FINAL REPORT

Cost of Residential Servicing

Prepared for
Auckland Council

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THE CENTRE FOR INTERNATIONAL ECONOMICS
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Summary

Auckland's population has grown significantly over the past decade and it is forecast to continue growing into the future. Auckland currently has around 1.4 million people, although expectations are for a future population of 2.3 million people by 2051. Auckland Council plays a role in planning the future growth of the city. It has already undertaken several studies to improve its understanding of how best to accommodate the future population. This study, undertaken by the CIE and ARUP, further builds the evidence to inform the Council's future land use planning decisions.

Study purpose and approach

This study was commissioned under Action 15 of the Housing Action Plan, which called for Council to undertake *more thorough empirical research showing the true cost of servicing different types of development and assessing the impacts of location and typology*.

This study is part of a wider research program by Council assessing land use policies. The stated aims of the study were to:

- Inform and improve plans for growth (e.g. efficient allocation of land supply) and the integrated delivery of infrastructure
- Enhance asset management planning
- Promote affordable housing outcomes
- Enhance financial policy development (e.g refine development contributions policy)

It was decided to use a case study approach using actual costs – or estimates of costs – based on known projects. It was envisaged that this would allow a direct comparison between developments with different characteristics that could then be used to benchmark costs for future developments. It was hoped that this would be of particular use for asset management planning and for understanding the alignment between the costs of servicing different developments and charges to users/developers.

This project looks at cost information from a number of current (or recently completed) developments with an aim to informing Auckland Council about the expected range of costs associated with servicing future residential sites based on their location and intensity of development.[1] This will include the costs relating to the range of services provided by the Council to service new developments as well as Central Government costs relating to new developments:

- water, wastewater and stormwater services
- transport infrastructure

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1 The study does not consider whether the expenditure incurred for a development site is the most efficient way of providing the infrastructure.

- community services and parklands.

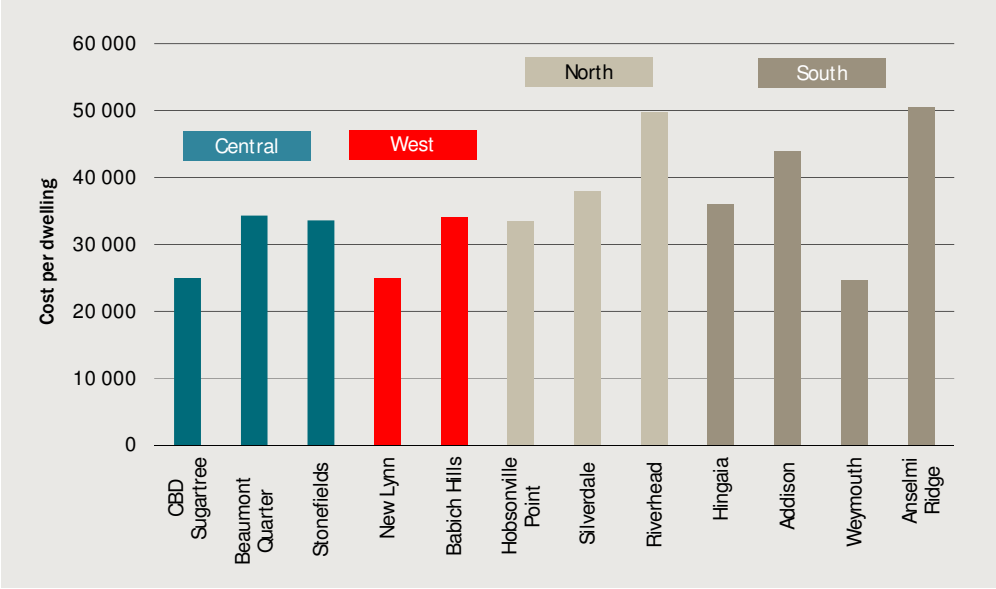
Servicing cost variance findings by density of location

Chart 1 provides a summary of the estimated per dwelling cost of servicing each of the case studies. Costs presented are based on the future cash flow stream, converted to 2012/13 dollars.

These costs are a mix of historical and future costs attributable to each development covering water, wastewater, stormwater, parklands and transport infrastructure. After reviewing the information available on the cost of providing community services – halls, schools, hospitals and libraries – it was decided not to include cost estimates for these facilities. Existing research conducted by Auckland Council indicated that hospital facilities are constructed to deliver services to a region, rather than the local neighbourhood[2], while there was insufficient data available at the case study level to conclude that there was either a locational or a density element to the cost of providing the other community services.

The costs illustrated predominately reflect a direct expenditure outlay for Auckland Council. However, in cases where assets were funded through an Infrastructure Funding Agreement between council and a developer, or provided as offset to a development (or financial) contribution, the cost of capital was inferred based on comparable unit cost data and information on the physical attributes of the asset.

1 Summary of infrastructure costs attributable to case study by location



Note: These costs predominantly reflect future growth costs as identified in the forward programs of infrastructure providers
Data source: CIE, Auckland Council, Arup

2 Auckland Council, *Health Facilities and Population Growth in Auckland*, July 2013

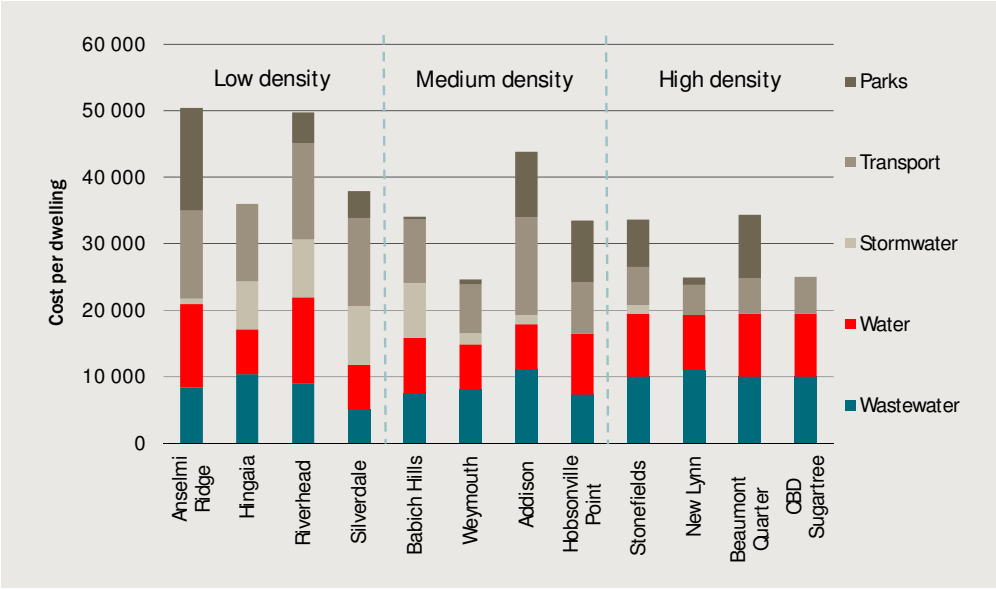
The costs show that the developments in the North are, on average, the most expensive to service costing around $40,374 per dwelling. Developments in the South cost, on average, $38,736 per dwelling, while developments in the Central area cost $30,967 per dwelling and those in the West cost $29,496 per dwelling.

Cost differences between sites reflect a number of different factors. For the greenfield areas the costs are typically driven by the need to expand network infrastructure: water, wastewater and transport. In brownfield areas, the network infrastructure generally is already in place and, where there is spare capacity in the network, the marginal cost of providing infrastructure to an additional household in these locations is found to be comparatively low. However, the average cost of expanding the network to cater for growth in these locations may well be higher than in greenfield sites. Consequently, it is important that there is a good level of understanding about the level of excess capacity in the existing networks when planning the location of future developments.

Servicing cost variance findings by density of development

Chart 2 provides a breakdown of the infrastructure costs by development type. The findings from the case study analysis were that the low density developments were, on average, the most expensive to service costing an average of $41,633 per dwelling. The medium density developments were the next most expensive, costing an average of $33,890 per dwelling, while the high density developments cost an average of $28,077 per dwelling. However, as Chart 2 shows, there was a considerable variation in costs between sites of a similar density.

2 Summary of infrastructure costs by density and asset type



Note: These costs predominantly reflect future growth costs as identified in the forward programs of infrastructure providers
Data source: CIE, Auckland Council, Arup

Servicing cost variance findings by infrastructure type

Water, wastewater and stormwater

The findings point to a variance in the cost of water and wastewater provision based on location. Significant capital expenditure is required to connect greenfield developments to water networks; where investment is required to provide trunk infrastructure to service the development, it is provided at a high marginal cost given the small populations serviced.

Where there is spare capacity in existing assets, the cost of providing services to infill developments is generally lower than the cost of providing services to greenfield sites with no existing infrastructure. However, in the future, if there is sufficient spare capacity in the assets provided to service these greenfield sites, the cost of connecting additional sites to these assets will fall. Also, there may be significant differences in the cost of upgrading infrastructure based on location that would need to be considered in comparing the costs of future developments.

The case study analysis highlights that some of the infrastructure costs are related to the specific characteristics of the case study area. For example, soil type, the slope of the land and the presence of natural conduits significantly influence the costs of providing stormwater assets.

Transport

The findings for road transport also suggest a variance in servicing costs based on locality; the outlying developments had the highest costs per dwelling reflecting the high cost of expanding the road network to cater for growth around the rural urban boundary and of linking the developments to the network. However, there was much less variation in costs per dwelling between the central developments and developments located outside the isthmus but with relatively easy access to the major urban arterial road networks, such as Babich in the west and Weymouth in the south.

For public transport, per dwelling servicing costs were found to be highest for the central developments and for New Lynn, reflecting the high public transport modal share of trips in these areas.

Social Infrastructure

There was some evidence of a locality/density variance in servicing costs for social infrastructure based on the case study analysis.

Hospitals and schools generally service wide catchments areas. Even where facilities are provided specifically to service a local population, there was insufficient evidence to suggest that there is a significant locational element to the cost of servicing based on the case study analysis.

An analysis of the provisions made for parklands suggest that there has been a significant locational/density variance in the cost per dwelling of servicing the case studies. The area of parkland per dwelling set aside for low density developments in outlying regions was considerably higher than for denser developments and for infill developments. For infill developments in central locations, the area of parkland provision was low, reflecting a lack of available space and the fact that these developments already had access to centrally located parkland.

The case study experience highlights that there has not been a standard approach to park provision – particularly where parks have been provided through IFAs or as offsets to financial and development contributions – and this lack of transparency has resulted in outcomes that were not necessarily cost effective for Council.

Conclusions

The results from this study were intended to help inform and improve the efficiency of Council's approach to delivering land supply and infrastructure, enhance asset management planning and assist with financial policy development. Key findings of the case study analysis include:

- On average, the cost of providing infrastructure services to the greenfield case studies was estimated to be more expensive than for infill developments. However, the case study analysis highlights the considerable variation in costs between case studies of similar location/density. Council will need to examine the specific proposed development sites in detail in order to understand the extent to which any site-specific characteristics would influence the conclusions regarding the higher relative cost of greenfield development.
- The findings highlight the role of existing spare capacity in the network in determining the cost of providing services. The major wastewater investment programs underway in Auckland, which are driven both by the need to replace ageing assets and to cater for future growth, are evidence of the high average cost of upgrading the established network and have added substantially to the cost of servicing new developments which place demand on these assets.
- Once infrastructure is in place, the incremental cost of further development in an area may be quite small, even though the overall cost is large. That is, the decisions should not be based on past costs that are 'sunk' and should only be based on incremental future costs. Once installed the incremental cost of further developing these areas may be small where there is spare capacity in the system. Council will need to consider the extent of spare capacity in the network assets across the whole Auckland area.

Limitations of conclusions

The intention of this study was to compare the infrastructure servicing costs for a selection of residential developments to see if these costs were influenced by the intensity and/or locality of the development. This approach required sourcing a mixture

of historical and future costs, both for infrastructure that was provided specifically to service the development and for any expansion or upgrade of network infrastructure required to cater for additional demand attributable to the development.

Prior to the amalgamation of Auckland Council, the responsibility for local infrastructure provision and operation resided with the former territorial authorities, whose approach to both financing and cataloguing capital and operating expenditure varied considerably. This presented problems for the case study approach as detailed expenditure breakdowns for assets were not always available and, as a result, it was not possible to get uniform coverage of historical infrastructure costs associated with the case study developments.

The legacy councils also appeared to have adopted slightly different approaches to delivering infrastructure, notably with respect to service delivery standards and infrastructure funding agreements, and this may account for some of the variation the in costs provided.

The lack of historical data is likely to underestimate the true cost of servicing developments where the capacity to cater for those developments was provided under earlier investment programs.

There were similar issues when it came to projecting future servicing costs, as it was not always known whether a new development would precipitate the need for further capacity building that had not yet been factored into forward work programs.

A significant limitation of the case study approach was the lack of data on operating costs; neither Watercare nor Stormwater were able to provide estimates of operating costs for specific assets. Given that infrastructure providers may elect for a trade-off between capital expenditure and operating expenditure costs over the life of an asset, the capital expenditure component alone may not adequately reflect the relative cost differences of infrastructure provision between sites.

Where possible, assumptions have been used to overcome the limitations detailed above. However, the costs per dwelling cannot be said to provide a precise estimate of the cost of servicing an area; rather, they provide *relative* indicative cost estimates of servicing the different case study developments.

Moving forward

The findings of the study have highlighted the difficulties in determining the share of infrastructure costs relating to new developments. The limitations of the case study approach meant that it has not been possible to provide robust estimates of the cost of servicing particular sites. However, the study has highlighted that there does appear to be a considerable variance in the cost of servicing sites, not only based on their location and density, but also owing to site specific characteristics.

With respect to informing and improving the efficiency of delivering land supply and infrastructure, the report highlights the relationship between the cost of servicing greenfield sites and the extent to which those sites are able to access existing

infrastructure. Auckland Council has recognised the importance of having an integrated approach to infrastructure and land supply release. Under the Proposed Auckland Unitary Plan approximately 20 per cent more urban zoned land will be available outside the current urban limit. The new rural urban boundary is designed to facilitate the efficient provision of infrastructure required for greenfield housing development.

The case study approach has been useful in terms of highlighting the importance of improving Council processes with respect to how detailed capital and operating expenditure data is recorded. The study has also shown how the lack of a consistent approach in entering infrastructure funding agreements with developers, or accepting infrastructure in lieu of development (financial) contributions, has not always resulted in cost effective outcomes for Council.

Council is continuing to improve its processes to enable a more robust estimation of the cost of servicing individual developments and of understanding whether the development, or a combination of the development and the wider community, should be charged for infrastructure provision.

The use of more detailed estimates of the cost of servicing will enhance Council's ability to structure development contributions to reflect to the costs of providing infrastructure to a particular area or type of development, thereby promoting more efficient land use. Council has been continuously working to improve its cost allocation methodology through improvements to asset management plans. This has included increasing the number of funding areas, refining the allocation of costs between developers and also between developers and existing rate payers.

1 Introduction

Auckland's population has grown significantly over the past decade and it is forecast to continue to grow into the future. Auckland currently has around 1.4 million people, although expectations are for a future population of 2.3 million people by 2051.[3]

> The Auckland Plan's development strategy outlines that over the next 30 years sufficient capacity is required for 160,000 dwellings and 110,000 jobs in areas outside the 2010 metropolitan urban limits. Of this growth, 90,000 dwellings and 61,000 jobs are directed to the main greenfield areas of Warkworth, Silverdale, the Northwest (Kumeu, Huapai, Riverhead and Whenuapai) and the South (Drury, Karaka South, Paerata and Pukekohe).
>
> The Proposed Auckland Unitary Plan (PAUP) includes a Rural Urban Boundary (RUB) to define where further urbanisation can occur over the next 30 years as well as defining areas that will remain rural. Once implemented, approximately 20% more urban-zoned land will be made available outside the current urban limit.

This level of growth will place significant pressure on the underlying infrastructure required to deliver the range (and standard) of services demanded by the community. This is envisaged to require a high level of investment and planning over the next 30 years as well as careful staging and sequencing of development.

Residential development sites require different investments in physical infrastructure, such as roads and electricity networks, and social infrastructure, such as education and health, depending on their proximity to existing networks and the spare capacity in those networks. These investments are currently incurred by the Council, other government agencies, developers, utilities and ultimately by households.

The investments made in physical and social infrastructure will be of a different type and of a different size depending on whether a development is infill or greenfield in nature. In new areas, entirely new infrastructure may be built and, for some types of infrastructure, land will have to be purchased. For existing areas, investments may be required to upgrade existing facilities or to expand facilities if they are operating close to capacity.

Where there is existing capacity, there will be no costs for some expansion. However, once capacity constraints are met upgrades can be more expensive than on the fringe. Therefore, for areas with 'spare capacity' the *marginal* cost of expansion is relatively low although the *average* cost may be high. Future decisions are typically made on the marginal cost of expansion, recognising that previous investments are already 'sunk'.

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3 http://www.aucklandcouncil.govt.nz/EN/newseventsculture/OurAuckland/News/Pages/aucklandsstrongpopulationgrowthcontinues.aspx

Auckland Council has already undertaken several studies to understand how best to accommodate the future population. A key study was the Auckland Plan Scenario Evaluation Workstream, which considered four alternative land use and transport scenarios reflecting different assumptions on the *compactness* and *density* of the city.[4] The study was based on a range of high level quantitative data and qualitative information sources.

In regards to infrastructure provision, the study concluded that

> A compact approach with focused intensification in specific locations provides the most cost effective and feasible form of development for infrastructure providers, and that expansive growth is often more costly, requiring significant investment in new network components.[5]

The study also concluded that,

> This evaluation clearly shows that a compact spatial form is preferable for Auckland.

The findings of this technical study provided important input into the Auckland Plan. The Auckland Plan provides a comprehensive long-term strategy for Auckland's growth and development. It is supported by the Proposed Auckland Unitary Plan, which provides the platform for bringing together the visions of the Plan. The Unitary Plan will determine:

- what can be built and where
- how to create a higher quality and more compact Auckland
- how to provide for rural activities
- how to maintain the marine environment.[6]

As outlined in the Auckland Plan there is a range of challenges facing the Council. Some of the key challenges include:

Prioritisation of development areas: The Council has a constrained budget that means that infrastructure provision must be prioritised. There are also physical limitations which slows down the pace at which infrastructure can be rolled out. Some of the key questions include:

- How much total infrastructure is required to service an area?
- What is the typical cost of this infrastructure?
- The rollout strategy - broadly speaking the Council has two options for delivering its future infrastructure strategy:
  - The 'shot gun' approach where infrastructure provision is commenced in a large number of areas. While there is greater coverage of development sites this is likely to result in a slower provision of infrastructure and potentially a slower rollout of new dwellings.

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4 Auckland Council (2011), *Auckland Plan Scenario Evaluation Workstream*, September.

5 Auckland Council (2011), *Auckland Plan Scenario Evaluation Workstream*, September, p15.

6 http://www.aucklandcouncil.govt.nz/EN/planspoliciesprojects/plansstrategies/unitaryplan/Pages/abouttheproposedunitaryplan.aspx

- The targeted approach, which focuses infrastructure provision on specific areas and is expected to allow infrastructure (and new dwellings) to be rolled out more rapidly (particularly in a constrained budget environment). The challenge is to choose the area (or areas) to prioritise first, as picking 'winners' is challenging as it relies on an understanding of both the costs of providing infrastructure services as well as an understanding of consumer preferences. There is limited value in choosing areas that are cheap to develop but have where consumers place little value in living.

Incentivising development: One challenge faced by the infrastructure providers is the timing of the development. Under the current approach, the infrastructure is rolled out but there is no guarantee that developers will undertake the development. The result is that there is a greater chance of asset stranding or under-utilisation for a longer period.7 Utility providers may be able to adopt a more flexible approach to delivering infrastructure. For example, it is more common for utilities to consider staging infrastructure provision (e.g. use of modularised sewerage treatment plants) to better align with the rate of development. However, there is a trade-off as the unit cost of delivering the infrastructure upfront may be cheaper.

Auckland Council[8] has recognised the need to take a strategic approach to future capital spend across Auckland in its next 10-year budget. This is known as the Long-term Plan (LTP) 2015-2025. Councillors and council staff have developed an initial set of spatial priorities that will enable a reduced capital programme to be targeted to those areas where the investment will have maximum impact in achieving identified strategic objectives. Council and CCO investment has been aligned to achieve this. These projects have been selected as those that will unlock the potential for business and community development in those priority areas.

This Project

As noted earlier, alternative spatial locations and forms are expected to have differing cost implications for the Council to deliver a range of services, largely reflecting the differing infrastructure needs to support the future developments. The differing infrastructure costs will reflect the:

- extent to which there is spare capacity in the *existing* infrastructure to meet the future needs of the development
- cost of constructing *additional* infrastructure to meet the needs of the development. These costs will vary between developments depending on the site-specific characteristics.

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7 As noted below, the objectives of this project are more narrow and do not specifically deal with, for example, solutions to incentivise development.

8 http://www.aucklandcouncil.govt.nz/en/planspoliciesprojects/plansstrategies/longtermplan2015/Pages/home.aspx

The purpose of this project is to collate and present information on the cost of alternative development options based on case studies of current (or recently completed) developments.[9] This will include the costs related to the range of services provided by the Council to service new developments as well as Central Government costs related to new developments. This will provide the Council with a *guide* as to the costs of alternative development options for the city.

The Council will utilise this information to apply it to future development decisions. Further, the cost information is only one part of the equation. Information about consumer preferences should also be collected by Council (separate to this study) to help guide future land-use planning decisions. That is, developments that offer the least cost infrastructure delivery may not necessarily align with consumer preferences.[10]

The study does not include advice on alternative approaches to recover the cost of infrastructure provision. The alternative approaches can provide (to varying degrees) a disincentive for developers and can impede the rate at which developments are rolled-out.

9 The study does not consider whether or not the expenditure incurred for a development site is the most efficient way of providing the infrastructure.

10 The Council has commissioned a study to better understand the housing preferences of the community in Auckland.

2 The approach

This chapter provides an overview of the approach adopted for this project including the case studies and the cost items chosen.

Case Studies

The project is required to collect information on twelve case studies. The selection of the case studies was undertaken by the Council, broadly based on the following criteria:

- to provide a selection of different types and locations of development which are expected to be representative of future developments.
- where robust cost information is more likely to be readily available.

The Case Studies were drawn from different geographical regions and for development of varying scale and density. Table 2.1 summarises the various case studies selected for the project.

2.1 Expected dwelling production upon completion of development

Development	Region	Development Type (Density)	Maximum dwellings produced
Case Study C1 CBD Sugartree	Central	High	500 – 1 000
Case Study C2 Beaumont Quarter	Central	High	less than 500
Case Study C3 Stonefields	Central	Medium	greater than 1 000
Case Study W1 New Lynn	West	High	less than 500
Case Study W2 Babich	West	Low	500 – 1 000
Case Study N1 Hobsonville Point	North	Medium	greater than 1 000
Case Study N2 Silverdale	North	Low	greater than 1 000
Case Study N3 Riverhead	North	Low	500 – 1 000
Case Study S1 Hingaia	South	Low	greater than 1 000
Case Study S2 Addison	South	Medium	greater than 1 000
Case Study S3 Weymouth	South	Medium	less than 500
Case Study S4 Anselmi Ridge	South	Low	less than 500

Source: Auckland Council and http://www.stonefields.co.nz/Masterplan.aspx

Cost information

Infrastructure type

Cost information was sought from a range of services provided by the Council and other government agencies, as described in table 2.2. Based on advice from the Council we have not included any costs associated with electricity distribution/transmission networks or telecommunications networks.[11] The costs that we have obtained for this project were sourced from Council and other providers and were not developed by the consulting team.

2.2 Infrastructure types

Infrastructure item	Relevant organisation(s)
Education	NZ Ministry of Education
Health	NZ Ministry of Health
Water	Auckland Council (Watercare)
Wastewater	Auckland Council (Watercare)
Stormwater	Auckland Council
Roads	New Zealand Transport Agency, Auckland Transport
Buses and ferries	Auckland Transport
Railways	New Zealand Transport Agency, Auckland Transport, Kiwi Rail
Community facilities (libraries, community centres)	Auckland Council
Open space and recreation	Auckland Council

Source: The CIE and ARUP.

Capital versus operating costs

When planning the acquisition or lease of assets, the initial capital outlay is often the main element being considered. There are, however, ongoing costs that will be incurred over the life of the asset that are less visible but no less essential to the operation of the asset. These costs need to be taken into account as part of any Business Case of a capital works proposal.[12]

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11 The 2011 Technical Report prepared by the Council did obtain high level electricity costs. The report noted the "difficulty with servicing expansive growth. Electricity distribution in urban Auckland is based on a modular network which must connect back to one of Transpower's Grid Exit Points (GXPs). While this is easier to do within existing urban areas given the shorter distances to the GXPs, new greenfield areas are more difficult and expensive to connect" (p126).

12 Australian Government (2006), *Whole-of-Life Costing for Australian Government Property Management Financial Management Guidance No. 15*, Department of Finance and Deregulation.

Utility providers, for example, may have different asset management strategies reflecting the 'opex/capex tradeoffs'. Therefore, just focusing on the capital expenditure component may provide a distorted picture of the cost of servicing different areas.[13] For example, utilities' may choose an asset management strategy that has less upfront capital expenditure but ultimately leads to higher ongoing operating costs. This also applies to a range of other services provided by Council (e.g. ongoing upkeep for parklands with more shrubs/garden beds compared to parklands with just grass).

Information was sought on both the capital expenditure (capex) as well as the operating expenditure (opex) associated with the case studies. However, a lack of available data meant that only opex data relating to road maintenance and public transport operating costs could be estimated. Data limitations and difficulties in extracting site-specific costs from historical transport infrastructure cost data also precluded the estimation of historical transport costs.

Private developer costs

In some instances (such as parklands and stormwater solutions) private developers may construct the asset and 'gift it' to the Council. In this instance, Council may not incur upfront capital expenditure but instead incurs ongoing operating expenditure.[14] Our focus is on the costs incurred by Council, not the private costs for developers. The challenge, however, has been that in some cases (particularly with the historical costs incurred by the legacy councils) specific agreements were negotiated between the council and the developer.

Geographical spread of infrastructure costs

The costs of a development, particularly related to network infrastructure, do not just reflect the infrastructure costs at the development site. Typically, they also reflect infrastructure upgrades that reflect the needs of a broader region. In this instance, the costs of a new development need to reflect both the infrastructure directly related to the specific development as well as some share of regional infrastructure that was also constructed to service the development as well as the broader region.

This concept is illustrated in the following charts. For example, for water infrastructure (Infrastructure Type 1) there may be different assets constructed to service sub-regions and broader regions as well as to meet the whole of Auckland's future population needs. The catchment levels may differ for different infrastructure types. The catchment areas for wastewater infrastructure (Infrastructure Type 2), for example, may not align perfectly with the catchment areas for water infrastructure.

Considering the transport network, the immediate infrastructure requirements to provide access to and within the site will be easier to identify than the enhancements to

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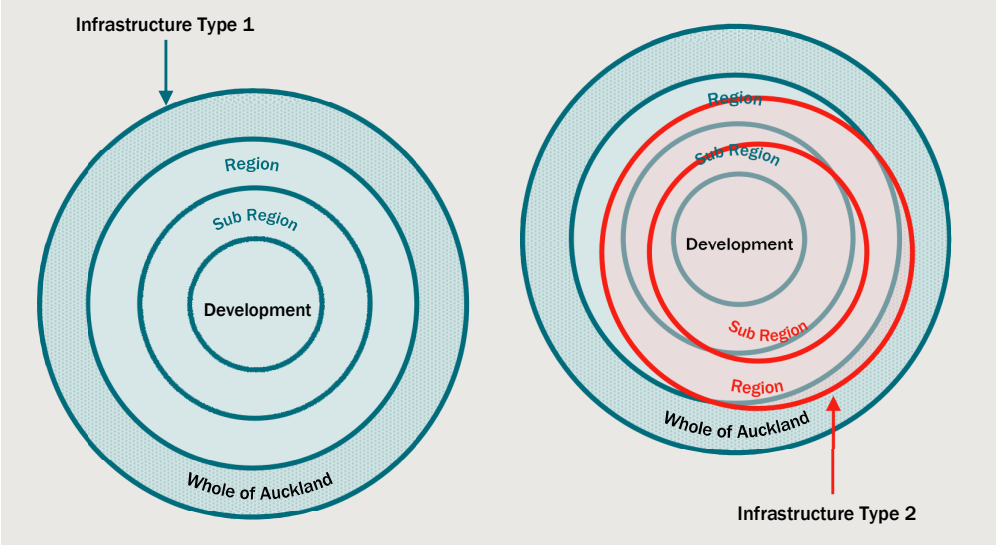
13 Price regulators have confronted these issues over many years. See, for example, https://www.ofwat.gov.uk/future/monopolies/fpl/pap_tec1105capex.pdf

14 In some instances, the vesting of assets may have been associated with an offset in developer contributions.

the wider transport network required to accommodate the growth in travel demand. With respect to the case studies, it is important to identify whether external transport infrastructure or service costs have been attributed to specific developments in the past. Notwithstanding this, it is important to understand both the impact of specific developments on the requirements of the wider networks and how developments in certain localities contribute to the need for additional transport services and infrastructure. The requirements for the wider transport network are easier to assess looking forward rather than back.

2.3 Illustration of infrastructure catchment areas



Source: The CIE

Time period for infrastructure cost information

The case studies relate to developments either fully or partially completed. Where the development sites are fully completed the expenditure information would primarily be based on historical data, although there may also be some future operating expenditure.

For development sites that are partly completed (e.g. Stage 1 of a four stage development) both the *historical* as well as the *future* capital expenditure data is required.

In these instances, the expected future capital expenditure would also depend on the expected future demand for the service. Service providers may adopt alternative scenarios (e.g. high, medium, low) to capture some of the uncertainty in these costs.

The timing of the infrastructure expenditure for the infrastructure development *outside* the development site is likely to differ to the construction within the development site. For example, it is likely that the infrastructure to service the wider catchments will have been constructed prior (say 5-10 years) to the commencement of work at the development site. Therefore, historical expenditure data was also requested for the timeframe prior to the commencement of the development.

Presentation of the cost information

The cost information has been presented in absolute dollar figures as well as the cost *per dwelling* figure based on the planned dwelling potential of the site/area. That is, costs (discounted to 2012/13 dollars) divided by planned dwelling potential. The costs would include all costs incurred to date as well as any additional costs that will be incurred into the future to complete the development.[15]

15 Information could also be presented as a cost *per realised* dwelling, based on uptake of area. This would be based on a time profile of costs and dwellings realised (including estimates of the future time profile for the rollout of dwellings) and assets to service the area. This uptake would be impacted by what is going on elsewhere in Auckland. Hence, if there are more development areas uptake will be slower and costs per realised dwelling will be higher. There was insufficient data available for us to present the costs in this way.

3 Water, Wastewater and Stormwater infrastructure

In this chapter, we present the information in relation to the costs of providing water, wastewater and stormwater infrastructure services.

Water and Wastewater costs

Watercare Services Ltd (Watercare) has been the provider of bulk water and wastewater services to the Auckland region since 1991. On 1 November 2010, following Auckland regional governance reforms, the company took over ownership and management of all the public water and wastewater assets within the Auckland Council region and began retailing services directly to the people of Auckland. The exception is the Papakura district, where retail services are managed via a franchise agreement with United Water International Pty Ltd.[16]

Watercare has an extensive network of assets to supply the wider Auckland region. It has a large capital works program of approximately $4.8 billion (in nominal terms) planned for the 10-year period from 1 July 2012 to 30 June 2022. Approximately 50 per cent of the planned expenditure relates to wastewater assets, while 47 per cent relates to water assets. About 42 per cent of the forecast expenditure is attributed to meeting the requirements for growth.[17]

Watercare's asset management planning is based on a forecast population increase across the Auckland region from 1.48 million people to 1.75 million by 2022 and 1.95 million by 2031. It assumes that

> The Auckland Plan will determine the distribution of growth across the Auckland region. However, it is likely that much of this growth will occur in the Rodney and Franklin wards, where most of the city's urban expansion will occur in the form of green-field development. Some urban expansion is also projected for other areas such as Flatbush and Massey North/Westgate, but the rest of the forecast growth is expected to occur through intensification of existing urban areas.

The vast majority of Watercare's expenditure can be classified as wider network costs that service a larger catchment beyond the just the case study development site. Watercare has identified a range of projects that service the case study sites. Each of the

16 Watercare Services Ltd (2011), Asset Management Plan – 1 July 2012 to 30 June 2022, December, p.7.

17 Watercare Services Ltd (2011), Asset Management Plan – 1 July 2012 to 30 June 2022, December, p.6.

projects also services a wider network outside the case study sites and, therefore, only a portion of the costs can be attributed to the development.

Further, in some instances, the projects may have multiple objects only one of which is related to growth. For example, upgrades to wastewater treatment facilities may relate to the need to meeting wastewater discharge standards, maintaining network integrity/performance, as well as meeting future growth. Watercare has separately identified the proportion of the investments attributable to growth.

Watercare has indicated that developers provide the infrastructure required within each development site and there is no adjustment to developer charges in recognition of these costs. That is, the capital expenditure on water and wastewater assets within the development sites is funded by the developer.

Wastewater investments

Table 3.1 provides a summary of the key investments identified that will service the various development sites. There is a mixture of timings for the investments:

- Some have already been completed, such as the West Lynn Diversion and the South-Western Interceptor;
- Some have commenced and will be completed over the next decade, such as the Central Interceptor and the upgrade to the Mangere Wastewater Treatment Plant and;
- Others, such as the upgrade to the Army Bay Wastewater Treatment Plant, will not commence for several years.

The projects are a mix of augmentations to existing assets and construction of new assets to cater for the higher expected population that will need to be serviced by these assets in the future.

The majority of the projects listed in table 3.2 are owing to the need to meet future growth. Notable exceptions to this are the Central Interceptor, Concourse/Western Interceptor and Waterfront Interceptor projects, for which only a proportion of the expenditure is attributable to growth.

Each of these projects is expected to service a wider region, not a specific case study site. The case study populations generally make up a very small share of capacity growth, the exceptions being projects with narrow catchment areas servicing case studies in the north, as well as the local Takanini branch sewer and West Lynn diversion.

3.1 Wastewater infrastructure

Project name	Regions serviced	Catchment	Case studies effected
Army Bay Outfall	North	Whangaparaoa	Silverdale
Army Bay WWTP	North	Whangaparaoa	Silverdale
Central Interceptor	Central, West	Auckland Isthmus, Eastern Beaches, Eastern Suburbs	CBD Sugartree, Beaumont Quarter, Stonefields, Merchant Quarter, Babich

Project name	Regions serviced	Catchment	Case studies effected
Concourse/Western Interceptor	West		Hobsonville Point, Babich
Hingaia	South	Hingaia	Hingaia
KHR	North	Kumeu, Huapai and Riverhead	Riverhead
Mangere WWTP	Central, West, South	Auckland Isthmus, South Auckland, Papakura	CBD Sugartree, Beaumont Quarter, Stonefields, Merchant Quarter, Babich, Hingaia, Addison, Weymouth
NorSGA	North	NorSGA	Hobsonville Point, Riverhead
Northern Interceptor Stage 1	North	NorSGA, West Harbour, Massey, Te Atatu	Hobsonville Point, Riverhead
Orewa	North	Orewa	Silverdale
Project Hobson	Central	Auckland Isthmus, Eastern Beaches, Eastern Suburbs	CBD Sugartree, Beaumont Quarter, Stonefields
Pukekohe Trunk Sewer	South	Pukekohe	Anselmi Ridge
Pukekohe WWTP	South	Pukekohe	Anselmi Ridge
Pukekohe Local Sewer	South	Pukekohe	Anselmi Ridge
Puketutu Island Rehabilitation	Central, West, South	Auckland Isthmus, South Auckland, Papakura	CBD Sugartree, Beaumont Quarter, Stonefields, Merchant Quarter, Babich, Hingaia, Addison, Weymouth
Rosedale WWTP	North	North Shore, NorSGA, West Harbour, Massey, Te Atatu	Hobsonville Point, Riverhead
South Western Interceptor	South	South Auckland, Papakura	Hingaia, Addison, Weymouth
Takanini Branch Sewer	South	Takanini	Addison
Waterfront Interceptor	Central	Auckland Isthmus, Eastern Beaches, Eastern Suburbs	CBD Sugartree, Beaumont Quarter, Stonefields
West Lynn Diversion	West	New Lynn, Kelston, Titirangi (East)	Merchant Quarter, New Lynn

Note: Dollars are reported in nominal terms, except cost per dwelling which is reported as the net present value in 2012/13 prices
Source: WaterCare

No information was available on the operating costs over the longer term for each of these projects.

The discounted per dwelling costs of providing the future infrastructure projects outlined in Watercare's capital works program are presented in table 3.2. The table shows for each project analysed the projected or actual start and end data of the construction works and the associated cost, in nominal terms. Watercare has allotted a share of the cost to capacity growth and provided the associated growth in capacity (dwellings). The net present value of the growth portion of the project cost was calculated using a 7% discount rate.

No works are included that were completed prior to 2008 as earlier costing information from the former territorial authorities was not available. This is a significant limitation of the analysis, as it is likely that earlier capacity growth played a key role in accommodating demand from some of the case studies.

3.2 Wastewater cost per dwellings

Project name	Asset type	Start date	Completion date	Project cost	Attributable to growth	Dwelling Capacity Growth	Cost per dwelling 2012/13
				$m	Per cent		$m
Army Bay Outfall	New Outfall	2012	2018	15	100	12 000	1 063
Army Bay WWTP	Augment existing treatment plant	2017	2025	40	100	12 000	1 898
Central Interceptor	New trunk pipeline	2009	2023	800	30	350 000	561
Concourse/Western Interceptor	New Storage Tank	2008	2012	15	50	17 000	524
Hingaia	New pumping station	2004	2007	7	100	5 000	2 252
KHR	New Pumpinng Station and PWC Network	2010	2013	12	100	6 000	2 143
Mangere WWTP	Earlier treatment plant upgrade	1998	2003	300	50	90 000	3 771
Mangere WWTP	Augment existing treatment plant	2012	2018	200	100	70 000	2 429
NorSGA	New pumping station	2006	2013	35	100	17 000	2 545
Northern Interceptor Stage 1	New trunk pipeline	2013	2018	170	100	75 000	1 859
Orewa	New pump station and rising main	2006	2008 and 2020	15	100	20 000	899
Orewa	Rising main upgrades	2009	2012	3	100	1 500	2 293
Project Hobson	New trunk pipeline	2007	2010	130	50	37 000	2 306
Pukekohe Trunk Sewer	Augment existing trunk pipeline	2013	2018	34	50	67 000	208
Pukekohe WWTP	Earlier treatment plant upgrade	2005	2008	25	100	11 500	3 267
Pukekohe WWTP	Augment existing treatment plant	2014	2021	59	100	35 000	1 213
Pukekohe Local Sewer	Augment existing trunk pipeline	2018	2020	2	100	350	3 683
Puketutu Island Rehabilitation	n/a	2011	2045	173	50	150 000	250
Rosedale WWTP	Augment existing treatment plant	1992	2009	103	50	73 000	1 678
Rosedale Outfall Upgrades	New Outfall	2006	2009	116	100	222 000	734
South Western Int	Augment existing trunk pipeline	2006	2010	35	100	28 000	1 700
Takanini Branch Sewer	New trunk pipeline	2006	2008 and 2020	15	100	6 000	2 996
Waterfront Interceptor	Augment Existing Pipeline	2014	2025	250	50	116 000	687
West Lynn Diversion	Augment Existing Pipeline	2004	2008	9	100	3 500	4 003

Note: Based on the maximum dwelling production once the development has been completed.

Source: WaterCare

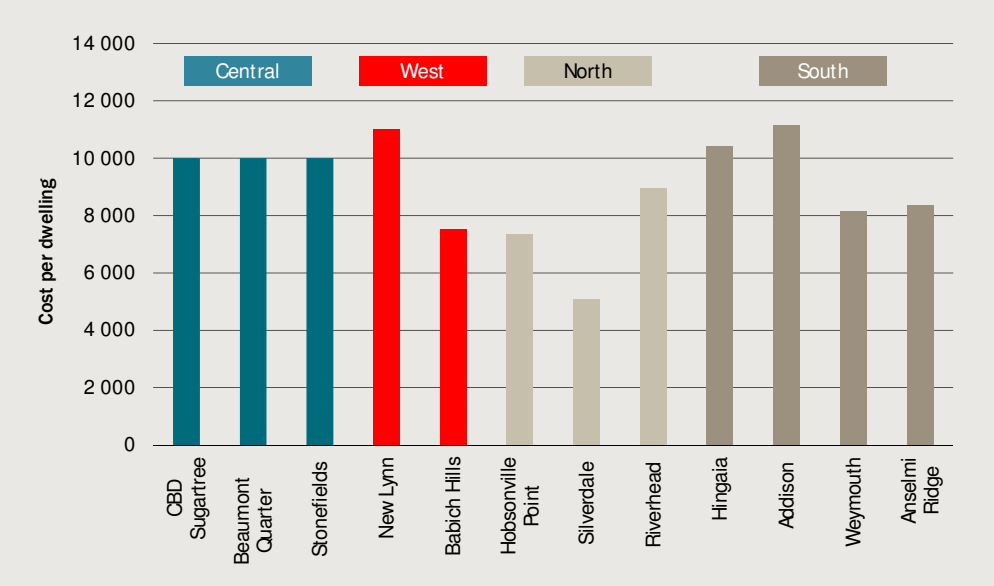
Cost per dwelling

The estimated wastewater cost per dwelling attributable to each case study development (and taking account of only the growth related component) is presented in chart 3.3, where the cost for each case study is the sum of the growth cost per dwelling for each project on which the case study places demand. Based on the analysis, the cost per dwelling is (on average) highest in the Central region ($10,003 per dwelling), followed by the West region ($9,274 per dwelling). The cost per dwelling of providing wastewater services was highest for Hingaia and Addison case studies in the south and New Lynn in the west.

On average, the case studies in the central region were the most expensive to service. A number of Auckland's key wastewater assets are nearing the end of their economic life and/or are running close to full capacity. The work required to upgrade these assets is substantial and extensive. Residential developments in the central region were allocated costs from the two largest capital expenditure programs – the Central Interceptor and the Mangere Wastewater Treatment Plant (WWTP) upgrade. Only 30 per cent of the Central Interceptor project is attributable to growth with the existing network reaching the end of its economic life. The project also services a large population, so despite the high capital outlay the cost per dwelling is comparatively low. The Mangere WWTP upgrades are associated with a higher cost per dwelling but the costs are widely distributed, covering developments in the west, central and southern regions (excluding Anselmi Ridge in the south). Developments in the central region were also attributed costs from the Waterfront Interceptor and Project Hobson. While the Waterfront Interceptor has a comparatively low cost per dwelling serviced, Project Hobson – the replacement of an ageing sewerage pipe crossing Hobson Bay – has one of the highest per dwelling costs and only impacts on costs for the centrally located case studies.

The summarised costs are for the projects in Watercare's forward works program only.

3.3 Wastewater cost per dwelling for case study areas



Note: Dollars are the present value of the future cost stream, reported in 2012/13 real dollars.

Data source: Estimates based on WaterCare data

Water investments

Watercare has invested significantly in its water assets to meet future growth. Similar to the wastewater projects noted above, these assets typically service a wider catchment area beyond just the case study development site.

Table 3.4 provides a summary of the identified key investments that will service the case study sites. A large number of the projects have already commenced and are to be completed in the next 1 to 5 years.[18]

As with wastewater, only limited information is provided for historical capacity building works. This is a significant limitation of the analysis, as it is likely that earlier capacity growth played a key role in accommodating demand from some of the case studies.

No information was available on the operating costs over the longer term for these projects.

3.4 Project to provide water services to case study regions

Project name	Case studies affected	Start date	Completion date	Project cost, $m	Attributable to growth	Dwelling Capacity Growth	Cost per dwelling 2012/13
				$m	Per cent		$m
Upgrade of Waikato WTP (50MLD)	All case studies	2011	2014	50000	100	70000	715
Waikato WTP 50MLD and pipeline	All case studies	2000	2002	110000	100	70000	3423
Waikato WTP to 75MLD	All case studies	2006	2007	25000	100	40000	938
Waikato WTP 100 MLD	All case studies	2008	2009	50000	100	40000	1638
Hunua 4 watermain	CBD Sugartree, Beaumont Quarter, Stonefields, New Lynn, Babich, Hobsonville Point	2011	2018	450000	80	200000	1587
Mt Wellington watemain including East Tamaki SR	CBD Sugartree, Beaumont Quarter, Stonefields	2008	2010	20000	70	15000	1183
Pukekohe North Franklin main	Anselmi Ridge	2010	2014	75000	75	10000	5835
Kumeu/Huapia/Riverhead pipeline (KHR)	Riverhead	2010	2014	35000	90	6000	5446
Northern Strategic Growth Area (NORSGA)	Hobsonville Point	2010	2014	15000	90	17000	824

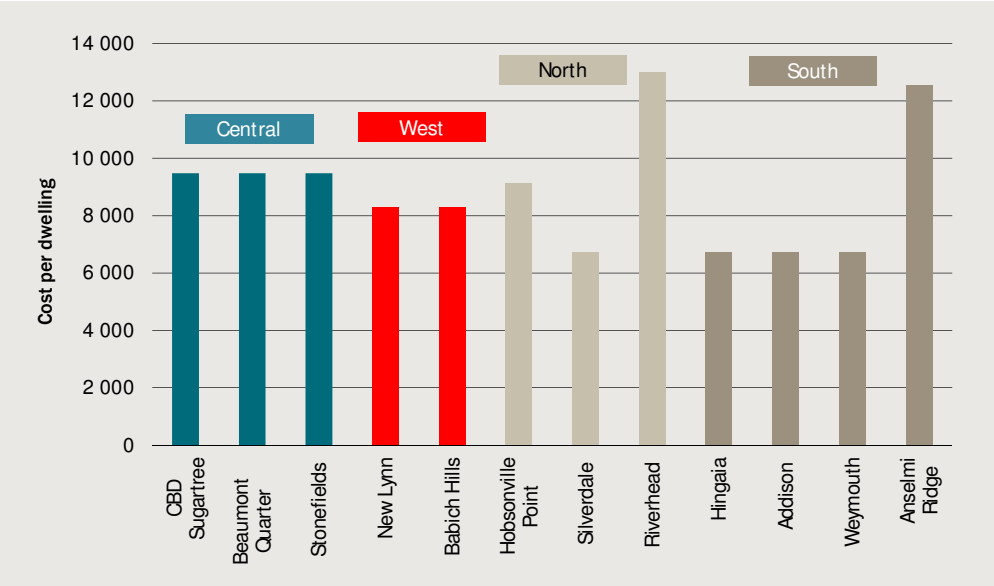
Source: Watercare

18 Further information about the Watercare projects can be obtained via the following link https://www.watercare.co.nz/about-watercare/projects/Pages/default.aspx

Cost per dwelling

Watercare provided data on the share of each project's costs attributable to growth and the associated increase in capacity, which was used to calculate the cost per dwelling associated with growth as shown in the last column of table 3.4. Chart 3.5 presents a summary of the aggregated costs per dwelling for the projects servicing each of the cases studies and includes some minor local projects

3.5 Wastewater cost per dwelling for case study areas



Note: Dollars are the present value of the future cost stream, reported in 2012/13 real dollars.

Source: Estimates based on WaterCare data

Based on the analysis, the cost per dwelling is (on average) highest in the North region ($9,609 per dwelling), followed by the Central region ($9,485 per dwelling). The most expensive areas to service based on the projects identified were Riverhead in the north, at a cost of $12, 985 and Anselmi Ridge in the south, at a cost of $12,550.

The high cost of servicing Riverhead is attributable to the Kumeu/Huapia/Riverhead (KHR) pipeline investment, which provided the area with a public water system. Local investment also accounted for the high cost of servicing Anselmi Ridge, which was apportioned a share of the investment in the Pukekohe North Frankin main. These assets service a comparatively small projected population but involve high capital outlays.

Stormwater

Stormwater services in Auckland are provided by a department within the Council. Prior to the 2010 amalgamation of the Council, stormwater services were separately provided by each of the individual councils.

There is a range of different stormwater assets required to service new developments. The three largest cost items are:

- Land purchases
- Decentralised treatment facilities
- Trunk piped infrastructure

Some of the key drivers of stormwater costs identified include:

- Proximity to receiving waters which reduces transportation costs, particularly piping of infrastructure. For example, developments located closer to coastlines are typically cheaper to service.
- The natural topography, such as naturalised stream channels, which also reduce the need for piping.
- Where the developments result in a larger surface area of new roads this typically results in higher costs given the additional volume of stormwater flows that are required to be managed.
- Land purchase costs, which are typically lower away from major centres. Further, generally speaking, land purchase costs are lower in any area where there is flooding. Land costs are also affected by the requirement for buffer zones.

Developers typically incur the costs associated with providing the stormwater services within the development area. For example, trunk piped infrastructure are typically funded upfront by developers.[19] The exception to this are instances where larger trunk piped infrastructure is required within a development site to service a wider catchment. In these instances, the Council funds these assets through individual infrastructure funding agreements (IFAs).[20]

Historical costs (prior to 2010)

Historically there have been negotiated agreements that have blurred the line between council and developer funding of assets, while a further challenge in obtaining historical stormwater costs was the limited availability of data. In order to overcome these issues historical stormwater cost data was estimated for each case study from 'first principles' based on robust information about the type and location of stormwater assets obtained from Council's GIS database. The GIS database includes information on the location, length, area and (in some instances) material type of Council stormwater assets. However, the GIS database includes all stormwater assets owned by Council including those assets originally installed by developers but subsequently vested to Council. The Council's stormwater estimated the share of assets paid for by the public sector with each case study.

The costs were estimated using 2012 valuation data using the Optimised Replacement Cost method, which is consistent with the Council's Asset Management Plans. Where

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19 The costs are not recovered from developers at a later stage, either through the gifting of assets or a reduction in developer charges.

20 Andrew Chin, email 3 December 2013

assets were not in the valuation database, costs were estimated from first principles using unit rates. An inflation rate was applied to convert the 2012 valuation data to 2014 dollars. The value of land purchases was also included in Council's estimates of historical stormwater costs.

Future costs

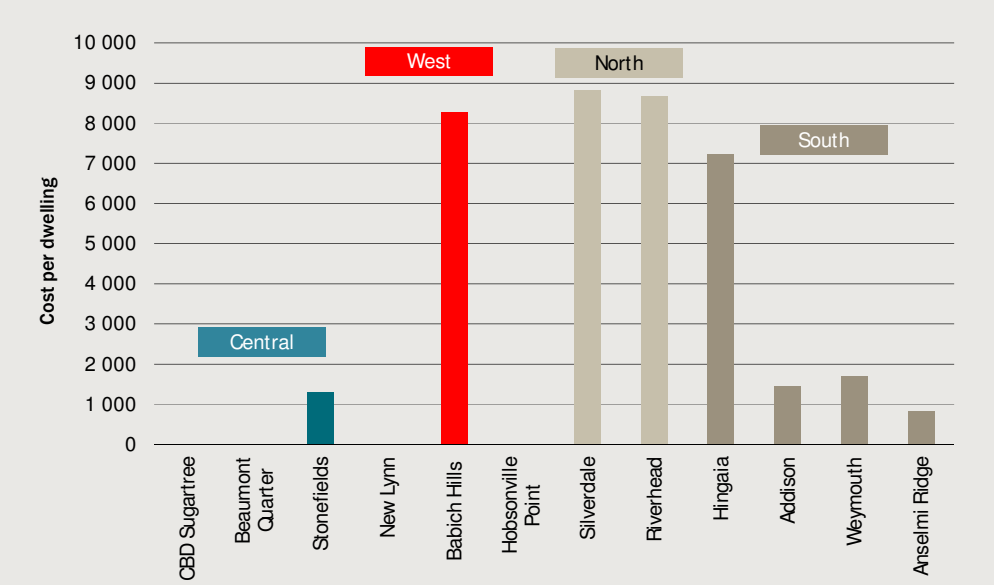
Regarding future costs, the Council has previously commissioned separate independent analysis to estimate the additional costs for providing stormwater services to future potential development areas. These costs are reported in Morphum Environmental Ltd's January 2014 study titled *Technical Report for Stormwater Growth Acceleration Model Stage 1 & 2*. Some of these costs have been superseded by IFAs between Council and developers.

Cost per dwelling

Chart 3.6 below presents the cost per dwelling to the Council of providing stormwater related infrastructure for each case study. There are no new Council projects to manage stormwater in many of the case study sites in the Central region. This, in part, reflects the fact that the developments are replacing existing 'hard surfaces' where stormwater assets already have sufficient capacity. The outer areas in the North and South regions typically require new stormwater assets as there are no assets currently in place. This reflects the greenfield nature of these sites.

In the case of Hobsonville Point, the developer has provided the stormwater facilities. As the development does not discharge into the public stormwater network, they have not been charged development contributions related to stormwater. In Hingaia, Council has requested the developer to provide infrastructure with capacity in excess of their requirements to cater for additional growth in the area and has entered in into a partnership agreement to fund part of the stormwater infrastructure. Developments adjacent to the Hingaia residential site using this infrastructure will have to pay development contributions. At Addison, the infrastructure provided by the developer does discharge into the public stormwater network and so development contributions have been levied. However, like Hingaia, the infrastructure provided by the developer is to service a wider population and Council is working on a partnership arrangement with the intention of co-funding the required infrastructure.

3.6 Stormwater cost per dwelling for case study areas



Note: This includes a combination of past and projected costs to the public sector, but excludes costs attributable to private developers.

Source: Estimates based on Auckland Council data

The costs above provide an indication of per dwelling costs associated with accommodating growth in each of the case studies under investigation. However, stormwater costs can be significantly higher. Table 3.7 below provides some further examples of stormwater costs (per dwelling) in different areas. The stormwater costs in 'Takanini Structures 2a, 2b and 4' are estimated at closer to $23,000 per dwelling. This largely reflects a new conveyance system (the Takanini Conveyance Channel Infrastructure) in what is a flood prone area. This highlights the importance of site-specific characteristics in driving some costs.

3.7 Stormwater costs associated with other developments

Project	Cost
	$/dwelling
Takanini Structures 2a, 2b and 4	22 663
Takanini Structures 1a and 1b, 5	2 117
Hingaia 1b	2 079
Whenuapai Stage 2b (north SH18, Future Business)	817
Whenuapai Stage 2	17 169
Southern RUB Area Core P	13 258
Southern RUB Pukekohe West Optional	4 176
Southern RUB Whangapouri Option	8 894
Whenuapai Stage 3, Future business and residental	2 667
Whenuapai Stage 3, Monterrey Park area (WCC)	3 803

Source: Estimates based on Auckland Council data

4 Transport infrastructure

Council and Government provide transport services including roads, heavy rail, light rail, buses, ferries, cycleways and footpaths. Depending on planning policy and the growth path, the types of transport that people use and the type of infrastructure that the Council needs to invest in could all change.

In the context of this study, transport infrastructure consists of fixed installations (including roads, railways, pedestrian paths, cycleways and terminals such as railway stations, bus stations/stops and ferry terminals) and the public transport vehicles traveling on these networks (including buses, trains, and ferries).

Key drivers of direct transport costs at a local level include demand for new and upgraded local roads and intersections to accommodate increases in car trips generated by new development as well as increased demand for car parking, local bus services and walking and cycling infrastructure. More regionally, drivers of direct transport costs include demand for new and upgraded distributor and arterial road networks to serve rising demand for motor vehicle travel as well as provision of new and/or upgraded regional bus facilities, rail infrastructure and ferry terminals.

The costs of transport infrastructure spending are significant and considered a key driver of locational costs as highlighted in a Sydney study (box 4.1). The Council's Long Term Plan 2012-2022 estimates that transport infrastructure expenditure of around $675 million will be required over this period to meet demand associated with growth (for "Public Transport and Travel Demand Management" and "Roads and footpath").

4.1 Relative magnitude of transport costs, the Sydney case

In work undertaken for Sydney, the transport infrastructure/connections and congestion costs were estimated to be around $15.8 billion (in Net Present Value terms, AUD) over the period 2010-2030 to deliver a 'fringe focused' growth strategy. The transport costs for a strategy focused on more infill areas was closer $12 billion. [21]

For Sydney the transport related costs were estimated to be between $26 900 per dwelling to $35 000 per dwelling depending on which growth scenario was adopted. In comparison the costs related to water/wastewater and electricity network costs amounted to between $15 700 to $18 900 per dwelling. The infrastructure costs related to education, health services, fire services and local council infrastructure was around $41 000 per dwelling.

21 CIE (2010), The Benefits and Costs of Alternative Growth Paths for Sydney, p.13.

Newman and Kenworthy (1999)[22] estimated the transport costs associated with inner city and fringe development in Australian cities using functions of vehicle kilometres travelled (VKT) covering all private, public and external costs (e.g. fatalities, injuries, property damage, air pollution and noise pollution). This study found that the recurring annual cost of transport associated with an inner city dwelling was $18,611, compared to $36,747 for a dwelling on the urban fringe.[23] It also found that capital expenditure on roads for inner city dwellings amounted to approximately 10 per cent of total capital infrastructure investment compared to 22 per cent for a dwelling on the urban fringe.

Other studies such as that undertaken by the Council's Transport Strategy Unit (the Transport in greenfield Areas (TIGA) report) also provide some indication of the relative importance of transport expenditure (Box 4.2). Importantly, it also highlights the different costs per dwelling of servicing the different greenfield areas (Silverdale being the cheapest area and Warkworth being the most expensive).

Estimating the transport costs related to particular developments is complex. City transport systems operate as a network with interactions with the built environment and respond to a range of human behavioural factors and needs. In order to estimate the transport related cost of residential servicing we have adopted two approaches:

- ***Actual costs***: Based on information supplied by Auckland Council and Auckland Transport to identify the public sector's contribution to actual direct transport capital, maintenance and operational costs as a result of each case study;
- ***Wider Transport Network costs***: Using the Auckland Regional Transport (ART3) model results provided by Auckland Council to assess the future transport costs associated with each case study through measuring their contribution to regional transport infrastructure required to support growth.

However, owing to difficulties (outlined in the next section) in isolating the direct costs for each case study, only wider transport network costs were quantified for this study.

Direct transport expenditure

There remain significant gaps in our knowledge of the transport infrastructure over the past decade attributable to particular case studies. This is due, at least in part, to the legacy of the individual Councils who governed the region prior to formation of Auckland Council and Auckland Transport in 2010. In addition, variability in who has paid for infrastructure in the past (i.e. a Council or a developer) has meant that more information on transport infrastructure costs is available for some case studies than for others. For example, in instances where a project has been a Council driven initiative (e.g. Merchant Quarter New Lynn), Council has made significant contributions to investment. In other instances where the project is driven by the private sector (e.g.

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22 Newman, P and Kenworthy, J (1999), *Sustainability and Cities: Overcoming Automobile Dependence*, Island Press, Washington.

23 Figures presented in Australian dollars based on 2007 prices.

4.2 Findings of the TIGA Report

The TIGA report outlines the development of conceptual transport networks in Auckland's major greenfield growth areas. The conceptual network provides a transport network that supports the following key outcomes:

- Supporting a quality urban form
- Protecting the environment
- Achieving an efficient and cost-effective transport network
- Contributing to social and economic aspirations

Each of these key outcomes can inform network structure, network scale, public transport infrastructure and public transport service provision in the greenfield areas to create a fine-grain matrix to guide the development of the conceptual transport networks. Four greenfield areas were selected including: Warkworth (Northern Cluster), Silverdale (Northern Cluster), Kumeu/Huapai/Whenuapai/Riverhead ("the Northwest"), Drury/Karaka/Paerata/Pukekohe ("the South").

Initial cost estimates were provided by Auckland Transport and NZTA for the purposes of giving Auckland Council an indicative cost for the proposed road networks within the Rural Urban Boundary (RUB) areas. The costing simply estimates the likely capital cost of the road and public transport infrastructure based on typical typologies and costs from similar networks elsewhere in the region. The report estimates that between $3.8 and $4.7 billion is required to support the transport network to service the expected growth in these areas with no distinction made between the demand from employment and residential growth. The estimated costs per dwelling are provided in the table below.

It is likely to be a lower bound estimate of costs as they exclude projects that are already identified in the Auckland Plan as well as costs associated with the likely upgrading of existing infrastructure outside the greenfield areas themselves (where these possible projects are not already identified in the Auckland Plan).[24]

Estimated cost per dwelling of providing transport related infrastructure

Greenfield Area	Approximate cost per dwelling	
	Lower bound	Upper bound
	$	$
Warkworth	57 518	82 169
Silverdale	28 863	36 434
Northwest	51 948	67 532
South[a]	31 690	47 038

Note: The lower bound and upper bound estimates for the South utilise the three scenarios (West- East Focus, Corridor Focus, Pukekohe Focus)
Source: Auckland Council (2013), TIGA Report, p32.

[24] Auckland Council (2013), TIGA Report, p32.

Stonefields), developers have been required to pay for any additional infrastructure provided. As Council records do not include information on private sector spending it has been difficult to compare the relative investment between these different types of case studies.

There are also other challenges associated with adopting a historical approach to the question of transport infrastructure. Most notably, Auckland Transport has indicated that past decision making around investment has been largely reactive. Budget limits on transport infrastructure spending have resulted in a focus on investment in projects with the highest priority to address immediate needs rather than supporting a planned approach to satisfy forecasted demand. Auckland Transport anticipates that a considerable amount of further transport infrastructure investment will be required to enable some of the case study developments but planning for this investment is still in its relative infancy and costs are yet to be estimated.

Metropolitan Centre case studies

Auckland Transport has indicated that for the case studies within the CBD (Sugartree and Beaumont Quarter) there has been limited public sector expenditure attributable to the developments. While significant transport expenditure has occurred in the CBD area, this services commuters from outer suburbs.

This approach is supported by evidence that a significant proportion of residents in the CBD areas typically walk or cycle to their workplace. The 2013 Census indicates that over 25 per cent of people in the City of Auckland, walked, jogged or cycled to work.[25] Further, evidence suggests that where development within high density mixed use settings such as the CBD or a major centre generates a demand for travel, this is more likely to be by passenger transport. Even when travel is undertaken by car, it is considered more likely that this will be in the counter-direction to peak flow and in so doing will be less likely to aggravate congestion or a need for additional road infrastructure.[26]

The only case study within the Metropolitan Centre with a considerable amount of investment in transport infrastructure is the New Lynn Merchant Quarter project.

The New Lynn Transit Oriented Development (TOD) project[27], is a key urban renewal and revitalisation project within the Auckland Metropolitan Centre. Auckland Transport estimates that approximately $280 million has been invested in transport infrastructure for the Merchant Quarter development within the New Lynn TOD, which includes local

25 Statistics New Zealand, 2013 Meshblock dataset (Available at: http://www.stats.govt.nz/Census/2013-census/data-tables/meshblock-dataset.aspx)

26 Munro, Ian and the Auckland Council Development Contributions Team (2012). '*Residential Activity Demand and Attribution – Auckland Council Development Contributions Policy 2012',* Auckland Council March 2012.

27 Key sources of funding for the transport infrastructure associated with this case study included KiwiRail, NZTA and the Auckland Regional Transport Authority.

roads and intersections, car parking, pedestrian and cycling infrastructure and major new bus and rail infrastructure. Without this expenditure this first stage of the New Lynn urban renewal project, which includes 130 dwellings as well as other commercial and community uses, would not be able to proceed.

It is evident that this investment will also serve future stages of development in the New Lynn area itself (currently planned to accommodate 1,800 new dwellings) as well as the wider region, including people travelling from other areas to access jobs, services and facilities provided as part of the New Lynn development. This makes attributing the full cost of the transport investments in this case study somewhat problematic.

Isthmus case studies

Within the Isthmus area, the case study selected was Stonefields. This provides a useful example of a private sector led project.

The Stonefields case study development is being delivered by the Todd Property Group. Auckland Transport has indicated that transport infrastructure expenditure for this case study development has included new local and collector roads, upgrades to distributor and arterial roads, intersection improvements, new car parking, new and upgraded pedestrian and cycling infrastructure and new bus infrastructure. Based on the information provided by Auckland Transport it appears this expenditure includes a mix of Auckland Council/Auckland Transport investment and developer investment via direct infrastructure delivery and development contributions. No information has been provided on the quantum of expenditure by Council or the developer.

Metropolitan Limit case studies

Auckland Transport has indicated that developers provide most of the infrastructure required within the development sites, while most of the development within the surrounding area is funded by Council. This applies mostly to case studies at the metropolitan limit (including Millwater, Addison, Weymouth, Babich Hills and Karaka Lakes) and within the satellite towns and rural and coastal towns (including Riverhead South and Anselmi Ridge). An example is Hobsonville Point.

The Hobsonville Point development is being delivered by the Hobsonville Land Company, a wholly owned subsidiary of the Housing New Zealand Corporation. Auckland Transport has indicated that transport infrastructure expenditure for this development has included new local, collector and distributor roads, intersection improvements, new car parking, new pedestrian and cycling infrastructure, new local and regional bus infrastructure and a new ferry terminal and ferry services. All transport infrastructure within the development precinct itself has been paid for by the developer. However, Auckland Transport has indicated that expenditure on transport infrastructure beyond the precinct has been provided by Auckland Council/Auckland Transport. This includes in the order of $3.8 million spent on a new passenger ferry

terminal, up to $2.1 million to be spent on car parking at the ferry terminal and upgrades to bus services estimated to be around $125,000 per annum.[28]

Importantly, Auckland Transport has highlighted that much of the transport infrastructure investment linked to the Hobsonville Point development, including the ferry terminal and highway upgrades, were driven by other significant development activities already planned in the wider area prior to the development occurring. As such, rather than being the driver initiating this infrastructure investment, the Hobsonville Point development simply led to this investment being brought forward to serve a significant new and growing urban catchment. It has also been noted by Auckland Transport that the provision of new and upgraded transport infrastructure serving the area has stimulated demand for further development that, in turn, is expected to generate the need for more infrastructure upgrades (e.g. an improved interchange).

Conclusions

While the lack of consistent and comparable historical information on the cost of transport infrastructure associated with each case study means that the residential servicing costs cannot be readily generated for a review and/or comparison between case studies, there are a number of useful messages that can be taken away from the investigations undertaken.

First, a mixed approach to transport infrastructure expenditure has been adopted across the case study projects in terms of the mix of private sector versus public sector investment based on the specific aims of previous Legacy Councils. A key distinction amongst the case studies examined appears to be developments delivered by public initiative (e.g. Auckland Council or the Housing New Zealand Corporation) versus those delivered by the private sector. In terms of the former, information provided by Auckland Transport indicates that Auckland Council/Auckland Transport (and their predecessors or other government agencies including KiwiRail and New Zealand Transport Agency (NZTA)) have invested significantly in transport infrastructure to enable development. For the latter, the developer has been required to deliver, or contribute, a significant component of the transport infrastructure needed when there was no alignment with public initiatives. This funding model has been a historical legacy and may not operate in the future due to changes legislation, which demands greater consultation and cooperation between the private and public sectors when planning residential developments.

Second, we understand short term planning for transport infrastructure upgrades has typically been 'reactive' to the immediate issues of concern with investment limited to high priority upgrades required in the short-term, which limited investment in future developments particularly in the greenfield areas.

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28 This includes variations to existing bus service contracts including an additional $83,142.50 for bus services from 4 Feb 2013 to 30 June 2013 and annual costs of $42,721.50 up to the end of the contract period for school bus services to and from Hobsonville Point school. *Source: Email Arlene Jose, Contracts Administrator, PT Operations and PT Commercial, Auckland Transport dated 24/03/2014.*

Third, limits on transport budgets have been identified as a key constraint on medium and long term planning for local transport infrastructure investment. This has made it challenging for Auckland Transport to estimate the likely future costs attributable to particular developments even in areas where it is recognised that, cumulatively, development will generate transport demand that will impact significantly on local traffic networks in the future.

Wider transport network costs

The impact of the size, composition and location of development on the cost of providing transport infrastructure in a city is a complex issue. The interaction between drivers of demand and the transport network costs can be difficult to assess given the range of behavioural, economic and social factors involved. There are many potential outcomes depending on planning priorities and objectives. Our approach has been to adopt Auckland's current land use policy and transport plan to underpin our analysis of the wider transport network costs.

The estimation of the costs associated with each case study is based on the transport infrastructure requirements as reflected in the Integrated Transport Programme (ITP) of Auckland Transport, which is based on the use of scenario 8IB. Auckland Council's ART3 model was used to estimate transport demand across the Auckland region based on the scenario's -projections of future land use, medium population growth, and assumptions regarding further development being on the fringes of the urban areas. Given that many of the case studies involve significant future development, we have assessed the impacts of the case studies in a future year. The transport analysis has been undertaken for a 2041 demand year for the morning peak period in order to align with the ITP investment programme outcomes. Auckland Council supplied the proposed investment totals for all of the transport projects reflected in the ITP as at 1 March 2014.

In summary, the analysis identified the following:

- The cost contribution of each case study to the road and public transport projects identified in the ITP
- Road and Public Transport operating costs

Limitations of the analysis

ART3 is a strategic (regional) transport model with 564 land use zones that covers the entire Auckland region. Many of the case studies cover areas much smaller than their ART3 land use zone, some are the same size (e.g. Stonefields), while others crosses multiple ART3 zones. This is particularly the case in the outer case studies such as Riverhead South and Anselmi Ridge where the recent upgrade to the ART3 model has disaggregated zones. The approach taken therefore has been to use the ART3 zones as indicative of the case study traffic movements and report results relative to demographics and trip making for comparative purposes.

The analysis uses the most likely transport network outcome for 2041 based on the current policy and planning frameworks of Auckland Council and Auckland Transport.

We acknowledge that planning is an ongoing process and that changes to the land use and transport scenarios may produce different results. We also understand that further work on the ITP has refined the project and cost assumptions used for this analysis, which may alter cost outcomes.

The analysis could potentially double count demand on the proposed 2041 transport infrastructure measures if trips occur between two case studies. This would not have a significant impact on this analysis given the size of the case study developments assessed.

Overview of modelling results

This section provides a summary of the forecast transport characteristics for the case studies from the ART3 modelling to inform the assessment of wider transport costs.

The Auckland Transport Model suite (ATM2) provides the best source of transport demand forecasts for the Auckland region for this project. ATM2 consists of the Auckland Strategic Planning model (ASP) for land use forecasts and the Auckland Regional Transport model (ART3) for travel demand forecasts that operate together to derive future year land use and demand incrementally from base year conditions.

Transport model outputs were used to estimate transport network travel demand impacts by location and hence the requirement for network expansion as identified in the Auckland Plan.

A key issue was agreeing the level of service requirements for the transport network to guide future infrastructure requirements. Our approach used the currently accepted Integrated Transport Programme scenario to provide a consistent basis for the analysis. This provides a significant advantage over other methodologies in that the future infrastructure and service requirements are set and consistent for all case studies and the analysis is consistent with the Programme. This approach required the selection of a future year scenario to adopt as a basis for our analysis and the identification of each case study's contribution to travel demand on new infrastructure and services to assess the marginal cost attributed to each development. The 2041 demand scenario was selected for this analysis.

A key consideration with respect to the ART3 model is that it is a strategic model for the whole region and the transport zones are quite coarse in some locations. Our approach was to identify a representative zone or group of zones for each case study and scale the trips and costs associated with the development accordingly in order to arrive at a cost per dwelling.

The methodology required some level of detail for the major transport infrastructure projects, but a more aggregate approach for general service improvements (for example rail and bus services across the region).

The ART3 model outputs we obtained from Auckland Council (based on the 2041 Scenario I 8B scenario) included:

- Total demand attributed to new transport infrastructure

- A select link and line analysis of the assignment of demand for each zone(s) from the new infrastructure
- The cost estimate associated with each infrastructure proposed as part of the ITP
- Total zone trips for road and PT by purpose (generation and attraction)
- Overall passenger km for the case study zone(s)
- Overall vehicle km for the case study zone(s)
- Total network passenger km
- Total network vehicle km
- Average travel times by mode
- Mode split

A select link approach was used to analyse the impacts caused by each of the 12 case studies on each of the projects identified in the ITP. The ART3 model produced outputs for the volume (trips) using each of the ITP identified projects (the select link) and the length of the link. Modelling outputs for public transport projects provided data indicating the total assigned passengers for the network, passenger volumes using the project (select link), and the link length.

The 12 case studies are outlined in Table 4.3 along with the ART3 zone(s) the development is contained within, the number of households assumed in the ART3 model for each zone and the projected number of household for each case study. It is important to note that because ART3 is a strategic model covering the Auckland region, the transport zones will not necessarily align with the case studies hence case studies can be within a zone, cover the entire zone, or be spread across a number of zones.

4.3 Case studies for assessment

Case Study	ART Zone	Population Zone(s)	Households Zone(s)	Households Case Study	Households Case Study/Zone(s)	Employment Zone(s)	Total Trips Zone(s)
CBD Sugartree	215	9 851	4 889	563	0.12	20 682	7 604
Beaumont Quarter	224	4 948	1 803	240	0.13	2 598	3 283
Stonefields	350	4 401	2 500	2 500	1.00	207	2 307
New Lynn Merchant Quarter	210	14 288	5 088	130	0.03	7 972	11 496
Babich Hills	165	5 391	2 275	600	0.26	497	2 738
Hobsonville Point	149, 150	9 988	3 820	3 000	0.79	4 567	8 962
Silverdale	15	4 346	2 158	1 450	0.67	1 433	3 170
Riverhead South	123, 130, 131, 132, 133	16 982	7 419	800	0.11	1 372	9 050
Hingaia	516, 517	14 909	6 348	1 400	0.22	1 198	7 537
Addison	499	2 349	789	2 750	3.49	1 995	2 706
Weymouth	496	4 721	1 998	280	0.14	416	2 455

Anselmi Ridge	500, 517,534, 536, 537, 541	61 370	22 335	181	0.01	11 546	34 543

Source: ART3.2 Model Outputs

The ART3 model is updated regularly to account for changes in projected household numbers within the zones. However, it appears that the model had not been updated for the Addison development when it was run for this study. The estimated dwelling production for the Addison development in 2750, but the projected number of dwellings in zone 499 in 2041 is just 789 households. In order to preserve the relationships between the demand for transport and households in the Addison zone, 789 was used as the number of households in 2041. Using the higher household number would have led to an underestimation of the costs attributable to households in the Addison development given that the zone cost is based on the number of trips generated by the lower household projection.

Our approach was to undertake an assessment of the impact of each of the larger ART3 zones on the wider transport network and proportion the result down using the ratio of households in the case study to those in the relevant ART zone(s).

Those developments that appear to incorporate the whole ART zone are:

- Hobsonville Point
- Stonefields
- Silverdale (Millwater)

Table 4.4 outlines the average trip length and travel time for all car trips in each case study zone(s) in the morning peak, as well as the public transport mode split for that zone(s), which are estimated as the share of PT trips versus all morning peak traffic in the relevant ART zone(s). The highest public transport mode splits are in the CBD and the Merchant Quarter in New Lynn, which is a Transit Orientated Development.

4.4 Private vehicle travel statistics for the AM Peak for the case studies

Case Study	Public transport mode split	Average trip length (car)	Average trip time (car)
	Per cent	km	min
CBD Sugartree	51	10.1	16.5
Beaumont Quarter	30	7.3	12.4
New Lynn Merchant Quarter	23	6.7	10.4
Stonefields	15	5.3	8.1
Hobsonville Point	9	8.1	10.3
Weymouth (1st special housing area)	10	7.8	11.1
Addison (Takanini)	9	10.0	14.7
Silverdale (Millwater)	9	9.2	9.1
Babich Hills	11	7.6	10.5

Karaka Harbourside Estate	7	10.9	14.5
Riverhead South	4	11.2	12.8
Anselmi Ridge (Pukekohe)	4	7.4	7.4

Source: ART3.2 Model Outputs

Trip lengths provided in table 4.4 are the average for all trips (employment plus household trips). As can be seen in table 4.3, some of the zone(s) have high employment levels compared to their populations – notably CBD Sugartree, Beaumont Quarter and New Lynn Merchant Quarter. The zone(s) therefore attract a high number of employment trips in the morning peak that are not related to the demand generated from the case study households which impacts on average trip length with Sugar Tree being a notable example.

The ART3 model allows trips to be analysed by type, and in order to isolate the cost of infrastructure attributable to the case study households, the analysis was refined to look at household generated trips. All household generated trips out of the zone were included in the analysis, while a 2.5 per cent share of home-based-work trips into the zone were also included to account for demand created by households within the zone in the morning peak.

By analysing household generated trips, it was possible to remove all of the employment impacts as well as much of the influence of trips generated by households from outside the zone(s). However, each zone(s) share of the capital costs for each of the projects identified in the ITP was apportioned based on the zone(s) share of total vehicle trips using the project i.e. both employment and household generated trips. It was then assumed that all household generated trips in a zone have the same characteristics and the costs directly attributable to a specific the case study were determined by applying the ratio of case study households to total zone households.

The same approach was used to calculate PT infrastructure costs. However, it was found that trips generated by high employment in a zone caused a high proportion of infrastructure costs to be allocated to the zone, especially those related to the TIGA and City Rail Link (CRL). This resulted in high zone costs where employment was high and relatively high PT costs for the household of the zones in question, especially in the case of the CRL. This suggests that using the averages in these instances is likely to lead to an overestimation of the costs of household generated trips.

Capital Costs

The projects included in the analysis are only those that directly related to either road or public transport infrastructure projects. Costs associated with region wide programs identified in the ITP have not been included. We understand that costs are being updated as the ITP is developed hence the analysis represents assumptions at a point in time.

Road

For road projects, the approach taken was to undertake select links of demand generated across each ITP project for the zone(s) identified in table 4.3. The number of home-based trips (calculated as all household generated trips out of the zone(s), together with a 2.5 per cent share of trips into the zone(s)) was calculated for the zone(s). The share of household generated trips to total trips was applied to the zone(s) cost allocation to get a cost allocation for household generated trips and then scaled back to determine the case study development cost using household shares.

Table 4.5 shows the results of the analysis of the road costs associated with each case study. The zone cost is based on the zone's share of total vehicle trips using each project identified from the ITP in the AM peak. Costs are given in 2012/13 prices.

As would be expected the number of trips by households in the centrally located developments are generally lower. CBD Sugartree has the lowest estimated home-based trips per household, but it does not have the lowest cost per household. This is because the total costs for the zone are heavily impacted by the high number of trips generated for employment purposes.

Riverhead South, Anselmi Ridge and Silverdale have the highest cost per household. These case study developments are in outlying regions with a high ratio of household to total zonal trips caused by limited choices to alternative transport modes including public transport.

4.5 Road capital costs attributed to each case study

Case Study	Zone share of VKT	Zone Cost	2041 Zone households	Zone Trips	Total Home-Based trips	Trips per Household	Cost per Household
	Per cent	$					$
CBD Sugartree	1.92	52 684 733	4 889	7 604	1 686	0.34	2 389
Beaumont Quarter	0.42	13 244 825	1 803	3 283	986	0.55	2 206
Stonefields	0.14	17 373 561	2 500	2 307	1 230	0.49	3 705
New Lynn Merchant Quarter	0.82	31 703 669	5 088	11 496	3 288	0.65	1 782
Babich Hills	0.27	11 581 537	2 275	2 738	1 463	0.64	2 721
Hobsonville Point	2.23	76 781 815	3 820	8 962	3 236	0.85	7 256
Silverdale	0.57	68 045 711	2 158	3 170	1 278	0.59	12 711
Riverhead South	3.72	193 527 604	7 419	9 050	4 985	0.67	14 368
Hingaia	1.15	88 325 985	6 348	7 537	3 793	0.60	7 003
Addison	0.43	16 638 632	789	2 706	735	0.93	5 725
Weymouth	0.13	5 688 255	1 998	2 455	1 172	0.59	1 359
Anselmi Ridge	5.79	438 583 389	22 335	34 543	15 865	0.71	9 019

Note: 2012/13 prices

Source: ART3.2 Model Outputs

Public Transport Capital Costs

A similar approach to that undertaken for road projects was used to estimate each case study's share of the capital and operating cost of new public transport projects identified in the ITP. Total passenger kilometres generated by each of the zones outlined in table 4.3 for each public transport project identified in the ITP were modelled using the ART3 model and then scaled down using the case study's share of the zone(s) dwellings. The cost related to each case study was then calculated by applying its share of passenger kilometres generated to the capital costs of the project. Operational costs were calculated by applying a unit rate to the estimated passenger kilometres of the capital project.

The costs of the City Rail Link project were apportioned to the case studies based on total rail system usage rather than usage of the City Rail Link in isolation. This was done partly because of challenges in performing a select link analysis for the CRL and partly because this project has significant network wide benefits, for example allowing a more frequent train service across the rail network.

The results in Tables 4.6 and 4.7 illustrate that public transport costs are highest for household in outlying regions where public transport is accessible and for central regions that have a relatively high public transport modal share. Household costs for bus services are highest for central developments and at Millwater, where some bus priority measures have been identified in the ITP. The central regions have been allocated some rail costs, but the highest costs are seen for developments with rail access outside of the Isthmus. As the City Rail Link project is the major expenditure item identified in the ITP it has significantly influenced this assessment. Addison (Takanini) has the highest household rail cost allocation, which will include part of the CRL expenditure. Case studies remote from rail, for example Millwater and Hobsonville Point and Riverhead South, have the least costs apportioned.

4.6 Public transport infrastructure costs – bus

Case Study	Zone share of total VKT	Zone cost	2041 Zone households	Zone trips	Home-based zone trips	Trips per household	Cost per household
	Per cent	$					$
CBD Sugartree	5.47	20 967 771	4 889	2 375	299	0.06	540
Beaumont Quarter	0.98	2 855 039	1 803	438	242	0.13	876
Stonefields	0.05	593 173	2 500	407	341	0.14	199
New Lynn Merchant Quarter	2.47	5 689 945	5 088	1 021	405	0.08	444
Babich Hills	0.04	94 436	2 275	101	83	0.04	34
Hobsonville Point	0.33	995 129	3 820	286	178	0.05	162
Silverdale	0.39	1 197 205	2 158	94	61	0.03	361
Riverhead South	0.11	305 789	7 419	117	77	0.01	27
Hingaia	0.05	130 940	6 348	161	128	0.02	16
Addison	0.03	77 492	789	79	44	0.06	55

Weymouth	0.05	106 679	1 998	79	61	0.03	41
Anselmi Ridge	0.11	261 001	22 335	472	397	0.02	10

Source: ART3.2 Model Outputs

4.7 Public transport infrastructure costs – rail

Case Study	Zone share of total VKT	Zone cost	2041 Zone households	Zone trips	Home-based zone trips	Trips per household	Cost per household
	Per cent	$					$
CBD Sugartree	4.31	100 369 036	4 889	5 394	679	0.14	2 584
Beaumont Quarter	0.31	7 147 425	1 803	995	550	0.31	2 193
Stonefields	0.05	5 495 153	2 500	124	104	0.04	1 840
New Lynn Merchant Quarter	1.23	29 056 438	5 088	2 319	920	0.18	2 266
Babich Hills	0.79	18 686 711	2 275	229	189	0.08	6 786
Hobsonville Point	0.10	2 268 058	3 820	650	404	0.11	369
Silverdale	0.03	640 822	2 158	214	139	0.06	193
Riverhead South	0.01	289 900	7 419	265	174	0.02	26
Hingaia	1.62	37 158 014	6 348	366	290	0.05	4 639
Addison	0.55	12 456 633	789	178	101	0.13	8 915
Weymouth	0.65	15 300 340	1 998	180	139	0.07	5 906
Anselmi Ridge	5.90	110 580 546	22 335	1 072	901	0.04	4 161

Source: ART3.2 Model Outputs

Operating Costs

Road maintenance and renewal costs

Urban arterial roads require ongoing maintenance related to all of the following:

- Road pavements and surfaces
- Kerb and channel, and road sweeping
- Footpaths and footpath cleaning in town centres
- Bridges
- Signs
- Traffic signals and system coordination
- Streetlights and electricity
- Road markings
- Retaining walls
- Weeds
- Collecting debris or cleaning road surface after crashes, spillages and storms.

A discussion paper produced by the NZTA in June 2012 regarding maintenance and operations of roads estimated that maintaining roads in New Zealand on average cost about $500 million per annum equating to $20,000 per lane per km. Auckland Transport has provided data regarding maintenance and operations costs of roads specific to the region indicating it to be in the order of $30,000 per km. The latter cost was used to estimate each of the case studies contributions to the road maintenance and renewal costs for the region as outlined in Table 4.8.

4.8 Road Maintenance Cost estimates for each case study

Case Study	Maintenance Cost per HH
	$
CBD Sugartree	62
Beaumont Quarter	143
New Lynn Merchant Quarter	216
Stonefields	170
Hobsonville Point	239
Weymouth (1st Special Housing Area)	289
Addison (Takanini)	441
Silverdale (Millwater)	320
Babich Hills	347
Karaka Harbourside Estate	259
Riverhead South	409
Anselmi Ridge (Pukekohe)	301

Source: ART3.2 Model Outputs; Arup estimates

The analysis shows that the inner locations such as Sugar Tree, the Beaumont Quarter, the Merchant Quarter and Stonefields generally generate less private vehicle traffic and shorter trips than the outer locations and therefore their contribution to road maintenance cost is less.

The average cost for CBD locations, Sugar Tree and Beaumont Quarter, are generally between 30 per cent and 50 per cent lower compared to the outer locations.

The analysis in table 4.8 is based on total vehicle kilometres travelled for the zone(s) in the AM peak and not just home-based trips.

Public Transport

An analysis of the potential public transport operating cost to accommodate each case study has been undertaken as shown in Table 4.9. Public transport operating costs are generally difficult to source. For this analysis, we applied an average operating cost of $1.5/vehicle km, an average occupancy of 40 people for bus travel and an average operating cost of $15/vehicle km and an average occupancy of 350 people for rail. An average trip length as estimated for car travel for each case study was used, along with an annualisation factor of 500. Note that the higher cost per household calculation

reflects those case studies where public transport is more accessible and used as reflected by the mode splits in Table 4.9. In such cases, for example in the CBD locations where the public transport mode share is higher, the impact on the highway network is less.

4.9 Household public transport operating cost (Annual)

Case Study	2041 Zone households	Annual variable bus cost	Annual variable bus cost per household	Annual variable rail cost	Annual variable rail cost per household
		$	$	$	$
CBD Sugartree	4 889	5 605	1.15	14 550	2.98
Beaumont Quarter	1 803	4 544	2.52	11 796	6.54
Stonefields	2 500	1 952	0.78	5 068	2.03
New Lynn Merchant Quarter	5 088	7 593	1.49	19 714	3.87
Babich Hills	2 275	1 562	0.69	4 054	1.78
Hobsonville Point	3 820	3 331	0.87	8 649	2.26
Silverdale	2 158	1 148	0.53	2 981	1.38
Riverhead South	7 419	1 438	0.19	3 732	0.50
Hingaia	6 348	2 392	0.38	6 209	0.98
Addison	2 750	832	0.30	2 159	0.79
Weymouth	1 998	1 149	0.57	2 982	1.49
Anselmi Ridge	22 335	7 438	0.33	19 310	0.86

Source: ART3.2 Model Outputs; Auckland Transport operating cost estimates

Summary of transport costs

The analysis of the costs associated with each case study with respect to the wider transport network required to support the development is based on:

- The average cost associated with new transport infrastructure proposed by the ITP in 2041.
- Estimated average cost of annual maintenance of the highway network and operation of public transport services.

We have presented a summary of annual present value capital and operating costs separately.

The analysis of the case studies indicates that generally the inner infill developments require less new infrastructure than the outer area greenfields developments to support growth.

The operating cost analysis for transport shows a similar trend to the capital costs. Road maintenance costs were identified as being much higher for the outer area greenfield developments compared to inner infill growth. The public transport operating costs

associated with inner areas is of course higher as more people have better access to and indeed use, public transport compared to the outer areas.

Impacts of urban form and location

Table 4.10 shows that generally the central and western case studies resulted in lower transport costs than the northern and southern case studies. Generally, the high-density developments result in lower transport costs per household than low and medium density examples.

4.10 Transport capital costs by region and development type

Development	Region	Development Type (Density)	Highway Cost/HH	Rail cost/HH	Bus Cost/HH	Total Cost/HH
			$	$	$	$
Case Study C1 CBD Sugartree	Central	High	2 389	2 584	540	5 513
Case Study C2 Beaumont Quarter	Central	High	2 206	2 193	876	5 275
Case Study C3 Stonefields	Central	Medium	3 705	1 840	199	5 744
Case Study W1 New Lynn	West	High	1 782	2 266	444	4 492
Case Study W2 Babich Hills	West	Low	2 721	6 786	34	9 541
Case Study N1 Hobsonville Point	North	Medium	7 256	369	162	7 787
Case Study N2 Silverdale	North	Low	12 711	193	361	13 265
Case Study N3 Riverhead	North	Low	14 368	26	27	14 421
Case Study S1 Hingaia	South	Low	7 003	4 639	16	11 658
Case Study S2 Addison	South	Medium	5 725	8 915	55	14 695
Case Study S3 Weymouth	South	Medium	1 359	5 906	41	7 306
Case Study S4 Anselmi Ridge	South	Low	9 019	4 161	10	13 190

Source: ART3.2 Model Outputs; Arup and Auckland Transport estimates

Recommended further work

The analysis provides useful guidance on the wider transport network cost associated with developments of different locations and form. The study has highlighted a lack of available data to assess the actual cost of development. We consider it important to address these gaps to inform future planning and funding of development in Auckland.

Further, more detailed modelling could be undertaken to assess individual developments in the model by disaggregating the transport zones and applying a similar approach to estimate the transport infrastructure and operating cost for developments. Potentially Auckland could be divided into segments and different urban forms could be selected for analysis, which could drive development staging and funding.

The modelling assessment has considered the 2041 development scenario only. There would be some value in further investigating the impacts of the staging of development

in different areas of Auckland to 2041.The modelling analysis could be progressed further to inform public and private sector funding.

5 Social and other services

This chapter presents information that was made available to us in relation to a range of social services provided by the Council and other government agencies.

Although Council and government agencies expenditure on social and other services is significant, the evidence suggests that these services are generally provided to service a catchment area significantly wider than the case study developments.

Parks and Recreational facilities

The Council commonly requires land to be set aside for reserves and parks to ensure that the new developments provide these facilities as open space for their residents. Often the Council purchases sites from developers or is gifted the land by the developer in lieu of a developer contributions payment. The Council's Contributions Policy states that

> Financial contributions take on residential units, either in the form of land or cash, are to provide for the open space needs of the new residents in the proposed development, so that existing ratepayers do not have to pay for any increase in demand. The provision of open space within a development which is additional to private open space provided or required in a development should be considered to contribute to open space needs of the new residents and so lessen their demand for open space outside of the development.[29]

Public open space has historically been funded primarily by financial contributions (through the Resource Management Act) and development contributions (through the Local Government Act) with the costs of public open space acquired for city-wide benefits being offset by some use of rates revenue.

For the purposes of this project, information is required on both costs incurred directly by Council as well as indirect costs in the form of assets transferred in lieu of developer contributions payments. This poses a challenge, as a single consistent database of these historical transactions is not available. Where land was purchased, the purchase cost was not always recorded. The values recorded for the parks in the Council's asset register reflect the value of land in its current use as parkland, and not the cost to the Council of purchasing the land prior to it being designated parkland. [30]

Table 5.1 collates the available information on parks provision for the case studies. Data on the actual, or proposed, purchase price was available for Beaumont Quarter, New

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29 Auckland Council (2012), Financial information, policies and fees, Auckland Council

30 As noted earlier, information on the ongoing operating costs was not available. However, based on discussions with Council officers we do not expect these costs to be significant (compared to the capital costs).

Lynn and Riverhead South, Babich Hills and Weymouth. Following discussions with the parks team, the cost of land provision at Silverdale, Hobsonville Point, Stonefields and Anselmi Ridge was assumed to fall with a range of $200 to $300 per square metre. A cost of $200 was assumed, but the true cost for the land provision may be higher or lower than this figure.

It should be noted that there are different types of parklands and the case study land areas per lot provided in table 5.1 may not be measuring like for like.

For Beaumont Quarter, Hobsonville Point and Addison the costs outlined in table 5.1 are not actual costs as the land was vested. The real cost to council relates to lost financial contribution income for Beaumont Quarter and lost development contribution income from the other two developments. The costs identified in the table are estimates of the cost to Council if it had directly provided the land.

5.1 Parklands expenditure data

Case study	Means of provision	Land provision per dwelling	Assumed cost*/m²	Estimated cost per dwelling
		m²	$	$
CBD Sugartree	n/a	n/a	n/a	n/a
Beaumount Quarter	Financial contribution offset	14	686	9 547
Stonefields	Direct cost to council	35	200*	7 040
New Lynn Merchant Quarter	Direct cost to council	6	200	1 111
Babich Hills	Direct cost to council	4	100	417
Hobsonville Point	Development contribution offset	46		9 221
Silverdale	Direct cost to council	20	200*	4 000
Riverhead South	Direct cost to council	20	235	4 700
Hingaia	n/a	n/a	n/a	n/a
Addison	Development contribution offset	49	200	9 852
Weymouth	Direct cost to council	10	79	767
Anselmi Ridge	Direct cost to council	77	200*	15 470

* Estimated cost - the true cost per m2 may be higher or lower than this figure.
Source: Auckland Council

In 2007, the Franklin District Council purchased 13 hectares of land adjacent to the existing sports complex with the intention of developing a large scale sports and recreation hub in the centre of Karaka. The Karaka Sports Park serves as open space for the Karaka Harbourside development but also caters for a much larger catchment area.

The information in table 5.1 suggests the cost of land provision and area acquired per lot for the case study developments varies considerably. In the case study examples, it ranges from 4.2m2/lot for Babich Hills to 77m2/lot for Anselmi Ridge.

There is an expectation that greenfield developments will be provided with new reserves/park areas, but this is not the case in locations where there are already sufficient park facilities easily accessible. Most centrally located high-density

developments do however provide some level of on-site private open space for residents at their own cost. Where land is not provided, development contributions are invested in enhancing existing park facilities.

Less land is generally provided per lot for medium and high-density developments than for low-density developments; a widely dispersed development requires a greater coverage per lot – often over multiple sites.

For the New Lynn development, around 6m^2 of parkland was provided per lot at a cost of $200 per m^2. The parkland was purchased to enable high density residential in the precinct with apartments fronting the park. New Lynn is a good example of how new reserve land might be planned and provided for around new transit oriented high density metropolitan centre development areas.

Riverhead South and Silverdale both had relatively low land provisions per lot (20m^2) compared to other low density sites, but the cost per square metre was on par with that seen for New Lynn. (The Silverdale open space was provided as part an Infrastructure Funding Agreement with the developer and therefore it was not possible to directly source a cost for the land.)

The Sugartree development in the CBD has not been provided with any new reserve land by Auckland Council. The existing reserve network was assumed sufficient to cope with the new development.

The Beaumont case study development was provided with council funded reserve land at the time of development in 2002 at a cost of $1.7 million or $523 per square metre. The purchase of this land was agreed between Auckland City Council and the developer in the form of a funding agreement. Land was accepted in lieu of financial contributions related to the development's resource consent. It is unlikely this land would have been purchased through council funding under current practice.

In regards to Addison and Hobsonville Point, the reserves were vested in lieu of development contributions. Land provisions per lot for Addison and Hobsonville Point– at an estimated 49m^2 and 46m^2 respectively – were substantially higher than for the Riverhead South and Silverdale developments. However, it's assumed that the cost per square metre paid for the land (or where land was vested, the assumed price if council had provided the land directly) in each site was similar and therefore the costs per dwelling were significantly higher.

Council proposes to purchase parklands covering an area of 0.29 ha in Weymouth. There are two existing neighbourhood parks located in close proximity that would also serve this development. Open space is also provided through land acquired for stormwater purposes and an existing esplanade reserve network adjoins the site.

The Stonefields open space was provided as part of an Infrastructure Funding Agreement with the developer. A total of 8.8 ha was allocated as open space, excluding water area.

The most expensive case study development to service is Anselmi Ridge, with 77m^2 planned for each lot (total of 1.4 ha) at an estimated cost of $200 per square metre.

The wide variance in the estimated cost per lot for the different case studies highlights the risk of not having a standard approach to calculating expenditure on parkland acquisitions. Land was provided at a relatively high cost in Addison, Hobsonville Point and Beaumont Quarter and all involved agreements with developers, with the land provided as an offset against either financial or development contributions.

The cost to Council of parkland provision is considerable. Values for some of the case studies are on par with the cost of other infrastructure requirements – water, wastewater, stormwater and transport. The New Lynn Merchant Quarter, Babich Hills, Weymouth and CBD Sugartree developments are associated with the lowest outlays per dwelling. These developments also have the lowest provisions per lot, as they are all medium and high-density developments where existing parkland is already available for residents' use.

Although Anselmi Ridge, a low density greenfield development, is projected to have the highest cost per lot, the medium density developments at Addison and Hobsonville Point are associated with higher costs per lot than the low density developments at Silverdale and Riverhead South. What the case study experience highlights is that there has not been a standard approach to park provision and as a result – particularly where parks have been provided through IFAs or as offsets to financial and development contributions – this lack of transparency has resulted in outcomes that were not necessarily cost effective for Council.

Auckland Council does not currently collect financial contributions to acquire parks and open space, but the practise of developers providing land as offset to development contributions remains common. The parks team indicated that the $200 to $300 per square metre range is increasingly used as a benchmark for evaluating parkland provision in greenfield sites.

Health care[31]

District Health Boards (DHBs) are responsible for providing or funding the provision of health services in their district. The Northern DHB Support Agency (NDSA) is a shared services agency joint venture owned by the three Auckland Metro DHBs (Auckland, Counties Manukau and Waitemata) in their roles as health and disability service funders, for areas of service provision identified as benefiting from a regional solution

When planning for the future, the DHBs take account of increasing population numbers, but also the demographic structure of the population, particularly the age profile but also the ethnic diversity (given the high levels of certain diseases among some ethnic groups and need for language and cultural services).

Planning for population growth is about future asset management (i.e. beds and facilities) but it also requires an understanding of trends in service design and models of

31 This section draws largely from the research already undertaken by Auckland Council's Research Investigations and Monitoring Unit as presented in the July 2013 report *Health Facilities and Population Growth in Auckland*.

care. A significant focus of health care planning is on improving 'models of care' (how health services are delivered) and the health of a population in order to manage future demand for services/facilities. That is, it differentiates between asset management (i.e. planning for future facilities) and clinical change (i.e. changing the way clinical services are delivered).

Research conducted by Auckland Council indicates that hospital facilities are constructed to deliver services to a region, rather than the local neighbourhood. This is consistent with the findings from our previous work in the Sydney context.[32] In this sense, the health related costs are unlikely to vary depending on the geographical location of the new development or the density of the development.

Education expenses

Information was sought from the Ministry of Education regarding the expenditures incurred in relation to the case studies. Table 5.2 presents the information provided.

5.2 New schools in case study sites

Sites	School name	Capacity	Year completed	Site purchase and school construction cost
		Students	year	$ m
Hingaia	Hingaia Peninsula School	540	2012	15
Hobsonville Point	Hobsonville Point Primary	690	2013	79 [a]
	Secondary Schools	1 500	2014	
Stonefields	Stonefields Primary School	520	2014	27

[a] Combined expenditure for both schools

Source: Andre Lipa email 19 Nov 2013 and David Giffen 25 Nov 2013. http://nzschools.tki.org.nz/ , http://www.minedu.govt.nz/theMinistry/AboutUs/mediaCentreLanding/MediaResponses/12April2013ResponseToNZHeraldOnAucklandRollGrowth.aspx Email from Ministry of Education 14 January 2014.

While both primary schools were built to service the new developments, Hobsonville Point secondary school also services a wider catchment area.

The Ministry also provided annual information on capital allocations and roll numbers for the 2008 to 2014 period for schools whose catchment areas included the case study developments. The data shows that there has been considerable variation in enrolment growth for schools within the same catchment areas. The popularity of a suburb and the academic performance of particular school are likely contributors to this variance. However, generally, a growing school age population has driven strong demand for education facilities across the Auckland region.

Where there is residual capacity in existing facilities, this could lower the costs associated with servicing a new development. However, the data provided by the

32 CIE and ARUP (2012), *Costs and benefits of alternative growth scenarios for Sydney*, prepared for NSW Planning.

Ministry suggests that there is little spare capacity in schools in densely populated areas and that additional capital expenditure is often required to cater for growth in roll numbers. These schools are largely limited to expanding facilities within their existing footprint – sometimes at the expense of sport and recreation space – due to a lack of land that can be developed in close proximity to the school.

Education costs are more directly proportional to population growth as opposed to the density of development. There is little evidence from the roll growth and capital allocation data that location is a key factor in driving costs per student for established schools. However, where new schools are built, land purchase will be a key component of costs; the cost and availability of land will influence the design of the school and the size of its site. Table 5.1 illustrates that the cost of constructing primary schools of a similar size can vary significantly.

Looking ahead, Auckland will need to create large numbers of school places to cater for population growth and this will mean both building new schools and expanding existing schools. One option would be to add additional storeys to schools in built up areas, but the Ministry was unable to provide data with which to compare the cost of providing additional school spaces by adding height to these schools, with the traditional model of land purchase and construction of new schools in less densely populated areas. Consequently, it was not possible to infer from the evidence available that there was a locational/density variance in the cost (per student) of providing education facilities to the case study developments.

Libraries

The Council provides library services to the community and has provided the following information about the libraries constructed to service the case study areas.

5.3 Anticipated expenditure on libraries

Case study area	Name	2013/14 OPEX Budget	"2013/14 CAPEX Budget	Comment
CBD (sugar tree)	Central Library	4 567 193	765 965	Regional library servicing a wide area
Beaumont Quarter	Leys Institute	271 508	37 500	Overcapacity but no new facility identified as yet
Stonefields	Panmure Library	791 030	96 250	No new facilities identified
Hobsonville Point	Kumeu Library	371 092	31 250	New Massey Library. Capex $13.4m Existing Massey Library opex will need to be increased to allow for significantly larger facility
Silverdale (Millwater)	Orewa Library	680 477	18 125	At capacity but no new facilities identified
Riverhead South	Kumeu Library	680 477	18 125	No new facilities identified
Merchant Quarter New	New Lynn Library	950 024	19 000	No new facilities identified

Case study area	Name	2013/14 OPEX Budget	"2013/14 CAPEX Budget	Comment
Lynn				
Babich Hills	Old Ranui Library	525 075	-	New Ranui library capex $5.3m.
Addison (Takanini)	Manurewa Library	731 613	20 550	New Takanini library $5.6m.
Weymouth	Te Matariki Clendon Library	658 686	48 500	No new facilities identified
Karaka Lake/Harbour Side Estate (Hingaia)	Papakura Library	755 467	35 000	No new facilities identified
Anseimi Ridge	Pukekohe Library	543 596	10 000	No new facilities identified

Source: Auckland Council

The libraries listed above service a wider catchment than the case study areas. The expected capital expenditure on the existing libraries that service the case study sites is relatively small and largely relates to renewals rather than expansions. A number of libraries are at or over capacity. A number of new facilities have been identified in Hobsonville Point, Babich Hills and Takanini; but while it is probable that additional facilities will be identified (or existing facilities expanded) to cater for future growth, these costs are not incorporated into current budgets.

We have not sought to attribute the costs of library services to particular case study areas given that these libraries service a wide area and there is limited information to estimate the contribution of the case study area to the total library costs for the region.

Other community facilities

In regards to other community facilities, a number have been identified that service two of the development case studies.

- in Sugartree a new facility, Pioneer Women's Hall, totalling $3.7 million is planned for the development site. The new facility is planned to be constructed in the 2013/14 and 2014/15 financial years.[33]
- in Hobsonsville Point – the Council is currently negotiating the acquisition of two buildings for community facilities – for a community hall and a community house to serve the new community which in anticipated to be in the order of 3-4,000 (taking into account the residential component of the Council owned land as well as the HLC land). The budget for acquisition and refurbishment of these buildings is $4.2m.[34]

33 Other facilities identified include, the Fickling Centre and the Roskill Youth Zone, constructed in 2010/11 financial year, totalling $4.3 million. This services the Three Kings development site.

34 Email Auckland Council 3 April 2014.

Waste services

The waste services provided to the community include the collection of waste (typically from the kerbside) and its transportation and disposal at landfill sites. The waste is typically transported from dwellings to centralised transfer stations that aggregate the waste for bulk transportation to landfills. These aggregation facilities are typically funded and managed by private firms. Additional recycling facilities are also utilised.

Landfills sites are owned by Council and no recently constructed landfill assets are attributed to the case study development sites. Further, there also appears to be significant spare capacity in the landfills such that the location of any new developments over the next 10 years will have no bearing on the capex on landfills.

The location and type of development is unlikely to have a bearing on the cost of providing waste services. These costs typically relate to broader regional population growth. Further, there is also currently spare capacity in the landfills surrounding Auckland and new sites are not expected in the near future.

The location and type of development however may have a bearing on the costs of transporting the waste. No data is available on these costs but they are not expected to be significant in comparison to the other cost items discussed in previous chapters, particularly in light of the large number of transfer stations located around Auckland.

Summary of social and other costs

In summary, there is insufficient evidence of a locational or density element to the cost of providing education and health facilities based on the case study approach. Health facilities are largely provided at a regional, rather than a neighbourhood level. Given a lack of spare capacity in the school system, understanding whether the marginal cost of providing education for future developments will differ based on location will require understanding household preferences for particular schools, population growth projections within different catchment areas and the costs involved in expanding or constructing schools in those areas.

There is some evidence of a locational/density variance in the cost to Council of providing reserves based on an analysis of the case studies. In general, lower density developments are associated with higher per dwelling costs for park provision because they require larger areas of land to per purchased per lot. However, there was considerable variance in costs. This highlights the fact that historically there has not been a standard approach to calculating the cost of reserves. Where land has been provided by the developer as an offset to financial or development contributions, this has not always been a cost-effective outcome for Council.

The Local Government Act 2002 Amendment Bill (no 3), which came into force on 8 August 2014, limited the community infrastructure activities councils can collect development contributions for to community centres and halls, play equipment on neighbourhood parks and public toilets. Libraries, swimming pools and recreational facilities are no longer included as community infrastructure. The Act also changed the

parks provision, such that development contributions can no longer be collected for reserves from non-residential developments. These changes shift some of the burden for providing these facilities to existing ratepayers. As a result, it has become increasingly important for Council to understand the additional demand that future residential developments will put on existing social infrastructure, whether the additional population will require new ratepayer funded infrastructure and how the cost of providing that infrastructure per dwelling compares to other areas.

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