



LOW CARBON LIVING
CRC

Beyond White Gum Valley

Knutsford: Integrating energy, water and built form solutions in an urban regeneration and infill precinct



Authors	Mike Mouritz, David Galloway, Geoffrey London and Tatjana Todorovic
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Acronyms

DES -Distributed Energy System

AUDRC - Australian Urban Design Research Centre

OP - One Planet

BAU - Business as usual

WGV - White Gum Valley

Executive Summary

Background

The Knutsford precinct, approximately one and half kilometres east of the centre of Fremantle, presents a unique opportunity for urban renewal. Over the past fifteen years there have been sustained investigations, planning processes, and research into the potential of the precinct to realise the ambition of the City of Fremantle to achieve “a world-class exemplar of sustainable and resilient urbanism”.¹ This ambition has been consistently supported across all the different investigations, with variation only in the actions needed for its delivery. In fact, LandCorp (the State Government land development agency) as one of the key landowners within the precinct, has taken a leadership role by implementing significant innovations within it project referred to as East Village – as documented in a parallel report².

Knutsford comprises approximately 20 hectares of re-developable land, a mix of vacant and brownfield sites and operating businesses which, in total, has the potential to accommodate 950 to 1380 dwellings³. A modest amount of redevelopment has been occurring over the last 10 years with approximately 70 town houses and apartments developed as part of Knutsford Stage 1 developed by Knutsford Joint Venture⁴.

During 2018 LandCorp commenced design and approvals of a further 36 townhouses and sites for approximately 56 apartments – referred to as East Village (but previously referred to as The Museum site) . The ReNEW Nexus – Smart Cities and Suburbs program in association with the CRCs for Water Sensitive Cities and Low Carbon Living contributed to decisions to install integrated sustainable water and energy solutions within a governance framework provided by survey strata for the townhouses.

LandCorp controls a further 9ha of brownfields land within the precinct creating the potential for continued implementation and development of sustainable initiatives. With the collaboration of the City of Fremantle there are further opportunities to extend the water and energy initiatives into the broader urban realm,

establishing a distinctive community with sustainability outcomes informing its physical character – its streets, parklands, and building types. Additionally, the existing warehouse precinct has a unique identity and contains a diverse mix of residential and business start-up uses which adds cultural and economic dimensions to the City’s objective of creating a world-class example of sustainable and resilient urbanism.

The Project

Beyond WGV set out to investigate site specific scenarios for sustainable infill at the Knutsford Precinct (which incorporates the Knutsford and Swanbourne Structure Plan areas) in the City of Fremantle. The emphasis has been on identifying ways to enabling distributed district scale infrastructure to deliver low carbon and resilient development, particularly the possibility of community battery storage. The aim was also explore the potential for distributed water infrastructure scenarios through a proposed partnership with the CRC for Water Sensitive Cities.

District scale infrastructure is envisioned to provide new opportunity for delivering liveable and resilient communities while capturing value from various mechanism such as battery storage, demand management, energy and water efficiency, diversified load balancing, economies of scale and reduced head works cost. The challenge with introducing these distributed systems is how do they integrate with the existing large scale systems, what are the fundamental elements of the business case that support their introduction and what is the best way to manage these systems.

The project reports on the findings of these investigations through five reports:

- This report – see focus of this report below.
- East Village – A sustainable urbanism project by LandCorp – which focuses on the governance, design and technical innovations related to sustainable urbanism incorporated into the East Village project by

¹ Dr Brad Pettitt, Mayor City of Fremantle, September 2018 at the CRC industry and academic workshop

² See report titled East Village at Knutsford – A case study in sustainable and resilient urbanism by LandCorp - Mouritz (ed) 2019

³ These estimates are based yield calculations drawn from the Structure Plans that provide the planning framework for the area.

⁴ The Knutsford JV is a formal arrangement between LandCorp and private sector partners.

LandCorp (the WA Government land development agency) within the Knutsford Precinct. This project illustrates what is possible at an individual site scale when an innovative developer takes a leadership role.

- Beyond White Gum Valley – Knutsford Community and Stakeholder Engagement Report - which focuses on the evolution in the consultation and engagement processes underway within the Knutsford Precinct aimed at helping to enhance the potential of the precinct realising the vision of being a world class example sustainable and regenerative urbanism.
- Beyond White Gum Valley Precincts Guide: Energy Village – which aims to provide guidance on achievable options for implementing a precinct distributed energy system (DES) that will minimise utility grid import and reduce external dependency, while increasing resident’s energy savings, and incorporating community energy sharing potential.
- Knutsford Precinct - Renewable Energy Strategy – that seeks to identify the most prospective technical and commercial solution to the provision of renewable electrical power to the Knutsford precinct, recognising the diverse land ownership and long development timelines.

Collectively these reports represent a body of work which help to illustrate the status of the challenges with implementing distributed energy and water systems within the context of an urban regeneration project. They highlight the need for a coordinated and integrated process that works towards realising the potential for benefits

This report

This report has two functions.

Firstly, in Section 3, it documents the process and output from an industry and research workshop hosted by LandCorp in partnership with the City of Fremantle in September 2018. The workshop brought together the industry and academic partners who had been working in the CRCs for Water Sensitive Cities and Low Carbon Living, together with invited industry consultants, to explore how urban development in Knutsford could be supported by integrated and sustainable built form, water and energy systems.

Secondly, in Section 4, it combines:

- the output from the workshop,
- integrates the other investigations into the Knutsford area discussed in the reports highlighted above,
- further, it seeks to incorporate the thinking involved in the CRC Water Sensitive Cities’ infill typology research that is using Knutsford as a case study (reported in their documents on the CRC WSC web site),

to present key themes about future directions for the precinct, along with identifying further research opportunities, all aimed at creating a more sustainable and resilient form of urban regeneration that Knutsford.

The three themes that emerge from the investigations are discussed below.

Themes

Theme 1: Detailing the Vision and Narrative – What might “a world-class exemplar of sustainable and resilient urbanism” look like? Knutsford is a generational project. Its ambition and complexity require a high level of integration, over time, of continually changing technologies, cultures, social and economic patterns.

Meeting this challenge is beyond the scope of conventional planning and business-as-usual development. An overarching Vision with a supporting narrative is needed, one that provides a conceptual and value driven armature for the development. For its success this vision needs buy-in and ownership by people associated with Knutsford, and the capacity to inspire and inform different scales and types of development. The first pass at creating a narrative with the stakeholders within the warehouse part of the precinct has been created (see “Beyond White Gum Valley – Knutsford Community and Stakeholder Engagement Report”). This needs to be owned, built on and further enhanced.

Theme 2: Governance – operationalizing the Vision, factors to be considered include:

- Establishing representative groups to enable the development and broker relationships within the precinct (see “Beyond White Gum Valley – Knutsford Community and Stakeholder Engagement Report”).
- Enhance and further develop the overarching vision and narrative.
- Develop terms of reference for the various enabling groups.

- Selecting and implementing a guiding development sustainability framework such as One Planet Living as used by the City of Fremantle.
- Developing and facilitating the appropriate administrative and business models to facilitate development across the precinct.

Theme 3 Catalytic Projects – projects that can be implemented now to pave-the-way, establish qualitative standards, and support future developments within Knutsford, including:

- Built form exemplars appropriate to different uses (including the appropriate kinds of light industrial uses) and parts of the precinct.
- Sustainable Energy and Water infrastructure rolled out across the whole precinct particularly focusing on energy and water processing integrated into the built form.
- Multi-function green spines along transit and access routes.
- Multi-modal transit links, including CAT buses and Trackless Tram (see appendix 7), to central Fremantle that service urban densification projects.

Research

A set of research priorities are outlined below:

Research Priority 1: Narrative driven design and development – Build on the work from the CRCLCL’s community engagement process and continue working with the agents⁵ and stakeholders⁶ to further identify and strengthen the Knutsford Vision and narrative and link it to the development process and to performance targets. Document and review the evolution of this process.

Research Priority 2: Trade-off mechanisms – the next phase of research involves further development of trade-off mechanisms for precinct wide, metricated, sustainability performance targets. An administrative framework is necessary to broker trade-offs and synergies between individual developments to meet these targets. Develop and document the processes and methodologies required to ensure each individual development contributes to and benefits from this process in a transparent manner.

Research Priority 3: Precinct Development and Management Structure – identify the most appropriate groups to enable the long-term development and management of Knutsford and specifically:

- Adopt and implement a sustainability development framework such as One Planet Living.
- Select metricated sustainability design and reporting targets.
- Identify administrative and business systems needed to roll out the various initiatives.
- Develop goals and terms of reference for the various groups.
- Advise, document and review the evolution of this process.

Research Priority 4: Building typologies - Develop exemplars and pilot projects of building typologies that:

- Explore a suite of potential built form typologies and dwelling types that might occur in the different regeneration / re-development areas across the precinct, include typologies which could accommodate light industrial and creative uses (not just commercial and residential) typologies. Knutsford, as a whole, provides a matrix of locations, characteristics and uses, each requiring its own exemplars of sustainable built form outcomes, while also reinforcing the identified Knutsford character.
- Use the existing warehouse typology as a reference point and blend warehouse and residential use typologies to provide transitions / buffers between the core warehouse area and the new residential areas. Explore these typologies to a level of detail that enables costing to +/- 20% accuracy.

Research Priority 5: Integrated energy and water systems – Undertake simultaneous research to design integrated energy and water systems and supporting administrative and financial framework, including:

- Using the sustainability and resilience targets developed to guide the design and deployment of precinct scale energy and water solutions by building

⁵ “agent” is a person or organization that can bring about change

⁶ “stakeholder” is a person who has an interest in an area but is unlikely to be able to create change

on the work undertaken at East Village (see the report - East Village – A sustainable urbanism project by LandCorp).

- Explore the potential of these solutions to extend to surrounding and existing areas beyond the immediate Knutsford precinct.
- Selecting the most appropriate governance structure and business models for this process using the Management Oversight group described above (see also - Beyond White Gum Valley Precincts Guide: Energy Village).
- Identifying and recommending how to remove any regulatory barriers.

1. Introduction

The CRC for Water Sensitive Cities and CRC for Low Carbon Living are cooperative arrangements between industry and academia to research the issues at the cutting edge of creating sustainable urbanism.

Historically, these two CRC's were operating independently, however it is well recognised that energy, water and built form are strongly interconnected. This has become particularly apparent in the research projects associated with the Knutsford precinct in the City of Fremantle. This convergence presented a unique opportunity to bring researchers and industry representatives from both the CRC's to look at common and converging issues associated with the urban regeneration and prototyping of a precinct scale sustainable neighbourhood in Knutsford, based on what has been learned from the existing research and planning⁷. This was particularly relevant in the context of the diverse range of builds that may occur at Knutsford, including: repurposing of a light industrial and warehouse area, retrofit of existing urban housing, new apartments and town houses, and urban infill.

A workshop was held on 17th September 2018 at LandCorp's offices in Perth, to explore and establish an agreed vision for the broader precinct that integrates urban design, built form typologies, energy and water initiatives for this precinct.

As the workshop occurred under the mandate of the CRCs the investigations at the workshop were limited to this water, energy and built form thematic areas. Despite this, two important issues emerged from the workshop, firstly there was strong support for the City of Fremantle's vision for Knutsford as *"a world-class exemplar of sustainable and resilient urbanism"*⁸. This had been a recurring theme over the range of previous investigations; and secondly, creating a sustainable urban precinct was much broader than just energy, water and built form and needed a detailed narrative to extend the picture of what Knutsford could become.

As a consequence of this, subsequent to the workshop, researchers from Curtin University and the University of Western Australia, and practitioners from a number of disciplines have continued and broadened the investigations

into how to create Knutsford as a sustainable and resilient urban development. These investigations draw on an ongoing community engagement process being coordinated by Curtin University and the City of Fremantle as part of the CRC LCL's research initiatives; and also, the body of work and analysis of the precinct previously commissioned by LandCorp and /or City of Fremantle⁹.

Both the immediate output of the workshop and the follow-up work by the researchers are presented in this report, and culminate in a set of specific themes about key areas of potential action and an ongoing research agenda to support implementation.

⁷ Projects associated with the CRC, ReNEW Nexus, LandCorp and City of Fremantle activities.

⁸ Dr Brad Pettitt, Mayor City of Fremantle, September 2018 at the CRC industry and academic workshop

⁹ This includes reports and studies by AUDRC, Hames Sharley and Josh Byrne and Associates.

2. Knutsford – the place

The Knutsford precinct, see Figure 1 below, is 1.5 kilometre east of the centre of Fremantle consists of approximately 20 hectares of re-developable vacant land, brownfield sites, old warehouse and industrial uses, existing residential developments and operating businesses.

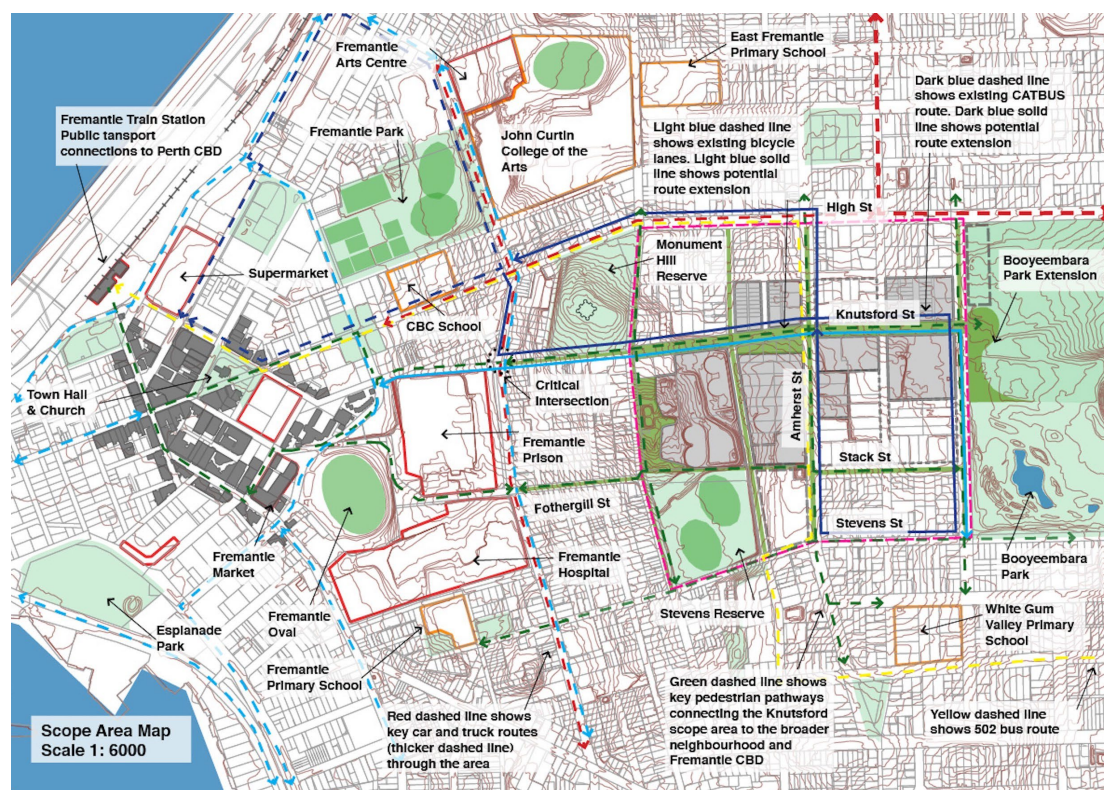
It is nominally bounded by Blinco, Stack, Montreal and Swanbourne Streets, however its cultural, economic and social links make it one of Fremantle’s centres. From a planning perspective the study area falls within a broader context as depicted by Figure 1 and covered by two structure plan documents:

- Knutsford Street East - Local Structure Plan - As amended Adopted Sept 2017.
- Swanbourne Street - Local Structure Plan – Sept 2015.

The warehouse area within this precinct is emerging as an “Industrial Arts Quarter” –as advocated by the representatives of local business and residents¹⁰.

The area is made up of about 30ha, with around 10ha of land owned by LandCorp, a 2.53ha area owned by the City of Fremantle used as its works depot, and numerous parcels of land held by a variety of landowners.

Figure 1 The Knutsford Precinct and Surrounds



¹⁰ See the companion report - Beyond White Gum Valley - Community and Stakeholder Engagement Report

Historically, Knutsford was a warehouse and industrial area but was identified in the late 1990s by the Western Australian Planning Commission for redevelopment. Subsequently the area has been rezoned as a site for mixed use and urban infill to accommodate 950 to 1380 dwellings through the adoption of two structure plans identified above. These structure plans require developments to implement sustainable planning principles and practices. Previous planning and urban design analyses have all highlighted the unique qualities of the area and includes the following studies commissioned by LandCorp:

- AUDRC – At Knutsford – Site Analysis - 2015 & Master Plan October – 2016.
- Hames Sharley – Former Museum & City of Fremantle Depot – Preliminary Site and Context Analysis – May 2015.
- Josh Byrne & Associates - Knutsford Street Precinct Green Spine – October 2017.

A modest amount of redevelopment has been occurring over the last 10 years with approximately 70 town houses and apartments developed as part of Knutsford Stage 1 developed by the Knutsford Joint Venture. During 2018, LandCorp commenced design and approvals of a further 36 townhouses and sites for approximately 56 apartments – referred to as The Museum site in this report – however now referred to as East Village. The townhouses incorporate leading edge integration of sustainable water and energy solutions within a governance framework provided by survey strata. LandCorp's leadership provides examples of implementing sustainable energy and water technologies into new developments that can be expanded into the considerable number of new builds and redevelopments that will occur within the precinct.

The existing warehouse area contains a unique design character and a diverse mix of businesses, infill and residential conversions. It houses a strong business start-up culture with activities ranging from video production through to wood recycling. There is a real opportunity to build on this local character and start-up culture to deliver a vibrant economic addition to infill housing outcomes. The City has also been investigating future depot accommodation and development options for its depot site

Knutsford provides the opportunity to create a sustainable and resilient urbanism as part of the incremental re-development process. The challenge will be to find a way to coordinate and deliver these outcomes across multiple land parcels, different owners and varying time frames.

3. The Industry and Academic Workshop

The CRC Industry and Academic Workshop (September 2018) was designed to develop a clear statement of ambitions, issues, research areas and future projects that would apply to precinct scale sustainable urban renewal projects, generically, and more particularly in relation to Knutsford Precinct.

The findings of this workshop will help set the research agenda for the CRC for Water Sensitive Cities (in particular the IRP4 project), and were incorporated into the CRC LCL Beyond WGV report, as well as inform other future research relating to sustainable urbanism, see [Section 5](#).

3.1 Methodology

The workshop ran over one day and used a *design thinking* approach within the One Planet Living framework.¹¹ It used the real world development context of the wider Knutsford development with what had been learned from the nearby WGV project, the East Village site (previously referred to as the Museum site or Lot 1819) in Knutsford, research projects being developed under the CRC WSC and insights from the researchers who are involved in projects in other parts of Australia.

Participants¹² were drawn from partners - City of Fremantle (3), LandCorp (3), government agencies (5) specialist consultants (9), and Universities - Curtin University, UWA, UQ, Monash (8).

A number of the participants had significant design expertise that was utilised during the workshop.

The process was divided into morning and afternoon sessions. The morning was spent briefing the participants about the site, what had been learned from other projects and an introduction to some of the design thinking processes that could be applied in the afternoon.

The afternoon was devoted to developing concepts of a sustainable urban development at Knutsford focusing on built form, urban design, energy and water. These concepts were then interrogated to identify knowledge or

process gaps to their implementation. These gaps helped inform future research priorities.

The results of the morning and afternoon sessions are presented below.

3.2 The morning session - setting the scene

3.2.1 Formation of design teams

Three areas of thematic speciality were identified - Energy, Water and Built Form¹³. Participants were asked to self-identify according to their primary and secondary area of speciality. They were then asked to organise themselves into design teams of approximately 6 people with a balanced representation from each thematic area.

3.2.2 Policy framework

Dr Brad Pettitt, the Mayor of the City of Fremantle, gave an overview of the history of the Knutsford area and the advice that the City has set a long-term objective (say 30 years) that the precinct should become a **“world class example of sustainable urban development”**.

3.2.3 Site familiarisation

A combination of pre-prepared presentations from the thematic specialists and additional informal input from the participants built the picture of what was known about the existing Knutsford site.

As this was a design-orientated workshop some of the thematic specialists/researchers repackaged their material to explain what the tools and methodologies they had developed could *do*, as well as presenting their specific findings.

The thematic presentations and important insights and comments were provided by:

- City of Fremantle’s aspirations for the area – Brad Pettitt (Mayor City of Fremantle).
- Site descriptions landform, geology and hydrology – Daniel Martin (UWA).
- Existing infrastructure, previous uses, implications of these uses, planning and development framework – Mike Mouritz (Curtin University).
- LandCorp’s involvement in development in Knutsford – Naomi Lawrence (LandCorp) and Anna Evangelisti (LandCorp).
- Built form and design of new residential areas – Michael Patroni (Space Agency).

¹¹ <https://www.bioregional.com/oneplanetliving/>

¹² See Appendix 1 for attendee list

¹³ These were presented as fairly general “catch all” themes - for example Built Form covered architecture, urban design, planning and community engagement.

- Built form, character and place identity – Julian Bolleter (UWA) and Geoffrey London (UWA).
- Ecological character, greening opportunities and energy and water system ideas – Josh Byrne (Curtin University).
- BAU energy, water and waste overview – Jonathon Small (Tabec) and Peter Howard (Water Corporation).

3.2.4 Lessons Learned from other Projects

Various participants presented the lessons learned from the other projects, such as the nearby WGV, the East Village (previously referred to as the Museum Site lot 1819), the CRC for WSC - IRP4 residential infill project and urban design proposals for Salisbury in South Australia and other CRC projects.

The speakers were requested to focus on the nature of their product / technology / methodology, describe what it did and how it could be applied at Knutsford.

Briefing on lessons from elsewhere included:

- Salisbury, South Australia – Nigel Bertram (Monash University).
- Water balance modelling tool – Marguerite Renouf (University of Queensland).
- Energy and Water solutions for the Museum Site– Josh Byrne (Curtin University and JBA).
- Energy Village Concept - Lio Herber (Curtin University) and Matt Rule (Balance Group).

3.2.5 Innovation and ideas

Prior to the workshop and in other forums, some participants had already presented a range of innovative ideas that could be applied to Knutsford. This session asked them to present these ideas as start-up style “pitches” to the workshop. In a number of cases this work was a direct extension of what was reported in the previous sessions on Site Familiarisation and Lessons from elsewhere.

3.2.6 Lessons Learnt

In summary the most significant lessons from these presentations were:

- The City of Fremantle has set a long term (say 30 year) agenda that this area will be an internationally recognised example of sustainable urban development.
- This aspiration was consistently supported by the participants in the workshop and is reflected across all the different investigations that have been undertaken into the area, with variation only in the actions needed for its delivery.

- In Knutsford there is a mixture of land owners – currently the major development areas are owned/managed by LandCorp and the City of Fremantle, however over time there will more land parcels coming up for development. There is an agreed need for a precinct-wide approach that leverages scale of numbers to deliver the proposed energy, water and urban design initiatives.
- There are no major technical barriers to the installation of renewable energy and water systems at a precinct scale, the major challenges sit in the areas of:
 - Developing alternative / integrated water and energy infrastructure that can align with multiple residential land owners and incremental development of larger lots with multiple owners and development timeframes.
 - Engaging the stakeholders including business and citizens¹⁴.
 - Keeping the vision of what is being created focused for say 30 years.
 - Developing appropriate governance and business models to support the rollout of alternative infrastructure solutions – such as exploring the energy village model and expanding it to a governance structure for water and energy.
 - Identifying and overcoming any regulatory barriers to the above process.
- The existing building fabric provides a distinct identity for Knutsford and important cues for adjacent new developments. There is rich potential for a unique building typology with a warehouse character and flexibility of internal use.
- There is a risk that BAU development processes will erode the unique character and varied uses of the precinct. At risk is the diverse mix of business and cultural activities that is presently occurring within the precinct.
- There is the potential for significant improvements to public transport.

3.2.7 Targets

The participants were asked to develop design targets for the whole precinct with the assumption, as discussed in the next section, that some future administrative framework would be available to allow greater collaboration and trade-offs between development lots and thereby make it practical to meet the targets.

¹⁴ This is now well advanced due to the work done with the Knutsford community through the Project RP3043 –Beyond

White Gum Valley - Engagement Research - For community engagement / facilitation.

The workshop used the One Planet (OP) framework to guide the development of targets. All participants were provided with a copy of the OP Goals and Guidance for Communities and Destinations as a reference document. The OP framework was effective for guiding the sustainability and resilience discussion because it forced the groups' thinking to move beyond specific discipline areas, however this was challenging because it moved people into unknown territory.

The Targets that were developed are presented in [Appendix 2](#).

3.3 The Afternoon Session

3.3.1 Process

During the afternoon session each of the design teams was asked to combine all that they had learned during the morning session into a conceptual design for integrated energy, water and built form. A number of sustainability design principles were presented to guide the afternoon workshop. These are presented in Appendix 3, and were mainly focused on moving the participants' thinking away from a planning-based approach of focusing on solving a specific problem, into a design-based approach that focused on how to embody a vision of what the precinct could become.

Following the review, the final afternoon session required each group to return to their design concepts with the aim of interrogating the ideas with two questions:

- What is there in these designs that we don't know how to do?
- What is getting in the way of us making this happen?

The ideas that emerged from this interrogation were extensive. On a number of occasions, during a peer review process, or through the combined workshop discussion session, an original idea from one group was extended into other areas.

3.2.2 Outputs

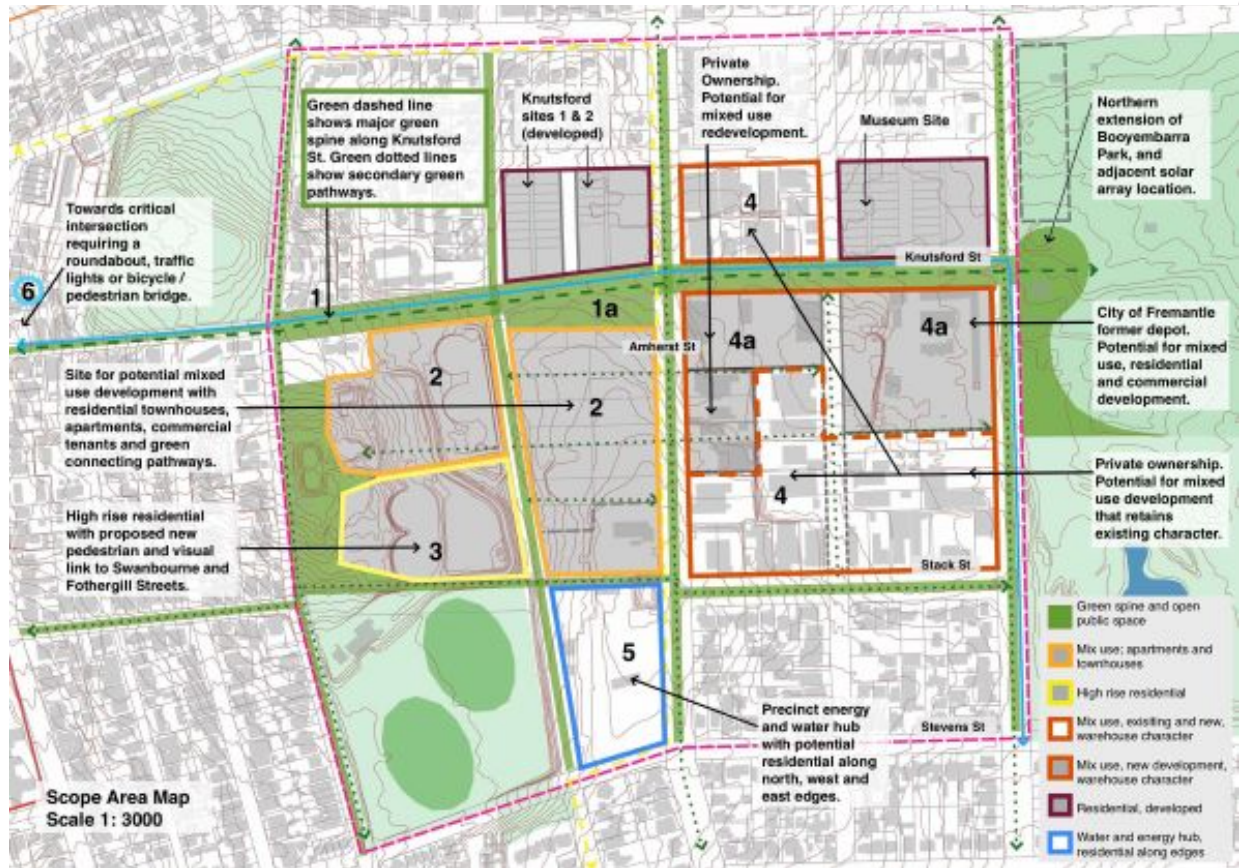
There was a significant degree of agreement between the design teams about the strategies to be adopted in Knutsford. This agreement was shared across participants, by researchers and government and industry representatives. Conceptual design sketches and a synthesis of these are shown in Appendix 4. This was followed by a review / reporting on the designs and an integration of the designs by each group of the other's work. A synthesis of those ideas are presented in Figure 2 – Workshop synthesis diagram.

A summary of the key outputs of the workshop in terms of the significant number of the planning, design and technological initiatives identified for Knutsford is presented below in Box 1. These relate to the potential

for implementation of known and tested ideas, rather than original research. Appendix 5 tabulates the issues and opportunities that were drawn from the documented workshop process. One of the key core topics to emerge from the workshop and subsequent discussion related to the question of how to make things happen, which leads to the question of governance. This topic is discussed in Section 5.

Building on the workshop themes an investigation into a range of built forms accommodating the different stylistic, economic, social and energy and water requirements of different parts of Knutsford are discussed in Appendix 6.

Figure 2 Workshop synthesis diagram.



BOX 1 – Key Outputs from the Workshop

OVERALL AMBITION

To deliver a mixed-use medium density precinct of world class sustainable renewal that builds on the existing unique economic, cultural and physical character of the area.

PROPOSALS from different tables grouped under subject headings.

WATER

- Working with the aspiration of a world class green liveable environment, determine the feasibility/viability of stormwater/rainwater harvesting versus other options.
- Aim for precinct-wide 100% recycled water through a variety of means (soak wells, infiltrations, landscaping, grey water systems, etc).
- Determine the precinct boundaries needed for viability.
- Understand the volume of waste water availability and the staging of its collection and supply over time.
- Storm water collection and distribution systems should use the site topography and gravity.
- Determine the business model behind using waste water, not just for treatment and irrigation but understanding its value to the overall project
- Determine the optimal governance arrangements, including private vs public ownership of water, for community rainwater/stormwater harvesting -.
- Use the water balance/mass balance tool to assist with answers on options.

ENERGY

- Determine whether the retailer can be eliminated.
- Explore the workings of distributed ledgers and their practicality for embedding networks and peer-to-peer trading
- Establish a business model for peer-to-peer trading.

HOUSING TYPOLOGIES / BUILT FORM / IDENTITY

- Housing typologies to be developed to provide:
 - a distinctive identity for the precinct
 - increased density relative to existing Knutsford development
 - a diversity of living options and occupants.
 - integrated solutions for energy efficiency, including orientation, glazing, integrated batteries.
 - integrated solutions for water efficiency, including grey water recycling, green roofs, rain water tanks.
- The existing built fabric provides cues for creating an identity ‘native’ to the Knutsford precinct and of developing, in response, typologies with warehouse-like flexibility for adaptation into different types of uses.
- The new typologies on sites adjacent to existing industrial and mixed-use fabric should integrate smoothly with those existing forms.

ECONOMIC AND CULTURAL

- Within the precinct there is an interesting and important set of businesses with a start-up business culture that needs to be enhanced and fostered.
- Existing industrial and mixed-use fabric should be included as a key component of the masterplan vision and be allowed to expand or contract over time.

Box 1 (continued) Key Outputs from the Workshop

UTILITIES

- Establish a centralised, precinct-scale, water and energy hub located on the current Western Power site:
 - Knutsford precinct to be a test bed for a self-sustainable neighbourhood, with support for the wider precinct to transition incrementally to self-sustainability
 - Explore the concept of the “Village Utility Model as the potential governance structure for energy and recycled water for the benefits of the whole precinct, potentially to include food waste other waste treatments
 - Test the idea of an energy and recycled water ‘Village Utility’ for the benefit of the whole precinct, potentially to include food waste and other waste treatments
 - Determine the appropriate business models (ownership, operator, phasing, scalability, staging, public versus private, community – or Public Private Community partnership. PPCP) for the energy / water hub
 - Determine the viability of retrofitting the surrounding residential areas
 - Determine the spatial implications, the physical requirements and necessary buffers for an alternative energy village model
- Explore the feasibility of a common utility trench along Knutsford St (and, potentially, elsewhere in the precinct):
 - Seek cooperation of utility providers
 - Determine trench size and degree of access required
 - Determine appropriate ownership, with single ownership favoured
- Explore the potential of district heating and cooling and the pneumatic collection of waste:
 - Determine the load profiles
 - Determine the appropriate business model
- Determine the ‘sweet spot’ for the number of dwellings/population and the ratio of mixed use vs residential for the precinct to be self-sustainable
- Determine which services should be precinct-centralised, and which decentralised. For example, storm water treatment and food waste recycling may be more viable as centralised (i.e. one treatment plant to service the whole precinct), but grey water systems might work better on individual sites.

PRECINCT PLANNING

- Establish a green spine along Knutsford Street as a clear physical identity for the sustainable precinct, for connecting existing green amenities, and for pedestrian and cycling connection to the Fremantle city centre
 - The narrowed street to align with a new linear park within its 30-metre-wide reserve. The park to provide a continuous tree canopy with a variety of community-focused uses at ground level along the length of the green spine
 - Utilise the green spine for storm water collection and storage along its length
 - Terminate the Knutsford Street green spine in new parkland, a narrow northern extension of Booyeembara Park along Montreal Street.
 - Extend the green spine to Amherst St and the extended Chalmers Street, increasing walkability, decreasing heat island effect and increasing rain water retention
- Encourage the provision of additional green public space, by widening the green spine along Knutsford Street for the block between Chalmers and Amhurst streets, and in the central parts of development blocks.
- Establish better public transport for the precinct
 - Extend the CAT bus route to loop through the precinct
 - Support development of the trackless tram
 - Explore incentives to reduce individual car ownership
- Explore the commercial potential of coordinated food production and roof farming in the precinct.
- Encourage retention and development of existing non-residential activities in the precinct.

4. The Next Steps

Historic planning and development work, and the output from the Workshop, has delivered a broad and comprehensive understanding of “*WHAT* should happen at Knutsford?” The overarching question that emerged from the workshop and in follow on discussion undertaken by researchers from Curtin University and The University of Western Australia, was “*HOW* can this ‘WHAT’ be facilitated?”

These considerations drew on the output of the workshop, the CRCLCL’s community engagement process, the CRCWSC’s infill typology work, and other research; and is presented below as a series of issues that need to be resolved followed by a discussion of the key research themes and description of research priorities.

4.1 Knutsford and Urban Regeneration Issues in Western Australia

Historically, delivery of sustainable energy and water systems for residential developments has been focused on finding economically viable solutions for stand-alone business-as-usual projects. The Workshop found that there was no substantive technical barrier to the implementation of energy and water systems at a precinct scale. The focus was strongly on taking what has been learned from the existing CRCs and related research, building the linkages between them, and thereby increasing their effectiveness.

In Western Australia, the use of energy and water innovations at scale has almost exclusively been on sites with a single owner/manager guiding the development. Moving into a setting like Knutsford, with multiple land-owners, long established uses, and a specific local character and identity, requires a very different approach. This is further compounded by a number of issues:

- Each site is different and requires its own unique combination of factors to produce a sustainable and resilient urbanism. The most economically efficient delivery model of the existing planning and development industry is optimised for a roll out of standard subdivision and typical housing product. This model does not presently deliver leading edge characteristics of a sustainable and resilient urbanism.
- Development direction for areas that are complex and will evolve over time, like Knutsford, require a clearly understood narrative that explains the

vision and an agreed development framework to operationalize this vision.

- For the most part, the WA development industry is based on conventional planning and business-as-usual delivery mechanisms. This is compounded by the WA development system based on the desire for the orderly allocation of land, particularly of greenfield sites. These mechanisms are not adequate to deliver a sustainable and regenerative urbanism in complex, mixed-use brownfield sites.
- To meet precinct-wide sustainability objectives, the traditional site-by-site, compliance-based development framework is too small in scale, and contains no imperatives to encourage organisation of trade-offs and synergies across a precinct.
- The typical processes of re-development often lead to gentrification which can erode the local cultural and economic fabric of places, such as Knutsford, which have a strong and unique local character and identity.
- Finding a built form design and development approach that strengthens the unique physical attributes, built character and economic activities will be key to the Knutsford area’s success.
- The residential ‘market’ is cautious about unusual design products and living amongst other uses which may be perceived as nuisance.
- The purveyors of the business and cultural activity which give the area character are not generally well equipped to undertake redevelopment. In other words, the people with the ideas are often not the ones with the money to make things happen.
- Matching the people with the ideas with development ‘mentors’ and/or investors could make a difference.
- When precinct scale development projects move into the “cross” arena¹⁵ the traditional decision-making structures e.g. local government, and legislative frameworks and regulatory roles, are not designed to provide negotiation and brokerage to organise sustainable and resilient outcomes. Other mechanisms or structure may be needed to assist in this.
- The commonly used and accepted development governance and financial models tend to be orientated towards single developments. There are few that are applicable to regulate and fund precinct wide developments with multiple land owners.

¹⁵ Requiring that the project crosses boundaries, tenures, agencies, owners, typologies, technologies, cultures etc.

- New skills are needed to broker engagement between those who can significantly influence the direction and delivery of the development (agents¹⁶) across a precinct, and those with an interest in the area (stakeholders), in order to work collaboratively over sufficiently long time frames to deliver the desired sustainable urbanism outcomes.
- There will be an ongoing challenge to go beyond a BAU approach as often, when part of the development process advocates for BAU, the potential for sustainable outcomes is considerably reduced.
- To achieve a built form outcome that is more innovative in terms of flexibility of land uses and builds on the character of the area will require leadership and facilitation. There is a risk that standard development models could erode the character and vision.
- Rather than site-by-site planning, complex development projects, like Knutsford, would benefit from more long-term proactive design and management structures which support the vision of the precinct as a whole.
- This development process needs to respond to a detailed and comprehensive narrative that recognises history and context.
- It is worth looking abroad for the many examples of similar types of projects from which to draw inspiration. One example is De Ceugel – a recent redevelopment in Amsterdam which is a ‘cultural urban hub on the cutting edge of technology, sustainability and art which seeks to be a symbol of the social transition to a contemporary circular lifestyle.’ – shown in Figure 3 below. Equally there is much to be gained from engaging with groups like Eco districts who have been developing a protocol as a comprehensive framework to guide urban and community development from planning to implementation. (see <https://ecodistricts.org/>)

4.2 Future Directions at Knutsford

From a design and technology perspective, we have all the pieces of the jigsaw puzzle. The challenge now is to bring them together to make them bigger than the sum of their parts. There is no single correct approach to produce a sustainable and resilient urbanism: it is about optimisation, better coordination and the capacity of each project within the precinct to evolve to meet a broad suite of targets over time.

Decisions will need to evolve over 10 to 20-years and, full redevelopment could be more than a generation away. In this context, the existing planning frameworks and decision-making structures may prove inadequate for the task. A pervasive narrative that articulates the vision of the area, is understood by the people who live there, and informs and guides the development direction is needed to support redevelopment. The engagement processes under way with citizens and businesses have begun to lay the foundation for this vision and narrative.

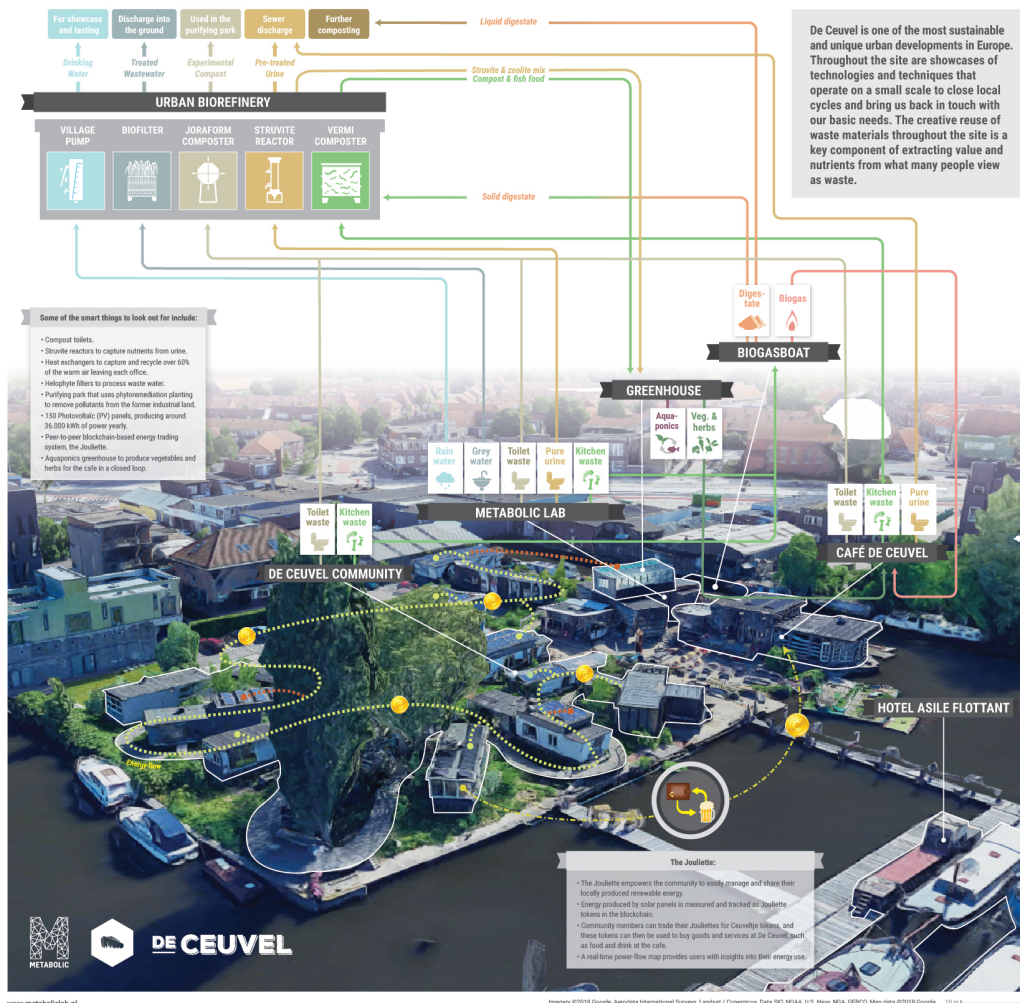
In response to this some key issues need to be addressed:

- There is a need for industry wide recognition that sustainable and resilient urbanism is far more than the deployment of green technology into business-as-usual developments. It extends into precinct and residential design, economic, cultural, greening and other arenas.

¹⁶ Using the term *agent* or *agency* in this context implies intentional actions in certain contexts to produce outcomes in the real world. There is no connection with real estate agents.

For more discussion of agent and agency see <https://plato.stanford.edu/entries/agency/>

Figure 3 De Ceuvel – Amsterdam – an example of similar aspirational sustainability focused development (Source: <https://deceuvel.nl/en/about/sustainable-technology/> sourced January 2019 - Graphic produced by Metabolic for Amsterdam Museum - Permission provided)



The primary focus of the narrative about the regeneration area needs to move from the usual focus on yield to what the people who will live and work in the area want and need.

- Better tools and methodologies are needed to optimise the mix of factors needed to be considered and deployed to produce a sustainable urbanism.
- All sustainable and resilient urban development projects will have strategic integrating actions or projects, for example energy and water infrastructure, that are catalytic and can take the development of an area to a new level. Identifying and supporting these projects is essential. Similarly, the development industry often needs guidance to explore new, and more appropriate built form in conjunction with future businesses and residents to overcome the

business-as-usual approach of “see what works elsewhere and tweak it a bit”.

- Iterative, design-based approaches, and supporting governance and financial structures, need to lead the development process with planning providing a supporting and statutory role.
- New financing models are needed that can support inexperienced developers and the timeframes needed to deploy sustainable initiatives and avoid the drive for a quick return on investment followed by an exit from the market.
- New structures are needed to engage and empower local communities to do the heavy lifting to create long term sustainable and resilient urban developments.

- The combination of development and community empowerment needs to be guided by responsive design and governance processes which respond to a strong vision with a guiding narrative that is continually being refined and developed as development takes place and new activities and character traits emerge.
- These governance structures or mechanisms will need representation from a range of agents and stakeholders in different combinations depending on the issue at hand. Their fundamental roles might include:
 - The custodians and developers of the Vision and guiding narrative.
 - Set metricated sustainability performance targets within an agreed framework¹⁷.
 - Organise and broker actions to deliver outcomes across sites and between developers and landowners.
 - Organise and broker actions to meet the targets
 - Facilitate 'harmony' between residents and business activities¹.
 - Fill the gaps between the citizens' aspirations and what Local and State Government are able to deliver.

4.3 Themes and Research Priorities

Based on the above, three crucial themes and associated research priorities emerged from these investigations, and are discussed below.

Theme 1: Detailing the Vision – What might “a world-class exemplar of sustainable and resilient urbanism” look like? Knutsford is a generational project. Its ambition and complexity requires a high level of integration, over time, of continually changing technologies, cultures, social and economic patterns.

Meeting this challenge is beyond the scope of conventional planning and business-as-usual development. An overarching Vision with a supporting narrative is needed, one that provides a conceptual and value driven armature for the development. For its success this vision needs buy-in and ownership by people associated with Knutsford, and the capacity to inspire and inform different scales and types of development.

Theme 2: Governance – operationalizing the Vision, factors to be considered include:

- Establishing representative groups to enable the development and broker relationships within the precinct.
- Developing the overarching vision and narrative
- Develop terms of reference for the various enabling groups.
- Selecting and implementing a guiding development sustainability framework such as One Planet Living as used by the City of Fremantle.
- Developing and facilitating the appropriate administrative and business models to facilitate development across the precinct.

Theme 3: Catalytic Projects – projects that can be implemented now to pave-the-way, establish qualitative standards, and support future developments within Knutsford, including:

- Built form exemplars appropriate to different uses including industrial uses and parts of the precinct.
- Sustainable Energy and Water infrastructure rolled out across the whole precinct particularly focusing on energy and water processing integrated into the built form.
- Multi-function green spines along transit and access routes.
- Multi-modal transit links, including CAT busses and Trackless Tram, to central Fremantle that service urban densification projects (See Appendix 7).

Research Themes

Research Priority 1: Narrative driven design and development – Build on the work from the CRCLCL's community engagement process and continue working with the agents¹⁸ and stakeholders¹⁹ to further identify and strengthen the Knutsford Vision and narrative and link it to the development process and to performance targets. Document and review the evolution of this process.

Research Priority 2: Trade-off mechanisms – the next phase of research involves further development of trade-off mechanisms for precinct wide, metricated, sustainability performance targets. An administrative framework is necessary to broker trade-offs and

¹⁷ For example One Planet Living

¹⁸ “agent” is a person or organization that can bring about change

¹⁹ “stakeholder” is a person who has an interest in an area but is unlikely to be able to create change

synergies between individual developments to meet these targets. Develop and document the processes and methodologies required to ensure each individual development contributes to and benefits from this process in a transparent manner.

- Identifying and recommending how to remove regulatory barriers.

Research Priority 3: Precinct Development and Management Structure – identify the most appropriate groups to enable the long-term development and management of Knutsford and specifically:

- Adopt and implement a sustainability development framework such as One Planet Living
- Select metricated sustainability design and reporting targets
- Identify administrative and business systems needed to roll out the various initiatives
- Develop goals and terms of reference for the various groups
- Advise, document and review the evolution of this process.

Research Priority 4: Building typologies - Develop exemplars and pilot projects of building typologies that:

- Explore a suite of potential built form typologies and dwelling types that might occur in the different regeneration / re-development areas across the precinct, include typologies which could accommodate light industrial and creative uses (not just commercial and residential) typologies. Knutsford, as a whole, provides a matrix of locations, characteristics and uses, each requiring its own exemplars of sustainable built form outcomes, while also reinforcing the identified Knutsford character (see images of examples of possible design ideas)
- Use the existing warehouse typology as a reference point and blend warehouse and residential use typologies to provide transitions / buffers between the core warehouse area and the new residential areas. Explore these typologies to a level of detail that enables costing to +/- 20% accuracy.

Research Priority 5: Integrated energy and water systems – Undertake simultaneous research to design integrated energy and water systems and supporting administrative and financial framework, including:

- Using the sustainability and resilience targets developed to guide the design and deployment of precinct scale energy and water solutions
- Selecting the most appropriate governance structure and business models for this process using the Management Oversight group described above



Image 1. Award winning apartment tower showing integration of vertical green spaces into a high-density development - Bosco Verticale, Milan, Italy, photo supplied with permission from Stefano Boeri Architetti.



Image 2. Integration of new builds into existing repurposing of warehouses with ample supply of public spaces - Swan Market, Oakland California, USA. Photo supplied with permission from Michael Pyatok.



Image 3. The opportunities for repurposing warehouses is unlimited – this warehouse has become a film studio and performance space. Oficina Theater, San Palo, Brazil. Photo supplied with permission Nelson Kon fotografias.



Image 4. Fine furniture manufacturing factory built within repurposed parts from other warehouses is the heart of the Piet Hein Eek space, Eindhoven, Netherlands. It is a mix of laboratory, workshop, showroom, shop and restaurant within a urban renewal project. Photo supplied with permission Piet Hein Eek Architectuur.

APPENDIX 1 - ATTENDEE LIST

- Anna Evangelisti: (anna.evangelisti@landcorp.com.au)
- Brad Pettitt (MAYOR@fremantle.wa.gov.au)
- Daniel Martin (daniel.martin@uwa.edu.au)
- David Galloway (david@ferart.com) (Facilitator)
- Gaye Mackenzie (gaye_mackenzie@icloud.com)
- Geoffrey London (geoffrey.london@uwa.edu.au)
- Greg Ryan (Greg.Ryan@landcorp.com.au)
- Jonathon Small (jsmall@tabec.com.au)
- Josh Byrne (josh@joshbyrne.com.au)
- Lio Herber (lio.hebert@postgrad.curtin.edu.au)
- Marguerite Renouf (m.renouf@uq.edu.au)
- Matt Rule (matt@balgroup.com.au)
- Matt Stack (Matt.Stack@planning.wa.gov.au)
- McCredie, Jane (Jane.McCredie@dplh.wa.gov.au)
- Michael Patroni (patroni@spaceagency.com.au)
- Mike Mouritz (mike.mouritz@curtin.edu.au)
- Nadine Riethmuller (Nadine.Riethmuller@watercorporation.com.au)
- Naomi Lawrance (Naomi.Lawrance@landcorp.com.au)
- Nigel Bertram (nigel.bertram@monash.edu)
- Owen Hoar (Owen.hoar@hotmail.com)
- Peter Howard (peter.howard@watercorporation.com.au)
- Phillida Rodic (PHILLIDAR@fremantle.wa.gov.au)
- Phillip Cook (phillipc@fremantle.wa.gov.au)
- Roberta Fotnarelli (roberta.fornarelli@curtin.edu.au)
- Shelley Shepherd (shelley@urbaqua.org.au)
- Sue Martins (Susanne.MARTINS@communities.wa.gov.au)
- Tatjana Todorovic (tatjana.todorovic@uwa.edu.au)

APPENDIX 2 - ONE PLANET LIVING TARGETS

The workshop developed targets that would set the framework for the design thinking process. As this workshop was primarily linked to the CRCs for LCL and WSC only some of the ten One Planet Principles were investigated, specifically *Sustainable Water*, *Zero Carbon Energy* and *Culture and Community*. Inevitably as the workshop investigated integrative and cross-boundary issues, discussion broadened into *Land and Nature*, and *Travel and Transport*.

Some observations can be made about the response of participants to the challenge of developing targets:

- As has been stated earlier one of the major themes that emerged during the workshop was that the bigger challenges were now with integration and leadership rather than just the development of specific technological solutions. Having specific, precinct wide targets and an appropriate brokering framework would assist all participants work together to meet these targets.
- Participants oscillated between wanting to develop targets that were good for the citizens / biosphere, and what was technically/economically feasible in the Knutsford context
- The knowledge about KPI's etc. was fairly well siloed i.e. people knew about their area of speciality but did not have a good understanding of areas outside their speciality
- Participants found it difficult to assign a specific indicator (metric) to a KPI
- The One Planet framework is a good basis for future discussion about Targets and should be used to drive the design process not as a BAU compliance framework.

KPI's, Indicators and Targets that were identified are presented below

Sustainable Water

OPERATIONAL TARGET

80% reduction in mains water use << *not sure about this c.f. comments below*

OR

80% of water used in the precinct is recycled

20% of water used in the precinct is introduced from outside system

Of this 20% of water introduced from outside the system ?% is from rain / stormwater harvested

Precinct developments are designed so that water collection systems and distribution systems get the use of the topography and gravity

STRETCH TARGET

100% water recycled across a range of processing options e.g. soak wells, infiltrations, landscaping, grey water systems, etc.)

Zero liquid discharge

Zero Carbon Energy

OPERATIONAL TARGET

50% OR 80% less than BAU - energy

Apply energy targets on buildings / 7.5 NatHERS rating / 30% EV penetration

Make sure water related energy use is accounted / optimised in energy equations << *not sure about this*

STRETCH TARGET

Net positive carbon energy

Community and Culture

OPERATIONAL TARGET

Increase the area devoted to the public realm to >20%. Traditionally the public realm has been equated to POS, however this needs to be redefined into the proportion and density of a range of public realm uses across commercial, residential, parks etc. This need to be understood better, and appropriately 'measured', in order to build social and cultural capital not to, for example 'sterilise' areas with unused degraded POS spaces

Diversity of housing types, occupancy rate and use

Number of people involved in the warehouse group, in business networks etc.

Success of public / private partnerships << *not sure what this meant*

Number of Community events

Level of involvement in green link

The statements below were taken from the notes, and should probably be interpreted as statements of intent

- Make the place really desirable – support a type of market niche – about alternative / life blood,
- Extend the time frame of the delivery / ambition

Land and Nature

OPERATIONAL TARGET

30% of tree canopy

Connection and effective use of existing green amenities (golf course, Booyeembara park, reserves and so on); these spaces to effectively service wider precinct.

STRETCH TARGET

None identified

Travel & transport

OPERATIONAL TARGET

Proportion of the precinct easily accessible by walking

Enable cycling from/to and on the site

Cat bus - evolve to Trackless Tram ASAP

OR

Cat bus by 2020

STRETCH TARGET

Personal car ownership – to zero

APPENDIX 3 SUSTAINABLE AND RESILIENT URBAN DESIGN PRINCIPLES

During the morning session, a number of design approaches or principles were introduced. Workshop participants were encouraged to use these to frame the development of their project and research ideas.

One Planet Living

The One Planet Living is a design framework with the objective that developments should support people having better life within a fair share of the earth's resources. It also has the implicit interest in repairing and regenerating past ecological and social damage; which has strong synergies with moving from sustainability into resilience and regeneration.

While the One Planet Living concept is aspiration ally easy, in reality, it is significantly different to how most sectors of the development industry operate. It requires thinking about project development and delivery across ten sustainability principles and using a process of continuous improvement to build sustainable and resilient community.

Operationalizing the One Planet Living framework forces cross-sectorial thinking, however the quality of the output is potentially much higher than using ad-hoc approaches often used by the development industry to introduce eco-technology.

Recognise context – the need for bespoke solutions

Locations vary significantly and attempts to roll out familiar pre-existing solutions can compromise the quality of the final output. This points to the need for bespoke solutions to produce sustainable / regenerative urbanism however, in practice, this has rarely been achieved. Similarly, each context has attributes that can be co-opted into producing cost effective solutions that may not be seen in BAU design processes.

The Workshop endorsed the design of a built form that supports and strengthens the unique physical attributes, built character and economic activities of an area such as Knutsford.

Multiple Boundaries

In the BAU development process the boundary of the urban development is usually defined by ownership or planning status. In sustainable / regenerative urbanism boundaries can be multiple, thematically driven, fuzzy, overlapping and scale dependent.

Complex Projects

Urban regeneration projects are typically complex and messy. There is often no simple starting point. A useful approach is to accept that complex projects work in the "cross arena", that is across boundaries, tenures, technological platforms, values, cultures etc., and with the attendant need to accommodate different development objectives and timeframes. This presents the challenge of allocating responsibility for the "heavy lifting" required to achieve the aspirations of sustainable / resilient urbanism.

As a guiding principle, at a precinct scale, new forms of governance structures and business models are needed to achieve this heaving lifting. These structures need to be inclusive of the different actors, be welded together by a strongly shared narrative, have a limited level of command and control capability matched with a flexibility and capacity to adapt and evolve while avoiding bureaucratic rigidity.

Establishing Meaningful Targets

Having targets can help drive sustainable / regenerative urbanism. There are, however, examples where targets have stifled development because they are too inflexible when applied to specific developments. At a precinct scale sustainable / regenerative development could begin to utilise the “bubble” concept that has been operating in pollution control since the 1970’s. In this approach the whole development area is seen as being in a “bubble” with transfers of energy and materials across the boundary.

Targets (or KPI’s) can be assigned to performance outcomes within and across this boundary, and allow “horse trading” between the various developments to maximise the efficiency of delivery of sustainable / resilient urbanism.

Balance effort with results - Return on Investment

When considering precinct wide sustainability proposals there can be the risk that a dominant engineering and planning paradigm will only see technological solutions as a viable way forward. In reality, delivering sustainable and resilient outcomes relies on a blend of conceptualisation, design, technology, build, behaviour change, management and enterprise responses. Consequently, the selection and deployment of technology has to be compared with the cost and benefits of non-technological alternatives that meet the same objectives.

APPENDIX 4 - CONCEPTUAL DESIGN SKETCHES FROM WORKING GROUPS

During the working group process each group was asked to take what they already knew, and what they had learned from the morning briefing, and develop a concepts for what could occur at Knutsford.

The outputs are shown below.

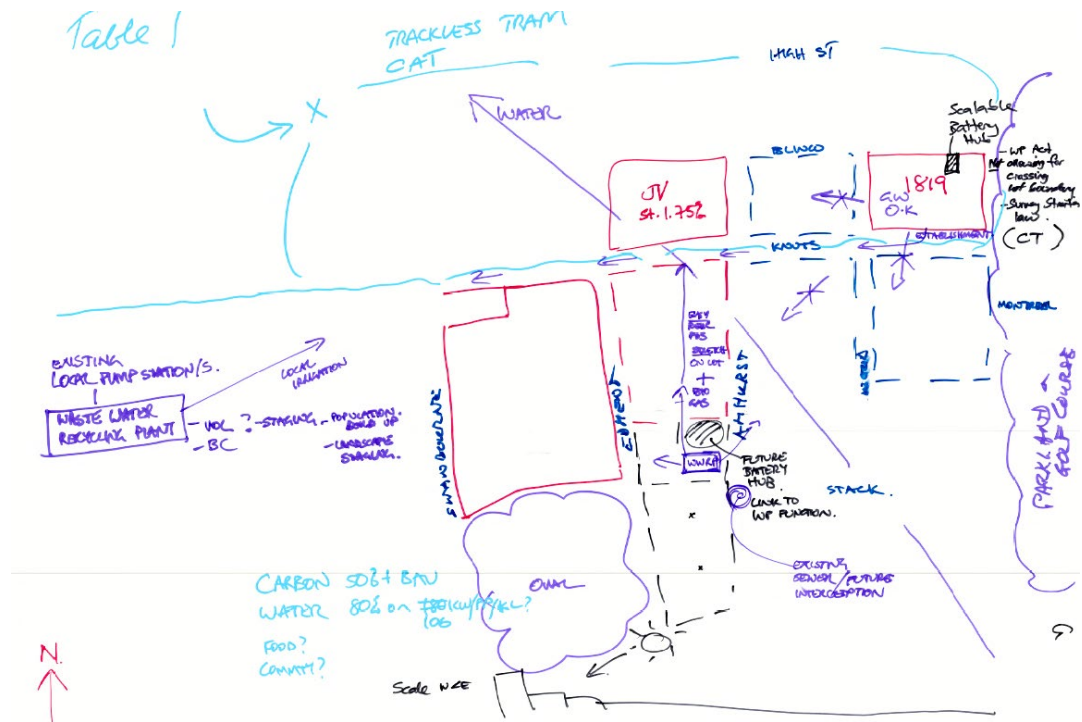
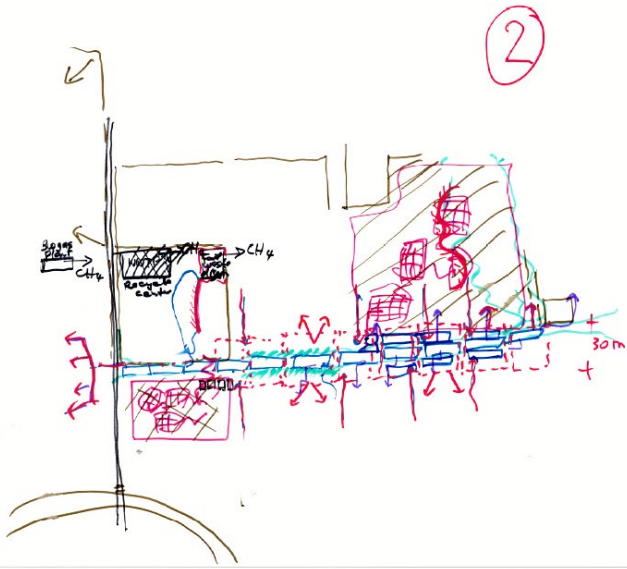


Table 1



rainwater collect. & storage - centralised for precinct green zone?
 electric - each lot -> Modular integrated in linear park
 to service public spaces, commercial private??
 food waste - centralised } from depo site?

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Table 2

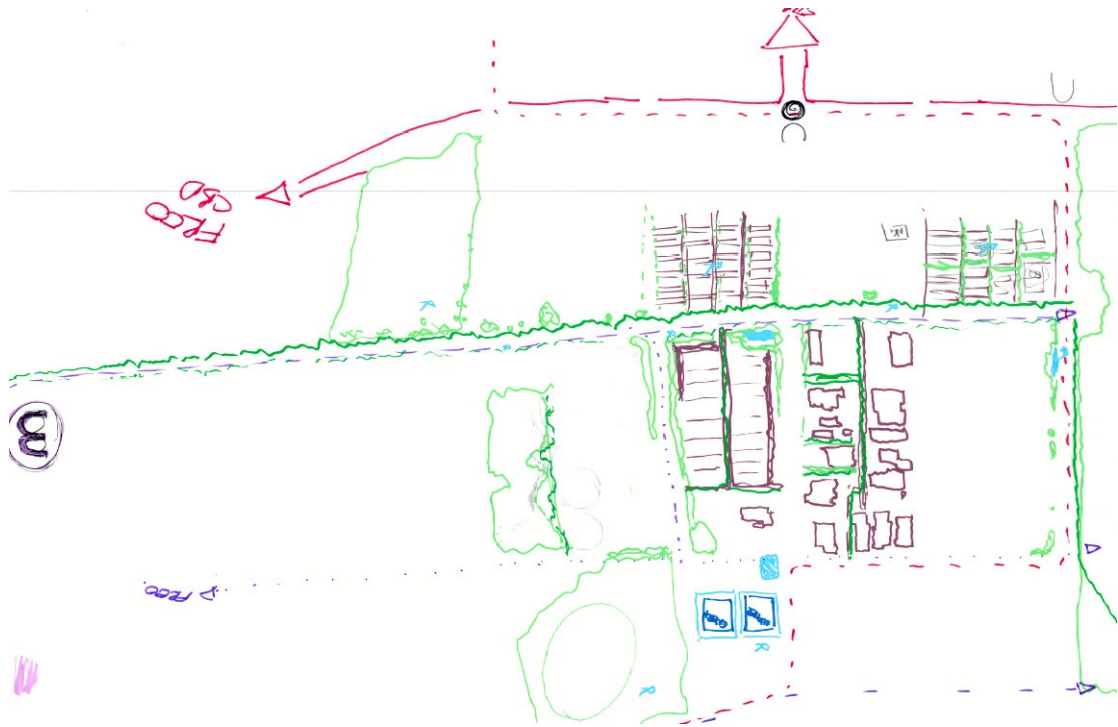


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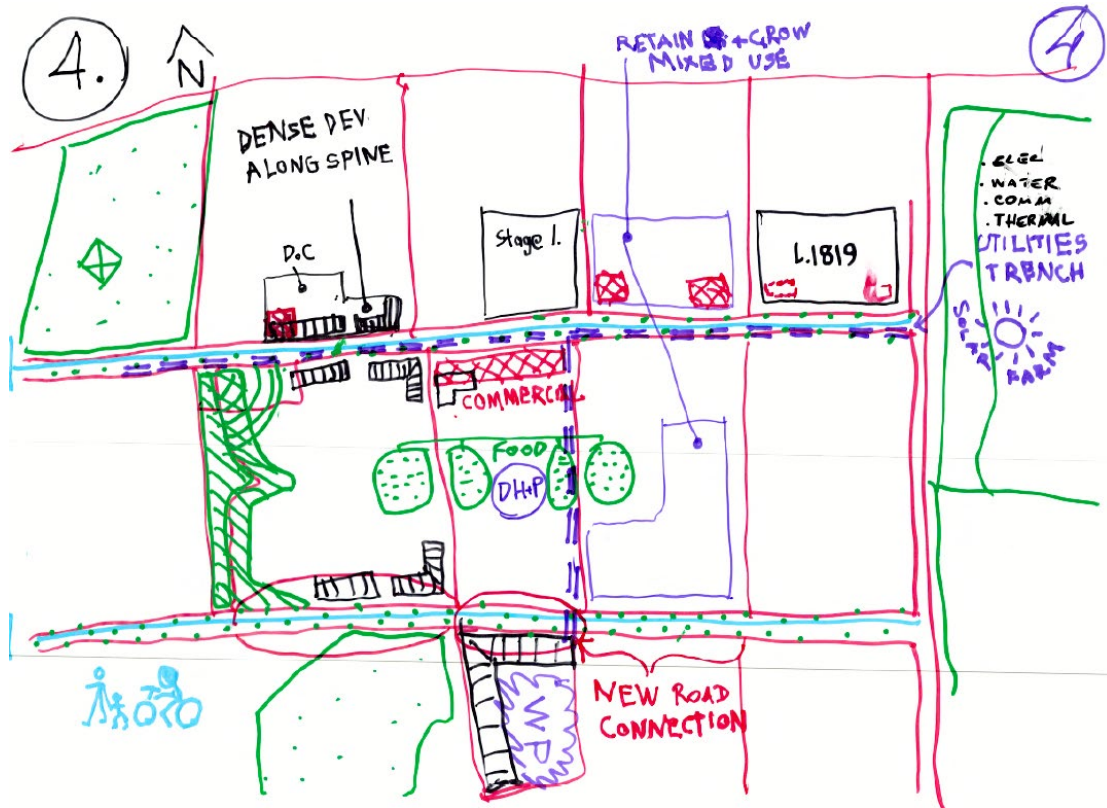


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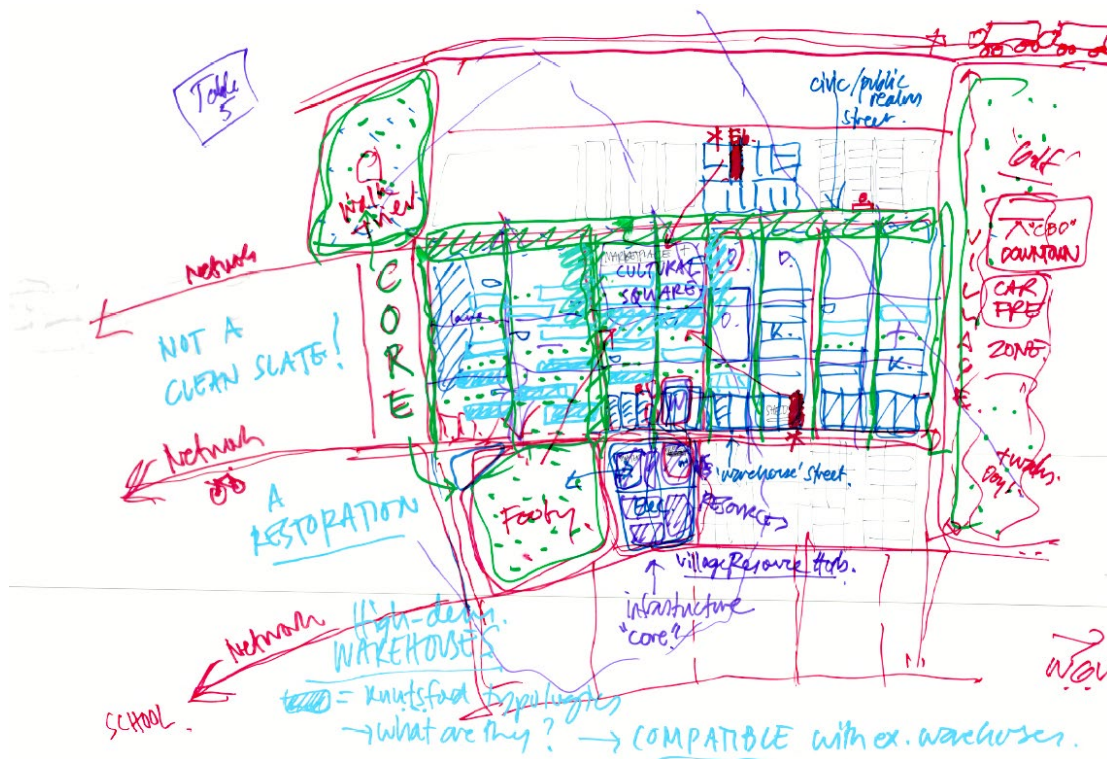


Table 5

APPENDIX 5 - IDEAS AND ISSUES – WHAT NEEDS TO BE ADDRESSED TO DEVELOP KNUTSFORD

The Issues and Ideas that emerged from the CRC Academic and Industry Workshop's groups' individual design processes are summarised below.

Subsequent to the individual group work, the workshop participants did a combined peer review process of each group's work. Discussion from this review process extended many of the ideas generated from the individual groups, these are also listed below.

Emerging Issues and Ideas	Extension of the ideas
<i>How to create the Vision</i>	
The City wants to see Knutsford as a world class example of sustainable and resilient urbanism (Mayor)	How do we support the vision of what this place is going to be and make it work over a 20-30 year time frame?
There is a mandate from the citizens to do something amazing in the area	
This workshop has been good for opening up the vision of what could happen	This needs to be extended into another similar design exercise including citizens and developers
Who is going to maintain the story of what this place is about?	Ideally the citizens should hold the narrative
Why weren't the citizens or developers included in this workshop?	This needs to be extended into another similar design exercise for citizens and developers
How do we start thinking at a precinct scale and not constrain ourselves trying to work out how to do things site by site	
Who is going to do the brokering between all the different parties to try and work out the deals that will make this all happen	
How do we work out the "sweet spot" that maximises the sustainable / resilient urban outcomes with the financial cost?	
This place needs some kind of village council to "run the show"	What is the optimal kind of governance arrangements for making these concepts work?
How is all this going to be financed –what are the financial models to make this work?	
We need a good inventory of the policy barriers that these ideas throw up and strategies to manage these barriers.	
Is there a role for "Infrastructure WA"?	What is the potential for the citizens and Local Government to set up their own investment fund?
What is the potential for modular / staged development.	
How do we determine when we are "world class"?	
<i>The Existing Real Estate Market</i>	
We are working in a flat real estate market (2018), developers want to build single residential because that gives the best return at the moment.	
New apartment developments are designed to respond to current BAU market data.	How do we avoid designing single use suburbs OR how do we design a suburb/development such that there is a flexibility in building typologies that easily accommodates changing demographics
Most development and design decisions are made based on ROI as the primary criteria	Ideally development and design decisions are made around what is good for the humans who will live there and the biosphere
Developers want to do developments that give a return within 3 – 5 years	Can something like a community title be used to build a funding base / fee structure for allocation of developer contributions to precinct scale initiatives
New housing is unaffordable for typical Knutsford residents	
Current development designs homogenises the market into the upper end of the socio-economic demographic	
<i>Why do more than BAU?</i>	
Does any of this stuff (technology and building typologies) that is being discussed consider who is	

going to live in the housing or what is good for these people	
While BAU is working financially, there is a moral reason for taking the sustainable and resilient path.	From other experience it appears that all the sustainable and resilience innovation makes urban developments more attractive and better places to live.
There is a strong perception in the development industry that taking the sustainable and resilient path is more expensive and more difficult to do.	If you have a good enough and compelling story about the built form and the neighbourhood – you can sell it
Looking at the total carbon and water footprint (including food, supply chain for good etc.) brings a real sense of perspective	
The biggest challenge is how to do the staging of development to integrate the delivery of all the things being talked about.	There are regulatory barriers to integrated development, but we don't have a good understanding of what they are
What is the business model to incrementally stage development so that it supports doing meeting the City and citizens mandate?	There is no available methodology for balancing /comparing the attributes investment in one form of sustainability / resilience strategy over another
<i>Planning</i>	
How do we adapt the planning framework to support coordinated precinct scale development particularly as if we are going to do sustainable resilient urbanism we need more than orderly allocation of land	
Knutsford needs a town centre	
How does this development link to schools, ovals, green spaces etc.	
There is a need for a new road through the Western Power site to build the grid layout of Knutsford	
How do we ensure that the developments in Knutsford bring benefits to surrounding neighbourhoods	
What is the role of the City of Fremantle to shape incremental development?	
Two basic planning schemes are in place, but these are orientated towards orderly development of land within a BAU framework	The current combination of structure plans, building typologies, BAU water and energy supports incremental development of the area, but this development will only be industry standard / BAU / incremental improvement and probably wont meet the City or citizens' mandate
Current planning schemes and processes are unlikely to be adequate to support the community and the aspirations expressed in the workshop	
Currently there are multiple land parcels with multiple owners (20 – 100)	In the future as subdivisions occur there will be a greatly increased number of land parcels and owners. This will impact on how decisions can be made
Each of the lots have a different development time frame there is no way currently available to ensure orderly development such that the sustainability / resilience agenda can be built into the new developments	Is there a way to roll out the intent of the concept of community title across the whole of Knutsford
Strata title is a good way for managing cross issues on one site	Community title will probably enable of cross issues development over a number of sites but still within one land package that is owned by one agent
<i>Knutsford Style and Feel</i>	
We need to door knock everybody who is living there so we can understand what they want to see Knutsford become, this has to be mirrored by what they are willing to contribute	
The underlying question about built form is a tension between gentrification and economic viability of development vs. the character of the locality	
How do we design for the people who are going to live there including people who live there vs. people who work there, how to cater to diverse demographics in terms of age, gender, income, mixture socio economic and cultural background etc.	
New housing is gentrifying the area	Strong support to preserve, enhance and expand the warehouse culture
Most design decisions are based on short time frames	We need some form of precinct development fund that buffers the wider real estate market
Some empty lots owned by LandCorp. One lot owned by the city	What in the framework that will guide the decisions about the initiatives and actions to support the common good of the precinct

<i>Built Form</i>	
Current development typified by large of development "chunks" based on lots	In the future development will be characterised by small, fine scale incremental development
The warehouse is the basic unit of built form typology> How do we use this as the starting point for future design and development?	Expansion of warehouse use and typology into new developments, use hybrid building form as transitions
Currently the built form is defined by a collection of warehouses in different conditions	Warehouses need to be kept in operation but in repaired and enhanced condition. Need to look for the retention of, and increasing complexity, of warehouse uses. The Smart Warehouse is the new metaphor
Industrial character and industrial uses should prevail in the precinct	Advanced industrial uses need to be embedded in the fabric of the community
Current new apartment developments stylistically reference the warehouses	
The warehouse is the basic unit of built form typology – how do we use this as the starting point of all future development and design	
Poor quality civic infrastructure	We need to create streets and public spaces that are safe, comfortable and easy to move around.
You can link into Fremantle, its very easy – walkable in xx minutes, CAT / T Tram by 2020	
We need a diversity and flexibility of building typologies that is able to accommodate all the other sustainability initiatives (including water and energy)	
<i>Water and Energy</i>	
Site has no barriers for BAU energy and water supply and waste disposal	The package for non-BAU connection has to be compelling through lower costs, and/or its more efficient, more reliable and has less external impacts
Lots of good ideas and concepts about what could happen in the energy water and waste space, but we don't know how to do this	Specific sites in Knutsford (East Village) have good demonstrations of innovations in batteries, renewable energy and water, who decides what we do and how do we roll this out?
How do we optimise decision making around energy and water solutions at a precinct scale	
Which of these technologies can/need to be centralised within the precinct and which work better if they are distributed?	
Underground & groundwater contamination issues	How do we do the design and development of the area so that contamination issues remediated, rendered inert and/or water decontaminated
How do we apply the tools developed by the CRC (such as the water balance tool) to Knutsford?	
We can roll out good water and energy initiatives if there is one owner/manager a single development parcel	We don't know how to roll out water and energy initiatives across a whole precinct
Package energy and water processing and organise the technology and business model such that customers only have to pay for connection they don't have to pay for use	
Package energy and water processing into a single hub (on the Western Power site)	
How do we use reprocessed water /sewer mining for food production	
How do we reduce the statutory buffers around waste water treatment plants so that local processing becomes viable	
Could we do district scale heating and cooling?	What are the load profiles, what business model, can this be integrated with the water and energy utilities
The solar power (PV) is easy because it is about wires and smart systems and we know how to do this	
Basic design concept - Energy flows, Matter cycles and Gravity rules	
Are there any ways of reducing headworks costs using innovative technologies so as to lower establishment costs to get developments up and going	

Do distributed ledgers work as intended? Are they a practical way of embedding networks and peer to peer trading?	
<i>Greening</i>	
Strong support for greening link into the centre of Fremantle c.f. AUDRC (Julian Bolleter) and Green Corridor LandCorp, City of Fremantle, JBA (Josh Byrne)	Fully developed green corridors reflecting historic ecosystems. Major food production occurring in and on development areas
Reintroduce water into the landscape Put water into the green link and duplicate the links across the locality. Use the green link to treat the water	
Need to consider the existing ecosystem, is there a clear boundary between 'nature' and built environment, how to provide a link between existing parks, how to rejuvenate damaged, how to develop without damaging what is already there	
This needs more attention to how to produce food within the precinct using available water and nutrients	
What is the business model for using waste water as an irrigation source?	

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APPENDIX 6 - LAYOUT AND BUILT FORM CONSIDERATIONS

1 Purpose of this document

This appendix documents a set of principles and built form considerations that might be used to guide future refinement of built form and uses

2 Principles

2.1 *The Core*

The Core of this precinct is the cross road formed by Knutsford and Amherst Streets. There is the potential for Amherst St, down a valley between the urban areas to the east and west, to become a high street; with Knutsford Street becoming the arterial access into Fremantle.

2.2 *Uses and economic activity*

- The warehouses and their embedded economic and cultural activity is the current heart of the Knutsford area. This has an emerging identity as the *Knutsford Industrial Arts Quarter*
- This economic and cultural activity and existing *raison d'être* needs to be supported to avoid the area becoming a dormitory apartment suburb of Fremantle through conventional redevelopment.
- The fabric of the warehouse area lends itself to a combination of:
 - upgrade of existing facilities to support and strengthen current uses,
 - infill and densification with residential / unconventional as well as conventional mixed use development, and,
 - embedding arts and entertainment facilities into the heart of the area.
- The warehouse precincts will continue to be of commercial/industrial / entertainment character. Consequently, existing use rights need to be protected and codified. KSE Structure Plan allows this. Conversely residential / mixed use, with caveats and brokering behaviours that recognise existing uses, is still appropriate for the warehouse precincts.
- Residential / mixed use precincts around the warehouse precincts should be designed to provide a buffering / feathering of uses, between the purely residential areas and the warehouse precincts.
- The challenge of a blanket approach to mixed use across the whole of the Knutsford and Swanbourne St structure plan needs to be refined to focus on key facilitating opportunities commercial / retail along core areas – such as along Knutsford and along Amhurst St.

2.3 *Access*

- The intention is that the area will be highly walkable and promote cycling over other vehicle use, consequently the following principles should apply:
 - Design of access ways should be predicated on ease of walking and cycling– this is determined by topography (slope) and amenity (shade, stopping and rest points). This does not necessarily imply the shortest travel distance.
 - Access should be destination focused. That is, if a person is going to walk, they need a good reason to walk.
 - The combination of walking access, destination focus, topography and amenity will impact on the shape of residential areas.
- Vehicle access into the Knutsford area is well serviced by a grid based road system. This can be strengthened.

- Access to Fremantle is provided by Knutsford St. This access should be greatly strengthened, which may impact on the existing green corridor which was developed by work undertaken by JBA for LandCorp.
- Amherst St lies at the bottom of a valley with future urban development reaching up slope to the east and west. Amherst St may be another location for the green corridor concept, particularly given that:
 - the greatest density of population will be along the Amherst St axis rather than the Knutsford St axis
 - because of the topography there is opportunity for the greening to be integrated into a waste water management system leading to a processing hub on the Wester Power site.

2.4 *Greening*

- There are large areas of public space such as road reserves that are available for greening, particularly for Knutsford St and Amhurst St. Preliminary proposals have been developed for Knutsford Street as a core spine.
- Correspondingly there are significant park areas to the east and south.
- POS has been allocated within the Swanbourne St Structure plan area.
- Greening should focus on public access and use of green areas, irrespective of whether the ownership is public or private
- Consideration of greening should look beyond provision of green on the ground surface and extend into vertical building faces and roof top structures
- Provision of locally grown food could be a focus of the greening (concepts of vertical gardens were floated).
- Greening needs to be supported by well-developed private and community management strategies

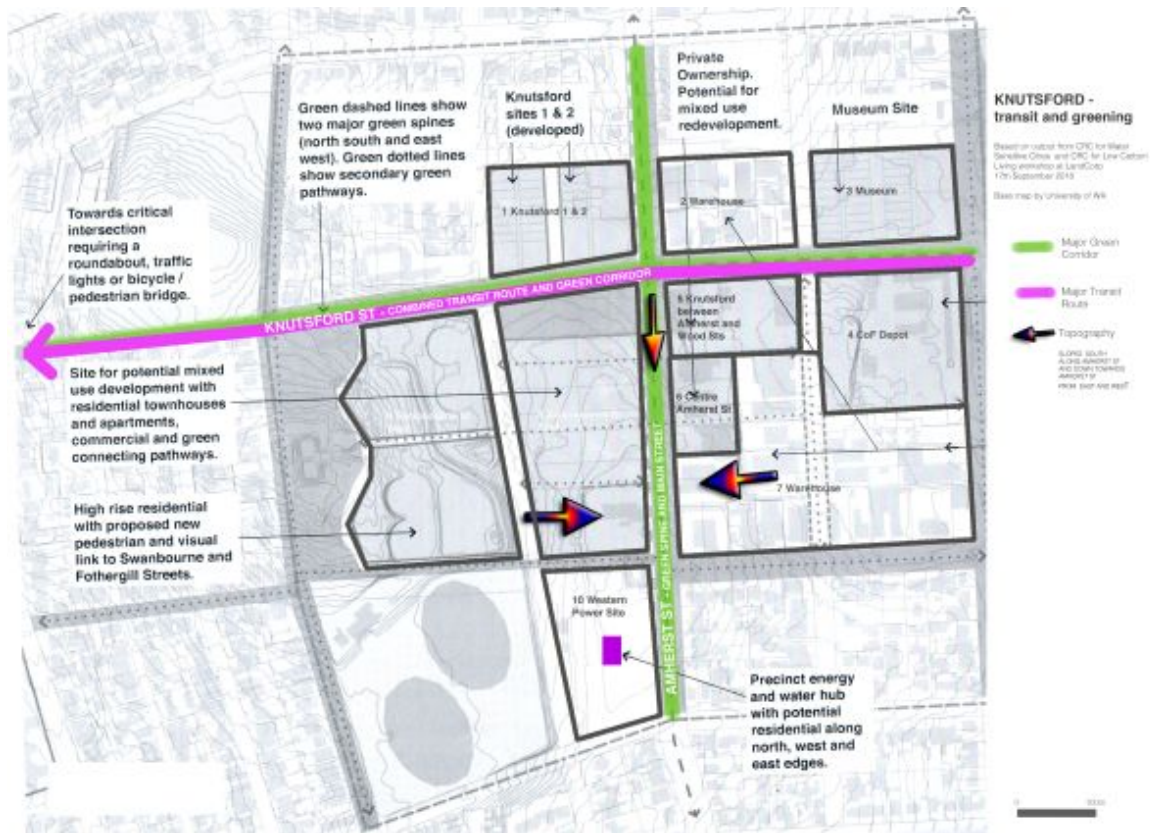
Map 1. Graphic depicting long terms use



3 Specific Sub-Precincts

A set of sub-precincts have been identified on the basis of use (existing and proposed), ownership (see draft plan). This provides a starting point for documenting insights and suggestions around a core set of possible actions and/or approaches as a starting point to guide conversations about next steps within an ongoing process of guiding and stimulating urban regeneration.

Map 2 Draft Plan with numbered sub-precincts (Note – these sub-precinct have been placed over the earlier plan – and we really need a clean plan – with just these sub-precinct)



Sub-precinct 1 Knutsford Sites 1 & 2

Already developed but needs investigation for the possibility of providing:

- better access for residents to community and common space
- incorporation of the area into renewable energy and sustainable water supply

Sub-precinct 2 & 7 Warehouse Precincts

Warehouses with intact structures: see previous notes re structure plan and brokering behaviours.

- Review of quality of existing built form for potential to redevelop or repurpose
- Identify potential land use conflicts that may impede future development of both the economic character of the area and residential uses
- Develop regulatory guidance that recognises existing use rights of businesses and supports these continuing to operate in the context of future development of the area
- Develop appropriate residential / commercial caveats for new builds that recognise changes in use in neighbourhoods that may have nuisance uses.
- Create a business development framework based on existing uses to strengthen enterprises, support innovation and build on the start-up culture
- Develop concepts of built forms that increases residential density immersed in the warehouse area while still supporting existing and proposed economic innovation in the area
- Develop a built form that reflects the character and style of the existing warehouse area

- Identify where internal access between properties can be improved and permeability increased to make the area a walkable precinct
- Identify appropriate locations for water supply, waste water and energy corridors
- Incorporate locations for greening / food production integrated into water supply and waste water infrastructure. This may be on walls and rooftops as well as public space.

Sub-Precinct 3 East Village

Under development but needs investigation for the possibility of providing:

- better access for residents to community and common space
- leveraging off the energy and water initiative in this development for the rest of the Knutsford area

Sub-Precinct 4 City of Fremantle Depot

Area owned by City of Fremantle with existing long term use as a City works depot:

- Clarify future use of the Depot site including options for smaller footprint for existing activities or total exit of the site, this is impacted by the level and location of contamination of the site and will drive future development scenarios.
- Recognise that the location of this site lends itself to a layout and new built typology that allows transitions between uses from the warehouse industrial precinct (7) into the town house / apartment style development of East Village (3).
- Because the City owns the site there is the opportunity for it to support a mixed use, transition housing between warehouses. A proportion of affordable housing could also be considered here although separate funding and delivery mechanisms for affordable housing would need to be further considered
- Recognise that there is the opportunity for delivery of street frontage commercial / retail / food and beverage that integrates with the greening concept of Knutsford

Sub-Precinct 5 Knutsford St between Amherst and Wood Sts

Area of land with little if any built structures:

- Recognise that this site is sandwiched between warehouse industrial precincts (2) & (7) and lends itself to a layout and new built typology that needs to accommodate / take advantage of this location but also may be impacted by neighbouring existing use rights.
- Recognise that there is the opportunity for delivery of street frontage commercial / retail / food and beverage that integrates with the transport link of Knutsford St

Sub-Precinct 6 Centre Amherst St between Stack and Knutsford

Area of land with little if any built structures:

- Recognise that the location of this site lends itself to a layout and new built typology that allows transitions between uses from the warehouse industrial precinct (7) into the town house / apartment style development of Neo-Barcelona

- Recognise that there is the opportunity for commercial / retail / food and bev that with Neo-Barcelona across Amherst St
- Recognise that there is a significant opportunity for this development to strengthen a green link / high street style of development along Amherst St

Sub-Precinct 8 Swanbourne St - East

Currently vacant area lending itself to higher density

- Incorporate the Western Power lot at the south of the site into the structure plan.
- Remove the green space claimed on the frontage of Knutsford St, and embed it as pocket parks and green corridors in the heart of the development see note re landscape principles
- Develop walkable spaces and laneways within the area and that focus on providing end of travel destinations that provide north-south access to the Knutsford St transit route and east-west access to Booyeembarra Park via and possible future the commercial areas along Knutsford and Amherst Sts, and entry into the Warehouse area.
- This area should start density transitions from the warehouse (7) and warehouse / residential transition uses (6) into the high density area of Swanbourne St - West

Sub-Precinct 9 Swanbourne St – West

Highly varied topography lending itself to high density

- The topography of this area lends itself to a high density favela / Cinque Terre style of development spilling up the western slope
- Significant increases in density and using the topography would support the installation of sustainable water and energy systems
- The level areas in the base lends itself to a green / walking link into Stephens St

Sub-Precinct 10 Western Power Site

Based on the assumption that an energy and water hub may be located in the Western Power depot, review the technological options for reducing the footprint of the existing Western Power transformer and switching gear to free up land for development and an extension of Swanbourne St– East (7) into this area

APPENDIX 7 - TRACKLESS TRAMS AND KNUTSFORD

A report by Peter Newman,
Professor of Sustainability,
Curtin University



The Trackless Tram (source: with permission from the Trackless Tram Tour participants June 2019)

Executive Summary

This report explores how the new technology of Trackless Trams could facilitate housing regeneration projects of the WA Housing Authority and LandCorp, with a particular focus on the potential creation of urban re-development opportunities along the Murdoch to Fremantle corridor including the Knutsford precinct including East Village. It seeks to demonstrate how the new technology may enable extra-urban regeneration possibilities and that this can be made part of a procurement process for urban regeneration projects, providing an innovative planning partnership that can deliver both the transit and the urban development.

The work being done at Curtin through the Sustainable Built Environment National Research Centre (SBEnc) has focussed on a corridor demonstration project of an innovative Trackless Tram from Canning/Curtin through to Stirling. While such a project could fit within the responsibility of MetroNet, this concept is much more about facilitating urban regeneration in the inner and middle suburbs where there is high demand for more affordable housing as well as social and public housing. MetroNet 2.0 is perhaps the way to think about this project.

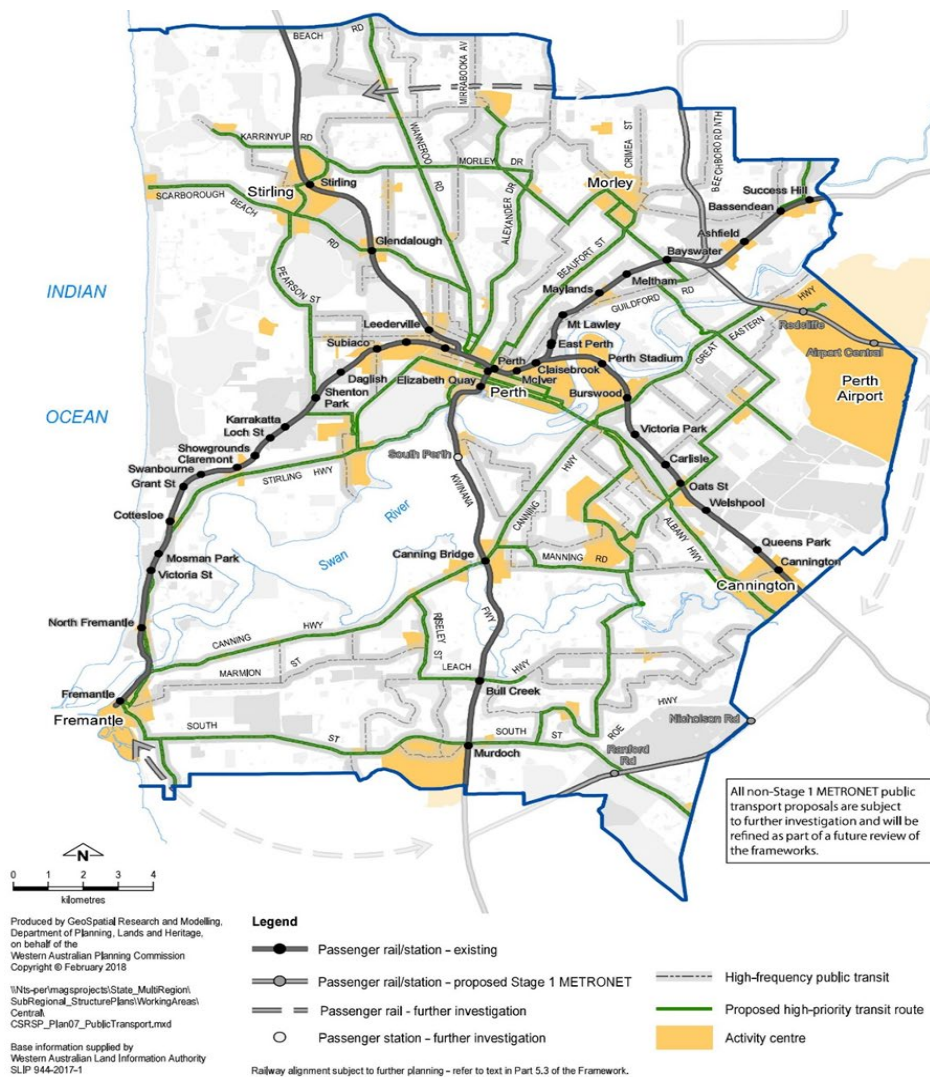
A team from Curtin University²⁰ completed a guide to how this technology could be used to help unlock increased land value for developments such as Brownlie and Cecil Avenue. Curtin along with five local governments (including Canning) have been working towards a Business Case on a Trackless Tram from Canning to Stirling. The report suggests the Trackless Tram idea needs now to be worked into the planning system and partnership-building process of these and other urban regeneration projects in order to accelerate the potential redevelopment process across the city. This paper looks at how such a concept could be used in the Knutsford precinct as part of a corridor regeneration from Murdoch to Fremantle.

The next phase of the SBEnc project will help to deliver the Trackless Tram projects in several cities across Australia and will go from the development of a framework for designing station precincts that integrate new technology and place-based planning, into how a corridor of such precincts could be developed into a partnership project such as a City Deal.

²⁰ Peter Newman, Mike Mouritz, Sebastian Davies-Slate, Evan Jones, Karlson Hargroves, Rohit Sharma and David Adams (2018). *Delivering Integrated Transit, Land Development and Finance – a Guide and Manual: with Application to Trackless Trams*. Sustainable Built Environment National Research Centre (SBEnc), Australia.

Introduction

The WA Department of Transport is suggesting that Perth requires a new set of Green Routes as set out in Map 1 below²¹. These are still being drafted but are suggested to be high priority transit routes integrated with land development to increase density; they would establish a new kind of public transport-linked road management system in Perth and would be part of the Metropolitan Region Scheme. The High Priority Transit Routes identified below were found to have opportunities to integrate with land development and support the aim of achieving a more compact urban form proposed in Directions 2031. They are likely to be the Green Routes of the future in Perth. This forms the context for the work being done at Curtin on Trackless Trams.



Map 1: High Priority Transit Routes (Source: WA Department of Transport)

²¹ Bodhi Alliance Pty Ltd Consulting Pty Ltd; Trackless Trams in Perth: From Concept to Reality, Discussion Paper, prepared for Curtin University; 2019.

What are Trackless Trams?

Trackless Trams are new technology electric buses that are more like a light rail than a bus; they are optically guided using autonomous technologies that create very high ride quality, speed and capacity but do not require the expensive rail and electric catenary systems that characterise light rail. Trackless Trams can move at a speed of 70-80kph and have a capacity of 300 – 500 passengers depending on the number of carriages that are used (3-5). It is estimated to cost around \$4-6m per km which is 10 to 20 times cheaper than light rail²². Powered by lithium-ion batteries, it can be recharged in just 30 seconds at a solar-powered station. Since the vehicles run on rubber tyres, there is no requirement to dig up existing road infrastructure to lay rails (perhaps some concrete at stations to prevent rutting), and this means minimal disruption to local businesses and existing service infrastructure. It can be installed virtually overnight. A detailed assessment has been published²³.



Figure 1. The Trackless Tram (Source: with permission from the Trackless Tram Tour participants June 2019)

Table 1 shows that a Trackless Tram offers considerable advantages compared to Bus Rapid Transit (BRT) and Light Rail Transit (LRT). The Trackless Tram is a way to bring quality urban development around the corridors more successfully than any other previous approaches. It is a system that can be fitted into a road overnight, as the stations can be prefabricated offsite and then the urban regeneration project can be built around it.

²² Peter Newman, Mike Mouritz, Sebastian Davies-Slate, Evan Jones, Karlson Hargroves, Rohit Sharma and David Adams (2018). Delivering Integrated Transit, Land Development and Finance – a Guide and Manual: with Application to Trackless Trams. Sustainable Built Environment National Research Centre (SBEnrc), Australia.

²³ Newman Peter, Karlson Hargroves, Sebastian Davies-Slate, Daniel Conley, Marie Verschuer, Mike Mouritz, Dorji Yangka and Garry Glazebrook (2019) The Trackless Tram: Is it the Transit and City Shaping Catalyst we have been waiting for? J. Transportation Technologies, 9, 31-55. doi: [10.4236/jtts.2019.91003](https://doi.org/10.4236/jtts.2019.91003).

Characteristics	BRT	LRT	TT
Speed and capacity	✓	✓ ✓	✓✓
Ride quality	X	✓✓	✓✓
Land development potential	X	✓✓	✓✓
Cost	✓	X	✓
Disruption in construction	✓	X	✓✓
Implementation time	✓	X	✓
Overall	✓	✓✓	✓✓✓

Table 1. Comparing BRT, LRT and Trackless Tram.

Source: Newman, *The Conversation* 26 Sept 2018.

As the transit system is so attractive and yet relatively cheap, it is likely to attract significant land value increases around stations. This is the basis of a new way to find the funding and financing of the transit system which has been pursued at Curtin and is called The Entrepreneur Rail Model²⁴. Thus, the innovation is both in transport technology and planning, through a new way to integrate transit and land use through private funding and financing. This partnership approach is at the heart of the City Deal concept that is now a bi-partisan Federal Government approach about how they wish to pursue infrastructure and city development into the future.

Planning has been done on a Curtin/Canning to Stirling corridor using this model – see corridor and development sites in Figure 2. The planning has been conducted with the Local Governments, together with some community and business engagement. The idea is to enable a Trackless Tram route to be developed through a series of already-identified new and regenerated urban centres, rather than planning the route and attempting to add land uses afterwards. A further study has begun on a route that goes from Murdoch Station to Fremantle and out to the new Knutsford Precinct and is the focus of this report.

²⁴ Newman P, Davies-Slate S, and Jones E (2017), The Entrepreneur Rail Model: Funding urban rail through majority private investment in urban regeneration, *Research in Transportation Economics* <http://dx.doi.org/10.1016/j.retrec.2017.04.005>



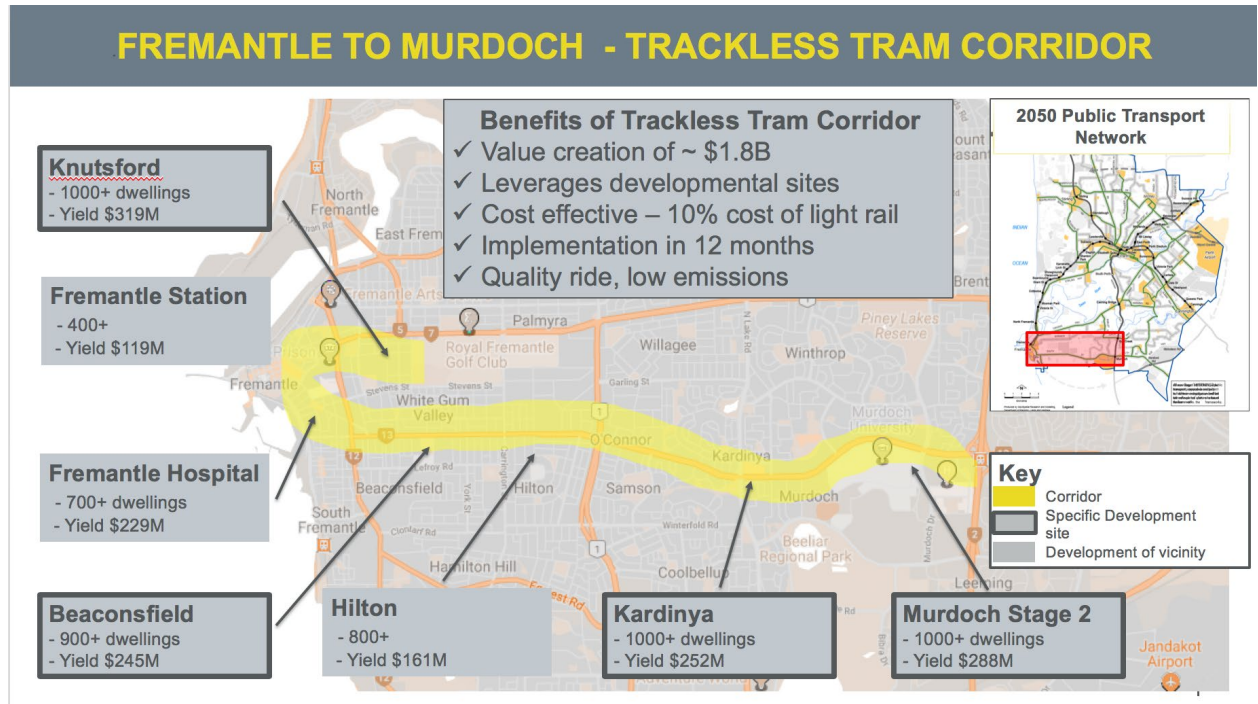
Figure 2: Canning/ Curtin to Stirling Trackless Tram corridor with potential development sites.

Source: Newman et al., 2018.

Background of Study Sites.

This option is focused on the Housing Authority developments proposed on South Street in Beaconsfield and the Knutsford Precinct by LandCorp as well as other potential sites along the route investigated by Dan West as part of a Masters dissertation.

A map of the route and the potential development sites is provided below.



Method for calculating redevelopment potential

The research method adopted was generally as follows:

- Desktop research was conducted to identify the types of planning, design and other interventions required to increase the housing yield promised by the Trackless Trams construction.
- The calculation of value creation estimate for the proposed Trackless Tram corridor was based on an assumption of an increase in yield and unit values for a selection of big potential re-developable sites along the corridor.
- To quantify the increased development intensity which high-quality public transport enables, an additional increase in value of land for residential purposes of 20% and of commercial purposes of 50%, was applied (based on previous research in Perth by James McIntosh, Roman Trubka and Peter Newman²⁵) and an increased yield of 20% was applied to each site. This additional yield could come from reduced parking to building ratio requirement on sites with close access to a Trackless Tram station.

²⁵ McIntosh J., Trubka R., Newman P., (2014) Can Value Capture work in a car dependent city? Willingness to pay for transit access in Perth, Western Australia **Transportation Research – Part A**: Vol. 67, September 2014, 320–339

Trackless Trams and its impact on Value Uplift

The results of the value uplift analysis are given in the Table below. There is a creation of extra value in land through urban regeneration of \$1.7b due to the building of a Trackless Tram. A proportion of this could be used by the developers along such a corridor to help pay for the Trackless Tram, for without it the extra value would not be created and indeed much of the potential development may not ever happen without the Trackless Tram unlocking this potential.

TRACKLESS TRAM - FREMANTLE TO MURDOCH CORRIDOR - POTENTIAL VALUE CREATION									
SITE	SIZE sqm	NATURE OF SITE/ DEVELOPMENT	Current Number of Dwellings	Number of dwellings plus 20%	Value of Residential 'Unit'	Value of residential unit with 20% uplift	YIELD WITHOUT TT	YIELD WITH TT	VALUE CREATION
Knutsford	11500	Multiple site redevelopment of largely industrial land - largely govt owned	912	1094	\$795,000	\$ 954,000	\$ 725,040,000	\$ 1,044,057,600	\$ 319,017,600
South Quay	154642	State govt owns 30% of land area.	461	553	\$795,000	\$ 954,000	\$ 366,495,000	\$ 527,752,800	\$ 161,257,800
Fremantle Station	206158	Area surrounding Fremantle station.	343	412	\$795,000	\$ 954,000	\$ 272,685,000	\$ 392,666,400	\$ 119,981,400
Fremantle Hospital	258876	47% state govt owned	655	786	\$795,000	\$ 954,000	\$ 520,725,000	\$ 749,844,000	\$ 229,119,000
Beaconsfield	355845	Low commercial percentage area includes beyond boundaries of Beaconsfield development	810	972	\$687,500	\$ 825,000	\$ 556,875,000	\$ 801,900,000	\$ 245,025,000
Hilton	422419	Hilton town centre redevelopment. Redevelopment across multiple sites - limited large scale, easily developable sites. Low Govt ownership	697	836	\$527,500	\$ 633,000	\$ 367,667,500	\$ 529,441,200	\$ 161,773,700
Kardinya	63583	Kardinya Shopping centre and surrounding residential area. 3 centre plus tavern all interested in developing site.	987	1184	\$580,000	\$ 696,000	\$ 572,460,000	\$ 824,342,400	\$ 251,882,400
Murdoch	30000	Mixed Use Precinct Stage 2. Landcorp development next to rail line	900	1080	\$728,500	\$ 874,200	\$ 655,650,000	\$ 944,136,000	\$ 288,486,000
SUB- TOTAL			5765	6918			\$ 4,037,597,500	\$ 5,814,140,400	\$ 1,776,542,900
Bullcreek	65815	Owned by Stockland. South Street frontage on other side of Freeway	814	977	\$700,000	840,000	\$ 569,800,000	\$ 820,512,000	\$ 250,712,000
TOTAL			6579	7895			\$ 4,607,397,500	\$ 6,634,652,400	\$ 2,027,254,900

Next Stages in Trackless Trams and Urban Regeneration Research

A number of corridors across Australia are now considering a Trackless Tram as the basis of activating urban regeneration. These corridors are now being studied to take them through a series of steps as set out below. The precincts examined in this report can be the basis of a similar study and the conclusions used to help create better urban regeneration in other centres around present rail systems or potential transit stations.

The variety of urban projects being planned across Australia with an interest in the Trackless Tram have certain core goals that can be seen as follows:

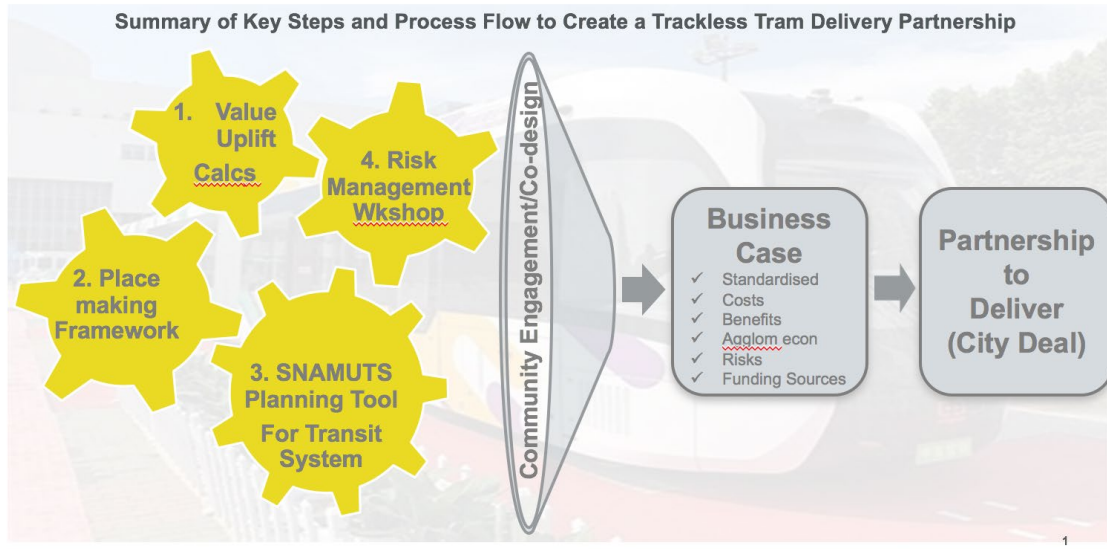
1. They are all looking to help create better urban places, especially **urban centres** with lively, mixed use activities that are not being ruined by excessive traffic,
2. They want to see whether a **Trackless Tram** can help unlock the potential urban regeneration opportunities, and
3. They need guidance on how to assess and evaluate their project and set up the kind of **partnerships** that will be required to deliver the Trackless Tram and the urban regeneration together. In nearly all cases these projects were seeking to be part of a City Deal or similar multi-level government/private sector/community partnership.

The CUSP team believe they have a set of tools that will be developed and applied across the various projects though not all projects will use all the tools. They can fit together as shown in the diagram below.

Tools

1. **Value uplift calculation.** This will enable a 'without Trackless Tram' and a 'with Trackless Tram' estimation of the development value in particular land areas that are seen to be the best opportunity for urban regeneration. This will be worked out with key people in each place. This be used as part of a Business Case.
2. **Place-making Framework.** This is the Framework that will be created from a literature review of the factors creating a good place. It will specifically be developed in each place from a workshop. The literature review will also develop a new 'place-making value uplift' factor that has been found in cities. This will also be channeled into a Business Case.
3. **Risk Management Workshop.** This will be an opportunity for all the key questions to be raised about Trackless Trams and how they can be fitted into an Australian city. Key issues will then be used to fill out a standard Risk Analysis for feeding into the Business Case.
4. **SNAMUTS Planning Tool.** This tool developed by Jan Scheurer (RMIT) and Carey Curtis (Curtin) will be used to enable a set of calculations to be used that will predict how the Trackless Tram and associated urban regeneration can enable transit accessibility to be improved.
5. **Community Engagement.** All these tools can involve community at various levels but if they are done together and provided in a workshop with all key stakeholders the opportunity is there to create a coherent partnership that can better define the project.
6. **Business Case.** Together these tools lead to a Business Case that can be drawn up using a standard tool needed by State and Federal Governments. The Business Case will include estimates of all costs and benefits including such extra benefits as agglomeration economies from the urban regeneration, the overall strategic goals that are meeting the city's plans as well as those from state and federal governments, and potential funding sources.
7. **Partnerships for Delivery.** This will draw upon the options set out in the Trackless Tram Guide and will be based upon the best opportunities in the city. A City Deal framework will be likely as a major approach in many cities.

TRACKLESS TRAM PARTNERSHIP DEVELOPMENT MODEL



Conclusion

Trackless Trams can have a significant beneficial effect on uplifting the value of the proposed urban regeneration projects of local and state governments across Australia and unlocking their potential to help fund such attractive new transit technology. To enable this to happen requires partnerships between the three levels of government, as well as developers and communities looking to bring life into aging suburbs, mostly in inner and middle areas. Such partnerships that involve private investment in precinct regeneration should now be worked into the planning system and procurement of these innovative transit and redevelopment projects. One such potential corridor would run from Murdoch station to Fremantle and around to Knutsford. This would add a powerful innovation feature to the whole Knutsford redevelopment and in particular to the highly innovative East Village. It would therefore assist in bringing extra investment and interest in the project.