of suitable quality for concrete manufacture but the distance from Auckland means it is not cost effective and the resource is limited in volume.



The inshore sands at the Pakiri Embayment are extracted under two resource consents held by McCallum Bros. Ltd. In terms of composition the mineralogy of the inshore sand is the same as the offshore resource but is finer nearer to the shore. This has limited effect on its use in concrete manufacture as the amount of cement required for a particular target strength is similar for both resources. The combined consents allow for approximately 136,000 tonnes to be extracted annually. The inshore resource consents are set to expire in September of 2020.

The offshore resource consent at the Pakiri Embayment is owned by Kaipara Ltd. Extraction activities are currently limited to 270,000 tonnes annually within the 30-metre bathymetric contour. Extraction can occur at a higher rate outside the 30m contour, provided a pre-dredge assessment is undertaken. The current consent allows for a maximum of 3.6 million tonnes to be extracted over a 20-year period. The offshore resource consent is set to expire in February 2023. Sand extraction from both the inshore and offshore licences are operated by McCallum Bros. Ltd.

1.2 Sand and Aggregate

The use of sand for concrete production is directly linked to the use of aggregate for the same purpose. As demand for ready mix concrete increases, demand for sand and aggregate increases linearly as the proportions are broadly fixed.

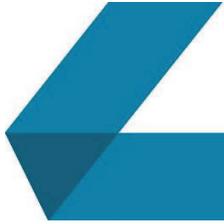
Aggregate demand from Auckland is expected to increase from approximately 12.3million tonnes annually to between 18.3million and 22.8million tonnes over the next 30 years. These growth volumes have been accepted by the Environment Court in a number of different contexts and are important for sand production growth.

The majority of aggregate is to be used for concrete in all forms for construction mainly, roads, and infrastructure requirements, as it comprises between 75% and 90% of their volume. This figure does not relate solely to aggregate material, but sand as well. They are used in combination to provide the bulk, base and binding agents required in the final product. This indicates a definite link between sand and aggregate products, concrete production and growth.

1.3 Report Aims

The purpose of this report is to highlight the role that the Pakiri embayment sand resource plays in meeting Auckland's sand needs and therefore the importance of the consents that allow continued extraction of that resource for supply. First by outlining the role sand plays in the regional and national economy, then by assessing recent trends in sand production and consumption in Auckland in comparison with Pakiri's production. The second is to translate the volume of sand supply from the alternative sources into a set of transportation costs to assess the overall economic and environmental impacts they have.

Two scenarios of future Auckland market demand growth are then created. Once completed, the role Pakiri currently plays is extrapolated into the future under the proposed changes to operating conditions to highlight the economic and environmental benefits to the region in the form of reduced transportation costs that result.



2 Approach

In order to estimate the impact that the Pakiri site currently has and will potentially have on the upper North Island economy, it is necessary to identify the role sand plays within each of the regional economies, then grow the local economies under both a business as usual future and a high growth future (to provide a different range of scenarios), and then place the renewal of the resource consents into the resulting future production and consumption context.

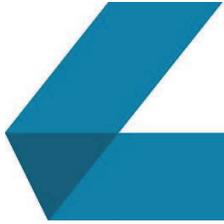
Once this base position is established the factual (the renewal of the consent) and counterfactual situations (without Pakiri) are able to be assessed. The assessment process draws from the costs of supplying the Pakiri expansion quantity from the principal alternatives. In this instance, the next most logical location for supplying the Auckland market is from Atlas and Winstone Aggregate's Helensville sites. Obtaining sand supply from these locations and moving it to Penrose requires transport of the materials 110 kilometres along the road network (55 kilometres one-way, with limited to no backload potential).

The combined costs of additional transport are a key measure of benefit that accrues to the upper North Island economy as a result of the renewal of the Pakiri extraction site consent and continuing operation.

In summary this report presents and assesses;

- A summary of Auckland's likely growth future. This draws from recent publications relating to historic growth and predictions, including the Auckland Growth Monitor. This information forms the basis for estimates of sand likely to be required to sustain growth.
- The role sand plays in Auckland's growth and potentially as a key component of the nation's economic growth. These effects are not driven by sand but are certainly facilitated by the availability, cost and quality of sand. This has been sourced from a range of documents that provide estimates of the volumes of sand required to build the structure of Auckland city.
- The role Pakiri plays and can potentially play in meeting a share of the total Auckland market demand.
- An overview of the principal alternatives to the Pakiri site. This identifies additional costs and benefits from sourcing the sand from within and outside the region. This is based on avoided transportation costs
- The benefits of using Pakiri sand over other resources from a technical and environmental perspective.

We have assessed the principal alternatives to using the Pakiri extraction site, in terms of capacity in other Auckland quarries plus those further afield that would need to be drawn on should consent for Pakiri extraction fail to be renewed. These principal locations for sourcing sand outside of Auckland are in the Waikato Region.



3 Auckland's Growth Future

The most recent guide to what Auckland will look like in the future is the Auckland Plan. The 'Auckland High-Level Development Strategy' outlined within the Plan is based on a top-down, aspirational approach to growth planning over the next 30 years. In combination with the other guiding documents, (the Auckland Economic Development Strategy and Growth Goals and the Unitary Plan), a baseline picture of the drivers of sand demand is produced. This section describes the Auckland Development Strategy, focusing on the scale, type and timing of growth.

3.1 The Auckland Plan – A vision for growth

The Auckland Plan is based around a vision to make Auckland the world's most liveable city. The current Plan outlines a number of regional goals and outcomes and includes a comprehensive set of strategic directions for Auckland's future development. The current Plan is the first update of the original Auckland Plan (2012).

Key points from this growth strategy include:

- 313,000 additional dwellings anticipated in Auckland over the next 30 years. The Statistics NZ high projection for 2043 is an additional 325,000 dwellings and so could be considered the upper range of anticipated growth for planning purposes.
- A quality compact city form with future development focused within Auckland's urban footprint. This limits expansion into the rural hinterland and rural land fragmentation.
- The Unitary Plan identifies capacity for around 1 million additional dwellings – of these some 326,000 are economically feasible at today's prices.
- A target of 408,000 dwellings has been set as required over the next 30 years. This takes into account both a margin (as required under the NPS on Urban Development Capacity) and an existing shortfall of some 35,000.
- Sequencing will target areas within the existing urban areas where the greatest development capacity is taken up (nodes and development areas), and bulk funding for infrastructure in identified Future Urban Land
- Residential development in rural areas will be focused on the countryside living zones and around the two rural nodes – Pukekohe and Warkworth.
- Expansion into greenfield areas will be managed within the Rural Urban Boundary.



Growth inside the Metropolitan Urban Limit (MUL) is focused on intensification, particularly in urban centres (and their 10-minute walkable catchments). Some centres will require a significant change in density (identified as nodes) while others only a moderate change.

3.2 Scale and timing of growth

Table 3.1 provides a summary of key growth figures contained in the Auckland Plan 2050. Of note is the difference between anticipated growth in dwelling numbers and the currently feasible capacity (currently showing a 27,000 shortfall – or 2.5 years of growth). Over the next 10 – 15 years it is highly likely that the feasible capacity will increase thereby ensuring that based on the current zonings there will be sufficient capacity to cater for growth.

Figure 3.1: Anticipated growth in population and dwellings (2018 – 2048)

	Population 2018	Pop Growth 2018 - 2048	Dwellings 2018	Dwelling Growth 2018 - 2048	Feasible Capacity 2017
Existing Urban Area	1,486,000	443,300	491,700	195,000	117,500
Future Urban Area	44,200	243,400	15,300	99,000	114,800
Rural Area	126,400	33,400	47,100	19,100	53,700
TOTAL	1,656,600	720,100	554,100	313,100	286,000

Source: *The Auckland Plan 2050*

The Auckland Plan gives some guidance to the timing of growth and development and how the market might respond to demand and supply dynamics. The Council talks about Auckland’s growth in terms of the next three decades – each with a different focus and recognising that it may take a generation to shift dwelling preferences towards compact, higher density living.

- 2018-2028: The greatest amount of growth is anticipated in this first decade – reflecting the high recent population growth. This is expected to taper off and return to more modest long-term rates towards the end of the first decade. The majority of growth in the first decade will be focused on the existing urban areas (83,470 dwellings out of a total of 119,100 or 70%) (Figure 3.2)
- 2028 - 2048: The Council has less certainty about demand and supply of capacity that will be needed in the second 2 decades. Growth pushes into future urban areas in the second decade (up to 42% of anticipated growth) before declining to make up about 30% of growth in the third decade as intensification takes up a larger share and the population ages overall. Rural growth remains a minor share overall (less than 7%)

The implementation of the NPS-UDC means that Council have an obligation to monitor and respond to capacity shortfalls every three years. This means that adjustments to changes in growth drivers will be made on an ongoing basis.



Figure 3.2: Anticipated Dwelling Growth (dwellings) 2018 - 2048

Area	Decade 1 2018 - 2028	Decade 2 2028 - 2038	Decade 3 2038 - 2048
Existing Urban	83,470	53,255	58,282
Future Urban	29,150	42,804	27,020
Rural	6,448	6,505	6,120
Total	119,068	102,564	91,422
Share of Total			
Existing Urban	70%	52%	64%
Future Urban	24%	42%	30%
Rural	5%	6%	7%
Total	100%	100%	100%

Source: *The Auckland Plan 2050*

The risks for achieving Auckland’s growth vision are two-fold. First, the high regulatory costs associated with the development process in New Zealand, particularly for large scale projects. While Auckland Council is looking at ways to incentivise and facilitate development, the Resource Management Act (RMA) sets the wider regulatory context. Recent movements by central government including the implementation of the Housing and Urban Development Authority (HUDA), will ensure that regulations do not impinge on the development process.

Second, the efforts government are making to influence the cost of home ownership. This may see a number of initiatives launched in the next few years, including (but not limited to); government sponsored house building (e.g. Kiwibuild), legislation that overcomes the efforts of local governments to limit urban expansion to within the RUB, revision of the processes and principals contained in the Resource Management Act aimed at reducing both the time and costs involved in the development process.

3.3 Other relevant information in the Plan

The Auckland Plan also signals:

- Infrastructure lead development: Investment in infrastructure to facilitate development and redevelopment. That is, recognition that infrastructure is both a shaper and enabler of growth.
- Partnerships: New ways required to develop. To implement many of the priorities in the Plan, Central Government, Local Government and private sector initiatives will be required to lead and fund development. It is anticipated that public-private partnerships will be more common. The Hobsonville development and Tamaki development (in which the Auckland Council will be a joint owner with Government of the new Tamaki Regeneration Company) could be exemplars for other urban development authorities in the region.
- Masterplan approaches: There is also an increasing trend towards Area Plans, Centre Plans and Precinct Plans. Britomart and now Wynyard Quarter are examples that have/are working well, with good political and public support). We anticipate that



future development in centres especially will be large scale, coordinated projects (amalgamating land owners), rather than ad-hoc private/single site developments.

3.4 Implementing the Auckland Plan

There are a number of statutory and non-statutory Council documents that draw direction from the Auckland Plan. Three plans are especially critical in terms of delivering the vision of the Auckland Plan and its growth strategy – The Auckland Unitary Plan, The Infrastructure Strategy and the Future Urban Land Supply Strategy. These are discussed below.

3.4.1 The Unitary Plan

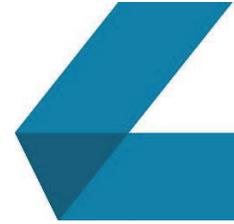
The Unitary Plan is a statutory document that has replaced the legacy council district plans. The latest updating of the plan was in October 2018. The plan sets out the planning rules for Auckland and creates (through its embodied zoning framework) sufficient capacity for employment and housing over the next 30 years. Drafting the Unitary Plan proved to be a very complex task. The Draft Plan was published in March 2013 as the basis for continued informal feedback, and has continued through more formal feedback stages, hearing stages and appeals to the Environment Court. Currently (December 2018), it is not fully operative, with appeals on some aspects still before the courts.

The Plan outlines key issues of Regional Significance, of which the top 2 relate to urban growth and infrastructure provision. The Plan indicates that significant infrastructure (and therefore significant consumption of sand) will be developed in line with the timing and direction of the Unitary Plan. It is also important to note that there have been a number of alterations in the distribution, quantum and typology of residential housing anticipated over the next 10 – 20 years through the submission process of the Unitary Plan. These issues are not settled and potentially have a significant impact on the demand for sand. For example;

- Intensification requires more multi-storey developments in and around centres and generally within the existing urban areas. This may mean more use of sand in the production of houses but less in terms of new roads.
- ‘Extensification’ of residential will see more housing developed in new urban areas and potentially outside the RUB (Rural Urban Boundary). This could potentially see significant demand for sand for new infrastructure (roading, pipes, facilities and retail centres), but less for housing in itself (due to the higher percentage of wood used in stand-alone dwellings for structural elements)

3.4.2 The Infrastructure Strategy

Auckland’s latest iteration of its Infrastructure Plan forms part of the LTCCP 2018 – 2028. The strategy takes a medium to long term view of Auckland’s Infrastructure (to 2048), highlighting the portfolio, issues and challenges as well as opportunities over the next 30 years. It explains key decisions and provides an overview of investment to 2048. Infrastructure is broken down into transport, water and community assets.



Decisions made on future investment are driven initially by the Auckland Plan. This lays out outcomes, focus areas and the direction for the long-term development of Auckland. Alignment of investment in infrastructure decisions across council, with central government and in line with future direction is key to efficiently meeting current and future growth needs.

Future growth will add over 310,000 dwellings and 250,000 jobs to Auckland by 2048 – the majority requiring buildings to work in as well as roads, pipes, parking areas, footpaths, parks halls, community centres, pools and halls. All these require concrete and therefore sand. To place Auckland's growth in perspective, growth over the past 2 years is equal to Wellington's forecast growth over the next 30 years and of New Zealand's total working age population growth to 2048 – 75% will occur in Auckland. This means that Auckland's importance and dominance of the New Zealand economy will grow rather than diminish over the next 30 years.

In addition to growth, ongoing climate change will impact on existing infrastructure and dwelling location leading to decisions about relocation and change – again requiring additional construction and associated infrastructure.

Finally, Auckland's growth is stimulating development across the rest of the upper North Island. Port development in Tauranga and Whangarei is driven by Auckland growth as is the infrastructure to connect these to Auckland and improve connection between the cities of Tauranga, Hamilton and Auckland.

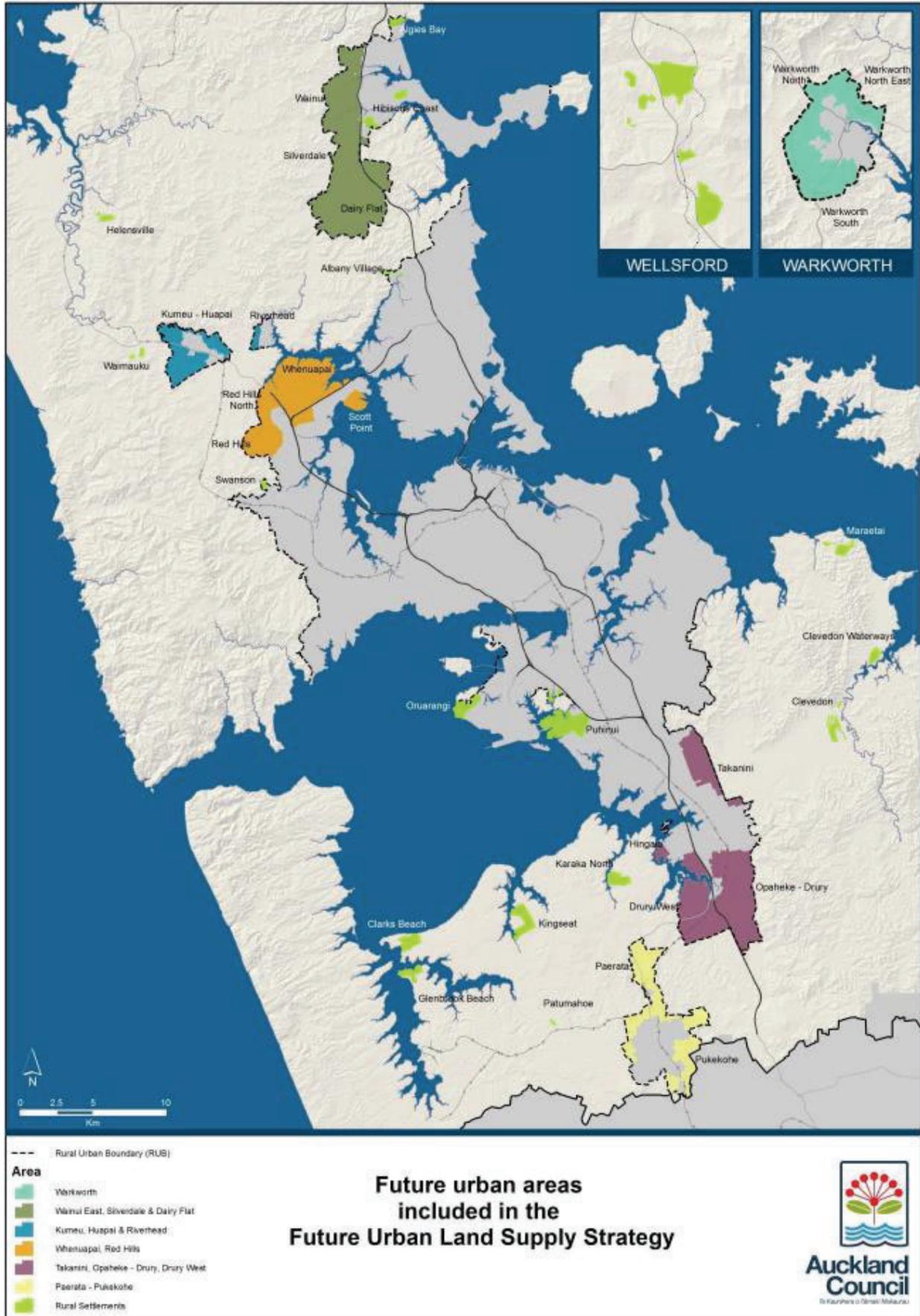
Over the next decade, it is estimated that Auckland requires investment of around \$30bn for infrastructure. However, as outlined in the Financial Strategy, acceptable increases in the general rates and other existing funding sources would only enable around \$20bn of investment. Targeted rates, and new instruments such as regional fuel taxes, will raise this to around \$25bn.

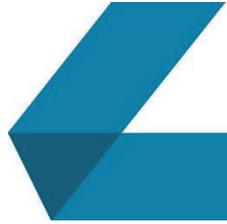
3.4.3 Future Urban Land Supply Strategy

Future urban land will be required to accommodate up to 40% of anticipated population growth to 2048. Again, the Auckland Plan sets the direction that Auckland Council follow to ensure that growth is accommodated appropriately. The Plan has settled on a quality compact approach to growth that focuses development in existing areas, while at the same time identifying some 15,000ha of rural land for future urbanisation to accommodate some 137,000 dwellings and around 67,000 jobs.

In terms of sand requirements, this is significant both in terms of the scale and location of growth (Figure 3.3). The majority of future urban land is located in the southern parts of Auckland, around Drury, Pukekohe and Takanini. Other significant blocks are located at Dairy Flat and Whenuapai. The Northern rural towns of Wellsford and Warkworth also have large areas identified for future urbanisation (Figure 3.3).

Figure 3.3: Location of future urban areas (Auckland Unitary Plan) – July 2017





3.5 Implications for Sand Sector

The growth goals as outlined in the Auckland Plan, are likely to have significant implications for the production and consumption of sand in Auckland. The growth in the working age population will require higher levels of employment and new businesses to establish or be located in the region. It will also mean higher tourist numbers with the resultant increased pressure on local infrastructure.

Development of the roading networks aligns with the government's view of facilitating economic growth and development. This is likely to mean that construction and roading will expand relative to population and industry growth.

Therefore, it is relatively straightforward to translate growth into direct demand for sand. In the modelling below two scenarios of future demand are generated. The first adopts recent historical growth as the basis for growing the demand for sand into the future. Effectively, this scenario adopts Auckland's average consumption per head of population and projects future consumption based on this ratio and a medium growth future for Auckland's population.

The second scenario assumes that the growth goals and targets Auckland Council has set will stimulate the Auckland economy to the point where GDP growth maintains a steady 2.5% into the future.

These two scenarios define the space within which the true Auckland future will lie, and so will form a low and high view of future sand consumption for the purposes of this report.

4 Sand Use

As a key component of concrete, sand is a foundation product. Concrete is used in every aspect of economic activity in New Zealand and without a ready supply of appropriately located sand, the production of concrete and the development of buildings, roading and infrastructure would halt – or would cost considerably more. Sand is also used in landscaping, on sports-fields and in industrial processes.

In this section of the report historic production and consumption of sand across New Zealand is examined and likely future consumption is explored under two growth scenarios.

4.1 Historical New Zealand Ready-Mix Production

We have based sand production figures on ready-mix concrete production within New Zealand over the past 17 years¹. This is because individual sand production figures are not available for the entire period, but have been amalgamated in with other building materials such as aggregate. With this in mind, ready-mix (and therefore sand extraction) in New Zealand since the millennium has generally followed the fortunes of the economy. Following the economy, ready-mix production in New Zealand went through a period of growth, increasing in volume by 52.8%, from 2.44m cubic metres produced in 2000 to a high of 3.73M cubic metres produced in 2007. After 2007, concrete production decreased each year to a low in 2011 of 2.64M cubic metres (Table 4.1). Ready-mix production has since increased each year to 4.1M cubic metres in 2018 (requiring approximately 1.64M tonnes of sand).

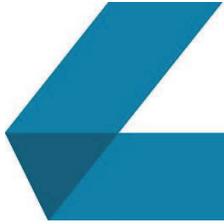
Auckland has consistently remained the largest regional producer of ready-mix concrete in the country since 2000, in line with it being the largest economy. Auckland produced 1.49M m³ of ready-mix in 2018, requiring 0.60M tonnes of sand (based on an average of 400kg of sand per cubic metre of concrete). The combined Waikato/Bay of Plenty Regions have stayed within the top three producers of ready-mix over the period, with 0.71M m³ (0.28M tonnes of sand) of ready-mix produced in 2018 placing them second in the country. The Northland Region is generally near the bottom of the list (sixth in 2018) with 0.17M m³ of ready-mix produced – consistent with it being one of the lowest populated regions in the country. Figures for all regions can be found in Table 4.1.

Table 4.1: New Zealand Ready-Mix Production (million cubic metres) 2008-2018

Region	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Northland	0.11	0.09	0.09	0.07	0.08	0.08	0.11	0.12	0.13	0.15	0.17
Auckland	1.15	0.90	0.91	0.93	0.90	1.03	1.17	1.26	1.46	1.46	1.49
Waikato, Bay of Plenty	0.62	0.45	0.46	0.44	0.46	0.47	0.58	0.62	0.67	0.74	0.71
Rest of New Zealand	1.61	0.68	1.23	1.19	1.38	1.55	1.80	1.88	1.75	1.77	1.73
Total New Zealand	3.44	2.70	2.69	2.64	2.82	3.13	3.66	3.87	4.02	4.12	4.10

Source: Statistics New Zealand

¹ To this we have added sand used for other purposes in Auckland. We do not have total sand use values for all New Zealand.



Because of the nature of sand as a low-value, high-weight product, it does not travel well. This means that for sand extraction to be economical, it should be located proximate to the areas it is required. The current extraction sites located throughout the Auckland Region can be seen in Figure 5.1.

4.1.1 Auckland Sand Extraction

As mentioned above, the amount of sand extracted annually is unavailable. However, sand extraction consents and sales estimates have been supplied to M.E Consulting for the 2018 year. Based on these, it is estimated that approximately 750,000 tonnes of sand were sold from Auckland sand suppliers. This is noteworthy because the amount of sand required to produce the amount of ready-mix concrete indicated above (1.49M cubic metres) is approximately 600,000 tonnes. This means that some of the sand extracted within Auckland will have been either stored, sold into other industries or exported to other regions.

Sand also has other uses in landscaping, industrial applications and the turf industry. The amount involved in these is low but still significant as compared with the ready-mix concrete industry. In total, it is estimated that in 2018, 150,000 tonnes of sand was used for other purposes in Auckland. McCallum Bros Ltd. currently sells 45,000 tonnes of sand into these markets from the three consented areas. The sand sales and supply figures above have been based on existing sales information McCallum Bros. Ltd. holds or from the respective industries.

4.2 Historic Per Capita Ready-Mix Production and Demand

Sand extraction and demand within a region is closely linked, given that sand is a bulky, relatively low-value product that does not lend itself to transportation over long distances. Assuming that no (or an insignificant amount of) sand is imported or exported into/out of New Zealand, we can then assume that total production is equivalent to total demand at the national level. We can also assume that the demand per capita is equal across New Zealand, given that while the use of sand in ready-mix concrete for larger buildings is likely to be higher in metropolitan areas, other infrastructural assets are higher on a per capita basis in provincial and rural areas (such as length of roading).

Based on the average national per-capita consumption of ready-mix concrete, it is possible to show which areas are in shortfall and which are in over-supply of ready-mix (and therefore sand). Since 2000, the supply of ready-mix in Auckland has fluctuated between shortfall and oversupply, with a shortfall 2012-2015 and a surplus for the rest of the time period. This indicates that there is some capacity for export from Auckland of ready-mix (or sand) to other regions.

The national average level of consumption of ready-mix concrete over the past 18 years is 0.76 cubic metres per capita. However, this has varied greatly, ranging from a low of 0.64 cubic metres (2011) to a high of 0.88 cubic metres (2005, 2007). Based on an average of 400 kilograms of sand per cubic metre of ready-mix, this equates to 0.30 tonnes of sand per capita (average), 0.24 tonnes per capita (2011) and 0.35 tonnes per capita (2005, 2007). Table 4.2 presents demand for ready mix concrete for the upper North Island and the rest of New Zealand over the past 10 years. Table 4.3 then translates that into sand demand for the same areas.

Table 4.2: Ready-mix Demand per Capita (cubic metres) 2008-2018

Region	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Northland	0.70	0.54	0.56	0.44	0.50	0.47	0.68	0.69	0.79	0.86	0.93
Auckland	0.82	0.64	0.64	0.64	0.61	0.69	0.76	0.80	0.90	0.88	0.88
Waikato, Bay of Plenty	0.93	0.66	0.66	0.63	0.66	0.66	0.81	0.85	0.90	0.97	0.92
Rest of New Zealand	0.83	0.38	0.62	0.59	0.66	0.72	0.80	0.83	0.78	0.82	0.78
Average New Zealand	0.81	0.63	0.62	0.60	0.64	0.70	0.81	0.84	0.86	0.86	0.84

Source: Statistics New Zealand

Table 4.3: Sand Demand per Capita (tonnes) 2008-2018

Region	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Northland	0.28	0.22	0.22	0.18	0.20	0.19	0.27	0.28	0.31	0.34	0.37
Auckland	0.33	0.25	0.25	0.26	0.24	0.28	0.31	0.32	0.36	0.35	0.35
Waikato, Bay of Plenty	0.37	0.26	0.26	0.25	0.27	0.27	0.32	0.34	0.36	0.39	0.37
Rest of New Zealand	0.33	0.15	0.25	0.24	0.26	0.29	0.32	0.33	0.31	0.33	0.31
Average New Zealand	0.32	0.25	0.25	0.24	0.26	0.28	0.32	0.34	0.34	0.34	0.34

Source: Statistics New Zealand

4.3 Future Sand Demand

4.3.1 Standard Growth

Auckland's projected future sand demand is based on the national average per capita demand from 2014-2018 (0.34 tonnes per person per year) multiplied by the percentage difference between the 2014-2018 Auckland average and the national average (Auckland's per capita demand was approximately 2% higher than the national average in 2014-2018). Added to this is 0.08 tonnes per person to cover landscaping, turf and industrial uses. Table 4.4 shows the expected population growth of New Zealand regions.²

A portion of sand growth will be tied to the growth in the economy that is unrelated to household or population growth, as the economy provides a range of services for other regions in New Zealand and responds to export demands that are unrelated to population growth within the region. We have assumed that the average growth in sand demand captures both aspects, and can be used to project a relatively conservative future for Auckland sand demand (equivalent to 1.5%)³. It can be seen that Auckland is expected to out-grow other New Zealand Regions, based on its ability to capture a significant share of the nation's population growth. This means that in the future, Auckland is going to require a higher proportion of New Zealand's total sand production than it has done in the past.

² This is based on Stats NZ medium level population projections.

³ This is conservative relative to the Auckland Growth Monitor 2018, which indicates average GDP growth of 3.9% over the past five years, and annual growth of 2.2% since March 2017).

Table 4.4: Projected Population Growth 2018-2043

Region	2018	2023	2028	2033	2038	2043	% Change 2018-2043
Northland	179,100	183,280	188,570	192,470	195,060	196,760	10%
Auckland	1,695,900	1,859,320	1,990,200	2,112,060	2,222,600	2,326,140	37%
Waikato	468,800	489,760	510,830	529,100	544,590	558,300	19%
Bay of Plenty	305,700	322,220	333,720	343,310	350,870	356,930	17%
Rest of New Zealand	2,236,150	2,303,180	2,366,410	2,417,910	2,479,370	2,484,740	11%
Total New Zealand	4,885,500	5,157,760	5,389,730	5,594,850	5,792,490	5,922,870	21%

Source: Statistics New Zealand Medium Growth Projections

4.3.2 Sand Demand with High Economic Growth Projection

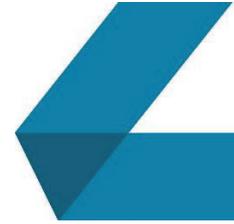
To provide a range for comparison, we have estimated the maximum level of sand required by Auckland per year from 2018-2043. Under this high economic growth projection, we have increased and sustained the growth to 2.5% per annum. This is greater than the 2.2% growth seen between March 2017 and 2018. It has been assumed that growth in demand for sand is linearly related to economic demand growth.

Figure 4.1 below, shows the growth range of sand demand under both these scenarios. The blue section shows sand demand for 2018 as a baseline. The orange section shows the growth in demand due only to population growth (and standard economic growth), the grey section shows likely demand if economic growth rates are sustained at 2.5% (the high growth scenario). The range determined from these two sections is between 1.01M tonnes and 1.19M tonnes of sand in 2043, an increase of between 0.29M tonnes and 0.45M tonnes from 0.74M tonnes in 2018.

Under the high growth future, the region will almost double the sand consumed in 2013 by 2043. This will require the retention of existing sand extraction resources, ensuring that there is sufficient supply to meet or facilitate regional growth. Currently, Auckland extraction sites hold sufficiently large volumes to meet the demand under the high growth scenario, although expiry of all of these consents by 2028 (at the latest) will render this supply non-existent.

A concern for Auckland's future growth would be the loss of a sand resource on the east coast of New Zealand, with the only other nearby marine sourced sand being available from the Taporapora sand banks located within the Kaipara Harbour on the west coast. Should this resource fail then Auckland would be left with no sufficiently large consents and would without doubt be unable to supply its sand requirements. Volumes available in the Waikato region on their own fall woefully short of the volume requirements and are considered less desirable for high strength concrete applications.

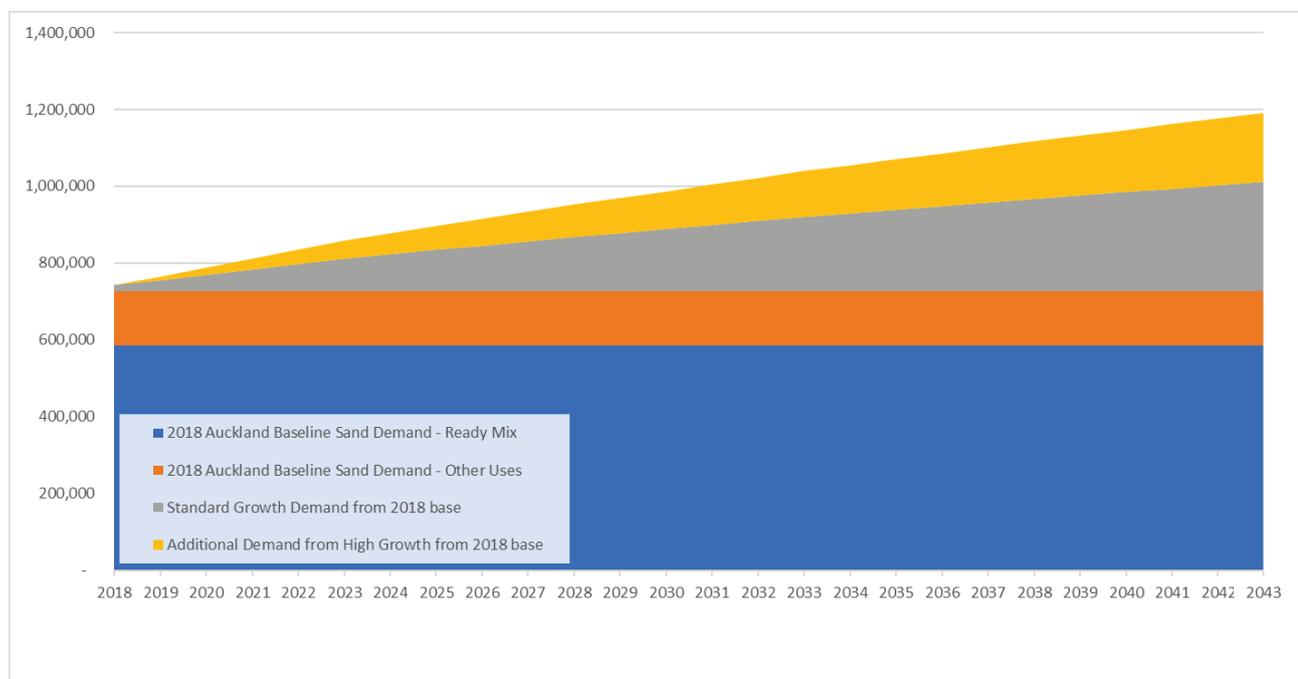
A further concern should the west coast sites become relied upon is the operational capability of the current extractors. The Kaipara Harbour is an aggressive harbour which has inclement weather regularly. This limits the extraction operations to only 70% of potential days. On top of this the point of discharge is up a smaller river which means that vessels are limited in number and in size. Further, the presence of endangered Maui and Hector's Dolphins nearby to the Kaipara Harbour could potentially cause operations at the Taporapora extraction site to cease or be a reason for future consent applications to be denied. The sum total of this is that operationally these sites are incapable of extracting the full volume required should the Pakiri sites not be renewed.

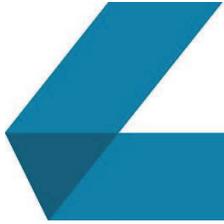


Together with the potential operational constraints, limiting the supply of sand to one supplier or one region is also likely to increase the cost of the product to the final consumer as competition is removed. Failure to renew the resource consents at Pakiri would effectively create a monopoly on high-quality sand for use in construction, potentially increasing construction costs for the end user as the market is cornered.



Figure 4.1: Projected Future Sand Demand (Standard- and High-Growth Scenarios)





5 Pakiri Extraction

Having established the scope and scale of the Auckland market for sand and its potential future growth and change (in the context of national growth), it is necessary to understand the current role of sand extracted under the Pakiri consent. Once this is understood it is possible to assess the potential role it may play in the future. This section summarises the Pakiri operation in comparison with other Auckland extraction operations.

5.1 Historical Context

Extraction operations at the Pakiri embayment have a relatively long history, with consents first granted to McCallum Bros. Ltd in the 1940's. Extraction operations have increased in volume through the years through a number of parties. Throughout this period, continued monitoring of the sand resource has been established to ensure that extraction is sustainable. The sustainability of Pakiri as a sand resource has been upheld by previous Environment Court decisions which examined the evidence and determined that natural geophysical processes replenish the resource effectively.

5.2 Current situation

Of the three consents available in the Mangawhai Pakiri embayment, McCallum Bros. Ltd owns two (inshore consent) and Kaipara Ltd own one (offshore consent), with McCallum Bros. Ltd exclusively extracting sand from all three. The inshore consents allow for the extraction of 76,000 cubic metres of sand per annum (136,000 tonnes) and expire in September of 2020. The offshore consent expires in either 2023 or when 2 million cubic metres (approx. 3.6m tonnes) of material has been extracted, whichever occurs first. The offshore consent is limited to 150,000 cubic metres annually (approx. 270,000 tonnes) within the 30m bathymetric contour but does allow for further extraction beyond the 30m contour if pre-dredge assessments are undertaken. It should be noted that Pakiri's sand is of a high quality, making it appropriate for all types of uses within the construction sector – especially within ready-mix concrete.

Currently, the operation at Pakiri is running at nearly full capacity, with approximately 346,000 of the maximum 406,000 tonnes extracted in the most recent figures for the last year. It should be noted that approximately 20,000 tonnes of this sand is sold into regions outside of Auckland. In competition, are two consents with the capability to extract 1,080,000 tonnes located in the Kaipara Harbour that are held by Winstone Aggregates (approx. 475,000 tonnes annually) and Atlas (approx. 605,000 tonnes annually). However, the most recent figures indicate only approximately 200,000 tonnes and 193,000 tonnes (respectively) have been extracted from these consents in the last year. This means that the offshore operation at Pakiri is currently the largest supplier in the Auckland market, as well as being a major player in the Bay Of Plenty and Waikato markets. As shown in Table 5.1 below, the combined consents at Pakiri make up 43% of Auckland's overall sand sales although it only makes up 27% of the consented volume.

The implication that can be drawn from this is that the offshore extraction at Pakiri is more economically viable than the alternatives. Figure 5.1 shows the location of the existing sand extraction and distribution sites near to Auckland.

Figure 5.1: Sand Supplier Distribution Sites

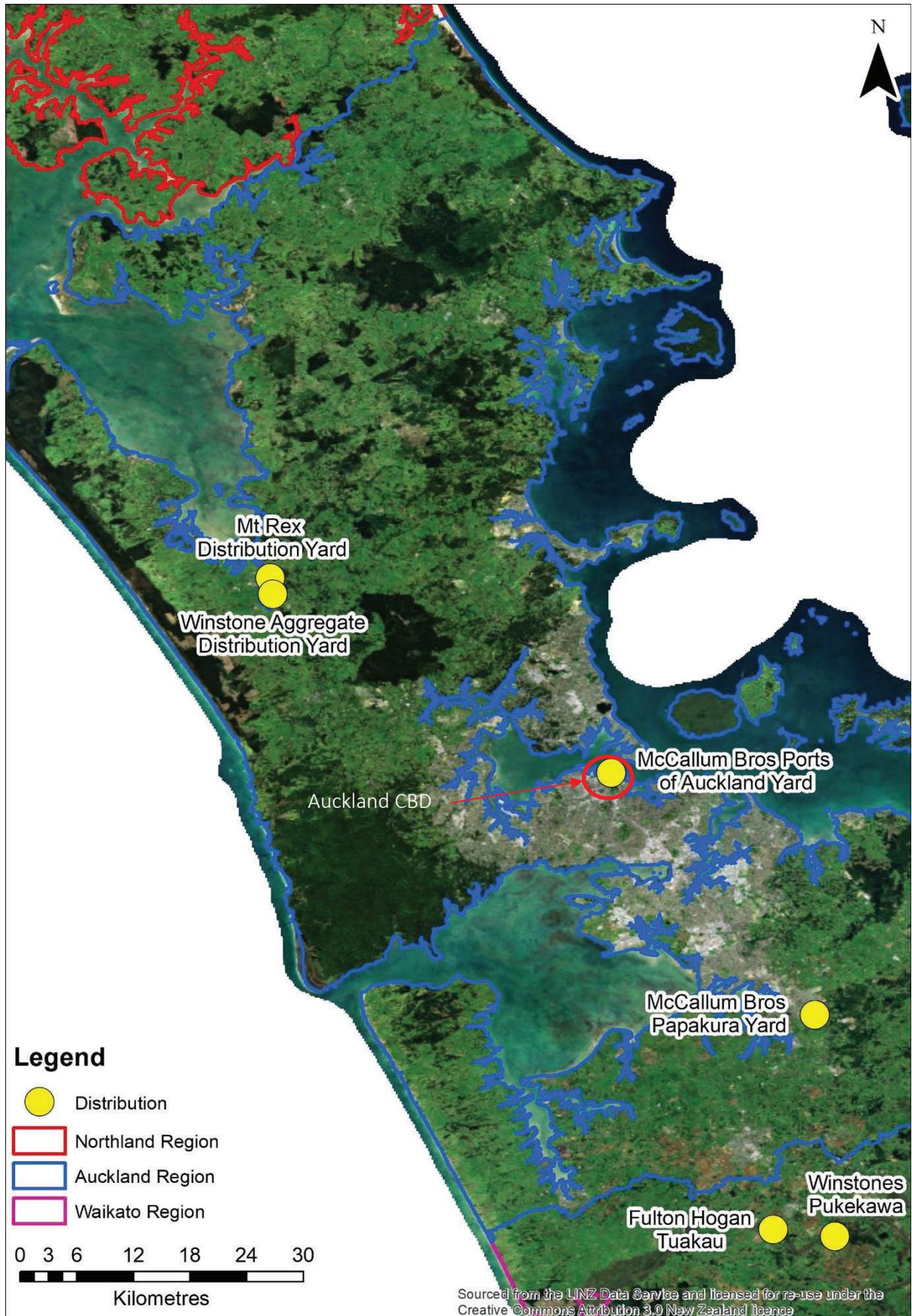


Table 5.1: Production Capacity and Sales of Open Auckland Extraction Sites

Quarry	Owner	Operator	Consented Maximum Volume (tonnes)	% of Max Market Supply	Current Sold (tonnes)	% of Current Market Supply	Spare Capacity (tonnes)
Pakiri Offshore	Kaipara Ltd	McCallum Bros Ltd	270,000	18%	210,000	29%	60,000
Pakiri Inshore	McCallum Bros Ltd	McCallum Bros Ltd	136,800	9%	116,800	16%	
Taporapora Sandbank	Winstone Aggregates	Winstone Aggregates	475,200	32%	200,000	28%	275,200
Taporapora Sandbank	Atlas	Mt Rex Shipping	604,800	41%	193,367	27%	411,433
Total			1,486,800		720,167		766,633

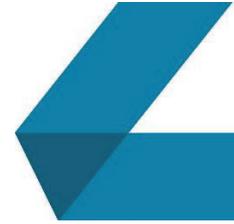
Note: 20,000t of Pakiri Inshore sand is sold outside the Auckland Market

5.3 Future demand

Auckland is expected to see significant levels of population and household growth in the coming decades. Projections indicate that some 9,000-13,000 new dwellings per year will be required in order to accommodate this growth up to 2038. This growth will drive up demand for sand across Auckland. If the Pakiri consents were not to be renewed in 2020 and 2023, there would be a significant drop in the sand supply to Auckland, as well as the Northland and Waikato/Bay of Plenty regions which are also partially supplied by Pakiri.

Renewal of the consent at Pakiri delivers substantial benefits to Auckland, Northland, the Bay of Plenty and Waikato Regions.

- First, because sand is a high-mass low-value product, it is expensive to transport long distances via the road network (described in more detail below).
- Second, the sand at Pakiri is proven to be very high-quality and advantageous for use in ready-mix concrete, unlike some of the sands from sources within the Waikato and Bay of Plenty which have quality issues related to volcanic material inclusions.
- Third, the operation at Pakiri is a known resource, meaning that time and costs are not incurred to explore other potential alternatives.
- Fourth, the environmental impacts of extraction at Pakiri are well-known and quantified as evidenced by decisions made by the Environment Court relating to current operations there (Decision No. A066/2006 and Decision No. A 1/2003 for offshore).
- Fifth, having resources on both coasts minimises the risks to Auckland's sand supply through adverse weather events or unforeseen geographical events that may occur. While consents on the West Coast could supply all of Auckland's sand what would happen in the event of a site closure in this region?
- Sixth, there is a significant advantage of barging direct to Auckland's CBD and other ports in the northern region of New Zealand. Based on current volumes supplied, the loss of the Pakiri consents would result in an extra 10,500 truckloads being required from the Helensville sand plants at the current volumes. This would increase congestion significantly on these western road links and equates to 21,000 truck movements to account for a forward and return trip from the sand plants in Helensville.
- Pakiri sand is the only sand that can be used for Auckland's beach replenishment projects. This is based on the **Mauri** (source) and specification of the sand.
- Finally, renewal of the consent means that sand supply is secured within Auckland into the future, especially in light of the expiry of the Taporapora Sandbank consents due in 2027.



Although these two consents theoretically⁴ have sufficient capacity to cater for the loss of Pakiri if required, their own expiry jeopardises Auckland’s sand supply further. Figure 5.2 builds on Figure 4.1 to show the sand supply deficits under the standard and high growth scenarios, with and without the renewal of consent for extraction at Pakiri. Note that we have included the loss of capacity from Pakiri inshore in 2021, Pakiri offshore in 2023 and Taporapora Sand Banks in 2028.⁵ Essentially, under current consents, assuming no renewals the Auckland Region’s sand supply availability will hit zero in May 2027 – when the supply lines drop below the break-even line. The shortfall is therefore the amount of demand growth from that point onward.

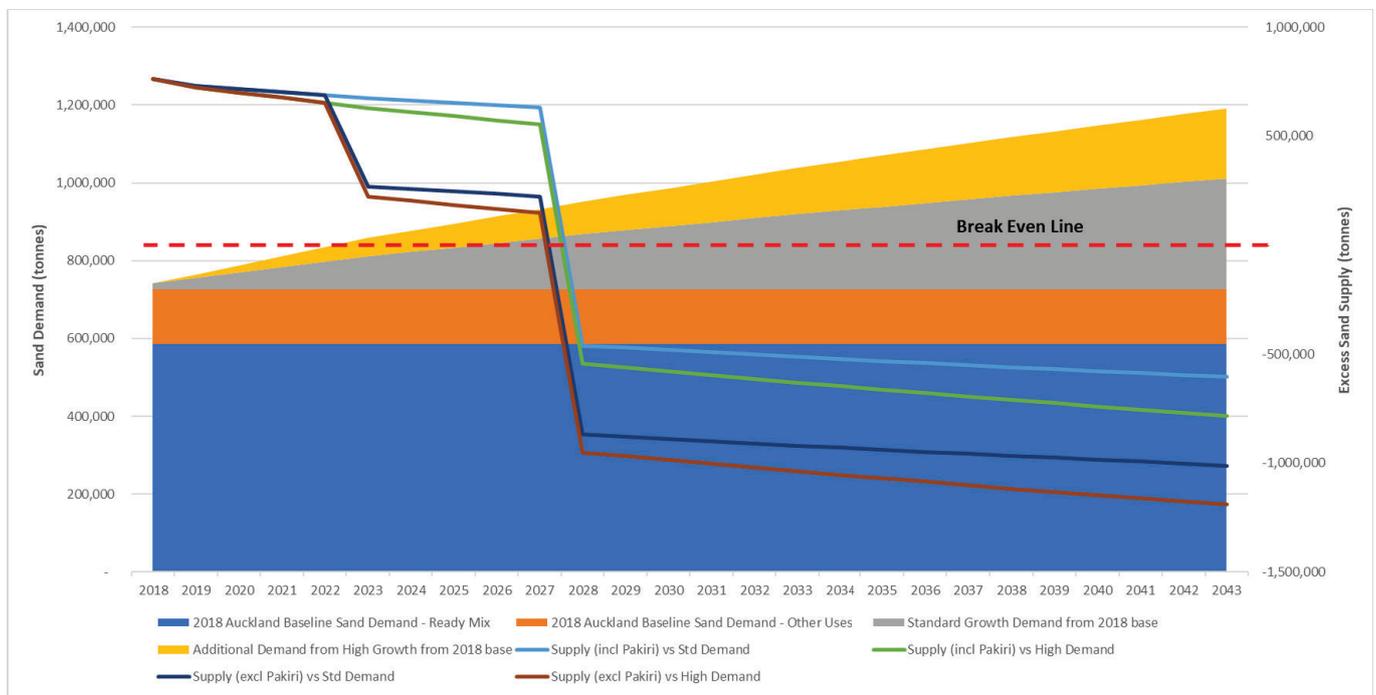
Pakiri, with its location and ease of long-term access to a high-quality sand resource, its ability to deliver in a low-cost manner into the heart of Auckland, is ideally situated to help meet the growing demand for sand in Auckland, Northland, Bay of Plenty and Waikato. Protecting the volume of sand available from Pakiri will assist in maintaining more cost-effective construction activities around Auckland and the wider regions. Furthermore, it is our understanding that McCallum Bros Ltd have been approached by clients in other parts of the country (e.g. Hawke’s Bay) requesting quotes for sand extraction and delivery. This reinforces the view that the operation is nationally significant and should be protected appropriately.

⁴ Although the consents enable extraction of more than one million tonnes of sand annually, past figures indicate that the operators extract less than half of this. This means that either infrastructure or market (cost) constraints inhibit the operators’ ability to extract at the maximum level.

⁵ Although the Taporapora consents expire in May 2027, we have assumed that they may still be able to extract sand for those first 5 months of the year. The figure is therefore slightly conservative.



Figure 5.2: Auckland Sand Demand Versus Excess Supply, 2018-2043





6 Auckland Costs and Benefits

In order to establish the worthiness of renewing resource consent for extraction at Pakiri, it is necessary to establish the costs and benefits associated with the potential renewal in comparison with the principal alternatives to sourcing sand from Pakiri.

This section focuses on the avoided transportation costs achieved and the reduced production of CO₂ by retaining the sand supply from Pakiri as opposed to sourcing the sand from elsewhere within the region. In doing so, it assumes that the costs of extraction are similar for extraction sites within the Auckland Region. The focus in the following section is on the longer-term benefits of maintaining the supply.

6.1 Transport and Associated Costs

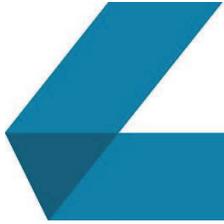
Transporting sand is a costly process. Industry information indicates that to move a tonne of sand 1km along the road network costs 17 cents.⁶ Given that the nearest available source of sand within Auckland is from the Winstone/Atlas storage yards in Helensville which are 55km away from Ports of Auckland, this means that every truck movement (with 30 tonnes of sand into the CBD) along the road network costs \$280.50. With sand costing approximately \$35 per tonne delivered to a concrete plant (\$1,050 per truckload), road transport to the Auckland CBD area from Helensville represents a 27% increase in the overall price. Furthermore, this transport cost can effectively be doubled, as the truck needs to return to the plant and is unlikely to have any load to offset the price. This means that the delivered cost of that sand is significantly higher than sand delivered by barge to the CBD.

The additional cost to transport the shortfall from Helensville due to the loss of the Pakiri operation, would be an additional cost of \$6.1M to \$7.6M annually.⁷ Note that these amounts would be likely to increase in future in response to volume growth out of Pakiri that would need to be replaced. It should also be noted that the Taporapora Sand Bank consents expire in 2027, and transport costs are likely to increase further after this point. Using the same rationale, to source the shortfall from Winstone Aggregate's Pukekawa Sand Plant⁸ in Waikato would cost between \$7.2M and \$9.0M annually based on a 130km round trip. Although this plant does not have the capacity to supply the total potential shortfall. Other than the Pukekawa operation, the nearest Waikato-based plant with any capacity is located in Cambridge, a 300km round-trip. Transport costs from these locations are likely to rise further as suppliers raise delivery prices in step with increases in diesel and maintenance costs. There are also the additional costs of the wear and tear on the road network as well as traffic congestion arising from transport from these plants.

⁶ Based on the average cost to run a truck a specified distance. The average cost is calculated based on a full load one-way priced at 34 cents and an empty load back at 0 cents. This does not include any profit margin for contractor rates.

⁷ Range based on 326,000 tonnes (2018 year rate) to 406,000 tonnes (maximum consented), at an average of 30 tonnes per truck.

⁸ The largest non-Auckland sand plant that is able to supply some of the shortfall caused by closure of Pakiri. Note that the land-based sands from this plant do have issues due to volcanic inclusions. Although the nearby Fulton Hogan Tuakau plant has a larger consent (324,000 tonnes annually), the operation is already at capacity.



Adding to the actual transport costs, there are also additional environmental costs. The economic costs of the different pollutants have been calculated for particulate matter, nitrogen, carbon monoxide, hydrocarbons, and carbon dioxide. The base values have been sourced from the NZTA Economic Evaluation Manual 2018⁹ based on average heavy vehicle emissions.¹⁰ Based on these, the environmental cost is in the range of \$360,000 to \$450,000 per year to transport the shortfall from Helensville to Ports of Auckland. The cost increases to \$398,000 to \$497,000 if the sand shortfall was sourced from the Pukekawa Sand Plant. Note that these are the one way costs, based on the distance travelled and the weight of sand involved/trip.

Although there are, of course, transport costs associated with extraction at Pakiri currently, these are significantly less than those associated with road transport. This is because the operation currently uses barges as the main form of transport to Ports of Auckland, which reduces both road congestion, infrastructure damage and emissions significantly when compared to road-based transport. Adding an extra 10,500 to 13,560 truck movements¹¹ is likely to exacerbate these issues. Again, note that these are one-way only, double if return trips are considered.

Assuming that road transport and environmental costs remain approximately the same, renewal of the consent at Pakiri could save between \$6.6m and \$8.2m annually, or \$132m to \$165m between 2023 and 2043. This represents the economic benefit (in the form of avoided costs) that accrue to Auckland's economy - and ultimately households – if the Pakiri consent is renewed. However, this is likely to be on the conservative side, as it assumes that the Helensville plants are able to meet the shortfall caused by Pakiri's consent expiry. In all likelihood, the transport costs will be significantly higher when the Taporapora consents expire and sand is needing to be sourced from further and further afield. These costs have also only been calculated to Auckland Central – they are likely to rise further if sand transport is needed to supply Northland, Waikato/Bay of Plenty, or other regions.

6.2 Reduced Cement Usage

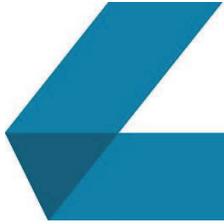
Sands sourced from Pakiri are known to be of high quality and ideal for use in concrete, particularly where high compressive strength concrete is required. As the required strength in concrete increases, more cement is required, which in turn increases the alkalinity of the product which poses some risks with adverse reactions with the aggregates used. Alkali Aggregate Reactivity is a phenomenon where expansive reactions can take place due to the high pH of the concrete. This can lead to the concrete degrading over time which will ultimately lead to a shortening of the life of the structure.

Waikato sourced sands are known to be susceptible and contribute to Alkali reactivity in concrete, in particular where those concrete mixes used are above 40Mpa which most infrastructure concretes are. To eliminate this risk these sands are avoided in concrete in Auckland.

⁹ Available at: <https://www.nzta.govt.nz/resources/economic-evaluation-manual>

¹⁰ We have based the values on an average speed of 60km/hr at a gradient of 0%. They are therefore relatively conservative.

¹¹ Based on current and maximum extraction rates at 30 tonnes/truck.

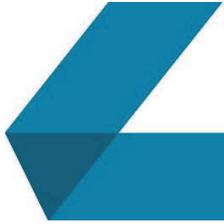


The use of Pakiri sands also provides an avenue to reduce cement content in the mix due to its favourable mineralogy and particle size distribution. A typical concrete mix using Pakiri sand will allow a reduction of an average of 20kg of cement per cubic metre of concrete (based on a standard 20mpa mix). With the market price of cement being approximately \$220 per tonne this equates to a saving of \$4.40 per tonne of sand vs using a Waikato sourced sand. This value does not include the reduction in risk of Alkali Silica reaction plus the increased transport costs for transporting sand from either Helensville or Tuakau (the closest Waikato sourced sand).

6.3 Reduced CO₂ Emissions

If the Pakiri resource consents should not be renewed the extra trucking kilometres could equate to another 21,000 return trucking trips on the road from Helensville to Auckland at current extraction volumes at 110km each. This equates to a further 2.3million km travelled on Auckland roads than if the Pakiri consents were maintained. Assuming there is little difference in the cost or CO₂ emissions of delivery by barge of either sand to the point of discharge then Helensville sourced sand will contribute a further 1,304 tonnes of CO₂ to the environment annually.

Further to this, based on the reduction in cement required in using Pakiri sourced sand there are CO₂ reductions vs using Waikato sourced sand. Based on 20kg of cement being saved per cubic metre of concrete produced there is a saving of 18kg of CO₂ on the manufacturing side of the concrete per cubic metre. Based on all volume coming from the Waikato to replace the Pakiri contribution to Auckland's sand resource the resultant increase in CO₂ emissions would be in the order of 12,600 tonnes.



7 Conclusions

Efficient and sustainable access to sand will be an important factor in both facilitating Auckland's economic growth aspirations and providing infrastructure such as roading, buildings, and other infrastructure to support Auckland's rapidly growing population and economy.

Auckland's major alternative sand suppliers are at least 55km away by road, and with the cost of a single truck load of sand doubling every 30km (due to its high mass, relatively low value nature), this means that sourcing sand from Pakiri is much less expensive than from other plants within and outside of the Auckland Region.

The Pakiri operation is ideally located in Auckland with access to up to 406,000 tonnes of high-quality sand annually (more beyond the 30m Bathymetric contour). It is able to be barged into central Auckland at a lower cost than alternatives. The Pakiri consents are set to expire in 2023 at the latest, meaning that this deficit would need to be supplied from other sources should the consents not be approved. Due to its location, Pakiri is ideally set-up to deliver sand efficiently and cheaply to Auckland Central, as well as other parts of Northland, Bay of Plenty and the Waikato. Although there is theoretically enough capacity within other resources across the Auckland Region to meet the deficit caused by the expiry of the Pakiri consents, in practice this is likely to be relatively expensive and inefficient in terms of transport. Renewing the consent ensures a steady supply of high-quality sand to different markets in the North Island and requires no further infrastructural expansion or maintenance.

Under current projections, Auckland's demand for sand will rise from 740,000 tonnes in 2018 to between 1,011,700 and 1,191,500 tonnes annually by 2043. It has been noted that Auckland has relatively few sand extraction operations, and that the staggered expiry of these is only going to limit Auckland's ability to meet this growing demand. Currently Pakiri is Auckland's largest supplier by market share, indicating that it is the most efficient and viable option in terms of sand supply. If the consents here are not renewed, the shortfall is theoretically able to be assumed by other plants within Auckland, but only in the short-term (to 2027) and at a higher cost economically and environmentally.

Finally, it has been shown that through renewal of Pakiri's consent, there may be a direct cost-saving of at least \$132million from the transport cost savings within Auckland between 2023 and 2043. This is based on the direct road transport and environmental costs that come as a result of transporting the shortfall along the road network from Pakiri's nearest competitor in Helensville. The 110km round trip and a stable transportation cost of 17 cents per km tonnedrive these estimates,¹² as well as further costs due to vehicle emissions. This estimate is likely to be on the low side, as expiry of the Helensville plant consents in 2027 mean that transport distances will be increased. Note that any additional costs relating to road congestion and infrastructure wear-and-tear will further increase these estimates. Overall transport costs are significantly lower from the Pakiri extraction site, due to the nature and location of the operation allowing the sand to be efficiently transported to the required destination via barge. Further, reduced CO₂ emissions

¹² Based on a full load 55km at 34 cents per kilometre tonne and an empty load back 55km at 0 cents per kilometre tonne.



during both cement production and usage also add to the environmental cost savings associated with sand extraction at Pakiri.

The savings in transport, environmental and social costs represent the key economic benefit of allowing the operations at Pakiri to renew their consents, assuming that the other costs of production are constant between alternative locations.

Based on a current market share of 43% in the Auckland region, the resource is one that needs to be considered as regionally significant and is potentially nationally significant given Auckland's future growth. As such it is essential that access to such an important resource is maintained.