Before the Selwyn District Council

under: the Resource Management Act 1991

in the matter of: Proposed Private Plan Change 73 to the Operative District Plan: Dunns Crossing Road, Rolleston

and: **Rolleston West Residential Limited**
Applicant

Statement of Evidence of Paul Farrelly (Greenhouse gas emissions)

Dated: 13 September 2021

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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 the plan change application by Rolleston West Residential Limited (the *Applicant*) to rezone approximately 160 hectares of land in two separate locations on Dunns Crossing Road, Rolleston to enable approximately 2,100 residential sites and two commercial areas.

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.

SCOPE OF EVIDENCE

6 My evidence will deal with the following:

6.1 Greenhouse gas (*GHG*) emissions from existing land use; and

6.2 Future anticipated GHG emissions arising from the proposed plan change.

SUMMARY OF EVIDENCE

7 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.

8 A considerable level of GHG emissions are already occurring on the Holmes and Skellerup Blocks, as a result of livestock that is grazed on the land.

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

10 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.

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

12 Stand alone or detached housing emissions are much lower on a per m^2 basis than the emissions of apartments or multi-story developments. This is a 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 We consider that over time, the frequency of travel between Rolleston and Christchurch will reduce, due to working from home becoming 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 increases.

18 We consider it likely that the uptake of electric vehicles 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 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).

INTRODUCTION TO GREENHOUSE GASES

20 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.

21 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.

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

23 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.

24 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.

25 By definition, the GWP of CO_2 is 1.

26 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, with its impact estimated at 84 times that of carbon dioxide over a 20 year period.

NATIONAL POLICY ON URBAN DEVELOPMENT

27 The National Policy Statement on Urban Development 2020 requires decision makers to consider whether proposals "support reductions in greenhouse gas emissions".

28 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.

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

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

31 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.

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

33 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.

34 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.

35 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.

36 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 of itself actually reduces GHG emissions.

EMISSIONS FROM EXISTING LAND USE

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

38 An aerial view of the land in PC73 shows that it is flat, partially irrigated, with very limited tree coverage and is used for grazing and crop growing.

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

40 According to the farmer of the proposed plan change sites, the land is currently used as follows:

> *"[For the Holmes Block] We have been growing Barley and Maize on the property over the spring/summer period and then for approximately 4 to 5 months we will graze approximately 440 rising 2 year old replacement heifer calves on the block. Also we currently have 32ha of Lucerne on this block which is mowed for silage usually 4 times per year".*
>
> *"For the Skellerup block we have been using approximately half of the block to grow a winter crop for grazing dry cows (up to 1000) over the period June to August and the other half is used for up to 400 grazing yearling heifers and then cutting grass silage for supplementary feed."*

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

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

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

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

41.4 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

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

42 Emissions for a farming operation can be calculated using guidance provided by the Ministry for the Environment (*MFE*)[1]. In this guide, MFE provide annual emissions on a per animal basis.

43 The relevant emissions factors, per cow, per annum are as follows:

43.1 Enteric fermentation – 1,452 kg CO2-e;

[1] Measuring Emissions: A Guide for Organisations – 2020 detailed guide.

43.2 Manure management – 19.5 kg CO2-e; and

43.3 Agricultural soils – 237 kg CO2-e.

44 MFE factors above are based on a Global Warming Potential (*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.

45 Even though cows are not currently grazed fully year round on the existing blocks, the use of the land is currently supporting the growth of up to 840 dairy cows, that emit GHGs throughout their lifetime.

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

47 So when establishing the level of emissions arising from the current land use, I consider it appropriate to calculate emissions based on a total of 840 cows (440 on Holmes Block, 400 on Skellerup).

48 I note that the land in PC73 was rezoned from Rural (Outer Plain) to Living 3 with these changes taking effect on 5 March 2012.

49 The fact that the land use has not changed in the 9 years since it was rezoned suggests that the economic case for low density housing is not strong enough to encourage its development as allowed by Living 3 zoning.

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

51 Using MFE factors for agriculture, the emissions of the existing land use can be calculated as 840 cows * (1,452 + 19.5 + 237) = 1,435,140 kg CO2-e, or 1,435 tonnes CO2-e per annum.

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

53 Using the Greenhouse Gas Protocol's recommendation to use a GWP value of 28 for calculating methane, these emissions increase to 1,607 tonnes CO2-e.

54 To put this into perspective, 1,607 tonnes CO2-e is equivalent to the following:

54.1 6 million vehicle kilometres travelled in a typical NZ vehicle (using the MFE's default private car emission factor per km of 0.265); or

54.2 The average annual electricity usage emissions of approximately 2,300 houses.

55 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*)[2], sixth assessment report makes this clear:

> *"Stabilizing the climate will require strong, rapid, and sustained reductions in greenhouse gas emissions, and reaching net zero CO2 emissions. Limiting other greenhouse gases and air pollutants, <u>especially methane</u>, could have benefits both for health and the climate"*

56 I consider that the conversion of the Holmes and Skellerup blocks from farming to residential development, expected to occur as a result of the proposed plan change, will lead to a material reduction in emissions.

57 This should be taken into account when comparing this proposed development 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

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

58.1 Construction of the infrastructure required to support the development;

58.2 Construction of the dwellings and commercial buildings; and

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

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

[2] 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.

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

60.1 The 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.

60.2 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 from the site.

60.3 In terms of materials for infrastructure, there is currently limited scope to avoid the use of greenhouse gas producing construction materials, however we 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.

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

60.5 While the existing land use is grazing, the site is zoned for low density residential which is sought to be increased through this plan change as follows:

(a) Holmes: Currently zoned to enable 97 rural residential allotments, PC73 seeks changing this to 1,150 residential allotments.

(b) Skellerup: Currently zoned to enable 51 rural residential allotments, PC73 seeks changing this to 950 residential allotments.

60.6 I expect that the amount of infrastructure related materials required would not be substantially different were the currently zoned number of houses built or the number proposed by the plan change – rather the materials are more a function of the hectares to be developed than the number of dwellings.

60.7 Therefore, from an emissions intensity perspective (that is the emissions per resident), there is a benefit in increasing the density of housing in the development, which the proposed plan change would support.

61 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.

61.1 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.

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

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

(b) reduce the size of a dwelling.

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

61.4 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.

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

61.6 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%.

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

61.8 On a per m2 basis, across a 90 year period, the lifetime emissions are highest for apartments (21 kg CO2-e/m2/yr) compared to lifetime emissions for detached housing and medium density housing (13 kg CO2-e/m2/yr).

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

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

62 Noting that emissions are also a function of dwelling size, it is important to consider the size of dwellings that would likely be built if the plan change is approved.

62.1 It is reasonable to expect that, on average, larger houses would be developed under the current Level 3 low density zoning rules than would be developed under the higher density Living zone Z rules. It is also reasonable to assume that larger houses would not necessarily accommodate more people.

63 As such, the emissions/per person arising from housing can be expected to be lower for houses developed under the applicable Living Z rules than those that would be developed under Living 3 rules.

64 When it comes to emissions from operational energy use, the main factors that influence this are 1) how energy efficient a dwelling is, 2) the type of energy that is used in the dwelling, 3) the size of the dwelling and 4) the use of on-site renewables

65 Emissions in PC73 can be minimised by encouraging[4] 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.

66 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.

67 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 CO2-e per annum at current grid emissions factors. As NZ's electricity grid becomes increasingly renewable these emissions can be expected to reduce to around 250 kg CO2-e per annum[5] in 2030. Note that

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

[5] 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 is 101 g CO2-e/kWh.

emissions from energy use are largely carbon dioxide, with little methane emitted in electricity generation.

68 An ideal site for passive design is a flat site, that is free of obstructions to the north and unlikely to be built out in future.

69 As such I consider the sites in PC73 to be ideal for passive house construction.

70 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.

71 Furthermore, as apartments are unlikely to be built in the proposed plan change sites given the applicable Living Z rules, most houses are expected to be detached or semi-detached, and I would expect there to be a relatively high uptake of solar.

72 As already mentioned, I would also expect that, on average, smaller houses would be developed under the proposed Living zone Z rules than the current Level 3 low density zoning.

73 Taking these factors into account, I expect that dwellings built in the PC73 sites would be relatively energy efficient compared to other developments and consequently would have relatively low emissions per resident.

EMISSIONS FROM TRANSPORTATION

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

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

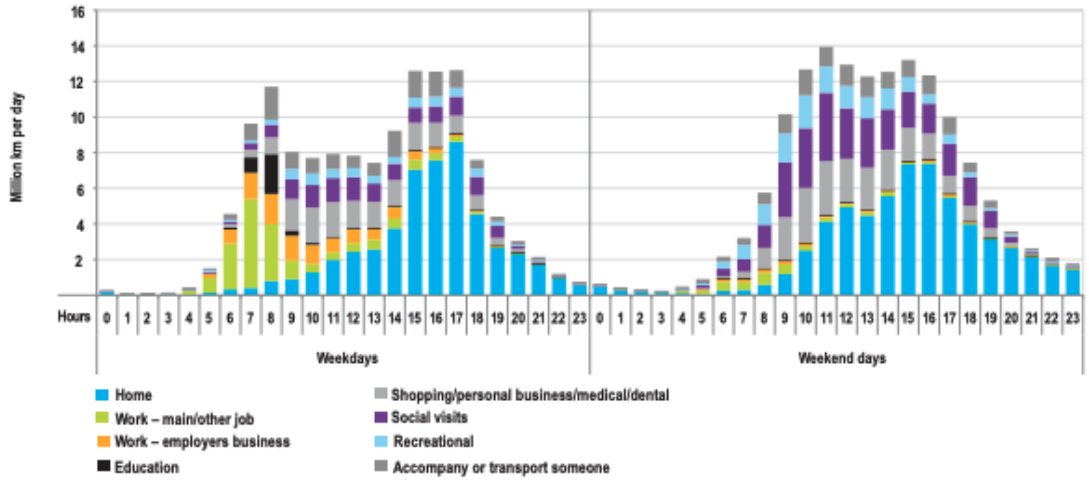
76 It is extremely difficult to accurately model or predict the level of travel related emissions that may occur from residents of any proposed development, and indeed how these may compare to the travel related emissions of an equivalent number of residents in any other location.

77 The most comprehensive data for the types of trips that people undertake in New Zealand is provided by the Ministry of Transport.[6]

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

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

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



79 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.

80 The proposed plan change developments, whilst on the fringes of Rolleston, are located approximately as close to the centre of Rolleston as other greenfield land in the area, as indicated in Hugh Nicholson's evidence.

81 PC73 Holmes Block is noted as 3.3km from an indicative Rolleston town centre point, whilst the Skellerup block is noted as 4.2km from this point. This compares to other plan change areas ranging from 2.9 – 3.5km from the indicative centre point of Rolleston.

82 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.

83 Therefore it could be expected that many "shopping" and potentially "recreational" trips would occur locally, via active traffic modes, to the proposed commercial areas within the Holmes and Skellerup blocks, as opposed to the centre of Rolleston. Residents in the Holmes block are also likely to utilise the existing Stonebrook shopping centre.

84 The tenancies in the Holmes and Skellerup Blocks commercial areas proposed 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 Skellerup and Holmes Blocks and mitigate the need for travel further to other destinations.

85 With its close proximity and excellent access to West Rolleston Primary School it can also be expected that a significant proportion of "education" trips from residents in the Hughes block will be undertaken using active modes, as opposed to in private passenger vehicles.

86 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.

87 In terms of commuting trips:

87.1 It is highly likely that instances of working from home will increase substantially in the future, which will substantially reduce the frequency of commuting.

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

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

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

87.5 It is therefore highly likely that residents of the Holmes and Skellerup blocks who work in a Christchurch office will be strong adopters of working from home.

87.6 Working from home can further be supported by ensuring that there is robust broadband conectivity provided to the developments.

88 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.

88.1 The Christchurch City Council's submission states that the current commute time for a vehicle is 25 minutes, compared to 90 minutes for a bus. This will clearly reduce the current attractiveness of commuting by bus rather than by private vehicle, however over time as services are improved and bus commute times reduce relative to driving time (e.g. through additional 'express' services), it is likely that public transport uptake will increase.

88.2 Efforts could be made to encourage car-pooling wherever possible. An increased density of housing in the Skellerup and Holmes blocks would likely lead to greater instances of car-pooling than a lower density development would.

88.3 The CCC could also continue undertaking actions to motivate more car pooling, such as increasing car parking charges on weekdays, or limiting parking availability in the city.

89 We expect that a significant proportion of commuter trips undertaken in passenger vehicles between Rolleston and Christchurch will be in electric, or hybrid vehicles.

89.1 Our rationale is that the round-trip commuting distance between Rolleston and Christchurch, at 50km, is close to the ideal distance to maximise EV uptake.

89.2 Research[7] indicates that two of the biggest barriers to EV adoption in NZ are the cost of EVs and range anxiety.

89.3 With regards to the cost of EVs:

(a) On average, a second hand EV costs between $5-10k more than a comparable Internal Combustion Engine (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*) calculates that for an average NZ vehicle (that travels 11,000km per annum) the annual fuel savings of an EV are $1,460.

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

(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.

90 A second major barrier to EV uptake is range:

90.1 Due to its more affordable price (compared to other EVs) and availability, the most commonly purchased 2nd hand EV in NZ is currently a Nissan Leaf (2011-2016 models).

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

90.3 We consider that Leafs will continue to be the most commonly purchased 2nd hand vehicles for at least the next 3-5 years.

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

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

90.6 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.

90.7 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.

90.8 Ideally batteries should only be charged to 80% in order to maximise their life.

90.9 80% *116km = 93km, so this gives a maximum daily range of 93km for a 2nd hand leaf.

90.10 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.

90.11 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.

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

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

91 With a distance of 27km from the Hughes Block to the centre of Christchurch, assessed as the location of the Riverside market (daily round trip 54km) and 27km (daily round trip 54km) also from the Skellerup block, it is reasonable to expect that there will be a high uptake of EVs in the proposed developments.

RESPONSE TO SUBMISSIONS

92 I note in the Christchurch City Council's submission, under points 22-25 it is stated that 40% of people in Rolleston North currently travel into Christchurch for work or school.

93 I acknowledge that this is the current state of affairs for Rolleston North, however I would expect to see a significant reduction in the occurrence of travel between Rolleston and Christchurch as Rolleston grows, and as working from home becomes embedded as a "new normal":

93.1 Increased instances of working from home – the experience of Covid-19 has shown that a significant proportion of workers are able to perform their duties from a home office. We note that many large employers now offer employees significant autonomy and flexibility when it comes to where and when they choose to complete their work duties.

93.2 Workers who commute to work face travel costs and time. It stands to reason that the longer the commute a person faces, the more likely it is that they will opt to work from home regularly, especially where their home is modern and well-equipped.

93.3 With the distance between the proposed development and Christchurch being 27km, and with high quality modern housing, we anticipate that a significant proportion of the residents of the new development will opt to work from home on a regular basis.

93.4 Enhanced work, educational and recreational opportunities within Rolleston as the township continues to grow. This will limit the relative attractiveness of Christchurch as a destination and therefore the frequency with which residents travel to Christchurch will reduce.

CONCLUSIONS

94 I consider that, on balance, the proposed development likely supports a reduction in GHG emissions, relative to other

development opportunities available in the greater Canterbury region.

95 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.

96 I expect that housing built in the PC73 blocks, under a Living Z zoning will have relatively low life-time emissions on a per resident basis, due to the type of housing (no multi-story apartments) and size of houses envisaged to be built.

97 I further expect that emissions per resident would be significantly lower if PC73 is developed under the proposed plan change to Level Z zoning, as opposed to if it were developed under its current Level 3 zoning.

98 I acknowledge that travel related emissions are likely to be higher for residents in the proposed PC73 blocks compared to residents of green-field developments in Christchurch, however I expect the materiality of this from an emissions perspective to diminish over time as Rolleston grows, working from home becomes even more common and as the penetration of electric vehicles increases.

99 I consider that there is no material difference in the likely travel related emissions for residents in the proposed PC73 blocks compared to other green-field sites in Rolleston.

Dated: 13 September 2021

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Paul Farrelly