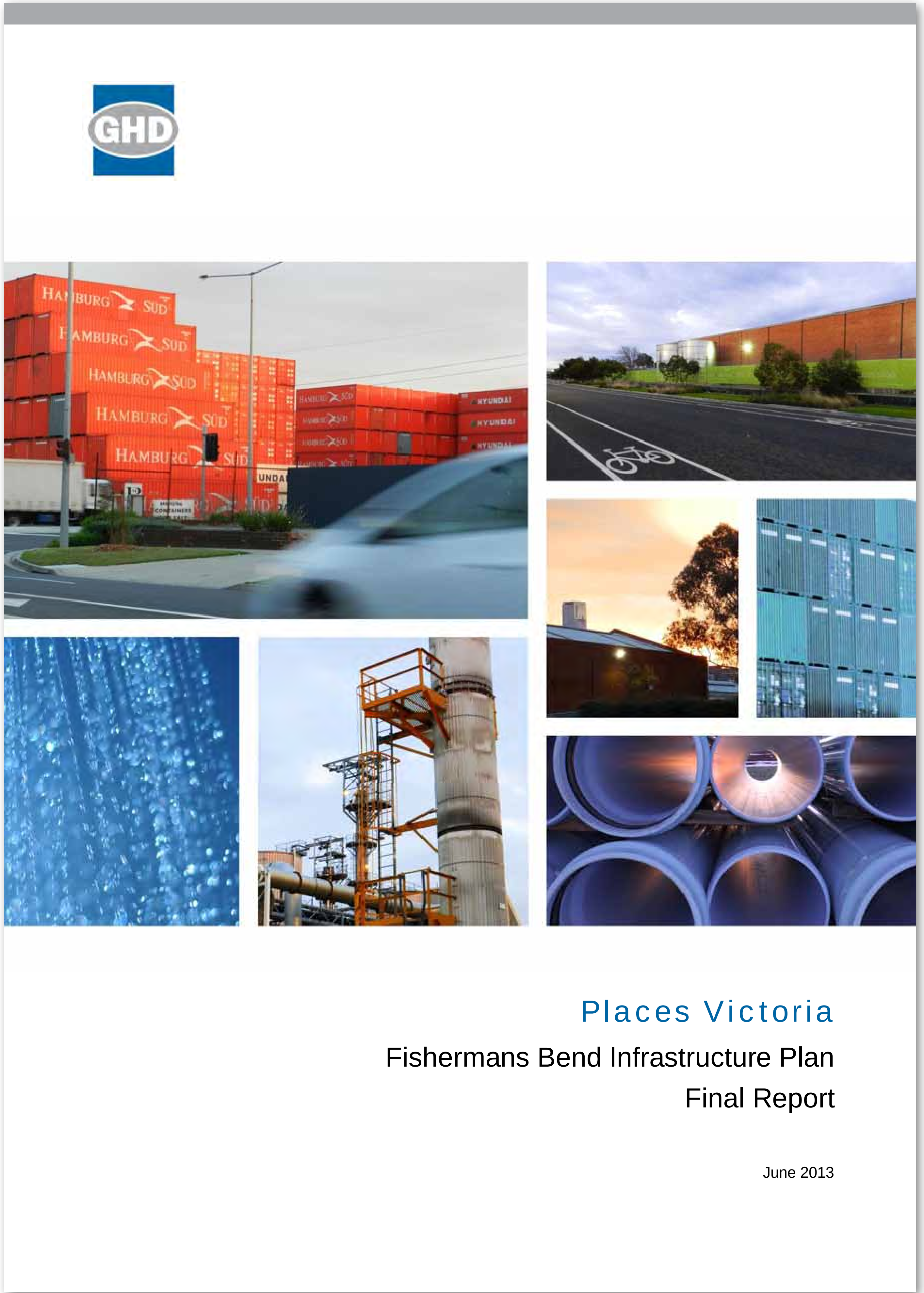


Places Victoria

Fishermans Bend Infrastructure Plan

Final Report

June 2013

VOLUME 2

Executive summary

In July 2012, the State Government announced the creation of the Fishermans Bend Urban Renewal Area (FBURA) and the rezoning of the approximate 248 ha to Capital City Zone (CCZ1). Places Victoria was tasked with developing the Strategic Framework Plan and the Development Contributions Plan for the area, and in March 2013, engaged GHD to develop a Utility Infrastructure Plan for the FBURA. The key requirements of this project, as outlined in the original project brief, are:

- Review and analyse previous work
- Prepare a technical and financial analysis of an integrated servicing strategy (ISS)
- Deliver an infrastructure plan that presents a best practice sustainable approach to infrastructure provision for Fishermans Bend.

This report covers the development of the infrastructure plan, the costs associated with delivering the plan and the critical next steps to confirm the feasibility and methods for its implementation. This report is subject to, and must be read in conjunction with, the assumptions and qualifications contained throughout the Report.

Background

A Utilities and Environment Working Group (the Working Group) comprised of representatives from various Government agencies and departments was established to provide oversight to the project and set the strategic direction for the plan. The Working Group has identified Fishermans Bend as an opportunity to establish a leading example of sustainable development and showcase of an integrated approach to energy, water, and waste.

In accordance with exemplar EcoDistricts around the world, GHD developed a set of quantitative targets to drive the achievement of the Working Group's strategic objective and to provide a framework for measuring the performance of the proposed strategy. As the development progresses, these targets are to be regularly reviewed to ensure the development continues to meet and exceed best practice standards.

Development of the Integrated Servicing Strategy

The development of the ISS involved a comprehensive process including:

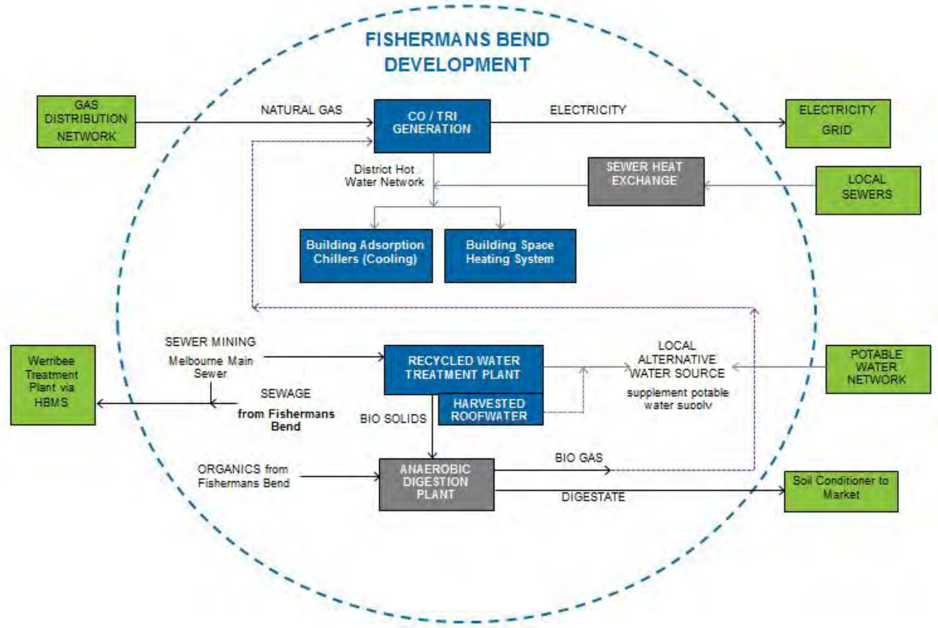
- A review of exemplar Eco Districts and sustainable infrastructure options.
- Identification of the preferred sustainable infrastructure options for the ISS, based on a high level technical review and an assessment against the objectives and performance criteria developed by the Working Group.
- Conceptual development of the adopted ISS, including preliminary sizing of infrastructure capacities and footprints.
- Development of a Business as Usual (BAU) infrastructure servicing option for the purposes of comparing traditional precinct servicing methods to the ISS.

The key elements of the adopted ISS are summarised in the table below.

Elements of the options considered	Business as Usual	Integrated Servicing Strategy
Upgrades to existing infrastructure	Upgrades to existing water, sewerage, drainage, energy, waste and telecommunications infrastructure are common to both BAU and the ISS.*	
Development scale initiatives	Stormwater attenuation at the building scale.	Cogeneration and district energy Sewer heat recovery Integrated water management including: - Sewer mining - Stormwater retention (including reuse) and attenuation at the building scale. - Water sensitive urban design Smart meters and intelligent network
Precinct Wide Mandates		Mandate high performance buildings

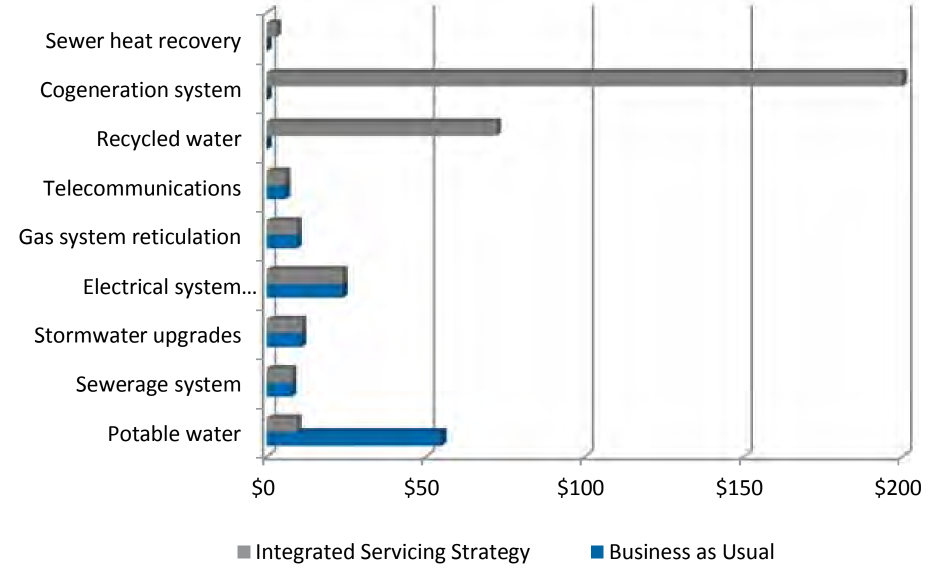
*With the exception of potable water upgrades.

The image below illustrates the development scale initiatives for the ISS and how they interact with existing energy and water networks.



The anaerobic digestion plant is identified in the figure to demonstrate how it would integrate with the system if it was implemented at the city scale.

The following graph summarises the suite of upgrades and their associated costs for both BAU and the ISS.



The inclusion of cogeneration, sewer heat recovery and recycled water infrastructure significantly increase the cost of the ISS in comparison to BAU. For the upgrades required to existing infrastructure, the costs are the same for both the BAU and ISS, with the exception of the potable water upgrades. The upgrades to the potable water system for the ISS are significantly less in comparison to BAU, as the proposed recycling strategy and demand reduction initiatives reduce the extent of the potable water augmentation required to service the development.

Why the ISS

The cost of the ISS is $343 M which involves a significant cost premium in comparison to a BAU servicing strategy (i.e. $113 M). The largest component of this cost premium is due to the cogeneration and district heating, which is estimated at $200 M.

The additional costs associated with the ISS, and in particular the cogeneration and district heating, may attract alternative funding sources such as private sector investment (including ownership and operation) or public investment/partnerships (i.e. public private partnership arrangements). The extent of interest from the public or private sector to invest in the integrated infrastructure outlined above is unknown at this stage, and further work is required to quantify the benefits and return on investment for these potential investment opportunities.

An understanding of the benefits that may be derived by the ISS is critical to justifying the extent of investment required. Some of the potential benefits that may be achieved through the implementation of the ISS include:

- Engaging and liveable internal and external environments that promote healthy, productive and happy living
- Reduction in carbon emissions from buildings
- Reduction in potable water use in the order of 60% and sewage volumes discharged from site
- Reduction in peak power usage
- Potential reduction in waste to landfill
- Reduction in stormwater and associated contaminants to Port Phillip Bay

In addition, there is potential that the ISS may defer and/or avoid future upgrades to major water and energy infrastructure both upstream and downstream of the Fishermans Bend precinct.

By way of example, in 2011/12, $1.280 billion of capital expenditure was invested in water, sewerage and drainage infrastructure across Melbourne (*source: 2011/12 annual report for Melbourne Water and Melbourne's metropolitan water utilities*). Similar amounts would be expected across the range of utility infrastructure. In addition upgrades to water, energy and waste management infrastructure will require significant capital expenditure in the future to ensure utility services cater for population growth, in addition to ongoing upgrades and replacement of ageing assets. The potential to defer a proportion of these future costs through investment in precinct scale infrastructure that will reduce the load on existing water and energy networks, has the potential to deliver significant savings to the State.

Further work is required in consultation with the utilities to define the long term major infrastructure upgrades that may be deferred / avoided by adoption of the ISS within Fishermans Bend, so that these cost savings may be understood for the ISS.

Governance and Ownership

The ownership roles and responsibilities in the BAU are well understood. A combination of public sector and private sector agencies currently provide the full range of infrastructure required. For the ISS there are opportunities for direct private investment and ownership for the alternative technologies – the cogeneration plant and district heating network, the recycled water plant and the sewer heat exchange.

The report discusses governance issues covering the following:

- Mandating high performance buildings – including options for achieving high performance buildings across Fishermans Bend
- Cogeneration – including barriers to implementation and methods for overcoming
- Development control – including a discussion regarding the overall management of the development

Funding and Financial Analysis

MacroPlan completed a funding and financial analysis as part of this report. Their entire report is included as an appendix, plus Section 11 summarises the funding aspects of the report. Key findings from the report include:

- A combination of funding scenarios is likely to be employed to fund the FBURA infrastructure: regulated contributions, developer contributions, infrastructure recovery charge, residential infill levy and municipal rates and charges.
- During the period 2016 – 2020 the suite of mechanisms can deliver approximately $37m to $65m, which is roughly equivalent to the BAU costs, but approximately $40m - $70m lower than the ISS requirements. A funding surplus is generated post 2020.
- Costs for utility infrastructure are subject to upfront capital contributions, and as such incur peaking. In the BAU the marginal cost is $63 / m2, with a peak marginal cost of utilities theoretical cost is $156 / m2. In the ISS the marginal cost of utilities is $190/m2, with a peak marginal cost of utilities cost of $475 / m2. It is expected that there will be net funding shortfalls in the peak years.

Recommendations

Further investigations are required to define the infrastructure requirements in greater detail and how they might be staged and integrated with the proposed FBURA, along with the governance,

ownership and commercial arrangements for delivery of the plan. To that end, a number of next steps have been defined for the broad categories of design and development, implementation and governance. Of particular importance include:

- Investigation options for a development authority model.
- Establishment of a development authority to undertake responsibilities such as coordination of development across two municipalities and a diverse number of private developers, encourage sequential development, drive the implementation of high performance buildings across the precinct and create an environment that is conducive to private investment.
- Ensure the ISS is sufficiently flexible to accommodate alternative/superior integrated solutions that may emerge in the future.
- Quantify the potential system wide 'avoided costs' that may result from adoption of the ISS both within Fishermans Bend and across other urban renewal areas in consultation with the utilities.
- Investigate the potential return on investment for specific infrastructure including cogeneration, sewer heat recovery and wastewater recycling that might attract private sector investment.
- Undertake further investigations to test the assumptions adopted throughout this high level study.

Glossary of Project Terms

The following provides a list of the project 'terms' and their abbreviations.

- Australian Energy Market Commission (AEMC)
- Business as Usual (BAU)
- Capital City Zone 1 (CCZ1)
- City of Melbourne (CoM)
- City of Port Phillip (CoPP)
- City West Water (CWW)
- Department of Treasury and Finance (DTF)
- Development Contributions Plan Overlay (DCPO2)
- Fishermans Bend Urban Renewal Area (FBURA)
- Gross Floor Area (GFA)
- Hobsons Bay Main Sewer (HBMS).
- Integrated Servicing Strategy (ISS)
- Integrated Water Cycle Management (IWCM)
- Melbourne Main Sewer (MMS) Office of Living Victoria (OLV)
- Membrane bioreactor plant (MBR)
- Melbourne Water (MWC)
- Parking Overlay and associated schedule (PO1)
- Precinct Structure Plans (PSPs).
- Recycled water treatment plant (RWTP)
- Waste sorting station (MRF)
- Waste transfer facility (WTF) – A processing site for the temporary deposition of waste.

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Appendices

1. Introduction and Background

1.1 Background

In July 2012, the State Government announced the creation of the Fishermans Bend Urban Renewal Area (FBURA), and the rezoning of the approximate 248 ha to Capital City Zone 1 (CCZ1). Places Victoria was tasked with developing the Strategic Framework Plan and the Development Contributions Plan for the area.

GHD was engaged in June 2012 to prepare an existing utility infrastructure assessment for the area, based on a number of development scenarios. The key aspects of this project were to develop an understanding of the location of existing infrastructure, and importantly, its capacity for future development. This was achieved through a process of consultation and discussion with the various utility stakeholders. In December 2012 the development scenarios were revised and the findings of the utility infrastructure assessment were reviewed accordingly in consultation with the stakeholders. This was included as an addendum to the original report.

In March 2013 GHD was engaged by Places Victoria to develop a Utility Infrastructure Plan for the Fishermans Bend Urban Renewal Area (FBURA). This work builds on our previous work, and also some work completed by the Moreland Energy Foundation Limited (MEFL). The work by MEFL established a sustainability objective for the development, and also, a preliminary integrated servicing strategy that highlighted a number of opportunities for integrated and sustainable infrastructure in the development.

The Utilities and Environment Working Group has provided oversight to both this project and preceding projects. The working group consists of representatives of various Government agencies and departments, including Places Victoria, the City of Melbourne, the City of Port Phillip, the Department of Planning and Community Development, Sustainability Victoria, and the Environment Protection Authority.

1.2 Purpose of this report

The key requirements of this project, as outlined in the original project brief, are:

- Review and analyse previous work
- Prepare a technical and financial analysis of an integrated servicing strategy
- Deliver an infrastructure plan that presents a best practice sustainable approach to infrastructure provision for Fishermans Bend.

This report will ultimately form part of the Strategic Framework Plan for the development, and will also provide some inputs to the Development Contribution Plan.

1.3 Consultant Team

GHD has assembled a team of consultants to provide inputs into this report. These consultants, and their respective scopes of work, are as follows:

- Portland Sustainability Institute (PoSI) – general input to international exemplars, and regular review and feedback on the plan.
- Moreland Energy Foundation Limited (MEFL) – general input to international exemplars, and input into governance models.

- MacroPlan – assistance with financial aspects of project. MacroPlan's report is included in its entirety in Appendix F. In addition, portions of their report are included in the main body of this report.
- WT Partnership – provided cost estimates for the utility infrastructure. WT Partnership's report is included in its entirety in Appendix E. In addition, portions of their report are included in the main body of this report.

1.4 Definitions

Two broad strategies were developed by GHD for the Infrastructure Plan at Fishermans Bend. The development of these options was based on an extensive technology scan, previous studies and consultation with the industry. The options are described below:

1. Business as Usual servicing strategy.

The Business as Usual (BAU) strategy involves augmentation of the existing water, waste and energy networks from existing sources (i.e. Loy Yang and Melbourne's natural water resources) to cater for the growth in the precinct. This strategy is considered a 'traditional approach' to water, waste and energy system upgrades.

2. Integrated Servicing Strategy (ISS) or the 'Integrated Plan'.

Similar to the BAU servicing strategy, the ISS also involves augmentation of the existing water, waste and energy networks. However, the ISS includes additional integrated infrastructure that involve generation of energy and water at the precinct scale as well as high performance buildings that significantly reduce base energy and water demands. The reduction in demand, combined with local generation of energy and water resources would reduce the precincts overall demand on Melbourne's existing energy and water resources compared with BAU (i.e. Loy Yang and Melbourne's natural water resources). Programs for waste would aim to increase resource recovery and provide trunk infrastructure where feasible.

The options outlined above involve both upgrades to existing utility infrastructure, implementation of new infrastructure and regulation and policy to support their development. Figure 1 summarises the key elements of each option.

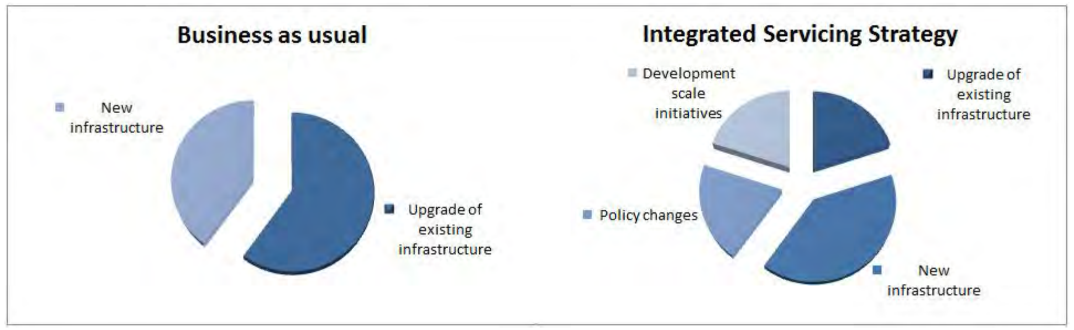


Figure 1 Elements of the BAU and ISS Strategies

The practicality of both strategies was tested through consultation with utility service providers and asset planners. A summary of this consultation is outlined for each utility in Sections 9 and 10 in addition to the process for development and assessment of the BAU and ISS.

The BAU and ISS options are pictured in Appendix A.

1.5 Scope and limitations

This report: has been prepared by GHD for Places Victoria and *may only be used and relied on by Places Victoria for the purpose agreed between GHD and Places Victoria as set out in section 1.2 of this report.*

GHD otherwise disclaims responsibility to any person other than Places Victoria arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Places Victoria and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

WT Partnership has prepared the preliminary project cost estimate set out in Section 10 of this report ("Cost Estimate") using information reasonably available to the WT Partnership employee(s) who prepared this report; and based on assumptions and judgments made and included in its report in Appendix G.

The Cost Estimate has been prepared for the purpose of preliminary financial modelling and must not be used for any other purpose.

The Cost Estimate is a preliminary estimate only. Actual prices, costs and other variables may be different to those used to prepare the Cost Estimate and may change. Unless as otherwise specified in this report, no detailed quotation has been obtained for actions identified in this report. GHD does not represent, warrant or guarantee that the [works/project] can or will be undertaken at a cost which is the same or less than the Cost Estimate.

Where estimates of potential costs are provided with an indicated level of confidence, notwithstanding the conservatism of the level of confidence selected as the planning level, there remains a chance that the cost will be greater than the planning estimate, and any funding would not be adequate. The confidence level considered to be most appropriate for planning purposes will vary depending on the conservatism of the user and the nature of the project. The user should therefore select appropriate confidence levels to suit their particular risk profile.

1.6 Assumptions

A number of assumptions have been made in the development of the infrastructure requirements for the BAU and ISS, which are outlined in Appendix B. The following general assumptions apply to the project as a whole:

- Infrastructure requirements have been prepared for ultimate development of the adopted development scenario.
- Water and energy demands and waste generation rates are assumed to be uniform across the precinct.

- The infrastructure proposed under the ISS does not necessarily apply to the entire development, and the extent of application is based on other exemplar precincts.
- Individual lot scale infrastructure is not included in the plan.
- The infrastructure plan is based on existing road layouts.
- Cost estimating assumptions are included in Appendix F.

1.7 Structure of this report

This report is structured as follows:

- Section 1 – introduction and background
- Section 2 – provides context for the development with discussion of the existing infrastructure
- Section 3 – details the development scenario considered in this report
- Section 4 – provides discussion of the policy context for the development
- Section 5 – details the BAU Strategy
- Section 6 – details the targets and objectives developed as part of this study
- Section 7 – details the Integrated Servicing Strategy
- Section 8 – provides a high level discussion of costs and benefits of the integrated strategy
- Section 9 – details the governance strategy
- Section 10 – details the infrastructure plan cost estimates
- Section 11 – provides an analysis of the various funding arrangements available for utility infrastructure, and what levels of contribution may be required to fund the works
- Section 12 – provides a preliminary assessment of the key risks associated with the plan
- Section 13 – provides recommendations for future work to progress the project.

2. Existing Conditions

1.1 Context for the Fishermans Bend development

Fishermans Bend is located on a peninsula south west of Melbourne's CBD. It is geographically bound by the Yarra River to the north and west, and Port Phillip Bay to the south. South Melbourne bounds the area to the east and Port Melbourne to the south.

Project borders were identified for the precinct in September 2011 by the Department of Planning and Community Development (DPCD). This assessment focuses on six distinct precincts within the project border as shown in the Figure 2. For the purposes of this assessment, these six precincts will be collectively referred to as the Fishermans Bend Urban Renewal Area (FBURA). The FBURA covers an area of approximately 248 hectares.

The Lorimer Precinct, coloured red in Figure 2 is within the municipality of the City of Melbourne. The remaining five precincts, the Montague, Wirraway East and West, and Sandridge North and South Precincts, are located within the municipality of the City of Port Phillip.

The precincts are split by the Westgate Freeway that runs generally east west through Fishermans Bend.

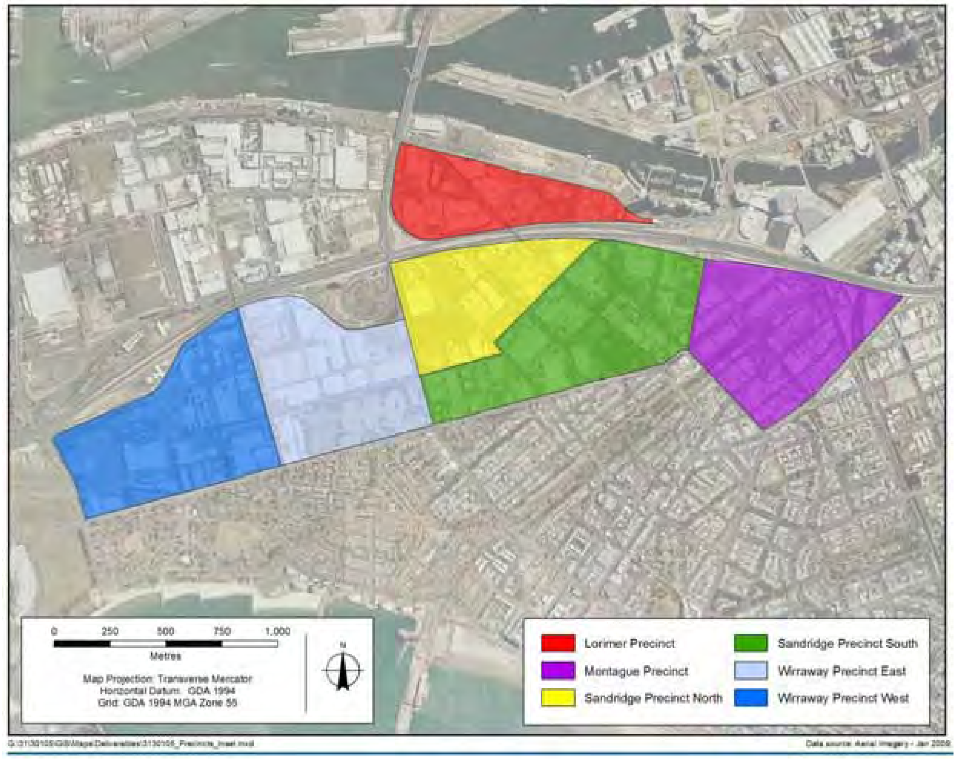


Figure 2 Fishermans Bend Urban Renewal Area

The municipality and approximate size of each precinct are listed in Table 1.

Table 1 Precinct Size

Precinct	Gross Area	Municipality
Montague	43 hectares	City of Port Phillip
Lorimer	27 hectares	City of Melbourne
Sandridge North	32 hectares	City of Port Phillip
Sandridge South	53 hectares	City of Port Phillip
Wirraway East	49 hectares	City of Port Phillip
Wirraway West	44 hectares	City of Port Phillip
Total	248 hectares	

2.1 Existing Land Use

The existing land use in the FBURA is predominantly industrial and business, with a small amount of residential. Due in part to the history of industrial land use in the FBURA, there is varying risk of land contamination. Golder Associates completed a Land Contamination Study on behalf of Places Victoria in 2012.

This report states that the near surface stratigraphy for the FBURA is anticipated to consist of the Port Melbourne Sand and Coode Island Silt capped by a layer of fill over much of the area. It is anticipated that there may be contaminants throughout the FBURA. Groundwater is generally shallow, ranging from around one metre to three metres below the surface.

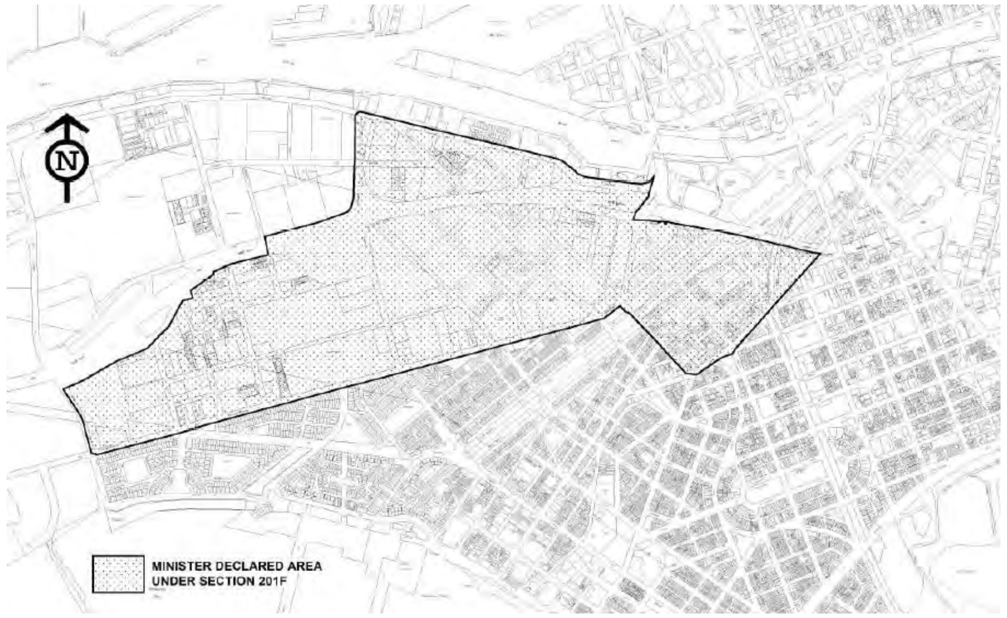
There is large and active ownership by developers, particularly Goodman and MAB, across the precincts.

In the Montague Precinct, there is some smaller office industry and a number of automotive premises. A recent study by SGS found there are approximately 3,850 jobs in the Montague precinct[1].

There are major freight transport routes along Plummer and Williamstown Roads and the FBURA contains vital access to Webb Dock and for other port related traffic. Road reserves are generally wide to support large vehicle access. The Westgate Freeway is grade separated by Salmon and Ingles Streets and is accessible from Todd Road (Wirraway Precinct) and Montague Street (Montague Precinct). There is a light rail line along Montague Street and one bus service to the area.

On 5 July 2012, 248 hectares of the FBURA were rezoned to Capital City Zone via Ministerial Amendments C102 (City of Port Phillip) and C170 (City of Melbourne). The area included is shown in Figure 3.

[1] SGS Economics and Planning (2012), *Fishermans Bend Economic and Employment Study,* Melbourne, Victoria.



Source: Planning Schemes Online retrieved from http://planningschemes.dpcd.vic.gov.au on 10 August 2012

Figure 3 Fishermans Bend Minister Declared Urban Renewal Area

The amendment implements a comprehensive suite of changes to the Port Phillip Planning Scheme to facilitate the transition of the Fishermans Bend Urban Renewal Area (FBURA) from a primarily industrial precinct to a genuine mixed use precinct with a residential and commercial focus[2]. These changes include:

- Modification of the schedule to Clause 61.01 of the Port Phillip Planning Scheme to make the Minister for Planning the responsible authority for administering the Fishermans Bend area for development proposals over a certain threshold
- Rezoning the land within the Fishermans Bend Urban Renewal Area to the Capital City Zone (CCZ1) excluding existing areas in public ownership.
- Removal of Design and Development Overlays (Schedule 2, 8 & 9) from the land within the Fishermans Bend Urban Renewal Area
- Introduction of a new Schedule to the Development Contributions Plan Overlay (DCPO2) to the Fishermans Bend Urban Renewal Area
- Introduction of the Parking Overlay and associated schedule (PO1) to the overlay for the Fishermans Bend Urban Renewal Area
- Introduction of a new Local Planning Policy Clause 22.10– Urban Design within Fishermans Bend
- Updates to the Local Planning Policy to reflect the changes to strategic direction

[2] Planning Schemes Online 'Port Phillip Planning Scheme Amendment C102' retrieved from http://planningschemes.dpcd.vic.gov.au on 10 August 2012

2.2 Existing Infrastructure

In 2012 GHD completed an infrastructure capacity assessment for Places Victoria to confirm the existing utility infrastructure within the FBURA, which was completed through a combination of Dial Before You Dig enquiries, and meetings with the service authorities. For a detailed discussion of the existing infrastructure please refer to this previous report.

In addition to an understanding of the existing infrastructure, GHD reviewed a number of development scenarios with the authorities. These scenarios are detailed in Table 2. Whilst the scenarios do not exactly match the adopted development scenario they do provide a basis for understanding the possible impact of the discussion scenario on the existing infrastructure. Table 3 details the results of previous discussions with the service authorities.

Table 2 Redevelopment Scenarios

Scenario		Number of Dwellings	Commercial / Retail Gross Floor Area (GFA)
1	Incremental	5,000	50,000 m²
2	Low Density	15,000	200,000 m²
3	Medium Density	30,000	500,000 m²
4	High Density	60,000	850,000 m²

Table 3 Summary of Impacts

	Scenario			
Sector	**Incremental**	**Low Density**	**Medium Density**	**High Density**
Stormwater	There is no change to the public open space areas therefore the impact on the stormwater network would be dependent on any increase in impervious land areas within lots	In each of the low, medium and high density scenarios, there is an increase in the public open space area. The increased public open space area, if grassed or vegetated, would increase the pervious area in the relevant precinct and would achieve Melbourne Water's desire to have no impact on stormwater flows due to any increase in impervious areas for established areas There may also be greater potential for water reuse for irrigation of the public open spaces which would be of benefit to the viability of some integrated water management strategies that may be considered Any increase in impervious area within lots would have an impact on the stormwater drainage network and may require stormwater management		
Water Supply	Could be supplied from existing infrastructure	New 600 mm pipeline required between Punt Road and the FBURA	15 ML underground storage tank and new 600 mm pipeline required between Punt Road and the FBURA	30 ML underground storage tank and a new 825 mm pipeline required between Punt Road and the FBURA
Sewerage	The higher the density the greater likelihood of higher costs South East Water considers that the trunk network is likely to have sufficient capacity under all four scenarios however this would ultimately need to be confirmed with Melbourne Water Upgrades to South East Water's reticulation system and possibly some of the branch sewers (Fishermans Bend Branch Sewer, Ingles Street Branch Sewer and Bridge Street Branch Sewer) may be required under all four scenarios			
Gas Supply	For the incremental and low density scenarios there is likely to be no material change to what was previously reported		For the medium and high density scenarios, due to the doubling and tripling of the commercial / retail component there may well be the need for additional infrastructure which may include construction of larger mains and network reinforcements	

	Scenario			
Sector	**Incremental**	**Low Density**	**Medium Density**	**High Density**
	In each scenario, depending on the timing and development plans (i.e. realignment of roads, block titles, road modifications & beautification etc.) it is likely that MultiNet would be forced to consider bringing forward a component of its renewal works and would require a co-contribution approach to fund works that are required to be brought forward			
Electricity	Supply will continue to be from existing zone substations Supply will continue to be from the existing FBTS	Supply will continue to be from existing zone substations with some upgrading required This scenario is likely to trigger the standby transformer at the FBTS being placed on load	This scenario is likely to trigger the E Zone[3] substation being converted into an 11 kV zone substation This scenario is likely to trigger the standby transformer at the FBTS being placed on load and a fourth transformer being added	This scenario is likely to trigger the E Zone and Port Melbourne zone substations being converted into 11 kV zone substations This scenario is also likely to trigger a new zone substation This scenario is likely to trigger the standby transformer at the FBTS being placed on load and a fourth transformer being added
	New 11 kV feeders and local substations will be required to match the load generated by redevelopment in each scenario			
Telecommunications	The greater the number of premises in the FBURA the greater the capacity that NBNCo will need to allocate to the area Commercial / retail development typically requires double the fibre allocation of residential development therefore significant increases in commercial / retail development would have a bigger impact than the equivalent increase in residential premises If redevelopment occurs after NBNCo has rolled out NBN to the area as part of their brownfields rollout, and the number of premises ends up being significantly greater than what was allowed for, NBNCo may need to redesign their network or reinstall additional fibre The cost to developers is the same under each scenario; however any redesign or retrofitting of the NBN network following the brownfields rollout is likely to be costly for NBNCo			

[3] E Zone substation is a substation owned by CitiPower and located near the Fishermans Bend terminal station.

3. Proposed Development Scenario

At the commencement of this assignment, Places Victoria proposed the following development scenario, outlined in Table 4, to be adopted for the Fishermans Bend infrastructure plan.

Table 4 Development Scenario

Precinct	Residential Population	Commercial Gross Floor Area (sqm)
Montague	20,900	198,000
Lorimer	13,500	126,562
Sandridge North	12,350	243,912
Sandridge South	15,180	286,350
Wirraway East	11,495	108,418
Wirraway West	10,020	93,937
Total	**83,455**	**1,057,179**

The adopted development scenario involves the following characteristics:

- Average household population density of 2.1 people per dwelling
- 197 dwellings per hectare
- 207 workers per hectare

The distribution of density across the precinct is pictured in Figure 4 below. The grey shaded areas indicate land set aside for open green space.

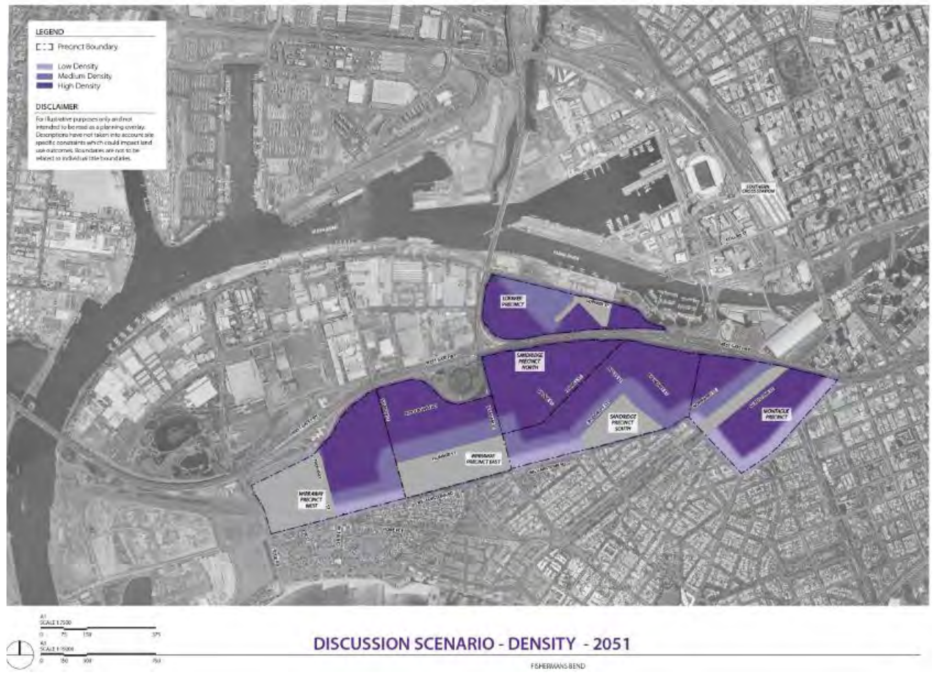


Figure 4 Fishermans Bend Adopted Development Scenario

4. Strategic and Policy Context

4.1 Introduction

The following section presents a brief overview of the strategic and policy framework that currently exists at Fishermans Bend, specifically as it relates to utility infrastructure of energy, water and waste.

4.2 Municipal Sustainability Policy

4.2.1 City of Port Phillip Strategy

The City of Port Phillip (CoPP) has a number of strategic documents that cover the area of sustainability. In particular:

- Greenhouse Plan – Low Carbon City. This document was released in 2011, and covers a range of areas such as sustainable design and transport, waste reduction and purchasing and procurement. This is further detailed in Figure 5.
- City of Port Phillip's Water Plan. The aim of this plan, adopted in 2010, is to "create a city that embraces the sustainable management of all water sources, through water efficiency, stormwater management, and water harvesting and reuse"[4].
- Climate Change Adaptation Plan. This plan, adopted in 2010, provides the City of Port Phillip's plan for adapting to climate change. The overall aim of the plan is to make the City of Port Phillip more resilient to the impacts of climate change. It presents a range of objectives around climate resilient buildings, dealing with flooding, beach protection, urban heat island effect and so on.
- These documents accord with the intentions of this plan.

Source: City of Port Phillip 2011, Greenhouse Plan – Low Carbon City, City of Port Phillip, Melbourne 2011

Figure 5 City of Port Phillip Greenhouse Plan Structure

[4] City of Port Phillip, *City of Port Phillip's Water Plan*, City of Port Phillip, Melbourne, viewed 4 June 2013, < http://www.enviroehub.com.au/uploads/policies-and-strategies/Water_Strategy.pdf>

4.2.2 City of Melbourne Planning Scheme Amendment C187

The City of Melbourne's planning scheme amendment, C187, was enacted in April 2013. The aim of the amendment is to provide guidelines to:

- Minimise the production of greenhouse gas emissions and maximise energy efficiency.
- Minimise mains potable water use and encourage the use of alternative water sources.
- Minimise waste going to landfill, maximise the reuse and recycling of materials and lead to improved waste collection efficiency[5].

While the ultimate amendment was diluted when reviewed by the Planning Panel, the document provides leadership in the area of sustainability. In particular the document contains performance measures that address the various requirements of energy, water and waste for differing types and sizes of buildings.

4.3 OLV strategy

The Victorian State Government has established a new agency titled the Office of Living Victoria (OLV), originally within the Department of Sustainability and Environment, but now located in the Department of Environment and Primary Industries (DEPI). The purpose of the agency is to work with various organisations and government departments to influence the way urban environment and water cycle systems are planned for, designed and managed. The agency will also implement a number of reforms to drive generational change in the way Melbourne uses rainwater, stormwater and recycled water to reduce the need for large-scale pipelines, desalination plants and major pumping and treatment plants.

To achieve this, OLV has established three key objectives:

1. To integrate urban planning and water cycle management planning at city/regional scale.
2. To embed IWCM in the design and construction of Victoria's precincts and buildings.
3. To deliver an informed and common understanding of IWCM.

OLV has also identified a priority to develop IWCM performance targets for inclusion in Precinct Structure Plans (PSPs). At the time of preparing this report, official targets had not been provided by OLV. However, GHD met with OLV during the stakeholder consultation phase of the assignment, and were provided with an initial indication regarding the potential order of magnitude of the targets that might apply to the FBURA. These targets have been adopted for the purpose of this project and should be reviewed when official targets are provided by OLV.

In addition, the direction of this new government agency is to consider opportunities for local recycling (i.e. both wastewater recycling and storm/roof water harvesting capture and reuse) to reduce the impact of the growth on Melbourne's water and sewerage networks. OLV has identified this as being key to achieving "a smart and resilient water system for a liveable, sustainable and productive Melbourne". The development of an integrated water management solution for Fishermans Bend is to incorporate OLV's overarching objectives.

[5] Department of Planning and Community Development, 2012, *Panel Report – Melbourne Planning Scheme, Amendment C187,* Melbourne

4.4 State Waste Management Strategy

In April 2013 Sustainability Victoria released "Getting Full Value – The Victorian Waste and Resource Recovery Policy". The newly released policy includes seven principle goals:

- Assist Victorians to reduce the waste they generate and save Victorian's money through efficient use of resources
- Facilitate strong markets for recovered resources
- Facilitate a Victorian waste and resource recovery system that maximises the economic value of waste
- Reduce the environmental and public health risks of waste
- Reduce illegal dumping and littering
- Reform and strengthen the way institutions work and are governed to effectively implement waste policy[6]

There are a number of strategic directions that sit beneath each of these goals. Ultimately these goals and directions will provide the basis for waste management policy into the future. The report provides details of waste generation and diversion. In particular it notes that major gains have been made in the construction sector, where the report estimates the recovery rate is around 83%.

[6] Sustainability Victoria 2013, *Getting Full Value – The Victorian Waste and Resource Recovery Policy,* State of Victoria, Melbourne, viewed on 4 June 2013,
< http://www.dse.vic.gov.au/__data/assets/pdf_file/0005/164372/Getting-full-value-WEB.pdf>

5. Business as Usual Strategy

The 2012 infrastructure capacity assessment also identified capacity and constraints associated with existing trunk and major infrastructure in the FBURA, and the extent of BAU (BAU) upgrades required to cater for intensified residential and mixed use development.

In 2013, Places Victoria confirmed a new the development scenario to be adopted (i.e. population density and distribution) for development of the infrastructure plan. Based on this data, GHD refined the BAU upgrade identified in the infrastructure capacity assessment in consultation with the relevant utilities.

This section sets out the findings.

5.1 Water Supply

5.1.1 Authorities Consulted

Melbourne Water Corporation (MWC) is the responsible authority for the trunk water supply transfer network in the FBURA. South East Water Corporation (SEW) is the water retailer responsible for the distribution and reticulation network. City West Water (CWW) is the responsible authority for the distribution and reticulation network to the north of the precinct. Whilst CWW is not directly affected by the development in Fishermans Bend, the CWW network may form part of the solution for augmentation of the Fishermans Bend water supply network.

5.1.2 Future Water Demands

A business as usual approach to the nominated development scenario for Fishermans Bend will trigger the need for upgrade works to both the water supply reticulation and distribution network within Fishermans Bend and the transfer network into the precinct also. The extent of the upgrades required is dependent on peak water supply demands and the capacity of the existing system to cater for these demands.

Table 5 summarises the demands estimated for the BAU strategy.

Table 5 Water Demands

	Peak hour demand (L/s)	Peak day demand (L/s)	Peak day demand (ML/day)
BAU	800	300	26

The assumptions adopted for the development of the demand figures in the table above are outlined in Appendix B, and are consistent with those adopted by SEW for the Southbank Integrated Water Management strategy:

SEW has advised that it is currently creating a subzone within the Fishermans Bend potable water network to assist it in better understanding the existing potable water demand within the area and the capacity of the existing system to cater for future development within Fishermans Bend. At the time of preparing this report, SEW advised that the results of the investigation would be available in approximately 2-3 months. In the absence of this information, and for the purposes of defining the infrastructure requirements associated with the BAU and ISS options, the infrastructure capacity has been sized for the estimated future ultimate demand. This does not assume any capacity in the existing system and therefore is a conservative estimate.

5.1.3 Upgrade Options:

Initial advice from SEW indicated that a new 600 mm pipeline and a 17 ML underground storage tank and pump station would be required for a 'Medium Density' redevelopment scenario.

This option was refined by GHD in consultation with SEW and MWC for the adopted development scenario. The upgrades required are outlined in Table 6 below:

Table 6 Water Supply Upgrades

Option	Transfer Source	Transfer requirement	Storage*	Distribution network	Reticulation network
BAU	MWC 1100 Punt Road main	4 km of 600 mm pipeline	8 ML tank	450 mm cross connection between the existing 300 mm loop to distribute peak flows	Extensions to service individual developments not assessed

*MWC has advised that the Punt Road main does not have capacity to supply the Fishermans Bend peak hour demand, therefore, inclusion of storage will be necessary to balance the peak supply rate.

SEW also advised that for hydrant flow and gravity supply, a minimum residual pressure of 35 metres is required in the street to provide a residual pressure of 20 metres at the 'furthest disadvantaged hydrants' within the development.

SEW is also investigating the feasibility of stipulating a minimum potable water main size of 225 mm throughout the CBD and inner urban areas (such as Fishermans Bend) to ensure there is sufficient water for fire fighting purposes. Given this is still under consideration, no allowance has been made for minimum size 225 mm water mains in the plan.

5.2 Sewerage

5.2.1 Authorities Consulted

MWC is responsible for the trunk sewerage network in the FBURA. SEW is the water retailer responsible for sewerage distribution and reticulation infrastructure.

5.2.2 Future Sewage Generation Loads

Table 7 summarises the sewerage generation rates assumed to determine the impact of the adopted development scenario on the existing sewerage infrastructure network.

Table 7 Sewage Generation Rates

Strategy	Residential (L/p/d)	Non-residential (L/p/d)
BAU	149	86

The impact of the sewage loading rates outlined in the table above was assessed using the latest version of the Hobsons Bay South Yarra Infoworks CS sewerage model provided by SEW. Using the model, the impact of the total sewage load for the adopted development scenario (i.e. 83,445 Residents and 42,285 Employees) was confirmed. An inflow and infiltration rate was also applied to confirm the capacity of the sewerage system to cope with both future sewage loads and wet weather inflow and infiltration.

5.2.3 Upgrade Options

South East Water

The following guidelines were adopted in consultation with SEW for defining the requirement for sewerage upgrades within Fishermans Bend.

- Upgrade to the sewerage network when the 'freeboard to spill' (i.e. the distance from the top water level in the sewer to ground level) was less than 1 m for the 1 in 5 year average recurrence interval (ARI) design storm event.
- Upgrade the sewerage network when dry weather surcharge exceeds 0.5 m above the sewer obvert.

Based on these guidelines it was found that in all but two isolated locations, the existing sewerage system within Fishermans Bend would cope with the increased sewage load from development within the precinct. In these two isolated locations the following upgrades would be required to increase the hydraulic capacity of the existing sewerage system.

- Pump station to receive overflow from the existing sewer, with the overflow set at sewer obvert level.
- Associated rising main to discharge to a downstream sewer with sufficient capacity.

These upgrades are outlined further in the Table 8.

Table 8 Sewerage System Upgrades

Upgrade Description*	Pump Requirement	Rising Main Details
High level diversion from the Inglis Street branch sewer to divert flows to the Melbourne Main Sewer	8 kW (26 L/s @ 23 m)	960 m of 150 mm
High level diversion from the Nott Street branch sewer to divert flows to the Melbourne Main Sewer	9 kW (47L/s @ 13 m)	370 m of 180 mm

* Diversion of flows is to an existing sewer that runs parallel to the Melbourne Main sewer to pick up reticulation connections before discharging to the Melbourne Main Sewer.

In addition to the upgrades outlined in the Table 8, it was assumed that all gravity sewers would be re-lined. The reduced diameters and changes to roughness values were taken into account in the hydraulic modelling.

Similar to the water supply network, extensions to the sewerage network to service individual developments was not assessed as the cost is assumed to be borne by the developer.

Melbourne Water Corporation

MWC was consulted to confirm the impact of the adopted development scenario on its trunk infrastructure. The key MWC infrastructure affected by the increased loads from the FBURA includes the Melbourne Main Sewer (MMS) and Hobsons Bay Main Sewer (HBMS). In addition, downstream infrastructure such as Brooklyn Pump Station, Hoppers Crossing Pump Station and Western Treatment Plant would be affected also.

MWC advised that upgrade of the HBMS is included in MWC's 20 Year Capital Plan. The project is driven by asset condition, but may also address capacity constraints in the system. MWC advised that any future renewal works for the HBMS would take into account growth, including the Fishermans Bend development. Therefore, future plans to upgrade this critical asset would ensure there is sufficient hydraulic capacity to cater for increased sewage loads.

The MMS runs from the Yarra River to Fennell Reserve and through to Swallow Street, where it connects to the HBMS. MWC recently completed the MMS replacement to address hydraulic constraints in the sewerage system. The new sewer has approximately three times the capacity of the original brick-lined sewer, and MWC advised that it has sufficient capacity to cater for the increased sewage loads from the Fishermans Bend development.

MWC also advised that its infrastructure downstream of the HBMS (i.e. Brooklyn pump station etc) has either sufficient existing capacity to cater for the increased sewage loads from Fishermans Bend, or there are planned upgrades that would address any constraints in the near future (i.e. upgrade of the activated sludge plant at Western Treatment Plant).

In summary, the Fishermans Bend development would not trigger any upgrades to the MWC headworks in excess of their existing future planned capital works program.

5.3 Stormwater Drainage & Flooding

5.3.1 Authorities Consulted

The regional drainage network in Fishermans Bend is managed by MWC. City of Melbourne (CoM) and City of Port Phillip (CoPP) are responsible for local drainage infrastructure, typically servicing catchments less than 60 Ha within their municipalities.

5.3.2 Stormwater Flooding

CoPP advised that for the 5 year rainfall event, significant flooding occurs in the Montague precinct under current conditions. CoPP also identified three flooding hot spots:

- Gladstone Lane / Montague Street – where tidal related and frequent street flooding has caused the lane to become muddy. Damage has been reported to cars parked in the lane and there have also been reports of flooding entering buildings.
- Montague Street – blockages over grates has been noted at an underpass. Associated flooding has also impacted on traffic flow.
- Johnston / Munro Streets – In heavy rain, runoff cannot enter pipes. Building damage due to flooding where there is a combination of high tide and rainfall. In tidal flooding events, mud and debris is pushed up the pipeline.

In addition to the flooding hot spots outlined above, CoPP has advised that flooding across Fishermans Bend is widespread and more extensive than the flooding shown in Appendix C.

CoPP advises that their modelling indicates existing issues will be exacerbated by long term secondary consolidation of the Coode Island Silts as well as increasing Bay and River levels due to climate change and increasing development in the upstream catchment.

The flat and low lying nature of the FBURA constrains the municipal and MWC stormwater drainage networks.

As reported in the original infrastructure capacity study (*Fishermans Bend Infrastructure Assessment, GHD, 2012*), the CoPP indicates there are constraints in the stormwater network due to the MWC drainage outfalls, which may be exacerbated by the low lying nature of the land. These constraints can result in flooding caused by high tides reducing the capacity of the MWC stormwater drains to discharge runoff into Port Phillip Bay.

In response to flooding issues within the precinct, in April 2013, MWC provided advice regarding an increase to the recommended floor levels for the Fishermans Bend area. Their advice confirmed that the current 100 year flood level for the Fishermans Bend area is 1.6 m Australian Height Datum (AHD) and based on climate change predictions reflected in Clause 13.01 (State Coastal Inundation and Erosion Policy), the adopted flood level for 2040 is 1.8 m AHD (200 mm rise above existing level) and the adopted 2100 level is 2.4 m AHD (800 mm above the existing level). Based on this advice, MWC recommended the following floor levels as outlined in Table 9.

Table 9 Recommended Floor Levels – Fishermans Bend

Land Use	Floor Level Metres AHD
Habitable Residential and Office	3.0
External entry to individual dwellings	1.9 to 2.1
Commercial Lobbies/Retail	2.4
Lifts/Services	3.0
Garage/Car Parking entry	2.4 plus 600 mm mechanical freeboard
On street parking spaces	1.9 to 2.1

A tailwater[7] level of 2.4 m AHD was assumed in line with the 100-year bay level with sea level rise provided by MWC (year 2100), therefore there will be little drainage from Fisherman's Bend via gravity. The areas which are above the 2.4 m AHD level drain to lower lying areas which would themselves not drain, thus transferring the problem downstream if no alternative is provided. With potentially high tailwater levels in the Bay and the Yarra River, Table 10 summarises the volumes that would need to be stored or pumped to minimise flooding of Fisherman's Bend or downstream areas.

Table 10 Stormwater Flood Volume

Stormwater flood volume	5 year	100 year
Volume of rainfall on catchment for 72-hour event (m3)	250,400	488,960

As outlined in Table 10, there are significant volumes of stormwater that need to be addressed in the FBURA.

In addition, a draft plan from MWC showed the results of the revised 100 year flood level for Fishermans Bend. This is included in Appendix C.

5.3.3 Upgrade Options

Whilst the increase in proposed green space may slightly improve flooding issues in the short term, future long term secondary consolidation of Coode Island Silts, as well as increasing Bay and River levels due to climate change and increasing development in the upstream catchment will likely exacerbate existing flooding.

[7] Tailwater refers to the water level in the receiving water body, in this case either the bay or the Yarra River.

Even without a local rainfall event, predicted Bay and River level increases due to climate change will result in inundation of many areas. Typically the low lying areas which already experience flooding issues under current conditions could be expected to be more frequently flooded. Improving protection from this type of flooding is likely to require more than just pumps and storages, in some areas it may require a flood wall / barrage, back flow prevention devices etc. It is important that an overall concept is developed that can cope with the foreseeable changes that may occur. Ideally the plan should be implemented in a progressive manner so that adequate drainage standards can be achieved without unnecessarily large upfront commitments to allow for an uncertain future. This sort of inundation will need to be addressed on a regional level, and is beyond the scope of this plan.

To address these flooding issues, a number of options were developed which are summarised in Table 11 below. Each of these options takes into account future bay and river levels as advised by MWC.

Table 11 Drainage Upgrade Options

Upgrade Description	Comments
Fill	Fill the roads and/or potentially allow developers to determine the best approach to raise their habitable floor levels. Limitations of such an approach include: - The extent of imported fill required for the site would involve approximately 1 m of fill over an area of 250 hectares. It is unlikely that fill volumes of this order would be available in the current market and this solution is likely to be cost prohibitive. Other limitations of such an approach include: - Issues exist with staging widespread fill across the road pavements in parallel to development of the precinct. - In addition, the value of existing road pavements would be lost. The sustainability of such a solution as consolidation continues would present drainage issues in the future. Also there is potential for drainage and amenity impacts on neighbouring areas. **Option discounted.**
Stormwater harvesting and reuse from in ground drainage system	Salt water ingress from high groundwater tables and tidal flooding would result in expensive water treatment requirements, therefore reducing the viability of the option. Therefore, stormwater harvested from the Fishermans Bend drainage network was not considered further. **Option discounted.**
Stormwater harvesting channel network	Implementation of an extensive network of channels and distributed storage in a stormwater harvesting system, would have the benefit of separating stormwater from saline groundwater or floodwater. However, the practicality of such a network will be dependent on the urban form of the proposed development. **Option to be considered further.**

Upgrade Description	Comments
Stormwater retention/attenuation at the building scale and reuse	Stormwater retention/attenuation at the building scale is a critical element of the drainage solution. On-site stormwater retention storage would reduce the load on the gravity drainage network and also provide an alternative water source for reuse within the building and for irrigation of green areas immediately adjacent (including appropriately designed green rooves) to the building. In addition to reuse of the harvested stormwater, stormwater retention through raingardens, green rooves, pervious pavements and soak wells. The optimal retention strategy is to be determined at the building scale. **Option adopted.**
Stormwater infiltration within community infrastructure.	The adoption of precinct and street scale water sensitive urban design has the potential to play a role in overall stormwater management within Fishermans Bend. This would include innovative options such as pervious pavements, street scale rain gardens, permeable tramways etc. However, the benefits of adopting initiatives such as these are likely to be limited due to high groundwater levels across Fishermans Bend, and therefore should be considered as a complimentary alternative to the drainage strategy. **Option currently limited, to be considered further.**
Stormwater storage within open space areas	Approximately 45 -50 hectares (to be confirmed) of green space is proposed for the Fishermans Bend development. This green space provides a useful site for open attenuation of the stormwater. The green space can also substantially enhance stormwater quality if it is landscaped with grasses or wetland vegetation, as well as including soils that promote infiltration to the ground. An alternative option is to incorporate concrete storages modules below the green space areas, although this alternative is likely to be cost prohibitive. **Option adopted.**
Pumping	Despite the stormwater storage proposed within the buildings and green space areas, residual flooding would need to be addressed via a pumped system to transfer stormwater to the Yarra or the Bay. Whilst stormwater pumping is a 'last resort' due to the cost and associated energy consumption, it is considered unavoidable for the Fishermans Bend development, as the area required to provide sufficient storage is greater than that available in open space areas. **Options adopted.**

Based on the high level options outlined in the table above, further analysis was undertaken to determine the preferred drainage strategy which is shown in Appendix A. The steps undertaken include:

- Estimate the future imperious areas for the adopted development scenario
- Delineating drainage catchments based on GIS line work of the existing Council and MWC drainage network , 1 m contour data and open space locations, to identify suitable storage locations and outlets within the precincts
- Where proposed open space was inadequate or not in required locations, additional open space areas were considered, sized to store the 5-year 72-hour storm volume without pumping. Sizing was based on catchment areas, rainfall depths and the 5-year 72-hour rainfall depth of 100 mm being retained onsite for 50% of the property area within the catchment. The required areas were subsequently deemed to be prohibitively large, or the storages too deep to be practical in light of the water table level and alternative

solutions were developed as detailed below. Basins in open spaces were assumed to be either 0.6 m or 1.2 m deep, with 1v:5h batter slopes from the existing ground level, and set back 3 m from the edge of the open space.

- US EPA SWMM hydrological and hydraulic model was used to simulate the depth of flooding in the storages and existing streets for the 5 and 100 year design storms (for a range of durations from 10 minutes through to 72 hours). The modelled stormwater systems includes a number of assumptions and characteristics including:
  - The model assumes the first 101 mm of runoff from 50% of the non-open space block area is captured onsite, and does not enter the drainage network. This allows for onsite retention and reuse.
  - The current investigation has assumed that there is, or will be, adequate capacity to transfer flows within the precincts to the storage / outlet locations. The performance of the existing stormwater drainage network is expected to improve with the recommended outfalls; however detailed assessment of the collection system is beyond the scope of the current investigation.
  - The extent of pumping required to transfer flow to the Yarra or the Bay from areas below the 2.4 m AHD tail water level was estimated.
  - Designated open space areas were nominated as buffer storages.
  - Typically wet wells are located at key non-open space catchment outlets.
  - A two stage pump solution is proposed with each individual pump sized to cope with the 5 year event. The combined capacity of both pumps is adequate to limit the ponded flood depth within the existing road network for a 100 year ARI event to a maximum 150 mm. The depth of 150 mm is typical of a top of kerb level in accordance with the more restrictive of the major storm ponding depth limits contained in Table 5.2 of Guide to Road Design Part 5A: Drainage - Road Surface, Networks, Basins and Subsurface – Austroads 2013. In areas of high flow velocity stability criteria may require lesser depths (refer Australian Rainfall and Runoff Project 10).
  - Minimum required volumes between start and stop levels (to limit allowable pump starts per hour) were considered in sizing the wet wells and setting start and stop levels, along with existing ground levels and the inverts of the existing drainage network. Where the inverts of the existing drainage network were not known they were estimated based on an assumed cover of 0.6 m.

Based on the modelling, the preferred upgrade option is outlined in Table 12:

Table 12 Preferred Drainage Options

Description	Capacity of upgrade	Comments
Stormwater attenuation at the building scale*	75,000 m3	Each building to store 50% of the runoff for a 5 year 72 hour event
Mandate for all new buildings to incorporate green rooves across the precinct	NA	Green rooves to reduce the impervious area of the development and minimise the volume of storage required in each of the basins.
Open storage	45,000 m3 (assumed depth 0.6 m) 42,000 m3 (assumed depth 0.6 m) 25,000 m3 (assumed depth 0.6 m) 21,000 m3 (assumed depth 1.2 m) 5,000 m3 (assumed depth 0.6 m)	To be stored across the five proposed green areas.

Description	Capacity of upgrade	Comments
Stormwater pump stations	45 kW @ 600 mm diameter 60 kW @ 800 mm diameter 45 kW @ 600 mm diameter 45 kW @ 225 mm diameter	Pump stations to transfer peak flows to the Yarra and the Bay. 4 m wet well assumed for three pump stations, 2 m diameter for the fourth.
Flooding within roads	N/A	Maximum allowable flood value of 150 mm in the existing roadways for a 100 year event.

* Roofwater harvesting to include automated control of the individual storage tanks via an intelligent network to ensure that storages are emptied ahead of approaching rainfall events. Such systems may currently be prohibitively expensive for individual households, however, with greater update of the technology, it is anticipated to become more affordable in the future.

The stormwater upgrade option outlined in Table 12 has the following limitations that are to be considered further:

Limitations

- Further analysis is required including complete modelling of the collection system, taking into account detailed development plans and terrain data to optimise the entire system including storage layout and pumping infrastructure.
- In addition, analysis to estimate the frequency of flooding of the open space areas is required to assess the suitability of using these areas for both storage and community spaces.
- There may be low points or constraints within the existing drainage system which may also need upgrading. These have not been assessed at this conceptual stage.
- Further assessment of the capture and storage assumptions should be undertaken as development concepts are further detailed and refined.
- While the concepts have considered their potential impact on neighbouring areas, it is suggested that further integration beyond the current precincts may lead to improved drainage outcomes for both the precinct and the surrounding areas.
- Further consideration of the landscaping and WSUD potential of the storages should be undertaken to best support the multiple uses proposed within the communal open spaces.
- Excavation in green open space is to remain above ground water table. Further investigation is required.
- The proposed concept has made a number of assumptions regarding the desired reliability and standard of proposed drainage system. It is recommended that a detailed risk and value management assessment is undertaken to refine these initial assumptions. This process should further consider a number of aspects including:
  - Power failure
  - Blockage
  - Residence time
  - The balance between cost and level of service
  - Energy requirements and durability of the system
  - Safety and egress

5.4 Electricity

5.4.1 Authorities Consulted

The Victorian transmission network is predominantly owned, maintained and operated by SPI PowerNet. The assets that SPI PowerNet owns, maintains and operates include terminal stations and transmission lines, which connect the power stations to the terminal stations.

The distribution network connects to the Terminal Stations, and extends to the individual properties. The relevant distribution business in the FBURA is CitiPower.

5.4.2 Future Energy Demands

The electricity demands estimated for Fishermans Bend are summarised in Table 13.

Table 13 Electricity Demands

	Residential (MWH/annum)	Commercial (MWH/annum)
BAU	251,000	146,000

The nominated development scenario for Fishermans Bend will trigger the need for upgrade works to the distribution network within Fishermans Bend.

5.4.3 Upgrade Options:

The existing electricity assets within Fishermans Bend include:

- Fishermans Bend Terminal Station (converts overhead electrical energy from 220 kV to 66 kV)
- Existing zone substations
- 6.6 kV overhead distribution network

The Fishermans Bend Terminal Station is located west of the Lorimer Precinct and converts electrical energy from 220 kV to 66 kV and supplies the CitiPower and Powercor electricity distribution network which in turn supply the neighbouring areas. SPI Powernet requires that the proposed development does not encroach on transformer access routes to the FBTS. Its existing spare capacity (as at 2011) for the FBTS is 59 MVA. One of the 220/66 kV transformers at FBTS together with a 220 kV circuit breaker and some 66 kV circuit breakers will be replaced in circa 2019 to replace aged assets with increased failure rates. These upgrade works are likely to take three years to complete and will cost in the order of $25 million. These works need to be confirmed through detailed demand energy modelling, which would be completed by CitiPower.

The existing zone substations in the FBURA and immediate surrounds are listed in Table 14.

Table 14 Zone Substation Attributes

Zone Substation	Rating	Present Loading	Voltage
E Zone Substation (E)	22 MVA	7.4 MVA	6.6 kV supply
West Gate Zone Substation (WG)	72 MVA	40 MVA	11 kV supply
Port Melbourne Zone Substation (PM)	28 MVA	17 MVA	6.6 kV supply
Fishermans Bend Zone Substation (FB)	64 MVA	25 MVA	11 kV supply

Zone Substation	Rating	Present Loading	Voltage
Montague Zone Substation (MG)	62 MVA	45 MVA	11 kV supply
Docklands Substation (DLF)	unknown	unknown	22 kV supply

The existing spare capacity for the zone substations (not including the Docklands Substation) is 114 mVA.

A concept for the necessary upgrades to the Fishermans Bend distribution network was developed by GHD in consultation with CitiPower. In summary the upgrades involve:

- Upgrade the electricity distribution network from 6.6 to 11 kV
- Upgrade all existing zone substations to 11 kV
- Increase the number of zone substations to cater for the increased load
- Conversion of all overhead power lines to an 11 kV underground power network

A summary of the upgrades is outlined in Table 15.

Table 15 Upgrades to the Electricity Network for BAU

Description	Quantity	Comments
New 1000 kVA substations	33	Assume pad mounted zone substations that may be located in building basements. The locations are to be determined as the development progresses
11 kV 80 mm cable	1,466	Underground cable
11 kV 100 mm	12,040	Underground cable
11 kV 125 mm	6,344	Underground cable

Based on discussions with CitiPower, we understand that upgrades to all upstream infrastructure (i.e. zone substations etc) would be funded by CitiPower through their tariff scheme.

We have assumed that the overhead 220 kV and 66 kV lines would not be replaced with an underground line due to the significant cost involved and potential for significant disruption.

GHD initially proposed to upgrade the electricity network to 22 kV, however, CitiPower advised that this would involve a fundamental change in the current system. Whilst an upgrade to 22 kV is possible, the upgrade would need to be undertaken over a short period of time to justify the expenditure of upgrading from 11 kV to 22 kV. If there is uncertainty regarding the development period, the upgrade to 11 kV is easier to achieve and fund.

5.5 Gas

5.5.1 Authorities Consulted

APA GasNet is the transmission pipeline network and asset owner. Gas is depressurised at city gates and field regulators to appropriate pressures for the distribution of gas to final users. The asset manager organisation Zinfra is responsible for the gas distribution assets in the FBURA on behalf of United Energy and MultiNet Gas, the asset owner.

5.5.2 Future Energy Demands

Table 16 summarises the estimated gas demands for the precinct.

Table 16 Gas Demands

Strategy	Residential (GJ/annum)	Commercial (GJ/annum)
BAU	1,151,550	163,260

The adopted development scenario for Fishermans Bend will trigger the need for upgrade works to the distribution network within Fishermans Bend.

5.5.3 Upgrade Options

The existing gas assets within Fishermans Bend include:

- A 750 mm diameter gas transmission pipeline that runs through the Montague precinct and along the south west corner of Wirraway. This pipeline is considered by APA GasNet to be a major asset and pipeline protection works may be required for asset integrity and public safety reasons. Asset integrity works for this major asset has not been considered in the development of the plan.
- The existing gas distribution network in the FBURA consists of low, medium and high pressure gas mains. The Lorimer, Montague and Wirraway Precincts have some coverage of high pressure gas mains. The Sandridge Precinct has extensive high pressure gas coverage. There is also transmission pressure gas to the now decommissioned Simex cogen plant.

Upgrades to the gas network for Fishermans Bend will involve extension of the high pressure gas network to areas currently not serviced. This is summarised in Table 17.

Table 17 Extension to the High Pressure Gas Network

Description	Quantity	Comments
Lorimer Precinct	1,300 m	Extension of 150 mm high pressure gas main to areas not serviced.
Montague Precinct	6,000 m	
Sandridge Precinct	2,400 m	
Wirraway Precinct	1,850 m	

5.6 Tele-communications

5.6.1 Authorities Consulted

Telstra remains the dominant telecommunications provider particularly in the fixed line market, however, with the introduction of the National Broadband Network (NBN) this will likely change. NBNCo is wholly Government owned, with the role to design, build and operate the NBN. NBNCo will become the wholesale provider of fixed line telecommunications through a network of fibre optic cables to be rolled out over the next 10 years or so.

5.6.2 Upgrade Options

Optical fibre communication is the best available technology for Internet, telephony and data transmission. Optical fibre has greater speed and capacity than traditional Telstra copper-based services.

NBNCo has flagged release of its business grade services, these services will be designed to support high speed internet access and multi-line telephony, similar to existing Telstra business services within the Precinct.

On 29 March 2012, NBNCo announced Stage 1 of their large-scale rollout of the National Broadband Network. The FBURA is not within the three year rollout. NBNCo had previously advised that the rollout to the FBURA is likely to occur in the medium term, and at this stage there are no changes to this advice. NBNCo are confident that roll out of the optical fibre network will address issues associated with insufficient capacity in Telstra's existing network.

An optical fibre system will support the implementation of a smart metering grid across the development (refer to Section 7).

5.7 Waste

5.7.1 Authorities Consulted

The Metropolitan Waste Management Group is responsible for municipal solid waste management and planning in Melbourne. They have a number of objectives including to ensure waste and resource recovery is supported by statutory planning processes and decisions. In addition, the CoPP and CoM are responsible for garbage and recycling services within the FBURA.

The current waste management targets were set by Sustainability Victoria (SV) in 2004. The key targets and the actual results to 2009 – 2010 are included in Table 18 [8].

Table 18 Current Waste Diversion Targets

Description	2014 Target	2009 – 2010 Result
Solid waste recovered for reuse, recycling and/or energy generation	75%	66%
Municipal solid waste recovered	65%	48%
Construction and demolition waste recovered	80%	80%

In April 2013 the DSE released "Getting Full Value – The Victorian Waste and Resource Recovery Policy"[9]. This document is a policy document that sets the 30 year vision for waste management in Victoria. It does not set specific measurable goals, but rather is set at a higher level.

5.7.2 Future Waste Generation Volumes

Table 19 summarises the waste generation volumes estimated for the BAU strategy, these are based on assumptions outlined in Section B.

Table 19 Waste Demands

Strategy	Garbage (tonnes/annum)		Recyclables (tonnes/annum)
	Organics	Non-Organics	
BAU	13,350	26,700	36,700

[8] Department of Sustainability and Environment (2012), *Waste Policy Review – Discussion Paper*, DSE, Melbourne, Victoria
[9] Department of Sustainability and Environment (2013), *Getting Full Value: the Victorian Waste and Resource Recovery Policy*, DSE, Melbourne, Victoria

It is anticipated that the increased density of the proposed development will generate an increased volume of waste in comparison to the volume currently generated. In addition, throughout the development of the precinct, a significant volume of waste will be generated by construction activities.

5.7.3 Upgrade Options

Sustainability Victoria has identified a series of opportunities to improve the recovery rates and end use markets for construction waste. It is proposed that these be applied to all development works within Fishermans Bend:

- Construction waste management planning
- Sustainable procurement including a framework that addresses:
  - The financial, social, ethical and environmental implications of the purchase of good and services
  - Development of specifications, accreditation, quality assurance and awareness processes
- Investment in infrastructure and produce development in proximity to markets

Consideration of how waste will be handled in large developments is required, particularly in high rise developments. Measures that assist in the source separation of recyclables from non-recyclables are considered key to increasing diversion rates.

Within the precinct, waste is currently handled at the existing waste transfer facility (WTF), pictured in Figure 6 that exists on the corner of Boundary and White Streets.

Figure 6 City of Port Phillip Waste Transfer Station

The existing WTF, operated by CoPP, is situated within the area proposed for high density redevelopment in the Sandridge precinct. Relocation of the WTF to outside of the FBURA will be critical to enhancing the amenity of the existing area, and to ensure roads within this precinct are not congested by trucks and large vehicles associated with the operation of the WTF, which is often early in the morning. At present the WTF accepts drop off of general household waste and also a range of recyclables.

The same level of service provided by the existing WTF is to be maintained, and therefore, the ultimate location of the WTF needs careful consideration, either to a new location within FBURA or an area outside of, but in close proximity to the FBURA. A total area of 7,500 m^2 is required for the new facility (based on the size of the current site). At this stage a suitable site has not been identified.

In addition, regular waste and recycling collection services are proposed within the precinct along with waste compaction at the building scale. This would typically be undertaken by a contractor such as SITA or Veolia. Compaction of waste can achieve up to a 4:1 compaction ratio (i.e. 4 m^3 of waste is compacted to 1 m^3), which would minimise waste transfer costs.

6. Targets and Objectives for the Plan

The Fishermans Bend development has been identified as an opportunity to establish a leading example of sustainable development, and showcase an integrated approach to energy, water, and waste. This opportunity has been articulated by the overarching strategic statement prepared by the Fishermans Bend Utilities and Environment Working Group (the Working Group) and is summarised below:

> *The Fishermans Bend Urban Renewal Area will be recognised internationally as a leader in the design, delivery and operation of sustainable infrastructure. Integrated energy, water and waste systems will utilise local resources within and beyond the precinct to minimise environmental impacts and support a resilient and connected neighbourhood. New approaches to delivery, finance and governance will maximise collaboration across public and private entities, ensuring the system is viable and a generator of significant social, environmental and economic value."*
>
> *Fishermans Bend Utilities and Environment Working Group Strategic Statement*

This overarching strategic statement was further developed by the Utilities Working Group into a set of qualitative targets and objectives for the Plan. These are summarised in Table 20.

Table 20 Targets and Objectives for the Plan

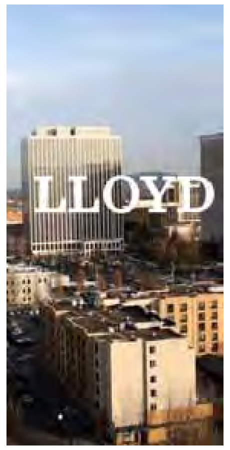
Objective	Performance criteria
Deliver a low carbon city that minimises greenhouse gas emissions.	• Energy demand reduced through improved building efficiency. • Use of non-renewable energy resources minimised by incorporating local low carbon energy generation. • Reliance on cars reduced by integrating sustainable transport solutions that promote other modes of travel.
Deliver an integrated water cycle management solution that minimises potable water use and improves the health of waterways and open spaces.	• Potable water demand reduced through improved building efficiency and alternative water supply solutions. • Adverse impacts on receiving water bodies reduced through improved quality of stormwater run-off. • Adverse impacts of local nuisance flooding reduced through stormwater management solutions.
Deliver a waste management system that reduces environmental impacts and maximises the recovery of resources.	• Amount of waste to landfill reduced by providing local infrastructure to facilitate recycling and capture of resources. • Building services improved to provide efficient waste collection services. • Ability to adapt waste management practices through improved infrastructure provision

Objective	Performance criteria
Deliver buildings that are environmentally sustainable.	• Environmental impacts of buildings reduced through increased stringency of building performance requirements. • Building services delivered more efficiently by encouraging connection to precinct-wide sustainable infrastructure. • Affordable living outcomes improved through reduced operational costs.
Deliver an integrated infrastructure solution that is adaptable and resilient.	• Ability to adapt to shifts in government policy, market conditions and technology enabled through a flexible delivery model. • Future risks on infrastructure and development reduced through planning for potential climate change impacts. • Synergies across systems captured through a holistic view of infrastructure provision.

6.1 Best Practice Approach to Targets and Objectives

With the assistance of Portland Sustainability Institute (PSI), GHD undertook a scan of international EcoDistricts to understand the types of targets, goals and objectives that have driven exemplary outcomes for these developments. In each case, quantitative targets and objectives were adopted to drive the implementation of the scheme to assist in achieving the overarching objectives for the development.

A summary of the targets and objectives for three of these EcoDistricts is provided below.

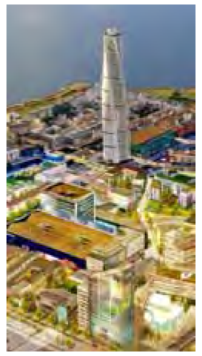


Lloyd Ecodistrict

Located in Portland, Oregon, this EcoDistrict involves approximately 160 ha of commercial development and some residential development. A set of targets were developed for the precinct which are largely based on a 'zero in/zero out' policy regarding resource management. They also developed a 'return on investment goal' which required capitalisation on investments within ten years or less.

Targets for the EcoDistrict include:

- creation of 10,000 new jobs
- 60% energy reduction
- 58% water reduction
- 93% waste reduction



Malmo Western Harbour

Located in Malmo Sweden, this EcoDistrict involves approximately 140 ha of former polluted ship yard and industrial land, to mixed use and residential development.

The target for the district is to produce 100% of renewable energy. To achieve this, the development includes low carbon energy sources such as biogas from residents' waste, and also highly efficient housing stock.

Capital Hill EcoDistrict

Located in Seattle, Washington the EcoDistrict involves a 220 ha site and a mix of residential and commercial development is proposed as part of the redevelopment.

At this stage only qualitative goals have been developed, it is intended that these would inform the development of measurable goals for the development at a future stage.

6.2 Quantitative Targets for Fishermans Bend

In accordance with these exemplary developments, the objectives and performance criteria for Fishermans Bend were distilled into a number of quantitative targets for the precinct, which are summarised in Figure 7.

Figure 7 Quantitiatve Targets for Fishermans Bend

The targets outlined in the figure above will provide an effective tool to provide leadership, guidance and strategic direction for achieving the sustainability objectives for the development.

The purpose of these targets is to provide a basis for comparison of the BAU and ISS options and as development commences, the targets are to be reviewed periodically (i.e. every 5 years) to ensure the precinct continues to meet and exceed best practice standards.

For the adopted development scenario, Table 21 summarises the estimated consumption and waste generation volumes for Fishermans Bend. An assessment of the extent to which the adopted ISS achieves the set targets for water, waste and energy, in comparison to the BAU option, is outlined in Section 8. Further investigation and consideration of OLV and Council strategies is required to ensure alignment between these goals and the strategies.

Table 21 Targets and Objectives for the Plan

Target	BAU Demands and Waste Generation Volumes	Targets against the Benchmark
Population	• Anticipated to increase to: – 84,445 residents – 42,285 employees	NA
Carbon emissions from buildings	394,220 CO2 -e/year	5 Star/Green Star minimum performance standard*
Potable water use	6,500 ML/annum	2,600 ML/annum
Waste to Landfill	76,700 tonnes/annum	75 % recovery by weight
Wastewater discharge	5,770 ML/annum	4,040 ML/annum
Stormwater reduction**	1,500 ML/annum	900 ML/annum

* Or suitable equivalent standard

** In addition to the stormwater volume reduction target, best practice water quality standards should be mandated across the precinct.

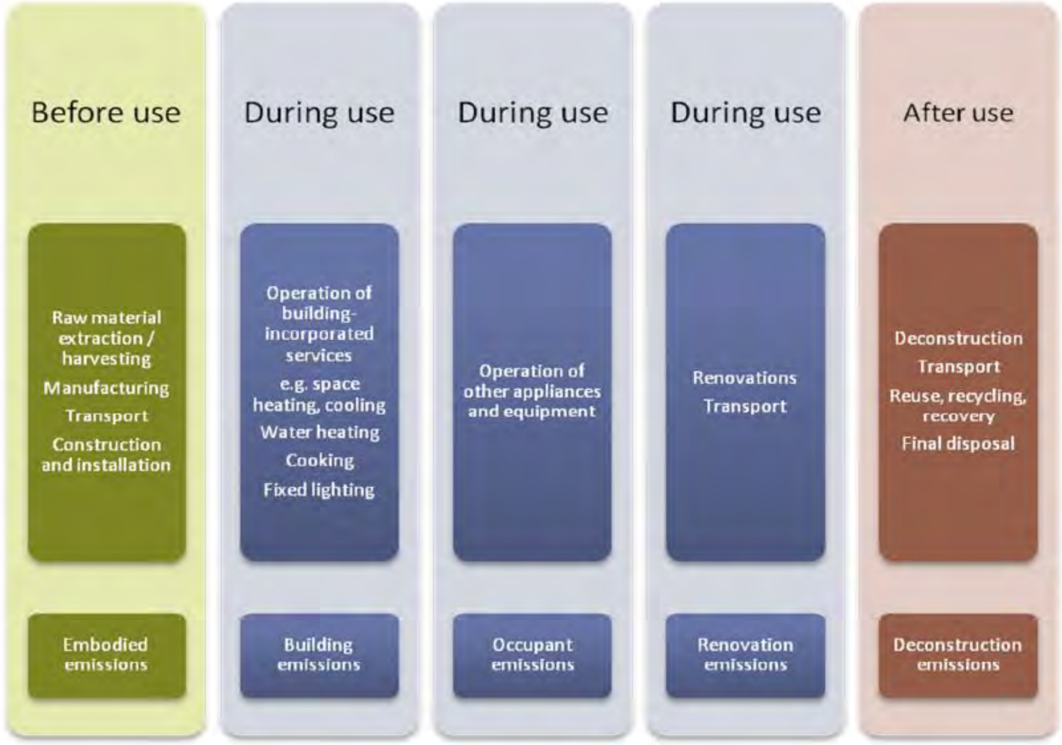
6.3 Carbon Neutrality

Whilst there is no legislation in Australia that directly requires new development to achieve carbon neutrality, there are existing guidelines, such as the City of Melbourne's C187 Planning Scheme Amendment that encourages that "all new buildings are eco-friendly to improve the efficiency of individual buildings"[10]. In other parts of the world there are individual cities and/or countries that have regulatory programs to achieve carbon neutrality. For example, in the United Kingdom, all new residential buildings are to be carbon neutral by 2016, whilst in Seattle, by 2030, the City has plans to be the first North American city to achieve carbon neutrality.

So whilst a target of net zero carbon emissions for all new buildings within Fishermans Bend is certainly achievable, a detailed carbon reduction strategy would be required to map out the how the precinct will achieve such an objective. A strategy should seek to address the following important questions:

- What elements of residential or commercial buildings should aim to go carbon neutral? The answer to this question will vary depending on the nature of the development. The various phases of building life cycle are shown in Figure 8.

[10] Melbourne Planning Scheme Amendment C187 – energy, water and waste efficiency



Source: Reidy, C., Lederwasch, A., and Ison, N., 2011, Defining zero emission buildings – Review and recommendations: Final Report. Prepared for Sustainability Victoria by the Institute for Sustainable Futures, University of Technology, Sydney.

Figure 8 Conceptual breakdown of building life cycle.

The Australian Sustainable Built Environment Council (ASBEC) suggests the starting point should be zero emissions from building-incorporated services, or "building emissions" as detailed in Figure 8. Incorporation of other elements from the building life cycle may be considered in the future.

- Who is responsible for implementing and administering the strategy, and how are stakeholders engaged to enact such a strategy?
- What role will offsets play in achieving carbon neutrality?
- How will greenhouse gas emissions be accounted for and reported?
- Will the journey to carbon neutrality be a staged process? A long term aspiration to achieve carbon neutrality may need to be balanced by setting short/medium term targets to progress towards the ultimate goal. For Fishermans Bend, Figure 9 presents a potential timeline for progression to carbon neutrality. The importance in achieving carbon neutrality is to plan to achieve the ultimate objective right from the start.

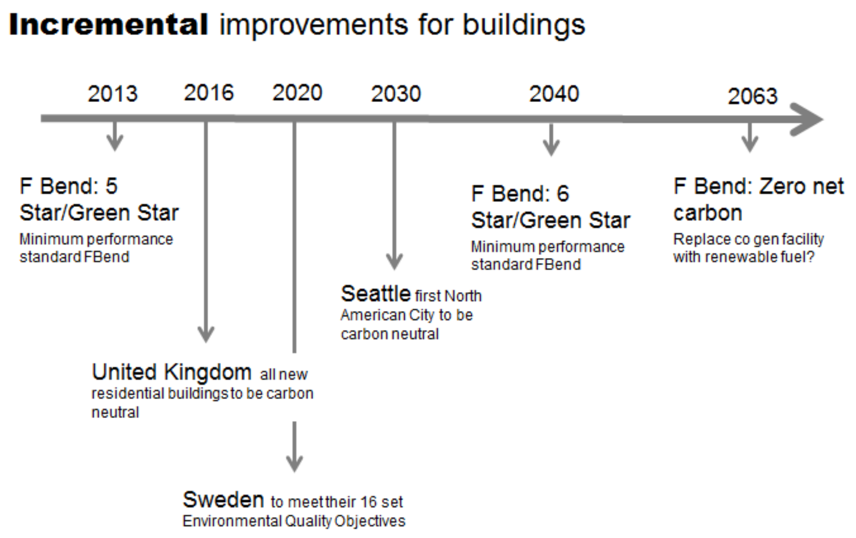


Figure 9 Potential steps for progression to Carbon Neutrality

6.4 Potable Water Use, Wastewater Discharge and Stormwater Runoff

Targets for potable water use, wastewater discharge and stormwater runoff will be provided by the OLV. However, preliminary advice indicates that for the inner urban area, the targets will be in the order of those outlined in Figure 5. The objectives of these targets are to drive a reduction:

- in the demand for Melbourne's potable water supplies
- in the impact of flooding on people and property
- in the pressure on the capacity of Melbourne's existing drainage infrastructure
- in the volume of wastewater discharged to Melbourne's Eastern Treatment Plant and Western Treatment Plan.

6.5 Waste Management

SV sets waste management targets for Victoria, as discussed in Section 5.7.1. These targets have been set to the end of 2014. In adopting targets for FBURA it was considered appropriate to set more ambitious targets than the current targets, notwithstanding the current targets are not being met in all cases. Nevertheless, these targets should be monitored and reviewed and revised either up or down depending on future trends.

In addition to the municipal solid waste target above, a target for construction waste should also be set. The current SV target is 80% recovery by weight. Again a more ambitious target is thought appropriate, and 85% across the life of the project seems achievable.

7. Integrated Servicing Strategy

Although the focus of this section is on the development of the ISS, the ultimate preferred ISS will be overlaid on existing networks of electricity, gas, water, wastewater, telecommunications and solid waste management. The development of the ISS may therefore be considered as a local intervention into the BAU servicing strategy for the project area, which could reduce/defer or even eliminate the extent of BAU infrastructure required. The intervention will occur in stages over the life of the development.

This section will compare how the ISS strategy will impact on the BAU requirements outlined in the previous section as fundamental to a successful outcome. In addition it will set out the process for selection of the preferred ISS for Fishermans Bend. The process has involved consultation with the Utilities Working Group to ensure it meets their aspirations, objectives and performance criteria.

In summary, the process for development of the ISS has involved:

- Review of integrated infrastructure options developed by previous studies
- Review of international exemplar urban developments in collaboration with Portland Sustainability Institute (PSI) to identify any additional options that should be considered for the Fishermans Bend ISS.
- Shortlisting of the options based on their technical viability for Fishermans Bend and the extent to which they would contribute to the projects objectives and performance criteria.
- Identification of the preferred ISS
- Development of ISS concept including preliminary sizing of infrastructure capacities and footprints.
- Refinement of BAU infrastructure for the ISS

This section provides a summary of the outcomes from each of the key steps outlined above.

7.1 Assessment of Options for Integrated Strategy

In November 2012, Places Victoria undertook a workshop with the Working Group and selected industry stakeholders. The workshop was facilitated by Moreland Energy Foundation (MEFL) with the primary purpose of developing draft preferred servicing strategies for energy, water and waste infrastructure for the FBURA. The output from the workshop included the identification of an extensive list of potential options for an integrated infrastructure plan for Fishermans Bend.

GHD reviewed the list and identified several additional options that would also be considered. The purpose of this phase was to build on the previous list of options identified to provide a comprehensive list that would be used to inform the development of a best available ISS for the FBURA. In addition, a review of each option was undertaken to understand its purpose, its potential application scale, history of application and approximate capital cost.

In addition, the suitability of each of the options was analysed based on its technical feasibility and the extent to which it contributes to the projects objectives and performance criteria which were distilled into six “key success factors” as pictured in Figure 10.

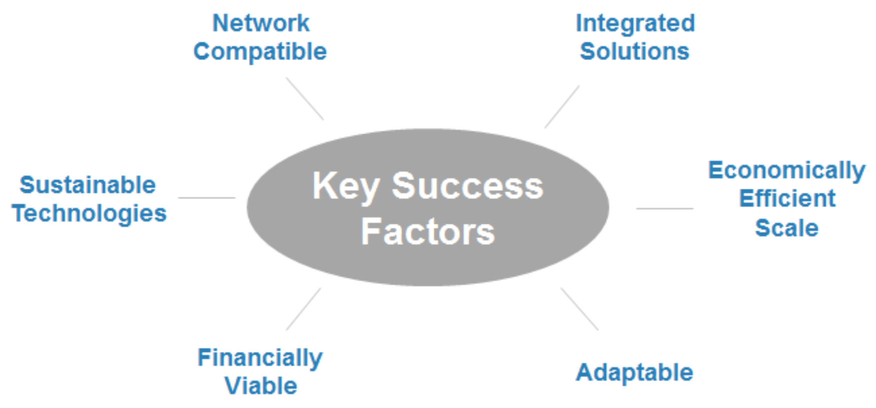


Figure 10 Key Success Factors for Development of the ISS

A summary of the key success factors is outlined below:

- **Network Compatibility**: Compatibility with existing regional infrastructure networks.
- **Proven Sustainable Option**: Contributes to meeting the water, waste and energy goals for the Fishermans Bend development, and is proven in the field.
- **Integrated Solutions**: Integrates and is synergistic with the best overall servicing strategy.
- **Economically Efficient Scale**: May be implemented at the optimum scale for the respective technology/strategy.
- **Robust and Adaptable**: Adaptable to changing circumstances over the life of the development including advancements in technologies, costs, local capacity and the rate of development. Has the ability to be scaleable.
- **Financially Viable**: Financially viable for the investor and provider (i.e. government, business enterprise or a private corporation.

A ‘traffic light’ process was undertaken to determine the role that the option might play in contributing to an overall ISS that achieves the Key Success Factors. A green score indicated a ‘definite role’, orange indicated a ‘possible role’ and red ‘no role at all’. The results of the traffic light assessment are included in Appendix D.

Table 22 provides a list of each of the options considered, and a brief summary of the key findings from the review. A detailed review of each option is included in Appendix D.

Table 22 Options Considered for the ISS

Strategy / Initiative	Application Scale	Description
High performance buildings – energy and water	Building scale	High performance buildings are designed and built to be environmentally responsible and resource efficient throughout the buildings life, achieved through energy, water and material efficiency, waste reduction and improved indoor environment quality. Measurement tools for high performance buildings include GreenStar and NABERS. High performance buildings will achieve 6 star Green Star and 6 Star NABERS. **High performance buildings will be essential in Fishermans Bend to reduce the peak demand and overall energy consumption.**
Intelligent networks – smart metering	Smart meters - Installed at household / building level. Smart grid – established at district level.	A smart meter is for measuring and recording production and consumption of electricity. It is also capable of including functional requirements such as load management ability, tamper detection, remote access and communication, and customer interaction interfaces. This results in greater control and awareness of energy consumption. **Smart meters will be essential in establishing a smart grid network within Fishermans Bend, for sophisticated energy management; network shut downs, network stability and network reliability.**
Energy efficient public lighting	Community / city scale	Sydney, New York, London and Hong Kong have all conducted trials of LED lights. The City of Sydney will now replace 6,500 street and park lights with LEDs over the next 3 years. **LEDs use half the light of conventional bulbs and are considered complimentary to an ISS for Fishermans Bend.**
Geothermal energy	Electricity production and thermal network – development scale Lower grade heat applications – smaller scale	Geothermal is a very low emission thermal energy source. Geothermal energy is most commonly exploited in volcanic areas where magma nears the surface and brings heat from greater depths. Technology requires at least 80-100 degrees at depths of ~ 500 m to be viable. **Within Fishermans Bend temperatures of ~30 degrees are expected at depths of 500 m (*source Sustainability Victoria), therefore, technology not considered viable.***
Heat Piles	Thermal energy. Building scale	Heat piles work in a similar way to geothermal energy, in that they use a carrier fluid heated by ground temperatures, and then further heated by a heat pump. This fluid can then be pumped through a secondary circuit to provide heating. The most feasible method of installation is as part of piling operations for building construction. **Given the building scale application of this technology, it is not considered appropriate for the integrated solution. It may be utilised by developers as part of building construction.**

Strategy / Initiative	Application Scale	Description
Wind generation	Available from building size, in the order of 1 to 15kW, to precinct scale turbines up to 5MW.	Wind turbines use kinetic energy from the wind to drive a generator and produce electricity. Wind turbines can be horizontal or vertical axis configuration. Horizontal axis turbines are the most common arrangement and must point directly into the wind to operate. Vertical axis turbines can operate with wind coming from any direction, and therefore perform well in urban environments, but require a larger drive train, limiting their practical size. **Wind patterns within the Melbourne urban environment are reported to be unsuitable for the generation of energy (*The Viability of Domestic Wind Turbines for Urban Melbourne, Sustainability Victoria, 2007*). Further precinct scale wind generation is not considered appropriate for the development, or likely to be approved by authorities.**
Solar PV Building / Precinct Scale	Scalable for houses/buildings to large, precinct scale power stations. Precinct scale Solar PV systems are limited by available space	Solar Photovoltaic (Solar PV) modules produce emissions free, renewable energy by converting sunlight directly into electricity. Building scale systems can export excess electricity back into the utility grid and offer a potential revenue source if the utility offers a feed in tariff. Mounting solar PV on Westgate Bridge sound barriers was identified as a potential Precinct Scale opportunity. Generation potential was estimated to be 1,168 MWh/annum assuming vertical inclination, which is approximately <1% of the total precinct demand. The option was therefore not considered viable for Fishermans Bend. Electricity offset potential is relatively low for high density precincts, as the rooftop / wall area available per person is low. **Implementation of Solar PV may be driven by developers as a technology for achieving their high performance building standard.**
Anaerobic digestion (organic waste + biosolids)	District scale	Anaerobic Digestion is a process by which biodegradable material is broken down in the absence of oxygen. This produces a renewable energy (biogas) which can be used in a gas turbine to produce electricity. For Fishermans Bend, organic food waste and biosolids (if a local wastewater recycling plant is developed for the scheme) could be anaerobically digested to produce biogas within the precinct. Preliminary estimates indicate that anaerobic digestion of organics and biosolids generated within Fishermans Bend would equate to an approximate 300kW generator. Typically a 1MW generator is the smallest economically viable size for a precinct biogas scheme. **Compatibility of this approach with existing and planned waste management across the local government area is to be evaluated. A 'standalone' scheme for the FBURA is not considered viable.**
Tri/ cogeneration	Building scale At the precinct scale,	Gas turbines combust natural gas or biogas to spin a generator and produce electricity. Waste heat from the turbine exhaust can also be captured and used for space heating or process heat in a combined heat and power (CHP) arrangement. The heat can also be used for space cooling via an absorption chiller in

Strategy / Initiative	Application Scale	Description
	turbines may be scaled up to achieve greater efficiencies.	Trigeneration configuration. Gas produces nearly half the emissions as coal per unit of energy and installed in a distributed energy system, with higher transmission efficiency, is a much cleaner energy source than connecting to a coal fired energy grid. **Tri/cogeneration provides a low carbon source of energy for Fishermans Bend and is central to implementation of a precinct scale energy system.**
Sewer heat recovery	Individual or multiple building scale.	A heat exchange system to convert the low grade sewage heat to approximately 70 degrees, which can then be distributed via a district hot water system. This is a low carbon, renewable source of energy. **This technology would complement a sewer mining scheme in Fishermans Bend, where the sewage mined from assets such as the Melbourne Main Sewer provides both a source for recycled water, but heat energy also.**
Local wastewater treatment (sewer mining)	Building scale May be scaled up to a precinct scale sewer mining scheme to achieve greater efficiencies.	Significant potable water savings can be achieved where treated wastewater is used to substitute non potable water demands. Recycled water can be reticulated through a third pipe network throughout a precinct to substitute potable water demands for toilet flushing, laundry use (typically cold water), garden watering and irrigation of community green spaces. The Melbourne Main Sewer (MMS) that runs through the Montague and Lorimar precincts provides a significant 'sewage resource' for 'mining', treatment to Class A standard and reticulation throughout the precinct. This would enhance the resilience of the water supply network within the precinct and ensure open spaces have a reliable source of water during drought periods. **Sewer mining is central to the integrated water management strategy for Fishermans Bend.**
Stormwater / roofwater harvesting	Building scale Precinct scale benefits may be derived if storages are operated via an intelligent network.	Stormwater harvesting is limited in Fishermans Bend due to contamination from salt water ingress from high groundwater tables and tidal flooding. Roofwater harvesting involves collection of rainwater from building rooves, storage of the rainwater within the buildings and reuse of the harvested roofwater within the building and immediate surrounds. Automated control of the building scale stormwater storage tanks via an intelligent network (and sophisticated weather forecasting data) would enable the storages to be emptied ahead of approaching rainfall events to provide localised flood mitigation. **Roofwater harvesting is also central to the integrated water management strategy for Fishermans Bend and will provide additional benefits associated with localised flood mitigation for the precinct.**
Vacuum, pneumatic or automatic waste collection	Cluster scale Precinct scale	The purpose of Vacuum Waste Systems is to collect waste via a network of pipes leading from fixed collection points to one or more terminals. They are used widely in Europe, Asia and the Middle East where waste collection vehicles are constrained from accessing new developments due to snow, narrow streets etc. There are currently no systems operating in Australia.

Strategy / Initiative	Application Scale	Description
		The system enables cities to reduce the number of waste collection vehicles that enter residential areas for waste collection. Existing schemes are typically implemented at the precinct scale in higher density settings. **Vacuum Waste may be useful in Fishermans Bend areas where the width of lanes/roads prevent access from waste collection trucks, or where eliminating waste collection vehicles is identified as a priority to enhance the amenity of the area.**
Waste sorting station (MRF)	Precinct or city scale	A waste sorting station would involve the separation of mixed waste into several streams for direct sale to markets or recovery by composting or conversion to energy. As identified for the Anaerobic Digestion option, preliminary estimates indicate that a waste to energy scheme for Fishermans Bend would not be viable. **Compatibility of this approach with existing and planned waste management across the local government area is to be evaluated. A 'standalone' scheme for the FBURA is not considered viable.**
District heating / cooling	Precinct scale	A district heating / cooling scheme would involve reticulation of hot and cold water throughout the precinct. The heat may be used for space heating and hot water within the buildings, and cooling via adsorption chillers. **This option is complimentary to a tri/cogeneration solution as it involves the transfer of a low carbon source of energy for Fishermans Bend, and is central to implementation of a precinct scale energy system.**
Community small scale composting facilities	Precinct scale	Community composting and community gardens provide an opportunity to reduce the volume of food and green waste to landfill. The success of this option relies on community participation, and therefore requires support from Council to raise community awareness regarding local composting facilities. This could potentially lead to a City where local organic food is grown and sold. **This option is complimentary to the overall waste management strategy for Fishermans Bend.**

7.2 Shortlisting the Options

Following the review of the potential options for the ISS and identification of the suitable scale for implementation, the options were sorted into the following categories and an optimal scale for implementation identified:

- *Demand Management Initiatives:* Initiatives that reduce the base energy and water demands and generation of waste across the precinct.
- *Precinct Scale Energy/Water Generation Initiatives:* Initiatives that generate energy and water within the precinct, therefore reducing the precincts overall demand on Melbourne's existing energy and water resources (i.e. Loy Yang and Melbourne's natural water resources).
- *Transfer Infrastructure:* Alternative methods of transferring water, waste and energy within the precinct.

In addition, for each option it was identified if it should (i) be included in the infrastructure plan (ii) be implemented by some other mechanism or (iii) is unsuitable for implementation within Fishermans Bend. Table 23 describes this further:

Table 23 Options Considered for the ISS

Category	Strategy / Initiative	Implementation
Demand Management	High performance buildings – energy and water	Mandate through ***planning instruments***.
	Intelligent networks – smart metering	***Implement at precinct scale*** with rollout of NBN.
	Energy efficient public lighting	***Implement at precinct scale***
	Community composting	***Council to implement at precinct scale.***
Precinct Scale Energy or Water Generation	Geothermal energy	***Not viable at this time***
	Heat piles	***Developer driven*** - not included in the plan. Available to developers to meet their high performance standards.
	Wind generation	***Not viable at this time***
	Solar PV Building / Precinct Scale	***Developer driven*** - not included in the plan. Available to developers to meet their high performance standards.
	Anaerobic digestion (organic waste + biosolids)	***Not viable at this time*** for Fishermans Bend in isolation, consider in the future as part of a broader city scale initiative.
	Tri/cogeneration	***Implement at precinct scale***
	Sewer heat recovery	***Implement at precinct scale***
	Local wastewater treatment (sewer mining)	***Implement at precinct scale***
	Stormwater harvesting / roofwater harvesting	***Implement at building scale (roofwater harvesting only)***
Transfer	Vacuum, pneumatic or automatic waste collection	***Investigate viability once road network is confirmed***
	Waste sorting station (MRF)	***Not viable at this time*** for Fishermans Bend in isolation, consider in the future as part of a broader city scale initiative.
	District heating / cooling	***Implement at precinct scale***

7.3 Adopted Integrated Solution

Following the review of the integrated options, the preferred ISS was defined. The key elements of the ISS include:

- Introduction of planning controls to mandate the development of high performance buildings (both residential and commercial) within the precinct.
- Precinct scale initiatives that involve the generation and transfer of energy and water

The precinct scale initiatives are notated in the ISS system diagram below. Figure 11 shows how the proposed precinct scale initiatives interact with the existing water and energy networks and proposed BAU infrastructure.

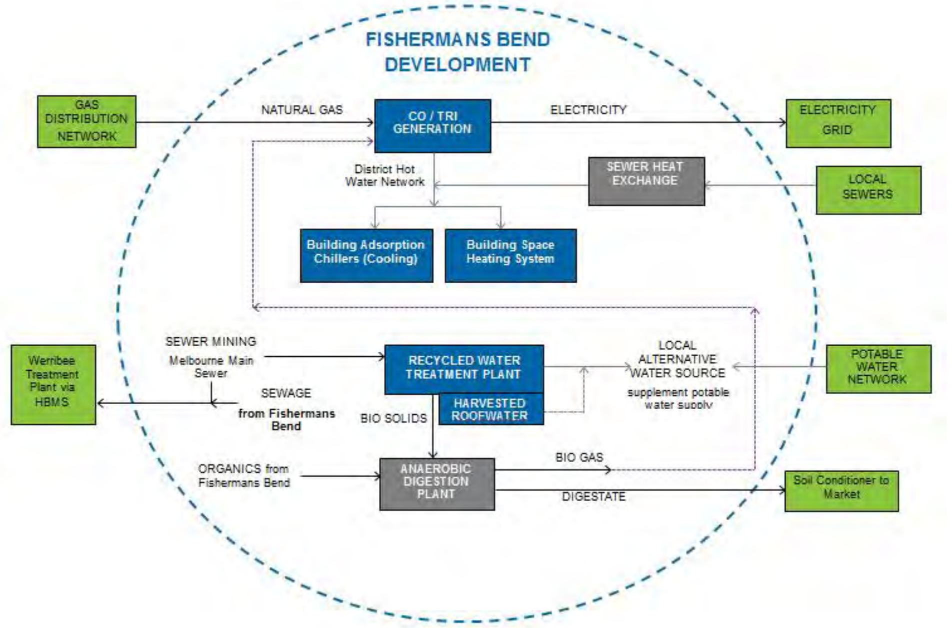


Figure 11 ISS System Diagram[11]

The need to create / augment / extend a wide range of infrastructure across FBURA may present an opportunity to provide shared trenches, in the form of oversized pipes and culverts. Further investigation is required to determine the feasibility of such trenches, and what barriers might exist to their installation.

7.3.1 High Performance Buildings

Definition

High Performance Buildings requires all buildings in the development to operate and consume resources at a level that is above and beyond minimum regulatory requirements. In particular, the design and operation of the buildings will need to enable the district to work towards carbon neutrality in operation by 2040.

[11] The anaerobic digestion plant is identified in the figure to demonstrate how it would integrate with the system if it was implemented at the city scale.

The infrastructural, building system and environmental performance of each building to meet these objectives is captured under the term ‘High Performance Buildings’. It addresses the specific performance requirements of the building within the physical building envelope that designers and building operators need to adhere to (and if possible exceed), in order to meet the objectives of the Key Moves. A High Performance Building in the Fisherman Bends project will generally need to adhere to:

- Passive design standards
- Maximum peak energy demand limits
- Annual total energy consumption limits based on building type and use
- Annual energy consumption limits of thermal comfort control systems in buildings
- Building fabric and construction performance levels
- Where applicable, on-site energy generation from renewable sources or provisions to allow for its implementation in the future
- Infrastructure provision for connections in district systems
- Water consumption limits based on building type and use, climate neutral water strategies
- Manage stormwater quality and quantity to best practice
- Waste generation limits
- Material use and consumption that limit total environmental impact
- People friendly and engaging internal environments of that promote healthy, productive and happy living
- Ongoing behaviour management and systems maintenance that enable the overall performance of the building to be tuned

Recommended approach

There are existing building assessments and performance frameworks that can be used to define and measure High Performance Buildings for this project. They are numerous and have been used widely on building and city projects of various scales, internationally and nationally. They provide an industry standard benchmark for defining the requirements of High Performance Buildings to meet the overall objectives of the Key Moves for Fishermans Bend. A summary of the key frameworks and the relevant parameters for High Performance Buildings is provided in Appendix E.

A detailed study of the intended building typology mix, district energy design and project phasing is required to develop the specific metrics of performance for High Performance Buildings for Fishermans Bend. Notwithstanding this, we recommend the application of One Planet Living as an over-arching framework for all buildings and selecting relevant metrics from the Green Star Rating and the ‘best of’ the most well understood international frameworks. The One Planet Living methodology identifies 10 key principles to follow as outlined in Figure 12.

Figure 12 One Planet Living Methodology

These can be used to describe the overall ambition for High Performance Buildings whilst using relevant Green Star metrics to achieve an equivalent 5 or 6 Star performance for the various building typologies. Only metrics that enable the building to meet the objectives of the Key Moves will be used. Where metrics are not covered by Green Star, relevant and appropriate metrics from the other frameworks can be used. This approach creates a tailored framework of performance for the buildings to be developed that address the project specifically with regards to financial structure, project phasing, ownership and the local economic context. This Fisherman Bend specific performance framework can then be used by developers, designers and operators to design, commission and run High Performance Buildings to achieve the objectives of the Key Moves.

It is imperative that the framework is developed to complement existing Melbourne specific programmes, initiatives and targets relating to the building performance and climate change adaptation policies. Namely the City of Melbourne ‘Zero Net Emission by 2020’ plan; the targets for Melbourne under the C40 programme and Melbourne’s commitments with the Clinton Climate Initiative.

7.3.2 Cogeneration and District Energy

Definition

A cogeneration and district energy option for Fishermans Bend involves gas turbines, driven by natural gas initially, potentially transitioning to biogas in the future. The gas turbines would produce electricity to be fed into the proposed 11 kV grid within the precinct. The residual heat would be used for space heating and hot water which would be circulated through a district ‘hot water loop’. The heat may also be used to provide cooling via absorption chillers within the individual buildings. It may also be supplied to the recycled water treatment plant to improve its efficiency, however, the costs for this have not been allowed for in the plan.

At this preliminary stage, a cogeneration system is proposed rather than trigeneration as it is believed to be more cost effective to reticulate thermal energy (via hot water) by one set of pipes, for heating and cooling within the buildings. Adsorption chillers are proposed within the individual buildings to convert the thermal energy into cooling. This also avoids energy losses that would result from reticulation of the cold water across the precinct. This approach also enables the chiller to be sized according to the buildings cooling requirements, (i.e. larger for commercial buildings that typically have a higher cooling load) and avoid the risk of either over or under sizing a central cooling plant.

In addition, the Fishermans Bend development involves a significant amount of residential development. The cooling load for residential development is not considered significant enough to justify the installation of an additional set of pipes for reticulation of cold water. Passive design standards achieved through high performance buildings will ensure the cooling load is minimised across the precinct. Further investigations are required to optimise the district energy concept.

A flow diagram of the proposed cogeneration system is shown in Figure 13

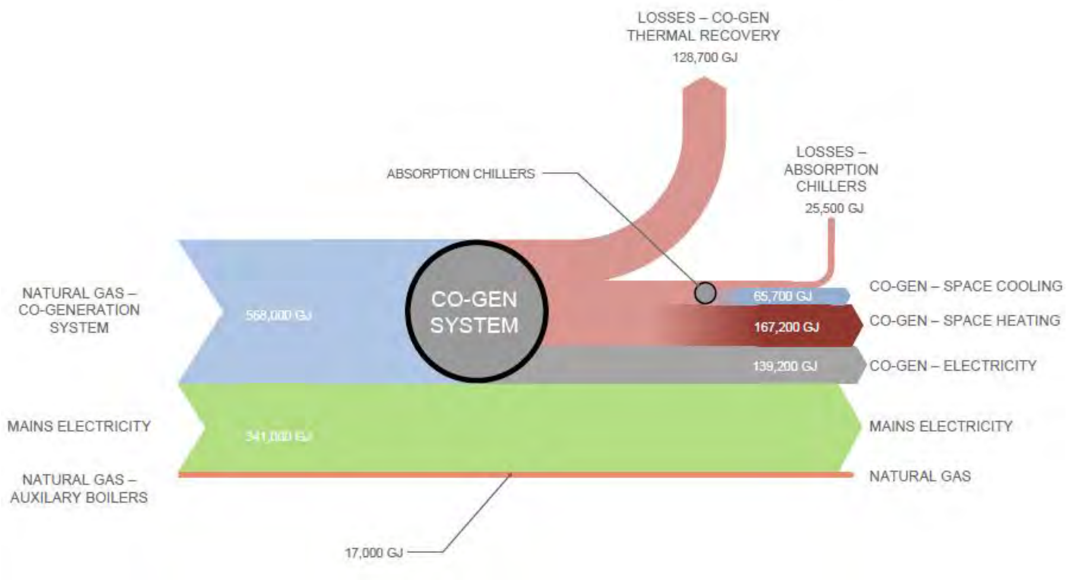


Figure 13 Cogeneration system

Siting and Staging of Infrastructure

Implementation of cogeneration and a district energy system should be staged as development occurs to ensure investment is matched to the district 'demand' for the system.

To ensure the viability of these schemes, implementation should be targeted at areas that have the greatest density of demand for thermal energy. Therefore, for Fishermans Bend, the Medium and High density areas are proposed to be supplied by the district energy system. The supply area is shown on the district energy map in Appendix B and includes a residential population of 22,553 dwellings and 964,337 m^2 of commercial GFA. It is also assumed that only 50% of the properties within Montague may access the district energy system, as redevelopment within this precinct is already underway, and therefore these developments forego the opportunity to connect.

At this preliminary stage, three potential sites were selected by the Utilities Working Group for siting the cogeneration plants. The sites are shown on the district energy map in Appendix B.

Two of the sites were selected on the basis of colocation of the cogeneration plants with the existing zone substations, to minimise the length of 11 kV HV line to transfer electricity generated by the cogeneration plant to the zone substation. The ultimate location of the plants needs further consideration as part of the next design stage. Other potential locations include co-location with future potential train metro stations.

Infrastructure Requirements

Table 24 summarises the infrastructure requirements associated with a cogeneration and district energy scheme for Fishermans Bend.

Table 24 Cogeneration Infrastructure Requirements

Description	Quantity	Comments
10 MW (ISO) of combustion gas turbines*	3	Turbines to be housed in purpose built housing
Waste heat recovery boilers	3	Boilers to heat hot water for the district hot water loop
Supply and install underground 11 kV main from the cogeneration plants to existing zone substations	3	Length of mains varies depending on the distance of the gas turbines to the existing zone substations.
DN 225 twin district hot water loop	8,500 m	Pre insulated pipes for reticulation of hot water

* A this early stage, a conservative estimate has been made for the size of the cogeneration plant for the purposes of developing cost estimates. Preliminary investigations indicate that the size of the plant may range from 10-30 MW depending on a number of variables.

Further investigation is required to confirm the optimal size for the cogeneration plant which should consider:

- Avoidance of waste heat.
- The diversity of heat demand, which in turn dictates the hours of operation for the cogeneration plant.
- The commercial model for cost recovery of the cogeneration and district energy system (including the thermal energy market and revenue that may be generated from the thermal energy and electricity generated).
- The 'feed in tariffs' (i.e. tariff for electricity fed back to the State's electricity grid, and the price of natural gas.
- The actual footprint required, which is currently estimated at 1,000 m^2 for each of the three plants to allow provision of a small zone substation with each of the plants.

7.3.3 Sewer Heat Recovery

Definition

Sewer heat recovery is a complimentary initiative to the cogeneration and district energy option described above. Sewer heat recovery involves the use of reverse refrigeration heat pumps to convert low grade sewage heat (typically 20-25 degrees in Melbourne) to approximately 70 degrees, which can then be distributed via a district hot water system similar to the cogeneration and district energy system described above.

Siting and Staging of Infrastructure

Access of sewage is proposed at the same location as the diversion structure for the sewer mining facility. Reticulation of heat is limited to an area of approximately 100 metres from the source, and therefore a small area within Montague is proposed to be supplied the heat recovered from the sewage source. Advice from a technology supplier indicates that sufficient heat could be derived from approximately 0.25 l/s of sewage to heat a single apartment. Typical flows through the MMS have the potential to provide heat for approximately 1200 apartments. The heat requirement is to be balanced with the volume of sewage extracted for sewer mining, which requires optimisation to maximise the efficiency of the scheme. Further investigation is required to confirm the heat that may be recovered from sewage, and the potential to supply this heat throughout the precinct, beyond a radius of 100 metres from the source.

Installation of the sewer heat pumps and associated reticulation network is to be implemented at the same time as development of the sewer mining facility, therefore reducing the need for a second access point to the MMS.

Infrastructure Requirements

Table 25 summarises the infrastructure requirements associated with the sewer heat recovery proposed for Fishermans Bend.

Table 25 Sewer Heat Recovery Infrastructure Requirements

Description	Quantity	Comments
DN 225 twin district hot water loop	800 m	Pre insulated pipes for reticulation of hot water
1500 kW electric heat pumps	1	Including appropriate housing and controls

7.3.4 Integrated Water Management (Roofwater Harvesting and Sewer Mining)

Definition

Integrated Water Management (IWM) initiatives proposed for Fishermans Bend include roofwater harvesting and reuse at the building scale, sewer mining to provide a recycled water source to supplement harvested roof water and treatment of stormwater to best practice water quality standards.

Collection of rainwater from the available roof area will require installation of rainwater tanks at the building scale (for both multi-dwelling and commercial properties), and a third pipe network to distribute the harvested roofwater for reuse within the building (for toilet flushing and laundry use) and immediate surrounds.

Automated control of the building scale stormwater storage tanks via an intelligent network (and sophisticated weather forecasting data) would ensure the storages are empty ahead of approaching rainfall events, to provide localised flood mitigation.

Sewer mining within Fishermans Bend will involve the extraction of sewage from the Melbourne Main Sewer (MMS) for treatment to Class A standard and reticulation throughout the development via a third pipe network. Treatment of sewage to Class A quality will allow the treated effluent to be used for irrigation purposes and to meet a range of other non-drinking water demands including toilet flushing, car washing, clothes washing (typically cold supply only) and irrigation of parks and gardens. It can also be used in cooling towers.

Siting and Staging of Infrastructure

Roofwater harvesting will require storage to be included in each of the buildings, i.e. within the building basement or a common body corporate area. The provision of storage at the building scale will be implemented as development progresses; this infrastructure is therefore infinitely flexible for staging. A storage volume of approximately 1 m^3 per 10 m^2 of roof area would be required.

To supplement the harvested stormwater, approximately 8 ML/day is to be extracted from the MMS and reticulated throughout the development. The footprint required for the 8 ML/day recycled water treatment plant (RWTP) will be in the order of 5,000 – 10,000 m^2, depending on the configuration of the plant and the volume of buffer storage included.

A potential site for the plant has been identified below the West Gate Bridge overpass. This site has been identified as potentially suitable as it does not encroach on developable land and is in close proximity to the MMS which provides a significant sewage resource for sewer mining (approximately 300 L/s average dry weather flow). It is also positioned at the confluence of Fishermans Bend and other key developments including Southbank and Docklands, therefore providing an opportunity to expand the scheme to supply these developments also. Approval from VicRoads and Citylink is required to confirm the suitability of this location.

A membrane bioreactor plant (MBR) plant is proposed for the RWTP. MBR plants are modular and flexible to staging. The associated infrastructure such as the diversion structure from the MMS, chemical storage tanks (for disinfection), housing for the MBR plants are less flexible to staging, therefore considerable upfront investment is required to establish the RWTP and associated infrastructure.

Infrastructure Requirements

Table 26 summarises the infrastructure requirements associated with sewer mining and roofwater harvesting within Fishemans Bend.

Table 26 IWM Infrastructure Requirements

Description	Quantity	Comments
8 ML Class A RWTP (Membrane Biorector Plant and appropriate disinfection)	1 No.	To be housed with appropriate noise and odour control to reduce necessary buffer distances.
Diversion from the MMS	1 No.	Diversion from 2200 MMS, sewer is approximately 10 m deep at this location.
Third pipe network throughout the FBURA	20 km	Pipe diameters ranging from 150 – 300mm
Buffer storage	1 ML	Storage sizes to be optimised during concept design of the RWTP
Class A recycled water storage	3 ML	
Roofwater harvesting	76,000 m^3	1 m^3 per 10 m^2 of roof space

7.3.5 Smart Meters and Intelligent Networks

Definition

For Fishermans Bend, smart meters are proposed for measuring and recording production and consumption of electricity, and potentially also for the provision of load management ability, tamper detection, remote access and communication and customer interaction interfaces. In addition, smart water meters are proposed to allow for continuous monitoring of water consumption and the analysis of the data by water managers to assist with water demand management and water efficiency. In addition, the timely relaying of this data to the water user can result in significant changes in water use behaviour.

Intelligent networks will also be critical to the automated control of the individual stormwater storages within each of the buildings to ensure the storages are emptied ahead of storm events. This will enable the storages to provide both flood attenuation and provision of storage of harvested rainwater for reuse within the buildings.

Ideally the smart energy and water meters would be integrated within a single intelligent distribution network to be established via an optical fibre network, such as the NBN.

Typically, smart metering has features such as real time monitoring, high resolution interval metering, automated data transfer and access to the data via the internet (provided by an optical fibre network).

Siting and Staging of Infrastructure

Smart meters are to be installed within all new residential and commercial buildings at the time of development. A program currently exists to retrofit all existing buildings with smart meters, which means all buildings will have smart meters in due course. There has been no rollout of water meters to date, however this development could provide the ideal location for a broad trial.

A central control system is to be established in the early stages of the development to ensure automated control of stormwater storages at the time of installation and therefore provision of flood attenuation storage as the development rolls out.

Infrastructure Requirements

The key infrastructure requirements for this initiative will be the meters and the central control system.

7.3.6 Waste Management

Table 22 and Table 23 detail the waste management infrastructure considered for ISS. As discussed it is not considered feasible for Vacuum Waste to be included in the ISS at this stage. It may be in the future as detail increases that this can be reviewed and some level of vacuum waste included.

There will need to be some level of consideration of waste management in HPBs, either through consideration of source separation or some form of onsite compaction. There are also possibilities for integration with the social infrastructure plan through small scale composting schemes.

There will also need to be consideration of waste management programs, both for regular municipal waste and construction waste.

7.4 Impacts of the Adopted Integrated Solution on Business as Usual Infrastructure

The BAU upgrades will largely apply to the ISS also with the exception of:

- Water supply – a reduction to the extent of upgrades required under the BAU strategy
- Gas – an increase to the extent of upgrades required under the BAU strategy.

This is discussed further in the following sections:

7.4.1 Impacts on Water Supply

The demand reductions achieved by mandating high performance buildings, in addition to the provision of a recycled water source to substitute potable water demands for toilet flushing, laundry and irrigation demands within community green space areas, will significantly reduce the demand for potable water.

The following refinements to the water supply augmentation required under the BAU scenario are summarised in Table 27. The BAU upgrades are included also for comparison purposes.

Table 27 Water Supply Upgrades

Option	Transfer Source	Transfer requirement	Storage*	Distribution network	Reticulation network
BAU	MWC 1100 Punt Road main	4 km of 600 mm pipeline	8 ML tank	450 mm cross connection between the existing 300 mm loop to distribute peak flows	Extensions to service individual developments not assessed
Integrated Servicing Strategy	CWW 600 mm MSCL potable water main at Queens Bridge	1.4 km of 500 mm pipeline	N/A	N/A	Extensions to service individual developments not assessed

The OLV is undertaking a 'city wide' modelling exercise of the potable water network that would confirm the capacity of the CWW network to cater for future water demands, assuming city scale adoption of an integrated water cycle management. There is a risk that if the water savings outlined above are not realised under the ISS, SEW would be required to construct works to augment the system (which may potentially involve a pipeline between Fishermans Bend and Punt Rd). Therefore, it is critical that the capacity of the CWW pipeline to supply these is understood.

7.4.2 Impacts on Gas Network

The proposed cogeneration plants require a supply of high pressure natural gas of no less than 1550 kPA (15.5 bar) at the inlet to the turbine. APA GasNet was consulted regarding options for supplying the required gas feed to the cogeneration plants. They advised that a high pressure transfer pipeline would be required to transfer gas from a nearby existing City Gate, provision of a custody transfer metre and associated pipe work.

7.5 Review of the Adopted Integrated Servicing Strategy against the Key Success Factors

The following provides a summary of the adopted elements of the ISS against the key success factors.

Network Compatibility

High Performance Buildings maybe integrated into a development regardless of nature or timing of changes to networks.

Cogeneration and District Energy utilises existing natural gas as the primary gas source and generates electricity that is fed into the existing energy grid.

Sewer Heat Recovery system recovers heat from the existing sewerage network.

Sewer Mining includes potential to supply recycled water to Fishermans Bend and other precincts also, i.e. Docklands, Southbank etc.

Roofwater harvesting is complimentary to the existing network as it reduces the load on existing stormwater drains.

Proven Sustainable Option

High Performance Buildings can achieve potential reduction s in energy use in the order of 25-30% *World Green Building Council*

Cogeneration and District Energy is an efficient heat source that offsets the precincts energy demand and produces a lower carbon electricity source for the grid.

Sewer Heat Recovery 'closes the loop' on heat energy that is lost to the sewers.

Sewer Mining scheme reduces potable water consumption and increase the resilience of the existing water supply network by diversifying water supply sources.

Roofwater harvesting reduces pollutants to waterways and Port Phillip Bay and increase the resilience of the existing water supply network by diversifying water supply sources.

Water sensitive urban design achieves best practice water quality design standards.

Integrated Solutions

High Performance Buildings are central to an integrated infrastructure solution.

Cogeneration and District Energy may be integrated with both water and waste (i.e. biogas from organic solid waste and biosolids). It has multiple uses including electricity generation/district heating and cooling.

Sewer Heat Recovery Sewer heat recovery provides an additional source of heat energy for the district heating and cooling system.

Sewer Mining heat may be recovered from the sewage 'mined' from the MMS.

Roofwater harvesting is an additional source of alternative water to integrate with recycled water.

Economically Efficient Scale

High Performance Buildings may be implemented across the precinct if mandated through planning controls.

Cogeneration and District Energy is proven to be economically efficient at precinct scale and has potential for staged implementation.

Sewer Heat Recovery is economically efficient at the precinct scale.

Sewer Mining as synergies with a sewer heat recovery scheme as the heat may be recovered from the sewage 'mined' from the MMS.

Roofwater harvesting distributed storages provide an economically efficient scale for implementation as development occurs.

Robust and Adaptable:

The plan must be sufficiently flexible to accommodate alternative/superior integrated solutions that may emerge in the future. The following describes how the proposed elements of the ISS may be flexible to adapting to new technologies in the future.

High Performance Buildings may take advantage of advancements in technology.

Cogeneration and District Energy may be transitioned to different source inputs (i.e. natural gas initially, then biogas if it becomes available). Also, an alternative energy source may be adopted in the future for the district energy network if an alternative technology emerges.

Sewer Heat Recovery may take advantage of advances in sewer heat pump technology, as sewer heat pumps may be replaced or upgraded.

Sewer Mining treatment technology has limited flexibility to take advantage of advancements in technology as the treatment technology is relatively fixed.

Roofwater harvesting may be enhanced in the future with smart metering.

8. Why the ISS?

Adoption of the ISS will generate a number of benefits for the local community and environment within the FBURA, and also more broadly, generate a number of system wide benefits for Melbourne's centralised energy and water networks. These benefits however rely on a significantly higher capital investment in precinct scale infrastructure within Fishermans Bend. As outlined in Section 10, the estimated capital cost of the ISS in comparison to BAU is $343M in comparison to $113M respectively. This is due to the additional infrastructure elements proposed under the ISS outlined below (which are partly offset by a $29M reduction in potable upgrades in comparison to the BAU scenario).

- Recycled water – $72M
- Cogeneration – $200M
- Sewer heat recovery – $3M

The additional costs associated with the infrastructure outlined above may attract alternative funding sources such as private sector investment (including ownership and operation) or public investment/partnerships (i.e. public private partnership arrangements). The extent of interest from the public or private sector to invest in the integrated infrastructure outlined above is unknown at this stage, and further work is required to quantify the benefits and return on investment for these potential investment opportunities.

As outlined previously, an understanding of the benefits that may be derived by the ISS is critical to justifying the extent of investment required. This section provides an outline of the benefits associated with the BAU and ISS which are summarised by:

- Costs and benefits that have been quantified by the targets nominated in Section 6.
- A qualitative summary of the broader benefits associated with the ISS including intangible benefits, and other benefits that may be quantified at some point in the future.

8.1 Costs and Benefits for BAU and ISS

Whilst there is a significant cost premium associated with implementation of the ISS, the ISS would provide greater benefits not only within the FBURA, but across Melbourne as a whole. The purpose of the targets developed in Section 6 was to provide a basis for quantifying the extent of these benefits for the ISS in comparison to BAU. The results are outlined in Table 28.

Table 28 Costs and Benefits for BAU and ISS

	Target	Business as Usual	ISS	Target
Costs	Preliminary capital costs for precinct infrastructure	$113M	$342M	NA
Benefits	Carbon emissions from buildings**	394,220 tonnes CO2 -e/year	282,920 tonnes CO2-e/year	5 Star/Green Star minimum performance standard
	Potable water use	6,500 ML/annum	2,500 ML/annum	2,600 ML/annum
	Total Waste	76,700 tonnes/annum	Unquantifiable at present	75 % recovery of municipal solid waste
	Wastewater discharge	5,770 ML/annum	4,190 ML/annum	4,040 ML/annum
	Stormwater reduction	1,500 ML/annum	1,100 ML/annum	900 ML/annum
Monetised Benefits	Reduction in carbon emissions from buildings	NA	$2.6 M/annum	-
	Nitrogen diverted from Port Phillip Bay	NA	$0.6 M/annum	-

* At this stage there is no infrastructure or concept to quantify the actual diversion of municipal solid waste.

** The reduction in carbon emissions figures are based on typical energy consumption for 5 Star Green Star and 4 Star Green Star buildings for the ISS and BAU strategy respectively. This translates to a comparison of performance standards between 'Australian Excellence' and 'Best Practice'. A comparison of the performance of the ISS strategy to typical existing building stock performance (which is much lower than the detailed BAU strategy) will lead to a far greater reduction in CO2-e emissions.

The monetised benefits outlined in Table 28 are based on:

- $800/kg water quality offset rate associated with cost of treating Nitrogen (Melbourne Water)
- $23 per tonne of CO2 emitted (Australian Government Clean Energy Regulator)

A complete life cycle cost analysis is required to ensure a thorough comparison of the costs and benefits associated with the BAU and ISS options.

The benefits delivered by the results summarised in Table 28 are outlined further below.

8.1.1 Reduction in Carbon Emissions

Figure 13 summarises the energy use by buildings for the BAU and ISS, which form the basis of the carbon emissions shown in Table 28. The difference in energy use between BAU and the ISS is estimated at 740,000 GJ/year and may be attributed to:

- Implementation of high performance buildings.
- Adoption of a low carbon source for heating and cooling (i.e. cogeneration and sewer heat recovery).

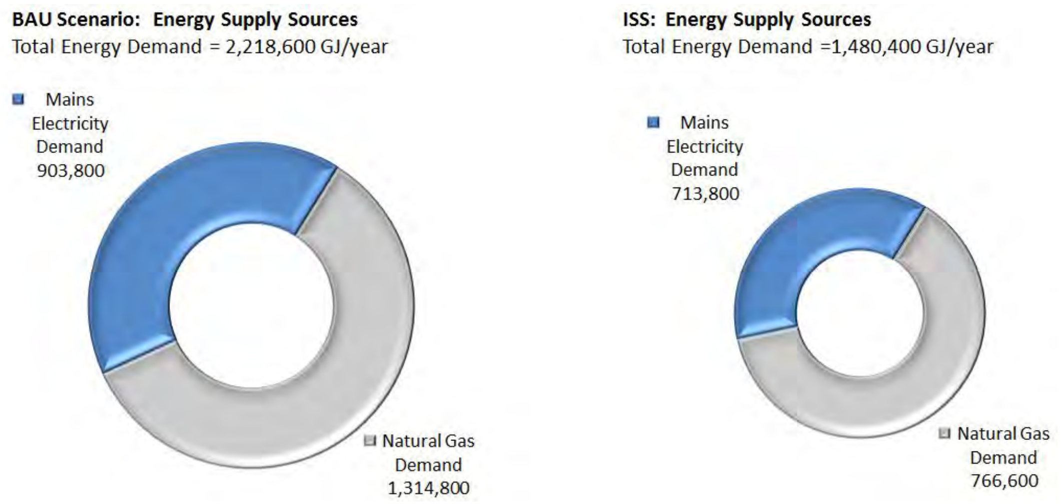


Figure 14 Reduction in Energy Use

The benefits of reducing energy use within Fishermans Bend include:

- **Distribution efficiencies** will be achieved through the district energy network as the losses associated with transmission and distribution of electricity from remote power stations is reduced, as the production of electricity and thermal energy is located within the development.
- **Network demand reductions** will be achieved by generating energy onsite. The cogeneration plant and demand management initiatives flatten electricity and natural gas network demand profiles which can reduce the load on the upstream energy network.

8.1.2 Reduction in Potable Water Use

Figure 14 summarises the reduction in potable water use for the BAU and the ISS. The difference in potable water use may be attributed to:

- Implementation of high performance buildings resulting in a reduction in potable water use of 1,570 ML/year.
- Roofwater harvesting and reuse within the buildings resulting in a reduction in potable water use of 400 ML/year
- Sewer mining and reticulation of the recycled water throughout the precinct for irrigation of open space, garden watering, toilet flushing and laundry use within the residential and commercial buildings, resulting in a reduction in potable water use of 1,900 ML/year

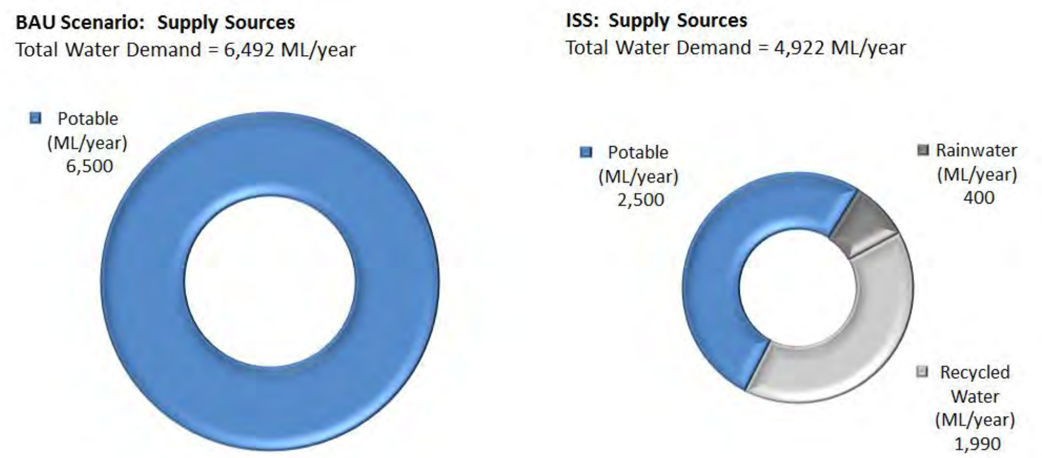


Figure 15 Reduction in Potable Water Use

The benefits delivered by reducing potable :

- **Access to secure and fit-for purpose water supply.** For the ISS, additional supply sources including rainwater and recycled water will enhance the diversity and resilience of the Fishermans Bend water supply system.
- **Enhanced liveability** will be achieved by ensuring that during periods of drought, there is a secure source of water for irrigation of community green spaces. This will therefore ensure that the community's use and enjoyment of public open space, private gardens and sporting fields is not impeded.
- **A reduction in sewage discharged to Western Treatment Plant** will in turn result in a reduction in the volume of recycled water discharged to Port Phillip Bay which is critical to protecting aquatic biodiversity within the bay.
- **Cleaner and healthier waterways** through reduced volumes of stormwater and sewage disposed to the Yarra River and Port Phillip Bay. Healthy waterways provide not only environmental benefits, but also improved opportunities for both passive and active recreation.
- **Effective drainage and flood mitigation** by utilising green space areas for short term stormwater detention and proposed rainwater tanks within individual buildings will reduce pollution levels and nuisance flooding across the development.
- **Urban design** by integrating water sensitive design into the landscape, improving aesthetics and social amenity as well as environmental outcomes.

8.1.3 Waste diversion

The ISS includes goals and some measures to improve diversion of waste. Ultimately these goals though are supported largely by programs and education, rather than infrastructure. The inclusion of devices for source separation in developments will be important assisting meeting the set targets.

Nevertheless, achieving the targets can mean significant savings in landfill costs. The current gate cost for municipal waste is between $55 and $60 per tonne[12]. Assuming a 5% increase in diversion in the ISS, and using the demand estimated in Section 5.7.2, leads to a saving of

[12] Department of Sustainability and Environment (2012), *Waste Policy Review – Discussion Paper*, DSE, Melbourne, Victoria

approximately $230,000 per annum. This is not insignificant, particularly as there are possible savings also in the additional diversion of construction waste.

There are also the unquantifiable benefits associated with extending the life of the existing landfills.

8.2 Broader Benefits Associated with the ISS

In addition to the benefits outlined in the Table 28, the following summarises some of the broader benefits that have not been quantified in this report.

Benefits of High Performance Buildings

There are a number of benefits associated with high performance buildings. The World Green Building Council[13] has documented a number which include reduced energy costs from heating, cooling, lighting and ventilation and reduced water consumption which all contribute to an overall lower operating cost for the buildings. In addition, evidence from their studies carried out over the past decade, has shown that green buildings tend to have higher asset values than their conventional counterparts. This is based on:

- Higher rental rates attributed to the attractiveness of green buildings due to their superior indoor environment, lower operating costs (i.e. lower energy and water utility bills).
- Higher sale prices. In a study of NABERS-rated buildings in Australia, buildings with higher NABERS ratings tended to achieve sales premiums of up to 21% in comparison to lower NABERS ratings buildings which reported discounts as low as 13%.

Research also shows that high performance buildings and indoor environments can improve worker productivity and occupant health and wellbeing, resulting in improved business outcomes. High performance buildings include attributes such as natural daylight, use of materials within minimal toxins, appropriate outdoor ventilation, thermal comfort and open and inviting spaces that promote interaction. Research has shown that by creating a healthy work environment, optimum levels of employee productivity, happiness and performance may be achieved.

Deferral of Future Upgrades to System Headworks

There is potential that the ISS may defer and/or avoid future upgrades to major water and energy infrastructure both upstream and downstream of the Fishermans Bend precinct.

By way of example, in 2011/12, $1.280 billion of capital expenditure was invested in water, sewerage and drainage infrastructure across Melbourne (*source: 2011/12 annual report for Melbourne Water and Melbourne's metropolitan water utilities*). Similar amounts would be expected across the range of utility infrastructure.

In addition, potential future costs may involve augmentation to Melbourne's desalination plant to meet the demands of Melbourne's increasing population, and in addition, upgrades to major water and sewerage trunk infrastructure (i.e. Hobsons Bay Main Sewer). The Engineers Australia 2010 infrastructure report card identified the following challenges to future management of Victoria's electricity generation and transmission network:

- Ensuring that new generation is built for a growing population
- Ensuring supply security
- Delivering clean coal technology
- Maintaining the supply of natural gas

[13] The Business Case for Green Building, World Green Building Council, 2013.

- Implementing demand management

Upgrades to water, energy and waste management infrastructure will require significant capital expenditure in the future to ensure utility services cater for population growth, in addition to ongoing upgrades and replacement of ageing assets. The potential to defer a proportion of these future costs through investment in precinct scale infrastructure that reduces the load on existing water and energy networks, has the potential to generate significant savings for the State.

However, quantification of the potential system wide 'avoided costs' that may result from adoption of the ISS both within Fishermans Bend and across other urban renewal areas (i.e. E Gate, Docklands etc) require an understanding of the extent to which the ISS may avoid or defer these major upgrades. This cannot be quantified at this point, and therefore, the potential savings have not been captured in the plan.

Further work is required, in consultation with the utilities, to define the long term major infrastructure upgrades that may be deferred / avoided by adoption of the ISS within Fishermans Bend.

Improved Liveability

The implementation of high performance buildings will achieve an engaging and liveable internal and external environment that promotes healthy, productive and happy living within the precinct. In particular, the availability of recycled water will provide a base for irrigating the precincts parks and gardens. This in turn can lead to increased utilisation with the associated benefits to the residents. Further there are opportunities for localised composting schemes, in conjunction with community gardens. Again this has significant liveability benefits. This increased liveability may in turn support the development of a highly productive commercial district.

Improved liveability may also be achieved through the protection of Melbourne's natural water resources achieved by the reduction in stormwater and associated contaminants to Port Phillip Bay.

Synergies with Surrounding Precincts

There is potential for the recycled water treatment plant proposed for Fishermans Bend to supply recycled water to surrounding precincts including Southbank and Docklands. There is an increasing demand for recycled water in these surrounding precincts, and therefore, supply of recycled to these areas would ensure there is a 'recycled water market' available immediately, therefore improving the commercial viability of the proposed recycled water treatment plant. In addition, there is potential for the total costs of the plant to be shared by the Fishermans Bend and surrounding developments.

Reduction in the Demand for Non-Renewable Resources

The ISS would achieve a significant reduction (in comparison to BAU) in the demand for Melbourne's natural and non-renewable resources such as surface water supplies and brown coal energy.

Brown coal fuels 92 percent of the electricity generated in Victoria, making it a huge contributor to total greenhouse gas emissions as it creates more emissions than other fuels such as black coal, natural gas and other clean renewable energy sources.[14] The CSIRO[15] has cited greenhouse gas emissions as a cause for inducing many changes in the global climate system

[14] Environment Victoria; http://environmentvictoria.org.au/index.php?q=content/problem-brown-coal
[15] CSRIO; http://www.csiro.au/Outcomes/Climate/Understanding/Climate-Change-Continues/Future-climate-change-depends-on-global-greenhouse-gas-emissions.aspx

during the 21st century including global warming, and the potential for further warming in the future. As a result, Australia is likely to become warmer, with uncertain rainfall changes in the north, and less rainfall and more droughts in the south. Therefore, efforts to reduce the reliance on brown coal energy sources within new urban development precincts, such as the FBURA, are paramount to reducing the potential for further global warming in the future.

In addition, approximately 80% of Melbourne's potable water comes from closed water catchments in the Yarra Ranges which involves 157,000 hectares of protected forest. Melbourne's natural water resources also provide the flows for rivers and creeks, in the Yarra River basin, which support an abundance of natural biodiversity. In the future, Melbourne's natural water resources will be supplemented by desalinated water, however despite the availability of this additional resource, reducing the reliance of urban development precincts on Melbourne's natural water resources will be critical to ensuring long term health of the Yarra River basin.

9. Governance

9.1 Introduction

This section looks at the various governance and ownership issues associated with the proposed development. There is a review of:

- BAU ownership arrangements
- Implications for the integrated infrastructure ownership
- Governance issues

There is also a series of associated recommendations.

9.2 BAU Roles and Ownership

The BAU infrastructure exists within a well-defined set of governance arrangements. These arrangements cover issues such as asset ownership, planning and funding arrangements.

9.2.1 Water Sector

When discussing the water sector we consider sewerage, potable water, recycled water and stormwater. Key to this sector is that almost all assets are held in public ownership. Some exceptions to this rule have emerged in recent years with construction of recycled water plants, and also the desalination plant, which have levels of private ownership. The core infrastructure though remains in public ownership.

There is a clear allocation of ownership and regulatory responsibilities, which promotes the reliable supply and delivery of water throughout Victoria. Table 29 details the key sector stakeholders for Fishermans Bend.

Table 29 Government Stakeholders

<table>
<tr><th>Stakeholder</th><th>Role</th><th>Legislation Ascribing Powers and Responsibilities</th></tr>
<tr><td>Victorian Government (Water Minister)</td><td>Regulate aspects of water management
Policy development
Reporting to Parliament on the performance of each water business
Determines the Statement of Obligations (SOO) for each water authority</td><td rowspan="2">The Water Act 1989 (Vic)
The Financial Management Act 1994 (Vic)
The Water Act 2007 (Cth)</td></tr>
<tr><td>The Department of Environment and Primary Industries (DEPI)
(Water Group)</td><td>Provide advice on policy, service performance and compliance
To act as a liaison between the Minister and each water business
Reviewing key reporting documents
Implementing Government policies</td></tr>
</table>

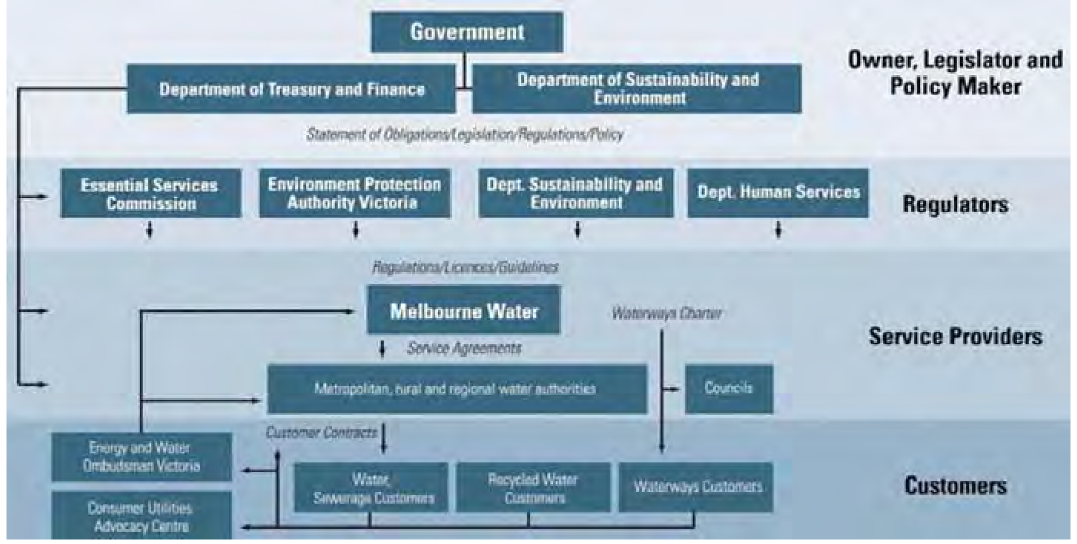
Stakeholder	Role	Legislation Ascribing Powers and Responsibilities
Department of Treasury and Finance (DTF)	Owner/Shareholder Financial management (setting financial reporting guidelines, reviewing annual reports and corporate plans), capital works approvals for significant projects (through the Gateway Review Process).	
Essential Services Commission (ESC)	Pricing and performance regulation	*Part 1A of the Water Industry Act 1994 (Vic)* *Essential Services Commission Act 2001 (Vic)* *Water Industry Regulatory Order 2003*
Department of Health	Technical regulator - Safe drinking water (water quality testing)	*Safe Drinking Water Act 2003 (Vic)* *Safe Drinking Water Regulations 2005*
Environment Protection Agency (EPA)	Technical regulator - Environmental Protection	*Environment Protection Act 1970 (Vic)*
Energy and Water Ombudsman (Victoria)	Dispute Resolution	Section 1227G of *the Water Act 1989 (Vic)*

The physical delivery of water and associated services is provided by the various water corporations and other authorities as detailed in Table 30.

Table 30 Water Corporations

Stakeholder	Role
Water Corporations and Licensees	
MWC	Provides bulk water and bulk sewerage services (transfer and treatment) in the Melbourne Metropolitan area and manages rivers and creeks and major drainage systems in the Port Phillip and Westernport region, and particularly in Fishermans Bend
South East Water	The licensee delivers retail water supply (including recycled water) and sewerage services to customers in Fishermans Bend
Other Drainage Authorities	
Local Government	Local Drainage for catchments less than 60 Ha in area
Vic Roads	Operates and maintains drainage infrastructure within its road corridors, including pavement drainage, cross-drainage structures, and water quality devices associated with roads under their control

This arrangement is further detailed in Figure 16, which provides a diagrammatic representation of the industry arrangement.



Source: Melbourne Water, Water Plan, 2008

Figure 16 – Industry Breakdown

9.2.2 Power Sector

In discussing the power sector we refer to the provision of electricity and gas. As with the water sector there exist well established arrangements that govern the provision of gas and electricity.

There are two significant differences from the water sector:

- Ownership of the electricity and gas infrastructure is private.
- The markets are regulated at the Federal level rather than State.

These two issues influence the way power is managed throughout Victoria. Table 31 and Table 32 detail the stakeholders in the electricity and gas sectors respectively.

Table 31 Key Electricity Stakeholders

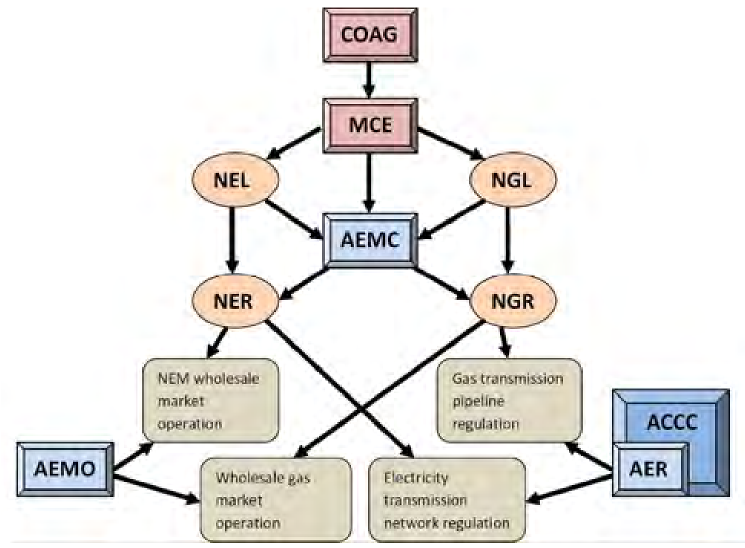
Agencies	Responsibilities
National	
Department of Resources, Energy and Tourism	The national policy body regarding Australia's resources, energy and tourism sectors
Ministerial Council on Energy (MCE) (acting on behalf of COAG)	The national policy and governance body for the Australian Energy Market
Australian Energy Market Commission (AEMC)	Rule-making, market development and policy advice on the NEM
Australian Energy Regulator (AER) (part of the ACCC)	Enforcement of and compliance with the National Electricity Rules Economic regulation of electricity transmission and distribution networks Bringing court proceedings in respect of breaches

Agencies	Responsibilities
Australian Energy Market Operator (AEMO)	Overseeing the reliability and security of the NEM, managing the NEM National transmission planning for the electricity transmission grid.
Victoria	
The Department of Environment and Primary Industries (DEPI)	Electricity-related policy and programs including feed-in tariffs, clean coal technology, the Energy Technology Innovation Strategy (ETIS) and the Smart Meters program.
Essential Services Commission (ESC)	Regulator for electricity retailers and manages licence arrangements for the distribution and sale of electricity in Victoria.
Energy and Water Ombudsman (Victoria)	Handles complaints against electricity companies by customers
Energy Safe Victoria (ESV)	Safety regulator responsible for electricity in Victoria. Ensures compliance with *Electricity Safety Act 1998.*

Table 32 Key Gas Stakeholders

Agencies	Responsibilities
National	
Department of Resources, Energy and Tourism	The national policy body regarding Australia's resources, energy and tourism sectors
Ministerial Council on Energy (MCE) (acting on behalf of COAG)	The national policy and governance body for the Australian Energy Market
Australian Energy Market Commission (AEMC)	Responsible for rule-making, market development and policy advice on the NEM
Australian Energy Regulator (AER)	Economic regulator for natural gas transmission and distribution pipelines in all States and Territories (except WA) and enforces the National Gas Law and National Gas Rules
Australian Energy Markets Operator (AEMO)	Independent system operator of gas networks in Victoria and all other States (except Western Australia)
Victoria	
The Department of Environment and Primary Industries (DEPI)	Administers the construction of gas transmission pipelines, facilitate investment, and manage and plan for gas supply emergencies
Essential Services Commission (ESC)	Monitors the gas retail sector's compliance, performance monitoring and reporting complaints.
Energy and Water Ombudsman (Victoria)	Handles complaints against gas and electricity companies by customer
Energy Safe Victoria (ESV)	Safety regulator responsible for electricity and gas in Victoria. Ensures compliance with *Electricity Safety Act 1998*

The above roles and responsibilities are further detailed diagrammatically in Figure 17.



Source: ACIL Tasman: Energy transmission network planning, 2010

Figure 17 Energy market governance model

The existing arrangements are both a strength and a weakness with regard to the proposed infrastructure plans. The BAU requirements are well handled, and are designed to facilitate efficient delivery of necessary infrastructure. However, as will be discussed in Section 9.4, the arrangements can prove to be a barrier to the alternative technologies, such as cogeneration.

9.2.3 Telecommunications

On 1 July 1997, the Australian telecommunications industry became subject to a regulatory framework designed to promote:

- The long-term interests of end-users of telecommunications services, and
- The efficiency and international competitiveness of the Australian telecommunications industry.

The responsibility of telecommunication services in Australia falls within the Commonwealth's jurisdiction. The Commonwealth holds exclusive regulatory powers to serve this function. Through its regulators, the Australian Communications and Media Authority (ACMA) and the ACCC, the Commonwealth Government aims to create an environment that promotes investment, competition and innovation in the telecommunications market.

Table 33 summarises the key industry stakeholders and their responsibilities.

Table 33 Telecommunications Industry Stakeholders

Stakeholder	Role
Department of Broadband, Communications and the Digital Economy	Provide advice and policy direction for the communications industry
ACMA	A Federal Government body responsible for the regulation of broadcasting, the internet, radio communications and telecommunications
ACCC	Regulates competition in the telecommunications industry

Stakeholder	Role
Communications Alliance Ltd	The peak communications industry body. It has primary responsibility for developing technical, operational and consumer industry codes and standards
Australian Communications Access Forum (ACAF)	An industry self-regulatory body, approved by the ACCC. Its role includes recommending which services should be subject to the telecommunications access regime, as well as generating and updating an access code.
Telecommunications Industry Ombudsman (TIO)	An independent dispute resolution forum for complaints made by residential and small business consumers of telecommunications services
Telecommunications Universal Service Management Agency (Proposed 2012)	Proposed Agency to commence operation from July 2012 with responsibility for the delivery of universal service outcomes and public interest services. It will be established as an agency under the Financial Management and Administration Act 1997 and will fulfil its statutory functions by contracting with third parties on behalf of the Government
Carriage service providers (such as Telstra, Vodafone, Optus and NBNCo)	Deliver a wide range of telecommunications services including fixed telephony, mobile and internet services

9.2.4 Waste Management

Responsibility for waste management in Victoria falls to the public sector, shared between Councils and Waste Management Groups. There are 13 waste management groups in Victoria, with 12 groups covering regional Victoria, and a single group, the Metropolitan Waste Management Group (MWMG), covering the 30 Melbourne metropolitan municipalities. The private sector role in waste management is in service provision, both to the municipalities and directly to the public.

The MWMG has responsibility to:

- Plan for waste management and resource recovery facilities and services across metropolitan Melbourne
- Facilitate procurement of efficient and sustainable resource recovery and residual waste disposal services for councils
- Help build the capacity and knowledge of councils and their communities of world best practice waste minimisation and the opportunities and options available for improved services and infrastructure[16]

Councils arrange for the collection and disposal of household and some commercial waste and recyclables, although these services are generally provided by private sector operators under contract to the municipalities or the Metropolitan Waste Management Group. Collection from larger developments and apartment developments is generally provided directly by private waste management companies, rather than under the control of Council.

[16] Metropolitan Waste Management Group 2013, Metropolitan Waste Management Group, Southbank, Victoria, viewed 3 June 2013, <http://www.mwmg.vic.gov.au/about-mwmg/about-overview>.

9.2.5 BAU Governance Implications

There are well established roles and responsibilities in the BAU scenario, which are well understood by industry. As such we would not recommend attempting any change to these arrangements for BAU. This would extend to the BAU components of the integrated scheme, as will be discussed in future sections.

9.3 ISS Roles and Ownership

The ISS consists of a combination of BAU infrastructure and alternative infrastructure. The BAU exists within the arrangements described above. There are opportunities though with the alternative technologies to provide alternative ownership and governance models. The particular items of infrastructure that lend themselves to these arrangements are:

- Cogeneration plant and district heating network
- Recycled water plant
- Sewer heat recovery

The nature of these initiatives, in that they have future revenue streams, not only encourages alternative ownership models, and by association private investment; they will require it. It is extremely unlikely Government will fund these initiatives in their entirety. Therefore it is essential that some form of Public Private Partnership (PPP) be initiated for these assets.

There are various models of PPP that could be applied to generate private sector investment. These include:

- BOT – Build, Operate, Transfer. A private entity builds and operates a facility for an agreed period, during which time the entity receives the associated revenue. At the end of the agreed period the facility is transferred to the public.
- BOOT – Build, Own, Operate, Transfer. As for the BOT scheme except the private entity owns the facility.
- BOO – Build, Own, Operate. In this scheme the asset remains the property of the private entity.

Infrastructure Australia (IA) identifies two possible models for PPP in its National Public Private Partnership Guidelines[17]:

- Design Build Finance Operate (DBFO)
- Design Build Finance Maintain (DBFM)

IA details a process for determining the most appropriate model for delivery, which they believe is the critical step in the process. Thus, the actual preferred model for these particular items should be investigated in detail in consultation with the private sector and government to achieve best value.

9.4 Governance Issues

Beyond the ownership and responsibility issues there remain a number of governance issues that will significantly impact the delivery of the infrastructure plan. These are detailed in the following sections.

[17] Infrastructure Australia 2008, National PPP Guidelines – Volume 1: Procurement Options Analysis, Commonwealth of Australia, Canberra

9.4.1 Mandating Building Performance Standards

Fundamental to the ISS is the construction of high performance buildings, and the associated demand reductions. Without the reduction in demand the ISS will in some cases be undersized and, more generally, will not meet the sustainability targets set as part of this report. While essential, achieving a mechanism that provides the right level of control of performance standards is not without issue.

There appear three possible methods for controlling, or attempting to control, the performance standards:

- **Planning scheme controls**. Examples are:
  - Overlay control. This could be introduced as a schedule to one of the existing overlay controls within the Victorian Planning Provisions (VPPs).
  - Incorporated document. An incorporated document sits within the Planning Scheme at Clause 81.

  These controls could be used to set a framework to guide the planning and design of buildings throughout the precinct.
- **Building Code of Australia (BCA)**. The BCA is the document that sets the building standards for all buildings throughout Australia.
- **Design Guidelines**. A design guideline could be created as an incorporated document, as referenced above, and hence as part of a planning scheme amendment, or alternatively, could be incorporated onto title as a caveat or restriction.

Recent Planning Scheme Amendment C187 to the Melbourne Planning Scheme provides the most recent guidance as to what is acceptable detail to be incorporated within a planning scheme amendment, in terms of the ability to mandate specific requirements. While the initial draft was quite prescriptive, the document was significantly altered following the Panel Hearing process and the release of the Panel's report of recommendations.[18] The alterations served to remove the prescriptive elements and alter them to guidelines.

The BCA is the document that controls building requirements and particularly sets requirements for heating and cooling, building fabric and the like, it appears to be the appropriate document to control the building design requirements. However, the document is an Australia wide document, and appears unable to be altered for localised or site specific solutions. As such its usefulness in this application appears limited.

Design guidelines are useful tools and can be very effective in controlling the design standards of a development / precinct. Where the guidelines are introduced into a planning scheme as an incorporated document, a planning scheme amendment would be required. This amendment would likely be subject to the standard to public notice / exhibition requirements. As such it would be expected that any mandatory requirements would be diluted.

The other alternative for design guidelines is to establish them as a restriction or caveat on a title. This has proved very effective for the Dandenong LOGIS project. The key difference in the LOGIS project is that Places Victoria controls the titles via its project partner MWC. There does not appear to be a mechanism that would allow such a restriction to be instigated in the instance of Fishermans Bend.

[18] Department of Planning and Community Development, 2012, *Panel Report – Melbourne Planning Scheme, Amendment C187,* Melbourne

As a result of the above, it appears unlikely in the current regulatory and planning environment that mandating high performance buildings will be possible. Rather the best approach appears to be a combination of planning controls and development guidelines. While even this combination will not achieve the ultimate goal of mandating, it will go part of the way there. In addition, it is hoped that market forces will drive the high performance goals – both in terms of the quality of the product and the need to meet buyers' expectations, and also in terms of whole of life cost assessments.

Ultimately there is a danger that mandatory or any prescriptive requirements will stifle development. Working with the developers is likely to be best approach. However further work is required to determine the bset method for achieving the aim of high performance buidings.

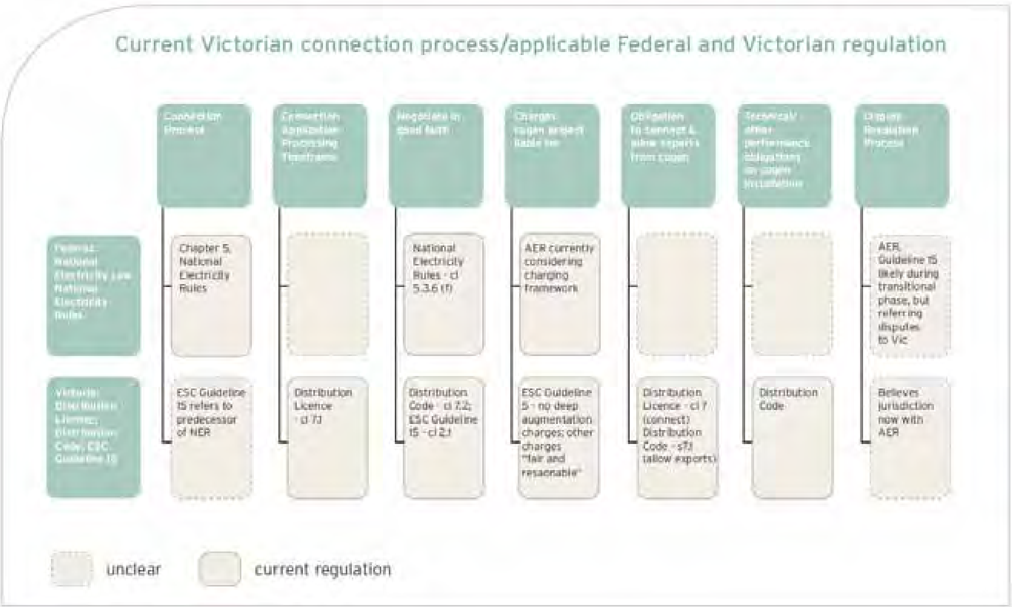
9.4.2 Cogeneration

A number of barriers exist that make the implementation of cogeneration schemes difficult. There are detailed studies that look at these barriers, in particular studies by the Institute for Sustainable Futures [19] and another by ClimateWorks[20]. The barriers are partly related to the regulatory environment that exists for the distribution of energy and partly the commercial environment. Ultimately the two environments are entwined.

The studies deal with regulatory barriers, which are extensive, and can be significant. Examples of key barriers include:

- The connection process. Various studies have identified a complex and uncertain process as being a significant barrier. Both the above studies proposed actions to reduce this uncertainty. The current connection process is detailed in Figure 18.
- Restrictions on islanded systems. Essentially this relates to the restrictions that exist in the National Energy Rules that:
- "a person must not own or operate a distribution system that forms part of the interconnected transmission and distribution system, unless that person is registered or has gained an exemption from the AER from the requirement to register"[21].

[19] Dunstan, C., Langham, E and Daly, J. (2009), *Barriers to Trigeneration in Sydney: Working Group Discussion Paper and Action Plan*, prepared by the Institute for Sustainable Futures, University of Technology, Sydney for the City of Sydney, October 2009.
[20] ClimateWorks Australia (2011), *Unlocking Barriers to Cogeneration: Project Outcomes Report*, ClimateWorks Australia, Melbourne, September 2011.
[21] Ibid



Source: ClimateWorks Australia

Figure 18 Current Victorian connection process

Ultimately these barriers are considered beyond the scope of this project to influence. Rather the focus of this project should be on the commercial barriers, which should be more able to be influenced. There is potential for significant commercial uncertainty associated with the development due to the nature of the development at Fishermans Bend. In particular, the roll out of developments may not be sequential. There is significant risk of customer leakage as the cogeneration may not be available at the correct time to accord with the individual developments.

One potential solution to potential customer leakage is to run as broad a network as possible initially, but this has obvious financial implications. An alternative solution is to provide an environment that gives the necessary encouragement for developers to utilise the cogeneration scheme. There are restraint of trade issues associated with mandating connection to any scheme, but measures can be enacted that are encouraging rather than proscriptive.

The experience of the Portland Sustainability Institute (PoSI) is that there is a need for significant upfront engagement from the government, either Local Government or State Government, to drive connections by meeting with individual developers and assisting prescriptive to secure customers.

9.4.3 Development Control

There is an overall governance question that sits above all these, at least as it relates to the delivery of infrastructure, which is how should the development itself be managed? There are a number of characteristics of this development that should be considered with regard to overall management, such as:

- **The development sits in two municipalities**. There is a real risk if the development is left to the control of the City of Port Phillip and the City of Melbourne that a lack of coordination between the two municipalities could undermine the development. This is of particular concern for utilities, as coordination is essential both in terms of location and also timing.

- **Ownership is diverse**. There are a large number of owners in FBURA, from small single lot owners to larger groups such as Goodman and MAB. Coordinating development to suit the likely diverse expectations will be challenging.
- **There is no clear development front**. The lack of an obvious development front brings significant potential risks. Out of sequence development is difficult to manage and will be more difficult to provide infrastructure to. Possible mitigations include artificially creating a development front by use of catalytic projects.
- **The requirement for high performance buildings**. This issue is discussed in Section 9.4.1. Having this issue controlled by two agencies creates the risk of differing approaches in the two areas, with the attendant problems that could create.
- **The need for private investment**. This project will require significant private investment, particularly for the cogeneration initiative. To achieve this investment will require significant effort to create an environment that is conducive and also to find the best private partners.

Given the above, it seems most appropriate that a single development authority should be created to control development, to the extent possible. This position is supported by the market.[22]

[22] Property Council of Australia 2012, “Melbourne’s Future – A plan for Fishermans Bend”, Property Council of Australia, Melbourne, viewed 4 June 2013, <http://www.propertyoz.com.au/library/A%20Plan%20for%20Fishermans%20Bend.pdf>

10. Infrastructure Plan Cost Estimates

Cost estimates for both the BAU and the integrated infrastructure plan. The full versions of the cost estimates are included in Appendix G. The estimates must be read in conjunction with the full set of exclusions and assumptions included in the full report.

The results of the estimates are shown in Table 34.

Table 34 Summary of Infrastructure Costs

Item	Business As Usual Cost ($)	Integrated Infrastructure Plan Cost ($)
Recycled Water	Excluded	45,401,030
Potable Water	34,582,650	5,957,750
Sewerage	4,894,110	4,894,110
Stormwater	6,926,200	6,926,200
Electrical	15,024,830	15,024,830
Gas	5,970,360	5,970,360
Cogeneration	Excluded	125,681,600
Sewer Heat Recovery	Excluded	1,877,000
Telecommunications	3,702,275	3,702,275
Sub Total Trades	**71,100,425**	**215,435,155**
Prelims and Supervision (8%)	5,690,000	17,240,000
Margin (5%)	3,840,000	11,640,000
Total Construction	**80,630,425**	**244,315,155**
Consultant Fees (8%)	6,460,000	19,550,000
Design Development Contingency (15%)	12,100,000	36,650,000
Construction Contingency (15%)	13,809,575	41,984,845
Sub-Total On Costs	**32,369,575**	**98,184,845**
TOTAL DESIGN AND CONSTRUCTION BUDGET as at May 2013 (EX GST)	**113,000,000**	**342,500,000**

10.1 Additional Cost Elements

While not included in the cost statement provided above, the following additional items might need consideration as part of future assessments.

10.1.1 Relocation / Undergrounding of 220 kV power lines

As part of our 2012 review of Fishermans Bend's existing infrastructure, SP Ausnet provided high level costings for the relocation of the 220 kV power lines that transect FBURA. That information is reprinted below:

The following options to relocate the existing 220 kV FBTS – NPSD/BLTS double circuit tower line were identified by SPI PowerNet based on a high level review of the neighbourhood. The costs are indicative and high level and should be used for comparative purposes only. These costs are subject to change.

New Tower Line South of Freeway

- *A new 36 m wide double circuit easement and new transmission tower line, free of encumbrance from existing Tower 9 along the southern side of the freeway to existing Tower 15 must be created prior to decommissioning and removal of the existing tower line*
- *Desktop design and construction estimate of $15 M excludes costs associated with planning permission and easement acquisition*

New Tower Line North of Freeway

- *A new 36 m wide double circuit easement and transmission tower line, free of encumbrance from existing Tower 9 over freeway near Todd Road then via tower line generally along Cook St to new tower on north side of Freeway opposite existing Tower 15 must be created prior to decommissioning and removal of the existing tower line*
- *Desktop design and construction estimate of $25 M excludes costs associated with planning permission and easement acquisition*

Two New Underground Cables South of Freeway

- *Two new 9 m wide underground cable easements and transmission cables, free of encumbrance from existing Tower 9 along the southern side of the freeway to existing Tower 15 must be created prior to decommissioning and removal of the existing tower line. A separate easement is required for each 220 kV underground circuit. The easements will require re-instatement of existing roadways*
- *Desktop design and construction estimate of $65 M including costs for two underground/overhead transition installations (each 45 m x 45 m) but excluding costs associated with planning permission and easement creation*

Two New Underground Cables North of Freeway

- *Two new 9 m wide underground cable easements, free of encumbrance from existing Tower 9 under the freeway near Todd Road then generally along Cook Street to FBTS must be created prior to decommissioning and removal of the existing tower line. A separate easement is required for each 220 kV underground circuit. The easements will require significant re-instatement of existing roadways.*
- *Desk top design and construction estimate of $90 M including costs for two underground/overhead transition installations (each 45 m x 45 m) but excluding costs associated with planning permission and easement creation.*

All four of the above options are subject to additional capacity and reliability requirements specified by AEMO. Each option would involve a significant planning approval process and a detailed easement route negotiation and creation process. This process could take in the order of 8 – 10 years. Any easement will require the removal of existing buildings and potential compensation to owners. The preferred alignment would depend greatly on the acquisition of land.

Costs associated with the relocation of the existing 220 kV FBTS – NPSD/BLTS double circuit tower line due to redevelopment aspirations would be attributable to the developer that requests the works.

10.1.2 Underground Storage

A key area of concern for the Utilities and Environment Working Group was the concept of using open space areas as flood storages to mitigate the impacts of peak flood events. The possibility of incorporating some or all of the required storage as underground storages was discussed through the various workshops.

WT Partnership was asked to prepare estimates for the various storages, with results shown in Table 35. Table 34 shows costs for five separate underground storages, these storages would be located beneath the green open space areas as an alternative to the open space detention storages shown in Appendix A. These estimates should incorporate all the standard contingencies from the previous table. In addition there is no allowance for pumping costs, should this be required. These costs are not considered significant, when considered against the overall costs of the storage.

Table 35 Indicative Costing for Underground Flood Storage

Item	Description	Unit	Qty	Rate $	Cost $
1.1	Underground storage – Atlantis underground modular water tanks each 450 mm high x 408 mm wide x 685 mm length (8 modules per m^3)	Ml	45	310,000	13,950,000
1.2	Underground storage – Atlantis underground modular water tanks each 450 mm high x 408 mm wide x 685 mm length (8 modules per m^3)	Ml	42	310,000	13,020,000
1.3	Underground storage – Atlantis underground modular water tanks each 450 mm high x 408 mm wide x 685 mm length (8 modules per m^3)	Ml	25	310,000	7,750,000
1.4	Underground storage – Atlantis underground modular water tanks each 450 mm high x 408 mm wide x 685 mm length (8 modules per m^3)	Ml	21	310,000	6,510,000
1.5	Underground storage – Atlantis underground modular water tanks each 450 mm high x 408 mm wide x 685 mm length (8 modules per m^3)	Ml	5	310,000	1,550,000
				TOTAL	**42,780,000**

11. Funding and Finance Analysis

11.1 Introduction

The following sections are extracted from the MacroPlan Funding Options and Financial Sensitivity Analysis, which is presented in full in Appendix H.

11.2 Overview

The rezoning of the FBURA to the Capital City Zone will result in increased property values throughout the precinct as a result of significant future development potential of privately held land.

This uplift creates the opportunity for value capture which may be used to fund required upgrades and new infrastructure through 'value capture' mechanisms.

Funding of utilities infrastructure is a relatively small component of infrastructure works required to enable urban development (renewal) to occur within Fishermans Bend.

A number of avenues exist for the collection of funds by Government and Servicing Authorities to deliver the infrastructure required by the precinct in order for the significant increase in development density and land use change to occur.

The funding mechanisms selected for examination in this paper are:

- Regulated Contributions to utility providers / asset owners
- Developer Contributions
- Infrastructure Recovery Charge (IRC)
- Residential infill levy
- Municipal rates and charges
- Private investment

11.3 Regulated Contributions to utility providers / asset owners

11.3.1 Overview

Providers of utilities typically seek contributions for infrastructure in the form of an up-front capital contribution (or works in kind) and/or in the form of infrastructure payments (charges). This process may apply in relation to the provision of new and/or upgraded infrastructure items relating to a variety of utilities infrastructure needs including drainage, water, stormwater, sewerage, gas, electricity and telecommunications. Whilst developer contributions are typically fixed for open space, transport, contributions sought for utilities may be negotiated and the formula for determining up-front and staged infrastructure contributions is ambiguous.

In instances where utilities infrastructure is planned and funds are available, owners of utilities networks will generally take responsibility for delivering such infrastructure and may recover such costs from users over time.

Where such infrastructure is not planned or funding is not available, contributions from land-owners/developers may be sought to cover infrastructure costs. The amount of the contribution sought (either in the form of an up-front capital contribution or through staged infrastructure payments) is subject to a number of variables including a process of negotiation between utilities providers and individual land-owners / developers.

In the case of Greenfield developments, upfront infrastructure requirements tend to be funded in stages by developers in accordance with an infrastructure delivery program and a defined sequence of development. Where Greenfield development occurs out of sequence, individual developers may elect to fund part or the entire up-front infrastructure required to facilitate development, with the option to recover this cost from utilities providers.

Whilst the principles of Greenfield development typically apply to infill development, there are a number of complexities in the case of FBURA. These are outlined below.

11.3.2 Key Issues

It is not apparent whether the relevant utilities providers (water, gas, electricity, telecommunications) have the required funding available to deliver new and upgraded infrastructure up-front, or the extent to which a share of proposed utilities infrastructure may be funded up-front in accordance with the suggested delivery timetable.

There are obviously a large number of individual land owners within FBURA and potential development fronts across multiple precincts – presenting challenges for utilities providers in coordinating up-front contributions involving a negotiated process.

It is not apparent which land owners/developers might elect to undertake development in the immediate-term and which will defer development, with implications for the sequence of infrastructure contributions and ultimately the timing of development more widely across the precinct.

Whilst there are a number of large individual land owners located in precincts such as Wirraway and Sandridge, it is not clear the extent to which such groups will elect to fund a large share of enabling infrastructure works involving a potential requirement to recover this cost from utilities providers over time.

A number of different infrastructure delivery agencies including State Government and Councils will be involved in coordinating both the physical requirements as well as statutory and financial requirements supporting orderly roll-out of various infrastructure types. This process itself will require significant further investigation to ensure effective and timely infrastructure coordination.

11.4 Developer Contributions

11.4.1 Overview

Developer contributions are payments (or in-kind works, facilities or services) for infrastructure required to facilitate orderly development. Contributions for infrastructure works are typically negotiated with infrastructure providers. Contributions by developers/land-owners may be made in the form of either or both:

- Negotiated up-front capital contributions or works in kind
- Staged payments over time

The Minister for Planning recently announced a new framework for the application of development contributions in Victoria as set out in A New Victorian Local Development Contributions System – 'A Preferred Way Forward'. The new framework proposes a combination of standard contributions based around five infrastructure categories:

Community facilities (fixed levy)

- Open space facilities (fixed levy)
- Transport infrastructure (variable levy)
- Drainage infrastructure (variable levy)

- Public land (variable levy)

The new framework proposes the use of pre-determined standard levies, which could be imposed on new development in growth areas, regional settlements, rural settlements, established areas and strategic redevelopment sites.

11.4.2 Comments

According to the new framework, a Standard Levy is proposed as the default in each development setting, but with the opportunity to apply a tailored Development Levy Scheme (in Growth Areas and Large Scale Strategic Development Areas) if strategically justified such as FUBRA.

A Standard Levy will be applied per dwelling for Urban Areas and Strategic Development Areas in both a metropolitan and non-metropolitan context. It is proposed that different levies be set for residential and non-residential development in these areas to provide flexibility and equality.

Whilst a levy mechanism applied to FBURA would certainly provide for future cost recovery, it is not entirely clear what levy amount might reasonably be applied to recover the costs relating to utilities infrastructure, particularly those utilising new technologies.

The application of such a mechanism is examined at a high level below and is something for further careful examination by DCPD in collaboration infrastructure providers and the development industry.

11.4.3 Cash-flow assessment and sensitivity analysis

Appendix H includes the cash flow assessment and sensitivity analysis for this funding mechanism.

11.5 Infrastructure Recovery Charge (IRC)

11.5.1 Overview

An Infrastructure Recovery Charge (IRC) can be levied on developers up to 10% of development value in designated Urban Renewal Areas under the Urban Renewal Act. The Discussion Scenario provides for approx. 1,053,180 m2 gross developable commercial/retail floor space and 40,225 dwellings. The following assessment applies to commercial/retail developments and excludes residential development, which is the subject of a separate examination in the next section involving an infill levy. Timing assumptions are in accordance with timings issued 23 May 2013.

It is acknowledged that an IRC is not currently supported by the Department of Treasury and Finance.

11.5.2 Financial Analysis

For the purposes of analysis, reference is made to the Discussion Scenario development profiles (above) for each precinct.

The development profiles assume that a relatively small portion of total commercial/retail developable floor area occurs during the period 2015-2020, with up to 40% occurring during the period 2020-2025 and the balance occurring thereafter to 2040.

The above development profiles are applied to the total amount of commercial/retail floor space delivered during the periods 2015-2020, 2021-2025, 2026-2030.

Application of a 10% IRC to commercial/retail development value assuming normal development costs (including escalation) has the potential to generate $18m during the period

2015-2020, $95m during the period 2021-2025, and up to $260m during the period 2026-2030. This assessment excludes residential development, which is the subject of a separate examination in the next section involving a levy.

Table 36 Estimated IRC Return

Item	2016-2020	2021-2025	2026-2030
Average Rate of Development Profile	7%	30%	50%
Estimated value of IRC (@5%)	$9m	$47m	$130m
Estimated value of IRC (@10%)	$18m	$95m	$260m

Source: MacroPlan Dimasi 2013

Appendix H includes sensitivity analyses for the IRC.

11.5.3 Interpretation

This demonstrates that an infrastructure cost recovery mechanism linked to the volume and value of development will generate significantly higher potential for cost recovery in the future, reflecting staged patterns of development across the various precincts. Where residential development values are also subject to an IRC, the total value of cost recovery would increase significantly.

Specific details pertaining to the application of an IRC including tests relating to efficiency, equity, need and nexus would require further examination by Places Victoria.

11.6 Residential Infill Levy

11.6.1 Overview

An infill levy or residential developer contribution might be applied to all residential dwellings across FBURA to fund precinct-wide infrastructure improvements such as recycled water, cogeneration and sewer heat recovery systems.

The levy would need to be set at a level that is deemed to be affordable, equitable and efficient with a clear nexus between beneficiaries and infrastructure.

Such a mechanism could be applied during the periods 2015-2020, 2021-2025, 2026-2030.

Table 37 Possible Residential Infill Levy Levels

Item	Levy per dwelling	Density dwellings per ha
Recent Growth Area Precedents	$5,000 - $17,000	8-19
FBURA Forecasts		
Standard Levy	$9,600	
Scenario A 100% DCP	$13,000	74
Scenario B 100% DCP	$15,500	147
Scenario C 100% DCP	$13,500	294
Discussion Scenario	$17,663	276

Source: Property Council of Australia, Urban Enterprise March 2011, Places Victoria

11.6.2 Financial Analysis

Further the purposes of analysis, reference is made to the Discussion Scenario development profiles (above) for each precinct. The development profiles assume that on average up to 7% of total residential developable floor area occurs during the period 2015-2020, with 30% occurring during the period 2020-2025 and the balance occurring thereafter to 2040.

Application of a $10,000 residential levy per dwelling during the development horizon has the potential to generate up to $30m during the period 2015-2020, $120m during the period 2021-2025, and up to $200m during the period 2026-2030.

Table 38 Estimated Return from Residential Infill Levy

Item	2016-2020	2021-2025	2026-2030
Approx. No. Dwellings	2,800	12,000	20,000
Estimated value of levy (@ $5,000 per dwelling)	$15m	$60m	$100m
Estimated value of levy (@ $15,000 per dwelling)	$30m	$120m	$200m

Source: MacroPlan Dimasi 2013

Appendix H includes sensitivity analyses for the Residential Infill Levy.

11.6.3 Interpretation

As per the IRC, this demonstrates that a residential levy mechanism linked to the volume of residential infill development will generate significantly higher potential for cost recovery in the future, reflecting staged patterns of development across the various precincts.

Specific details pertaining to the application of an infill levy including tests relating to efficiency, equity, need and nexus would need subject to further examination by Places Victoria.

11.7 Municipal Rates

11.7.1 Overview

This section describes a simple infrastructure funding mechanism which may be explored in the context of funding precinct-wide infrastructure improvements such as recycled water, cogeneration and sewer heat recovery systems.

Both City of Melbourne and City of Port Philip Council use the Net Annual Value (NAV) of all properties within the municipal area as the basis of valuation for rating purposes. The NAV approximates the annual net rental for a commercial property and approximately five per cent of the capital improved value for a residential property.

The mechanism explored in this study involves a 20-30 per cent increase in the rate in the dollar applied to the NAV for all properties located within FBURA. In 2012, municipal rates were charged at a rate of 3.8445 cents per dollar against the NAV in the City of Port Philip. The following scenario analysis has been applied to precincts located within the City of Port Philip and is not applied to Lorimer which is located within the City of Melbourne.

This rate is calculated as a special rate / charge. The method for calculating a special rate/charge involves variations to the rate in the dollar applied to the NAV of property. The approach used for defining the 'amount of a special rate/charge' and 'its application' under the Local Government Act is different to that of a differential rate. Calculation / application of a special rate / charge involves:

1. Establishing the full cost of works/infrastructure including cost of finance (where applicable) to be funded via a special rate/charge
2. Defining the benefited area, with particular reference to nexus / beneficiaries within the benefit area
3. The timeframes for application of the special rate/charge to recover the full cost defined in (item 1)
4. Is subject to third party appeal under the Local Government Act through VCAT

A sensitivity analysis was used as a method of demonstrating the capacity to fund such infrastructure over time using a special rate/charge under the Local Government Act. This is due to the considerable uncertainties involved (at this stage) in establishing the portion of the total utilities infrastructure cost to be funded through this mechanism (item 1); the benefited area associated with such infrastructure (item 2); and the timeframes the Victorian Government foreshadows for repayment of such infrastructure, in accordance with peak debt priorities (item 3).

11.7.2 Financial Analysis

A flat 25 per cent increase in the rate in the dollar currently applied to all properties located within Montague, Sandridge and Wirraway precincts has the potential to generate approx. $18.6 million [23] in additional rate revenue over 20 years in NPV terms.

A flat 30 per cent increase in the current rate in the dollar over 20 years generates approx. $22.3million [24] in additional revenue during this period in NPV terms.

[23] *These estimates assume an increase in average land values (i.e. NAV used for valuation purposes) of 3.5 times during the 20 year assessment period which is not unrealistic for the FBURA area.*

[24] *As for previous note.*

Table 39 Estimated Return from Municipal Rates

Timing of Value Capture	Required Increase in rate in the dollar applied to NAV		
	25%	30%	50%
10 years	$5.0m	$6.0m	$10.0m
15 years	$11.0m	$13.2m	$22.0m
20 years	$18.6m	$22.3m	$37.2m

Source: MacroPlan Dimasi 2013

11.7.3 Key Issues

The suggested funding mechanism has the following characteristics:

- Immediacy – this arrangement presents a clear and transparent infrastructure program which can be applied now
- Market certainty – this arrangement provides certainty for land owners who currently pay rates and does not involve new legislation, policy or instruments to take effect
- Tax efficient – this arrangement allows for a level of pass-through to commercial tenants (via rents) and is therefore tax deductable
- Nexus – this arrangement maintains nexus to the development which triggers the mechanism
- Relatively equitable and efficient – this arrangement has the potential to addresses current gaps in the Development Contributions System (currently subject to review)

11.7.4 Interpretation

The suggested funding mechanism has the potential to generate a contribution to the total cost of delivering new technologies capable of achieving long-term sustainability benefits for the precinct.

The total value of additional revenue generated may increase (or decrease) in all scenarios depending on the likely future increase in the value of properties located within FBURA.

There is a potential mismatch in this option between the timing of value capture and infrastructure investment. The timing of value capture is largely a reflection of sequencing assumptions relating to development. The mechanisms explored relate to the quantum of development and/or NAV of all properties located within FBURA. Both the volume of development and NAV have the potential to trend upwards over time, meaning the potential for value capture will be larger in future periods.

11.8 Private Investment

11.8.1 Overview

The extent of public or private investment appetite in major sustainability initiatives to be located within FBURA, such as cogeneration and water recycling is unknown.

11.8.2 Key Comments

The following general observations apply:

- Timing – cogeneration and water recycling infrastructure is unlikely to be required during the initial phases of development in FBURA and more likely to be delivered during the period after 2020-2025
- Public investment/partnerships – it is unlikely such infrastructure would be publicly funded in its entirety; whilst there may be some potential for a public private partnership (PPP) arrangement, any publicly funded element would likely involve deferred funding during the life of the asset
- Private investment, ownership and operation - significant private investment in such infrastructure will be required to ensure timely delivery to ensure roll-out, utilisation, ownership and long-term operation of such sustainability assets
- Long-term revenue potential – it is acknowledged that cogeneration may provide for long-term revenue streams through progressive use and distribution of such technologies within FBURA and possible distribution of energy through the national electricity network. It is likely that water recycling technologies will deliver localised benefits within FBURA and surrounding areas but not on regional basis
- Sustainability benefits – the proposed technologies have the potential to deliver long-term sustainability benefits within FBURA and more broadly through demonstration of the benefits of such technologies

11.9 Possible Government Initiatives

There is a range of possible initiatives Government could enact to entice private sector investment into the ISS, particularly as it relates to the cogeneration system, sewer heat system and the recycled water plant. These include:

1. Identify candidate sites capable of accommodating cogeneration system, sewer heat recovery system and the recycled water plant within FBURA
2. Define how such infrastructure will integrate with users within FBURA, including wider energy and water networks where appropriate
3. Undertake early market sounding to more closely define investor appetite and requirements to enable Government to procure appropriate site(s) and/or provide appropriate support for investors seeking to purchase land directly for use in delivering such infrastructure
4. Government to procure a site or sites capable of accommodating the proposed infrastructure systems to enable early investment by potential private sector operators
5. Identify types of private investors (owners/operators) of this infrastructure nationally and internationally with a view to inviting such parties to tender
6. Undertake a market call seeking investor interest to be followed by a tender process in which parties will be invited to either purchase the sites or partner with Government to deliver such infrastructure within FBURA

11.10 Summary

There is more than sufficient capacity for cost recovery to fund proposed new and upgraded utilities infrastructure under both options during the period 2016-2030. Each option may be funded through all or a combination of mechanisms explored in this paper, including a Standard

Levy (DCP), Infrastructure Recovery Charge (IRC), Residential Infill Levy, municipal rates and charges and private investment, refer Appendix I for the governance and funding options for the proposed infrastructure.

- The estimated nominal amount of value recovered through a Standard Levy (DCP) is $45m – $60m, an Infrastructure Recovery Charge is $185m – $370m and a Residential Infill Levy is $175m – $350m during the period 2016-2030. This is more than the total nominal amount required to fund utilities infrastructure under each of the proposed options during this time.
- During the period 2016-2020, the suite of mechanisms above is capable of delivering $37m – $65m, which is broadly equivalent to the total utilities infrastructure cost of $34m under Option 1. The total utilities cost under option is approx. $40m – $70m higher than total cost recovery during this timeframe. This gap relates to cogeneration and recycled water systems which may not be delivered until after 2020 and will likely require significant up-front private investment resulting in long-term sustainability value for FBURA and potential private investment returns.

An increase in municipal rates may also generate additional value capture capable of funding shared local infrastructure improvements, such as stormwater drainage works and improvements to water infrastructure.

Whilst the extent of private investment appetite in major sustainability initiatives such as cogeneration and water recycling is unknown, it is likely such infrastructure will require direct investment, ownership and operation by private parties to be delivered.

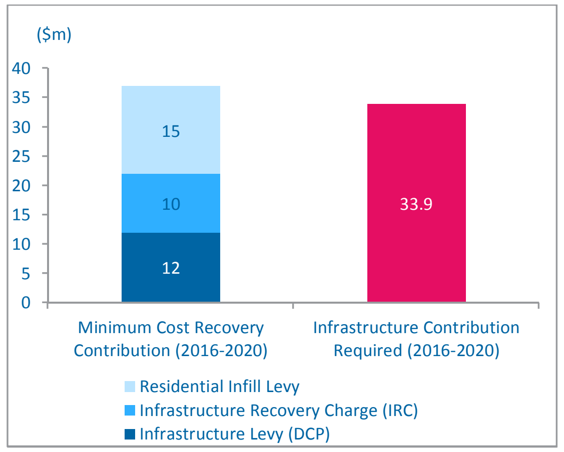
It is acknowledged that cogeneration and recycling technologies have the potential to deliver long-term sustainability benefits for FBURA and provide long-term revenue streams through production and distribution networks.

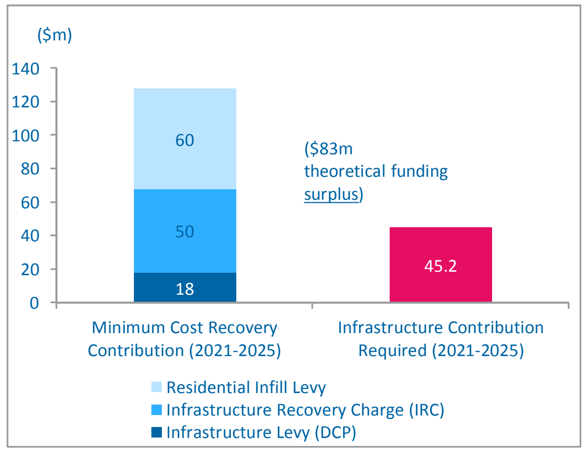
Appendix H contains a peak funding analysis which highlights peak infrastructure funding risk in the context of staged land developments and value uplift, resulting in potential funding gaps during some years.

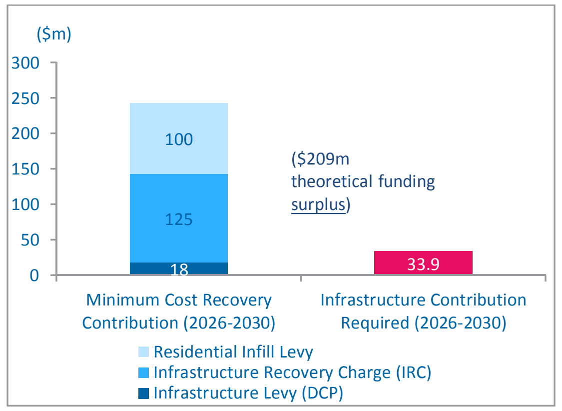
Table 40 Cost Recovery System

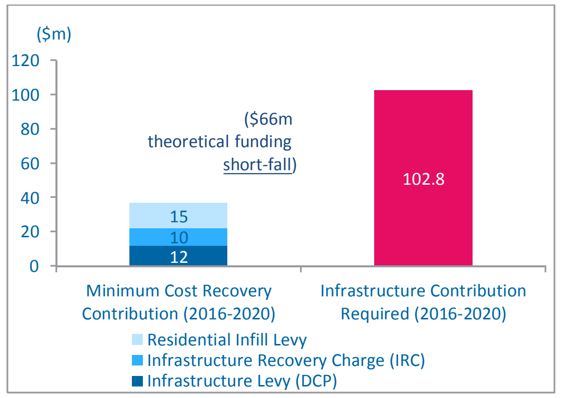
Item	Rate	Total Cost Recovered ($m) 2016-2030	Marginal Proportional Cost ($Nominal/m2)	Nominal Cost Recovery ($m) 2016-2020	Nominal Cost Recovery ($m) 2021-2025	Nominal Cost Recovery ($m) 2026-2030
Infrastructure Levy (DCP)	$20- $25/m2	45-60	25-33	12-15	18-23	1-20
Infrastructure Recovery Charge (IRC)	5%-10%	185-370	102-205	9-18	47-95	130-260
Residential Infill Levy	$5,000-$10,000	175-350	97-194	15-30	60-120	100-200
Net Funding Position	**-**	**405-780**	**-**	**37-65**	**120-240**	**235-470**

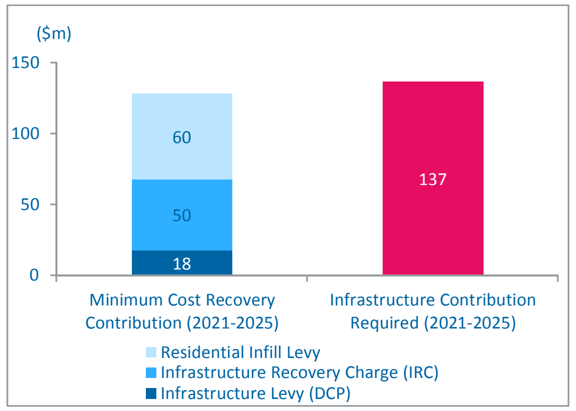
Source – MacroPlan Dimasi 2013

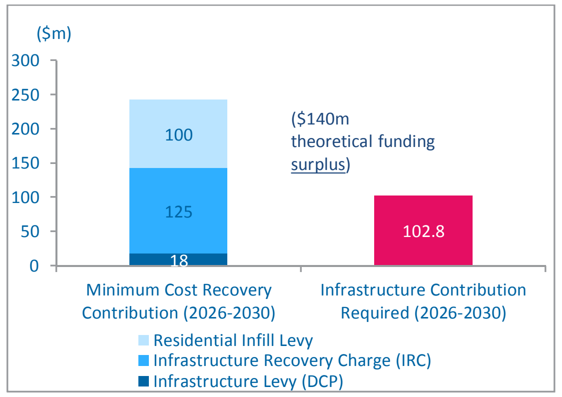

($m)
40
35
30
25
20
15
10
5
0
15
10
12
33.9
Minimum Cost Recovery Contribution (2016-2020)
Infrastructure Contribution Required (2016-2020)
Residential Infill Levy
Infrastructure Recovery Charge (IRC)
Infrastructure Levy (DCP)


($m)
140
120
100
80
60
40
20
0
60
50
18
($83m theoretical funding surplus)
45.2
Minimum Cost Recovery Contribution (2021-2025)
Infrastructure Contribution Required (2021-2025)
Residential Infill Levy
Infrastructure Recovery Charge (IRC)
Infrastructure Levy (DCP)


($m)
300
250
200
150
100
50
0
100
125
18
($209m theoretical funding surplus)
33.9
Minimum Cost Recovery Contribution (2026-2030)
Infrastructure Contribution Required (2026-2030)
Residential Infill Levy
Infrastructure Recovery Charge (IRC)
Infrastructure Levy (DCP)


($m)
120
100
80
60
40
20
0
($66m theoretical funding short-fall)
102.8
15
10
12
Minimum Cost Recovery Contribution (2016-2020)
Infrastructure Contribution Required (2016-2020)
Residential Infill Levy
Infrastructure Recovery Charge (IRC)
Infrastructure Levy (DCP)


($m)
150
100
50
0
60
50
18
137
Minimum Cost Recovery Contribution (2021-2025)
Infrastructure Contribution Required (2021-2025)
Residential Infill Levy
Infrastructure Recovery Charge (IRC)
Infrastructure Levy (DCP)


($m)
300
250
200
150
100
50
0
100
125
18
($140m theoretical funding surplus)
102.8
Minimum Cost Recovery Contribution (2026-2030)
Infrastructure Contribution Required (2026-2030)
Residential Infill Levy
Infrastructure Recovery Charge (IRC)
Infrastructure Levy (DCP)

12. Risks

Risks for the Fishermans Bend project were identified in collaboration with the Utilities and Environment Working Group at a workshop on the 10 April 2013. Risks were identified by the group for the key areas of community, technical and financial. A further workshop was conducted with members of the GHD project team to assess and expand on specific risks associated with the ISS, and to identify mitigation measures and recommendations to address each of the individual risks.

Some of the key risks identified by this process are outlined below and the complete list is provided in Appendix J.

Community

- Community acceptance and perception of the infrastructure proposed by the plan. Consultation with Council and the community will be critical to addressing this risk.

Technical

- Ability to acquire suitable land to accommodate the infrastructure proposed by the plan (i.e. cogeneration plants, recycled water treatment plant and the new waste transfer station).
- Failure to realise the energy and water savings proposed by the high performance buildings and conversely, unprecedented growth across the FBURA and surrounding areas.
- Slow uptake of recycled water, energy and waste initiatives.
- Lack of flexibility to accommodate alternative/superior integrated solutions that might emerge in the future.
- Construction on Coode Island Silt and contaminated land.

Financial

- Non delivery of cogeneration due to lack of commercial viability or other unforeseen reasons, which may lead to a failure to achieve the sustainability targets set out in the plan. However this will not undermine the proposed infrastructure plan for Fishermans Bend.
- Lack of uptake of the recycled water and district energy systems and therefore failure to recover the capital costs of these schemes.
- Lack of interest or inability to agree terms from the private sector to invest in cogeneration and recycled water treatment infrastructure.
- Unacceptable developer contributions.
- Timing for staging of development and infrastructure.

Some of the key recommendations to mitigate the risks outlined above include:

- Undertake consultation with Council, the community and developers.
- Complete further design and development of infrastructure proposed by the plan to confirm the footprint area requirements. Opportunities for co-location with other precinct infrastructure (i.e. zone substations, metro stations etc) are to be investigated further also.

- Establishment of a development authority to govern supply contracts for the provision of integrated infrastructure, administer the high performance buildings standards, engage with developers and the community regarding the ISS.
- Ensure siting and provision of utility infrastructure considers the risk of contaminated land and construction on Coode Island Silt.
- Quantify the magnitude of each risk by considering likelihood and consequence.

The recommendations outlined above are described further in Section 13 – Recommendations.

13. Recommendations

The Fishermans Bend infrastructure plan is high level in nature, and was intended for the purpose of defining the preliminary infrastructure requirements associated with the BAU and ISS options and their associated costs within ±30% accuracy.

A number of environmental and community benefits have been identified for the ISS, and the financial analysis has identified that there is potential to leverage private sector investment to provide an additional funding source for the costs associated with the ISS.

Therefore, the following summarises a number of recommendations and critical next steps to confirm the feasibility and methods for implementation of the ISS. In summary, the recommendations suggest further investigations are required to define the infrastructure requirements in greater detail, and how they might be staged and integrated with the proposed FBURA, along with the governance, ownership and commercial arrangements for delivery of the plan.

13.1 Next Steps

Design and development recommendations

- Further modelling and investigations are required to test a number of the assumptions made throughout this strategy and to refine the proposed upgrades in consultation with the Utilities.
- Consult with OLV once they have completed their city wide modelling to confirm the potable water upgrade strategy.
- Continue discussions with the energy sector regarding the interface between the proposed cogeneration system and the existing energy grid.
- Continue consultation with APA GasNet and United Energy to confirm the feasibility of the required gas extension to supply the cogeneration plants.
- Undertake further feasibility analysis of the district energy scheme including consideration of potential demand envelopes and commercial delivery models.
- Consult with the developers; successful implementation of the plan will rely on their participation and 'buy in', therefore early engagement will be key.
- Consult with cogeneration providers to confirm technologies available and potential commercial models for implementation.
- In consultation with the authorities, better understand when upgrades are required and the level of demand that will trigger / instigate the first stage of initial investment in infrastructure.
- Confirm the footprint required for the infrastructure and associated buffer distances, and the potential impact this might have on surrounding developments, in particular the impact of the recycled water treatment plant on the Montague and Lorimer precincts. Commence discussions with Council and relevant developers regarding acquisition of land.
- Consult with City West Water, South East Water and other relevant agencies to confirm the potential for supplying recycled water from the proposed Fishermans Bend recycled water treatment plant to surrounding precincts including Southbank and Docklands. There is an increasing demand for recycled water in these surrounding precincts. In doing so, confirm the potential for cost sharing arrangements for the recycled water treatment plant.

Implementation and governance recommendations

- Investigation options for a development authority model.
- Establishment of a development authority to undertake responsibilities such as coordination of development across two municipalities and a diverse number of private developers, encourage sequential development, drive the implementation of high performance buildings across the precinct and create an environment that is conducive to private investment.
- Determine the preferred procurement methods for cogeneration and recycled water treatment plants.
- Determine the potential to expand the Fishermans Bend scheme beyond the precinct (i.e. to integrate a recycled water supply network to Southbank and Docklands and a potential city wide waste to energy scheme).

Financial recommendations

- Consultation with developers to confirm feasibility of proposed tariff structures.
- Quantify the benefits associated with the ISS including the potential system wide 'avoided costs' that may result from adoption of the ISS both within Fishermans Bend and across other urban renewal areas in consultation with the utilities.
- Undertake an economic assessment of the proposed ISS that includes capital and operating costs, revenue streams and any potential avoided costs as outlined previously.
- Investigate the potential return on investment for specific infrastructure including cogeneration, sewer heat recovery and wastewater recycling that might attract private sector investment. This will be critical in confirming the potential interest from public or private sector to invest in the scheme.

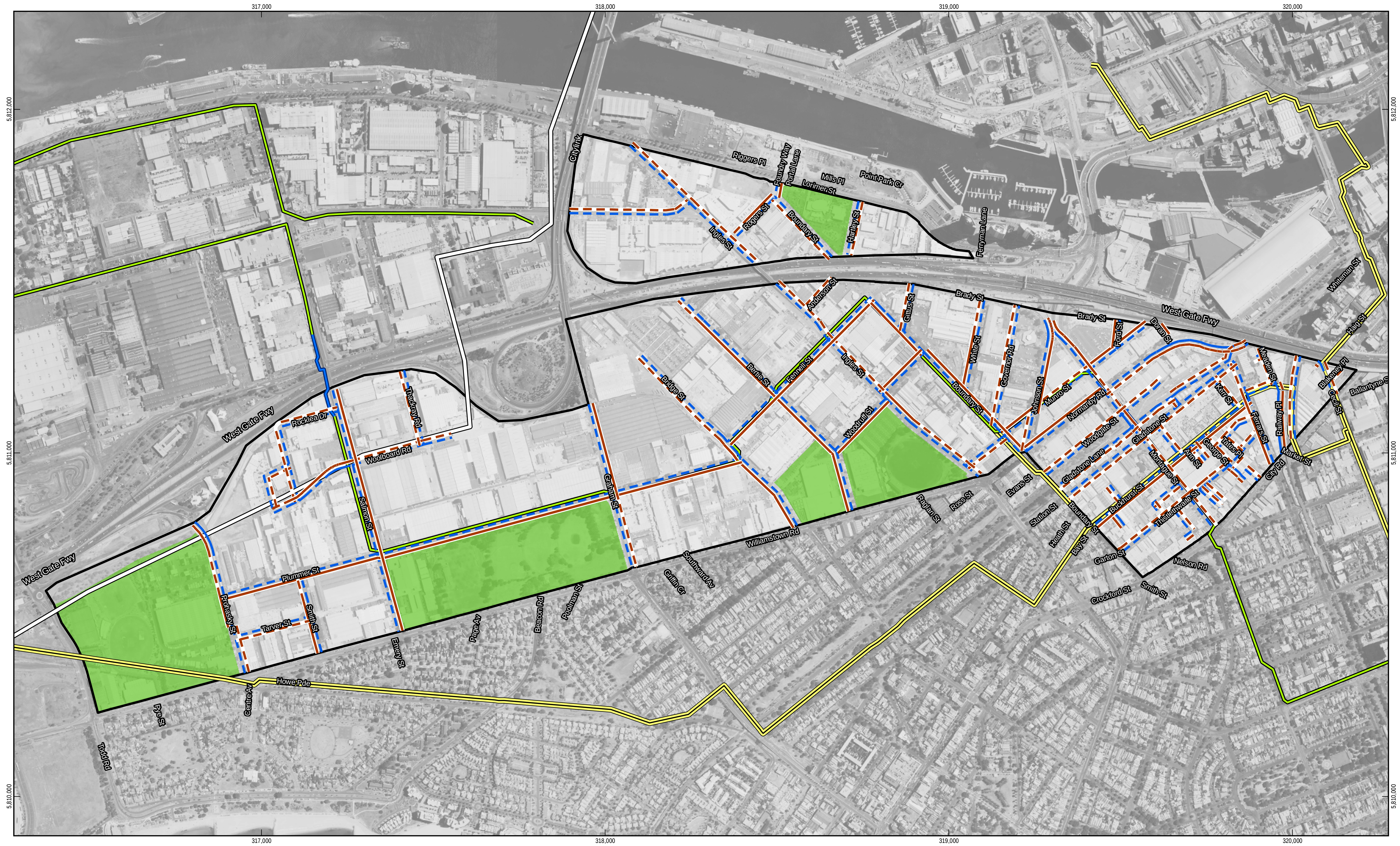
13.2 Further recommendations

The following additional recommendations are provided for the FBURA.

- Development of an environment that encourages developers to connect to cogeneration and district heating to ensure commercial viability.
- Use planning controls to encourage sequential development to improve the efficiency of infrastructure development.
- Determine the preferred framework for mandating high performance buildings.
- Determine a preferred high performance building framework for the project will need to consider the financial impact per building and the vehicle by which it can be implemented.
- Work with industry to promote and educate regarding benefits of high performance buildings.

Appendices

Appendix A – Business as Usual and Integrated Servicing Strategy Plans



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0 50 100 200 300 400
Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

LEGEND

- Existing 220kV Transmission
- Existing Overhead fibre
- Existing Underground fibre
- Proposed 11 kV Underground electricity network
- Existing gas transmission pipeline
- Existing high pressure gas network
- Proposed extension of high pressure gas network
- Future open space

Note: 33 new 1000 kV substations proposed, location to be determined (not shown on map)

Places Victoria
Fishermans Bend Infrastructure Plan

Job Number	31-30105
Revision	A
Date	21 Jun 2013

Business as Usual
Gas and Electricity Upgrades

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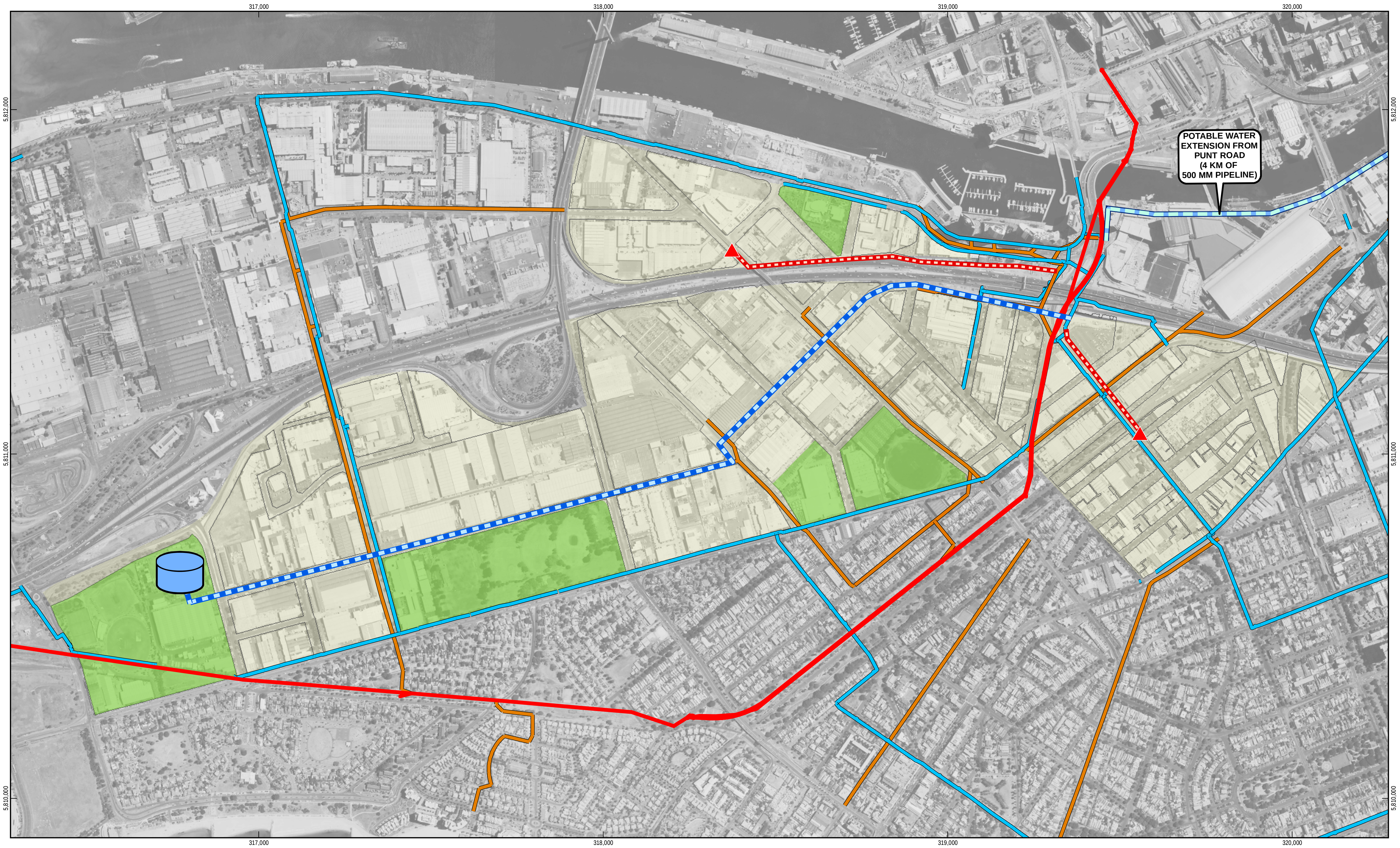
180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com

Data source: DSE, Aerial Imagery, 2009; DSE, VicMap, 2013; SP Ausnet, Power Lines, 2011; APA, Gas transmission line, 2011. Created by:mjahanshahi



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0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

LEGEND

- Existing water distribution main (SEW)
- Existing sewer main (SEW)
- Existing Melbourne Main and Hobsons Bay Main Sewers
- Proposed sewage rising main
- Proposed high level relief sewage pump station
- Proposed 500 mm potable water extension (Interface point with exsisting system to be determined)
- Proposed 450 mm potable water network upgrade
- 8ML potable water storage tank
- Future open space

Places Victoria
Fishermans Bend Infrastructure Plan

Business as Usual
Water Infrastructure Upgrades

Job Number	31-30105
Revision	A
Date	21 Jun 2013

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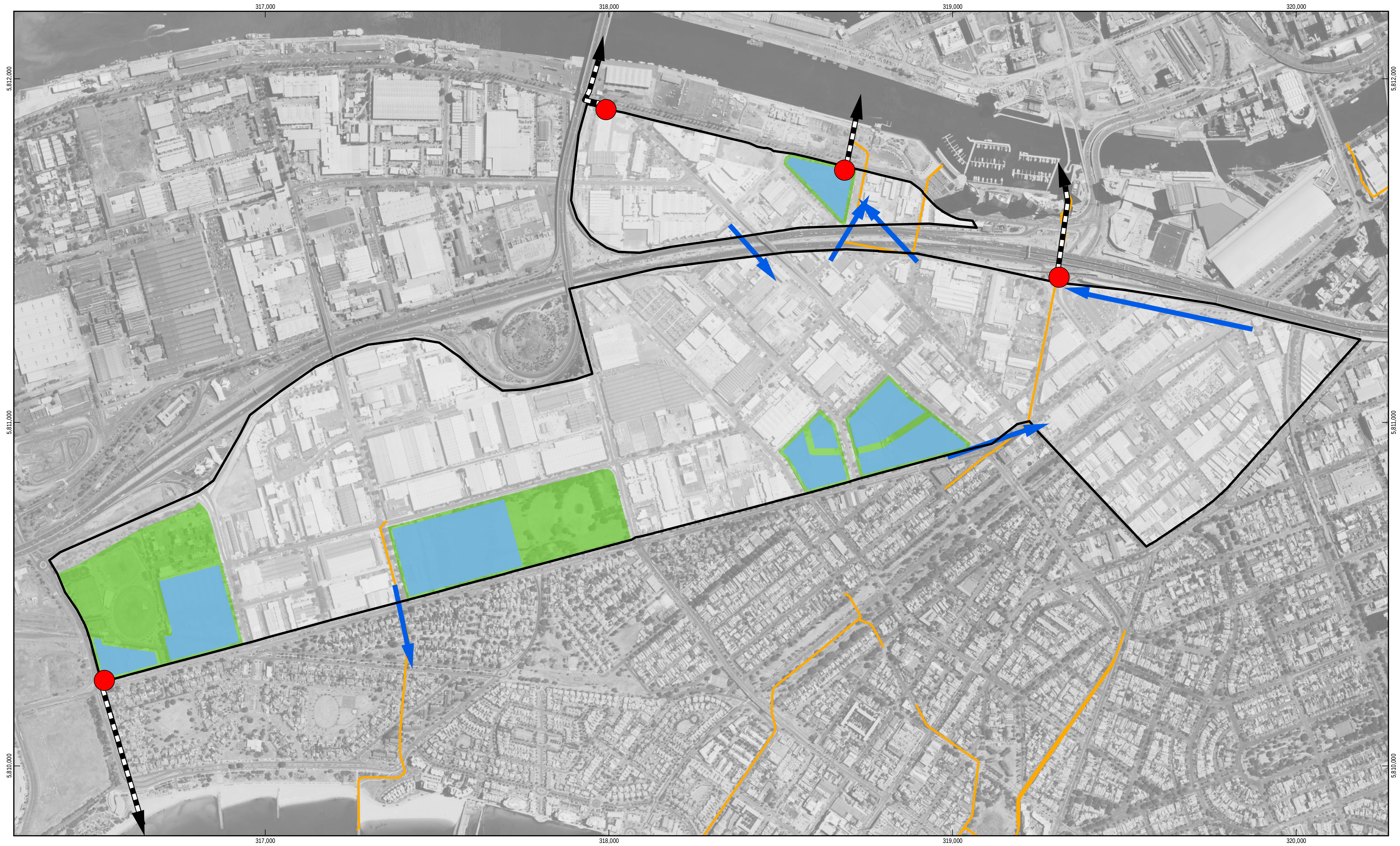
Data source: DSE, Aerial Imagery, 2012, DSE VicMap, 2013; SEW, Existing Mains, 2012. Created by:mjahanshahi



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0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

LEGEND

- Melbourne Water Drainage Assets
- Proposed stormwater detention in proposed open space areas
- Future open space
- Stormwater pump station
- Gravity flow directions assumed
- Stormwater rising main

GHD

Places Victoria
Fishermans Bend Infrastructure Plan

Job Number	31-30105
Revision	A
Date	21 Jun 2013

Business as Usual
Drainage Infrastructure Upgrades

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180 Lonsdale Street Melbourne VIC 3000 Australia **T** 61 3 8687 8000 **F** 61 3 8687 8111 **E** melmail@ghd.com **W** www.ghd.com

Data source: DSE, Aerial Imagery, 2009; DSE, VicMap, 2013; City of Port Phillip, Drainage assets, 2012; City of Melbourne, Drainage assets, 2012; Melbourne Water, Drainage pipelines, 2012. Created by:mjahanshahi

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0 0.25 0.5 1 1.5

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

LEGEND

- Existing waste transfer facility to be relocated inside or outside of precinct
- Fisherman's Bend Precinct
- Nearby waste transfer facilities

GHD

Places Victoria
Fishermans Bend Infrastructure Plan

Job Number	31-30105
Revision	A
Date	21 Jun 2013

Business as Usual
Municipal Waste Upgrades

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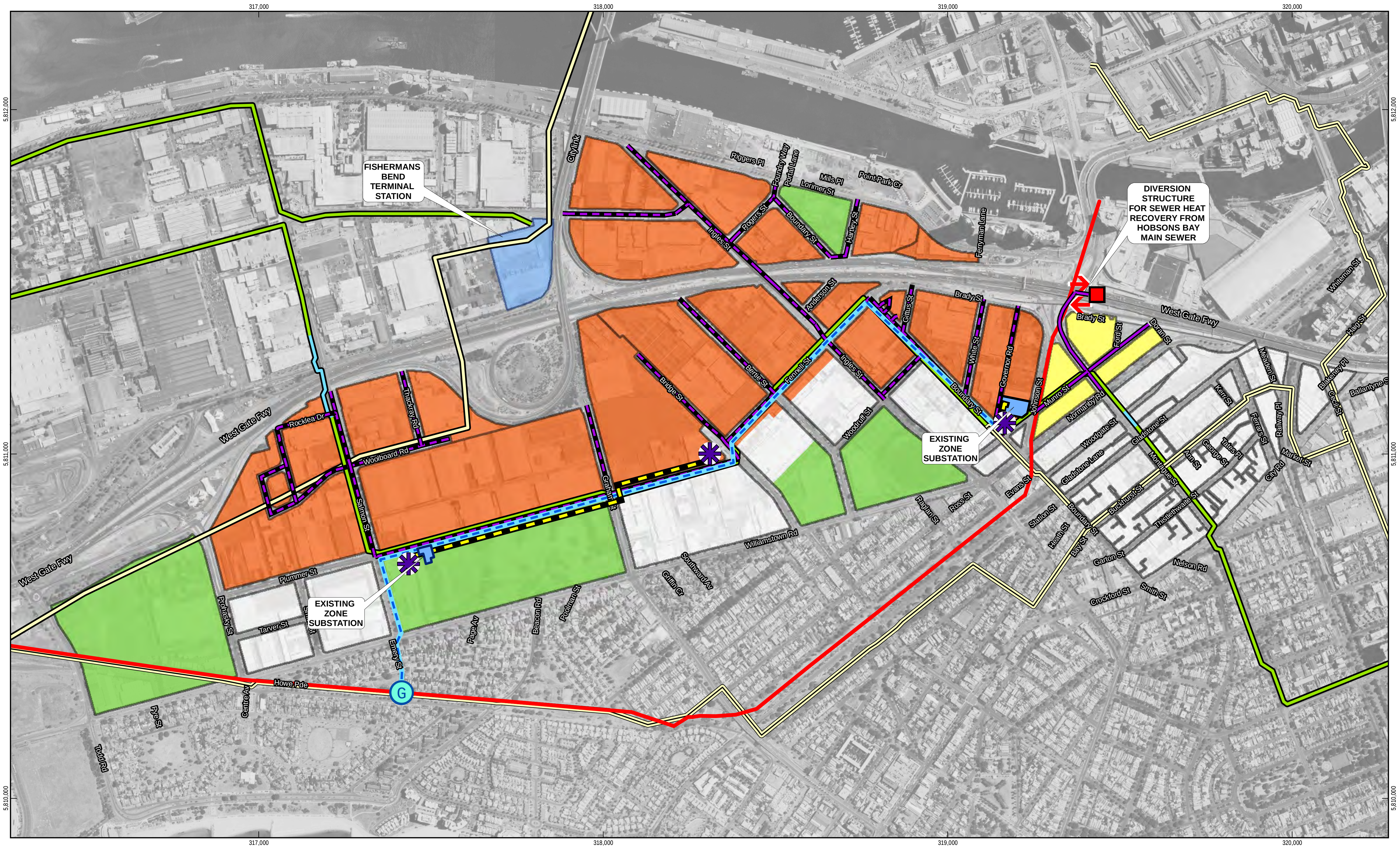
Data source: DSE, Aerial Imagery, 2009; DSE, VicMap, 2013. Waste Facilities captured by GHD. Created by:mjahanshahi



1:10,000 Paper Size A3

0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

LEGEND

- Potential sites for co-generation plants
- High density areas serviced by co-generation district energy system
- Sewer heat recovery district energy system
- Future open space
- Proposed district hot water loop
- Existing gas transmission pipeline
- Proposed extension of high pressure gas transfer main for cogeneration plants supply
- City Gate
- Proposed 11 kV HV line to supply electricity to existing zone substations
- Existing 220 kV Transmission
- Existing Overhead Fibre
- Existing Underground Fibre
- Existing Melbourne Main and Hobsons Bay Main Sewers
- Proposed sewer heat recovery facility
- Proposed diversion structure from Hobsons Bay Main Sewer

GHD

Places Victoria
Fishermans Bend Infrastructure Plan

Job Number	31-30105
Revision	A
Date	21 Jun 2013

Integrated Servicing Strategy
District Energy and Heating

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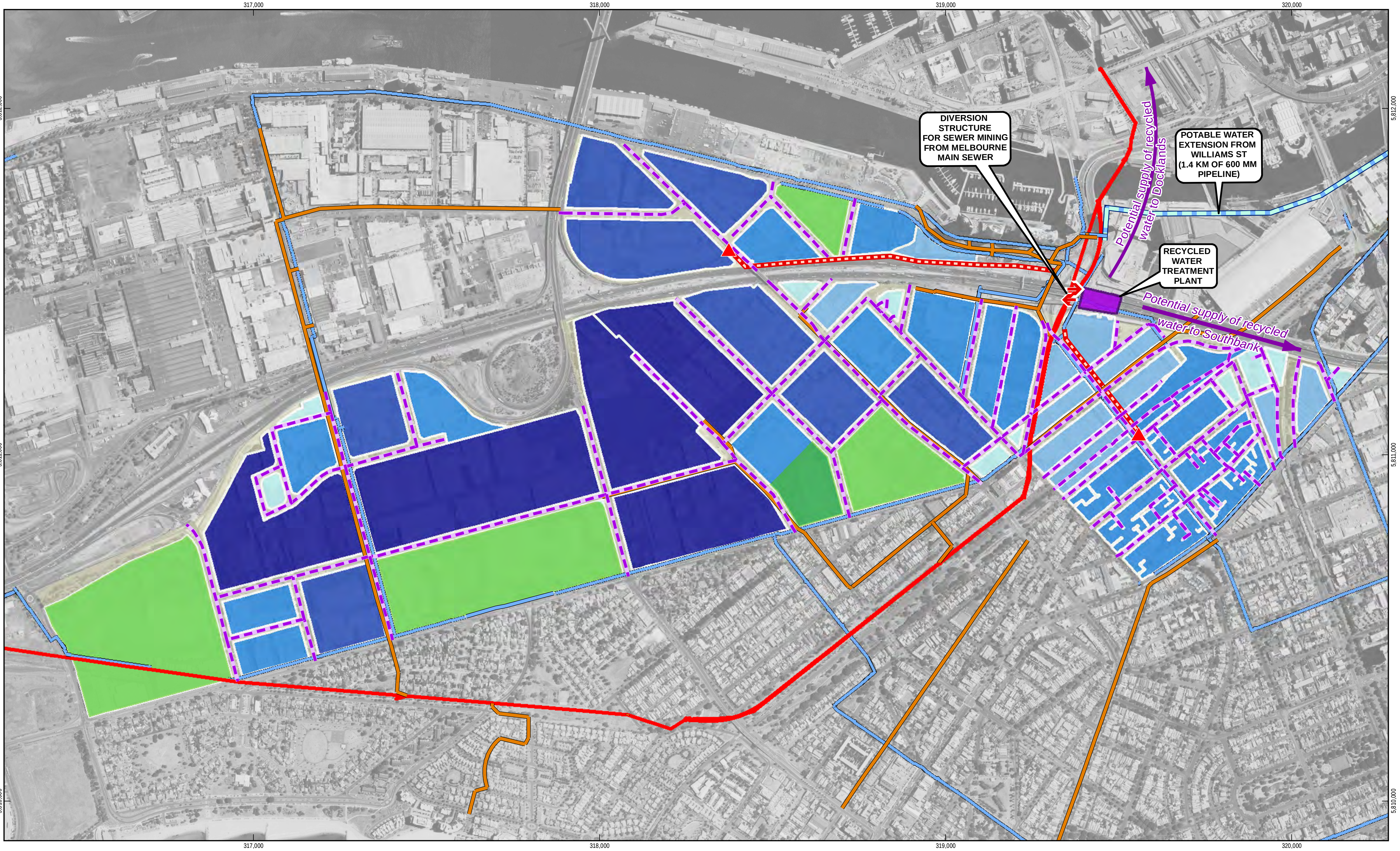
Data source: DSE, Aerial Imagery, 2009; DSE, VicMap, 2013; SP Ausnet, Power Lines, 2011; APA, Gas transmission line, 2011. Created by:mjahanshahi



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0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

LEGEND

- Existing water distribution main (SEW)
- Existing sewer main (SEW)
- Existing Melbourne Main and Hobsons Bay Main Sewers
- Future open space
- Proposed sewage rising main
- High level relief sewage pump station
- Proposed diversion structure from Hobsons Bay Main Sewer
- Proposed 600 mm potable water extension (Interface point with exsisting system to be determined)
- Proposed recycled water distribution network
- Proposed recycled water treatment plant (Class A plant)

Harvested roof water

- Less than 2 ML/yr
- 2 ML/yr - 5 ML/yr
- 5 ML/yr - 10 ML/yr
- 10 ML/yr - 20 ML/yr
- 20 ML/yr - 47 ML/yr

GHD

Places Victoria
Fishermans Bend Infrastructure Plan

Job Number	31-30105
Revision	A
Date	21 Jun 2013

Integrated Servicing Strategy
District Integrated Water Cycle Management

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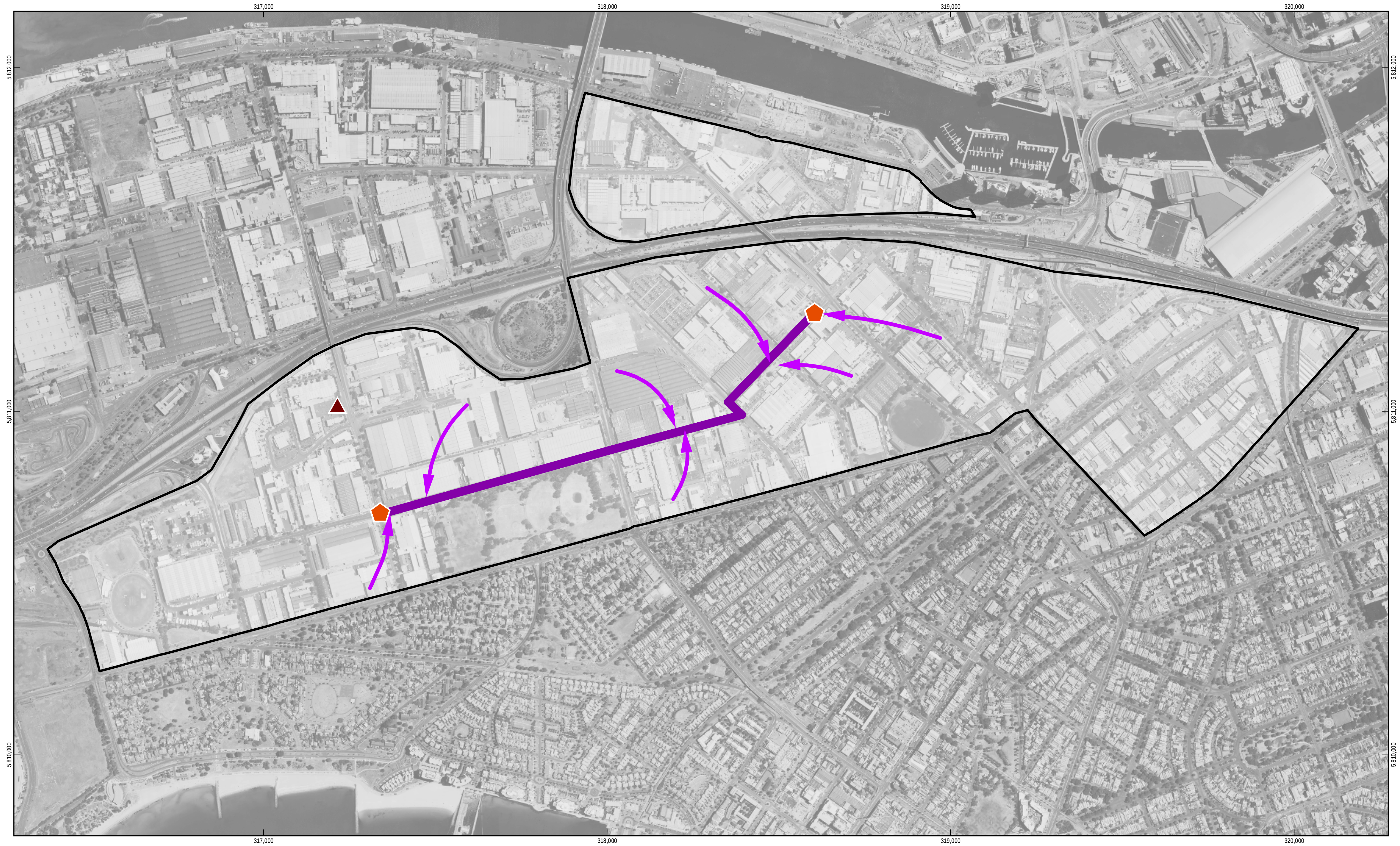
Data source: Data source: DSE, Aerial Imagery, 2012, DSE VicMap, 2013; SEW, Existing Mains, 2012. Created by:mjahanshahi



1:10,000 Paper Size A3

0 0.05 0.1 0.2 0.3 0.4

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

LEGEND

- Fisherman's Bend Precinct
- Proposed metro station
- Potential transfer facility for vacuum waste (not costed in ISS)
- Potential inputs to vacuum waste (not costed in ISS)
- Potential vacuum waste trunk network (not costed in ISS)

GHD

Places Victoria
Fishermans Bend Infrastructure Plan

Job Number 31-30105
Revision A
Date 21 Jun 2013

Integrated Servicing Strategy
Municipal Waste Upgrades

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Data source: DSE, Aerial Imagery, 2009; DSE, VicMap, 2013. Waste Facilities captured by GHD. Created by:mjahanshahi

Appendix B – Assumptions

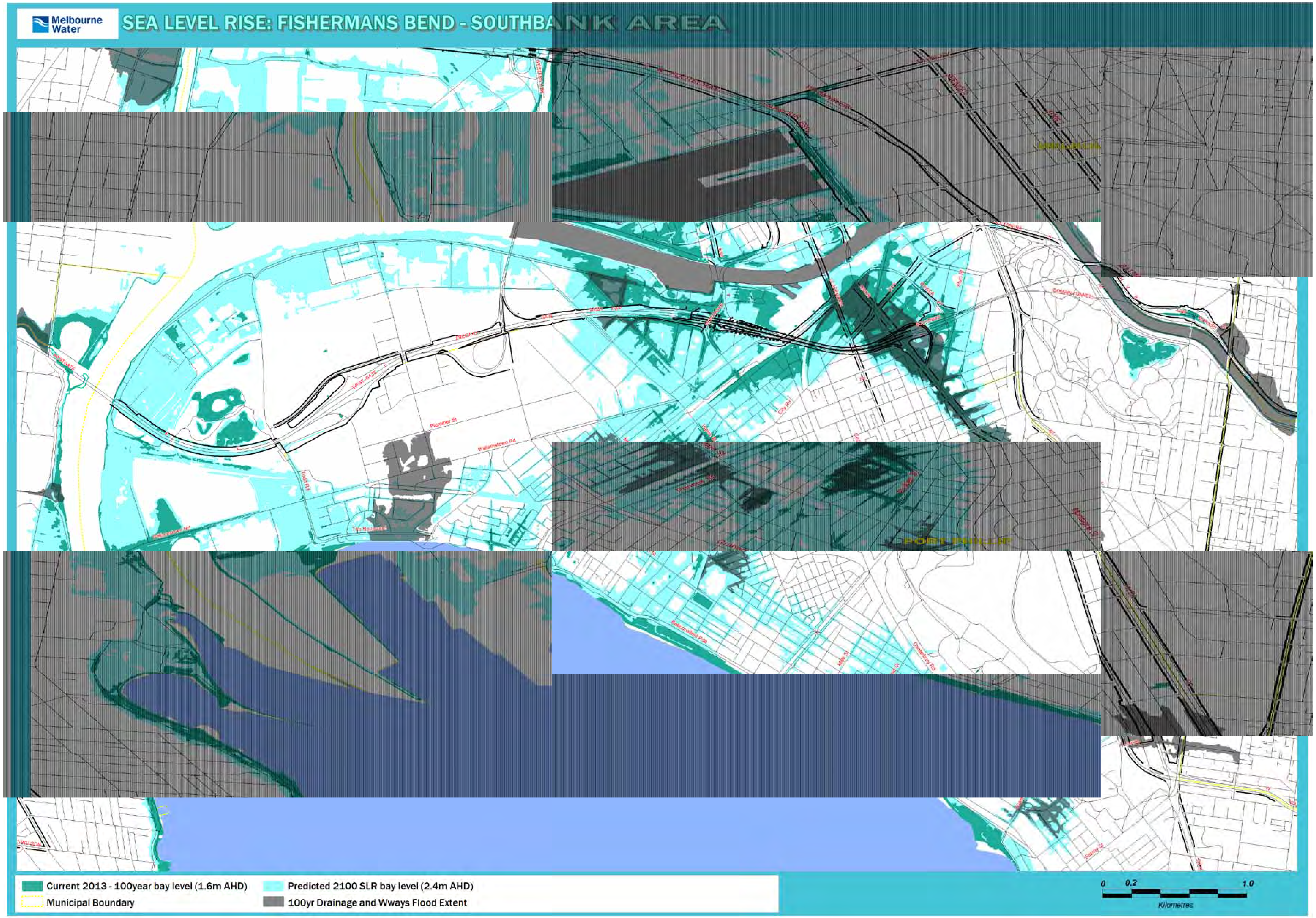
GHD | Report for Places Victoria - Fishermans Bend Infrastructure Plan, 31/30105

Item	Assumption		Unit	Comments
	BAU	ISS		
Water				
Residential potable water demand	165	106	L/person/ day	
Residential non potable water demand	NA	50	L/person/ day	
Commercial potable water demand	95	91	L/person/ day	
Commercial non potable water demand	NA	56	L/person/ day	
Residential peaking factor (potable water)	1.5	1.5	-	Maximum day / average day
Residential peaking factor (potable water)	4.3	4.6	-	Maximum hour / average day
Commercial peaking factor (potable water)	1.4	1.5	-	Maximum day / average day
Commercial peaking factor (potable water)	2.4	2.6	-	Maximum hour / average day
Irrigation application rate	2.5	2.5	ML/ha/ annum	
Proportion of green space irrigated	75%	75%		Propotion of gross area irrigated (i.e. 'active green space')
Peak irrigation factor	0.2	0.2		Ratio of 'maximum month demand' to the 'annual demand'
Additional green space	10%	10%		Proportion of developable area dedicated to green space
Green roof area	20%	20%		Percentage of roof area that is 'green roof'
Gas				
Residential gas demand	78	32	MJ/ dwelling/ day	BAU includes demand for: - Ovens/Stovetops - Domestic Hot Water - Space Heating ISS includes demand for: - Ovens/Stovetops - Domestic hot water, space heating & cooling to be provided by cogeneration source. - Auxilary boilers for peak demand
Commercial gas demand	0.4	0.3	MJ/m^2/ day	BAU includes demand for: - Domestic Hot Water - Space Heating ISS includes demand for: - Domestic hot water, space heating & cooling to be provided by cogeneration source. - Auxilary boilers for peak demand

Item	Assumption		Unit	Comments
	BAU	ISS		
Electricity				
Residential electricity demand	9.216	8.162	kWh/ dwelling/ day	BAU includes demand for: - Lighting - Appliances - Space Cooling ISS includes demand for*: - Lighting - Appliances
Commercial electricity demand	0.316	0.176	kWh/m²/ day	BAU includes demand for: - Lighting & Power - Transportation - Ventilation - Space Cooling ISS includes demand for*: - Lighting & Power - Transportation - Ventilation
* Electricity demand met by cogeneration system, with supplementary electricity provided from the grid.				
Waste				
Residential garbage generation rates	5.5	5.5	kg/ dwelling	Based on GHD survey data and recent audits on building waste generation volumes.
Residential recycling generation rates	3.5	3.5	kg/ dwelling	
Commercial garbage generation rates	10.8	10.8	kg/ 100sqm	
Commercial recycling generation rates	11.1	11.1	kg/ 100sqm	
Cogeneration System				
Thermal Efficiency – Cogeneration Plant	N/A	0.25	%	
Absorption Chiller COP (weighted average)	N/A	0.72	kWr/kWr	
Heat Recovery Efficiency	N/A	0.70	kWr/kWr	
Boiler Efficiency	0.83	0.83	%	
IPLV Chiller	3.0	3.0	kWr/kWr	
Commercial Energy Consumption Breakdown				
Light and Power	39	39	%	
Transportation	5	5	%	
Ventilation	17	15	%	
Cooling	10	10	%	

Item	Assumption		Unit	Comments
	BAU	ISS		
Heating	24	26	%	
Domestic Hot Water	5	5	%	
Residential Energy Consumption Breakdown				
Space Heating	37	37	%	
Cooking	5	5	%	
Domestic Hot water	23	23	%	
Appliances	25	25	%	
Lighting	7	7	%	
Space Cooling	3	3	%	
Sewer Heat Recovery				
Heat recovery	NA	0.25	L/s	Flow rate required to recover sufficient heat per dwelling

Appendix C – 100 Year Flood Results


Melbourne Water
SEA LEVEL RISE: FISHERMANS BEND - SOUTHBANK AREA
Current 2013 - 100year bay level (1.6m AHD)
Municipal Boundary
Predicted 2100 SLR bay level (2.4m AHD)
100yr Drainage and Wways Flood Extent
0 0.2 1.0
Kilometres

Appendix D – Traffic Light Assessment

Traffic Light Assessment of Options for Integrated Servicing Strategy

	What is the potential role of each strategy / initiative in contributing to a servicing solution with the following characteristics?							
Strategies and Initiatives	Proven Sustainable Technologies	Network Compatible ?	An integrated solution?	Economically Efficient Scale?	Robust and Adaptable ?	Financially viable?	Option to be included in the Integrated Infrastructure Strategy?	Initiative adopted for Integrated Servicing Strategy?
High performance buildings - energy and water	Growing evidence that green building design reduces energy consumption and greenhouse emissions. The World Green Building Council estimate that the reduction in green building's energy use compared to a conventional code-compliant building range from 25-30%. South East Water estimate that implementation of water efficiency measures could reduce water consumption from 165 L/p/d to 106 L/p/d for high density developments.	May be integrated into a development regardless of the nature or timing of changes to networks.	Demand reductions are central to an integrated infrastructure solution	Implementation across the entire scale of the development may be achieved, however this must be mandated through planning instruments across development area.	New buildings may take advantage of any advancements in high performance building technologies over time.	Based on research undertaken by the World Green Building Council, design and construction costs are expected to range from-0.4 to 12.5% to exceed the performance of a 'code compliant' building, with the latter value corresponding to a zero carbon building project. Demand reductions also contribute to potential to reduce/and or avoid infrastructure costs if building performance is guaranteed through Design Guidelines.	**High performance buildings will be essential in Fishermans Bend to reduce the peak demand and overall energy consumption.**	**Yes**
Intelligent networks - smart metering	Smart electricity meters are now standard technology and will be in every home and small business in Victoria by the end of 2013. Smart water meters are also available. A review undertaken by Accenture (2011) regarding effectiveness of smart systems found that on average, a 7.9% reduction in energy consumption could be achieved.	Significant benefits accrue to the network from the use of smart meters as supply and demand may be balanced by network operators. Also customers better understand their energy use enabling them to identify energy saving opportunities during peak periods, therefore reducing 'grid congestion.	A combined electricity / water meter would contribute to synergistic management of these networks. In Malta, a energy/water meter was developed out o necessity as they are 100% reliant on fossil fuel power and desalinated water. The meter collects and analyses data from thousands of digital sensors to provide data and assist in making decisions about how and when power is used.	Consumer benefits will accrue for installation within individual dwellings. Network advantages will only accrue if smart metering is applied at the whole development scale.	As technology improves, meters can be easily replaced or re-programmed so they are very robust and adaptable to improvements in technology.	Based on previous studies and application around the world, the cost-benefit is likely to positive.	**Smart meters will be essential in establishing a smart grid network within Fishermans Bend for energy management, network shut downs, network stability and network reliability.**	**Yes**
Energy efficient public lighting	Sydney, New York, London and Hong Kong have all conducted trials of LED street lights. The City of Sydney has a program to replace 6,500 street and park lights with LEDs over the next 3 years. LEDs use half the light of conventional bulbs. Further research is required however to confirm the best technology.	Energy efficient lighting will reduce the demand on the network, and/or eliminate the demand if locally powered (eg solar PV)	Demand reductions that may be achieved through energy efficient lighting are central to an integrated infrastructure solution	Benefits of implementing energy efficient lighting may be realised if it is implemented across the entire development scale.	Selection of a particular technology for energy efficient street lighting limits the potential to take advantage of other technologies in the future until assets are replaced.	Cost benefit needs to be assessed further.	LEDs use half the light of conventional bulbs and are considered complimentary to an Integrated Servicing Strategy for Fishermans Bend.	No
Geothermal energy	Geothermal is a very low emission thermal energy source.	Geothermal energy may be used for space heating and cooling, water heating and thermal water treatment processes.	Geothermal energy outputs have multiple uses including electricity generation and district heating and cooling. The energy source may be integrated with other sources (i.e. the existing energy network), to supplement/provide back up to the geothermal energy source.	Within Fishermans Bend - the relatively low temperatures available at significant depths mean that this is not an economically viable option for Fishermans Bend, regardless of the scale of implementation.	Geothermal energy schemes may be staged as development occurs.	The financial viability is dependant on the depth and temperature of the geothermal energy source.	Within Fishermans Bend, temperatures of ~30 degrees are expected at depths of 500 m (source Sustainability Victoria), therefore, technology not considered viable for generation of geothermal energy.	No
Wind energy	Wind turbines use wind energy to produce electricity with no emissions.	Electricity produced from wind turbines may be utilised at the development scale or fed into the existing electricity grid.	Wind powered energy may be integrated with other sources (i.e. the existing energy network), to supplement/provide back up to the wind energy source.	A significant area of land would need to be set aside for wind turbines to generate sufficient energy to justify this source. For an inner urban precinct such as Fishermans Bend - it is not viable to set aside high value developable land for wind turbines.	Wind turbines may be staged as development occurs, however, once wind turbines have been installed, the opportunity to take advantage of advancements in future technology is limited.	The wind patterns at Fishermans Bend are not suitable for the generation of energy and therefore, investment in this technology would not be financially viable.	Wind patterns at Fishermans Bend are not suitable for the generation of energy. Further, precinct scale wind generation is not considered appropriate for the development, or likely to be approved by authorities.	No
Solar Power Photovoltaic	Solar Photovoltaic (Solar PV) modules produce emissions free, renewable energy by converting sunlight directly into electricity.	Electricity produced from solar PV may be utilised at the development scale or fed into the existing electricity grid.	Solar energy may be integrated with other sources (i.e. the existing energy network), to supplement/provide back up to the wind energy source.	A the precinct scale, there is potential to mount solar PV on Westgate Bridge sound barriers. However, the energy generation potential is 1,168 MWh/annum which is <1% of the total precinct demand. Therefore, solar PV is not considered economically efficient at the precinct scale	Solar PV may be staged as development occurs, however, once solar PV has been installed, the opportunity to take advantage of advancements in future technology is limited.	Within a high density development, solar PV is not considered a financially viable option. Advancements in the technology in the future may improve its financial viability.	Implementation of Solar PV may be driven by developers as a technology for achieving their high performance building standard.	No
Aerobic Digestion (food + biosolids)	Anaerobic digestion is a very mature technology and widely used, particularly in commercial/industrial settings.	Compatibility of this approach with existing and planned waste management across the local government area is to be evaluated	AD is a truly integrated solution as it combines waste treatment with energy production.	It is not economically efficient to implement an AD scheme within Fishermans Bend alone. A broader waste to energy scheme should be implemented at the city scale, which could achieve a significant reduction in the volume of waste to landfill and a greater volume of biogas to offset natural gas demands. In addition, the value of the AD products (i.e. biogas and residuals such as soil conditioners) are likely to increase over time.	A large investment would be required in AD which limits opportunities to take advantage of new technologies in the future.	Anaerobic digestion of solid organic waste and biosolids captured from local wastewater treatment is likely to be cost prohibitive. AD of organic waste relies on a MRF facility which is both expensive and involves a large footprint area.	Compatibility of this approach with existing and planned waste management across the local government area is to be evaluated. A 'standalone' scheme for the Fishermans Bend precinct is not considered viable.	No
Tri/ Cogeneration	Produces electricity for the grid and generates a heat source for a district heating and cooling system, therefore offsetting the precincts energy demands. Sustainability benefits are significantly enhanced if the feedstock is obtained from a renewable source (eg biogas).	May be incorporated with existing networks by: 1. Utilising existing natural gas as the primary gas source. 2. Generating electricity that is fed into the existing high voltage electrical network. Therefore, the existing electric grid acts as a 'balancing storage' for electricity generated within Fishermans Bend.	Tri generation has the potential to integrate with both water and waste (i.e. utilising biogas generated from anaerobic digestion of organic solid waste and biosolids from local wastewater treatment). Tri generation outputs have multiple uses including electricity generation and district heating and cooling.	Tri generation has been proven to be economically efficient at the building and precinct scale but likely to be most economical at whole of development scale. It has the potential for staged implementation as development occurs.	Tri/Cogeneration is a modular system that may be transitioned to different source inputs (i.e. natural gas initially and then biogas if it became available). Technology however is locked in to a tri/cogeneration system to provide thermal energy for a district heating and cooling system and therefore has limited flexibility to an alternative technology in the future.	Financial viability to be confirmed by further analysis. Existing tri generation schemes exist that suggest this technology is viable if implemented at a precinct or whole of development scale.	**Tri/cogeneration provides a low carbon source of energy for Fishermans Bend and is central to implementation of a precinct scale energy system.**	**Yes**
Heat energy from sewers	Growing evidence that heat recovery from sewers is a viable source of heat energy. However only three examples exist worldwide, Vancouver, Tokyo and Oslo. The technology also 'closes the loop' on heat energy that is lost to the sewers. Energy to waste to energy stream.	System is compatible with the existing network as it recovers heat from the existing sewage network.	Sewer heat recovery provides an additional source of heat energy for the district heating and cooling system.	Examples of implementation of sewer heat recovery exist at the precinct scale. The Vancouver example provides heating for approximately 16,000 people plus commercial facilities.	As sewer heat pump technology advances, sewer heat pumps may be replaced or upgraded to take advantage of advancements in the technology	Accessing the sewer line is less invasive and involves lower costs in comparison with other heat recovery options such as geothermal energy	**This technology would complement a sewer mining scheme in Fishermans Bend, where the sewage mined from assets such as the Melbourne Main Sewer provides both a source for recycling, but for heat energy also.**	**Yes**
Collect & treat sewage from precinct (sewer mining)	There are many examples of precinct scale wastewater recycling schemes. Decentralised wastewater recycling schemes reduce potable water consumption and increase the resilience of the existing water supply network by diversifying water supply sources.	Precinct scale wastewater recycling involves diversion of sewage from existing sewers which can reduce the pressure on downstream sewerage networks. A precinct scale recycled water scheme at Fishermans Bend includes the potential to supply recycled water to other precincts also, i.e. Docklands, Southbank etc.	Solids captured from the wastewater treatment process may provide an alternative energy source through anaerobic digestion and biogas recovery. In addition, heat may be recovered from the sewage 'mined' from the Melbourne Main Sewer.	The optimal scale for implementation is at the precinct scale. Treatment plants are modular and implementation may be staged as development occurs.	The technology for local wastewater treatment plants is fixed (i.e. MBR). Once a treatment technology has been selected, the flexibility to take advantage of advancements in the technology are limited.	Treatment infrastructure and third pipe network for distribution of recycled water is costly. There is greater financial viability for these schemes at the precinct scale.	**Sewer mining is central to the integrated water management strategy for Fishermans Bend.**	**Yes**

Strategies and Initiatives	Proven Sustainable Technologies	Network Compatible ?	An integrated solution?	Economically Efficient Scale?	Robust and Adaptable ?	Financially viable?	Option to be included in the Integrated Infrastructure Strategy?	Initiative adopted for Integrated Servicing Strategy?
Roofwater harvesting	There are many examples of stormwater harvesting schemes around Melbourne. Stormwater harvesting reduces pollutants to waterways and Port Phillip Bay and increase the resilience of the existing water supply network by diversifying water supply sources.	Stormwater harvesting is complimentary to the existing network as it reduces the load on existing stormwater drains.	Is an additional source of alternative water to integrate with recycled water, which may utilise the same third pipe network for distribution across the precinct and/or within the building.	Distributed storages provide an economically efficient scale for implementation as development occurs.	Roofwater harvesting may be enhanced in the future with smart metering.	Stormwater harvesting will be necessary to address flooding issues. Maximising the use of stormwater storages to provide both flood mitigation and also storage of an alternative water source, maximises the viability of investing in stormwater storage.	**Roofwater harvesting is also central to the integrated water management strategy for Fishermans Bend and will provide additional benefits associated with localised flood mitigation for the precinct.**	**Yes**
Vacuum, pneumatic or automatic waste collection system	Vacuum systems are used widely in Europe, Asia and the Middle East where waste collection vehicles are constrained from accessing new developments due to snow, narrow streets etc. There are currently no systems operating in Australia. The system enables cities to reduce the number of waste collection vehicles that enter residential areas for waste collection.	A vacuum waste system is a stand alone technology and therefore does not integrate with the existing network.	A primary separation facility would enable mixed waste to be separated into several streams for direct sale to markets or recovery by composting or conversion to energy.	By its nature this technology is small scale. Capacity per precinct would be no more than 20,000 tonnes per year. Approximately 40,000 tonnes of solid waste will be generated within Fishermans Bend at ultimate development. Vacuum waste is only considered a potentially viable solution for Fishermans Bend in the higher density areas.	Once the vacuum waste technology has been selected (i.e. Envac), opportunities to take advantage of advancements in waste collection technology are limited.	Vacuum systems generally have a high capital cost which can involve 0.5-1% of the total cost of a new development. Implementation of this technology is likely to be more viable in higher density areas.	Vacuum Waste may be useful in Fishermans Bend areas where the width of lanes/roads prevent access from waste collection trucks, or where eliminating waste collection vehicles is identified as a priority to enhance the amenity of the area. However, it has not been included in the core infrastructure plan.	No
Materials Recovery Facility (MRF)	MRF technology is mature and application of various types of MRF is widespread.	Compatibility of this approach with existing and planned waste management across the local government area is to be evaluated	If the MRF is used to separate organics for waste to energy processing this contributes to an integrated solution	Similar to AD.	Similar to AD.	Similar to AD.	Similar to the Anaerobic Digestion initiative, the compatibility of this approach with existing and planned waste management across the local government area is to be evaluated. A 'standalone' scheme for the Fishermans Bend precinct is not considered viable.	No
District heating/ cooling	Highly efficient method of providing locally generated thermal energy for heating and cooling of homes and commercial space. There are many international examples of the implementation of this technology for district heating and a growing number for district cooling.	The system distributes hot and cold water throughout higher density areas of a precinct which reduces the precincts demand for electricity from the existing grid network.	Would integrate with a precinct based tri-co/generation facility and reduce the demand on the reticulated gas and electricity grid.	These schemes are typically implemented at the precinct scale, where the heat source exists at a centralised location. In Stockholm, a much larger scheme exists which involves over 765 km of a district heat network.	District heating and cooling relies on a central heat source such as tri/cogeneration. Once implemented, the distribution infrastructure and central heat source is 'fixed' and therefore has limited flexibility to future changes in technology. A district heating and cooling network may be staged to service new development as it occurs.	Financial viability to be confirmed by further analysis. Existing tri generation schemes exist that suggest this technology is viable if implemented at a precinct or whole of development scale.	**This option is complimentary to a tri/cogeneration solution as it involves the transfer of a low carbon source of energy for Fishermans Bend, and is central to implementation of a precinct scale energy system.**	**Yes**

Appendix E – High performance buildings

Relevant Frameworks for High Performance Buildings

Framework	Description	Applicable building typologies	Recognition in the market	Tangible Benefits	Operational carbon performance requirements	Embodied carbon performance requirements	Energy Efficiency Metrics	Water metrics	Waste metrics	Internal Environmental Quality (IEQ) metrics	People wellbeing and happiness	Material use metrics	Ownership / responsibility for achieving performance requirements	Certification and administration costs
One Planet Living by BioRegional	An implementation framework of holistic environmental and societal principles, based on sustainable consumption & development. All performance targets must be met. Based on actual performance.	• All building types • Communities	Very well respected, global leader	• Highly advanced measure of sustainability in the built environment • Marketable outcome • Being part of a growing group of organisations and councils considering their total environmental impact	Net zero carbon emission in operation	None	Net zero carbon emission in operation	Promotes reuse & recycling, minimising water extraction & pollution	Net zero waste in operation	Promotes high levels of IEQ with numerous metrics	Promotes healthy lifestyles and physical, mental & spiritual wellbeing	Promotes use of local, reclaimed, renewable and recycled materials in construction	Building designers & building occupants	Free open source methodology, verification and endorsement of projects requires certification fee
Living Building Challenge by Living Future Institute	Holistic international design philosophy & certification program. All performance targets must be met. Based on actual performance.	• All building types • Neighbourhoods	Very well respected, global leader	• Rigorous measure of sustainability in the built environment • Marketable outcome • Being part of a growing group of organisations and councils considering their total environmental impact	100% onsite renewable energy	Total embodied carbon footprint from construction must be offset	Net Zero Energy	Net zero water	Promotes a reduction of waste in construction and operation	Promotes high levels of IEQ with numerous metrics	Promotes healthy lifestyles and physical, mental & spiritual wellbeing	Promotes use of local, reclaimed, renewable and recycled materials in construction	Building designers & building occupants	Project certification cost depends upon size of development (<230m^2 = USD1,750; up to >50,000m^2 = USD25,000)
Green Star by GBCA	A voluntary Australian based environmental rating system for the built environment. Based on anticipated performance	• Education • Healthcare • Industrial • Multi-Unit Residential • Offices • Public Buildings • Retail Centres	National recognition for achieving an understood benchmark in performance	• Marketable outcome • Industry recognition	None (Green Star – Performance to be released in late 2013)	None	Promotes reduction in carbon emissions	Promotes reuse & recycling, minimising water extraction & pollution	Promotes a reduction of waste in construction and operation	Promotes high levels of IEQ with numerous metrics	Not assessed	Promotes the minimisation of resource consumption and the selection and reuse of materials	Building designers	Green Star Accredited Professional required. Project cost depends upon size of development
BREEAM by UKAS	A voluntary UK based environmental rating system for the built environment. Based on anticipated performance	• Communities • Offices • Retail • Industrial • Schools	International and national recognition that a genuine commitment to improving the organisations total environmental impact has been put in place and is ongoing	• Marketable outcome • International recognition • Actual improvement in total environmental impact that is measurable	None	None	Promotes reduction in carbon emissions	Promotes minimising water consumption	Promotes a reduction of waste in construction and operation	Promotes high levels of IEQ with numerous metrics	Not assessed	Promotes the minimisation of resource consumption and the selection and reuse of materials	Building designers	BREEAM Accredited Assessor required. Project cost depends upon size of development
LEED by USGBC	A voluntary US based environmental rating system for the built environment. Based on anticipated performance	• Commercial • Homes • Neighbourhood Development • Schools • Retail • Healthcare	Acknowledgement that the principles have been followed and general understanding that an equivalent performance has been targeted.	• Equivalent performance as a certified building without the administration costs associated with it • Reduced administrative effort	None	None	Promotes reduction in carbon emissions	Promotes reuse & recycling, minimising water extraction & pollution	Promotes a reduction of waste in construction and operation	Promotes high levels of IEQ with numerous metrics	Not assessed	Promotes the minimisation of resource consumption and the selection and reuse of materials	Building designers	LEED Accredited Assessor required. Project cost depends upon size of development
Passiv Haus	A voluntary standard for energy efficiency in buildings. It is a comfort based energy assessment.	• Residential • Offices • Schools • Retail	International and national recognition for achieving a well understood benchmark	• Highly marketable outcome • International recognition • National recognition	Total Energy < 120 kWh/m^2/year Heating or Cooling Energy < 15 kWh/m^2/year	None	Total Energy < 120 kWh/m^2/year Heating or Cooling Energy < 15 kWh/m^2/year	Not assessed	Not assessed	Promotes high internal air quality	Not assessed	Not assessed	Building designers & building occupants	Passivhaus Certified Designer required for accredited building.

Appendix F – Review of Integrated Servicing Strategy Options

Demand management

High performance buildings

Purpose

High performance buildings are designed and built to be environmentally responsible and resource efficient throughout the buildings life. This is achieved through energy, water and material efficiency, waste reduction and improved indoor environment quality.

Measurement tools for high performance buildings include GreenStar and NABERS. High performance buildings will achieve 6 star Green Star and 6 Star NABERS.

From an energy point of view high performance buildings should be mandated to reduce the peak demand and overall energy consumption.

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From an energy point of view high performance buildings should be mandated to reduce the peak demand and overall energy consumption.

Potential application scale

Building scale

History of application

Many new office, residential, retail and commercial buildings are being designed and built to achieve high Green Star and NABERS ratings.

Government accommodation policies stipulate minimum building performance requirements.

Approx Capital Operating Cost

Increase in Capital costs against business as usual:

5 Star – 3 to 5% Increase

6 star – further 5%

References

www.gbca.com.au

www.nabers.com.au

Davis Langdon “The Cost and Benefit of Achieving Green Buildings”.

Intelligent networks/ smart meters

Purpose

A smart meter is essentially an enhanced electricity meter as it has far greater functionality than a conventional electricity meter for measuring and recording production and consumption of electricity. A smart meter is also capable of including functional requirements such as load management ability, tamper detection, remote access and communication, and customer interaction interfaces. This results in greater control and awareness of energy consumption.

Smart meters would be installed in households and buildings in place of a standard retailer meter.

Smart meters will be essential in establishing a smart grid network within Fishermans Bend. Smart grids involve the installation of smart distribution networks, smart infrastructure such as car charging stations and software for sophisticated control energy management; network shut downs, network stability and network reliability.

A smart water meter is a normal water meter connected to a data logger that allows for continuous monitoring of water consumption. The purpose of smart meters is to collect water consumption data in a timely manner and allow for the analysis of the data by water managers to assist with water demand management and water efficiency. In addition, the timely relaying of this data to the water user can result in significant changes in water use behaviour. Other benefits of smart water metering and intelligent networks include automated control of the building scale stormwater storage tanks via an intelligent network (and sophisticated weather forecasting data) would enable the storages to be emptied ahead of approaching rainfall events to provide localised flood mitigation.

Potential application scale

Smart meters - Installed at household / building level.

Smart grid – established at precinct scale.

History of application

Western power in Perth has been running a smart grid trial as part of the Solar City program since 2009. As part of the trial 9,000 meters were rolled out. Smart meters are now an established technology and are available as an option to purchase when installing or replacing a meter.

The Victorian Government has mandated that all residential and small business electricity customers in Melbourne and throughout the state must have a Smart Meter installed by the end of 2013.

Costs

There are a number of smart meter options available on the market. Minimum $150 per meter

References

http://www.perthsolarcity.com.au/annual-report/

http://www.smartgridsmartcity.com.au/

Energy efficient public lighting

Purpose

Public lighting accounts for a significant proportion of a City's annual electricity bill and greenhouse gas emissions. Energy efficient lighting therefore offers an opportunity to significantly reduce a city's carbon footprint.

LED lights are considered a suitable option for energy efficient public lighting as they use approximately half the light of conventional bulbs.

Potential application scale

Precinct scale

History of application

Sydney, New York, London and Hong Kong have all conducted trials of LED street lights. The City of Sydney has a program to replace 6,500 street and park lights with LEDs over the next 3 years.

Approx Capital Operating Cost

The City of Sydney are replacing approximately 6,500 street and park lights with LEDs which is anticipated to cost $7 million and expected to save the City almost $800,000 a year in electricity bills and maintenance costs (LEDs have a longer lifespan than conventional bulbs).

References

http://www.cityofsydney.nsw.gov.au/vision/sustainability/energy/led-lighting-project

Energy production

Geothermal Energy

Purpose

Geothermal is a very low emission thermal energy source that is most commonly exploited in volcanic areas where magma nears the surface and brings heat from greater depths. Potential uses include:

- Electricity production
  - Dry Steam Systems - are applicable to fields that produce steam from wells sited in reservoirs that are predominantly steam-filled in the ground. This is the most economical geothermal power generation system.
  - Flash Power Systems - work on separated steam at saturation conditions from wells that produce mixtures of steam, water and gases. They employ conventional steam turbines working at very low inlet pressures and temperatures.
  - Binary Systems - the binary geothermal plant (also called Organic Rankine Cycle (ORC) power generation system) is totally different from the steam units because the hot geothermal fluid is not used in the power cycle directly. The hot water passes through a heat exchanger where an organic liquid, e.g. pentane or isobutane, is vaporized and used to drive a turbine.
- Space heating and cooling
  - Geothermal heat for district scale heating and cooling systems (utilising absorption or adsorption chillers).
- Water heating
  - Low temperature geothermal heat used (for example) for pool heating.
  - Domestic hot water could potentially be sourced directly from the geothermal aquifer or heated via this source through heat exchangers.

- Thermal water treatment processes
  - Desalination of water using multi-effect distillation processes driven by geothermal heat.
  - Wastewater treatment using membrane distillation bioreactor operating at elevated temperatures supplied by geothermal energy.

Inputs and outputs

Input – Electricity to power pumps

Outputs – Heat energy in the form of hot water, electricity

Tapping the geothermal resource requires bores to produce extraction and injection wells with associated pumping infrastructure. The output is water at temperatures determined by the extraction depth (approx. 100°C at 3,000m).

Potential application scale

Depends on geothermal applications:

Electricity production and thermal network – structure plan area + area of influence

Lower grade heat applications – smaller scale

History of application

International projects

In 2010 it is estimated that 67,246 GWh of electricity was produced from some 10,715 MW of installed geothermal capacity. The top five countries in terms of installed capacity are : USA (3,060 MW), PHILIPPINES (1,904 MW), INDONESIA (1,197 MW), MEXICO (958 MW), and ITALY (843 MW). [25]

A recent project in Unterhaching, Germany, has shown that a 3,300 m deep well with water at 125° C can provide electricity in a non-volcanic sedimentary aquifer setting. The Kalina power plant in Unterhaching provides 3.36 MW electric (since 2008) and 40 MW thermal energy (since 2007) used for district heating. [26]

Australian projects [27]

Power The Birdsville Organic Rankine Cycle Geothermal Power Station (Birdsville Plant) which produces 80kW, which is enough energy to power the town of Birdsville. The Plant is Australia's only Hot Sedimentary Aquifer project currently producing electricity. www.ergon.com.au.

Low grade heat Numerous swimming pools, schools, commercial scale and domestic buildings across Australia use geothermal heat pumps for heating and cooling. One of the largest and best known systems is installed at the Geoscience Australia building in Canberra. www.ga.gov.au

[25] Source: Ruggero Bertani, Geothermal Power Generation in the World, 2005–2010 Update Report
[26] Source: WA Geothermal Centre of Excellence
[27] Source: Australian Geothermal Industry Association

Deep drilling projects currently underway

Paralana -The 30 MW Paralana project is located adjacent to the Beverley Uranium Mine.

Cooper Basin - The 25 MW Cooper Basin demonstration project will demonstrate the potential of hot-rock geothermal energy for zero-emission, base-load power.

Jurien-Woodada - owned by New World Energy Limited, is the most advanced geothermal play in Western Australia for electricity production. The project is adjacent to transmission infrastructure and large resource-driven energy markets in the mid-west region. The project area has the potential to contain both hot sedimentary aquifer and EGS styles and is being assessed for delivery of electricity into Western Australia's South West Interconnected System.

Otway Basin - The Penola Project is part of Panax's Limestone Coast Project and is the largest of only three known Measured Geothermal Resources in Australia.

Panax's Salamander-1 well, drilled in 2010 is the first deep geothermal well drilled in the Otway Basin. It was completed in record time and is the first to demonstrate conventional geothermal technology in Australia. First steam was produced and the well-testing program was also completed on the project in 2010.

The Salamander-1 well met its primary objectives. At 4,000 metres projected geothermal temperatures were exceeded by more than 10°C and target reservoir rocks met the requirements for the development of a geothermal demonstration plant.

Costs [28]

Electricity generation	$4m per MWel
District Cooling network	$540-640k per kWth

Note that these costs do not include drilling, commissioning and maintaining the production and injection wells. A cost estimate for a 3 km well doublet is in the order of 20 Million AUD.

References to websites / papers / relevant documents

Geothermal Energy - Renewable Energy World

www.renewableenergyworld.com/rea/tech/geothermal-energy

Australian Geothermal Energy Association

www.agea.org.au/

Geothermal Energy Resources - Geoscience Australia

www.ga.gov.au/energy/geothermal-energy-resources.html

Wind

Purpose

Wind turbines use kinetic energy from the wind to drive a generator and produce electricity. Wind turbines can be horizontal or vertical axis configuration. Horizontal axis turbines are the most common arrangement and must point directly into the wind to operate. Vertical axis turbines can operate with wind coming from any direction, and therefore perform well in urban environments, but require a larger drive train, limiting their practical size.

[28] Source: WA Geothermal Centre of Excellence

Inputs and outputs

Wind turbines use wind energy to produce electricity with no emissions.

Potential application scale

Wind turbines are available from building size, in the order of 1 to 15kW, to precinct scale turbines up to 5MW. Wind turbines can produce noise in operation and visible impact which should be considered when selecting and placing units.

History of application

Wind energy has a long history and is now become a viable energy source on a large scale which can compete with traditional fossil fuel energy sources. Large scale wind farms have been installed in many areas of Victoria however large turbines are advised not to be installed within close proximity of residential houses. Opportunities on an urban scale are more difficult to capture due to wind being obstructed by buildings and trees etc. and small scale wind is still expensive.

Costs

Capital Cost - $10,000 - $15,000/kW

Operating Costs - $300 - $500 per year

References

Sustainability Victoria - Melbourne Urban Wind Viability Report

Solar Photovoltaic

Purpose

Solar Photovoltaic (Solar PV) modules produce emissions free, renewable energy by converting sunlight directly into electricity.

The capital cost of Solar PV panels has dropped significantly in recent years and the cost of producing electricity via Solar PV is rapidly approaching the cost of energy supplied by the grid (grid parity).

Building scale systems can export excess electricity back into the utility grid and offer a potential revenue source if the utility offers a feed in tariff.

Inputs and outputs

Solar PV systems collect sunlight and convert solar energy directly into electricity. There are no emissions generated by the Solar PV process.

Potential application scale

The modular format of Solar PV systems' allow them to be scaled from individual houses/buildings to large, precinct scale power stations. Precinct scale Solar PV systems are limited in size by available space (Solar PV systems require approximately 7m^2/kW).

History of application

Global solar photovoltaic (PV) demand for 2012 reached a record 29.0 GW. By the end of 2010, the total installed capacity of PV based solar power systems in Australia was over 570 MW.

In Melbourne, a Solar PV system exists on the PV Noise Barrier for the Tullamarine-Calder Interchange. The project involves 500m length of vertically-inclined PV panels, totalling 24kW of peak power output. Whilst the vertical inclination is sub-optimal for solar production, the vertical wall achieved the noise-wall's height requirement with the least resources, and as therefore was the most cost-effective solution.

Approx Capital Operating Cost

Scale	Technology	Capital Costs	Operational Costs
Building	Solar PV	$1500/kW-Installed Capacity	Up to $150/year
Precinct	Solar PV	$1000/kW	$6000/year per. MW-Installed Capacity

References

http://www.goingsolar.com.au/media/upload/file/CS-Tullamarine%20Calder%20Interchange.pdf

Central Institute of Technology – PV Installation

Anaerobic digestion

Purpose

Anaerobic Digestion is a process by which biodegradable material is broken down in the absence of oxygen. This produces a renewable energy (biogas) which can be used in a gas turbine to produce electricity.

Inputs and outputs

Input – waste products, sludge, wastewater

Output – biogas, biosolids

Potential application scale

District scale

History of application

MWC's Western (Werribee) Sewage Treatment Plant has been utilising anaerobic digestion for the production of biogas since 2001. The gas is produced in large anaerobic lagoons, an anaerobic reaction is produced and methane is generated. The methane is recovered and used to power reciprocating engines on site for power generation.

Costs

Four AD plants in Europe with capacity of up to 25,000 tonnes per year have capital costs of between A$316 and A$799 per tonne. Another has an operational cost of A$34.80 per tonne.

References

Woodman Point WWTP

Tri/cogeneration

Purpose

Gas turbines combust natural gas or biogas to spin a generator and produce electricity. Waste heat from the turbine exhaust can also be captured and used for space heating or process heat in a combined heat and power (CHP) arrangement. The heat can also be used for space cooling via an absorption chiller in Trigeneration configuration. Gas produces nearly half the emissions as coal per unit of energy and installed in a distributed energy system, with higher transmission efficiency, is a much cleaner energy source than connecting to a coal fired energy grid.

Inputs and outputs

Gas turbines require a gas supply and can operate on natural gas or biogas. The turbines produce electricity, heat and release emissions during operation.

Potential application scale

Gas turbines can be installed in building or precinct scale. The CSIRO national energy centre is operating a building scale gas microturbine with 30kW capacity and similar in size to a household refrigerator. Precinct scale High Effeciency Gas Turbines (HEGTs) can be scaled up to precinct and Structure Plan Area.

History of application

Gas turbines have a long history, they are reliable, low emission and are used for many different applications with a combination of other technologies.

Costs

Capital Cost - $1m/MW

Operating Cost - $50/MWh

References

Verve Energy – high efficiency gas turbines

Sewer Heat Recovery

Purpose

Sewer heat recovery is a low carbon, renewable source of energy. It involves a heat exchange system to convert low grade sewage heat to approximately 70 degrees, which can then be distributed via a district hot water system. Sewer heat recovery involves the use of reverse refrigeration heat pumps to convert low grade sewage heat (typically 20-25 degrees in Melbourne) to approximately 70 degrees, which can then be distributed via a district hot water system similar to the cogeneration and district energy system described above.

Inputs and outputs

Inputs – Low grade sewage heat/electricity

Outputs – Thermal energy

Potential application scale

Installed at household / building level / district level.

History of application

The use of a low grade heat source such as sewage is a relatively new approach to the generation of thermal energy for district hot water schemes.

Cities that have adopted this approach include Vancouver, Tokyo and Oslo. In each of these cases, the supply of heat recovered from sewage is at a precinct scale.

Costs

Not identified within Australia.

References

http://www.greenenergyfutures.ca

Water

Membrane bioreactor (MBR) – sewer mining configuration

Purpose

Significant potable water savings can be achieved where treated wastewater is used to substitute non potable water demands. Recycled water can be reticulated through a third pipe network throughout a precinct to substitute potable water demands for toilet flushing, laundry use (typically cold water), garden watering and irrigation of community green spaces.

An MBR plant could be installed in the area to enable wastewater "mined" from the local wastewater collection system to be treated to a high level where it could be reused for a variety of non-drinking water supply purposes. To minimise the cost and footprint of the treatment plant, in this situation waste activated sludge from the plant and possibly other treatment residuals (e.g. macerates screenings) are returned to the sewerage system. Alternatively the remaining organic fraction could be co-processed with the organic stream of municipal solid waste.

Inputs and Outputs

Refer to "treated wastewater recycling for non-drinking water supply purposes", above.

Potential Application Scale

Refer to "treated wastewater recycling for non-drinking water supply purposes", above.

History of Application

MBR's are a proven technology widely used in many parts of the world. As the membrane filtration technology improves over time, the plants are becoming more energy efficient, and the relative cost of MBR plants (cost relative to more traditional activated sludge treatment with tertiary filtration, to achieve an equivalent quality) is reducing.

Costs

The capital cost of a "large scale" MBR plant configured in this manner, i.e. not including any sludge treatment or dewatering facilities, is in the order of $3M per ML/d of capacity.

References

1. GHD, 2010. Report for Wungong Urban Water Project, Refinement of Sewer Mining and NDW Distribution Concepts and Cost Estimates, unpublished report prepared for the Armadale Redevelopment Authority, April 2010

Roofwater harvesting

Purpose

Roofwater harvesting involves collection of rainwater from building rooves, storage of the rainwater within the buildings and reuse of the harvested roofwater within the building and immediate surrounds. Automated control of the building scale stormwater storage tanks via an intelligent network (and sophisticated weather forecasting data) would enable the storages to be emptied ahead of approaching rainfall events to provide localised flood mitigation.

Potential Application Scale

Rainwater tanks can be applied at the building scale within the development area (single dwelling, multi- dwelling or commercial)

History of Application

Rainwater tanks have been used in Victoria for many years. In metropolitan areas where scheme drinking water is available, rainwater tanks can provide a valuable alternate water source and provide incremental flood mitigation, if operated correctly.

Costs

The 2007 report by Marsden Jacobs *The cost-effectiveness of rainwater tanks in Urban Australia* (for the National Water Commission) indicated the following costs:

- a rainwater tank for indoor/outdoor use ranges from $3.25/kL - $8.85/kL
- a rainwater tank for outdoor use only ranges from $2.87/kL - $5.74/kL

The report indicated that the cost efficiency and yield from rainwater tanks varies considerably between individual properties and is influenced significantly by the connected roof area as well as end use.

References

1. Marsden Jacobs Associates 2007 The cost effectiveness of rainwater tanks in urban Australia. Prepared for the National Water Commission.
2. http://www.public.health.wa.gov.au/3/659/2/rainwater_collection.pm

Stormwater treatment

Purpose

To detain and treat the stormwater generated from impervious areas on site using wetlands or underground tanks to store the stormwater for later use. Uses may include irrigation or other non-potable uses.

Inputs and Outputs

The inputs will include stormwater runoff and potentially a treatment option (ie UV, chlorination or iron removal), depending on final use.

The outputs may include sludge removal from wetlands or tanks as sediment settles out of the stormwater. If treatment is required, other outputs may include backwash or sludge.

Potential Application Scale

Stormwater treatment is applicable at the structure plan or local precinct scale.

History of Application

Stormwater harvesting schemes are in operation in the eastern states of Australia, particularly Victoria and New South Wales. Some examples of stormwater harvesting projects include:

- Blackmans Swamp Creek Stormwater Harvesting Scheme in Orange which is capable of providing 1300ML – 2100ML/year of additional water. This scheme cost of $5m (which included extensive consultation)
- Afton Street Stormwater Project in Melbourne

Costs

The cost of harvesting and storing stormwater will be more expensive than the business as usual approach of diverting stormwater to the existing drainage system. The additional costs will be in the infrastructure (i.e. wetland or tanks) as well as in any treatment necessary.

References

1. http://www.orange.nsw.gov.au/site/index.cfm?display=147115

http://www.melbournewater.com.au/content/water_recycling/what_is_recycled_water/other_water_supplies/stormwater_harvesting.asp

Waste

Vacuum, pneumatic or automatic waste collection system.

Purpose

To collect waste by way of a network of pipes leading from fixed collection points to one or more terminals.

Inputs and outputs

Inputs - Power, mixed waste

Outputs – mixed waste

Potential application scale

Each network linked to a central terminal has a finite capacity. Larger networks require more power. Systems also have a maximum range of several kilometres. Networks are not flexible or easily retro-fitted, expanded or upgraded as pipes and disposal points are fixed after construction. Networks can be installed in phases with new pipes added to an existing network as the development expands. Networks are most efficiently installed as part of integrated utilities systems or retro-fitted with the maintenance of other services.

Envac's SVS 500 system specifies a 2 km suction distance from the furthest inlet to the collection terminal. The maximum capacity of the system is 8,500 dwellings (two fraction system) and 20 tons per day although as few as a couple of hundred dwellings is the minimum size that could be serviced.

History of application

Invented by Envac in Sweden the first vacuum waste system was installed in a hospital in 1961 and the first residential application was in 1965. Systems have been installed and operating outside Sweden since the 1970s. Vacuum systems are used widely in Europe, Asia and the Middle East. Envac also developed a mobile vacuum system in the late 1980s. There are a now a large number of manufacturers and operators in the market.

Costs

Vacuum systems generally have a high capital cost in the order of 0.5-1% of the total capital costs of a development in which they might be installed. Operators of vacuum systems also may have to enter into long term maintenance contracts. No vacuum systems have been installed in Australia yet but estimates for a system proposed by the City of Sydney puts capital costs at as great as $5,000 per tonne per year and operational costs at $55 per tonne.

References

- http://greenhotels.com/newsletter.php
- Envac (2012) FAQ The Stationary Vacuum System - N:\AU\Sydney\Projects\14\0156113\KNOWLEDGE, REFERENCES & RESOURCES\Equipment, Technology and Service Providers\Vacuum Systems\ FAQ Stationary vacuum systems March 2012
- http://www.waste-management-world.com/index/display/article-display/5369340195/articles/waste-management-world/collection-transport/2011/01/Waste_Collection_Vacuum_System_for_Sporting_Village.html
- http://www.rvac.com.sg/index.html
- http://www.marimatic.fi/
- http://www.envacgroup.com/
- http://www.envac.com.au/
- http://www.rosrocaenvirotec.com/RosRocaWeb.html
- http://www.ecosir.com/
- City of Sydney, Environment and Heritage Committee (2011) Green Square Town Centre Automated Waste Collection System Feasibility Study Attachment A - Green Square Town Centre High Level Feasibility Assessment for an Automated Waste Collection System
- City of Sydney, Environment and Heritage Committee (2011a) Green Square Town Centre Automated Waste Collection System Feasibility Study Attachment B Summary Of Benefits And Issues For An Automated Waste Collection System At Green Square Town Centre

Small-scale waste to energy (WtE)

Purpose

To convert mixed waste to energy at the precinct level.

Inputs and outputs

Inputs – mixed waste

Outputs – energy, residual

Potential application scale

By its nature this technology is small scale. Capacity per precinct would be no more than 20,000 tonnes per year. This could mean one 20,000 t facility or two 10,000 t facilities. Scaling facilities beyond this would reduce the number required and defeat the purpose of having local precinct-based plants.

History of application

Waste to energy falls into two areas; thermal and biological. Thermal treatment encompasses a wide range of technology types from mass burn incineration to plasma arc. Biological generally means anaerobic digestion which produces a biogas that is burnt to produce electricity.

Some thermal technologies, such as mass burn incineration at large scale facilities are very mature WtE technologies. This technology in particular has been widely used in Europe for decades for energy and heat generation.

More recent technologies such as gasification, pyrolysis and plasma arc have been used successful for converting particular individual waste materials to energy, such as wood waste. Their application to mixed waste processing is only a recent development and mostly applied at a larger scale.

Micro scale anaerobic digesters are commonly used on farms for in China and India. There are more than 40 million small scale anaerobic digesters operating world-wide. Small scale AD systems also have as their primary feedstock animal manure and food waste and produce gas for cooking, heating, lighting and electricity production, as well as liquid fertiliser and compost. Although most new AD systems in the US and Europe are for processing agricultural waste, AD systems can also process food waste. When the technology was first developed AD system processed mixed waste but with the development of source separation programs and sophisticated separation systems most new AD facilities designed for municipal and commercial waste only process separated organics.

Costs

Four AD plants in Europe with capacity of up to 25,000 tonnes per year have capital costs of between A$316 and A$799 per tonne. Another has an operational cost of A$34.80 per tonne.

References

Lunstrøm, Petter (no date) Energos Gasification Technology – Proven Small-scale, Energy from Waste http://www.ieatask33.org/app/webroot/files/file/2011/Norway.pdf

Themelis, Nickolas J. (2007) Thermal Treatment Review Waste Management World 8 (4) http://www.waste-management-world.com/articles/print/volume-8/issue-4/features/thermal-treatment-review.html

Ellyin, Claudine (2012) Small Scale Waste-To-Energy Technologies Department of Earth and Environmental Engineering, Columbia University. Submitted in partial fulfilment of the requirements for M.S. degree in Earth Resources Engineering

GEM - http://www.gemcanadawaste.com, http://www.gem-ltd.co.uk, http://www.mswpower.com/Waste-to-Energy.aspx, http://cogentech-inc.com/id19.html

Marty, E. (2002) Case study - Production of Fuels from Waste & Biomass by the EDDITh Thermolysis Process Recent Industrial Developments http://www.ienica.net/usefulreports/pyrolysiscs2.pdf

Compact Power - http://gasifiers.bioenergylists.org/files/Compact_power.pdf

Naanovo - http://www.naanovo.com/wte

WasteGen - http://www.wastegen.com

GGI Energy - http://www.ggienergy.com/

Novo Energy - http://wte.novoenergyllc.com/

Ellyin, Claudine and Themelis, Nickolas J. (2011) Small Scale Waste-To-Energy Technologies NAWTEC 19, Lancaster PA, May 16-18 http://www.nawtec.org/Portals/2/2011/Ellyin_Claudine.pdf

Envikraft - http://www.envikraft.com, http://www.envikraft.dk/

UK Department of Energy and Climate Change and Department for Environment Food and Rural Affairs - http://www.biogas-info.co.uk/index.php/feedstocks.html and http://www.biogas-info.co.uk/index.php/ad-map.html

De Baere, Luc and Mattheeuws (2010) Anaerobic Digestion of MSW in Europe BioCycle 51(2): 24 http://www.biocycle.net/2010/02/anaerobic-digestion-of-msw-in-europe/

Large scale centralised separation, composting and WtE facility

Purpose

Separate mixed waste into several streams for direct sale to markets or recovery by composting or conversion to energy.

Inputs and outputs

Inputs – mixed waste

Outputs – recyclable materials (glass, cardboard, plastics, metals), compost, digestate, biogas and energy (depending on the technology), residual.

Potential application scale

All the proposed technologies can be expanded. Some are designed to be modular so scaling up is easily done by adding another module. In this case, the final facility design would be developed for the maximum waste capacity and then modules added or elements upgraded for the individual components, separation, composting, digestion and WtE as the development progressed and large quantities required processing.

History of application

The technology for mechanical separation of waste streams was developed in the US in the 1970s. For many years these materials recovery facilities (MRFs) were used to further separate source-separated recyclables. The first MRF was built in Australia in the early 1990s. In time MRF concepts and separation technologies were applied to other waste streams including construction and demolition, commercial and industrial and mixed waste.

Most MRFs use similar technologies including, rotating trommels, disc and other screens, magnets and eddy currents, vibrating and bouncing conveyors and air blowers as well as manual separation. More recently, more sophisticated technologies such as optical recognition has reduced the need for direct human involvement in sorting and has also reduced the size of materials particles that can be separated and therefore increasing the range of materials that can be sorted.

Waste to energy falls into two areas; thermal and biological. Thermal treatment encompasses a wide range of technology types from mass burn incineration to plasma arc. Biological generally means anaerobic digestion which produces a biogas that is burnt for energy.

Some thermal technologies, such as mass burn incineration at large scale facilities are very mature WtE technologies. This technology in particular has been widely used in Europe for decades for energy and heat generation.

More recent technologies such as gasification, pyrolysis and plasma arc have been used successful for converting particular individual waste materials to energy, such as wood waste. Their application to mixed waste processing is only a recent development. There are no thermal treatment plants currently operating in Australia.

Costs

A number of composting facilities have been operating in Australia. Published capital costs for these range between $10 million for a 21,000 t per year facility to $100 million for a 195,000 t per year facility.

Several anaerobic digestion facilities are also operating in Australia. Published capital costs range between $35 million and $50 million for 75,000 t and 100,000 t per year facilities.

Estimates have been published of the costs of a range of AWT facility for the ACT. To process 50,000 tonnes per year, capital costs range between $15 million for in-vessel composting, $24 million for AD, $39 million for gasification and around $50 million for pyrolysis or incineration. Processing costs range from $67 per tonne for in-vessel composting up to $133 per tonne for gasification.

Capital costs to establish a MRF are in the order of $10-$15 million and around $30-$35 per tonne operating costs.

References

http://www.ben-global.com/

http://www.epem.gr/waste-c-control/database/html/costdata-00.htm

URS (2010) Final Report – Supplementary Report – Economic modelling of Options for Waste Infrastructure in the ACT for ACT Department of the Environment, Climate Change, Energy and Water

http://www.alpheco.co.uk/

http://www.civicenvironmental.com/

http://www.bekon.eu/

http://oaktech-environmental.com/

http://www.epem.gr/waste-c-control/database/html/costdata-00.htm

http://www.horstmann.pl/_uk/kompostownie-technologia.shtml

http://www.entsorga.it/

Appendix G – WT Partnership Cost Estimate

GHD | Report for Places Victoria - Fishermans Bend Infrastructure Plan, 31/30105

12 June 2013

GHD
180 Lonsdale Street
MELBOURNE VIC 3000
Attention: Mr Sam Rowland / Ms Elizabeth Hausler

Dear Sir / Madam

FISHERMANS BEND INFRASTRUCTURE WORKS
BUDGET ESTIMATE NO. 1 REVISION 2

We are pleased to confirm our Masterplan Budget Estimate No. 1 Revision 2 dated 31 May 2013, based on GHD Fishermans Bend Infrastructure Plan Revision A dated 2 May 2013, for the above project.

1.0 ESTIMATE SUMMARY

We estimate the cost of construction cost in the amount of Option 1 Integrated Infrastructure Plan $342,500,000 (Excl GST), Option 2 Business as Usual $113,000,000 (Excl GST), and Option 3 Underground Storage 68,000,000 (Excl GST) at current day costs.

The Estimate No. 1 Revision 2 is summarised as follows:

	Integrated Infrastructure Plan Option 1 $	Business as Usual Option 2 $	Underground Storage Option 3 $
Construction Cost	215,435,155	71,100,425	42,780,000
Preliminaries & Margin	28,880,000	9,530,000	5,750,000
Sub-Total Trade Works	**244,315,155**	**80,630,425**	**48,530,000**
Consultant Fees	19,550,000	6,460,000	3,890,000
Design Development & Construction Contingency	78,634,845	25,909,575	15,580,000
TOTAL BUDGET ESTIMATE AT MAY 2013 (EXCL GST)	**$342,500,000**	**$113,000,000**	**$68,000,000**

WT PARTNERSHIP

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2.0 PROJECT DEFINITION

The project comprises:

- Recycled Water, Potable Water, Sewerage, Stormwater, Electrical, Gas, Cogeneration and Telecommunications Infrastructure works to two of the infill land precincts in Fishermans Bend, (Integrated Infrastructure Plan)
- Potable Water, Sewerage, Stormwater Electrical, Gas and Telecommunications Infrastructure works to two of the infill land precincts in Fishermans Bend, (Business as usual)
- Stormwater storage with Atlantis underground modular water tanks (Option 3)

3.0 DOCUMENTATION

This estimate is based on the following documentation:

- GHD Drawings:
  - Fishermans Bend Infrastructure Plan Revision A, dated 2 May 2013
  - Yarra Valley Water Kooyong Water Mining Scheme Figure 08 (RWTP Option 1 SYM Connections)
  - Places Victoria - Fishermans Bend Infrastructure Assessment (GHD Existing Service Plans)
- GHD Spread Sheet Workbooks:
  - Quantities for Costing, issued 30 May 2013
- Utility Descriptions, issued 9 May 2013

4.0 SPECIFIC INCLUSIONS

The Estimate assumes competitive lump sum tender for the whole of the Works from suitably qualified contractors.

The Estimate is inclusive of the following allowances:

- All Quantities are as per GHD Spreadsheet Workbook dated 30 May 2013
- Preliminaries and Margin - 13%
- Consultants Fee allowance - 8%
- Design Development contingency - 15% (as advised by GHD)
- Construction contingency - 15% (as advised by GHD)

5.0 KEY DESIGN ASSUMPTIONS

- Excavation and backfill of pipework within Fishermans Bend to take place as part of overall site development of the area (no making good above pipework has been allowed only trench backfill)
- Potable water extensions allowed to be bored in rock with boring pit shafts every 200 m
- Service pits / manholes every 50 m of pipework
- Shoring to all trenches (given assumed ground conditions)
- Backfill with crushed rock / sand
- Pumps to be submersible in a chamber, backup pumps allowed to sewerage system
- Water and recycled water pipework allowed as 1 m deep
- Sewer pipework allowed as 1.5 m deep (Based on rising main)
- Rock beaching / headwalls to stormwater storage areas, (Allowance of $500,000)
- Telecommunication allows for NBN 100 mm conduit and pits (cabling by others)
- Infrastructure sizes / types as specified by GHD

6.0 SPECIFIC EXCLUSIONS

The following items are specifically excluded from this estimate:

- Demolition of existing factories / buildings and existing infrastructure
- Reinstatement and landscaping costs to stormwater storage
- Public realm or ground plane works
- Allowance for transfer station / future waste plant
- Traffic management
- Recycled water plant and cogeneration system (business as usual option)
- Making good existing roads around the precinct
- Service connections for the developments (assumed as an individual development cost)
- Descaling of existing sewer pipes
- Major repairs to existing infrastructure

- NBN and communications cabling
- Asbestos removal
- Specific Conditions relating to an environmental impact study
- Decontamination and removal of hazardous materials
- Existing service clashes / alterations
- Unforeseen ground conditions
- Staging of the works
- Rock removal
- Night works
- Fibre optic cabling and equipment
- Developer headworks contributions (i.e. Citipower / Melbourne Water)
- Lease buy outs
- Land acquisition
- Purchase of land / assets
- Disposal of abandoned services (assume abandoned services left in ground)
- Assumed developer to fund individual stormwater storages within buildings (as per note by GHD)
- Cost escalation beyond May 2013
- GST

7.0 CONCLUSION / DISCLAIMER

We highlight that due to the preliminary nature of the documentation, our Estimate should be viewed as indicative and a preliminary opinion of the probable order of cost based on a concept without definition of design scope or quality.

Where WT Partnership has not been provided with sufficient information, we have made assumptions and allowances, which will require detailed review once the design is developed.

Please review the detail of our Estimate, in particular the many assumptions as to scope, quality, performance and finishes of the current design intent to ensure it generally reflects your requirements.

The estimate has been prepared expressly for GHD for the purpose of preparing a preliminary feasibility assessment and is not to be used for any other purpose or distributed to any third party.

WT PARTNERSHIP

FISHERMANS BEND INFRASTRUCTURE WORKS
BUDGET ESTIMATE NO. 1 REVISION 2

12 JUNE 2013

Do not hesitate to contact us to discuss any aspect, which requires clarification or amendment to the assumed scope of works on our part.

Yours faithfully
WT PARTNERSHIP

D. Thomas

DAVID THOMAS
Director

Enclosure Estimate No. 1 Revision 2

WTP Ref: 13103-02 | RD sa

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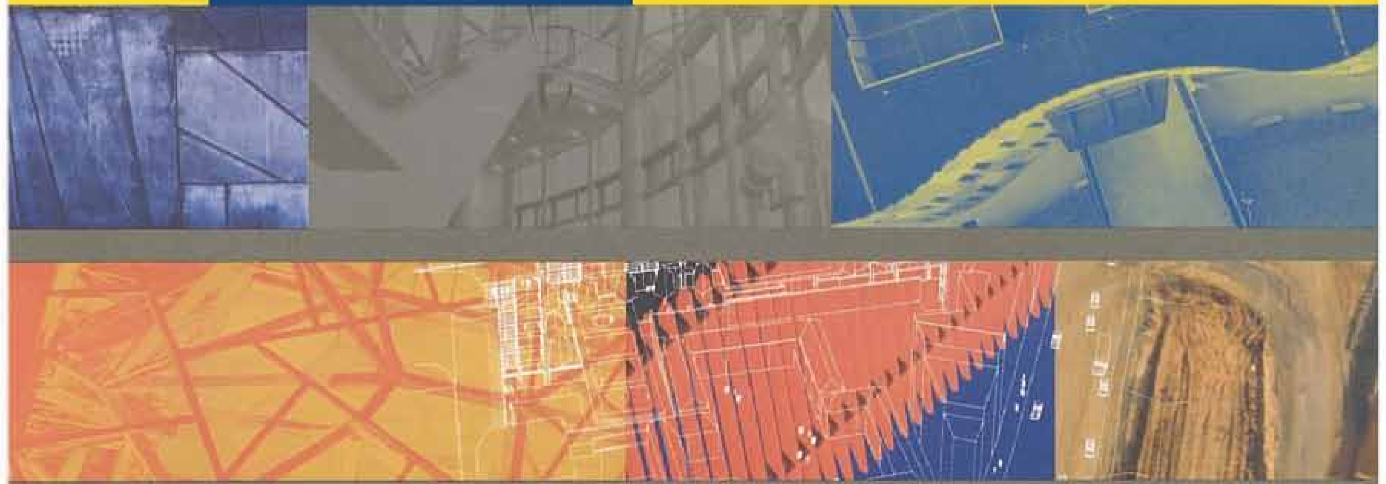
WT PARTNERSHIP



FISHERMANS BEND INFRASTRUCTURE WORKS

BUDGET ESTIMATE NO. 1 REVISION 2

12 June 2013

ESTIMATE SUMMARY

WT PARTNERSHIP

13103 - Fishermans Bend Infrastructure
Fishermans Bend Infrastructure
Intergrated Infrastructure Plan - Option 1

Job No: 13103
Cost Base Date: 9/05/2013
GFA (m2): 0.00

Date Printed: 30/05/2013

	Section	Unit	Quantity	Rate	Cost ($)
1	Estimate Criteria				
2	Recycled Water				45,401,030
3	Potable Water				5,957,750
4	Sewerage System				4,894,110
5	Stormwater Upgrades				6,926,200
6	Electrical System Upgrades				15,024,830
7	Gas System Reticulation				5,970,360
8	Cogeneration System				125,681,600
9	Sewer Heat Recovery System				1,877,000
10	Telecommunications				3,702,275
	Sub-Total Trade Works as at May 2013				**215,435,155**
11	Preliminaries & Supervision	%	8	215,435,155	17,240,000
12	Margin	%	5	232,675,155	11,640,000
	Total Construction Costs as at May 2013				**244,315,155**
	<u>On-Costs</u>				
13	Consultants Fees	%	8	244,315,155	19,550,000
14	Design Development Contingency	%	15	244,315,155	36,650,000
15	Construction Contingency	%	15	280,965,155	41,984,845
	Sub-Total On Costs				**98,184,845**
	TOTAL DESIGN AND CONSTRUCTION BUDGET ESTIMATE as at May 2013 [EXCL GST]				**342,500,000**

ESTIMATE DETAIL

WT PARTNERSHIP

13103 - Fishermans Bend Infrastructure
Fishermans Bend Infrastructure
Intergrated Infrastructure Plan - Option 1

Job No: 13103
Cost Base Date: 9/05/2013
GFA (m2): 0.00

Date Printed: 30/05/2013

Item	Section	Unit	Qty	Rate $	Cost $
1	**Estimate Criteria**				
	Extent of work				
1.1	Recycled Water, Potable Water, Sewerage, Stormwater, Electrical, Gas, Cogeneration & Telecommunications Infrastructure works to two of the infill land precincts in Fishermans Bend (Integrated Infrastructure Plan)				
1.2	Potable Water, Sewerage, Stormwater Electrical, Gas & Telecommunications Infrastructure works to two of the infill land precincts in Fishermans Bend (Business as usual)				
	Documentation				
1.3	GHD Drawings:				
1.4	Fishermans Bend Infrastructure Plan Revision A. Dated 02 May 2013				
1.5	Yarra Valley Water Kooyong Water Mining Scheme Figure 08 (RWTP Option 1 SYM Connections)				
1.6	Places Victoria - Fishermans Bend Infrastructure Assessment (GHD Existing Service Plans)				
1.7	GHD Spread Sheet Workbooks:				
1.8	Quantities for Costing. Issued 30 May 2013				
1.9	Utility Descriptions. Issued 09 May 2013				
	Inclusions				
1.10	The estimate includes the following items:				
1.11	All Quantities are as per GHD Spreadsheet Workbook dated 30 May 2013				
1.12	Preliminaries and Margin 13%				
1.13	Consultants Fee allowance 8%				
1.14	Design Development Contingency 15% [As advised by GHD]				
1.15	Construction Contingency 15% [As advised by GHD]				
1.16	Excavation and backfill of pipework within Fishermans Bend to take place as part of overall site development of the area (No making good above pipework has been allowed only trench backfill)				
1.17	Potable water Extensions allowed to be bored in rock with boring pit shafts every 200m				
1.18	Service Pits/manholes every 50m of pipework				
1.19	Shoring to all Trenches (given assumed ground conditions)				

ESTIMATE DETAIL

WT PARTNERSHIP

13103 - Fishermans Bend Infrastructure
Fishermans Bend Infrastructure
Intergrated Infrastructure Plan - Option 1

Job No: 13103
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Date Printed: 30/05/2013

Item	Section	Unit	Qty	Rate $	Cost $
1	**Estimate Criteria**				*(Continued)*
1.20	Backfill with Crushed Rock/sand				
1.21	Pumps to be submersible in a Chamber. Backup Pumps allowed to Sewerage system				
1.22	Water & Recycled water pipework allowed as 1m deep				
1.23	Sewer pipework allowed as 1.5m deep				
1.24	Allowance for Rock Beaching/headwalls to Stormwater Storage areas $500,000				
1.25	Telecommunication allows for NBN 100mm conduit and pits (cabling by others)				
1.26	Infrastructure sizes/types as specified by GHD				
	Exclusions				
1.27	The following items are specifically excluded from this estimate:				
1.28	Demolition of existing factories/ buildings and existing infrastructure				
1.29	Reinstatement and landscaping costs to stormwater storage				
1.30	Public realm or ground plane works				
1.31	Allowance for Transfer Station/future waste plant				
1.32	Traffic management				
1.33	Recycled water plant & Cogeneration system (Business as usual Option)				
1.34	Making good existing roads around the precinct				
1.35	Service connections for the developments (assumed as an individual development cost)				
1.36	Descaling of existing sewer pipes				
1.37	Major repairs to existing infrastructure				
1.38	NBN & communications cabling				
1.39	Asbestos removal				
1.40	Specific Conditions relating to an environmental impact study				
1.41	Decontamination & Removal of hazardous materials				
1.42	Existing service clashes/alterations				
1.43	Unforeseen Ground Conditions				
1.44	Staging of the works				

ESTIMATE DETAIL

WT PARTNERSHIP

13103 - Fishermans Bend Infrastructure
Fishermans Bend Infrastructure
Intergrated Infrastructure Plan - Option 1

Job No: 13103
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Item	Section	Unit	Qty	Rate $	Cost $
1	**Estimate Criteria**				*(Continued)*
1.45	Rock Removal				
1.46	Night Works				
1.47	Fibreoptic cabling and equipment				
1.48	Developer Headworks contributions (i.e. Citypower/Melbourne Water)				
1.49	Lease Buy outs				
1.50	Land Acquisition				
1.51	Purchase of land/assets				
1.52	Disposal of abandoned services (assume abandoned services left in ground)				
1.53	Assumed developer to fund individual stormwater storages within buildings (as per note by GHD)				
1.54	Cost escalation beyond May 2013				
1.55	GST				
2	**Recycled Water**				
	Sewage Treatment System				
2.1	Sewage treatment system complete including sewage mining off-take structure and building structure (Based on 9 M/L a day)	Item	1	30,000,000	30,000,000
2.2	Shaft built over the Melbourne Sewer including an automated penstock valve 2400mm dia	Item	1	incl above	
2.3	Valve Pit 2500 x 2500	Item	1	incl above	
	Pumps				
2.4	Sewer Mining Diversion pump 92L/s pump based on diverting 8 ML/day at a constant rate (Assume a 4m wet well diameter - 3.5m deep)	No.	2	200,000	400,000
2.5	Recycled water distribution pump station 125kw (185L/s)	No.	2	220,000	440,000
	Storage				
2.6	Class A 3ML recycled water storage tank (partly buried)	Item	1	3,600,000	3,600,000
	Reticulation				
2.7	150 dia PE pipe complete including fittings, trenching, bedding and backfill	m	16,736	460	7,698,560
2.8	300 dia PE pipe complete including fittings, trenching, bedding and backfill	m	3,269	630	2,059,470

ESTIMATE DETAIL

WT PARTNERSHIP

13103 - Fishermans Bend Infrastructure
Fishermans Bend Infrastructure
Intergrated Infrastructure Plan - Option 1

Job No: 13103
Cost Base Date: 9/05/2013
GFA (m2): 0.00

Date Printed: 30/05/2013

Item	Section	Unit	Qty	Rate $	Cost $
2	**Recycled Water**				*(Continued)*
2.9	Allowance for pits to pipework assumed 1 pit every 50m	No	401	3,000	1,203,000
					45,401,030
3	**Potable Water**				
3.1	500 dia MSCL water main complete including boring from existing Williams Street potable water main at Queens Bridge	m	1,350	3,965	5,352,750
3.2	Allowance for connection to existing 600 dia MSCL water main	Item	1	200,000	200,000
3.3	Pits to pipework assumed 1 pit every 100m	No	27	15,000	405,000
					5,957,750
4	**Sewerage System**				
	Pump stations				
4.1	8kW/26L/s at 23m Pump station (including pump station wet well and diversion from existing sewer) - High level relieving pump station	Item	1	55,000	55,000
4.2	Backup Pump to above	Item	1	55,000	55,000
4.3	9kW/47L/s at 13m Pump station (including pump station wet well and diversion from existing sewer) - High level relieving pump station	Item	1	60,000	60,000
4.4	Backup Pump to above	Item	1	60,000	60,000
	Reticulation				
4.5	Supply and install sewerage rising main DN150 PE PN16 and connection to downstream sewer	m	960	545	523,200
4.6	Supply and install sewerage rising main DN 180 PE PN16 and connection to downstream sewer	m	370	635	234,950
4.7	Allow for 2 m deep manholes (Assumed 1 pit every 50m)	No	27	8,000	212,800
	Pipework relining				
4.8	Reline existing DN100mm sewer	m	1,092	520	567,840
4.9	Reline existing DN150mm sewer	m	4,236	110	465,960
4.10	Reline existing DN225mm sewer	m	9,531	170	1,620,270
4.11	Reline existing DN250mm sewer	m	23	170	3,910
4.12	Reline existing DN300mm sewer	m	2,392	220	526,240
4.13	Reline existing DN436mm sewer	m	81	420	34,020
4.14	Reline existing DN450mm sewer	m	234	420	98,280
4.15	Reline existing DN464mm sewer	m	288	420	120,960

ESTIMATE DETAIL

WT PARTNERSHIP

13103 - Fishermans Bend Infrastructure
Fishermans Bend Infrastructure
Intergrated Infrastructure Plan - Option 1

Job No: 13103
Cost Base Date: 9/05/2013
GFA (m2): 0.00

Date Printed: 30/05/2013

Item	Section	Unit	Qty	Rate $	Cost $
4	**Sewerage System**				*(Continued)*
4.16	Reline existing DN565mm sewer	m	544	470	255,680
					4,894,110
5	**Stormwater Upgrades**				
	Pumping stations				
5.1	45kW/300L/s pump (Assume a 4m wet well diameter - 3.5m deep)	No.	3	125,000	375,000
5.2	60kW/700L/s pump (Assume a 4m wet well diameter - 3m deep)	No.	3	150,000	450,000
5.3	45kW/300L/s pump (Assume a 4m wet well diameter - 3.5m deep)	No.	3	125,000	375,000
	Reticulation				
5.4	600 dia PE pipe PN16 complete including fittings, trenching, bedding and backfill	m	265	1,580	418,700
5.5	600 dia PE pipe PN16 complete including fittings, trenching, bedding and backfill	m	200	1,580	316,000
5.6	800 dia PE pipe PN16 complete including fittings, trenching, bedding and backfill	m	150	1,930	289,500
5.7	225 dia PE pipe PN16 complete including fittings, trenching, bedding and backfill	m	400	680	272,000
5.8	Allow for pits to pipework. (Assumed 1 pit every 50m)	No	21	5,000	105,000
	Stormwater detention basins				
5.9	Excavation of proposed green space for open stormwater storage Catchment 0 (Excavation 1:5 batters)	m3	45,000	25	1,125,000
5.10	Excavation of proposed green space for open stormwater storage Catchment 3 (Excavation 1:5 batters)	m3	42,000	25	1,050,000
5.11	Excavation of proposed green space for open stormwater storage Catchment 4 (Excavation 1:5 batters)	m3	25,000	25	625,000
5.12	Excavation of proposed green space for open stormwater storage Catchment 6 (Excavation 1:5 batters)	m3	21,000	25	525,000
5.13	Excavation of proposed green space for open stormwater storage Catchment 7 (Excavation 1:5 batters)	m3	5,000	25	125,000
5.14	Allowance for Rock Beaching/headwalls to Stormwater Storage areas	Item	1	500,000	500,000
5.15	Pump to transfer stored stormwater to the bay 45kW/50L/s	No.	3	125,000	375,000
					6,926,200
6	**Electrical System Upgrades**				

ESTIMATE DETAIL

13103 - Fishermans Bend Infrastructure
Fishermans Bend Infrastructure
Intergrated Infrastructure Plan - Option 1

Job No: 13103
Cost Base Date: 9/05/2013
GFA (m2): 0.00

Date Printed: 30/05/2013

Item	Section	Unit	Qty	Rate $	Cost $
6	**Electrical System Upgrades** *(Continued)*				
	Distribution network				
6.1	Supply and install underground 11 kV 80 mm cable including conduits	m	1,466	315	461,790
6.2	Supply and install underground 11 kV 100 mm cable including conduits	m	12,040	320	3,852,800
6.3	Supply and install underground 11 kV 125 mm cable including conduits	m	6,344	335	2,125,240
6.4	Allow for pits to pipework (Assumed 1 pit every 50m)	No	397	5,000	1,985,000
	Substations				
6.5	1000 kVA pad mounted zone substation	No	33	200,000	6,600,000
					15,024,830
7	**Gas System Reticulation**				
	Reticulation				
7.1	150mm dia gas main complete including fittings, trenching, bedding and backfill	m	11,592	455	5,274,360
7.2	Allow for pits to pipework (Assumed 1 pit every 50m)	No	232	3,000	696,000
					5,970,360
8	**Cogeneration System**				
	Gas main extension				
8.1	Extension of high pressure gas transfer main to supply the cogeneration plants - Extension of transfer pipeline from an existing city gate (allowed as 200mm dia)	m	1,900	2,600	4,940,000
	Co-generation				
8.2	10MW co-generation plant complete including exhaust heat recovery and building (approx 350m2 by 17 m high)	No	3	35,000,000	105,000,000
8.3	11kV main from Cogen Plant to existing substation	m	50	300	15,000
8.4	11kV main from Cogen Plant to existing substation	m	900	300	270,000
8.5	11kV main from Cogen Plant to existing substation	m	700	300	210,000
8.6	Allow for pits to pipework. Ratio 1 pit every 50m	No	33	5,000	165,000
	District hot water loop				
8.7	2 x 225 dia district hot water loop complete including connections and trenching	m	8,508	1,700	14,463,600
8.8	Allow for pits to pipework (Assumed 1 pit every 100m)	No	86	3,000	258,000
8.9	Pump for the district hot water loop system 5kW/60L/s	No.	6	50,000	300,000

ESTIMATE DETAIL

13103 - Fishermans Bend Infrastructure
Fishermans Bend Infrastructure
Intergrated Infrastructure Plan - Option 1

Job No: 13103
Cost Base Date: 9/05/2013
GFA (m2): 0.00

Date Printed: 30/05/2013

Item	Section	Unit	Qty	Rate $	Cost $
8	**Cogeneration System** *(Continued)*				
	Electricity Distribution Network				
8.10	Upgrade Custody Transfer Meters	No	2	20,000	40,000
8.11	Upgrade field regulator meters	No	2	10,000	20,000
					125,681,600
9	**Sewer Heat Recovery System**				
9.1	2 x 225 dia district hot water loop complete including connections and trenching	m	810	1,700	1,377,000
9.2	Supply and install 1500kW electric heat pump	Item	1	400,000	400,000
9.3	Housing for sewage heat pump	Item	1	100,000	100,000
					1,877,000
10	**Telecommunications**				
10.1	NBN or equivalent fibre optic conduit including trenching and backfill	m	20,005	155	3,100,775
10.2	Allow for pits to pipework (Assumed 1 pit every 50m)	No	401	1,500	601,500
10.3	Cabling excluded	Note			
					3,702,275

ESTIMATE SUMMARY

WT PARTNERSHIP

13103 - Fishermans Bend Infrastructure
Fishermans Bend Infrastructure
Business As Usual - Option 2

Job No: 13103
Cost Base Date:
GFA (m2): 0.00

Date Printed: 30/05/2013

	Section	Unit	Quantity	Rate	Cost ($)
1	Potable Water				34,582,650
2	Sewerage System				4,894,110
3	Stormwater Upgrades				6,926,200
4	Electrical System Upgrades				15,024,830
5	Gas System Reticulation				5,970,360
6	Telecommunications				3,702,275
	Sub-Total Trade Works as at May 2013				**71,100,425**
7	Preliminaries & Supervision	%	8	71,100,425	5,690,000
8	Margin	%	5	76,790,425	3,840,000
	Total Construction Costs as at May 2013				**80,630,425**
	On Costs				
9	Consultants Fees	%	8	80,630,425	6,460,000
10	Design Development Contingency	%	15	80,630,425	12,100,000
11	Construction Contingency	%	15	92,730,425	13,809,575
	Sub-Total On Costs				**32,369,575**
	TOTAL DESIGN AND CONSTRUCTION BUDGET ESTIMATE as at May 2013 [EXCL GST]				**113,000,000**

ESTIMATE DETAIL

WT PARTNERSHIP

13103 - Fishermans Bend Infrastructure
Fishermans Bend Infrastructure
Business As Usual - Option 2

Job No: 13103
Cost Base Date:
GFA (m2): 0.00

Date Printed: 30/05/2013

Item	Section	Unit	Qty	Rate $	Cost $
1	**Potable Water**				
1.1	Potable Water extension from Punt Road: DN500 MSCL. Offtake from existing City West Water potable water network and connection to existing network within Fishermans Bend	m	4,000	3,965	15,860,000
1.2	Allowance for connection to existing 600 dia MSCL water main	Item	1	200,000	200,000
1.3	Allow for pits to pipework. Ratio (assumed 1 pit every 50m)	No	80	15,000	1,200,000
1.4	8ML Underground Storage Tank	ML	8	1,200,000	9,600,000
1.5	Installation of 450mm dia Pipeline	m	3,311	1,150	3,807,650
1.6	Allow for pits to pipework. Ratio 1 pit every 50m	No	67	5,000	335,000
	Pumping stations				
1.7	110kW/270L/s pump	No.	4	350,000	1,400,000
1.8	10kW/20L/s pump	No.	3	60,000	180,000
1.9	Allowance for Pump Station Housing, pipework & Mechanical/Electrical equipment	Item	1	2,000,000	2,000,000
					34,582,650
2	**Sewerage System**				
	Pump stations				
2.1	8kW/26L/s at 23m Pump station (including pump station wet well and diversion from existing sewer) - High level relieving pump station	Item	1	55,000	55,000
2.2	Backup Pump to above	Item	1	55,000	55,000
2.3	9kW/47L/s at 13m Pump station (including pump station wet well and diversion from existing sewer) - High level relieving pump station	Item	1	60,000	60,000
2.4	Backup Pump to above	Item	1	60,000	60,000
	Reticulation				
2.5	Supply and install sewerage rising main DN150 PE PN16 and connection to downstream sewer	m	960	545	523,200
2.6	Supply and install sewerage rising main DN 180 PE PN16 and connection to downstream sewer	m	370	635	234,950
2.7	Allow for 2 m deep manholes (Assumed 1 pit every 50m)	No	27	8,000	212,800
	Pipework relining				
2.8	Reline existing DN100mm sewer	m	1,092	520	567,840
2.9	Reline existing DN150mm sewer	m	4,236	110	465,960

ESTIMATE DETAIL

WT PARTNERSHIP

13103 - Fishermans Bend Infrastructure
Fishermans Bend Infrastructure
Business As Usual - Option 2

Job No: 13103
Cost Base Date:
GFA (m2): 0.00

Date Printed: 30/05/2013

Item	Section	Unit	Qty	Rate $	Cost $
2	**Sewerage System**				*(Continued)*
2.10	Reline existing DN225mm sewer	m	9,531	170	1,620,270
2.11	Reline existing DN250mm sewer	m	23	170	3,910
2.12	Reline existing DN300mm sewer	m	2,392	220	526,240
2.13	Reline existing DN436mm sewer	m	81	420	34,020
2.14	Reline existing DN450mm sewer	m	234	420	98,280
2.15	Reline existing DN464mm sewer	m	288	420	120,960
2.16	Reline existing DN565mm sewer	m	544	470	255,680
					4,894,110
3	**Stormwater Upgrades**				
	Pumping stations				
3.1	45kW/300L/s pump (Assume a 4m wet well diameter - 3.5m deep)	No.	3	125,000	375,000
3.2	60kW/700L/s pump (Assume a 4m wet well diameter - 3m deep)	No.	3	150,000	450,000
3.3	45kW/300L/s pump (Assume a 4m wet well diameter - 3.5m deep)	No.	3	125,000	375,000
	Reticulation				
3.4	600 dia PE pipe PN16 complete including fittings, trenching, bedding and backfill	m	265	1,580	418,700
3.5	600 dia PE pipe PN16 complete including fittings, trenching, bedding and backfill	m	200	1,580	316,000
3.6	800 dia PE pipe PN16 complete including fittings, trenching, bedding and backfill	m	150	1,930	289,500
3.7	225 dia PE pipe PN16 complete including fittings, trenching, bedding and backfill	m	400	680	272,000
3.8	Allow for pits to pipework. (Assumed 1 pit every 50m)	No	21	5,000	105,000
	Stormwater detention basins				
3.9	Excavation of proposed green space for open stormwater storage Catchment 0 (Excavation 1:5 batters)	m3	45,000	25	1,125,000
3.10	Excavation of proposed green space for open stormwater storage Catchment 3 (Excavation 1:5 batters)	m3	42,000	25	1,050,000
3.11	Excavation of proposed green space for open stormwater storage Catchment 4 (Excavation 1:5 batters)	m3	25,000	25	625,000
3.12	Excavation of proposed green space for open stormwater storage Catchment 6 (Excavation 1:5 batters)	m3	21,000	25	525,000

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ESTIMATE DETAIL

WT PARTNERSHIP

13103 - Fishermans Bend Infrastructure
Fishermans Bend Infrastructure
Business As Usual - Option 2

Job No: 13103
Cost Base Date:
GFA (m2): 0.00

Date Printed: 30/05/2013

Item	Section	Unit	Qty	Rate $	Cost $
3	**Stormwater Upgrades**				*(Continued)*
3.13	Excavation of proposed green space for open stormwater storage Catchment 7 (Excavation 1:5 batters)	m3	5,000	25	125,000
3.14	Allowance for Rock Beaching/headwalls to Stormwater Storage areas	Item	1	500,000	500,000
3.15	Pump to transfer stored stormwater to the bay 45kW/50L/s	No.	3	125,000	375,000
					6,926,200
4	**Electrical System Upgrades**				
	Distribution network				
4.1	Supply and install underground 11 kV 80 mm cable including conduits	m	1,466	315	461,790
4.2	Supply and install underground 11 kV 100 mm cable including conduits	m	12,040	320	3,852,800
4.3	Supply and install underground 11 kV 125 mm cable including conduits	m	6,344	335	2,125,240
4.4	Allow for pits to pipework (Assumed 1 pit every 50m)	No	397	5,000	1,985,000
	Substations				
4.5	1000 kVA pad mounted zone substation	No	33	200,000	6,600,000
					15,024,830
5	**Gas System Reticulation**				
	Reticulation				
5.1	150mm dia gas main complete including fittings, trenching, bedding and backfill	m	11,592	455	5,274,360
5.2	Allow for pits to pipework (Assumed 1 pit every 50m)	No	232	3,000	696,000
					5,970,360
6	**Telecommunications**				
6.1	NBN or equivalent fibre optic conduit including trenching and backfill	m	20,005	155	3,100,775
6.2	Allow for pits to pipework (Assumed 1 pit every 50m)	No	401	1,500	601,500
6.3	Cabling excluded	Note			
					3,702,275

CostX WT Partnership Page 3

ESTIMATE SUMMARY

WT PARTNERSHIP

13103 - Fishermans Bend Infrastructure
Fishermans Bend Infrastructure
Underground Storage - Option 3

Job No: 13103
Cost Base Date:
GFA (m2): 0.00

Date Printed: 30/05/2013

	Section	Unit	Quantity	Rate	Cost ($)
	Option: Underground Storage				
1	Underground Storage				42,780,000
	Sub-Total Trade Works as at May 2013				**42,780,000**
2	Preliminaries & Supervision	%	8	42,780,000	3,430,000
3	Margin	%	5	46,210,000	2,320,000
	Total Construction Costs as at May 2013				**48,530,000**
	On-Costs				
4	Consultants Fees	%	8	48,530,000	3,890,000
5	Design Development Contingency	%	15	48,530,000	7,280,000
6	Construction Contingency	%	15	55,810,000	8,300,000
	Sub-Total On Costs				**19,470,000**
	TOTAL DESIGN AND CONSTRUCTION BUDGET ESTIMATE as at May 2013 [EXCL GST]				**68,000,000**

CostX WT Partnership Summary 1

ESTIMATE DETAIL

WT PARTNERSHIP

13103 - Fishermans Bend Infrastructure
Fishermans Bend Infrastructure
Underground Storage - Option 3

Job No: 13103
Cost Base Date:
GFA (m2): 0.00

Date Printed: 30/05/2013

Item	Section	Unit	Qty	Rate $	Cost $
1	**Underground Storage**				
1.1	45,000m3 of Underground storage (Assumed depth 0.6m, Atlantis underground modular water tanks each 450mm high x 408mm wide x 685mm length (8 modules per m3))	ML	45	310,000	13,950,000
1.2	42,000m3 of Underground storage (Assumed depth 0.6m, Atlantis underground modular water tanks each 450mm high x 408mm wide x 685mm length (8 modules per m3))	ML	42	310,000	13,020,000
1.3	25,000m3 of Underground storage (Assumed depth 0.6m, Atlantis underground modular water tanks each 450mm high x 408mm wide x 685mm length (8 modules per m3))	ML	25	310,000	7,750,000
1.4	21,000m3 of Underground storage (Assumed depth 0.6m, Atlantis underground modular water tanks each 450mm high x 408mm wide x 685mm length (8 modules per m3))	ML	21	310,000	6,510,000
1.5	5,000m3 of Underground storage (Assumed depth 0.6m, Atlantis underground modular water tanks each 450mm high x 408mm wide x 685mm length (8 modules per m3))	ML	5	310,000	1,550,000
					42,780,000

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Appendix H – MacroPlan Funding Analysis

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Fishermans Bend Urban Renewal Area

Development Contributions Plan Funding Options & Financial Sensitivity Analysis

FINAL DRAFT REPORT

3 June 2013

Important Notice

If you are a party other than GHD or Places Victoria, MacroPlan Dimasi:

owes you no duty (whether in contract or in tort or under statute or otherwise) with respect to or in connection with the attached report or any part thereof; and will have no liability to you for any loss or damage suffered or costs incurred by you or any other person arising out of or in connection with the provision to you of the attached report or any part thereof, however the loss or damage is caused, including, but not limited to, as a result of negligence.

If you are a party other than GHD or Places Victoria and you choose to rely upon the attached report or any part thereof, you do so entirely at your own risk.

The responsibility for determining the adequacy or otherwise of our terms of reference is that of Places Victoria.

The findings and recommendations in this report are given in good faith but, in the preparation of this report, we have relied upon and assumed, without independent verification, the accuracy, reliability and completeness of the information made available to us in the course of our work, and have not sought to establish the reliability of the information by reference to other evidence.

Any findings or recommendations contained within this report are based upon our reasonable professional judgement, based on the information which is available from the sources indicated. Should the project elements, external factors and assumptions change, then the findings and recommendations contained in this report may no longer be appropriate.

Accordingly, we do not confirm, underwrite or guarantee that the outcomes referred to in this report will be achieved.

Executive Summary

Overview

MacroPlan Dimasi (the Author) has been engaged as a sub-consultant to GHD to explore a range of funding mechanisms to deliver utilities infrastructure in Fishermans Bend Urban Renewal Area (FBURA); and prepare a financial analysis addressing various infrastructure sequencing scenarios to assess peak infrastructure costs, governance issues and risks.

Two options for delivery of utilities infrastructure have been examined:

- Option 1 – Business As Usual (BAU): using current technologies and capabilities, at an estimated cost of $107,500,000 excluding GST as at May 2013; and
- Option 2 – Integrated Infrastructure Plan: using a combination of current technologies and best practice technologies available at an estimated cost of $342,500,000 excluding GST as at May 2013.

The Author has examined the following infrastructure contributions mechanisms

- Regulated Contributions to utility providers / asset owners
- Developer Contributions
- Infrastructure Recovery Charge
- Residential Infill levy
- Municipal rates and charges

There is more than sufficient capacity for cost recovery to fund proposed new and upgraded utilities infrastructure under both options during the period 2016-2030. Each option may be funded through all or a combination of mechanisms explored in this paper, including a Standard Levy (DCP), Infrastructure Recovery Charge (IRC), Residential Infill Levy, municipal rates and charges and private investment.

Regulated Contributions to utility providers / asset owners

- A contribution is likely to be sought from utilities providers in relation to many of the infrastructure items identified in both Options 1 and 2. The extent of this infrastructure contribution is not clear.
- The cost of recycled water infrastructure, sewer heat recovery and cogeneration systems are not items that would be typically delivered by utilities providers and would be the subject of a separate funding mechanism.
- Whist developer contributions are typically fixed for open space, transport contributions for utilities may be negotiated and the formula for determining up-front and staged infrastructure contributions is ambiguous.

Developer Contributions, Infrastructure Recovery Charge, Residential Levy

- The estimated nominal amount of value recovered through a Standard Levy (DCP) ($45m-$60m), Infrastructure Recovery Charge ($185m-$370m) and Residential Infill Levy ($175m-$350m) during the period 2016-2030. This is more than the total nominal amount required to fund utilities infrastructure under each of the proposed options during this time.
- During the period 2016-2020, the suite of mechanisms above is capable of delivering $37m-$65m, which is broadly equivalent to the total utilities infrastructure cost of $34m under Option 1. A funding surplus is generated during the period following 2020.
- The total utilities cost under option 2 is approx $40m-$70m higher than total cost recovery during this timeframe. This gap relates to cogeneration, recycled water and sewer heat recovery systems which may not be delivered until after 2020 and will likely require significant up-front private investment resulting in long-term sustainability improvements within FBURA and potential private investment returns. A funding surplus is generated during the period following 2020.

Peak infrastructure

Upfront capital contributions as well as whole-of-life contributions are likely to be sought from utilities providers in relation to each of the infrastructure items identified in Option 1 and some of the items under Option 2. The cost of recycled water infrastructure, sewer heat recovery and cogeneration systems are not items that would be typically delivered by utilities providers and would be the subject of a separate funding mechanism.

- Under Option 1, the marginal cost of utilities infrastructure calculated on a per square metre basis (assuming a net developable area of 180ha) is estimated at approx $63/m2 – peaking at a theoretical cost of $156/m2 during each of the years 2016, 2021 and 2026 and averaging around $40/m2 in each other year. This means there is a high possibility of a net funding short-fall in peak periods requiring up-front contributions from developers which may be recouped during later years.
- Under Option 2, the marginal cost of utilities infrastructure calculated on a per square metre basis is estimated at approx $190/m2 – peaking at a theoretical cost of $475/m2 during each of the years 2016, 2021 and 2026 and averaging around $119/m2 in each other year. As in Option 1, there is a very high possibility of a net funding short-fall in peak periods requiring up-front contributions from developers which may be recouped during later years.

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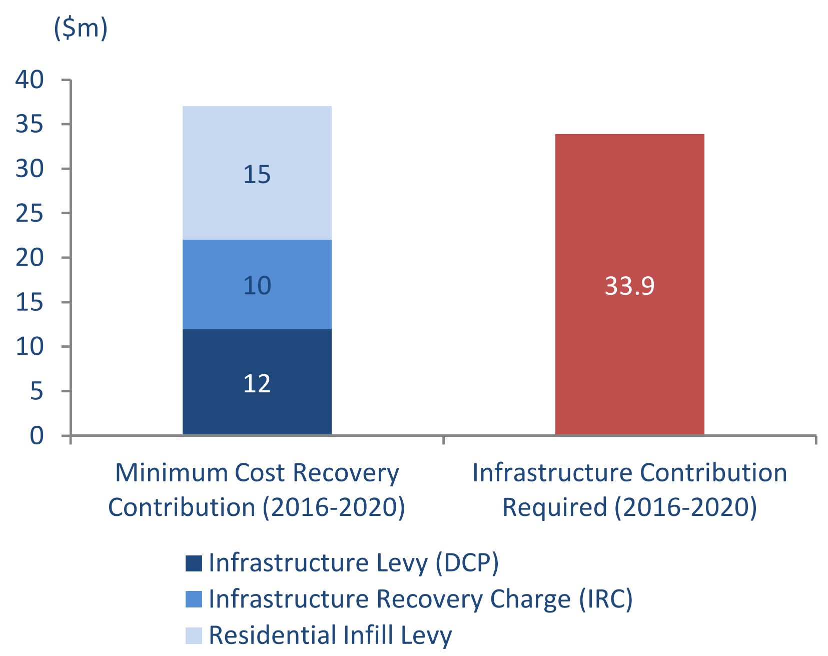
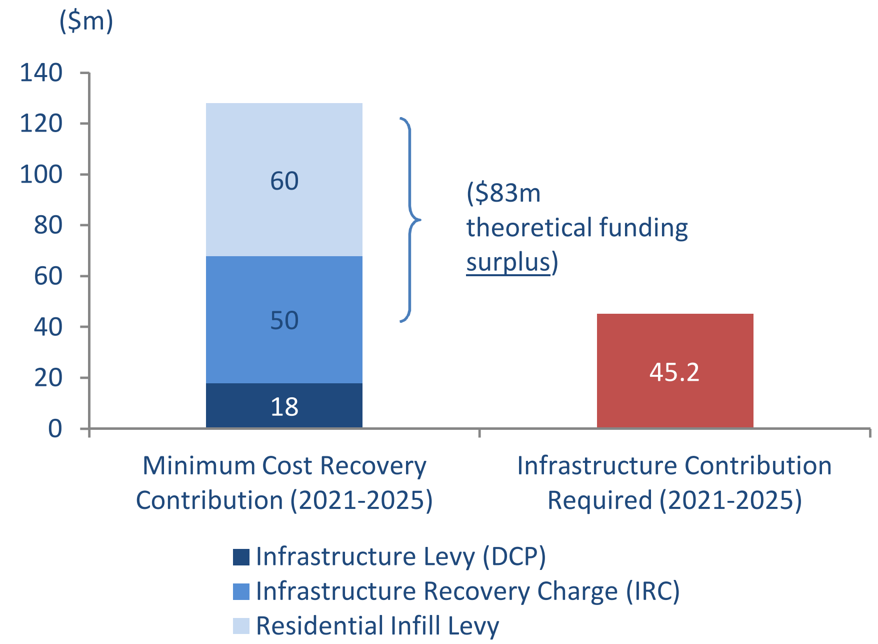
Executive Summary

Option 1 – Estimated <u>minimum</u> theoretical cost recovery from Developer Contributions, Infrastructure Recovery Charge, Residential Levy

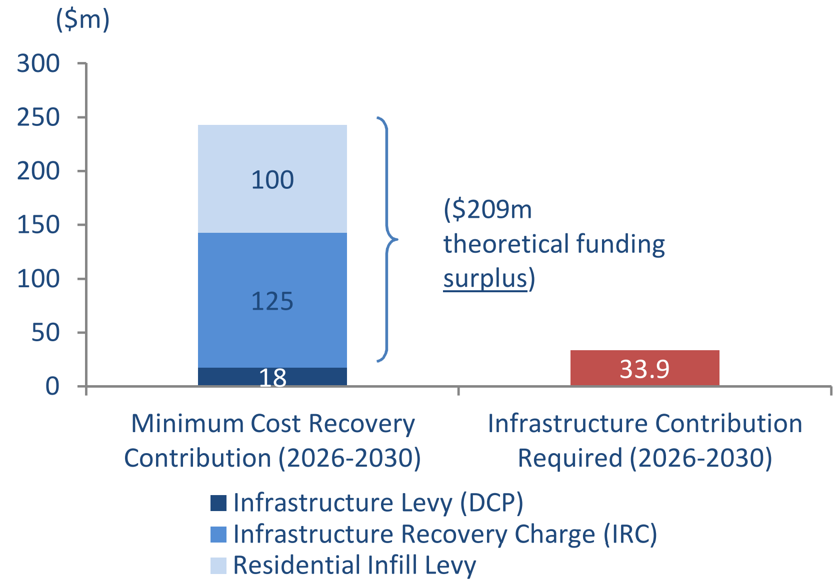
<u>2016-2020</u>



<u>2021-2025</u>

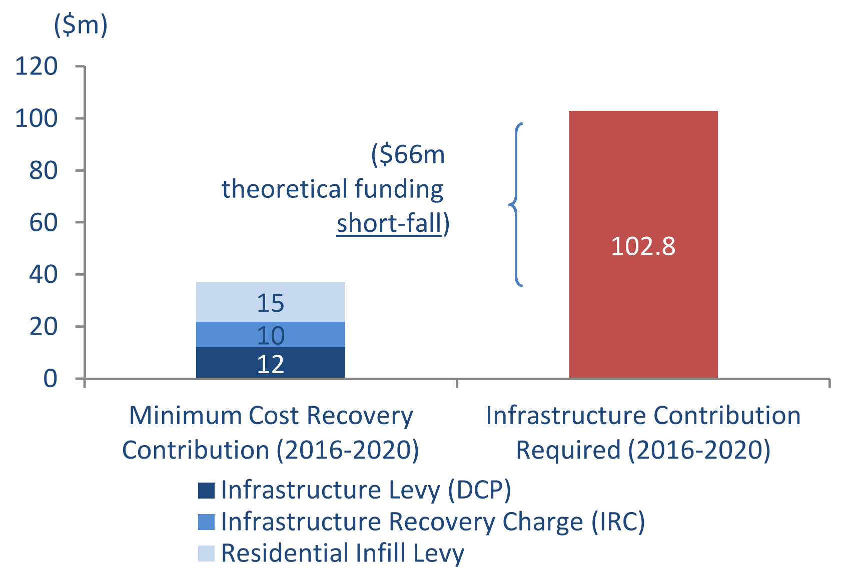


<u>2026-2030</u>

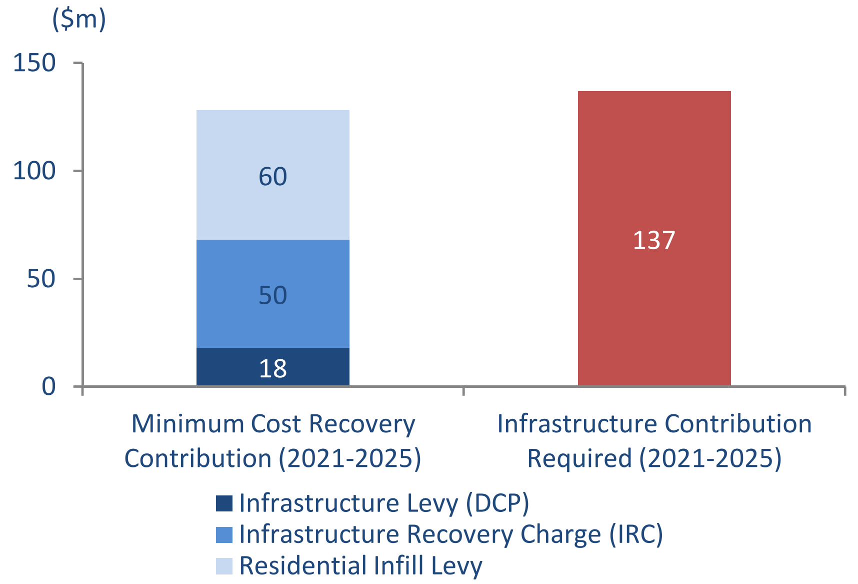


Option 2 – Estimated <u>minimum</u> theoretical cost recovery from Developer Contributions, Infrastructure Recovery Charge, Residential Levy

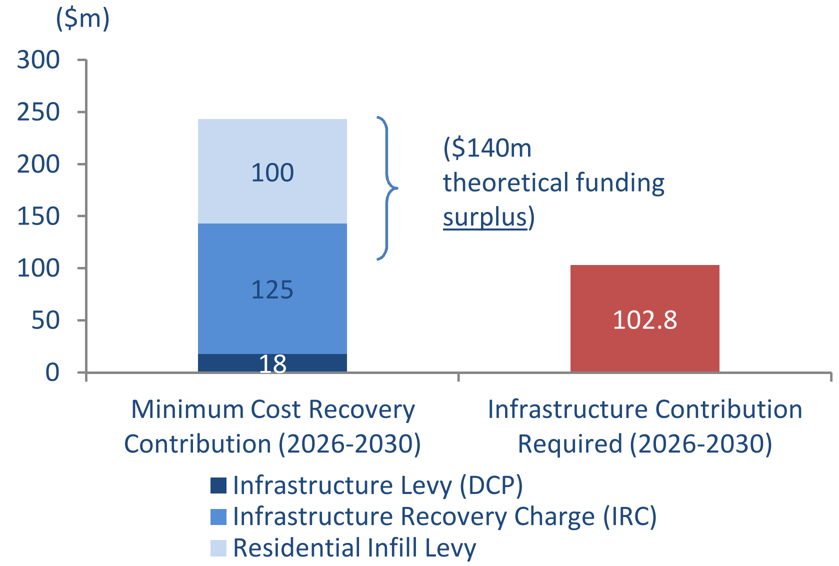
<u>2016-2020</u>



<u>2021-2025</u>



<u>2026-2030</u>



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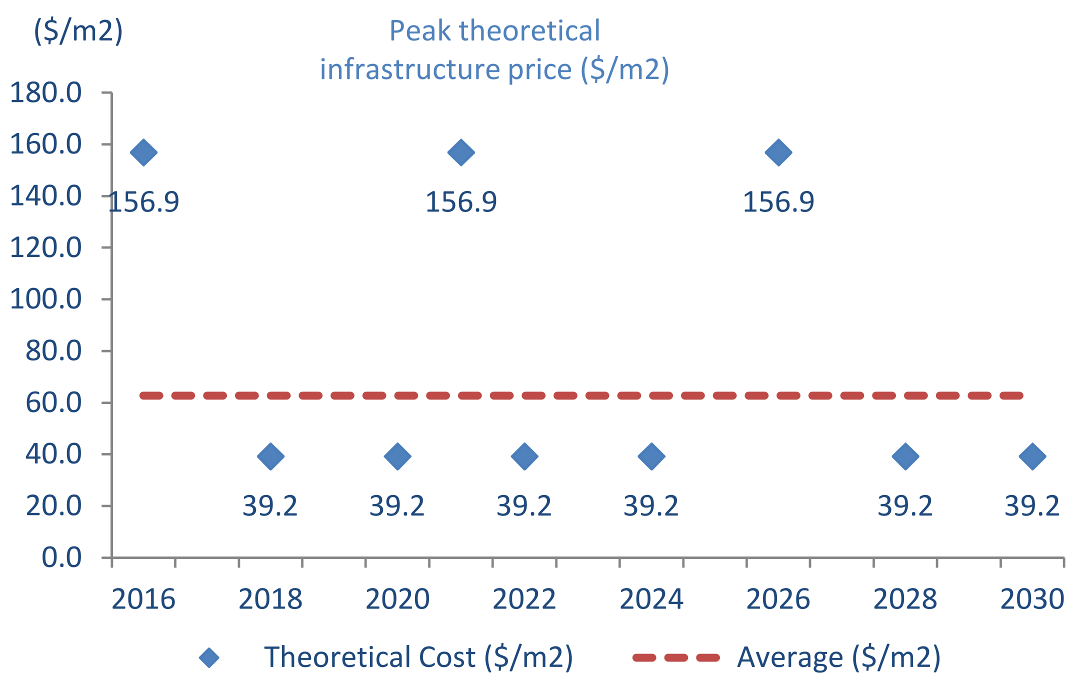
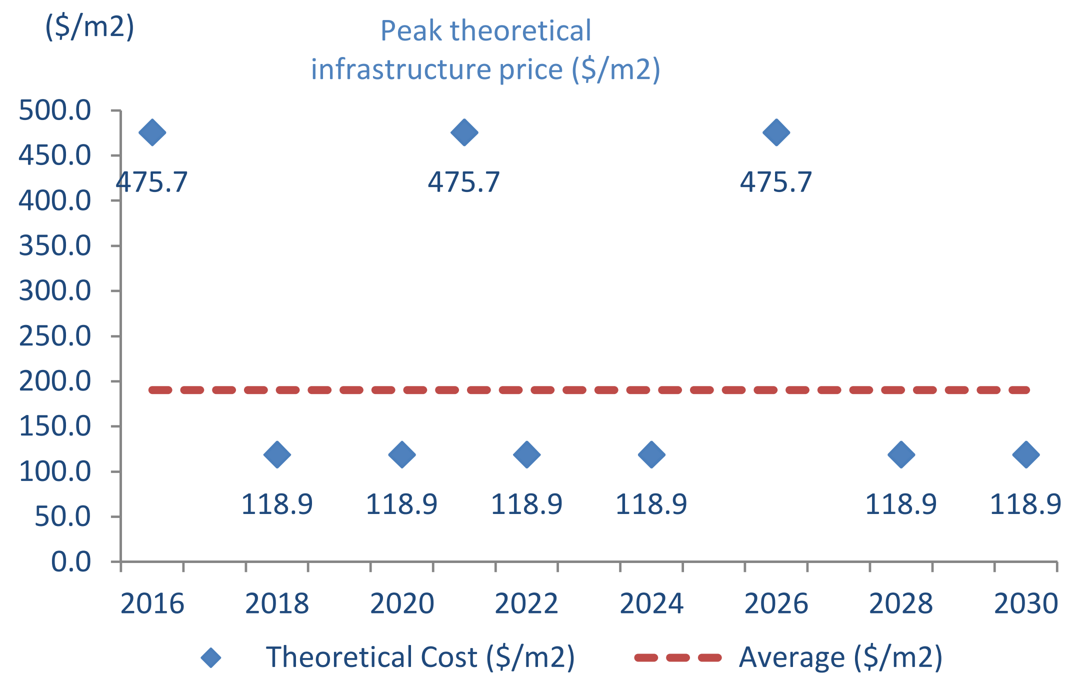
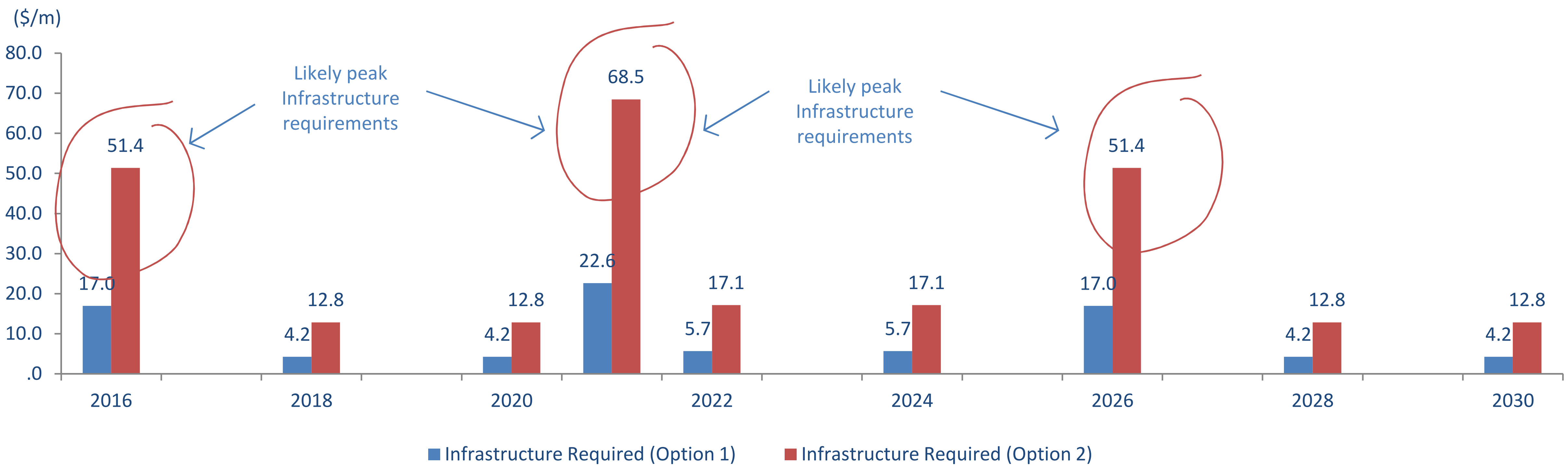
Executive Summary

Option 1



Option 2





Executive Summary

Municipal rates and charges

An increase in municipal rates may also generate additional value capture capable of funding shared local infrastructure improvements, such as stormwater drainage works and improvements to water infrastructure.

Private Investment

Whilst the extent of private investment appetite in major sustainability initiatives such as cogeneration and water recycling is unknown, it is likely such infrastructure will require direct investment, ownership and operation by private parties to be delivered.

It is acknowledged that cogeneration and recycling technologies have the potential to deliver long-term sustainability benefits for FBURA and provide long-term revenue streams through production and distribution networks.

Impacts on value uplift

Value uplift relating to land within FBURA will likely occur in stages in response to a range of factors, including the timing and cost of infrastructure to be delivered throughout FBURA.

The factors influencing future development within FBURA and associated theoretical land values (land value uplift) are many and varied – i.e. planning and policy measures; the type, quantum, timing and costs of infrastructure; investor and market appetite; access to development funding; developer profit and risk; physical and environmental constraints to the development of land; etc. This assessment focuses on delivery of utilities infrastructure holding all other factors constant.

The marginal cost of utilities infrastructure calculated on a per square metre basis (assuming a net developable area of 180ha) is between $63/m2 (Option 1) and $190/m2 (Option 2)

An examination of the impacts of changes in the sequencing of infrastructure indicates that bringing forward (or deferring infrastructure) by 1-2 years doesn't significantly impact on theoretical land values.

Deferring the timing of infrastructure delivery until at least 2020 does not change the total impact on theoretical land values, only the timing of the increase in line with deferred infrastructure.

Theoretical land values are likely to vary across different precincts within FBURA reflecting development sequencing as well as a range of market factors and large scale infrastructure items such as light rail extension into parts of FBURA.

The timing of infrastructure delivery impacts the estimated current value of infrastructure (i.e. net present value) with potential consequences for estimating the total cost recovery required in the future to partially (or wholly) offset utilities infrastructure costs.

Implementation

The sequencing of utilities infrastructure under either of these options will require inter-agency coordination to ensure efficient and timely delivery of wider infrastructure required within FBURA, particularly roads and rail infrastructure.

There are efficiencies in coordinated infrastructure roll-out and funding across the precinct and the requirements for such coordination need to be further examined.

Where the full cost of delivering utilities infrastructure is not fully funded by utilities providers, a range of alternative infrastructure funding mechanisms may be required to assist infrastructure delivery.

Contents

1 Introduction

1.1 Study Context

MacroPlan Dimasi (the Author) has been engaged as a sub-consultant to GHD to explore a range of funding mechanisms to deliver utilities infrastructure in Fishermans Bend Urban Renewal Area (FBURA); and prepare a financial analysis addressing various sequencing scenarios to assess peak infrastructure costs, governance issues and risks.

The outputs of this study will assist Places Victoria:

- Identify funding mechanisms capable of funding the total cost of utilities infrastructure and associated works to be delivered within FBURA;

- Assess the likely impacts of infrastructure on market and investment signals, development sequencing and timeframes for development across FBURA

1.2 Specific Tasks

The Author has been engaged to provide high level commentary in relation the following:

Task H – Funding Analysis

A funding analysis will be conducted to understand the range of available funding mechanisms (in accordance with both local and State Government public finance arrangements) that could be used for FBURA, including:

- Regulated Contributions to utility providers / asset owners
- Developer Contributions
- Infrastructure Recovery Charge
- Residential Infill levy
- Municipal rates and charges

Task I – Funding Analysis

Based on the funding analysis conducted in Task H and resource demand estimates presented in Task E, a financial analysis will be undertaken for the Preferred Integrated Servicing Strategy and BAU strategy for FBURA to determine the costs and benefits of the Preferred Integrated Strategy.

This will involve adopting a standard DCP approach using a DCF analysis addressing various sequencing scenarios to assess peak infrastructure costs, interagency governance arrangements and risks.

1.3 Structure of this Report

This report contains the following elements

- Part 2 outlines the characteristics of FBURA and the various development scenarios explored by Places Victoria; a high level interpretation of strengths, weaknesses, opportunities and threats relating to development at FBURA and the relevance of such factors for this assessment; and details of the Discussion Scenario.

- Part 3 describes the utilities infrastructure and costs associated with each item under two delivery scenarios.

- Part 4 analyses the capacity for a range of appropriate funding mechanisms which may provide theoretical value capture to facilitate utilities infrastructure items identified and the implications relating to each including high level commentary relating to implications of sensitivities (+/-) in development yield and consequences for total cost recovery potential .

- Part 5 discusses Places Victoria's preferred sequencing arrangements with respect to the Discussion Scenario and a high level interpretation of the sensitivity of theoretical land values to variations in infrastructure sequencing.

2 The Site

2.1 Overview

The Victorian State Government has nominated approximately 248 hectares of land located at Fishermans Bend in Melbourne Victoria as an urban renewal area.

Fishermans Bend Urban Renewal Area (FBURA) has been declared a site of State significance and rezoned as part of an expanded Capital City Zone (CCZ).

The rezoning expands the CCZ by more than 50 per cent and has the potential to generate significant new business investment and employment and new housing supply. It is expected to significantly contribute for future urban renewal and growth in Melbourne during the next 30+ years.

Places Victoria has defined a Discussion Scenario representing a preferred commercial development outcome reflecting both policy aspirations and market signals.

Table 1. Potential Scenarios

Scenario	Population (persons)	Dwellings (no.)	Commercial/ Retail GFA (sqm)	New jobs (no.)
Existing	*200*	*103*	-	-
Discussion Scenario	83,445	40,225	1,057,179	50,000

Source: Places Victoria 2013

2.2 Site Location, Size, Developable Precincts

Fishermans Bend is a locality within the City of Port Phillip and the City of Melbourne at the heart of Melbourne's $82 billion international trade gateway. Positioned immediately to the east of the West Gate Bridge, it is adjacent to the suburb of Port Melbourne and opposite Coode Island.

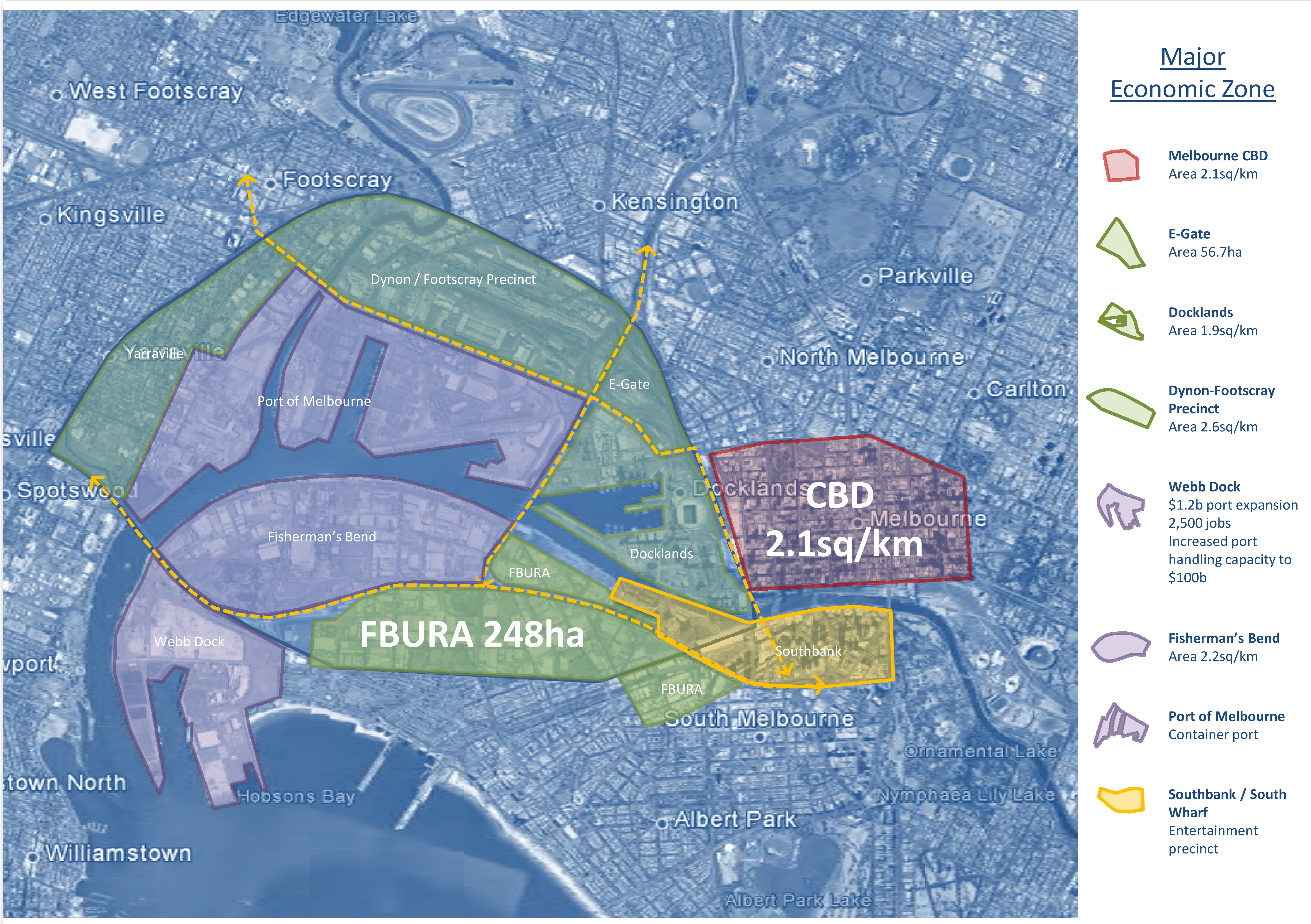
The 248 hectare Fishermans Bend Urban Renewal Area (FBURA) is located within Fishermans Bend and comprises up to six discrete precincts – Montague, Lorimer, Sandridge (north and south) and Wirraway (east and west). Three of the four precincts are located within the City of Port Phillip on the southern side of the Westgate Freeway, while Lorimer Precint is located within the City of Melbourne.

The net developable area of the FBURA is estimated at 180ha (Places Victoria), representing approximately 74% of the total land area on average.

An overview of each precinct is presented below.

Precinct	Land Area (ha)	Net Developable Area (ha)	% Net Developable Area	Reported Indicative 2012 Average Land Value ($/m2)
Montague	43	30	70%	$3,000-$3,500
Lorimer	27	25	93%	$850-$1,000
Sandridge north & south	85	67	79%	$800-$900
Wirraway east and west	89	58	65%	$800-$900
Total	**248**	**180**	**74%**	-

Source: CLUE, City of Port Phillip, Knight Frank 2012


Edgewater Lake
West Footscray
Footscray
Kingsville
Kensington
Parkville
Dynon / Footscray Precinct
North Melbourne
Carlton
Yarraville
Port of Melbourne
E-Gate
sville
Spotswood
Docklands
CBD
2.1sq/km
Melbourne
Fisherman's Bend
Docklands
FBURA
FBURA 248ha
Webb Dock
Southbank
FBURA
South Melbourne
town North
Hobsons Bay
Ornamental Lake
Nymphaea Lily Lake
Albert Park
Williamstown
Albert Park Lake
Major Economic Zone
Melbourne CBD
Area 2.1sq/km
E-Gate
Area 56.7ha
Docklands
Area 1.9sq/km
Dynon-Footscray Precinct
Area 2.6sq/km
Webb Dock
$1.2b port expansion
2,500 jobs
Increased port handling capacity to $100b
Fisherman's Bend
Area 2.2sq/km
Port of Melbourne
Container port
Southbank / South Wharf
Entertainment precinct

2 The Site

2.3 Discussion Scenario

Places Victoria has defined a Discussion Scenario for analysis purposes. The Discussion Scenario reflects an examination of three alternative long-term development and sequencing possibilities for FBURA.

The Author is aware this examination has revealed the most likely commercial development and delivery scenario involves total population in excess of 80,000 people, in excess of 40,000 dwellings, over 1 million m2 commercial/retail floor space and up to 50,000 new jobs.

The Discussion Scenario forms the basis of an examination of utilities infrastructure requirements for FBURA and associated cost estimates.

2.4 Key Points

The Author makes the following general remarks in relation to the discussion scenario.

- **Critical mass supporting future value capture** – the estimated total gross commercial/ retail floor area is in excess of 1 million m2, with the potential to generate significant value uplift for land owners, developers across all FBURA precincts during coming decades. This will facilitate future capacity for cost-recovery across the FBURA precinct.
- **Multiple development fronts required** – the projected growth in resident population, local employment and additional floorspace requirements within FBURA indicates the potential for (and indeed a need for) multiple development fronts capable of delivering sustainable development across FBURA. This will have implications for the sequencing of utilities infrastructure and other infrastructure such as transport and main roads. This will require coordination among a number of planning, policy and infrastructure authorities to ensure effective long-term development outcomes.
- **Infrastructure catalyst to investment** – development is mostly likely to occur in accordance with the delivery of infrastructure and services, such as utilities, main roads and transport infrastructure. This means the timing of infrastructure will be an important catalyst for investment and generate 'critical mass' within key commercial nodes capable of supporting a diverse mix of activities and users.

3 Utilities Infrastructure and Costs

3.1 Overview

Cost estimates associated with the utilities infrastructure identified by GHD have been provided by WT Partnership. The cost estimates provided are based on GHD Fishermans Bend Infrastructure Plan Revision A and sequencing requirements as at 28 May 2013.

Cost estimates for utilities infrastructure have been provided in relation to two separate development scenarios, namely a traditional implementation method reflecting a 'business as usual' approach and an alternative scenario reflecting the use of new technologies including renewable energy and water options.

Option 1 – Business As Usual (BAU)

Under this scenario services are provided to the region in the same format and style that is the current business practice.

Option 2 – Integrated Infrastructure Plan

Under this scenario latest technology related to the provision of utilities to an area is implemented. This includes co-generation whereby a gas powered energy plant produces electricity and heated water to the FBURA. The electricity produced is supplied back into the power grid, and the heat produced is used in buildings in the region.

Sequencing of Utility Infrastructure Development

Indicative sequencing for the delivery of utility infrastructure has been provided by GHD in consultation with Places Vic. This sequencing has infrastructure development not commencing before 2015, with the implementation being rolled out over the following 30+ years in a staggered format.

3.2 Basis of Cost Estimates (Inclusions/Exclusions)

Cost estimates provided by WT Partnership include provision of the following utilities:

- Recycled Water
- Potable Water
- Sewerage System
- Stormwater Upgrades
- Electrical System Upgrades
- Gas System Reticulation
- Cogeneration System
- Sewer Heat Recovery System
- Telecommunication
- Preliminaries & Supervision
- Project Margin
- Consultants Fees
- Design Development Contingency
- Construction Contingency

WT Partnership highlight a number of exclusions in their report, including the absence of escalation in the cost estimates provide. The Author has allowed for escalation of the total cost of infrastructure at a rate of 3.5% compounded annually (as discussed with WT Partnership) for discounting purposes.

The type of funding mechanism used will be influenced by the timing of delivery/provision of infrastructure to the region, and in several cases will be best placed to be undertaken in conjunction with transport (road, rail, light rail, trams etc) and community facilities.

3.3 Option 1 – Business As Usual (BAU)

In the Business as Usual scenario is expected to be completed using current technologies and capabilities. The budget estimate for Option 1 as at 30 May 2013 is **$113,000,000** excluding GST.

Budget Estimation (excl GST), Option 1, 30 May 2013

Option 1 Business As Usual		Unit	Quantity	Rate	Cost ($)
1	Potable Water				34,582,650
2	Sewerage System				4,894,110
3	Stormwater Upgrades				6,926,200
4	Electrical System Upgrades				15,024,830
5	Gas System Reticulation				5,970,360
6	Telecommunication				3,702,275
	Sub-total Trade Works				***71,100,425***
7	Preliminaries & Supervision	%	8%	71,100,425	5,690,000
8	Project Margin	%	5%	72,930,425	3,840,000
	Total Construction Costs				**80,630,425**
9	Consultants Fees	%	8%	76,580,425	6,460,000
10	Design Development Contingency	%	15%	76,580,425	12,100,000
11	Construction Contingency	%	15%	88,070,425	13,809,575
	Sub-Total on Costs				***32,369,575***
	Total Design and Construction Budget				**113,000,000**

Source: WT Partnership FBURA Infrastructure Works Budget Estimation (30 May 2013)

3.4 Option 2 - Integrated Infrastructure Plan

The Integrated Infrastructure Plan option for development prepared by WT Partnership uses a combination of current technologies and best practice technologies available. The budget estimate for Option 2 as at 30 May 2013 is **$342,500,000** excluding GST.

The Integrated Infrastructure Plan option includes two items that add significant cost to the delivery of the option, including recycled water and a cogeneration system – each of which will deliver long-term sustainability benefits for FBURA.

Budget Estimation (excl GST), Option 2, 30 May 2013

Option 2 Integrated Infrastructure Plan		Unit	Quantity	Rate	Cost ($)
1	Recycled Water				45,401,030
2	Potable Water				5,957,750
3	Sewerage System				4,894,110
4	Stormwater Upgrades				6,926,200
5	Electrical System Upgrades				15,024,830
6	Gas System Reticulation				5,970,360
7	Cogeneration System				125,681,600
8	Sewer Heat Recovery System				1,877,000
9	Telecommunication				3,702,275
	Sub-total Trade Works				***215,435,155***
10	Preliminaries & Supervision	%	8%	215,435,155	17,240,000
11	Project Margin	%	5%	232,675,155	11,640,000
	Total Construction Costs				**244,315,155**
12	Consultants Fees	%	8%	244,315,155	19,550,000
13	Design Development Contingency	%	15%	244,315,155	36,650,000
14	Construction Contingency	%	15%	280,965,155	41,984,845
	Sub-Total on Costs				***98,184,845***
	Total Design and Construction Budget				**342,500,000**

Source: WT Partnership FBURA Infrastructure Works Budget Estimation (30 May 2013)

4 Funding Options Analysis

4.1 Overview

The rezoning of the FBURA to the Capital City Zone resulted in a significant increase in property values throughout the precinct, due to the future development potential of privately held land being significantly enhanced.

This value uplift creates the opportunity for funding of required upgrades and new infrastructure through a ‘value capture’ mechanism.

Funding of utilities infrastructure is a small component of infrastructure works required to enable urban development (renewal) to occur within Fishermans Bend.

A number of avenues exist for the collection of funds by Government and Servicing Authorities to deliver the infrastructure required by the precinct in order for the significant increase in development density and land use change to occur.

The funding mechanisms selected for examination in this paper are:

- Regulated Contributions to utility providers / asset owners
- Developer Contributions
- Infrastructure Recovery Charge (IRC)
- Residential infill levy
- Municipal rates and charges
- Private investment

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4 Funding Options Analysis

4.2 Regulated Contributions to utility providers / asset owners

Overview

Providers of utilities typically seek contributions for infrastructure in the form of an up-front capital contribution (or works in kind) and/or in the form of infrastructure payments (charges). This process may apply in relation to the provision of new and/or upgraded infrastructure items relating to a variety of utilities infrastructure needs including drainage, water, stormwater, sewerage, gas, electricity and telecommunications. Whist developer contributions are typically fixed for open space, transport, contributions sought for utilities may be negotiated and the formula for determining up-front and staged infrastructure contributions is ambiguous.

In instances where utilities infrastructure is planned and funds are available, owners of utilities networks will generally take responsibility for delivering such infrastructure and may recover such costs from users over time.

Where such infrastructure is not planned or funding is not available, contributions from land-owners/developers may be sought to cover infrastructure costs. The amount of the contribution sought (either in the form of an up-front capital contribution or through staged infrastructure payments) is subject to a number of variables including a process of negotiation between utilities providers and individual land-owners / developers.

In the case of Greenfield developments, upfront infrastructure requirements tend to be funded in stages by developers in accordance with an infrastructure delivery program and a defined sequence of development. Where Greenfield development occurs out of sequence, individual developers may elect to fund part or all of the up-front infrastructure required themselves to facilitate development, with the option to recover this cost from utilities providers.

Whilst the principles of Greenfield development typically apply to infill development, there are a number of complexities in the case of FBURA.

Key Issues

It is not apparent whether the relevant utilities providers (water, gas, electricity, telecommunications) have the required funding available to deliver new and upgraded infrastructure up-front, or the extent to which a share of proposed utilities infrastructure may be funded up-front in accordance with the suggested delivery timetable.

There are obviously a large number of individual land owners within FBURA and potential development fronts across multiple precincts – presenting challenges for utilities providers in coordinating up-front contributions in involving a negotiated process.

It is not apparent which land owners/developers might elect to undertake development in the immediate-term and which will defer development, with implications for the sequence of infrastructure contributions and ultimately the timing of development more widely across the precinct.

Whilst there are a number of large individual land owners located in precincts such as Wirraway and Sandridge, it is not clear the extent to which such groups will elect to fund a large share of enabling infrastructure works involving a potential requirement to recover this cost from utilities providers over time.

A number of different infrastructure delivery agencies including State Government and Councils will be involved in coordinating both the physical requirements as well as statutory and financial requirements supporting orderly roll-out of various infrastructure types. This process in itself will require significant further investigation to ensure effective and timely infrastructure coordination.

4 Funding Options Analysis

Peak Funding Assessment

In light of the above, it is difficult to accurately calculate what proportion of utilities infrastructure would realistically be funded up-front by utilities providers or by developers (potentially in negotiation with relevant municipal Councils). It is not known what proportion of the cost would be recovered generally through staged contributions involving a cost recovery plan. This reflects the Author's own discussions with various industry stakeholders including the utilities networks and developers.

Upfront capital and whole-of-life contributions are likely to be sought from utilities providers in relation to each of the infrastructure items identified in Option 1 and some of the items under Option 2.

- The marginal cost of utilities infrastructure calculated on a per square metre basis (assuming a net developable area of 180ha) is estimated at approx $63/m2 (Option 1) – peaking at a theoretical cost of $156/m2 during each of the years 2016, 2021 and 2026 and averaging around $40/m2 in each other year. This means there is a high possibility of a net funding short-fall in peak periods requiring up-front contributions from developers which may be recouped during later years.

- The marginal cost of utilities infrastructure calculated on a per square metre basis is estimated at approx $190/m2 (Option 2) – peaking at a theoretical cost of $475/m2 during each of the years 2016, 2021 and 2026 and averaging around $119/m2 in each other year. As in Option 1, this means there is a very high possibility of a net funding short-fall in peak periods requiring up-front contributions from developers which may be recouped during later years.

The cost of recycled water infrastructure, sewer heat recovery and cogeneration systems are not items that would be typically delivered by utilities providers and would be the subject of a separate funding mechanism.

Option 1

Item	Infrastructure cost ($Nominal)	Other costs pro-rated ($Nominal)	Total Cost ($ Nominal)	Marginal Proportional Cost ($ Nominal /m2)
Potable Water	34,582,650	20,379,602	54,962,252	30.5
Sewerage System	4,894,110	2,884,106	7,778,216	4.3
Stormwater Upgrades	6,926,200	4,081,619	11,007,819	6.1
Electrical System Upgrades	15,024,830	8,854,152	23,878,982	13.3
Gas System Reticulation	5,970,360	3,518,341	9,488,701	5.3
Telecommunication	3,702,275	2,181,756	5,884,031	3.3
Total	**71,100,425**	**41,899,575**	**113,000,000**	62.8

Option 2

Item	Infrastructure cost ($Nominal)	Other costs pro-rated ($Nominal)	Total Cost ($ Nominal)	Marginal Proportional Cost ($ Nominal /m2)
Recycled Water	45,401,030	26,777,778	72,178,808	40.1
Potable Water	5,957,750	3,513,914	9,471,664	5.3
Sewerage System	4,894,110	2,886,573	7,780,683	4.3
Stormwater Upgrades	6,926,200	4,085,111	11,011,311	6.1
Electrical System Upgrades	15,024,830	8,861,728	23,886,558	13.3
Gas System Reticulation	5,970,360	3,521,351	9,491,711	5.3
Cogeneration System	125,681,600	74,127,702	199,809,302	111.0
Sewer Heat Recovery System	1,877,000	1,107,065	2,984,065	1.7
Telecommunication	3,702,275	2,183,622	5,885,897	3.3
Total	**215,435,155**	**127,064,845**	**342,500,000**	190.3

Source: WT Partnership FBURA Infrastructure Works Budget Estimation (30 May 2013)

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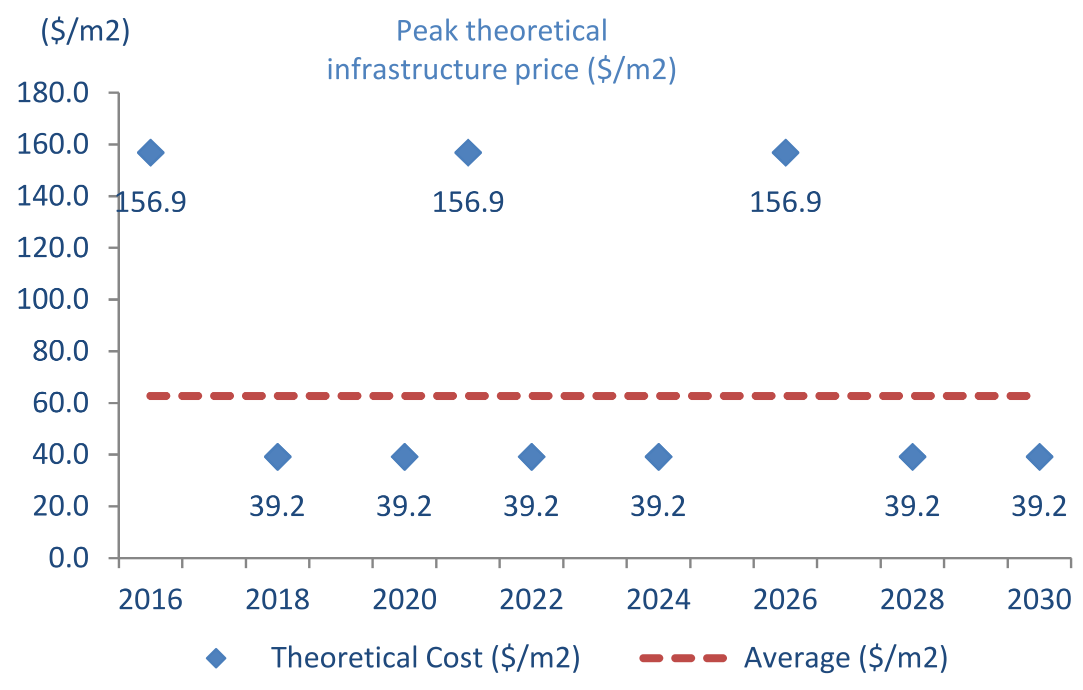
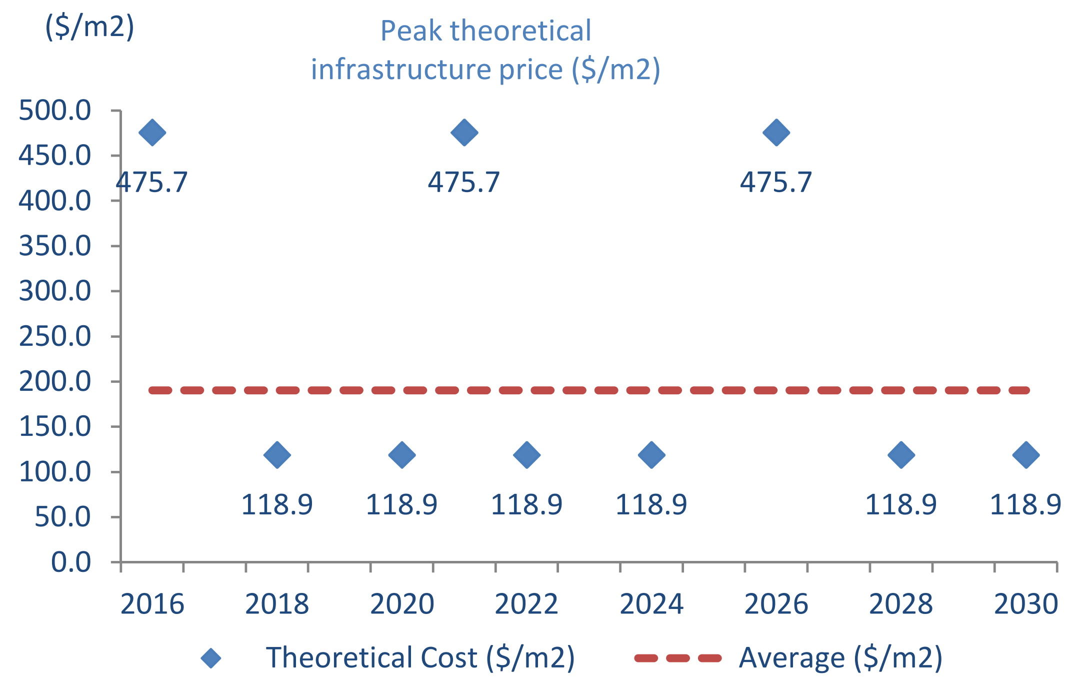
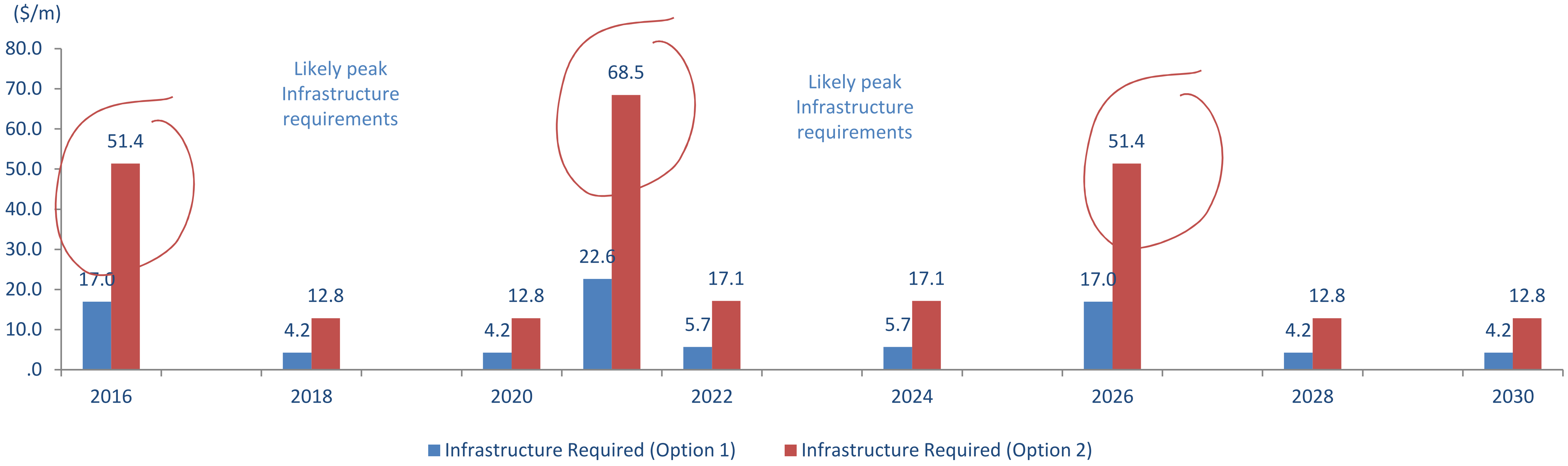
4 Funding Options Analysis

Option 1



Option 2





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4 Funding Options Analysis

4.3 Developer Contributions

Overview

Developer contributions are payments (or in-kind works, facilities or services) for infrastructure required to facilitate orderly development. Contributions for infrastructure works are typically negotiated with infrastructure providers. Contributions by developers/land-owners may be made in the form of:

- Negotiated up-front capital contributions or works in kind; and/or
- Staged payments over time

The Minister for Planning recently announced a new framework for the application of development contributions in Victoria as set out in A New Victorian Local Development Contributions System – 'A Preferred Way Forward'. The new framework proposes a combination of standard contributions based around five infrastructure categories:

- Community facilities (fixed levy)
- Open space facilities (fixed levy)
- Transport infrastructure (variable levy)
- Drainage infrastructure (variable levy); and
- Public land (variable levy).

The new framework proposes the use of pre-determined standard levies, which could be imposed on new development in growth areas, regional settlements, rural settlements, established areas and strategic redevelopment sites.

Comments

According to the new framework, a Standard Levy is proposed as the default in each development setting, but with the opportunity to apply a tailored Development Levy Scheme (in Growth Areas and Large Scale Strategic Development Areas) if strategically justified such as FUBRA.

A Standard Levy will be applied per dwelling for Urban Areas and Strategic Development Areas in both a metropolitan and non-metropolitan context. It is proposed that different levies be set for residential and non residential development in these areas to provide flexibility and equality.

Whilst a levy mechanism applied to FBURA would certainly provide for future cost recovery, it is not entirely clear what levy amount might reasonably be applied to the recover costs relating to utilities infrastructure, particularly those utilising new technologies.

The application of such a mechanism is examined at a high level below and is something for further careful examination by DCPD in collaboration infrastructure providers and the development industry.

4 Funding Options Analysis

Cash-flow assessment

For the purposes of this analysis, the indicative sequence of delivery for utilities infrastructure is outlined below:

- Year 2013-2015: 0% (of the total estimated cost) – meaning no new or upgrade utilities infrastructure is provided
- 2016-2020: 30%, half of which is to be injected in the first year, i.e. 2016 – potentially requiring an up-front capital contribution (either from developers or other sources) together with staged infrastructure contributions
- 2021-2025: 40%, half of which is to be injected in the first year, i.e. 2021 – potentially requiring further up-front capital contributions (most likely from developers) to be complemented by staged infrastructure contributions
- 2026-2030: 30%, half of which is to be injected in the first year, i.e. 2026 – further contributions from developers as required

As there is no clear direct or readily measureable relationship between infrastructure delivery and the sequencing of land developments, the Author has made the following assumptions relating to the timing of development of land serviced by utilities infrastructure:

- Year 2013-2015: 0% (reflecting limited initial development activity)
- Year 2016-2020: 30% of land serviced, or 6% each year
- Year 2021-2025: 40% of land serviced, or 8% each year
- Year 2026-2030: 30% of land serviced, or 6% each year

The most recent Pre-Budget submission prepared by the Property Council of Australia (PCA) on the 31 January 2013 stated that development contributions typically range from $22.50/m2 - $27.5/m2 in development areas, averaging a cost of around $20,000 per Greenfield lot in Victoria.

The first two tables on the following page shows the application of a 'one-off flat-rate development' contribution charged at rates of $15/m2, $20/m2 and $25/m2 annually for developable land activated in accordance with the staging plan above.

Whilst a portion of the total nominal contribution may be required up-front as part of a negotiated arrangement, it is clear that adopting a standard benchmark rate applying to Greenfield development will deliver between 31% and 51% of the nominal utilities infrastructure cost under Option 1.

At $20-$25/m2, this is almost equivalent to the cost of delivering the potable water utilities infrastructure or a combination of sewerage, stormwater, gas, electrical and telecommunications systems. The funding gap is significantly higher under Option 2.

This raises questions in relation to the capacity for one-off flat-rate annual development contributions to fund large portions of utilities infrastructure up front; and whether utilities providers and developers might be willing to negotiate higher development contributions, either through more significant up-front capital/works contributions or payment of higher marginal charges at stages of the development horizon.

Further information relating to the application of development contributions under the new DCP framework, including a discussion of the short-comings and limitations of the application of such a scheme to infrastructure is provided in a separate study titled *Fishermans Bend Urban Renewal Area Funding Options Paper*, PwC April 2013.

A sensitivity analysis is provided in the following pages showing both (+/-) impacts on net developable area assuming all other variables remain the same.

4 Funding Options Analysis

Option 1 Assuming annual growth in the contribution rate of 3.5% p.a.

Contribution Rate*	Nominal Contributions recovered ($) 2016-2020	Nominal Contributions recovered ($) 2021-2025	Nominal Contributions recovered ($) 2026-2030	Total Nominal Contributions ($)	Total Infrastructure Required ($m)	Share of Total Nominal Infrastructure Cost ($)	Estimated Nominal funding Gap ($)
$15.0/m2	8,687,195	13,756,883	12,254,146	**34,698,224**	$113m	31%	-78,301,776
$20.0/m2	11,582,926	18,342,511	16,338,861	**46,264,298**		41%	-66,735,702
$25.0/m2	14,478,658	22,928,138	20,423,577	**57,830,373**		51%	-55,169,627

Option 2 Assuming annual growth in the contribution rate of 3.5% p.a.

Contribution Rate*	Nominal Contributions recovered ($) 2016-2020	Nominal Contributions recovered ($) 2021-2025	Nominal Contributions recovered ($) 2026-2030	Total Nominal Contributions ($)	Total Infrastructure Required ($m)	Share of Total Nominal Infrastructure Cost ($)	Estimated Nominal funding Gap ($)
$15.0/m2	8,687,195	9,632,597	10,611,089	**34,698,224**	$342.5m	10%	-307,801,776
$20.0/m2	11,582,926	12,843,463	14,148,118	**46,264,298**		14%	-296,235,702
$25.0/m2	14,478,658	16,054,329	17,685,148	**57,830,373**		17%	-284,669,627

Source: WT Partnership, MacroPlan Dimasi 2013

Source: MacroPlan Dimasi 2013

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4 Funding Options Analysis

Sensitivity Analysis (+15% net developable area)

A 15% increase in the net developable area to 2,070,000 m2 (assuming all other factors remain unchanged) will deliver between 35% ($15/m2) and 59% ($25/m2) of the nominal utilities infrastructure cost under Option 1.

The funding gap is slightly improved under Option 2, delivering between 12% ($15/m2) and 19% ($25/m2) of the nominal utilities infrastructure cost under this option.

Option 1 Assuming annual growth in the contribution rate of 3.5% p.a. (allowing for 15% increase in net developable area)

Contribution Rate	Nominal Contributions recovered ($) 2016-2020	Nominal Contributions recovered ($) 2021-2025	Nominal Contributions recovered ($) 2026-2030	Total Nominal Contributions ($)	Total Infrastructure Required ($m)	Share of Total Nominal Infrastructure Cost ($)	Estimated Nominal funding Gap ($)
$15.0/m2	9,990,274	15,820,415	14,092,268	**39,902,957**		35%	-73,097,043
$20.0/m2	13,320,365	21,093,887	18,789,691	**53,203,943**	$113m	47%	-59,796,057
$25.0/m2	16,650,457	26,367,359	23,487,113	**66,504,929**		59%	-46,495,071

Option 2 Assuming annual growth in the contribution rate of 3.5% p.a. (allowing for 15% increase in net developable area)

Contribution Rate	Nominal Contributions recovered ($) 2016-2020	Nominal Contributions recovered ($) 2021-2025	Nominal Contributions recovered ($) 2026-2030	Total Nominal Contributions ($)	Total Infrastructure Required ($m)	Share of Total Nominal Infrastructure Cost ($)	Estimated Nominal funding Gap ($)
$15.0/m2	9,990,274	15,820,415	14,092,268	**39,902,957**		12%	-302,597,043
$20.0/m2	13,320,365	21,093,887	18,789,691	**53,203,943**	$342.5m	16%	-289,296,057
$25.0/m2	16,650,457	26,367,359	23,487,113	**66,504,929**		19%	-275,995,071

Source: WT Partnership, MacroPlan Dimasi 2013

4 Funding Options Analysis

Sensitivity Analysis (-15% net developable area)

A 15% decrease in in the net developable area to 1,530,000 m2 GFA (assuming all other factors remain unchanged) will deliver between 26% ($15/m2) and 44% ($25/m2) of the nominal utilities infrastructure cost under Option 1.

The funding gap is worse under Option 2, delivering between 9% ($15/m2) and 14% ($25/m2) of the nominal utilities infrastructure cost under this option.

Option 1 Assuming annual growth in the contribution rate of 3.5% p.a. (allowing for 15% decrease in net developable area)

Contribution Rate	Nominal Contributions recovered ($) 2016-2020	Nominal Contributions recovered ($) 2021-2025	Nominal Contributions recovered ($) 2026-2030	Total Nominal Contributions ($)	Total Infrastructure Required ($m)	Share of Total Nominal Infrastructure Cost ($)	Estimated Nominal funding Gap ($)
$15.0/m2	7,384,116	11,693,350	10,416,024	**29,493,490**	$113m	26%	-83,506,510
$20.0/m2	9,845,487	15,591,134	13,888,032	**39,324,654**		35%	-73,675,346
$25.0/m2	12,306,859	19,488,917	17,360,040	**49,155,817**		44%	-63,844,183

Option 2 Assuming annual growth in the contribution rate of 3.5% p.a. (allowing for 15% decrease in net developable areaeld)

Contribution Rate	Nominal Contributions recovered ($) 2016-2020	Nominal Contributions recovered ($) 2021-2025	Nominal Contributions recovered ($) 2026-2030	Total Nominal Contributions ($)	Total Infrastructure Required ($m)	Share of Total Nominal Infrastructure Cost ($)	Estimated Nominal funding Gap ($)
$15.0/m2	7,384,116	11,693,350	10,416,024	**29,493,490**	$342.5m	9%	-313,006,510
$20.0/m2	9,845,487	15,591,134	13,888,032	**39,324,654**		11%	-303,175,346
$25.0/m2	12,306,859	19,488,917	17,360,040	**49,155,817**		14%	-293,344,183

Source: WT Partnership, MacroPlan Dimasi 2013

4.4 Infrastructure Recovery Charge (IRC)

Overview

An Infrastructure Recovery Charge (IRC) can be levied on developers up to 10% of development value in designated Urban Renewal Areas under the Urban Renewal Act. The Discussion Scenario provides for approx 1,053,180m2 gross developable commercial/retail floor space and 40,225 dwellings. The following assessment applies to commercial/retail developments and excludes residential development, which is the subject of a separate examination in the next section involving an infill levy.

Item	2015-2020	2020-2025	2025-2040
Montague	14.7%	41%	44.3%
Sandridge North	6.7%	34.1%	59.2%
Sandridge South	4.8%	26.3%	68.9%
Lorimer	3.7%	7.4%	88.9%
Wirraway East	7.8%	52.9%	39.3%
Wirraway West	4.9%	19.3%	75.8%

Source: Places Victoria Discussion Scenario

Financial Analysis

Further the purposes of analysis, the Author has referred to the Discussion Scenario development profiles (above) for each precinct.

The development profiles assume that on average up to 7% of total commercial/retail developable floor area occurs during the period 2015-2020, with 30% occurring during the period 2020-2025 and the balance occurring thereafter to 2040.

The above development profiles are applied to the total amount of commercial/retail floor space delivered during the periods 2015-2020, 2021-2025, 2026-2030.

Application of a 10% IRC to commercial/retail development value assuming normal development costs (including escalation) has the potential to generate $18m during the period 2015-2020, $95m during the period 2021-2025, and up to $260m during the period 2026-2030. This assessment excludes residential development, which is the subject of a separate examination in the next section involving a levy.

Item	2016-2020	2021-2025	2026-2030
Average Rate of Development Profile	7.00%	30%	50%
Estimated value of IRC (@5%)	$9m	$47m	$130m
Estimated value of IRC (@10%)	$18m	$95m	$260m

Source: MacroPlan Dimasi 2013

Interpretation

This demonstrates that an infrastructure cost recovery mechanism linked to the volume and value of development will generate significantly higher potential for cost recovery in the future, reflecting staged patterns of development across the various precincts. Where residential development values are also subject to an IRC, the total value of cost recovery would increase significantly.

Specific details pertaining to the application of an IRC including tests relating to efficiency, equity, need and nexus would need subject to further examination by Places Victoria.

4 Funding Options Analysis

Sensitivity Analysis (+15% residential development yield)

A 15% increase in the volume of commercial/retail floor space delivered to 1,211,157 m2 GFA (assuming all other factors remain unchanged) results in the following:

- At 5% - $11m during the period 2015-2020, $55m during the period 2021-2025, and up to $150m during the period 2026-2030.
- At 10% - $24m during the period 2015-2020, $125m during the period 2021-2025, and up to $350m during the period 2026-2030.

Item	2016-2020	2021-2025	2026-2030
Estimated value of IRC (@5%)	$11m	$55m	$151m
Estimated value of IRC (@10%)	$24m	$125m	$348m

Source: MacroPlan Dimasi 2013

Sensitivity Analysis (-15% residential development yield)

A 15% decrease in the volume of commercial/retail floor space delivered to 895,050 m2 GFA (assuming all other factors remain unchanged) results in the following:

- At 5% - $7.8m during the period 2015-2020, $40m during the period 2021-2025, and $112m during the period 2026-2030.
- At 10% - $13m during the period 2015-2020, $68m during the period 2021-2025, and up to $190m during the period 2026-2030.

Item	2016-2020	2021-2025	2026-2030
Estimated value of IRC (@5%)	$7.8m	$40m	$112m
Estimated value of IRC (@10%)	$13m	$68m	$190m

Source: MacroPlan Dimasi 2013

4 Funding Options Analysis

4.5 Residential Infill Levy

Overview

An infill levy or residential developer contribution might be applied to all residential dwellings across FBURA to fund precinct-wide infrastructure improvements such as recycled water, cogeneration and sewer heat recovery systems.

The levy would need to be set at a level that is deemed to be affordable, equitable and efficient with a clear nexus between beneficiaries and infrastructure.

Such a mechanism could be applied during the periods 2015-2020, 2021-2025, 2026-2030.

Item	Levy Per dwelling	Density dwellings per hectare
Recent Growth Area precedents	$5,000-$17,000	8-19
FBURA Forecasts		
Standard Levy	$9,600	
Scenario A 100% DCP	$13,000	74
Scenario B 100% DCP	$15,500	147
Scenario C 100% DCP	$13,500	294
Discussion Scenario	$17,663	276

Source: Property Council of Australia, Urban Enterprise March 2011, Places Victoria

Financial Analysis

Further the purposes of analysis, the Author has referred to the Discussion Scenario development profiles (above) for each precinct. The development profiles assume that on average up to 7% of total residential developable floor area occurs during the period 2015-202, with 30% occurring during the period 2020-2025 and the balance occurring thereafter to 2040.

Application of a $10,000 residential levy per dwelling during the development horizon has the potential to generate up to $30m during the period 2015-2020, $120m during the period 2021-2025, and up to $200m during the period 2026-2030.

Item	2016-2020	2021-2025	2026-2030
Approx. No. Dwellings	2,800	12,000	20,000
Estimated value of levy (@ $5,000 per dwelling)	$15m	$60m	$100m
Estimated value of levy (@ $10,000 per dwelling)	$30m	$120m	$200m

Source: MacroPlan Dimasi 2013

Interpretation

As per the IRC, this demonstrates that a residential levy mechanism linked to the volume of residential infill development will generate significantly higher potential for cost recovery in the future, reflecting staged patterns of development across the various precincts.

Specific details pertaining to the application of an infill levy including tests relating to efficiency, equity, need and nexus would need subject to further examination by Places Victoria.

4 Funding Options Analysis

Sensitivity Analysis (+15% residential development yield)

A 15% increase in the volume of residential development lots delivered to 46,259 lots (assuming all other factors remain unchanged) results in the following:

- At $5,000 - $16m during the period 2015-2020, $70m during the period 2021-2025, and up to $115m during the period 2026-2030.
- At 10,000 - $32m during the period 2015-2020, $140m during the period 2021-2025, and up to $230m during the period 2026-2030.

Item	2016-2020	2021-2025	2026-2030
Estimated value of IRC (@$5,000 / dwelling)	$16m	$70m	$115m
Estimated value of IRC (@10,000 / dwelling)	$32m	$140m	$230m

Source: MacroPlan Dimasi 2013

Sensitivity Analysis (-15% residential development yield)

A 15% decrease in the volume of residential development lots delivered to 34,191 lots (assuming all other factors remain unchanged) results in the following:

- At $5,000 - $12m during the period 2015-2020, $50m during the period 2021-2025, and $85m during the period 2026-2030.
- At 10,000 - $24m during the period 2015-2020, $100m during the period 2021-2025, and up to $170m during the period 2026-2030.

Item	2016-2020	2021-2025	2026-2030
Estimated value of IRC (@$5,000 / dwelling)	$12m	$50m	$85m
Estimated value of IRC (@10,000 / dwelling)	$24m	$100m	$170m

Source: MacroPlan Dimasi 2013

4 Funding Options Analysis

4.6 Municipal Rates

Overview

This section describes a simple infrastructure funding mechanism which may be explored in the context of funding precinct-wide infrastructure improvements such as recycled water, cogeneration and sewer heat recovery systems.

Both City of Melbourne and City of Port Philip Council use the Net Annual Value (NAV) of all properties within the municipal area as the basis of valuation for rating purposes. The NAV approximates the annual net rental for a commercial property and approximately five per cent of the capital improved value for a residential property.

The mechanism explored in this study involves a 20-30 per cent increase in the rate in the dollar applied to the NAV for all properties located within FBURA. In 2012, municipal rates were charged at a rate of 3.8445 cents per dollar against the NAV in the City of Port Philip. The following scenario analysis has been applied to precincts located within the City of Port Philip and is not applied to Lorimer which is located within the City of Melbourne.

Financial Analysis

A flat 25 per cent increase in the rate in the dollar currently applied to all properties located within Montague, Sandridge and Wirraway precincts has the potential to generate approx $18.6million^ in additional rate revenue over 20 years in NPV terms.

A flat 30 per cent increase in the current rate in the dollar over 20 years generates approx $22.3million^ in additional revenue during this period in NPV terms.

Note: ^ These estimates assume an increase in average land values (i.e. NAV used for valuation purposes) of 3.5 times during the 20 year assessment period which is not unrealistic for the FBURA area

Timing of Value Capture	Required Increase in rate in the dollar applied to NAV		
	25%	30%	50%
10 Years	$5.0m	$6.0m	$10.0m
15 Years	$11.0m	$13.2m	$22.0m
20 Years	$18.6m	$22.3m	$37.2m

Source: MacroPlan Dimasi 2013

Key Issues

The suggested funding mechanism has the following characteristics:

- Immediacy – this arrangement presents a clear and transparent infrastructure program which can be applied now.
- Market certainty – this arrangement provides certainty for land owners who currently pay rates and does not involve new legislation, policy or instruments to take effect.
- Tax efficient – this arrangement allows for a level of pass-through to commercial tenants (via rents) and is therefore tax deductable.
- Nexus – this arrangement maintains nexus to the development which triggers the mechanism
- Relatively equitable and efficient – this arrangement has the potential to addresses current gaps in the *Development Contributions System* (currently subject to review).

Interpretation

The suggested funding mechanism has the potential to generate a contribution to the total cost of delivering new technologies capable of achieving long-term sustainability benefits for the precinct.

The total value of additional revenue generated may increase (or decrease) in all scenarios depending on the likely future increase in the value of properties located within FBURA.

4 Funding Options Analysis

4.7 Private Investment

Overview

The extent of public or private investment appetite in major sustainability initiatives to be located within FBURA, such as cogeneration and water recycling is unknown.

Key Comments

The Author makes the following general observations:

- Timing – cogeneration and water recycling infrastructure is unlikely to be required during the initial phases of development in FBURA and more likely to be delivered during the period after 2020-2025.
- Public investment/partnerships – it is unlikely such infrastructure would be publicly funded in its entirety; whilst there may be some potential for a public private partnership (PPP) arrangement, any publicly funded element would likely involve deferred funding during the life of the asset.
- Private investment, ownership and operation - significant private investment in such infrastructure will be required to ensure timely delivery to ensure roll-out, utilisation, ownership and long-term operation of such sustainability assets.
- Long-term revenue potential – it is acknowledged that cogeneration may provide for long-term revenue streams through progressive use and distribution of such technologies within FBURA and possible distribution of energy through the national electricity network. It is likely that water recycling technologies will deliver localised benefits within FBURA and surrounding areas but not on regional basis.
- Sustainability benefits – the proposed technologies have the potential to deliver long-term sustainability benefits within FBURA and more broadly through demonstration of the benefits of such technologies.

4.8 Summary

There is more than sufficient capacity for cost recovery to fund proposed new and upgraded utilities infrastructure under both options during the period 2016-2030. Each option may be funded through all or a combination of mechanisms explored in this paper, including a Standard Levy (DCP), Infrastructure Recovery Charge (IRC), Residential Infill Levy, municipal rates and charges and private investment.

- The estimated nominal amount of value recovered through a Standard Levy (DCP) ($45m-$60m), Infrastructure Recovery Charge ($185m-$370m) and Residential Infill Levy ($175m-$350m) during the period 2016-2030. This is more than the total nominal amount required to fund utilities infrastructure under each of the proposed options during this time.
- During the period 2016-2020, the suite of mechanisms above is capable of delivering $37m-$65m, which is broadly equivalent to the total utilities infrastructure cost of $34m under Option 1. The total utilities cost under option to is approx $40m-$70m higher than total cost recovery during this timeframe. This gap relates to cogeneration and recycled water systems which may not be delivered until after 2020 and will likely require significant up-front private investment resulting in long-term sustainability value for FBURA and potential private investment returns.

An increase in municipal rates may also generate additional value capture capable of funding shared local infrastructure improvements, such as stormwater drainage works and improvements to water infrastructure.

Whilst the extent of private investment appetite in major sustainability initiatives such as cogeneration and water recycling is unknown, it is likely such infrastructure will require direct investment, ownership and operation by private parties to be delivered.

It is acknowledged that cogeneration and recycling technologies have the potential to deliver long-term sustainability benefits for FBURA and provide long-term revenue streams through production and distribution networks.

Option 1

Item	Base Cost ($m Nominal)	Total Cost ($m Nominal)	Marginal Proportional Cost ($m Nominal /m2)	Nominal Cost ($m) 2016-2020	Nominal Cost ($m) 2021-2025	Nominal Cost ($m) 2026-2030
Total	**71.1**	**113.0**	**62.8**	**33.9**	**45.2**	**33.9**

Option 2

Item	Base Cost ($m Nominal)	Total Cost ($m Nominal)	Marginal Proportional Cost ($m Nominal /m2)	Nominal Cost ($m) 2016-2020	Nominal Cost ($m) 2021-2025	Nominal Cost ($m) 2026-2030
Recycled Water	45.4	72.2	40.1	21.7	28.9	21.7
Cogeneration System	125.7	199.8	111.0	59.9	79.9	59.9
Sewer Heat Recovery System	1.9	3.0	1.7	.9	1.2	.9
Other	42.5	67.5	37.5	20.3	27.0	20.3
Total	**215.4**	**342.5**	**190.3**	**102.8**	**137.0**	**102.8**

Cost Recovery Summary

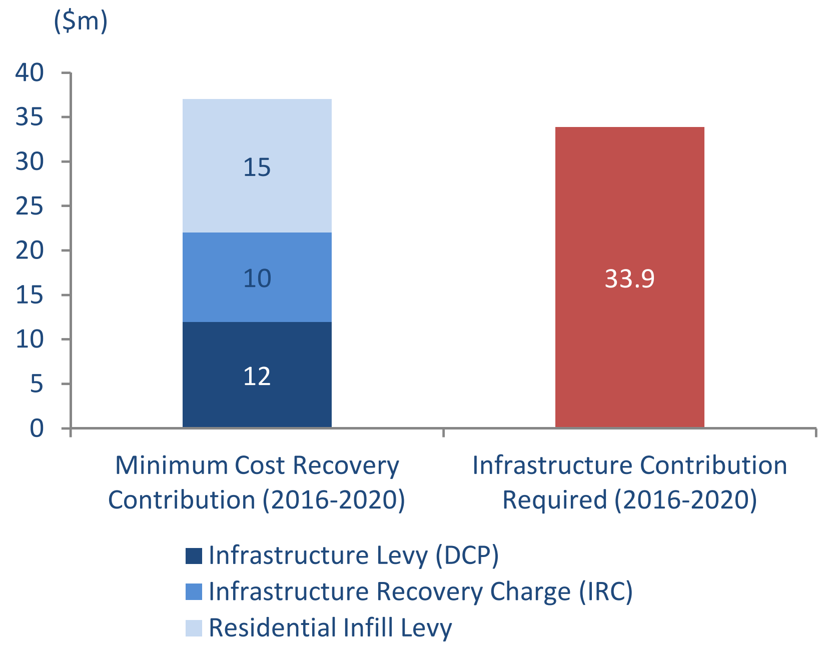
Item	Rate	Total Cost Recovered ($m) 2016-2030	Marginal Proportional Cost ($ Nominal /m2)	Nominal Cost Recovery ($m) 2016-2020	Nominal Cost Recovery ($m) 2021-2025	Nominal Cost Recovery ($m) 2026-2030
Infrastructure Levy (DCP)	$20-$25/m2	45-60	25-33	12-15	18-23	16-20
Infrastructure Recovery Charge (IRC)	5%-10%	185-370	102-205	9-18	47-95	130-260
Residential Infill Levy	$5,000-$10,000	175-350	97-194	15-30	60-120	100-200
Net Funding Position	**-**	**405-780**	**-**	**37-65**	**120-240**	**235-470**

** Note: Numbers may not add due to rounding*

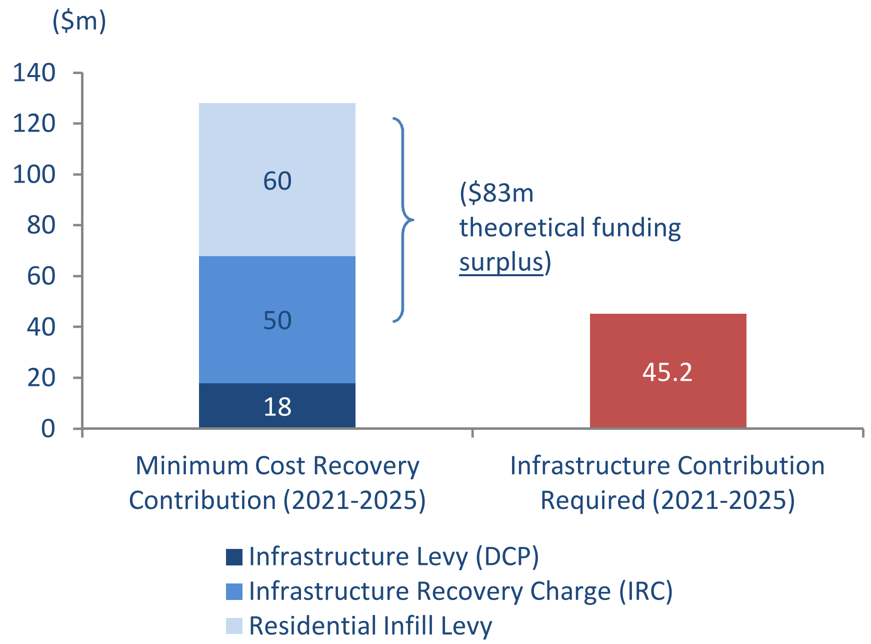
4 Funding Options Analysis

Option 1 – Estimated <u>minimum</u> theoretical cost recovery from Developer Contributions, Infrastructure Recovery Charge, Residential Levy

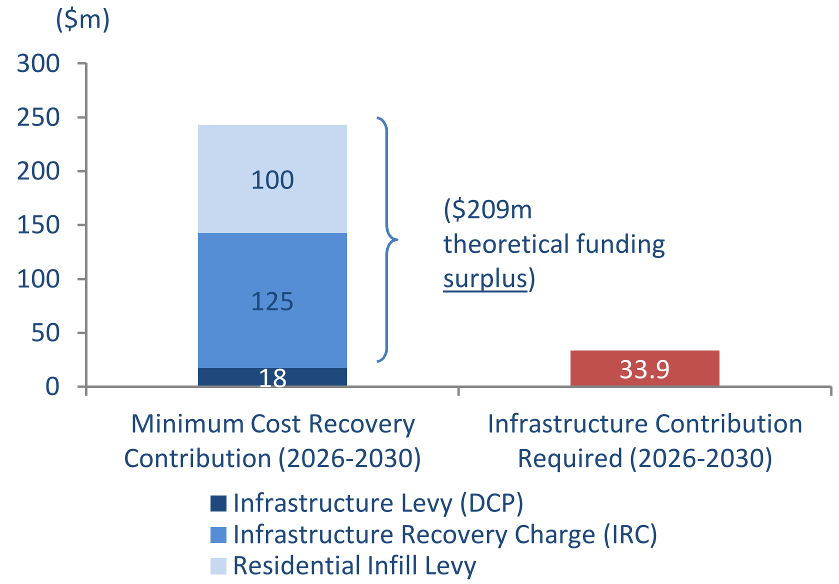
<u>2016-2020</u>



<u>2021-2025</u>

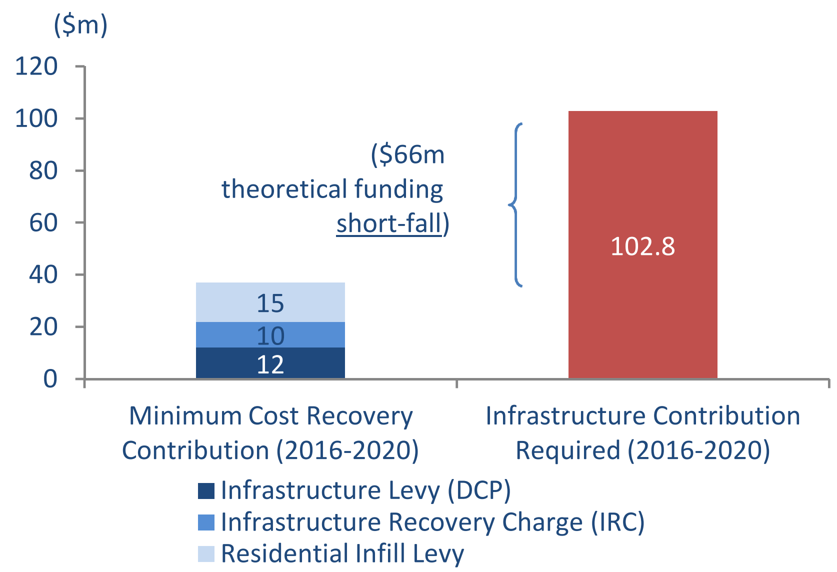


<u>2026-2030</u>

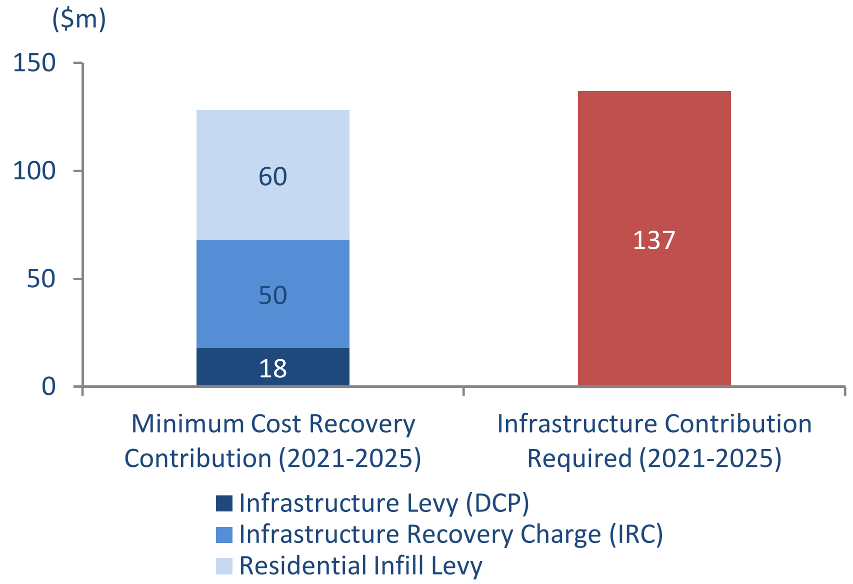


Option 2 – Estimated <u>minimum</u> theoretical cost recovery from Developer Contributions, Infrastructure Recovery Charge, Residential Levy

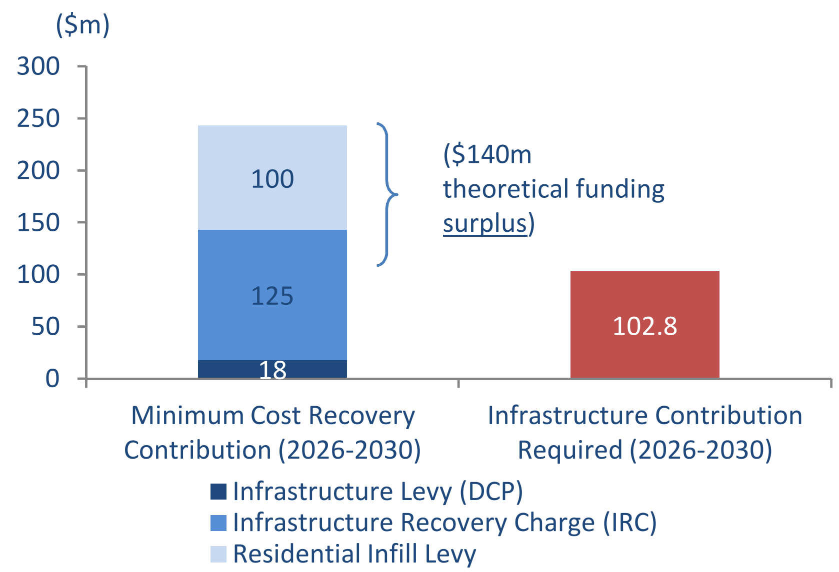
<u>2016-2020</u>



<u>2021-2025</u>



<u>2026-2030</u>



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5 Sequencing Scenarios

5.1 Overview

Redevelopment of FBURA will involve significant urban renewal and city growth during the coming 2-3 decades.

The sequencing of development across each FBURA precinct and the viability of development may be significantly impacted by infrastructure availability and costs.

Assumptions relating to sequencing have been provided by GHD, indicating utilities related infrastructure will be predominately delivered to the site during the period of 2015-2030.

These assumptions enable a cash-flow analysis for the period 2013-2030. The following indicators are to be monitored through the analysis:

- Timing of cash-flow required to facilitate infrastructure in accordance with the proposed sequencing plan;
- The current cost (or Net Present Value, NPV) of utilities expenditure over 2013-2030;
- Potential impact on theoretic land values arising resulted from facilitated by utilities infrastructure over the period 2013-2030.

5.2 Options

The following cash-flow analysis is based on the two options discussed above:

- **Option 1 – Business As Usual**: estimated cost of $113m excluding GST as at 30 May 2013;
- **Option 2 – Integrated Infrastructure Plan**: estimated cost of $342.5m excluding GST as at 30 May 2013, which includes additional items namely recycled water, sewerage heat recovery and a cogeneration system.

Detailed cost estimates for both options are provided by WT Partnership in Section 3.3 and 3.4. These estimates are used as the basis of the cash flow analysis.

5.3 Key Assumptions

A number of assumptions have been adopted by the Author in undertaking the analysis. These are listed below.

- Total cost of utilities is assumed to be fixed (provided by WT Partnership) and delivered during the period 2013-2030 based on the sequencing scenarios (provided by GHD)
- Preliminaries, project margin and other on costs are as estimated by WT Partnership
- Total Net Developable Area: 180ha
- Escalation of all costs at 3.5% compounding annually
- Discount Rate: 6.0% (generally in accordance with DTF guidelines)
- Land Value @ Year One: $1,000/sqm
- Land Value Growth: 3% per annum

5.4 Methodology

The Author has adopted a discounted cash flow (DCF) analysis during a construction timetable of 2013-2030 for the utilities servicing the land of FBURA to be delivered on a fixed cost basis.

5 Sequencing Scenarios

5.5 Sequencing

Timing of Utilities Infrastructure

The table below indicates the sequence (provided by GHD) of delivery for utilities to be delivered in the FBURA. In the Base Case scenario adopted (as shown), expenditure on utilities does not occur in a linear fashion. However in most cases it occurs in small amounts over 5 year tranches with up to 50% of the cost allocating in the first year of each 5-year tranche. That is:

- Year 2013-2015: 0% (of the total estimated cost)
- 2016-2020: 30%, half of which is to be injected in the first year, i.e. 2016
- 2021-2025: 40%, half of which is to be injected in the first year, i.e. 2021
- 2026-2030: 30%, half of which is to be injected in the first year, i.e. 2026

Note: the same development sequencing will be used for both Option 1 and Option 2.

Timing of Development of Land serviced by Utilities Infrastructure

The relationship between infrastructure roll-out and timing of development and quantum of land is not certain. Land may be developed at a faster or slower pace depending on a range of factors including infrastructure. Some of these factors are market appetite and demand, level of investor appetite and risks, access to development funding, timing of site works and construction, developer profit and risks. This means there may not be a direct or readily measureable relationship between sequencing of infrastructure delivery and sequencing of land delivery.

For this reason, the Author has made the following assumptions relating to the timing of development of land serviced by utilities infrastructure:

- Year 2013-2015: 0% (as no utility expenditure occurs)
- Year 2016-2020: 30% of land serviced, or 6% each year
- Year 2021-2025: 40% of land serviced, or 8% each year
- Year 2026-2030: 30% of land serviced, or 6% each year

Utilities Cost Delivery Sequencing, All Options, Base Case

Item	Sum	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Recycled Water	100%				15%	3.75%	3.75%	3.75%	3.75%	20%	5%	5%	5%	5%	15%	3.75%	3.75%	3.75%	3.75%
Potable Water	100%				15%	3.75%	3.75%	3.75%	3.75%	20%	5%	5%	5%	5%	15%	3.75%	3.75%	3.75%	3.75%
Sewerage System	100%				15%	3.75%	3.75%	3.75%	3.75%	20%	5%	5%	5%	5%	15%	3.75%	3.75%	3.75%	3.75%
Stormwater Upgrades	100%				15%	3.75%	3.75%	3.75%	3.75%	20%	5%	5%	5%	5%	15%	3.75%	3.75%	3.75%	3.75%
Electrical System Upgrades	100%				15%	3.75%	3.75%	3.75%	3.75%	20%	5%	5%	5%	5%	15%	3.75%	3.75%	3.75%	3.75%
Gas System Reticulation	100%				15%	3.75%	3.75%	3.75%	3.75%	20%	5%	5%	5%	5%	15%	3.75%	3.75%	3.75%	3.75%
Cogeneration System	100%				15%	3.75%	3.75%	3.75%	3.75%	20%	5%	5%	5%	5%	15%	3.75%	3.75%	3.75%	3.75%
Sewer Heat Recovery System	100%				15%	3.75%	3.75%	3.75%	3.75%	20%	5%	5%	5%	5%	15%	3.75%	3.75%	3.75%	3.75%
Telecommunication	100%				15%	3.75%	3.75%	3.75%	3.75%	20%	5%	5%	5%	5%	15%	3.75%	3.75%	3.75%	3.75%

Source: GHD 2013

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5 Sequencing Scenarios

5.6 Cash Flow Analysis

Option 1 & 2, Base Case

- Based on the sequencing Base Case provided by GHD, the Net Present Value (NPV) of utilities under Option 1 ($113m) at a discount rate of 6.0% is ($85.9m) and under Option 2 ($342.5m) is ($260.4m).
- The comparison of Option 1 and 2 shows that Option 1 involves traditional technology and implementation whilst Option 2 proposes the latest technologies, sustainable solutions and renewable energy utilisation, which involve higher implementation costs. In Option 2, Recycled Water and Cogeneration System add up to over ($171.1m) (nominal), accounting for almost 80% of utility costs.
- The average utility cost calculated as a proportion of total net developable area of 180ha) is approx $63/sqm for Option 1 and approx $190/sqm for Option 2.

In the absence of infrastructure being delivered in FBURA, the theoretical land value is assumed to increase at a conservative rate of around 3-5% annually assuming an unchanged policy environment and holding all other factors constant. This is assumed for comparison purposes only.

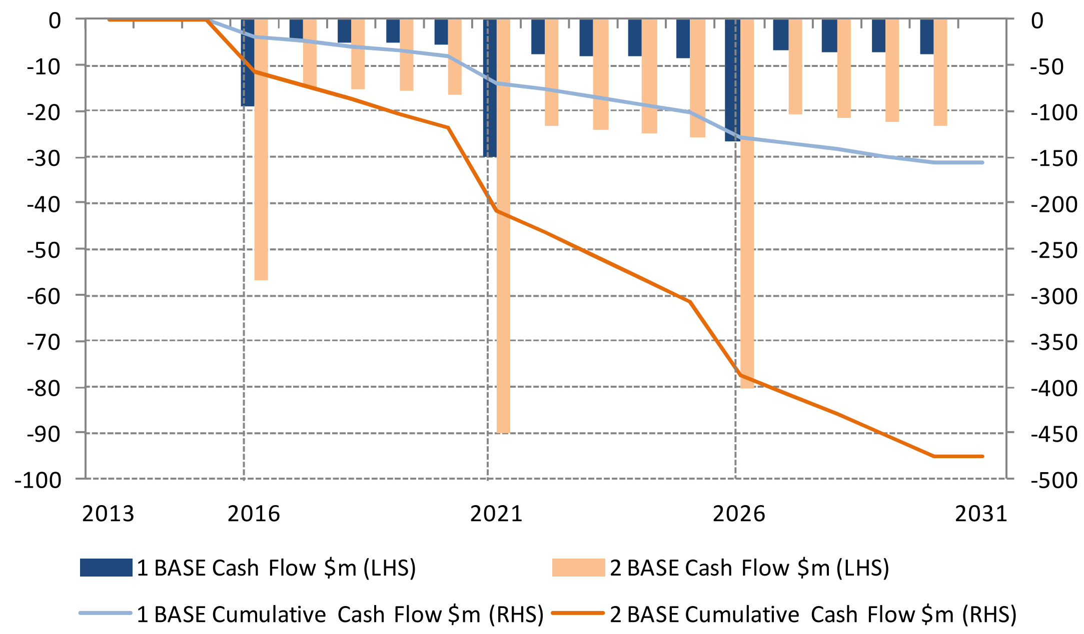
As utilities are rolled out in different stages, potential impacts on land value each year may vary, with generally higher potential increases required in theoretical land value at earlier stages due to larger amount of infrastructure delivered resulting in activation of development.

The increase in theoretical land values after the first tranche of infrastructure is estimated at 16% for Option 1 and over 48% for Option 2 reflecting the suggested sequencing scenarios.

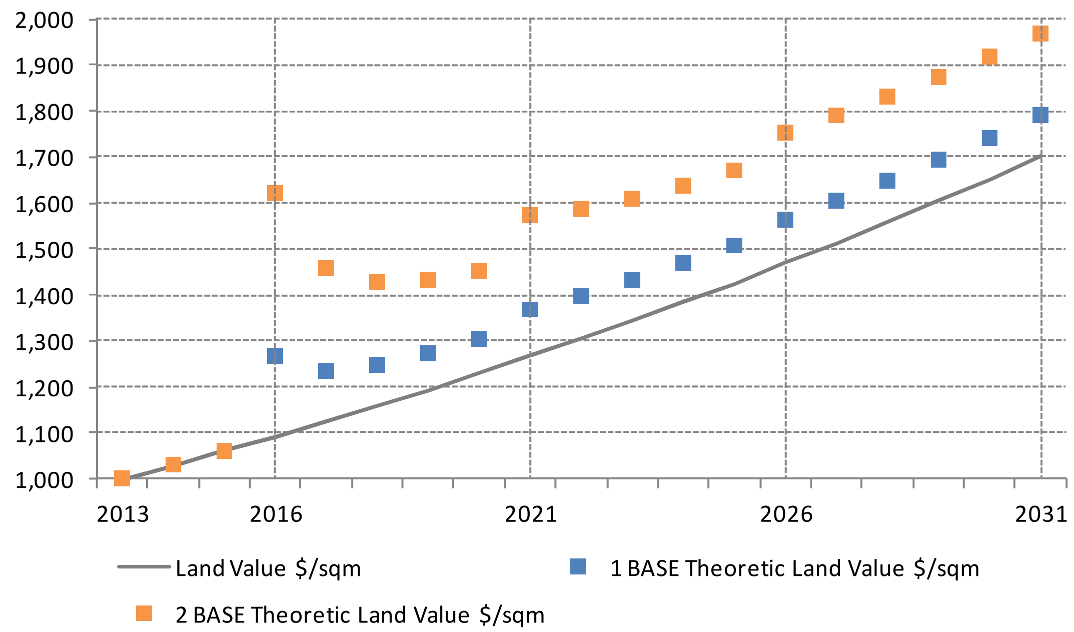
NPV of Utilities Cost over 20 Years (excl GST), Option 1 & 2, Base Case

NPV ($)	Option 1 Business As Usual	Option 2 Integrated Infrastructure Plan
Base Case	($85,904,032)	($260,372,842)

Cash Flow of Utilities Cost, Option 1 & 2, Base Case



Potential Impact on Land Value, Option 1 & 2, Base Case



Source: MacroPlan Dimasi

5 Sequencing Scenarios

5.7 Observations

Theoretical land values are likely to vary across different precincts within FBURA reflecting development sequencing as well as a range of market factors and large scale infrastructure items such as light rail extension into parts of FBURA.

The timing of infrastructure delivery impacts the estimated current value of infrastructure (i.e. net present value) with potential consequences for estimating the total cost recovery required in the future to partially (or wholly) offset utilities infrastructure costs.

The marginal cost of utilities infrastructure calculated on a per square metre basis (assuming a net developable area of 180ha) is between $63/m2 (Option 1) and $190/m2 (Option 2).

The following examination of the impacts of changes in the sequencing of infrastructure indicates that bringing forward (or deferring infrastructure) by 1-2 years doesn't significantly impact on theoretical land values.

The examination also implies that when the sequencing of infrastructure is deferred by a longer period i.e. 5 years, it is expected that the expenditure would be pushed out to a longer term so the NPV would be reduced in accordance with the revised timing assumptions.

5.8 Sensitivity Analysis

Two sequencing scenarios are adopted (below) to test the sensitivity of changes in timing of utilities expenditure on theoretical land values:

- **Scenario A – Early Activation**: involving all utility expenditure activated 1 year earlier (i.e. 2015) allowing for the same pattern of infrastructure expenditure during the infrastructure roll-out period.

- **Scenario B – Deferred Activation**: involving all utility expenditure activated 1 year later (i.e. 2017) allowing for the same pattern of infrastructure expenditure during the infrastructure roll-out period.

The tables below show differential sequencing for the Base Case, Scenario A and B.

Sequencing of Utilities Cost Delivery and Land Serviced, Base Case, Scenario A & B

Base Case	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Utility Cost				15%	3.75%	3.75%	3.75%	3.75%	20%	5%	5%	5%	5%	15%	3.75%	3.75%	3.75%	3.75%	
Land Serviced				6%	6%	6%	6%	6%	8%	8%	8%	8%	8%	6%	6%	6%	6%	6%	

Scenario A Early Activation	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Utility Cost			15%	3.75%	3.75%	3.75%	3.75%	20%	5%	5%	5%	5%	15%	3.75%	3.75%	3.75%	3.75%		
Land Serviced			6%	6%	6%	6%	6%	8%	8%	8%	8%	8%	6%	6%	6%	6%	6%		

Scenario B Deferred Activation	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Utility Cost					15%	3.75%	3.75%	3.75%	3.75%	20%	5%	5%	5%	5%	15%	3.75%	3.75%	3.75%	3.75%
Land Serviced					6%	6%	6%	6%	6%	8%	8%	8%	8%	8%	6%	6%	6%	6%	6%

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5.8 Sensitivity Analysis (cont)

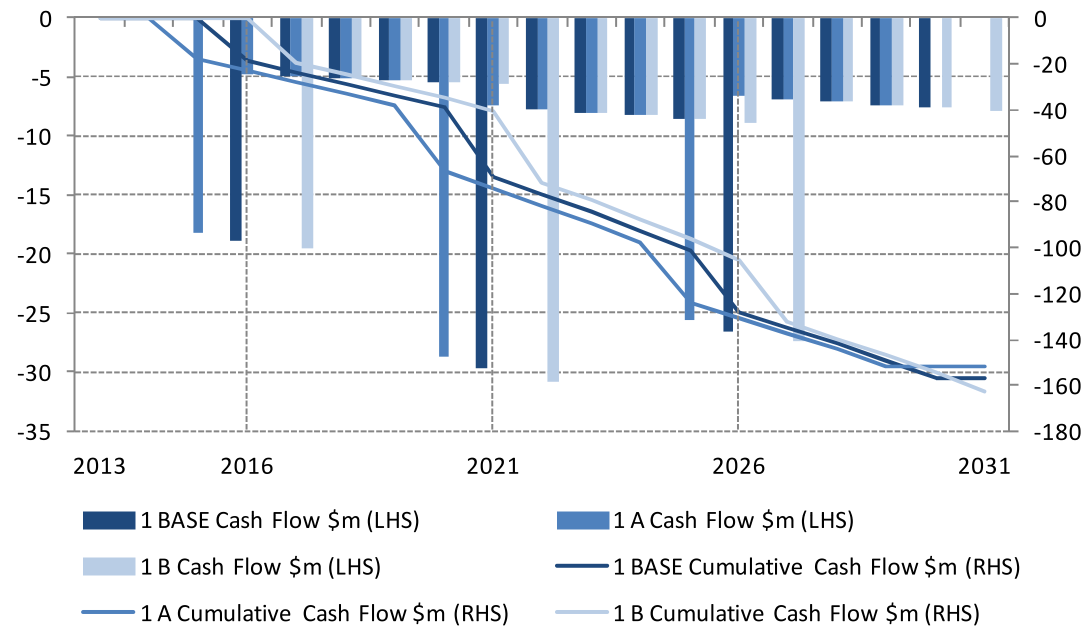
Option 1, Base Case, Scenario A & B

- Sensitivities to timing is tested based on two sequencing scenarios for Option 1. The NPV of utilities cost over the implementation period for Base Case and the two scenarios is ($85.9)m, ($88.0)m and ($83.94)m respectively. Scenario B – Deferred Activation is expected to achieve relatively lower cost in terms of present value than other scenarios.
- Scenario A – Early Activation shows higher cash flow at earlier stages whilst in Scenario B cash flow is expected to be deferred across later stages to some extent.
- In Scenario A, the potential impact on land value uplift is brought forward by one year whilst that in Scenario B is deferred to later stages.
- By bringing utility spending one year forward as in Scenario A, theoretic land value is expected to increase by 16% from the Base Case at year 2015; by deferring one year as in Scenario B, theoretic land value is expected to increase by 5.7% from the Base Case at 2017.
- The difference of land value impact between three scenarios is relatively small for Option 1 as the total amount of utilities cost for Option 1 is relatively small.

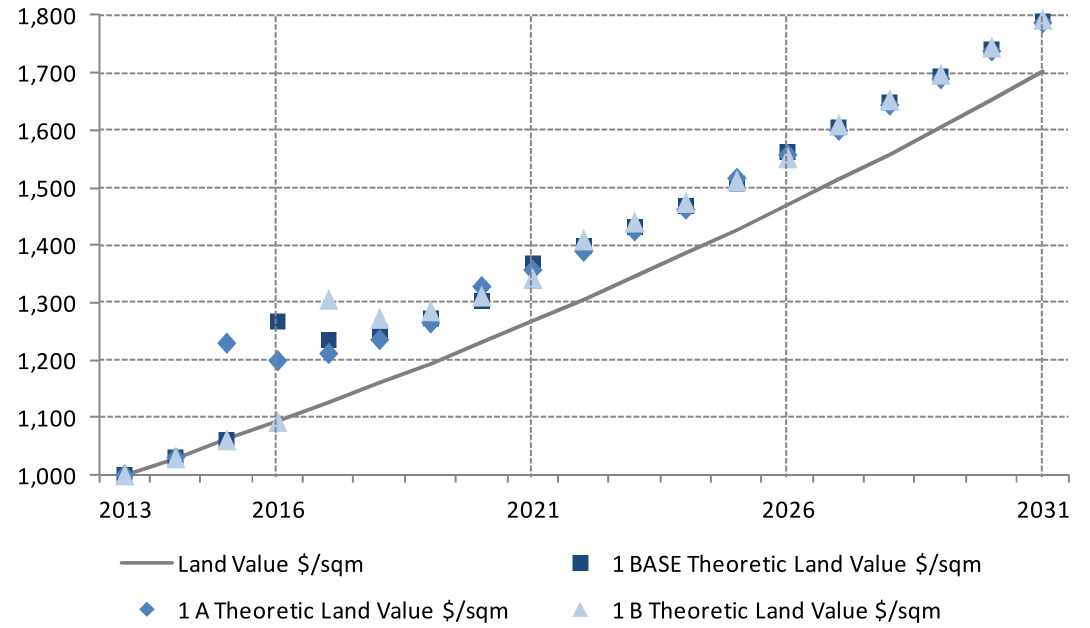
NPV of Utilities Cost over 20 Years (excl GST), Option 1, Base Case, Scenario A & B

NPV ($)		Option 1 Business As Usual
Base Case		($85,904,032)
Scenario A	Early Activation	($87,979,009)
Scenario B	Deferred Activation	($83,877,994)

Cash Flow of Utilities Cost, Option 1 , Base Case, Scenario A & B



Potential Impact on Land Value, Option 1, Base Case, Scenario A & B



Source: MacroPlan Dimasi

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5 Sequencing Scenarios

5.8 Sensitivity Analysis (cont)

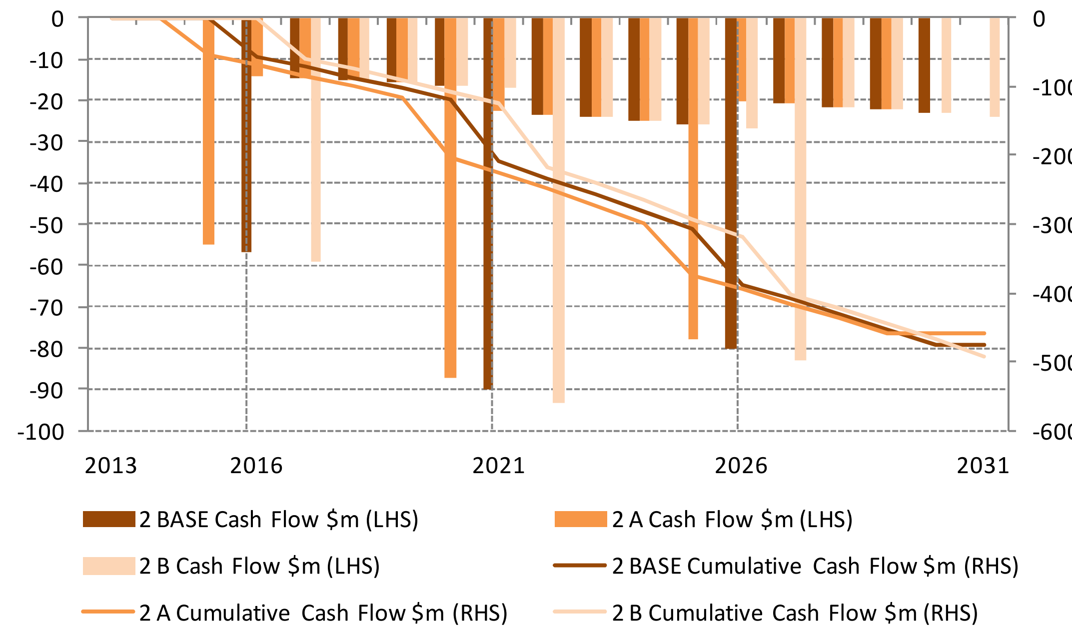
Option 2, Base Case, Scenario A & B

- Sensitivities to timing is tested based on three sequencing scenarios for Option 2. The NPV of utilities cost over the implementation period for Base Case and the two scenarios is ($260.4)m, ($266.7)m Scenario A and ($254.2)m Scenario B respectively. Scenario B – Deferred Activation is expected to achieve relatively lower cost in terms of present value than other scenarios.
- Scenario A – Early Activation shows higher cash flow at earlier stages whilst in Scenario B cash flow is expected to be deferred across the implementation period and funding pressure could be shifted to later stages.
- In Scenario A, the potential impact on land value uplift is brought forward by one year whilst that in Scenario B is deferred to later stages.
- By bringing utility spending one year forward in as Scenario A, theoretic land value is expected to increase significantly by 48% from the Base Case at year 2015; by deferring one year as in Scenario B, theoretic land value is expected to increase by 15% from the Base Case at 2017.
- Option 2 shows significant potential land value uplift at the start of utility implementation period due to large amount of total utility cost and upfront spending. It indicates higher sensitivity to timing, as the change of commencement time would involve significant impact on land value to a certain year.

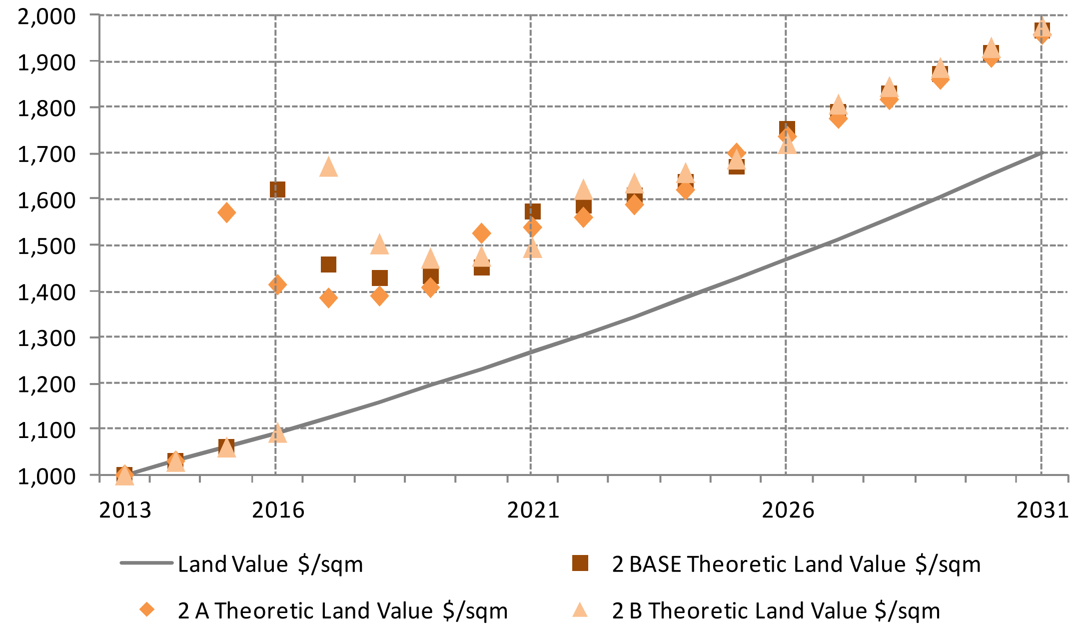
NPV of Utilities Cost over 20 Years (excl GST), Option 2, Base Case, Scenario A & B

NPV ($)		Option 2 Integrated Infrastructure Plan
Base Case		($260,372,842)
Scenario A	Early Activation	($266,662,041)
Scenario B	Deferred Activation	($254,231,973)

Cash Flow of Utilities Cost, Option 2 , Base Case, Scenario A & B



Potential Impact on Land Value, Option 2, Base Case, Scenario A & B



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Source: MacroPlan Dimasi

5 Sequencing Scenarios

5.9 Summary

Value uplift relating to land within FBURA will likely occur in stages in response to a range of factors, including the timing and cost of infrastructure to be delivered throughout FBURA.

The factors influencing future development within FBURA and associated theoretical land values (land value uplift) are many and varied – i.e. planning and policy measures; the type, quantum, timing and costs of infrastructure; investor and market appetite; access to development funding; developer profit and risk; physical and environmental constraints to the development of land; etc. This assessment focuses on delivery of utilities infrastructure holding all other factors constant.

The marginal cost of utilities infrastructure calculated on a per square metre basis (assuming a net developable area of 180ha) is between $63/m2 (Option 1) and $190/m2 (Option 2).

An examination of the impacts of changes in the sequencing of infrastructure indicates that bringing forward (or deferring infrastructure) by 1-2 years doesn't significantly impact on theoretical land values.

Deferring the timing of infrastructure delivery until at least 2020 does not change the total impact on theoretical land values, only the timing of the increase in line with deferred infrastructure.

Theoretical land values are likely to vary across different precincts within FBURA reflecting development sequencing as well as a range of market factors and large scale infrastructure items such as light rail extension into parts of FBURA.

The timing of infrastructure delivery impacts the estimated current value of infrastructure (i.e. net present value) with potential consequences for estimating the total cost recovery required in the future to partially (or wholly) offset utilities infrastructure costs.

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Appendix I – Governance and Funding Options

SUMMARY OF POSSIBLE FUNDING MECHANISMS

Infrastructure Item	Responsible Agency	Possible Funding Mechanism							
		DCP	Municipal Rates and Charges	Regulated contributions	Grants	IRC	Residential Infill Levy	Direct developer funding	Private Investment
Potable water - reticulation network	South East Water			■					
Potable water - external to precinct	South East Water			■				■	
Recycled water - reticulation network	South East Water			■					
Recycled water - plant and associated	South East Water			■					■
Sewerage	South East Water			■					
Power - reticulation network	CitiPower			■					
Cogeneration Plant	AER					□			■
District Heating network	AER					□			■
Stormwater - reticulation network	City of Melbourne / City of Port Phillip	■	■		■		□		
Stormwater - detention ponds	City of Melbourne / City of Port Phillip	■	■		■		□		
Stormwater - pumps and rising mains	City of Melbourne / City of Port Phillip	■	■		■		□		
Waste management	City of Melbourne / City of Port Phillip		■		■		□		

■ Most likely
□ Some potential, subject to investigation

Appendix J – Risk Assessment Matrix

Risk Category	Risk	Mitigation	Recommendations
Community	Community acceptance and perception of wastewater recycling.	Implement a community consultation and education program to promote recycled water reuse within the precinct.	Council and water authorities to consult with the community and developers regarding the proposed use of recycled water, for substitution of non potable demands.
	Community reject the proposed location of the waste transfer station (WTS).	Select a WTS location that reduces the interface with sensitive land use areas.	Council and Metropolitan Waste Management Group to identify a suitable site for the new WTS, and reserve an appropriate area of land.
	Community reject the proposed location for the recycled water treatment plant (RWTP) due to the potential impact on the Montague and Lorimer precincts.	Ensure appropriate buffer distances are achieved for the proposed RWTP site.	Undertake a concept design of the RWTP to confirm the footprint area and measures to reduce the buffer distance required (i.e. noise and odour control measures).
	Unable to secure land and buffer distances for assets	Land acquisition strategy required to ensure sufficient land is set aside to accommodate the required infrastructure (including the waste transfer station).	Undertake detailed design to confirm land area requirements, and PV to consult with developers,Council and EPA to identify the appropriate location for the proposed infrastructure and necessary actions to ensure the appropriate area of land is 'set aside'.
Technical	Cross connection of recycled and potable water in high rise apartments	Establish a process to achieve greater focus on carrying out plumbing audits within buildings.	Consult with the BCA and water authorities to identify improvements to existing auditing and approvals processes for connection to third pipe networks.
	Inadequate operation of RWTP and cogeneration plant.	Ensure supply contract provides sufficient controls for operation and maintance.	Establish a development authority to govern the supply contracts for management and operation of integrated infrastructure.
	Demand savings for high performance buildings are not achieved, resulting in undersized infrastructure and constraints to development.	Dedicated development authority to govern the implementation of high performance buildings standards.	Establish a development authority to ensure developers comply with high performance building standards and broader precinct outcomes.
	Uptake of recycled water is slow.	Supply to other precincts such as Southbank and Docklands to achieve a better staging outcome and initial demands for the RWTP.	Consult with City West Water, South East Water and neighboring developers to ensure the recycling strategy for Fishermans Bend considers other 'recycled water markets' surrounding the precinct.
	The plan is not flexible to accommodate alternative/superior integrated solutions that may emerge in the future.	Regularly review the plan to ensure other alternatives are considered.	Establish a development authority to consider potential emerging technologies and suggestions from the market regarding other alternatve solutions that might emerge in the future.
	Differential settlement due to poor ground conditions (i.e. associated with Coode Island Silt).	Ensure utilitiy infrastructure design and construction account for ground conditions.	Undertake detailed geotechnical investigations in critical areas across the site, particularly in areas where key infrastructure is proposed (i.e. RWTP site, potable water storage tank etc).
	Contaminated land encountered during construction.	Ensure utilitiy infrastructure design and construction account for contaminated ground.	Undertake detailed contaminated land investigations and consider the risk of encountering contaminated land in selecting suitable sites for key infrastructure.

Risk Category	Risk	Mitigation	Recommendations
	Plan does not re-use existing streets, which conflicts with key assumption of utilities infrastructure plan (i.e. assumed use of exisiting streets and services).	Consider the impact of not re-using existing streets as service coridors on the overall cost of the infrastructure plan.	Undertake a sensitivity analysis on the utility infrastructure plan costs. Particularly if new services are required to be deployed in advance of the creation of new streets.
	Building design, particularly high rise, does not accommodate or easily facilitate separation of recyclables	High performance building standards should address this issue.	Investigate options for source separation.
Financial	Lack of connections to recycled water and district energy systems resulting in a failure to recover the capital cost of infrastructure.	Encourage uptake through consultation with developers and outlining their initial building costs and the benefits to the end owner of the built product. Consider mandating a requirement to connect.	Commence consultation with developers to confirm their interest in connecting to recycled water and district energy schemes. Investigate the optimal framework/mechanism for mandating a connection to the district energy and recycled water network (i.e. a planning scheme ammendment).
	Opportunity to maximise the customer base for recycled water and cogeneration reduces over time as Fishermans Bend development progresses ahead of implementation of the scheme.	Encourage developers to make provision for connection to recycled water and district energy at a later stage. Develop lower cost short term connections, if viable	Commence consultation with developers to encourage them to make provision for connection to recycled water and district energy at a later stage.
	Lack of interest (or inability to agree terms) from private sector to invest in cogeneration and recycled water treatment infrastructure.	Provide confidence to the private sector regarding the availability of an adequate demand for recycled water and district energy.	Undertake proactive engagement with developers to encourage connection to district energy and recycled water schemes and/or investigate the optimal framework/mechanism for mandating a connection to a district energy and recycled water network (i.e. a planning scheme ammendment).
	Unacceptable developer contributions resulting in an impediment to development.	Secure alternative funding sources (i.e. private sector investment).	Identify opportunities for private sector investment in key infrastructure within the scheme (i.e. RWTP and cogeneration).
	Out of sequence development results in a signficiant impact on costs	Developers or Private Sector Infrastructure providers pay bring forward costs for out of sequence development. Precinct development planning encourages in sequence development	Develop an appropriate infrastructure precinct development plan that considers efficient delivery of infrastructure and encourages developers to bring forwarddevelopment in sequence.
	Unprecedented growth across inner urban Melbourne places significant pressure on water and energy resources, triggering major upgrades to system headworks	Utilities to undertake system wide modelling to confirm the capacity of existing systems to cater for unplanned growth.	Based on the results of a system wide modelling exercise, allocate the incremental costs associated with long term upgrades to water and energy networks triggered by the Fishermans Bend development. In doing so, identify the potential future avoided costs associated with implementing the ISS. Capture these avoided costs as "whole of government costs" so these can be considered for offseting against ISS costs

Risk Category	Risk	Mitigation	Recommendations
	Timing for staging of BAU upgrades are not clear and therefore, financial analysis is flawed.	Confirm the impact of different timing scenarios for BAU infrastructure.	Undertake a sensitivity analysis for different staging scenarios, and confirm the impact to financial analysis results. Need to understand the risks to the private sector and what underwriting from Government could potentially be required for scheme viability

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