

**BUILDING BETTER
HOMES, TOWNS
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Ko ngā wā kāinga hei
whakamāhorahora

**Assessing Environmental Sustainability
outcomes at neighbourhood scale.
A Post-Occupancy Evaluation
of Hobsonville Point, Auckland**

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**Building Better Homes Towns and Cities
National Science Challenge
Working Paper 19-05**

October 2019

Title	Assessing environmental sustainability outcomes at neighbourhood scale. A Post-Occupancy Evaluation of Hobsonville Point, Auckland. Working Paper 19-05
ISSN (online)	2624-0750
Author(s)	Paola Boarin, Natalie Allen, Errol Haarhoff
Series	Building Better Homes Towns and Cities working papers
Series Editor	Errol Haarhoff

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Acknowledgements

This work was funded by Building Better Homes, Towns and Cities National Science Challenge, Strategic Research Area – Shaping Places: Future Neighbourhoods.

The authors would like to thank Katja Lietz, General Manager Masterplanning and Placemaking at HLC, and Louelle Botes, Programme Manager Development Evaluation at HLC, for their time in sharing information about the evolution of HLC and their work to deliver Hobsonville Point.

The authors are very grateful to Sonja Lister, Principal Specialist – Consultant Lead, Resource Consents, at Auckland Council, for providing the documentation used for the analyses of Hobsonville Point.

Special thanks also to Meredith Dale for her expertise and guidance in developing this work and to Dana Coleman for the graphic elaborations.

Recommended citation

Boarin, P., Allen, N. & Haarhoff, E. (2019). Assessing environmental sustainability outcomes at neighbourhood scale. A Post-Occupancy Evaluation of Hobsonville Point, Auckland. Working Paper 19-05. Auckland, New Zealand: National Science Challenge 11: Building Better Homes, Towns and Cities.

This report is available from: <http://www.buildingbetter.nz/resources/publications.html>.

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Building Better Homes, Towns and Cities National Science Challenge

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Abstract

This Working Paper has been produced as part of the National Science Challenge 11 – Building Better Homes, Towns and Cities: Ko ngā wā kāinga hei whakamahorahora (NSC11). This research sits within the Strategic Research Area (SRA) Shaping Places: Future Neighbourhoods. This research is aligned to other studies as part of NSC11, looking at the post occupancy evaluation of Hobsonville Point as a (mixed density mixed typology) master-planned residential development, in Northwest Auckland – New Zealand.

This research is specifically focussed on assessing the environmental sustainability of neighbourhoods; it further develops and tests a framework for the Post Occupancy Evaluation (POE) of neighbourhoods according to how well they consider the issues and opportunities of environmental sustainability in their planning and delivery.

Following a literature review (published in Working Paper 18-01), this research began with an analysis and synthesis of three international assessment tools and one New Zealand framework to develop a guiding matrix to undertake POEs, with a test on Hobsonville Point in Auckland. This matrix became the underpinning methodology guiding this research and categorised environmental performance measures according to energy use, water management and conservation, ecology and habitat, and waste management and pollution control responses and measures. It functions across the neighbourhood and block scales and asks questions about how well a neighbourhood has performed at both these critical scales. In this way, this research represents the advancement towards the definition of an overarching framework for the Post Occupancy Evaluation of New Zealand neighbourhoods.

The conclusions drawn through this work show that a POE needs to function at both a block and a neighbourhood scale and the achievement of many of the criteria is influenced by city-wide strategic planning for mobility, energy, waste and water production and consumption. For these reasons, it is important that clear goals are set up involving all relevant stakeholders, as well as a detailed set of assessment criteria are defined for enabling outcomes to be measured against desirable performance levels on a short, medium and long term.

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1. Project framing: environmental sustainability and Post-Occupancy Evaluation of neighbourhoods

The New Zealand building sector is facing pressure from significant population growth, increasingly stringent construction standards for low energy buildings and environmental performance, and the greenhouse gas emissions targets set out for New Zealand under the Paris Agreement. A well-structured, long-term and holistic approach to housing and urban development is urgently needed in New Zealand, to manage and mitigate for the environmental impacts of urban living. As such, this paper considers environmental sustainability in the context of the New Zealand building sector.

Over the past decade, several local and international guidelines and standards have been developed around the integration of sustainability in the design of the built environment. This has generated a large number of successful best practice examples of both sustainable building design and sustainable urban development. Environmental sustainability targets have also become an imperative for investors and developers, along with criteria for the approval and distribution of bonuses, government incentives and discounts that reward sustainable design (for instance, mortgages for home buyers or loans for retrofitting activities). However, there is limited understanding and validation of whether environmental sustainability goals and design performance standards are actually met. If we don't objectively assess the overall impacts at the end of a building process, to measure what has been achieved through development, we will never be sure if (and how) the sustainability criteria defined in the first instance were actually effective in achieving those goals; this will limit the evolution of strategies and reduce project, product and process innovation.

The difference between predicted performance at the design phase and measured performance at the operation phase, the so-called 'performance gap' (de Wilde, 2014), can be observed at both the building and neighbourhood scales. An effective way to bridge this gap is through a Post-Occupancy Evaluation (POE) process, a concept more commonly used to evaluate buildings "[...] in a systematic and rigorous manner after they have been built and occupied for some time" (Preiser, Rabinowitz, & White, 1988, p. 3). The POE process takes a focus on occupants' needs and design decisions, as opposed to resulting performances. In doing so it adds value to built environment practice by highlighting 'lessons learned' that will contribute to the creation of better buildings and neighbourhoods in the future. As POEs are concerned with both subjective (the occupants' needs) and objective (design criteria) aspects, their impact is potentially very wide, ranging from enhanced user experiences (such as creating liveable spaces and opportunities for connections among residents), to the new or improved environmental sustainability policies and certification schemes, leading to the ultimate definition of long-term sustainability plans and roadmaps.

POEs have now become an accepted practice for buildings, especially those where high energy and environmental performances were targeted at the design stage. This has also been

supported by the development and use of a large number of voluntary rating tools and certification systems worldwide, with examples being LEED, BREEAM, Green Star, WELL, HQE and the Living Building Challenge. Unfortunately, the practice of POE at the neighbourhood scale is still limited (Churchman & Ginosar, 1999, p. 267), due to the greater complexity of evaluations at this scale, and the (negative) implications for urban planning and urban design processes and the evolution of related policies and guidelines.

A previous piece of research conducted within the framework of the National Science Challenge 11 - Building Better Homes, Towns and Cities, by the authors of this report, reviewed a number of existing methodologies for the evaluation of neighbourhood environmental sustainability and analysed successful examples of POE, both internationally and in New Zealand (Boarin, Besen, & Haarhoff, 2018). The study highlighted that results from POE can often be unexpected and that, given the lack of real performance data, many design assumptions can be found to be inaccurate. However, this is still value in neighbourhood POE's that focus on universal principles and environmental protection.

Based on the comparison between the most-used existing assessment schemes for neighbourhood sustainability internationally (i.e., LEED for Neighbourhood Development and BREEAM Communities) and the ones that are more commonly used in the New Zealand context (i.e., Green Star Communities and Beacon Pathway Neighbourhood Sustainability Framework), the research developed a proposal for a new Post-Occupancy Evaluation framework to be used for the sustainability assessment of neighbourhoods in New Zealand. Further research could also align with work underway considering how this aligns to Kaupapa Māori, however this was beyond the scope of this research at this time.

This research advances the proposal for a POE framework for New Zealand neighbourhoods, with a singular focus on environmental sustainability aspects (as opposed to a previous larger scope which involved equity and health as well). Considering other social, cultural, and economic dimensions of sustainability are beyond the scope of this POE.

A case study of the Hobsonville Point neighbourhood, the largest master-planned residential development in New Zealand, was used to test the proposed POE framework, to understand related challenges and opportunities and to highlight recommendations for increasing the delivery of environmentally sustainable outcomes in the future.

2. A methodology for the definition of a Post-Occupancy Evaluation framework of New Zealand neighbourhoods

2.1. Introduction and methodology

This project began with a literature review of neighbourhood Post-Occupancy Evaluation, offered in Working Paper 18-01, which included a review of existing best practices, assessment tools and certification schemes (Boarin et al., 2018). The purpose of the review was to identify and analyse the features of the most popular tools for neighbourhood environmental sustainability design and assessment, to inform the development of a framework suitable for the New Zealand context. Note however, that the framework resulting from this research is not intended to replace existing frameworks, but rather to synthesise and simplify international methods and core values for application to the New Zealand context and sustainability challenges. As such, this research aims to make the neighbourhood scale POE framework and relevant data accessible and usable by the local built environment and building industry. The framework should be used as a simplified tool to inform decision-making at the early stages of the design process, as well as for the Post-Occupancy Evaluation of design outcomes. The research analysed and compared a selection of environmental sustainability rating systems and guidelines to define objectives and strategies at both the neighbourhood and block scales. These were:

- LEED Neighborhood Development v4, developed by the U.S. Green Building Council and first released in 2007, is a neighbourhood rating and certification system that supports better, more sustainable and well-connected design and development at the community scale (U.S. Green Building Council, 2014);
- BREEAM Communities International v1.1:2012, developed by the British Research Establishment and first released in 2008, is an assessment and certification tool that supports planners, designers and developers with integrating sustainable design into masterplanning for large-scale development projects (BRE Group, 2012);
- Green Star Communities v1.1, developed by the Green Building Council of Australia and first released in 2015, is a rating system that assesses the planning, design and construction of large-scale development projects at a precinct, neighbourhood and/or community scale (Green Building Council of Australia, 2016);
- Beacon Pathway Neighbourhood Sustainability Framework, developed by Beacon (a New Zealand Incorporated Society) and released in 2012, is an assessment tool for New Zealand neighbourhoods to measure for their resilience, adaptability, community feel, amenity and environmental sustainability (Beacon Pathways, 2014).

LEED Neighborhood Development and BREEAM Communities International were chosen for this research because, while they were developed first, they have also become the most widely used and respected rating systems for achieving greater sustainability in the built

environment around the world. The Green Star Communities rating system is supported by the New Zealand Green Building Council, although no projects have been certified with this tool in New Zealand so far. The Beacon Pathway Neighbourhood Sustainability Framework is the only tool developed specifically for the New Zealand context, based on the findings of international research completed by Beacon Pathway. In terms of structure, LEED, BREEAM and Green Star have a similar approach; identifying sustainability impact categories, assessing performance against these criteria and awarding credits or points if performance thresholds are successfully achieved. Following third-party verifications, the level of certification awarded is determined from the sum of points achieved by a project. Each of the chosen rating systems address sustainability in a broad sense, considering social, environmental and economic sustainability aspects and measures, but only the Beacon Pathway Neighbourhood Sustainability Framework is oriented towards neighbourhood POE rather than the design and construction phases.

Figure 1 shows the tools selected for the development of a New Zealand framework.

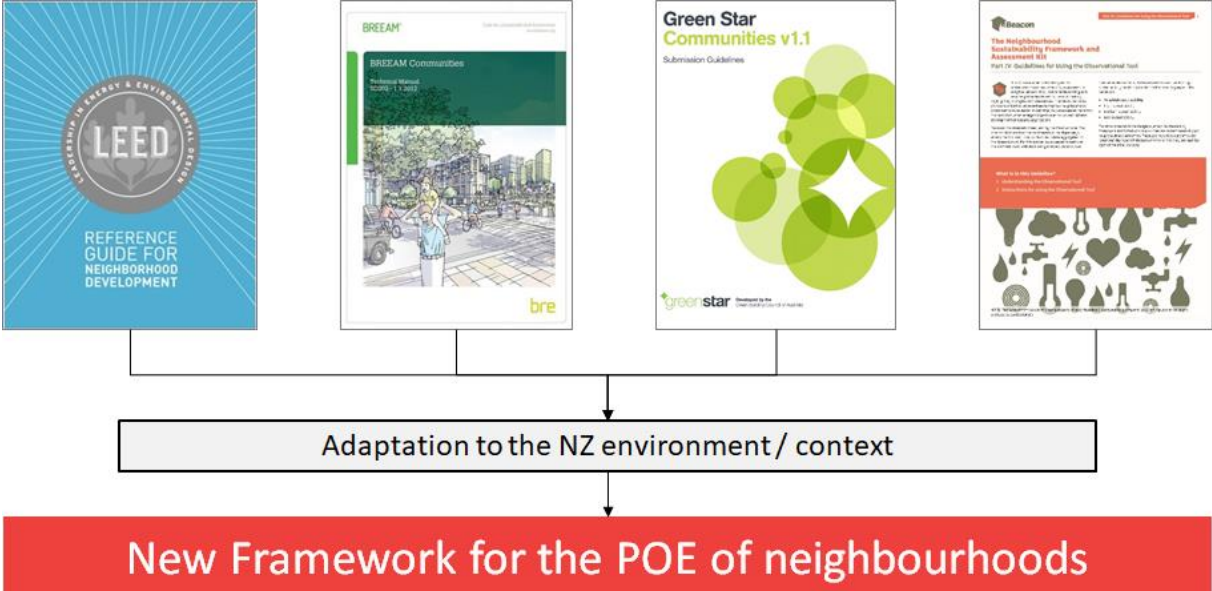


Figure 1. Environmental sustainability assessment methods and rating systems used to develop a POE framework of neighbourhoods in New Zealand.

An analysis and cross-comparison of the four rating systems highlighted common goals and strategies, performance indicators and thresholds, and key aspects specific to the New Zealand context. The process for developing a new framework involved identifying assessment categories, evaluating how they were considered across the four international rating tools and determining their relevance to the New Zealand neighbourhood context. Each category contains a set of specific assessment criteria which impact the environmental sustainability of that development either at the block or neighbourhood scale. Collectively, this research has developed a new framework for environmental sustainability focused POE assessment at the neighbourhood and block scale, relevant to the New Zealand statutory context. Figure 2 summarises the POE framework developed in this research.

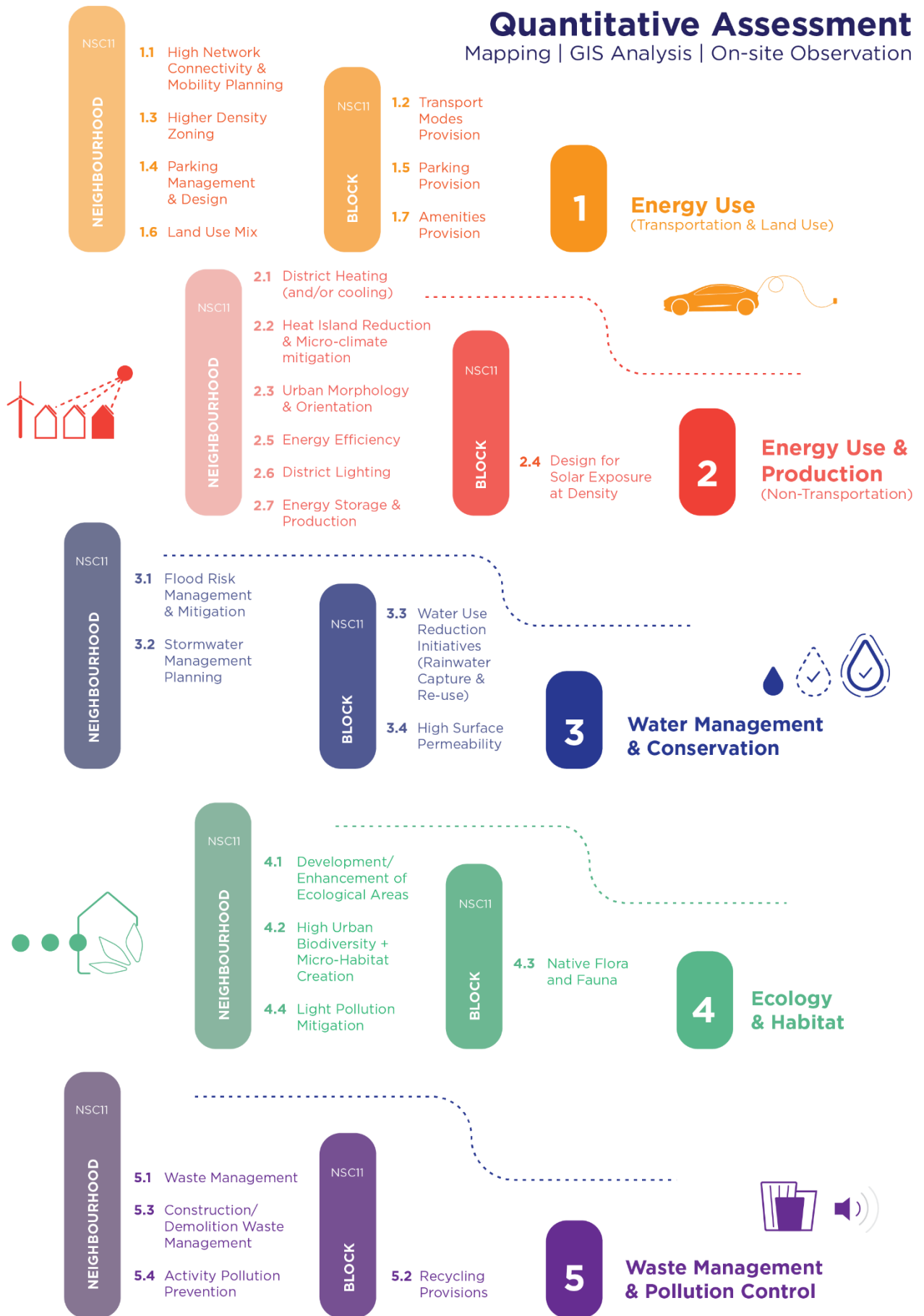


Figure 2. Summary of the POE framework for the analysis of neighbourhood developments in New Zealand.

For each category of environmental sustainability, performance criteria are set out with a series set of questions on sustainability outcomes for either the neighbourhood or block scale. These questions were developed through the synthesis of criteria from the four reference assessment tools, and re-crafted to easily incorporate into this POE tool for New Zealand.

Table 1 shows the assessment criteria questions by category and scale for this new POE framework.

Table 1. POE framework by assessment category and questions related to each criteria and scale.

CATEGORY	CRITERIA	
	NEIGHBOURHOOD SCALE	BLOCK SCALE
1. ENERGY USE (TRANSPORTATION & LAND USE)	1.1 High Network Connectivity and Mobility Planning	1.2 Transport Modes Provision
	1.1.1 Does the development have a mobility strategy?	1.2.1 Does the footpath network support safe, continuous pedestrian journeys, and meet or exceed design standard NZS 4404:2010?
	1.1.2 Are there provisions made in the neighbourhood to connect the project to an existing or planned city-wide/regional bus network?	1.2.2 Are less than 20% of the block lengths of the circulation network interrupted by vehicle crossings?
	1.1.3 Does the neighbourhood have a cycling strategy?	1.2.3 What is the ratio of continuous bicycle infrastructure to sections interrupted by vehicle crossings?
	1.1.4 Are there provisions made in the neighbourhood to connect the project to an existing or planned city-wide/regional cycle-network?	
	1.1.5 Does the development have a strategy for pedestrian movement, including an identified pedestrian network?	
	1.3 Higher Density Zoning	
	1.3.1 Did the development have density targets?	1.3.6 What ratio of doors and windows are set back no more than 7.5m from the street edge?
	1.3.2 How do these targets relate to the city-wide and national targets?	
	1.3.3 Did these targets include calculations about the environmental capacity of the neighbourhood?	
1.3.4 What is the built density ratio compared to the proposed density ratio?		
1.3.5 What percentage of properties have ground floor activation provision?		
1.4 Parking Management & Design	1.5 Parking Provision	
1.4.1 Do car parks comprise more than 20% of the total development footprint area?	1.5.1 What is the average number of designated parking spaces per unit?	
1.4.2 Are any individual surface parking lots larger than 0.8 hectares?	1.5.2 What ratio of the car parks are on building frontages versus off-street	

	1.4.3 What is the ratio of car parking provisions to cycling, walking and public transport provisions?	surface parking lots at the side or rear?
	1.6 Land Use Mix	1.7 Amenities Provision
	1.6.1 What is the distribution of urban amenities categories across the neighbourhood?	1.7.1 What is the ratio of urban amenities categories to houses?
2. ENERGY USE & PRODUCTION (NON-TRANSPORTATION)	2.1 District Heating (and/or Cooling)	
	2.1.1 Is there a plan for a district heating or cooling system, which includes the distribution network and connections to the dwellings?	2.1.2 Is there a response at the block scale to provide district heating and or cooling solutions?
	2.2 Heat Island Reduction and Micro-climate Mitigation	
	2.2.1 Is there a strategy for heat island reduction and micro-climate mitigation across the neighbourhood?	2.2.2 Does at least 50% of the total project site area, in plan view, comprise building or landscaping elements that reduce the impact of the heat island effect?
	2.3 Urban Morphology and Orientation	
	2.3.1 Was there a strategy for a climate-sensitive design across the neighbourhood?	2.4 Design for Solar Exposure at Density
	2.4.1 Are 75% or more of the blocks within the neighbourhood aligned at ± 15 degrees of geographical east-west, and the east-west length?	
	2.5 Energy Efficiency	
	2.5.1 Were energy efficiency standards set for across the neighbourhood that will result in at least a reduction in carbon dioxide emissions?	2.5.2 Are the projects minimum Homestar 6 or Passive House certified to encourage energy efficiency within each development?
	2.6 District Lighting	
	2.6.1 Is there a strategy for reducing energy requirements for lighting? (e.g. through the use of LEDs)	
2.7 Energy Storage and Production		
2.7.1 Is there provision in the masterplan for PV, micro-hydro, micro-wind turbines or biomasses across the neighbourhood?	2.7.3 Are the connections available at the block scale for increased local energy production?	
2.7.2 Is there an agreement for the neighbourhood to be net positive?		
3. WATER MANAGEMENT AND CONSERVATION	3.1 Flood Risk Management and Mitigation	N/A
	3.1.1 What are the overland flowpaths and what mitigation strategies have been employed?	N/A
	3.2 Stormwater Management Planning	3.3 Water Use Reduction Initiatives (Rainwater Capture & Re-use)
	3.2.1 Have Water Sensitive Urban Design (WSUD) principles been applied at the site?	3.3.1 Is there a resource or building consent requirement for water tanks and water reuse?

	3.2.2 Was there a stormwater management plan developed for the neighbourhood?	
		3.4 High Surface Permeability
		3.4.1 What materials and strategies have been used at the block scale to ensure surface permeability? 3.4.2 What is the average surface permeability across the block?
4. ECOLOGY & HABITAT	4.1 Development/Enhancement of Ecological Areas	N/A
	4.1.1 Was an ecological impact assessment (EclA) undertaken at the site? Does the development have an ecological management plan?	N/A
	4.2 High Urban Biodiversity + Micro-Habitat Creation	4.3 Native Flora and Fauna
	4.2.1 What types of ecological environments are integrated into the planning? 4.2.2 Does the development have a native flora and fauna management plan? 4.2.3 Is there a framework with mitigation targets/ or offsetting scheme for disruption of habitat?	4.3.1 Has a native flora and fauna strategy for the neighbourhood been implemented at the block scale?
	4.4 Light Pollution Mitigation	
	4.4.1 Have light pollution mitigation measures been undertaken?	4.4.2 Has lighting at the block scale been designed to reduce light pollution?
5. WASTE MANAGEMENT AND POLLUTION CONTROL	5.1 Waste Management	5.2 Recycling Provisions
	5.1.1 Have Council recycling requirements been exceeded? If so, how?	5.2.1 Have a variety of recycling methods, in excess of Council requirements, been facilitated at the block scale?
	5.3 Construction / Demolition Waste Management	N/A
	5.3.1 Is there a construction/demolition waste management plan?	N/A
	5.4 Activity Pollution Prevention	N/A
	5.4.1 Was an erosion and sediment control plan implemented and complied with across the neighbourhood/for the block? If there were compliance breaches, what were the mitigation measures or adverse effects?	N/A

A case study of the Hobsonville Point neighbourhood in Auckland was used to test this POE framework. This case study presents a unique opportunity to apply a sustainability-oriented POE framework. Hobsonville Point is the largest master-planned residential

‘greenfield’ development in New Zealand (Figure 3). The 167-hectare development site is located 25 km north-west of Auckland’s city centre. As a former New Zealand Defence Force base, the site was predominantly Crown-owned; it was made available for urban development in 2002. Homes. Land. Community. (HLC), a government agency wholly owned by Housing New Zealand, was purposefully established to lead the development, with the original aim to provide 3,000 new dwellings.¹ In a New Zealand first for a development of this scale, a Sustainable Development Framework (SDF) set out aspirational goals, objectives and indicators for achieving sustainability, which will be discussed further in Section **Error! Reference source not found.** The Hobsonville Point precinct was divided into sub-precincts and further divided into ‘superlots’ that were constructed in stages (Figure 4 & Figure 5). More information on the planning and design of Hobsonville Point can be found in Haarhoff, Allen, Austin, Beattie, & Boarin, 2019.



Figure 3. Hobsonville Point (indicated in red) in relation to Auckland Central and the main neighbourhoods, the motorway network (blue lines) and the ferry service (orange dashed line) (Haarhoff et al., 2019).

¹ HLC was originally known as Hobsonville Land Company, but was rebranded in 2017 to be ‘Homes. Land. Community’ as the scope of their projects broadened beyond Hobsonville Point alone. HLC is a 100% subsidiary of Housing New Zealand and as of 01 October 2019 will become part of Kāinga Ora, the Urban Development Authority set up under the newly created Ministry of Housing and Urban Development.



Figure 4. Hobsonville Point illustrative Concept Plan (Hobsonville Land Company, 2017c).



Figure 5. Aerial view of Hobsonville Point development as of end of 2018 (source: photomerge based on Google Earth images).

A combination of qualitative and quantitative methodologies was used to collect information for the POE assessment; informal interviews, on-site observations, analysis of Resource Consent approved plans, decision reports and official documentation, either public or made available by HLC, such as Comprehensive Development Plans for each sub-precinct.

3. The “Sustainable Development Framework” for Hobsonville Point

In 2008, HLC developed a performance measurement and reporting framework to guide the development of Hobsonville Point and assess the outcomes on the long term. The “Sustainable Development Framework” (Hobsonville Land Company, 2015) was reviewed regularly since its establishment and reported against annually.

The framework was developed to fulfil and implement the strong vision around sustainability that characterised the new neighbourhood, focussing on how people could experience it and on the physical quality of the built environment and its multiple sustainability angles. At the same time, HLC’s intention was to develop a tool that could be robust and useful, but also feasible from a decision-making and implementation point of view so that the industry could easily use it in a long-term project such as Hobsonville Point. In fact, in conversations with staff at HLC it was highlighted that, in a rapidly changing national context in regards to the availability and usability of national sustainability tools (or the lack thereof) at the time of the development, the agency decided to opt for the definition of their own framework to define the aspirations and objectives of the project, to measure their success, to explore practical measures to fulfil the vision and to allow HLC to measure performances (Lietz, 2010, p. 3).

The HLC’s “Sustainable Development Framework” is based on the following vision statement:

‘To build a strong, vibrant community that sets new benchmarks for a quality and accessible urban development with an environmentally responsible focus’. (Hobsonville Land Company, 2015)

This vision is translated into a hierarchical structure (Figure 6) based on four sustainable development spheres, i.e. Environmental, Economic, Social and Cultural. Each sphere is further developed into several dimensions, each with objectives and indicators. Two types of indicators were defined (Lietz, 2010, p. 3):

- long term indicators, which measure desired outcomes (such as household energy consumption) and in some cases will be assessable only once the development will be completed, as post-occupancy evaluation;
- development indicators, which measure long-term outcomes (such as the restoration and enhancement of native habitat) that fulfil the developer’s vision.

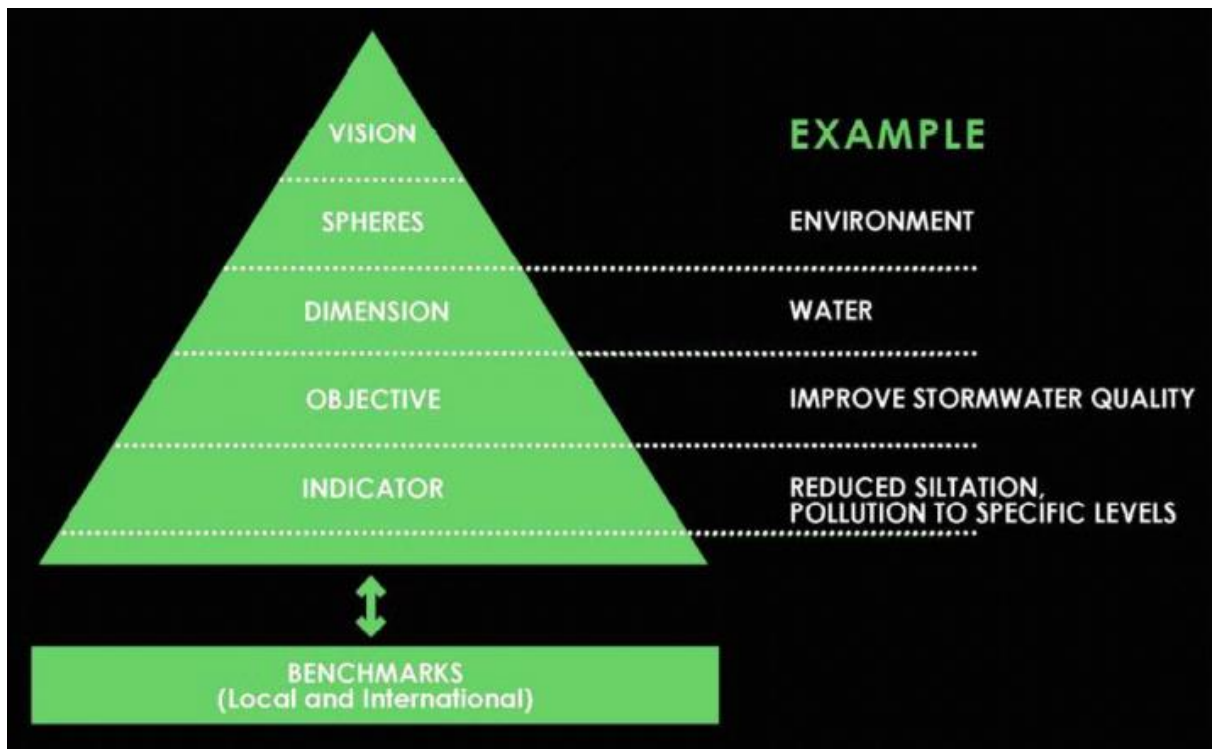


Figure 6. The HLC’s “Sustainable Development Framework” hierarchical approach (Hobsonville Land Company, 2015).

As this research is concerned with environmental sustainability only, the Environmental sphere is the most aligned with the scope of the POE framework. Some aspects included in the Economic sphere will be considered too, as transport initiatives are included under this category in the HLC’s “Sustainable Development Framework”.

The Environmental sphere is driven by the vision of a “development [that] must minimise its impact on the wider environment and enhance the natural systems of the site” (Hobsonville Land Company, 2015, p. 6) and underpins four aspirational goals:

- *the ecological health of the Hobsonville Point site and adjacent marine area is improved;*
 - *no carbon emissions from stationary energy use;*
 - *low impact water management throughout the development;*
 - *waste is minimised throughout the development.*
- (Hobsonville Land Company, 2015, p. 6)

Four dimensions are defined for the Environmental sphere, each one with objectives and indicators (Figure 7). These dimensions are:

- Ecology, focussed on maintaining and enhancing native habitat, retaining native vegetation, restoring the coastal edge to form a continuous green corridor and minimising contamination in stormwater runoff within the development;

- Energy, focussed on contributing to the fight to climate change and improving the long-term security of electricity supply, achieved through good design and use of modern technologies, with renewable energy forms utilised wherever possible;
- Water, focussed stormwater quality control and the minimisation of contamination of the Waitemata, achieved through stormwater management and reduced water consumption that will help reducing the need for water supply infrastructure upgrades and reduce the risk of overflows from the sewage network during heavy rain;
- Resource efficiency, focussed on minimising waste, achieved through the reuse of existing buildings and structures on the site and through construction waste reduction and management (reuse and/or recycle), including educational initiatives for residents to minimise household waste.

Sphere	Dimension	Objectives	Long term indicators	Development indicators
1. Environmental	Ecology	<ol style="list-style-type: none"> 1. Create an integrated natural habitat 2. Increase indigenous biodiversity 	<ol style="list-style-type: none"> 1. A continuous green corridor with native vegetation covering at least 10% of the site is retained/established. 2. Pre and post development native flora and fauna counts indicate that species diversity and abundance has increased in key areas. 	<p>Native habitat areas along the coastal corridor are maintained and enhanced. A management plan for the coastal area is completed that covers planting, weed and pest management strategies.</p> <p>Eco sourced native plants are used where native plants are planted in public areas.</p> <p>Local seed is collected and grown into plants for key revegetation species.</p> <p>Education/management programme in place while HLC on site.</p> <p>See "Water" for stormwater quality indicators.</p>
	Energy	<ol style="list-style-type: none"> 3. Reduce non-renewable energy use 4. Energy efficiency 	<ol style="list-style-type: none"> 3. Average household grid energy (reticulated gas and electricity) consumption is 6,500 kWh/year or less. 	<p>Houses built to a calculated BPI of 1.2 or lower for thermal performance and 5.5 Star HERS hot water rating or equivalent performance level.</p> <p>All properties have smart meters.</p> <p>At least 3 on site demonstration renewable generation projects.</p> <p>Education/management programme in place while HLC on site.</p>
	Water	<ol style="list-style-type: none"> 5. Reduce water consumption 6. Improve water quality 	<ol style="list-style-type: none"> 4. Average residential town supply water consumption is 100 litres or less per person per day. 	<p>All stormwater, except roof water, receives treatment before being discharged into the harbour.</p> <p>All houses have 6/3 litre, or less, dual flush toilets.</p> <p>3 Star or better water saving fixtures.</p> <p>Dwellings are served by rain tanks sized to supply 75% of water used in household toilets, laundries and gardens.</p> <p>No in-built irrigation will be provided in gardens.</p> <p>Education/management programme in place while HLC on site.</p>
	Resource efficiency	<ol style="list-style-type: none"> 7. Recycle and renew existing buildings and other infrastructure 8. Reduce off-site waste disposal 	<ol style="list-style-type: none"> 5. Mixed household waste collected is 100kg/person/year or less. 	<p>At least 20% of existing buildings will be retained and renovated or reused off site.</p> <p>The majority of construction and demolition waste is recycled.</p> <p>At least 3 public recycling bins are provided in public spaces.</p> <p>Education/management programme in place while HLC on site.</p>

Figure 7. Summary of dimensions, objectives and indicators for the Environmental sphere (Hobsonville Land Company, 2015, p. 6).

The dimension of 'Transport' is included in the Economic sphere and will be considered in this research as it has an impact on the environment too. The Economic sphere is driven by the vision of a "development [that] must enable the Hobsonville Point community to contribute to economic growth and improved productivity" (Hobsonville Land Company, 2015, p. 8) and underpins four dimensions, i.e. growth, employment, viability and transport. In regard to transport, aspirational goals refer to single occupancy car travels being minimised and public transport use increased. The dimension is focussed on providing good public transport and creating an environment where people can meet their day-to-day needs locally (Figure 8).

Sphere	Dimension	Objectives	Long term indicators	Development indicators
2. Economic	Growth	9. Contribute to Auckland's economic growth through development of business opportunities at Hobsonville Point 10. Accelerate the supply of homes, including affordable homes, into the Auckland market.	6. At least 80% of residents state that they have used a local shop, restaurant, café or service in the last week. 7. 80% of businesses indicate that their business has grown in the last 12 months. 8. One new home is delivered every working day.	6ha employment zone facilitated and serviced as part of Council land previously zoned for marine industry. Opportunities for local retail businesses established. Fibre to the premises installed. Education/management programme in place while HLC on site.
	Employment	11. Facilitate local employment.	9. At least 0.65 jobs per household are available at Hobsonville Point. 10. The percentage of residents in employment who work locally (North West Auckland) is measured.	At least 5% of premises on the spine road are suitable for conversion to commercial/mixed use. 5 ha is provided for mixed use development. Education/management programme in place while HLC on site.
	Viability	12. Optimise return on investment for the Crown. 13. Demonstrate the overall economic benefits of an integrated urban development approach 14. Demonstrate the impacts of an environmentally efficient development approach on household expenditure	11. Business case targets are met. <i>See Environmental sphere for indicators on electricity and water usage.</i>	Financial indicators agreed with Government are met. House performance and occupant perceptions are monitored to better understand the value of energy and water efficient houses.
	Transport	15. Minimise dependence on motor vehicles for daily activity	12. 50% or more households have one vehicle or less. 13. 40% or fewer workers travel to work by driving themselves. 14. Mode share of resident trips is monitored through the resident survey and targets are set by 2015 and achieved by 2021.	75% of dwellings are within 400m walking distance of a bus stop and all are within 800m. 75% of dwellings are within 800m walking distance of areas zoned for <ul style="list-style-type: none"> convenience store, community facility, early childhood education. 75% of dwellings are within 1200m walking distance of the primary school. 75% of dwellings are within 1600m walking distance of the secondary school. Bike and car share schemes are established. Shared off-road pedestrian and cycle paths on Hobsonville Point Road and Squadron Drive. On-road cycle lanes on Hobsonville Point Road. Education/management programme in place while HLC on site.

Figure 8. Summary of dimensions, objectives and indicators for the Economic sphere (Hobsonville Land Company, 2015, p. 9). Only the 'Transport' dimension is of interest for this research.

Some environmental sustainability considerations are also included in the Cultural sphere. The sphere is driven by the vision of a “development [that] must allow people to celebrate their own cultural heritage, while also enabling residents to share values, beliefs, customs, behaviours, identity and a sense of place and community” (Hobsonville Land Company, 2015, p. 12) and underpins four dimensions, i.e. Sense of Place ‘Turangawaewae’, Custodianship ‘Kaitiakitanga’, Heritage and Cultural Life. Aspirational goals refer to acknowledging and respecting people’s cultural heritage, have a sense of belonging, respecting and caring for the natural environment and participate in social and cultural activities. The Custodianship ‘Kaitiakitanga’ dimension contributes to the achievement of the overall environmental sustainability strategy though promoting social responsibility among residents and working in partnership with local iwi, Ngāti Whātua o Kaipara and Te Kawerau ā Maki to safeguarding the natural values of the site. These objectives and indicators are not assessed in this research as it is concerned with natural and built environment environmental sustainability, but they are acknowledged and commended as part of a comprehensive strategy.

4. Results of the Post-Occupancy Evaluation on Hobsonville Point, Auckland

This section presents the results of the POE on the Hobsonville Point case study. It is structured according to the assessment categories of the POE framework (Figure 2) and according to the questions in Table 1. As per the two-scale approach of the POE Framework, the whole neighbourhood development was analysed, as well as a sample of two blocks in the Buckley sub-precinct (blocks 23 and 25) and two in the Sunderland sub-precinct (blocks SB2 and SB3). These blocks were considered representative of the overall environmental sustainability strategy implemented at Hobsonville Point, and these blocks were completed at the time of this research (Figure 9 and Figure 10).



Figure 9. Hobsonville Point and blocks selected for the analyses (base map from Google Earth, 2018).

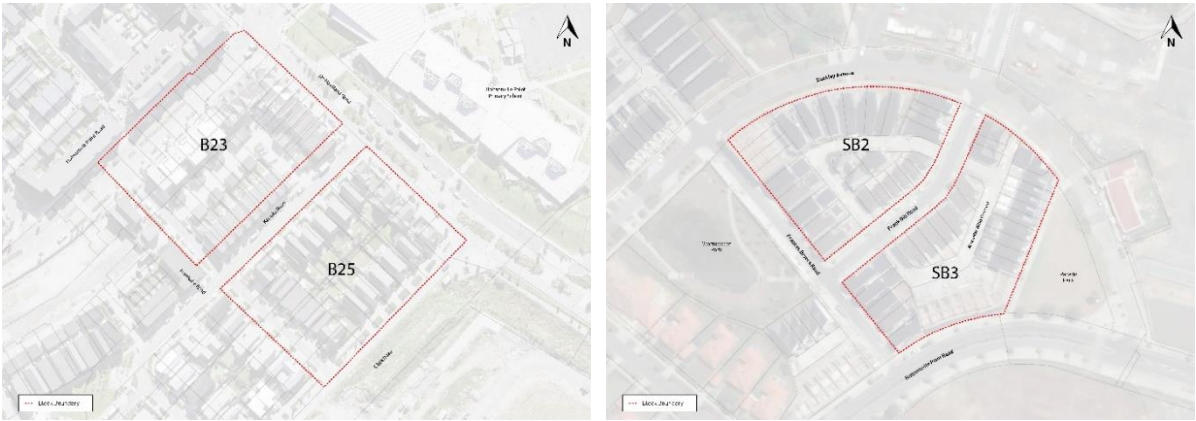


Figure 10. Boundaries of the case study blocks in Buckley-A (left) and in Sunderland (right).

4.1. Energy Use (Transportation & Land Use)

4.1.1. Hobsonville Point Sustainable Development Indicators

The SDF for Hobsonville Point acknowledges that transport is the “largest user of energy in Auckland [...] and is arguably the most pressing environmental, economic and social issue for urban development” (Hobsonville Land Company, 2015). It outlines an aspirational goal that “single occupancy car travel is minimised and public transport use increases” (Hobsonville Land Company, 2015). Objectives and indicators related to Energy Use (Transportation & Land Use) fall under the Economic sphere of the SDF, as shown in Figure 11.

Sphere	Dimension	Objectives	Long term indicators	Development indicators
2. Economic	Growth	9. Contribute to Auckland’s economic growth through development of business opportunities at Hobsonville Point 10. Accelerate the supply of homes, including affordable homes, into the Auckland market.	6. At least 80% of residents state that they have used a local shop, restaurant, café or service in the last week. 7. 80% of businesses indicate that their business has grown in the last 12 months. 8. One new home is delivered every working day.	6ha employment zone facilitated and serviced as part of Council land previously zoned for marine industry. Opportunities for local retail businesses established. Fibre to the premises installed. Education/management programme in place while HLC on site.
	Employment	11. Facilitate local employment.	9. At least 0.65 jobs per household are available at Hobsonville Point. 10. The percentage of residents in employment who work locally (North West Auckland) is measured.	At least 5% of premises on the spine road are suitable for conversion to commercial/mixed use. 5 ha is provided for mixed use development. Education/management programme in place while HLC on site.
	Viability	12. Optimise return on investment for the Crown. 13. Demonstrate the overall economic benefits of an integrated urban development approach 14. Demonstrate the impacts of an environmentally efficient development approach on household expenditure	11. Business case targets are met. See <i>Environmental sphere for indicators on electricity and water usage.</i>	Financial indicators agreed with Government are met. House performance and occupant perceptions are monitored to better understand the value of energy and water efficient houses.
	Transport	15. Minimise dependence on motor vehicles for daily activity	12. 50% or more households have one vehicle or less. 13. 40% or fewer workers travel to work by driving themselves. 14. Mode share of resident trips is monitored through the resident survey and targets are set by 2015 and achieved by 2021.	75% of dwellings are within 400m walking distance of a bus stop and all are within 800m. 75% of dwellings are within 800m walking distance of areas zoned for <ul style="list-style-type: none"> convenience store, community facility, early childhood education. 75% of dwellings are within 1200m walking distance of the primary school. 75% of dwellings are within 1600m walking distance of the secondary school. Bike and car share schemes are established. Shared off-road pedestrian and cycle paths on Hobsonville Point Road and Squadron Drive. On-road cycle lanes on Hobsonville Point Road. Education/management programme in place while HLC on site.

Figure 11. Transport strategy as per HLC’s SDF (Hobsonville Land Company, 2015, p. 9).

4.1.2. Assessment against POE framework

1. Energy Use (Transportation & Land Use)
NEIGHBOURHOOD SCALE
1.1 High Network Connectivity and Mobility Planning
1.1.1 Does the development have a mobility strategy?

In the early stages of development, a tripartite agreement between Waitākere City Council (WCC), HLC and the Auckland Regional Transport Authority (ARTA) established an agreement for providing a baseline level of service for transportation in and around Hobsonville Point. However, there was no integrated spatial plan or strategy to manage the delivery of transport services thereafter. This situation was not helped by the amalgamation of local government in 2010, to form Auckland Council. With two of the three parties to the

agreement no longer in existence, in hindsight it looks like the details of this agreement were largely forgotten.

While the Hobsonville Point development did not have a robust mobility strategy, SDF provides guidance for maximum walking distances (and percentage of provision) to key amenities, targets for bike- and car-share schemes, shared off-road pedestrian and cycle paths on primary roads and on-road cycle lanes on Hobsonville Point Road (Figure 12). In the long-term, the SDF sought to minimise household car ownership, commuter car travel and car mode-share of trips made by residents (Figure 13).

75% of dwellings are within 400m walking distance of a bus stop and all are within 800m.	Over 80% of existing and planned dwellings are within 400m and 98% are within 800m of a bus stop serviced by an existing route.
75% of dwellings are within 800m walking distance of: Convenience store Community facility Early childhood education	Over 80% of dwellings that are completed or under construction are within 800m of a Convenience Store or supermarket. Additional neighbourhood retail nodes are planned in future precincts which will increase access further. Over 80% of dwellings that are completed or under construction are within 800m of the Early Learning Centre Just fewer than 50% of all planned homes are within 800m of the Sunderland Lounge (hall) and/or the Headquarters Building (community house). The adjacent Scott Point Park will add additional recreational and community spaces.
75% of dwellings are within 1200m walking distance of the primary school.	Over 85% of completed and planned dwellings at Hobsonville Point are within 1200m of Hobsonville Point Primary School.

Figure 12. Performance against development indicators for Economic sustainability, related to transport (Hobsonville Land Company, 2019, p. 18).

Long Term Indicators	Target	Results				Comment
		2014/15	2015/16	2016/17	2017/18	
Households with one vehicle or less.	50% or more	Not yet measured	29%	Not measured	34%	Measured via Beacon Residents' Survey in 2017/18. Up by 5% since 2015/16, but 16% off the 2026 target.
Workers who travel to work by driving themselves.	40% or less	79%	44% of residents travel to work or study by driving themselves.	Not measured	47% of residents travel to work or study by driving themselves.	Measured via Beacon Residents' Survey in 2017/18. Up by 3% since 2015/16 survey.

Figure 13. Progression in achieving long-term indicators related to using and commuting with private cars (graphic elaboration based on Hobsonville Land Company, 2019, p. 17).

Informed by the SDF, the Comprehensive Development Plan for Buckley (Hobsonville Land Company, 2009), for example, provided a detailed Movement strategy for the development (Figure 14). The CDP highlighted key motorway links, primary roads, bus routes, designated cycleways and key walking catchments relative to the development area.

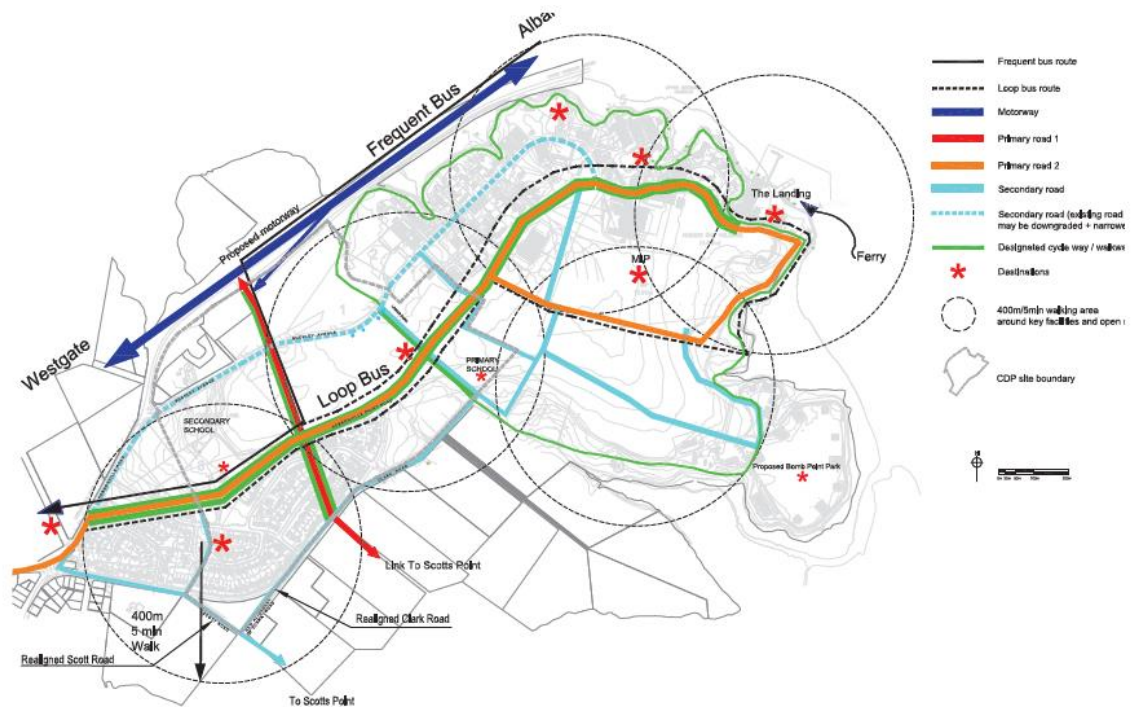


Figure 14: Movement strategy for Hobsonville Point from Buckley CDP (Hobsonville Land Company, 2009).

The following sections of this evaluation will specify how bus, ferry, cycling and pedestrian mobility were provided for in Hobsonville Point. At the time of this research, transport provisions in Hobsonville Point include (Figure 15):

- three bus routes;
- one ferry route to city centre;
- two car sharing stations, with a total of 2 cars;
- two bike sharing stations, with a total of 8 bikes;
- a number of scooter stations;
- designated pedestrian paths;
- designated cycle lanes;
- shared off-road pedestrian and cycle paths.

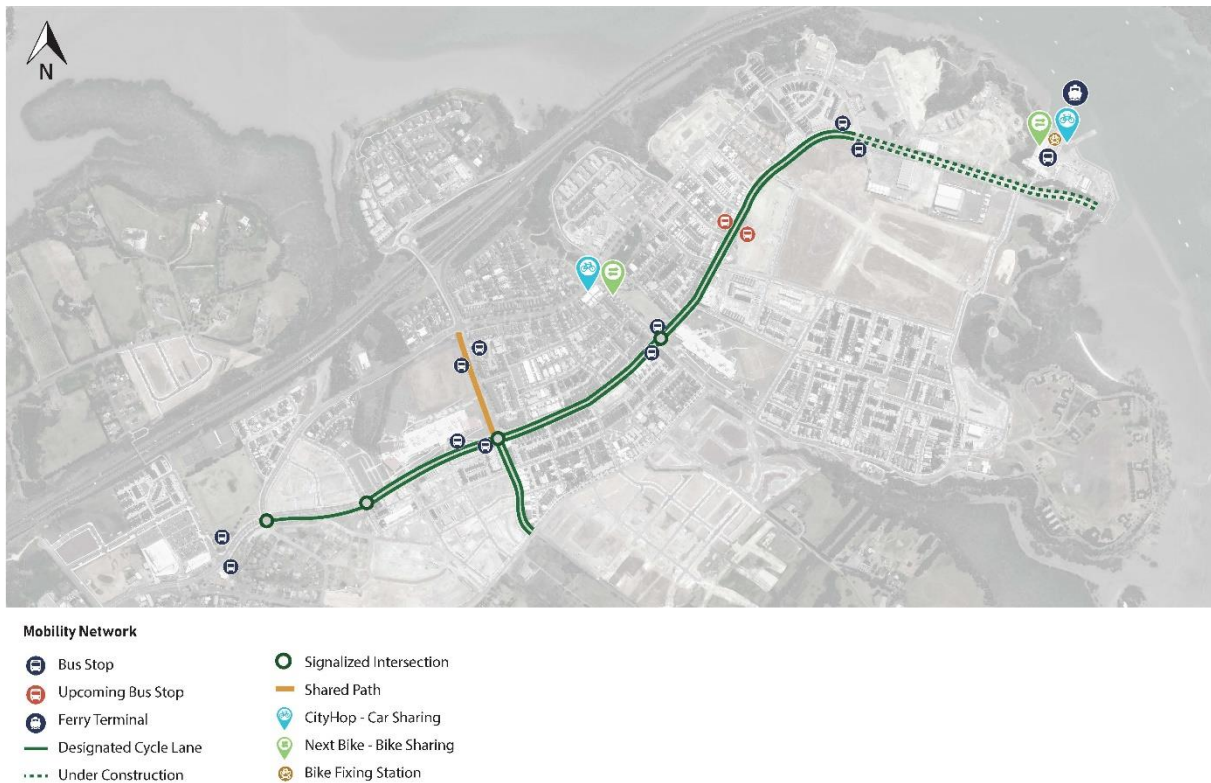


Figure 15. Integrated mobility approach for Hobsonville Point.

Mobility provision for Hobsonville Point could have been improved with a comprehensive mobility strategy. This would have supported the delivery of a coordinated multi-modal network with good connections to surrounding transport networks (bus/ferry/cycle), and appropriate staged delivery in sync with the development process. Aside from the CDP high-level movement strategy, Hobsonville Point poorly delivered on mobility – namely, public transport and regional network connections for cycling. In lieu of a clear strategy, often a champion on the Local Board or within Auckland Transport is required to deliver non-statutory development outcomes. Unfortunately, Hobsonville Point lacked such a champion and the provision of public transport services and regional cycling connections was not executed well. In interviews, HLC staff reflected on the challenges that arose when residents began to occupy the first dwellings but the new bus and ferry routes (and stops) were not in place – an unfortunate consequence of not having a mobility strategy.

The SDF objectives and long-term indicators for transport took a particular focus on reducing car dependency, car ownership and reducing single-occupancy commuter car trips, and, the transport-related development indicators were primarily focused on localised elements of mobility. In the wider context of mobility and the SDF goals, the development indicators failed to include targets for the complete range of alternatives to car travel, such as public transport (bus and ferry) and cycle network connectivity, that would help deliver on the main objective. Public transport and interregional network connectivity are critical elements of sustainable transport planning, along with walking and cycling.

Beacon Residents Survey results demonstrate that the SDF objective to reduce car dependence in Hobsonville Point has not been achieved to date. Households with one vehicle or less number 34%, as opposed to the targeted 50%, and the percentage of commuters using privately owned cars is 47%, as opposed to the targeted <40% (Hobsonville Land Company, 2019, p. 17). With both measures, there has been a substantial improvement over just a few years and there is still time to improve up to the 2026 target timeframe.

1. Energy Use (Transportation & Land Use)
NEIGHBOURHOOD SCALE
1.1 High Network Connectivity and Mobility Planning
1.1.2 Are there provisions made in the neighbourhood to connect the project to an existing or planned city-wide/regional bus network?

Pre-development, the Hobsonville Point area was serviced by infrequent public bus services. As discussed for item 1.1.1, there was no mobility strategy or clear plan for public transport provision. At a high-level, the Buckley CDP movement plan indicated a bus ‘loop’ within Hobsonville Point, and a frequent service between Albany and Westgate (Figure 14).

Over time, Auckland Transport has developed new, improved routes to service Hobsonville Point which were delivered independently of HLC’s CDP movement plan for the neighbourhood. At the time of this research, the Hobsonville Point neighbourhood is served by three public bus routes (Figure 16 and Table 2).

Table 2. Summary of bus services for Hobsonville Point (Auckland Transport, 2019). Note: at Westgate, there are additional connections to over 10 services in the wider region by network, destinations including Albany, Massey, Henderson, New Lynn and the City Centre via the NW motorway.

ROUTE NUMBER	CONNECTIONS	FREQUENCY (WEEKDAY)	FREQUENCY (WEEKEND)
120	Henderson to Constellation Station via Westgate and Hobsonville Road	30 mins	30 mins
112	Westgate and the Hobsonville Ferry terminal, main route through West Harbour & Hobsonville	30 mins	30 mins
114	Whenuapai to Westgate and Hobsonville Point, including the Hobsonville Ferry terminal	Variable at peak (20-45 mins) or hourly	Hourly

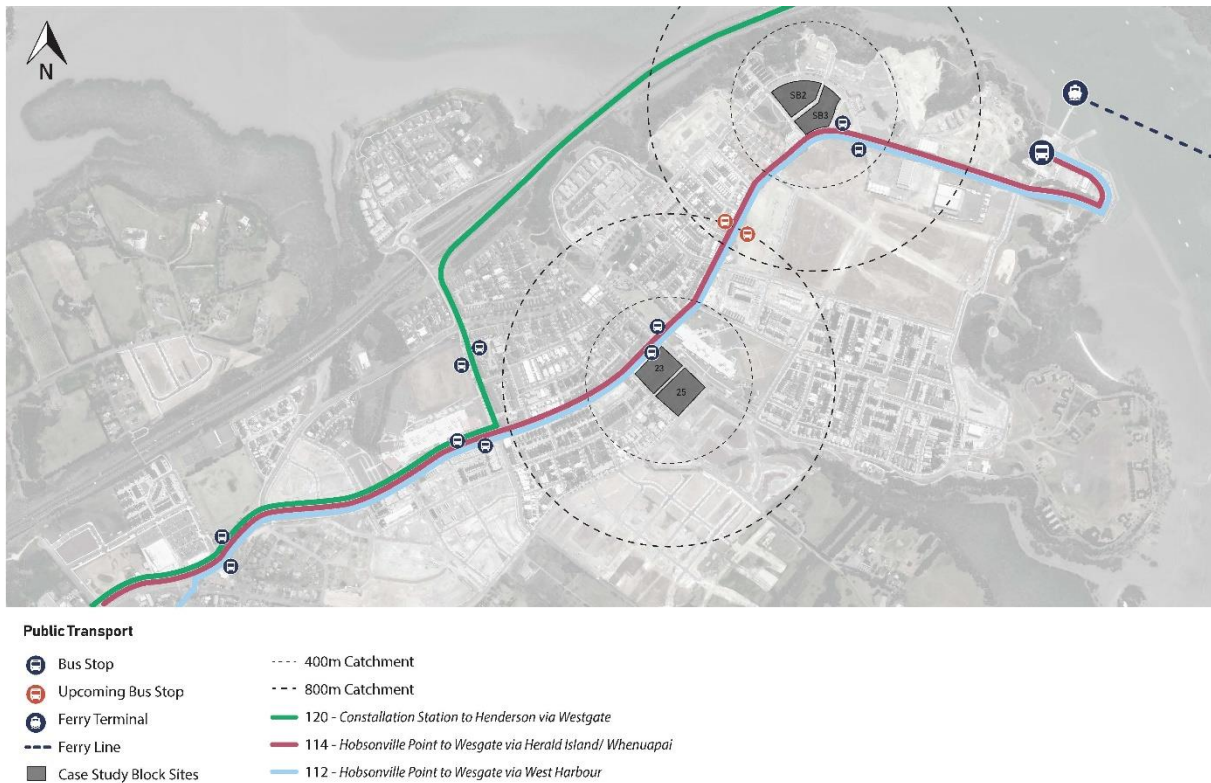


Figure 16. Public transport services in Hobsonville Point and distances from case study blocks.

The SDF development indicators (Figure 13) and CDP provisions (Figure 14) for Hobsonville Point have delivered a neighbourhood urban form where the majority of residents are within convenient walking distance (5-10 min) of a bus stop. HLC's Annual Sustainability Report 2017/18 found that over 80% of completed and planned dwellings were within 400m (5 min walk) of a bus stop, and 98% within 800m (10 min walk) of a bus stop, which exceeds the SDF target for transport. Figure 17 to Figure 21 show the evolution in meeting the target as reported in the available Annual Sustainability Reports. There are variations in the actual measured achievement per year, but this is related to the rapidly evolving construction process in Hobsonville Point. In all cases the threshold was exceeded.

75% of dwellings are within 400m walking distance of a bus stop and all are within 800m.

85% of dwellings within 400m, 100% within 800m of a bus stop in Comprehensive Development Plan area.
In the first stage all homes are within 400m of the temporary bus stop on Buckley Avenue.

Figure 17. 2011/12 results (Hobsonville Land Company, 2013, p. 10).

75% of dwellings are within 400m walking distance of a bus stop and all are within 800m.

85% of dwellings within 400m, 100% within 800m of a bus stop in Buckley A Comprehensive Development Plan area.

Figure 18. 2012/2013 results (Hobsonville Land Company, 2014, p. 10).

75% of dwellings are within 400m walking distance of a bus stop and all are within 800m.	78% of existing and planned dwellings are within 400m and 98% are within 800m of a bus stop serviced by an existing route. Additional routes are planned which will bring all homes within 800m of a bus stop. Only 3 completed houses are more than 400m from an existing bus stop.
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Figure 19. 2014/2015 results (Hobsonville Land Company, 2016, p. 10).

75% of dwellings are within 400m walking distance of a bus stop and all are within 800m.	78% of existing and planned dwellings are within 400m and 98% are within 800m of a bus stop serviced by an existing route. Additional routes are planned which will bring all homes within 800m of a bus stop.
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Figure 20. 2015/2016 results (Hobsonville Land Company, 2017a, p. 10).

75% of dwellings are within 400m walking distance of a bus stop and all are within 800m.	Over 78% of existing and planned dwellings are within 400m and 98% are within 800m of a bus stop serviced by an existing route. Additional routes are planned which will bring all homes within 800m of a bus stop.
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Figure 21. 2016/2017 results (Hobsonville Land Company, 2018, p. 10).

75% of dwellings are within 400m walking distance of a bus stop and all are within 800m.	Over 80% of existing and planned dwellings are within 400m and 98% are within 800m of a bus stop serviced by an existing route.
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Figure 22. 2017/2018 results (Hobsonville Land Company, 2019, p. 18).

Hobsonville Point has a unique coastal context and a public ferry service to the city centre has become a key element of the public transport offering for the neighbourhood. The ferry service is not mentioned into the transport dimension of the SDF. However, it has been quite a notable drawcard for residents who work in the city centre. The public ferry service supports sustainable transport outcomes and lower car commuting statistics in Hobsonville, as compared to the rest of Auckland (Bijoux, 2013). Similar to bus services, there was no key strategy for implementing the ferry service. There were challenges coordinating between Auckland Transport and HLC to establish this service. Subsequently, issues arose regarding service frequency and capacity and how the ferry could meet demand from residents as dwellings were occupied in stages.

Public transport offers a sustainable alternative to private car travel as it is significantly more energy efficient. In order to achieve the most sustainable outcome, public transport needs to be a reliable, affordable and convenient service that is a thoroughly attractive alternative to private car travel. In the case of Hobsonville Point, poor planning around public transport provision and poor coordination of public transport with housing delivery has limited the ‘pull’ toward public transport patronage over car use. In focus group discussions with Hobsonville Point residents, some remarked that the public transport service was not good enough “so people feel they need to drive” (Haarhoff et al., 2019). Another factor that has limited the service capacity and uptake of public transport is the lack of employment density in Hobsonville Point: employment was planned for in the early stages of the development (around 3,000 jobs), but it has not been delivered on the ground.

1. Energy Use (Transportation & Land Use)
NEIGHBOURHOOD SCALE
1.1 High Network Connectivity and Mobility Planning
1.1.3 Does the neighbourhood have a cycling strategy?

The neighbourhood doesn't have a separate cycling strategy, however the SDF set out goals to support cycling through dedicated development indicators (Hobsonville Land Company, 2015, p. 9):

- bike and car share schemes are established;
- shared off-road pedestrian and cycle paths on Hobsonville road and squadron drive;
- on-road cycle lanes on Hobsonville point road.

The sustainable transport objective to minimise dependence on cars for daily activities (Figure 12) is supported by these provisions for cycling. The Buckley CDP movement plan (Figure 14) demonstrates the proposed cycle routes along Hobsonville Point Road, Squadron Drive and an off-road shared path around the coastal walkway (Figure 23). Figure 23 also demonstrates the completed cycling network at the time of writing.



Figure 23. Designated cycling network.

The 5km Coastal Walkway is heavily used for both walking and cycling and provides a high-quality recreational space for the neighbourhood. Paired with precinct development, sections of these cycle routes were delivered section by section. This delivery model has its weaknesses because it means that continuous dedicated cycling facilities were not available

for residents from when they moved in. For example, at the time of writing separated cycle facilities were not yet complete along both sides of Hobsonville Point Road (around Launch Bay and Catalina Precincts).

A bike share service is available on site in two different locations, one at the ferry terminal and the other close to the centre of the neighbourhood, offering a total of eight shared bikes for Hobsonville Point (Figure 23). A bike fixing station with tools is available at the Ferry terminal, too. While this technically meets the SDF target, eight shared bikes are a meagre contribution to sustainable transport provision for a community of over 5,000 people. Targets for development frameworks should be specific and relevant: in this case, the bike share target was vague and thus lacked ‘teeth’ to really deliver sustainable transport outcomes for Hobsonville Point. A bike share programme with bike share capacity for the entire community could have a tangible impact on cycling mode share for daily trips and support the SDF objective to reduce car dependency.

A strength of the arterial spine of cycling infrastructure at Hobsonville Point is how it supports access to key community amenities, such as shops, public transport and schools. Some improvements could be made to improve safety for cyclists accessing these services and amenities once off the designated cycle lanes in Squadron Drive and Hobsonville Point Road. Also, there is limited provision of cycle parking infrastructure at the ferry terminal to match the anticipated or idealised uptake of cycling for daily trips as alternatives to car trips. Facilities like this would also support multi-modal journeys with both public transport and active transport, further enhancing the sustainable transport choices for Hobsonville Point residents.

An ‘infrastructure first’ cycling strategy that delivers a complete network prior to occupation would have improved cycling uptake among new residents from day one. This approach supports sustainable transport choices and minimises dependence on the private car for daily trips. Some noticeable weaknesses are:

- more attention to developing dedicated on-road cycle paths could have been given to areas around schools and shopping areas;
- continuity of cycle paths not guaranteed on main streets and shopping areas;
- not many bicycle racks are available close to the ferry, thus not encouraging a more sustainable mobility strategy from commuters;
- beyond the two spine roads, moving in the backstreets around the neighbourhood with a bicycle is often difficult because of the small width of the street and because of the many cars parked on-street, making cycling often unsafe.

Another critique of the cycling infrastructure delivered at Hobsonville Point relates to safety. The designated cycle lanes provide space for cyclists, however the separation from traffic is only a painted line on the road. For its time, this cycling infrastructure was considered advanced, good practice for New Zealand urban development. Many greenfield subdivisions of this scale don’t even provide cycling infrastructure. However, for future developments, safer segregated cycleways with physical barriers between cycle lanes and vehicle lanes would

be preferable on arterial routes. Local streets should be designed for low speeds to support safety for cars and cyclists on the road.

Despite the highlighted downsides, from on-site observations and conversations with staff at HLC, it is clear that cycling is considered a positive feature of Hobsonville Point. There is potential to extend cycling activity even further among residents by activating a larger scale mobility strategy, including integrated multi-modal commuting options.

1. Energy Use (Transportation & Land Use)
NEIGHBOURHOOD SCALE
1.1 High Network Connectivity and Mobility Planning
1.1.4 Are there provisions made in the neighbourhood to connect the project to an existing or planned city-wide/regional cycle-network?

The provisions for cycle infrastructure in this development were limited to within the Hobsonville Point precinct. Waitakere City Council previously had made a commitment to provide cycling infrastructure on Hobsonville Road and State Highway 18. However, following the local government amalgamation to form Auckland Council this commitment was misplaced, and only sections of this network have been delivered. There is a cycle connection from the Squadron Drive shared path north to a cycleway along State Highway 18 to the North Shore. However, there is no continuous cycle network connection to Westgate, the large regional commercial centre. From a change of Councils to the fact that inter-regional cycle connections were essentially out of scope (off site) and out of control of HLC, the failure in this provision is multi-faceted.

Local cycle infrastructure in Hobsonville Point provides a direct connection to the Hobsonville Ferry terminal. At the downtown terminal, there is good connectivity to inner city separated cycle infrastructure along Quay Street, Nelson Street and via Beach Road to the Grafton Gully cycleway. The Hobsonville Point ferry service allows passengers to take bikes on the ferry. This supports multi-modal journeys and trip-chaining, both of which support sustainable transport outcomes and a convenient and efficient alternative to car travel.

The effectiveness and utility of cycle infrastructure is critically linked to its position in the wider network, and the extent of this network. The more connected and extensive the network, the more people are likely to use it: this is called the ‘network effect’ (Nunns, 2014). Cycle infrastructure integrated into a quality network is more convenient, efficient, safe and attractive for users. While the Hobsonville Point development has limited regional connectivity to cycle networks, the wider network is also limited. Hence, the overall effect on cycle uptake and sustainable transport outcomes from being connected to this network is unlikely to be significant. Better integration between Auckland Transport and HLC could have supported co-delivery of a quality cycle network in and around Hobsonville Point.

1. Energy Use (Transportation & Land Use)
NEIGHBOURHOOD SCALE
1.1 High Network Connectivity and Mobility Planning
1.1.5 Does the development have a strategy for pedestrian movement, including an identified pedestrian network?

The SDF considers the pedestrian network connectivity to bus stops, schools and community amenities and services (Figure 12). Using indicative 5-minute and 10-minute ‘pedsheds’² for pedestrian movement (400m/800m radius), the SDF indicators form a basis for a pedestrian strategy. Sub-precinct Comprehensive Development Plans (CDP) gave further detail for pedestrian movement provisions, to give effect to the SDF and guide design for resource consent.

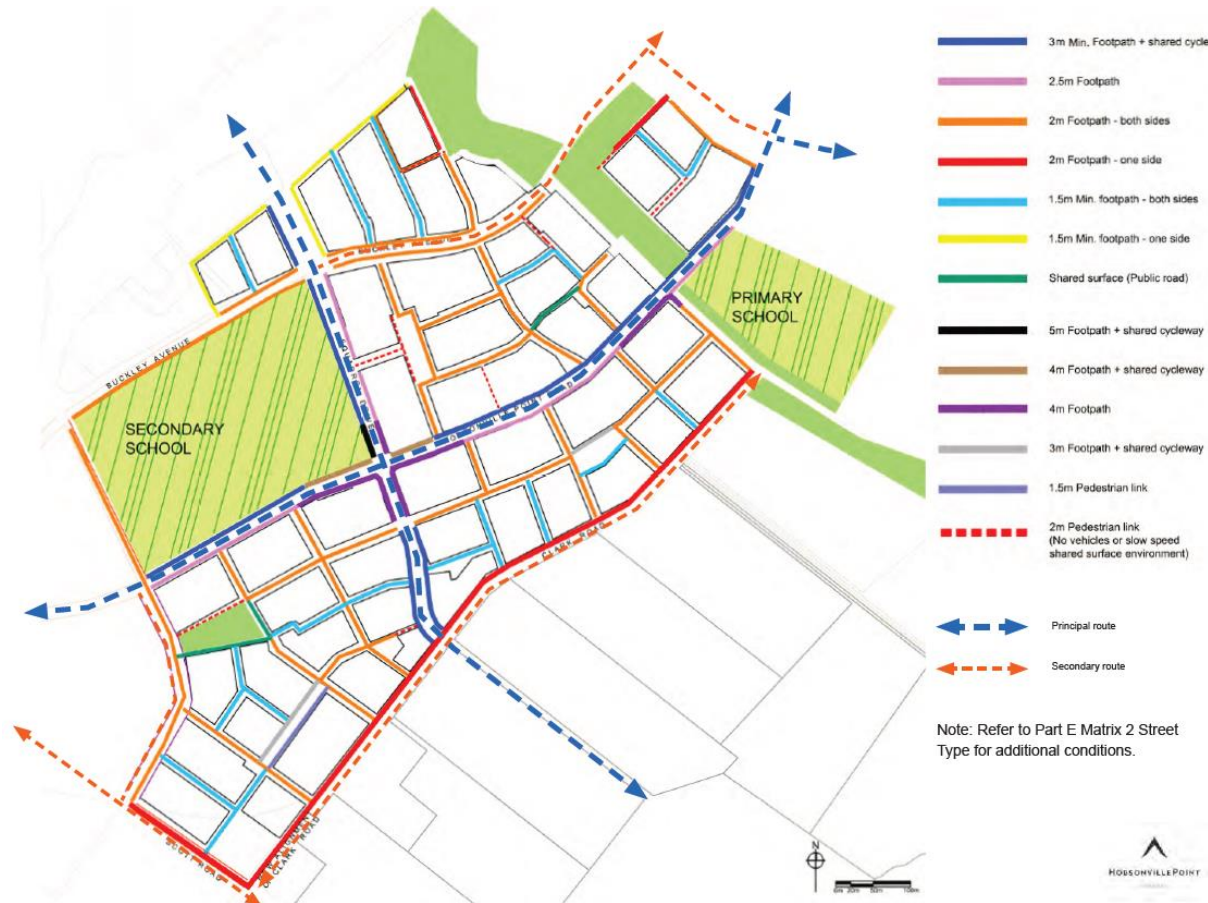


Figure 24: Footpath Network and Road Hierarchy Plan, Buckley CDP (Hobsonville Land Company, 2009).

The Movement plan (Figure 14) and Footpath Network plan (Figure 24) provided design guidance around the proposed pedestrian network, footpath width, location, typology and additional pedestrian links or shared paths for the neighbourhood. The CDP anticipated “short

² ‘Pedsheds’ are walkable catchments. They are usually represented by five- or ten-minute walking distances from a node, town centre, or key amenity.

blocks served by a pedestrian-friendly street network” (Hobsonville Land Company, 2009) and with specific design strategies for key character streets and a matrix of street types to guide design of other streets (Hobsonville Land Company, 2009). The matrix clearly establishes the speed limit, road classification and typology, street character and role, vehicle and cyclist provisions, footpath widths, street planting, furniture and lighting.

From on-site observations and conversations with staff at HLC, it is clear that residents enjoy the walkable nature of the neighbourhood. This is particularly evident in areas close to the schools, in the area of Catalina Bay and along the Coastal Walkway. Figure 25 illustrates the pedestrian network at Hobsonville Point.



Figure 25. Designated pedestrian network and integration with the Coastal Walkway.

While being a special character street, Hobsonville Point Road doesn’t appear to be used by pedestrians as much as anticipated. This could be due to the predominant residential character of the ground floor frontages: there are still few amenities and businesses facing the street which would provide ‘destinations’ and active frontages to attract pedestrians.

Besides the main pedestrian axes, all backstreets are equipped with footpaths on both sides, although these are continuously interrupted by vehicle access to private premises and garages. This might represent a potential safety risk in some of the blocks, also considering the low visibility produced by the concurrent presence of cars on-street and off-street. Another critical aspect is related to the position of the main supermarket. Although the HLC’s 2017/2018 Sustainability Report states that the indicator for the proximity of convenience stores or supermarkets is achieved, the position of the only supermarket in the very boundary

of the site to the West remains an arguable choice that doesn't allow everybody in the neighbourhood to access the supermarket at walkable distance.

The Coastal Walkway is definitely one of the highlights in the pedestrian strategy, intersecting with the amenity strategy for the neighbourhood. The "Hobsonville Point Coastal Walkway is a 5km walkway that forms a circuit around two thirds of the Hobsonville Point site and features opportunities for play, integrated art, resting places, and visual reminders of the area's history" (Hobsonville Land Company, 2017b, p. 1). The walkway is predominantly on flat land and is children and wheelchair friendly.

Overall, pedestrian facilities have been clearly thought about at Hobsonville Point and the neighbourhood has a quality, comprehensive pedestrian network (Figure 25). Walkability performance against the SDF measures well exceeded the targets in the 2017/18³ year, when most of the precinct developments were complete (Figure 26).

Long Term Indicators	Target	Results				Comment
	2026	2014/15	2015/16	2016/17	2017/18	2017/18
% of school children who bike/walk or catch public transport to school.	60% or more	Not surveyed	Not measured	Not surveyed	67% ⁹	10 % higher than average for Auckland, as measured by Healthy Auckland Together baseline report 2015.
% of residents who feel that the Hobsonville Point site is very/reasonably safe for pedestrians.	95% or more	Not surveyed	97%	Not surveyed	97%	Measured via Beacon Residents' Survey 2017/18.
% of cyclists who feel that cycling within the Hobsonville Point site is very/reasonably safe.	95% or more	Not surveyed	90%	Not surveyed	90% ¹⁰	Measured via Beacon Residents' Survey 2017/18.

Figure 26. Performance against development indicators in the Social dimension 2017/18 (Hobsonville Land Company, 2019, p. 24).

³ As with the 2016 survey, a large proportion of people didn't know whether it was safe for cycling and under 14s to play outside, possibly reflecting that these activities are not ones their household undertakes. If the 'don't know' responses are removed, perceived safety of cycling and children playing outside was high, with approximately 90% of respondents considering these to be safe or very safe.

1. Energy Use (Transportation & Land Use)
BLOCK SCALE
1.2 Transport Modes Provision
1.2.1 Does the footpath network support safe, continuous pedestrian journeys, and meet or exceed design standard NZS 4404:2010?

In general, neighbourhood blocks in Hobsonville Point support safe, continuous pedestrian journeys. The 2017/18 Beacon Pathway Residents’ Survey results provide lived-experience evidence for this. Approximately 90% of respondents felt that the neighbourhood was safe for children under 14 and safe for cycling too (Hobsonville Land Company, 2019, p. 24). Furthermore, 51% of primary school children in Hobsonville Point walked to school (Haarhoff et al., 2019) – this is significantly higher than the New Zealand average of 29%. These behavioural measures and perceptions from residents demonstrate that the vision for a walkable neighbourhood is considered to have been fulfilled.

To deliver walkability the Social dimension of the SDF included an objective to “ensure Hobsonville Point is accessible to people at all stages of life and ability” (Hobsonville Land Company, 2015). The SDF established long-term indicators and development indicators to work toward this (Figure 26):

- 60% of school children bike/walk or catch public transport to school;
- 95% of people feel that the Hobsonville Point site is very/reasonably safe for pedestrians;
- 95% of cyclists feel that cycling within Hobsonville Point is very/reasonably safe.

Subsequently, the CDPs established guidance for the detailed design of footpaths to implement the SDF aspirations for walkability. For example, the Buckley CDP stated that “footpath treatment takes precedence over driveway to indicate pedestrian priority” (Hobsonville Land Company, 2009). Typical cross sections for all of the different street typologies were provided in each CDP, for examples refer Figure 27 and Figure 28. The Hobsonville Point development precincts had a clear vision for footpath design, to support walkability. The CDP set out detailed guidance for designers and engineers, because the proposed footpath design deviated from the Engineering Code of Practice.

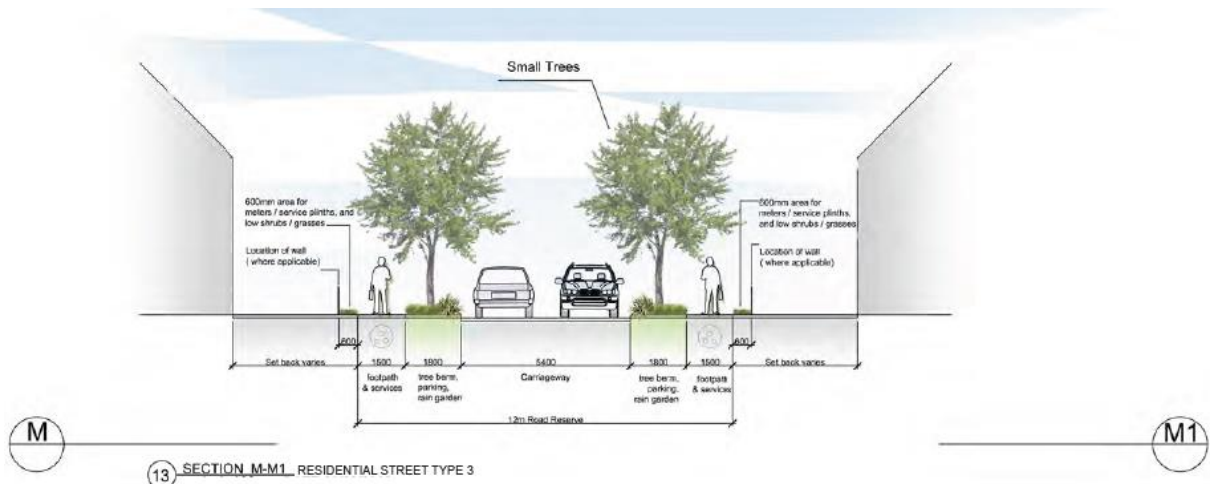


Figure 27: Residential street design cross section (Harakeke Street) from Buckley CDP (Hobsonville Land Company, 2009, p. 56).

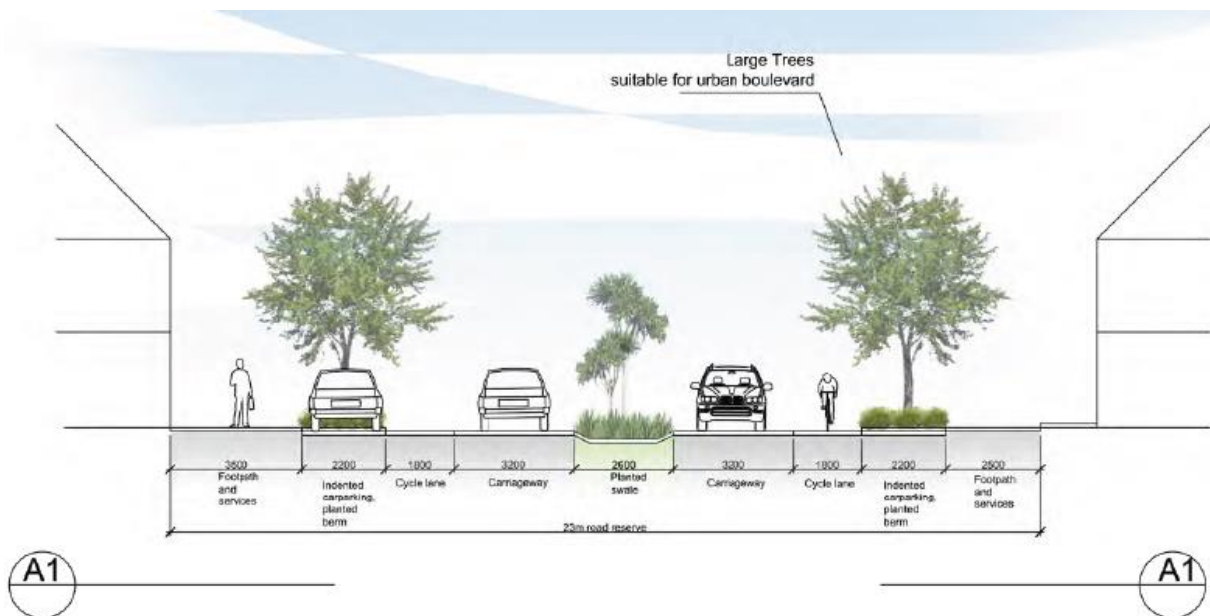


Figure 28: Hobsonville Point Road cross-section from Sunderland CDP (Isthmus Group, construct, & JV, 2013, p. 120).

Standard NZS 4404:2010 is the national standard focused on the infrastructure requirements for land development and subdivision. Specific road design standards are laid out across three categories (Table 3) and pedestrian provisions are provided for under the Link Context category. NZS 4404:2010 essentially requires footpaths to be designed in accordance with Austroads guides and NZTA ‘Pedestrian planning and design guide’ (Patent No. Amendment No. 1, 2010). At the local scale, however, footpath design is informed by the local Council Engineering Code of Practice (developed with reference to these national standards). As shown in Table 3, there are many factors which are taken into consideration when designing a road and, hence, when designing footpaths. A local Code of Practice is the most appropriate way to achieve good outcomes for pedestrians. While the Hobsonville Point

engineering design deviated from the Auckland Transport Code of Practice, it largely complied with the national standards and provided for safe pedestrian journeys.

Table 3: NZS 4404:2010 synthesis of Road Design Standard elements

PLACE CONTEXT	DESIGN ENVIRONMENT	LINK CONTEXT
Land use	Number of Lots / dwelling units	Pedestrian provision
Urban / Suburban / Rural	Target speed	Cyclist provision
Local attributes	Road width	Movement lane
	Max. grade (%)	Road classification

Alternatively, this item of the POE framework could consider compliance with local Codes of Practice and assess how appropriate this was for the development context, rather than the national standard. It appears that with Hobsonville Point, HLC did not consider the operative engineering design standards fit for purpose to deliver on its vision for a walkable neighbourhood. As such, HLC commissioned bespoke engineering standards through CDP.

Engineering standards for road design can be overly focused on designing for cars based on the road classification hierarchy, in lieu of a holistic mobility perspective that equally values other forms of transport such as walking and cycling in road design. To deliver fit-for-purpose pedestrian infrastructure, footpath design (width, location, etc.) should relate to the context. For example, wider footpaths are required in and around higher activity areas, such as parks, schools and retail centres, that attract pedestrians for everyday activities.

Footpaths that support safe and continuous journeys for everyone, from home to amenities and community spaces, enhance social sustainability as well as environmental sustainability. Walkable streets support accessibility and are an attractive mobility option that can serve the whole community.

1. Energy Use (Transportation & Land Use)
BLOCK SCALE
1.2 Transport Modes Provision
1.2.2 Are less than 20% of the block lengths of the circulation network interrupted by vehicle crossings?

In Buckley Block 23, with the rear access lane, all private vehicle access in this block is contained internally within the block. The width of the access lanes from Kanuka Road and Harakeke Road sum to less than 20% of the total block length (perimeter). Block 25 in the Buckley sub-precinct does not have a rear access lane; each lot has private vehicle access to garages directly from the road. The percentage of block lengths of the circulation network interrupted by vehicle crossings is 19%. Blocks 2 and 3 in the Sunderland sub-precinct have a combination of a rear access lane and vehicle access to private garages directly from the road. In this study block, the percentage of block length of the circulation network interrupted by vehicle crossings is 12%.

As such, both study blocks comply with this provision. Vehicle crossings provide access to garages and rear lanes, but they also disrupt pedestrian movement along the footpath. A low ratio of block length to vehicle crossings (<0.20) demonstrates that the footpath network is safer because potential conflicts between pedestrians and vehicles are reduced. However, this measure does not provide any insight on pedestrian safety within the rear laneways, which were designed without footpaths as ‘shared spaces’.

As previously discussed, overall residents surveyed rated highly the feeling of safety for pedestrians in Hobsonville Point (Figure 26). This perception supports habits of walking in the community and sustainable alternatives to car-dependent travel for everyday activities.

1. Energy Use (Transportation & Land Use)
BLOCK SCALE
1.2 Transport Modes Provision
1.2.3 What is the ratio of continuous bicycle infrastructure to sections interrupted by vehicle crossings?

In the Buckley and Sunderland blocks analysed, cycle infrastructure is provided along Hobsonville Point Road (Figure 23). On both of these streets, lots adjacent to the main arterials make use of a rear access lane for vehicle access. As such, there are no vehicle crossings onto Hobsonville Point Road to disrupt bicycle infrastructure. However, there are on-street car parks (for adjacent shops) and a bus stop along this specific section of Hobsonville Point Road which will introduce potential conflicts between vehicles and cyclists. Also, as previously noted, the cycle lane here is delineated by a painted lane only and there is no physical separation between road users to support safer cycling.

Continuous cycle infrastructure supports safer cycle journeys and contributes toward the ‘network effect’ which makes cycling a more attractive and convenient transport alternative to the private car.

1. Energy Use (Transportation & Land Use)
NEIGHBOURHOOD SCALE
1.3 Higher Density Zoning
1.3.1 Did the development have density targets?

Precinct CDP set out density targets for housing, however there is little evidence of the rationale behind these figures. Auckland’s long term spatial plan (Auckland Council, 2012) anticipated density of 30 dwellings per hectare for this site, which is considered low density for New Zealand. The Auckland Plan (Auckland Council, 2012) set out ten geographic priority areas for development within the 2010 Metropolitan Urban Limits for the first three years, including Hobsonville/Westgate, Massey North: “a major greenfield development in the northwest, including a large quantity of new housing, and the emerging metropolitan centre

of Westgate” (Auckland Council, 2012). Hobsonville Point incorporated several Special Housing Areas including Catalina Precinct (#2), Scott Point, Sunderland Precinct, and Hobsonville surrounds (#14). The original 10ha residential precinct for Hobsonville Point was proposed to incorporate 3000 housing units (Auckland Council, 2015a). Land Use zoning to provide for high density residential urban development in these precincts was operative by 2012.

The comprehensive masterplan development for the entire Hobsonville Point precinct provided for 2,500 to 3,000 dwellings in total⁴. However, this figure wasn’t based on any statutory planning provision or delivery target per se, but formed from assumptions of what an acceptable and viable level of density would be in the context of housing preferences and market conditions in Auckland (Ibid.). Through each CDP, HLC set out minimum and maximum yield targets by block to ensure that the planned density (more intense than any other development in NZ at the time) would be delivered. For example, Table 4 shows the residential unit yield provisions for the blocks in the Sunderland precinct. At completion, the total development yield will have exceeded what was anticipated: around 4,000 dwellings delivered by HLC with an additional 800 dwellings from Panuku Development Auckland in the Airfields Precinct.

Table 4. Sunderland precinct residential unit yield table (Isthmus Group et al., 2013).

Development block	Minimum Yield	Maximum Yield
1	87	175
2	0	0
3	37	75
4	27	55
5	62	120
6	12	20
7	0	1
8	13	30
9	18	35
10	18	35
11	49	90
12	0	0
13	8	15
14	9	30
15	8	15
16	3	5
17	14	30
18	33	40
19	4	4
20	20	40
21	9	20
22	13	30
23	35	45
24	106	250
25	7	15
TOTAL	592	1175

⁴ The masterplan was updated, and the density changed, a number of times as the development evolved. Even today, there are a number of superlots being masterplanned and delivered at higher than anticipated densities. Both the number of dwellings and type of dwellings has therefore changed at multiple sites.

High density urban neighbourhoods support sustainable living because the intensity of housing is more land efficient and makes it feasible for key amenities like schools, shops and parks to be located closer to where people live. High density neighbourhoods, integrated with the necessary urban amenities, reduce travel demand. This compact urban form makes walking and cycling to everyday activities a convenient and attractive choice for people, to support sustainable transport outcomes.

1. Energy Use (Transportation & Land Use)
NEIGHBOURHOOD SCALE
1.3 Higher Density Zoning
1.3.2 How do these targets relate to the city-wide and nationwide targets?

Legacy Waitākere City Council or Auckland Regional Council plans, or the Auckland Plan 2012, did not set out city-wide development density targets. Equally, at the time of development planning there was no national housing strategy or nationwide development targets for housing density. HLC representatives highlighted the weaknesses of not having a nationwide housing strategy to guide this development.

Since the inception of the Hobsonville Point development, the National Policy Statement on Urban Development Capacity (NPS-UDC) came into effect. This policy requires local territorial authorities to periodically report on the capacity for housing and business development in their region, and to demonstrate how this is incorporated into infrastructure and land-use planning. In future applications of this POE framework, the NPS-UDC and local Council reporting against this policy will provide a helpful basis for comparing performance against local, regional and national density targets.

Under the Resource Management Act (1991), sustainable development must provide for the needs of both current and future generations (section 5). The NPS-UDC is a policy which establishes a mandate for Councils to assess the future demand for housing in their communities, to plan and provide capacity for the delivery of housing to meet this need: hence, it supports sustainable urban development. While Hobsonville Point has delivered more housing than was initially planned, the development was not planned to respond to a particular housing demand with a particular capacity for housing. Without a target or clear consideration of the local or regional demand for housing it is difficult to comment on the success of density targets to deliver sustainable development in this case.

1. Energy Use (Transportation & Land Use)
NEIGHBOURHOOD SCALE
1.3 Higher Density Zoning
1.3.3 Did these targets include calculations about the environmental capacity of the neighbourhood?

The density targets at Hobsonville Point seem to have been developed arbitrarily, with no clear rationale or statutory directive. As such, it is not clear if environmental capacity calculations were considered when developing these targets.

However, HLC was cognisant of the environmental impacts of development. For example, the Sustainable Development Framework (Hobsonville Land Company, 2015) was prepared with the knowledge that carbon emissions from transport were greater and more critical to consider than household energy related emissions. In response, a number of development indicators focused on reducing car-dependence and transport-related emissions, with a lesser focus on reducing household related emissions. HLC acknowledged the interrelationship between transport planning and development density; there is a need for a systemic change around transport to employ high density development efficiently.

In line with the ethos of the former Waitākere City Council, this development integrated stormwater management with low impact urban design and development approaches. The catchments in Hobsonville Point are unique, with most stormwater draining directly to the sea rather than to a stream. These hydrological features led to a stormwater management strategy that focused on stormwater quality, rather than quantity (though both were achieved in design). Informal research findings from Waitākere City Council drainage engineers suggest that beyond 30% impervious area in a catchment, there are significant adverse water quality impacts that can't easily be remedied. So, the comparative downstream impact of 60%, 70% or 80% of total impervious area from development is rather negligible. For stormwater quality, the environmental capacity is much the same for low-density and high-density residential development.

With this in mind, HLC opted to concentrate residential development in high density areas, while providing a full system of stormwater management that sustained sensitive riparian margins, wetlands and coastal buffers as part of the system. Any attempt to reduce urban density to achieve less than 30% impervious coverage and avoid adverse water quality impacts, was not considered practical.

1. Energy Use (Transportation & Land Use)
NEIGHBOURHOOD SCALE
1.3 Higher Density Zoning
1.3.4 What is the build density ratio compared to the proposed density ratio?

The 167-ha Hobsonville Point development has 4,500 dwellings completed or in the pipeline for construction. Initially, 3,000 dwellings were planned by the original Masterplan (Table 5).

Table 5: Build density ratio for Hobsonville Point

	PROPOSED	BUILT
DWELLINGS	3,000	4,500
DENSITY RATIO	18 d/ha	27 d/ha

The completed build density ratio is 50% higher than the planned density. Higher density development provides a range of benefits such as infrastructure efficiency, supporting local centre viability and efficient use of land as a resource. However, it is not clear how or if the masterplan adapted to the change in built density to ensure all aspects of the development could serve this larger population sustainably. Environmental considerations of higher density include more (potential) private vehicles, pedestrians and greater neighbourhood energy demand from households, to public transport capacity and catchments for the provision of amenities such as parks and community facilities.

Build density ratio demonstrates the average proportion of developable area to housing. In terms of sustainability, more intense development which accommodates more people per hectare can support infrastructure efficiencies, with roading, three-waters reticulation, telecommunications and electricity, agglomerate the footprint of environmental impacts (e.g. impervious area) and use land more efficiently to provide space for environmental enhancement areas such as coastal revegetation or stormwater management. The appropriate build density ratio for a development is context-specific and should reflect environmental capacity and housing demand requirements and deliverable capacity for the development. The average proposed and build density ratios in Hobsonville Point fall within a 'low density' range of 10-30 dwellings per hectare. Across the development sub-precincts, there are areas of higher and lower density housing from standalone dwellings to duplexes, walk-up terraces and apartments. However, on average, providing for a medium density build ratio (30-60 d/ha) or high density (60-80+ d/ha) would support more sustainable development outcomes.

1. Energy Use (Transportation & Land Use)
NEIGHBOURHOOD SCALE
1.3 Higher Density Zoning
1.3.5 What percentage of properties have retail ground floor activation provision?

One of the primary design concepts for the Sunderland CDP was ‘Activation of the Spine’, Hobsonville Point Road, “[to maximise] opportunity for activity, vibrancy and vitality” to support economic sustainability (Isthmus Group et al., 2013). In local retail centres along Hobsonville Point Road, the CDP provides for ‘occupied frontages’ for potential retail ground floor activities. Building setback controls for residential activities establish standards to support street-level activation, passive surveillance from outlook to the street (refer item 1.3.6). In general ground floor activation has been considered for most dwellings and mixed-use development sites in Hobsonville Point.

1. Energy Use (Transportation & Land Use)
BLOCK SCALE
1.3 Higher Density Zoning
1.3.6 What ratio of doors and windows are set back no more than 7.5m from the street edge?

All doors and windows are set back no more than 7.5m from the street edge (i.e. ratio = 1.0). For Buckley and Sunderland, the CDP established building setback standards, with some building line variation allowed for, with secondary elements such as bay windows. The Buckley CDP has an Urban Form Plan which clearly sets out the minimum and maximum setbacks for all frontages in the sub-precinct (Figure 29). Along Hobsonville Point Road, building setbacks are limited to provide for a sense of enclosure on the street (minimum of 0.0 m). However, up to 3.5m setback is provided for to allow for northerly outdoor living space (Hobsonville Land Company, 2009). The other Buckley study block minimum and maximum setbacks range from 2m-5m and 2m-3.5m. The Sunderland CDP has a Height and Frontage Plan which defines boundary setbacks to support the planned street character (Isthmus Group et al., 2013). Minimum and maximum setbacks for the Sunderland study blocks range from 0-1.5 m (urban street formal) to 0-3.5 m (urban street informal) (Figure 30). The development setback controls set out in the CDP have been delivered through the resource consent process.



Figure 29: Buckley precinct setbacks, Urban Form Plan (Hobsonville Land Company, 2009).



Figure 30: Sunderland precinct setbacks, Height and Frontage Plan (Isthmus Group et al., 2013).

Building setback controls provide for strong built edges along the street, supporting passive surveillance and more efficient use of developable land for housing. However, in practice, spaces such as living rooms and bedrooms that face onto the street are often screened with blinds or curtains to maintain privacy. There needs to be greater clarity around the requirement for maximum setbacks, and how architectural design can support the desired outcomes on the street.

1. Energy Use (Transportation & Land Use)
NEIGHBOURHOOD SCALE
1.4 Parking Management & Design
1.4.1 Do car parks comprise more than 20% of the total development footprint area?

Data was not available to accurately assess this measure for this research. However, a conservative estimate of parking provision by land use activity suggests that the total area for

parking does not comprise more than 20% of the total development footprint area at Hobsonville Point (roughly estimated at 8.5%) (Table 6).

Table 6: Parking provision estimate for Hobsonville Point. Note 1: conservatively assumed 2 car park space per residential dwelling. Note 2: minimum on-street parking of 0.5 spaces per dwelling as per Buckley CDP (most conservative).

LAND USE	ESTIMATE OF PARKING AREA
Housing ¹	11.2 ha
Education	1.0 ha
Retail /Commercial	1.7 ha
Roading ²	0.2 ha
Open Space	0.02 ha

The over-provision of carparking supports and encourages car-dependent lifestyles, because it reinforces and establishes driving as the most convenient and attractive mode of transport. Hence, excess car parking indirectly reduces the mode share of public and active transport modes. A low percentage of parking provision over the development area suggests that the development has balanced and more sustainable transport framework.

1. Energy Use (Transportation & Land Use)
NEIGHBOURHOOD SCALE
1.4 Parking Management & Design
1.4.2 Are any individual surface parking lots larger than 0.8 hectare?

Large surface parking spaces in Hobsonville Point include the following (with approx. area):

- Catalina Bay (1.2 ha)
- Hobsonville Secondary School (0.6 ha)
- Brickworks (0.2 ha)

The Catalina Bay parking area was a paved area used in the former aviation base at Hobsonville Point. So, in terms of the environmental effects of the development, the additional effects of this surface parking lot would be marginal with slightly different stormwater quality impacts (e.g., heavy metals, TSS⁵) because of slightly different use of the area and largely unchanged stormwater quantity impacts. The other large surface parking areas of note in Hobsonville Point are less than 0.8 hectare in area. Large areas of impervious surface, such as a surface parking lots, contribute toward urban heat island effect and generate large volumes of stormwater runoff. Overall, the Hobsonville Point development has constrained and divided surface parking areas to enhance environmental sustainability outcomes. It should be noted that just outside of the Hobsonville Point Precinct is a local retail centre on Hobsonville Road with a large surface parking lot (1.2 ha). While it is outside of the

⁵ Total Suspended Solids, includes soils, and other debris suspended in stormwater.

study area, it does serve the Hobsonville Point community and therefore is worth considering in terms of sustainable development outcomes.

1. Energy Use (Transportation & Land Use)
NEIGHBOURHOOD SCALE
1.4 Parking Management & Design
1.4.3 What is the ratio of car parking provisions to cycling, walking and public transport provisions?

Data was not available to accurately assess and compare transport provision ratios for this research. For future developments, these metrics should be defined and established as targets from the start, so that Post Occupancy Evaluation is straightforward. Setting clear targets that balance car parking provision with walking and cycling provisions would support the delivery of sustainable transport outcomes. In the context of Hobsonville, the SDF could have benefitted from this metric to provide a clear built-environment metric to reduce car dependence and support walking and cycling.

By observation, provisions for car parking seem greater than for public transport, which has low service frequency (Table 2). Public transport is largely provided within a 10-minute walk from every home. However, each one-bedroom home was required to have at least one car park, and larger homes two parking spaces. Provision for walking and cycling is reasonable, as discussed for items 1.1.3 and 1.1.5, but there is room for improvement to support sustainable transport outcomes. In addition, the non-descriptive development indicator for bike share provision which has delivered only eight shared bicycles, at two docking stations, reflects poor provision for active transport in balance with car parking in Hobsonville Point. To improve the provisions for cycling, there could be more cycle parking at retail and transit-oriented destinations, and/or a more comprehensive bike share programme with higher capacity docking stations.

1. Energy Use (Transportation & Land Use)
BLOCK SCALE
1.5 Parking Provision
1.5.1 What are the average number of designated parking spaces per unit?

For the Buckley study blocks, there are up to 158 parks available including car pads, private garaging, visitor parking and on-street parks. For designated parking spaces (99 total), there are 1.68 parking spaces per dwelling unit (Figure 31). For the Sunderland study blocks, there are 151 parks available including private garaging, car pads and on-street parks. For designated parking spaces (89 total), this equals 1.33 parking spaces per dwelling unit (Figure 32).



Figure 31: Buckley study blocks car parking provisions.

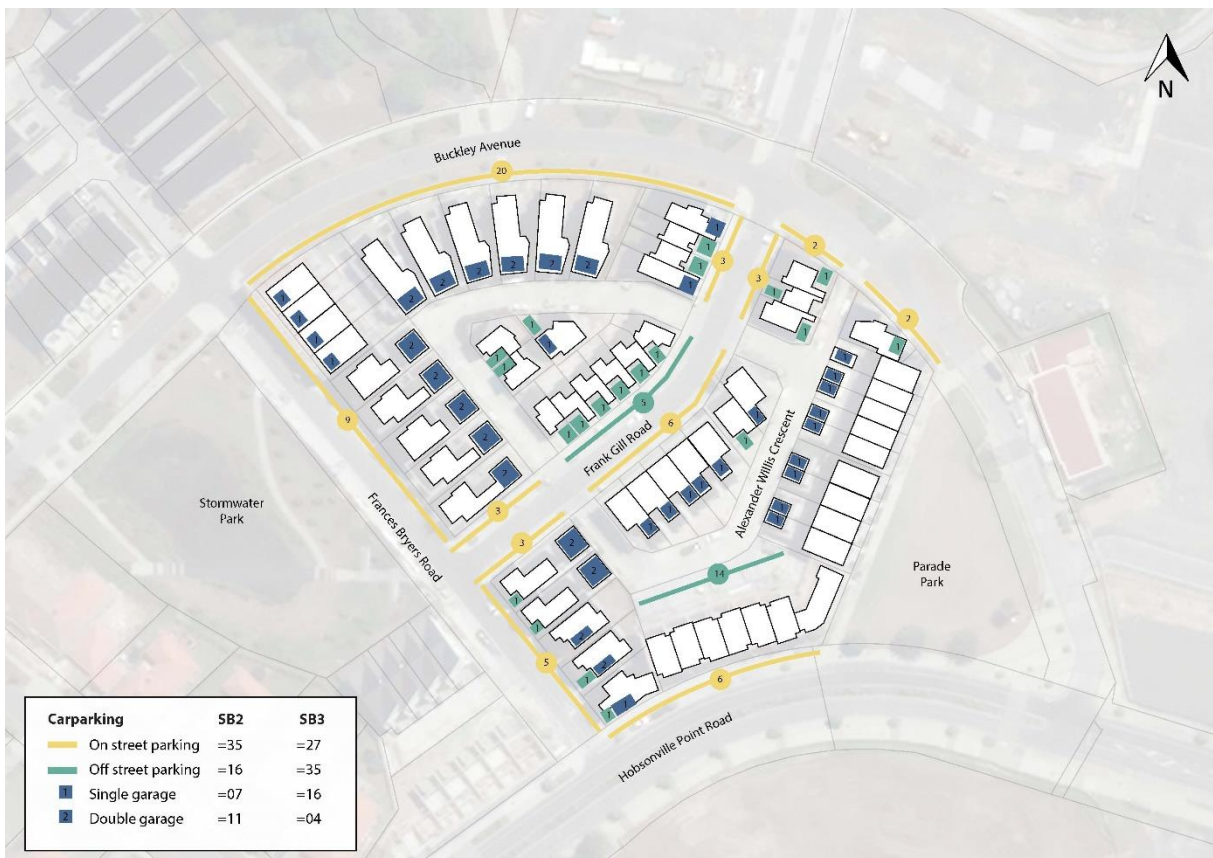


Figure 32: Sunderland study blocks car parking provisions.

As discussed for item 1.4.1, parking provision supports car-dependent lifestyles. In Hobsonville Point, most residential units were provided with 1-2 designated parking spaces, and visitor or on-street parking to provide additional capacity. When the Hobsonville Point development began, residential development rules in Waitākere City required a minimum of two parking spaces per unit (Waitākere City Council, 2014, p. 33). In contrast, Hobsonville Point was progressive in that the CDP development controls that did not set minimum parking requirements per residential unit. However, the CDP development guides could have made better provision to support alternatives to car travel and deliver on the SDF development objectives for sustainable transport. For example, the Urban Design Guide for Waitākere City established that where car parking requirements were less stringent, such as apartment buildings, it is necessary to “provide secure convenient bicycle storage” (Waitākere City Council, 2014). Resident focus groups raised a number of issues with the provision of parking, including the alternative use of garages for purposes other than parking cars (Haarhoff et al., 2019).

1. Energy Use (Transportation & Land Use)
BLOCK SCALE
1.5 Parking Provision
1.5.2 What ratio of the car parks are on building frontages versus off-street surface parking lots at the side or rear?

In the Buckley study blocks, the ratio of building frontages versus off-street surface parking is 1.06. There are 51 car parks on building frontages (including garages and carports) all in block B25, and in block B23, there are 48 are off-street surface parking spaces to the rear (Figure 31). In the Sunderland study block, 27 car parks are on building frontages (including garages and carports) and 62 are accessed from the rear or as off-street surface parking.

Fourteen surface parks have been grouped together in Sunderland block SB3, to provide compact parking for the walk-up units. By grouping surface parking like this, the development layout can use space more efficiently and offer larger residential lots or units. Similarly, by using a rear lane the vehicle manoeuvring areas and impervious area allocation is shared and minimised across the block because individual lots don’t require individual driveways and turning areas. Rationalising car parking provision to the rear or side of the block also supports safe and continuous pedestrian journeys along the street (refer item 1.2.1).

1. Energy Use (Transportation & Land Use)
NEIGHBOURHOOD SCALE
1.6 Land Use Mix
1.6.1 What is the distribution of urban amenities categories across the neighbourhood?

As a master-planned development, each precinct plan for Hobsonville Point incorporated neighbourhood amenities such as “homes, schools, retail [...] neighbourhood

parks, reserves, walkways and cycleways, bus stops and the main road network” (HLC, 2017, para. 1). There are three local activity centres: Catalina Bay, Brickworks and Hobsonville Centre (just outside of the study area). Roads and open space networks provide linkages between amenities not located within these centres, such as local parks, schools, or other community facilities. Open spaces are distributed throughout Hobsonville Point so that all residents have access to a public green opens spaces within 5-10 minutes of home. And there are a variety of open space types, to support different activities and recreation preferences.

A key weakness of urban amenities provision is the fringe location of the Hobsonville Centre for Hobsonville Point residents (Figure 33). The nearest supermarket is located in this centre and it is not within walking distance for a significant proportion of Hobsonville Point residents. The SDF established economic development indicators for 75% of dwellings to be located within 800m of a convenience store, community facility and early childhood education.

Walkability and accessibility to urban amenities is often characterised around the ‘pedshed’ or walkable distance for 400-800m (5-10 minutes). The SDF objectives set a target of 75% for 400m walking distance to bus stops, 1200m walking distance to primary school and 1600 m walking distance to secondary school (Figure 12). Each of these urban amenities access targets were exceeded by the development (HLC, 2018). In the 2017/18 Annual Report on the SDF, over 80% of dwellings were within walking distance of a convenience store or supermarket, and an Early Learning Centre (HLC, 2018). The SDF target for proximity to a community facility has not been met; just under 50% of planned dwellings will be within 800m of either the Sunderland Lounge or Headquarters Building (HLC, 2018). However, the report notes that future development at Scott’s Point will improve the provision and proximity to community facilities. While a convenience store is an urban amenity, this SDF target could have been strengthened by aiming for a supermarket to be within a walkable distance for 75% of dwellings in Hobsonville Point. Sustainable development framework indicators need to be realistic and specific and, in this case, a more realistic provision of urban amenities would have specified a supermarket.

In reality, Hobsonville Point lies within an existing urban context that provides additional urban amenities, including the supermarket, around the subject neighbourhood. For example, the Hobsonville Point development has not provided any places of worship provided as urban amenities; but there are a number of places of worship in the surrounding Hobsonville and Westgate areas that could serve residents of Hobsonville Point.

Urban amenities are the facilities and services that support everyday life and daily activities in the neighbourhood, such as shops, schools, community facilities and recreation spaces. Convenient access and close proximity to urban amenities, within walking distance for example, supports sustainable development outcomes because it reduces dependency on car trips to meet daily life needs.

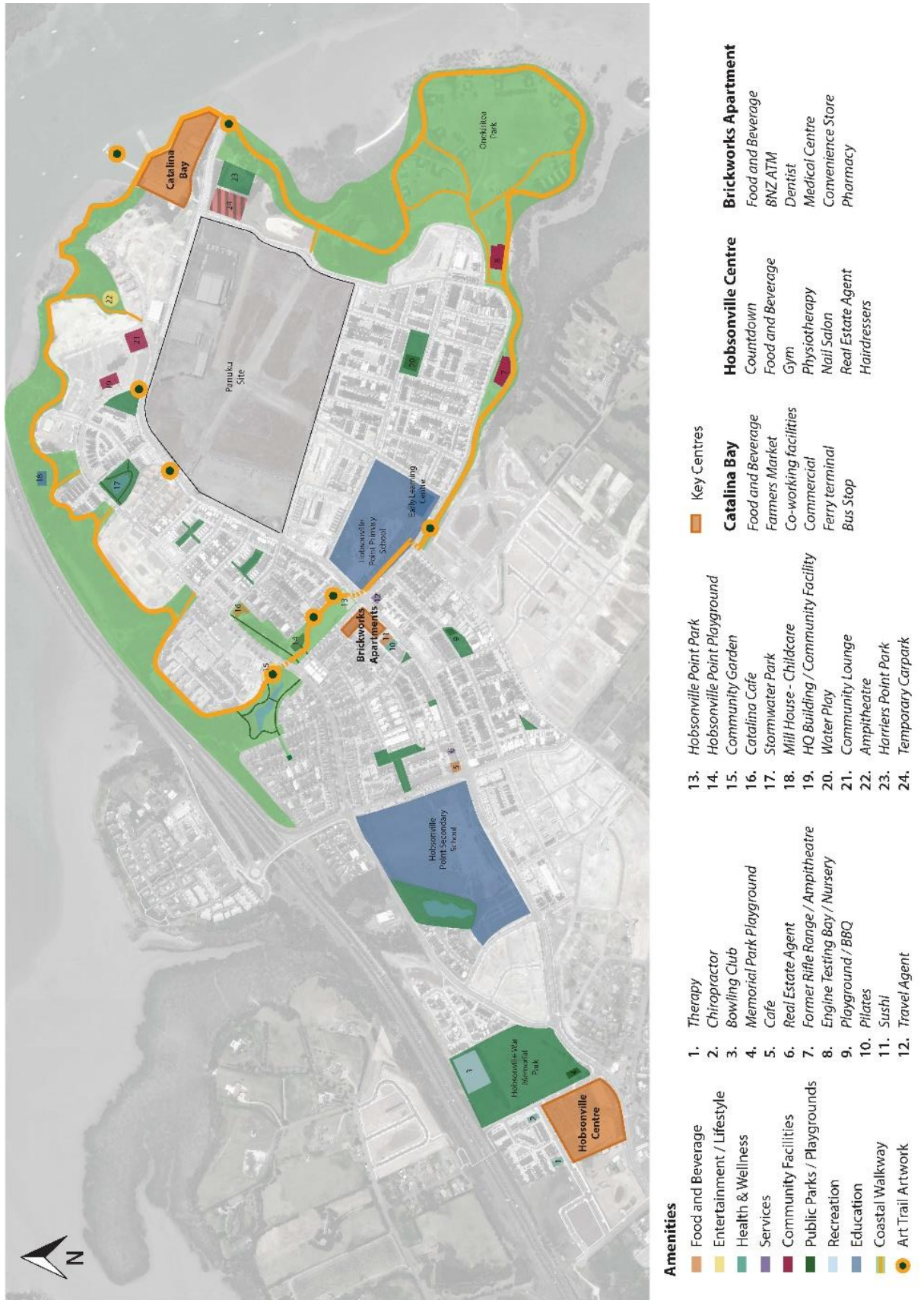


Figure 33. Distribution of urban amenities in Hobsonville Point.

1. Energy Use (Transportation & Land Use)
NEIGHBOURHOOD SCALE
1.7 Amenities Provision
1.7.1 What is the ratio of urban amenities categories to houses?

Hobsonville Point has been marketed as a family-friendly neighbourhood with ample urban amenities to support a range of lifestyles and stages of life. The ratio of early childcare centres per dwelling seems rather low, as each centre typically only has capacity for 30-40 children. That said, there are ten childcare centres in West Harbour which likely serve families in Hobsonville Point, too.

In general, Hobsonville Point residents make good use of the urban amenities in their neighbourhood and give positive feedback about them (Bijoux, 2013). In the Beacon Pathway case study of the Hobsonville Point Neighbourhood, Bijoux highlighted that “key areas for improvement include [...] increased provision of local shops, professional services and business and employment opportunities as well as the further development of communal amenities and opportunities for community building” (Bijoux, 2013). Indeed, the lack of employment provided within the neighbourhood is a loss for the community, and detracts from the overall sustainability of the neighbourhood. It means that most residents must travel out of Hobsonville Point to access employment.

Table 7: Summary of urban amenity ratios for Hobsonville Point (for 4,500 dwellings).

URBAN AMENITIES	RATIO PER DWELLING
Public spaces & recreation (15)	1 per 300
Cafe & restaurants (14)	1 per 345
Public Art (9)	1 per 500
School (2)	1 per 2,250
Early Childhood centre (2)	1 per 2,250
Retail, services & health facilities (12)	1 per 265
Community facilities (buildings, gardens) (5)	1 per 900
Heritage buildings (6)	1 per 750

4.2. Energy Use & Production (Non-transportation)

4.2.1. Hobsonville Point Sustainable Development Indicators

The SDF acknowledges that energy use and climate change are closely linked, that long-term security of the electricity supply and how energy is used and managed are issues that must be addressed (Hobsonville Land Company, 2015). The Framework outlines an aspirational goal of ‘no carbon emissions from stationary energy use’ (Hobsonville Land Company, 2015). Objectives and indicators related to Energy Use fall under the Environment sphere include of the SDF, as shown in Figure 34.

Sphere	Dimension	Objectives	Long term indicators	Development indicators
1. Environmental	Ecology	<ol style="list-style-type: none"> 1. Create an integrated natural habitat 2. Increase indigenous biodiversity 	<ol style="list-style-type: none"> 1. A continuous green corridor with native vegetation covering at least 10% of the site is retained/established. 2. Pre and post development native flora and fauna counts indicate that species diversity and abundance has increased in key areas. 	<p>Native habitat areas along the coastal corridor are maintained and enhanced. A management plan for the coastal area is completed that covers planting, weed and pest management strategies.</p> <p>Eco sourced native plants are used where native plants are planted in public areas.</p> <p>Local seed is collected and grown into plants for key revegetation species.</p> <p>Education/management programme in place while HLC on site.</p> <p>See "Water" for stormwater quality indicators.</p>
	Energy	<ol style="list-style-type: none"> 3. Reduce non-renewable energy use 4. Energy efficiency 	<ol style="list-style-type: none"> 3. Average household grid energy (reticulated gas and electricity) consumption is 6,500 kWh/year or less. 	<p>Houses built to a calculated BPI of 1.2 or lower for thermal performance and 5.5 Star HERS hot water rating or equivalent performance level.</p> <p>All properties have smart meters.</p> <p>At least 3 on site demonstration renewable generation projects.</p> <p>Education/management programme in place while HLC on site.</p>
	Water	<ol style="list-style-type: none"> 5. Reduce water consumption 6. Improve water quality 	<ol style="list-style-type: none"> 4. Average residential town supply water consumption is 100 litres or less per person per day. 	<p>All stormwater, except roof water, receives treatment before being discharged into the harbour.</p> <p>All houses have 6/3 litre, or less, dual flush toilets.</p> <p>3 Star or better water saving fixtures.</p> <p>Dwellings are served by rain tanks sized to supply 75% of water used in household toilets, laundries and gardens.</p> <p>No in-built irrigation will be provided in gardens.</p> <p>Education/management programme in place while HLC on site.</p>
	Resource efficiency	<ol style="list-style-type: none"> 7. Recycle and renew existing buildings and other infrastructure 8. Reduce off-site waste disposal 	<ol style="list-style-type: none"> 5. Mixed household waste collected is 100kg/person/year or less. 	<p>At least 20% of existing buildings will be retained and renovated or reused off site.</p> <p>The majority of construction and demolition waste is recycled.</p> <p>At least 3 public recycling bins are provided in public spaces.</p> <p>Education/management programme in place while HLC on site.</p>

Figure 34. Energy strategy as per HLC’s SDF (Hobsonville Land Company, 2015, p. 7).

The series of Annual Sustainability Reports prepared by HLC have measured performance against these indicators, year-on-year since 2014 (Hobsonville Land Company, 2019) (Figure 35).

Long Term Indicators	Target	Results				Comment
		2014/15	2015/16	2016/17	2017/18	
Average household grid energy (reticulated gas and electricity) consumption.	6500 kWh or less	6269 kWh	5665 kWh	5816 kWh	6128 kWh	25% lower than the Auckland average of 8200 kWh ¹ and 5% below our 2026 target.

Figure 35. Performance against long-term indicators for Environmental sustainability, related to energy (Hobsonville Land Company, 2019, p. 10)

Development indicators	Comment
Houses built to a calculated BPI of 1.2 or lower for thermal performance and 5.5 Star HERS hot water rating or equivalent performance level.	This standard has been incorporated into the resource consent process for Hobsonville Point and must be met by all builders.
All properties have smart meters.	Smart meters installed as standard.
At least three on-site renewable generation projects.	2kW solar photovoltaic system installed on the Catalina Café. HLC will investigate explore other renewable generation projects.

Figure 36. Performance against development indicators for Environmental sustainability, related to energy (Hobsonville Land Company, 2019, p. 12)

4.2.2. Assessment against POE framework

2. Energy Use & Production (Non-Transportation)
NEIGHBOURHOOD SCALE
2.1 District Heating (and/or Cooling)
2.1.1 Is there a plan for a district heating or cooling system, which includes the distribution network and connections to the dwellings?

At the neighbourhood scale, there was no plan for a precinct-wide heating or cooling system with distribution to individual dwellings in Hobsonville Point. HLC did consider a district heating and cooling system, but there was insufficient demand to justify it and very few energy-intensive buildings such as multi-storey apartments, offices or industrial activities that would benefit from such investment. Further, with the high thermal performance standards set for the development (houses were built to a Building Performance Index (BPI) of 1.2 or lower) HLC preferred to provide for solar hot water rather than a district heating/cooling system. The energy development indicator required 5.5 Star HERS (Home Energy Rating Scheme) hot water rating or equivalent performance level (Hobsonville Land Company, 2015). HLC focused on setting indicators and targets that they could control and that would make a difference for energy consumption.

District heating and cooling systems provide localised energy for space heating, thus reducing the energy demand (and losses) from the national grid for heating and cooling. However, they do require an additional distribution network to service each dwelling. The energy source can be from renewable or non-renewable sources: from combined heat and power (combustion), to solar or geothermal. While around 80% of electrical energy is generated from renewable sources in New Zealand, at peak times (e.g. winter evening peak) extra electricity demand is often met by non-renewable sources (Ministry of Business Innovation and Employment, n.d.). Around 25% of electricity consumption in New Zealand is from residential activities (Ministry of Business Innovation and Employment, n.d.). For future large-scale urban developments in New Zealand, consideration of a district heating and

cooling system may be justifiable to support energy resilience and a more sustainable, renewable energy supply.

2. Energy Use & Production (Non-Transportation)
BLOCK SCALE
2.1 District Heating (and/or Cooling)
2.1.2 Is there a response at the block scale to provide district heating and or cooling solutions?

Heating and cooling provisions were provided for at the individual house scale. Refer section 2.1.1 for more information.

2. Energy Use & Production (Non-Transportation)
NEIGHBOURHOOD SCALE
2.2 Heat Island Reduction and Micro-climate Mitigation
2.2.1 Is there a strategy for heat island reduction and micro-climate mitigation across the neighbourhood?

The SDF and CDP do not specifically mention strategies to address heat-island reduction or micro-climate mitigation. However, from a holistic perspective, ecological and stormwater management provisions of the SDF and sub-precinct CDP design elements do offset potential Urban Heat Island (UHI) and urban micro-climate effects. These integrated design and contextual elements include:

- impervious coverage limitations;
- building coverage limitations;
- green open spaces;
- coastal context;
- enhancement of native habitat areas;
- provisions for a continuous green corridor.

Public streetscape and parking design guidance aimed to incorporate a low impact design approach, where possible, with stormwater treatment and permeable surface controls (Hobsonville Land Company, 2009; Isthmus Group et al., 2013). Low-impact design principles have been used for the design of public streetscapes and parking areas. CDP streetscape design typologies specify vegetation, including street trees; however, there is no express reference to street trees being required for shading or heat island reduction. Conversely, for concrete driveways the Sunderland CDP advised that “black oxide should be added to the concrete mix to soften its appearance when constructed” (Isthmus Group et al., 2013): this suggests that UHI has not been considered in the design of hardstand areas. The UHI effect is caused by elements such as dark roofs or hard stand areas and a lack of vegetation which reduce natural shading and reflectivity for solar radiation which regulate temperature. High-density urban developments are at high risk of UHI, because of the intensity of developed area. In New Zealand’s temperate climate, these phenomena affect energy usage, increasing

demand for air conditioning in hotter periods and reducing energy demand in cooler periods. There are also additional adverse effects on flora and fauna, weather patterns (wind, rain, humidity) and population health. By understanding how neighbourhood design can contribute or mitigate against UHI, it is possible to reduce overall energy demands, improve wellbeing and liveability and reduce wider environmental effects.

2. Energy Use & Production (Non-Transportation)
BLOCK SCALE
2.2 Heat Island Reduction and Micro-climate Mitigation
2.2.2 Does at least 50% of the total project site area, in plan view, comprise building or landscaping elements that reduce the impact of the heat island effect?

From the available data, it does not seem that at least 50% of the project site area consists of elements aimed to reduce UHI. Residential development in Hobsonville Point does not incorporate green roofs or specify highly reflective, light-coloured roof materials (specific SRI data unavailable) to reduce the heat island effect. Basic landscaping elements in front yards, berms and rear yards provide vegetation that could offer mitigation against UHI. For the Sunderland blocks, the permeable (landscaped) area is 34% and for the Buckley blocks it is 40%. Data about shading potential and vegetation types was not available for this research.

Urban development in Hobsonville Point is intensive, at least as compared to other suburban areas in New Zealand, and so is at risk of UHI effects. However, in Hobsonville Point, the surrounding coastal context, balance of development densities across the site, block developed permeability and wider provision of greenery and open spaces could be adequate to mitigate against UHI. To confirm if this is the case, pre-and post-development temperature measurements would be useful, to provide evidence about in-situ UHI and micro-climate effects. Ideally, this POE framework should be coupled with a development framework that establishes UHI as a design imperative so that pre-and post-development comparisons can be made.

2. Energy Use & Production (Non-Transportation)
NEIGHBOURHOOD SCALE
2.3 Urban Morphology and Orientation
2.3.1 Was there a strategy for a climate-sensitive design across the neighbourhood?

Each CDP specified the neighbourhood layout and provided precinct-level guidance about dwelling orientations for solar gain and solar access to private open spaces. For example, the Sunderland CDP recommended “orientation of living spaces to the north, the use of eaves and other external shading structures to avoid overheating, good insulation”(Isthmus Group et al., 2013). Also, general architectural ‘design for living’ guidance in this CDP promoted the use of passive solar design principles in homes (orientation, thermal mass, glazing, shade, ventilation, air-tightness). The Buckley CDP also provides guidance for

“capitalising on good solar orientation to the north and west” (Hobsonville Land Company, 2009). Across Hobsonville Point, all residential dwellings had to be designed and constructed to achieve “[a] 5-Star thermal performance rating using the New Zealand HERS star rating calculator draft version 1.2 [May 2008] or an equivalent rating in any subsequent final version introduced by the government (Hobsonville Land Company, 2009; Isthmus Group et al., 2013). This blanket requirement for thermal performance, along with the CDP guidance, provided a clear mandate for climate-sensitive design in Hobsonville Point. Information on the % of buildings that achieved such standard upon completion as of today is unavailable.

2. Energy Use & Production (Non-Transportation)
BLOCK SCALE
2.4 Design for Solar Exposure at Density
2.4.1 Are 75% or more of the blocks within the neighbourhood at ±15 degrees of geographical east-west, and the east-west length?

Across the study blocks in Sunderland and Buckley only one block edge was within +/- 15 degrees of geographical East-West, which was the curved northern edge of Sunderland SB2 on Buckley Avenue. Figure 37 and Figure 38, together with Table 8 and Table 9, analyse the orientation of the blocks.

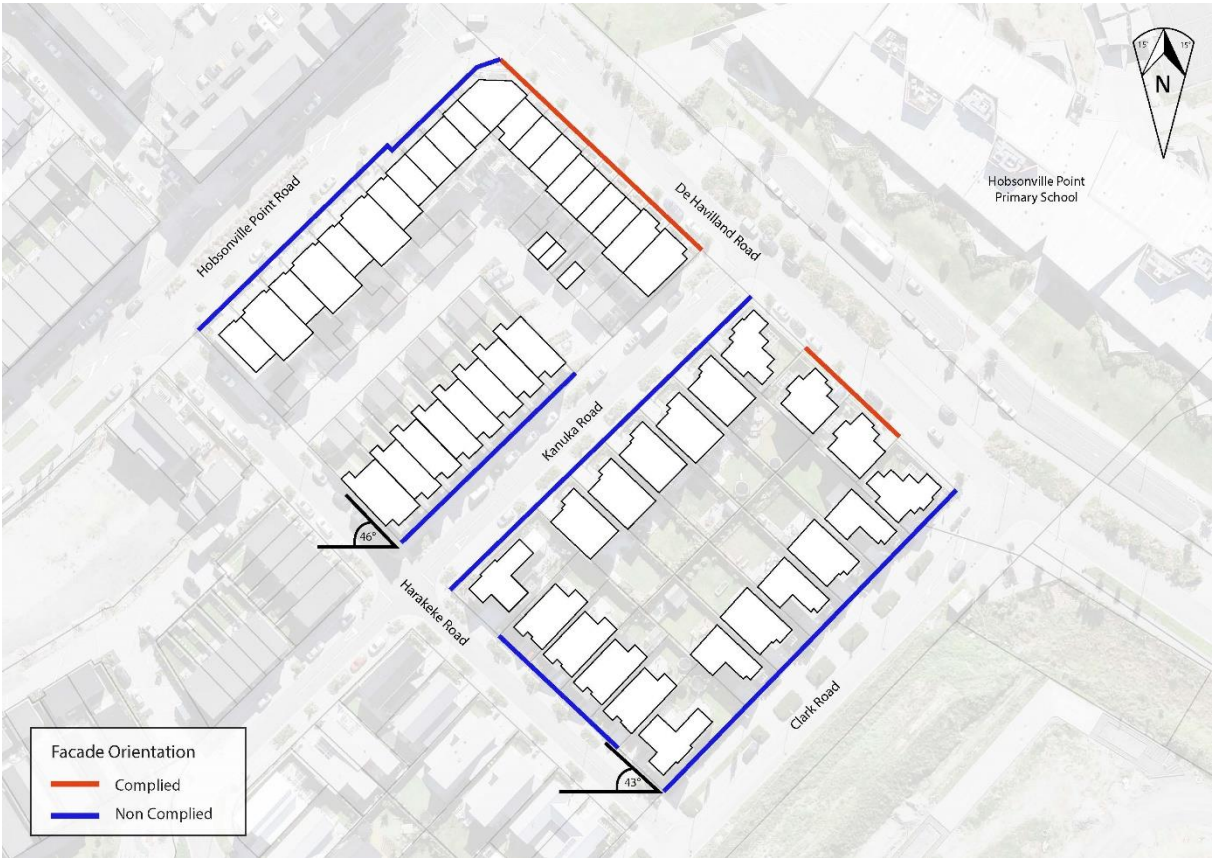


Figure 37: Buckley façade orientation analysis.

Table 8: Buckley B25 & B23 block orientation summary

BUCKLEY BLOCK IDENTIFIER	BLOCK ORIENTATION (DEGREES FROM GEOGRAPHICAL EAST-WEST)	EAST-WEST BLOCK LENGTH (M)
Hobsonville Point Road	+ 44° E	90m
Clark Road	+ 44° E	92m
Harakeke Road	+ 45° W	B23: 65m B25: 64m Both: 140m
Kanuka Road	+ 44° E	B23: 92m B25: 92m
De Havilland Road	+ 43° W	B23: 61m B25: 62m = 144m

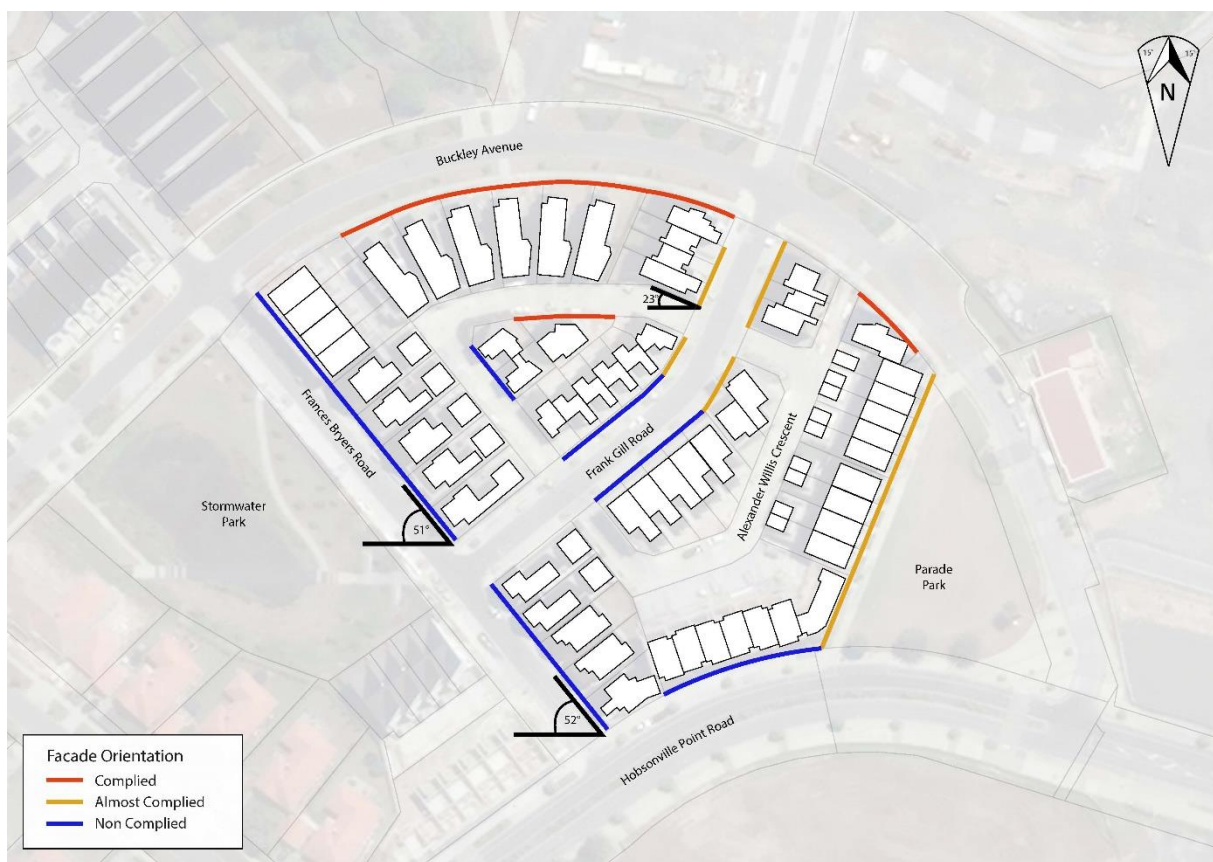


Figure 38: Sunderland facade orientation analysis.

Table 9: Sunderland SB2 & SB3 block orientation summary

SUNDERLAND BLOCK IDENTIFIER	BLOCK ORIENTATION (DEGREES FROM GEOGRAPHICAL EAST/WEST)	BLOCK LENGTH (M)
Frances Bryers Road	+ 52° W	SB2: 79m SB3: 47m Both: 139m
Frank Gill Road (West)	+ 67° E	108m
Frank Gill Road (East)	+ 39° E	115m

Hobsonville Point Road	+ 20° E	58m
Buckley Ave (SB2: curved)	+ 16 W to - 32 W	125.5m
Buckley Ave (SB3)	+ 40° W	51m
Public Reserve	+ 68° E	72m

Block length and solar orientation of blocks is good practice climate-sensitive design and contributes to a lower household energy demand for heating and cooling. It is important that this factor is considered in the early stages of development so that block orientation and layouts allow future buildings to make the most of solar gain and solar access opportunities. With the previous land use, the block orientation and layout in Hobsonville Point were limited at times (e.g. Sunderland blocks). However, where the block orientation is constrained, the choice of building typology most appropriate to the block can improve solar gain and solar access (e.g. standalone dwellings rather than continuous terraces).

In future iterations of the POE framework, a more detailed 3D modelling of both the terrain and the buildings would help understanding and assessing the urban morphology together with the sun path analysis to provide a more accurate climate-sensitive design.

2. Energy Use & Production (Non-Transportation)
NEIGHBOURHOOD SCALE
2.5 Energy Efficiency
2.5.1 Were energy efficiency standards set for across the neighbourhood that will result in at least a reduction in carbon dioxide emissions?

An aspirational goal of the SDF was “no carbon emissions from stationary energy use” (Hobsonville Land Company, 2015, p. 6). To achieve this, the SDF set a target for average annual household grid energy consumption (electricity and reticulated gas) to be 6,500 kW/h or less by 2026. In the 2017/18 Sustainability report, the average energy consumption for Hobsonville Point households (6,128 kW/h) was 25% lower than the Auckland average (8,200 kW/h) (Hobsonville Land Company, 2019).

Household emission reductions through energy savings have been achieved primarily through thermal performance and hot water rating requirements for homes (standards set out in CDP). Also, all properties have smart meters to enable users to monitor their energy usage at peak times and, for example, choose to schedule the dishwasher or washing machine to operate when electricity is cheaper. To meet peak demands, additional sources of power generated from fossil-fuels are often initiated. As such, reducing power use during peak periods often serves to reduce carbon emissions also. The SDF acknowledges the link between energy use and climate change, thus by setting targets and development indicators to reduce energy consumption, carbon dioxide emissions from the development could be reduced.

2. Energy Use & Production (Non-Transportation)
BLOCK SCALE
2.5 Energy Efficiency
2.5.2 Are the projects minimum Homestar 6 or Passive House certified to encourage energy efficiency within each development?

Homes were not constructed to certified Passive House standards. When development planning began for Hobsonville Point, the Homestar rating system did not exist. However, as mentioned in item 2.3.1, all homes in Buckley and Sunderland blocks were built to comply with a 5-Star thermal performance rating using the New Zealand HERS star rating system. This performance standard encourages energy efficiency through design, by improving dwelling thermal performance and reducing household energy demands for heating and cooling.

In the Sunderland precinct, all homes were built to the Homestar 6 rating standard (Strang, 2014). It is not possible to determine how many Homestar 6 houses have actually been delivered, as it was up to the individual developers' builders who delivered the super lots from the masterplan.

2. Energy Use & Production (Non-Transportation)
NEIGHBOURHOOD SCALE
2.6 District Lighting
2.6.1 Is there a strategy for reducing energy requirements for lighting?

HLC specified public LED street lighting throughout the Hobsonville Point development. It was a deliberate and progressive move to pilot more sustainable lighting technology for subdivision and provide an example to other developments. In private dwellings, there was no target or requirement for low-energy light fittings. However, HLC successfully lobbied the builders to adopt LED lighting and it was easily adopted because it is not difficult to install, or much more expensive than alternative light.

LED lighting is much more energy efficient, requiring less energy and with a longer operating lifespan than conventional incandescent lighting. By incorporating LED lighting across the development, the household and public energy demand from lighting has been reduced (no specific data available to demonstrate improvement). For future developments, a sustainable development indicator to establish a sustainable lighting target is recommended. With a measurable, specific target for reducing energy requirements for lighting in place, the extent of energy savings across the development could be calculated.

2. Energy Use & Production (Non-Transportation)
NEIGHBOURHOOD SCALE
2.7 Energy Storage and Production
2.7.1 Is there provision in the masterplan for PV, micro-hydro, micro-wind turbines or biomasses across the neighbourhood?

HLC investigated numerous options for local energy storage and production, including micro-wind turbines and combined heat and power. HLC’s investigation into local energy production concluded that solar photovoltaics (PV) would be the most sensible option for Hobsonville Point. However, while these were considered a good symbol of sustainability, at scale they couldn’t be justified as a power source for the development. HLC was aware of the high cost of PV and this would make it more difficult to implement, compared to alternative energy saving measures, such as thermal performance and hot water systems. As such, the CDP did not require any local energy storage or production. In addition, the development site was already within a reticulated power network, so HLC worked with Vector to roll out an integrated power and telecommunications system for the development.

The SDF included a development indicator to provide at least two on-site demonstration renewable energy generation projects by 2026. The 2017/18 Annual Sustainability Report reported that a 2 kW solar photovoltaic system was installed on the Catalina Café and further demonstration projects were being explored (Hobsonville Land Company, 2019). While demonstration projects have their place, they do not make a significant contribution to local energy production. However, if possible, it would be interesting to understand the impact of these demonstration projects on the uptake of micro-energy systems in local households or businesses.

Photovoltaics, micro-hydro, micro-wind turbines or biomass are forms of localised renewable energy production. Similar to a district heating and cooling system, they can provide low emissions energy sources that are independent of the national grid and hence more resilient and sustainable. As the price of PVs lowers with greater production volumes and robotic manufacturing, it is expected that future developments will incorporate more of them.

2. Energy Use & Production (Non-Transportation)
NEIGHBOURHOOD SCALE
2.7 Energy Storage and Production
2.7.2 Is there an agreement for the neighbourhood to be net positive?

There was no agreement for a net positive development in Hobsonville Point and, to the best of our knowledge, no neighbourhood development in New Zealand has achieved a net positive outcome.

A net-positive energy building produces more energy than what it consumes, and net-positive energy neighbourhoods are those:

“in which the annual energy demand is lower than annual energy supply from local renewable energy sources. Their energy infrastructures are connected to and contribute to the efficient operation and security of the wider energy networks. The aim is to support the integration of distributed renewable energy generation into wider energy networks and provide a functional, healthy, user friendly environment with as low energy demand and little environmental impact as possible.” *(Ala-Juusela, Crosbie, & Hukkalainen, 2016, fig. 1)*

An energy-positive neighbourhood maximises energy efficiency – which was an SDF objective – and minimises peak power demand in homes, public spaces, transport and commercial areas. To achieve net-positivity also requires local renewable energy generation and storage infrastructure. A net positive cost of energy means that energy costs break even or make a profit. This can be achieved by selling excess electricity back to the grid.

2. Energy Use & Production (Non-Transportation)
BLOCK SCALE
2.7 Energy Storage and Production
2.7.3 Are the connections available at the block scale for increased local energy production?

No – Refer section 2.7.1.

4.3. Water Management and Conservation

4.3.1. Hobsonville Point Sustainable Development Indicators

The SDF for Hobsonville Point sets out an aspirational goal of “low impact water management throughout the development” (Hobsonville Land Company, 2015, p. 6). The SDF acknowledges that stormwater quality control is important because of the sensitivity of the receiving environment (Waitematā Harbour). Low impact design approaches, such as a treatment train to minimise contamination, is envisioned to manage stormwater quality and quantity. Also, the SDF acknowledges that “reducing water consumption will help reduce the need for water supply infrastructure upgrades (such as a new dam or pipeline) and reduce the risk of overflows from the sewage network during heavy rain” (Hobsonville Land Company, 2015, p. 6). Under the Environmental sphere, the SDF includes objectives and indicators relating to water management and conservation, as per Figure 39.

Sphere	Dimension	Objectives	Long term indicators	Development indicators
1. Environmental	Ecology	<ol style="list-style-type: none"> 1. Create an integrated natural habitat 2. Increase indigenous biodiversity 	<ol style="list-style-type: none"> 1. A continuous green corridor with native vegetation covering at least 10% of the site is retained/established. 2. Pre and post development native flora and fauna counts indicate that species diversity and abundance has increased in key areas. 	<p>Native habitat areas along the coastal corridor are maintained and enhanced. A management plan for the coastal area is completed that covers planting, weed and pest management strategies.</p> <p>Eco sourced native plants are used where native plants are planted in public areas.</p> <p>Local seed is collected and grown into plants for key revegetation species.</p> <p>Education/management programme in place while HLC on site.</p> <p>See “Water” for stormwater quality indicators.</p>
	Energy	<ol style="list-style-type: none"> 3. Reduce non-renewable energy use 4. Energy efficiency 	<ol style="list-style-type: none"> 3. Average household grid energy (reticulated gas and electricity) consumption is 6,500 kWh/year or less. 	<p>Houses built to a calculated BPI of 1.2 or lower for thermal performance and 5.5 Star HERS hot water rating or equivalent performance level.</p> <p>All properties have smart meters.</p> <p>At least 3 on site demonstration renewable generation projects.</p> <p>Education/management programme in place while HLC on site.</p>
	Water	<ol style="list-style-type: none"> 5. Reduce water consumption 6. Improve water quality 	<ol style="list-style-type: none"> 4. Average residential town supply water consumption is 100 litres or less per person per day. 	<p>All stormwater, except roof water, receives treatment before being discharged into the harbour.</p> <p>All houses have 6/3 litre, or less, dual flush toilets.</p> <p>3 Star or better water saving fixtures.</p> <p>Dwellings are served by rain tanks sized to supply 75% of water used in household toilets, laundries and gardens.</p> <p>No in-built irrigation will be provided in gardens.</p> <p>Education/management programme in place while HLC on site.</p>
	Resource efficiency	<ol style="list-style-type: none"> 7. Recycle and renew existing buildings and other infrastructure 8. Reduce off-site waste disposal 	<ol style="list-style-type: none"> 5. Mixed household waste collected is 100kg/person/year or less. 	<p>At least 20% of existing buildings will be retained and renovated or reused off site.</p> <p>The majority of construction and demolition waste is recycled.</p> <p>At least 3 public recycling bins are provided in public spaces.</p> <p>Education/management programme in place while HLC on site.</p>

Figure 39. Water strategy as per HLC’s SDF (Hobsonville Land Company, 2015, p. 7).

The series of Annual Sustainability Reports prepared by HLC have measured performance against these indicators, year-on-year since 2012. The results of these reports up to 2018 are provided in Figure 40Figure 41.

Long Term Indicators	Target	Results				Comment
	2026	2014/15	2015/16	2016/17	2017/18	2017/18
Average residential town supply water consumption per person per day.	100 litres or less	105 Litres	108 Litres	107 Litres	106 Litres	32% lower than Auckland average of 157 litres per person per day ² . 6L away from our 2026 target.

Figure 40. Sustainable Development Performance against long term water indicators (Hobsonville Land Company, 2019, p. 10).

Development indicators	Comment
All stormwater, except roof water, receives treatment before being discharged into the harbour.	Achieved
All houses have 6/3 litre, or less, dual flush toilets.	Achieved. 6/3 litre or better required as part of consent.
Three star or better water-saving fixtures.	Achieved. Required as part of consent.
Dwellings are served by rain tanks sized to supply 75% of water used in household toilets, laundries and gardens.	Achieved for the majority of dwellings but not practical for some apartments.
No in-built irrigation will be provided in gardens.	Not being monitored but implemented into contractual agreements with builders and Comprehensive Development Plans.

Figure 41. Sustainability performance against development water indicators (Hobsonville Land Company, 2019, p. 12).

4.3.2. Assessment against POE framework

3. Water Management and Conservation
NEIGHBOURHOOD SCALE
3.1 Flood Risk Management and Mitigation
3.1.1 What are the overland flowpaths and what mitigation strategies have been employed?

The SDF did not specifically consider flood risk mitigation. Also, a precinct-wide Flood Risk assessment was not completed. Prior to development, natural streams and gulleys on site functioned as overland flowpaths. Through development, minor earthworks altered the natural overland flowpaths and site-specific mitigation was required in some cases. Geomaps Overland Flowpath and flood plain data provide an indication of the post-development overland flowpaths on each of the case study blocks (Figure 42 and Figure 43).

The Sunderland SB2 and SB3 resource consent decision report for land use and subdivision (Daniels, 2016) recognised that an overland flowpath runs through the site. Auckland Council's Geomaps indicates that the flowpath catchment is between 4,000 m² to 3.0 ha (Figure 42). For the Sunderland development, the overland flowpath was diverted and

contained along the roads. No specific finished floor levels were prescribed for this sub-precinct.

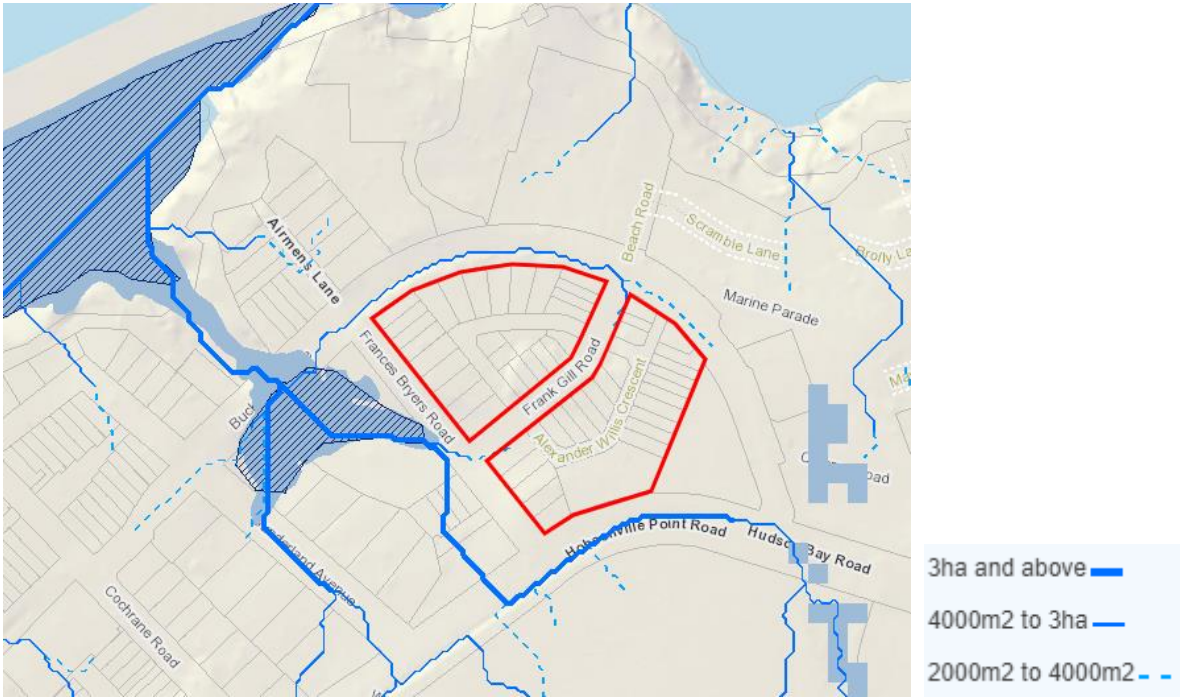


Figure 42: Sunderland Stage 1 - SB2 & SB3 Overland flowpath (Source: Auckland Council Geomaps).

The Buckley B25 resource consent decision report for land use and subdivision states that:

The overland flowpath from the upstream catchment will be conveyed by Ponga Street and Harakeke Road. It is proposed to construct finished floor levels 600mm above the surrounding road and as such the buildings will be clear of the overland flow” (Bury, 2014, p. 17).

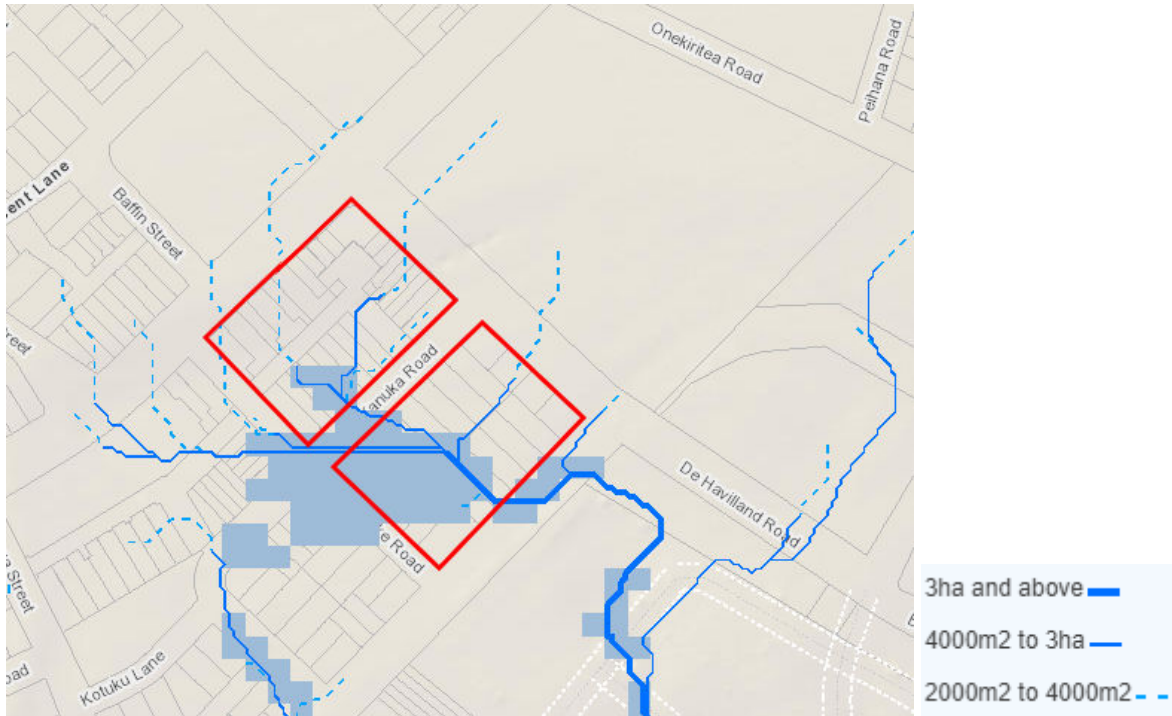


Figure 43: Buckley blocks – B23 & B25 Overland flowpath (Source: Auckland Council Geomaps).

Flood risk management, including consideration for overland flowpaths, is important for sustainable urban development. Extreme rainfall events which cause excess surface water flooding presents a risk to developed areas. Flood risk management is critical to resilient and sustainable development that will support communities despite these conditions. Where a development is within or adjacent to a flood plain or overland flowpath, mitigation measures such as raised floor levels, unobstructed flowpaths, swales or dedicated (undeveloped) ponding areas should be considered. Planning and mitigation for flood risks are not a cure-all solution, as extreme rainfall events are largely uncertain, however these measures aim to reduce the frequency and severity of any impacts on habitable areas (homes) and community infrastructure.

The Stormwater Code of Practice establishes various requirements for flood risk mitigation in Auckland on the basis of ‘design storm events’ with set probabilities of rainfall frequency and duration (1 in 50 year storm event or 1 in 100 year storm event) (Auckland Council, 2015b).

3. Water Management and Conservation
NEIGHBOURHOOD SCALE
3.2 Stormwater Management Planning
3.2.1 Have Water Sensitive Urban Design (WSUD) principles been applied at the site?

The SDF for Hobsonville Point set out an aspirational goal for ‘low impact water management’. Low impact water management, which adopts principles of Low Impact Urban

Design and Development (LIUDD), is generally synonymous with Water Sensitive Urban Design (WSUD)⁶.

An Integrated Catchment Management Plan (ICMP) for the entire Hobsonville Peninsula prepared by URS (2008) addresses the effects of stormwater and wastewater discharges on the receiving environment, and provides a framework for integrating catchment-wide water resources management into the development. The ICMP incorporates LIUDD and integrates a treatment train approach. Subsequently, the CDP for Sunderland and Buckley, provides for development of a ‘treatment train’ in accordance with low-impact water principles. A treatment train approach employs a series of sequential stormwater management controls to provide ‘complete’ stormwater quality and quantity treatment within a catchment or development site. As per the SDF, the Hobsonville Point neighbourhood provided treatment for all stormwater, except roof water, before being discharged into the harbour (Figure 41).

The Hobsonville Point treatment train begins with at-source stormwater mitigation, then measures to capture and treat overland flows, and finally interventions to enhance receiving environments to improve their stormwater functions (Table 10). In practice, the ICMP and CDP provisions related to low impact water management or WSUD were implemented through the resource consent process.

Table 10: Stormwater 'treatment train' elements and implementation at Hobsonville Point

TREATMENT TRAIN SEQUENCE	SCALE	EXAMPLE
1. At-source stormwater control with on-site rainwater re-use tanks in every residential lot in this development. These devices reduce stormwater runoff downstream and control peak flows of stormwater, reducing flood risk downstream.	SITE	Resource consent conditions provided that rainwater tanks were installed on each residential Lot to provide re-use volume of 75% of the water required for toilet flushing, washing machine and garden use (to comply with the ICMP and CDP for Buckley).
2. Treatment of surface runoff and overland flow management. The ICMP prioritised treatment devices in the locations where surface water would be most contaminated, such as the major road corridors.	BLOCK	The Buckley B25 resource consent decision reported that “stormwater quality will be treated at a proprietary stormwater filter device in Ponga Street and stormwater quantity managed by a flow control system in Clark Road” (Bury, 2014).
3. Major stormwater treatment devices including stormwater ponds and wetlands. These were specified by the ICMP, to provide adequate stormwater treatment prior to discharge to the receiving environment.	NEIGHBOURHOOD	Unitary Plan controls, which later superseded CDP guidelines, were clear on the fact that “catchment-wide stormwater management facilities such as wetlands and treatment ponds should only be used as a final form of treatment, not the primary form”(Daniels, 2016) ⁷ .

⁶ LIUDD was previously the preferred terminology for this stormwater design approach in Auckland, as at the inception of Hobsonville Point. Now, Auckland Council uses the WSUD terminology (Auckland Council, 2015b; Lewis et al., 2015).

⁷ Auckland Unitary Plan, I605 Hobsonville Point Precinct, Rule 3:K.5.17.6, 4(g).

The treatment train approach is the preferred WSUD approach to stormwater management. However, in practice, this was not fully implemented in the SB2 and SB3 blocks of the Sunderland sub-precinct. Various design constraints at intersections, or limited developer understanding of CDP requirements, led to various concessions for stormwater device location or size provided at the design and construction phases. In one of the study blocks, low impact stormwater devices were initially not installed by the developer to treat stormwater prior to discharge to a wetland, based on a perceived precedent from other precincts. This oversight was discovered late in the design phase by stormwater specialists at Auckland Council, which at that late stage in the development process was not economical to fully accommodate this requirement. In this case, non-compliant treatment devices (providing 50-60% treatment) were permitted in the road reserve to provide water quality and quantity treatment prior to discharge to the wetland.

From interviews with HLC, it is clear that there is room for improvement among urban design and landscape architecture professionals about the best place to locate rain gardens and other stormwater treatment devices involved in the WSUD approach. HLC recognises the need for more joined-up thinking between the design disciplines, including stormwater engineers, to achieve the better outcomes for stormwater. For example, raingardens should be located in streets where the water is most contaminated; that is, a minor residential street with a rain garden is not an efficient provision of infrastructure to achieve stormwater treatment targets.

Similar to flood risk management, WSUD principles seek to manage stormwater and surface water runoff to support social and environmental sustainability. As an alternative to ‘hard’ network stormwater infrastructure, WSUD instead promotes a stormwater management design approach that reduces stormwater volumes and peak flows and provides for stormwater quality treatment. Collectively, these measures reduce flood risk, support water resource efficiency resilience and improve water quality entering the (coastal) receiving environment, which has positive ecological implications.

3. Water Management Planning
NEIGHBOURHOOD SCALE
3.2 Stormwater Management Planning
3.2.1 Was there a rainwater management plan developed for the neighbourhood?

The SDF for Hobsonville Point set out an aspiration for “low impact water management throughout the development” in the environmental sphere, water dimension (Hobsonville Land Company, 2015). In essence, this is an aspiration for sustainable rainwater management which has formed a basis for the implementation of specific rainwater management measures in Hobsonville Point, above and beyond usual urban development standards. Stormwater management or surface water management is one aspect of the rainwater management approach, which has already been discussed in the preceding items of Section 3. The other

elements to consider for rainwater management are water supply and groundwater management.

In terms of water supply and consumption, the SDF set a long-term development indicator of 100 L/p/day (or less) average town supply water consumption per person per day by 2026. Across the last four years of annual sustainability reporting, the average residential water consumption has been between 105 and 108 L/p/day (Figure 40). While Hobsonville Point has technically not yet met this SDF target, town supply water consumption is 32% lower than the Auckland average and is quite close to the 2026 target (Hobsonville Land Company, 2019). The specific elements that have contributed toward achieving this target are set out as development indicators in the SDF (Hobsonville Land Company, 2015):

- all stormwater, except roof water, receives treatment before being discharged into the harbour;
- all houses have 6/3 litre, or less, dual flush toilets;
- three star or better water saving fixtures;
- dwellings are served by rain tanks to supply 75% of water used in household toilets, laundries and gardens;
- no in-built irrigation will be provided in gardens.

Figure 41 shows that the SDF water-related development indicators have all been achieved, except for the irrigation target. Irrigation wasn't monitored specifically, but HLC used contractual agreements with builders and the CDP to prevent irrigation being installed. The other rainwater management elements including on-site rainwater re-use tanks, other stormwater treatment train devices, water-saving fixtures and dual-flush toilets were delivered through the resource consent process.

No specific comment or provision for groundwater management was set out in the SDF or CDP. While low impact water management provisions that balance surface permeability and imperviousness, support groundwater recharge (infiltration back into ground water). That said, there was no specific development indicator related to groundwater management or minimum permeable areas. In Auckland, the predominant clay soils make groundwater recharge less of a critical water management issue. However, for future applications of this POE framework, groundwater management should be retained: in other parts of Auckland and New Zealand with more permeable soils and/or groundwater aquifers this would be a critical consideration for environmental sustainability of urban development. Equally, in some development situations a high groundwater table is a constraint, and so a rainwater management plan should consider how to mitigate and manage this to support sustainable urban development.

Sustainable rainwater management aims to reduce household water consumption, integrating resilience and efficiency into how households use water resources. Also, it aims to maintain natural hydrological functions (as much as possible) with provisions for groundwater recharge and low impact stormwater management. Water is critical to sustainable urban

development, as a resource for households (potable and non-potable water supply) and to support natural functions in the environment from hydrology and ecology to meteorology and hydrogeology.

3. Water Management Planning
BLOCK SCALE
3.3 Water Use Reduction Initiatives (Rainwater Capture & Re-use)
3.3.1 Is there a resource or building consent requirement for water tanks and water re-use?

The Comprehensive Development Plans (CDP) in both the Buckley and Sunderland sub-precincts set out requirements for each residential unit to have water tanks to supply 75% of non-potable water use within the house, as per the SDF water-related development indicators (Hobsonville Land Company, 2015, p. 7). These general consent conditions outlined in each CDP were incorporated into resource consent conditions and approved by Auckland Council for each sub-precinct.

The Buckley CDP Building Matrix established the following condition (Hobsonville Land Company, 2009, sec. 5.1):

5.1 vii The residential units will have their toilet, laundry and garden water use supplied from rainwater tanks. Rain tanks will be sized to achieve at least 75% of toilet, garden and laundry use supplied from rainwater, using the Waitākere City Council developed TUSC calculator. Above ground tanks are to be integrated into the landscaping so as not to be visually intrusive. Some flexibility in rain tank minimum size is permitted to ensure effective landscape integration. All dwellings will be fitted with water efficient fixtures, including 3 Star or better toilets, shower heads and taps over hand basins, or achieve equivalent flow rates by other means.

The resource consent for land use and subdivision for Buckley block B23 then established the following condition (Bury, 2015, sec. 20): (i): Covenant for all units to be entered into as per section 108(2)(b) (Figure 44).

- (i) Rainwater runoff from each of the proposed dwellings except on lots 17 to 25 must be collected and reused for toilet flushing, washing machine and garden use. The tank must be sized as per the table below. Stormwater tanks shall be integrated into buildings and/or landscaping so they are not visually intrusive. Some flexibility in rain tank minimum size is permitted to ensure effective landscape integration.

Tank sizes for Detached and Attached Housing:

1 Bedroom (includes studio)	1000L
2 Bedroom	2000L
3 Bedroom	3000L
4 Bedroom	3000L (roof area > 110m ²) or 5000L (roof area < 110m ²)
5 Bedroom	5000L

Note: all attached houses to be 3000L max to achieve acceptable amenity.

Tank sizes for Apartments:

1 Bedroom (includes studio)	1000L
2 Bedroom	1000L
3 Bedroom	1500L
4 Bedroom	2000L
5 Bedroom	2500L

Figure 44: Covenant for rainwater tanks, Buckley block 23 (Bury, 2015).

The Sunderland CDP land use and activities condition states (Isthmus Group et al., 2013, sec. 3.3.1.7):

3.3.1.7 All new residential units shall have their toilet, laundry and garden water use supplied from rainwater tanks. Rainwater tanks for the relevant building typologies will be sized in accordance with the table below. Rain tank capacity for attached housing and apartment typologies can be provided in either individual or as communal rainwater systems. All dwellings will be fitted with water efficient fixtures, including 3 Star (under the Water Efficiency Labelling Scheme (WELS) Apr 2010) or better toilets, shower heads and taps over hand basins, or achieve equivalent flow rates by other means.

Refer to Table 11 for detached and attached housing typologies.

Table 11. Detached and Attached Housing.

1-Bedroom (incl. studio)	1000 L
2-Bedroom	2000 L
3-Bedroom	3000 L
4-Bedroom	3000 L (roof area > 110m ²) or 5000 L (roof area < 110m ²)
5-Bedroom	5000 L

The resource consent for land use and subdivision for Sunderland then established the following condition (Isthmus Group et al., 2013):

Condition 21:

- c. Fitted with water efficient fixtures, to a minimum 3-Star standard (under the Water Efficiency Labelling Scheme (WELS)).*
- d. Non-potable water requirements (for toilets, laundry and gardens) supplied by rainwater tanks (or bladders) sized in accordance with the table below. Rain tank/bladder capacity for attached housing typologies can be provided in either individual or as communal rainwater systems.*

Prior to the occupation of the dwelling, these requirements shall then be implemented in full for each dwelling and maintained thereafter, unless agreed in writing by the SHA Consenting Manager.

Advice Note:

- i. The time of application for building consent is a trigger for the requirement to provide the design ratings to council. This is not a requirement of building consent.*
- ii. This condition is to ensure compliance with Condition 3.3.1.6 of the Sunderland CDP and Part 3, Chapter K, Rule 5.17.4.1.10 of the PAUP.*

Through the consent process, the relevant standard conditions were applied to give effect to the CDP and SDF. Specifically, the Water related objectives (Hobsonville Land Company, 2015, p. 7):

- reduce water consumption;
- improve water quality.

Each residential unit had rainwater tanks and water-efficient fixtures installed successfully. From an interview, HLC representatives reflect that people have been willing to accept and maintain these devices. Also, data from Annual Sustainability Reports show that they are consistently performing well and meeting development indicator targets set out in the SDF (Hobsonville Land Company, 2019). The rainwater re-use tanks provided in Hobsonville Point are a key element of what sets Hobsonville Point apart as a sustainable development.

Individual on-site rainwater re-use tanks contribute toward at-source stormwater management (first step of WSUD treatment train), water resource efficiency (reduced water consumption) and some level of water resilience. On-site rainwater re-use tanks reduce consumer demand on the reticulated potable water network, because laundry, toilets and gardens use non-potable water collected on-site. In Auckland, as with most urban areas, potable water supply is sourced from natural water sources, treated at a centralised plant and then supplied to neighbourhoods via the reticulated water network. Hence, having a localised water supply option (albeit partial) is more energy efficient and provides some resilience for water supply, by being separate from the metropolitan network.

3. Water Management Planning
BLOCK SCALE
3.4 High Surface Permeability
3.4.1 What materials and strategies have been used at the block scale to ensure surface permeability?

To ensure surface permeability in each sub-precinct, impervious surface limits were established through the CDP. CDP conditions were carried through as resource consent conditions, and included in the Hobsonville Point Precinct Plan (Auckland Council, 2016) which later superseded the CDP. Impervious surface coverage conditions ensured that a minimum permeable surface area was maintained, depending on the development typology.

The Buckley CDP conditions stated (Hobsonville Land Company, 2009):

5.1 11 Garden Apartment: 85% site coverage, Townhouse, 85% impervious coverage and minimum 15% permeable coverage.

5.1 xiv There shall be an average impermeable surface limit of 79% over all Superlots including rear lanes, and made up as follows with reference to Section D Development Plans, Plan 3: Land Use:

a. 100% in the Apartments, Mixed Use Retail and Mixed Use Retail Neighbourhood Centre zones

b. 85% in the zones for residential units supporting flexible ground floor uses

c. 65- 100% in the Residential Housing zones, subject to the applicant providing an assessment of the cumulative impermeable surfaces across the CDP area demonstrating that stormwater infrastructure capacity will not be exceeded, and that 79% average impermeability will not be exceeded

5.2 vii There shall be a maximum of 90% impermeability on all roads and lanes within the legal road reserve. There shall be a maximum of 40% impermeability within the Buckley Avenue East road reserve.

Buckley block B23 resource consent (Bury, 2015) conditions highlighted infringements with the CDP standard for impervious coverage in Lots 2-10, Lots 17-20 and Lots 23-25. Under section 113 of the RMA, the planner considered these infringements “small in scale and will generate effects less than minor while not compromising the outcomes desired by the CDP” (Bury, 2015, p. 2). The consent decision report established Covenants on the title of each unit that infringed the impervious coverage control, to limit the total impervious coverage to the proposed extent for the life of the dwelling (Bury, 2015). Also, Consent Notices were entered into for these lots, pursuant to Section 221, to record that the impervious coverage limits (including specified infringements) must be adopted and adhered to for stormwater

mitigation purposes (Bury, 2015). A schedule of building typology and impermeable areas for each Lot was required to be included in the covenant.

Similarly, Buckley block B25 resource consent stated that the proposal was consistent with the level of impervious surfaces anticipated by the Buckley CDP, and so “effects on water quality and quantity in terms of stormwater runoff...will be less than minor” (Bury, 2014).

The Sunderland CDP General Conditions established the following controls (Isthmus Group et al., 2013):

3.0.5 Site Services

The consent holder shall implement methods to ensure that the following specified impermeable surface limits are not exceeded:

- i. 90% within the legal road reserves;*
- ii. 5% within Parks reserves;*
- iii. 100% in the Neighbourhood Centre, and sites accommodating Apartments;*
- iv. 80% average over all blocks including rear lanes;*
- v. 65-100% in the residential housing areas subject to the applicant providing an assessment of the cumulative impermeable surfaces across the CDP area demonstrating stormwater infrastructure capacity and that 73% average impermeability will not be exceeded.*

At resource consent, these impermeable surface conditions were complied with across the Sunderland sub-precinct, with the exception of five lots which marginally exceeded the controls. Through the resource consent process the wider environmental effects of these infringements were considered less than minor and no additional mitigation was required (Arthur & Daniels, 2016; Hopkins, 2016).

It is worth mentioning that, midway through the Hobsonville Point development, the CDP were superseded by the Hobsonville Precinct Plan (Auckland Council, 2016). This precinct plan establishes the planning controls that apply to development in the Hobsonville Precinct under the Auckland Unitary Plan (**Error! Reference source not found.**), once The Housing Accords and Special Housing Areas Act lapsed. Table 12 details the maximum impervious area controls for Hobsonville Point, by residential building typology.

Table 12. Hobsonville Precinct Plan controls for maximum impervious area and minimum landscaped area. (Auckland Council, 2016).

Sub-precinct/area	Maximum impervious area	Maximum building coverage	Minimum landscaped area
Buckley Sub-precinct (Sub-precinct B)	70% for detached housing*, or 85% for attached housing*	60% for detached housing, or 75% for attached housing	30% for detached housing, or 15% for attached housing
Sunderland Sub-precinct (Sub-precinct C)	80% for detached housing 85% for attached housing	55% for detached housing 65% for attached housing	15%

In public spaces, such as streetscapes and reserves, impervious surface limits were also prescribed by the CDP. At resource consent, Landscape Plans provided guidance on the nature of permeable surfaces, planting specifications for permeable landscaped areas. CDP also provided guidance on streetscape and carparking design, to include low impact design features, such as raingardens, and also use of permeable surface materials where possible (and depending on the speed environment or street function in question) (Hobsonville Land Company, 2009; Isthmus Group et al., 2013).

As previously discussed in item 1.3.3, beyond 30% impervious coverage, the adverse water quality impacts of urban development can't easily be remedied. As such, the comparative effect of different permeable coverages to accommodate different housing typologies has a negligible downstream impact. However, it was highly beneficial that development at Hobsonville Point adhered to impervious coverage limitations to ensure permeable areas were maintained. Surface permeability supports natural hydrological functions including rainwater infiltration into the ground, evapotranspiration and regulating runoff. Also, permeable areas regulate temperature and mitigate against the urban heat island effect. Vegetated permeable surfaces such as lawns and gardens also provide important visual amenity for neighbourhoods, and habitat for native flora and fauna. For sustainable development, permeable surfaces offer a multiplicity of benefits and maximum impervious coverage controls are one way to integrate these into development plans.

3. Water Management Planning
BLOCK SCALE
3.4 High Surface Permeability
3.4.2 What is the average surface permeability across the block? ⁸

For the Sunderland study blocks, the average surface permeability across the residential area is 34% (Table 13). The CCDP for Sunderland blocks SB2 and SB3 required that impermeable surface limits do not exceed 73% average over all blocks in residential housing areas, including rear lanes. The average impervious area across the residential lots (only) is 66%, and thus this requirement for surface permeability has been met.

Table 13: Surface permeability summary for Sunderland residential blocks SB3 and SB2. Note: figures relate to residential lots only, excluding access lots and road reserves.

	TOTAL BLOCK AREA (M²)	AVERAGE IMP. (%)	TOTAL IMP. AREA (M²)	AVERAGE PERM. (%)	TOTAL PERM. AREA (M²)
SB3	4,161	67%	2,785	33%	1,376
SB2	5,174	65%	3,351	35%	1,824
TOTAL	9,335	66%	6,136	34%	3,200

For the Buckley study blocks, the average surface permeability across the residential area is 40%, and average impermeability is 60% (Table 14). The CDP for Buckley required that impermeable surface limits do not exceed 85% for Garden Apartments or 75% for Townhouses, with a 79% average impermeable coverage over the entire Superlots, including rear lanes. The average impervious area across the residential lots (only) is 66%, and thus this requirement for surface permeability has been met.

Table 14: Surface permeability summary for Buckley residential blocks B23 and B25. Note: figures relate to residential lots only, excluding access lots and road reserves.

	TOTAL BLOCK AREA (M²)	AVERAGE IMP. (%)	TOTAL IMP. AREA (M²)	AVERAGE PERM. (%)	TOTAL PERM. AREA (M²)
B23	4,715	76	3,605	24	1,110
B25	5,876	47	2,765	53	3,111
TOTAL	10,591	60	6,370	40	4,221

Provisions to maintain surface permeability have benefits for stormwater management, supporting groundwater recharge, evapotranspiration, slowing and reducing surface runoff and reducing strain on the stormwater network and buffering against surface flooding. A good balance of permeable area also contributes to mitigating against the urban heat island effect, supports biodiversity and amenity as permeable areas are often grassed or landscaped areas.

⁸ In the philosophy of this being a preliminary framework this question has been left vague – complex calculation and international evaluations are very specific, and the data is not readily available. When monitoring and evaluation programmes are more established in New Zealand, this may change.

4.4. Ecology and Habitat

4.4.1. Hobsonville Point Sustainable Development Indicators

The Hobsonville Point SDF includes an Ecology dimension within the Environmental sphere (Hobsonville Land Company, 2015). The aspirational goal for ecology is “the ecological health of the Hobsonville Point site and adjacent marine area is improved” (Hobsonville Land Company, 2015, p. 6).

Sustainability objectives and indicators related to the Ecology dimension are illustrated in Figure 45.

Sphere	Dimension	Objectives	Long term indicators	Development indicators
1. Environmental	Ecology	<ol style="list-style-type: none"> 1. Create an integrated natural habitat 2. Increase indigenous biodiversity 	<ol style="list-style-type: none"> 1. A continuous green corridor with native vegetation covering at least 10% of the site is retained/established. 2. Pre and post development native flora and fauna counts indicate that species diversity and abundance has increased in key areas. 	<p>Native habitat areas along the coastal corridor are maintained and enhanced. A management plan for the coastal area is completed that covers planting, weed and pest management strategies.</p> <p>Eco sourced native plants are used where native plants are planted in public areas.</p> <p>Local seed is collected and grown into plants for key revegetation species.</p> <p>Education/management programme in place while HLC on site.</p> <p>See “Water” for stormwater quality indicators.</p>
	Energy	<ol style="list-style-type: none"> 3. Reduce non-renewable energy use 4. Energy efficiency 	<ol style="list-style-type: none"> 3. Average household grid energy (reticulated gas and electricity) consumption is 6,500 kWh/year or less. 	<p>Houses built to a calculated BPI of 1.2 or lower for thermal performance and 5.5 Star HERS hot water rating or equivalent performance level.</p> <p>All properties have smart meters.</p> <p>At least 3 on site demonstration renewable generation projects.</p> <p>Education/management programme in place while HLC on site.</p>
	Water	<ol style="list-style-type: none"> 5. Reduce water consumption 6. Improve water quality 	<ol style="list-style-type: none"> 4. Average residential town supply water consumption is 100 litres or less per person per day. 	<p>All stormwater, except roof water, receives treatment before being discharged into the harbour.</p> <p>All houses have 6/3 litre, or less, dual flush toilets.</p> <p>3 Star or better water saving fixtures.</p> <p>Dwellings are served by rain tanks sized to supply 75% of water used in household toilets, laundries and gardens.</p> <p>No in-built irrigation will be provided in gardens.</p> <p>Education/management programme in place while HLC on site.</p>
	Resource efficiency	<ol style="list-style-type: none"> 7. Recycle and renew existing buildings and other infrastructure 8. Reduce off-site waste disposal 	<ol style="list-style-type: none"> 5. Mixed household waste collected is 100kg/person/year or less. 	<p>At least 20% of existing buildings will be retained and renovated or reused off site.</p> <p>The majority of construction and demolition waste is recycled.</p> <p>At least 3 public recycling bins are provided in public spaces.</p> <p>Education/management programme in place while HLC on site.</p>

Figure 45. Ecology strategy as per HLC’s SDF (Hobsonville Land Company, 2015, p. 7).

The series of Annual Sustainability Reports prepared by HLC have measured performance against these ecological sustainability indicators, year-on-year since 2012. Figure 46, Figure 47 and Figure 48 summarise the reporting outcomes up to 2018.

Long Term Indicators	Target	Results				Comment
	2026	2014/15	2015/16	2016/17	2017/18	2017/18
A continuous green corridor with native vegetation covering at least 10% of the site is established/retained.	10% native vegetation	On track	On track	On track	On track	2018 Biodiversity survey positive, with further recommendations on improving native fauna and flora.
Pre- and post-development native flora and fauna counts indicate that species diversity and abundance has increased in key areas.	Increased diversity and abundance	Small improvement in diversity	Not surveyed	Not surveyed	Small improvement in diversity	As above

Figure 46. Long term ecological indicators, 2017/18 Annual Sustainability Report (Hobsonville Land Company, 2019, p. 10).

Long Term Indicators	Target	Results				Comment
	2026	2014/15	2015/16	2016/17	2017/18	2017/18
% of residents who have taken action during the past year to improve the natural environment.	55% or more	Not surveyed	58%	Not surveyed	67%	Measured via Beacon Residents' Survey in 2017/18.
% of residents who report seeing tui and fantails in their garden or neighbourhood during the last month.	Increase s over time	Not surveyed	21%	Not surveyed	35%	Measured via Beacon Residents' Survey in 2017/18.

Figure 47. Long term indicators from the Cultural sphere, relevant to Ecology, 2017/18 Annual Sustainability Report (Hobsonville Land Company, 2019, p. 30).

Development indicators	Comment
Native habitat areas along the coastal corridor are maintained and enhanced. A management plan for the coastal area is completed that covers planting, weed and pest management strategies.	Weed clearing, mulching and planting and pest control continued this year.
Eco-sourced native plants are used where native plants are planted in public areas.	Locally-sourced, native plants have been recommended for all areas to be re-vegetated. 10,000 local, native plants have been grown on site from parent plants within the Tamaki Ecological District (a proportion raised from seeds local to Hobsonville Point). 965 of these plants were used to finish the Hobsonville Point Coastal Walkway.
Local seed is collected and grown into plants for key revegetation species.	On site nursery was successfully established by Kaipatiki Project

Figure 48. Development indicators for Ecology, 2017/18 Annual Sustainability Report (Hobsonville Land Company, 2019, p. 12).

4.4.2. Assessment against POE framework

4. Ecology & Habitat
NEIGHBOURHOOD SCALE
4.1 Development/Enhancement of Ecological Areas
4.1.1 Was an ecological impact assessment (EclA) undertaken at the site? Does the development have an ecological management plan?

Ecological Management Plans (EMP), which include Ecological Impacts Assessments (EclA), were completed in various forms for Hobsonville Point throughout the development process. Specific EMP and EclA were not made available for this research aside from the most recent biodiversity monitoring report (Wildlands Consultants, 2018). However, resource consent and CDP conditions give some insight into how these documents contributed toward the development and enhancement of ecological areas. For example, the Sunderland precinct CDP set out the following condition (Isthmus Group et al., 2013):

No physical works, including infrastructure, buildings, earthworks or vegetation removal ... shall be undertaken within the proposed esplanade reserve or within any riparian stream or coastal margin, until a detailed ecological management plan relating to the proposed physical works has been prepared and approved by the Council, which covers (but is not limited to) the following matters:

- *provision for the protection of rare or threatened species and their habitat;*
- *provision for the protection of lizards, including areas outside esplanade reserves;*
- *connections between habitat nodes along existing natural coastal and stream networks, and safe passage of wildlife populations;*

- *the protection and enhancement of the quality and quantity of stormwater inputs to the harbour environment (e.g. stormwater outfalls);*
- *provision for the retention and enhancement (wherever possible) of permanent streams to provide suitable fauna habitat;*
- *provision for the protection of notable plants, threatened plant species and locally uncommon plant species in the area;*
 - *predator control;*
- *appropriate forms of mitigation, if avoidance of adverse ecological effects cannot be avoided.*

Early on in the development, HLC was advised to approach the coastal edge ecological improvements over a period of 10 years. An Ecological Management Plan set out a strategy for a slow ecological transition which would sustain the existing biodiversity of the exotic grassland ecosystem, while supporting the establishment of indigenous species to ultimately improve ecological values. Weed species were kept where they formed a canopy, but removed in the undergrowth, particularly noxious weeds such as privet. Year-by-year implementation of the weed management plan, coupled with periodic biodiversity surveys, have demonstrated the impact of the plan. Throughout the development process, weed clearing, planting, mulching, and pest control have continued to maintain and enhance native habitat areas as per the SDF indicator (Hobsonville Land Company, 2019, p. 12).

Specialist ecologists Wildlands Consultants were engaged by HLC to measure and monitor the abundance and diversity of indigenous species throughout the development process at Hobsonville Point. The initial assessment of the pre-development environmental condition is an important step which informs the EMP approach and priorities:

In 2008, Hobsonville Point included exotic grassland, buildings, roads, residential gardens, exotic scrub, and indigenous forest and scrub. Along the shoreline, in the upper Waitematā Harbour, there were extensive areas of estuarine vegetation, particularly at Bomb Bay, Catalina Bay, and between Hobsonville Point and Upper Harbour Drive. By 2015 there had been extensive loss of exotic grassland, and some loss of exotic scrub and indigenous forest and scrub. This was to make way for buildings (both residential and retail developments) and roading, and the creation of parks and green areas. From 2015 to 2018 this trend has continued, with some loss of indigenous forest and scrub due to the construction of the northern boardwalk and, locally, some increases in indigenous scrub and wetlands due to restoration plantings. (Wildlands Consultants, 2018, p. 1)

As a former airbase, pre-development Hobsonville Point was a largely grass-covered flat area, with gullies filled in, and where the coastal edge was in poor condition. There were many noxious weeds and issues with pest animals, including rabbits and possums. Ecologists discovered a special sub-species of kānuka specific to Hobsonville Point, and later identified in other coastal areas, as compared to kānuka in the rest of Auckland.

Ecological assessment of the development site prior to or as part of masterplan development is critical to capture the ecological values, habitats, and indigenous species that should be protected and enhanced through development. Ecological environments are important though often overlooked layers of the urban environment, which support flora and fauna and the provision of ecosystem services. In the case of Hobsonville Point, the coastal environment was a critical element that was integrated into the development plan and SDF for ecological enhancement. Coastal enhancement that has been delivered through development, coupled with the public coastal walkway, has brought about improved wellbeing for the local (human) community and ecological communities of Hobsonville Point.

4. Ecology & Habitat
NEIGHBOURHOOD SCALE
4.2 High Urban Biodiversity
4.2.1 What types of ecological environments were integrated into the planning?

In 2008, Wildlands Consultants assessed the existing vegetation and habitats in Hobsonville Point, which included:

- exotic grassland;
- exotic scrub;
- kānuka-maritime pine forest;
- kānuka forest;
- mānuka scrub;
- estuarine vegetation.

On the basis of the existing ecological context and potential for enhancement, Wildlands Consultants gave HLC recommendations about the type of ecological environments suitable in different places, to create an integrated natural habitat and increase indigenous biodiversity as per the SDF ecological objectives (Hobsonville Land Company, 2015, p. 7). Hobsonville Point has unique natural features that influence the diversity and specific types of ecological environments that exist or could be re-established in different areas. For example, environmental specialists found that the ground was quite saline and the soil of poor quality, which affected which plants would be suitable for revegetation. Also, with the previous land use and existing habitats, Wildlands Consultants recently noted that the indigenous biodiversity of ecological environments of Hobsonville Point is still “primarily limited by the scarcity of mature indigenous trees, the widespread presence of pest plants and pest animals,

and the species composition of the recent indigenous plantings” (Wildlands Consultants, 2018, p. 33).

HLC worked with Gecko Trust and ECA Matters Trust to set up an on-site nursery (Kaipatiki Project Plant Nursery) to collect seeds on-site and to begin a process of growing eco-native plants for replanting at Hobsonville Point. Kaipatiki Project Plant Nursery is now supported by Foundation North, the Ministry for the Environment, Kaipatiki Local Board, Qrious and Environment Hubs Aotearoa (Kaipatiki Project, 2019). While there is the temptation to make new developments look well-planted from the beginning, or even ignore native vegetation and habitats in landscaping, HLC stood by the ecological advice from Wildlands Consultants to pursue a more natural (slower) ecological regeneration process that was appropriate to the local ecological environments. In general, this approach has worked well; however, for various reasons, some areas required extra input around planting.

The statutory mandate to protect and enhance natural ecological environments through urban development at Hobsonville Point was limited. Under the operative Waitākere District Plan, Hobsonville Point was largely zoned as a ‘General’ Natural Area with contained ‘Coastal’ and pocket ‘Restoration’ zones (Waitākere City Council, 2014a). HLC has championed the integration of native ecological environments into the redevelopment of Hobsonville Point above and beyond these requirements. For example, the Kaipatiki Project Plant Nursery is a standout initiative that has enhanced sustainable ecological outcomes across the development. The SDF ecological objectives and indicators for Hobsonville Point have provided a pathway for an integrated ecological focus throughout the phases of development.

As discussed for item 4.1.1, a pre-development ecological assessment, a stocktake of ecological environments, is critical to support the planned integration of ecological environments into the development. In large development sites, such as Hobsonville Point, there can be a range of different ecological environments to take account of and understand, in order to achieve ecologically sustainable development.

4. Ecology & Habitat
NEIGHBOURHOOD SCALE
4.2 High Urban Biodiversity
4.2.2 Does the development have a native flora and fauna management plan?

There was no specifically named ‘native flora and fauna management plan’ for Hobsonville Point. However, the work Wildlands Consultants were engaged to do – from initial assessments to ecological management planning, monitoring and recommendations – provided an ecological framework with a similar function. The SDF ecological development indicators and long-term indicators provided aspirational guidance around how flora and fauna elements should be managed through development on each site (Hobsonville Land Company, 2015). The specialist advice from Wildlands Consultants and CDP conditions supported development to achieve these targets.

The Kaipatiki Project Plant Nursery was an important feature of the Hobsonville Point development flora and fauna management strategy. This nursery provided eco-native plants and other seedlings from the Tamaki eco-region for the regeneration of indigenous flora in Hobsonville Point.

The biodiversity monitoring programme commissioned by HLC and delivered by Wildlands Consultants has provided periodic reporting related to ecological management (Wildlands Consultants, 2018). It looks at specific sites of interest and uses indicator species to measure biodiversity and natural habitat condition over time. From a POE perspective, this programme is critical to sustaining the momentum of ecological enhancement and ecological sustainability through development. As the site has changed and responded to urban development and native revegetation, the biodiversity monitoring programme has highlighted opportunities to maintain and enhance indigenous flora and fauna. It has also provided up-to-date observations about the current and potential ecological trajectory for the site, beyond the active development phase. Compared to other sustainable development indicators, ecological indicators are highly dependent on on-going management. Wildlands Consultants notes that:

If exotic plants and pest animals, including rats, mice, possum and hedgehog, are controlled, indigenous flora and fauna can be expected to increase in diversity and abundance. The integrity of presently weed-free areas will be maintained, and indigenous species will increase in abundance and become increasingly dominant in places where exotic plants are currently abundant. (Wildlands Consultants, 2018)

In the latest monitoring report, Wildlands Consultants gave post-development recommendations about how to further enhance flora and fauna biodiversity (Wildlands Consultants, 2018), including:

- a review of plant schedules for indigenous plantings, to ensure that these are reflective of the former indigenous vegetation of the site. In particular, plantings should include a higher percentage of kānuka (*Kunzea robusta*), and more long-lived forest trees such as kohekohe, tōtara, taraire, rewarewa, pōhutukawa, and kowhai;
- where necessary, the enrichment of existing areas of mature mānuka or kānuka with long-lived forest tree species. This will prevent the loss of these areas as the existing canopy reaches old age and enters canopy collapse;
- the installation of nesting and roost boxes for indigenous fauna that are reliant on cavities in old trees, which are largely absent from the site;
- pest plant control throughout all areas of indigenous vegetation, to ensure that these do not become increasingly dominated by exotic plant species;
- pest animal control across the site, with a particular focus on rats, hedgehogs, and possums.

If the measures described above are implemented, the current biodiversity values of Hobsonville Point are likely to be retained or enhanced.

In the case of Hobsonville Point, flora and fauna management through the biodiversity monitoring programme does not seem to have any statutory compliance requirement post-development. The SDF sets a precedent for valuing ecological sustainability, and reporting on it annually until 2026 (Hobsonville Land Company, 2015). As such, it is likely that HLC, a state-owned development agency, will continue to steward the ecological enhancements into the foreseeable future (at least 2026).

A native flora and fauna management plan sets a precedent for valuing indigenous species naturally found in the ecological environments on-site. It is important to delivering ecological sustainability, because it provides guidance about how to maintain and enhance natural habitats and increase indigenous biodiversity in a way that is locally and project relevant.

4. Ecology & Habitat
NEIGHBOURHOOD SCALE
4.2 High Urban Biodiversity
4.2.2 Is there a framework with mitigation targets / or offsetting scheme for disruption of habitat?

Prior to this development, the extent of native habitat in Hobsonville Point was minimal, as noted under item 4.2.1. Exotic grassland was the dominant terrestrial land cover, and the coastal edge was in poor ecological condition. As such, disruption to natural habitat wasn't considered a critical development factor for Hobsonville Point. In fact, the SDF development targets were oriented toward maintaining and enhancing native habitat areas, such as the coastal corridor.

The biodiversity monitoring programme carried out by Wildlands Consultants has tracked development progress toward ecological targets, and monitored changes to areas of native habitat (Figure 46 to Figure 48). Wildlands Consultants used the SDF to develop suitable field measurements and methods for monitoring and reporting against each indicator. Measurements were related to biodiversity and abundance of indigenous flora and fauna, including species of birds, lizards and ground fauna, through the stages of development. The first and second monitoring assessments were completed in November 2008 and December 2015 (Wildlands Consultants, 2018). The 2018 biodiversity monitoring report provides a summary of how diversity and abundance of indigenous species has increased in key habitat areas:

Key ecological changes: 2008-2015.

With the development of the area for residential housing, Hobsonville Point has undergone substantial change since 2008. However, most of this development has occurred in areas, such as former airfields, that were

already highly modified. As a result, there have been few direct effects on indigenous habitats, which largely occur along the shoreline and in the adjoining harbour. Extent of indigenous habitats has probably increased, with losses of indigenous forest and shrubland countered by new plantings of indigenous species, and control of pest plants. With time, the new plantings are expected to increase the extent of indigenous forest on the site, provided that indigenous forest canopy species are included in plantings. The avifauna in 2015 was dominated by the same species present in 2008, with a possible increase in species that favour urban environments or construction sites with earthworks. Rodent numbers may have been less than in 2015, but this would require additional sampling to confirm.

Key ecological changes: 2015-2018.

Since 2015, the extent of residential housing at Hobsonville Point has increased dramatically. However, this has not had a large impact on indigenous habitats as most of this has been within the former airfield boundary. The most notable impact to indigenous biodiversity is the removal of areas of kānuka forest to make way for the northern boardwalk, and the invasion of pest plant species when areas of mature indigenous canopy are starting to senesce. There has been an increase in indigenous habitats due to restoration plantings. Further indigenous plantings, and pest plant and animal control, is essential to ensure further biodiversity gains. Once the pest plants in the wider area are controlled, reinvasion will be heavily reduced, and this will both improve indigenous biodiversity values and decrease the cost of ongoing control work (Wildlands Consultants, 2018).

Native habitats support natural ecological functions, flora and fauna. If these habitats are disrupted by development there will be a loss of ecological value and ecosystem services provided by the natural environment, from lost species diversity and abundance. As such, mitigation measures or targets to offset native habitat disruption are critical to ecologically sustainable urban development. Unfortunately, disruption to natural environments can be somewhat inevitable in urban development. This is particularly relevant to New Zealand where it is not uncommon for greenfield and brownfield urban development areas to include native habitat areas with indigenous flora and fauna of varying diversity and abundance. In fact, a large-scale urban development project on such a site presents a unique opportunity to increase indigenous biodiversity and enhance native habitat areas. Hobsonville Point demonstrates the value of a framework that establishes ecological targets, in this case the Sustainable Development Framework (Hobsonville Land Company, 2015) with a primary goal

for sustainability. Equally, Hobsonville Point has demonstrated the value of consistent and robust ecological advice throughout the project, from the planning stage to post-construction monitoring phases.

4. Ecology & Habitat
BLOCK SCALE
4.3 Native Flora and Fauna
4.3.1 Has the native flora and fauna management plan been implemented?

As discussed for item 4.2.2, management of flora and fauna in the development of Hobsonville Point has been supported by periodic biodiversity monitoring and reporting with recommendations, as well as the Kaipatiki Project Plant Nursery. With development at the block scale, there are risks that the larger-scale plans for ecological environment could be compromised through poor implementation. For example, to function well, ecological corridors need to be continuous and of adequate width to provide functional natural habitats for flora and fauna. The 2017/18 Annual Sustainability report (Hobsonville Land Company, 2019) demonstrates that the development has been consistently on track to deliver a continuous green corridor along the coast, with native vegetation covering at least 10% of sites (established or retained) (Figure 46 and Figure 48).

For block development resource consents, there was no statutory requirement for a native flora and fauna management plan unless development was within an esplanade reserve or within any riparian stream or coastal margin (refer item 4.2.1). At the block scale, resource consents included landscape and planting plans that indicate the location and species for planting which give effect to the neighbourhood scale ecological management plans, where relevant (though many exotic species are included in neighbourhood planting plans). The restoration of ecological values in Hobsonville Point is an on-going process. With the SDF guiding HLC toward a goal of ecologically sustainable development, it seems that HLC will remain committed to reviewing progress and making adjustments to the flora and fauna management for Hobsonville Point as advised by Wildlands Consultants up until 2026.

Evidence of what the flora and fauna management approach has achieved to date, includes an increase in the percentage of residents who report seeing tui and fantail in their neighbourhood. The 2017/18 Beacon Pathway Residents’ Survey found these reports increased from 21% to 35%, from 2015 to 2017 (Hobsonville Land Company, 2019). The latest Biodiversity Monitoring Report (Wildlands Consultants, 2018) recorded ten indigenous and 12 exotic bird species at the 12 monitoring stations. The increase and enhancement of native habitats in Hobsonville Point, to increase native and exotic birdlife in neighbourhoods, demonstrates the holistic benefits of ecological management within sustainable development planning.

4. Ecology & Habitat
NEIGHBOURHOOD SCALE
4.4 Light Pollution Mitigation
4.4.1 Have light pollution mitigation measures been undertaken?

Mitigation for light pollution was not explicitly provided for in the Hobsonville Point SDF under the Environmental sphere. Also, CDP or resource consent plans did not explicitly link lighting requirements to ecological matters. Ecologically sensitive design for street lighting, lit buildings and public spaces is recommended to support natural lunar and solar cycles as much as possible, for natural flora and fauna. The ecological corridor around the Coastal Walkway is one area in Hobsonville Point where ecologically sensitive lighting design is advisable. The Sunderland CDP (Isthmus Group et al., 2013) established that lighting should not be provided along the Coastal Walkway, except at each entry to the walkway or where required for pedestrian safety (to avoid Crime Prevention Through Environmental Design (CPTED) issues). The CDP doesn't explicitly state that this provision is for ecological reasons, to avoid light pollution. Regardless, the lighting provisions will support ecological communities in the coastal area by limiting light pollution.

In natural environments, light cycles from the sun and moon provide natural cues and conditions that stimulate and support organism behaviours such as sleep functions, physiological processes and the biological clock (McNaughton, 2019). Disruption of solar light cycles from excess artificial light at night can adversely impact nocturnal animals, who are active only in the dark, and cause premature flowering of certain plant species. Conversely, many ecological behavioural activities are synchronised with lunar cycles (Kyba & Hölker, 2013). Lunar cycle disruption from a phenomenon called dim sky glow – at the city and neighbourhood scale – have diffuse environmental impacts. McNaughton (2015) describes three main ways to reduce sky glow:

- reduce light trespass into the night sky by shielding or directing the light source downwards;
- reduce the amount of light emitting into the night sky by dimming or switching off the light source; and,
- reduce the scattering of light in the night sky by avoiding light sources that emit strongly in the blue part of the spectrum (as short wavelengths scatter more).

Ecological sustainability outcomes from the Hobsonville Point SDF could have been enhanced if light pollution matters were specifically mentioned as a development indicator. It is challenging to balance the needs of human urban development and ecological communities; however, the overall social, environmental and cultural costs and benefits should be balanced to enable the most sustainable development outcome.

4. Ecology & Habitat
BLOCK SCALE
4.4 Light Pollution Mitigation
4.4.2 Has lighting at the block scale been designed to reduce light pollution?

As per item 4.4.1, there is no evidence that lighting design at the block scale was designed to reduce light pollution for ecological reasons. Sub-precinct CDP provisions and resource consent conditions related to lighting at the block scale aimed to meet illumination standards and to provide a safe environment for pedestrians as well as vehicles (Bury, 2014, 2015; Daniels, 2016; Hopkins, 2016). It is a challenge to balance the provision of infrastructure such as street lighting, lighting in parks and public spaces, with ecological values in an urban development context.

When preparing future development frameworks similar to the SDF, recommendations for lighting pollution and lighting mitigation could be included in the scope of ecological assessments. Ecological specialists could provide specific advice on particular light-sensitive species that are (or are anticipated to be) present in local ecological communities, including sensitive areas. Such advice could be incorporated into specific development conditions of Comprehensive Development Plans and resource consents to achieve more sustainable ecological outcomes.

4.5. Waste Management and Pollution Control

4.5.1. Hobsonville Point Sustainable Development Indicators

The SDF for Hobsonville Point outlines an aspirational goal that “waste is minimised throughout the development” (Hobsonville Land Company, 2015). Waste from construction can be reduced through good design, and facilitating waste stream separation, for reuse or recycling. HLC proposed to provide appropriate facilities and education to support residents to minimise household waste. Objectives and Indicators related to resource efficiency fall under the Environmental sphere of the Framework, as illustrated in Figure 49.

Sphere	Dimension	Objectives	Long term indicators	Development indicators
1. Environmental	Ecology	<ol style="list-style-type: none"> Create an integrated natural habitat Increase indigenous biodiversity 	<ol style="list-style-type: none"> A continuous green corridor with native vegetation covering at least 10% of the site is retained/established. Pre and post development native flora and fauna counts indicate that species diversity and abundance has increased in key areas. 	<p>Native habitat areas along the coastal corridor are maintained and enhanced. A management plan for the coastal area is completed that covers planting, weed and pest management strategies.</p> <p>Eco sourced native plants are used where native plants are planted in public areas.</p> <p>Local seed is collected and grown into plants for key revegetation species.</p> <p>Education/management programme in place while HLC on site.</p> <p>See “Water” for stormwater quality indicators.</p>
	Energy	<ol style="list-style-type: none"> Reduce non-renewable energy use Energy efficiency 	<ol style="list-style-type: none"> Average household grid energy (reticulated gas and electricity) consumption is 6,500 kWh/year or less. 	<p>Houses built to a calculated BPI of 1.2 or lower for thermal performance and 5.5 Star HERS hot water rating or equivalent performance level.</p> <p>All properties have smart meters.</p> <p>At least 3 on site demonstration renewable generation projects.</p> <p>Education/management programme in place while HLC on site.</p>
	Water	<ol style="list-style-type: none"> Reduce water consumption Improve water quality 	<ol style="list-style-type: none"> Average residential town supply water consumption is 100 litres or less per person per day. 	<p>All stormwater, except roof water, receives treatment before being discharged into the harbour.</p> <p>All houses have 6/3 litre, or less, dual flush toilets.</p> <p>3 Star or better water saving fixtures.</p> <p>Dwellings are served by rain tanks sized to supply 75% of water used in household toilets, laundries and gardens.</p> <p>No in-built irrigation will be provided in gardens.</p> <p>Education/management programme in place while HLC on site.</p>
	Resource efficiency	<ol style="list-style-type: none"> Recycle and renew existing buildings and other infrastructure Reduce off-site waste disposal 	<ol style="list-style-type: none"> Mixed household waste collected is 100kg/person/year or less. 	<p>At least 20% of existing buildings will be retained and renovated or reused off site.</p> <p>The majority of construction and demolition waste is recycled.</p> <p>At least 3 public recycling bins are provided in public spaces.</p> <p>Education/management programme in place while HLC on site.</p>

Figure 49. Resource efficiency strategy as per HLC’s SDF (Hobsonville Land Company, 2015, p. 7).

The series of Annual Sustainability Reports prepared by HLC have measured performance against these indicators, year-on-year since 2012. The resource efficiency results up to 2018 are provided in Figure 50 and Figure 51.

Long Term Indicators	Target	Results				Comment
	2026	2014/15	2015/16	2016/17	2017/18	2017/18
Mixed household waste collected per person per year.	100kg or less	Not measured	Not measured	Not measured	226kg per person per year ³ This is still much lower than the Ministry of the Environment figure of 734kg of levied waste per person annually ⁴	Beacon Pathways assisted HLC in devising a way to measure household waste in the absence of a reliable Auckland Council method.

Figure 50. Performance against long-term indicators for resource efficiency in sustainability (Hobsonville Land Company, 2019, p. 11)⁹.

Development indicators	Comment
At least 20% of existing buildings will be retained and renovated or reused off site.	Achieved
The majority of construction and demolition waste is recycled.	Achieved. A construction recycling programme is in place and achieved an average of 85% diversion from landfill for the June 17/July 18 period. To date, 75% of construction waste has been diverted from landfill since the initiation of this programme. ³ Supporting establishment of a local Eco Point Group that has an environmental focus – with activities such as a trip to the local waste transfer station to learn about household waste and how to avoid/minimise generating it.
At least three public recycling bins are provided in public spaces.	Three public recycling bins are already installed. More will be added.

Figure 51. Performance against development indicators for resource efficiency in sustainability (Hobsonville Land Company, 2019, pp. 12–13).

⁹ Note: the 2018 Beacon Hobsonville Point Residents survey asked respondents about their household waste generation. Waste generated (litres/person/year) averaged 1,737 litres/person/year, ranging from 140 litres/person/year to over 7,000 litres/person/year. This equates to an average of 226 kg/person/year, with 13% of people generating 100 kg or less of waste per year. This was converted to kg. A conversion factor of 130kg/tonne is used based on the Ministry for the Environment conversion factor for waste or material carried in rubbish bags or in cars (www.mfe.govt.nz/publications/waste/calculation-and-payment-waste-disposallevy-guidance-waste-disposal-facility-2).

4.5.2. Assessment against POE framework

5. Waste Management and Pollution Control
NEIGHBOURHOOD SCALE
5.1 Waste Management
5.1.1 Have Council recycling requirements been exceeded? If so, how?

Hobsonville Point is served by Auckland Council’s residential recycling services (bi-weekly collection) and thus currently meets council recycling requirements. In addition, three recycling bins have been provided in public spaces, with more planned for installation. This was a resource efficiency development indicator set out by the SDF for Hobsonville Point (Hobsonville Land Company, 2015). As with the rest of Auckland, municipal waste management services will expand to include food waste collection for Hobsonville Point soon.

Aside from recycling, the Hobsonville Point SDF established a long-term indicator to reduce household waste to landfill from this development (Hobsonville Land Company, 2015). HLC has supported community education programmes for household waste reduction and other initiatives such as the Compost Collective, who process local food scraps and garden waste to produce rich compost for the Catalina Community Garden. HLC also supports a local Eco Point Group that hosts and plans environmentally focused activities that encourage waste minimisation (Figure 51).

In terms of general household waste production, so far Hobsonville Point is not delivering on the target of less than 100kg/person/year. The Auckland ‘Make the most of Waste’¹⁰ website states that the average Aucklander produces 160kg of waste to landfill per year (Auckland Council, 2019b). In Hobsonville Point, the 2017/18 Beacon Pathway survey found that residents produced 226kg/person/year of waste on average (Figure 50). This is self-reported waste generation, so is not a completely sound measure, but it provides a general indication of waste volumes from the neighbourhood.

Accurate data on household waste to landfill can be collected by weighing rubbish trucks that had completed collection in Hobsonville Point at least once a year, for reporting against the waste management indicators of the SDF. However, discussions with HLC highlighted the difficulty in working with Auckland Council waste officers, compared to the former Waitākere City Council, to collect quantitative data about waste production.

Recycling supports resource efficiency by diverting materials such as glass, paper, cardboard and certain plastics from going to landfill and providing a pathway for the materials to be repurposed. However, in terms of waste reduction and resource efficiency, recycling is only one component. To work toward Auckland Council aspirations of zero waste by 2040, a more holistic waste management approach is required both city-wide and development-wide.

¹⁰ This Council supported programme is working toward a goal of zero-waste Auckland by 2040. Auckland aspires to be Zero Waste by 2040, taking care of people and the environment, and turning waste into resources (Auckland Council, 2018).

5. Waste Management and Pollution Control
BLOCK SCALE
5.2 Recycling Provisions
5.2.1 Have a variety of recycling methods, in excess of Council requirements, been facilitated at the block scale?

Household recycling methods are discussed in item 5.1.1. Each dwelling has an Auckland Council recycling bin for glass, paper, cardboard, metal cans, and hard plastics that is collected every two weeks.

5. Waste Management and Pollution Control
NEIGHBOURHOOD SCALE
5.3 Construction / Demolition Waste Management
5.3.1 Is there a construction/demolition waste management plan?

The Hobsonville Point development adopted a resource efficiency and waste minimisation focus, set out by the SDF (Hobsonville Land Company, 2015), that applied throughout the construction phase. There was no formal construction/demolition waste management plan. However, HLC facilitated various construction-stage waste management initiatives, including a construction recycling programme to achieve SDF targets. In 2017/18, the programme diverted 85% of waste from landfill and since the programme began, approximately 75% of construction waste has been diverted from landfill (Figure 51).

Construction waste management was a significant challenge for HLC to address. Building sites aren't controlled, there can be over 50 different contractors and sub-contractors working with their own equipment, materials and timeframes on any number of sites across the development – often there is no one to explain how the recycling and waste management system works. The 2016/17 Annual Sustainability Report credits the continuous improvement around waste diversion to the waste contractor, Green Gorilla (Hobsonville Land Company, 2018). Green Gorilla provided a one-bin service for on-site waste, frequent collections to avoid waste contamination, and then they would separate waste to achieve an average of 75% waste recycling. Green Gorilla provided periodic reports on waste minimisation throughout the construction phases, which supported the annual reporting against the SDF. In 2016, they upgraded to an automated recycling system and were planning to increase the recycling rate further in close collaboration with HLC.

In terms of demolition, the SDF established a goal to retain, renovate or re-use (off-site) at least 20% of existing buildings, which was achieved (Figure 51). Notable heritage buildings renovated and retained on site included Chichester Cottage, Mill House, the former officer's homes along Sunderland and Cochrane Avenues, Sunderland Hangar, Seaplane Hangar and the Armoury.

While the construction/demolition waste management programme implemented at Hobsonville Point is commendable, there is still room for improvement. For future

developments, HLC reflects that an on-site sorting and recycling system would likely achieve higher diversion rates and reduce overall waste from construction.

Construction and demolition waste contributes around 50% of Auckland’s total waste to landfill (Auckland Council, 2019a). As such, construction/demolition waste management plans make a significant impact on development sustainability performance around waste and resource efficiency at the city-scale, before dwellings are even occupied. A demolition waste management plan is particularly relevant for brownfield development, where existing buildings and infrastructure are a resource available for re-use, renovation or relocation as part of the development. For greenfield development, construction waste management is where construction-phase resource efficiency can be provided for.

5. Waste Management and Pollution Control
NEIGHBOURHOOD SCALE
5.4 Activity Pollution Prevention
5.4.1 Was an erosion and sediment control plan implemented and complied with across the neighbourhood/for the block? If there were compliance breaches, what were the mitigation measures or adverse effects?

Erosion and sediment control are typically managed through resource consent conditions which require an erosion and sediment control plan (ESCP) and monitoring for compliance against the plan during the construction period. In particular, ESCPs are critical during the bulk earthworks phase, when there are large areas of exposed soil and the highest risk of surface water contamination exists. As per Auckland Council resource consent requirements, ESCPs were prepared for each superblock (scope of bulk earthworks, superlot subdivision, public roading and major three-waters infrastructure, etc.) and block-level (residential block subdivisions, dwellings and servicing infrastructure for individual lots). At the block or lot scale, the area for erosion and sediment control and scope of earthworks is smaller and thus the risk of contamination is smaller.

For this research, data about compliance and monitoring for erosion and sediment control were not available. Thus, any instances of surface water contamination, other adverse environmental effects or non-compliance with the ESCP cannot be commented on. Compliance and monitoring against the ESCP are critical to this item of the POE framework: this is how the actual sustainability outcomes from erosion and sediment control can be discerned.

Sediment in surface water has adverse effects on aquatic life in freshwater and marine environments. This is why ESCPs are critical to sustainable development, to avoid adverse effects on ecological environments and natural habitats. Standard erosion and sediment control practices vary, depending on the scale and type of works, including (Leersnyder, Bunting, Parsonson, & Stewart, 2016):

- Structural approaches

- Coagulant and Flocculant treatment
- Non-structural approaches
- Water management controls
- Soil and surface stabilisation

In Auckland, ESCPs should be prepared in accordance with the standard set out in Auckland Council Guidance Document 005 (Leersnyder et al., 2016).

5. Discussion

5.1. Key recommendations for neighbourhood POE Frameworks for New Zealand

A shift is happening in urban development in New Zealand, with greater understanding of the importance of monitoring and POE in delivering better built environment outcomes. Because of the shifting scale of developments toward whole neighbourhoods as opposed to single buildings, it is important that POEs also accommodate and consider this scale. Hence, for this research the proposed POE framework for sustainable development takes on the neighbourhood scale and block scale. POEs have limited use being applied building-by-building when compared to across the system of a neighbourhood.

Post-development monitoring is generally recommended, but often suitable baselines aren't established pre-development and there is not funding support or any strong mandate for private developers to deliver meaningful monitoring post-occupation. The process of developing this POE Framework has identified a roadmap for achieving environmental sustainability through neighbourhood development in the New Zealand context. Other social, cultural and economic dimensions of sustainability could be similarly studied to develop a POE that considered sustainability generally, rather than environmental sustainability specifically as is the case in this research.

The Hobsonville Point development, led by the government subsidiary HLC, included some post-occupancy monitoring as part of the annual reporting against the Sustainable Development Framework (SDF), however a holistic POE framework for assessment was developed retrospectively to undertake the assessment. From this research, the following recommendations are provided about this neighbourhood POE framework for New Zealand.

5.1.1. General recommendations

- POE framework items must be measurable and specific so that a robust evaluation can be completed. For a number of evaluation items, as noted in the previous sections, the data available (or lack thereof) influenced how the sustainable outcomes could be measured. If POE were more widespread and established, they would naturally become a more accepted part of delivering neighbourhoods.
- To support a robust POE assessment, a development framework that is compatible or comparable to the POE framework is recommended. For this research, the Hobsonville Point SDF and the proposed POE framework did not align completely, which made it difficult to assess some items or left gaps in the assessment where planning or delivery did not overlap. However, the SDF did establish a number of helpful baselines, such as for

ecology and water management that supported sustainable development outcomes in the neighbourhood.

- A neighbourhood sustainable development framework should set out audacious, bold targets for environmental sustainability. Equally, the POE framework should not be afraid to hold high standards to achieve environmental sustainability outcomes. Section 4 highlighted various instances where the Hobsonville Point SDF or the POE Framework were let down by weak or low-level goals or targets for sustainability. Consequently, the development planning, or assessment against the POE framework delivered a limited, or status quo urban development outcome.
- The primary legislation for urban development in New Zealand is the Resource Management Act. The purpose of the RMA is “to promote the sustainable management of natural and physical resources” (Resource Management Act, 1991, sec. 5(1)). The POE framework for sustainable development in New Zealand would need to align with this Act, its purpose and principles and subsidiary planning documents (National Policy Statements, Regional Policy Statements, Unitary Plans, Regional Plans and District Plans) to support sustainable neighbourhood development.
- This POE has been designed to reflect international best-practice standards, as outlined in the LEED, BREEAM and Green Star assessment criteria used to inform this POE. The focus has been on universal factors that affect the performance of neighbourhoods according to environmental sustainability criteria. However, uniquely New Zealand influences, such as methods to measure kaitiakitanga, while beyond the scope of this research, could add additional relevance to a POE in a New Zealand context.

5.1.2. Energy Use and Production (Transportation)

- In testing this POE framework at Hobsonville Point, the focus became predominantly on buses in the context of public transport strategy. Future iterations and tests of this framework should consider broader public transport strategy, including buses, ferries, trams and trains, and their integration across modes as well. Sustainable transport planning must consider how to support multi-modal journeys and set metrics to plan for and measure the delivery of multi-modal travel through an integrated mobility network.
- The strategy from HLC had integrated views on mobility but these could not be entirely implemented. The cycle network, for example, ends where the neighbourhood ends and is poorly integrated with ferry travel. Where the development lacked the most was in terms of how it dealt with carparking as compared to public transport access as the density increased three-fold from the original projections.

- As yet, there has not been a strong focus on electric cars, e-bikes or e-scooters and integrated mobility in general in the SDF or this POE framework. Electric vehicles present a low-emissions alternative to car travel and extend the convenient range of active travel by bike and scooter. To provide a holistic view of sustainable transport options, for planning, delivery and POE, electrified transport modes could be included in the POE framework for completeness. This may also include considerations of electrified public transport provision and shared e-bike or e-scooter services.
- Going forward, future iterations of this POE framework should provide an avenue to evaluate how a development has responded to local Council demand and capacity provisions as per the NPS-UDC. In doing so, the POE framework would include a check against nationwide and regional targets for housing development.

5.1.3. Energy Use and Production (Non-transportation)

- The viability of sustainable energy production and energy efficiency measures depends on the scale and context of the development. In the Hobsonville Point case study, local energy production of any kind (beyond demonstration projects) was viewed as being not economical or practical given that the site was already serviced by the reticulated power network and did not have large energy users (e.g. manufacturing plant). However, this in large part is an issue in New Zealand because the buy-back of excess energy is not incentivised and therefore the resilience and growth of this sector is not currently being supported. For New Zealand, the neighbourhood scale may be too small to accommodate a district renewable energy production scheme in an economical and efficient manner, although some examples are starting to emerge (e.g. the district heating that serves the university district in Dunedin). However, it is still advised to keep these items in the POE framework to maintain sustainable energy considerations in neighbourhood development planning, as viability factors may change.
- With 3D modelling and BIM software becoming more and more integrated in the design practice, more attention should be given to modelling urban morphology (terrain and built form, existing and designed) and to analyse sun exposure and interactions between buildings in order to maximise solar gains and develop suitable solar shadings where needed. Hobsonville Point development did not focus on this aspect from the early stages and therefore the masterplan does not always reflect considerations on block exposure and lots orientation. With the attention moving towards the implementation of denser neighbourhoods, this aspect becomes strategic to ensure comfort conditions and energy consumption reduction for heating and cooling.

- In regard to the energy and thermal performance of new buildings in Hobsonville Point, a number of mandatory requirements were given in regard to the minimum quality of the building enclosures and building services. Although the outcome of this prescription is a neighbourhood that, overall, sits at a higher level compared to average neighbourhoods in New Zealand, occupants expressed some dissatisfaction in regard to summer overheating, in particular due to the lack of cross ventilation (Haarhoff et al., 2019). A Home Star 6 level was targeted for the development, but was mostly not achieved because dependent on the individual developers' initiative. HLC's effort in targeting higher energy standards for Hobsonville Point housing is commendable, but it needs to be backed up by a higher-level requirement. In this regard, it is important to highlight that the poor requirements of the New Zealand Building Code in terms of building performance is not helping the country delivering a comfortable and efficient building stock and this aspect cannot be left to the initiative of private developers.

5.1.4. Water Management Planning

- The POE item regarding flood risk management should consider flood prone areas, ponding areas and areas at risk of coastal inundation as well as overland flowpaths.
- For stormwater management, WSUD and LIUDD are essentially analogous approaches to sustainable water management. Different local government bodies in New Zealand generally apply one of these two approaches. For completeness and clarity, the POE framework could incorporate both terms to avoid confusion and to reflect that both are acceptable and valid approaches.
- The POE item regarding surface permeability needs to be more specific, to include a specific permeable coverage threshold or some other quantitative metric or mitigation measures that can be used to assess the sustainable development outcome for this item.
- As noted in section 5.1.1, it was challenging to assess the Hobsonville Point development against this POE framework because the SDF indicators didn't always align with or relate to the POE framework. While sustainability of water aspects has largely been achieved, the POE assessment became repetitive and lost clarity in parts because of the differences between the two approaches to planning and evaluating sustainable development.
- Ideally, sustainable water management should adopt the catchment as the base unit for planning. The catchment area is often different from the neighbourhood area and neighbourhoods can include multiple catchments or several sub-catchments. Hence, to design and develop the site to achieve truly sustainable water management, the complete catchments need to be considered. Also, the characteristics of local catchments should be

considered so that development responses are sensitive to the key environmental and ecological functions the catchment supports and any specific hydrological processes or risks related to surface water ponding, coastal inundation or a high groundwater table, for example.

5.1.5. Ecology and Habitat

- The POE Framework elements for ecological sustainability seem to overlap in various respects. There is little clarity about what distinguishes Ecological Management Plans, Flora and Fauna Management Plans and Ecological Impact Assessments, or how these relate to standard processes or procedures of professional ecological practice in New Zealand. For example, the Environment Institute of Australia and New Zealand, Inc. have standard guidelines for EcIA for use in New Zealand (2015). Future iterations of this POE framework would benefit from a streamlined, best-practice ecological framework for sustainable development that is relevant to the New Zealand context.
- Furthermore, the POE Framework would benefit from a clear structure that supports best-practice sustainable, ecological development through the stages of urban development. Notably, the pre-development EcIA is a critical baseline assessment that determines what ecological environments are present, and what native habitats could be enhanced through development. And, an on-going monitoring programme that developers are committed to in the medium-term is critical to establishing sustainable ecological enhancement.
- Ecological planning and monitoring must be carried out at the appropriate, relevant scales. For example, block scale assessment for ecological matters may not capture the full picture of an ecological environment and its functions. While stormwater management should begin at the catchment scale, ecological management should begin at the scale of the eco-region and the extent of local ecological environments across, beyond or bordering the development site.

5.1.6. Waste Management and Pollution Control

- The POE framework assessment would benefit from a broader perspective on waste management that includes organic or food waste, construction waste, and waste to landfill, as well as recycling. This would provide a more comprehensive assessment of resource efficiency for sustainable development, rather than just reviewing recycling requirements. Also, it would reflect the growing focus on waste minimisation among local governments, such as Auckland Council's goal of zero waste to 2040.
- Assessment of erosion and sediment control measures should reference a standard, such as GD05 in Auckland (Leersnyder et al., 2016), and must consider compliance records. The

environmental impacts of non-compliance and compliance with an ESCP is where the POE framework can determine sustainable development outcomes from construction.

- In the context of a new development especially, focusing more on pollution during construction would be essential. In this instance, a lot of the data that would be needed to track the pollution rates and mitigations was not available or monitored.

5.2. Summary observations from POE Framework application

Hobsonville Point was a useful case study to test the proposed neighbourhood POE framework. It has provided helpful insights about what is required to achieve environmentally sustainable neighbourhoods, both from the planning stage and for POE application. These observations are considering the development at **one point in time** – as a whole, Hobsonville Point is changing fast and some superlots are still being delivered. More amenities are also coming online and the density is continuing to increase through market demand.

The development of Hobsonville Point was led by a government-owned urban development agency, HLC. Being delivered by the public sector made this urban development project feasible, from acquiring the land for development (a former airbase made available by the Ministry of Defence) to adequate financial resources to deliver greenfield development at this quality and scale. Specifically, HLC had the capacity to establish a Sustainable Development Framework, a masterplan and commission CDP to guide development in each sub-precinct. These guiding documents have supported quality development outcomes with numerous elements of environmental sustainability integrated into the neighbourhood. In general, private developers are unlikely to have the resources or motivation to initiate and deliver development at this scale (risky) and quality (more expensive). In addition, HLC as a public sector developer, had the capacity to champion the implementation of the SDF throughout the design and development phase and, critically, to continue this role into the occupancy period. HLC is committed to the SDF until 2026.

That said, the SDF could have been strengthened in some areas by setting more specific, relevant and measurable targets. For example, the bike share and cycling targets were limited and access to critical urban amenities such as the supermarket were not reflected in the SDF. The SDF objective to reduce car-dependent journeys would have had a more robust built-environment response if there were indicators that set audacious goals and provisions for public transport and cycling. Hobsonville Point SDF objectives and indicators reflect the awareness that car dependency is an issue, but the overall framework lacks measures supporting alternative, sustainable transport that would significantly deliver on this target. This is a reflection of how neighbourhoods are difficult to deliver in isolation from the rest of the city and that city-wide strategy is required for change to happen regarding integrated options for mobility and alternatives to car travel at a neighbourhood scale.

Hobsonville Point has demonstrated the value of having a development framework, to guide planning and design decisions and to deliver principled development outcomes – in this case, environmental sustainability. HLC has achieved a commendable outcome for neighbourhood sustainability in Hobsonville Point. While not all aspects of sustainability could be provided for in the end, HLC was able to make important decisions about where the greatest gains could be made, what was feasible in the market, appropriate to the site and therefore developed sustainable development targets accordingly. On reflection, HLC representatives highlighted this as the greatest challenge – figuring out what can be achieved practically for sustainable development.

HLC demonstrated a hierarchy of documents and processes that were able to deliver sustainable neighbourhood development:

- Sustainable Development Framework;
- Precinct Masterplan;
- Sub-precinct Comprehensive Development Plans;
- Resource consent design;
- Annual Reporting against SDF.

This structure supported the implementation of the SDF across the scales of development, from the neighbourhood scale to the block scale. In particular, the CDP provided clear design guidance through the different stages of resources consent (super lot subdivision, and each sub-precinct block) and building consent to deliver on the relevant built environment components of the SDF.

The Hobsonville Point neighbourhood is an improvement, in comparison with typical greenfield neighbourhood developments that we know in New Zealand. We can learn a great deal from the progress made at Hobsonville point and, taking the view that the goal is continual improvement, this research outlines ways in which the approach to delivering environmental sustainability can be refined going forward. In the context of existing neighbourhoods, where delivery is arguably more complex than on greenfield sites, a POE framework, coupled with a guiding development framework, gives clarity as to how environmental sustainability outcomes can be prioritised.

6. Conclusions

While recognising and commending the experience of Hobsonville Point and the work done to develop an overarching sustainability framework, this research considers how lessons can be learned to work towards increasing the environmental sustainability outcomes for future neighbourhood developments. To support sustainable development outcomes, it is important to prepare a development framework prior to development, with baselines defined that will support comparison post-development. The structure and content of the framework should ideally be developed as compatible with a neighbourhood POE framework to facilitate the assessment process.

In terms of baselines, with a greenfield development such as Hobsonville Point it is difficult to measure neighbourhood baselines for aspects related to the local population, because no one lived there before the development. However, the SDF did form targets relative to Auckland-wide averages for waste production, energy consumption, transportation, for example, that were helpful for comparison at the neighbourhood POE stage. For the ecological targets, the initial Ecological Impact Assessment established the baseline for ecological environments which is standard practice. For brownfield development, setting development baselines would be much more straightforward.

Development frameworks, master plans and CDP should be resilient and responsive to market changes and design changes that follow. In Hobsonville Point, the build density was greater than the planned density, and the lack of employment provided has impacted various aspects of sustainability planning and performance. For example, there should be feedback loops to re-iterate strategies for transport, energy, waste or ecological management, for example, if the population density and land-use activity mix changes. Although exact numbers vary, at Hobsonville Point, density has tripled from 2,500-3,000 dwellings/5,000 people to 4,500/5,000 dwellings and 11,000 people, but greenspace and amenities have stayed the same.

In practice, a POE needs to function at both a block and a neighbourhood scale and achieving many of the criteria are influenced by city-wide strategic planning for mobility, energy, waste and water production and consumption. A comprehensive POE would need to consider sustainable, intergenerational wellbeing in line with Treasury's Living Standards Framework (Smith, 2018). This POE is focused on natural capital and environmental sustainability outcomes. Furthermore, with this POE, the researchers have no intention of replacing existing international assessment methods and tools because existing tools are a much broader and deeper in their approach. This POE is designed to be a preliminary tool which is accessible and can support decision-making processes during the project design phases, and then used as a way to monitor and evaluate progress towards a clear set of environmental sustainability goals.

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