BEFORE INDEPENDENT HEARING COMMISSIONERS APPOINTED BY THE WAIMAKARIRI DISTRICT COUNCIL

IN THE MATTER OF	The Resource Management Act 1991 (**RMA** or **the Act**)
AND	
IN THE MATTER OF	Hearing of Submissions and Further Submissions on the Proposed Waimakariri District Plan (**PWDP** or **the Proposed Plan**)
AND	
IN THE MATTER OF	Hearing of Submissions and Further Submissions on the Proposed Waimakariri District Plan
AND	
IN THE MATTER OF	Submissions and Further Submissions on the Proposed Waimakariri District Plan by **Momentum Land Limited**

EVIDENCE OF ROBERT (BOB) CHRISTOPHER WILSON ON BEHALF OF MOMENTUM LAND LIMITED REGARDING STREAM 12E REZONING OF LAND

Dated: 27 June 2024

Presented for filing by:
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INTRODUCTION

1 My name is Robert (Bob) Christopher Wilson.

2 I hold a Bachelor of Engineering (Honours) in Energy Engineering from University College Cork, Ireland, and a Master of Science in Sustainable Energy Engineering from South East Technological University, Ireland. I am a Certified Energy Manger (CEM) with the Association of Energy Engineers (AEE); a LEED Building Design & Construction Accredited Professional and a registered member of the Chartered Institute of Building Services Engineers (CIBSE).

3 I am an Energy & Sustainability Engineer at Lucid Consulting Australia.

4 As an Energy & Sustainability Engineer at Lucid Consulting Australia I have worked on multiple projects encompassing the life cycle Green House Gas (GHG) emission analysis and reduction duties including: Kiaora Lands Solar PV feasibility study, RMIT City Campus Decarbonisation project, and multiple Health Infrastructure NSW ESD Assessment projects. Prior to this, I worked as a Mechanical Engineer with Arup Ireland where I worked on multiple projects encompassing the life cycle GHG emission reduction and climate resilience duties including: RES4BUILD – Renewable Energy Systems for Buildings European Horizon 2020 Research Project, Dell campus decarbonisation feasibility report, and multiple Irish Water Energy Efficient Design (EED) services projects.

5 My role in relation to the Waimakariri Proposed District Plan is as an independent expert witness to Momentum Land Limited (**Momentum**) on Greenhouse Gas emissions analysis and reduction.

6 Although this is not an Environment Court proceeding, I have read the Environment Court's Code of Conduct and agree to comply with it. My qualifications as an expert are set out above. The matters addressed in my evidence are within my area of expertise, however where I make statements on issues that are not in my area of expertise, I will state whose evidence I have relied upon. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed in my evidence.

SCOPE OF EVIDENCE

7 My evidence is presented on behalf of Momentum, a submitter in these proceedings.

8 I have also considered other statutory documents listed in my evidence including the New Zealand National Policy Statement on Urban Development 2020 (**NPS-UD**) and the Building Act 2004 No 72.

9 In my evidence I address the following matters:

(a) The context of the Momentum Proposal;

(b) The methodology applied for the calculation and analysis of GHG emissions and their reduction;

(c) The Reference Proposal model inputs and results;

(d) The Momentum Proposal model inputs and results;

(e) The Momentum Proposal GHG emission reduction features and opportunities identified through the analysis;

(f) Assessment of the Momentum Proposal GHG emissions compared to the Reference Proposal GHG emissions; and

(g) Analysis of location-based transportation emissions from the Momentum Proposal compared to other potential locations for greenfields residential development.

SUMMARY OF MY EVIDENCE

10 My evidence encompasses this statement of evidence document and the following appendices:

- **Appendix A** – Assumptions and Limitations
- **Appendix B** - Development Material Data
- **Appendix C** – Emission Inventory
- **Appendix D** – GHG Emissions Reduction Initiatives Summary

- **Appendix E** – McIntosh Reserve Layout Drawing

11 My evidence has been prepared to discuss how well the proposed North Kaiapoi and Momentum development proposal (**Momentum Proposal**) aligns with the objectives and policies of the **NPS-UD**, namely whether the urban environments that form part of the Proposal:

(a) support reductions in greenhouse gas emissions; and

(b) are resilient to the current and future effects of climate change.

12 The approach of my evidence is based on the EN15978:2011 - Sustainability of Construction Works Standard and accounts for the lifecycle greenhouse gas emissions of the urban environment. Transport Emissions associated with the built environment in operation are accounted for based on the EN16258:2013 - Methodology for calculation and declaration of energy consumption and GHG emissions of transport services.

13 The scope of my assessment is confined to the Momentum Proposal project boundaries of the South and North Blocks over the full project lifecycle from cradle (module A) to grave (module C) (**Figure 1**).

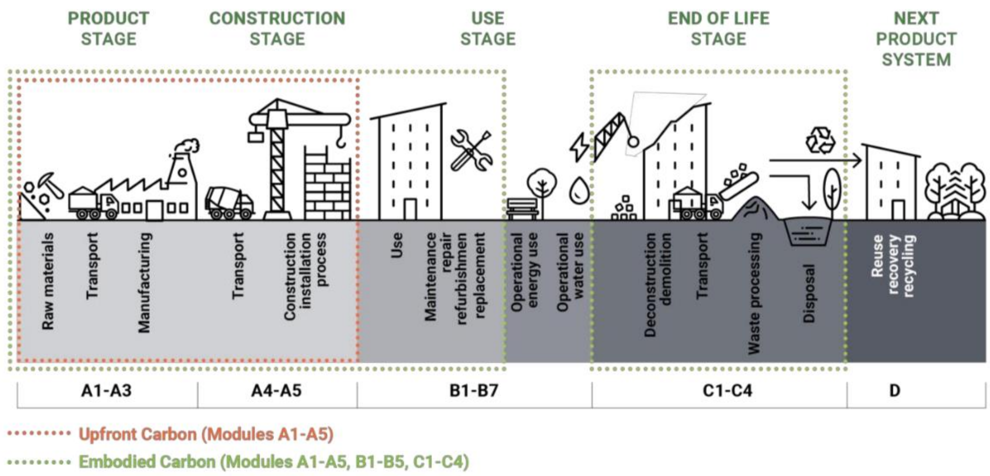


Figure 1: Construction Life Cycle Stages Graphic (credit: GBCA).

14 A three-stage assessment analysed the lifecycle greenhouse gas emissions impact of the Momentum Proposal over a 30-year study period:

(a) Assess the baseline life cycle greenhouse gas emissions. This baseline is a typical greater Waimakariri district development based on the

Momentum Proposal that would need to be built elsewhere to meet the demand for housing in the Waimakariri District. It employs the parameters set out in the Development Model and does not include the key Momentum Proposal GHG emission reduction features. This is called the **Reference Proposal**.

(b) Assess the projected life cycle greenhouse gas emissions of the Momentum Proposal for comparison with the Reference Proposal.

(c) Quantify the GHG emissions reduction potential of the Momentum Proposal, and identify any additional potential opportunities to further reduce its life cycle greenhouse gas emissions.

15 My evidence demonstrates that the Momentum Proposal supports reductions in greenhouse gas emissions in the following respects:

(a) Features that reduce the direct upfront carbon impact of the infrastructure works.

(b) Features that facilitate lower carbon forms of transport, and lower overall vehicle kilometres travelled.

(c) Restoration of a 6 ha ecological area with associated carbon sink impacts.

16 As part of the Momentum Proposal there is additional fill requirement at this site to allow it to be resilient to future potential flood impacts. This has an additional upfront GHG emission impact for this site, that may not be present in average other sites, which is included in this assessment. However, this additional fill improves the site resilience to the future effects of climate change in the form of potential flooding.

17 My analysis shows that the Momentum Proposal (dark blue column in Figure 2) has a 12.2% reduction in greenhouse gas emissions, equating to approximately 17,000 tCO2e, compared to the Reference Proposal model.

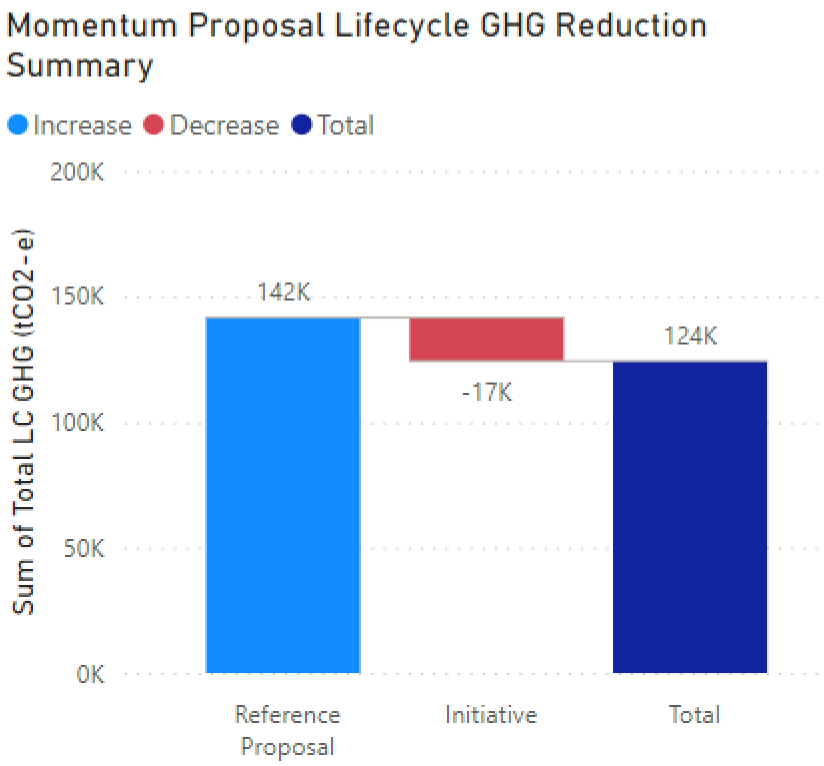


Figure 2: Momentum Proposal Vs Reference Proposal GHG Reduction Potential.

18 The GHG emissions savings are mainly associated with the key carbon reduction features included in the Momentum Proposal design. The development's proximity to Kaiapoi Key Activity Centre (KAC) and its active or low carbon travel infrastructure represent 51% and 39% of the estimated GHG reductions respectively. There is potential for greater GHG emissions reduction by implementing one or more of the identified opportunities such as use of low carbon concrete or the installation of a solar PV system.

19 The Reference Proposal assumes a nominal average distance location between the identified four major urban areas in the greater Waimakariri area (Kaiapoi, Rangiora, Ohoka and Pegasus-Woodland), and that is what is included in the Reference scenario in Table 1 below. This is because a similar development to the Momentum Proposal could likely be located in any developed area (subject to land availability, feasibility and locational factors) such as Kaiapoi, Rangiora, Ohoka or Pegasus-Woodland, all of which would result in differing transport emissions.

20 Therefore, for further transparency, a scenario analysis of transport GHG emissions has been conducted. As shown in Table 1, this is to compare the transport travel distance and associated GHG emissions of the Momentum

Proposal to 4 other location scenarios including the Reference Proposal nominal location.

Table 1: Location Scenario Analysis Summary.

Scenario	Location	Distance to KAC (km) one-way	Work+Education Travel Distances (km) one-way
Reference	Nominal	4	19.95
Rangiora	Rangiora	2	14.23
Ohoka	Ohoka	8	21.66
Pegasus	Pegasus	3	24.52
Momentum Proposal	North Kaiapoi	2.5	19.39

21 As shown by Figure 3, the Momentum Proposal is the 2nd lowest transport GHG emitter at approximately 59,000 tCO2e, a 14% reduction compared to the Reference Proposal scenario, which had a median value of 68,000 tCO2e over the 30-year study period.

22 It is noted that the Rangiora case has the lowest overall transport emissions at 44,500 tCO2e. This is a result of the significantly lower Work and Education Travel Distances provided by the 2018 census for Rangiora as shown in Table 1.

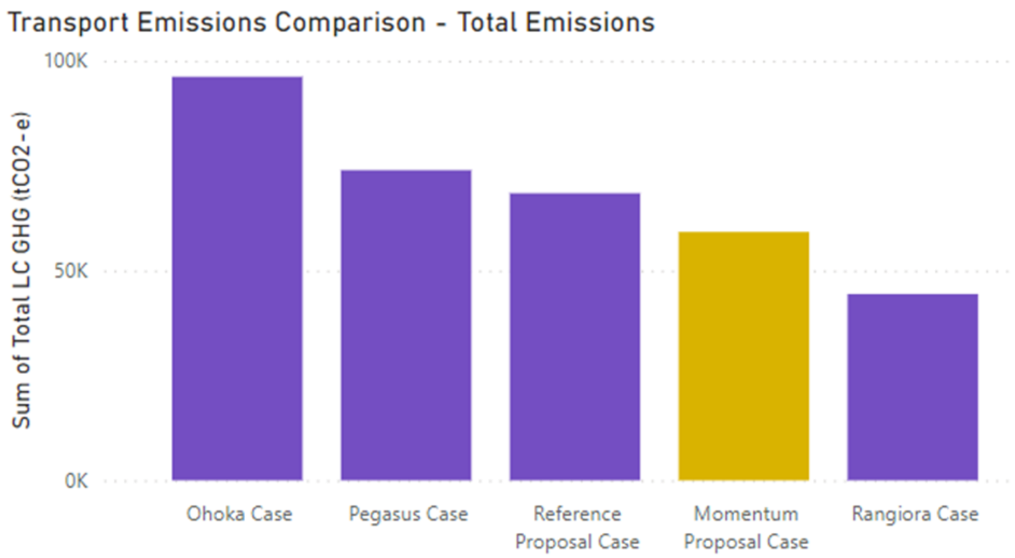


Figure 3: Locations Review Sensitivity Analysis Graph.

23 I also note that the following key features included in the Momentum Proposal model are likely to mitigate the impacts of climate change and increase the resilience of the development:

(a) Significant works and fill to ensure homes are sited in a way that is less likely to flood than would otherwise occur.

(b) A decentralised and flexible low pressure sewage system to provide additional resilience to future climate change effects and naturally occurring disasters such as earthquakes.

CONTEXT

Purpose of assessment

24 A Greenhouse Gas (**GHG**) Emissions Study is required to support the rezoning application of the Momentum Proposal. The purpose of my evidence is to present the findings of the Momentum Proposal GHG Emissions Study. The Study and my evidence provide an assessment on the GHG emissions over the entire lifecycle of the proposed development, from all relevant sources across all lifecycle stages including construction, operation, and end-of-life, and compares this to a Reference Proposal.

25 My evidence demonstrates how key features of the Momentum Proposal reduce the developments lifecycle GHG emissions. I also present a number of additional GHG emission reduction opportunities that could be incorporated into the Momentum Proposal, which will serve to support further reductions in greenhouse gas emissions.

Planning Framework

26 The NPS-UD sets out objectives and policies for urban development under the Resource Management Act 1991. Councils must give effect to these objectives and policies.

27 The relevant objectives of the NPS-UD are:

(a) **Objective 1**: New Zealand has well-functioning urban environment that enables all people and communities to provide for their social, economic, and cultural wellbeing, and for their health and safety, now and into the future.

(b) **Objective 8**: New Zealand's urban environments:

(i) Support reductions in greenhouse gas emissions; and

(ii) Are resilient to the current and future effects of climate change.

28 These objectives are supported by several policies including Policy 1, the relevant clauses of which are copied below.

(a) **Policy 1**: Planning decisions contribute to well-functioning urban environments, which are urban environments that, as a minimum:

(i) Support reductions in greenhouse gas emissions; and

(ii) Are resilient to the current and future effects of climate change.

Approach and Method of Analysis

29 The approach of my evidence is based on the EN15978:2011 - Sustainability of Construction Works standard and accounts for upfront and embodied GHG (modules A1-A5, B1-B5, C1-C4), and operational GHG (B6-B7) as the GHG emissions boundary. Figure 4 displays the GHG life cycle and the associated modules with further information available in EN15978. Module D – Next Product System (i.e. reuse, refurbishment and recycling) is not within the scope of this evidence.

30 The scope of my evidence is confined to the project boundaries of the Momentum Proposal, being the South and North Block extensions, across the full project lifecycle from cradle (module A) to end of life (module C). The ecological reserve is included as a Momentum Proposal potential carbon sink in the operational (module B6-B7) stage.

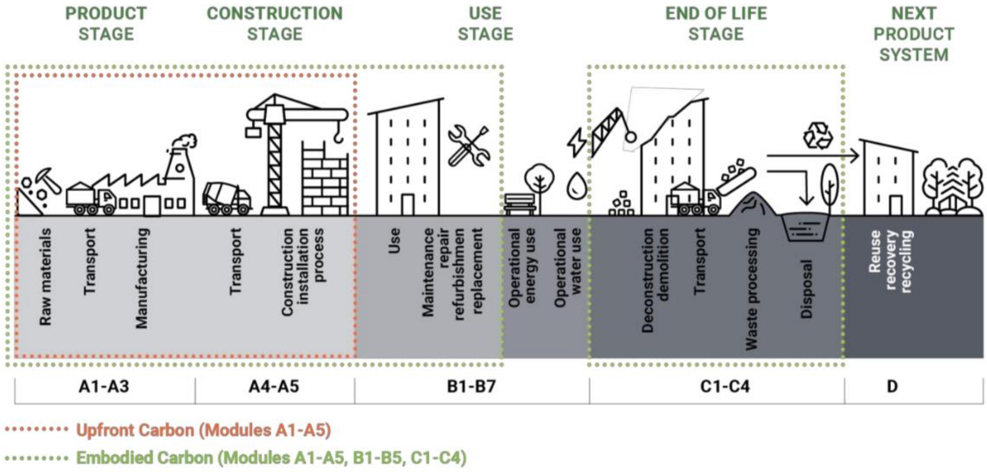


Figure 4: Construction Life Cycle Stages Graphic (credit: GBCA).

31 A three-stage assessment analysed the lifecycle greenhouse gas emissions impact of the Momentum Proposal over a 30 year study period:

(a) Assess the baseline life cycle GHG emissions. This is a similar, average Waimakariri District development based on the Momentum Proposal that would need to be built elsewhere to meet the demand for housing in the Waimakariri District. It employs the parameters set out in the Development Model and does not include the key Momentum Proposal GHG emission reduction features. This is called the Reference Proposal.

(b) Assess the projected life cycle greenhouse gas emissions of the Momentum Proposal for comparison with the Reference Proposal.

(c) Quantify the GHG emissions reduction potential of the Momentum Proposal, and identify any additional potential opportunities to further reduce its life cycle greenhouse gas emissions.

32 The lifecycle of the Momentum Proposal, and hence the Reference Proposal, has been assumed to be 60 years, which is the default lifecycle for development projects in with EN15978:2011. However, the study period has been reduced to the first 30 years of the lifecycle to better align with New Zealand long-term development planning and established 2050 sustainability targets. This means the GHG assessment model does not reach end of life stage within the study period and therefore the disposal or replacement of major infrastructure (e.g. drainage, buildings etc.) at end of life is not included in the GHG calculations.

Only the resurfacing of the asphalt road network and replacement of streetlight lamps after 20 years is included in the assessment.

33 Where possible GHG emissions are accounted for and quantified with relevant associated assumptions and limitations as per below or detailed in the Appendices.

Assumptions and Limitations

34 My evidence and the GHG assessment calculations are subject to limitations and assumptions as detailed in **Appendix A** of this evidence. For the GHG assessment model every effort was made to use accurate and representative data where available. In the absence of Momentum Proposal specific information typical New Zealand and Australian benchmark data was utilised when available. Where no data was available, assumptions based on reasonable engineering experience and best practise were made.

Standards and Guiding Documents

35 The following standards and documents form the basis of the approach for this assessment.

Table 2: Standards and guiding documentation summary.

Source	Author	Date
EN15978:2011 - Sustainability of Construction Works standard	British Standards Institution (BSI)	2011
EN16258:2013 - Methodology for calculation and declaration of energy consumption and GHG emissions of transport services.	European Committee for Standardisation (CEN)	2013
National Policy Statement on Urban Development 2020 (NPS-UD)	Ministry for the Environment and Ministry of Housing and Urban Development	2020
Measuring Emissions: A Guide for Organisations	Enviro-Mark Solutions Limited. Ministry for the Environment	2023
Momentum Development Proposal Project GHG Emissions Study Workshop 1	Bob Wilson, Lucid Consulting	19 October 2023
Email Correspondence: *RE: Moore Block - Carbon Emissions study evidenceing –* Materials	Rob Howe, Woods	31 October 2023

Source	Author	Date
Email Correspondence: *RE: Moore Block - Carbon Emissions study evidenceing –* Project drivers	Chris Fowler, Saunders & Co.	11 November 2023
MOORE BLOCK – South and North block infrastructure reports	Momentum Land Limited	10 May 2023
Beach Grove – South Block MDRZ Design Testing Memo	Saddleback	14 March 2023
Beach Grove Expansion Project Presentation Discussion Document	Momentum Land Limited	22 July 2022

36 Assessment information and data is also based on expert evidence from the following;

Table 3: List of expert evidence that contributes to this assessment.

Individual	Company	Area of Expertise
Bruce Weir	Saddleback	Urban Design
Andy Carr	Carriageway	Transport
Fraser Colegrave	Insight Economics	Economics

THE MOMENTUM SUBMISSION

37 In broad terms, the Momentum submission seeks rezoning of the North and South Blocks from Rural Lifestyle Zone to Medium Density Residential Zone, which would enable urban development as generally described below.

38 This GHG emissions study evidence demonstrates how the Momentum Proposal can support reductions in GHG emissions, in line with the objectives and policies of the NPS-UD.

Project overview and scope

39 The Momentum Proposal would enable a modern land subdivision as an extension of the existing 600 lot Beach Grove development in North Kaiapoi, New Zealand. The vision for the Momentum Proposal encompasses three broad aspects:

(a) North block – approximately 650 lot urban development extension north of the Beach Grove development over 26 hectares.

(b) South block – approximately 120 lot urban development extension south west of the Beach Grove development over 6 hectares.

(c) Ecological reserve – a 6-hectare ecological reserve and stormwater area with wetland restoration bordering the development to the east.

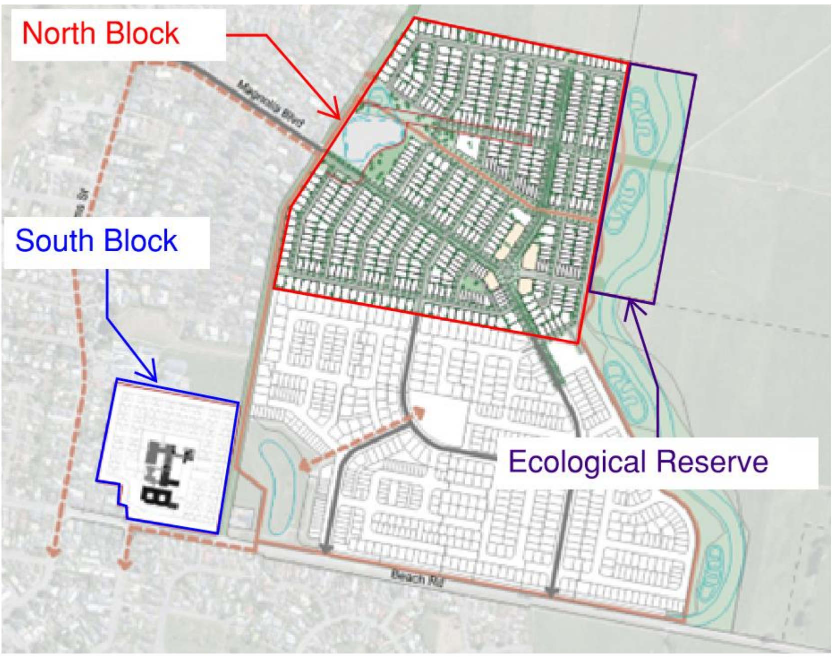


Figure 5: Momentum Proposal summary.

40 Of particular importance when assessing the Momentum Proposal against comparable projects with respect to GHG emissions is:

(a) The location of the site, supporting lower transport emissions to and from nearby locations; and

(b) The urban design, supporting lower transport emissions within the site boundary and reducing the need to travel beyond the site for basic needs; and

(c) The proposed ecological reserve which can act as a natural carbon sink.

METHODOLOGY

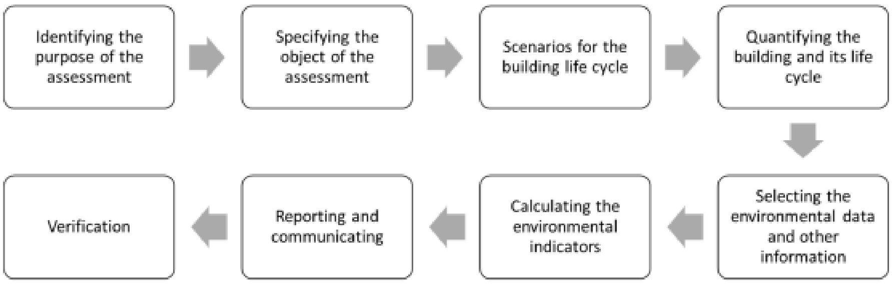
41 My evidence sets the framework for sustainable outcomes for the Momentum Proposal to demonstrate its alignment with the objectives and policies of the

NPS-UD. This is accomplished by quantifying the Momentum Proposal's GHG emissions footprint and comparing this to an alternative reference scenario – the **Reference Proposal** - using the same assessment parameters, and then identifying current and potential features to minimise the Momentum Proposal's GHG emissions footprint.

42 I have undertaken detailed analysis with the use of a custom Microsoft Excel based tool with input data and calculations available in the Appendices of this evidence.

43 The following provides an overview of my methodology and calculations.

44 The approach of my evidence is based on the EN15978:2011 - Sustainability of Construction Works standard and therefore follows the methodology set out in that standard which is summarised graphically below;



45 Table 4 details the methodology employed to complete the GHG Emissions assessment.

Table 4: Methodology summary.

Stage		Description
1	Identifying the purpose of the assessment	The purpose of the assessment is to demonstrate the alignment of the Momentum Proposal with the objectives and policies of the NPS-UD 2020.
2	Specification of the object of the assessment	The object of this assessment is the residential, commercial and infrastructure development included within the Momentum Proposal.

Stage		Description
3	Scenarios for defining the building life cycle	Two comparative analysis scenarios are used for this GHG emissions assessment; 1. Reference Proposal – a similar, average Waimakariri district development based on the Momentum Proposal that would need to be built elsewhere to meet the demand for housing in the Waimakariri District. 2. Momentum Proposal – the Momentum Proposal using the available specific design and construction information.
4	Quantifying the building(s) and its life cycle	The Reference Proposal is based on standard New Zealand and/or Australian urban development data and assumptions based on relevant technical information. The Momentum Proposal uses specific design and construction information where available, expert evidence provided, and assumptions based on relevant technical information and expertise where required.
5	Selection of environmental data and other information	Where possible environmental data from ISO 14044 compliant life cycle inventory datasets are used. Relevant New Zealand and/or Australian benchmark data is also be used. Assumptions based on relevant technical information and expertise are utilised where required.
6	Calculation of the environmental indicators	Global Warming Potential in the form of tCO_2-e is used as the environmental indicator.
7	Reporting of the assessment of results	Results from the life cycle GHG emissions assessment are summarised in this evidence life cycle modules A, B and C results shown individually and aggregated for the Reference and Momentum Proposal. The estimated GHG emissions reduction potential of features is also reported.
8	Verification of results	Not within scope of this study.

Calculations

46 The calculations in my evidence follow the approach set out in EN15978:2011, as set out in the New Zealand Ministry for the Environment 'Measuring

Emissions: A Guide for Organisations' 2023[1] document. The calculations and associated inputs are detailed in **Appendix C** of this evidence.

DEVELOPMENT MODEL

47 The Development Model is the set of universal characteristics of the Momentum Proposal and the average Waimakariri District development that will apply and form the basis of both the Reference Proposal and Momentum Proposal for the GHG emissions assessment model. The model's parameters are based on information provided about the Momentum Proposal development and supplemented by national statistics data and assumptions when required.

The Momentum Proposal – main elements

48 The Momentum Proposal model consists of 2 main elements, including their associated infrastructure:

(a) Residential Expansion.

(b) Commercial Centre.

49 Due to the nature and scope of the Momentum Proposal – mainly enabling serviced open lots available for custom built houses designed by future residents – the GHG assessment model has greatest emphasis and accuracy for elements directly influenced by the developer, namely:

(a) Infrastructure development (roads, footpaths, drainage, etc).

(b) Earthworks.

(c) Materials transportation.

(d) Long term operational vehicular emissions.

50 Therefore, these are the focus of the analysis of my evidence.

51 For other sources of GHG emissions where the Momentum Proposal has less control, average benchmark values from New Zealand and Australian sources

[1] *Measuring emissions: A guide for organisations: 2023 detailed guide*, Ministry for the Environment, Wellington, 2023.

have been used. These elements have less effect on the GHG emissions of the Momentum Proposal, but their inclusion allows each source of emissions to be viewed in context of the entire lifecycle of GHG emissions for a more representative life cycle assessment.

Residential Expansion

52 The Momentum Proposal will enable residential development as an expansion of the Beach Grove estate covering a total of 32 hectares within two blocks:

(a) The North Block (26 hectares)

(b) The South Block (6 hectares).

53 The North Block is designed to house approximately 650 residential lots[2] ranging in area from 200m^2 to 450m^2, and a small neighbourhood centre of mainly retail lots (see Commercial Centre section below). A road network with associated footpaths and drainage etc. will be extended from the existing Beach Grove development, in this case connecting through to Magnolia Boulevard in Moorcroft Estate, branching out through the area to provide access for the proposed lots.

[2] The residential lot numbers and dwelling numbers referred to in my evidence are the lower range of lot numbers detailed in the urban design evidence of Mr Weir, para [47](c).

Figure 6: Momentum Development Proposal North Block Map

54 A proposed simplified overview of the North Block development structure is provided in Figure 7.

Figure 7: Overview of a Proposed North Block Development Structure.

55 The South Block is designed to house approximately 120 residential lots ranging in area from 200m² to 350m². The existing road network with associated footpaths and drainage etc. will be extended into the development, in this case from Beach Road branching out through the area to provide access for the proposed lots. Another connection road will be made creating access to the unformed Paper Road to the east of the site.

Figure 8: Momentum Development Proposal Development South Block Map.

56 The South block will likely have a similar development structure to the North block as showcased in Figure 7.

57 The residential expansion in the Development Model parameters utilised are summarised below: -

(a) Total area: 320,000 m^2.

(b) Residential Gross Floor Area (GFA): 160,000 m^2.

(c) 770 dwellings.

(d) 1848 residents.

(e) 1080 cars.

(f) Roads (including footpath and drainage) 6m wide: 16,000 m.

(g) Sewage network: 5,495 m.

(h) Streetlights: 7.5m pole height LED lighting at 60m spacing on road network.

58 Location and transportation model elements are detailed in each respective scenario section of this evidence.

Commercial Centre

59 The Momentum Proposal includes a small commercial centre of mainly retail lots located within the North block (see Figure 9). This is typical of recent greenfield urban developments in the Waimakariri District's main centres and is therefore included in the Development Model for the Momentum Proposal and Reference Proposal assessment models. The small neighbourhood commercial centre is to provide residents with convenient access to local amenities and services without necessarily needing to travel by car to an urban centre, in this case to the centre of Kaiapoi over 2km away.

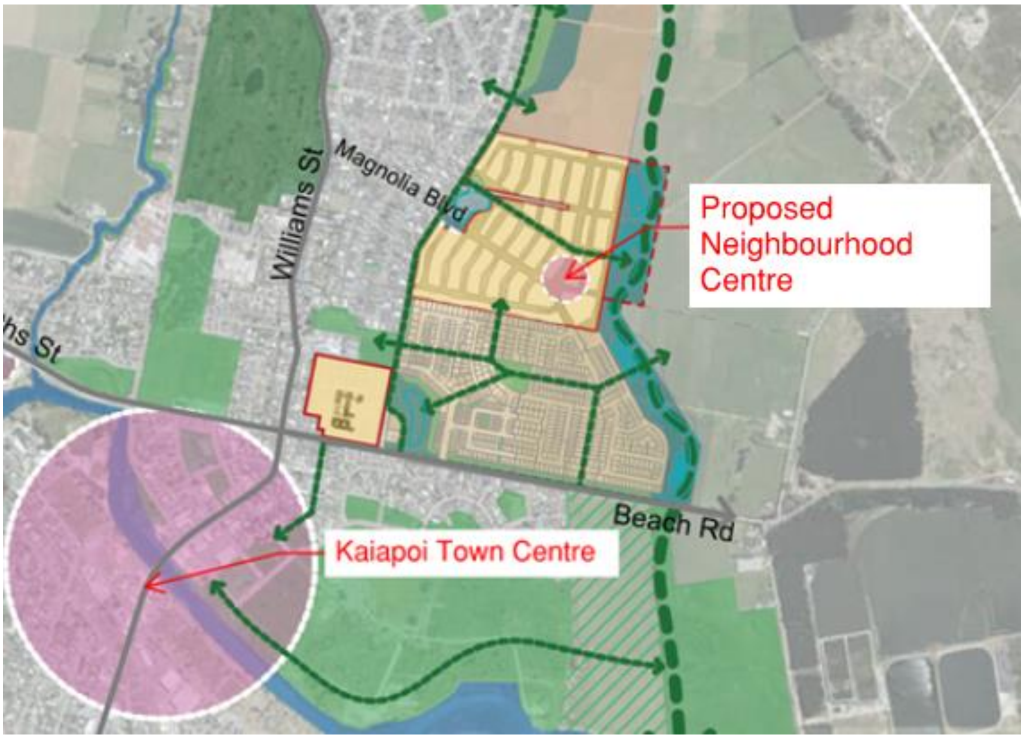


Figure 9: Momentum Development Proposed Neighbourhood Centre Map.

60 The commercial centre Development Model parameters utilised are summarised below:

(a) Commercial GFA: 1,000 m^2.

(b) Utilises same road, drainage, sewage, and lighting infrastructure as residential development.

REFERENCE PROPOSAL ASSESSMENT

61 The Reference Proposal is developed to assess the baseline GHGs emissions that would occur for a typical greater Waimakariri district development, based on the Momentum Proposal, that would need to be built elsewhere to meet the demand for housing in the Waimakariri District. It employs the parameters set out in the Development Model and does not include the key Momentum Proposal GHG emission reduction features.

Reference Proposal Model Inputs

62 The Development Model parameters form the basis of the Reference Proposal GHG emissions assessment model. Additional parameters that are applicable to any typical development elsewhere in the Waimakariri District such as site bulkfill and transport related emissions are also included in the assessment model.

63 A list of the Reference Proposal model inputs is provided below with the Reference Proposal specific inputs described in more detail following the table.

Table 5: Reference Proposal Main Model Inputs Summary.

Development Component	Description	Material/Activity Quantity	Unit
Commercial	Commercial Dev. Upfront carbon	1,000	m2 GFA
Commercial	Commercial energy consumption	1,000	m2 GFA
Residential	Residential Dev. Upfront carbon	160,000	m2 GFA
Residential	Residential energy consumption	160,000	m2 GFA
Residential	Residential water consumption	160,000	m2 GFA
Infrastructure and Landscape	Site Bulkfill	64,000	m2
Infrastructure and Landscape	Roads – Hardfill – Materials	16,000	m (of roads)
Infrastructure and Landscape	Roads – Hardfill – Transport to site	16,000	m (of roads)
Infrastructure and Landscape	Roads – Concrete - Materials	16,000	m (of roads)
Infrastructure and Landscape	Roads – Concrete – Transport to site	16,000	m (of roads)
Infrastructure and Landscape	Roads – Asphalt – Materials	16,000	m (of roads)

Development Component	Description	Material/Activity Quantity	Unit
Infrastructure and Landscape	Roads – Asphalt – Transport to site	16,000	m (of roads)
Infrastructure and Landscape	Sewage Pipe – Construction	10,991	m
Infrastructure and Landscape	Street Lighting – Materials	16,000	m (of roads)
Infrastructure and Landscape	Street Lighting – Transport to site	267	SL Luminaires
Infrastructure and Landscape	Roads - All – Maintenance	16,000	m (of roads)
Infrastructure and Landscape	Roads - Transport – Retail	1,790,250	km/yr
Infrastructure and Landscape	Roads - Transport - Employment - KAC	7,373,520	km/yr
Infrastructure and Landscape	Roads - Transport – Activity	1,790,250	km/yr
Infrastructure and Landscape	Street Lighting – energy consumption	16,000	m (of roads)
Infrastructure and Landscape	Roads - deconstruction & disposal/recycling	16,000	m (of roads)
Infrastructure and Landscape	Street Lighting - deconstruction & disposal/recycling	267	SL Luminaires

64 For this Reference Proposal, standard residential and commercial development upfront carbon[3], energy[4] and water consumption[5] benchmark values for Australia and New Zealand were used. The site was assumed to require only 50% of the bulkfill soil requirement of the Momentum Proposal, which lies within an identified flood hazard area.

65 For transport, the Reference Proposal is assumed to be a nominal average distance location between the identified four major urban areas in the Waimakariri District (Kaiapoi, Rangiora, Ohoka and Pegasus-Woodland). This is explained in more detail in paragraphs 136 – 145. For residents' annual vehicular travelling distances, it is assumed that driving to the nearest Key Activity Centre (KAC) and back occurs daily, 6 days per week, each for retail and activity

[3] GBCA and thinkstep-anz. (2021). Embodied Carbon and Embodied Energy in Australia's Buildings. Sydney: Green Building Council of Australia and thinkstep-anz

[4] https://www.formance.co.nz/news/building-for-climate-change/ [Last Accessed 19/04/2024].

[5] https://www.sydneywater.com.au/SW/your-home/using-water-wisely/water-efficiency-targets/index.htm [Last Accessed 19/04/2024].

associated tasks respectively. These trips include shopping, social events, leisure, and educational tasks. For employment related transport, available 2018 census data on work and education distances is utilised to estimate annual distances assuming driving roundtrip 5 days per week for 48 weeks of the year. Further analysis of location-based transport emissions is included in paragraphs 136 – 145 of this evidence.

66 The Reference Proposal sewage system is assumed to be a typical development wastewater network utilising a gravity sewer system of 150mm diameter non-pressurised UPVC pipe.

Table 6: Reference Scenario Vs Proposed Development Model Inputs.

Parameter	Reference Scenario	Proposed Scenario
Bulkfill Requirement	**262,500m3**	525,000m3
Distance to KAC	**4 km**	2.5 km
Distance to Employment Centre	**19.95 km**	19.39 km
Sewage System	**150mm UPVC gravity pipe system**	66mm UPVC low pressure system

67 These model inputs quantify the Reference Proposal over its life cycle as required. Considering these known inputs, appropriate environmental data is selected using accessible Life Cycle Inventory (LCI) databases such as the Melbourne School of Design EPiC Database [6], and relevant material Environmental Product Declaration (EPD) information from potential New Zealand or regional suppliers where available. For inputs with limited information or scope within the study, such as the residential housing units, relevant New Zealand and/or Australian benchmark data is utilised to display representative values.

68 Using the environmental data and model inputs the environmental indicator, in this case Global Warming Potential (GWP) of GHGs in the form of tCO2e, is calculated for the Reference Proposal over the life cycle study period of 30 years. These calculations and associated environmental data are included in the Appendices of this evidence with the resulting GHG emissions output set out below.

[6] http://epicdatabase.com.au/ [Last Accessed 19/04/2024].

Reference Proposal Model Results

69 The Reference Proposal model lifecycle GHG emissions are presented in Figure 10, split by each life cycle module within the study boundary, and categorised by each component of the development.

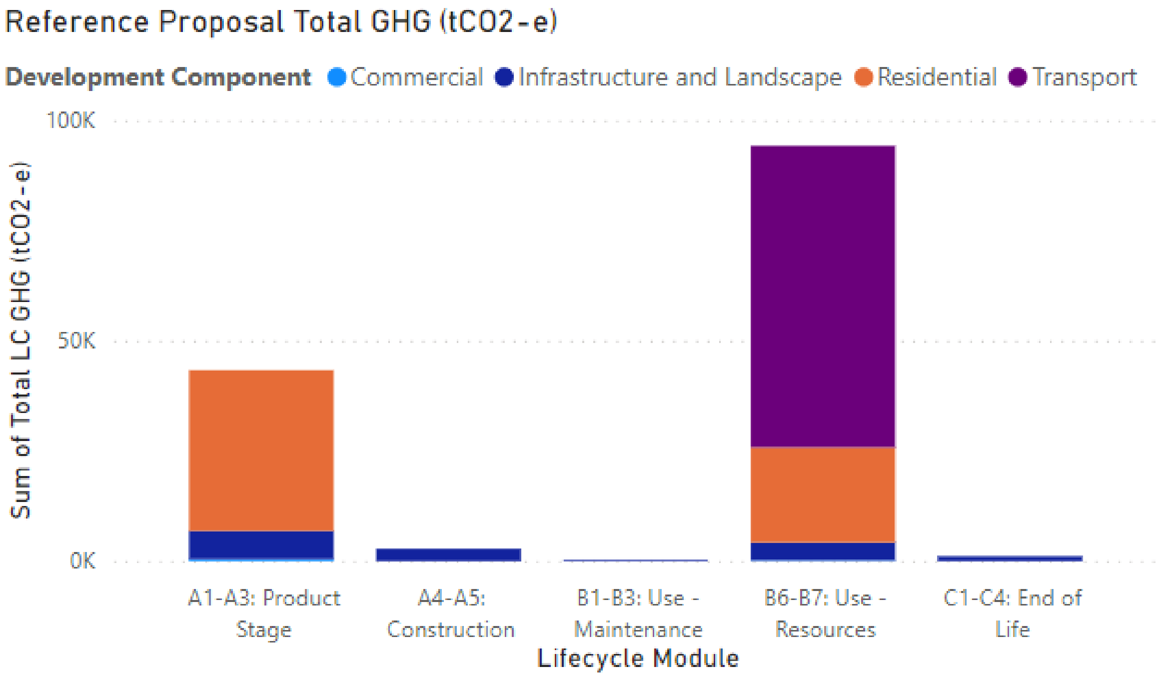


Figure 10: Greenhouse gas emissions over the life cycle of the Reference Proposal, categorised by lifecycle stage module (x-axis) and component source of emissions (colour legend).

70 From the results it is apparent that: -

(a) The B6-B7 Use–Resources module is the largest contributor of GHG emissions over the development life cycle accounting for approximately 90,000 tCO2e, dominated by transport related GHG emissions from private car use, and then residential energy consumption.

(b) The A1-A3 Product stage of material consumption is the second main contributor at approximately 42,000 tCO2e of GHG emissions, dominated by the residential upfront carbon (which accounts for modules A1-A5 in this case) and infrastructure material demand.

(c) There are minimal GHG emissions associated with infrastructure related construction stage, maintenance, and end of life modules.

(d) Transport related emissions are the most significant component of the Reference Proposal life cycle GHG emissions, accounting for just over 48% of total emissions as shown in Figure 11.

(e) Residential related emissions from the construction and operation phases follow second, representing just under 41% of the emissions source.

(f) Infrastructure and landscaping related emissions, which mainly represents the development of the road network used for transport, accounts for approximately 10.5% of the lifecycle GHG emissions.

(g) Commercial development related emissions are almost negligible at 0.5%.

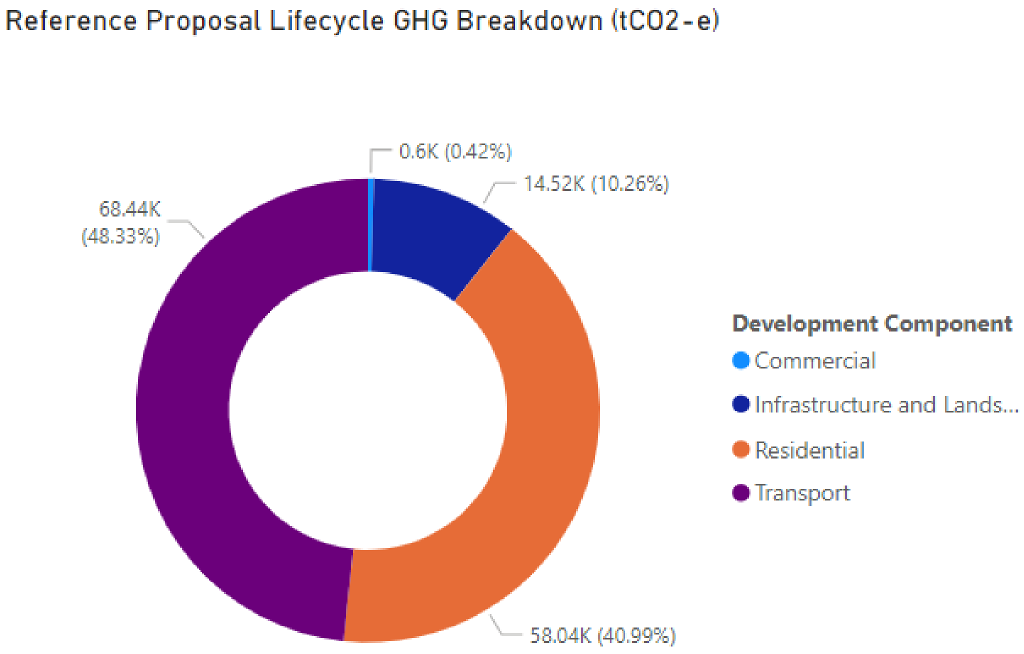


Figure 11: Breakdown of total lifecycle emissions by emissions source – Reference Proposal.

71 This analysis clearly indicates that transport related emissions, and the associated infrastructure required, are significant sources of lifecycle GHG emissions in the Reference Scenario and therefore should be a focus of any GHG emissions reducing features. While residential GHG emissions are high, there is little scope in the development's remit to affect residential emissions, which is the responsibility of whoever designs and owns the future home. Nevertheless, opportunities to reduce residential lifecycle GHG emissions are explored.

MOMENTUM PROPOSAL ASSESSMENT

72 The Momentum Proposal is developed to assess the expected GHG emissions from the indicative Momentum development design based on the Development Model and accounting for the proposed GHG and its key features such as proposed location and site bulkfill requirements,)

Momentum Proposal Model Inputs

73 The Momentum Proposal model parameters, in addition to the proposed GHG emissions reduction features, form the basis of the GHG assessment model inputs. The Momentum Proposal model encompasses the Residential Expansion, Commercial Centre parameters and Ecological Reserve as part of the development.

74 A list of the Momentum Proposal model inputs is provided below with the Momentum Proposal specific inputs described in more detail following the table.

Development Component	Description	Material/Activity Quantity	Unit
Commercial	Commercial Dev. Upfront carbon	1,000	m2 GFA
Commercial	Commercial energy consumption	1,000	m2 GFA
Residential	Residential Dev. Upfront carbon	160,00	m2 GFA
Residential	Residential energy consumption	160,000	m2 GFA
Residential	Residential water consumption	160,000	m2 GFA
Infrastructure and Landscape	Site Bulkfill	320,000	m2
Infrastructure and Landscape	Roads – Hardfill - Materials	16,000	m (of roads)
Infrastructure and Landscape	Roads – Hardfill – Transport to site	16,000	m (of roads)
Infrastructure and Landscape	Roads – Concrete - Materials	16,000	m (of roads)
Infrastructure and Landscape	Roads – Concrete – Transport to site	16,000	m (of roads)

Development Component	**Description**	**Material/Activity Quantity**	**Unit**
Infrastructure and Landscape	Roads – Asphalt - Materials	16,000	m (of roads)
Infrastructure and Landscape	Roads – Asphalt – Transport to site	16,000	m (of roads)
Infrastructure and Landscape	Bicycle Lane - Roads Asphalt – Materials & Transport	4,800	M (of bicycle lane)
Infrastructure and Landscape	Low Pressure Sewage System	770	Units (dwellings)
Infrastructure and Landscape	Low Pressure Sewage Pipe - Construction	5,495	m
Infrastructure and Landscape	Sewage System - Operation	72,000	kWh/yr
Infrastructure and Landscape	Street Lighting - Materials	16,000	m (of roads)
Infrastructure and Landscape	Street Lighting – Transport to site	267	SL Luminaires
Infrastructure and Landscape	Roads - All - Maintenance	16,000	m (of roads)
Infrastructure and Landscape	Roads - Transport - Retail	1,155,500	km/yr
Infrastructure and Landscape	Roads - Transport - Employment -KAC	7,166,544	km/yr
Infrastructure and Landscape	Roads - Transport - Activity	1,155,500	km/yr
Infrastructure and Landscape	Street Lighting – energy consumption	16,000	m (of roads)
Infrastructure and Landscape	Roads - deconstruction & disposal/recycling	16,000	m (of roads)
Infrastructure and Landscape	Street Lighting - deconstruction & disposal/recycling	267	SL Luminaires
Infrastructure and Landscape	Low Pressure Sewers - E/One System EC	770	Dwellings
Infrastructure and Landscape	Low Pressure Sewers - E/One System EC replacement	770	Dwellings

75 For the Momentum Proposal, many of the same inputs as the Reference Proposal were used, as it is the same Development Model. The main differences between these two scenario inputs include:

(a) Larger site bulkfill requirement.

(b) Momentum Proposal's site location and layout is used (with the same number of trips assumed) which varies the travel distances and modes compared to the Reference Proposal.

(c) Additional bicycle lane construction asphalt requirement – materials and transport included in one input.

(d) Updated low pressure sewage system with associated material requirement and increased operational energy consumption.

(e) The ecological restoration and stormwater area is included with more information provided below.

76 These model inputs quantify the Momentum Proposal over its life cycle as required. Considering these known inputs, appropriate environmental data is selected using accessible Life Cycle Inventory (LCI) databases such as the Melbourne School of Design EPiC Database, and relevant material Environmental Product Declaration information from potential New Zealand or regional suppliers where available. For inputs with limited information or scope within the study, such as the residential housing units, relevant New Zealand and/or Australian benchmark data is utilised to display representative values.

77 Using the environmental data and model inputs, the environmental indicator, in this case GWP of GHGs in the form of tCO2e, is calculated for the Momentum Proposal over the 30 year study period. These calculations and associated environmental data are included in the Appendices of this evidence with the resulting GHG emissions output given in paragraphs 82 - 86.

Ecological Restoration and Stormwater Area

78 A 6 hectare ecological restoration and stormwater area bordering the development to the east is included as part of the Momentum Proposal. The ecological reserve will be an extension of, and hence almost identical to the currently developed McIntosh's reserve to the south.

79 I understand that the Momentum Proposal's ecological restoration and stormwater area, is likely to be similar to the McIntosh reserve. As a result, the

landscaping of the slightly larger McIntosh reserve is assumed to be representative of the Momentum ecological restoration and stormwater area.

80 An overview of the McIntosh reserve with a cross-sectional view detailing its composition are provided in Figures 12 and 13 below.

81 The Momentum Proposal model ecological restoration and stormwater area parameters utilised are;

(a) Total area: 60,000 m^2.

*Figure 12: Overview Map illustrating the McIntosh Ecological Reserve (also available to view in **Appendix E**)*

Figure 13: Cross Section View of McIntosh Reserve

Momentum Proposal Model Results

82 The Momentum Proposal's life cycle GHG emissions are presented in figure 14, split by each life cycle module within the study boundary, and categorised by each development component.

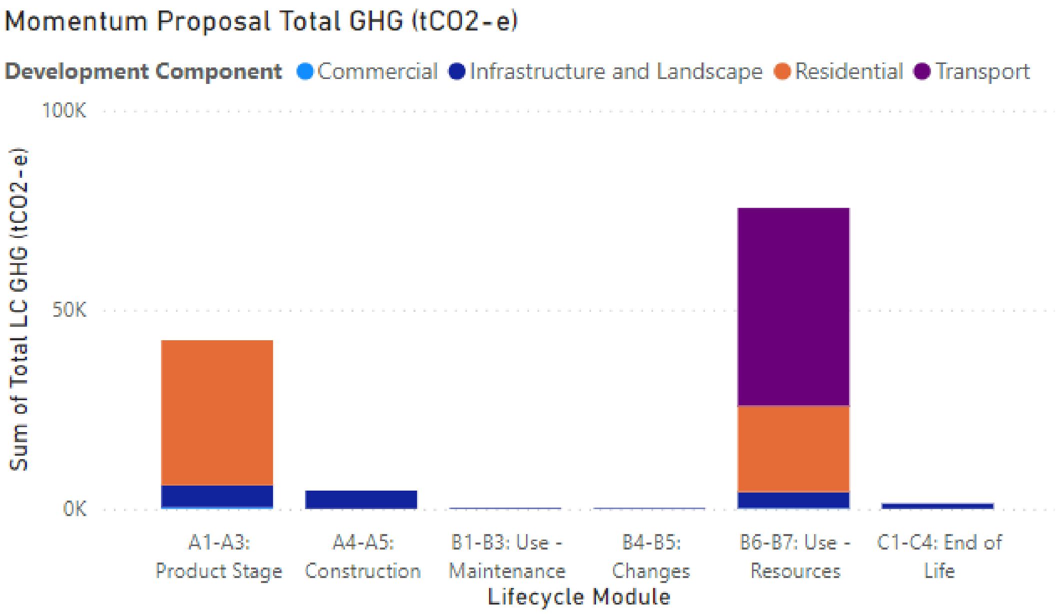


Figure 14: Greenhouse gas emissions over the life cycle of the development, categorised by lifecycle stage module (x-axis) and component source of emissions (colour) – Momentum Proposal.

83 Similar to the Reference Proposal, the B6-B7 Use–Resources module is the largest contributor of GHG emissions over the Momentum Proposal development life cycle, albeit at a reduced scale as now only accounting for approximately 75,000 tCO2e. This is mainly due to reduced transport related GHG emissions from private car use, and then residential energy consumption.

84 The A1-A3 Product Stage of material consumption is the second main contributor at approximately 45,000 tCO2e of GHG emissions, dominated by the residential upfront carbon (which accounts for modules A1-A5) and

infrastructure material demand. There are minimal GHG emissions associated with infrastructure related construction stage, maintenance, and end of life modules. The Momentum Proposal's B4-B5 modules minimal GHG emissions is related to the required replacement of the low-pressure sewage system pumps after approximately 15-20 years of the study period.

85 There has been a reduction in transport related GHG emission, but it is still a significant component of the Momentum Proposal's life cycle GHG emissions, accounting for a lower overall percentage at just over 40% of total emissions, as shown in Figure 15 below. The residential component emissions from the construction and operation phases exceed this being about 47% of the life cycle GHG emissions. Finally, infrastructure component emissions, which mainly represent the development road network used for transport, accounts for a little under 13% of the life cycle GHG emissions. Commercial development related emissions remain almost negligible at approximately 0.5%.

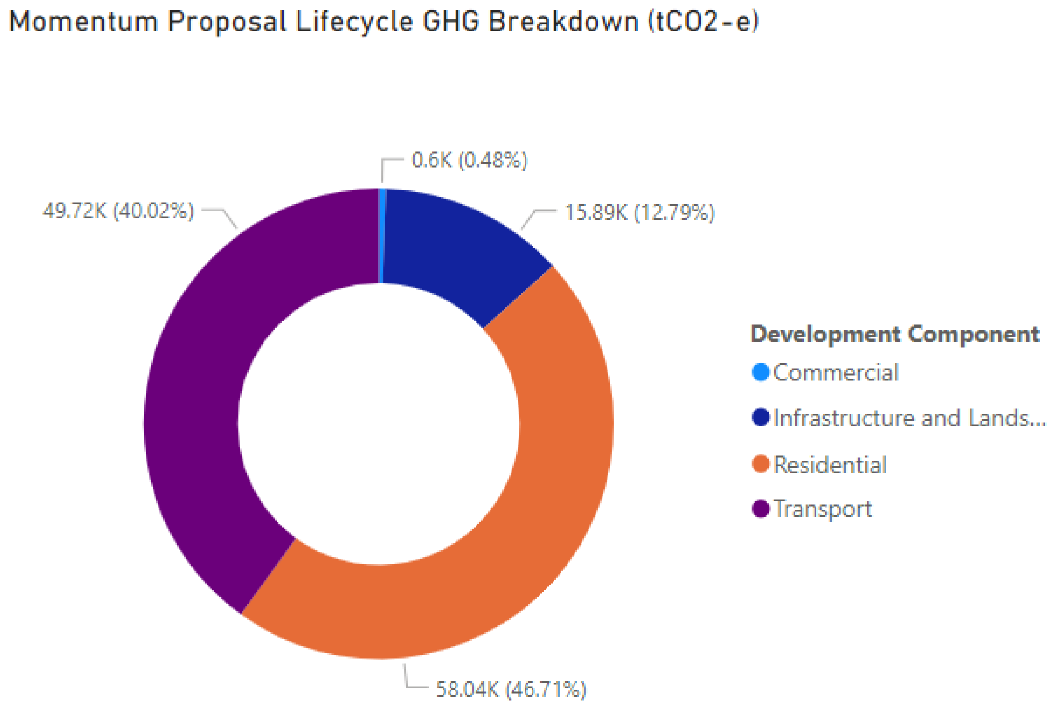


Figure 15: Breakdown of total lifecycle emissions by emissions source – proposed scenario.

86 The results show there has been an overall reduction in life cycle GHG emissions in the Momentum Proposal compared to the Reference Proposal. This is mainly driven by the targeted transport GHG emissions reduction features included in the Momentum Proposal. With lower transport emissions the proportion of life cycle emissions from the residential component has increased relatively and

therefore ought also to be targeted for further GHG emission reduction opportunities.

GHG EMISSIONS REDUCTION FEATURES INCLUDED IN MOMENTUM PROPOSAL

Momentum Proposal GHG Emissions Reduction Features

87 Based on a comparative analysis of the Momentum Proposal to the Reference Proposal there are a number of key design features included in the Momentum Proposal that reduce the development's GHG emissions, particularly emissions associated with ongoing transport. Transport emissions are the main source of GHG emissions across the lifecycle of the Reference and Momentum Proposals and therefore a number of key decisions can be made in site selection and urban design to reduce transport related emissions in the Momentum Proposal.

88 I have assessed the following features included in the Momentum Proposal:

(a) Locating the site close to Kaiapoi KAC.

(b) Including a bicycle lane throughout the development.

(c) Locating the site close to public transport options and employing 15-minute neighbourhood features.

(d) Including low-pressure sewer systems with pumps and tanks, in lieu of traditional gravity sewer systems.

(e) Including a 6 ha ecological restoration and stormwater area within the site boundary.

Kaiapoi Proximity

89 The Momentum Proposal is located close to Kaiapoi KAC and the onward connection to Christchurch, which provides significant benefit to reducing transport distances and related GHG emissions.

90 The features are compared against the nominal average Reference Proposal location with a ~4km distance one way from a KAC, and 19.95km distance one way from Christchurch City-based employment and educational facilities for the average resident.

Parameter	Reference Proposal	Momentum Proposal
Distance to Key Activity Centre	4 km	2.5 km
Distance to Employment Centre	19.95 km	19.39 km

91 The same number of trips have been assumed for the Reference Proposal and the Momentum Proposal transport emissions.

92 On this basis it is calculated that the Momentum Proposal's proximity to the KAC and main employment centre of Christchurch saves 1,477,476km of car travel per year across the activity, retail, and employment trips.

Momentum Proposal Location - Retail Transport -635,250 km/yr

Momentum Proposal Location - Activity Transport -635,250 km/yr

Momentum Proposal Location - Employment Transport -206,976 km/yr

93 Taking the average New Zealand petrol car (2025-2050) emissions factor of 0.208 kgCO2e/km[7] this results in a GHG saving of **8,196 tCO2e**, or a **5.8%** reduction compared to the Reference Scenario over the 30 year study period.

Feature	Description	GHG Savings (tCO2e)	%
Kaiapoi Proximity	Momentum Development Proposal's location near the key activity and employment centres reduces transport distances and emissions	8,196	5.8%

Bicycle Lane

94 Promoting increased cycling over car travel for shorter trips provides cost savings, helps reduce GHG emissions, and supports health and well-being benefits for residents.

95 The Momentum Proposal includes an enhanced streetscape providing a dedicated micro-mobility path or bicycle lane (pink line on graphics below) on

[7] https://www.nzta.govt.nz/roads-and-rail/highways-information-portal/technical-disciplines/environment-and-sustainability-in-our-operations/environmental-technical-areas/air-quality/vehicle-emissions-prediction-model/ [Last Accessed 19/04/2024].

the main road network (assumed to cover 30% of the total road network) within the development, for separate vehicles, pedestrians, and cyclists (Figure 16).

Figure 15: Proposed Road Network with Micro-mobility / Bicycle Lane (pink) Overview.

96 Providing safe and efficient bicycle network will promote the take-up of active travel, such as cycling, which will displace fossil fuel reliant car travel for short trips to local KACs such as Kaiapoi.

Parameter	Reference Scenario	Proposed Scenario
Asphalt Volume	5,920 m^3 Total (0 m3 for the bicycle lane)	7,696 m^3 Total (1,776 m3 for the bicycle lane)
Percentage of KAC activity or retail trips using zero emissions active travel	0%	25%

97 The 3m wide bicycle lane will require additional upfront carbon to construct using Asphalt (similar to the road), which has been incorporated into the model.

98 I note that I have not determined the precise mode share change that will result from this design change, but I have provided a calculation based on 25% of KAC activity or retail trips being replaced by zero carbon active travel methods.

99 The 25% active travel model share was assumed as an approximately median value of the 9–48% uptake in active travel highlighted in Municipal Association of Victoria Pop-up Bike Lanes Program reflections & lessons learned report8, and reiterated by the 11-48% increase described in Proceedings of the National Academy of Sciences research paper on 'Provisional COVID-19 infrastructure induces large, rapid increases in cycling'[9]. This illustrates the relative importance of facilitating active transport options on the overall greenhouse gas emissions of the site.

100 These changes result in an overall GHG saving of 1**,571 tCO2e**, or a **1.1%** reduction compared to the Reference Scenario over the 30 year study period.

Feature	Description	GHG Savings (tCO2e)	%
Bicycle Lane	Additional 3m bicycle lane on 30% of development roads to promote active travel to Kaiapoi centre	1,571	1.1%

[8] https://www.mav.asn.au/__data/assets/pdf_file/0006/32829/PUBL-DTP-MAV-Pop-up-Bike-Lanes-Program-reflections-and-Lessons-Learned-Jul-2023.pdf [Last Accessed 19/04/2024].

[9] Kraus, Sebastian & Koch, Nicolas. (2021). Provisional COVID-19 infrastructure induces large, rapid increases in cycling. Proceedings of the National Academy of Sciences.

15-Minute Neighbourhood – Transit Access

101 15-minute neighbourhoods support local communities and healthy lifestyles by prioritising place making, walking, cycling, micro-mobility and last mile freight, and support a culture of public transport use.

102 The Momentum Proposal employs the 15-minute neighbourhood principle in the design and structure of the residential expansion, maximising micro-mobility and connectivity through compact lot sizes and restricted block lengths around an enhanced road network.

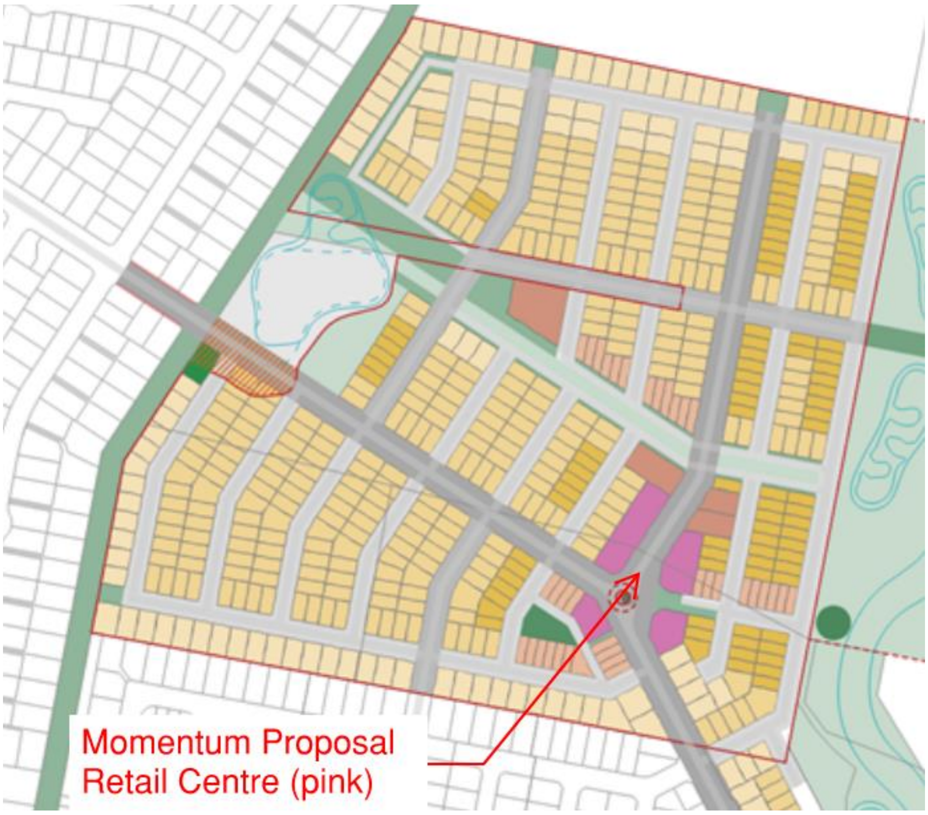


Figure 16: Momentum Development Proposed Neighbourhood Overview.

103 Nearly all residential lots are within 400m of a local convenient retail centre and multiple bus stops to nearby KACs and Christchurch. This promotes both reduced number of trips to KACs and importantly a modal shift to bus transport from private cars, which represents lower travel costs and lower carbon emissions. Particularly for longer trips to Christchurch, with the Momentum Proposal well located near to existing bus routes to Christchurch and has a shorter public transport commuting distance than many other locations in the Waimakariri District.

Parameter	Reference Proposal	Momentum Proposal
Percentage of commuting trips using bus transport.	0%	33%

104 I note that I have not determined the precise mode share change that will result from this design change, but I have provided a calculation based on 33% of car trips being replaced by bus transport. This 33% bus transport modal share was assumed based on the Environment Canterbury study that found the number of people using public transport increased by 33% due to a range of improvements including better modal access[10]. This value was more conservative than the Auckland Regional Urban Transport Plan 2023 projection of a 50% increase in public transport usage due increased accessibility to public transport[11]. This illustrates the relative importance of site selection and urban design in facilitating public transport and therefore the overall GHGs emissions of the site.

105 These changes result in an overall GHG saving of **7,095 tCO2e**, or a **5%** reduction compared to the Reference Scenario over the 30 year study period.

Feature	Description	GHG Savings (tCO2e)	%
15-Minute Neighbourhood - Transit Access	Residential blocks are compact to reduce distance to bus stops promoting modal shift for employment trips to Christchurch	7,095	5%

Low Pressure Sewers

106 Typical development wastewater networks utilise a gravity sewer system which uses large pipes that are installed in deep trenches and must follow a consistent downslope to a community waste water pumping station where it is transferred to an offsite treatment facility – as is assumed in the Reference Proposal.

107 The Momentum Proposal intends to install a low-pressure sewer system which features distributed tank and low-energy demand grinder pump systems in each dwelling, connected by a significantly smaller diameter network of piping (Figure 18).

[10] https://www.ecan.govt.nz/your-region/living-here/transport/public-transport-services/transforming-public-transport/ [Last Accessed 19/04/2024].
[11] https://at.govt.nz/about-us/transport-plans-strategies/regional-public-transport-plan-2023-2031-rptp [Last Accessed 19/04/2024].

Figure 17: E/One Grinder Pump System Network Graphic (credit: www.cummins-wagner.com).

108 The low pressure sewer system increases upfront carbon emissions in the form of the additional tanks and pumps for each dwelling – estimated to be approximately 786kgCO2e/unit based on the material weights of the system, and additional operational energy of the low energy grinder pump which is on average 100kWh/yr.

Parameter	Reference Scenario	Proposed Scenario
Sewage System Type	Gravity System	Low Pressure System
Network HDPE Pipe Size	150mm	66mm
Upfront carbon emissions for pipe, pumps and tanks (per dwelling).	392 kg CO2-e	786 kg CO2-e
Sewage pumping energy (per dwelling).	100 kWh per year	100 kWh per year

109 Due to a lack of available data, the Reference Proposal's centralised system pumping energy is assumed to be equivalent to the Momentum Proposal's low pressure system pumping energy for this assessment.

110 As a result, the inclusion of the low pressure sewage system in the Momentum Proposal is actually estimated to slightly increase GHG emissions by **772 tCO2e**, or **0.5%** compared to the Reference Proposal over the 30 year study period.

111 However, the decentralised and more flexible low pressure system is expected to provide additional resilience to future climate change and naturally occurring disasters such as earthquakes.

112 I have also not been able to quantify the benefit from lower repair frequency expected from this type of system, which would improve slightly the outcome of the results by reducing the Momentum Proposals sewerage system lifecycle GHG emissions.

Feature	Description	GHG Savings (tCO2e)	%
Low Pressure Sewers	Replace large gravity sewer with low pressure E/One Sewer System	-772	-0.5%

Ecological Restoration and Stormwater Area

113 The ecological restoration and stormwater area or reserve provides a natural retreat and stormwater management area adjacent to the residential development, rehabilitating an existing degraded farmland area and drain to reinvigorate it with wetland forest and bush planting, and low impact drainage (Figure 19).

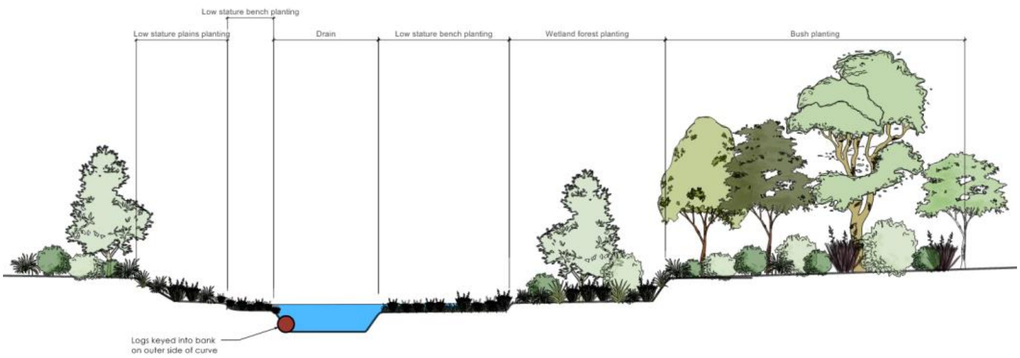


Figure 18: Example Ecological Reserve Cross Section Area from the McIntosh Reserve

114 An ecological reserve is not typical in standard residential developments and is therefore not included in the Reference Proposal. For the Momentum Proposal the existing degraded farmland and drain area will be rehabilitated to provide

an ecological reserve serving as a carbon sink, public amenity, and stormwater management area.

Parameter	Reference Proposal	Momentum Proposal
GHG Emissions reductions from ecological restoration	0 kg CO2-e per year	5,950 kgCO2-e per year

115 This provides an estimated GHG emissions reduction of **179 tCO2e**, or **0.2%** over the 30 year study period through absorbed carbon.

Feature	Description	GHG Savings (tCO2e)	%
Ecological Rehabilitation	Include a 6-hectare ecological restoration bordering the development to the east	179	0.2%

Table of Momentum Proposal's GHG emissions reduction features

116 A summary table of the Momentum Proposal's GHG emissions reduction features compared to the Reference Proposal is provided below.

No.	Feature	Description	GHG Savings (tCO2e) compared to Reference Proposal	% change compared to Reference Proposal
Momentum Development Proposal GHG Emission Reduction Features				
1	KAC Proximity	Momentum proposal's location near the Kaiapoi town centre reduces transport distances and emissions	8,196	5.8%
2	Bicycle Lane	Additional 3m bicycle lane on estate roads to promote active travel to Kaiapoi centre	1,571	1.1%
3	15-Minute Neighbourhood - Transit Access	Residential blocks are compact to reduce distance to bus stops promoting modal shift for employment trips to Christchurch	7,095	5.0%

No.	Feature	Description	GHG Savings (tCO2e) compared to Reference Proposal	% change compared to Reference Proposal
4	Low Pressure Sewers	Replace large gravity sewer with low pressure E/One Sewer System	-772	-0.5%
5	Ecological Restoration and Stormwater Area	Include a 6-hectare ecological restoration and stormwater area bordering the development to the east	179	0.2%

GHG EMISSIONS REDUCTION OPPORTUNITIES THAT COULD BE CONSIDERED FOR MOMENTUM PROPOSAL

117 In addition to the GHG saving features identified above that are already included as part of the Momentum Proposal, further GHG reduction opportunities could be considered for the future development.

Low Carbon Concrete / Infrastructure Material Recycled Content

118 The embodied carbon requirement of construction materials such as concrete and asphalt account for a significant portion of global GHG emissions, with concrete accounting for up to 10% of global GHG emissions in any given year. Consequently, there has been significant research into reducing these materials negative environmental impact.

119 Utilizing low-carbon concrete materials (LCCMs) has been recognised as an efficient way to reduce the built environment's embodied carbon. Replacing virgin material ingredients in concrete and asphalt production with recycled or low carbon alternatives such as ground granulated blast furnace slag (GGBS) is a method of producing low carbon concrete or asphalt materials. According to recent studies, more than 20% recycled material may be added to concrete or asphalt material without affecting structural quality. The adjacent Beach Grove development utilised recycled crushed concrete from local demolition contractors in 2014. If available, such an arrangement may be beneficial for GHG reduction.

Parameter	Reference Proposal	Potential Option
Recycled Asphalt and Concrete Content	0%	20%

120 For the Momentum Proposal, asphalt and concrete material usage in roads accounts for 33% of the infrastructure related GHG emissions. Replacing these materials with lower carbon alternatives including recycled materials up to 20% content, is estimated to reduce GHG emissions by **971 tCO2e**, or **0.7%** compared to the reference scenario.

Feature	Description	GHG Savings (tCO2e)	%
Low Carbon Concrete / Infrastructure Material Recycled Content.	Specify low carbon concrete and asphalt replacing virgin materials with recycled or GGBS content.	971	0.7%

Electrical Vehicle Infrastructure

121 Electric vehicles (EVs) will play a pivotal role in the decarbonisation of transport in the future. EVs are vehicles that run on electricity typically provided from the grid and which can be plugged in to recharge, rather than run on fossil fuels. The New Zealand Government is keen to support the uptake of electric vehicles alongside other low-emission forms of transport which will help to reduce GHG emissions and local air pollution.

122 To align with this drive for a future zero emissions transport economy, there are opportunities for EV charging infrastructure to be included in the future development of the Momentum land.

Parameter	Reference Proposal	Potential Option
Distance travelled by EVs for Employment	0 kms	840,000 kms

123 Assuming EV charging infrastructure is provided for an additional 10% of cars, this would displace 20% of the employment trips (excluding the 33% already replaced by bus transport) from petrol vehicles to EVs. This equates to approximately 840,000kms travelled by EVs. This is represented as 0 kms by EV for the Reference Proposal and 840,000kms by EV for the potential Momentum Proposal. It is acknowledged that it is unlikely that 0kms will be travelled by EVs

in the Reference Proposal case, however, as a comparative analysis to the Momentum Proposal, this simplifying assumption is acceptable.

124 This results in an overall GHG saving of 4,175 tCO2e, or a 2.9% reduction compared to the Reference Scenario over the 30 year study period.

Feature	Description	GHG Savings (tCO2e)	%
Electric Vehicle Infrastructure	Install EV infrastructure to enable residents replace fossil fuel vehicles with low carbon electric vehicles	4,175	2.9%

Solar PV System

125 Solar photovoltaic (PV) systems generate electricity from sunlight, producing zero carbon emissions. It is estimated that the average grid electricity emissions factor will be 0.05485 kgCO2e/kWh over the study period of 30 years.

Parameter	Reference Proposal	Potential Option
Onsite Solar PV Energy generation	0 kWh/yr	1,300,000 kWh/yr

126 This may be displaced by solar PV energy if installed onsite behind the meter. Assuming a 1,000m^2 PV system over the development's roofing or green area, producing an average 1300 kWh/m2/yr, offsetting approximately 4,278 tCO2e over the 30 year study period. This PV system will have an upfront carbon requirement of approximately **300 tCO2e** with a life expectancy of circa 30 years.

127 This results in an overall GHG saving of 3,678 tCO2e, or a 2.6% reduction compared to the Reference Proposal over the 30 year study period.

Feature	Description	GHG Savings (tCO2e)	%
Solar PV System	Install a behind-the-meter Solar PV system to utilise onsite renewable energy generation	3,678	2.6%

Higher Home Energy Efficiency Requirements

128 Residential energy consumption represents approximately 14% of the total GHG emissions of the Reference Scenario, assuming an average energy demand of 60 kWh/m2/yr of grid electricity over the 30 year study period.

129 This 60 kWh/m2/yr energy demand value is based on the expected 2024 building code H1 standard update setting it as the minimum efficiency level for new builds. A future update in 2028 of 30 kWh/m2/yr is expected with some home designers already operating to this level[12].

130 Therefore, there is a potential opportunity for the Momentum Proposal to require a higher standard of home energy efficiency, based on the 2028 requirements, reducing the residential energy demand and associated GHG emissions by 50%. This results in an overall GHG saving of **7,898 tCO2e**, or a **5.6%** reduction compared to the Reference Proposal over the 30 year study period.

Feature	Description	GHG Savings (tCO2e)	%
Higher Home Energy Efficiency Requirements	Require homeowners to achieve 2028 energy efficiency standards for new homes	7,898	5.6%

Convenient Commercial Centre

131 It is assumed in the Reference Proposal that a convenient commercial centre is provided in a typical Waimakariri District greenfield urban development to provide convenient access to daily retail requirements. On this basis, a convenient commercial centre has not been included in the GHG emissions reduction features section above.

132 However, in the scenario that a commercial centre is not provided in the Reference Development, the Momentum Proposal with its convenient commercial centre would provide additional potential GHG savings compared to the Reference Proposal by reducing the need for travel to the nearest KAC for retail requirements.

133 With the centrally located commercial retail centre it is assumed that 50% of driven retail trips to the KAC are displaced by zero carbon active travel modes such as walking or cycling. This results in a potential GHG saving of **6,747 tCO2e** for the proposed development, or a **2.4%** reduction compared to the Reference Scenario over the 30 year study period.

[12] https://energyefficienthomes.co.nz/why-building-a-standard-home-today-is-a-bad-investment/#:~:text=Currently%2C%20NZ%20homes%20are%20averaging,of%20what%20is%20used%20now [Last Accessed 25/04/2024]

Table of the Momentum Proposal's GHG Emission Reduction Opportunities

134 A summary table of the Momentum Proposal's GHG Emission Reduction Opportunities that could be considered by Momentum compared to the Reference Proposal is provided below.

No.	Feature	Description	GHG Savings (tCO2e) compared to Reference Proposal	% change compared to Reference Proposal
Momentum Development Proposal GHG Emission Reduction Opportunities				
6	Low Carbon Concrete / Infrastructure Material Recycled Content	Specify low carbon concrete replacing virgin Portland cement with recycled or GGBS material	971	0.7%
7	Electric Vehicle Infrastructure	Install EV infrastructure to enable residents to replace fossil fuel vehicles with low carbon electric vehicles	4,175	2.9%
8	Solar PV System	Install a behind-the-meter Solar PV system to utilise onsite renewable energy generation	3,678	2.6%
9	Higher Home Energy Efficiency Levels	Require homeowners to achieve stricter energy efficiency standards for new homes	7,898	5.6%
10	Convenient Commercial Centre (assuming none provided in Reference Proposal)	Locating a convenient commercial/retail centre in the heart of the development to avoid necessity of car trips to KAC	6,747	2.5%

135 Further details on the assumptions and calculations supporting these features are provided in the Appendices of this evidence.

LOCATION-BASED VEHICLE EMISSIONS ANALYSIS

136 The Momentum Proposal utilises the actual identified development site in Kaiapoi as the return location for vehicle-based emissions calculations. The Reference Proposal assumes a nominal average distance location elsewhere in the Waimakariri District for the baseline development. This is because a

proposed development could likely be located in any nearby developed area such as Kaiapoi, Rangiora, Ohoka or Pegasus-Woodland, all of which would result in differing vehicle emissions. As a result, the nominal reference location was chosen as the average of the distances travelled for each of these existing settlements.

137 A comparison of vehicle GHG emissions for the same scale of development in different locations has been completed. The sites selected for the analysis are the Reference Proposal (nominal location as discussed above) and the four main developed areas in the Waimakariri District: the Momentum Proposal at Kaiapoi, Rangiora, Ohoka and Pegasus-Woodland.

138 The location of these different sites, respective distances to their closest KAC based on Google maps estimates, and education and employment travel distances, as per the 2018 census[13], is provided in Table 7 and shown on Figure 20.

Table 7: Location Scenario Analysis Distances.

Scenario	Location	Distance to KAC (km) one-way	Work+Education Travel Distances (km) one-way
Reference Case	Nominal	4	19.95
Rangiora Case	Rangiora	2	14.23
Ohoka Case	Ohoka	8	21.66
Pegasus Case	Pegasus	3	24.52
Proposed Case	Momentum Proposal – North Kaiapoi	2.5	19.39

[13] https://datafinder.stats.govt.nz/table/104720-2018-census-main-means-of-travel-to-work-by-statistical-area-2/ [Last Accessed 19/04/2024]

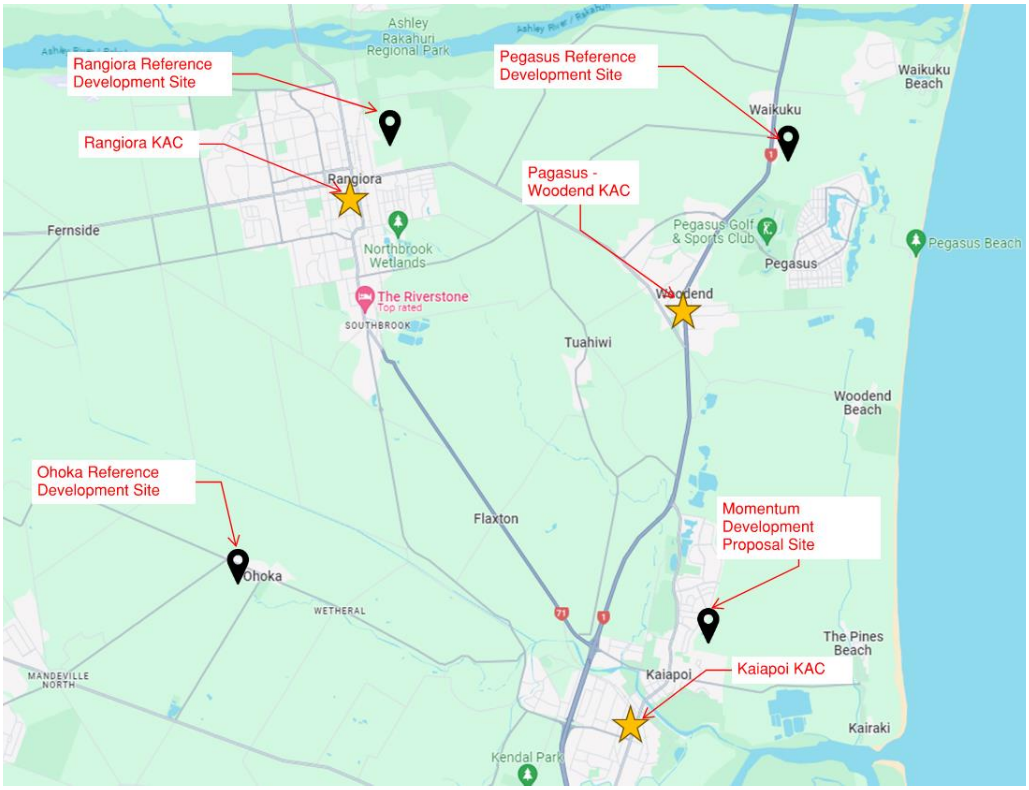


Figure 20: Reference Scenarios Location Map Overview.

139 These distances are applied to vehicle transport calculations for retail, activity and employment trips based on the following assumptions;

(a) Activity trips – 1 round-trip to KAC per dwelling per day for 6 days per week, 50 weeks per year.

(b) Retail trips – 1 round-trip to KAC per dwelling per day for 6 days per week, 50 weeks per year.

(c) Employment trips – 1 round-trip per dwelling per day for 5 days per week, 48 weeks per year.

140 Using the varying distances in each scenario case while assuming a consistent number of dwellings and commuting trips via car in each analysis cases produced the following results.

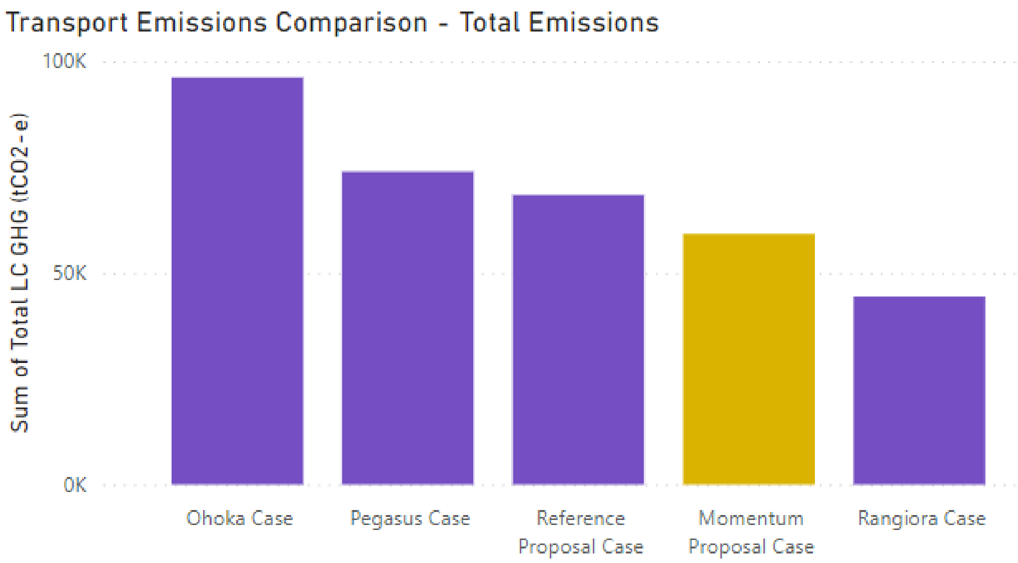


Figure 21: Reference Scenarios Transport Emissions Comparison – Totals.

141 From the results, the Ohoka case location has the largest lifecycle vehicle transport GHG emissions at approximately 95,000 tCO2e, with the nominal Reference Proposal case scenario the median value of 68,000 tCO2e over the study period.

142 The Momentum Proposal has the 2nd lowest vehicle transport emissions at approximately 59,000 tCO2e, a 14% reduction compared to the Reference Proposal case scenario.

143 It is noted that the Rangiora case is the lowest overall vehicle transport emissions at 44,500 tCO2e. This is a result of the significantly lower work and education travel distances provided by the 2018 census for Rangiora.

144 For each case, the transport GHG emissions are dominated by the employment travel requirement. The Ohoka reference case's relatively longer distance to the nearest KAC in Kaiapoi significantly increases the activity and retail transport emissions.

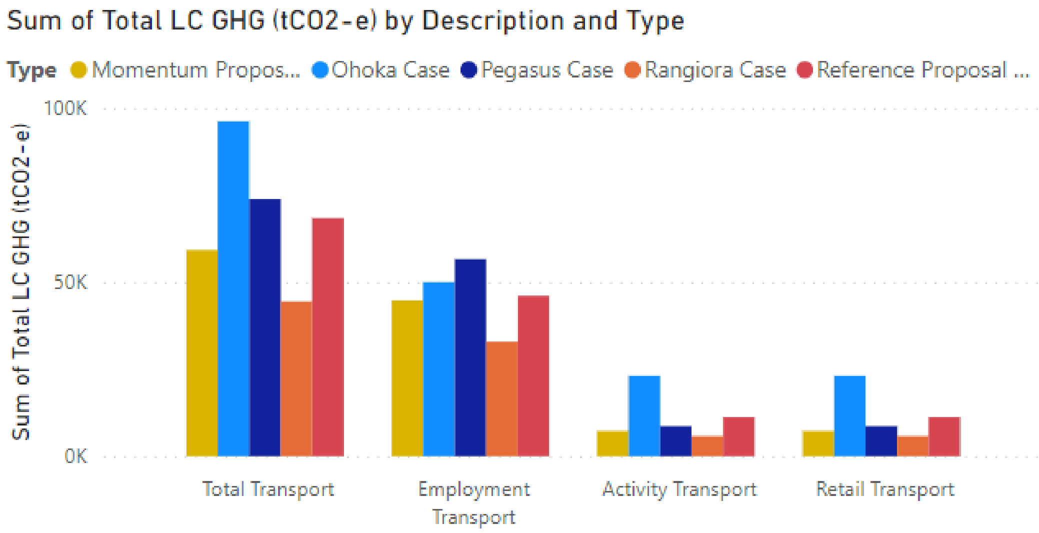


Figure 22: Reference Scenarios Transport Emissions Comparison – Breakdown.

145 The varying reference case locations in this analysis directly affect vehicle transport GHG emissions, depending on their proximity to the destination. This highlights the importance of proximity to KACs and employment centres for reducing a development's vehicle transport related GHG emissions.

CONCLUSION

146 Comparing the Reference Proposal to the Momentum Proposal a reduction in GHG emissions is evident. The Momentum Proposal's GHG emissions savings are mainly in the B6-B7 Use – Resources module, which accounts for savings in transport emissions due to the KAC proximity, bicycle lane and transit access features.

147 The Momentum Proposal's small A1-A3 module GHG increase is mainly due to the additional materials related to the low pressure sewage system such as the additional tanks and pumps required, and an increased asphalt requirement for the Momentum Proposal's bicycle lane.

148 While the A4-A5 module shows a slight increase in GHG emissions due to the Momentum Proposal's greater bulkfill requirement, the resulting increase in this module is less than 0.5% in overall GHG emissions.

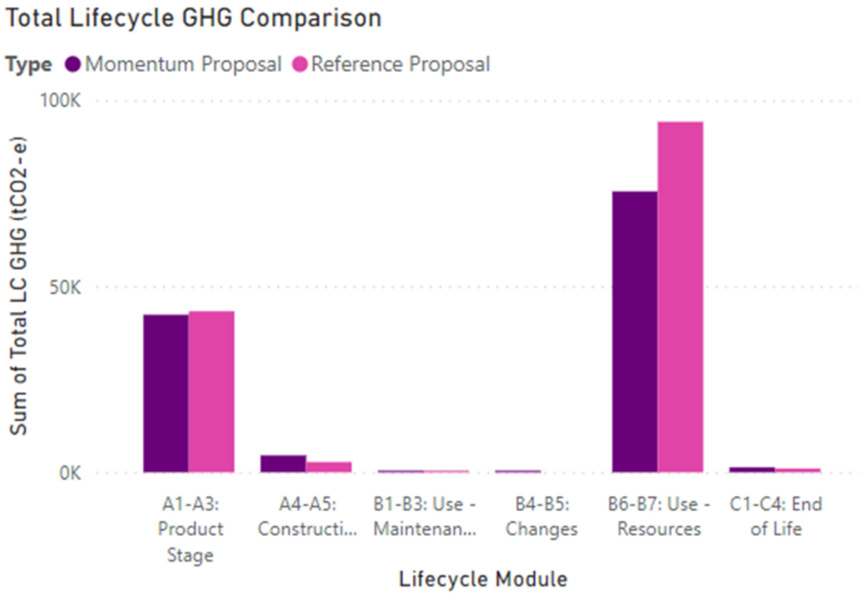


Figure 23 - Reference and Proposed Scenario Total Lifecycle GHG Emissions Comparison per Lifecycle Module

149 These GHG saving features result in the Momentum Proposal achieving a potential 12.2% reduction in GHG emissions compared to the Reference Proposal, equating to approximately 17,000 tCO2e over the 30 year study period.

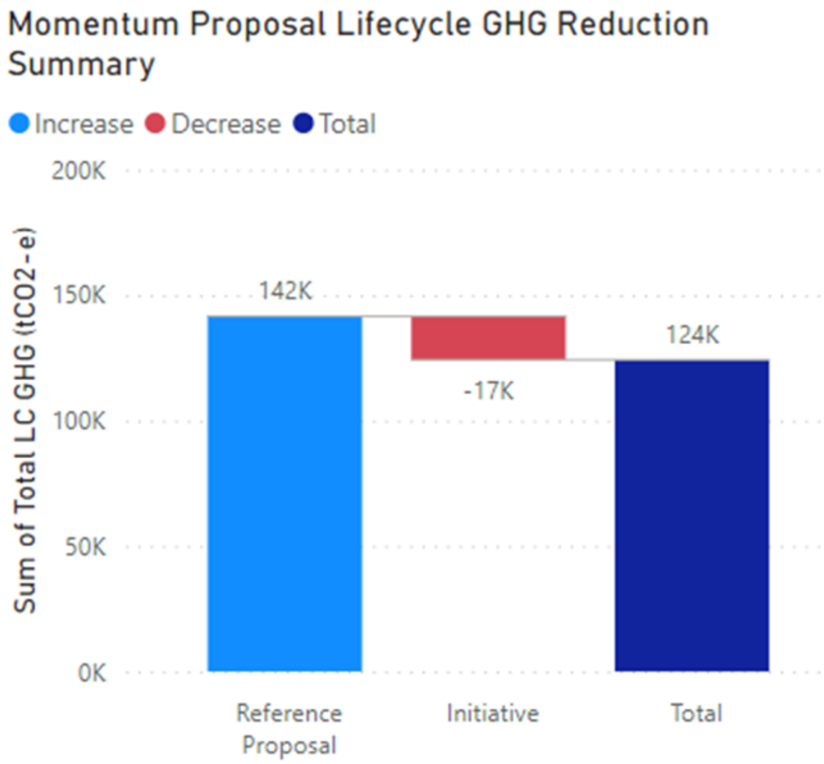


Figure 24 - Reference Proposal Vs Momentum Proposal Total Lifecycle GHG Emissions Reduction via Proposed Features.

150 The GHG emissions savings are mainly associated with the GHG reduction initiatives included in the Momentum proposal's design, including location. The Momentum proposal's proximity to Kaiapoi KAC and its active or low carbon travel incentivising layout represent 51% and 39% of the estimated GHG reductions respectively. There is potential for more GHG emissions reduction by implementing one or more of the identified opportunities such as low carbon concrete or a solar PV system.

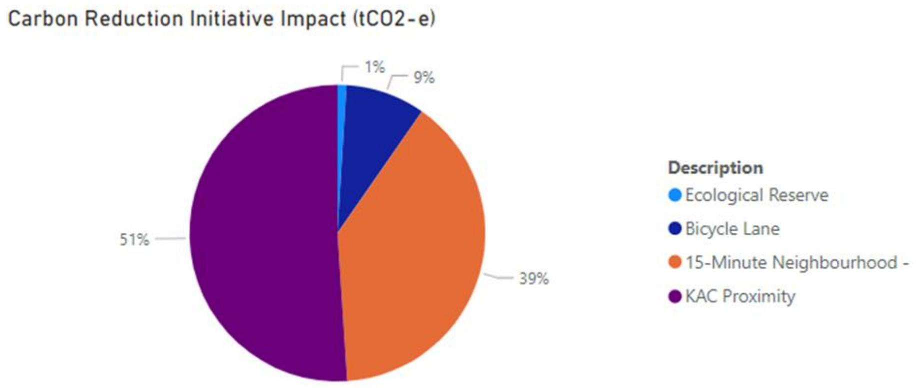


Figure 25 - Breakdown of total lifecycle GHG emissions Savings by Feature.

151 This evidence shows that the Momentum Proposal aligns with the objectives and policies of National Policy Statement for Urban Development 2020 (NPS-UD), namely that the urban environments that form part of the proposal:

- Supports reductions in greenhouse gas emissions; and
- Are resilient to the current and future effects of climate change.

152 According to the analysis the Momentum Proposal potentially achieves a 12.2% reduction in GHG emissions compared to the Reference Proposal, equating to approximately 17,000 tCO2e over the 30 year study period.

153 The Momentum Proposal's GHG emissions savings are mainly in the B6-B7 Use – Resources module, which accounts for savings in transport emissions mainly due to the KAC proximity, bicycle lane and transit access initiatives. Further GHG reduction potential opportunities are proposed for consideration for the future development also.

154 From the location sensitivity analysis of transport GHG emissions reduction, the Reference Proposal is the median value of approx. 68,000 tCO2e over the study

period. The Momentum Proposal has the 2nd lowest transport GHG emission at approx. 59,000 tCO2e, a 14% reduction compared to the Reference Proposal.

155 While this evidence does not purport to be a holistic assessment of climate change impacts and mitigation strategies, the following works included in the Momentum Proposal model are likely to mitigate the impacts of climate change and increase the resilience of the development:

- Significant works and fill to ensure homes are sited in a way that is less likely to flood than would otherwise occur.
- A decentralised and flexible low pressure sewage system to provide additional resilience to future climate change effects and naturally occurring disasters such as earthquakes.

156 Thank you for the opportunity to present my evidence.

Robert Wilson
27 June 2024