Nici Nel

From: official information
Sent: Wednesday, 30 June 2021 09:54
To: [redacted]
Cc: official information
Subject: RESPONSE 2 of 2: LGOIMA 21107 - [redacted] - Strategic Growth Committee Peer Reviews
Attachments: NIDEA Projections Peer Review - TOR - April 2021.DOCX; Peer Review - Strategic Growth Committee - 20 May 2021.pdf

Kia Ora [redacted],

Please find the completed report in question attached.

You have the right to seek an investigation and review by the Ombudsman of this decision. Information about how to make a complaint is available at www.ombudsman.parliament.nz or freephone 0800 802 602.

Kind Regards,

Tatiyana | Official Information & Legal Support Advisor
Legal Services & Risk | People and Organisational Performance
Email: officialinformation@hcc.govt.nz

Hamilton City Council
Te kaunihera o Kirikiriroa

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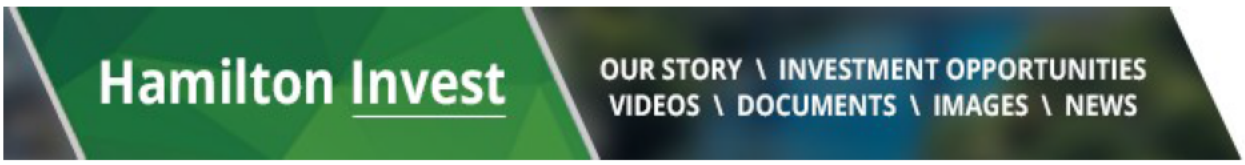

From: Colin Jones [redacted]
Sent: Tuesday, 29 June 2021 1:42 pm
To: official information <officialinformation@hcc.govt.nz>
Subject: FW: Response: LGOIMA 21107 - [redacted] - Strategic Growth Committee Peer Reviews

Could you please provide the said report. I understand it has been provided to councillors.

Kind Regards

[redacted]

From: official information <officialinformation@hcc.govt.nz>
Sent: Tuesday, 27 April 2021 1:15 PM
To: [redacted]
Cc: official information <officialinformation@hcc.govt.nz>
Subject: Response: LGOIMA 21107 - [redacted] - Strategic Growth Committee Peer Reviews

Kia Ora,

I refer to your **information request below**, Hamilton City Council is able to provide the following response.

Request 1 – The party that has been commissioned to undertake the "peer review"
Response 1 – Research and Evaluation Unit (RIMU), Auckland Council

Request 2 – The terms of reference of the " peer review"
Response 2 – Terms of Reference attached.

Request 3 – The time when the "peer review " is expected to be completed.
Response 3 – The Peer Review is expected to be completed by the end of April/ Early May.

Request 4 – A copy of the "peer review " when it is available.
Response 4 – The Peer Review will be made available as an attachment to the Growth Projections report at the 20th May Strategic Growth Committee.

You have the right to seek an investigation and review by the Ombudsman of this decision. Information about how to make a complaint is available at www.ombudsman.parliament.nz or freephone 0800 802 602.

Kind Regards,

Tatiyana | Official Information & Legal Support Advisor
Legal Services & Risk | People and Organisational Performance
Email: officialinformation@hcc.govt.nz

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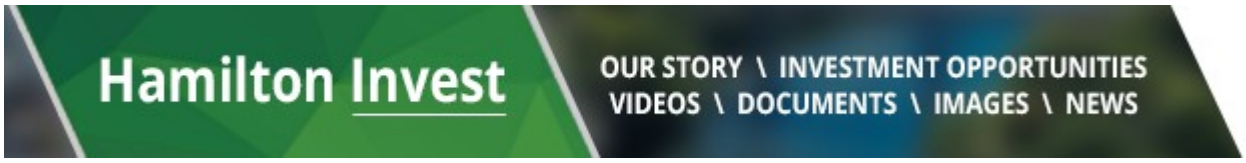

From: [redacted]
Sent: Tuesday, 30 March 2021 4:23 pm
To: official information <officialinformation@hcc.govt.nz>
Cc: Ewan Wilson <Ewan.Wilson@council.hcc.govt.nz>; Rob Pascoe <Rob.Pascoe@council.hcc.govt.nz>
Subject: Peer Review of Growth Projections

Good afternoon, That the Council in addition to the 12 November 2020 Strategic Growth Committee resolution "*requests staff report back to the Strategic Growth Committee within the LTP 2021-31 deliberation period, once the updated NIDEA growth projections that are based on the 2018 Census are available, which is expected to be March 2021, to inform any changes needed*", requests that staff commission an independent peer review of the Growth projections. Could you please therefore provide the following. (1) the party that has been commissioned to undertake the " peer review" (2) the terms of reference of the " peer review" (3) The time when the "peer review " is expected to be completed. (4) a copy of the "peer review " when it is available. Many thanks.

Kind Regards

[redacted]

Peer review of Hamilton City growth projections produced by the University of Waikato

3 May 2021

Prepared by Brian Osborne, Senior Statistical Analyst

Research and Evaluation Unit (RIMU)

Auckland Council

Executive Summary

At the Hamilton City Council meeting on 25 February 2021 Council meeting, staff were requested to commission an independent peer review of updated growth projections for Hamilton City prepared by NIDEA (National Institute of Demographic and Economic Analysis).

This document provides that peer review, as requested of Auckland Council's Research and Evaluation Unit (RIMU) by Hamilton City Council.

The purpose is to provide a 'common-sense' review of the NIDEA projections, with a focus on the reasonableness of the model outputs and approaches used. A full interrogation of the model and associated systems is out of scope.

The review considers the contents of the NIDEA report and undertakes comparisons between NIDEA projections and the most recent Stats NZ projections.

It is acknowledged that NIDEA did not have access to the 2018-base Stats NZ population projections used in this review. I have chosen to use the 2018-base projections however as a comparator, as this is the most relevant, practical, and up to date alternative to the NIDEA population projections. For households and families, the most recent available projections from Stats NZ are 2013-base.

Key findings of the peer review are that:

i) The overall methodology, as described in the NIDEA report, appears sound.

ii) Comparisons made between NIDEA and Stats NZ population projections, the primary means of assessing the reasonableness of the NIDEA projections in this review, show that projected total populations are very similar between the two sources. For example, in the medium growth scenario, percentage differences are within +/- 0.9% throughout the period 2018-2048.

iii) There is an unexpected difference between the NIDEA and Stats NZ projections in terms of projected age distribution that merits further investigation. Specifically — and while still within the bounds of reasonableness — there is a smaller increase over time in the proportion of the population aged 65 years and over in the NIDEA projections, as detailed in Section 2.1.2.

iv) There are differences in trends between some of the NIDEA and Stats NZ household type and family type projections that would be worth exploring further. However, it would be beneficial to wait until the new (2018-base) household and family projections from Stats NZ are produced, before undertaking this analysis.

v) The NIDEA projections consider only demographic factors. Land use considerations are excluded. Marked changes in local or regional infrastructure development, housing availability, land supply and/or planning rules have the potential to make any projections less accurate predictors of reality.

In conclusion, in the context of demographic projections where the future cannot be known with certainty and acknowledging NIDEA's caveat in the report (Page 89) that "…these projections are simply one tool that should be used in evaluating possible futures for the region", and without having access to more detailed data, I consider that the NIDEA growth projections are reasonable.

A small number of recommendations are provided in Section 5.0.

Attachment 2

Item 9

Contents

1.0 Introduction

Auckland Council's Research and Evaluation Unit (RIMU) has been commissioned by Hamilton City Council (HCC) to conduct a peer review of the growth projections for Hamilton City prepared by NIDEA (National Institute of Demographic and Economic Analysis) at the University of Waikato[1].

As per the objectives of the peer review Terms of Reference (see Appendix 1), I will not be providing a full interrogation of the NIDEA demographic model and associated systems. Instead, I have approached the review task by considering the reasonableness of the model outputs, and where practical, commenting on the methodology, inputs and assumptions used, as outlined in the NIDEA report.

I first consider the population projections and then the household and family projections which are derived from these.

2.0 Population Projections

In this section, I compare the NIDEA outputs with Stats NZ projections, and then focus on the methodology, inputs and assumptions used.

Without access to the underlying software used for the model, comparisons with Stats NZ projections is the most practical way to assess the reasonableness of outputs. Stats NZ projections are widely assessable and used by many New Zealand councils for planning purposes — including Auckland Council — and therefore the most appropriate comparator to use.

It is important to note that NIDEA population projections are provided to 2068, a 50-year time horizon out from the base year of 2018, whereas Stats NZ limits published sub-national projections to 30 years from the base year (latest release 2018-2048)[2].

Auckland Council's own growth model[3] provides projections, by way of comparison, from 2018 to 2051.

In light of the above,

i) the NIDEA time horizon of 2068 is considerably further into the future compared to other sub-regional projections. Users should be aware that levels of uncertainty related to projections typically become greater the further into the future they extend[4], and

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[1] As reported in Cameron, Michael P. and Cochrane, William: "2018-base Population, Family and Household, and Labour Force Projections for the Waikato Region, 2018-2068", Commissioned Research Report (Final Draft), Prepared for Waikato Regional Council, April 2021.

[2] Stats NZ do publish national level projections out to 53 years from the base year (2020-2073). They are able to extend custom-ordered projections sub-nationally on request, to assumptions agreed by the client; these have not been requested for this peer review.

[3] Auckland Council's growth model uses Stats NZ projections at TLA level as input, and then allocates population sub-regionally considering land use planning and other factors.

[4] See for example Table 8.2 in Stat NZ's report assessing the accuracy of their projections over time "https://www.stats.govt.nz/methods/how-accurate-are-population-estimates-and-projections"

ii) comparisons with Stats NZ population projections in this review will be limited to 2018-2048.

2.1 Comparison of NIDEA population projections with Stats NZ

As Stats NZ publish population projections at 5-year intervals, in the comparisons that follow I consider only those years for which Stats NZ figures are available.

2.1.1 Total Population

Looking first at the medium growth scenario as per the highlighted row in Table 1 below, the percentage differences between NIDEA and Stats NZ population projections are +/- 0.9% or less throughout the period 2018-2048, as shown in Table 1 (together with other projection scenarios).

This is quite a remarkable outcome given the different methodology used. While the similar results should not be interpreted as increasing the likelihood that the future population will match these projections, it does gives us the first indication that the NIDEA model is returning plausible results.

The percentage differences across the 2018-2048 period for the low and high growth scenarios are within +/- 1.5% and +/-2.3% respectively. In 2048 in the high growth scenario, the NIDEA population is projected to be 260,106, some 6,194 or 2.3% lower than that projected by the Stats NZ high growth scenario.

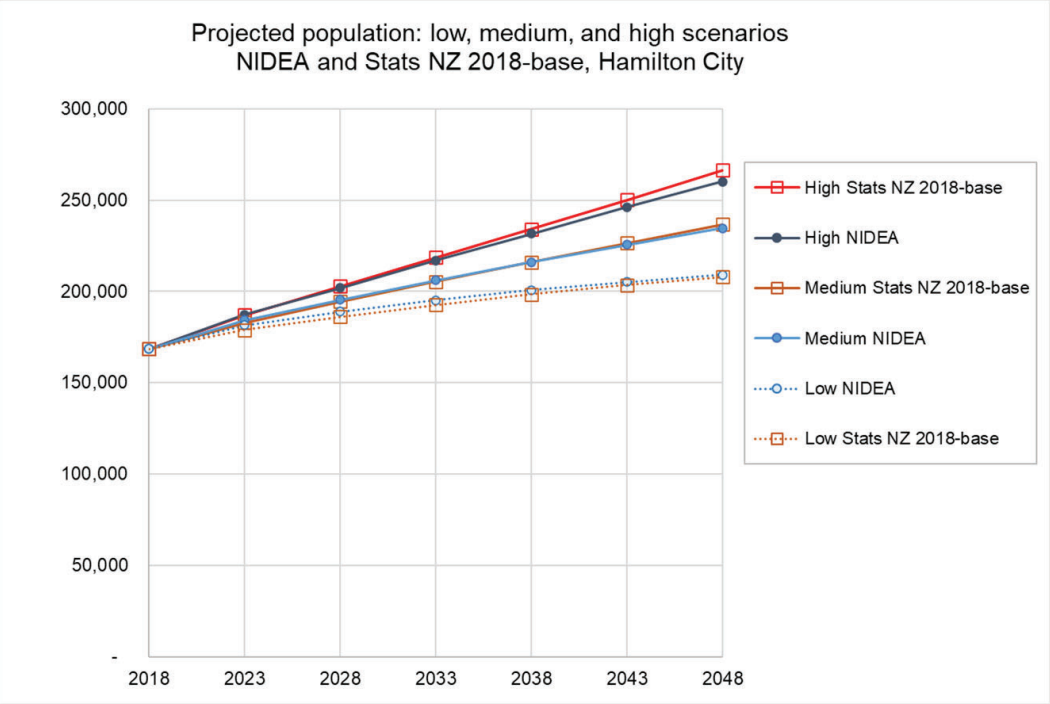
All these percentage differences are reasonable.

Furthermore, considering the projections in graph form in Figure 1, the three different NIDEA scenario populations always fall within the envelope formed by the low and high Stats NZ scenario populations.

Table 1: Comparison table for the NIDEA and Stats NZ (2018-base) population projections for low, medium and high scenarios, for Hamilton City. The medium scenario percentage differences are highlighted.

Scenario	Source	2018	2023	2028	2033	2038	2043	2048
Low	NIDEA	168,600	181,451	188,953	195,232	200,653	205,245	209,039
Low	Stats NZ 2018-base	168,600	179,000	186,200	192,700	198,400	203,500	207,900
Low	Difference	0	2,451	2,753	2,532	2,253	1,745	1,139
Low	% Difference	0.0%	1.4%	1.5%	1.3%	1.1%	0.9%	0.5%
Medium	NIDEA	168,600	184,374	195,445	206,038	216,116	225,598	234,490
Medium	Stats NZ 2018-base	168,600	183,000	194,400	205,400	216,000	226,500	236,600
Medium	Difference	0	1,374	1,045	638	116	-902	-2,110
Medium	% Difference	0.0%	0.8%	0.5%	0.3%	0.1%	-0.4%	-0.9%
High	NIDEA	168,600	187,302	201,955	216,888	231,656	246,069	260,106
High	Stats NZ 2018-base	168,600	187,000	202,800	218,500	234,200	250,200	266,300
High	Difference	0	302	-845	-1,612	-2,544	-4,131	-6,194
High	% Difference	0.0%	0.2%	-0.4%	-0.7%	-1.1%	-1.7%	-2.3%

Figure 1: Projected population comparisons, low, medium, and high scenarios, NIDEA and Stats NZ 2018-base, for Hamilton City. A version of this graph with the vertical axis minimum set to 150,000 to show more detail is provided as Figure A2.1 in Appendix 2.



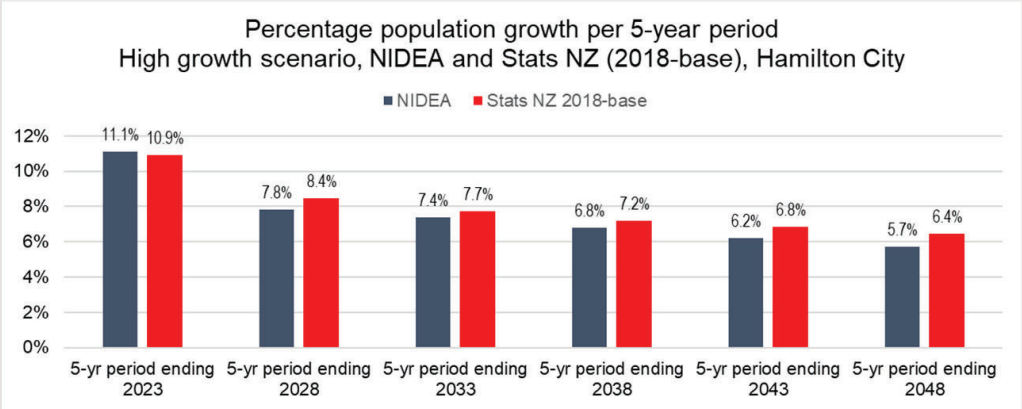
For completeness, a comparison table including the 'Stats NZ 2013(base)–2043 update' projections released in February 2017[5] (those to which NIDEA had access prior to generating their projections) is given in Appendix 2 (Table A2.1), for the medium scenario. The percentage differences between NIDEA projections and these Stats NZ 2013-base projections are also within +/- 1%.

The greatest differences over time between the NIDEA and Stats NZ (2018-base) projections occur in the high growth scenario. A comparison of percentage growth over each 5-year period is shown in Figure 2, which confirms that Stats NZ is projecting slightly higher growth rates than NIDEA for all periods except between 2018 and 2023.

As mentioned above, these differences between the NIDEA and Stats NZ projections are small.

[5] https://www.stats.govt.nz/information-releases/subnational-population-projections-2013base2043-update. These were released in February 2017 and will subsequently be referred to as "2013-base".

Figure 2: Comparison of the percentage growth over each 5-year period for the high growth scenarios, NIDEA and Stats NZ (2018-base).



2.1.2 Age distribution

The Executive Summary of the NIDEA report (page vii) notes that Hamilton City is projected to maintain a relatively young population age structure.

While there are a few different metrics that could be used to quantify and assess this, the statement is consistent with the 2018-base Stats NZ population projections (medium scenario) which show that Hamilton City has the lowest median age of all New Zealand TLAs in 2018. This is also projected to be the case in 2048[6].

In addition, Stats NZ projections show that Hamilton City in 2048:

i) is projected to have the highest percentage (51%) of 0-39 year olds, of all New Zealand TLAs, and

ii) is projected to have the second lowest percentage (19%) of those 65 years and over, of all NZ TLAs (after Wellington City).

The statement about the relatively young age structure in the NIDEA report is therefore sound.

While the age distributions for 2018 and 2043 are shown in the NIDEA report in Figure 27, the accompanying data in table format has not been provided for this review, so I did not look in detail at the age distribution.

However, the proportion of those 65 years and over at 2018 and 2043 between NIDEA and Stats NZ projections can be compared, since the former is given in the text of Page 50 of the report. The comparison is shown in Table 2.

[6] Subnational population projection characteristics, 2018(base)-2048, NZ.Stat table reference http://nzdotstat.stats.govt.nz/wbos/Index.aspx?DataSetCode=TABLECODE7989

Table 2: Proportion of the population aged 65years and over, NIDEA projections compared with Stats NZ 2018-base, for Hamilton City.

	2018	2043
NIDEA (medium) (page 50 of the NIDEA report)	11.6%	12.5%
Stats NZ (medium)	11.6%	17.8%

While NIDEA projects an increase of 0.9 percentage points from 11.6% to 12.5%, the Stats NZ projections show an increase of 6.2 percentage points, from 11.6% to 17.8%.

The range across all TLAs in New Zealand, according to the medium scenario Stats NZ projections is between a minimum of 5.4 percentage points increase between 2018 to 2043 (Christchurch City) and a maximum of 14.5 percentage points increase (Tasman District).

The proportion of the population aged 65 years and over for 2043 in conclusion therefore seems unexpectedly low, when compared with the 2018 figures[7], with the Stats NZ 2043 figures, and my own expectations.

It is recommended that this situation be looked into further, to check that the model is working optimally with regards to age distribution projections.

2.2 Population Projection methodology, inputs, and assumptions

2.2.1 Methodology overview

The general approach used by NIDEA for projecting population is that of a cohort component model.

This is a well-established technique, used by both Stats NZ and the Australian Bureau of Statistics (ABS), among others. The ABS summarises this approach well, specifically, as one which "begins with a base population for each sex by single year of age and advances it year by year by applying assumptions regarding future fertility, mortality and migration"[8].

The basic formula used by NIDEA, as outlined on Page 4 of the report, is therefore sound[9].

2.2.2 Overview of Inputs

Inputs to the model are listed on page 3 of the NIDEA report and include the following data from Stats NZ:

- Census of Population and Dwellings (1991 through 2018)
- Population estimates
- Period life tables
- Vital statistics data (i.e., births and deaths)

[7] 2018 figures for NIDEA and Stats NZ projections are identical, as they both start with the Stats NZ 2018 Population Estimate information released in 2020.

[8] https://www.abs.gov.au/methodologies/population-projections-australia-methodology/2017-base-2066

[9] A minor suggestion to check for clarity in the report on Page 4, in the methodology discussion: The current text "the population at the end of a year" and "…beginning of the year" sound like calendar years, whereas I assume the projections give the population at year ending June 30, in line with published population estimates? This could be clarified if my assumption is correct.

- Demographic projections, and the reported assumptions underlying those projections.

One of the objectives of this peer review, as per the Terms of Reference, is to assess "whether the NIDEA growth projections consider (in the inputs and assumptions) recent spatial planning, initiatives and strategies (e.g. Hamilton-Auckland Corridor, Hamilton-Waikato Metro Spatial Plan, etc)".

This question can be addressed by considering the inputs listed in the report and reviewing the methodology used. This confirms that the NIDEA projections do not explicitly consider land use planning or other strategies, such as those listed above. This is understandable for TLA-level projections such as these, as typically land use considerations would be factored in when projecting populations at finer spatial geographies (e.g., Statistical Area 2 or SA2 areas).

Land use information would generally be input together with the outputs of the NIDEA demographic projection model into a separate model specifically designed for this task. I understand that the WISE model (the Waikato Integrated Scenario Explorer) described as "a dynamic, spatially-explicit computer simulation model that integrates economic, demographic, environmental (climate, hydrology, water quality, biodiversity) and land use (suitability, accessibility, local influence, zoning) information"[10] can be used for this purpose by Waikato Region TLAs.

Regardless, it is acknowledged that considerations such as the cost of housing, the availability of residential land for future development, and relative attractiveness of the different TLAs in the Waikato Region may be sensitive to different regional and local policies and strategies. These consequently impact future population trends through migration patterns, but those factors are outside the scope of the NIDEA migration module and therefore the output projections.

2.2.3 Base populations

The technique to derive base populations for a 2018-base projection series, i.e., the use of 2018 population estimates from Stats NZ, is sound. The interpolation using census data to derive the single-year age groups as used by NIDEA may not have been ideal in previous years (when there was a variation in the magnitude of undercount across demographics, in particular a considerable undercount for young men), but with the addition of administrative data for the 2018 Census this is not likely to be a factor.

2.2.4 Fertility and mortality assumptions

Fertility assumptions used in the NIDEA projections were based on those used by Stats NZ and then modified as part of the calibration process to ensure projected births for the June 2018-2020 period matched those observed.

Mortality assumptions used Stats NZ's TLA-level subnational abridged life tables in conjunction with the national level life tables by single-year-of-age.

The data and approaches used as described in the report for fertility and mortality seem reasonable. It would have been helpful for the purpose of the peer review to compare the natural increase component of growth over time, as shown in Figure 36 of the report (page 49), with that from the Stats NZ projections. Undertaking such a comparison requires access

[10] http://www.creatingfutures.org.nz/wise/what-is-wise/

to the numbers underlying Figure 36 and while these were requested, they were not provided. This comparison has therefore not been undertaken.

2.2.5 Migration

The NIDEA projections produce separate net internal and net international migration figures, as shown in Figure 36 of the report (page 49).

In the published information on components of growth in the Stats NZ projections, these two migration components are integrated, and cannot be separated.

It would have been helpful for the purpose of the peer review to compare NIDEA's total net migration component of growth over time, with that from Stats NZ. Undertaking such a comparison requires access to the numbers underlying Figure 36 and while these were requested, they were not provided. This comparison has therefore not been undertaken.

2.2.5.1 Internal migration

The report provides a good level of detail on the gravity model used by NIDEA for projecting internal migration. The assumptions that drive it make logical sense, i.e., as stated in the NIDEA report, that "migration flows (in both directions) between larger origins and destinations, and between places that are closer together, are substantially larger (holding other factors constant) than migration flows between smaller origins and destinations, and between places that are further apart".

Clearly the 'holding other factors constant' caveat is a complication in the real world. For two hypothetical source TLAs with the same size and distance from Hamilton, factors such as differences in house prices or the availability of local tertiary education opportunities or jobs, would result in different migration patterns from each, but this would not be reflected by the gravity model.

As shown below, however, the migration module within the NIDEA model appears to be giving results consistent with expectations and historic observed data.

2.2.5.1.1 Age-specific in-migration profile

I first consider the age-specific in-migration profile produced within the model (Figure 1 in the report, page 10; also reproduced below as Figure 3) and how it compares with two other sources:

i) experimental data from Stats NZ using linked administrative data (2017) to estimate internal migration (illustrated in Figure 4); and

ii) estimates of internal migration derived from the 'where did you live 5 years ago' 2013 Census question (Figure 5).

Comparisons show the age-specific profile is reasonable, as follows.

The prominent peak in migrants centred around age 18, and the dip prior (around age 11) shown in Figure 1 of the NIDEA report (Figure 3 in this peer review document) is reflected well in the linked administrative data (Figure 4), even though the latter's peak is of lower relative magnitude.

In Figure 5, although the Census age-based migration data I have access to has coarser age bands and thus cannot be directly comparted, it is not inconsistent with the NIDEA graph.

Figure 3: Figure 1 of the NIDEA report, page 10. The figure caption in the NIDEA report is "Figure 1: Age-specific in-migration profile for Hamilton City". This has been reproduced to assist the reader in making comparisons with Figures 4 and 5 below.

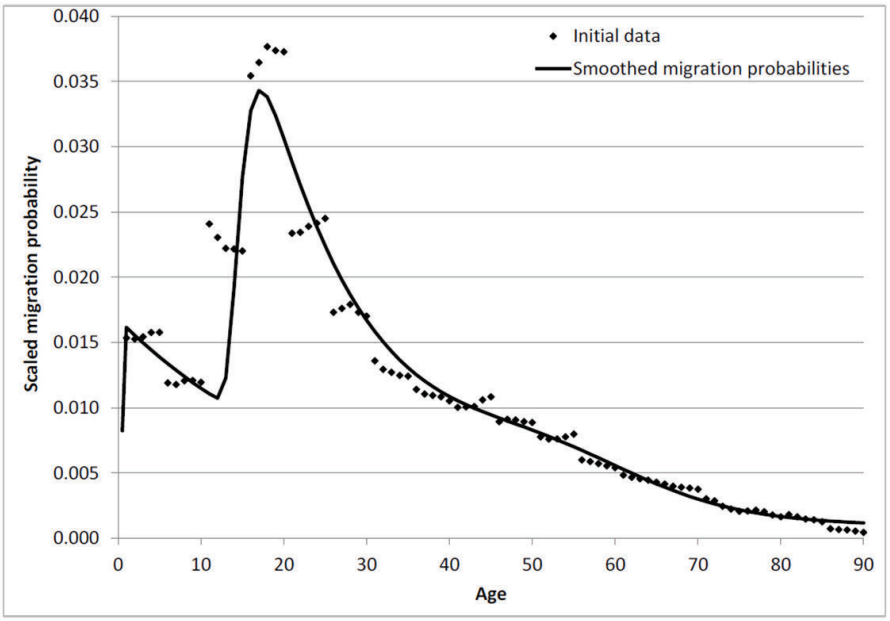
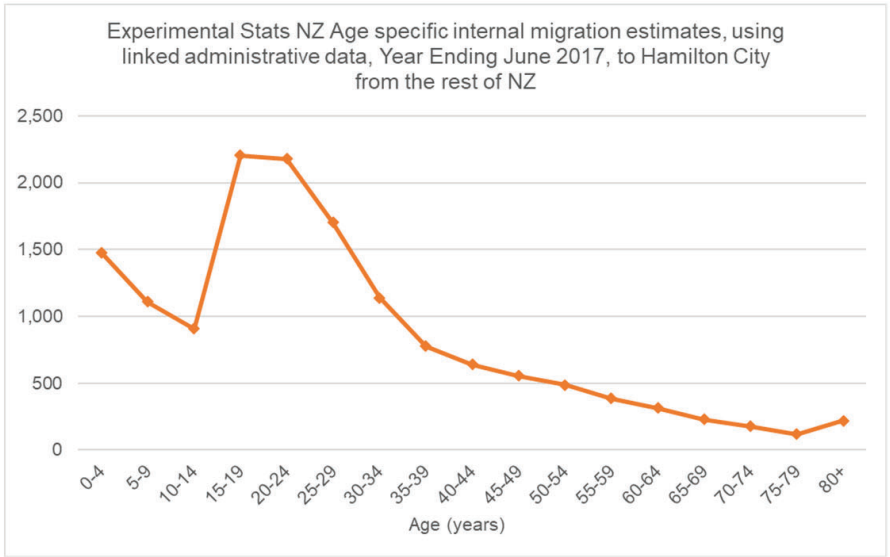
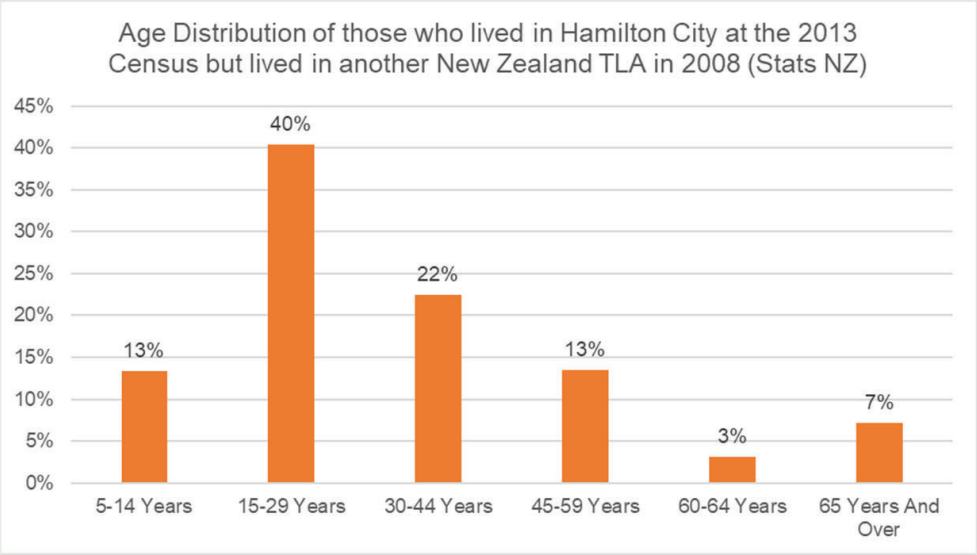


Figure 4: Stats NZ age-specific internal migration estimates to Hamilton City from the rest of NZ, using linked administrative data, for year ending June 2017[11].



[11] https://www.stats.govt.nz/reports/internal-migration-estimates-using-linked-administrative-data-201417

Figure 5. Stats NZ age-specific internal migration estimates to Hamilton City from the rest of NZ derived from 2013 Census data[12].



The NIDEA report mentions tertiary education as a factor in Hamilton being somewhat youthful in Section 5 (page 88) "possibly due to the presence of two large tertiary education institutions". This factor should not be underestimated – the Ministry of Education figures for 2019 showed over 20,000 students enrolled between the two largest institutions combined (University of Waikato and Wintec).[13] This is quite a significant number in the context of the 2019 total population estimate for the Hamilton City of 172,300. I also note for context that the 15-29 year peak for in-migration is more pronounced for Hamilton City (40% of all in-bound migrants, as shown in Figure 5) than the equivalent situation for Auckland (33%).

2.2.5.1.2 Top sources and destinations of internal migration

The list of the top 10 source TLAs for Hamilton City's in-bound domestic migration (i.e., excluding Hamilton City itself), according to the NIDEA projections in 2043, is shown in Table 6 (page 50) of the NIDEA report.

To assess whether the list (and ranking) of source TLAs seems reasonable, I compare with historic internal migration patterns shown by the 2013 Census 'usual residence 5 years ago' question. Although NIDEA used 2018 Census data in addition, I have focussed the analysis using primarily data from the 2013 Census to give an independent check. It should be noted that the 2018 Census data has a relatively high rate of missing data (14.7%) compared with the 2013 Census, for which the equivalent metric is 3.5%[14].

[12] Analysis of custom 2013 Census data obtained by Auckland Council, Stats NZ reference JOB-06247

[13] Provider-based enrolments, 2011-2020, Table ENR.46, https://www.educationcounts.govt.nz/__data/assets/excel_doc/0006/76659/Provider-based-Enrolments-2011-2020.xlsx

[14] https://www.stats.govt.nz/methods/data-quality-ratings-for-2018-census-variables

Table 3 lists the top 10 source TLAs as measured by the 'address 5 years ago' question asked in the 2013 Census[15],[16]. Each of the Census-based top six source TLAs' ranking, from high to low, match their respective ranking in the top six in the NIDEA migration counts, giving confidence that the gravity model NIDEA has developed for internal migration is producing reasonable results. (I would expect that over time, the set of TLAs in the top 5-10 would generally be fairly consistent over time, and thus comparing Census 2013 rankings with the NIDEA projected set of top TLAs in 2043 is an acceptable test for reasonableness).

The fact that Christchurch City appears in the Census 2013 top 10 but not in the NIDEA 2043 list is consistent with larger than usual out-migration from Christchurch between the 2008 and 2013 Censuses due to the February 2011 earthquake that would not be expected to continue far into the future.

When comparing the actual magnitudes of the migration (i.e., in numbers of migrants) between the two data sources, those from the 2013 Census are over a 5-year period. It is not 100% clear in the NIDEA report, but it appears the numbers are for "for 2043". The differences are neither unexpected nor unreasonable, given the uncertainty of future migration patterns.

Table 3: Comparison of the top 10 sources of internal migration to Hamilton City from elsewhere in NZ: 2013 Census data, looking at migration over the period 2008-2013; and NIDEA, 2043.

Source TLA	Population living in Hamilton City in 2013 that lived in the given TLA in 2008 (2013 Census)	Population living in Hamilton City in 2013 that lived in the given TLA in 2008 (2013 Census) **DIVIDED BY 5**	Number from NIDEA Report Table 6 for "Source", 2043 (page 50)	Ranking high to low, Stats NZ, looking at migration from 2008 to 2013	Ranking high to low, NIDEA, 2043
Auckland	4044	809	3288	1	1
Waikato District	3435	687	1114	2	2
Waipa District	2049	410	1089	3	3
Tauranga City	1281	256	409	4	4
Matamata-Piako District	1023	205	254	5	5
Rotorua District	948	190	202	6	6
Christchurch City	849	170	Not in top 10	7	Not in top 10
Thames-Coromandel District	564	113	Not in top 10	8	Not in top 10
Whangarei District	528	106	107	9	9
South Waikato District	495	99	Not in top 10	10	Not in top 10

[15] As an aside, an assessment of the 2018 Census data for completeness shows that the rankings are identical for each of the top seven TLAs as that shown in the 2013 Census data (Table 3), suggesting the set of primary source TLAs remains relatively consistent over time (2018 data sourced from http://nzdotstat.stats.govt.nz/wbos/Index.aspx?DataSetCode=TABLECODE8325).

[16] Those living in Hamilton City in 2008 are excluded from this table

Table 4 shows the equivalent comparison for destination TLAs. While there is less alignment in the exact ranking of the top four, the fact that the set of four match in each projection further supports confidence in the performance of the gravity model used for internal migration modelling[17].

Table 4: Comparison of the top 10 destinations of internal migration for Hamilton City between 2013 Census data (2008-2013 period migration) and NIDEA, 2043

Destination TLA	Population living in Hamilton City in 2008 that lived in the given TLA in 2013 (2013 Census)	Population living in Hamilton City in 2008 that lived in the given TLA in 2013 (2013 Census) **DIVIDED BY 5**	Number from NIDEA Report Table 6 for "Source", 2043 (page 50)	Ranking high to low, Stats NZ, looking at migration from 2008 to 2013	Ranking high to low, NIDEA, 2043
Waikato District	4407	881	1051	1	3
Auckland	4266	853	1887	2	1
Waipa District	2082	416	1254	3	2
Tauranga City	1296	259	513	4	4
Wellington City	747	149	Not in top 10	5	Not in top 10
Matamata-Piako District	657	131	290	6	5
Christchurch City	600	120	149	7	8
Rotorua District	462	92	217	8	6
Thames-Coromandel District	369	74	Not in top 10	9	Not in top 10
New Plymouth District	315	63	Not in top 10	10	Not in top 10

2.2.5.2 International migration (general)

The NIDEA report notes that international migration flows "…represent the most challenging component of population change to project, due to the extensive uncertainty over their future trajectory." (page 9 of the report).

This is certainly true and is well illustrated by the green shaded area of Figure 6, produced by Stats NZ.

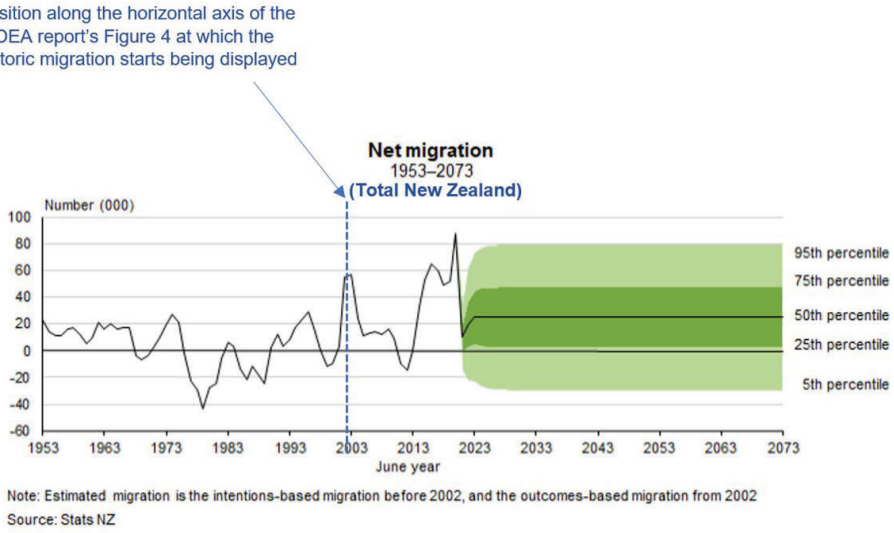
To the left of the green shaded area is the historic net migration. The green area illustrates the likelihood of various future migration values.

Specifically, Stats NZ notes that "…there is an estimated 50 percent chance that [future] net migration will fall within the dark shaded area. The light shaded area below and above the dark shaded area represents the range between 5th and 25th percentiles, and between the 75th and 95th percentiles. This means there is an estimated 90 percent chance that net migration will fall within the [combined] light and dark shaded areas".

I will return to Figure 6, in the context of adjustments made to consider COVID-19, in Section 2.2.5.3.

[17] The 2018 Census data has the same exact rankings for the first four TLAs as that shown in the 2013 Census data.

Figure 6: Net estimated (through June 2020) and projected (post June 2020, 2020-base projections) international migration to New Zealand as a whole, according to Stats NZ[18]. Blue text has been added, together with a dotted vertical line to aid comparison with Figure 4 in the NIDEA report – this is the point at which the NIDEA net migration line appears on the chart (the comparison with NIDEA migration in relation to COVID-19 will be described in more detail in Section 2.2.5.3).



International migration is also the most challenging part of the report to understand and comment on, due to the specialised nature of the modelling used.

As such, this peer review will primarily limit its consideration of international migration to the outputs and how they compare with other demographic projections[19].

The long-term net international migration for New Zealand as a whole, according to the NIDEA projections, is shown in Figure 4 of the report (page 12). Without the accompanying numbers it is not possible to determine the long-term figure shown precisely, but by inspection it appears to be around 23,000.

This is very similar in magnitude to the long-term figures used in the latest Stats NZ national population projections (2020-base, released December 2020) of 25,000[20].

The slightly lower long-term net migration assumption for NIDEA is consistent with NIDEA's use of the long-term historic average to help produce future assumptions, whereas Stats NZ uses slightly heavier weighting on migration observations from the recent past (together with assessment of long-term historic numbers) when assessing figures to use for their long-term future average migration rates.

Something that could benefit from clarification in the NIDEA report is the specific source of the figures 106,947 (long-term trend level of immigration) and 83,842 (long-term trend level

[18] Sourced from https://www.stats.govt.nz/information-releases/national-population-projections-2020base2073.

[19] The exception to this is a recommendation about documenting the source of the long-term average (1990-2020) for immigration and emigration, which I will discuss shortly.

[20] https://www.stats.govt.nz/information-releases/national-population-projections-2020base2073

of emigration) on Page 11 of the report. The report, in the paragraph prior, states that the long-run average for both immigration and emigration was taken "as the average annual level over the period from 1990-2020".

I have been unable to replicate these figures from either:

> i) the Stats NZ Infoshare table "Estimated migration by direction, 12/16-month rule (Annual-Jun)[21]" — which goes back only to year end June 2002, or
>
> ii) "Permanent & long-term migration key series (Annual-Jun)[22]" — which do not include departures after year end June 2018, or
>
> iii) a hybrid of the two, following the approach used in Figure 6 above, i.e., "intentions-based migration before 2002 and the outcomes-based migration from 2022.

Average annual arrival and departure figures from the 'Estimated migration' table (these are outcome-based statistics) over the dates for which both arrivals and departures were available, i.e., for year end June 1990 to 2018 were 81,867 for arrivals and 62,722 for departures.

Average annual arrival and departure figures from the 'Permanent & long-term migration key series' table (these are intentions based statistics[23]) over the dates for which both arrivals and departures were available, i.e., for year end June 2002 to 2020 were 121,591 for arrivals and 90,663 for departures.

There is most likely a simple explanation in terms of a different source being used, but this would be good to clarify.

2.2.5.3 International migration — considering the impact of COVID-19

The NIDEA report includes in Section 2.7 the potential impacts of the COVID-19 pandemic on various drivers of the population projections and how this has been factored into the projections — an important section.

The assumptions that mortality, fertility, and internal migration are broadly unaffected are totally reasonable.

In considering the reasonableness of NIDEA's assessment of the impact of COVID-19 on international migration, I look at examples from two other developers of population projections in terms of what they think may happen to migration because of COVID-19, one for New Zealand and one for Australia.

2.2.5.3.1 Stats NZ – COVID-19 impacts on migration to New Zealand

Stats NZ has considered the impacts of COVID-19 on the population projections in their latest national-level projections. This included seeking input through a survey of a range of

[21] Stats NZ Infoshare table reference ITM406AA. A reproduction of this table together with the average calculation used in provided as Table A2.2 in Appendix 2 for reference.

[22] Stats NZ Infoshare table reference ITM312AA. A reproduction of this table together with the average calculation used in provided as Table A2.3 in Appendix 2 for reference.

[23] For more information about the difference between outcomes-based and intentions-based migration statistics, see https://www.stats.govt.nz/assets/Reports/Outcomes-versus-intentions-measuring-migration-based-on-travel-histories/outcomes-versus-intentions-measuring-migration-based-on-travel-histories.pdf

people with experience in migration patterns and statistics across central government agencies, central and regional forecasting networks, as well as population specialists.

The resultant assumptions for international net migration per year (migrant arrivals minus migrant departures) inherent in the Stats NZ national population projections are:

- 10,000 in 2021
- 20,000 in 2022
- 25,000 in 2023 and beyond.

It is worth noting that:

i) the long-term (2023-onwards) projected annual figure of 25,000 is higher than the 15,000 used in the 2016-base national projections (for the period 2023-2068) published in October 2016[24]. This is due to higher levels of net migration observed between 2016-2020, than in years prior to 2014 (see e.g., Table A2.2 in Appendix 2), and

ii) the return from the reduced migration due to COVID to a stable long-term projected average value happens over a fairly short time frame (within 3 years), as illustrated in Figure 6[25].

2.2.5.3.2 .id Projections, Australia – COVID-19 impacts

Although COVID-19 affects each country differently with regard to migration, it is worth considering some of the thinking from Australia, given the country's similarities to New Zealand in its handling of the pandemic in terms of border controls, and the recent trans-Tasman bubble opening.

I consider here the observations made by one of the commercial developers of population projections in Australia, .id[26], as the Australian Bureau of Statistics does not appear to have published anything outlining their views on the impact of COVID-19 on future migration. .id considered a range of factors[27] to update their assumptions on international migration for growth forecast updates. The transparency with which they've published year-on-year figures allows us to look at the percentage of the long-term pre-COVID average they consider reasonable over time, for comparison with the NIDEA and Stats NZ projections.

Under the .id assumptions, shown in Figure 7 and Table 5, the long-term average net migration to Australia (from 2024/25 to 2050/51) is reduced to approximately 89% that of the non-COVID scenario.

[24] https://www.stats.govt.nz/assets/Uploads/National-population-projections/National-population-projections-2016base-2068/Download-data/npp16-table2.xlsx

[25] It is not suggested in charts of this nature that there will be no variability around (in this case) the long term 25,000 straight line; this is where Stats NZ have placed the average. Fluctuations are expected around this value.

[26] The inclusion of content from .id does not represent an endorsement of .id or its products by Auckland Council. The information shown here was visible on the website in October 2020 but date of first publication is not known.

[27] e.g., the possibility of a trans-Tasman travel bubble, development of a vaccine, the relative attractiveness of Australia for migrants, and the strength and resilience of the Australian economy compared with that of other countries.

Figure 7: Net Overseas Migration for Australia, with post-2020 assumptions for the base (i.e., no COVID) case (solid) and a scenario considering COVID-19 (dotted), as produced by the Australian demographic company .id.

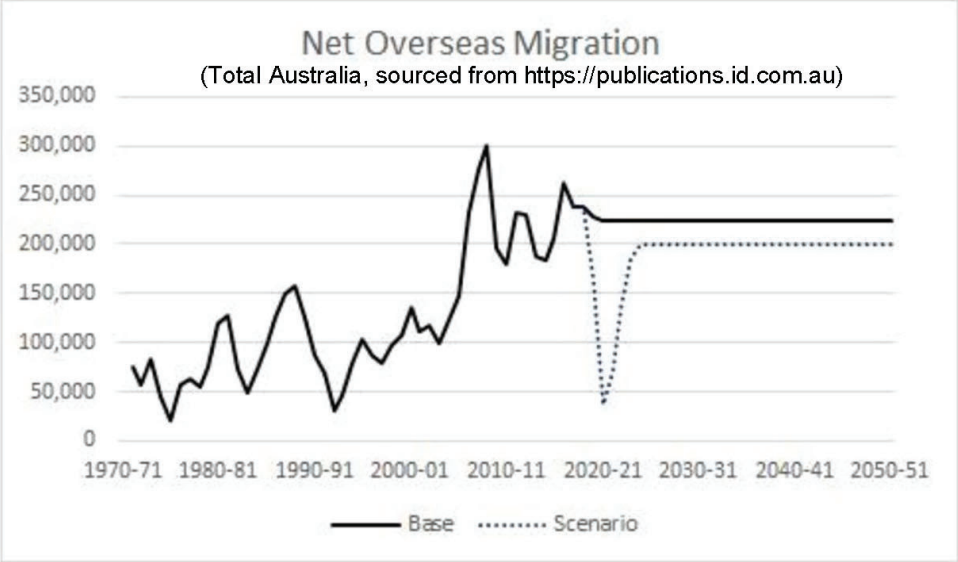


Table 5: Detailed year-on-year migration assumptions produced by id., Australia, together with the percentage of non-COVID-19 ("Base") scenario. Source: https://publications.id.com.au/covid-19-the-local-impact/forecast-australia-2031/overlay/national-forecast-assumptions/

	Net overseas migration to Australia from elsewhere in the world	Percentage of base case long-term average assumption prior to COVID-19 (i.e., 225,000)
.id base case, long-term average assumption prior to COVID-19	225,000	100%
2019/2020 (border closing mainly affects last quarter)	166,000	74%
2020/21	36,000	16%
2021/22	71,250	32%
2022/23	135,250	60%
2023/24	186,500	83%
2024/25	200,000	89%
2025/26	200,000	89%
2026/27	200,000	89%
2027/28 through 2049/50	200,000	89%
2050/51	200,000	89%

Comparing the general patterns of migration over time in the NIDEA projections for international migration (as shown in Figure 4 of the report) with those of Stats NZ and .id, I note that:

i) NIDEA is generally projecting a slower return to a long-term average, post the onset of COVID-19, than either Stats NZ (reaching it by 2023) or .id (reaching it by 2024/25). Figure 4 in the NIDEA report (medium projection) suggests the COVID-scenario figures won't fully return to pre-COVID long-term migration numbers until after 2040 (though they do closely approach each other prior to this date).

ii) NIDEA is not projecting a decrease in the long-term future average migration (with COVID-19) compared with the case without COVID-19. This is consistent with Stats NZ's assessment that the long-term future average under the 2020-base projections are no lower than they would have been without COVID-19. That is, the dip in the shorter term is only temporary and a 'full recovery' to the non-COVID-19 long term average is expected. (This contrasts with the .id projections, which see a reduction in migration persisting long term (to 89% of the non-COVID-19 case).

Given the above considerations, the assumptions about the impact of COVID-19 made by NIDEA, while showing a slightly longer time for 'recovery' post-COVID than the other two projection sources shown here, seem reasonable.

Given the Coronavirus pandemic, Stats NZ's caveat in their projections, "The projections do not take into account non-demographic factors (for example, war, catastrophes, or major government and business decisions) that may invalidate the projections[28]" seems more relevant today than it would have prior to COVID-19, and it may be that a similar comment is useful to include in the documentation for the NIDEA projections.

2.3 Conclusion: Population Projections

Considering the above comparison of the NIDEA projection outputs with Stats NZ projections and an assessment of the methodology used, together that of inputs and assumptions where applicable, the NIDEA population projections for the total age group seem reasonable.

It is recommended that the unexpected difference in the 65 year and over proportions in 2048 between the NIDEA and Stats NZ projections should be investigated further, however, to ensure the model is working optimally regarding age distribution.

3.0 Household and Family Projections

In this section, I first look at the way in which NIDEA assigns the projected population, derived as described above, to households and families. I then compare the outputs with the Statistics NZ projections and census trends.

The reason I have reversed the order in which I look at comparisons and methodology, compared with the population projections section above, is that Stats NZ is still to produce its 2018-base projections for families and households; the most recently available is the "2013(base) – 2038 update"[29].

This complicates comparisons somewhat, as will be outlined further below, and as they are also fairly dated, they are considered of secondary importance in assessing the NIDEA projections.

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[28] http://datainfoplus.stats.govt.nz/item/nz.govt.stats/728b04b1-c460-4729-a311-b02f1117795b/64/#

[29] These will be referred to as "2013-base" from now on.

3.1 Household and Family Projections methodology and assumptions

Fundamental to the family and household projections are assumptions about the living arrangements that people are likely to be in at a given age, as defined by Living Arrangement Type Rates (LATRs). LATRs can, as the NIDEA report explains, "be thought of as the probability of an individual being in a particular living arrangement".

This approach is consistent with that used by Stats NZ to derive household and family numbers from population projections; moreover, the NIDEA report states that the same LATR assumptions as Stats NZ's were used as a starting point (together with other assumptions from Stats NZ on the average number of families per family household, and the average household size for other multi-person households)[30].

In a similar approach to that used by NIDEA for fertility assumptions, NIDEA made some adjustments during the calibration process to the LATR assumptions to ensure outputs for 2018 were consistent with observed patterns, this time from census data — this is a positive indication of attention to quality control during the model development process.

The concept of LATRs is illustrated in Figure 8 below, which shows the LATRs for total New Zealand used in Stats NZ's 2013-base medium scenario projections[31]. The Hamilton City specific LATRs, in terms of patterns by age, are broadly similar to those for New Zealand as a whole[32].

Note that the "Type 1, 2, 3,…,7" designations on Figure 8, and associated numbers in the key, have been added solely to assist in identifying each curve, and are not part of the official classification.

One of the most prominent features is the 'bell curve' shape shown for the partner/parent in two-parent family classification ("Type 2"); the graph also shows the likelihood of being in a one-person household increases with age ("Type 6").

In their derivation of 2013-base projections for families and households, Stats NZ considered two different LATR assumption patterns:

i) remaining constant over time, and

ii) changing linearly over the period 2013 to 2038.

The latter was determined to be "the most suitable for assessing future family and household changes" and was the only one formulated to produce demographically plausible results.

It should be realised that living arrangements are driven by a wide range of factors, many of which are subject to change over the lifetime of projections. These include factors such as the propensity of young adults to stay in the parental home (which can be affected by the state of the job market or cost of housing), timing of childbearing, and the presence of extended family or non-related individuals in a household[33]. As such, LATR assumptions

[30] One area where the report could be clearer, is on Page 19: in the sentence "LATRs were assumed to follow the SNZ projections to 2038, then continue to improve in a linear fashion through until 2068", it is unclear to me what improvements in this context mean, it may be worth clarifying this.

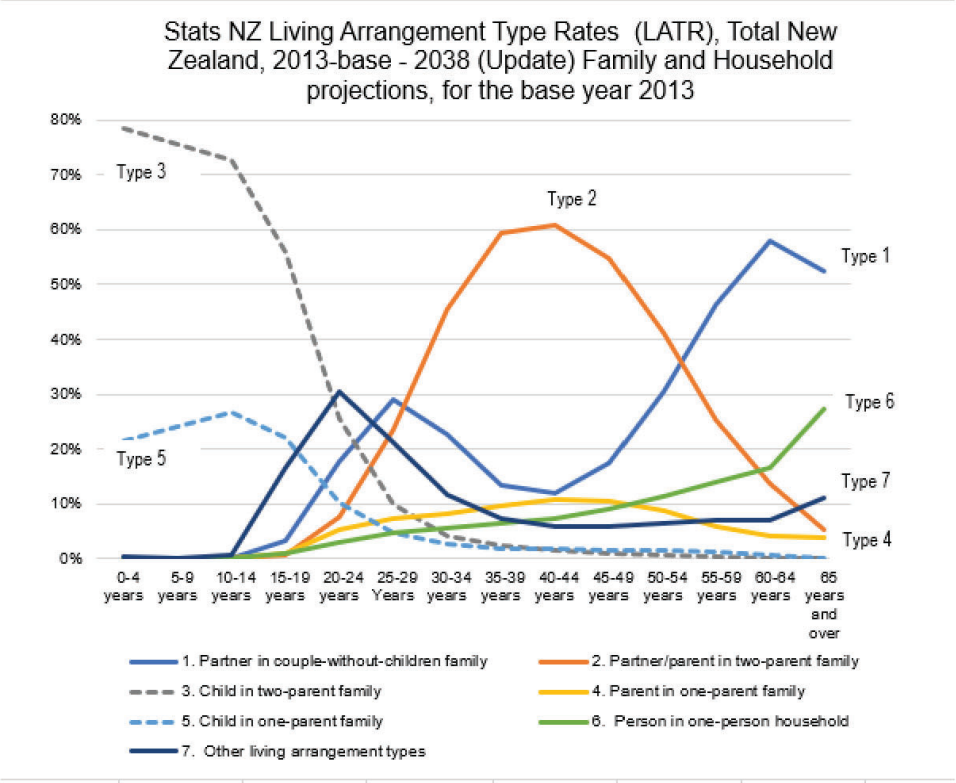
[31] http://nzdotstat.stats.govt.nz/wbos/Index.aspx?DataSetCode=TABLECODE7974

[32] A comparison table of the LATR distribution by broad age group for 2013 for Hamilton City and New Zealand appears as Table A2.4 in Appendix 2.

[33] These and more examples are given at http://datainfoplus.stats.govt.nz/item/nz.govt.stats/728b04b1-c460-4729-a311-b02f1117795b/64/

and how they might change over time is primary source of uncertainty in family and household projections.

Figure 8: Living Arrangement Type Rates (LATR), Total NZ



Comparison of the LATR from Stats NZ for Hamilton City between 2013 and 2038 show that the LATRs are quite stable over the projection period.

Looking at percentage point and relative percent point changes across all living type categories between 2013 and 2038, the three categories with the most change across the total population (i.e., all ages added together) for Hamilton City are:

i) Increases in the proportion of people likely to be a partner in couple without children families, from 20.8% in 2013 to 22.9% in 2038,

ii) Decreases in the proportion of people likely to be a child in two-parent family (note: this is also accompanied by a decrease in the proportion of child in one-parent families), and

iii) Increases in the proportion of people in one person households from 8.3% to 9.7%.

Considering now just the 65 years and over group, the assumptions show that the LATR for the partner in couple without children family increases over time (50.6% to 53.0%), as did that for the total population (20.1% to 22.9%).

However, the proportion in one person households 65 year and over decreases from 29.2% to 27.7% (compared to an increase from 8.3% to 9.7% for the total population). This is consistent with a likely closing of the gap between male and female life expectancy over time.

The above all seem reasonable assumptions.

3.2 Comparison of NIDEA household and family projections with Stats NZ projections

There is some difficulty comparing NIDEA and Stats NZ projections for households and families because the Stats NZ series has 2013 as a base, and NIDEA projections have 2018 as a base. This explains why the numbers in the NIDEA projections for the 2018 year are identical regardless of the scenario (low, medium, or high), but the numbers in the Stats NZ projections have different values for the 2018 year depending on the scenario.

Another difficulty in assessing the households and family projections is that while Stats NZ provides sub-national population estimates annually, they do not publish household or family estimates sub-regionally on an annual basis.

Two comparisons, described below, suggest the Stats NZ household projections show slightly higher levels of growth than has been observed over recent years. It is not clear whether this would continue into the future or not, however.

First, the national level household estimates for 2018 that Stats NZ provides[34] are compared with the 2013-base Stats NZ projections for the 2018 year (Table 6). I note that the estimates indicate a lower percentage increase in household numbers has occurred over the 2013-2018 period than that projected by the 2013-base projections.

Table 6: A comparison of the projected total NZ households (2013-base projections, projected households as at 2018) and estimated total NZ households at 2018.

Projected households, NZ Total, June 2018 (2013-base projections)	Estimated households, NZ Total, June 2018	Difference	Percentage difference
1,823,300	1,744,600	-78,700	-4.3%

Second, a comparison I can make at the Hamilton City level is the percentage growth between the Stats NZ 2013-base household projections for the 2013 to 2018 period and Census households over the same period. This is illustrated in Table 7, in the right-most column. Again, observed growth is less than that suggested by the Stats NZ projections over the 2013-2018 period[35].

It is not clear whether this trend would continue over time, but may explain part of the lower household numbers in the NIDEA projections (i.e., this factor may have been taken into account) when compared with Stats NZ's.

[34] Estimates are from Table 2 in the file this URL: https://www.stats.govt.nz/information-releases/dwelling-and-household-estimates-march-2021-quarter

[35] The difference observed between the 2013 Census figure (50,388) and that from the base year of the 2013-base projections (54,200) arises because the household estimates are derived by allocating to households the estimated resident population, rather than the Census population, which is smaller.

This will also have an impact on families which are a subset of households.

Table 7: A comparison of the percentage change in the number of Hamilton City households measured in the 2013 and 2018 Censuses with that projected by the 2013-base Stats NZ household projections.

	2013	2018	Change, 2013 to 2018	% Change, 2013 to 2018
Households, Census, Hamilton City	50,388	54,858	4,470	8.9%
Projected households, 2013-base household Stats NZ projections, Hamilton City	54,200	61,500	7,300	13.5%

3.2.1. Household Projections

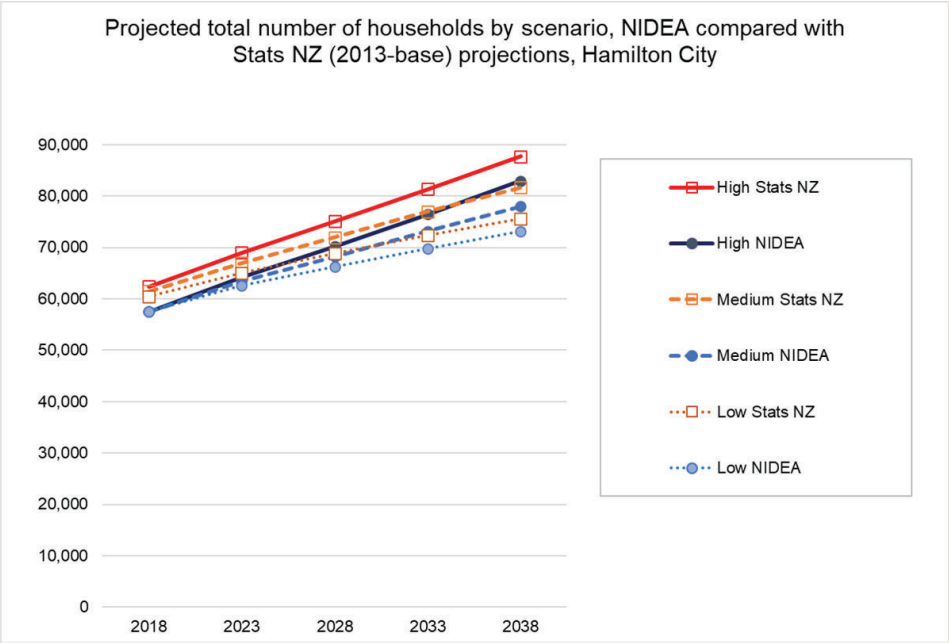
3.2.1.1 Number of households by scenario and type

The comparison between Stats NZ 2013-base household projections and those from NIDEA for years 2018, 2028 and 2038 is shown in Table 8 and graphed for each 5-year period in Figure 9.

Table 8: A comparison of the number of households by scenario, for NIDEA and Stats NZ (2013-base) projections.

Scenario	Source	2018	2028	2038
Low	NIDEA	57,479	66,285	73,128
Low	Stats NZ	60,500	68,800	75,600
Low	Difference	-3,021	-2,515	-2,472
Low	% Difference	-5.0%	-3.7%	-3.3%
Medium	NIDEA	57,479	68,250	78,035
Medium	Stats NZ	61,500	72,000	81,700
Medium	Difference	-4,021	-3,750	-3,665
Medium	% Difference	-6.5%	-5.2%	-4.5%
High	NIDEA	57,479	70,217	82,950
High	Stats NZ	62,400	75,100	87,700
High	Difference	-4,921	-4,883	-4,750
High	% Difference	-7.9%	-6.5%	-5.4%

Figure 9: Comparison chart showing the number of households by scenario, for NIDEA and Stats NZ (2013-base) projections. An alternative version of this graph, with the vertical axis minimum set to 50,000 to show more detail, is provided as Figure A2.2 in Appendix 2.



An observation from the above is that for all projection series, total household numbers are lower for NIDEA than for the equivalent Stats NZ projection. The percentage differences at 2018 range from -5.0% to -7.9%, depending on the projection scenario (low, medium or high). The relative differences from Stats NZ projections then reduce over time for all scenarios.

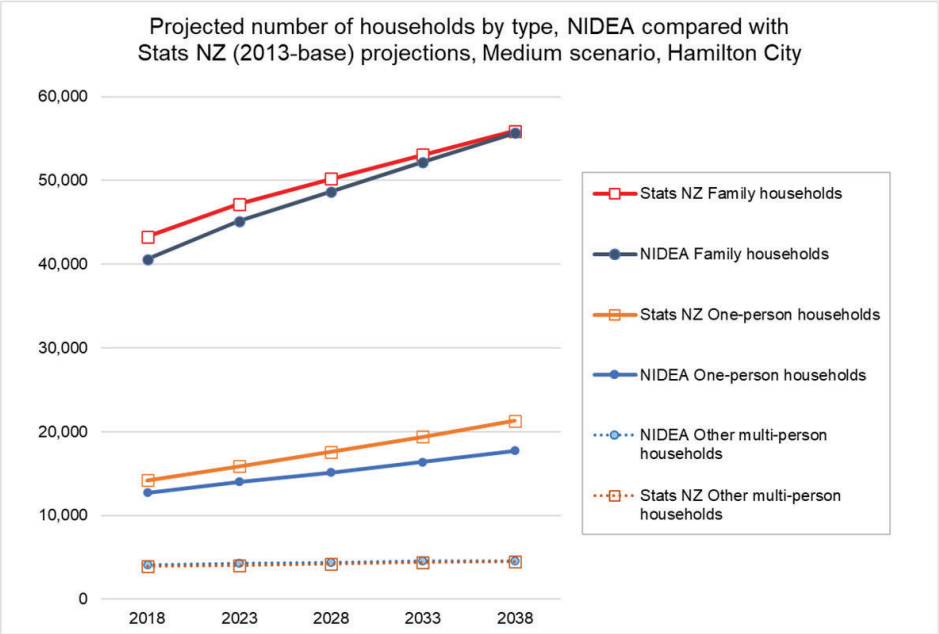
A comparison of the number of households by type between Stats NZ (2013-base) and NIDEA projections is summarised in Table 9 below and illustrated in Figure 10.

The most significant difference between the NIDEA and Stats NZ projections is in the "one person households" category. By 2038, in the medium projection, NIDEA has 3,573 fewer one person households than Stats NZ (a difference of some -16.8%), even though the percentage difference for total households is only -4.5%).

Table 9: Number of households by type, Medium Scenario, NIDEA compared with Stats NZ projections.

Scenario	Source	Household type	2018	2028	2038
Medium	NIDEA	Family households	40,600	48,689	55,684
Medium	Stats NZ	Family households	43,300	50,200	55,900
Medium	Difference	Family households	-2,700	-1,511	-216
Medium	% Difference	Family households	-6.2%	-3.0%	-0.4%
Medium	NIDEA	Other multi-person households	4,140	4,426	4,623
Medium	Stats NZ	Other multi-person households	3,900	4,200	4,500
Medium	Difference	Other multi-person households	240	226	123
Medium	% Difference	Other multi-person households	6.1%	5.4%	2.7%
Medium	NIDEA	One-person households	12,739	15,135	17,727
Medium	Stats NZ	One-person households	14,200	17,600	21,300
Medium	Difference	One-person households	-1,461	-2,465	-3,573
Medium	% Difference	One-person households	-10.3%	-14.0%	-16.8%
Medium	NIDEA	Total households	57,479	68,250	78,035
Medium	Stats NZ	Total households	61,500	72,000	81,700
Medium	Difference	Total households	-4,021	-3,750	-3,665
Medium	% Difference	Total households	-6.5%	-5.2%	-4.5%

Figure 10: Number of households by type, Medium Scenario, NIDEA compared with Stats NZ projections



3.2.1.2 Household type distribution

Setting aside the actual difference in numbers of households, a comparison of the household type distribution for the NIDEA and Stats NZ projections is shown in Figures 11 and 12.

The most obvious differences are:

i) the proportion of one person households in the NIDEA projections holds fairly steady over the projection period (from 22.2% in 2018 to 22.7% in 2038), whereas the Stats NZ projections show a steadily increasing proportion of one person households, from 23.1% in 2018 to 26.1% in 2038; and

ii) the NIDEA projections show a slight increase in the proportion of family households over time, whereas the Stats NZ projections show a slight decrease.

Meanwhile, a decreasing proportion of other multi-person households over time is a trend common to both projections.

Figure 11: Household type distribution (NIDEA projections, medium scenario)

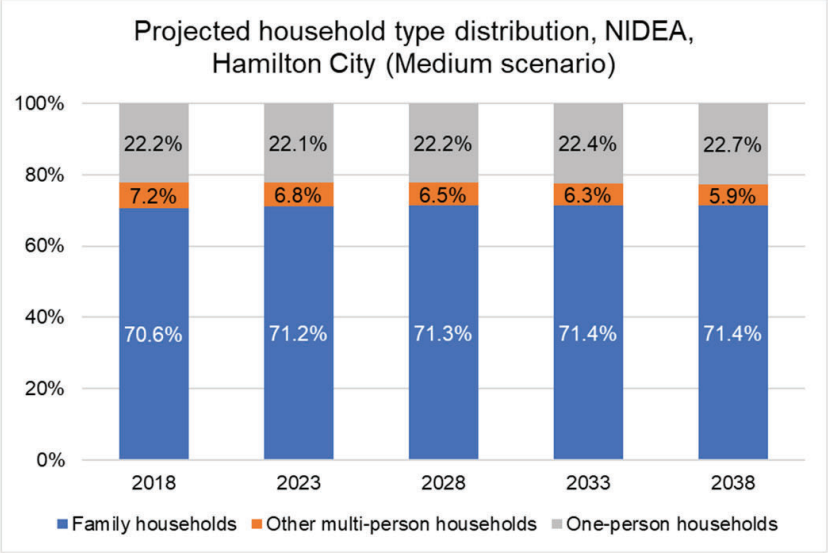
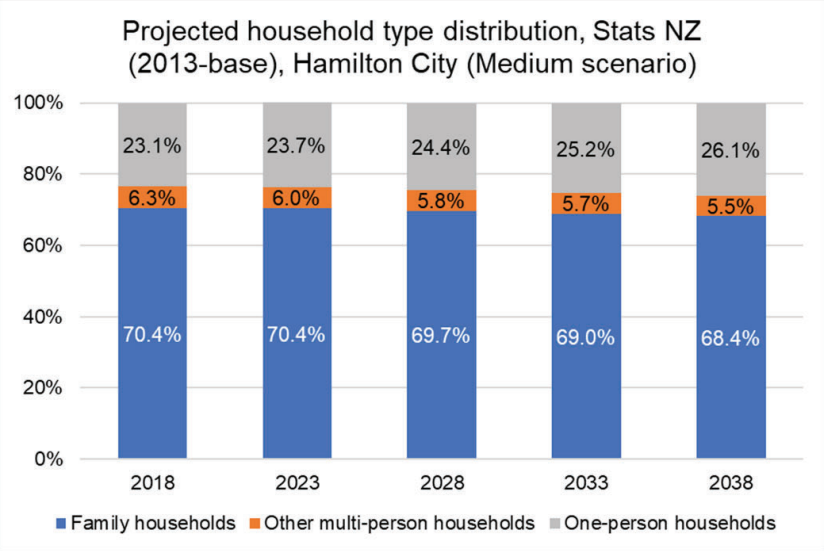


Figure 12: Household type distribution (Stats NZ (2013-base) projections, medium scenario)



Since the biggest difference between the NIDEA and Stats NZ 2013-base projections shown in both comparisons above is that for one person households, it is worth considering additional data on trends in household type shown by the 2006, 2013 and 2018 Censuses.

The distribution of households by type at each year is provided in Table 10. I observe that the proportion of one-person households changed very little between 2006 and 2018; this would suggest that the NIDEA projection showing a stable percentage in one-person households may not be unreasonable.

Table 10: Distribution of households, by household type, 2006, 2013 and 2018 Censuses.

	2006	2013	2018
One-family household (with or without other people)	67.2%	66.7%	67.0%
Two-family household (with or without other people)	2.7%	3.3%	3.4%
Three or more family household (with or without other people)	0.2%	0.2%	0.2%
Other multi-person household	7.6%	7.0%	7.2%
One-person household	22.3%	22.7%	22.2%
Total households stated	100.0%	100.0%	100.0%

3.2.1.3 Conclusion: Household projections

Considering the above comparison of the NIDEA projections with those of Stats NZ, I note that there was quite a difference in trends between the NIDEA and Stats NZ household projections for one person households. By 2038, NIDEA had significantly fewer households of that type than Stats NZ.

It is possible that this is related to the observation made in Section 2.2.1 of this review, i.e., that the proportion of those 65 years and over in 2043 in the NIDEA projections seemed lower than expected — since there is a correlation between those 65 years and over and one person households. This is worth further investigation.

It should be taken into account, however, that there are limitations inherent in the comparator dataset being used; that is, the 2013-base Stats NZ projections are now quite out of date. As such, it is hard to know to what degree, if any, one should be concerned about these differences.

The methodology used by NIDEA, on the other hand, appears sound, being based on Stats NZ's Living Arrangement Type Rates (LATR). The lower numbers of households projected by NIDEA may be partly explained by the observation that the Stats NZ household projections for the 2013-2018 period seem slightly too high, when compared with observations using the latest available information.

In conclusion, the NIDEA household projections seem reasonable.

3.2.2 Family Projections

Families are a subset of households and are also derived from the Living Arrangement Type Rate assumptions.

3.2.2.1 Number of families by scenario and type

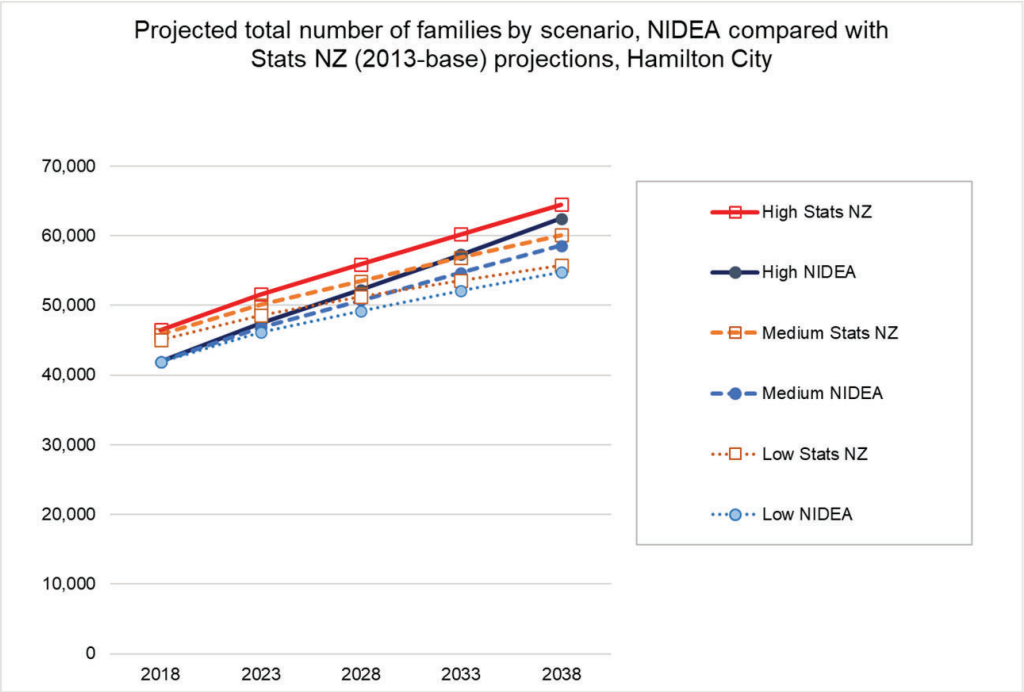
The comparison between Stats NZ 2013-base family projections and those from NIDEA over the period 2018-2038 is shown in Table 11 and Figure 13.

The NIDEA projections start out in 2018 with lower numbers of total families in all categories and all scenarios, and they remain lower than the Stats NZ projections through 2038, although the difference becomes less. At 2018 for example, in the medium scenario, the Stats NZ projections have 45,800 families compared with 41,930 in the NIDEA projections, a percentage difference of -7.0%. By 2038 the difference has reduced to -1.7%.

Table 11: A comparison of the number of families by scenario, for NIDEA and Stats NZ (2013-base) projections

Scenario	Source	2018	2028	2038
Low	NIDEA	41,930	49,238	54,741
Low	Stats NZ	45,100	51,200	55,700
Low	Difference	-3,170	-1,962	-959
Low	% Difference	-7.0%	-3.8%	-1.7%
Medium	NIDEA	41,930	50,760	58,598
Medium	Stats NZ	45,800	53,500	60,100
Medium	Difference	-3,870	-2,740	-1,502
Medium	% Difference	-8.5%	-5.1%	-2.5%
High	NIDEA	41,930	52,284	62,462
High	Stats NZ	46,500	55,900	64,500
High	Difference	-4,570	-3,616	-2,038
High	% Difference	-9.8%	-6.5%	-3.2%

Figure 13: Comparison graph showing the number of families by scenario, for NIDEA and Stats NZ (2013-base) projections. An alternative version of this graph, with the vertical axis minimum set to 40,000 to show more detail, is provided as Figure A2.3 in Appendix 2.



When considering the breakdown by family type, over time, in Table 11 (also shown in Figure 14), I note that:

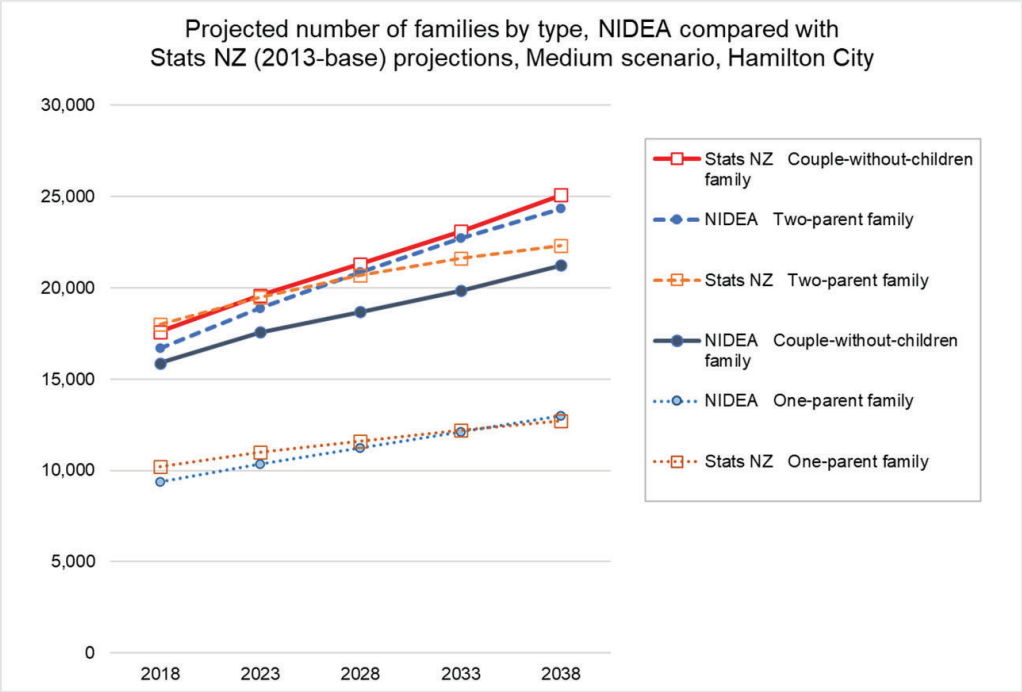
i) the numbers for the couple without children family category start in 2018 considerably lower than those for Stats NZ (-9.7%) and the divergence gets larger and larger over time, such that by 2038 the NIDEA counts (dark blue line in Figure 14) are 3,864 lower than the Stats NZ counts, a percentage difference of -15.4%.

ii) on the other hand, the magnitude of the gap between the NIDEA and Stats NZ for one and two-parent families reduces over time in the first part of the projection time-series, and then the number of these families actually surpass the numbers projected by Stats NZ.

Table 11: Number of families by type, Medium Scenario, NIDEA compared with Stats NZ projections

Scenario	Source	Family Type	2018	2028	2038
Medium	NIDEA	Couple-without-children family	15,886	18,677	21,236
Medium	Stats NZ	Couple-without-children family	17,600	21,300	25,100
Medium	Difference	Couple-without-children family	-1,714	-2,623	-3,864
Medium	% Difference	Couple-without-children family	-9.7%	-12.3%	-15.4%
Medium	NIDEA	Two-parent family	16,687	20,871	24,352
Medium	Stats NZ	Two-parent family	18,000	20,700	22,300
Medium	Difference	Two-parent family	-1,313	171	2,052
Medium	% Difference	Two-parent family	-7.3%	0.8%	9.2%
Medium	NIDEA	One-parent family	9,357	11,212	13,011
Medium	Stats NZ	One-parent family	10,200	11,600	12,700
Medium	Difference	One-parent family	-843	-388	311
Medium	% Difference	One-parent family	-8.3%	-3.3%	2.4%
Medium	NIDEA	Total Families	41,930	50,760	58,598
Medium	Stats NZ	Total Families	45,800	53,500	60,100
Medium	Difference	Total Families	-3,870	-2,740	-1,502
Medium	% Difference	Total Families	-8.5%	-5.1%	-2.5%

Figure 14: Number of families by type, Medium Scenario, NIDEA compared with Stats NZ projections



3.2.2.2 Family type percentage distribution

Setting aside the actual difference in numbers of families and focussing solely on the patterns of family type distribution in the Stats NZ and NIDEA projections, Figures 15 and 16 show that, taking the medium projection as an example:

i) the proportion of two-parent families increases slightly over time in the NIDEA projections, but decreases slightly over time in the Stats NZ projections,

ii) for couple without children families, the reverse applies.

Figure 15: Family type percentage distribution (NIDEA projections, medium scenario) for Hamilton City

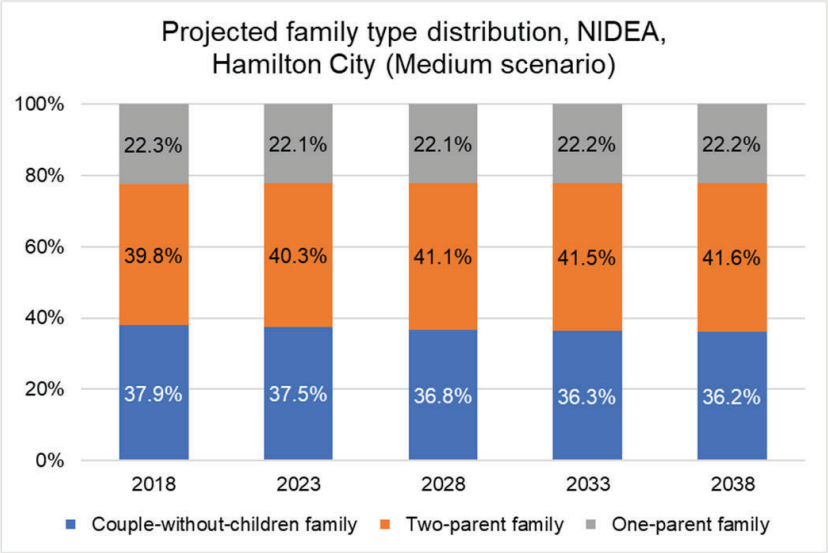
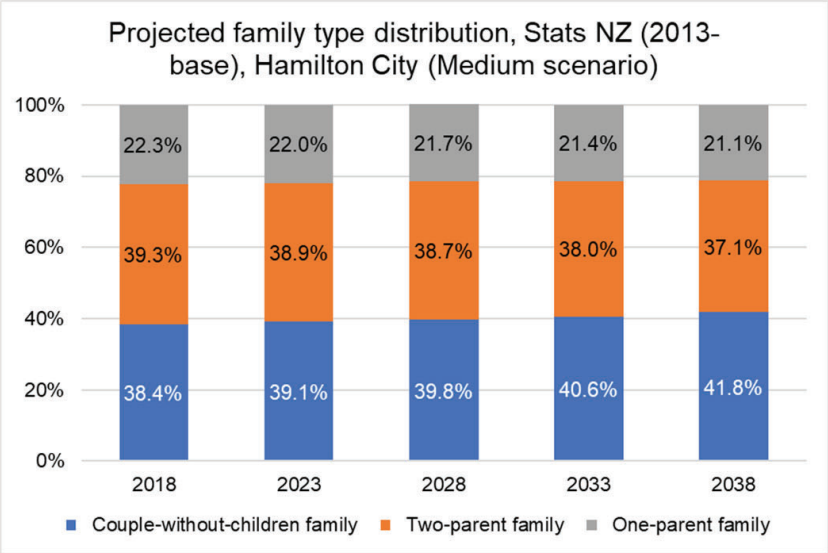


Figure 16: Family type percentage distribution (Stats NZ (2013-base) projections, medium scenario) for Hamilton City.



As in the assessment done for households, it is worth considering trends seen in the 2006, 2013 and 2018 Census data[36]. In the comparison to follow I assume that "Two-parent family"

[36] http://nzdotstat.stats.govt.nz/wbos/Index.aspx?DataSetCode=TABLECODE8402

(NIDEA) and "Couple with child(ren)" (Stats NZ) can be treated as equivalent for the purposes of the general trends in family type distribution considered here.

Table 12: Family type for Hamilton City, 2006, 2013 and 2018 Censuses.

	2006	2013	2018
Couple without children	38.2%	37.3%	36.5%
Couple with child(ren)	40.2%	40.7%	42.8%
One parent with child(ren)	21.6%	22.0%	20.7%

The Census data shows

i) a small decrease in the proportion of couple without children families over time,

ii) a small increase in the proportion of couples with children over time

iii) no clear sense of an increase or decrease in terms of the proportion of one parent with child(ren) families.

If the Census trends were to be extrapolated into the future,

a) trend (i) is consistent with the NIDEA projections but counter to the trend shown in the Stats NZ projections,

b) trend (ii) is consistent with the NIDEA projections but counter to the trend shown in the Stats NZ projections, and

c) it is difficult to make any conclusive remarks about the proportion of one parent with children families.

3.2.2.3 Conclusion: Family Projections

Considering the above comparison of the NIDEA projections with those of Stats NZ, there was quite a difference in trends between the NIDEA and Stats NZ family projections for couples with and without children. As noted in the conclusion for household projections, however, given that the 2013-base Stats NZ projections are now quite out of date, it is hard to know to what degree, if any, one should be concerned about these differences.

As for household projections, it is recommended that the NIDEA projections for family type be compared with the 2018-base household and family Stats NZ projections when released in 2022, to see how the areas of divergence between the 2013-base projections identified above are tracking.

In the meantime, noting that the methodology seems sound, being based on Stats NZ Living Arrangement Type Rates (LATRs), and the Stats NZ household projections (of which families are a subset) for the 2013-2018 period seem slightly too high compared with observations from the latest available information, the NIDEA family projections seem reasonable.

4.0 Overall conclusions

Differences between NIDEA projections and those from Stats NZ over the 30-year period 2018-2048 (or the 20-year period 2018-2038 for households and family projections) have formed the primary means of assessing the reasonableness of the NIDEA projections in this review. The NIDEA report — which gives a good amount of insight into the processes used in deriving the projections — has also proven very helpful for the review.

This peer review has found that:

i) growth trends for the total population are remarkably similar between the NIDEA and Stats NZ projections.

ii) when it comes to the age distribution of the population over time, the data provided has not allowed a full review of age-based projections to be made. However, the trend shown in the NIDEA projections for the percentage of those 65 years and over is quite different from that produced by the Stats NZ projections, suggesting that further investigation into the NIDEA projections by age group would be appropriate.

iii) While growth trends for some household and family types are somewhat divergent (in particular, trends in one person households, and families comprising couples with- and without-children), from Stats NZ projections, differences are not of a large enough magnitude to suggest any fundamental shortcomings with the NIDEA projections, particularly since the 2013-base Stats NZ projections are now quite dated.

It must be kept in mind that demographic projections have always involved a significant degree of uncertainty, and the recent COVID-19 pandemic has introduced yet another element of uncertainty on top of this.

In conclusion, and in the above context, after working through the contents of the NIDEA report and data tables, I consider that the methods, assumptions, inputs and outputs of the NIDEA projections, to the degree that they are practical to check, are reasonable.

5.0 Recommendations

I recommend that:

i) The situation outlined in Section 2.1.2., where the proportion of those 65yrs and over at 2043 is lower than that projected by Stats NZ, is investigated further to help justify or explain the differences seen here. It would be useful to check also if this is related to the projections for one person households being lower than that shown in Stats NZ and whether this part of the model is working optimally.

ii) Comparisons of the type performed in this review for households and families be repeated against the 2018-base projections from Stats NZ when they are released in 2022, to help assess the reasonableness of the trends for these, given the limitations in using old 2013-base projections for comparisons as performed in this review.

iii) The source of the international migration long-term figures be reviewed to check that the figures are consistent with Stats NZ figures, or explained otherwise if not, as per observations made in Section 2.2.5.2.

Appendix 1: Objectives of the Peer Review, from the Terms of Reference[37]

"The objectives of the Peer Review include:

- Conduct a common-sense check of the material covered in the report relating to the NIDEA population projection methodology, inputs, assumptions and outputs for Hamilton City. This will include, where appropriate and feasible, a comparison with those for the Stats NZ 2018-base population projections (e.g., components of population growth, population outputs). Comparisons with Stats NZ projections will be limited to the period 2018 to 2048 (the latter being the time horizon of Stats NZ subnational projections).

- Conduct a common-sense check of the material covered in the report relating to NIDEA Family and Household projections for Hamilton City. This will include, where appropriate and feasible, a comparison with the Stats NZ 2013-base family and household projection outputs (2018-base projections will not be available until 2022). The time period for comparisons will be restricted to 2018 to 2038, the latter being the time horizon of the Stats NZ sub-national family and household projections. Consideration of quantitative assumptions and inputs is out of scope for Family and Household projections.

- Provide a practical assessment as to whether the NIDEA growth projections consider (in the inputs and assumptions) recent spatial planning, initiatives and strategies (e.g. Hamilton-Auckland Corridor, Hamilton-Waikato Metro Spatial Plan, etc)

- Provide any recommendations or critiques of the NIDEA growth projections.

The peer review will not:

- Conduct a full interrogation of the NIDEA demographic model and associated systems."

[37] Terms of Reference NIDEA 2021 Growth Projections – Peer Review. [Hamilton City Council] Trim document number: D-3705612

Appendix 2: Additional figures and tables

Table A2.1: Showing NIDEA projections together with the Stats NZ medium scenario 2013-base and 2018-base projections (2048 excluded as the 2013-base projection horizon was 2043).

	2018	2023	2028	2033	2038	2043
NIDEA	168,600	184,374	195,445	206,038	216,116	225,598
Stats NZ (2013-base)	168,700	182,100	193,500	204,400	214,700	224,800
Stats NZ (2018-base)	168,600	183,000	194,400	205,400	216,000	226,500
% Difference (NIDEA minus Stats NZ 2013-base)	-0.1%	1.2%	1.0%	0.8%	0.7%	0.4%
% Difference (NIDEA minus Stats NZ 2018-base)	0.0%	0.8%	0.5%	0.3%	0.1%	-0.4%

Figure A2.1: An alternative version of Figure 1, identical except for setting the start point of the vertical axis to 150,000 to show detail.

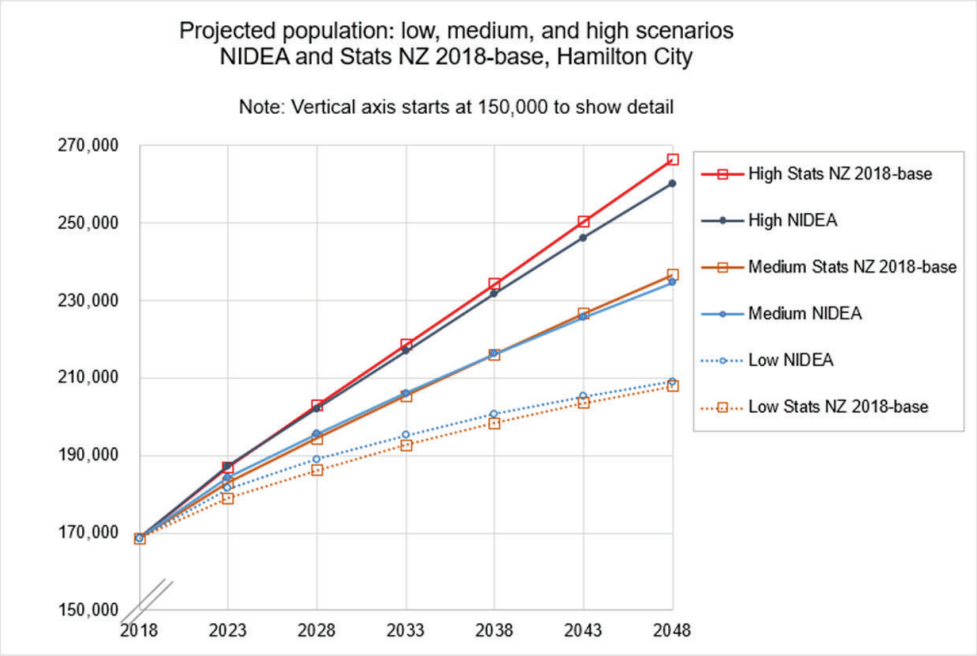


Figure A2.2: An alternative version of Figure 9, identical except for setting the start point of the vertical axis to 50,000 to show detail.

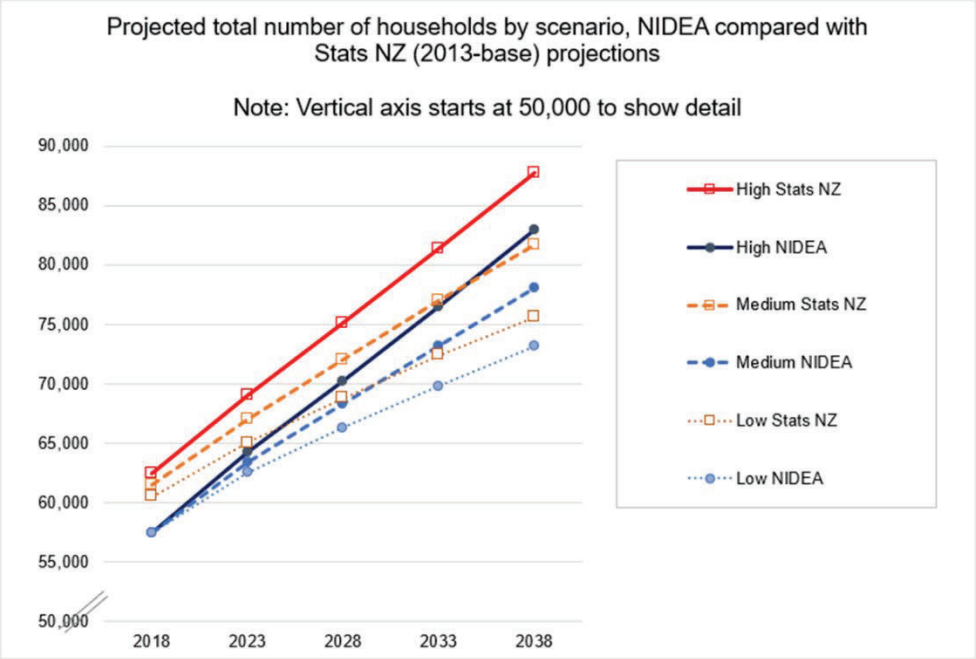


Figure A2.3: An alternative version of Figure 13, identical except for setting the start point of the vertical axis to 40,000 to show detail.

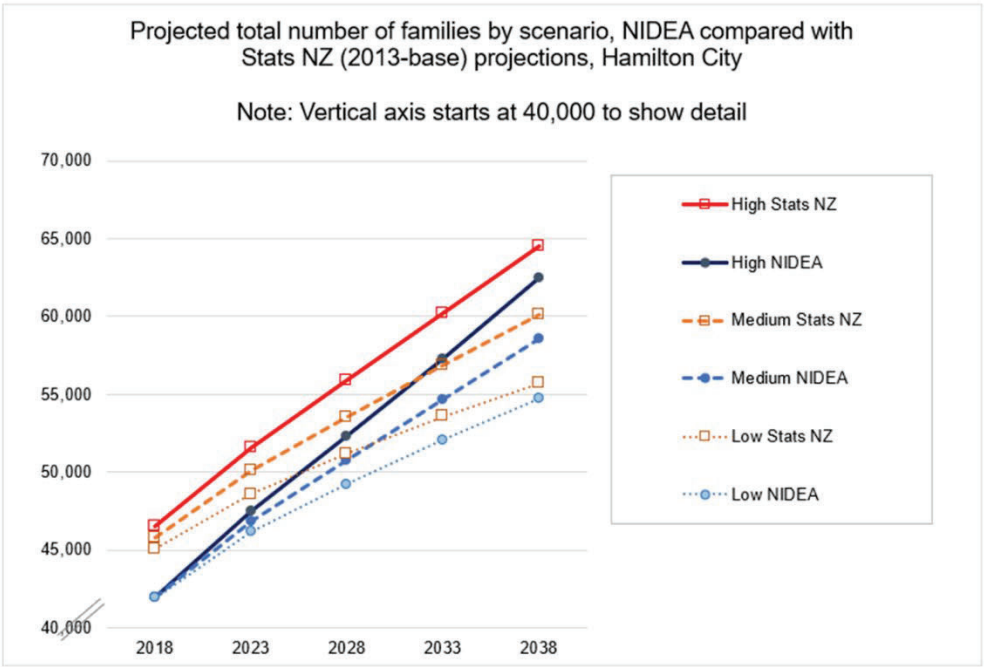


Table A2.2: Estimated migration by direction, 12/16-month rule (Annual-Jun), Stats NZ Infoshare Table Reference ITM406AA, Last updated 14 April 2021 10:45am

Estimated migration by direction, 12/16-month rule (Annual-Jun) Estimates		
	Arrivals	**Departures**
2002	127,609	72,529
2003	130,685	73,738
2004	109,331	84,775
2005	103,639	92,540
2006	105,398	91,927
2007	113,532	99,013
2008	117,659	105,619
2009	115,723	99,455
2010	101,756	92,787
2011	100,885	110,289
2012	100,734	115,717
2013	104,368	103,559
2014	118,274	84,812
2015	133,917	80,490
2016	144,182	79,569
2017	142,257	82,724
2018	138,055	89,060
2019	141,517	89,416
2020	160,715	74,572
Annual average, YE 2002 through YE 2020	**121,591**	**90,663**

Table A2.3 Permanent & long-term migration key series (Annual-Jun), Stats NZ Infoshare Table reference ITM312AA

Permanent & long-term migration key series (Annual-Jun) Total All Countries of Residence Total All Citizenships Actual Counts		
	Arrivals	**Departures**
1990	54,545	51,960
1991	55,948	43,526
1992	47,925	44,334
1993	50,811	42,109
1994	59,670	42,855
1995	69,572	46,843
1996	81,965	52,459
1997	74,492	57,722
1998	61,246	60,794
1999	56,252	67,621
2000	61,285	71,045
2001	69,489	78,755
2002	92,663	59,848
2003	97,250	54,733
2004	84,285	62,277
2005	79,139	70,546
2006	80,076	69,388
2007	82,700	72,622
2008	85,239	80,507
2009	88,251	75,736
2010	82,305	65,801
2011	84,016	80,149
2012	84,402	87,593
2013	88,235	80,328
2014	100,784	62,446
2015	115,655	57,396
2016	125,055	55,965
2017	131,355	59,050
2018	129,536	64,541
2019	111,969	Not available
2020	91,080	Not available
Annual average, 1990 through 2018	**81,867**	**62,722**

(For an explanation of why the figures differ considerably between these two series, see https://www.stats.govt.nz/assets/Reports/Outcomes-versus-intentions-measuring-migration-based-on-travel-histories/outcomes-versus-intentions-measuring-migration-based-on-travel-histories.pdf).

Table A2.4: A comparison of the differences in LATRs by broad age group for 2013 (medium scenario) between New Zealand and Hamilton City (Stats NZ).

Total New Zealand - LATR by broad age	0-14 years	15-39 years	40-64 years	65 years and over	Total people, all ages
Partner in couple-without-children family	0.0%	16.8%	31.2%	52.6%	23.1%
Partner/parent in two-parent family	0.0%	26.0%	40.9%	5.4%	22.7%
Child in two-parent family	75.7%	20.7%	0.7%	0.0%	22.5%
Parent in one-parent family	0.0%	6.0%	8.2%	3.7%	5.2%
Child in one-parent family	24.0%	8.7%	1.3%	0.1%	8.2%
Person in one-person household	0.0%	4.0%	11.3%	27.3%	8.8%
Other living arrangement types	0.3%	17.8%	6.4%	10.9%	9.5%
Total people	100.0%	100.0%	100.0%	100.0%	100.0%
Hamilton City - LATR by broad age	0-14 years	15-39 years	40-64 years	65 years and over	Total people, all ages
Partner in couple-without-children family	0.0%	17.2%	27.4%	50.6%	20.1%
Partner/parent in two-parent family	0.0%	24.2%	40.2%	5.4%	21.4%
Child in two-parent family	70.3%	15.3%	0.5%	0.0%	21.2%
Parent in one-parent family	0.0%	7.2%	10.2%	4.2%	6.1%
Child in one-parent family	29.4%	8.3%	1.4%	0.0%	10.0%
Person in one-person household	0.0%	3.7%	12.5%	29.2%	8.3%
Other living arrangement types	0.6%	24.0%	7.6%	10.7%	12.8%
Total people	100.0%	100.0%	100.0%	100.0%	100.0%
Percentage point difference (Hamilton minus NZ)	0-14 years	15-39 years	40-64 years	65 years and over	Total people, all ages
Partner in couple-without-children family	0.0%	0.4%	-3.7%	-2.0%	-3.0%
Partner/parent in two-parent family	0.0%	-1.9%	-0.7%	0.0%	-1.2%
Child in two-parent family	-5.4%	-5.4%	-0.2%	0.0%	-1.2%
Parent in one-parent family	0.0%	1.1%	1.9%	0.5%	0.9%
Child in one-parent family	5.4%	-0.3%	0.1%	-0.1%	1.8%
Person in one-person household	0.0%	-0.2%	1.2%	1.9%	-0.6%
Other living arrangement types	0.3%	6.2%	1.2%	-0.2%	3.3%
Total people	0.0%	0.0%	0.0%	0.0%	0.0%

DRAFT - Terms of Reference

NIDEA 2021 Growth Projections – Peer Review

Trim document number: D-3705612

Hamilton City Council
Te kaunihera o Kirikiriroa

1 Document Control

1.1 Version Control

Version	Author	Description of Change	Date
1.0	Nathan Dalgety	Initial Document	13/04/2021
1.1	Brian Osborne	Updated Objectives	20/04/2021
1.2	Nathan Dalgety	Document Finalised	23/04/2021

1.2 Document Approval

Approve

Signatory	Signature	Date
Greg Carstens		
Sarah Lomas		

2 Purpose

This document describes the terms of reference between Hamilton City Council and Auckland Council for the Peer Review of the NIDEA Growth Projections for Hamilton City, as outlined in the report "2018-base Population, Family and Household, and Labour Force Projections for the Waikato Region, 2018-2068"[1].

The terms of reference cover the objectives, expectations, deliverables and timeframes of the peer review.

3 Background

Growth projections are required to enable a local authority to prepare the Financial and Infrastructure strategies stated in sections 101(a) and 101(b) of the LGA. Projections help councils to understand the scale, location and timing of investment to deliver to the needs of the community. There are two principle organisations that produce growth projections for the Waikato: Statistics NZ and the University of Waikato National Institute of Demographic and Economic Analysis (NIDEA).

Due to the problems associated with the 2018 Census, key census data releases required to update the NIDEA demographic projections for the 2021-31 LTP have been significantly delayed. The update to the NIDEA growth projections to incorporate the 2018 Census have now been completed in April 2021.

At the Hamilton City Council 25 February 2021 Council Meeting, the Council resolved:

> *That the Council in addition to the 12 November 2020 Strategic Growth Committee resolution "requests staff report back to the Strategic Growth Committee within the LTP 2021-31 deliberation period, once the updated NIDEA growth projections that are based on the 2018 Census are available, which is expected to be March 2021, to inform any changes needed", requests that staff commission an independent peer review of the Growth projections.*

The Growth Funding & Analytics Unit (GF&A) at Hamilton City Council have engaged with the Research and Evaluation Unt (RIMU) at Auckland Council to conduct this independent peer review.

4 Objectives

The objectives of the Peer Review include:

- Conduct a common-sense check of the material covered in the report relating to the NIDEA population projection methodology, inputs, assumptions and outputs for Hamilton City. This will include, where appropriate and feasible, a comparison with those for the Stats NZ 2018-base population projections (e.g., components of population growth, population outputs). Comparisons with Stats NZ projections will be limited to the period 2018 to 2048 (the latter being the time horizon of Stats NZ subnational projections).

[1] The version to be reviewed is identified as "Commissioned Research Report (Final Draft) Prepared for Waikato Regional Council, April 2021". Those pages relevant to Hamilton City projections, and thus in scope for the review, are: i-22, 47-53, 86-93, 98 (Appendix Table A5), 117-119 (Appendix Tables A24-A26), and 135-140 (Appendix Tables A42-A44).

- Conduct a common-sense check of the material covered in the report relating to NIDEA Family and Household projections for Hamilton City. This will include, where appropriate and feasible, a comparison with the Stats NZ 2013-base family and household projection outputs (2018-base projections will not be available until 2022). The time period for comparisons will be restricted to 2018 to 2038, the latter being the time horizon of the Stats NZ sub-national family and household projections. Consideration of quantitative assumptions and inputs is out of scope for Family and Household projections.
- Provide a practical assessment as to whether the NIDEA growth projections consider (in the inputs and assumptions) recent spatial planning, initiatives and strategies (e.g. Hamilton-Auckland Corridor, Hamilton-Waikato Metro Spatial Plan, etc)
- Provide any recommendations or critiques of the NIDEA growth projections

The peer review will not:

- Conduct a full interrogation of the NIDEA demographic model and associated systems

5 Deliverables

The deliverables of the Peer Review will include:

- A report detailing the independent peer review of the NIDEA Growth projections, as set out in the Objectives of this Terms of Reference.

6 Costs

The RIMU unit at Auckland Council have indicated there will be no costs relating to this engagement, pending the work fits the agreed scope set out in this Terms of Reference.

7 Timeframes

Milestone	Due Date
NIDEA to complete the methods and assumptions report for the TA-level projections – to be supplied to RIMU as soon as received.	14th April 2021
NIDEA to complete the detailed report with all of results and interpretations - to be supplied to RIMU as soon as received.	16th April 2021
All data and reports to be supplied to RIMU	16th April 2021
Peer Review initiated (assuming scope in this draft)	19th April 2021
Peer Review completed	*Tbc* early May 2021
Strategic Growth Committee staff report due (may be a late report)	4 May 2021
Strategic Growth Committee	20 May 2021