Before the Selwyn District Council

under: the Resource Management Act 1991

in the matter of: Proposed Private Plan Changes 81 and 82 to the Operative District Plan: Dunns Crossing Road, Rolleston

and: **Rolleston Industrial Developments Limited** and **Brookside Road Residential Limited**
Applicant

Statement of Evidence of Paul Farrelly (Greenhouse gas emissions)

Dated: 26 August 2022

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STATEMENT OF EVIDENCE OF PAUL FARRELLY

INTRODUCTION

1 My full name is Paul Michael Farrelly.

2 I have a BE Civil Engineering (Hons) from University of Canterbury. I started my career as a traffic and road safety engineer, and have subsequently had over 25 years commercial experience working across a number of industries. Over the past 10 years I have worked in the energy and carbon field.

3 In the past 2 years I have worked for Lumen, an engineering consultancy, as a Principal Consultant in their dedicated energy and carbon team. In this capacity I have developed greenhouse gas (*GHG*) inventories for a significant number of organisations, in a broad range of sectors. This includes infrastructure companies, an airport, several electricity distribution businesses (*EDBs*), manufacturers, consulting firms and retail businesses. Through this work I am well versed in calculating GHG emissions.

4 I am familiar with:

4.1 The plan change application by Rolleston Industrial Developments Limited to rezone approximately 28 hectares of rural land in Rolleston to Living MD (*PC81*); and

4.2 The plan change application by Brookside Road Residential Limited to rezone approximately 110 hectares of rural land in Rolleston to Living MD and Business 1 (*PC82*).

together the *Proposed Plan Changes*, and Rolleston Industrial Developments Limited and Brookside Road Residential Limited together the *Applicants*.

CODE OF CONDUCT

5 Although this is not an Environment Court hearing, I note that in preparing my evidence I have reviewed the Code of Conduct for Expert Witnesses contained in Part 7 of the Environment Court Practice Note 2014. I have complied with it in preparing my evidence. I confirm that the issues addressed in this statement of evidence are within my area of expertise, except where relying on the opinion or evidence of other witnesses. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

SUMMARY OF EVIDENCE

6 When considering the GHG impacts of a potential land use change, it is important to evaluate both the emissions from the existing land use and the anticipated emissions arising from the new land use.

7 A considerable level of GHG emissions are already occurring on a portion of land subject to the Proposed Plan Changes, as a result of livestock that is grazed on the land.

8 These emissions occur primarily from methane, which is known to have a much greater impact on global warming than carbon dioxide.

9 Whilst new emissions will arise from the construction and operation of dwellings, and from travel undertaken by residents, these emissions would likely occur elsewhere in New Zealand if this development does not proceed, due to the need to build more houses to accommodate a growing population.

10 The location in Rolleston provides some climate resilience as none of the sites are within flood plain areas or near to coastlines.

11 Over a 90-year life cycle, energy usage is currently the most significant source of emissions that occurs in residential developments in New Zealand, followed by the embodied carbon of building materials.

12 Stand alone or detached housing emissions are lower on a per m^2 basis[1] than the emissions of apartments. This is because high embodied carbon materials (concrete and steel) are typically used to build apartments, compared to stand alone houses that are primarily constructed of timber.

13 Lifetime energy usage emissions from stand-alone homes can be minimised through the specification of energy efficient homes, the elimination of natural gas/LPG in developments, and encouraging a high uptake of solar PV panels.

14 The potential for solar PV uptake is much greater on stand-alone homes (compared to apartments or medium density multi-level homes) due to the much greater ratio of usable roof area to floor area.

15 GHG emissions arising from increased travel between Rolleston to Christchurch are cited (by Christchurch City Council) as an issue.

16 I consider that over time the frequency of travel between Rolleston and Christchurch will reduce, due to working from home becoming

[1] https://iopscience.iop.org/article/10.1088/1755-1315/588/2/022064/pdf

more prevalent, and Rolleston's growth will result in a greater proportion of trips remaining within the local area.

17 The GHG impact of commuting trips is also expected to reduce as uptake of electric vehicles (*EVs*) increases and the development of public transport infrastructure increases usability.

18 I consider it likely that the uptake of EVs will be much faster in "commuter-belt" areas such as Rolleston, where the daily commute distance is such that there is a strong economic incentive, via fuel cost savings, to choose an EV instead of a traditional internal combustion engine (*ICE*) vehicle, and where the round-trip distance is not so long that range anxiety becomes an issue.

19 Furthermore, the uptake of EVs is likely to be much greater in properties with a garage (as opposed to residences located in a denser urban area, where vehicles may be parked on the street).

20 Accounting for the points above, I consider that, on balance, the Proposed Plan Changes likely support a reduction in GHG emissions, relative to other greenfield development opportunities available in the greater Canterbury region.

INTRODUCTION TO GREENHOUSE GASES

21 There are several gases that contribute to the problem of global warming, the most prevalent of these being carbon dioxide (*CO_2*), methane and nitrous oxide.

22 Each of these gases have differing abilities to trap extra heat in the atmosphere, and it is the trapping of this heat that leads to global warming.

23 When evaluating GHG emissions, it is useful to have a common measure in order to allow comparisons between gases.

24 As CO_2 is by far the most prevalent of the GHGs, it is standard practice when measuring emissions to determine the level of each gas emitted, and then convert these emissions into their carbon dioxide equivalent, or CO_2-e.

25 The global warming potential (*GWP*) of a gas is a measure of its ability to trap extra heat in the atmosphere over time relative to CO_2. This is most often calculated over a 100-year period and is known as the 100-year GWP.

26 By definition, the GWP of CO_2 is 1.

27 Methane is a short-lived GHG and has a GWP that is 28-36 times that of carbon dioxide over a 100-year time frame. Over a shorter

year time frame its impact is much more significant, estimated at 84 times that of carbon dioxide over a 20-year period.

NATIONAL POLICY ON URBAN DEVELOPMENT

28 The National Policy Statement on Urban Development 2020 (*NPSUD*) requires decision makers to consider whether proposals "*support reductions in greenhouse gas emissions*".

29 When considering the GHG emissions of a proposed development or land change it is appropriate to consider the life-cycle emissions of the proposed development, and the net change in emissions compared to the emissions arising from the current land use.

30 It is notable that the NPSUD does not specify a geographical boundary in which the effect of greenhouse gas emissions should be considered.

31 Therefore I consider that supporting reductions in GHG emissions could be considered at a number of different levels – local, regional, national, or global.

32 The ultimate purpose of reducing GHG emissions is to limit global warming. In the context of this purpose, it should not matter where or how emissions reductions are supported.

33 New Zealand has a growing population and a critical need to build more affordable housing.

34 There are many potential ways that this growing population can be accommodated. For instance, dwellings can be built in different locations, different types of housing can be constructed, and different construction materials can be used.

35 Due to the materials required to build new housing, and the energy used in the operation of houses, some emissions arising from new developments are unavoidable.

36 Therefore, it is important that decisions on where to build houses in New Zealand are made in respect of their overall impact on GHG emissions, compared to other potential locations.

37 In the context of GHG emissions arising from housing related developments, I believe that GHG assessments should be based primarily on the basis of how the development's net life cycle emissions (that is an evaluation of emissions before and after the development) compare to alternative development options within New Zealand, as opposed to whether the development, in and of itself actually reduces GHG emissions.

EMISSIONS FROM EXISTING LAND USE

38 When considering a proposed development's impact on GHG emissions, it is first important to establish the level of emissions arising from the existing use of the land.

39 An aerial view of the land for the Proposed Plan Changes shows that it is flat, partially irrigated, with very limited tree coverage and is used primarily for grazing and crop growing.

40 The low tree coverage means that there is limited carbon sequestration currently occurring on the land.

41 The land in the proposed PC81 site is approximately 28 hectares and is understood[2] to currently be used for dryland arable farming or grazing purposes.

42 The land in the proposed PC82 sites is approximately 110 hectares and a variety of activities occur on the land[3]. Part of the land (approximately 46ha) has previously been used for intensive poultry activities. This is no longer occurring although the infrastructure (poultry sheds, etc.) remains. The remainder of the land (approximately 64 ha) is currently used for sheep and cattle grazing.

43 GHG emissions from the current farming operations include the following:

43.1 Enteric fermentation – the process by which ruminant animals produce methane by digesting feed;

43.2 Manure management – the storage and treatment of manure produces emissions;

43.3 Agricultural soils – soils emit nitrous oxide due to the addition of nitrogen to soils through manure, dung and urine;

43.4 Fertiliser use – applying nitrogen (urea-sourced or synthetic) fertiliser onto land produces nitrous oxide and carbon dioxide emissions. Applying lime and dolomite fertilisers results in carbon dioxide emissions; and

43.5 The use of energy in operating the farm – fossil fuels used in vehicles and electricity to power cow sheds/irrigators/pumps.

[2] Infrastructure report, Skellerup South, Inovo, dated 8 October 2021

[3] Preliminary Site Investigation, Fraser Thomas Limited, 15 October 2021

44 Emissions for a farming operation can be calculated using guidance provided by the Ministry for the Environment (*MFE*)[4]. In this guide, MFE provide annual emissions on a per animal basis.

45 The relevant emissions factors, per grazing cow, per annum are as follows, updated to reflect the latest emissions factors published by MFE in May 2022.

45.1 Enteric fermentation – 1,540 kg CO2-e;

45.2 Manure management – 21.4 kg CO2-e; and

45.3 Agricultural soils – 267 kg CO2-e.

46 The emissions factors for grazing sheep are lower than grazing cows, however as we have no data on the split of cows/sheep on the land, we have undertaken calculations based on an assumption that the land is grazed by cows only.

47 The MFE factors above are based on a GWP value of 25 for methane, however it is recommended by the Greenhouse Gas Protocol that a higher GWP, of at least 28, should be used when calculating methane emissions.

48 I expect that if the land were no longer used for grazing this would lead to an overall reduction in the number of dairy cows in the region.

49 No data has been provided for the number of animals on the PC81 and PC82 sites, but it would be reasonable to assume a similar stocking rate to that of land surrounding the Plan Change areas. From evidence provided in respect of Plan Change 73, it was identified (based on data provided by the farmer) that the stocking rate in the PC73 areas was 5.25 grazing cows per hectare.

50 For the portion of PC82 land that has historically been used for poultry farming, my expectation is that this land is unlikely to be used for grazing, or other activity, until such time as the poultry sheds are removed from the site. As such, I consider that the current emissions arising from this portion of the land can be assumed to be zero.

51 I note that the land in PC81 and PC82 is zoned rural outer plain zone.

[4] Measuring Emissions: A Guide for Organisations – 2022 detailed guide.

52 As such, I expect that were the rezoning request not to go ahead, the land would most likely continue to be used for grazing for the foreseeable future, with the associated emissions continuing.

53 When calculating the level of grazing-related emissions arising from the current land use, I have considered the applicable land area (for grazing) to be a total of the 28 ha in PC81 and 64ha in PC82 (i.e. not including the poultry farm infrastructure), for a total of 92ha. At an assumed stocking rate of 5.25 cows/ha, I calculate that the land would support a total of 483 grazing cows.

54 Using MFE factors for agriculture, the emissions of the existing land use can therefore be calculated as 483 cows * (1,540 + 21.4 + 267) = 883,117 kg CO_2-e, or 883 tonnes CO_2-e per annum.

55 This excludes any emissions from fossil fuels used on the farm, electricity use and any fertiliser application, as these figures are not available.

56 Using the Greenhouse Gas Protocol's recommendation to use a GWP value of 28 for calculating methane, these emissions increase to 989 tonnes CO_2-e.

57 To put this into perspective, 989 tonnes CO_2-e is equivalent to the following:

57.1 3.7 million vehicle kilometres travelled in a typical NZ vehicle (using the MFE's default private car emission factor per km of 0.265 kg CO_2-e); or

57.2 The average annual electricity usage emissions of approximately 963 houses[5].

58 There is an increasing level of awareness in the scientific community of the need to reduce methane emissions as soon as possible. The recent Intergovernmental Panel on Climate Change (*IPCC*)[6], sixth assessment report makes this clear:

> *"Stabilizing the climate will require strong, rapid, and sustained reductions in greenhouse gas emissions, and reaching net zero CO_2 emissions. Limiting other greenhouse gases and air pollutants, <u>especially methane</u>, could have benefits both for health and the climate"*

[5] The average residential home in Canterbury uses 8,550kWh per annum – per Electricity In New Zealand, 2018. The Electricity Authority. The MFE grid emissions factor (for 2020- the latest year available) is 0.120kg CO_2-e per kWh

[6] IPCC, 2021: Climate Change 2021: The Physical Science Basis. Contribution of Working Group 1 to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.

59 I consider that the cessation of farming activities on the land would constitute a reduction in emissions.

60 This should be taken into account when comparing this proposal against others, particularly where a development would convert land with currently low or negative emissions (e.g. a golf course, or tree covered area), to housing.

EMISSIONS FROM PROPOSED LAND USE

61 Like any new residential development, GHG emissions will be emitted during three different stages of the project:

61.1 Construction of the infrastructure required to support the development;

61.2 Construction of the dwellings and commercial buildings; and

61.3 Emissions arising from the occupation of the dwellings and businesses operating out of the commercial buildings – primarily these emissions relate to energy use.

62 Emissions will also arise from travel related activities of residents who live within the blocks.

63 In terms of GHG emissions from infrastructure work (i.e. prior to the construction of the houses):

63.1 While the existing land use is grazing, the sites are zoned rural and residential density is sought to be increased as follows:

(a) Skellerup South (PC81): Currently zoned as Rural (Inner Plains), PC81 seeks changing this to 350 residential allotments under Living MD zoning.

(b) PC82: Currently zoned as Rural (Outer Plains), PC82 seeks changing this to 1,320 residential allotments and two commercial sites under Living MD and Business 1 zoning.

63.2 The Proposed Plan Change sites are relatively flat which limits the amount of earthworks required and therefore the amount of fossil fuels that will be used in preparing the site for development.

63.3 Some soil may need to be removed from the sites, however given the cost of disposing soil, there will not be unnecessary removal of soil.

63.4 In terms of materials for infrastructure, there is currently limited scope to avoid the use of GHG producing construction materials, however I note that lower emissions materials are being developed all the time, and it is likely that when development commences that lower emissions materials can be specified by the developer.

63.5 The bulk of materials required in the development are anticipated to be roading related (concrete/asphalt) and piping.

64 The second major component of GHG emissions is the emissions associated with construction of the dwellings. The major contributing factor is emissions "embodied" in materials that are used in the build.

64.1 Embodied carbon relates primarily to the energy used to create the building materials. Examples of materials with high embodied carbon are concrete and steel, compared to timber which has comparatively low embodied emissions.

64.2 There are two main ways of reducing embodied carbon in a dwelling:

(a) build dwellings using lower-carbon materials; and/or

(b) reduce the size of a dwelling.

64.3 A recent (2020) study undertaken by Massey University and BRANZ[7] assessed the expected life cycle emissions for 3 different types of residential dwellings: detached housing, medium-density housing, and an apartment.

64.4 A lifecycle analysis takes into account the emissions expected to be emitted across the various life stages of the development – this includes construction, operation, and end of life treatment.

64.5 The study considers that a New Zealand home is expected to last for 90 years and, therefore, the analysis should consider emissions across this timeframe.

64.6 Key conclusions from the study were that the product stage (embodied carbon) is responsible for 16% of the life cycle emissions, with operational energy use responsible for 59%.

[7] Application of Absolute Sustainability Assessment to New Zealand Residential Dwellings - S J McLaren *et al* 2020 *IOP Conf. Ser.: Earth Environ. Sci.* 588 022064

64.7 Embodied carbon was relatively more significant for apartments, due to the greater use of high emissions materials such as concrete and steel in construction.

64.8 On a per m^2 basis, across a 90-year period, the lifetime emissions are highest for apartments (21 kg CO_2-e/m^2/yr) compared to lifetime emissions for detached housing and medium density housing (13 kg CO_2-e/m^2/yr).

64.9 As apartments are unlikely to be built in the proposed rezoning area, given the applicable Living MD rules, I consider that the embodied emissions resulting from the type of dwellings envisaged on the sites to be relatively efficient from a GHG perspective.

64.10 Furthermore, I think it is important to recognise that the emissions factor for electricity used in this study relates to a NZ average, whereas in reality the emissions for electricity usage in the South Island are lower than electricity in the North Island, due to the different mix of generation in the two islands. Most of the electricity used in the South Island comes from low emissions sources (hydro and wind), whereas electricity used in the North Island is generated from a mix of sources including geothermal, natural gas and coal. As such, the electricity used in the North Island has higher emissions.

64.11 Taking this into consideration, what this means is that embodied carbon is a much higher relative contributor to lifetime emissions for properties developed in the South Island compared to the North Island.

64.12 Therefore, in order to minimise the lifetime emissions associated with housing developed in the South Island we should be looking, as much as possible, to build houses using materials that have low embodied carbon such as standalone houses and medium density housing (townhouses).

65 When it comes to emissions from operational energy use, the main factors that influence this are:

65.1 how energy efficient a dwelling is;

65.2 the type of energy that is used in the dwelling;

65.3 the size of the dwelling; and

65.4 the use of on-site renewables.

66 Emissions in the Proposed Plan Change sites can be minimised by encouraging[8] energy efficient homes to be built, ensuring that natural gas/LPG infrastructure is not provided as part of the development and encouraging the uptake of solar PV panels.

67 New homes offer the potential to be much more energy efficient than traditional NZ houses, due to better building materials, higher levels of insulation and the ability to design homes to maximise thermal (or solar) gain.

68 There is growing awareness of the value of passive houses, and I expect to see an increased uptake of these type of homes in the coming years. A passive home is one that is primarily heated passively (via the sun), oriented to optimise solar gains in winter and to prevent overheating in summer. Passive houses target energy use of around 25 kWh/m^2. For an average sized (180 m^2) passive house, energy use would be expected to be just 4,500kWh per annum, which equates to approximately 450 kg CO_2-e per annum at current grid emissions factors. This is roughly half the electricity emissions of a typical New Zealand home. As NZ's electricity grid becomes increasingly renewable these emissions can be expected to reduce to around 250 kg CO_2-e per annum[9] in 2030. Note that emissions from energy use are largely carbon dioxide, with little methane emitted in electricity generation.

69 An ideal site for passive design is a flat site that is free of obstructions to the north.

70 As such I consider the sites in the Proposed Plan Changes to be ideal for passive house construction.

71 I also consider that the sites are well suited for solar PV due to the flat nature of the land and the relative lack of existing trees within the area.

72 Furthermore, as apartments are unlikely to be built in the Proposed Plan Changes, given the applicable Living Z and Living MD rules, most houses are expected to be detached or semi-detached, and I would expect there to be a relatively high uptake of solar.

73 Taking these factors into account, I expect that dwellings built in the Proposed Plan Change sites would be relatively energy efficient

[8] Rules mandating such requirements are not proposed, however they can be readily encouraged or promoted by the land developer and or home builders.

[9] Modelling recently released by The Climate Change Commission and used in *Inaia tonue nei: a low emissions future for Aoterora*, estimates a grid emissions factor of 55.1g CO2-e/kWh in 2030. The 2018 grid emissions factor was 101 g CO2-e/kWh.

compared to other developments and consequently would have relatively low emissions per resident.

CLIMATE RESILIENCE

74 There have been a number of adverse weather events affecting New Zealand in recent times and I think it is very timely that we place greater emphasis on where we build houses, in light of future anticipated climate change impacts.

75 The effects of climate change, including sea level rise, due to increased GHG emissions has meant that some locations, particularly next to coastlines, are no longer appropriate for housing development.

76 According to the Draft National Adaptation Plan[10] published by the Ministry for the Environment in April 2022:

> *A warmer and wetter climate may affect the durability of building materials and the life span of our homes and buildings. This could include an increased risk of damage due to coastal erosion or the risk of subsidence during intense rainfall and storm surges along the coastline.*

77 As such, I consider that the location of the Proposed Plan Changes, are at less risk of adverse effects from future sea level rise as compared to coastal locations in Canterbury.

78 Climate change will also increase the frequency and intensity of heavy rainfall events which will severely impact areas prone to flooding.

79 According to computer-based flood modelling carried out by Environment Canterbury (*ECan*) for the Selwyn District Council[11], the Proposed Plan Changes are not at high risk of flooding.

> *High risk areas were defined in the mapping tool as areas which would experience flood water levels greater than 1 m during a one in 500-year rainfall event.*

80 Housing developments proposed for Rolleston have inherent climate resilience.

81 If the anticipated impacts of climate change (sea level rise, flooding) occur sooner than currently expected, there is a chance that existing

[10] Ministry for the Environment. (2022). Draft national adaptation plan. Wellington: Ministry for the Environment.

[11] Wild, M. (2019). Selwyn River/Waikirikiri floodplain investigation. Christchurch: Environment Canterbury.

housing stock may become damaged and need to be replaced more quickly than may currently be anticipated.

82 In this context, it will be highly valuable for the region, and indeed New Zealand as a whole, to ensure that there is sufficient land available to meet an unexpected increase in future housing demands, in locations that have climate resilience, such as Rolleston.

EMISSIONS FROM TRANSPORTATION

83 Emissions from transportation are a function of mode of transport (i.e. vehicle type), distance travelled, and frequency of travel.

84 Emissions from transportation primarily arise from trips undertaken in vehicles that use fossil fuels, and in New Zealand this primarily means passenger vehicles.

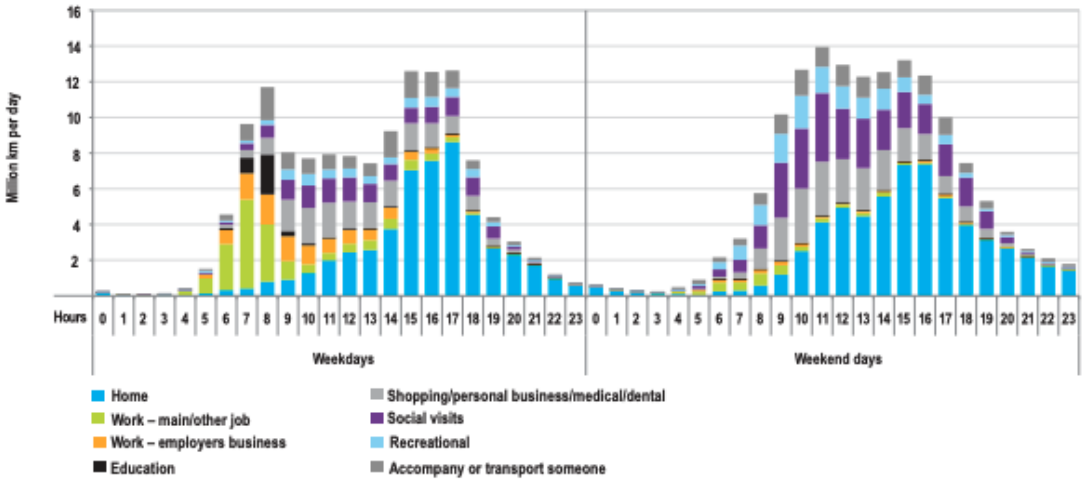
85 It is extremely difficult to accurately model or predict the level of travel related emissions that may occur from residents of any proposed development, and indeed how these may compare to the travel related emissions of an equivalent number of residents in any other location.

86 The most comprehensive data for the types of trips that people undertake in New Zealand is provided by the Ministry of Transport.[12]

87 The following chart from that study shows the average distances travelled per day for different purposes:

[12] Ministry of Transport. (2015). 25 Years of New Zealand Travel: New Zealand Household Travel 1989-2014.

Figure 12: Average distance per day by purpose and time of day (2010–2014)



88 This shows that, on average, people travel further on weekend days than they do on weekday days, so the relative influence of commuting on overall travel emissions may be less than is commonly assumed.

89 The Proposed Plan Change request developments, whilst on the fringes of Rolleston, are located approximately as close to the centre of Rolleston as other greenfield land in the area.

90 PC81 is noted as 4.6km from an indicative Rolleston town centre point, whilst the PC82 is noted as 3.5km from this point. This compares to other plan change areas ranging from 2.9 – 3.5km from the indicative centre point of Rolleston.

91 It is reasonable to assume that many "high frequency" trips are made to the most conveniently located destination for the purpose of the trip (e.g. nearest dairy/takeaway outlet/café) whereas trips to "destination" locations – such as heading to a larger supermarket for weekly shop occur relatively less frequently.

92 The recent announcements of a major retail development in Rolleston, adjacent to iPort, will likely mean that these trips in future will be to locations closer to the proposed developments:

92.1 PC82 and PC81 are located approximately 5.5 and 7 km from the iPort respectively.

93 A consent application for a Pak'N'Save supermarket at 157 Levi Road is currently under consideration. Although the distance between the Proposed Plan Change sites and the proposed Pak'N'Save location is similar to the distance to existing Rolleston supermarkets (~5 km), Pak'N'Save is widely considered the most

affordable supermarket chain. Some residents of the rezoning request sites, who may have travelled to a Pak'N'Save in Christchurch to save money on groceries, would no longer have to travel beyond Rolleston. Hence, reducing their emissions from vehicle use.

94 Therefore it could be expected that many "shopping" and potentially "recreational" trips would occur locally, via active traffic modes, to the proposed commercial areas and the wider Rolleston commercial areas.

95 The tenancies in the PC82 proposed commercial allotment will likely be self-selected, accounting for their likely desirability and convenience to nearby residents. For example, tenancies such as a day care centre, a café, a convenience store and potentially takeaways would be well utilised by the residents of the proposed block and mitigate the need for travel further to other destinations.

96 With its close proximity and access to West Rolleston Primary School (~1km), and the potential for new schools to bd developed within the Plan Change areas (as noted in the revised ODPs), it can also be expected that a significant proportion of "education" trips from residents in the PC81 and PC82 blocks will be undertaken using active modes, as opposed to in private passenger vehicles.

97 Given these factors, I consider the noted increased distances to the centre of Rolleston compared to other plan change areas to be relatively insignificant from an overall GHG perspective.

98 The successful development of the iPort would also reduce the travel distance for Rolleston residents needing to make lower frequency trips e.g. to a big box retail outlet, hence, reducing the emissions from these trips.

99 In terms of commuting trips:

99.1 It is highly likely that instances of working from home (*WFH*) will increase substantially in the future, which will substantially reduce the frequency of commuting.

99.2 The experience of Covid-19 has shown that a significant proportion of workers are able to perform their duties from a home office. Many large employers now offer employees significant autonomy and flexibility when it comes to where and when they choose to complete their work duties.

99.3 The incentive to WFH is greater for employees who live further from their place of employment, due to the time and cost savings.

99.4 WFH will likely be even more attractive to those who live in a new, well-built, warm home.

99.5 It is therefore highly likely that residents of the proposed developments (who work in a Christchurch office) will be strong adopters of WFH.

99.6 WFH can further be supported by ensuring that there is robust broadband conectivity provided to the developments.

99.7 There is emerging evidence[13] from around the world that WFH has become an established practice in much of the Western World, with recent statistics from the US suggesting that the number of days employees are spending WFH is increasing (for 1.58 days/week in Jan 2021 to 2.37 in June 2022).

99.8 In a study[14] conducted on metropolitan Australian WFH habits, researchers found that commute distance had an effect on the likelihood for someone to WFH. For a commute distance of 1-20 km, the probability of WFH was 29%, whereas for a commute distance greater than 30 km, the probability for WFH was closer to 39%. The distance from Rolleston to the centre of Christchurch is approximately 27 km, which suggests that there will be a strong likelihood that residents of Rolleston (who are employed in Christchurch) will indeed WFH reasonably regularly.

99.9 Additionally, people in the state of Victoria[15], Australia were found to be more likely to live in 'peri-urban' (commuter belt, semi-rural) areas if they had the option to WFH.

100 When it comes to commuting transport mode, in all likelihood the vast majority of trips (at least in the next 10 years) that occur between Rolleston and Christchurch will continue to be undertaken in passenger vehicles, or until such time as a high quality public transport options are provided.

100.1 In addition to the proposed retail outlets at iPort, it is notable that Carter Group are advancing a proposal for a 'park and ride' facility near the iPort.

[13] https://www.weforum.org/agenda/2022/07/work-from-home-employers-workers-work-life

[14] Hensher, D.A., Balbontin, C., Beck, M.J., Wei, E. (2021). The impact of working from home on modal commuting choice response during COVID-19: implications for two metropolitan areas in Australia. Sydney: Institute of Transport and Logistics Studies.

[15] Infrastructure Victoria. (2021). The post-pandemic commute: the effects of more working from home in Victoria.

(a) The idea of this is that drivers leave their vehicles at the 'park and ride' location then take public transport for the rest of their journey i.e., commute to work in Christchurch.

(b) The Northern Busway, a similar project, has been developed in Auckland with great success. Before the development of the Northern Busway, approximately one quarter of trips across the Auckland Harbour Bridge during the morning peak were taken by public transport. Now, it is more than one third with predictions being that more than half of these trips will be by public transport by the mid 2030s.[16]

(c) The option for 'park and ride' with associated public transport would reduce transport emissions from Rolleston residents.

101 I note the evidence of **Mr Fuller** regarding the potential for existing public transport bus routes (route 5 and Route 85) to be extended in order to service the Proposed Plan Change areas.

101.1 Collaboration with Environment Canterbury (ECan) in the development of appropriate bus routes within PC81 and PC82 would be beneficial for increasing uptake and reducing transport emissions from PC81 and PC82 residents.

101.2 Effective development of this transport network would allow residents to commute to both central Rolleston and Christchurch.

102 Until such time as the infrastructure for enhanced public transport is in place (which would be accelerated were the rezoning request approved), it is however reasonable to expect that a significant proportion of commuter trips undertaken in passenger vehicles between Rolleston and Christchurch will be in electric, or hybrid vehicles.

103 The uptake of EVs in New Zealand has been rapid[17] since 2021 with the introduction of the Clean Car discount, the availability of more EV models, and a substantial increase in the price of fossil fuels resulting in more and more New Zealanders looking to switch to electric.

[16] The Auckland Plan 2050. (2016). The Northern Busway. Auckland: Auckland Council.

[17] https://www.stuff.co.nz/motoring/129246542/evs-past-the-tipping-point-for-mass-adoption

104 The NZ government has also committed (in its May 2022 Emissions Reduction Plan) to a target of 30% of electric vehicles in the light vehicle fleet by 2035.

105 I have not been able to identify if uptake has been more rapid in Rolleston than other areas of the country, but I am of the view that the economics of owning an EV are compelling for anyone who commutes a reasonable (20km+) distance to work on a regular basis.

106 It is likely that the rate of EV uptake will be higher than the national average in the proposed West of Dunns Crossing Road development, for the following reasons.

106.1 The round-trip commuting distance between Rolleston and the centre of Christchurch, at 50km, is close to the ideal distance to maximise EV uptake.

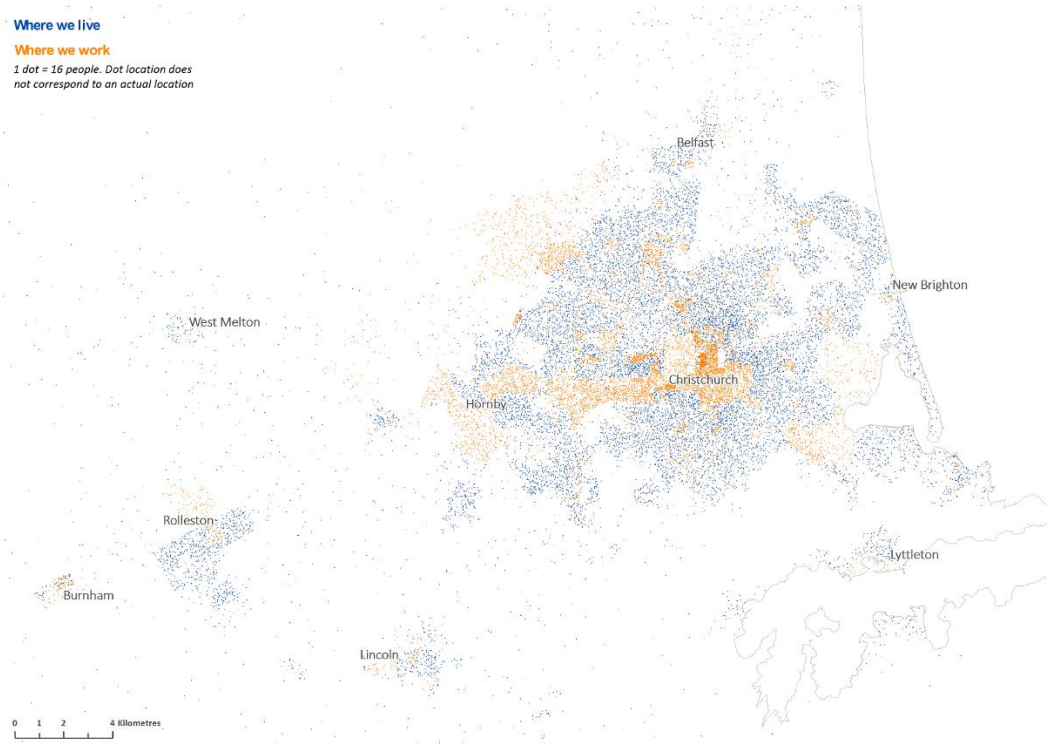
106.2 Data from the 2018 Census[18] shows that people typically do not live in the same area as their work. Rather, commuting to work in another location is more common.

(a) In Christchurch (refer Figure 1 below), it appears that a large proportion of the population in Greater Christchurch works in the western side of the city – the closest part of Christchurch to Rolleston.

(b) Whilst this indicates that there is most likely a shorter commute distance for residents of Rolleston (that work in Christchurch) than to the central city, the economics of EVs are still likely to be very attractive for anyone based in Rolleston who regularly commutes into any part of Christchurch.

[18] Stats NZ. (2020). Where we live versus where we work. Wellington: Stats NZ.

Figure 1: Where we Live vs Where we Work (Greater Christchurch)



106.3 Research[19] indicates that two of the biggest barriers to EV adoption in NZ are the cost of EVs and range anxiety.

106.4 With regards to the cost of EVs:

(a) On average, a second-hand EV costs between $5-10k more than a comparable ICE vehicle.

(b) Countering this, the annual running cost of an EV is much lower than a petrol/diesel equivalent, due to the lower cost of electricity. Furthermore the recently introduced clean car discount makes the up-front cost of EVs relatively lower.

(c) The Energy Efficiency and Conservation Authority (*EECA*) calculated in 2018 that for an average NZ vehicle (that travels 11,000km per annum) the annual fuel savings of an EV are $1,460. Given the increase in fuel prices since this analysis was completed, the

[19] Ministry for the Environment. 2018. *Reducing barriers to Electric Vehicle uptake: Behavioural insights analysis and review*

annual savings of an EV now can be expected to be substantially higher than the 2018 analysis.

(d) The level of savings increase as a vehicle travels further. Therefore, it stands to reason that the economic incentive for purchasing an EV is much greater for drivers who have a greater travel need, such as commuters between Rolleston and Christchurch.

106.5 A second major barrier to EV uptake is range:

(a) Due to its more affordable price (compared to other EVs) and availability, the most commonly purchased second hand EV in NZ is currently a Nissan Leaf (2011-2016 models).

(b) Leafs make up 50% of current EVs in NZ, and most of these have a 24 or 30kWh battery.

(c) I consider that Leafs will continue to be the most purchased second hand vehicles for at least the next 3-5 years.

(d) I expect that in the near-term employers will not be providing EV charging facilities (at work) for employees.

(e) Therefore - in the next 3-5 years, an EV owner will primarily need to charge their vehicle at home, or at public charging stations.

(f) The anticipated range for a 2011-2016 Nissan Leaf is between 120-170km (using the EPA measure). The average range across these models is 145km - assuming travel on flat terrain.

(g) Assuming a level of battery deterioration of 80% after 5 years - a 2nd hand leaf can be expected to have a "safe range" of 145*.8 = 116km.

(h) Ideally batteries should only be charged to 80% in order to maximise their life.

(i) 80% *116km = 93km, so this gives a maximum daily range of 93km for a 2nd hand leaf.

(j) Given that commuters may need, at times, to undertake errands on the way to (or more likely) from work, an additional distance of 10km into the commute should be factored in.

(k) In my view, the maximum 2-way commuting distance for a Leaf would be 83km (93-10) before a purchaser would need to upgrade to a vehicle with a larger

battery, which would have a much higher purchase price.

(l) A higher purchase price is likely to act as a significant deterrent and would be expected to put off many potential EV buyers.

(m) Therefore I consider that the optimal daily commute distance for maximum EV uptake is between 25-40km.

(n) The distance between the proposed West of Dunns Crossing Road sites and Hornby is approximately 15 km. To central Christchurch, the distance is 27 km.

107 With a distance of approximately 27km from the PC81 and PC82 to the centre of Christchurch, assessed as the location of the Riverside market (daily round trip 54km), it is reasonable to expect that there will be a high uptake of EVs in the proposed developments.

RESPONSE TO SUBMISSIONS AND OFFICER'S REPORT

108 The following provides a response to the emissions related submissions, grouping these together where possible.

109 In general, concerns raised in respect of emissions relate to transportation only.

Multi Modal Opportunities

110 Waka Kotahi have suggested that the applicant should consider opportunities for multi-modal transport both within and adjoining the plan change aera. Waka Kotahi noted that provision for an internal pedestrian and cycle network has been made, but that linkages to adjoining sites are reliant on other surrounding plan changes being accepted.

111 I am encouraged by the strong connectivity and alignment proposed by the revised ODPs for PC 81 and 82 and that of the adjoining Plan Change 73, noting that these Plan Changes are proposed by the same developer.

112 From my perspective, the combined PC 73, 81 and 82 plan changes would offer excellent walking and cycling opportunities, noting also that there are commercial areas planned for both PC73 (Skellerup block) and PC82. I further note that there exists the potential for school facilities to be developed within the plan change area (as noted in the revised ODPs), which I would expect to have excellent multi model connectivity to the residences within these areas.

113 I also note that the ODPs have identified pedestrian crossing facilities on Dunns Crossing Road and Brookside Road, which will allow for safe active mode access to the existing Rolleston township.

114 In my opinion, multi-modal transport opportunities have been well considered by the applicant.

Public Transport provision

115 Waka Kotahi notes that the sites are beyond the Projected Infrastructure Boundary, and as such there is currently limited planning for the provision of improved public transport. ECAN note the site is not directly served by public transport and there is currently no public transport planned for the area.

116 This is not surprising given the sites are currently unoccupied, however I note that there is an opportunity to extend the existing bus routes, as identified in **Mr Fuller's** evidence. I understand the ODP text for the Plan Changes enable the development of future public transport routes.

117 I also note **Ms White's** assessment that "*in my view, the funding and implementation of a public transport system is a matter that requires broader consideration, rather than being a site-specific matter relating to this plan change. As such, I consider it would be difficult to require the developer of this Site to fund and implement a public transport system to service the site."*

118 I agree with this statement, but note that the developer has expressed a willingness to work with ECAN to support the potential opportunity to expand the existing public transport system into the plan change areas.

Commuting emissions

119 Waka Kotahi notes that there are limited job opportunities and local amenities in the Rolleston township, which results in private vehicle commuter traffic into Christchurch City. On a similar note, **Ms White** comments that she shares the concerns of some submitters that there is limited accessibility from the plan change sites to jobs, by way of active transport. **Ms White's** concern is that there is not sufficient local employment, therefore residents need to travel (to Christchurch) for work and the distance is too great for active modes of travel.

120 Whilst it is true that historically there has been significant commuter traffic from Rolleston to Christchurch, the assessment of GHG emissions arising from proposed plan changes requires a consideration of the future state of Rolleston.

121 Rolleston has already reached a point where it is very well served with amenities, which already limits the need for travel into Christchurch City for recreational activities, such as shopping, entertainment, and sporting activities.

122 There is an increasing range and scale of employment opportunities emerging within the township, such as the continued development of iPort, the Rolleston fields retail complex development, The Station bulk retail development, and additional opportunities for more employment that will arise should the proposed Plan Change 80 area be developed.

123 I would expect most of the newly created jobs to be filled by local residents, and this will result in less non-active commuting emissions in future.

124 The distance from the centre of plan change area 82 to the centre of Rolleston is approximately 3.5km, while the distance to the iPort area is approximately 5km – these are distances that can be relatively easily cycled, particularly on flat land such as that within Rolleston. The distances from the centre of PC81 to Central Rolleston and iPort are approximately 5km and 6.5km, also distances that are quite achievable by bike. Given this, I do not agree that there is limited accessibility via active transport between the proposed housing areas and employment opportunities. I agree that PC82 has better accessibility than PC81.

CONCLUSION

125 I consider that, on balance, the Proposed Plan Changes likely support a reduction in GHG emissions, relative to other development opportunities available in the greater Canterbury region.

126 In particular I consider this to be the case for other proposed developments where the existing land use does not currently generate a significant level of emissions through agriculture.

127 I expect that housing built in the Proposed Plan Changes, under a Living MD zoning will have relatively low life-time emissions on a per resident basis, due to the type of housing (no multi-story apartments, meaning low embodied carbon building materials), size of houses envisaged to be built and the likelihood that these houses will not need to be replaced as a result of climate change impacts within an anticipated 90-year lifetime.

128 I acknowledge that travel related emissions are likely to be higher for residents in the proposed blocks compared to residents of equivalent green-field developments in Christchurch, however I am very confident that the materiality of this from an emissions perspective will diminish significantly over time as Rolleston continues to grow, there are more employment and recreation activities in Rolleston, WFH becomes even more frequent, public transport infrastructure within the Rolleston area advances, and as the penetration of EVs increases.

129 I consider that there is no material difference in the likely travel related emissions for residents in the proposed blocks compared to other green-field sites in Rolleston.

Dated: 26 August 2022

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Paul Farrelly