Daylighting Waste

Can Community-Based Recycling Depots Become Part of Auckland's Everyday Life?

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Abstract: This project explores the potential role of landscape architecture in waste minimisation, specifically around the conceptualisation, siting and design of Community Recycling Centres as part of the Auckland Council's zero waste–orientated Resource Recovery Network. Landscape architects may have new opportunities to affect the culture of waste by understanding the intersections of waste minimisation, resource recovery and community-based social marketing.

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Executive Summary

Chapter 1: Daylighting the Situation

This chapter opens by defining key concepts and establishes waste as a global problem, to be explored specifically through the lens of Auckland's aspirational goal of zero waste. To achieve this goal, Auckland Council promotes the establishment of community recycling centres (CRCs) as part of a region-wide resource recovery network and community waste minimisation plan. However, the role of CRCs in the context of Auckland's current waste industry and urban development framework is not well understood, and the first section of the chapter provides perspectives from the key stakeholders in resource recovery, including industry, government, non-profit organizations, and outlines some of their key interactions.

The first chapter also considers the role of landscape architecture in resource recovery. Literature shows little evidence that landscape architects have been substantially engaged with resource recovery operations. There also is scant literature on methodological approaches or design techniques for resource recovery. Further, literature has not addressed different meanings of community waste minimisation and how it can be accomplished. Thus, to discover how an adaptation of CRCs, an adaptation which this author terms "community-based recycling depots," might become part of Auckland's everyday life, the initial literature search is broadened to investigate planning and waste management, with the aim to clarify the problem through the lens of landscape architecture.

Chapter 2: Research Review and Investigations

This chapter explores community recycling centres (CRCs) in the context of community waste minimisation and outlines past attempts at CRC design. This review aims to understand how CRCs might fit within the existing waste network, specifically with the adoption in 2012 of the Auckland Council Waste Management and Minimisation Plan (WMMP). This aim is further supported in the review of two CRC scoping studies (Dickinson, 2012, p. 9; Luxton, 2013), two inorganic collection reports (Auckland Council, 2013a; Waste Not Consulting, 2007), and the formal Auckland Council

Waste Assessment (Auckland Council, 2012). Last, to understand the physical layout of CRCs, a study of the underlying variables affecting the design of existing facilities is undertaken both overseas and in NZ.

The review then considers the role of landscape architecture in waste minimisation. A study of community-based waste initiatives and methodologies that aim to affect behavioural change is undertaken, with site visits and a desk study to compliment and corroborate evidence uncovered in the literature on the layout and design of CRC sites.

Chapter 3: The Community-Based Recycling Depot: Concept

As noted, the proposed new model for resource recovery is a Community-Based Recycling Depot (CBRD), which is the focus of the third chapter. The model consists of six major components: an industrial area, a recycling drop-off, an image area, and a buffer area with "flows" and "social edges" integrated throughout the site. This model is formulated for a real-world site and includes criteria from which to evaluate a successful CBRD design.

Chapter Four: Community-Based Recycling Depot: Design and Testing: To evaluate the initial proposal, the model is tested following a traditional landscape architectural design process at an example site. This process involves a continuous critique of the on-going, site-based design propositions, and outlines how the model is attuned at the site level. This process also reviews the relationships that determine the successful location of possible sites for the new CBRD.

Chapter Five: Community-based Recycling Depot: Reflections and Conclusions

The on-going design process is frozen at a point that answers the basic design parameters and satisfies the purposes of the study. These are reflected upon as a means of moving forward in the future, with a clearer set of questions for a real-world project. It is found that landscape architects have opportunities to affect the design of resource recovery facilities through mitigation of environmental impacts, design for amenity value in an increasingly dense city form, and design of social edges for cultural change. When all three of these directives are integrated through design synergies are created that reduce the land area needed and provide for a more flexible, urban form capable of affecting waste-wise behaviour. Landscape architects therefore have a unique contribution to make in the design of community-based recycling depots part of our everyday urban landscape.

1. Daylighting the Situation

"What kind of culture would produce a product this toxic to put into the mouths of children? Design is the first signal of human intention. What is your intention?" (William McDonough, TED Talks 2009)

1.1 Introduction

The following key observations are put forward as a platform from which this thesis springs: many of the biggest issues facing mankind today are waste-based; solid waste is a symptom of inefficiency, poor industrial design, and poor resource management; waste is everyone's problem, with unequally shared responsibility for providing solutions; the habit of wasting is culturally condoned to the point of being a "normal" activity; current mechanical engineering solutions are not working as evidenced by the increasing rather than decreasing amounts of materials going to disposal; there is hope to turn this problem around through a "waste minimisation" movement; this movement is pushing for social change at a grass roots level. Within this idea is the possibility of transforming this ingrained culture by encouraging passionate individuals at the local level to demonstrate their zero waste commitment in order to "denormalise" a culture of wasting (Harri, 2011).

This new approach means a radical shift away from mechanical, engineered solutions to the design of social and spatial solutions. The possibility exists to integrate through design, the community recycling centre concept with community awareness raising programs. To explain all these points in detail is beyond the scope of this thesis but this chapter provides a brief overview of the people, place and purpose issues relative to landscape architects that are necessary to understand this transformation in order to assist the transition from a wasteful to a waste-free society.

Driven by national legislation and community advocacy, the Auckland Council has an innovative "zero waste" plan to encourage its residents to put less out in the kerbside collections. One of these strategies is the promotion of a network of community recycling centres that would place more responsibility for the management of some "resource streams" on the local communities and allow greater access to the "resource stream" by communities interested in local job creation (Auckland Council, 2012 pg. 68).

Compared to the "waste not" attitude after WWII sixty years ago, throwing things away used only a few times is considered a normal, acceptable activity Sheehan, 2010 pgs. 1-4). There is an undercurrent of change as governments and environmentalists are seeing the need to "denormalise" this culture in order to decrease the volume of waste and the harm that disposal

causes. Two key issues underlie this thesis: (1) waste is considered normal, but needs to be denormalized and (2) at the same time, discarded materials that are not yet recyclable need to be seen as improperly conceived products whose manufacturing and/or return processes need to be re-designed so that they can become a recyclable or returnable product. To negotiate and synchronize these two aims requires integrating technical and social solutions. Both approaches have a history—the former, much longer than the latter—and a detailed vocabulary. Thus, it is essential to begin this thesis by defining primary terms. These terms are then further explored in this introduction, and additional terms are defined later in the text and/or in the glossary.

- **At-source separation:** eliminating waste at source by sorting into recyclable categories at the place of production. For instance, separating out food scraps at home cleans up the other materials allowing easier, cleaner recovery of the remaining materials at a recycling centre
- **Community Recycling Centre (CRC)**: a local facility where residents can drop off selected materials such as recyclables, inorganic and some hazardous materials
- **Cradle to Cradle**: The re-design of production systems to consider non-toxicity and total life-cycle analysis to enable total recycling of all materials in the manufacturing of goods
- **Daylighting:** where a buried pipe comes out of the ground, to uncover or reveal
- **Denormalising:** to reverse what is currently considered normal
- **Disposal:** landfilling or incineration or waste to energy facilities
- **Greenwaste:** garden greens, branches, grass clippings
- **Inorganic collection:** biannual collection of large, bulky, discarded household goods from residential properties
- **Organics:** resource stream comprised of greenwaste and food scraps
- **Recyclables**: resource stream comprised of recyclable commodities; glass, paper, cardboard, metals and some plastics
- **Resource Recovery Network:** a networks of community recycling centres and larger hubs as an alternative path for discarded materials
- **Resource Recovery:** The activity of reclaiming the value of discarded
- **Resource stream:** a positive description of the term waste stream
- **Transfer Station:** a materials handling facility that collects, compacts and transports materials to a landfill or incinerator
- **Waste minimisation:** reducing the amount of material destined for disposal
- **Waste-wise behaviour:** behaviours that minimise waste going to kerbside and maximise avoiding, reusing and recycling such as home composting

- **Zero Waste:** the idea that waste is neither inevitable nor desirable. It is an aspirational goal that re-imagines a society without waste. Zero waste describes discarded materials as a symptom of poor design with the aim to redesign these systems and enable what was once waste to become an input for a new system, aka Cradle to Cradle Design.

Worldwide, nations are grappling with waste generation and management challenges. In many countries, there are imbalances between who is responsible for decreasing waste: consumers and governments versus the business and industries that produce goods, especially disposable ones (Sheehan, 2010 pg. 4). Moreover, solutions to the waste problem tend to be mechanical, "end-of-pipe" practices that support a convenient and efficient *disappearance* of waste such as landfilling or incineration, despite such solutions tending to exacerbate associated problems with pollution (Sheehan, 2010). Thus, most waste management systems worldwide actually increase, rather than decrease, wasting. Yet, in New Zealand, the Ministry for the Environment is making it national policy to decrease waste. This thesis will focus on developing a particular resource reduction model for Auckland, NZ because of its progressive plan towards a disposer-pays system and a resource recovery network (Auckland Council, 2012 pg. 35).

Waste as defined by the New Zealand (NZ) Ministry of the Environment (2013b) considers how waste is perceived: *Any material, solid, liquid or gas that is unwanted and/or unvalued, and discarded or discharged by its owner.* The definition is important because waste is defined by how it is perceived, that is, undervalued or unwanted, regardless of its inherent value. Negative terms for waste are "rubbish" and "garbage," while positive terms for waste are "discarded materials" or "discarded resources." The problem of waste is increasingly seen as a social, rather than technical, problem, with the New Zealand government recognising this shift by adopting waste minimisation legislation (Ministry for the Environment, 2010). This represents a major shift in national policy from one based solely on materials handling efficiency to one inclusive of social effectiveness. Leading this drive for waste minimisation are the advocates of "zero waste ".

Zero waste is a social transformation which shifts the collective mind-set from one that assumes waste is a normal and inevitable by-product of modern society to one that recognizes waste is an unnecessary and detrimental symptom of a non-sustainable culture. Zero waste groups endeavour to have waste understood as an undervalued resource with the potential to create jobs, minimise the ecological footprint and more equitably place responsibility for waste on the producers of waste. Zero Waste cities seek to minimise waste "at source," through a combination of distributed responsibility, valuing reuse, encouraging innovation for the development of new products from recovered materials, decentralising waste infrastructure, increasing the cost of wasting and

promoting cradle-to-cradle manufacturing design . The focus of the thesis is primarily how the physical design of community recycling centres might support this shift. This distinction is important because it redirects the focus from solely technical, mechanical solutions and towards a more holistic view of recycling facilities as awareness-raising facilities (Zero Waste New Zealand Trust, 2002)

Having adopted these principles, Auckland Council is leading the drive toward zero waste through the planning of a decentralised resource recovery network. The Auckland Council Waste Management and Minimisation Plan (WMMP) proposes as many as 35 local community recycling centres (CRCs) through which local communities can opt to take discarded materials. This multi-site concept suggests new opportunities for landscape architects to engage in the planning, design and development of such facilities, from critical site selection for the appropriate and sensitive integration of facilities into the urban fabric, to site planning and site-specific design. It also presents opportunities for landscape architects to use their skills in the design of purposeful outdoor space for social interaction, rather solely materials handling efficiencies.

New Zealand is fortunate to have over 30 community recycling centres scattered throughout the country, but mainly in small rural towns. Understanding how these manage potentially noxious impacts, provide safe and convenient handling of a wide variety of materials, become valued amenities of their local communities, and successfully shift the cultural mind-set of wastefulness to one of waste minimisation is a challenge. A successful CRC is expected to come from a design strategy capable of integrating opposites: engaging the *local* community while fulfilling the *national* mandate for waste minimisation, and making the *invisible* waste infrastructure *visible* while creating an urban *amenity* out of what could be considered an *objectionable* industrial land use.

Waste is a global issue. Yet a paradox exists in our society that blinds us to the true extent of the issue. While there is, “commonly a negative attitude towards wastefulness, waste is broadly supported and financed by community services such as public litter bins and waste collection programmes that make wasting easy and convenient. Further, the ubiquitous nature of kerbside waste pick-up every week communicates unabashedly that wasting is a publically sanctioned behaviour in our society” (Sheehan, 2010, p. 1). Consequently, the proliferation of landfills—the unseen reservoirs of our endorsed efforts to throw things “away”—has exacerbated groundwater pollution and greenhouse gas emissions (Zero Waste NZ Trust, 2002).

Landfilling remains the dominant approach to dealing with solid waste in New Zealand (Auckland Transition Authority, 2011). However, landfill sites are becoming more difficult to acquire as evidence of the long term environmental and health impacts of landfilling grows, and local

communities increasingly resist the construction of new landfills (NZ Waste Strategy Working Group, 2002). Nevertheless, in Auckland, New Zealand's largest city, waste tonnage is still increasing. As a consequence, Territorial Authorities are being asked both to reduce waste and seek out alternatives (Auckland Council, 2012).

As noted earlier, global waste management trends still lean toward technological, "end-of-pipe" solutions. The Zero Waste movement endeavours to minimise waste at source by distributing responsibility, coordinating value-added mechanisms, decentralising waste infrastructure, and disincentivising wasting at its source. Auckland Council has already taken a leading role in this international zero waste movement by implementing a disposer-pays charging system and advocating for a decentralised resource recovery network. This is expected to consist of as many as 35 local community recycling centres (CRCs) (Auckland Council, 2012).

This thesis project aims to study existing CRCs in the context of the WMMP in order to

- refine the existing CRC typology to better suit Auckland's unique culture and environment;
- develop a methodology for conceptualising, siting and designing new CRCs; and
- Evaluate how the conceptualised typology addresses the multiplicity of desired CRC outcomes (environmental and social) within the Auckland context.

1.2 History of the Waste Industry in Auckland

Since 1996, legislative action on waste has rapidly evolved. While the evolution is not yet complete, the trend is away from disposing materials (efficient waste management) and towards reducing, reusing and recycling (effective waste minimisation). These terms are used because the Waste Minimisation Act of 2008 requires territorial authorities to "promote effective and efficient waste management and minimisation in their districts" (NZ Parliament, 2008). The evolution includes raising community awareness with campaigns that break the cycle of disinterest and ignorance around wasting (see Figure 1).

Figure 1. A Zero Waste Event project aimed at breaking the cycle of disinterest and ignorance around waste (Image by Ron Sperber).

Between 1990 and 1997, Auckland's publically-owned waste infrastructure was gradually replaced with privately-owned transfer stations and landfills. This led to public reaction and the formation, in 1997, of the not-for-profit Zero Waste New Zealand Trust, which foresaw the growth of landfilling, lost employment opportunities, increasing pollution and loss of valuable resources. The Trust led a series of campaigns to target communities whose landfills were reaching capacity. The campaigns promoted alternatives to landfilling, rebranding waste as "local resources", and encouraged recycling instead of disposal. The Trust's efforts managed to successfully shift public perception, and subsequently the policymakers' agenda, from waste to resource (WMMP Working Group, 2000). (The Trust and its influence will be more closely examined as part of the stakeholder analysis later in this chapter.)

As a result, by 2002 the national New Zealand Waste Strategy) was developed (Ministry for the Environment 2002), which, in turn, informed the Waste Minimisation Act of 2008. These central government directives influenced the development of the 2011 Auckland Council Waste Management and Minimisation Plan (WMMP). The Auckland Council WMMP, for the first time, focused on the waste hierarchy, placing waste minimisation at the top (Auckland Council 2012, pgs. 18-19) From the perspective of the waste hierarchy (see Figure 2), the top three levels—*reduction*, *reuse* and *recycling*—are all considered waste minimisation. In this thesis, "waste minimisation" is the expected and measurable outcome of a successful community recycling centre which would be

brought about by *changing the culture* of wasteful behaviour at the community level rather than relying on technological fixes at a distance.

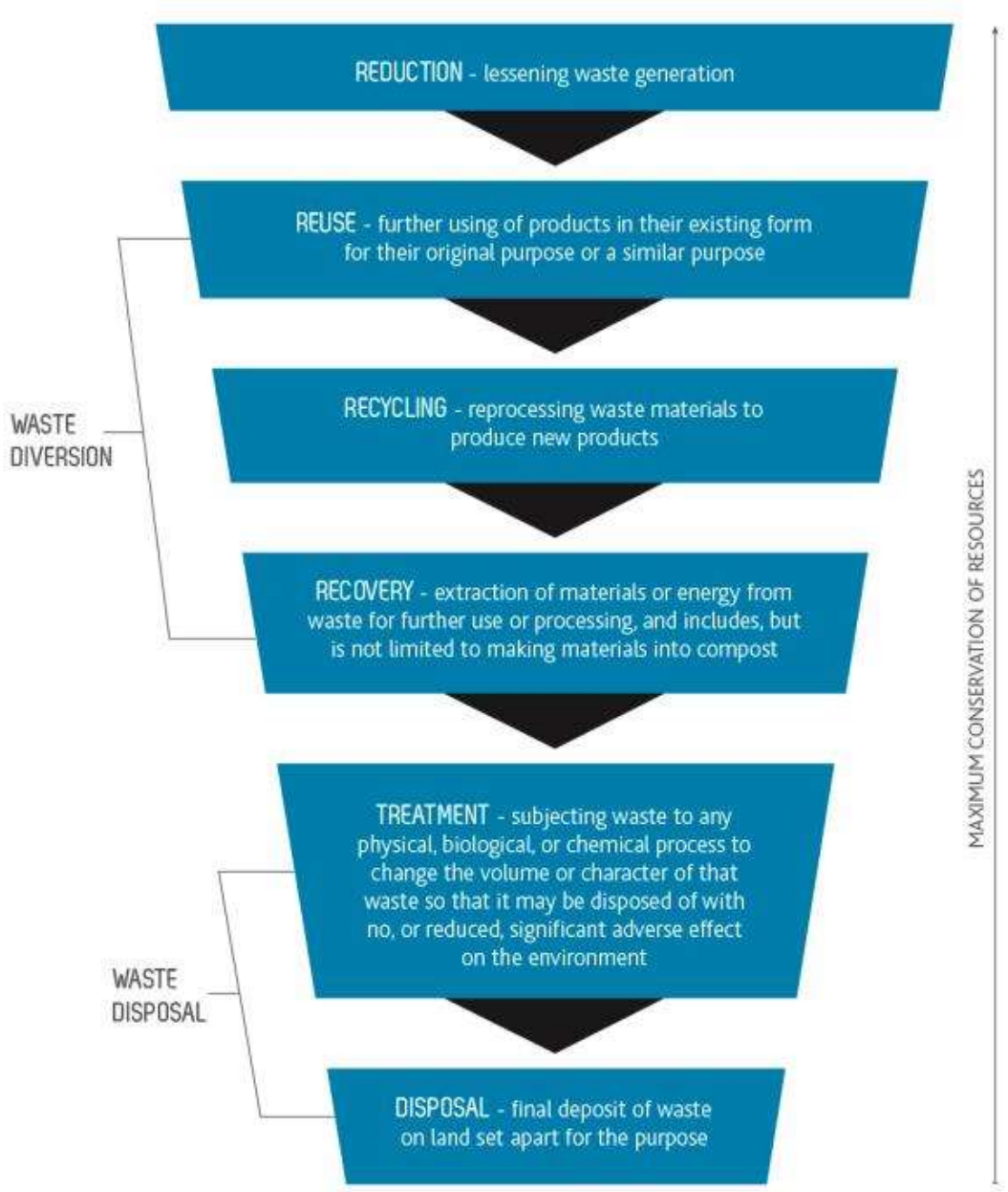


Figure 2. Common waste hierarchy that includes six levels (NZ Waste Strategy Working Group, 2002).

From the lay perspective, waste minimisation activities include any action that prevent material from going to the kerbside collection. This includes reductions in gardening greens, food and compostable discards; (organics), and glass, plastic, metals and paper (recyclables) as well as behavioural changes such as bringing one's own bags or containers to the supermarket, and thereby reducing non-essential materials waste. However, each group of stakeholders has a slightly different

take on what waste minimisation means, and this variation must be explored before considering technical aspects of waste minimisation.

1.3 Disparate Views of Stakeholders

Examining the perspectives of various groups towards waste minimisation helps reveal and contrast the social behaviours, economic aims, and environmental protection goals at play. This section begins with additional information on the past zero waste advocacy group in NZ, the Zero Waste New Zealand Trust. Considered next are the WasteMINZ members, the largest body of waste stakeholders in NZ, which includes the waste disposal industry, the recycling industry, the packaging industry. Also considered are the views of specialists and advocates, such as architects, landscape architects, and artists, along with the role of Auckland Council and Auckland residents, including the Community Recycling Network (CRN), which is a virtual network of communication linking community groups and recycling businesses across New Zealand.

1.3.1 The Zero Waste New Zealand Trust

The vision of zero waste is not only the reduction and diversion of waste streams to landfill (and other short-term waste solutions), but also the complete re-imagination of the *waste stream* to *resource stream*. Advocacy for this idea has expanded across New Zealand since the establishment of the Zero Waste NZ Trust in 1997 (Knight, 2007). The not-for-profit organisation, with initial support from the Tindall Foundation and the Community Business Environment Centre (CBEC), set a nationwide mission to engage councils and community groups whose landfills were reaching capacity. By 2007, more than 70% of New Zealand local Councils had become "zero waste councils" with the adoption of policies that targeted specific alternatives to landfilling (Knight, 2011) and timelines for reaching their goal.

Zero waste advocates also promote the creation of employment and business opportunities through the re-imagination of waste as a resource stream, lending weight to the idea that discarded material has a significant social value. In an effort to denormalise the notion of "waste," a new terminology is adopted to describe the waste management process as a "resource stream" needing "resource management" (WMMP Working Group, 2000). Such denormalistion starts from the assumption that most of the waste in our communities is a symptom of market failures caused by misguided, but well-meaning, policies (Sheehan, 2010 pg 4).

The first failure is the condoning of a consumer culture that purchases non-durable goods designed to be thrown away after a relatively short life. This acceptance of disposable goods was part of major marketing campaign after the conservative years of WWII to encourage consumerism. This has resulted in the "normalisation" of a polluting behaviour. As a mass culture we do not think about "throwing something away", and even feel we are "doing the right thing" by putting it in the rubbish container instead of say, the street where it would be "littering". As a culture we are conditioned to think there is nothing wrong with putting used items in the disposal bin. Zero waste advocates promote the "denormalisation of wasting" to "think again" about what throwing away means and why we are doing it.

The second failure is the condoning of non-recyclable, non-durable goods produced by businesses and industries that must continually replace them. This externalises the disposal costs on the Council and ratepayers. The third failure is the public acceptance of using tax dollars to support waste disposal as then it is perceived as being "free," and so, there is little incentive by consumer or industry to reduce this waste.

The second failure is well described by the Post Carbon Reader Series on Waste:

> The market's invisible hand pushes us toward choices that are under-priced. If the market had been working correctly, the real costs of wasteful products would long ago have given the producers and consumers clear feedback telling them to produce less waste. But because local government 'pays' for it the critical feedback loop was broken. In this way our communities have become unwitting enablers of the market's turn to massive scales of excess production and consumption. (Sheehan, 2010, p. 4)

The Zero Waste Trust closed in 2010, but leaves a legacy of community recycling centres across NZ. These centres tend to be run as community-council partnerships at Council-owned transfer stations or landfill sites. The success of these partnerships is evidenced by their level of waste diversion. For example, since 1999, Opotiki District Council has diverted more than 90% of material that historically would go to landfill (Knight, 2007). The vision of waste minimisation marks a distinct break with short-term interventions such as recycling, which McDonough (2009) describes as "down-cycling," as the mitigation is only the temporary reuse of materials until they finally find an end in landfills. A zero waste future promotes the re-imagination and re-design of our manufacturing systems as cyclical, not linear, resource management systems.

1.3.2 WasteMINZ Members and the Community Recycling Network

The largest body of waste stakeholders is represented by WasteMINZ, the national waste industry body in New Zealand. Its membership is comprised mainly of businesses, industry, and councils with community-based organizations in a distinct minority due to the high cost of membership. The next subsections explore waste minimisation activities and attitudes of some of WasteMINZ major stakeholders: the waste disposal industry, the recycling industry, the packaging industry, and Auckland Council. Sitting to the side of WasteMINZ is CRN, the Community Recycling Network whose members are engaged in efforts to divert materials from landfill, as opposed to many of the WasteMINZ members whose primarily responsibility is for responsible disposal to landfill. CRN is discussed in more detail later.

The waste industry is composed of three major players: landfill owners, landfill operators and waste haulers. Two privately owned landfills serve the Auckland area which compete with each other for "flow control" to maintain a steady income from disposal fees. Prices for landfilling are relatively low in Auckland because of this competition (Wilson, Middleton, Purchas, & Crowcroft, 2009). Different from the landfill owners are the landfill operators. The landfill operators profit from the management of ever-increasing waste flows, hauling contracts, and tipping fees. In this respect, landfill operators are focused on efficient handling, with clear disincentives to reduce waste (Auckland Transition Authority, 2011). They see waste reduction as the responsibility of those producing waste and themselves as purveyors of an important public health and safety service, derived as an inevitable and unavoidable by-product of an industrial society.

Prior to 2008, a landfill owner's business model was to fill and close a landfill as quickly as possible. Income then came from the sale of electricity generated by burning off landfill gas (Transpacific Industries, 2013). When Auckland's waste industry was first privatised, its landfills were seen as valuable long-term assets coveted by asset management companies. Since the adoption of Auckland Councils' WMMP reshuffling has occurred. By February 2014, both landfills had been sold to Chinese waste infrastructure companies. However, with electricity consumption flat, the price of electricity expected to fall (Rutherford, 2012)Council plans for organic matter diversion and a carbon tax on landfills (Ministry for the Environment NZ, 2013a) the future profitability of landfilling is in question. This will have major implications for the future of landfilling in the region.

1.3.3 The Recycling Industry

This industry is focused on the recycling of valuable commodities such as glass, paper, cardboard, plastics and metals. These materials have an on-going value and are easy to collect and

remanufacture. There are many sectors to the recycling industry in Auckland. There are a few, large multi-national corporations such as VISY, and SIMS Pacific Metals, which engage in local collection and overseas remanufacturing. Some, like O-I Glass remanufacture in New Zealand. Among the many New Zealand-owned companies that both produce and remanufacture in New Zealand are Carter-Holt-Harvey Full Circle, and Reclaim, which collect paper and exports most plastics. Interwaste is a NZ company that collects, processes and ships hazardous waste overseas, complying with strict international standards. There are dozens of smaller New Zealand companies that are specialist recyclers for items such as tyres, construction salvage, compost, printer cartridges, e-waste and more. Other major players in the recycling businesses are Fulton Hogan, ONYX, and Smart Environmental which collect from kerbside, run recycling drop-off facilities or sorting facilities known as Material Recovery Facilities (MRFs). Private companies like Resene Paints and Fisher and Paykal Appliances have nation-wide, take-back recycling systems.

1.3.4 The Community Recycling Network

Many recycling businesses are members of the Community Recycling Network. CRN membership includes community groups with zero waste objectives. Collectively, these two factions press for legislation to "level the playing field" to raise the price of landfilling to allow resource recovery to compete with disposal. The disposal model is very cost efficient, employing less people and having more rapid throughput than resource recovery. CRN members pressure the government to raise the cost of landfilling, primarily through raising the national Waste Levy. They point to the fact that European nations have disposal fees to landfill in the hundreds of dollars per tonne. They state that greater diversion could be achieved and more recycling businesses created if central government raised the levy from $10 a tonne to at least $30, like Australia, with the aim of increasing this levy over time.

Obviously, no single group represents the recycling industry as the stakeholders range from multi-national waste industry players to single-person companies that are engaged in varied combinations of remanufacturing, exporting, disposing and hauling. However many of these players are members of the Community Recycling Network and/or WasteMINZ.

The website of Reclaim, a New Zealand-owned company that is a member of both the Community Recycling Network and Waste MINZ, provides insight into the recycling industry as a whole. The Reclaim website states, "Compared to other developed countries, NZ has a vague and scattered approach to achieving zero waste status." The website discusses the importance of choosing recyclable packaging and supporting cradle-to-cradle design. The site also specifies the problems associated with rising tonnages to landfill and the importance of reusing resources to minimise the

environmental footprint. The site further explains that in terms of landfill fees and management, NZ falls behind much of the rest of the world. For example, landfill fees in the UK are 15 times higher than those in NZ. Reclaim notes that economies of scale are important to consider, given NZ's small population base and promotes raising the waste levy to make recycling economically competitive with landfilling. The website also promotes the slogan "waste starts with us and ends with us". (Reclaim, 2014)

In summary, the Reclaim website places waste responsibility for recycling on personal, individual consumer behaviour AND on the responsibilities of business and industry in the form of cradle-to-cradle industrial design. Presumably, this view is typical of the recycling industry's interest to encourage kerbside recycling, cradle-to-cradle packaging design, and widespread recycling behaviours. (Reclaim, 2013)

1.3.5 The Packaging Industry

The Packaging Council of New Zealand (PAC NZ) is another major player in the waste industry. One of its three stated goals is to be "a strong advocate for voluntary rather than mandatory product stewardship" (PAC.NZ, 2013). Its members include the major beverage manufacturers, grocery store chains and packaging manufacturers. PAC NZ is trying to maintain the status quo of voluntary product stewardship instead of moving towards cradle-to-cradle design and/or mandatory product stewardship that would require packaging producers to be responsible for "taking back" their packaging. PAC NZ promotes its own voluntary product stewardship programs and anti-litter campaigns such as Love NZ, Keep New Zealand Beautiful and the Coca-Cola Foundation Beverage Container Recycling Community Grant Programme (PAC.NZ, 2013). Despite their efforts, there is widespread public support for a return to bottle deposits, also known as CDL, or Container Deposit Legislation to require mandatory product stewardship.

In summary, PAC NZ sees waste minimisation as a consumer responsibility to choose products wisely and in recyclable containers. They see it as a Council responsibility to minimise waste by providing "free" kerbside recycling collections. They believe the Council should educate residents about waste minimisation, while business and industry remain voluntarily responsible for product stewardship.

1.3.6 Other Organisations

In addition to the Zero Waste New Zealand Trust, other organisations have taken up the objectives of zero waste in terms of management of total product life cycle, often called "Extended Producer Responsibility" or EPR. The concept of total life-cycle design/management was elaborated upon by architect William McDonough and environmental chemist Michael Braungart in their book *Cradle to*

Cradle (2009), namely, the solution is in designing products that are totally non-toxic and renewable. McDonough and Braungart seek to place greater onus for waste minimisation on the designers of products and the design of manufacturing systems. In short, they see design as a waste minimisation solution; the two entities described next have embraced the challenge.

The **Product Policy Institute** (PPI) is an NGO working to transform the "throw away," toxic society into a waste-free, non-toxic one. Their goal is to promote cradle-to-cradle producer responsibility in which manufacturers are responsible for collecting and recycling their products and packaging. They seek to redesign industrial systems so that market forces drive the use and reuse of safer chemicals and materials. PPI develops educational materials, lobbies governments, and assists public interest advocates in advocating for producer responsibility. The institute determined that providing the United States with consumer goods and materials is the largest share, by far, of direct greenhouse gas emissions (see Figure 3). This calculation included the energy used at all stages of the life cycle, namely, to extract, and process the resources, to manufacture and transport the products, to operate retail outlets and use the products themselves and then to dispose of them by recycling, or burning in incinerators. The PPI therefore makes the case that we need to dramatically redesign our provision systems to address climate change and post-peak oil impacts (Product Policy Institute, 2013).

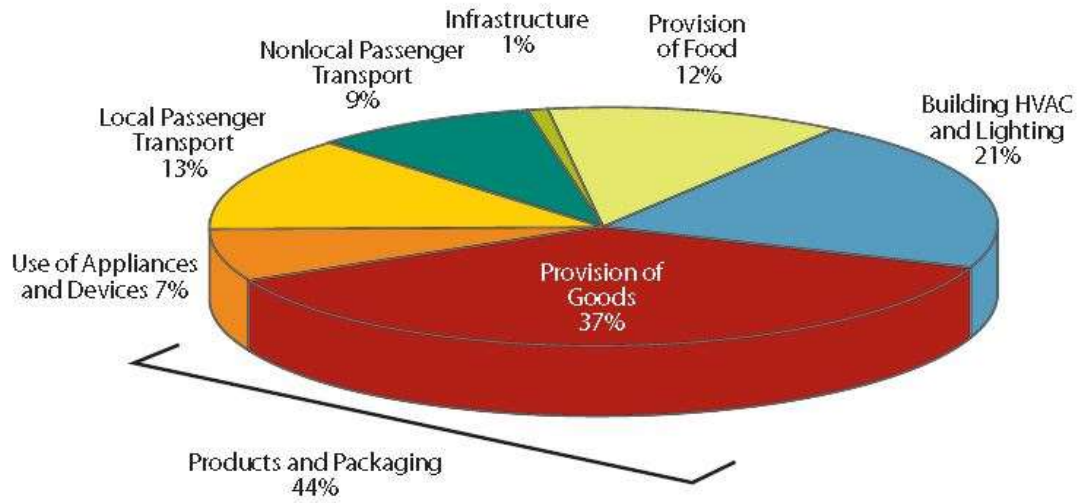


Figure 3. Consumption-based view of sources of US greenhouse gas emissions in 2007, including emissions from products made abroad and consumed in the US (Post Carbon Institute)

The **Post Carbon Institute** "connects level thinking with on-the-ground ideas to transition from a carbon dependent world to a post carbon world as quickly, equitably and sustainably as possible" (Product Policy Institute, February 2014, webpage). It supports the PPI goals for extended producer

responsibility and offers strategies (online and in print) on how to accomplish this. To help communities transition into more resilient societies, the Post Carbon Institute provides evidence-based research projections on likely outcomes of economic, energy, environmental and social trends (Post Carbon Institute, downloaded February 2014).

The **Zero Waste International Alliance** is composed of educators, councils, business and NGOs around the world. The Alliance partners university researchers with businesses to solve waste problems and develop market strategies to promote durable over non-durable goods. The Alliance also holds Webinar series and fosters communication between countries that have or are endeavouring to have zero waste policies.

Like the Product Policy Institute and the Post Carbon Institute, the Zero Waste Alliance wants business and industry to take more responsibility for minimising waste through the life-cycle design of their products, and if necessary, through mandatory extended producer responsibility

1.3.7 Auckland Residents

Auckland residents have a wide range of attitudes towards waste minimisation. Before the Auckland Council amalgamated, each of the seven legacy councils had differing waste collection bylaws. Rodney, Waitakere and North Shore councils had programs and incentives to discourage putting out materials in the kerbside collection, while Manukau and Auckland cities lacked incentives. In Auckland and Manukau city councils, rubbish was paid for through rates, making it seem as though it were “free.” Both of these Councils paid the highest percentage of Council budgets for waste disposal (Wilson et al., 2009).

To understand waste minimisation attitudes and identify possible motivations towards region-wide waste minimisation behaviour, the new, amalgamated Auckland Council commissioned the Auckland Household Waste Prevention Study. In 2012 Nielsen Media Research interviewed a representative sample of 3,210 residents and presented the results in 2013 with the following aims:

- conduct a robust and representative study of Auckland residents regarding their household waste habits;
- understand householder worldviews and attitudes in relation to waste and the environment;
- establish the extent of food waste prevention and waste aware shopping practices;
- understand participation rates for waste wise behaviours including recycling, composting, cloth nappy use, as well as gifting, selling and recycling of e-waste, select household hazardous materials and large household items;

- identify barriers and motivators to minimising waste for a range of waste types: recyclables, food, garden, nappies, whiteware, and hazardous household waste, large household and e-waste(Hazardous waste was limited to domestic paint, paint tins and motor oil);
- establish how willing and able residents are to minimise their waste;
- explore how people would prefer to find out more about waste; and
- cross-analyse and segment the results to determine key differences across the region, for example, by demographic and attitudinal groups as well as target groups such as CBRD apartment dwellers, Hauraki Gulf residents and ethnic communities (Nielsen, 2013).

The survey identified five categories of people with similar waste minimisation behaviours based on age, income, level of concern for the environment, number of waste minimisation behaviours practised and willingness to change behaviours. These five groups were:

1. **Segment One: Younger and Less Active in Waste Minimisation**. Characterised by 20% of Auckland's population, the youngest group, the least willing to change behaviours, with the lowest level of concern for the environment. This group was most likely to be living in rental accommodation, in central Auckland, with a combined income of less than $100,000.
2. **Segment Two: Higher Income and Less Community Focused**. 23% of Aucklanders, combined incomes of over $100,000, less open to changing behaviour.
3. **Segment Three: Community Minded Immigrants**. 9% of Aucklanders, more likely to have a high level of concern about the environment but below average waste minimisation activity. More pre-school children at home, most likely to be struggling financially, and more likely to be living in Housing NZ accommodation. High level of church, family and community focus.
4. **Segment Four: Low Income, Born Locally.** 27% of the population, slightly above average in waste minimisation behaviours, and willingness to change. Living in South and West Auckland. Relatively high proportion of people saying they are struggling financially with the highest proportion of low-income households.
5. **Segment Five: Older and More Active in Waste Minimisation**. 21% of Aucklanders, most likely to engage in waste minimisation behaviour and most likely to agree to change. Strong level of concern about waste and the environment, tend to be older (over 50), the highest proportion of home ownership and incomes over $100,000.

The waste prevention study stated that 74% of Aucklanders felt that waste reduction was an important issue, and 59% stated having a feeling of personal responsibility for their impact on the environment. Two-thirds of those surveyed admitted to having few waste minimisation behaviours in place, yet nearly two-thirds were also willing to change such behaviours (Nielsen, 2013). This may

indicate that some Aucklanders are concerned about waste, but may require some further mitigating resolution to actually reduce their waste. The Auckland Household Waste Prevention Study is further discussed in the research and design chapters.

1.3.8 Auckland Council

The views of Auckland Councillors and Local Board members are summarized in the WMMP. This document explains the need for public influence over the resource stream, public ownership of the waste infrastructure or other means of influence over disposal pricing of the private waste industry in order to meet WMMP waste minimisation targets (Auckland Council, 2012). To accomplish this, the WMMP proposes the following methods: moving to a region-wide user–pays rubbish collection system, introducing a kerbside organic collection, implementing an inorganic booking collection system, developing a resource recovery network, and advocating to central government for mandatory product stewardship and amendments to the Waste Minimisation Act that would require business and industry to minimise waste.

In support of the zero waste directives, Auckland Council foresees resistance from ratepayers to the exorbitant cost of building future landfills, so there is clear incentive to keep the existing landfills open, or advocate for alternative, less costly approaches to managing the waste stream. Auckland politicians may also want to avoid finding, consenting and financing new landfill sites, and they now understand the inherent conflict between private ownership of the waste infrastructure and the need to minimise material flows to landfill. On the other hand, Auckland Councillors must face residents who resist paying price increases to use existing landfills. At the same time, Auckland Councillors are reluctant to encourage community recycling centres without a business plans that verify their positive cost-benefit. Councillors also want to be able to address concerns about odour, dust, noise and other negative externalities and/or stereotypes associated with the transfer station model. The need for additional information is evidenced by Local Board funding of two scoping studies: one in the Albert Eden Precinct and the other in the Henderson-Massey Precinct (Dickinson, 2012).

The Council has strict regulations on the siting of waste infrastructure. Currently, waste infrastructure consists of recycling stations and refuse transfer stations. Both are in the industry activity table and permitted only in industrial zones.

Differences between Auckland and Central Government

The Auckland Council Waste Assessment identifies eleven legislative tools to manage and minimise waste in New Zealand. On a national level, the central government revised the New Zealand Waste

Strategy of 2002 into the 2010 Waste Strategy that "allows a flexible approach so councils will set waste reduction targets that are realistic for their given circumstances" (Ministry for the Environment, 2010, p.5). The revised strategy was a response to missed goals, namely, "the zero waste vision of the 2002 Strategy was ambitious, and many of its targets were unable to be measured or achieved" (Ministry for the Environment NZ, 2010, p.5). The Auckland Council Waste Assessment recommends establishing waste reduction targets to press for reduction of waste to landfill. The Assessment states:

> "…in spite of [national waste minimisation legislation], the emphasis of waste management systems in New Zealand largely favour landfill disposal over waste reduction. The international waste hierarchy is often quoted but seldom implemented. This is because of conflicts of interest by waste companies and lack of incentives/disincentives to encourage preferred behaviours." (Auckland Transition Authority, 2011, p. 2)

1.4 Perspectives of Design Professionals on Waste Minimisation

A library search revealed that landscape architects have historically been active in some aspects of resource re-use and adaptation of closed landfills. Many individual landscape architects have used recycled tires, timbers and glassphalt, in landscape projects for decades. In addition, landscape architects have a long history of involvement of turning landfills into parks. Frederick Law Olmstead turned New York's place of dumpsites wastelands, slaughterhouses and noxious establishments into Central Park. During the early 1860s Olmstead served as executive secretary of the United States Sanitary Commission, an agency that trained many prominent sanitarians (Engler, 2004).

However, landscape architectural involvement in the prevention of landfills, waste minimisation and recycling centre design appears to be a new avenue of work. A library search of landscape architecture journals and magazines from 1998 to 2013 including Landscape Architecture Magazine, PaseaDos, Topos, Scape and JoLA, did not find any references to recycling centres or amenity centres. Only one San Francisco landscape architect, Walter Hood, proposed a recycling centre design for an inner city neighbourhood, but this was not built. It is possible that landscape architects are working with engineering firms that are involved in waste infrastructure siting, design and planning, and this work is presented in engineering journals.

Architect and critic John May believes the environmental design profession has a role in revealing the truth about waste. May explains that a top-down, large-scale "remediation" of landfills fails to recognise the larger problem—that waste is sanctioned by a consumption-oriented society which does not perceive its impact on the future health of the environment. May rejects the beautification

of landfills as superficial and encourages design professionals to reveal the deeper culture of wastefulness inherent in the landfill process (May, 2008).

Figure 4. Image of mirror-covered garbage truck in a Christmas parade, from *The Social Mirror* by Mierle Ukeles Laderman, (Engler, 2004; Mierle Ukeles Laderman, 1983).

Design interventions that aim to reveal the internal working of culture and society, such as *The Social Mirror* (Figure 4), are an attempt to give literal form to an abstract idea. This mirror-covered garbage truck was the last "float" in the Santa's Day Parade in New York City in 1983, symbolizing the need for clean-up from the parade and the Christmas season and the need to move away from a consumptive society. The truck was met with laughter but its presence also put forward the serious issue—that waste is a both a product and a reflection of ourselves and our consumptive society. Laderman's mobile art piece "forced direct confrontations between what is perceived to be the lowest of culture and the highest of art and between citizens and their waste services" (Engler, 2004, p. 96).

Freud (in Engler, 2009) tells us that waste is not a threat in itself but its avoidance or repression creates fear. Confronting the taboos that are associated with waste makes us face up to the truth—acceptance of dirt and ugliness is a liberating act. Instead of blaming ourselves for creating waste, we blame the waste itself for its noxious qualities. In this light, it is our cultural attitudes towards waste, more than the discarded materials themselves, that are the problem (Engler, 2004).

In her book *Designing America's Waste Landscapes*, landscape architect Mira Engler explains that the siting of public waste water treatment plants, stormwater devices and transfer stations physically isolates them from the rest of society. This separation results in "hidden landscapes of waste," and she appeals to the design profession to make these landscapes visible by putting them in visible places or designing waste water treatment, transfer stations and stormwater facilities that allow for public tours (Engler, 2004). Through this interaction, individuals could overcome their fear of waste and waste infrastructure. Engler thus promotes decentralising waste infrastructure and transferring responsibility for waste from an institutionalised level to a personal level (Engler, 2004).

Engler believes that uplifting the landscapes of waste requires addressing two main issues: first, how to avoid the problems created by a culture of wasting and the places that support such venues; second, how to deal with existing problems created by waste. Engler states:

> "Society considers waste a private matter but a public issue. Waste has been distanced and repressed but it shapes our lives and landscapes. Landscapes of waste should be brought closer to our everyday environments and normalised. Systems of waste should be decentralised with aesthetics employed to facilitate this change." (Engler, 2004, p. xv)

Engler justifies decentralisation by explaining when waste landscapes are in public view, "the marginal landscapes of waste {are found} to be complementary to highly valued landscapes and attractive and productive in their own way" (Engler, 2004, p.?).

Thus, she contests the preconceived, hierarchical assumption that waste landscapes are inherently inferior and instead seeks "to explore how design and artworks can change these perceptions into positive and constructive ideas and mould them into new spatial possibilities" (Engler, 2004, p. ?).

Engler's position presents a question: Are the problems generated from a hidden agenda within the waste industry or by ignorance on the part of the public? Engler supports the latter view, that the establishment of the waste industry was due to disinterest and the typical, "out-of-sight-out-of-mind" attitude towards waste. She surmises that the American waste industry grew because of its ability to relieve municipalities of their garbage problem in a way that was efficient, inexpensive, and invisible. The real problem, however, was lack of interest by the general public who failed to realise the multiple consequences of landfilling and passed individual responsibility on those who could instantly 'make it go away' (Engler, 2004).

Engler's view on the conditions needed for a flourishing, but hidden, waste industry is supported by the history of landfilling in the Auckland region. Engler gives this historical explanation:

"…the process to control and eliminate waste was set in place in the private and public domains. Waste was privatised while also being transferred underground to a public but hidden milieu. These significant developments both reflected and enabled modern cultural ideals of progress and cleanliness. Gradually America turned its waste, ever-growing in volume and type....into contemptible and harmful matter and declared war on it." (Engler, 2004, p. 75)

1.5 Summary

The major waste industry stakeholders discussed above seem to hold disparate views of waste minimisation. Businesses that profit from waste tend to see waste minimisation as Council or consumer responsibility. They see themselves as providers of an essential service, but not as waste minimisers. Those that make a profit from recycling tend to encourage maximum recycling rates through education and are supportive of Council efforts to raise awareness about the recycling aspect of waste minimisation. The packaging Industry also encourages and supports Council's recycling programs but resists mandatory product stewardship and works to maintain voluntary programs. Both the packing industry and recycling industries are keen to continue with "free" kerbside collection programs.

Knowledgeable residents and ratepayers paying for waste services would prefer to see costs of waste minimisation spread more equitably among manufacturing, business and consumers. Recent studies indicate two-thirds of Aucklanders are willing to change their habits to minimise waste but are unsure how to do so.

Zero waste advocates promote mandatory product stewardship (also known as extended producer responsibility) to require all business and industry to internalize costs and thus provide a market incentive to minimise waste. They value the educational role kerbside recycling plays but also see an unfairness in the ratepayers picking up the tab for returning recyclable packaging to manufacturers. Zero waste advocates see a need to minimise waste to avert global risks and impacts from pollution and climate change and the need to improve global resource management.

Auckland Council, which must represent all of these stakeholders, has taken a zero waste stance. Minimising waste is in alignment with central government's Waste Minimisation Act and the New Zealand Waste Strategy of 2010. Auckland Council has developed a WMMP that advocates for extended producer responsibility and changes to the Waste Minimisation Act to require business and industry, as well as government, to minimise waste.

The views of selected design professionals are similar to zero waste advocates and the Product Policy Institute, both of which promote the denormalisation of waste and extended producer responsibility. The Product Policy Institute is exploring new models of resource use around mandatory product stewardship and cradle to cradle design. What these new business models might be is still being formulated.

It is not known what other sectors think about siting waste infrastructure, but what is unique about selected design professionals is their insistence on making waste, the culture of wastefulness, and waste infrastructure both visible and accessible. This progressive perspective contrasts with Council urban planning policy of confining recycling centres to industrial zones.

Like the blind men and the elephant, each sector sees waste minimisation from its own perspective; yet all the perspectives need to be considered in the design of community-based recycling centres. The one overriding commonality is that waste minimisation is only truly possible by a shift in cultural behaviour.

2. Research Review and Investigations

2.1 Introduction

The previous chapter put forward the views of zero waste advocates, selected design professionals, waste industry stakeholders and Auckland Council towards waste minimisation. The chapter also provided a broad overview of Auckland's waste history and the Auckland Council WMMP.

This chapter focuses on defining and understanding the relationships between design perspectives, CRCs and the sites within which they are constructed; how they function in the context of local urban environments; and what they need to achieve to be considered successful. To examine these interconnections, the thesis first explores Auckland, its waste history, its unique waste context, and unique WMMP. The WMMP section (2.2) includes a discussion on community-based social marketing, the new kerbside inorganic collection, and the resource recovery network. The discussion deconstructs CRCs to understand basic components and relationships, and then examines criteria for siting CRCs within urban areas.

The research review also includes sections on scoping studies and underlying issues (2.3), and conceptualizing of CRCs and examples overseas and in NZ (2.4), including a focus on a NZ scoping study generic site plan. This chapter concludes with a summary before moving onto the heart of the thesis: the proposed CRC concept and design.

2.2 Investigation of CRCs, CBSM and the WMMP Action Plans

2.2.1 Auckland Council

Auckland Council's WMMP seems to align itself with Engler's approach "by creating a decentralised suprastructure which seeks to engage community in everyday waste minimisation behaviours" (Engler, 2004). The Auckland Council WMMP aligns with Engler's progressive vision. The WMMP is the amalgamation of all seven original, independent, council waste plans into one document, which was adopted in 2011. The WMMP's goal is "to become the most liveable city in the world and aim for the long term, aspirational goal of zero waste by 2040, turning its waste into resources," but concludes that it "will be challenging for the Council to achieve a significant reduction of waste to landfill under present ownership, governance and operational arrangements" (Auckland Council, 2012, p. 11).

This challenge is significant because 83% of the resource stream is controlled by the private waste industry through direct contracts between private haulers, operators and landfills operators (Auckland Council, 2010 pg. 30). Therefore, in order to achieve its zero waste goal, the WMMP makes this assertion:

> Because Auckland Council only influences approximately 17% of the region's waste, its ability to carry out {the national directive to minimise waste} responsibility is limited—and will remain so until it either gains more influence over the waste stream, or industry is given the same responsibilities as the Council. (Auckland Council, 2012, p. 58)

Auckland Council was one of the first in the world to advocate the establishment of a resource recovery network (RRN) as an alternative to landfilling. A 2005 report states that Aucklanders bury over a million tonnes of waste each year into landfill at an estimated annual cost of $162 million dollars. Yet an effective resource recovery network capable of taking all six processing modules would be able to divert at least 25% in five years and as much as 85% in 10 years (Envision NZ, 2005).

This network was part of the larger WMMP with the following strategic directives:

- reducing Auckland's reliance on landfills;
- reducing harm from waste;
- restricting organic waste going to landfill;
- developing an infrastructure and processes to maximise resource recovery;
- reducing council's responsibility for dealing with end-of-life consumer products and packaging through advocacy; and
- maximising local economic development opportunities (e.g. creating jobs in resource recovery (Auckland Council, 2012, p. 20).

These directives are elaborated in the Action Plans that describe new changes: a user-pays rubbish disposal system, a kerbside inorganic collection into a booking system, a kerbside organic collection, community awareness campaigns, and community waste reduction efforts, and community-based advocacy for waste minimisation. The WMMP supports the development of a resource recovery network and appeals to central government to revise to the Waste Management and Minimisation Act of 2008 to instigate mandatory product stewardship and require equal sharing of responsibility for waste minimisation between government, business and industry (Auckland Council, 2012).

The Resource Recovery Network is viewed as a parallel waste infrastructure to the existing private system that supports maximum resource recovery (Figure 5). The network was first proposed in

2005 in “Reclaiming Auckland’s Resources” as a way to garner control of portions of the waste stream currently going to landfill and redirect them to jobs and new businesses (Envision NZ, 2005). The original funding plan for the network was to redirect inorganic collection from a kerbside system to a booking system with support from landfill levy funds and the sale of reusable materials. Thus, community recycling centres would collect and consolidate materials for re-processing at larger, regional hubs. The hubs would contain transfer stations and collect the kerbside organic (food scrap and greenwaste) collections for consolidation and shipping to rural composting facilities.

The WMMP concludes, “The council strongly supports this [resource recovery network] concept as an essential component to achieving the goals the NZWA and the purpose of the WMA 2008” (Auckland Council, 2012, p. 55).

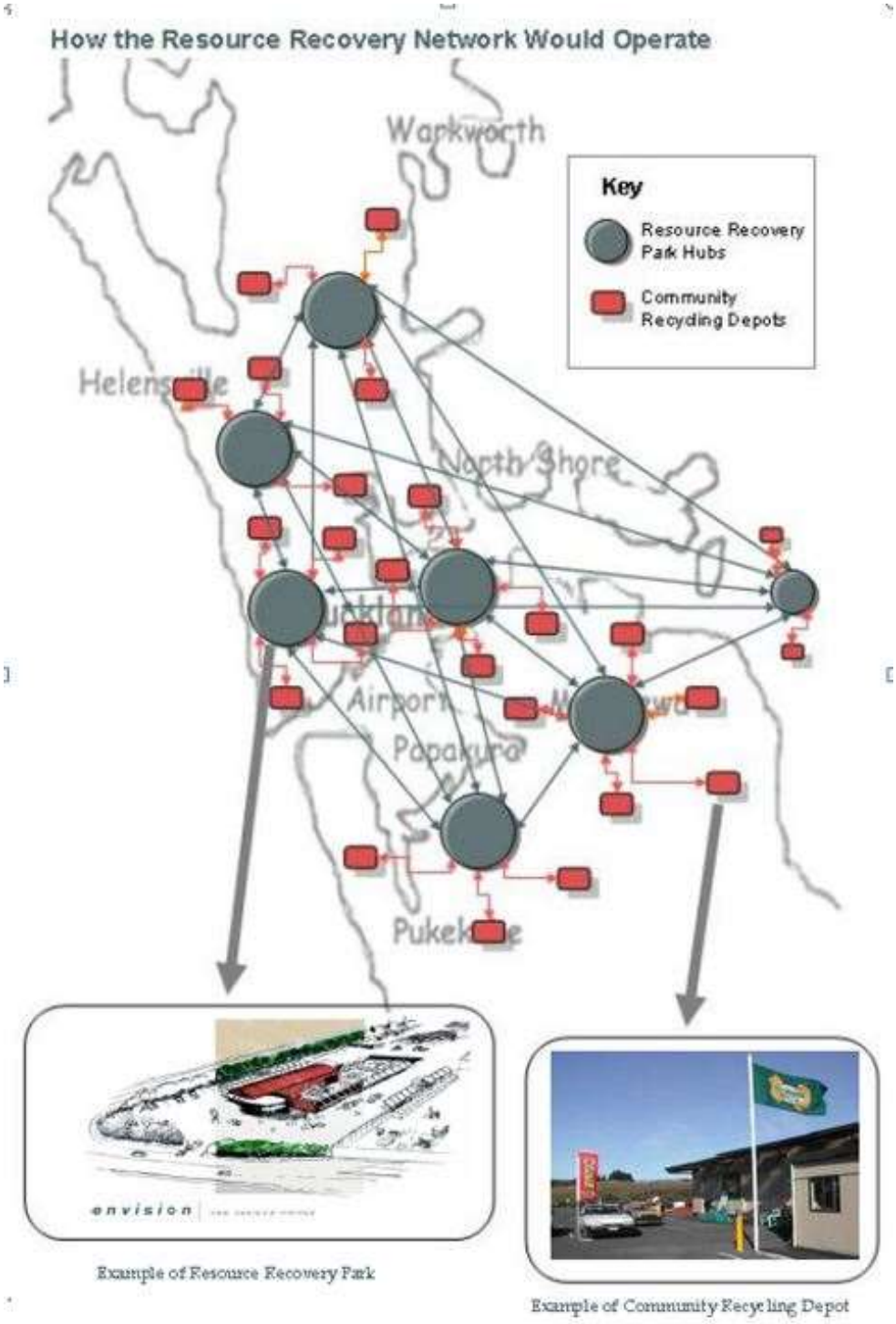


Figure 5. The proposed Resource Recovery Network as outlined in "Reclaiming Auckland's Resources" (Envision NZ, 2005)

This thesis integrates key elements of several WMMPs Action Plans into the design of CRCs to meet the Council's strategic waste and other environmental directives. Specific elements of interest are community-based social marketing, a user-pays inorganic booking collection, community awareness raising campaigns, and community waste reduction efforts.

2.2.2 Auckland's uniqueness

In most regions of New Zealand, community recycling centres (CRCs) are at Council-owned transfer stations or landfills in rural or provincial regions. Auckland is different in several respects:

- The Auckland region is by far largest city with one third of New Zealand's population. Unlike many rural areas, it has a growing population and very expensive land. The proposed Unitary Plan puts forward the need to accommodate a million additional residents by 2041.
- Densification is expected to require the integration of many land uses within the same zone to minimise transport distances and create a diverse urban form. The plan proposes to achieve this by creating flexible, mixed-use zones (Auckland Council, 2013b).
- The Council owns only one-quarter of the transfer stations and has influence over only the Whitford landfill, which is owned in a 50-50 partnership with a private landfill owner (Auckland Transition Authority, 2011).
- It is likely that CRCs locations will be based on local board areas. Many local board areas do not have a rural or industrial zone that would normally accommodate waste infrastructure (Dickinson, 2012).
- The design and siting of CRCs may be dependent on their planning definition. If CRCs are deemed "waste infrastructure," they may be required to be sited in industrial zones. If they are not deemed waste infrastructure, there will likely be challenges about defining what they are and how they fit—with minimal environmental impact—into a mixed-use zone.
- Unlike the rest of New Zealand, most Aucklanders are unfamiliar with the concept, benefits and amenities of CRCs simply because there are no urban Auckland examples for comparison.
- Unlike the rest of New Zealand, Auckland has a much-loved "inorganic collection "whereby once every two years, residents can put out large, bulky items that do not fit into the usual kerbside collection. Neighbouring residents enjoy free "shopping" through the kerbside piles but his has proven to be an expensive service and a dangerous form of litter. Kerbside materials can sit on the kerb for as long as two weeks prior to collection with scavengers scattering debris, and breaking glass as they search for valuable items. The WMMP proposes to use the savings from discontinuing the inorganic service to help fund the establishment of the resource recovery network.

2.2.3 Community-Based Social Marketing

Waste minimisation was defined in the previous chapter as actions that affect a cultural shift resulting in less waste to landfill. If true waste minimisation involves a cultural shift, this raises the question: What are the properties of successful waste minimisation campaigns? In an attempt to answer this concern, this thesis considered three references on changing behaviour around waste. The authors of a chapter on behavioural change in the book *Designing for Zero Waste* recommend taking the five-part process used to change substance abuse behaviour and applying it to the culture of wastefulness (Crocker, 2012). The two other books reviewed include *Psychology for A Better World* by University of Auckland psychologist Niki Harri (Harri, 2011) and *Fostering Sustainable Behaviour* by Doug McKenzie-Mohr (McKenzie-Mohr, 2011). Harri's approach focused on creating environments where people could model sustainable behaviours to fellow community members, while McKenzie-Mohr's approach emphasised the importance of engaging community to influence behavioural change within the particular community. McKenzie-Mohr cited examples of Council waste minimisation campaigns that successfully used this approach.

Determining which of these three approaches would be the most effective would require an extensive study of evaluative typologies in environmental psychology, and is therefore beyond the scope of the study. However, it is relevant that environmental psychologists identify methods that effectively influence waste minimisation behaviour. All three approaches may have relevance to the design of the physical form of CRCs. This multiplicity will be explored further in the design section of chapter 3.

Of the three behavioural change approaches, community-based social marketing is the one advocated by the Auckland Council WMMP Action Plan. This approach emphasises the importance and effectiveness of the community changing community attitudes from within, rather than relying on Council directives from without. A new set of is more likely to be adopted when people that the community relate to introduce, model and encourage sustainable behaviours. When a new behaviour as seen as "the way we do it here" it is more apt to be taken up (McKenzie-Mohr pg. 8). Therefore, empowering communities directly through engagement, other community groups, and schools and indirectly through Council communications are all part of the strategy to transition Aucklanders to waste wise behaviour.

Figure 6. Grey Lynn Waste Away 2030 group at a local farmers' market, promoting home composting and less wasteful products. Image by author.

Other current examples of community demonstrating the value of waste minimisation are upcycle cooperatives, community gardens and activities at some farmers/community markets held around Auckland (Figures 6 to 8).

Figure 7. Wilton Street Community Gardens group promoting growing local food, which minimises waste. Image by author.

Figure 8. Upcycle cooperative selling the wares of artists who improve upon second-hand goods. Image by author.

Combining resource recovery infrastructure with community waste education involvement is not a new idea (Envision NZ, 2003). Examples of community recycling centres that run waste education programs include Mid-Canterbury Wastebusters in Ashburton, Xtreme Waste in Raglan, Wanaka Wastebusters, Community Business and Environment Centre in Kaitaia, and the Nelson Environment Centre (Envision NZ, 2003). Two-thirds of all community recycling centres across NZ engage in waste minimisation education, usually through Council contracts.(Stone, 2002).

2.2.4 Differentiating Transfer Stations from Community Recycling Centres

Sources used to review Auckland's waste industry are drawn from government-funded reports, including The Waste Assessment (Auckland Transition Authority, 2011) , Auckland Stocktake (Wilson et al., 2009) , the Auckland WMMP (Auckland Council, 2012), the New Zealand Waste Strategies (Ministry for the Environment NZ, 2010), and the Waste Minimisation Act (NZ Parliament, 2008). To evaluate and qualify criteria derived from this literature, the thesis author completed site observation and analysis of two Auckland resource recovery operations the Waitakere Concourse Resource Recovery and Transfer Station and the Helensville Community Resource Recovery Centre. This first-hand assessment was necessary to assess the existing situation and understand how conventional systems work.

Transfer stations are the familiar local waste infrastructure across Auckland. These specially engineered stations are designed to receive waste in large quantities. They are designed with tipping pits or floors where the waste can be compacted into special containers for transport to landfill. The

basic components of transfer stations are shown in Figure 9. The stations are primarily designed for efficient throughput of a large amount of material in a short space of time, using compaction machinery for efficient transport to disposal. Therefore, the stations are designed to be secure, to weigh incoming vehicles, to allow manoeuvrability for large trucks to tip efficiently and exit quickly.

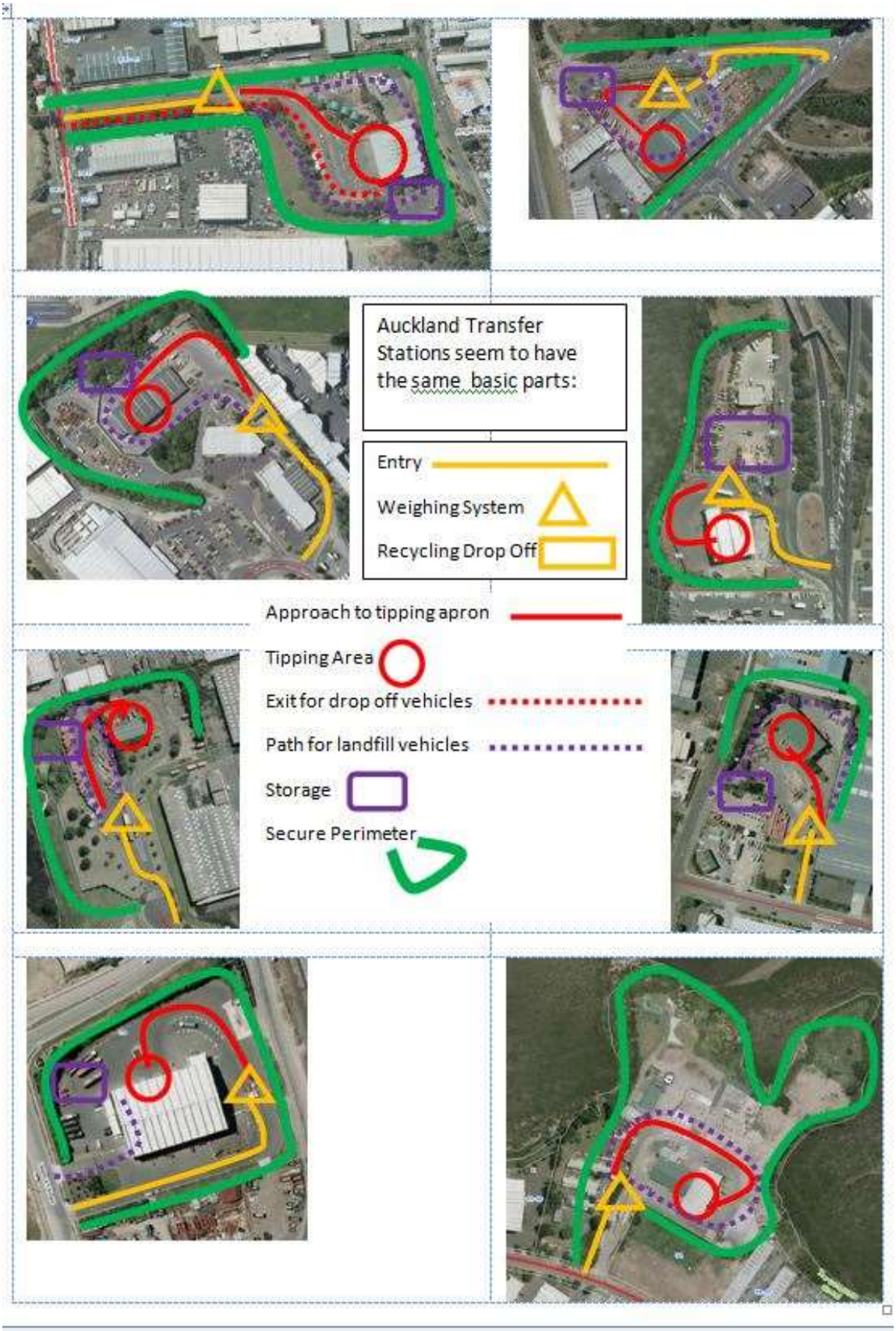


Figure 9. Comparison showing eight transfer stations in Auckland have the same components. Google Image adaptation by author.

There are important differences between CRCs and transfer stations, as summarised in Figure 10 and described below. Zero waste advocates see the RRN and its many CRCs as alternatives to the existing transfer station and landfill network. Although CRCs are found throughout 70% of New Zealand's territorial authorities, there is only one CRC in Auckland in Helensville (Envision NZ, 2003).

It is important to clarify whether a CRC is a transfer station or needs to contain a transfer station. Auckland Councillors may be encouraged to save money by converting or renaming existing private transfer stations into CRCs when in fact there are major differences and perhaps incompatibilities between them:

- Transfer stations take mixed materials that are uneconomical to sort and process; CRCs don't accept mixed materials. Instead, they focus on engaging their communities to recognize, sort and bring materials to them already sorted, ready to be economically processed. A transfer station accepts smelly bags that include food scraps, but a CRC would not allow these materials onsite.
- A transfer station incorporates a rapid throughput business model, whereas a CRC slows down the process to extract as much value as possible before sending non-recoverable material to disposal. Studies have shown an average of 75% of materials that are currently going to landfill could be diverted if separated out prior to disposal (Auckland Transition Authority, 2011).
- Transfer stations make their profit from tipping charges; CRCs make their profit from diversion from disposal, including the sale of recyclables materials and reusable goods, and proceeds from education contracts and contracts for managing a recycling drop-off.

Thus, given these fundamental differences this study asserts that CRCs are not transfer stations. This distinction figures into the CRC concept, design and testing, which are thoroughly discussed in section 3.

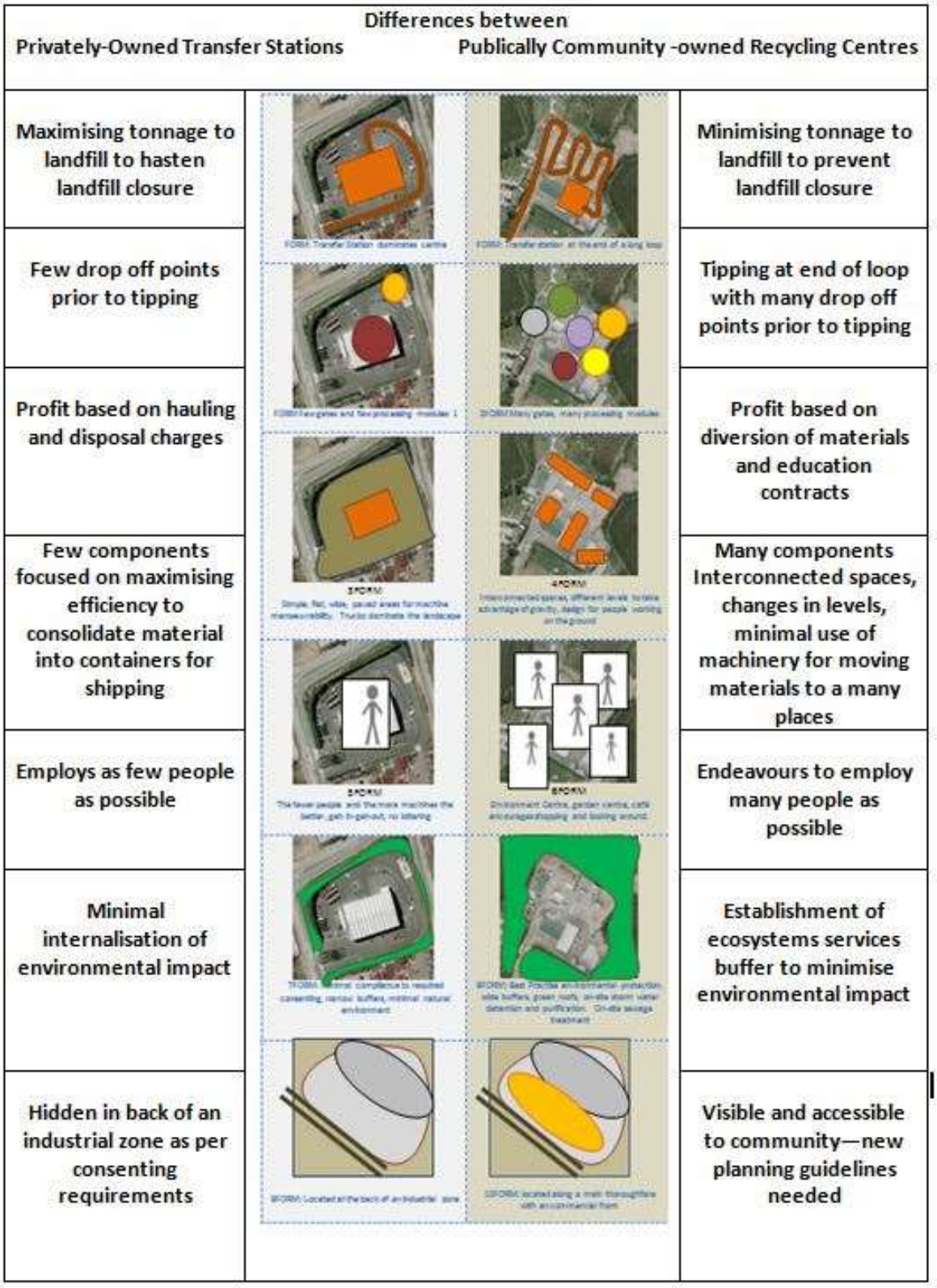


Figure 10. Differences between privately owned Transfer Stations and a publically Community-owned Recycling Centres. Image by author.

2.3 CRC Scoping Studies and Underlying Issues

2.3.1 Council WMMP and Related Analysis

The Auckland Council WMMP freely endorses the purpose of resource recovery network, stating "it is an essential component to achieving the goals of the NZ Waste Strategy and the purpose of the Waste Minimisation Act of 2008" (Auckland Council, 2012, p. 55). The resource recovery network is described as a network of CRCs. Although this study has identified what a CRC is, including how it differs from a standalone transfer station, it is essential to thoroughly understand what a CRC is and what it needs to do.

The WMMP only briefly describes CRCs and refers instead to a study completed in 2005, "Reclaiming Auckland's Resources." This investigation has since been superseded by the Albert-Eden-Puketapapa and the McClaren Park Henderson South Scoping studies, both of which were funded by local boards to investigate and provide clarity about the users, business model and functions of a CRC for the potential development of CRCs in these local boards (Dickinson, 2012), (Luxton, 2013).

The scoping studies describe the resource recovery network as a long-term project. The concept is still being developed but is likely to consist of three types of facilities: (1) a few central hubs dedicated to commercial and industrial discards and providing a central collection point for materials that cannot be stored at CRCs, (2) many local CRCs, possibly as many as one per local board, dedicated to household and local business discards, and (3) local drop-off facilities where limited space prohibits full-fledged CRCs. These three types of facilities are expected to be independently operated but share a common brand. It is likely they would collaborate with existing second-hand stores, charities, and commercial resource recovery operations. The Council's role would be to facilitate, rather than build and control, the network itself (Dickinson, 2012, p. 4).

CRCs are meant to serve their local community by being a "one-stop-shop" to drop off or purchase a wide range of materials, including household goods, building and do-it-yourself (DIY) materials, and outdoor equipment that currently part of kerbside inorganic collection. These items might be dropped off for free or collected for a charge, depending on the saleability of the item. Accepted goods might be repaired and resold or dismantled and recycled. Thus, CRCs can serve as "reverse retail outlets" that create local jobs or send materials back to remanufacturing instead of going to landfill. CRCs are also expected to focus on running new, inorganic booking collections (Dickinson, 2012, p. 5). The Auckland Council lists the purposes of CRCs below (Dickinson, 2012, p. 7):

The Purposes of Community Recycling Centres

- Make recycling/resource recovery convenient (one-stop-shop)
    - Create local jobs and business opportunities
- Reduce waste to landfill
- Enable discarded goods and materials to be distributed within the community at low cost
- Provide recycling businesses with collection points for materials
- Provide venues for environmental education and arts programmes
- Provide drop off points for hazardous waste and product stewardship schemes
- Provide other services for Council, for example, booked inorganic collections

In order to fulfil these purposes, the following functions of a CRC are listed below (Dickinson, 2012, p. 9):

Functions Recommended for a Community Recycling Centre

1. Drop-off area for reusable items
2. Repair workshop for reusable items
3. Retail store and sales yard for reusable items
4. Drop-off area for recyclable commodities
5. Drop-off area for bulky recyclable materials (whiteware, tyres, timber, scrap metal, etc.)
6. Dismantling area for bulky materials
7. Drop-off area and sales yard for construction and demolition materials
8. Greenwaste drop-off and processing area
9. Administration and environmental education area
10. Cafe/art gallery/display area
11. Hazardous waste drop-off and storage area
12. Residual waste drop-off

Both lists could be used to clarify the scope of CRCs, begin the design process, and evaluate the site plan development. One scoping study hypothesised few good examples of CRCs exist in Auckland due to the lack of community access to the resource stream (Dickinson, 2012). The scoping study outlines why demand for CRCs should increase, citing Council waste minimisation targets, increasing landfill costs, disposer-pays refuse charges, product stewardship potential, the switch to an

inorganic booking collection, and the introduction of sustainability awareness programs (Dickinson, 2012, p. 9). The WMMP Action Plan 2.13 lays out a comprehensive community development strategy designed to raise awareness and encourage change in waste perception and management. The strategy included community-based social marketing projects, local awareness raising projects, and place-based community-driven projects (see Figure 11) (Auckland Council, 2012).

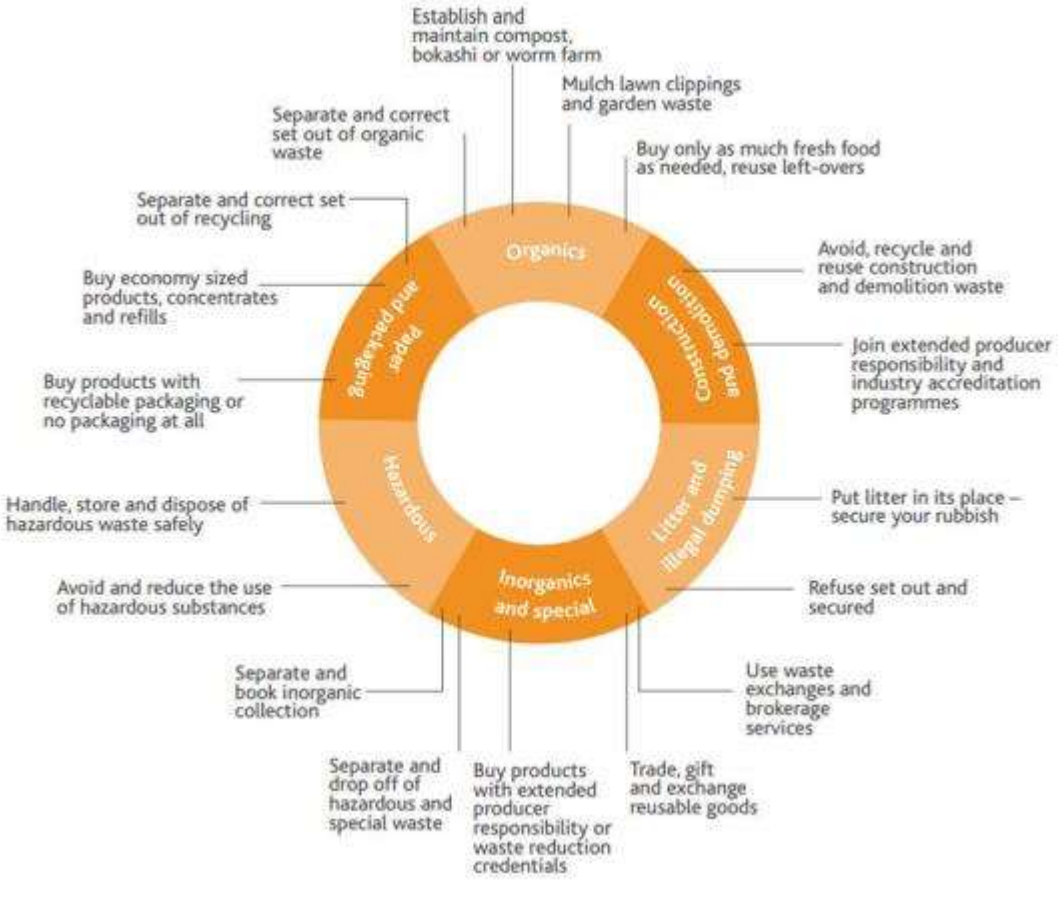


Figure 11. Everyday Waste Reduction Actions as presented by the Auckland Waste Management and Minimisation Plan (Auckland Council, 2012, p. 63)

The scoping study goes on to discuss possible funding sources: council grants, donations from philanthropists, local sponsorship, recycling companies support, and local boards funding. Product stewardship programs might encourage manufacturers to support CRCs if customers can return used products to the CRC for collection back to the manufacturers.(Dickinson, 2012). The WMMP advocates for product stewardship programs in its Action Plan 2.8 (Auckland Council, 2012). This might mean designing for future flexibility, such as the addition of reverse vending machines or other product return systems. (See glossary)

If established, the network is expected to share best practise operational guidelines and have similar operating policies and procedures throughout the system: standard operating hours, cleanliness levels, presentation of items for sale, and consistent pricing, signage and staff training. Health and safety standards are more easily maintained when commercial and service activities are kept separate from residential and sales activities (Dickinson, 2012). In particular, the drop off area should be kept separate from the service area. In addition, the first CRCs must be particularly well-designed as they set the precedent for future CRCs.

The Albert Eden scoping study outlined the process for selecting sites based on finding enthusiastic local community groups and council-owned land. The study stressed the importance of understanding how local community demographics influence the resource stream and therefore the business model. Synergies between CRCs, tertiary institutions and existing businesses were identified in the study, and described potential collaborations to divert recyclable materials, reusable goods, e-waste, scrap metal, construction and demolition materials, hazardous wastes, organic wastes and other materials (Dickinson, 2012). This emphasis on business interactions implies flexibility in the siting and functions of a CRC and the importance of understanding the site within the local community context.

Figure 12. Generic site layout for a Community Recycling Centre (Dickinson, 2012, p. 28).

Dickinson presented a generic site plan (Figure 12) and an indicative budget based on expected revenue and expenses. Several relevant business assumptions were made (Dickinson, 2012, pp. 29–30):

- Servicing an area with a population catchment of population is 35,000–40,000.
- Land and buildings are provided by Council at a nominal rent.
- Facility includes a reuse store and yard, recycling drop-off and greenwaste drop-off area.
- Staffing includes 1 full-time manager and 4.5 full time employees (FTE), increasing to 1 full-time manager and 7 FTE in year three. This is expected to rise.
- No council contracts are available for recycling or refuse, only hazardous waste.
- A small truck, forklift, bins, computers, etc. are factored in.
- Most income is derived from shop sales, business recycling services and environmental services.

2.3.2 CRC Role in Auckland's waste industry network

The report "Auckland Waste Stocktake and Strategic Assessment" presented a very useful diagram showing the entire Auckland waste industry, its waste producers, haulers, collectors and processors (Wilson et al., 2009, p. 72). This diagram was modified by this author, as shown in Figure 13 The concept put forward by the scoping studies are that a CRC would fit into the larger system by intercepting the residential and small business discards that are currently being "self-hauled". The solid lines in Figure 13 depict actual links and the dashed lines possible links. This indicates a parallel rather than competitive business model with the existing private waste industry.

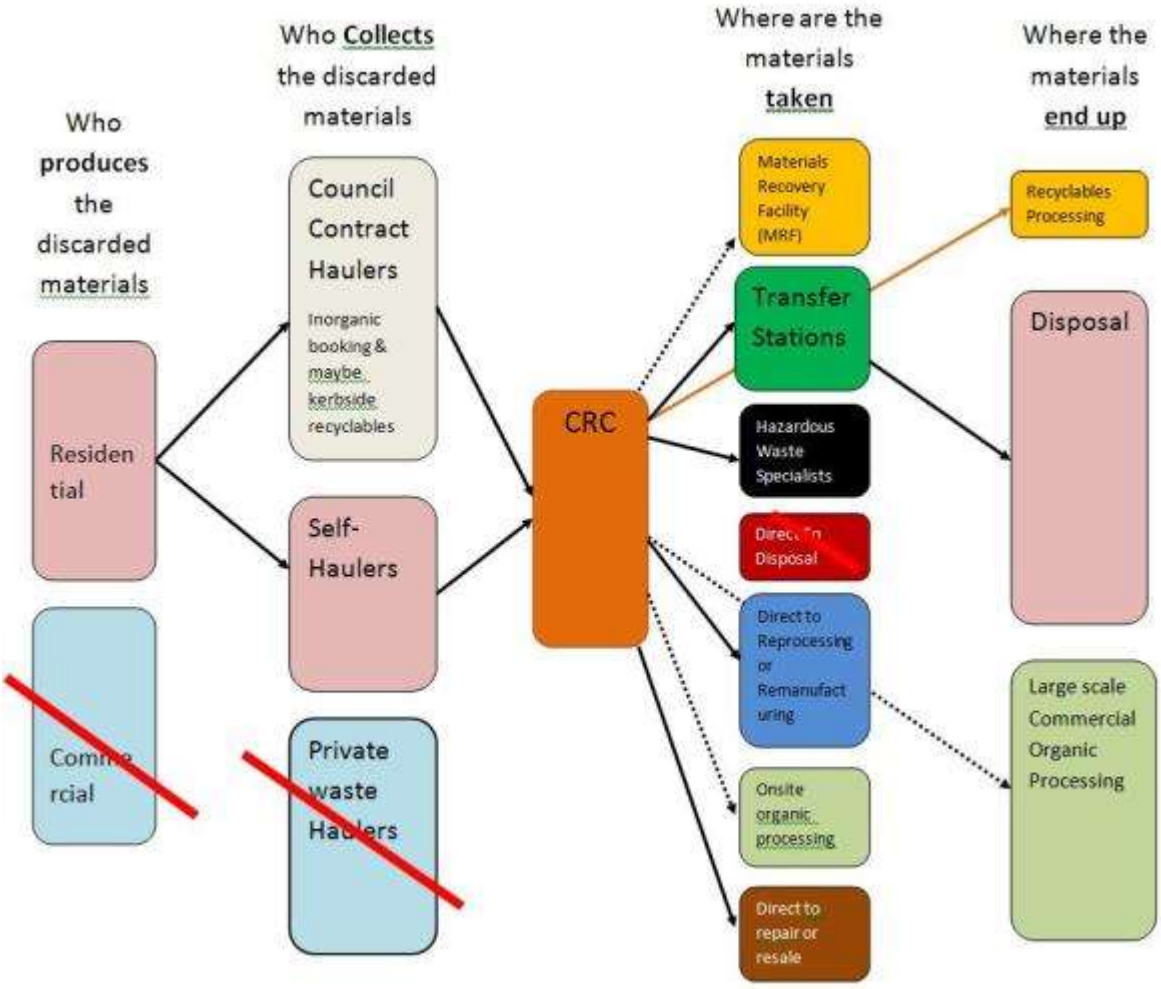


Figure 13. Diagram of how a Community Recycling Centre bridges waste hauling and disposal options (Wilson et al., 2009, p. 72 as modified by the author).

From the scoping studies, it is likely a CRC would need to be designed to manage the inorganic collection, a recycling drop-off, waste education contracts and a local, small-scale kerbside recycling collection. Questions surround how much a CRC would intercept from the commercial waste stream. Encouraging business and industry to use the CRCs requires knowledge of what type and quantity of materials would be coming, and design facilities accordingly. For the purposes of this study, it is assumed a CRC would take materials dropped off by self-haul businesses and set up "Cleaner Production" systems at businesses themselves, but the CRC would not seek contracts to collect from businesses or the construction trade.

2.3.3 CRC Ownership Issues

The report "Resourceful Communities" described CRCs throughout NZ, including their ownership and governance models (Envision NZ, 2003). This report documented the majority of recycling

centres were in community-council partnerships. Assuming this is the norm, Auckland Council will need to decide if they will be part owners in the CRCs, and if so, whether this partnership would be in public-private ownership or public-community ownership or public-private-commercial ownership. Neither the scoping studies nor the WMMP indicated what the preferred business structure would be. Research on existing CRCs across New Zealand shows that most are "social enterprises," or "for profit" organisations with a charitable purpose. Profits may go back into the community to create more jobs, improve zero waste diversion or achieve some other social or environmental benefit. These social enterprises focus on creating income from diverting materials from landfill by garnering council recycling and education contracts, running second-hand stores, and selling recycled product. Social enterprises point out that the waste industry cannot, by its current business structure, minimise waste. To be profitable the waste industry needs to haul and dispose of waste and to charge tipping fees. When landfill prices rise, recycling businesses become more profitable and take over an increasing percentage of the waste stream, further reducing the profitability of the disposal model (Zero Waste NZ Trust, 2002).

The other issue against private commercial ownership of CRCs is community buy-in. To achieve true waste minimisation and effective community change, the message should ideally come from the community, not Council or business (McKenzie-Mohr, 2011). Waste minimisation is more likely to be seen as an important community service and therefore valued and supported if the work is being done by a recognized community group.

For these reasons the thesis will assume that the CRC will be run by a social enterprise in partnership with the Council.

2.4 Past Attempts and Existing Designs of CRCs

This section examines past attempts to design CRCs. It studies site plans developed by community groups and the environmental design profession, seeks to determine the components of a CRC and how they relate to each other. Examples were found through the internet, and research included visits to existing CRCs across NZ. Aerial photos were used to understand the site layouts.

2.4.1 The New Zealand Resource Recovery Park Design Guide

In 2007 the New Zealand Resource Recovery Park Design Guide was published by the national waste industry organisation, the Waste Management Institute of NZ aka, WasteMINZ (Tonkin and Taylor, 2007). This guide was the first attempt by the New Zealand waste industry to develop an alternative to the transfer station model. The guide included six key features and functions:

- drop-off modules for organic, construction and demolition, reuse, and recycling materials prior to the tipping platform to maximise diversion;
- the possibility of processing, such as crushing, composting or sorting adjacent to the site
- inclusion of a reuse sales area and education centre;
- separation of residential from industrial/service vehicles;
- looped layout so vehicles could circle back and continue separating and dropping off;
- Differential pricing-showing free disposal for some items and more expensive charges for others, with the option of disposal the more expensive option.

Despite these intentions, the second-hand sale area and education centre seem tacked on rather than integrated into the overall site (Figure 14). The site shows vehicular patterns but omits pedestrian routes. The education centre is placed close to the exit of the site as though community members were a liability rather than key players. Therefore, it is assumed that awareness raising value of the general public plays a minor role, and the major emphasis is still on efficient mechanical materials handling. This layout seems to be transitional, including sales and education but failing to develop the overall site as a learning, working, and community engagement centre.

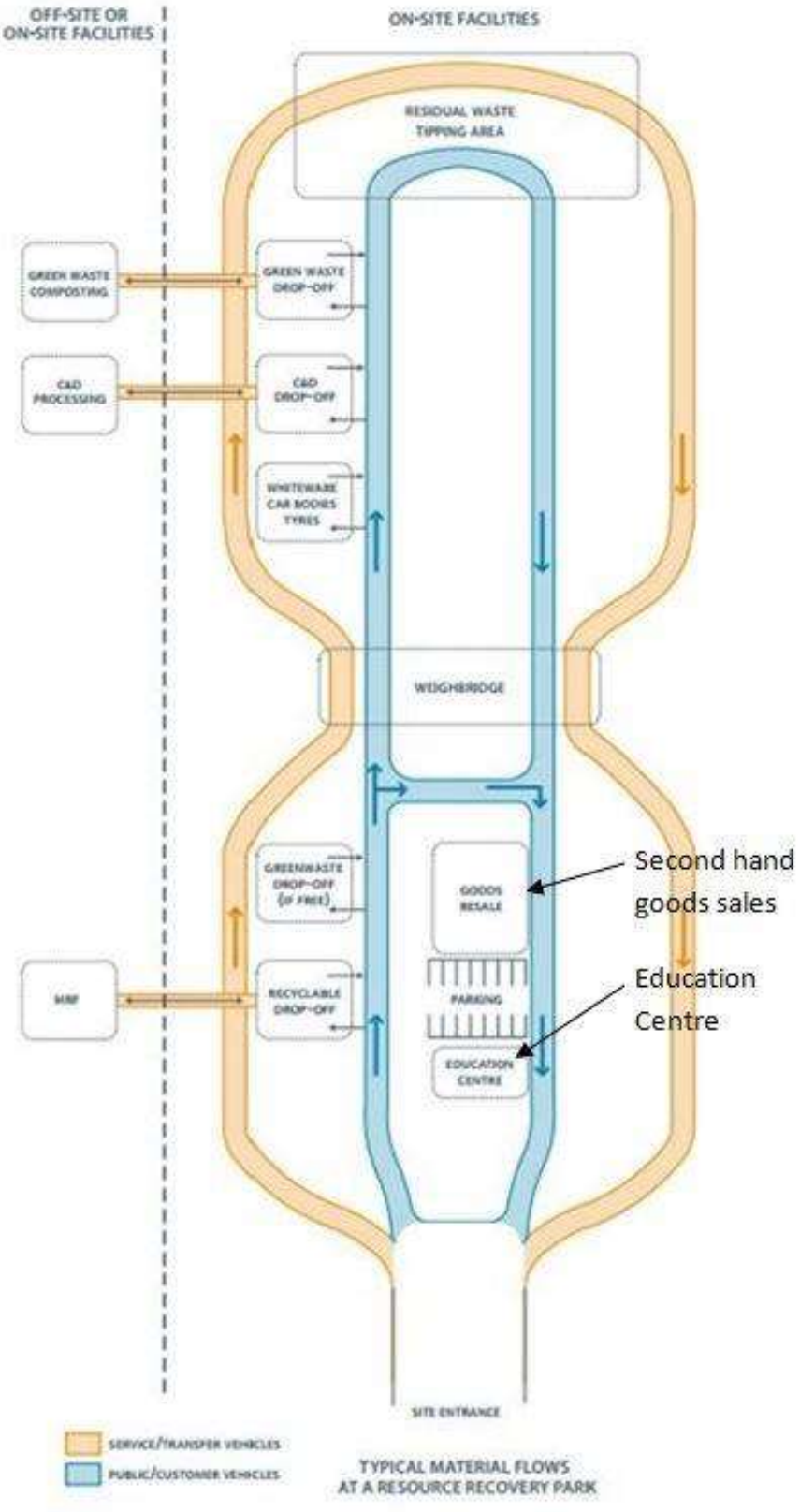


Figure 14. Diagram of typical materials flows at a Resource Recovery Park, WasteMINZ (Tonkin and Taylor, 2007).

2.4.2 Examples of Overseas Zero Waste CRCs

An effort was made to find overseas CRCs in a legislative and economic context similar to Auckland. The first priority was to find zero waste Councils. The Zero Waste international Alliance website ("Zero Waste International Alliance,") listed cities and countries with a zero waste goal: the Bay Area of California, Seattle (Washington), Boulder (Colorado) in the U.S.; British Columbia and Toronto; most of Australia, and many cities in Italy, England and Wales. Within these zero waste cities or countries a search was made of community recycling centres that had some of these features:

- national or regional waste minimisation directives;
- zero waste policies with disposer-pays incentives;
- a system of decentralised, local recycling centres as part of a larger resource recovery network;
- on-site waste minimisation, education and outreach programs;
- receipt of a wide range of materials from the six different processing modules
- council-community partnerships involving social enterprise and council governance and/or funding;
- a business model based on diversion from disposal or on increasing the value of discarded materials (reuse sales, recyclable sales, repair, refurbishment, upcycling, compost and plant sales, etc.) rather than on tipping charges;
- kerbside waste collections already in place for organic, recycling and rubbish
- professionally designed sites plan for aesthetic appeal and human interaction, not just mechanical efficiency;
- A population catchment of 25,000–50,000.

None of the examples found meet all of the criteria, but four CRCs were in similar situations and are described below: two in England, one in California and one in Australia.

Figure 15. Aerial photo and schematic of amenity centre in Somerset, England (WRAP, 2013)

Somerset, England (Figure 15)

The facility in Somerset, England, is part of a network owned and run by a group of Councils, collectively called Somerset Waste Partnership. Somerset already has kerbside recycling and an organic collection. Somerset differs from Auckland in being a rural region with many small towns locating their recycling drop-offs in industrial or rural areas. The Somerset facility includes a transfer station.

The facility in Somerset demonstrates a concentric, or onion-type, structure (see Figure 15). In the centre is an industrial area (grey) for service vehicles. Encircling the grey centre is a perimeter road for self-haul vehicles (orange) and between this is a recycling drop-off area (light orange). A hedge planting surrounding the site forms a screen. A stormwater pond lies within the industrial area. There appears to be a grade change between the industrial and residential loops that makes it easier for the general public to drop items into containers. The secure, contained industrial area provides a safe separation between residential and service/industrial vehicles, but limits future expansion. The industrial processing area is separate from the hedge buffer, which could otherwise provide eco-systems services for environmental impacts.

Crewkerne, England (Figure 16**)**

Crewkerne is also part of the Somerset Waste Partnership but has a reverse form. At Crewkerne, residents drop off materials in the middle of the site, and service vehicles collect around the outside edge. This concentric form is appropriate given the boundary is adjacent to industrial processing facilities. Again, there is a grade change to make it easy to drop materials into containers.

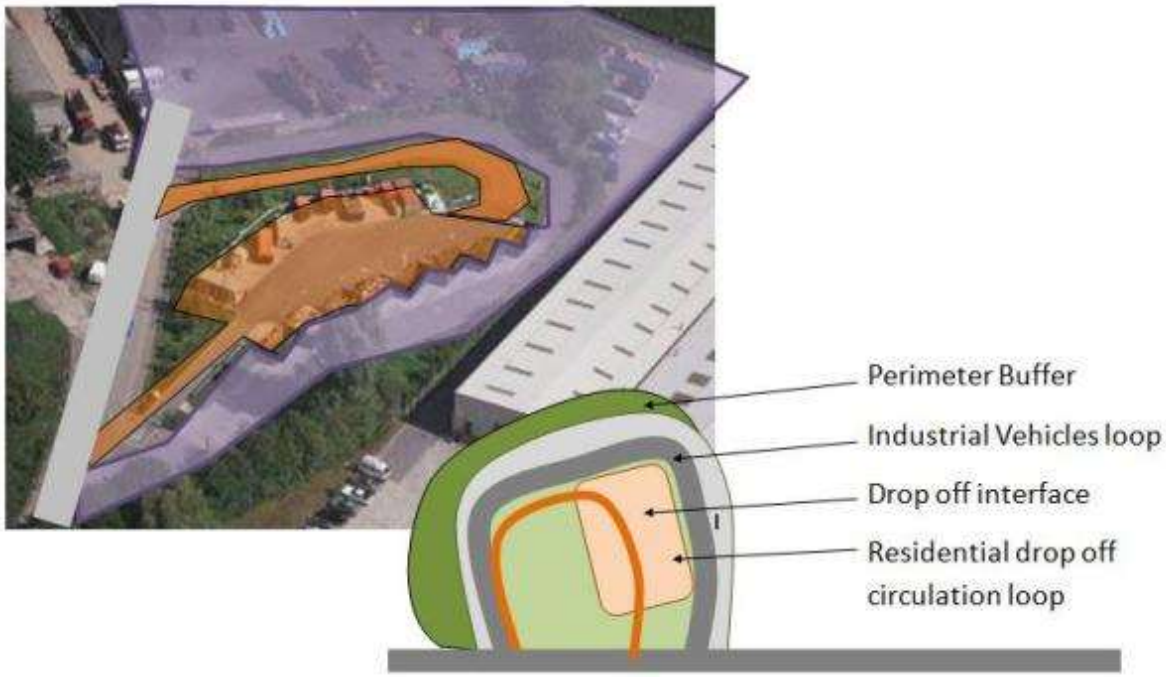


Figure 16. Aerial photo and schematic of amenity centre in Crewkerne, England. (WRAP, 2013)

El Cerrito, California

El Cerrito, located in the Bay Area of California, is an example of a community-council partnership where the local government owns the land and partially subsidises the recycling centre. El Cerrito has a population of roughly 33,000 and a long history of community support for its local recycling centre. El Cerrito has kerbside recycling and rubbish collections. It is ahead of Auckland in that it already has an established kerbside organic collection. However, it lacks an inorganic collection. The main function of the El Cerrito facility is to take hard-to-recycle materials such as large bulky items (furniture, bedding, mattresses, and whiteware), hazardous materials, and second-hand household goods. This function is similar to Auckland's proposed inorganic collection. The facility also accepts recyclable containers such as glass, plastic, metals and paper. It is not part of a larger network but features an environment centre (across the street), reuse, and industrial area for baling recyclable

materials. Like Crewkerne, El Cerrito's facility has a community recycling drop-off located in the centre and a service area around the perimeter, but it is C-shaped rather than concentric. The facility sits on 0.7 hectares with a wide, natural buffer around the perimeter. Unlike Crewkerne, it sits on the edge of a densely populated urban area. El Cerrito has been architecturally designed to send an aesthetic message about the value of recycling, reusing and reducing. The original facility was designed by architects Noll and Tam in 2012 for cost of $2.5 million dollars. This facility includes a transfer station (Figure 17).

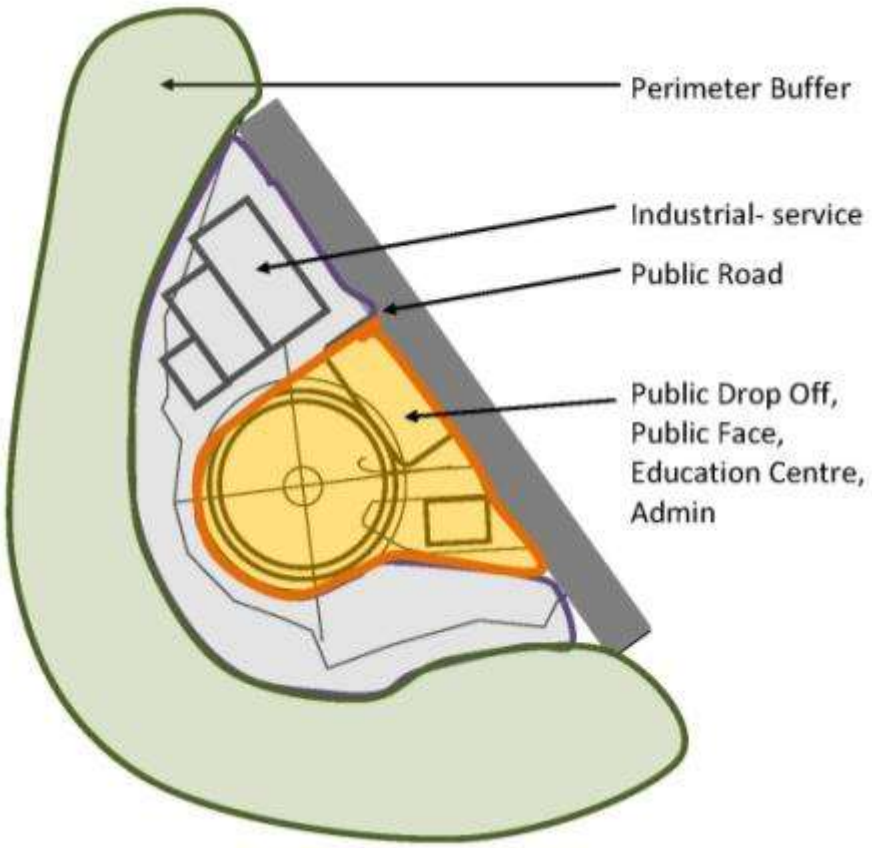


Figure 17. Diagram showing the drop-off centre in the centre of a recycling facility in El Cerrito, California. Image by author.

Major components at El Cerrito, as shown in Figure 17, include a green perimeter buffer provided by a native plant reserve, a surrounding industrial area with a designated service road, and a staffed, internal drop-off circle. The environment centre and reuse shop sit within this central core. Council staff and volunteers manage the recycling drop off and reuse area. The site's environmental footprint incorporates solar panels, rainwater harvesting and water infiltration swales. Unlike a transfer station, El Cerrito's facility lacks fences, weighbridges, and a tipping apron. It has a small backup lane, an extensive stormwater purification system, an administrative office and a

baling/compacting area. There is a transfer station at the end of the road that takes mixed materials and greenwaste. Figure 18 presents the site plan of the El Centro centre.

Figure 18. Site plan of a recycling facility in El Cerrito, showing inclusion of an environment centre, green technologies and reuse area (Noll and Tam, 2013).

El Cerrito is at the forefront of the design of community-based recycling facilities. It is an example of what a community/Council partnership can do with space, land and community support. Figure 19 shows an aerial photograph of the El Cerrito facility.

The facilities at Somerset, Crewkerne and El Cerrito share major components:

- a green perimeter buffer;
- an industrial area specialising in safe and efficient machinery that is separate and secure from the public and residential traffic;
- a community interaction area that provides waste awareness, community engagement and sales;
- A transition between the industrial area and social area in the form of a recycling drop-off where materials can safely be dropped off on the interior side and be serviced by staff on the industrial side.

Figure 19. Image of recycling centre (El Cerrito, California) aesthetically designed with aesthetic appeal to give value to resource recovery and its users (Noll and Tam, 2013)

Drive-Through Recycling Centre in Australia

Caloundra, Australia, has a drive-through recycling centre (DTRC) at a council-owned landfill (Figure 20 and Figure 21). A charitable organisation runs this facility providing work for disabled workers. The facility takes reusable goods, recyclables, and household discards. Drop-off occurs in an open shed that accommodates two lanes of traffic. Workers assist customers at different points depending on the discards. A repair/dismantling shed and a second-hand goods sales and administrative office are found along one side. After dropping off users continue on in their vehicles to the landfill to dispose of any remaining debris (Furius, 2008).

Figure 20. Image of a drive-through recycling centre (Owl Metals Inc., 2013).

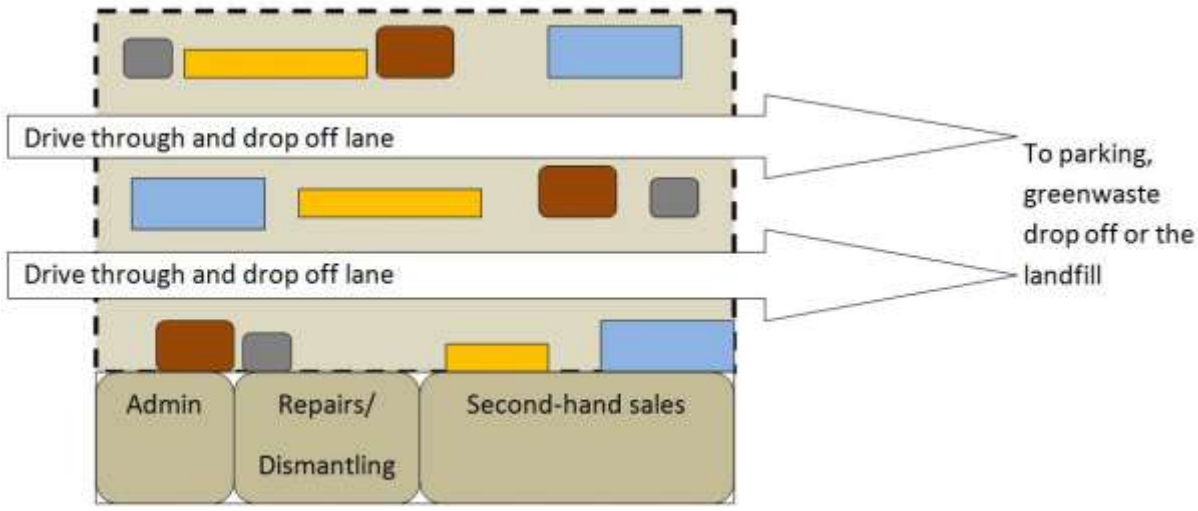


Figure 21. Schematic of drive through recycling centre in Caloundra, Australia. Image by author.

In summary, four layouts of CRCs were studied: two concentric (Somerset and Crewkerne), one C-shaped (El Cerrito), and one drive-through form (Caloundra). The facilities vary by materials accepted, staffing, layout of drop off points, interface with the industrial area, and security features. It is expected that each has benefits and limitations based on many factors that merit deeper investigation but are beyond the scope of this study.

2.4.3 Existing CRCs in NZ

There are many good examples of zero waste social enterprises running CRCs throughout NZ. Most of these are members of the Community Recycling Network (Community Recycling Network NZ, 2013). All have business models that seek income from sources other than tipping fees. However, many CRCs differ from those in Auckland because they are in provincial towns with smaller population catchments where the Councils still owns the waste infrastructure. It was important to find out how these CRCs handle potentially noxious impacts such as noise, dust, odour, rats, seagulls and trash, especially in the context of Auckland's increasingly dense urban form. CRCs with and without transfer stations were studied.

The Beachlands/Maraetai Resource Depot (1999-2004) was located in the middle of a small bedroom community east of Auckland. It took only recyclables, food scraps and greenwaste. The resource consent stipulated that to manage odours, organic waste was limited to a maximum of 10 cubic metres being composted at any one time, incoming materials had to be contained in sealed containers until composted, composting had to occur in sealed, in-vessel composting containers, and resultant freshly composted material had to be fed to compost worms to de-odourised any

remaining smells. Composting formulas were developed to aerobically "hot compost" the mix to avoid the objectionable odours of anaerobic composting. (Manukau City Council, 1999)

The Rotorua Recycling Centre takes only recyclables commodities such as glass, plastic, paper, metals; e-waste, and second-hand household goods. They avoided taking greenwaste, and mixed rubbish bags. (Rotorua District Council, 2014). In Auckland, the Sustainable Living Centre in Grey Lynn holds recycling, repurposing and composting courses (Sustainable Living Centre, 2014) and the Kaipatiki Project in Birkenhead coordinate composting courses (Kaipatiki Project, 2014). Both the Sustainable Living Centre and the Kaipatiki Project manage odours by limiting food scraps and greenwaste to those produced on site or from only a few neighbouring properties.

A number of new technologies are available to minimise odours. These include rapid microbial digestion such as the Bio Cosmo system (Bio Cosmo, Ltd., 2014), the use of a charcoal layer (biochar) to deodorise and trap odours, (Rodriguez, L. 2009) and sophisticated in-vessel composting systems that push the discharging air through bio-filters exemplified by Living Earth's composting facility outside Christchurch (Ebert Construction Company Ltd).

Overseas, one of the most effective ways to control all potentially noxious impacts was to put CRCs in fully enclosed buildings both for impact containment and for winter climates.

It is expected the most common method to control odours will be to disallow residents to bring any food scraps or soft greens like grass clippings to the facility. These materials are expected to be disposed of in the kerbside organic collection starting after 2015. Therefore, in this proposal, it is assumed only small amounts of food and garden greens generated on site would be allowed and composted on site in a variety of demonstration bins.

Common Components of NZ CRCs

A survey of 35 Council/community recycling centres listed the following site activities in order of frequency across centres (Stone, 2002):

- Managing a recycling drop off 85%
- Running a reuse store 85%
- Running educational programs 60%
- Greenwaste collection and shredding 45%
- Running Council contracts for kerbside collections 42%

- Processing (baling, shredding recyclables) 37%
- Managing a transfer station 35%

The survey results show the majority of CRCs (65%) do not include transfer stations. To further examine CRCs, the author completed site visits, aerial photos analysis, and discussion with site managers at the following NZ CRCs: Clean Streams Northland run by CBEC, (Kaitaia); Helensville Community Recycling Centre run by the Helensville Community Recycling Trust, Helensville; Xtreme Waste run by the Whangiora Community Trust, Raglan; Waitakere Concourse Resource Recovery and Transfer Station run by the Auckland Council; Rotorua Recycling Drop Off run by Rotorua City Council; and Trash Palace in Porirua run by the Mana Recovery Trust.

Only four of the sites cited above are further discussed because they relate to at least two of these three parameters: (1) applicability to the Auckland context, (2) appropriate scale and/or, (3) the handling of large, bulky, inorganic items. The last resource reviewed is a generic CRC site plan from the Albert-Eden Scoping Study.

Trash Palace, Porirua

Porirua, which has an urban population of roughly 50,000, is worth examining because the community operation, Mana Recovery Trust primarily collects and processes second-hand goods. It has a long-running history of resource recovery training the disabled into jobs. The trust runs many programs throughout Porirua but is best known for Trash Palace, a large reuse shop located near the transfer station on the edge of town. Trash Palace is a good example of a facility architecturally designed to sort, repair, and display inorganic materials for sale, which is expected to be the primary enterprise for CRCs in Auckland. (Figure 22).

The shopping area is placed on the main road. It integrates the inorganic drop-off inside the building opposite end the entry. The entry end parking is convenient, and a large sculpture made of recycled materials welcomes users. The facility does not have a transfer station but relies on the landfill further down the road.

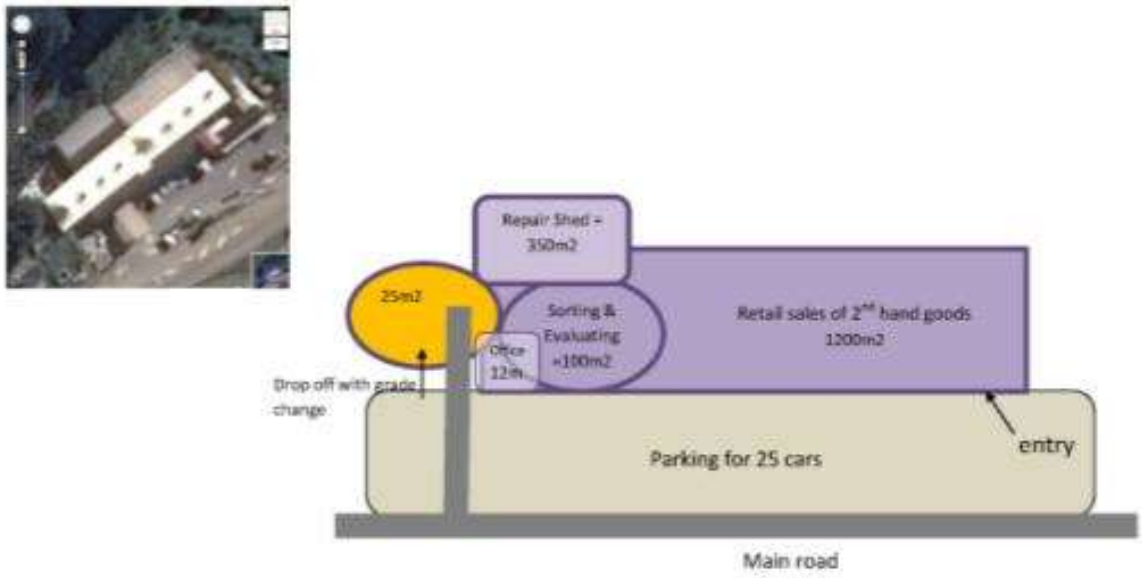


Figure 22. Schematic of the Trash Palace drop-off, reuse and parking areas in Porirua, NZ. Image by author.

Helensville

Helensville is Auckland's only community-owned recycling centre at a Council-consented transfer station and serves around 4000 rural residents. This centre, which covers a half hectare, features a long drop-off sequence, allowing users to drop off nineteen different categories of materials and then place landfill waste in the skip bins at the very end (Figure 23). When new residents arrive at the site, they are walked through the drop-off process. Returning clients then know what items are accepted and in which order to load their trailers. Understanding the categories and process spurs clients to recycle a wider range of materials and feel the satisfaction of not wasting. The Helensville layout illustrates the use of the entire recycling drop-off as an educational facility.

Figure 23. Enumerated map of drop-off system at recycling centre in Helensville, New Zealand. Google image adapted by author

As shown in Figure 23, eighteen of the nineteen drop off categories at Helensville are for reuse, recycling or resale. Only one of the drop-off points (#16) is for disposal. Helensville hosts an enthusiastic community group that use the perimeter of the site for gardening. Vegetables are grown and flowers rescued from greenwaste tipping. The wide, planted area is surrounded by a trash fence; together these act as a green screen to contain debris and internalise environmental impacts. However the community operators acknowledge a need to prevent stormwater runoff from entering the river. As a transfer station, Helensville incorporates a back-up lane and security fencing. An experienced operator visually estimates incoming weights. The community group aspires to add an education centre, composting bins and a mulcher for greenwaste processing. Instead of a concentric circle or linear drive-through layout, the vehicles drop off from point to point in a large loop rather than park and off load in one place.

The Waitakere Concourse Resource Recovery and Transfer Station

Like Helensville, the Waitakere Concourse Resource Recovery and Transfer Station is owned by Auckland Council. Unlike the Helensville facility which serves only 4,000 people, Waitakere serves around 230,000. Whereas Helensville covers half a hectare; Waitakere covers six hectares. Helensville has one simple circulation loop, and Waitakere has six circulation loops connected by one main circulation loop (Figure 24). The Waitakere site is significant because it incorporates waste education in the form of school tours and a Learning Centre.

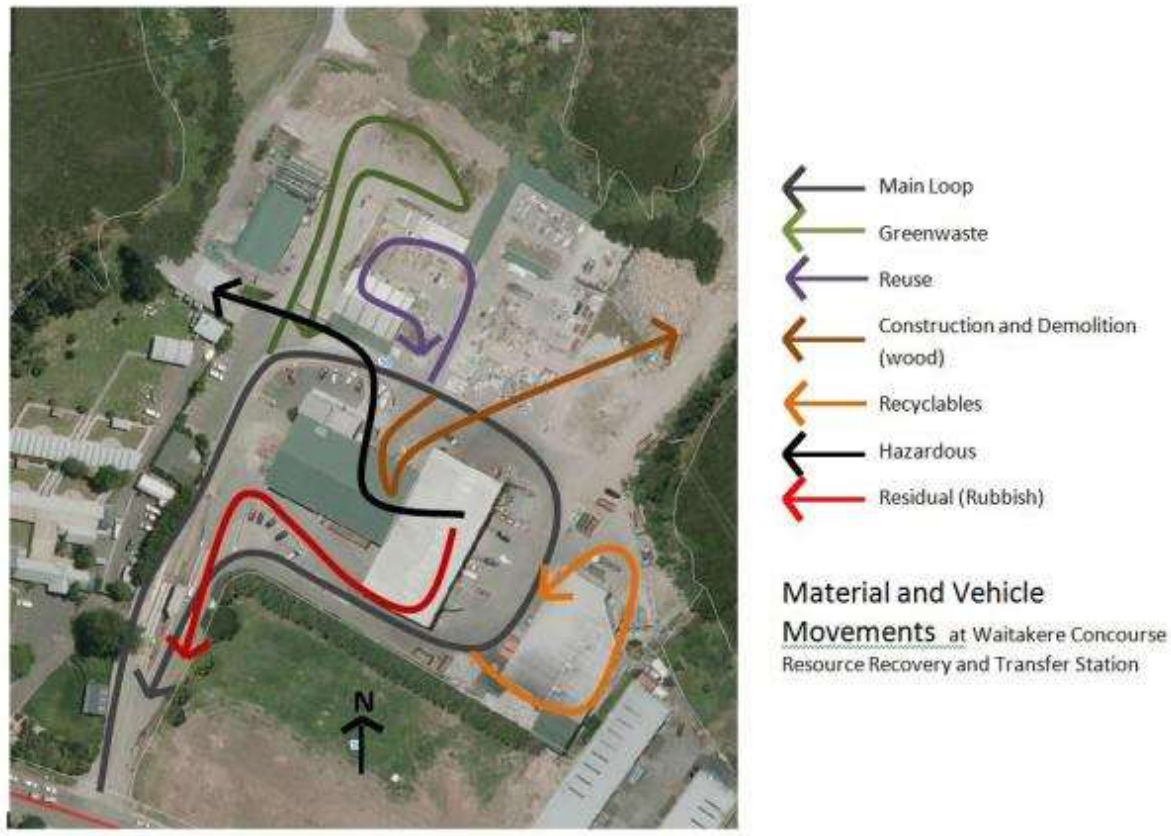


Figure 24. Schematic of materials flows through the Waitakere Concourse Resource Recovery and Transfer Station. Google image adapted by author.

Although Waitakere has a transfer station, it also endeavours to salvage reusable goods and hazardous materials off the tipping floor. Recovered materials are taken to the reuse shed to be repaired and/or sold on Trade Me. In another area, construction and demolition (C&D) materials are dumped and sorted. Reusable wood is taken to the wood pile for free collection. Hazardous materials taken to the hazardous storage area. The Learning Centre can host up to 30 children and their parents on site tours at a time.

But when the materials flow map and pedestrian map are overlaid, the incorporation of pedestrian paths appears poorly done, as though the site was designed originally for the vehicle flow and materials-handling machinery, and only much later to incorporate foot traffic. Children on tours must cross traffic lanes used by forklifts, front-end loaders, gantry trucks and compactor trucks. Machinery and vehicle activity is stopped when children go on tours. The Auckland Council is looking to re-design these facilities to remedy current failings and create an exemplary waste education facility. This study identifies a need to design Facilities for safe, separated walking routes for visitors and workers.

Figure 25. Schematic showing pedestrian activity at the Waitakere Concourse Resource Recovery and Transfer Station were not factored into its design. Google image adapted by author.

2.4.4 Analysis of the Scoping Study's Generic Site Plan Design

This subsection deconstructs the generic site plan presented in the Albert-Eden scoping study (Figure 26) and finds the following components:

- a safe and interactive place for the community to work, shop and visit;
- a welcoming and attractive public image with an appealing first impression;
- waste minimisation education and outreach programs on site and throughout the site;
- a recycling drop-off for a wide range of materials, a convenient "one-stop-drop";
- a safe, secure industrial area separate for machines and equipment;
- a shopping area that is easily visible and accessible;
- an inorganic drop off, sorting, repair and sales area; and
- A green buffer capable of internalising, minimising and containing potential impacts that might occur such as unsightly views, trash, odour, and stormwater.

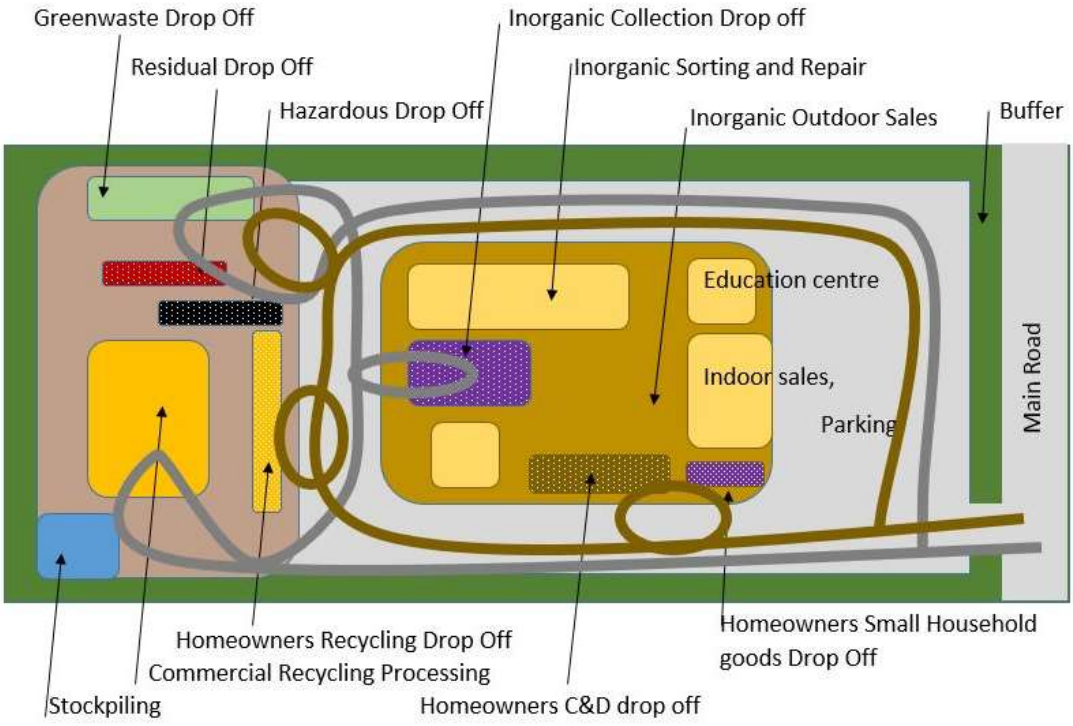


Figure 26. Analysis of the Albert-Eden generic site plan showing dotted areas as separate drop-off areas. Image by author.

Components: Conceptual Diagram

An analysis (Figure 26) revealed the generic site plan contained the same major components as the previously reviewed CRCs—perimeter buffer, industrial area and image area. Its main difference is having many drop offs instead of one designated drop off area. Other observations were:

- The flow of vehicles and materials is similar to Helensville, whereby the vehicles drive from place to place to drop off different items. Drivers can loop around several times if needed to deliver the different materials to their proper places. While this works for Helensville with a population of 4000, there is a question if it would become congested when serving a population of 40,000.
- The industrial area does surround or back onto the drop-off area. As a result, to dispose of, or recycle items coming in from the inorganic collection, staff would need to move items across the flow of traffic to the recycling drop off area or the residential disposal area. Since between one third and one half of all the inorganic collection needs to be disposed of this could be a major concern.
- Residential vehicles seem to share the same path as the service-commercial vehicles raising a question about how many commercial vehicles are expected and how congestion was assessed.
- If congestion is not an issue, then the looped circulation works well for providing convenient parking for clients to park and shop.
- A Looped layout is beneficial in that it creates a long edge with ample space to drop off which is good only if there are enough staff to monitor the many drop-off areas.
- It is not clear why there is a separate area designated solely for recyclable processing unless this is meant to be rental to a private recycling contractor. It is also not clear if the commercial inorganic unloading area would be self-contained with its own rubbish, and recyclable bins to negate the need to use the facilities on the other side of the road.

2.5 Summary

The literature and site review critiques the current situation and past attempts of CRC design. The following observations and principles guide the next phase of this study and its focus on developing a community-based recycling centre framework for Auckland:

- Auckland communities are already involved in waste minimisation in multiple ways. These include gardening courses, composting and worm farming, farmers' markets where zero waste groups sell compost bins and reusable products, upcycle shops that sell artistically re-worked second-hand goods, and zero waste events that enlist volunteer groups to educate others on source separation at the bin stations. There are also several environmental trusts that facilitate waste minimisation within their communities.

- Unlike other regions of NZ that have CRCs and are familiar with their benefits, most Aucklanders are familiar only with transfer stations and may hold a negative image of any infrastructure dealing with waste. Privately-owned transfer stations are not similar to CRCs and should not be considered community recycling centres for reasons of philosophy, business model, lack of space, materials accepted, and lack of community buy-in.
- Other invisible variables affecting the physical design of CRCs are population catchment, demographics, urban/rural, ownership of waste infrastructure, governance, funding source, and business model. The size and characteristics of the site itself is also a variable. At least six different forms of recycling centre drop-off were identified. All had recurring features such as some sort of perimeter buffer or security system, drop-off area(s), both manual and mechanical handling solutions, and a storage area. Many centres had additional features such as a reuse sales area, education centre and/or repair shop. The scoping studies pointed out that many other features are possible.
- Auckland community recycling centres may benefit from additional features, such as a back-up lane, a distinct industrial area, secure fencing around the industrial area, a weighbridge, separation of residential from industrial vehicles and a “staff only” area around machinery and equipment which may not have been necessary in areas of low population.
- With the exception of the Waitakere Concourse, Waste minimisation activities have not been adequately addressed in the CRCs studied. These features include pedestrian safety, community visibility, opportunities to model sustainable behaviours, and design for waste education.
- Design for flexibility and expansion is important, given the evolving nature of national legislation effecting product stewardship and banned-to-landfill categories.

Therefore, prior to conceptualizing a CRC form, it is important to be familiar with the variations of CRC design, understand the context in which they occur and understand why they are appropriate for their unique situation, the site and surrounding.

3.0 The Community-Based Recycling Depot: Presenting a Concept Diagram

This chapter presents the author's concept for a Community-Based Recycling Depot (CBRD), based on the findings of the literature and site review.

The design proposal is introduced as a concept diagram (Figure 28), which is a simple, understandable pattern that explains the major components of a facility and their relationships to each other. The diagram and its overview are followed by a detailed description of the model function and its subcomponents.

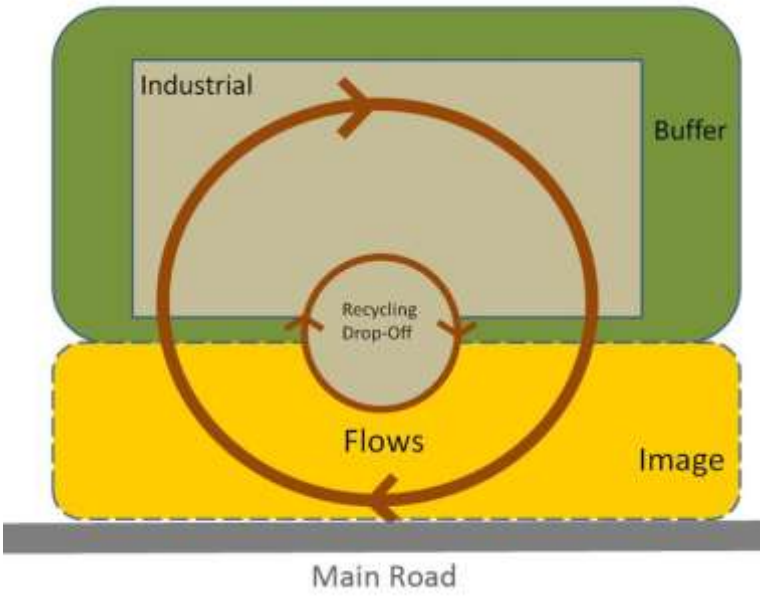


Figure 27. Conceptual diagram for a Community-based Recycling Depot (CBRD). Image by author.

The conceptual diagram includes six components, only five of which are shown on the diagram for reasons that will be become clear.

1. The **image area** addresses community engagement, public image, street visibility, outreach and sales. It is located to be visible to passers-by, adjacent to a busy road or a commercial area. It sits between the entry into the site and recycling drop off.
2. The **recycling drop-off area** sits between the image area and the industrial area and provides a wide range of drop-off opportunities for the community. It features a long interface that materials can be moved through into the industrial area yet in a contained form to allow ease of staffing and monitoring. It bridges into the image area.

3. The **industrial area** is closed to the public but still receives, sorts, processes and prepares a range of recoverable materials for transport. It has a secure entry and a secure perimeter.
4. The **buffer** provides screening, security, stormwater management, site tours and interpretive signage. Its purpose is to internalise and mitigate potential environmental impacts and support waste minimisation education. It wraps around the industrial area.
5. **Flows** are the movement of vehicles, people and discarded materials throughout the site. Industrial and residential traffic are kept separate except where they enter through the security area. The low of materials are diagrammed in detail later.
6. **Social edges** (not specified on the diagram) are areas that allow waste-wise behaviours to be demonstrated and observed by others.

The research will develop, test and model this concept diagram. As part of this process I will develop a new kind of CRC which I have called a *community-based recycling depot* or *CBRD.* In the process, social edges can be identified and developed.

Social edges are the places where sustainable behaviours and ideas can be showcased; they are the author's primary contribution to the field of resource recovery design. The thoughtful inclusion of social edges is what differentiates this typology as something new and different from existing CRCs. This new typology is thus called a *community-based recycling depot or CBRD.* From the literature review and an understanding of existing facilities, the following parameters describe a successful community based recycling depot. It would fit Auckland's unique context, meet Auckland Council waste minimisation directives, be considered a public amenity instead of a liability, meet national waste minimisation directives, have minimal environmental impact and fit unobtrusively into a an increasingly dense urban Auckland It is also proposed that these parameters be evidenced by

- Fitting Auckland's unique context
    - by internalising environmental impacts such as peak storm water flows, polluted water containment and purification, energy production, odours, dust and noise to the point of being suitable for a mixed use zone
    - Providing convenient resource recovery for a population catchment of between starting at 30,000 and growing to 50,000 people
- Providing a public amenity
    - by having an attractive appearance, both from off site and on site that gives value to the activity of resource recovery and its workers
    - providing local employment opportunities

    - providing safe and streamlined vehicle turning and materials handling
    - creation of desirable community "centre" to come to, for reasons other than recycling, fulfilling a local need and other amenities to support transitioning to a resilient, sustainable city
- Meeting Auckland Council waste minimisation directives
    - by taking at least some materials from of all six resource streams
    - satisfying several of the WMMP Action Plans,
    - creating places to showcase waste minimisation techniques and behaviours
    - engaging local people in waste minimisation activities in novel ways
    - Allowing for safe school tours without stopping equipment and vehicular movements
    - Demonstrating a decrease of materials to landfill within its catchment area.

Which collectively would redefine CBRDs as a land use activity suitable for mixed use zone rather than limited to only industrial zones and thereby daylight waste.

4.0 Community-Based Recycling Depots: Site Selection, Design and Testing

The concept diagram (Figure 28) was then tested through application to a real site. What now follows is a description of the process through which site identification and selection (4.1) conceptual design and modelling (4.2) conceptual diagrams of depot components (4.3) schematic design (4.4) preliminary design and social edges (4.5) can be made.

4.1 Overview of Methodology

Prior to beginning the design process it was necessary to find a suitable site to on which to develop the concept diagram.

The following methodology was used to identify a site. First, a rough minimum site area was determined. This was based on studying CRCs in similar contexts with similar population catchments and considering similar functions of an Auckland CBRD.

Next, siting parameters were determined. The most important criteria was the presence of a local board with enthusiastic, zero waste groups interested in starting CBRDs. The study thus focused on the North Shore and the urban Rodney area and found that Devonport, Kaipatiki, and Hibiscus and Bays local boards all had community zero waste groups keen to start CBRDs.

Within these local board areas, intersections between open space, industrial zones, mixed use zones and main arterials were mapped. The resulting sites were then evaluated using criteria based on community connectedness, land area/buffer potential and cost/consentability. The evaluation process provided a solid methodology for ranking the sites as to their desirability for a CBRD. This process short-listed the sites down to five, the most desirable site was expected to be the highest ranking; however, this was not the case. The two higher ranked sites already had industrial land use activities which undermined the design purpose of reclassifying CBRDs as a non-industrial land uses.

With a site identified, regional analysis provided a more accurate understanding of the population catchment, demographics, limits, and the expected amount of discarded materials. The regional analysis also considered how the site sat within the local board area, the effect of transport on the population catchment, unique demographics of the catchment area, and ability of patrons to access the site. Analysis also included environmental conditions illustrated by Unitary Plan maps on surrounding zoning, growth areas, town centres, schools and open space patterns. Stormwater catchments, sea level rise, open space corridors, landscape precincts and wildlife movements were also studied to influences on the site plan.

A site analysis was then done to gauge how the components of the concept diagram would layout over the site. This analysis determined the buildable and difficult-to-build areas and approximate locations of the image, industrial, and buffer components. Applying the concept diagram revealed that the image area was most appropriately placed along the main arterial and provided access into the site, the industrial area on a level area that could be screened from view, and the buffer area on non-buildable land, along streams and steep banks.

The site analysis informed the concept design. The image area aligned with the road frontage and the visible, level area. The industrial area aligned with the central truck parking and existing shed area, the buffer aligned with the steep banks and creek edges. From this, the author developed a schematic design. Standard parking, circulation and turning radii were applied assuming a maximum rigid truck of 10 metre length. Determination of building types and sizes, community engagement activities and industrial processing modules informed the detailed design of each of these components. Diagramming established relationships between vehicles, people and activities within each component. The process included identification of design decisions and their justification.

An iterative process involving experimentation, evaluation, and further exploration occurred. The final result of this design is a well-developed preliminary site plan, which includes an overlay describing the social edges and how they contribute to waste minimisation behaviour change based on a series of assumptions that were made to progress the design process. The author posits that valuable contribution of this section on the design is the documentation of a methodology, a set of questions that can be asked when approaching a CBRD design.

4.2 Siting Parameters

By working with the siting criteria as described above I decided to focus on siting a CBRD in the North Shore or the urban Rodney area. As noted earlier, the most important siting criteria was finding supportive Local Boards with proactive zero waste community groups. A contact list from a Council-sponsored conference on "Social Enterprise in Resource Recovery" was used to find the names of community groups and their addresses. Forty community groups were registered for the conference. Three groups were located on the North Shore, one each in the Takapuna, Kaipatiki, and Hibiscus and Bays Local Boards.

A previous study noted CRCs did not need to be located in visible areas because they were sought after by those who used them (Envision NZ, 2005). Therefore, it was recommended to site CRCs in industrial areas where consenting was easy. However, I argue that CBRDs should be placed along busy arterial roads to make them visible to everyone, not just those keen to use them. If the idea is to *normalise* waste minimisation, waste minimisation facilities need to be in *normal* locations, where shopping, second-hand stores and recycling drop-offs normally occur. I also argue the need to locate CBRDs where they are accessible to a wide range of people. A main arterial is likely to be along a bus route, which makes a CBRD accessible to those without cars—often the poor, the young and the elderly. Placing CBRDs in visible places also demonstrates a public value, an appreciation for the services they offer, whereas placing them in industrial areas or degraded areas projects a negative value. Therefore, a good location would be along a main arterial on the way to local focal point, which could be a shopping area or a community centre. Ideally, the site would backed onto an industrial area or other non-residential land use. Alternatively, shopping centres should be required to have their own public recycling facilities whereby customers can return their discarded packaging and non-durable goods.

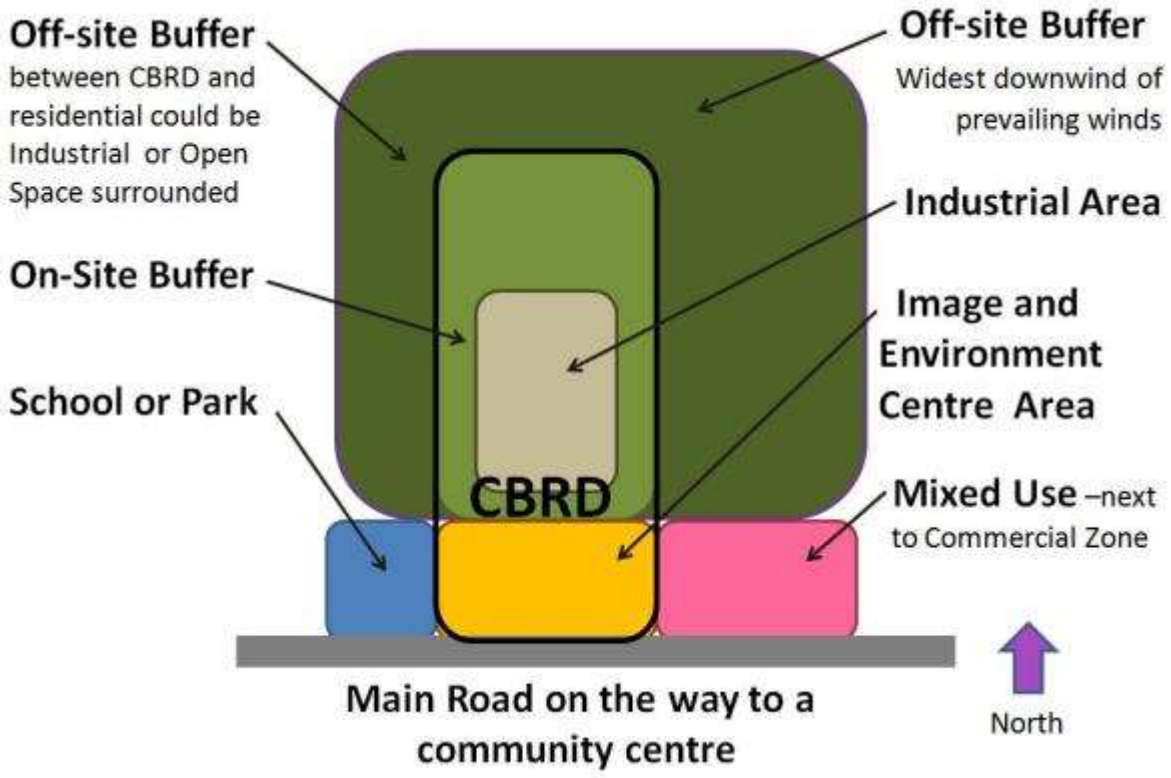


Figure 28. Considerations for siting a CBRD. Image by author.

Figure 28 diagrams an ideal site located on a main road leading to or from a community centre in a mixed use zone near existing shops for visibility, convenience and accessibility. The industrial part of the CBRD should be set back from the road, or visually screened by the perimeter buffer. Since the prevailing wind directions are from the south and southwest, the larger buffer areas would ideally be on the north and northeast.

Working out the catchment areas is beyond the scope of this thesis but for the purposes of design, the assumption is made that a CBRD would be located to serve either a population range of between 30,000 and 50,000 or an entire local board catchment, whichever was smaller. This assumption is based on the need to spread out the resource recovery network for convenience, accessibility and to prevent local CBRDs from being overwhelmed with too much product. Examples are Porirua's Trash Palace, Nelson's Environment Centres, and Rotorua's Recycling Centre. (Stone, 2002) Unlike the transfer station network that seeks to maximise incoming flows, CBRDs need to be able to manage throughput so the more labour-intensive work of extracting value can occur. This means local boards with catchments of over 50,000 might consider having more than one CBRD, particularly given the expected population growth of Auckland.

4.2.1 Identifying Potential Sites

The research study started by surveying the proposed Auckland Unitary Plan maps along with aerial photos on the Auckland Council GIS Viewer. Intersections between open spaces, community centres, industrial zones and main arterial roads were located on aerial photos and unitary plan maps. The process generated twenty-one possible sites as shown by red circles in Figure 29 below.

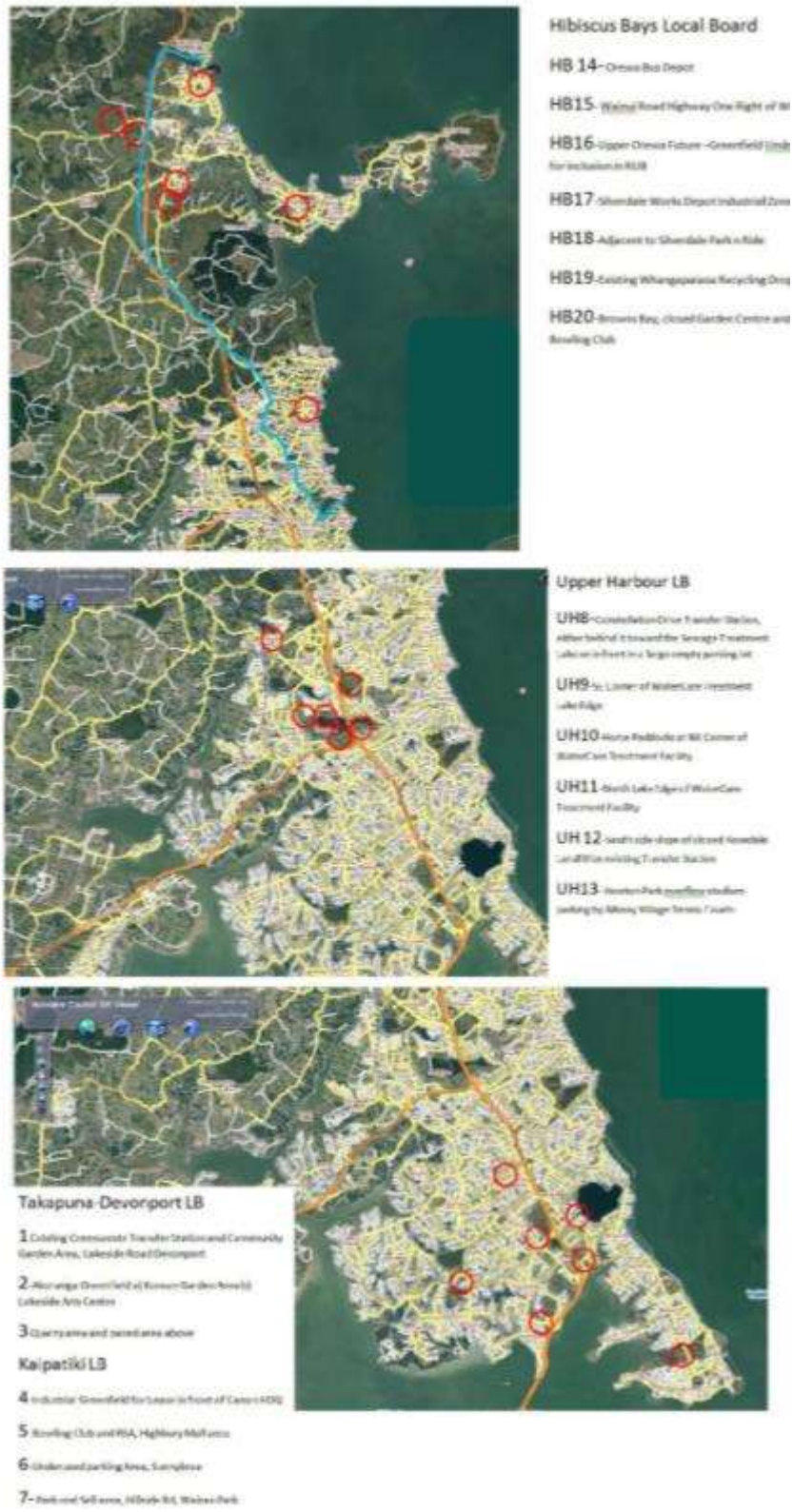


Figure 29. Identification of CBRD sites: Locating intersections between industrial zones, mixed use zones and open space along main arterials. Google images adapted by author.

4.2.2 Evaluating Sites

The potential sites were then visited, photographed and evaluated. A ranking evaluation table was created and each factor given one, two or three points (one point being less desirable, three being most desirable), see Figure 30 below.

	1 pt	2 pts	3 pts
Community connectedness	**Central** within 1.0 km of a community centre	Within 0.5 m of a community centre	Within 100 m of a community centre
	Proximate within 100m of both residential and commercial zones	Within 100m of both higher density, mixed use, commercial and business zones	Within 100m of residential, commercial, special purposes, business, industrial, public open space zones
	Visible to either residential or commercial or industrial traffic	Visible to two out of the three-residential, commercial and industrial traffic	Visible to all residential, commercial and industrial traffic
	Accessible via vehicle only	Accessible via vehicle, foot, bike	Accessible via vehicle, wheelchair, bus, foot, bike
	Visiting Opportunities on the way to a place occasionally visited	On the way to a place commonly visited	On the way to a place regularly visited
Environment	**Land area** 0.5 to 1.0 hectares if surrounding parcels are included	1.0+ hectares if surrounding parcels are included	1.0+ hectares under one title
	Buffer possible on one side	Buffer possible on two sides	Buffer possible on 3 sides
Economic	**Cost** privately owned brownfield	Cost existing brownfield but Council owned	Undeveloped, Council owned
	Consentable very difficult	difficult	Not difficult

Figure 30. Method used to evaluate the range of possible CBRD sites.

4.2.3 Selecting one site from the Range of Sites

The results are presented in Figure 31. The darker the columns, the more highly ranked the site.

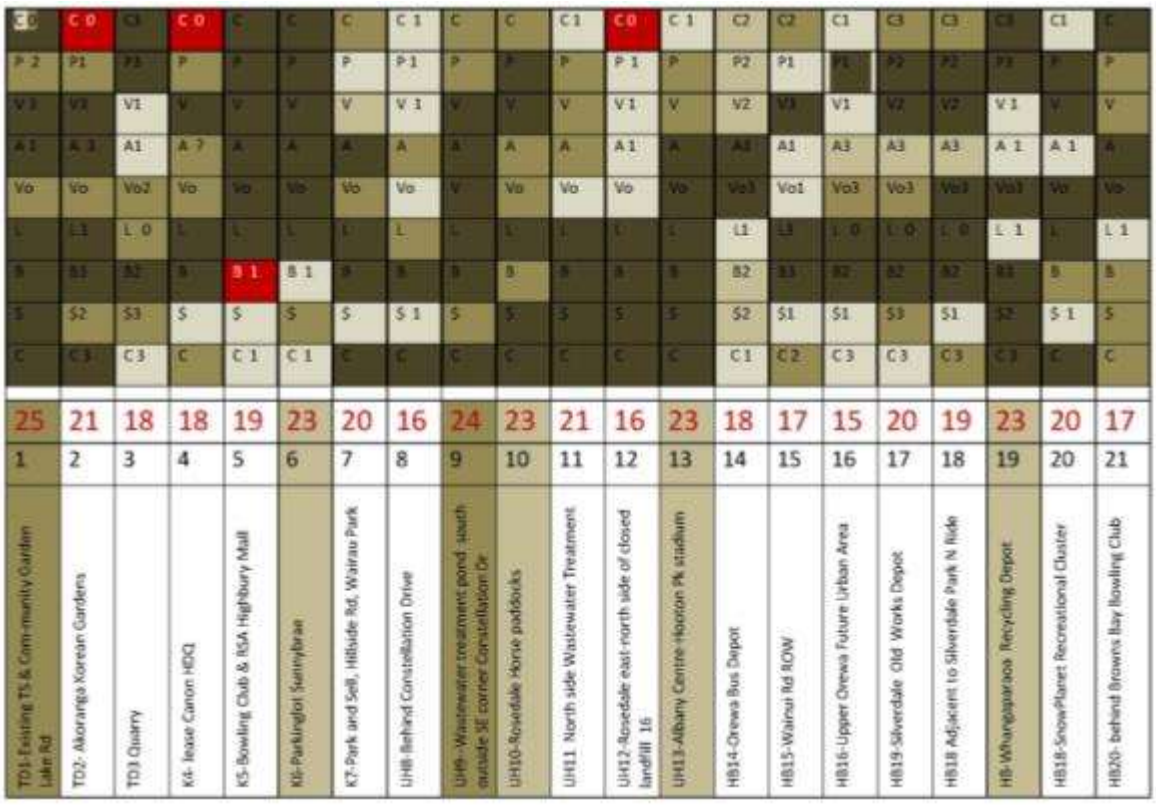


Figure 31. Results of CBRD site evaluation showing darkest columns as most desirable sites

The Whangaparaoa site was not the most highly ranked but was chosen over the others because it ranked highly across all criteria and was close to both residences and a community centre. Of the other five more highly ranked sites, one had an existing transfer station; one was on expensive, privately owned land; two were on unavailable green-field sites; and one was isolated from the community. The site chosen site was 1.3 hectares located on the main thoroughfare through a suburban community, in a mixed-use zone, on a Council-owned property with a working recycling drop-off.

4.2.4 Regional Analysis

Population demographics from Statistics NZ and Auckland Transport maps were used to study the regional situation. Analysis indicated this area would be likely to run a successful inorganic booking collection because of the lack of a current service and by a higher than average proportion of elderly residents (Statistics NZ, 2006) who are more apt to use recycling services. The potential construction

of Penlink Highway would be likely to densify the population of the area and increase road traffic along Whangaparaoa Road.

Auckland Council's proposed Unitary Plan maps and Auckland Council GIS viewer maps were used to study other aspects effecting feasibility. There is potential to link the north and south sides of the peninsula with a walking/pedestrian route through the site. Figure 32 illustrates how the site is disconnected from Auckland's other high-density populations.

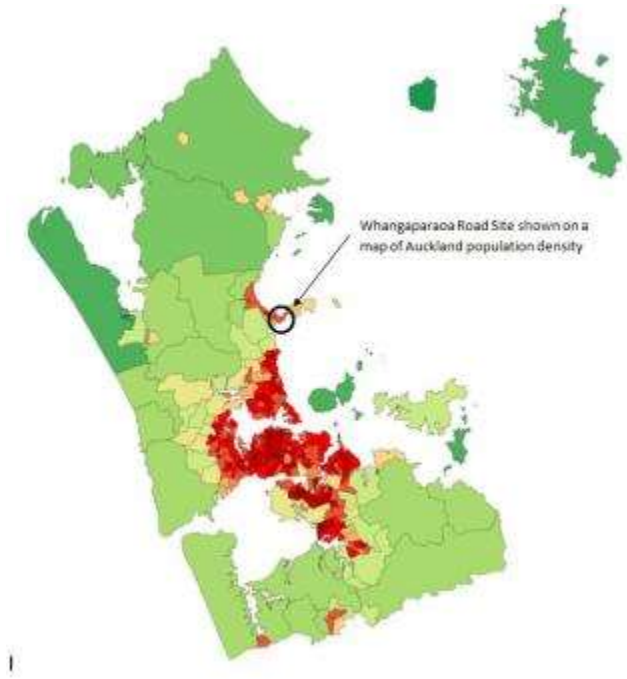


Figure 32. The Whangaparaoa site location overlaid onto an Auckland population density map (Furius, 2008).

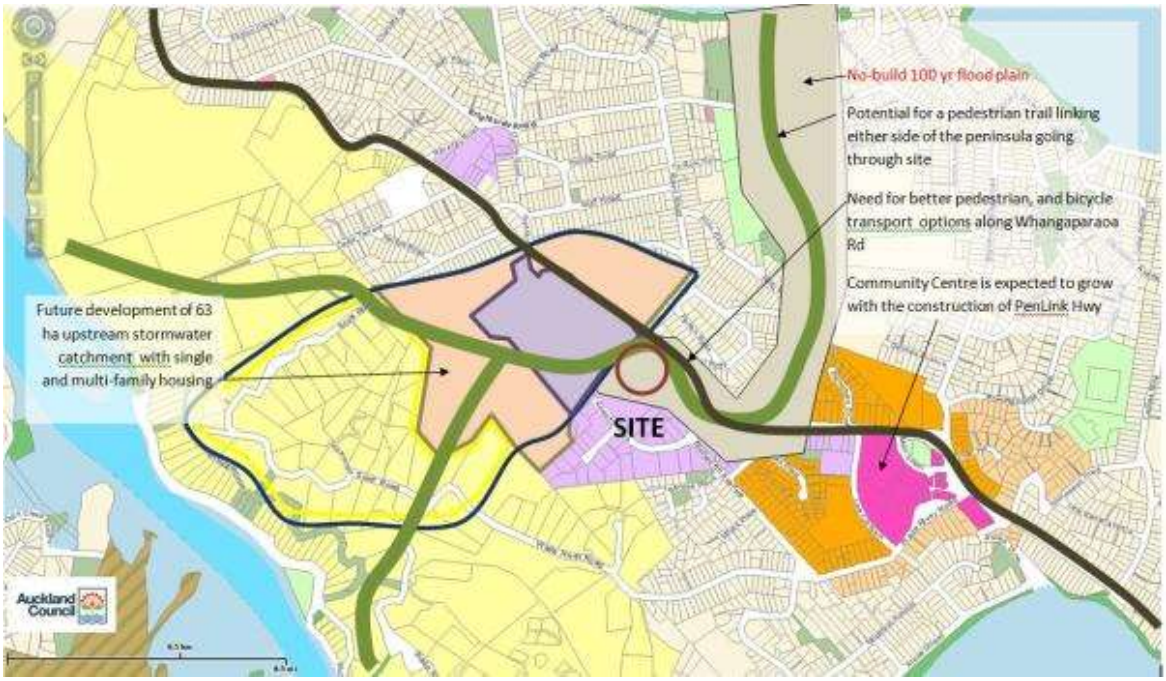


Figure 33. Summary of unitary plan maps (Auckland Council, 2013b).

Figure 33 summarises information from the Auckland Council's Proposed Unitary Plan Maps.

Figure 34. Aerial view of the Whangaparaoa Recycling Depot, the facility chosen as the case study site. Auckland Council GIS image adapted by author.

Figure 35 presents a view of the site from the Auckland council GIS viewer showing the aerial photograph and topographic contour lines. The site is outlined in red.

4.2.5 Site Analysis

Figure 35 summarises the site analysis. The site sits in a depression with steep banks on three sides. It was used as a local dump site until it was closed and capped over in the 1970s. Afterwards it became a Rodney Council works depot for many years (Figure 37). The site is currently used as a truck storage area. Fulton Hogan has a council contract to maintain the recycling drop-off in the eastern corner.

The location is deemed suitable for a CBRD because of its location on a main thoroughfare, service by four public buses routes, central to a growing residential population base and perception as a community recycling centre. It is also surrounded by commercial activities on three sides and is separated from a residential zone by Whangaparaoa Road. The site sits in a mixed use zone, allowing intensive development and minimal setbacks and height restrictions.

Challenges to site development include a 100-year floodplain and an existing stream and difficult-to-build banks. The largest on-site building sits on foundation pilings that are ten metres deep, driven through a landfill/peat soil complex and indicating geotechnical difficulties. The consent title limits the site to stormwater uses.

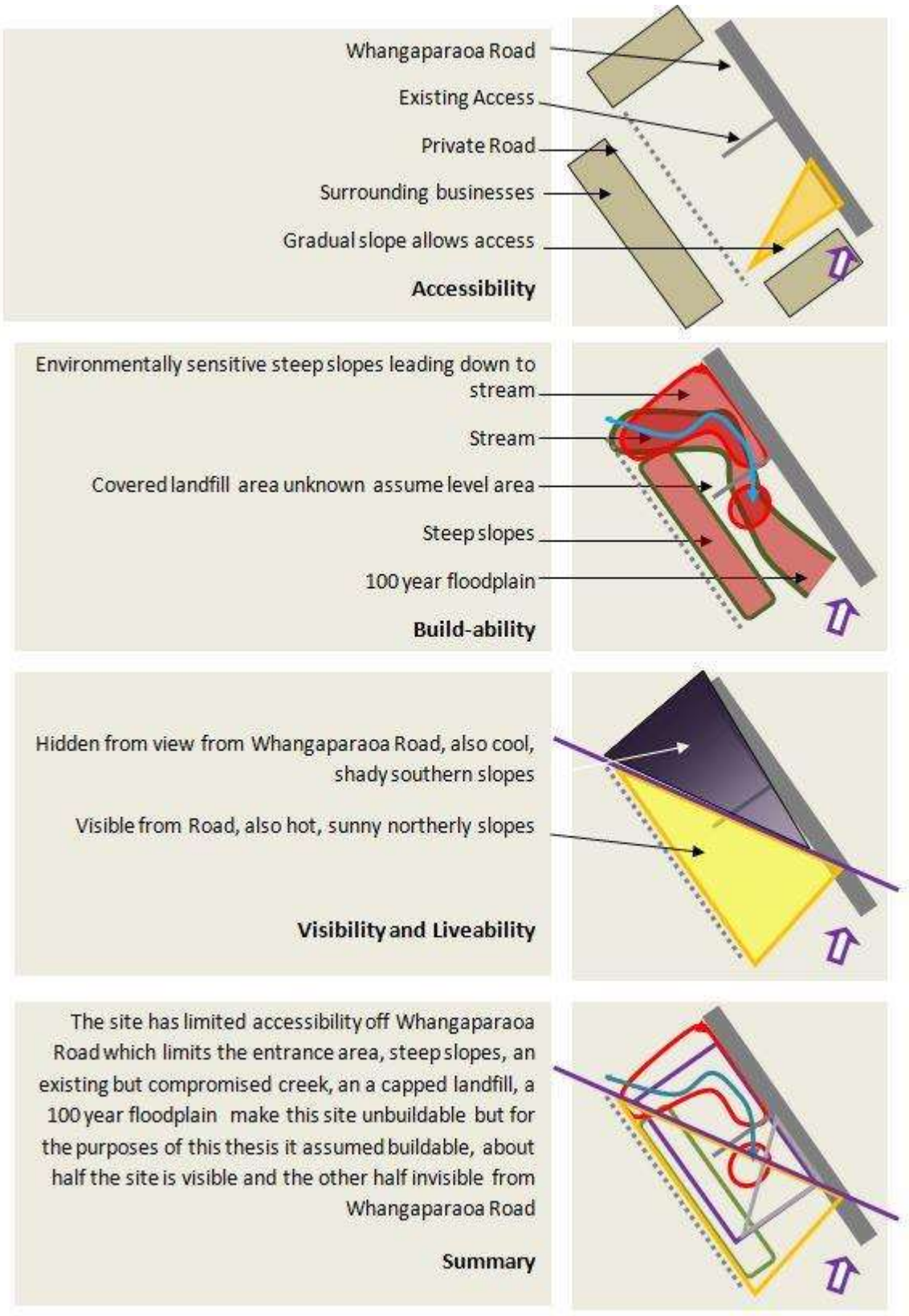


Figure 35. The Site Analysis reveals a difficult building site but this thesis assumes it is buildable. Images by author.

Figure 36. Photo of back of old Council Works depot whose foundations consist of 10-metre pilings driven into a capped-over landfill. Photo by author.

Proximity to existing Hospice and Salvation Army charity shops and new uses for currently empty shops, could provide business synergies (Figure 37). The thesis assumes a business model in which the CBRD acts as a second-hand goods wholesaler, offering incoming goods for sale to second-hand dealers or existing charities for consignment before being offered at the retail shop on site.

Figure 37 Identification of surrounding business synergies of the potential CBRD site. Image by author.

4.2.6 Site Selection Summary

The process of site selection began with finding Local Boards with supportive zero waste communities with site size an important consideration. The minimum size of land needed for a recycling drop-off, reuse centre, resource recovery processing area (evaluating, sorting, repairs and disassembly) parking, circulation and storage was estimated to be 0.7 buildable hectares. Other important siting parameters were accessibility, visibility, land costs and the ability to garner resource consents.

Zero waste community groups were found in Takapuna, Kaipatiki, and Hibiscus and Bays local boards. The twenty-one potential sites on the North Shore were found at the intersections of industrial, commercial, open space and arterial roads. "Free" and consentable land was found by considering Council-owned land in a mixed use, industrial or commercial zones. Consentability was considered possible on non-industrial sites that had a potential open space buffers. The sites were then visited and ranked.

The selected site was on the Hibiscus Coast off the main thoroughfare, Whangaparaoa Road. The ex-Rodney region was deemed desirable because of expected support for an inorganic booking collection. The site itself was deemed desirable for several reasons: potential synergies with surrounding businesses, an existing community recycling drop-off, a well-defined population catchment that is expected to double, depending on the construction of Penlink highway. The site serves a fairly typical Auckland demographic profile except for a higher percentage of people over 50 which would indicate a higher-than-average recycling interest according to the Household Waste Prevention Study. There is also potential to link up with existing walking networks from Stanmore Bay and thereby bring people into and through the site.

Drawbacks to the site include the large upstream stormwater catchment that poses on-site flooding hazards in peak storms and location within the 100-year floodplain designation. A trade-off may be made between "saving the stream" and piping it to provide more land. Technically, the site would be difficult to build on due to its geotechnical history as a closed landfill.

The site analysis indicated that the buildable area of the 1.3 hectare site was only 0.5 hectares. Thoughtful site planning and prioritisation will be needed to fit the recommended site functions onto this confined site, which highlights the benefit of incorporating design expertise into future CBRD planning.

4.3 Conceptual Design and Modelling

4.3.1 Application of Concept Diagram to the Site

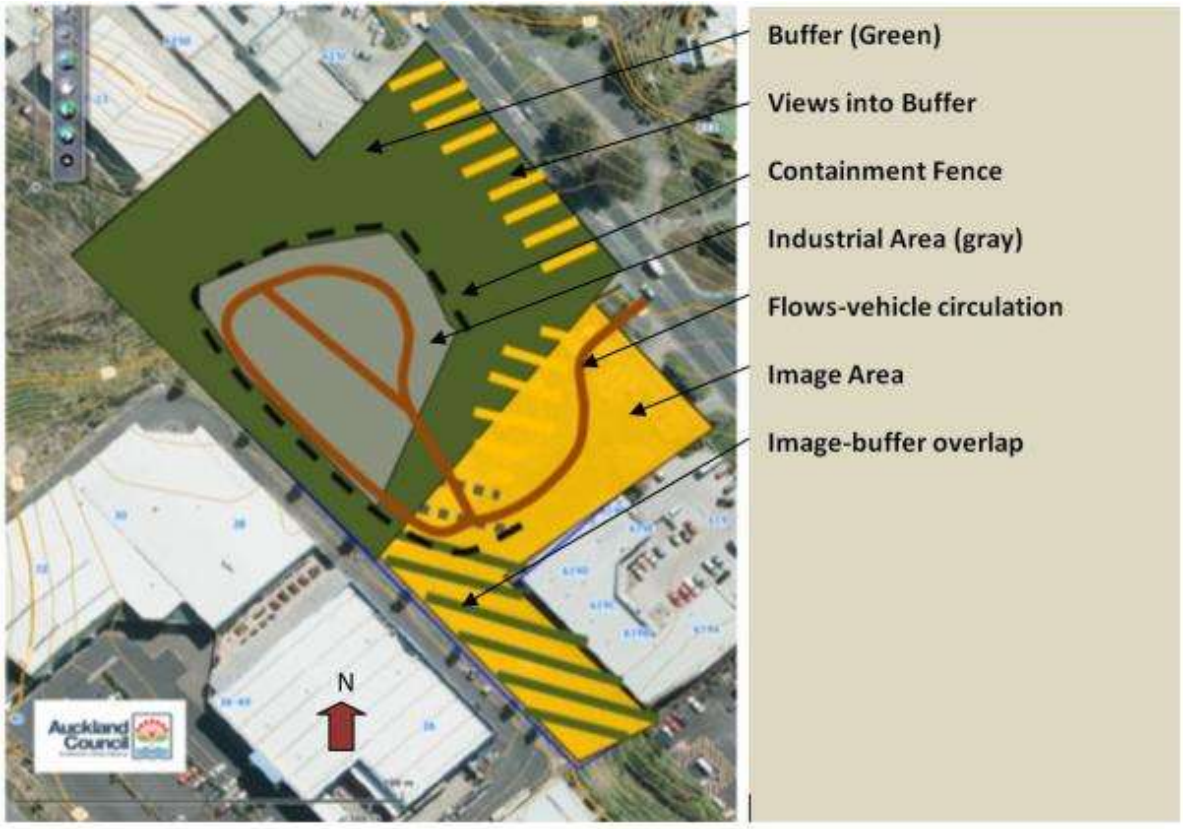


Figure 38. Application of the concept diagram to the site at 637 Whangaparaoa Road. Image by author.

The components shaped themselves to the site as shown in Figure 38. The buffer encompassed the steep slopes and existing creek area (green). The industrial area (grey) covered the central level area. The image-profitability area (yellow) covered the level area on the south with n the southern with access off Whangaparaoa Road. Site access was limited to a short stretch of Whangaparaoa Road as the remaining stretch exceeded 33% slope. Overlaps and blurring of edges occurred when the buffer became part of the image area along Whangaparaoa Road and when the steep banks of the buffer were considered for an image function of organic gardening and a garden cafe.

Conceptually, the concept diagram fits the site, however, further design refinement was needed to determine if this site was large enough to accommodate CBRD functions. Thus, one of the first steps was to define and prioritise the functions of the site.

4.3.2 Determining the Scope of the Project

The Dickinson scoping study listed twelve functions of a CRC (Dickinson, 2012). These were regrouped into the categories fitting the CBRD components of image, buffer, industrial, flows or recycling drop-off areas, as shown in Table 1 below.

Table 1. Component Areas and Functions found in scoping study

Component areas	Functions
Image	Drop-off area for reusable items Retail store Cafe/art gallery/display area Administration and environmental education area
Recycling Drop Off	Drop-off area for recyclable commodities, Greenwaste drop-off Hazardous waste drop off
Industrial	Dismantling area for bulky materials Residual waste drop-off Hazardous storage area Greenwaste processing area
Buffer	
Unclear	Commercial Inorganic collection drop-off Drop-off area and sales yard for construction and demolition materials Repair workshop for reusable items Outdoor sales yard for reusable items Drop-off area for bulky recyclable materials (whiteware, tyres, timber, scrap metal etc.) Residential inorganic drop off

The generic scoping study list was not able to provide a full range of possible functions, nor prioritise, functions as this is site and context dependent. Table 1 did not place any functions in the buffer area; found some functions could go in several places; found some of these functions could go between components, found some could be combined with other functions to serve dual purposes; and found some might not be considered appropriate for a CBRD at all, depending on the size of the site. The study found the development of a reliable site plan required additional

information about each component and then explore site layouts in the context of a business plan to determine how functions could synergistically fit together.

For example, it would be useful to know whether greenwaste is going to be dropped off by greenwaste contractors, residents, or both; and if the greenwaste would be stored until transported off site or shredded and stockpiled on site. It also would be critical to know the maximum amount that could be stored, how long it would be stored and whether that was limited by consenting requirements or site size.

A wider range of functions was found in the Resourceful Communities (Envision NZ, 2003) and the Assessment of Waste Minimisation Activities in NZ reports (Stone, 2002). In the real world, an expanded range of possible functions would be explored. These functions would be prioritised by a team including a landscape architect, business planner, materials handling engineer and the client. Collectively, this effort would define the workers involved in each process, what each process would entail, what would be stored or processed on site and the corresponding storage time and quantities, and how stored material might be transported from or sold on site. In order to progress from the design process, the following scope and functions were assumed.

Table 2 Clarifying Functions/Scope

Clarifying Functions/Scope			
Component Area	**What does it need to do well?**	**Disposers, receivers, processors**	**How much is coming in, how large an area is needed?**
Industrial Area	Drop-off area for recyclable commodities *capable of taking a small (less than 10,000 households) kerbside collection, and baling plastics, cardboard and paper on site*	From a local kerbside collection contract of less than 15,000 households	Assume the size of the existing Whangaparaoa recycling drop-off for now
	Dismantling area for taking apart large bulky items like whiteware, mattresses, furniture for recycling or rubbish	The inorganic booking collection would fill say, two bins and they would be emptied whenever full	Assume an 4x4 meter area each for whiteware, furniture and mattresses, reusable and non-reusable wood
	Drop-off area for reusable items from the inorganic collection *capable of receiving a full days' worth of inorganic collection*	From the inorganic booking collection coming in twice daily from a box truck	Assume the drop-off area size of Porirua's Trash Palace second-hand goods facility

Clarifying Functions/Scope			
Component Area	**What does it need to do well?**	**Disposers, receivers, processors**	**How much is coming in, how large an area is needed?**
	Hazardous waste storage meeting national standards, professionally staffed	From both the residential drop-off and any coming in on the inorganic booking collection or recyclables collection	Assume the size of the Waitakere Concourse hazardous storage area for now
	Residual waste *collected daily*	Assuming this would only be items coming from the kerbside recyclable collection, and the inorganic collection. No other residual waste taken	Assume no more than two 4 m skip bins per day.
	A safe, secure industrial area separate for machines and equipment separate from the recycling drop-off	For service vehicles and staff only	Assume the size of El Cerrito for now
Image Area	Outdoor retail store and sales yard for reusable items *capable of being a product stewardship drop, sell-on-behalf of, off and on-selling area for indoor goods*	Assuming this is for local residents, small businesses and self-haulers to drop off or on-sell	Outdoor yard the same size as the Waitakere Concourse's resale area
	A welcoming and attractive public image with appealing first impression that belies its industrial nature		
	Indoor store for reusable items *capable of being a product stewardship drop, sell-on-behalf of, off and on-selling area for indoor goods*	Assuming this is for local residents, small businesses and self-haulers to drop off or on-sell	Assume the drop off area size of Porirua's Trash Palace second-hand goods facility
	Administration and environmental education *area that allows for site*	For school groups up to 30 children and 10 parents and teachers at a time	Needs designing

Clarifying Functions/Scope			
Component Area	**What does it need to do well?**	**Disposers, receivers, processors**	**How much is coming in, how large an area is needed?**
	tours without stopping on site work		
	Cafe/art gallery/display area *that are exciting enough to bring people in that would not normally come*	For up to 40 people at time with a view of the facilities, garden area, and incoming goods	Ceres Environmental Park model, Australia
	Repair workshop for reusable items capable of being a retail repair shop as well	For both inorganic booking collection and residential drop off materials	Repair building the same size as the Waitakere Concourse's for now
	A shopping area that is easily visible and accessible even when the drop-off area is closed	For as many people from as wide an area as possible	Need to determine square metres available and total estimate size of each shop
	Commercial laundry for cleaning large items like furniture, mattresses, carpets besides regular items like clothing	For as many people from as wide an area as possible	Say double size of a commercial laundry for now
	A Food Cooperative and Ooooby (Out of Our Own Back Yards home produce sales) to encourage bringing one's own containers and minimising packaging	For as many people from as wide an area as possible	Size of an existing Bin Inn for now
Recycling Drop Off	Drop-off area and dismantling area for bulky (whiteware, tyres, timber, scrap metal etc.)	For local small businesses, residents and self-haulers only—not for commercial waste haulers	Might be shared with industrial area and dismantling area
	Repair workshop for reusable items *and capable of being a retail repair shop as well*		Might sit between the inorganic drop off and retail sales area
	Greenwaste drop-off area *that would be cleared completely at least every 3 days*	For residential, small business and self-haulers only	Assume a maximum of 3 to6 m kip bins
	Hazardous waste drop off *professionally staffed*	For local small businesses, residents and self-haulers only—not	Assume same size as El Cerrito

Clarifying Functions/Scope			
Component Area	**What does it need to do well?**	**Disposers, receivers, processors**	**How much is coming in, how large an area is needed?**
		for commercial waste haulers	
	Drop off area *for items by the general public for reusable, recyclable and DIY C&D materials*	For local small businesses, residents and self-haulers only—not for commercial waste haulers	Assume same size as El Cerrito
Buffer	A green buffer capable of internalising, minimising and containing potential impacts that might occur such as unsightly views, trash, odour, and stormwater.		Needs designing
Throughout	Throughout the site: A circulation plan that allows people to move safely within the site separate from vehicles		Needs designing
	Throughout the site: Consideration of spaces for community-based social marketing		Needs designing
	Throughout the site: Waste minimisation education and outreach programs on site and throughout the site.		Needs designing
	Throughout the site: Places to showcase of innovative, compact, low-impact technologies that allow processing of a wide variety of waste streams, particularly organic, in urban areas.		Needs designing

4.4 Developing Conceptual Diagrams for the Components

Concept diagrams were developed for each of the five components—the image, recycling drop-off, industrial and buffer areas, and flow diagram. The models were then integrated. The development of these models is explained in the next subsections.

4.4.1 Diagram of the Image Area

Figure 39. Image area diagram (by author).

The ideal arrival sequence through the Image area would provide an overview of all the shops and activities, with a clear view of the entry to the recycling drop-off (Figure 39). Once clients leave the recycling area, easy parking and shopping options would encourage them to stay and spend money on repaired, upcycled and pre-loved goods. A central parking area with trees and plantings serving all the facilities could also create a unifying central open space and perhaps double for events such as off-hours farmers' markets, carboot sales, and local fairs

To estimate land area needed for (Table 2) measured "image areas" from aerial photos of existing CRCs from cities or towns with population catchments greater than 30,000. It is assumed that through design the total amount of space will be able to be reduced.

Table 3 Land Area Estimation for the CBRD Image Area

Area Estimation for the Image Area	m^2	
Central Parking area-Porirua Trash Palace 21m x 25m, parking for 25 cars	600	
Administration Space- --Waitakere RR & TS)	100	
Outdoor Secondhand good sales-Waitakere RR &TS, 20m x 35m	750	
Indoor Secondhand goods sales-Orewa Hospice Shop 10m x 35m	350	
Product Stewardship drop off--reverse vending machine area	100	
Food Cooperative -Orewa Bin Inn 15m x 8m	120	
Learning Centre/Environment Centre-Waitakere RR & TS 6m x 20m	120	
Sell-on-Behalf-Of-Shop Waitakere RR&TS 20m x 10m	200	
Sidewalks, Tree pits, manouervability	300	
Entrance to Cafe and Garden area	20	
	2660	
*See the Industrial Efficiency area for the the recycling drop off calcs		

4.4.2 Diagram of Recycling Drop-off Area

The research investigation in chapter two found five basic layouts for recycling drop-offs. The C-shaped the El Cerrito drop-off layout was chosen to minimise staffing and maximise the edge between the industrial and recycling drop off area. A diagram conceptualising this form follows (Figure 40).

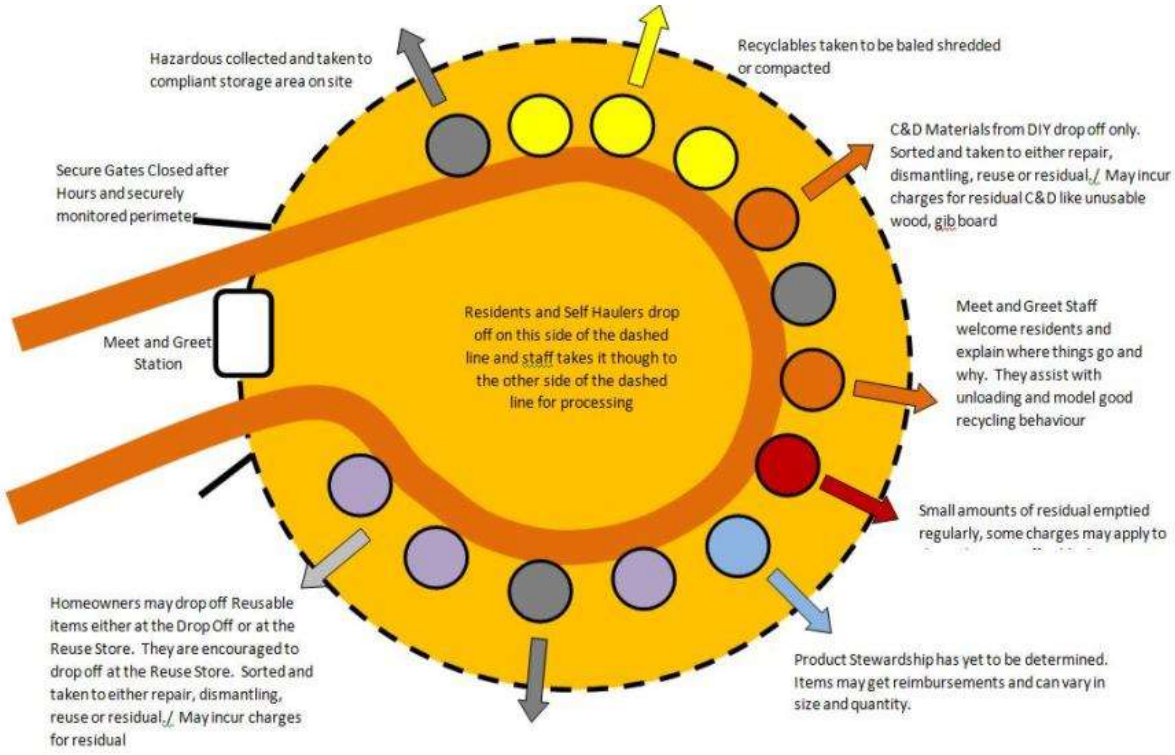


Figure 40. Recycling drop-off area concept diagram (by author).

4.4.3 Diagram of the Industrial Area

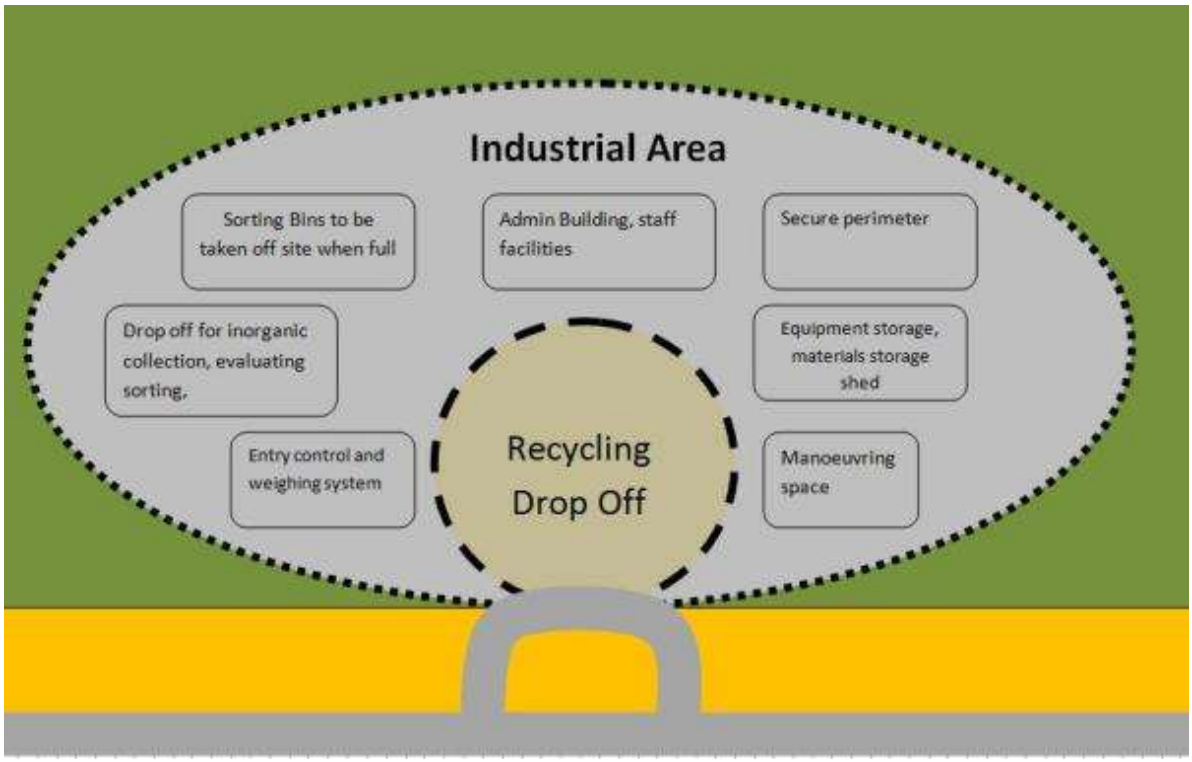


Figure 41. Industrial area concept diagram (by author).

The industrial area (Figure 41) houses processing equipment such as a baler, forklift, tractor and skip bins. It serves to stockpile materials for transport off-site. It might have an office admin/physical plant/staff room, facility and staff parking, and a hazardous storage material area. The layout depends greatly upon the materials being received, their quantities, and how quickly they are moved off site. While many smaller provincial recycling centres lack separation between the recycling drop-off and the processing area, it is assumed this is a secure area, off limits to the public given the safety issues of a dense urban form.

Assuming the incoming materials are from the kerbside inorganic booking collection in commercial trucks, then the flow of inorganic materials can be specifically diagrammed, as in Figure 42. Reports on the inorganic collection show the majority of the materials are wood-based (Waste Not Consulting, 2007). These materials would include furniture, treated timber, and construction debris. Other common materials are bedding, mattresses, and textiles. Scrap metal often comes through the inorganic collection in the form of old bicycles, exercise equipment, BBQs, lawn furniture and garden equipment. The inorganic collection also accepts large plastic items such as children's toys, lawn furniture, and non-metal garden equipment. Common recyclables in the inorganic collection include paper, cardboard, books, magazines. Tables for representative amounts and types of materials are available (Auckland Council, 2013a; Waste Not Consulting, 2007).

Hazardous materials would need to be individually separated into separate receptacles. Common household hazardous materials are batteries, paints, household cleaning chemicals, florescent tubes, low-energy light bulbs, and motor oil. Electronic waste, (e-waste) such as computers and computer equipment, TVs, whiteware and appliances are often classified as hazardous. Hazardous goods are taken to the secure storage area, where a trained operator classifies and stores them until they can be collected by specialised transport. The hazardous goods storage area proposed for the Waitakere Concourse is 6 by 10 metres. Information on hazardous waste can be found on the Auckland Council waste website (Auckland Council 2013c).

Small amounts of clean fill materials from household do-it-yourself projects such as bricks, tiles, masonry, concrete and gib-board might be taken if a clean fill operator was found. Large bays may be needed to take clean fill, scrap metal, e-waste, greenwaste, and bulky items to be disassembled. These bins need to be accessible, for handling with a fork lift or front end loader.

Common non-recyclable materials destined for disposal (residual materials) include tetrapak containers (aseptic packaging) treated timber, mixed timber products, waxed cardboard, non-recyclable plastics, and some forms of expanded polystyrene. The number of bins needed depends on the quantities and frequency of collection.

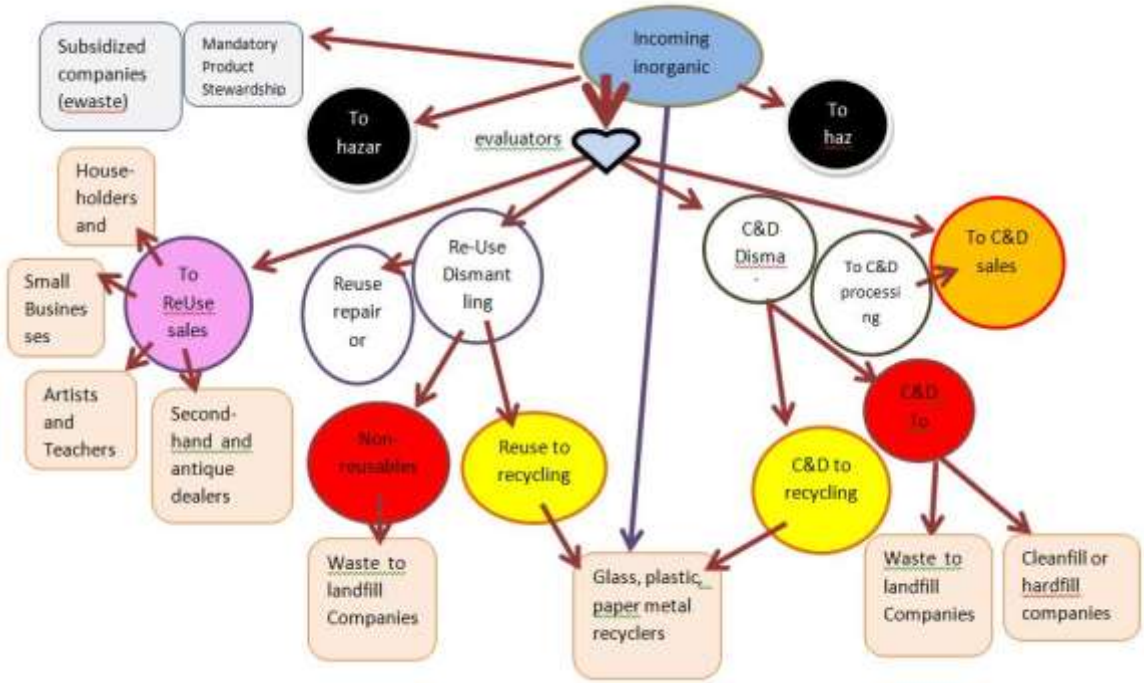


Figure 42. Inorganic collection flow chart (by author).

Figure 42 diagrams the expected flow of inorganic materials from the delivery truck (dark blue) through the industrial area. The inorganic collection is dropped off and evaluated (light blue heart)

into different categories: C&D materials ready for sale, discard, or dismantling with the parts recycled; recyclable materials; reuse materials to be dismantled and the parts recycled; reuse materials to be repaired before being sold; and reuse materials ready to be sold directly.

Organic materials are either disposed of, taken to an on-site composting bin, or put in a special container to be taken to a composting facility. Neither organic nor hazardous materials are supposed to be in the inorganic collection, but some contamination inevitably appears and needs to be addressed.

These materials (hazardous, recyclable, repairable, dismantled, rubbish, outdoor reusables, and indoor reusables) are then further categorised, depending on the business model. Reusable goods may be sold to second-hand dealers, collected by Hospice or Salvation Army, or sold on site. Repairable goods might be repaired on site by staff or by a consortium of upcyclers who would on-sell from their own shops.

The repair shed might be run as a Men's Shed, (see glossary) by an employment training organisation, or by volunteers who exchange some of their own time in exchange for using the facilities. Men's Sheds are equipped with a wide range metal and woodworking tools where users work under supervision usually as part of a training or rehabilitation program. Whichever way the materials move, there are opportunities for the public to watch, from a safe distance, as workers transform marginal materials into valued materials. These interactions between the public and on-site workers are valuable waste minimisation activities that do not happen at transfer stations. This model also assumes the Repair Shop is a stand-alone business whose workers are subsidized by disability schemes, that purchases goods to upcycle at a low rate and on-sells the repaired or upcycled products.

Deciding what materials a CBRD takes determines many of its features. Hazardous goods take special containment facilities, mixed C&D materials need a sorting area and a large outdoor sales area, paper and cardboard need dry storage until enough is collected to warrant shipping. Organic materials need different facilities depending on whether it is food scraps or greenwaste. Organic processing is also influenced by the quantities of in-coming materials coming. Small amounts of food scraps could be placed into worm bins, but greenwaste may need to be trucked off-site because the volumes are potentially large. Residual material needs skip bins that can be emptied and replaced daily. Plastic storage takes up more space but baling the plastics takes time and expensive machinery. Paper, cardboard and gib board need covered areas. Highly valuable materials like non-ferrous metals need to be locked up to prevent theft.

A CBRD aspiring to divert the maximum amount of material would have more categories and need more space and management. This effort would potentially take more staff but provide more waste minimisation awareness opportunities. There is also an issue of finding the right balance between maximum diversion and profitability. Short-term thinking values the transfer-station model because of its low cost per tonne. This low cost is due to minimal labour and rapid throughput. Resource recovery is a more expensive option given greater labour and slower throughput. Business planning needs to justify the ratio of labour costs to diversion tonnage.

The quantity, not just type, of materials a CBRD accepts is also an issue. The quantity of materials is a function of the season, the population catchment, the demographics of the catchment, and the landfill tipping charges. Studies show that peak transfer station use is during the summer and autumn months, especially over sunny, school holiday periods (Wilson et al., 2009). It is expected that this time period will also be peak CBRD use. Greenwaste and C&D materials are major components of summertime discards. Demographics also effect discard quantities. Larger population catchments, single-family homes, and wealthier areas generally have larger quantities of discarded materials per person than poorer, multi-family dwellings (Waste Not Consulting, 2007).

Understanding the quantity of materials to store is also vital prior to site planning design. Rapid processing and collection minimises on-site storage need but requires greater staffing, balers and/ or shredders. Proximity to existing recycling businesses that can readily take greenwaste, tyres, paper, glass, metals, reusable goods, C&D, e-waste and hazardous materials also affect storage decisions. Materials storage would be a function of the business model and the amount of space available on site. The scoping reports suggest a networked system of CRCs could share balers and shredders.

Solid waste textbooks show detailed flow charts for processing different resource streams. The design of the industrial area is expected to be done in conjunction with materials handling engineers familiar with the machinery and processes involved.

Table 3 summarises the estimated land areas for the industrial area as 2,920 square meters, assuming it will consist of a recycling drop off, an inorganic sorting and area, ten skip bins, a repair area, an inside turning radius of 10m (assuming the largest vehicle will be an eight-metre box truck), and a baling shed with storage space for recyclables. Nearly 3,000 square meters is considered a minimum area needed for a population of 33,000, which is the same population catchment as El Cerrito.

Table 4 Expected land area needed for industrial area

Industrial Area	m^2
Recycling Drop Off -37m dia based on El Cerrito layout	1100
Sorting area based on Trash Palace	50
Ring Road circling perimeter of recycling drop off, one way, 4 m wide	800
10 Skip bins, 2.5m x 6m	200
Manouerveability area	400
Repair Shed	60
Hazardous good storage Waitakere RR & TS	60
Baling Shed -Xtreme Waste	50
Recycling Drop Off storage based on Whangaparaoa RDO facility	200
TOTAL	2920

4.4.4 Diagram of the Buffer Area

The buffer has four purposes: to mitigate the environmental impacts of an industrial activity, provide natural, green relief in an urban environment, separate divergent land uses, and provide ecosystems services such as stormwater purification, stormwater retention. The buffer might also serve as an area from which the industrial area can be viewed, and perhaps allow for bike walking trails to circle the site. It might provide visual screening, dust and odour capture, air freshening, urban food or timber production, composting demonstration and research areas, organic material processing and organic gardening areas (Figure 43).

The buffer area wraps around the industrial area and extends out to the property lines. It would follow creeks, steep slopes, and other unbuildable areas, providing a transition between divergent land uses and separate the industrial area from sensitive areas such as residences and schools.

Transfer stations typically have a hedge against a chain-link fence to provide screening from adjacent land uses. A wider green buffer is suggested for a CBRD. To warrant its inclusion and be valued as an amenity given the high cost of land in urban areas, the buffer could be valued as a linear park and integral part of the CBRD supporting its functions and providing community and environmental benefit.

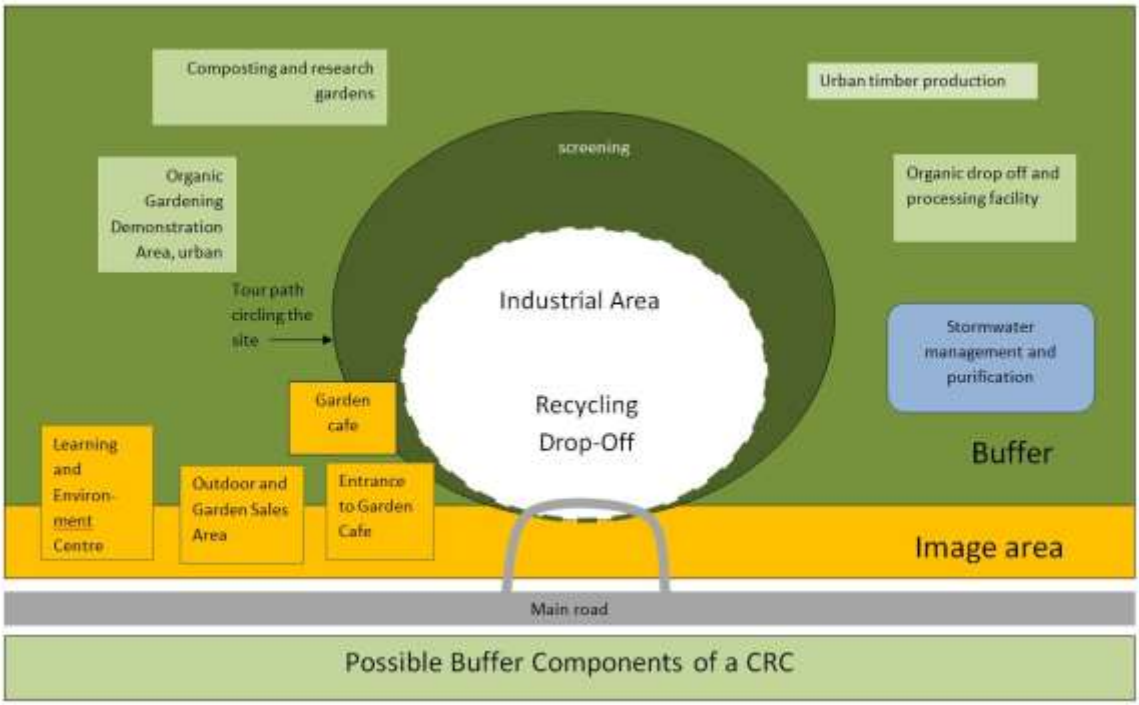


Figure 43. Buffer area concept diagram (by author).

Ecosystems services are not confined to perimeter planting and could extend to include green roofs, solar hot water and PV panels, and vertical gardens up the walls of surrounding buildings. An organic garden area in the buffer could provide many opportunities to display waste minimisation practices such as home composting systems, using home compost and vermicast, using alternatives to treated wood, harvesting rainwater, and selecting appropriate urban trees.

The buffer relates well to the organic processing and C&D materials because a good proportion of non-treated wood is capable of being mulched and used for paths or planting areas in the garden. Food scraps and greenwaste constitute roughly half of the domestic waste tonnage. The buffer area could display ways to minimise treated wood and display alternatives to treated wood. The buffer area may also be a good place to showcase the use of recycled materials in the landscape such as tyre walls, recycled glass paths, recycled concrete slab and retaining walls. The buffer also could feature durable hardwood timber trees species, building bamboo (moso) species, rain water infiltration swales use of recycled, non-toxic materials, uses of biochar, permeable surfacing, non-concrete surfacing, and rainwater harvesting.

4.4.5 Diagram of the waste flows

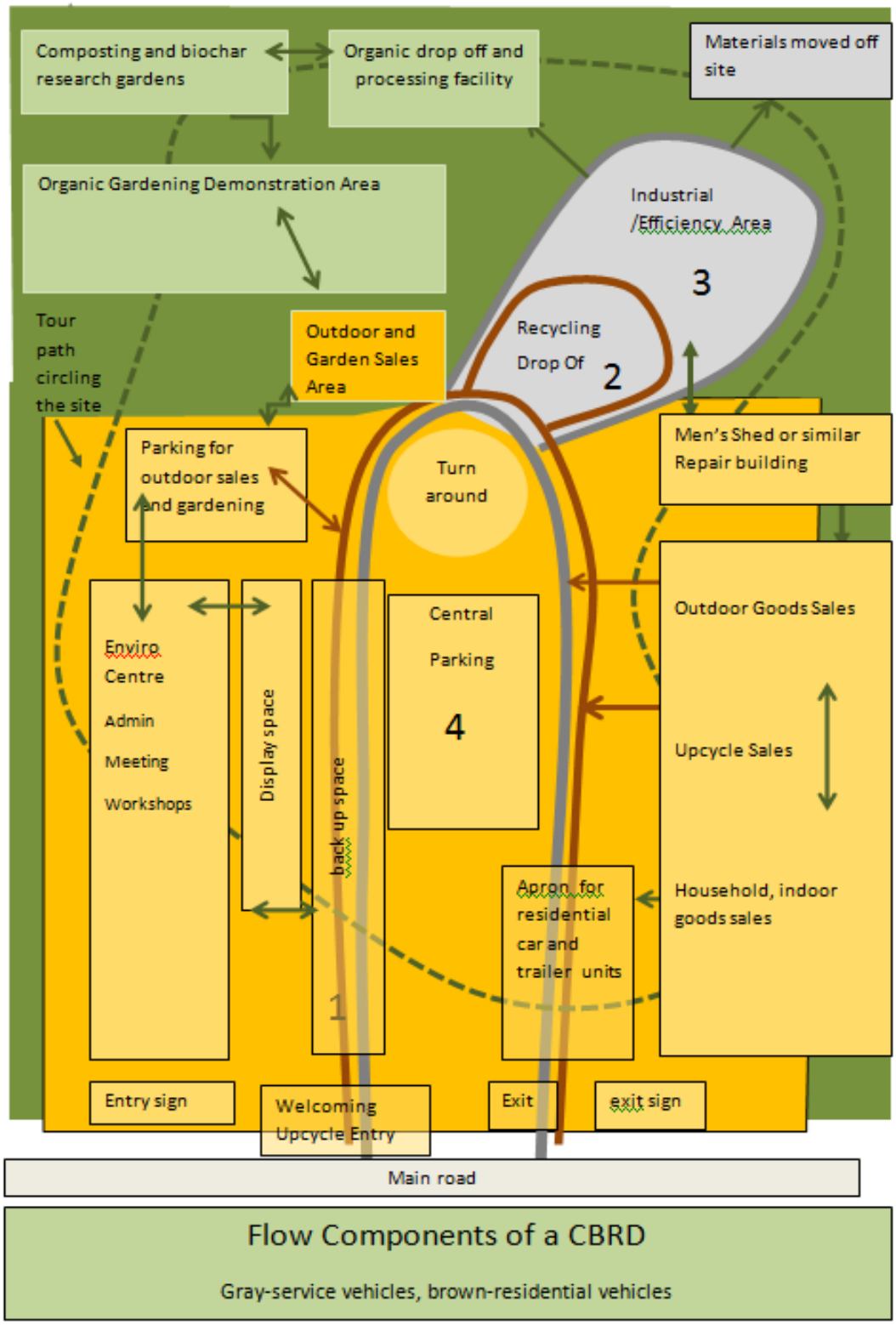


Figure 44. Flow components concept diagram for a CBRD

There are many types of flows within a CBRD (Figure 44):

1. Service vehicles, recycling industry collection vehicles (grey line)
2. Residential, self-haul customer vehicles (brown line)
3. Pedestrians (dashed green line)
4. Materials flows (not shown)

There are three vehicular loops:

1) The first loop depicts entry off the main road and into the image area (brown and grey). It is preferable, but not necessary, to place the sales areas towards the exit back to the main road along with convenient parking. This is dependent upon the space available and layout of the land.
2) The second loop (brown only) is the recycling drop-off where residents and self-haulers drop off a range of discarded materials. This may involve driving through security gates and over a weighing system, depending on the space available and the business model.
3) The last loop is the industrial area loop (grey only) that involves entering and exiting over a weighing system. This area is for staff and collection vehicles only. It also includes the service area platform where machinery like forklifts and tractors manoeuvre.

A wide variety of service and waste industry vehicles would potentially access the site to either delivering or take away:

- inorganic materials or kerbside recycling (box trucks);
- materials for remanufacturing, export or disposal (compactor trucks, gantry trucks); and
- Tractors, forklifts, pallet jacks and other materials handling equipment necessary to shift large items or pallets of materials to storage, processing or transport.

Generally motor vehicle servicing happens off site, however, at Waitakere Concourse Resource Recovery and Transfer Station, a small indoor work area provides space to fill tyres and replenish hydraulic fluid.

However, once laid out on the site and evaluated (Figure 50), the design failed to satisfy several criteria: it would not cater well to backing up trailers, and it lacked areas for unloading and storing large, bulky items like furniture or mattresses. This disparity existed because of the difference between American and New Zealand cultures. The El Cerrito plan moved all its large, bulky materials off site by placing them in shipping containers leaving the processing of the inorganic materials to

charitable organisations off site. Compared to New Zealand, few Americans own trailers so the American design did not allow for trailer backing space.

In hindsight, the recycling drop-off seemed the most variable component. This was due to the variability in who was dropping off, how material were being dropped off, what materials were being taken and where the materials were ending up. It needed to interface with the image area, the industrial area and the buffer area. It also needed the most research to integrate staff, residents, people, vehicles and the wide range of materials. This realisation resulted in returning to the five layouts assessed in the research review (Chapter 2): concentric (two in England), linear DTRC (Australia), looped drop off (Helensville), and C-shaped (El Cerrito). To compare and evaluate the "most appropriate" form, the five were each re-considered in two general frameworks:

- ease of monitoring, entry and exit policing , interfaced with the industrial area, user friendliness , safety (in terms of minimising backing up and circling around), and the ratio of drop-off edge to manoeuvrability; and
- What the design site could accommodate, given the concept layout, using the level area with a natural grade break along the west slope.

Schematic Plan

Each plan was applied, but none worked satisfactorily. This seemed to be because the proposed facility was expected to be used by a commercial truck bringing in the inorganic collection needing separate drop off facilities from the residential recyclable drop off area. None of the other areas needed to incorporate two types of drop off facilities. It was decided to integrate the useful parts of the five concepts to (1) minimise the amount of manoeuvrability space and maximise the drop off edge as in the concentric layout, (2) design for safe trailer back up and include non-back up options as in the Somserset layout, and (3) keep a looped system that would allow vehicles to return, if necessary to drop off again, The final schematic design for the recycling area is shown after integration with the image and industrial area.

4.5.3 The industrial Area

The design of industrial areas in resource recovery has traditionally been the domain of materials handling engineers. Here the focus is on understanding the movement of trucks, bins, storage and their interfaces but usually in the context of only the most common, largest quantities of major materials. The design of community-based resource recovery operations is more detailed. For instance, El Cerrito has over sixty categories into which materials can be sorted. Since the primary purpose of the proposed CBRC is to receive the inorganic collection, and secondarily to provide a

convenient drop off service to the local community for both recycling commodities and inorganic materials, further information was sought from two inorganic trialling reports—one issued in 2007 by the old Auckland City Council, another in 2013 by the reformed city Auckland Council. Both studies analysed the range of materials and their percentages of the total resource stream. Although the inorganic drop-off was not meant to take organic or hazardous items, they still ended up in the collection. As a result, it was determined the industrial area would need to include all six of the processing modules, not just four. The six being recyclables, small scale construction and demolition(C&D), organic, inorganic, hazardous, and residual. Both reports made it clear that their findings provided small snapshots of a very large picture which would indicate the need to design a space for flexibility (Waste Not Consulting, 2007; Auckland Council, 2013a).
Research from the author's survey of existing transfer stations was also applied to the design of the proposed CBRC, primarily to inform safety and security provisions. The suggested measures were; a secure perimeter fence, secure gates, back up lane, informational signage, and weighbridges. A weighbridge may not be used at all, but is included in the proposed design for completeness.

The selection of a weighing /weighbridge system needs specialist research, given the many different types of systems, such as portable or fixed, and variable lengths. How this system might be used for differential charging would likely involve the expertise of a specialist engineer. The approach apron to and from the weighbridge might also need special consideration. Depending on the business model, the weighbridge might be located before the recycling drop-off, in the recycling drop-off or

at the access into the industrial area. The industrial area schematic is shown below in Figure 51.

Figure 45. Industrial area schematic design of proposed CBRD.

Deciding where to separate the residential drop off traffic from the commercial drop of area traffic required studying the different ways the recycling drop-off and industrial area could interface. The site plan above assumes the residential drop off would happen within the recycling drop off circle and commercial trucks would drive around the recycling drop off circle into the gated industrial area to drop off. Another assumption was made that income would come from" diversion payments" so the site plan above shows incoming commercial trucks entering weighing system first to measure total tonnage. After dropping off the trucks would be re-weighed to determine the actual tonnage of material and this compared to the weight of material disposed. The resulting design took advantage of the level change and used it as a crenulated edge capable of taking many sorting bins. (The drop-off platform would be covered to keep the receiving containers dry.)

An assumption was also made about the maximum size and shape of service vehicles. A materials handling engineer would normally make the selections, but to progress the design process, an 8 metre box truck was assumed because that size was used in the inorganic collection trials. To determine a maximum height, an 8 metre long gantry truck was assumed that needed 4.1 metres clearance for the gantry mechanism. These specifications determined the minimum outside turning

radius of ten metres. A member of the trucking industry (an associate of the author) assisted with the design layout.

4.5.4 The Buffer Area

Since the buffer area is especially important around the industrial area, these two areas are linked by the following elements: security gates and fence, a specially designed stormwater/sewerage purification system, and plantings or a windbreak screen that would serve to screen, contain noise, dust, debris, odours and/or stormwater runoff. It was decided that public viewing would need to be from outside the fence or from above to allow staff and service vehicles to work without interruption. Specialists would be needed to work out how a camera surveillance system or other policing mechanism might best be included.

On flatter sites the spatial requirements of the perimeter buffer would have to compete with other activities. On this proposed site, there is a natural perimeter buffer formed by the steep banks and creek. Therefore, for this site, the biggest determinant of the buffer design may be the size of the long-term maintenance budget. For this research thesis, it is assumed there would be adequate funding for all possibilities. The schematic design assumed the existing creek would stay open (it would be a shame to pipe the creek while daylighting the waste) and the creek would follow its own ecological process—even if that meant the establishment of “weed species” (Figure 46).

A different approach was taken for the upper banks—with the idea to intensify their use for rainwater harvesting, screening, displays, urban agriculture, trails and art work. The deed of consent stated that this property was only to be used for stormwater management, so an emphasis in the design work was placed on incorporating low impact urban stormwater design. Discussions with a stormwater engineer resulted in the placement of an interception rain garden between the industrial area and the creek, infiltration swales along pavement edges, ornamental rain gardens down the main entrance road, and rainwater harvesting tanks doubling as retaining walls (Figure 46). A rough grading plan was developed.

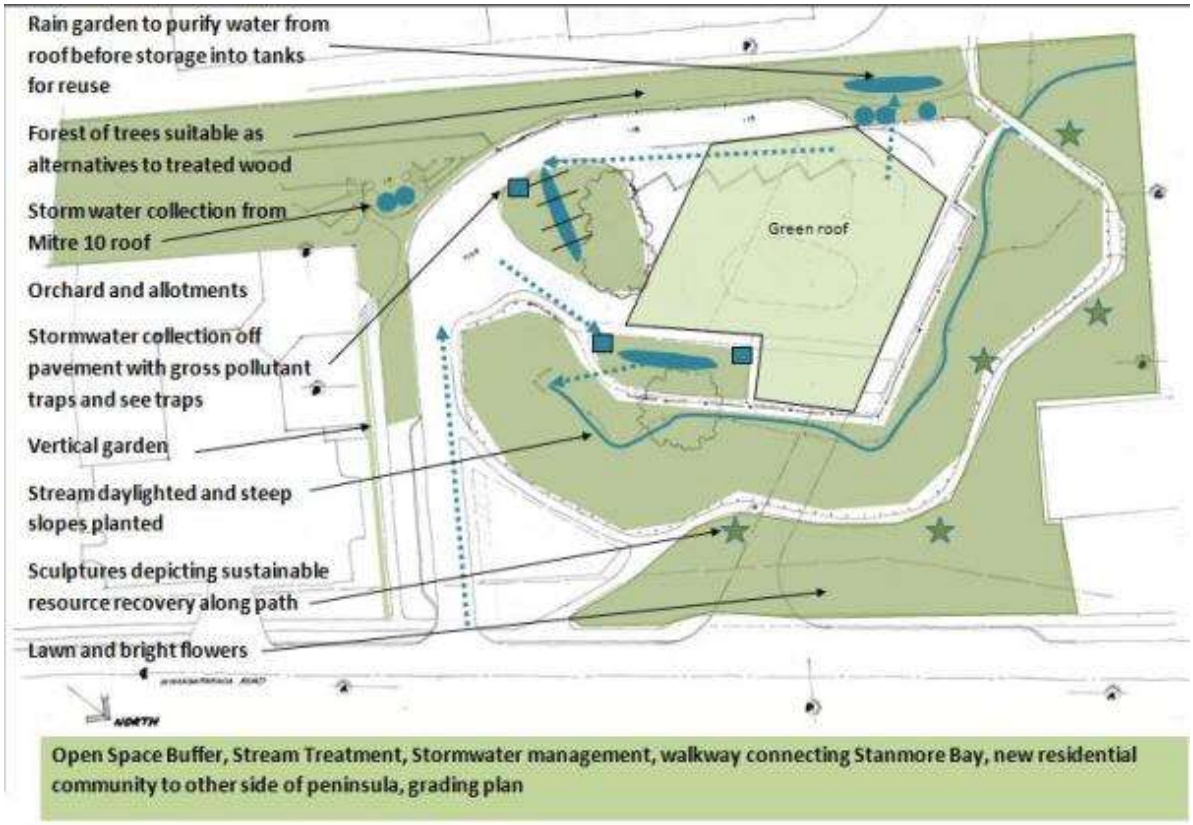


Figure 46. Buffer area schematic of proposed CBRD. Image by author.

The schematic buffer plan also took into account the need for an attractive entry, the view along the entry road, and impressions of some of the main visual elements such as the vertical gardens, the organic garden/composting area. This buffer schematic also shows the possibility of a large green roof covering the industrial area, both to screen it and contain environmental impacts.

4.5.5 Flows

Flows are about the sequence of movement of materials, people and vehicles through the site. . Flows also consider the sequence of spatial experience. This is especially important in terms of safety for preparing people for spatial change, and in terms of setting up learning experiences for social edges. Although "flows" are described separately, they are the unifying sequences between spaces and activities.

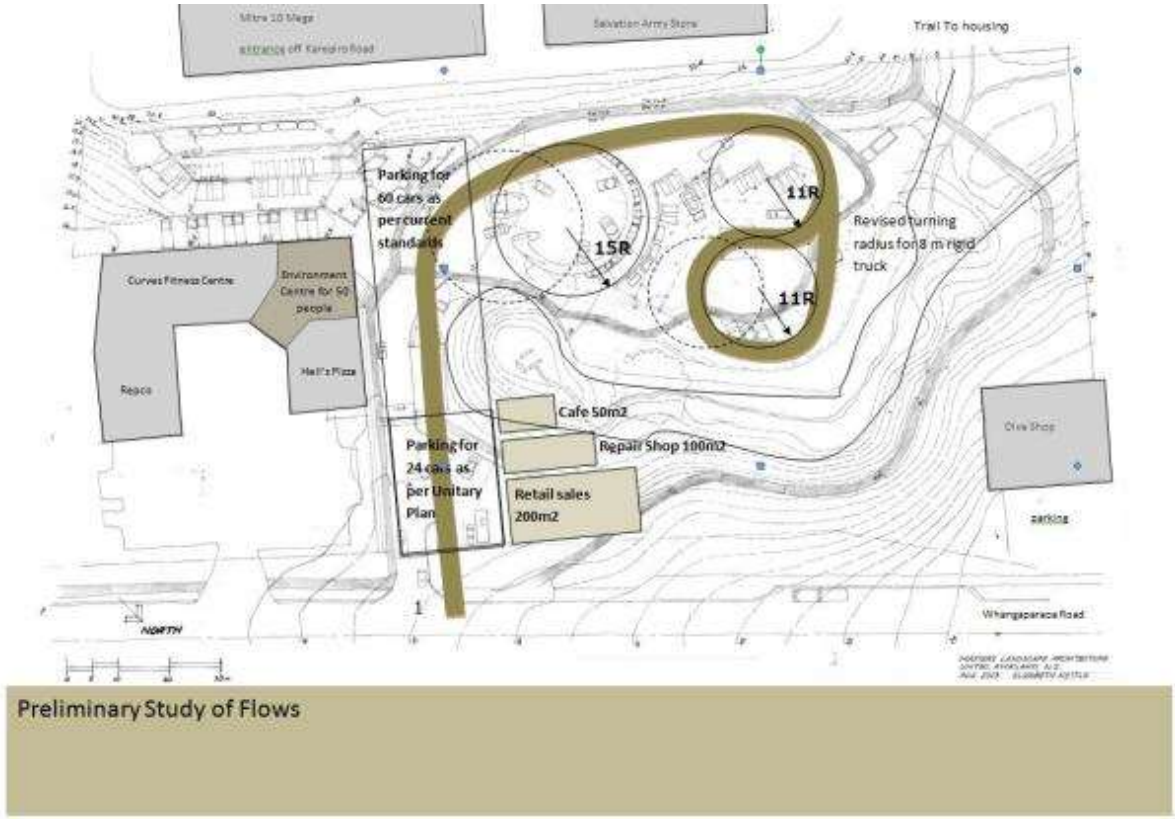


Figure 47. Industrial area schematic of proposed CBRD.

Breaks in flows happen when the environment changes--at starts, stops, entries, exits, and intersections, changes in levels, speed, times of day, and special events. Understanding how materials, vehicles and people move through the space is critical to the design of CBRDs to keep activities moving smoothly and safely. A very simple flow of commercial vehicles is one of several flows that were mapped during the schematic design phase. (Figure 47) Other important flows considered were of residential vehicles, collection trucks, school tours, inorganic materials, recyclable materials, weekend pedestrian visitors, off site visitors and shoppers.

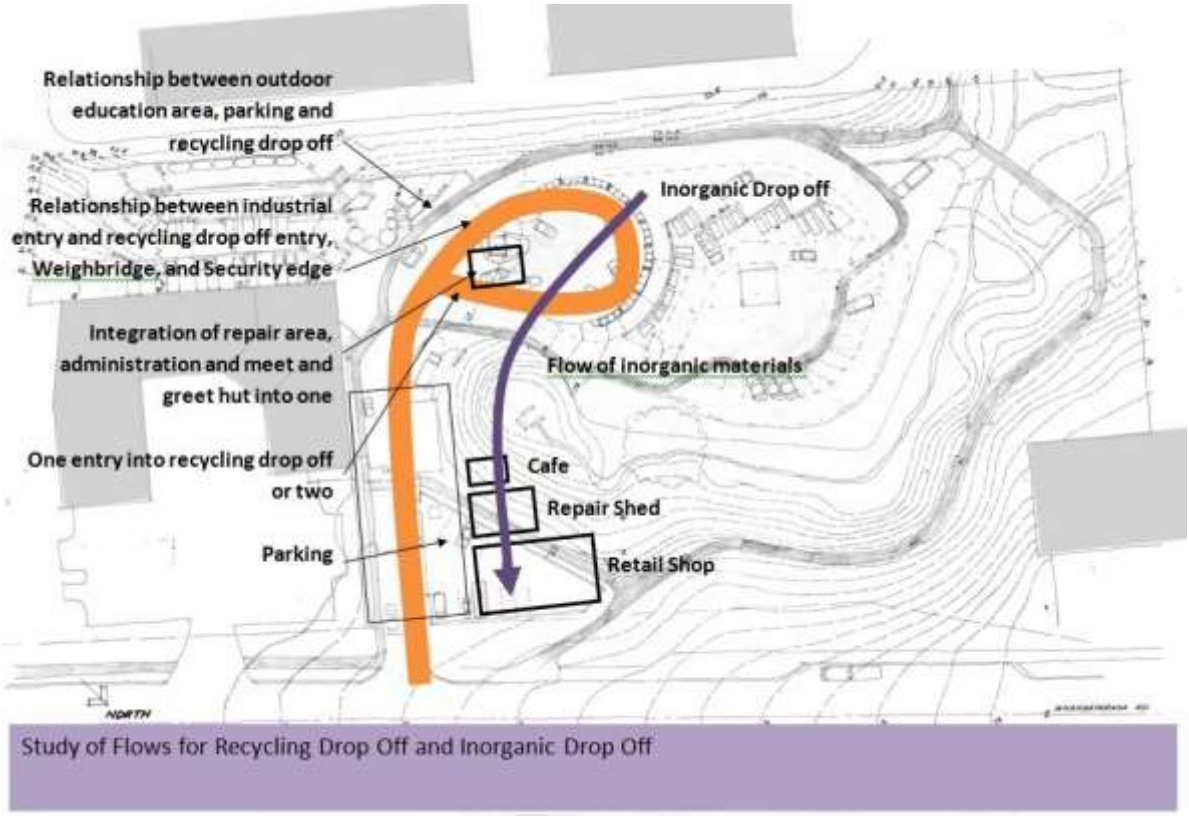


Figure 48. Flows of residential traffic and the inorganic collection to the sales area at proposed CBRD.

It was assumed that residential, self-haul and small businesses would follow a designated path to drop off a wide range of discarded materials inside the recycling drop off (orange loop in Figure 48). The flows diagram flags decisions to be made regarding entry into the recycling drop off, treatment of the shared edge between the recycling drop off and industrial area, and to the integration of the weighbridge and security systems. Ideally, the flow of saleable inorganic materials would move from the drop-off through the repair shop and to the retail second-hand goods shop (purple arrow). It seems appropriate to put the sales area on the road and the drop off /sorting area in the industrial area connected by one long building. However this design move would require filling in the stormwater pit and piping a section of stream.

The flows of pedestrians and children is mapped in Figure 49 showing the walk through the gardening and composting areas, over the sky bridge for observation into the recycling drop off and industrial area and around the perimeter of the site for residents passing through.

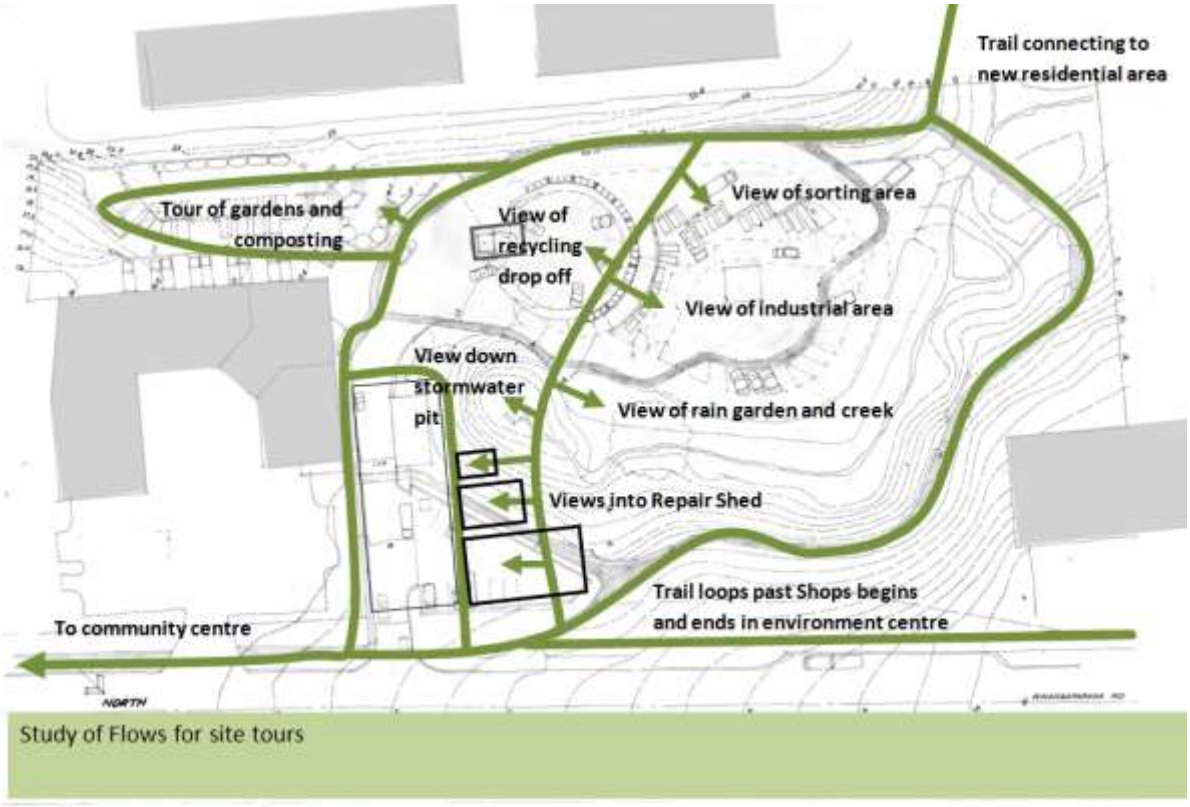


Figure 49. Desired flows of children and parents on site tours at the proposed CBRD.

4.6 Preliminary Design and Social Edges

The site plan was re-designed to address issues raised during schematic explorations (Figure 50). The result was a more space-efficient drop-off area, a walkway connecting the drop-off area to the sales and repair area, a community gathering area for use when the recycling drop off was closed, and a series of open spaces that allow for viewing and observation. The areas are identified by image area (pale salmon) industrial area (tan) and buffer (green). The surrounding existing buildings are grey.

Figure 50. Preliminary site plan for the CBRD at Whangaparaoa.

4.6.1 Waste-Wise Behaviours

The Auckland Council WMMP supports a community-based social marketing approach to transition residents towards waste minimisation. This approach could be described as letting the local pro-zero waste advocates work within their community to demonstrate fun and engaging waste minimisation behaviours. This approach is not about coercing, or manipulating; it is about letting residents see other zero waste residents make an effort and by example, to encourage voluntary change. The author believes that design can support this effort by providing the necessary infrastructure to display, model and engage waste-wise actions to its community. To this end, the author re-examined the list of waste wise behaviours provided by the Council Action Plan 2.13 (Auckland Council, 2012). These behaviours are categorized below. Some waste wise behaviour demonstrations could happen in several places others in specific places of the proposed design. These instances are noted;

Garden Area: Experimentation with different composting systems, (bokashi or worm farm, hot, or passive); different mulching systems (grass clippings, bark chip, cut weeds, shredded prunings, mulching mowers) and low-effort, intensive vegetable gardening.

Environment Centre, Oooby table, Farmers Market or Bulk Food Store: Encouragement by shop owners to experiment with shopping habits and meal preparation to minimise food scraps such as buying only as much fresh food as needed, re-using left overs; buying products with recyclable or no packaging; bringing one's own packaging, buying from neighbours, purchasing economy-sized products, concentrates and refills.

Recycling Drop-Off: Providing free takeaways of non-reusable wood, identifying treated wood, examples of creative use of reusable wood, a trading bulletin board for reusable building materials, ongoing staff interactions about what are hazardous materials and what a good idea it is to bring them to the recycling drop off, ongoing staff interactions about identifying new recyclable materials and staff encouragement to book a personal inorganic collection.

Cafe or Farmers Market: Encouragement by café staff and farmers market vendors to identify compostable containers, and separate them out from recyclables and rubbish.

Environment Centre, Second-hand Goods Shop, and Sell-on-Behalf-Of-Shop: Staff explanation of the advantages of joining an extended producer responsibility group or industry accreditation programs; opportunities to use waste exchanges and brokerage services; computer literacy courses in how to trade, gift and exchange re-usable goods; or shop on line for products with extended producer responsibility or waste reduction credentials.

An advantage of a physical site for the Cards is that behaviours can be publically demonstrated. Indeed, one of the difficulties identified in modelling waste wise behaviour was most waste minimisation behaviours happen in the privacy of the home (McKenzie-Mohr, 2011). The proposed design will daylight these opportunities by designing the site for them. By working with a waste educator, and a community-based social marketer, a landscape architect could include modelling places for three of the five steps involved in behaviour change: pre-contemplation, contemplation and preparation. Summarized below are all five stages, which are described in chapter four (Reducing Waste Household Behaviours) of *Designing for Zero Waste*(Crocker, 2012). This approach is combined with Nikki Harri's method of modelling positive actions.

Pre-contemplation*: raising awareness of the issue by*

Highlighting the benefits and opportunities of creating a zero waste culture, and

Getting people to reflect on their past environmentally friendly behaviour.

Contemplation*: encouraging consideration to change by*

Identifying barriers and enablers;

Developing a person's confidence in being able to achieve by giving them a small but positive experience of successfully doing the environmentally friendly action;

Seeing oneself as someone who cares;

Seeing others putting effort into caring; and

Seeing others doing a zero waste activity as a normal, standard behaviour.

Preparation: *modelling the planning stage by*

Showing equipment and explaining resources that the CBRD provides;

Talking to others who practice the activity;

Watching others do this activity;

Seeing the whole process from start to finish;

Exploring new techniques; and

Practising new techniques in a safe and non-threatening environment

The last two stages, which are hoped to happen at home, are

Action: *implementing the change*

Maintenance*: maintaining the change*

If the CBRD is successful, visitors will be more likely to adopt waste wise behaviours after observing and especially participating in the many waste minimisation activities on site. If the CBRD is successful, visitors will be more likely to maintain these behaviours with continued visits.

4.6.2 Social Edges: Site Plans

The CBRD infrastructure has identified places for numerous awareness raising opportunities:

- Displaying places (bulletin boards, webpages email notices, bulletin boards, kiosks, display walls).
- Gathering places
- Safe places from which to observe others Overlooks, high points,
- Tours, classes, workshops and courses These places (social edges) are shown on the site plan below (Figure 57):

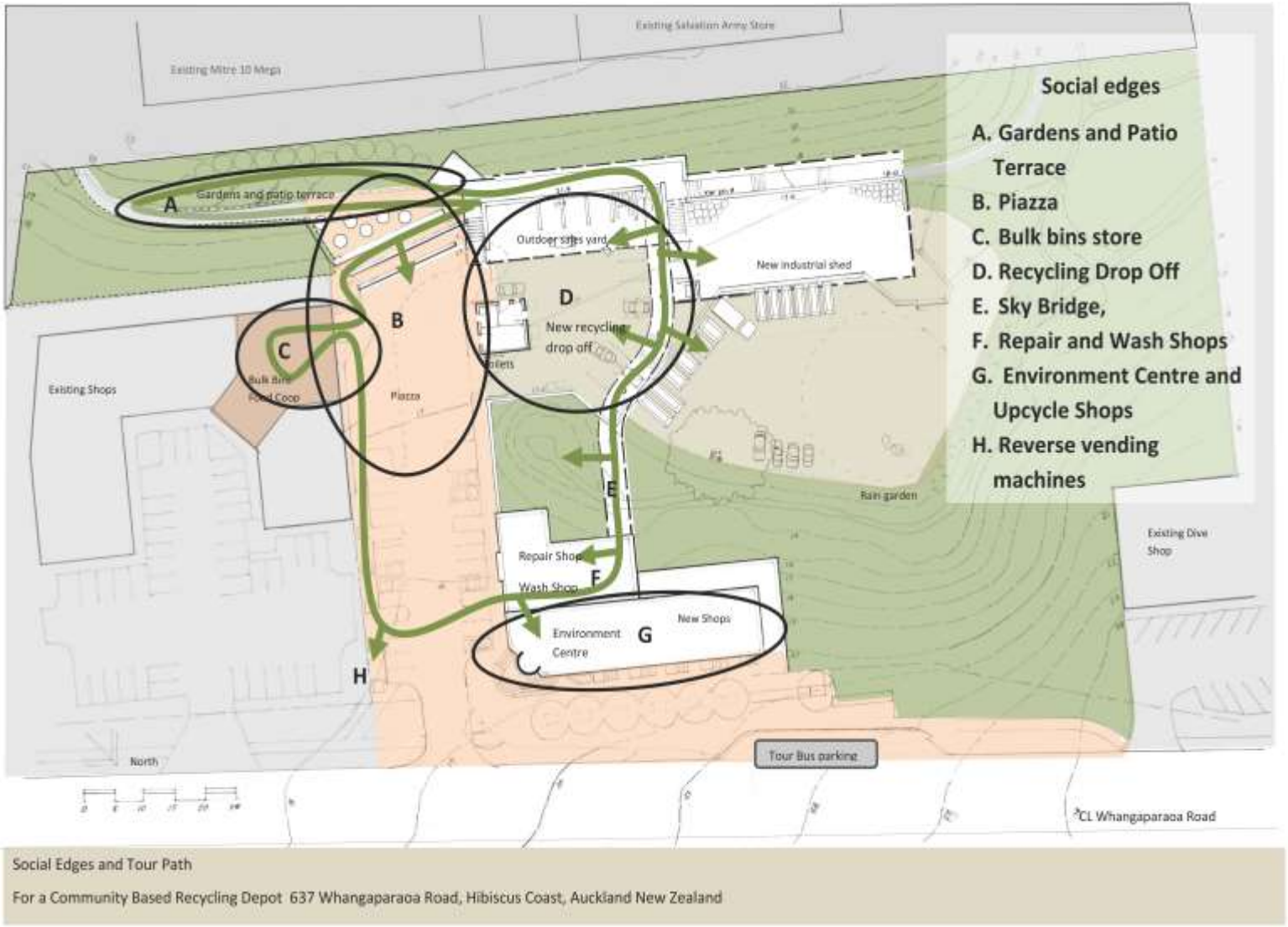
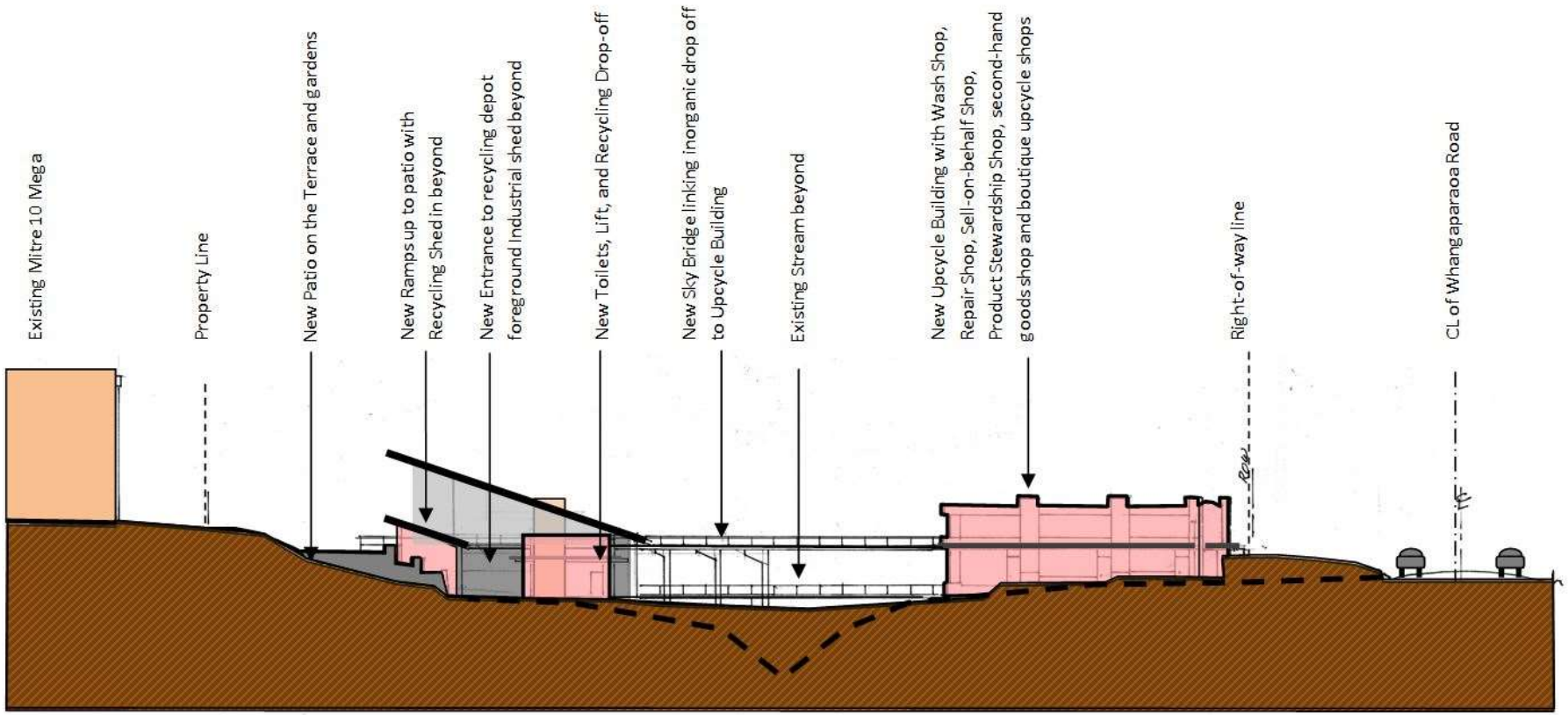


Figure 51 Site plan showing Social Edges



Section through the piazza-parking lot looking north

Figure 52.Sectional view of the proposed CBRD through piazza looking north.

Figure 53. Drawing of Upcycle Building to contain a Wash Shop, Repair Shop, Environment Centre, Sell-on-behalf-of Shop, Product Stewardship Returns Shop, and boutique Upcycle shops.

4.6.3 A Vision of the CBRD

INTRODUCTION

To help visualise the way in which the public will interact with the CBRD I have made a number of images accompanied with descriptions of the public interface of the CBRD.

At the Entrance of the CBRD, the first impression is of a colourful Art Deco Upcycle Building facade that is home to a Repair Shop, Wash Shop, Environment Centre, and upcycled second-hand goods shops. This visible, eye-catching entrance signals that this is the place to experience something fun, quirky, and worth exploring. The 1920-30's theme harkens back to the days of the lively days of flappers, the arts and crafts movement yet is reminiscent of resource conservation, the use of quality materials and skilful craftsmanship.

The parking lot doubles as a back-up lane on busy days when residents are waiting to enter the recycling drop off. The parking area is an attractive space with pavers, rain gardens and shade trees. Across the parking lot from the Upcycle Building are reverse vending machines (see glossary for an explanation) assuming a "back to the future" that returns to container deposits (product stewardship schemes).

Window shopping visitors watch workers cleaning and sterilizing mattresses, and washing upholstered furniture and large bedspreads at the Wash Shop. Next door, in the second-hand shop, volunteers from the Hospice Upcycle can be seen sorting clean, second-hand clothing. Views into the Repair Shop show young people learning reupholstering and how to artistically upcycle furniture to add value.

The electronic bulletin board and the push-pin bulletin board in the window of the Upcycle Building advertise cleaning and repair services to the larger community with evening classes on how to refurbish furniture. The window into the Environment Centre reveals children showing their wearable art creations on the Junk-to-Funk catwalk to an audience of parents. In the boutique shops, visitors to Trash Footwear can see artisans making flash custom shoes from seat belts, tyre treads and conveyor belts. In the ReKindle Furniture shop offers genuine kauri furniture recycled from demolished Auckland houses. Other signs advertise for bicycle repair, the Salvation Army, Bulk Buy Foods, the Whangaparaoa Transition Town Office, jobs at the Recycling Drop Off and the upcoming World of Wearable Arts (WOW) event.

Figure 54. Drawing of use of CBRD parking lot as a piazza on Sundays when recycling drop-off is closed.

At the Entry to the Bulk Foods Store (Figure 54) is an edible vertical garden with a large bulletin board advertising second-hand goods, courses on menu preparation, home composting and gardening classes, and "Buy Recycled Info." The entrance area includes seating where one can watch passers-by carrying

reusable bags and containers. The entrance also features the rent-a-bike rack, and a kiosk where visitors can exchange their reverse vending tickets for cash. Along the main walking path are places for other posters announcing the latest "No Impact Man" awards, upcoming community events (all zero waste events), composting courses and gardening equipment for sale. A covered area by the entrance or along the main path offers space for community fundraising stands such as an Oooby table, upcycled crafts, and sausage sizzles.

The Piazza: A large central gathering place (Figure 54) is created in the parking lot when the recycling drop-off is closed. The parking lot fills with marquees selling food, handcrafts, upcycled goods, garden plants and beverages. Customers get a beverage discount coupon for bringing their own drink containers. There is a place to plug in the Wash Truck so reusable dishes, cups and utensils can be used instead of disposables. The market is laid out to showcase the in-vessel compost bin that demonstrates how each day's leftover organic materials, such as PLA, paper and food scraps, will be safely hot composted. The compost is ultimately used on site in the gardens.

On the right of Figure 54 is **the toilet block** that mimics the art deco theme of the main building. A three-bin system with accompanying pictures shows what discards are accepted and how to separate them. On the left, the vacant shop has been converted to a Bulk-Foods Store with new doors and windows opening out onto the piazza space. A handicapped-access ramp rises between the terraced retaining walls leading up to a patio terrace with sun umbrellas and a little cafe. Activities are observable from above, making it possible to view and value what others are doing. The waste minimisation behaviours being demonstrated are the use of totally compostable packaging, sorting discards into three categories, bringing one's own bags, bringing one's own containers, bringing one's own coffee mug and getting a discount, and choosing to buy locally grown produce from an Oooby table.

Figure 55. Drawing of the Garden Cafe and adjacent gardening area, looking south (by author).

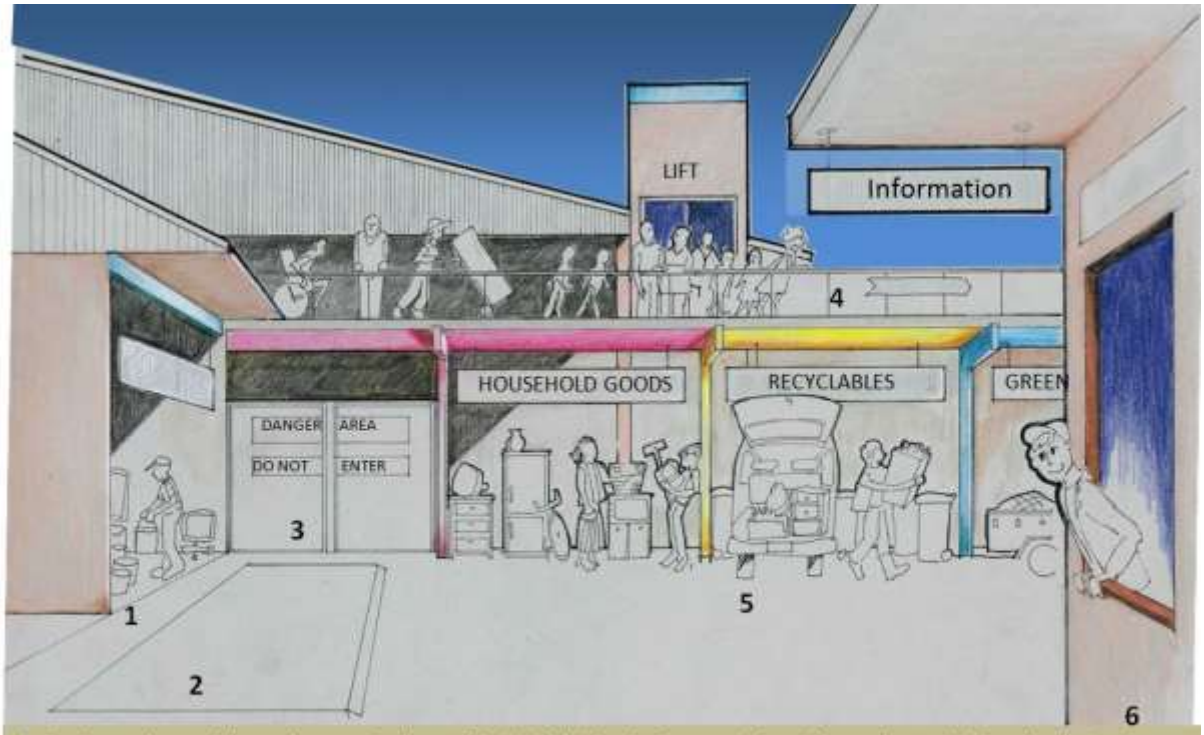
It the Gardens: the slope is regraded so the terraces fall towards the patio, connecting the gardens to the patio to read as an interconnected space. By creating a simple, single level walking path, the gardens become a public place to walk through and watch the efforts of those involved in composting, mulching, and gardening.

At the **Garden Cafe**, (Figure 55) staff explain why reusable/washable cups are used instead of compostable paper cups, and give discounts to people who bring their own cups. They ask every customer to separate out post-meal food scraps and paper for the worms. This request is reinforced by the presence of nearby worm bins, a display of worm liquid made and available for purchase on-site, and little signs on each table explaining how the surrounding potted plants are fed with worm liquid.

The garden beds near the tables look like homemade raised veggie beds. Informational signage explains urban agriculture is important and using one's own resources (organic waste) to grow more food for the city (veggies, flowers, herbs and salad greens) reduces one's environmental footprint. Customers are encouraged to look inside a worm farm and deposit food scraps directly. Informational signage explains what worm bins are, how they work and where to get one (from an on-site shop).

The **Garden Tour** shows off the allotments where veggies are grown in natural fertilizer made vermicast and biochar made on site. (Figure 55) The compost demonstration area showcases different composting methods and advertises free courses. Veggie and flower seedlings are offered for sale, and tour participants can pick their own herbal tea leaves for their cuppa.

The multi-purpose **water tanks**, (Figure 55) which line the west side of the garden, serve as retaining walls, water storage, stormwater attenuation, and spatial enclosure. The garden area would be shaded in late afternoon by the Mitre 10 Mega building (orange). The tanks would be used to store rainwater from the Mitre 10 and neighbouring buildings and store water for emergency preparedness, watering the gardens, the Wash Shop.



1. Outdoor sales yard, hazardous goods drop off 2. Weighbridge 3. Gates to industrial area beyond 4. Overhead viewing ramp to repair upcycle shops and environment centre 5. Assistants helping residents recycle shed, 6. Meet and Greet station

Figure 56. Drawing of the recycling drop-off, looking north through entrance gates (by author).

The view into the Recycling Drop Off (Figure 56) looks in from the piazza area to the big industrial shed beyond. On the right is the **Meet-and-Greet Station**, where a friendly worker explains how to use the drop off. The worker explains that the hazardous materials, sales office, e-waste, paper and cardboard drop-off are in the shed to the left. Second-hand goods and recyclables may be dropped off straight ahead, and greenwaste can be dropped off around the corner. All materials must be separated. Mixed loads that cannot be separated must go over the weighbridge and be paid for

before being left on site. The worker at the Meet-and-Greet window invites guests to take a walk on the sky bridge to the upcycle shops and second hand goods store.

From the **sky bridge**, (Figure 56) visitors view the recycling activities in both the recycling drop off and industrial areas including; unloading trucks, baling paper, crushing cans, inorganic sorting and disassembly. Further along the sky bridge, there are windows looking down to craftspeople repairing, and transforming used goods into upcycled goods. The sky bridge tour features informational sign explaining the importance of the rain gardens, the history of the site as a closed landfill, the fate of the compromised stream, the efficiency of the solar panels on the roofs and the capacity of the rainwater harvesting system.

The Buffer Tour takes groups around the site perimeter. Since treated wood is a large proportion of the waste stream, the tour displays groves of trees whose ground-durable wood is suitable to replace treated wood. Holding back the slope are a variety of retaining walls made from non-toxic, recycled building materials. The walkway is divided into sections, each one displaying a different recycled paving material; glasscrete, glassphalt, bamboo, shredded tyre walking surfaces and recycled timbers. The tour guide explains how the collected greenwaste and non-treated wood is taken off site, shredded and returned for sale, how non-treated wood can be turned into biochar as a permanent form of compost for the garden, how rainwater diversion can help slow peak stormwater flows.

For those interested in the gritty side, the **Recycling and Industrial Area Tour** carries through the industrial shed from which an overhead walkway allows visitors to watch workers bringing in the inorganic collection for sorting, dismantling recycling and ultimately, dispatching to the Repair Shop or sales areas. The tour guide explains what happens to items that cannot “be recycled” and discusses the implications. The tour maps out the alternatives to landfilling: the international hazardous waste processor, to clean fill, the Chinese rare metal salvagers, to the local paper recyclers, the industrial glass remanufacturer, and Southeast Asia to e-waste and plastic recyclers. From this high perspective, the solar PV panels, solar hot water panels, and green roofs can be seen. With a vista to the rain gardens, the tour guide explains contaminated stormwater capture and purification, and the buried landfill below.

A different tour is offered by the community **zero waste group.** The tour guide explains how second hand goods are “wholesaled” at this site as there is too much to be sold in Whangaparaoa alone. A small cafe sells coffee and buns to second hand dealers visiting from across Auckland. Here second

hand dealers are hoping to catch a bargain on the antiques being trolleyed to the retail area. The environmental centre looks over the parking area, and guides explain how viewers can enjoy films at night: the top floor of the centre can be used as seating and the large concrete wall of Hell' Piazzas is used as the screen. Inside the centre are offices for staff who work with schools on the Waste Wise Program, businesses on the Cleaner Production program, and residents keen to improve recycling and composting skills. A large meeting area accommodates school children before and after the site tour and providing for a package-free snack and interactive recycling games. Throughout, the centre features displays explaining where everyday goods come from and where they go when their lives are over.

At the conclusion of any tour, the guide explains that a Community-Based Recycling Depot is not really about waste: It is about a community taking responsibility for dealing with its environmental impact. It is ultimately about re-designing our consumer society to be a waste-wise society.

5.0 Conclusion and Reflections

Can a Community Based Recycling Depot become part of everyday life?

This thesis established the need for the denormalization of waste through a grassroots movement to facilitate a change in the culture of wasting. The proposed design of a CBRD focused on how landscape architects might play a role in this denormalisation through the redesign of the places where discarded materials are collected. The specific locality investigated was Auckland, NZ, but the findings have implications worldwide for waste minimisation, resource recovery and community-based interactions.

"Daylighting" is a term commonly used by landscape architects and engineers to describe exposing streams that have been piped. In this thesis I use the word to mean to reveal, to uncover, and expose. This research thesis began by exploring the role of landscape architecture in the design of community recycling centres (CRCs) in the context of the Auckland Council Waste Management and Minimisation Plan in order to:

- Refine the current CRC typology to better suit Auckland's unique culture and environment
- Develop a methodology for conceptualising, locating and designing new CRCs

- Evaluate the conceptualised typology in terms of its ability to address the multiplicity of outcomes (environmental and social) desired of a CRC within the Auckland context

The research-by-design process began by exploring the intersection between landscape architectural practise and waste and community recycling centres but evolved through the research process. The interface of landscape architectural practice and waste and community recycling centres deepened into "design for waste minimisation through spatial form". The result was the daylighting of serious social and environmental dysfunction, in which landscape architects could play a critical, rectifying role.

The overarching purpose of this study was about how landscape architectural practice could affect the design of community recycling centres, hence the research question, "how can community recycling centres become part of everyday life?" As the process of research-by-design evolved, three possible approaches were found (5.1) design of CRCs to minimize potential environmental impacts to allow inclusion in a mixed use zone, (5.2) design to re-imagine a resource recovery facility as a as an urban amenity and (5.3) design for the denormalisation of wasting through the creation of spaces supporting waste minimisation participation and observation. All three were integrated in the final design proposition.

The result of this research exploration was the daylighting of diametrically opposed design issues. From a landscape architectural perspective, how does a landscape architect successfully *make visible* and *raise awareness* around what is generally desired to be *invisible* and *out-of-sight-out-of-mind*? How does a landscape architect successfully introduce what could be perceived as; *objectionable industrial land use* be used as *an urban amenity?* How can the *physical form* of the built environment affect individual behaviour thus evoking *social change*?

5.1 Design within the Land Use Definitions

The introduction and Chapter One revealed New Zealand as one of the growing number of countries adopting waste minimisation legislation to address the growing waste disposal problem. New legislation has been responsible for the shift from *efficient waste management / engineering* solutions, towards the inclusion of *effective societal behavioural change*. The need to denormalise wasting was a commonality uniting many Auckland waste industry stakeholders. Recognition of the need to shift focus was the result of efforts by zero waste advocates who lobbied citizens and Councils about the problems of landfilling and incineration and the potentials of resource recovery.

Understanding the zero waste concept was critical in the development of the community recycling centre typology (CRC). It was found that the Unitary Plan land use classifications were insufficient to consider community recycling centres outside industrial zones. The choice was either to design a CRC that would be acceptable land use in a mixed use zone or create a new definition that would declassify CRCs as waste infrastructure. The thesis studied both options. First by looking at ways to minimise, internalise and avoid potential impacts of CRCs and secondly by re-imagining resource recovery facilities as an urban amenity. Critical were the questions about the inclusion of transfer stations in the design of CRCs, how transfer stations worked and how might CRCs differ. Research in Chapter Two determined that CRCs were not transfer stations and differed so significantly they might not be considered waste infrastructure. It was found:

1. CRCs are not transfer stations and do not take mixed waste
2. Kerbside collections of rubbish, recyclables and the new organic collection would not come to the CBRD
3. The proposed inorganic collection and recyclables drop off disallow materials that have potential impacts
4. A decentralised resource recovery network would distribute the waste quantities so that local centres would be dealing with only local materials.
5. There are examples of successful, community recycling centres serving similar-sized populations with sufficient experience in dealing with urban issues for study both in NZ and overseas.
6. Impacts can be avoided by a combination of regulation, spatial design and on-site management

5.2 Design for Urban Amenity

Based on the ability to negate undesirable environmental impacts, the next question was, “could a community recycling centre go beyond being a not-noxious place and be reimagined as desirable destination for reasons other than recycling?” This question required an understanding of the basic objectives and definitions of CRCs and the possibility of developing potential synergies with other urban needs. Some information was provided by the scoping studies. Examples were found both in NZ and overseas similar to Auckland’s in the form of the El Cerrito California Recycling Centre, the drive-through recycling centre in Caloundra, Australia, Trash Palace in Porirua. All of these projects were architecturally designed *to give value* to effective resource management and present an attractive *image.* These and other CRCs were then examined in order to understand and develop a

landscape architect's version of a CRC typology. This process was described in chapter two with the resultant concept diagram presented in chapter three.

To test the proposal and to integrate the design parameters it was important to use the concept diagram to inform a real site. Chapter four developed siting parameters, evaluated sites, ranked and finally selected a site on the Whangaparaoa peninsula. The concept diagram consisted of a central "Industrial Area" wrapped with a green "Buffer" and prefaced with a community-shopping "Image" area. A "Recycling Drop-off" sat between the community shopping area and the industrial area. "Flows" of people, materials and vehicles moved between these areas. An iterative site planning process progressed the project from concept, to schematic, to preliminary design yielding the minimum land area needed for a CRC and also a functional physical form. The subsequent form was dependent upon many assumptions such as a buildable site, adequate start-up funding, the requirement to build an attractive facility, a Council/community partnership business model, Council funding for waste education programs, profit from sales of repaired and recycled materials, Council subsidies in the form of a diversion value, garnering of the contract for a locally-run, inorganic collection and rental income from private businesses feeding off the resource stream.

Ideas for urban amenities were added on top of the design parameter list (listed on p71) with the idea of creating a sought-after destination. Listed as basic elements were; a convenient public recycling drop off, local employment opportunities, safe vehicle movements, and efficient materials handling as well as the internalisation environmental impacts. Urban amenity elements were added in the form of an outdoor piazza, walking trail connection, synergies for new business development, an environmental education centre, a community gardening area, Sky Bridge and a garden cafe. All of these elements could be considered as "social edges" thus serving the double purpose of a place for interactive community events that also incorporated waste minimisation education. The social edges were purposefully considered to support the waste minimisation activities described in the WMMP Council Action Plans.

5.3 Design to Denormalise Wasting

The deeper issue of the normalisation of wasting was found to underlie not only Auckland's waste problem but the global waste problem. This was, and is, the most difficult issue to address within the scope of landscape architectural design. Yet it is acknowledged that a change at this fundamental level could create a ripple effect that could ultimately transition entire countries to a more sustainable resource management system. How does a landscape architect design a community recycling centre that would facilitate a shift in personal habits? Research described in chapter two

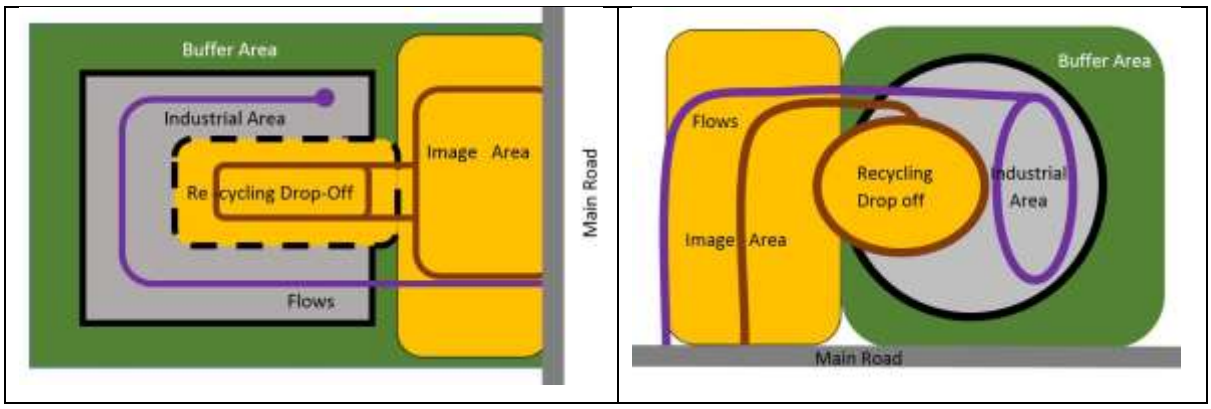
found several methods, including the Council-endorsed, community based social marketing approach. However, no examples were found where a CRC site had been designed specifically for this purpose. Further research revealed the possibility of designing places for modelling, participating and observing waste minimisation activities as an effective means of transitioning participants into the first three of the five steps of behavioural change process. This idea later evolved into the concept of social edges and the design of areas specifically for watching and modelling waste-wise behaviours.

Social edges are the places where sustainable behaviours and ideas can be showcased; they are the author's primary contribution to the field of resource recovery design. The thoughtful inclusion of social edges is what differentiates this project as something new and different from the existing CRCs typology. This new typology was thus called a *community-based recycling depot or CBRD.*

5.4 The need for further research

Many assumptions were made regarding the business model, governance and ownership structure that effect the physical design which need to be realistically evaluated. Further analysis of the concept diagram needs to be explored to reflect these real-world situations. Additional information about the type and quantity of materials generated by each community is a prerequisite to effective CBRD design along with an understanding of how the quantities and types of materials specifically influence the design. Collaboration with architects and engineers, especially in the areas of materials handling and on-site stormwater purification is needed. Research and experimentation with small scale, technologies that enable application in urban situations with minimal impact are needed.

Upon reflection, future studies that focus on the intersections between landscape architecture and marketing to address issues of, "how to create an enjoyable place with a serious message and "how to transform the unacceptable into the desirable", or "how spatial form affects acceptability to new ideas" are important.



The original concept diagram needs further testing. The left hand diagram represents a revised scoping study layout, creating a secure industrial area and a manageable staffing area with industrial vehicles separate from residential. The right hand diagram better describes the Whangaparaoa site concept, but may not be appropriate for other sites. It seems while the site functions can be defined by their relationships (by image, industrial, recycling drop off and buffer) their layout takes different forms when engaging with an actual site.

There is a need for further study into how a CBRD or CRC can fit unobtrusively into a mixed use zone. A useful exercise would be to determine the most common, problematic materials arriving from 30,000 people per week. From this, a range of options could be worked out to mitigate potential impacts of each. From this, a sliding scale would be created, ranking the costs of management options to the risk of impact. This would be an extremely useful tool in the future design of CRCs or CBRDs. For instance, if a business plan indicated that it was necessary to provide a local kerbside recycling service then a range of options for collecting, sorting, storing and mitigating could be worked out. Then the cost of managing the impacts could be compared with the income generated to find the most cost effective method and determine if it would be possible to safely attempt a kerbside collection in a mixed use zone. This in turn would be compared with the costs of a "clean your container before it goes into the recycling" campaign and monitored. If the local CRC or CBRD would run the behavioural change campaigns, this would be a way of determining the effectiveness of both the CBRD and behavioural change campaign as related to decreased management costs.

If behavioural change really is the future of resource recovery, then there is a genuine need to expand the vision of a CRC to incorporate the concept of social edges. This would require collaboration between the CRC designers, waste managers and environmental psychologists, like Nikki Harri. There is also the need to apply the design of social edges beyond waste minimisation into the issues of climate change, sustainable transport, urban agriculture and increasingly dense, mixed use, urban form.

5.5 Reflections and Implications on Daylighting Waste

The process of research by design broadened and deepened the vague, initial study of the intersection between landscape architecture, waste minimisation and physical form and evolved it into *the design of the built environment as a means to instigate social change.*

From a personal perspective, this project transitioned my thinking from one that insisted zero waste would only be possible with additional legislation and punitive economic sanctions to one that posited that a zero waste scenario would only be possible with a shift in personal attitudes and

behaviours. This was due to the study of attitudes of waste industry stakeholders which indicated that despite differences, all recognised the need for cultural behavioural change.

This in turn shifted my focus from designing physical infrastructure for a future that assumed a disposer pays system (direct ratepayer charging for kerbside organic, recycling and inorganic collection) to one of designing for situations that supported the modelling of positive behaviours and interactions with the discarded resource. This lead to the idea of the social edges. Design for social edges was also sparked by the new concept of denormalising wasting introduced by the Post Carbon Institute's and Nikki Harri's book Environmental Psychology for a Better World.

This thesis put forward a methodology for understanding a new design field that is challenging, controversial and provocative, not only from the standpoint of design but also because of how it challenges our entrenched behaviours. Landscape architects could have an important role to play in transitioning from a linear to a cyclical resource management system provided they are willing to integrate the gritty with the beautiful.

There are many parallels to daylighting water streams and daylighting waste streams. Just as forty years ago, the efficacy of stormwater piping was being questioned so now is the efficacy of solid waste management. Just as landscape architects took streams out of pipes and daylighted them into an ecological wholeness, so might landscape architects rescue the resource stream and return it as a cyclical, sustainable part of our urban resource management system. Just like daylighted streams, the waste stream needs to be slowed down and the resources reabsorbed. Rather than a few large systems that speed up and concentrate causing downstream detriment, ecologists—with the aid of landscape architects-- have realised a network of many, smaller scale systems are more effective. Like daylighted streams the transition away from the conventional to the resilient requires greater collective awareness about the issue and its benefits.

Landscape architects are trained in planning for people, integrating complex activities, designing outdoor spaces and creating amenity value. These skills y make them uniquely suited to enter the emerging field of community-based resource recovery design.

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Glossary

Community recycling centre (CRC): A resource recovery facility typically (?) established by a council-community partnership that operates waste facilities for the public good. Objectives may include extending the life of existing landfills, creating local jobs, and/or hiring disabled workers. CRCs are often run by not-for-profit organisations called "**social enterprises**". In Auckland a network of community recycling centres are proposed to create a **resource recovery network** (RRN). The network is composed of larger regional **resource recovery hubs** (hubs) that collect and consolidate materials from the community recycling centres (CRCs).

Community-based recycling depot (CBRD): A new typology put forward by this thesis study. These are community recycling centres specifically designed to incorporate community-based social marketing within Auckland's unique context.

Cyclical resource management systems: Stepwise processes that seek to extract as much value as possible from the resource stream, as opposed to **linear resource management systems**, which move resources to disposal (see Figure 65). Cyclical systems primarily address the *source* of waste and how to make less of it. Examples of cyclical systems are Cradle to Cradle design, waste education and product stewardship.

Disposal: Linear resource mismanagement systems of which landfilling, incineration and anaerobic digestion are the three most common. Landfilling is most common in New Zealand but in the UK and Europe, incineration is more common. This UK/European preference may be changing as impacts of incineration on the environment are taken into account. Incineration is commonly promoted as "Waste to Energy" or WTE. Like landfilling, incineration requires wastefulness to be profitable and ultimately ends up promoting wasteful behaviour rather than minimising it. Incineration therefore, is not considered an acceptable strategy in NZ. Anaerobic digestion involves taking organic waste out of the waste stream and processing it into methane gas for use in power generation or transport fuel(Zero Waste NZ Trust, 2002).

Linear resource management systems: Stepwise processes that move resources to disposal as opposed to **cyclical resource management systems**, which (see Figure 65). Seek to extract as much value as possible from the resource stream. Examples of linear systems are end-of-pipe solutions such as transfer station-to-landfill systems, transfer station-to-incineration systems, and mechanical-biological treatment systems moving residual materials to landfill or incineration. The focus of linear systems tends to be on materials handling and engineering efficiencies rather than social or economic change.

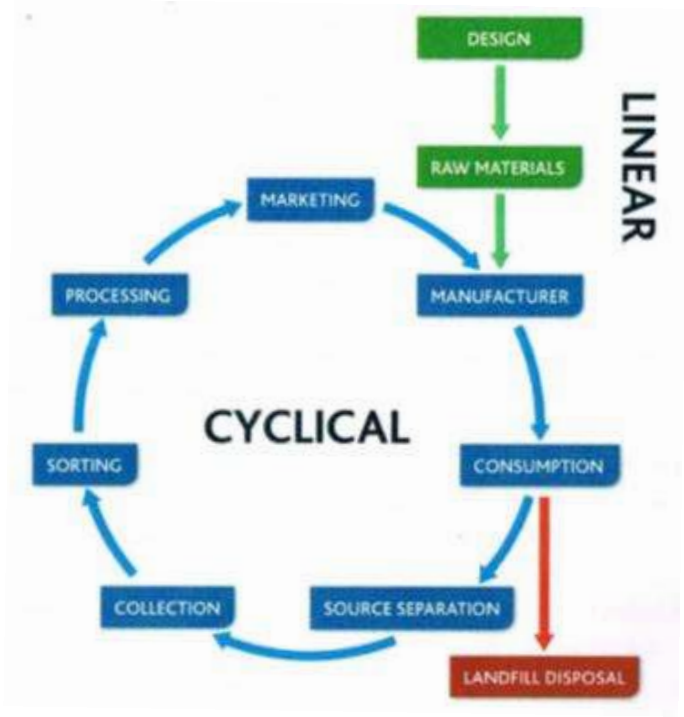

Figure 57 Cyclical versus linear resource management systems

Men's Shed: A place where men can share tools and workspace to build projects for the community, often with a supervisor working with disabled men.

Resource recovery facility (RRF): Recycling-focused industries whose profit model is based on diverting material from the resource stream before it gets to a transfer station or landfill. RRF include both publicly and privately-owned recycling drop-offs, recycling centres, amenity centres, reuse shops, second-hand stores, salvage yards, and demolition yards. Landfill operators may simultaneously operate resource recovery facilities, creating a hybrid operation.

Reverse vending machines: machines found throughout Europe that enable consumers to return containers at a grocery store or shopping mall. After the containers are inserted a ticket is issued reimbursing the container deposit and can be reimbursed in the store.

Transfer stations: Facilities that efficiently consolidate and move materials to disposal, driven by a business model that values throughput over extraction.

Waste: As defined by the NZ Ministry of the Environment:: *Any material, solid, liquid or gas, that is unwanted and/or unvalued, and discarded or discharged by its owner* (Ministry for the Environment NZ, 2013b). The definition is important because waste is defined by how it is perceived, that is, undervalued or unwanted, regardless of its inherent value. Waste is used synonymously with materials destined for disposal or landfill. The terms "rubbish," "garbage," "trash" and "residual"

are all negative terms for waste. “Discarded materials” and “discarded resources” are positive terms for waste.