IPART

Independent Pricing and Regulatory Tribunal
New South Wales

Assessment of Contributions Plan No. 15 (2020) – Box Hill Precinct

The Hills Shire Council

Final Report

Local Government

October 2020

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Local Government Committee Members

The Committee members for this review are:

Ms Deborah Cope, Chair

Ms Nicola Gibson

Ms Pamela Soon

Enquiries regarding this document should be directed to a staff member:

Cameron Shields (02) 9019 1901

Julia Williams (02) 9290 8457

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1 Executive summary

The Hills Shire Council (the council) has revised its *Contributions Plan No. 15 – Box Hill Precinct* (CP15 (2020)) and submitted the draft to IPART for review. The council seeks to levy the full, uncapped contributions amount in CP15 (2020) from 1 January 2021.[1] To be able to do so, the plan must be assessed by IPART and the council must make any changes requested by the Minister for Planning and Public Spaces (the Minister) or his nominee.

This is the fourth time IPART has assessed CP15. Since the plan was first adopted in July 2014 we have completed reviews in December 2014, March 2016 and October 2018.

We found that the plan largely reflects the reasonable costs of local infrastructure required for the new development. However, we have also found that the council's cost estimates for some transport works, including some roundabouts and some signalised intersections, are too high. We have made recommendations about the need (nexus) for some intersections and the amount of land the council has included in the plan for stormwater infrastructure. Our assessment also found that the council's approach to costing and apportioning the costs for the upgrade of Boundary Road is not reasonable because it does not account for the full scope of works required to upgrade the road and does not reflect the demand arising from the new development.

Our recommendations would reduce the total cost of land, works and administration in CP15 (2020) from $682.11 million to $664.21 million. This equates to a decrease in total costs of 2.6% relative to the plan submitted to us. Our recommendations would also reduce the contribution rates in the plan. For a typical dwelling, our recommendations would reduce indicative contributions by $2,840 (5.6%) to $48,082 for the Killarney Chain of Ponds catchment and by $2,134 (5.1%) to $39,587 for the Second Ponds Creek catchment.[2]

This Final Report sets out our findings and recommendations to the Minister on the amendments required to ensure that the plan reflects the reasonable costs of providing the necessary local infrastructure to accommodate the development of the precinct.

1 DPIE (letter from the Minister's Nominee), Letter to The Hills Shire Council, June 2020.

2 The modelled contribution rates fall by more than total costs because of the impact of other recommendations to reduce the discount rate in the model and the council's approach to calculating escalation factors.

1.1 Our key findings

We have conducted this assessment in accordance with the guidance provided by the Department of Planning, Industry and Environment (DPIE) in its Practice Note.[3] We found that most aspects of the plan meet the assessment criteria in the Practice Note, with the exception of nexus, reasonable cost and apportionment for some transport infrastructure and nexus for some land for stormwater management.

We received two submissions to our Draft Report, from The Hills Shire Council and Hawkesbury City Council. The submissions can be found on our website, and are addressed throughout this report.

Some signalised intersection and roundabout costs are based on unreasonable estimates

We found that the revised costing sources used by the council for most signalised intersections and two-lane roundabouts are too high. For signalised intersections, we consider the costings used in the previous version of the plan or revised costs provided by the council during our assessment are more reasonable. For some two-lane roundabouts, we have recommended a more reasonable estimate based on the IPART-assessed reasonable cost of a comparable roundabout in North Kellyville. Our recommendations for signalised intersections and roundabouts would reduce the cost of transport infrastructure in the plan by $25.20 million.

More of the costs of upgrading Boundary Road should be apportioned to the plan

We found that the council's approach to costing the upgrade of Boundary Road to an urban standard collector road is not reasonable because it does not account for the full scope of works required to upgrade the road and does not reflect the demand arising from the new development. We have recommended the council include additional costs, in recognition of is its shared role in planning and delivering the road. Our recommended approach to apportionment reflects advice from Transport for NSW (TfNSW) about the additional traffic volume expected to use the road from the Box Hill Precinct. Our recommendation would increase the cost of transport infrastructure in the plan by $17.71 million.

The council should remove the cost of land that is not required to deliver stormwater infrastructure

We found that the council has included additional stormwater land in the plan that is not required to deliver stormwater infrastructure. The council has included this land because of practical issues associated with land acquisition. We have found that nexus is not established for inclusion of additional stormwater land.

3 See Department of Planning and Environment (DPE), *Local Infrastructure Contributions Practice Note*, January 2019 (Practice Note). We also assessed whether CP15 (2020) contains information required by the *Environmental Planning and Assessment Regulation 2000.*

Open space provision in the Box Hill Precinct should increase

We found that the overall provision of open space in the plan is low. The provision of 1.45 hectares of open space per 1,000 new residents is below the Growth Centres' benchmark of 2.83 hectares per 1,000 residents.

The council has identified 44.27 hectares of water management land which may be suitable for recreation, but it has not included this land or its potential embellishment in the open space provision in CP15 (2020).[4] If this was included as open space, it would increase the rate of provision to 2.49 hectares per 1,000 residents.

1.2 Our recommendations

We have made 14 recommendations as a result of our assessment of CP15 (2020).

Our recommendations (and the page number on which they appear in the following chapters) for CP15 (2020) are listed below. All recommendations require action by the council.

Transport

1 Remove the cost of the signalised T-junction intersection at the corner of Terry Road and High Street [BHT18] because nexus is established for a pedestrian crossing only. This would reduce costs in the plan by $5,502,778. 21

2 Increase the cost of the intersection at the corner of Prosper Street and Mount Carmel Drive [BHT17] by $346,740 because nexus is established for a signalised intersection instead of a roundabout. 21

3 Reduce the cost of half-width roads by $1,889,008 to reflect a lower contingency allowance of 20%. 29

4 Reduce the cost of the Northern Connection Road if it is partially funded through the NWGA SIC. 29

5 Reduce the cost of two-lane roundabouts [BHR03 and BHR08] by $2,952,464, reflecting a more reasonable estimate of costs based on a comparable roundabout in North Kellyville. 29

6 Reduce the cost of signalised intersections, as shown in Table 4.10, by $22,246,060, reflecting the previous estimated costs (AECOM 2014) and revised costs provided by the council. 29

7 Apportion 67% of the costs of the Northern Connection Road to the plan, based on the most up-to-date population forecasts for Box Hill (CP15) and North Kellyville (CP13). 38

8 Revise the reasonable cost of upgrading Boundary Road to $32,395,205 and include 81.7% of this cost in the plan, reflecting the demand for the upgrade that is generated from the Box Hill Precinct. This would increase costs in CP15 (2020) by $17,706,650. 38

4 CP15 (2020), p 24.

9	Remove 17,248m^2 of land for stormwater infrastructure from the plan, for which nexus is not established. This would reduce the cost of stormwater land in the plan by $5,127,556.	49
10	Revise the cost of plan administration for CP15 (2020) to reflect 1.5% of the adjusted cost of works.	62
11	Recalculate all escalation factors using a compound annual average growth rate formula instead of a simple average formula.	66
12	Update the discount rate in the financial model to 3.2%, which is the latest available Local Government Discount Rate.	67
13	Comprehensively review the plan within the next five years to ensure assumptions about the scope, cost and apportionment of land and works reflect the progress of development in the precinct.	68
14	Update the plan to ensure that the maps showing locations of infrastructure are accurate and accessible.	68

The impact of our recommendations is presented in Table 1.1, Table 1.2, Table 1.3 and Table 1.4. More detailed tables on the recommended changes are presented in each of the infrastructure category chapters, and summarised at Appendix A.

We note that recommendation 4 is not reflected in our assessed reasonable costs.

The IPART-calculated contribution rates are indicative only and reflect our recommendations and the council's assumptions about the timing of revenues and costs in the plan.

Table 1.1 Summary of adjustments – CP15 (2020) ($Jun2019)

	Cost in plan ($Jun2019)	IPART - recommended adjustment ($)	IPART -assessed reasonable cost ($)
Transport			
Land	51,665,809	-402,778	51,263,031
Works	180,953,757	-12,186,699	168,767,058
Stormwater			
Land	82,752,997	-5,127,556	77,625,441
Works	84,974,681	0	84,974,681
Open space			
Land	170,321,018	0	170,321,018
Works	105,865,380	0	105,865,380
Community facilities			
Land	0	0	0
Plan administration	5,576,907	-182,800	5,394,107
Total	**682,110,548**	**-17,899,833**	**664,210,715**

Source: CP15 (2020) Works Schedule and IPART analysis.

Table 1.2 Indicative contributions (Killarney Chain of Ponds) by dwelling type ($Jun2019)

	Occupancy rate per dwelling	Indicative contribution ($)	IPART-adjusted contribution ($)	Difference ($)	Difference (%)
Subdivision, dwelling house, dual occupancy	3.4	50,922	48,082	2,840	5.6
Integrated housing	2.7	40,438	38,183	2,255	5.6
Senior housing	1.5	22,466	21,213	1,253	5.6
Multi-unit housing rates:					
1 bedroom	1.7	25,461	24,041	1,420	5.6
2 bedroom	1.8	26,959	25,455	1,504	5.6
3 bedroom	2.5	37,443	35,354	2,089	5.6
4 bedroom	3.1	46,429	43,839	2,590	5.6

Source: CP15 (2020) pp 6 and 19 and IPART analysis.

Table 1.3 Indicative contributions (Second Ponds Creek) by dwelling type ($Jun2019)

	Occupancy rate per dwelling	Indicative contribution ($)	IPART-adjusted contribution ($)	Difference ($)	Difference (%)
Subdivision, dwelling house, dual occupancy	3.4	41,721	39,587	2,134	5.1
Integrated housing	2.7	33,132	31,437	1,695	5.1
Senior housing	1.5	18,406	17,465	941	5.1
Multi-unit housing rates:					
1 bedroom	1.7	20,861	19,793	1,068	5.1
2 bedroom	1.8	22,088	20,958	1,130	5.1
3 bedroom	2.5	30,677	29,108	1,569	5.1
4 bedroom	3.1	38,040	36,094	1,946	5.1

Source: CP15 (2020) pp 6 and 19 and IPART analysis.

Table 1.4 Non-residential indicative contributions – per square metre of floor area

	Indicative contribution ($)	IPART-adjusted contribution ($)	Difference ($)	Difference (%)
Killarney Chain of Ponds	115.0	108.2	6.8	5.9
Second Ponds Creek	94.7	89.3	5.4	5.7

Source: CP15 (2020) p 7 and IPART analysis.

1.3 Structure of this report

The following chapters provide our analysis of CP15 (2020) against the criteria in the Practice Note, and explain the recommendations we have made for the council to make adjustments to the plan.

- Chapter 2 outlines the context for our assessment of contributions plans
- Chapter 3 provides an overview of CP15 (2020)
- Chapter 4 presents our analysis of transport infrastructure
- Chapter 5 presents our analysis of stormwater infrastructure
- Chapter 6 presents our analysis of open space embellishment
- Chapter 7 presents our analysis of plan administration
- Chapter 8 presents our analysis of cross-category issues, ie, land costs, the council's financial model, timing of infrastructure delivery (Criterion 4), consultation (Criterion 6) and other matters (Criterion 7).

2 Context and approach for this assessment

We commenced our assessment of CP15 (2020) in March 2020. This is the fourth time we have assessed CP15. To provide context for our assessment, the sections below outline:

- Why the council submitted CP15 (2020) for assessment
- Our approach and consultation process for assessment
- What will happen next.

2.1 Why has the council submitted its plan to IPART?

IPART assesses contributions plans from councils that propose to levy contributions above $30,000 per residential lot or dwelling in identified greenfield areas and $20,000 per residential lot or dwelling in other areas.[5]

The council has submitted the draft plan for IPART's assessment because the contributions for some types of residential development exceed the $30,000 per lot/dwelling review threshold, which applies under clause 6A(6) of the Ministerial Direction.[6] In addition, the Minister requested the council revise the plan to reflect updated population figures for the Box Hill Precinct.[7]

The council has until 31 December 2020 to adopt a contributions plan that has been reviewed by IPART and reflects amendments requested by the Minister or Minister's Nominee.[8]

2.2 What approach did we use for this assessment?

In assessing CP15 (2020) we considered:

- The criteria set out in the *Local Infrastructure Contributions Practice Note* (Practice Note) issued by DPIE[9]
- Information and further advice from the council, DPIE and TfNSW on various aspects of the plan.
- Information from meetings with stakeholders including developers, industry groups and Hawkesbury City Council.

5 Minister for Planning, *Environmental Planning and Assessment (Local Infrastructure Contributions) Direction 2012*, 21 August 2012, as amended (Ministerial Direction).

6 Ministerial Direction, as amended by the *Environmental Planning and Assessment (Local Infrastructure Contributions) Further Amendment Direction 2018* (issued on 18 December 2018).

7 Minister for Planning, Letter to The Hills Shire Council, August 2019.

8 DPIE (letter from the Minister's Nominee), Letter to The Hills Shire Council, June 2020.

9 Department of Planning and Environment, *Practice Note - Local infrastructure Contributions*, January 2019. The January 2019 Practice Note replaces the January 2018 *Practice Note - Local infrastructure Contributions*. The 2019 revision clarifies the timing of when a council can adopt a contributions plan (particularly where the draft plan proposes a rate above the maximum cap amount in the Direction). The assessment criteria for our review remain the same.

2.2.1 We considered the assessment criteria in the Practice Note

IPART's assessment functions for local infrastructure contributions plans are based on terms of reference issued by the Premier under section 9 of the *Independent Pricing and Regulatory Tribunal Act 1992* (see Appendix B).

As required by these terms of reference, we have assessed CP15 (2020) in accordance with the criteria set out in the Practice Note. The criteria require us to assess whether:

1. The public amenities and public services in the plan are on the essential works list.
2. There is a reasonable nexus between the proposed public amenities and public services in the plan and the development.[10]
3. The proposed development contribution is based on a reasonable estimate of the cost of the proposed public amenities and public services.
4. The proposed public amenities and public services can be provided within a reasonable timeframe.
5. The proposed development contributions are based on a reasonable apportionment of costs.
6. The council has conducted appropriate community liaison and publicity in preparing the contributions plan.
7. The plan complies with other matters we consider relevant.

We also assessed whether the plan contains the information required by Clause 27 of the *Environmental Planning and Assessment Regulation 2000*. A summary of our assessment of the CP15 (2020) against these requirements is provided at Appendix D.

2.2.2 We considered the Minister's advice on the recommendations from our 2016 and 2018 assessments of CP15

We previously assessed CP15 in 2014, 2016 and 2018, which enabled the council to apply for funding from the NSW Government to meet the gap between the contributions cap and the "IPART-assessed" reasonable cost of providing infrastructure in the plan. For the last review of CP15 in 2018, the Minister for Planning requested IPART focus its assessment on three nominated items, before the council could submit its application for Local Infrastructure Growth Scheme (LIGS) funding.

In response to our reviews of the plan in 2016 and 2018, the council was required to make 21 amendments to the plan. In assessing CP15 (2020), we have considered how the council has amended the plan to reflect the Minister's advice.

10 Nexus ensures that there is a connection between the land and facilities in a contributions plan and the demand for them arising from the new development.

Following our 2018 review, the Minister required the council to amend the plan in two stages:

1. **Stage 1** required the council to amend the plan to reflect 12 recommendations, before it was eligible to access LIGS funding. The council made the changes and adopted a version of the plan in November 2019.[11]
2. **Stage 2** required the council to reflect a higher estimated population for the precinct, make other minor changes and re-submit the plan to IPART for review.[12]

The November 2019 version of the plan is currently in force, 'CP15 (2019)'. The Minister's Nominee deemed CP15 (2019) to be an 'IPART reviewed contributions plan', enabling the council to levy contributions in accordance with that plan until 31 December 2020,[13] subject to clause 6E of the Ministerial Direction.[14] The council will be able to levy contributions in accordance with CP15 (2020) once it satisfies all of the following:

- IPART has completed its review of CP15 (2020)
- The Minister (or Minister's Nominee[15]) has advised the council of any amendments required to the plan
- The council approves the plan, having made the amendments in accordance with the advice of the Minister or Minister's Nominee.[16]

Having satisfied these requirements, CP15 (2020) will be an 'IPART reviewed contributions plan.'

2.2.3 We considered changes to the plan since our previous assessment

There have been changes to the plan since our previous assessment. These changes include a revised population projection for the Box Hill Precinct (with implications for the demand for and provision of infrastructure), new transport infrastructure items, revised scopes and costings of some infrastructure, and additional land in the plan. These changes are outlined further in Chapter 3 and in the relevant infrastructure chapters.

The Works Schedule for CP15 (2020) shows that the council has acquired over one third of the land in the plan, completed some stormwater and transport works, but delivered no open space embellishment.

Our assessment of CP15 (2020) has considered whether the council's actual and estimated costs are reasonable.

11 The Hills Shire Council, 26 November 2019, Ordinary Council Meeting Minutes, pp 8-9.
12 Minister for Planning, letter to The Hills Shire Council, August 2019.
13 Minister for Planning, letter to The Hills Shire Council, August 2019.
14 Ministerial Direction, 2012, as amended by the *Environmental Planning and Assessment (Local Infrastructure Contributions) Amendment Direction 2020* (issued on 18 June 2020). Subclause (4) provides that the council must not grant development consent relating to any land within The Hills local government area between 1 July 2020 and 31 December 2020 requiring the payment of a monetary contribution exceeding $50,000 for each dwelling authorised by, or each residential lot authorised to be created by, the development consent. However, the council may impose a condition requiring the payment of a monetary contribution that exceeds $50,000 per dwelling or per residential lot if the monetary contribution is paid after 1 July 2021 (subject to the provisions of the contributions plan and the other provisions of the amended Ministerial Direction that would, but for clause 6E, apply).
15 Ministerial Direction, 2012, as amended, cl 5(3)(c), *'…the Minister (or a nominee of the Minister) has advised the relevant council as to any amendments required to the contributions plan.'*
16 Ministerial Direction, 2012, as amended, cl 5(3).

2.3 What happens next?

The Minister, or his Nominee, will consider our assessment and, if appropriate, request the council to amend the contributions plan. Once the council has made any requested amendments, the plan becomes an 'IPART-reviewed plan' and the council may levy contributions in accordance with the adopted plan.

3 Overview of the plan

CP15 (2020) applies to development in the Box Hill Precinct, comprising the residential suburb of Box Hill and the Box Hill Industrial precinct, located approximately 40km north west of Sydney's CBD in the North West Growth Area (NWGA).

The precinct was rezoned for urban development in April 2013 and covers an area of 974 hectares, including approximately 724 hectares of land zoned for residential development and 133 hectares of industrial and commercial space.[17]

In 2017, DPIE released the *North West Priority Growth Area Land Use and Infrastructure Plan* (the LUIP), which included revised population estimates for the Box Hill Precinct.

3.1 Status of CP15 (2020)

The Hills Shire Council exhibited the revised CP15 (2020) between 17 December 2019 and 7 February 2020. The version of the plan that is currently in force was adopted in November 2019.

The revised plan, submitted to IPART in March 2020, is intended to address outstanding amendments relating to updated population projections for the Box Hill Precinct that the Minister requested in response to our 2018 review of the plan.

Since our 2018 review, the council has also made the following changes to the plan:

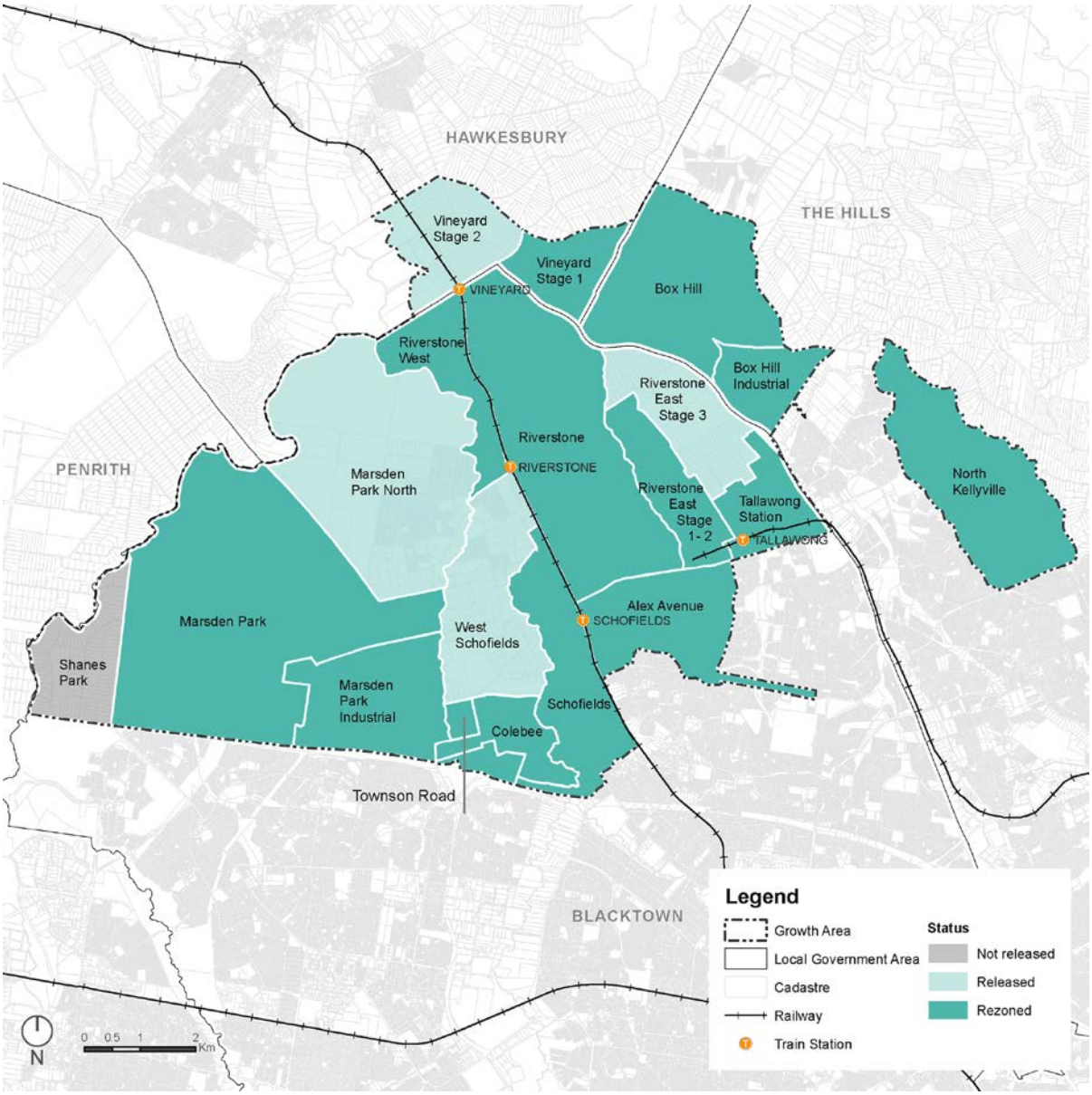
- **Transport** – new items (land and works for half-width roads fronting non-developable land, bridge works, one intersection), changes to a number of intersections, revised costings and 3.1 hectares of additional transport land.
- **Stormwater** – 1.7 hectares of additional land has been included in the plan because of practical issues associated with land acquisition.
- **Open space** – 0.2 hectares of additional land for an existing park.
- **Administrative amendments and updated assumptions** – including updates to the Net Present Value (NPV) model used to calculate contributions and incorporation of actual expenditure and revenue up to 30 June 2019.

17 State Environmental Planning Policy (Sydney Region Growth Centres) Amendment (The Hills Growth Centres), gazetted April 2013; and DPE, Fact Sheet Box Hill and Box Hill Industrial, March 2013.

3.2 Land and development in the Box Hill Precinct

As shown in Figure 3.1, the Box Hill Precinct is located in the north-east of the NWGA. In relation to other precincts, Boundary Road creates the border of the precinct with the adjoining Vineyard precinct to the west and Windsor Road separates Box Hill from Riverstone and Riverstone East precincts to the south.

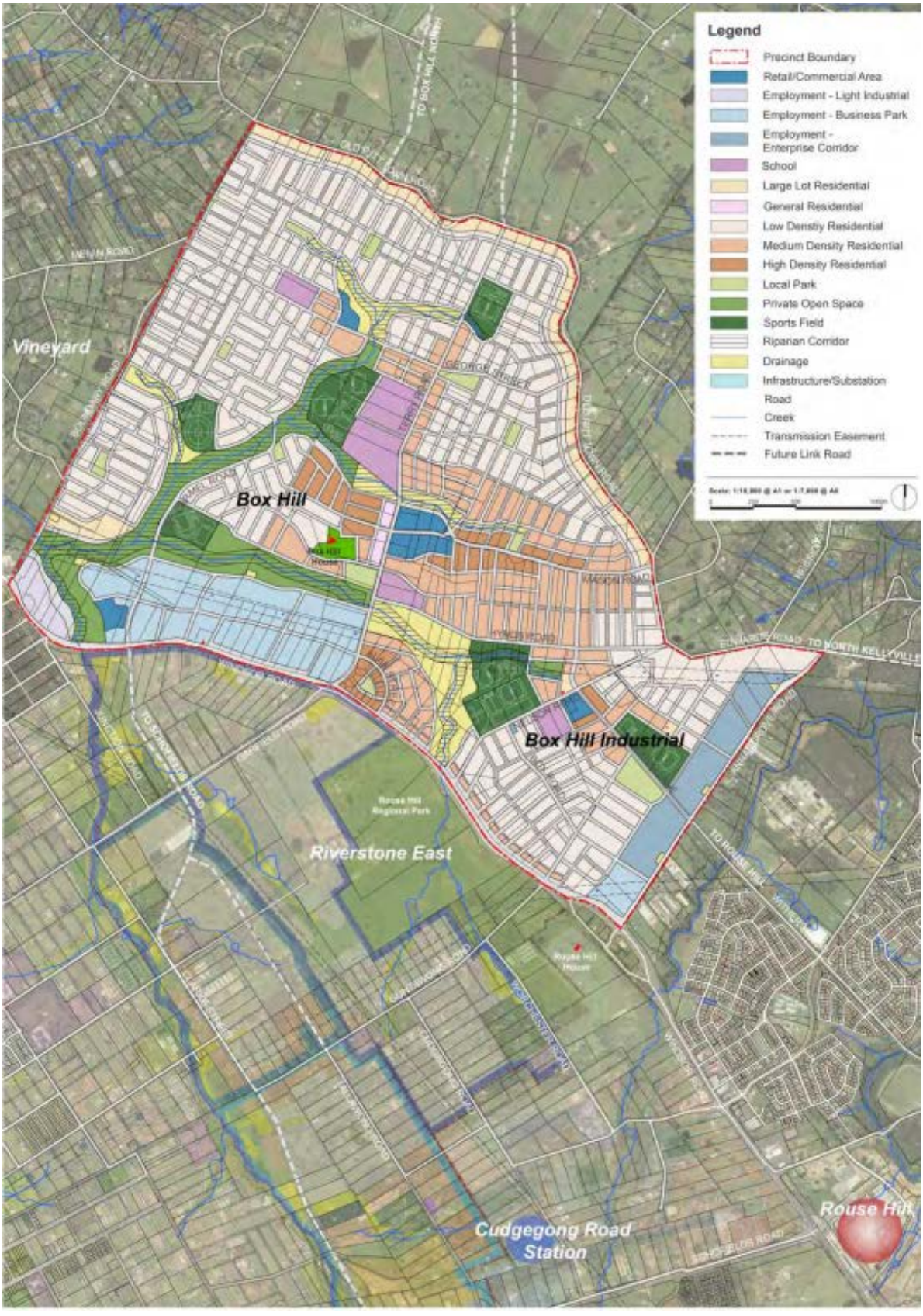
Figure 3.1 Map of the North West Growth Area



Source: DPIE website, https://www.planning.nsw.gov.au/-/media/Images/DPE/Maps/Plans-for-your-area/north-west-growth-area-map-2400x1696.gif?la=en

Figure 3.2 is the Box Hill Indicative Layout Plan (ILP), showing the broad level development outcomes for the Box Hill Precinct.

Figure 3.2 Box Hill Precinct Indicative Layout Plan



Source: DPIE, Box Hill Growth Centre Precincts, Development Control Plan, March 2018, p 45.

3.2.1 Changes to population projections

Since we reviewed CP15 (2018), the council has revised its estimate of the residential population to be accommodated in the Box Hill Precinct. The revised estimate reflects:

- Higher development yields arising from the NSW Government's Housing Diversity initiatives within the Growth Centre Precincts (in particular, application of minimum density targets without an associated maximum density limitation)
- Higher dwelling occupancy rates based on the 2016 Census.

The changes to population projections address two of the recommendations from our review of CP15 (2018). The Minister requested the council make these amendments to the plan.[18]

The expected net additional residential population in the plan's catchment area has increased by 11,796 people, from 30,687 in CP15 (2018)[19] to 42,483 in CP15 (2020). When fully developed, the precinct is expected to provide 13,276 dwellings (an increase of 3,052 dwellings from CP15 (2018))[20] and support around 17,700 jobs.[21]

Table 3.1 sets out the average occupancy rates for the different types of residential development based on historical analysis of six similar development areas in The Hills Shire Council LGA as at the 2016 Census.[22] The council uses these occupancy rates in CP15 (2020).

Table 3.1 The Hills Shire Council – Average occupancy rates

Dwelling type	Average occupancy rates
Dwelling Houses	3.4
Integrated Housing Development	2.7
Senior Housing	1.5
Multi-Unit Housing:	
1 Bedroom	1.7
2 Bedroom	1.8
3 Bedroom	2.5
4 Bedroom	3.1

Source: CP15 (2020), p 19.

Table 3.2 shows the land area, estimated floor space and resulting job forecasts for development in the Box Hill Precinct.[23]

18 Minister for Planning, Letter to The Hills Shire Council, August 2019.
19 CP15 (2018), p 20.
20 CP15 (2018), p 18.
21 DPIE, North West Priority Growth Area, Land Use and Infrastructure Implementation Plan, 2017.
22 CP15 (2020), p 19.
23 CP15 (2020), p 21.

Table 3.2 Total estimated jobs in Box Hill Precinct

Land use	Development area (ha)	Jobs per hectare of development area	Total jobs
B7 Business Park	69.4	183	12,700
B6 Enterprise Corridor	26.9	128	3,447
IN2 Light Industrial	6.1	63	381
B2 Local Centre	13.0	97	1,261
Total	**115.38**		**17,789**

Source: CP15 (2020), p 21.

3.3 Cost of land and works in CP15 (2020)

The total cost of land, works and plan administration in CP15 (2020) is $682.10 million ($Jun2019). This comprises:

- $304.74 million (44.7%) for the acquisition of land for local infrastructure
- $371.79 million (54.5%) for local infrastructure works
- $5.58 million (0.8%) for plan administration.

3.4 Contribution rates in CP15 (2020)

The council uses a NPV approach to calculate the contribution rates in CP15 (2020). It uses this approach to ensure that the value of contributions is not eroded over time and reflects the time value (or opportunity cost) of money. For CP15 (2020), the council has two NPV models which calculate contribution rates for residential and non-residential development. The models reflect assumptions about the timing of revenues (ie, when development is expected to occur), and the timing of expenditure (ie, when it expects to deliver the infrastructure in the plan over the next 25 years, the life of the plan).

The model discounts revenues and costs, based on the council's assumptions, to arrive at a present value contribution rate. The council's approach to modelling contribution rates is discussed further in Chapter 8.

3.4.1 Contributions are levied on a per person or gross floor area basis

Contributions for transport, open space and plan administration costs are calculated on a per person basis for residential development, and on a per square metre of gross floor area (GFA) basis for non-residential development.

Contributions for stormwater infrastructure costs are calculated on a per person basis for residential development, and on a per square metre of GFA basis for non-residential development. In addition, the council calculates separate stormwater contribution rates for development in the Killarney Chain of Ponds (KCP) drainage catchment and the Second Ponds Creek (SPC) drainage catchment.

Table 3.3 shows the plan's contribution rates by infrastructure category for residential and non-residential development.

Table 3.3 Contribution rates by infrastructure category in CP15 (2020) ($Jun2019)

Infrastructure category	Residential (per person)	Non-residential (per hectare)
Transport	4,187	862,600
Stormwater management (KCP)	*3,745*	*276,800*
Stormwater management (SPC)	*1,040*	*73,800*
Open space	6,937	0
Community facilities	0	0
Administration	108	*10,600*
Total (KCP)	**14,977**	**1,150,000**
Total (SPC)	**12,271**	**947,000**

Note: The plan includes separate contributions catchments for stormwater management costs. Development in the KCP catchment pays a contribution of $14,977 per person, while development in the SPC catchment pays a contribution of $12,271 per person.

School developments in Box Hill are only required to pay the per hectare contributions towards stormwater management land and works.

Source: CP15 (2020) pp 5 and 7.

3.4.2 Indicative residential contributions

Indicative residential contributions are derived by multiplying the per person rate by the expected number of occupants for each dwelling type. They range from $20,861 for a 1-bedroom multi-unit dwelling in the Second Ponds Creek catchment to $50,922 for a detached house in the Killarney Chain of Ponds catchment. Table 3.4 shows the indicative residential contribution rates in CP15 (2020).

Table 3.4 Indicative residential contribution rates in CP15 (2020) ($Jun2019)

Dwelling type	Occupants per dwelling	Indicative contribution ($)	
		Killarney Chain of Ponds	Second Ponds Creek
Subdivision, dwelling house, dual occupancy	3.4	50,922	41,721
Integrated housing[a]	2.7	40,438	33,132
Senior housing and boarding house rooms	1.5	22,466	18,406
Multi-unit housing:			
1 bedroom	1.7	25,461	20,861
2 bedrooms	1.8	26,959	22,088
3 bedrooms	2.5	37,443	30,677
4 bedrooms	3.1	46,429	38,040

a Small lot housing, The Hills Shire Council, LEP, cl 4.1B.

Source: CP15 (2020), pp 6 and 19.

3.4.3 Indicative non-residential contributions

Indicative non-residential contributions are derived from the per square metre rate of GFA. Contributions for schools are derived from the per square metre rate of GFA for stormwater management land and works only.[24] In the Killarney Chain of Ponds catchment, contributions are around $1,150,000 per hectare for non-residential development and $276,000 per hectare for schools. In the Second Ponds Creek catchment, the equivalent contributions are around $947,000 and $74,000 per hectare, respectively. Table 3.3 in section 3.4.1 above shows the indicative non-residential contribution rates in CP15 (2020).

24 This approach is consistent with the Minister's advice to the council on 23 June 2017.

4 Transport

The total cost of transport land and works in CP15 (2020) is $232.62 million (34.1% of total costs), comprising:

- $51.67 million for land (17.0% of the total cost of land)
- $180.95 million for works (48.7% of the total cost of works).

Our assessment of the transport land and works in CP15 (2020) is:

- **Criterion 1: Essential works** – All transport land and works are consistent with the essential works list.
- **Criterion 2: Nexus** – There is nexus between most transport land and works in the plan and development in the Box Hill Precinct. The council's revised transport modelling supports changes for two intersections.
- **Criterion 3: Reasonable cost** – The council's approach to estimating costs for different categories of transport works is reasonable, except:
  - The council should reduce the contingency allowance for half-width roads fronting non-developable land from 30% to 20%
  - The council should revise its estimated costs of some signalised intersections and some two-lane roundabouts
  - The council should reduce the cost of the Northern Connection Road if it is funded through the North West Growth Area Special Infrastructure Contribution (NWGA SIC)
  - The cost of upgrading Boundary Road to an urban standard collector road is too low.
- **Criterion 5: Apportionment –** The council's approach to apportioning costs is reasonable, except:
  - More costs for the upgrade of Boundary Road should be apportioned to CP15
  - The council should reflect the updated population estimates when apportioning costs for the Northern Connection Road.

Our assessment of land for transport against Criterion 3 (Reasonable cost) is in Chapter 8.

Based on our findings, we recommend adjustments to the plan we estimate would reduce the cost of transport land and works by $12.59 million (5.4%). Our findings and recommendations are summarised in Table 4.1.

Table 4.1 IPART-recommended adjustments for transport ($Jun2019)

Criterion	Findings	Recommendations	Land	Works
Total costs in plan			**51,665,809**	**180,953,757**
Essential works	All land and works in the plan are consistent with the essential works list.			
Nexus	Nexus is established for all land and works in the plan, except:			
	The council's transport modelling supports changes to the treatment of intersections	▼ Decrease the cost of upgrading BHT18 ▼ Increase the cost of delivering BHT17	-402,778	-4,753,260
Reasonable cost - Land	The cost of land for transport works is reasonable.			
Reasonable cost – Works	The cost of works is mostly reasonable, except:			
	The contingency allowance for half-width roads is too high	Reduce the contingency allowance from 30% to 20%		-1,889,008
	Part of the Northern Connection Road may be funded through the SIC	Reduce the cost of the road if funded through the SIC		*Not costed*
	Revised cost estimates for some two-lane roundabouts are unreasonable	Revise costs based on the estimated cost of a similar roundabout in North Kellyville		-2,952,464
	Revised cost estimates for some signalised intersections are unreasonable	▼ Reduce the cost of three intersections to reflect the AECOM 2014 technical study ▼ Revise the cost of six intersections to reflect the council's revised cost estimates		-22,246,060
Apportionment	Approach is mostly reasonable			
	The Northern Connection Road should be apportioned based on revised population estimates	Increase the cost of the Northern Connection Road so that the plan includes 67% of the total cost, in line with its share of the total population of the Box Hill and North Kellyville Precincts		1,947,443
	More of the costs of upgrading Boundary Road should be apportioned to CP15 (2020)	Increase the cost of Boundary Road to reflect updated transport modelling from TfNSW		17,706,650
Total IPART-recommended cost adjustment			**-402,778**	**-12,186,699**
Total IPART-assessed reasonable cost			**51,263,031**	**168,767,058**

Source: CP15 (2020) Works schedule, IPART analysis.

4.1 Overview of transport works in CP15 (2020)

Prior to re-zoning, the transport network in Box Hill was designed to cater for rural traffic volumes only. Urbanisation of the area requires new and upgraded roads, new bridges, intersections, bus stops and cycleways.

Transport works account for around 48.7% of works costs in CP15 (2020). The cost of transport works is driven by the cost of intersections ($63.0 million or 34.8% of total works costs) and bridges ($38.41 million or 21.2% of total works costs). Table 4.2 shows the cost of transport land and works in the plan.

Since our last assessment of the plan in 2018, the council has made changes to the scope and cost of transport works. In particular, it has included an additional $41.93 million to deliver half-width roads fronting non-developable land.

Table 4.2 Transport land and works in CP15 (2020) ($Jun2019)

Item	Cost of land	Cost of works	Total cost
New roads	10,270,365	29,632,127	39,902,492
Road upgrades	12,839,804	22,742,859	35,582,663
Road upgrades (half-width roads)	17,369,580	24,557,109	41,926,689
Bridges	5,792,187	38,411,785	44,203,972
Intersections	5,393,872	63,002,905	68,396,777
Bus stops	0	497,134	497,134
Cycleways	0	2,109,838	2,109,838
Total	**51,665,809**	**180,953,757**	**232,619,565**

Source: CP15 (2020) Works Schedule.

The locations of most transport land and works can be seen across multiple maps at pages 55-68 of CP15 (2020).

4.2 Criterion 1: Essential works

All land and works for transport in CP15 (2020) are consistent with the essential works list in the Practice Note.[25] The items of transport infrastructure in CP15 (2020) are set out in Table 4.3. There is a land component for most transport infrastructure items.

Table 4.3 Transport works items in CP15 (2020)

Items on the essential works list	
▼ New and upgraded roads	▼ Bus stops
▼ Bridges	▼ Cycleways
▼ Intersections	

Source: The Hills Shire Council, CP15 (2020), pp 37-39.

25 Department of Planning and Environment, *Local Infrastructure Contributions Practice Note*, January 2019.

4.3 Criterion 2: Nexus

In assessing whether there is nexus between the transport land and works and the development in the plan, we reviewed the findings in our previous assessments and consider they remain relevant. We have focused our assessment on changes to the plan since we last assessed it in 2016 and 2018.[26]

Since we last assessed the plan, the council has changed the treatment of some intersections, included additional land for some roads and intersections and added all remaining, undelivered half-width roads fronting non-developable land.

We have found that:

- The council has changed the treatment of eight intersections and relies on its internal traffic modelling to establish nexus for the intersection changes. We consider the council's approach to the traffic modelling and changes to the treatment of intersections are mostly reasonable. However, the council's traffic modelling supports the following further changes to intersections:
  - BHT18: change from a signalised intersection to a give-way signed intersection, with a signalised pedestrian crossing near the location.
  - BHT17: change from a roundabout to a signalised intersection.
- Nexus is established for the signalised intersection of Terry Road and Old Pitt Town Road, although this is not supported by the technical studies.
- The council has included an additional 3.1 hectares of land for transport infrastructure in CP15 (2020), and nexus is established for this additional land.
- The council has included $41.93 million to deliver 9.5km of half-width roads fronting non-developable land, and nexus is established for these land and works.

Recommendations

1 Remove the cost of the signalised T-junction intersection at the corner of Terry Road and High Street [BHT18] because nexus is established for a pedestrian crossing only. This would reduce costs in the plan by $5,502,778.

2 Increase the cost of the intersection at the corner of Prosper Street and Mount Carmel Drive [BHT17] by $346,740 because nexus is established for a signalised intersection instead of a roundabout.

26 At the request of the Minister for Planning, our 2018 review of CP15 primarily focused on changes to the plan since out 2016 assessment. We consider the findings from both our 2016 and 2018 assessments remain relevant.

4.3.1 Nexus for most transport works is established through technical studies and consultant advice

The technical studies relied on by the council to establish nexus for most transport infrastructure are unchanged from CP15 (2020) (Table 4.4).

Table 4.4 Technical studies for transport works in CP15 (2020)

Author	Title	Date
GHD	Box Hill and Box Hill Industrial Precincts – Transport and Access Study	February 2011
GHD	Box Hill and Box Hill Industrial Precincts – Post Exhibition Traffic Study Review	April 2012
AECOM	Boundary Road Strategic Concept Design Study	February 2013
AECOM	Traffic Management & Open Space Strategic Design	January 2014
Calibre Consulting	SEPP Amendments to rezone land for the relocation of Mount Carmel Road, Box Hill	March 2014
Brown Consulting	Intersection Design and Traffic Assessment	March 2014

Source: CP15 (2020), p 26; IPART, Assessment of The Hills Shire Council's Section 94 Contributions Plan No 15, March 2016, p 31; and IPART, Assessment of revised Contributions Plan 15 for Box Hill, October 2018, p 36.

The proposed transport network in CP15 (2020) relies on strategic traffic modelling prepared by GHD in 2011 during precinct planning, which identified likely traffic volumes on the road network to inform the future road hierarchy in the Box Hill Precinct.[27]

Since precinct planning, the council has made a number of changes to the initial scope and layout of transport infrastructure.

Our 2018 assessment considered changes to the transport network, in particular along Mount Carmel Road and Terry Road. Our 2018 assessment found:

- The additional technical studies commissioned by the council establish nexus for most items on Mount Carmel Road[28]
- The changes to Mount Carmel Road were reflected in subsequent planning documents from DPIE.[29]
- Changes to the scope of works along Terry Road were not supported by additional technical studies. However, we considered the council's explanations and intersection design maps provided to support the changes were sufficient to establish nexus for most items in the plan.

27 GHD, *Box Hill and Box Hill Industrial Precincts – Transport and Access Study*, February 2011, p 87.
28 Specifically the technical studies from Calibre Consulting and Brown Consulting listed in Table 4.4.
29 DPE, *Amendment to the Box Hill Precinct Plan (Mount Carmel Road), State Environmental Planning Policy (Sydney Region Growth Centres) 2006 – Finalisation Report*, August 2016; DPE, *Box Hill Growth Centre Precincts Development Control Plan*, May 2017 (DCP).

Since our 2018 assessment, the council has amended the transport infrastructure in the plan to include:

- $41.93 million for land and works to deliver 9.5km of half-width roads fronting non-developable land
- Four signalised intersections, one is a new item and three were previously identified as roundabouts; and two roundabouts which were previously identified as signalised intersections.
- 3.1 hectares of additional land to support the delivery of transport infrastructure we have previously assessed.

4.3.2 Nexus is established for intersection changes in CP15 (2020)

CP15 (2020) includes changes to intersections since we last reviewed the plan. These are outlined in Table 4.5.

Table 4.5 Changes to intersection treatments in CP15 (2020)

Item	CP15 (2018)	CP15 (2020)	Notes
BHT09	Signalised intersection	Roundabout	Change in scope and cost
BHT21	Signalised intersection	Roundabout	Change in scope and cost
BHT22	na	Signalised intersection	New item in the plan
BHR05	Roundabout	Signalised intersection	Change in scope and cost
BHR06	Roundabout	Signalised intersection	Change in scope and cost
BHR07	Roundabout	Signalised intersection	Change in scope and cost

Source: CP15 (2018), Works Schedule.

The scope and treatment of intersections in the Box Hill Precinct was originally established by the 2011 GHD transport study. During our assessment, the council presented internal traffic modelling and analysis to support changes to the treatment of intersections. The analysis considers the Volume to Capacity (V/C ratio) of AM and PM peak flows on the precinct's traffic network, based on the revised population and dwelling forecasts to 2036. The council's full analysis is provided at Appendix E.

We consider the council's modelling establishes nexus for all changes in intersection treatments in CP15 (2020), except for BHT22 (as outlined below at section 4.3.4). The changes are needed to accommodate the higher demand on transport infrastructure resulting from the revised population in the Box Hill Precinct.

4.3.3 The council's updated traffic modelling affects nexus for other intersections in the plan

The council's traffic modelling also establishes nexus for a signalised intersection at Prosper Street and Mount Carmel Drive (BHT17). The intersection is identified in CP15 (2020) as a two-lane roundabout, but information from the council supports its upgrade to a signalised intersection.

However, the council's traffic modelling does not support the signalised intersection of Terry Road and High Street (BHT18). The intersection is identified in the technical studies as a signalised intersection, but the traffic modelling from the council suggests a T-junction intersection with giveway/yield signage on High Street will be sufficient. We have therefore found that nexus is not established for signalised intersection BHT18.

In response to our Draft Report, the council agreed that BHT18 does not need an upgrade to a signalised intersection.[30] However, it noted that a signalised pedestrian crossing is still required, at a cost of approximately $200,000. We agree that a signalised pedestrian crossing is required to provide safe access for pedestrians across Terry Road to the proposed Box Hill City Centre and for cyclists to continue along the adjoining cycleways. We consider nexus is established for this crossing by the original traffic study, which identifies a signalised crossing of Terry Road near the location.[31]

As a signalised intersection is not required, the additional land in the plan for this intersection is also not required. Revising the cost to remove the land component and the cost of the signalised intersection, and replacing it with the cost of a signalised pedestrian crossing, reduces costs in the plan by $5,502,778.

4.3.4 Nexus is established for the signalised intersection of Terry Road and Old Pitt Town Road (BHT22)

CP15 (2020) includes a new signalised intersection at the junction of Terry Road, Old Pitt Town Road and Fontana Drive. The council has not provided transport modelling or detailed information to support nexus for the additional signalised intersection. It explained that the plan has been updated to include only the signalised portion of the intersection. The other works, ie, site preparation, line-marking and road reserves, have already been delivered by a developer as a condition of development consent.[32]

Based on the treatment of other intersections on Terry Road, the likely traffic volume on Terry Road and delivery of the road reserve to support a signalised intersection, we consider that nexus is established for the upgrade.

30 THSC submission to Draft Report, p 2.
31 GHD, *Box Hill and Box Hill Industrial Precincts – Transport and Access Study*, February 2011.
32 The council's response to our Draft Report noted that most, but not all additional works have been delivered by developers. An additional turning lane and other minor works will be required to deliver the signalised intersection.

4.3.5 Nexus is established for additional land that is required for transport infrastructure

CP15 (2020) includes 3.1 hectares of additional land for transport works compared with CP15 (2018). Some of this additional land reflects changes requested by the Minister in response to our previous assessment of an intersection on Terry Road.[33] Other additions relate to intersections, bridges and road upgrade works and are outlined in Table 4.6.

Table 4.6 Land added to the plan since our last assessment (hectares)

Item	CP15 (2018)	CP15 (2020)	Difference
Signalised intersections	0.10	1.14	1.04
Roundabouts	0.00	0.37	0.37
Road upgrades	1.78	2.25	0.46
Bridges	0.00	1.18	1.18
Total	**1.89**	**4.94**	**3.05**

Source: The Hills Shire Council, Responses to Questions from IPART, 20 May 2020, CP15 (2018), Works Schedule.

The council explained that the need for additional land was identified following an update of designs and review of the likely land area required to deliver the works.

We have reviewed the council's designs and consider the council's approach to revising the land areas is reasonable. The approach is consistent with our experience in other plans where councils have updated land areas for essential infrastructure following more detailed, site-specific designs and estimates.

4.3.6 Nexus is established for the inclusion of half-width roads

CP15 (2020) includes $41.93 million for land and works to deliver 9.5km of half-width roads fronting non-developable land. The inclusion of these works represents a change in approach for the plan, with the council previously requiring developers to deliver the roads as a condition of development consent. It is also the first time the council has taken an approach to include all half-width roads fronting non-developable land in a contributions plan. Figure 4.1 shows the location of half-width roads in the plan.

33 IPART, *Assessment of revised Contributions Plan 15 for Box Hill,* October 2018, Recommendation 7.

Figure 4.1 Half-width roads included in CP15 (2020)

Source: The Hills Shire Council, Response to questions from IPART, 20 May 2020.

The council has suggested that it may face difficulty requiring delivery of the roads, and their inclusion in the plan gives it a mechanism to 'require' developers to fund or construct the roads.[34]

The council also considers that the inclusion of land and works for half-width roads fronting non-developable land is consistent with IPART's technical advice.[35]

We provided advice to stakeholders in April 2019 about how we would assess nexus and apportionment of costs for roads in contributions plans. The relevant advice is outlined in Box 4.1.

34 Meeting with The Hills Shire Council, 6 March 2020.
35 Meeting with The Hills Shire Council, 6 March 2020.

Box 4.1 Our method for assessing roads in contributions plans

Our method for assessing nexus for, and apportioning cost of, roads in contributions plans will involve consideration of the following principles:

- Councils should secure the delivery of local and collector roads through conditions of development consent, where possible.
- Where it is not possible or practical to secure the delivery of a local or collector road (or segment of road) through conditions of development consent, there may be a case for including the road in the plan. This may be the case when:
  - The road or half-road fronts public or non-developable land
  - The road services a critical role in the transport network or the road is required to lead or facilitate development
  - It is not practical for an individual developer to provide the road, and/or
  - There is fragmented ownership of adjoining land.
- When including a road in a plan, the council should provide an explanation and supporting information, preferably in explanatory notes as part of a contributions plan, to encourage stakeholder engagement when the draft plan is exhibited.
- When considering which road costs need to be included in a plan, councils should separately consider:
  - Land acquisition costs
  - Works costs
  - Design costs.
- A simple approach to the apportionment of transport costs across the plan area (on a per person basis for residential development) is preferred to a more complex – but more accurate – approach.

Source: IPART, Inclusion of roads in contributions plans Fact Sheet, April 2019, p.2.

For most contributions plans we have assessed, councils have required developers to deliver all local roads as conditions of development consent, rather than include the costs of these roads in contributions plans. However, some other plans we have recently assessed, such as Blacktown City Council's CP24 for the Schofields Precinct, included sections of collector and local roads fronting non-developable land that had not been identified as necessary by the technical studies. These roads were:

- Upgrades of existing roads fronting public or environmental land
- New roads with no potential for a developer to construct a section of the road as a condition of development consent.[36]

For CP24 we found the council's approach was reasonable and nexus was established for the inclusion of the roads.

36 IPART, *Assessment of Contributions Plan No. 24 Schofields Precinct*, August 2019, p 38.

In practice, for CP15 (2020) we understand the council will continue to require developers to deliver the roads as a condition of development consent. It will then provide an offset against the developer's contribution amount for the value of the road construction, as estimated in the plan.[37]

We note that the council's approach effectively 'locks-in' the estimated cost of the infrastructure as the cost of the actual offset provided to developers. If the estimated costs in the plan are too high, then developers will deliver the roads for less than the contributions offset they receive. In this scenario, other developers who do not deliver the half-width roads end up paying a higher contribution rate, while developers that deliver the half-width roads pay a lower contribution rate.

We consider the council's approach is reasonable because it has provided a reasonable explanation for its change in approach and publicly consulted with stakeholders on the changes.

4.4 Criterion 3: Reasonable cost (works only)

The cost of transport works in CP15 (2020) is $180.95 million (48.7% of the total cost of works). This is $82.24 million (83.3%) higher than the cost of works in CP15 (2018), as shown in Table 4.7.

The higher costs primarily reflect the changed treatment of some intersections, the inclusion of half-width roads fronting non-developable land, and additional bridge works.[38]

The council has 'locked-in' approximately 20% of the costs of transport infrastructure in the plan through the Hills of Carmel Voluntary Planning Agreement (VPA) and by delivering a small portion of works. The VPA includes works relating to Mount Carmel Road, including a bridge and intersections. The agreed value of the items in the VPA are the base costs in the plan indexed to the expected date of construction, with no further allowances applied.

The cost estimates for the remaining transport works in the plan are based on cost estimates we previously considered in our 2016 and 2018 assessments and new estimates for some works including intersections and half-width roads. The council has indexed outstanding estimated costs for transport works to the revised base period of the plan (June 2019), using the ABS 3101 Road and bridge construction index for NSW.

37 Meeting with The Hills Shire Council, 6 March 2020.

38 The change in the cost of bridge works is being driven by the increase to the cost of the Northern Connection Road. The council includes all of the cost of the road and bridge as a bridge cost in the plan.

Table 4.7 Cost of works in CP15 (2018) and CP15 (2020) ($Jun2019)

	CP15 (2018)	CP15 (2020)	Difference	% change
New roads	30,400,685	29,632,127	-768,558	-2.5%
Road upgrades	22,553,059	22,742,859	189,800	0.8%
Half-width roads	0	24,557,109	24,557,109	100%
Bridges	25,259,310	38,411,785	13,152,475	52.1%
Intersections	17,925,471	63,002,905	45,077,433	251.5%
Bus stops	497,134	497,134	0	0%
Cycleways	2,082,838	2,109,838	27,000	0%
Total	98,718,498	180,953,757	82,235,259	83.3%

Note: CP15 (2018) costs have been indexed to the base period of CP15 (2020).
Source: CP15 (2020) Works Schedule and CP15 (2018) Works Schedule.

We found that:

- The use of actual costs for completed transport works, and costs agreed through the Hills of Carmel VPA, is reasonable.
- The council's approach to estimating costs for most transport works is largely unchanged from our previous assessment, and our previous findings remain relevant.
- The council's base cost estimate for half-width roads fronting non-developable land is reasonable, but the contingency allowance is too high.
- The council's revised cost estimate for the Northern Connection Road is reasonable, but the council should remove any costs if they are funded through the NWGA SIC.
- The council's revised cost estimate for two-lane roundabouts is reasonable for roundabouts BHR01 and BHR02 but too high for roundabout BHR03.
- The council's revised cost estimates for signalised intersections are too high. In response to our Draft Report the council provided new cost estimates for six signalised intersections that we found reasonable.
- The cost of upgrading Boundary Road is too low.

Recommendations

3 Reduce the cost of half-width roads by $1,889,008 to reflect a lower contingency allowance of 20%.

4 Reduce the cost of the Northern Connection Road if it is partially funded through the NWGA SIC.

5 Reduce the cost of two-lane roundabouts [BHR03 and BHR08] by $2,952,464, reflecting a more reasonable estimate of costs based on a comparable roundabout in North Kellyville.

6 Reduce the cost of signalised intersections, as shown in Table 4.10, by $22,246,060, reflecting the previous estimated costs (AECOM 2014) and revised costs provided by the council.

4.4.1 The base cost of half-width roads fronting non-developable land is reasonable, but the contingency allowance is too high

CP15 (2020) includes $24.56 million in works costs to deliver 9.5km of half-width roads fronting non-developable land. The council has used the IPART Benchmark cost for new local roads of $3,964 per linear metre ($Jun2019), divided by two to calculate the base cost of the half-width roads and then added a 30% contingency allowance.

We found that:

- The council's base estimate for the half-width roads is reasonable, but high compared with estimates for half-width roads in other plans we have recently assessed.
- The 30% contingency allowance applied by the council is higher than we have seen in other plans we have recently assessed.

Based on our comparison with other plans and the nature of the works, ie local roads being delivered as part of subdivision and precinct delivery, we recommend the council reduce the contingency allowance from 30% to 20% for these works.

The council disagrees with our recommendation to reduce the contingency allowance for these works.[39] It argues that a 30% contingency allowance is consistent with IPART's Benchmark Report for works at a strategic review stage.[40] We consider the lower contingency allowance is appropriate because:

- The works will be delivered in greenfield areas in conjunction with the subdivision and release of land, which will reduce risk.
- In most instances, the council will require developers to deliver the works as a condition of development consent.
- The base cost for the half-width roads is high compared with estimates in other plans we have assessed.

When the council next reviews the plan it should consider updating its base cost estimate for any outstanding half-width roads based on the actual cost of works delivered in the precinct.

4.4.2 The revised cost of the Northern Connection Road is reasonable

CP15 (2020) includes $15.79 million in works costs for the Northern Connection Road, which is a new road and bridge that will link Box Hill and North Kellyville.

The costs of the Northern Connection Road have increased since our 2018 assessment of CP15. The council's cost estimates include a new additional road segment ($6.75 million) and a revised cost estimate for the bridge, based on consultant advice.

In our review of CP13 (2018), we found the council's proposed cost estimate for the Northern Connection Road, including a bridge over Caddies Creek, was reasonable. This cost estimate was based on a detailed site-specific estimate by its cost consultant, Opus.

39 THSC submission to Draft Report, p 2.
40 IPART, *Local Infrastructure Benchmark Cost Report*, April 2014

We also note that $5.0 million is earmarked in the draft NWGA SIC, published in September 2018, to partially fund the upgrade of the Northern Connection Road.[41] If the Northern Connection Road infrastructure in CP15 (2020) (BRNKB01 and BRNKB01A) is funded through the NWGA SIC, the cost in the plan should be reduced by the extent of any funding provided.

The council's response to our Draft Report suggested removing this recommendation because the NWGA SIC is still a draft document and the funding for the upgrade of the Northern Connection Road is not certain.[42] We agree that the full costs should remain in the plan until the NWGA SIC is finalised, which is the intent of our recommendation.

4.4.3 The council's revised cost estimates for signalised intersections are mostly unreasonable

CP15 (2020) includes $49.09 million in works costs to deliver 14 signalised intersections. The cost estimates are based on three sources:

- **Costs based on the 2014 AECOM study:**
  - Signalised intersections (4): site specific 'high-level' estimates based on the 2014 AECOM study, which we previously assessed as reasonable in our 2016 assessment, indexed to the base period of the plan.[43]
- **Costs based on a two-lane, four-way intersection in North Kellyville** – at Barry Road and Withers Road. This estimate includes allowances for design (6%), project management (5.5%) and contingency (17%). Notably, the estimate also includes an adjustment to relocate public utilities, which accounts for approximately 24% of the cost estimate.
  - Four-way signalised intersections (7)[44]: an estimated cost of $5.3 million per intersection
  - T-junction signalised intersections (2): an estimated cost of $3.0 million per intersection, which is based on the same estimate as the four-way intersection, but has been adjusted down by the council to arrive at an approximation for a T-junction signalised intersection.
- **Costs for the intersection of Old Pitt Town Road, Terry Road and Fontana Drive**:
  - The council applied a rate of $1.5 million, and did not explain the source of the estimate. The works schedule indicates this is for the 'signals only' and does not include other works associated with delivering the intersection.

We have found that:

- The cost estimates for four signalised intersections based on the 2014 AECOM study are reasonable.
- The cost estimates for other signalised intersections are too high.

41 Information from The Hills Shire Council, 24 December 2019.
42 THSC submission to Draft Report, p 2.
43 The individual cost estimates are: $442,125 for BHT06, $1,771,448 for BHT11, $1,497,330 for BHT12, $777,035 for BHT19.
44 Including: BHT14, BHT15, BHT18, BHT20, BHR05, BHR06, BHR07.

The council provided revised cost estimates for six signalised intersections, in response to our Draft Report. We consider these revised cost estimates are reasonable.[45]

Table 4.8 compares the cost of signalised intersections in CP15 (2020) with the costs in CP15 (2018), which were based on the 2014 AECOM study.

Table 4.8 Comparison of signalised intersection costs in CP15 (2020) ($Jun2019)

Item	CP15 (2018)	CP15 (2020)	Difference
Signalised intersections identified in CP15 (2018)			
BHT06	442,125	442,125	0
BHT10	1,005,834	3,000,000	1,994,166
BHT11	1,771,448	1,771,448	0
BHT12	1,497,330	1,497,330	0
BHT13	826,774	3,000,000	2,173,226
BHT14	1,351,429	5,300,000	3,948,571
BHT15	1,988,089	5,300,000	3,311,911
BHT18	1,183,421	5,300,000	4,116,579
BHT19	777,035	777,035	0
BHT20	877,618	5,300,000	4,422,382
Sub-total	**11,721,102**	**31,687,937**	**19,966,835**
New signalised intersections			
BHR05	na	5,300,000	5,300,000
BHR06	na	5,300,000	5,300,000
BHR07	na	5,300,000	5,300,000
BHT22	na	1,500,000	1,500,000
Total	**11,721,102**	**49,087,937**	**37,366,835**

Source: CP15 (2020) Works Schedule and CP15 (2018) Works Schedule.

Signalised intersection costs based on the North Kellyville intersection are not reasonable because the scope of works is different

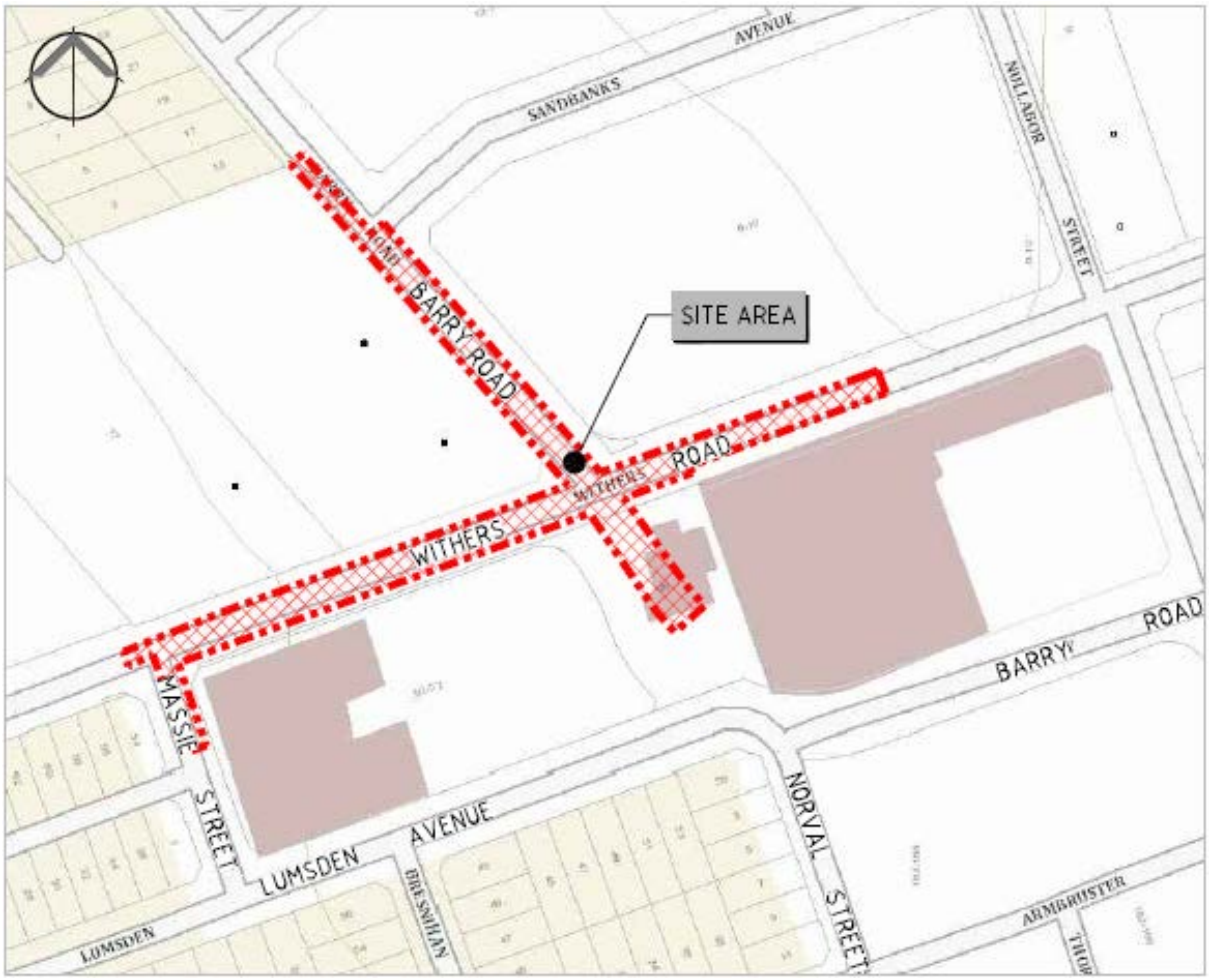
To support the costs of four-way signalised intersections, the council provided information about the intersection on which these costs are based, at Barry Road and Withers Road in North Kellyville, including:

- The detailed design prepared by Diversi Consulting in August 2019
- An accompanying cost estimate by quantity surveyors Mitchell Brandtman, prepared in October 2019.

The Diversi Consulting designs cover works that extend beyond the signalised intersection and include re-alignment and widening the future sub-arterial, Withers Road, and future collector road, Barry Road in North Kellyville (Figure 4.2).

45 Our assessment of the council's revised cost estimates for signalised intersections can be found on page 39.

Figure 4.2 Site area for the Withers Road/Barry Road & Hezlett Road and Barry Road bypass roads



Source: Diversi Consulting, *Withers Road and Barry Road Intersection: Civil Engineering Works Drawings*, August 2019, Mitchell Brandtman, *Kellyville Intersections Withers Road and Barry Road & Hezlett Road and Barry Road Bypass*, 15 October 2019.

The cost estimate from Mitchell Brandtman reflects the total cost of works extending beyond the signalised intersection as provided in the Diversi Consulting designs. Further, the cost estimate includes $1,540,609 for *public utilities adjustments* and $773,864 for *traffic management and temporary works*.

We consider that the scope of works included in the cost estimate is unlikely to be reflective of the cost of upgrading intersections in the less-developed Box Hill Precinct. For example, the North Kellyville intersection adjoins an existing shopping centre and includes overhead powerlines and new adjoining developments.

We have found that it is not reasonable for the council to use the North Kellyville intersection cost to estimate the cost of signalised intersections in CP15 (2020). The North Kellyville intersection is a major two-lane, four-way signalised intersection and the cost estimate includes works beyond the intersection upgrade. The council has applied the estimate to most remaining signalised intersections in CP15 (2020), regardless of whether they are of a similar design. For example, the council applies the $5.3 million cost estimate to BHT18 and BHT20, which are intersections of single-lane collector or local roads. It is also not reasonable to use the North Kellyville intersection to estimate the cost of T-junction intersections in CP15 (2020).

In our Draft Report we recommended the council re-apply the cost estimates from the 2014 AECOM report, indexed to the base period of the plan, or propose a more reasonable estimate of the cost of upgrading intersections in the Box Hill Precinct.

The council's response to our Draft Report provided reasonable cost estimates for six signalised intersections

The council agrees with our revised cost estimate for three of the signalised intersections (BHT13, BHT15 and BHT20).[46] It provided revised cost estimates for the other six signalised intersections (BHT10, BHT14, BHR05, BHR06, BHR07, BHT22), with greater detail about the scope of works required for these intersections.

Table 4.9 compares the cost of these six signalised intersections in the plan, with our proposed costs in the Draft Report and the council's revised cost estimates.

Table 4.9 Comparison of six signalised intersection costs in CP15 (2020) ($Jun2019)

Item	CP15 (2020)	IPART Draft Report	Council revised estimates
BHR05	5,300,000	826,774	2,123,082
BHR06	5,300,000	826,774	2,658,662
BHR07	5,300,000	826,774	2,658,662
BHT10	3,000,000	1,005,834	2,200,000
BHT14	5,300,000	1,351,429	1,597,971
BHT22	1,500,000	456,960	2,123,082
Total	**25,700,000**	**5,294,544**	**13,361,459**

Source: CP15 (2020), Works Schedule and IPART CP15 (2020) Draft Report, September 2020.

The council's revised cost estimates better account for the specific design requirements of the intersections. They are based on the council's intersection cost rates and include allowances for design, project management and contingency. Further, the revised estimates are similar to the cost of signalised intersections in other plans we have recently assessed. We consider the council's revised cost estimates for the six signalised intersections are reasonable.

For BHT22, the council clarified that the scope of works required is greater than outlined in the plan submitted to us for assessment. This intersection requires pavement for right turning lanes on Old Pitt Town Road, Terry Road and Fontana Avenue in addition to traffic signals.[47]

46 THSC submission to Draft Report, pp 3 and 4.
47 THSC submission to Draft Report, p 4.

Revising the cost of signalised intersections based on the council's revised cost estimates for six intersections and the 2014 AECOM report, indexed to the base period of the plan, for three intersections, reduces the overall cost of signalised intersections in the plan by $22,246,060.[48] Table 4.10 shows the IPART assessed reasonable cost for all signalised intersections in the plan.

Table 4.10 Comparison of signalised intersection costs in CP15 (2020) ($Jun2019)

Item	CP15 (2020)	IPART-assessed reasonable cost	Difference
Signalised intersections identified in CP15 (2018)			
BHT06	442,125	442,125	0
BHT10	3,000,000	2,200,000	-800,000
BHT11	1,771,448	1,771,448	0
BHT12	1,497,330	1,497,330	0
BHT13	3,000,000	826,774	-2,173,226
BHT14	5,300,000	1,597,971	-3,702,029
BHT15	5,300,000	1,988,089	-3,311,911
BHT18[a]	5,300,000	200,000	-5,100,000
BHT19	777,035	777,035	0
BHT20	5,300,000	877,618	-4,422,382
Sub-total	**31,687,938**	**12,178,390**	**-19,509,548**
New signalised intersections			
BHR05	5,300,000	2,123,082	-3,176,918
BHR06	5,300,000	2,658,662	-2,641,338
BHR07	5,300,000	2,658,662	-2,641,338
BHT22	1,500,000	2,123,082	623,082
Total	**49,087,938**	**21,741,878**	**-27,346,060**

a BHT18 is addressed as a nexus recommendation (recommendation 1). Nexus is not established for a signalised intersection and this IPART-assessed reasonable cost reflects the cost of a signalised pedestrian crossing only.

Source: CP15 (2020), Works Schedule and IPART analysis.

4.4.4 The council's cost estimates for some two-lane roundabouts are too high

CP15 (2020) includes $13.91 million in works costs to deliver nine roundabouts. The cost estimates per roundabout vary and include:

- **Single-lane roundabouts (5)**:
  - $464,564 per roundabout for BHT07 and BHT08, which is from the Hills of Carmel VPA, indexed to the base period of the plan
  - $480,034 per roundabout for BHT09 and BHT17, which is from the Hills of Carmel VPA, indexed to the base period of the plan
  - $468,910 for BHT21, which is based on the IPART-benchmark rate, plus a 30% contingency allowance, indexed to the base period of the plan.

48 Table 4.10 includes the reasonable cost of all signalised intersections in the plan. BHT18 is addressed as a nexus recommendation (recommendation 1) and is not reflected in the cost recommendation for intersections.

- **Two-lane roundabouts (4)** [BHR01, BHR02, BHR03, BHR08] - an estimated cost of $2,889,215 per roundabout, which is based on a two-lane roundabout at Withers Road and Russell Reserve Access Road in North Kellyville. The estimate includes allowances for design (2.5%), project management (2.5%) and contingencies (33%).

We consider the council's estimated costs for single-lane roundabouts, based on costs in the Hills of Carmel VPA or the IPART-benchmark are reasonable. These are similar to the costs we have found reasonable in other recently-assessed plans and they are unchanged from our previous assessment.

We asked the council for additional information to support its cost estimate for two-lane roundabouts. In response, the council provided costings for the proposed two-lane roundabout at the intersection on Withers Road and Russell Reserve Access Road in North Kellyville. The council also advised:

> The dual lane roundabout will be very similar to the proposed roundabout at the intersection of Withers Road and the Russell Reserve access, which also accommodates the designated access for the new Hillsbus Depot site. The roundabout has been designed and estimated to accommodate the turning paths for the largest type buses available to Hillsbus.

The cost estimate provided by the council is significantly higher than the reasonable cost of other two-lane roundabouts we have recently assessed in other plans, and higher than the estimates provided by AECOM in 2014. In our Draft Report we proposed a lower cost of $1,412,983 based on a cost estimate for two-lane roundabouts provided by Axess Advisory (Axess) for our assessment of CP13 (North Kellyville).[49]

In response to our Draft Report the council agreed with our revised cost estimate for the roundabout at the intersection of The Water Lane and Outback Street (BHR08), but disagreed with our draft recommendation for roundabouts at the intersections of:

- Hynds Road / Nelson Road / Edwards Road (BHR01)
- Mason Road / Old Pitt Town Road / Nelson Road (BHR02)
- George Street / Old Pitt Town Road (BHR03)[50]

The council notes:

> Council has completed 80% detailed designs for the full length of Old Pitt Town Road, including these intersections, and has nominated the costs based on a similar project (being the Withers Road and Russell Reserve Access Road). This cost estimate is considered to be a more accurate reflection of the likely cost of 2 lane circulating roundabouts.
>
> Furthermore, these intersections will need to be constructed individually. This is because Old Pitt Town Road and Edwards Road are not in the Contribution Plan or SIC, and consequently the roundabout costs must include all road widening, additional stronger pavement, kerb and gutter, concrete islands, utility relocations, street lighting, and delineation.

In addition, the council provided concept designs for BHR01, BHR02 and BHR03 which show the scope of works, including the roundabout works, kerb and guttering and concrete islands on the approach to each intersection.

49 The cost estimate includes a base cost of $974,471 plus allowances for project management (7.5%), design (7.5%) and contingency (30%).

50 THSC submission to Draft Report, p 3.

We have reviewed the additional information provided by the council and consider that its proposed cost estimates for BHR01 and BHR02 are reasonable, but at the higher end of estimates we have seen in other plans. This is because the council's estimates include high allowances for utilities relocation and traffic management, which we have found can be lower in greenfield area.

However, we do not agree with the council's proposed cost estimate for the roundabout at the intersection of George Street and Old Pitt Town Road (BHR03). The intersection does not require the same scope of works and it appears that some of the works, such as road resurfacing along George Street, kerb and guttering along the southern side of George Street and utilities relocation along the western side of Old Pitt Town Road have already been delivered by the adjacent developer as a cost outside the plan. We consider the Axess cost estimate of $1,412,983 is a more reasonable estimate than the cost proposed by the council.

When the council next reviews the plan, it should update the plan with actual costs or more detailed, site-specific estimates for roundabouts BHR01, BHR02 and BHR03.

4.4.5 The council's cost estimate for upgrading Boundary Road is too low

CP15 (2020) includes $8,757,039 in works costs for upgrades along Boundary Road, including:

- $1,185,648 for road resurfacing
- $7,571,391 for the full cost of upgrading the bridge over the Killarney Chain of Ponds.

The plan also identifies two signalised intersections. Our analysis of these intersections is addressed separately in section 4.4.3.

In our recent assessment of Hawkesbury City Council's draft Vineyard Contributions Plan (Vineyard CP)[51], we assessed Boundary Road in detail and made recommendations about the cost of the road. The IPART-assessed reasonable cost of upgrading Boundary Road to an urban collector standard in the draft Vineyard CP was $32,395,205 ($Jun2019).

This cost was based on a revised estimate provided by Hawkesbury City Council that comprised three components:

- Upgrade of the road segment to a collector-road standard
- Replacement of the existing bridge across the Killarney Chain of Ponds
- Upgrade of the signalised intersection of Windsor and Boundary Roads.[52]

It also included a proportion of the costs of the two intersections and the road resurfacing costs from CP15 (2020).

51 The Minister's Nominee sent advice to Hawkesbury City Council on the draft Vineyard CP on 22 August 2020. This advice accepts the IPART-assessed reasonable cost of upgrading Boundary Road to an urban collector standard. Hawkesbury City Council will amend and adopt the plan to reflect the Minister's Nominee's advice.

52 We made adjustments to this cost estimate, including around assumptions about the quantity of excavated materials to be removed from the site, reduced allowances for design costs and reduced contingency allowances.

This IPART-assessed reasonable cost for Boundary Road is the best available estimate of the cost of upgrading the road to an urban collector standard. We consider the cost of the Boundary Road upgrade in CP15 (2020) is too low and that it is reasonable for the council to include additional costs for the upgrade, consistent with the IPART-assessed reasonable costs in the draft Vineyard CP.

Our proposed recommendation combines our findings on the reasonable cost of upgrading Boundary Road and the apportionment of this cost between CP15 (2020) and the draft Vineyard CP. Our assessment of apportionment is in section 4.5.

4.5 Criterion 5: Apportionment

In assessing the apportionment of transport costs in CP15 (2020), we have taken into account demand for infrastructure arising from:

- Existing and new development
- Different types of development (i.e. residential vs non-residential)
- Development within and outside the precinct.

As outlined below, we found the council's approach to apportionment, which is unchanged since our last assessment, is mostly reasonable except that it should update the population estimates when apportioning costs of the Northern Connection Road; and apportion more of the costs of upgrading Boundary Road.

Recommendations

7 Apportion 67% of the costs of the Northern Connection Road to the plan, based on the most up-to-date population forecasts for Box Hill (CP15) and North Kellyville (CP13).

8 Revise the reasonable cost of upgrading Boundary Road to $32,395,205 and include 81.7% of this cost in the plan, reflecting the demand for the upgrade that is generated from the Box Hill Precinct. This would increase costs in CP15 (2020) by $17,706,650.

4.5.1 The council's approach to apportionment of transport costs is mostly reasonable

For most transport items in the plan, the council apportions costs between residential and non-residential development based on traffic modelling. The outcome is that around 60% of transport costs are apportioned to residential development, with the remaining 40% apportioned to non-residential development.

Transport costs are then apportioned within residential development on a per person basis and within non-residential development on a GFA basis.

The cost of some transport items in CP15 (2020) also involves the apportionment of costs to development outside Box Hill:

- The cost of the Northern Connection Road (which includes a bridge) between Edwards Road and Stringer Road is apportioned between CP15 and CP13 based on the anticipated populations in both plans.
- The cost of the upgrade of Annangrove Road to a sub-arterial road is apportioned equally between CP15 and CP11 (*Contributions Plan 11: Annangrove Road Light Industrial*).
- The cost of the upgrade of Boundary Road between Menin Road and Windsor Road is apportioned between CP15 and Hawkesbury City Council's Vineyard CP. The costs in the Vineyard CP are based on transport modelling (which is likely to be out of date), while the costs in CP15 (2020) reflect the costs of some items only and represent a partial funding of the upgrade of Boundary Road.

We consider the following findings of our previous assessments are still relevant:

- Apportionment of transport costs within the plan to residential and non-residential development based on traffic modelling for most items is reasonable. We note that the transport modelling was conducted by GHD in 2014 as part of its precinct planning in conjunction with DPIE and was based on the planning assumptions known at that time.
- The equal apportionment of costs for Annangrove Road between CP15 and CP11 is reasonable. Our previous assessment found this approach reflected the fact that the non-residential areas of both precincts will use the road as it directly bisects the Box Hill Precinct and the Annangrove Road Light Industrial Area. We also found that the relative amount of floor space for employment purposes was split fairly evenly between both precincts.

We consider the council's approach to apportioning costs for the Northern Connection Road is reasonable in principle, but it should update the calculation based on the latest available population estimates of each development area. This is consistent with our recommendation in CP13 (2018).

We have found that it is reasonable for the council to apportion more of the costs of upgrading Boundary Road to CP15 (2020), based on modelling of traffic volumes undertaken by TfNSW.

4.5.2 Costs for the Northern Connection Road should be apportioned based on the latest population figures

In CP15 (2020), the council apportions costs for the Northern Connection Road based on the population forecasts in the adopted version of CP15 (2018) and the North Kellyville Precinct (CP13 (2018)). This apportions approximately 60% of the costs to CP15 (2020).

In our Final Report for CP13 (2018), we make a recommendation for the council to update its apportionment calculation based on the latest available population estimate for Box Hill. We propose to make the same recommendation for CP15 (2020).

Based on the most up-to-date population estimates for Box Hill and North Kellyville, approximately 67% of costs of the Northern Connection Road should be apportioned to CP15 (2020).

This would increase costs in CP15 (2020) by $1.95 million.

4.5.3 More of the cost of upgrading Boundary Road should be included in CP15

The costs for Boundary Road in CP15 (2020) include costs for the bridge over the Killarney Chain of Ponds and costs from The Hills of Carmel VPA, including for road resurfacing and two intersections. These costs are apportioned 100% to the plan. In past assessments we considered this approach was reasonable.

For our assessment of the Vineyard CP, we assessed the nexus, cost and apportionment of Boundary Road in more detail. We found that Hawkesbury City Council's approach to apportionment was based on advice from transport consultants, Arup.

In 2015, Arup advised DPE that it expected future traffic demand on Boundary Road would come from:

- Box Hill – 48%
- Vineyard Stage 1 Precinct – 43%
- Other areas - 9%.

DPIE provided this advice to both councils.[53] The traffic modelling undertaken by Arup to inform this advice was based on now-outdated planning assumptions and a different road network hierarchy. Notably, the differences are:

- The road network hierarchy has changed. Traffic flows within the area are likely to change as vehicles use Menin Road to access Windsor Road and use Bandon Road instead of Boundary Road.
- The density of development in Box Hill has surpassed the expected dwelling yields which informed the original transport modelling. However, the expected density of development in the Vineyard Stage 1 Precinct has not changed because development will be governed by density controls.

These changes mean that the apportionment of costs to the Vineyard CP is based on traffic modelling which is inaccurate because the underlying assumptions have significantly changed. For CP15 (2020), the costs in the plan are not consistent with the approach in the Vineyard CP and do not account for all of the costs of upgrading the road.

In our assessment of the Vineyard CP we found Hawkesbury City Council's approach to the apportionment of costs was reasonable, but noted concerns with the funding arrangements between the two plans. We made a recommendation for DPIE to assist in resolving the issues for Boundary Road:

> The Department of Planning, Industry and Environment co-ordinate the planning and delivery of Boundary Road by establishing a working group that includes Hawkesbury City Council, The Hills Shire Council and RMS. The working group could consider matters such as:
>
> - Design requirements, standard and costs
> - Apportionment of costs (including any State Government funding)
> - Who will lead delivery and the timeframe for delivery.

53 Email from Arup to DPE – Vineyard Precinct – Boundary Road Traffic Volumes, 30 June 2015.

We met with DPIE and TfNSW to resolve cost and apportionment issues with Boundary Road

We met with DPIE and TfNSW to clarify the role of Boundary Road in the traffic network hierarchy and discuss an approach to the apportionment of costs between the two plans.

We asked TfNSW to investigate the traffic volumes on Boundary Road between Windsor Road and Old Pitt Town Road using its Strategic Traffic Forecasting Model to inform our apportionment calculations.

TfNSW's model calculates the traffic volumes using variables for the Vineyard Stage 1 and Box Hill Precincts. It considers both the AM and PM peak 2-hour periods, and produces the following results:

- 59% of the trips are from/to Box Hill Precinct, 12% of the trips are from/to Vineyard Precinct – (AM Peak 2-hour period)
- 58% of the trips are from/to Box Hill Precinct, 13% of the trips are from/to Vineyard Precinct – (PM Peak 2-hour period)

The model identifies trip volumes coming from other sources outside the two precincts. This result is expected from traffic modelling that considers regional traffic flows.

It is reasonable to apportion 100% of Boundary Road costs between the Vineyard CP and CP15

We consider it is reasonable for developers in the Box Hill Precinct and the Vineyard Stage-1 Precinct to pay, in aggregate, 100% of the costs for the upgrade of Boundary Road between Menin Road and Windsor Road. This approach is consistent with the approach used in other plans we have assessed, where major 'council owned' roads bordering precincts are entirely funded within the plan. The marginal demand for the road upgrade is being driven by the new development and therefore nexus is established to include all of the works in contributions plans.

For example, we have found that the following council approaches to apportioning the cost of roads that border two or more precincts within The Hills Shire LGA are reasonable:

- Apportioning the costs of upgrading Samantha Riley Drive equally between CP13 and CP08.
- Apportioning the costs of upgrading the Northern Connection Road based on the expected populations in CP15 and CP13.

Apportionment of costs for Boundary Road between CP15 and the Vineyard CP should be updated to better reflect the demand for upgrading the road

Table 4.11 details different approaches that have and could be taken to apportion the costs of upgrading Boundary Road between CP15 (2020) and the Vineyard CP.

Table 4.11 Apportionment approaches for Boundary Road ($Jun2020)

Approach	Draft Vineyard CP	CP15 (2020)	Unfunded
Current approach	13,929,938	8,757,039	9,708,228
Arup traffic modelling (2014)	13,929,938	15,549,698	2,915,568
Population	4,854,873	27,540,332	0
50/50 split	16,197,603	16,197,603	0
TfNSW traffic modelling (2020)	4,211,377	18,789,219	9,394,609
TfNSW traffic modelling (2020) (Ratio) *[IPART-preferred approach]*	5,931,516	26,463,689	0

Note: Population, CP15 (2020), 42,483 people and Draft Vineyard CP, 7,489 people.

Sources: CP15 (2020), p. 4; Draft Vineyard CP, p. 19; Email from ARUP to DPE – Vineyard Precinct – Boundary Road Traffic Volumes; Email from TfNSW – Boundary Road-Box Hill, 2 June 2010; Email from TfNSW – Modelling of traffic flow – Boundary Road, 10 July 2020.

Our preferred approach to apportioning 100% of the costs of upgrading Boundary Road between the two plans is to use a ratio of trips generated between the Vineyard Stage 1 and Box Hill Precincts, based on TfNSW traffic modelling. We consider this approach best represents the demand that is generated for the upgrade of Boundary Road from each precinct.

Under this approach, 81.7% of the costs of upgrading Boundary Road would be apportioned to CP15 (2020). This would increase the costs of the road in the plan by $17,706,650.

In response to our Draft Report, the council did not object to our recommendation to increase the costs of Boundary Road and revise the apportionment of these costs to CP15. However, it provided revised costs for upgrading the road to a sub-arterial standard.[54]

We note that at this stage, nexus is established for the upgrade of Boundary Road to a collector standard only. Therefore, our recommendation reflects an increase in the costs of upgrading Boundary Road to this collector standard.

The Hills Shire Council and Hawkesbury City Council consider Boundary Road should be upgraded to a sub-arterial standard

The two submissions to our Draft Report, from The Hills Shire Council and Hawkesbury City Council, both responded to our commentary and recommendations on Boundary Road, noting that the road should be upgraded to a sub-arterial standard.

The Hills Shire Council notes:

> Boundary Road will function as a sub-arterial route, requiring a four lane carriageway and bridge construction at the Killarney Chain of Ponds floodway. In the short term the route will carry traffic from Box Hill, Vineyard, Box Hill North and new employment areas within the North West Growth Area (Box Hill and Riverstone). It will also serve as the primary bus link to Riverstone Station in the short-to-medium term. That is why Council requested that the road be included in the SIC and it is also the reason that private accesses have not been permitted to the route, and why several intersection improvements have been proposed at critical locations.[55]

54 THSC submission to Draft Report, p 5.
55 THSC submission to Draft Report, p 5.

Hawkesbury City Council notes:

> The draft Special Infrastructure Contribution (SIC) released for the North West Growth Area shows current and proposed new SIC roads. The proposed road upgrade NXR 3.1 (Loftus Street – Windsor Road to Hamilton Street) would appear to suggest the need for a higher order road on Boundary Road; certainly, it raises this question at the very least.[56]

The relevant planning studies and documents support the classification of Boundary Road as an urban collector road only at this stage. While our recommendation reflects this collector road classification, we acknowledge the issues raised by both councils about the classification and cost of the Boundary Road upgrade. In particular, a number of factors appear to support the upgrade of Boundary Road to a sub-arterial standard, including:

- The proposed upgrade of Loftus Street in Riverstone to a sub-arterial standard, meeting with Windsor Road at the intersection with Boundary Road.
- Uncertainty around the proposed timing of the upgrade of the Bandon Road Corridor, and when and if works will continue over Windsor Road along Chapman Road and Menin Road in a timely fashion to support precinct development.
- The higher dwelling yields in Box Hill and Box Hill North, which will increase traffic volumes along Boundary Road as vehicles access Windsor Road.

The councils should continue to work with DPIE and TfNSW to investigate the re-classification of Boundary Road, if appropriate, and update the cost estimate for the road at their next reviews of CP15 and the Vineyard CP.

56 Hawkesbury City Council submission to Draft Report, p 1.

5 Stormwater

The total cost of stormwater land and works in CP15 (2020) is $167.73 million (24.6% of total costs), comprising:

- $82.75 million for land (27.2% of the total cost of land)
- $84.97 million for works (22.9% of the total cost of works).

Our assessment of the stormwater land and works in CP15 (2020) is:

- **Criterion 1: Essential works** – The land and works are consistent with the essential works list.
- **Criterion 2: Nexus** –There is nexus between the stormwater land and works in the plan and development in the Box Hill Precinct, except for additional land that is not required to deliver stormwater infrastructure.
- **Criterion 3**: **Reasonable cost** – Actual and estimated stormwater management works costs are reasonable.
- **Criterion 5: Apportionment** – The council's approach of apportioning stormwater management costs between the Killarney Chain of Ponds and Second Ponds Creek catchments and then residential and non-residential development is reasonable.

Our assessment of land for stormwater against Criterion 3 (Reasonable cost) is in Chapter 8.

Based on our findings, we recommend adjustments to the plan we estimate would reduce the cost of stormwater land and works by $5.13 million (3.1%). Our findings and recommendations are summarised in Table 5.1.

Table 5.1 IPART-recommended adjustments for stormwater ($Jun2019)

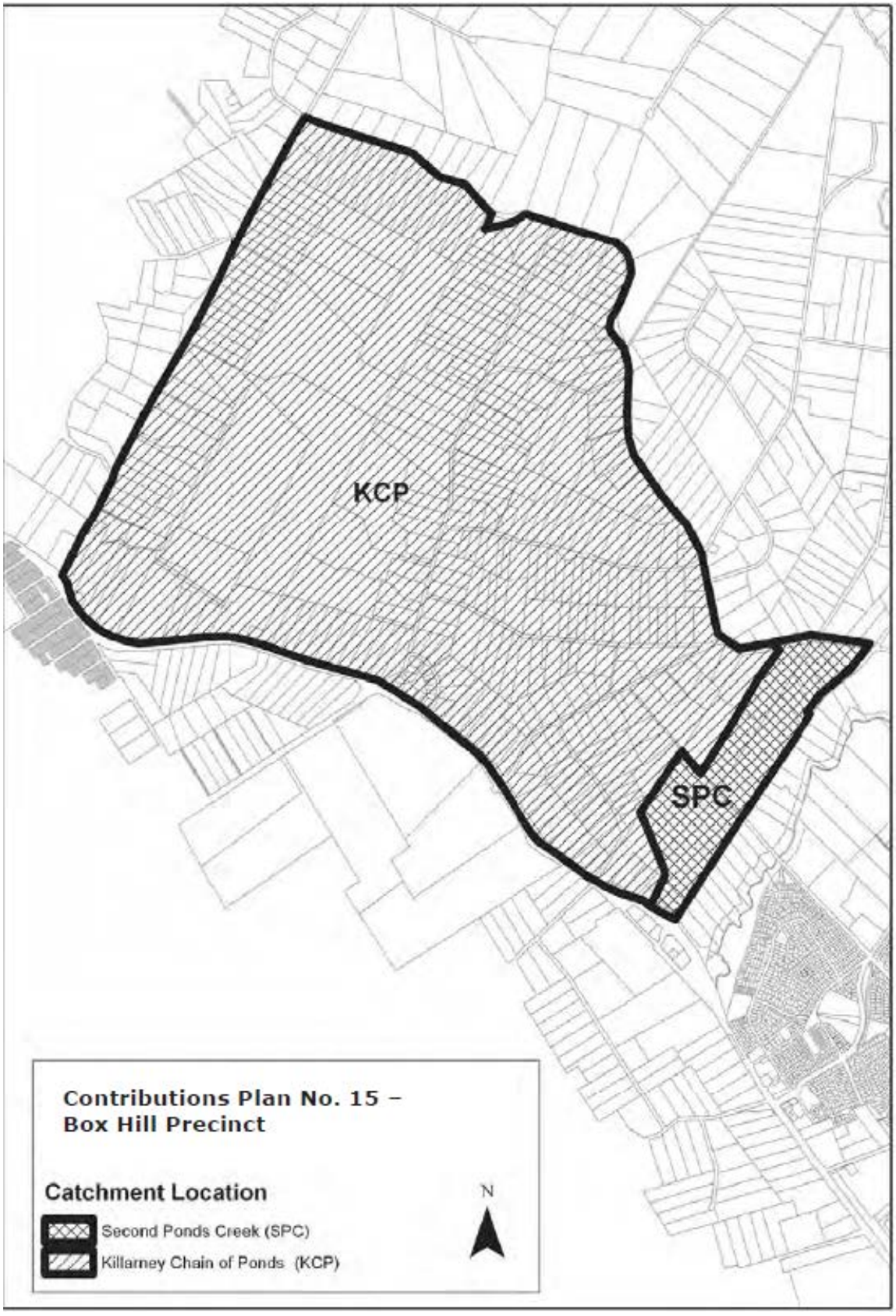
Criterion	Findings	Recommendation	Land	Works
Total costs in plan			**82,752,997**	**84,974,681**
Essential works	All land and works in the plan are consistent with the essential works list.			
Nexus	Nexus is established for all land and works in the plan except:			
	There is additional land in the plan that is not required for the delivery of stormwater infrastructure	Remove 17,248m^2 of additional land that is not required for stormwater infrastructure	-5,127,556	
Reasonable cost – Land	The cost of land is reasonable			
Reasonable cost – Works	The cost of works is reasonable			
Apportionment	Approach is reasonable			
Total IPART-recommended cost adjustment			**-5,127,556**	**0**
Total IPART-assessed reasonable cost			**77,625,441**	**84,974,681**

Source: CP15 (2020) Works schedule, IPART analysis.

5.1 Overview of stormwater works in CP15 (2020)

The major stormwater catchment in the Box Hill Precinct is the Killarney Chain of Ponds (KCP), covering approximately 635.35 hectares. The precinct also includes the smaller Second Ponds Creek (SPC) catchment, covering approximately 55.45 hectares (Figure 5.1).

Figure 5.1 Location of stormwater catchments in CP15 (2020)



Source: CP15 (2020) p 53.

The urbanisation of the Box Hill Precinct will require significant investment in a new, comprehensive water cycle management scheme to cater for the increase in impervious surfaces, which affect the hydrological cycle.[57]

The stormwater works items and costs in the plan are unchanged since we last assessed them in 2016, except for the indexation of costs to the revised base period of the plan (June 2019). The scope of works are also unchanged from when the council first adopted the plan in 2014.

Table 5.2 shows the cost of stormwater land and works in the plan, and Figure 5.2 shows the location of stormwater works in the precinct.

Table 5.2 Stormwater land and works in CP15 (2020) ($Jun2019)

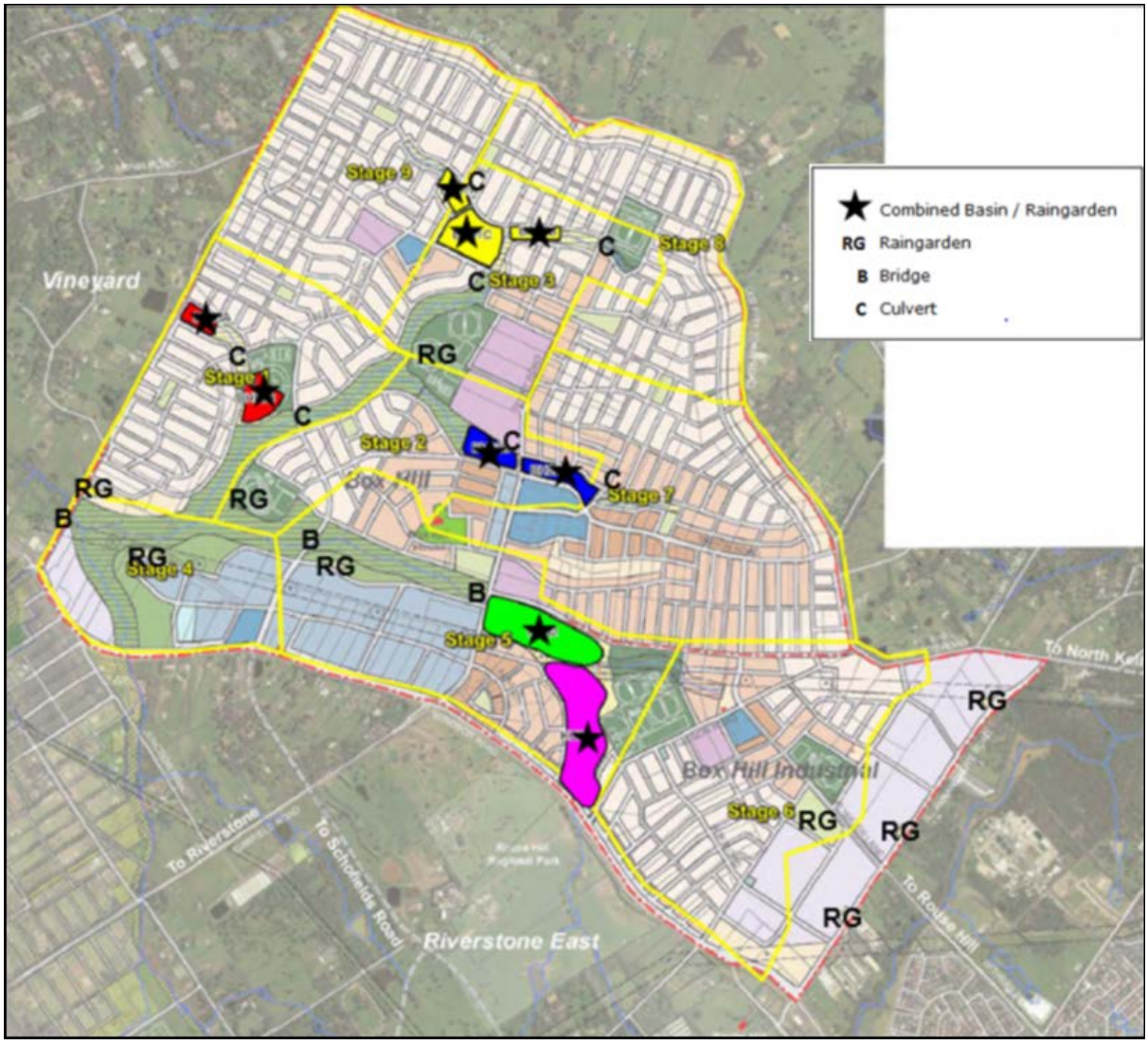
Item	Cost of land	Cost of works	Total cost
Killarney-Chain of-Ponds (KCP)			
9 combined basin and raingarden facilities	80,412,530	64,024,679	144,437,209
6 single raingarden facilities	640,735	6,018,407	6,659,143
7 culvert crossings	0	13,696,556	13,696,556
3 gross pollutant traps	0	196,500	196,500
Subtotal (KCP)	**81,053,266**	**83,936,143**	**164,989,408**
Second Ponds Creek (SPC)			
3 single raingarden facilities	1,699,731	1,038,539	2,738,270
Subtotal (SPC)	**1,699,731**	**1,038,539**	**2,738,270**
Total	**82,752,997**	**84,974,681**	**167,727,678**

Note: No land is required for the culvert crossings and gross pollutant traps.

Source: CP15 (2020) Works Schedule.

57 CP15 (2020), p 31.

Figure 5.2 Location of stormwater management infrastructure in CP15 (2020)



Source: The Hills Shire Council, Presentation to IPART, 8 September 2014.

5.2 Criterion 1: Essential works

All land and works for stormwater in CP15 (2020) are consistent with the essential works list in the Practice Note.[58] The works items are set out in Table 5.3.

58 Department of Planning and Environment, *Local Infrastructure Contributions Practice Note*, January 2019.

Table 5.3 Stormwater works items in CP15 (2020)

Items on the essential works list	
▼ Combined basin and raingarden facilities	▼ Single raingarden facilities
▼ Culvert crossings	▼ Gross pollutant traps

Source: CP15 (2020), p 37.

5.3 Criterion 2: Nexus

The council has included an additional 17,248m² of land for stormwater in CP15 (2020), at a cost of $5.13 million, which is not required to deliver stormwater infrastructure in the Box Hill Precinct. The council has included the additional land because of practical issues associated with land acquisition. We have found that nexus is not established for inclusion of this additional land to deliver stormwater infrastructure.

There are no changes to the scope of stormwater works items in CP15 (2020) from the previous versions of the plan we assessed in 2016 and 2018. We consider that the higher projected population in Box Hill is unlikely to require additional stormwater infrastructure, as the additional population largely reflects increased density and there is no significant change in impervious area. We consider the findings of our previous assessments are still relevant and that nexus is established for the stormwater management works in the plan.

Recommendation

9 Remove 17,248m² of land for stormwater infrastructure from the plan, for which nexus is not established. This would reduce the cost of stormwater land in the plan by $5,127,556.

5.3.1 Nexus is not established for additional land that is not required for stormwater infrastructure

The council identified an additional 17,248m² of land it needs to acquire because of practical issues associated with land acquisition. This land is included in CP15 (2020) as land for stormwater infrastructure.

The council advised that, for the five lots of land involved, it needs to acquire the whole lots, not just the areas that are required for stormwater infrastructure in the plan.

We acknowledge there may be practical challenges councils face in acquiring land for public infrastructure and that there may be occasions where whole lot acquisition is required to facilitate the timely provision of infrastructure to support development.

However, these practical challenges do not generally establish nexus for additional land in a contributions plan, particularly where this additional land represents a significant area and cost in the plan. Where a council needs to acquire land in excess of the requirements to deliver public infrastructure, it should:

- Re-sell any land that has development potential
- Incorporate any residual land for use by the residents of a precinct, wherever it is practical to do so.

We recognise that a council's ability to incorporate residual land for use by residents will depend on a range of factors, including the area of land available and its location. For example, small areas of residual land that a council acquires to facilitate the delivery of transport infrastructure may not have any other practical use for residents. It would be reasonable to include excess land in a contributions plan in these limited circumstances.

For the additional stormwater land in CP15 (2020), the council has advised that:

- With the progress of negotiations with one landholder, it no longer needs to acquire 4,034m^2 of the additional 17,248m^2.[59]
- It considers it is reasonable to keep the remaining 13,214m^2 of land in the plan because it is unclear whether it would have any value to an adjoining landowner. It notes that:
  - If the additional land can be sold to an adjoining land owner and incorporated into a future development site, the revenue generated from the sale would be returned to the plan as a cost saving.
  - If the additional land cannot be sold, the land would be incorporated into the adjoining water management land.[60]

We consider that there is no scope under the Practice Note to include land or works in contributions plans where nexus is not established. In our Draft Report, we outlined that it may be reasonable for the council to include residual land without development potential in the plan as open space, given the overall provision of open space in CP15 (2020) is low (see section 6.3.1). To retain the land in the plan, the council would need to demonstrate that this land is suitable as dual-purpose stormwater and open space land. It may also need to include additional embellishment costs in the plan to enable use of this land as open space. However, in responding to the Draft Report, the council did not propose a use for the additional land that may establish nexus for its inclusion.

If the additional land is included in the plan as the council has proposed, despite nexus not being established, this would increase contribution rates for developers. If the land was sold in the future and revenue returned to the plan, contribution rates would decrease for future developers. This would be an inequitable outcome for developers in the precinct. We also note that the council's preferred approach increases land costs in the plan overall and that there would be no clear incentive for the council to pursue the sale of this land in the future.

If the additional land is not included in the plan, consistent with the nexus criterion, it may still be necessary for the council to acquire the land because of the practical challenges associated with land acquisition. This would be funded from the council's general revenue, rather than from the contributions plan. The council would have a clear incentive to pursue the sale of this land in the future and the proceeds of the sale, including any profit, would be returned to general revenue. We acknowledge that there is a risk that some of the additional land may not be sold in the future and that, in this scenario, the rate-payers of the Hills Shire would pay for the land.

59 This relates to acquisition of land at 39-41 Boundary Road, Box Hill: Information from The Hills Shire Council, 20 May 2020.

60 THSC submission to Draft Report, p 6 and Information from The Hills Shire Council, 22 July 2020.

To address this risk and ensure that nexus is established for all land in the plan, the council should undertake further work to assess the development potential of the additional land. At its next review of the plan, the council should:

- Consider whether any of the additional land that does not have development potential should be included in the plan for essential local infrastructure
- Provide any relevant technical study or information to support its proposal and establish nexus
- Include any relevant works or embellishment costs to ensure that the additional land provides a benefit to the residents of the precinct.

5.3.2 Nexus for stormwater works is established through technical studies and consultant advice

The technical studies relied upon by the council to establish nexus for stormwater infrastructure, listed in Table 5.4, are unchanged from those used in our 2016 assessment. In addition to these studies, nexus for three culvert crossings was established in 2014 based on advice from AECOM.[61]

Table 5.4 Technical studies for stormwater works in CP15 (2020)

Author	Title	Date
J. Wyndham Prince	Box Hill/Box Hill Industrial Precinct Water Cycle Management Strategy Report	February 2011
J. Wyndham Prince	Box Hill/Box Hill Industrial Precinct Water Cycle Management Post Exhibition Strategy Report	June 2012
J. Wyndham Prince	Box Hill/Box Hill Industrial Precinct Water Cycle Management Post Re-exhibition Strategy Report	November 2012

Note: The technical studies were commissioned by DPIE.

5.4 Criterion 3: Reasonable cost (works only)

The stormwater works items and costs in the plan are unchanged since we last assessed them in 2016, except for the indexation of costs to the revised base period of the plan.

Since our last assessment, three stormwater management items, representing 15% of stormwater works costs, were included in the Hills of Carmel VPA, executed on 19 June 2018. The agreement was further amended on 13 December 2018 to reflect changes to the area of land. This has not resulted in any changes to the cost of works in the plan.

61 The Hills Shire Council, Response on queries to Box Hill CP15, 15 October 2014.

We found that:

- The council's approach to estimating costs for different categories of stormwater works is unchanged from our previous assessment, therefore our previous finding that this approach is reasonable is still relevant.
- The use of actual costs for completed stormwater works is reasonable. These actual costs are for works delivered as part of the VPA, including a detention basin (component of BH03B), a single raingarden (RGBH10) and culvert crossing (CR-D). The actual costs also include some basin and drainage structure works delivered by the council.

5.5 Criterion 5: Apportionment

The council's approach is unchanged since our previous assessment. We consider the findings of our 2016 assessment are still relevant and the council's approach to apportionment is reasonable.

CP15 (2020) apportions stormwater management costs between the KCP and SPC catchments based on the location of the works. Within each catchment, costs are apportioned between residential and non-residential development on a per hectare of Net Developable Area (NDA) basis. They are then apportioned amongst residential development on a per-person basis, and non-residential development on a GFA basis.

6 Open space

The total cost of open space land and embellishment in CP15 (2020) is $276.19 million (40.5% of total costs), comprising:

- $170.32 million for land (55.9% of the total cost of land)
- $105.87 million for open space embellishment (28.1% of the total cost of works).

Our assessment of the open space land and embellishment in CP15 (2020) is:

- **Criterion 1: Essential works** – The land and embellishment for open space are consistent with the essential works list.
- **Criterion 2: Nexus** – Nexus is established for the total area of land for open space and its embellishment. However, we note that the overall provision of open space is low.
- **Criterion 3: Reasonable cost** – The open space embellishment costs are reasonable.
- **Criterion 5: Apportionment** – The council's approach to apportioning open space costs to residential development on a per person basis is reasonable.

Our assessment of the reasonable cost of land for open space against **Criterion 3 (Reasonable cost)** is in Chapter 8. Our findings and recommendations are summarised in Table 6.1.

Table 6.1 IPART-recommended adjustments for plan administration in CP15 (2020) ($Jun2019)

Criterion	Findings	Recommendation	Land	Works
Total costs in plan			**170,321,018**	**105,865,380**
Essential works	All land and works in the plan are consistent with the essential works list			
Nexus	Nexus is established for all land and works in the plan			
Reasonable cost - Land	The cost of land is reasonable			
Reasonable cost - Works	The cost of embellishment is reasonable			
Apportionment	Approach is reasonable			
Total IPART-recommended cost adjustment			**-**	**-**
Total IPART-assessed reasonable cost			**170,321,018**	**105,865,380**

Source: CP15 (2020) Works schedule, IPART analysis.

6.1 Overview of open space in CP15 (2020)

CP15 (2020) includes 61.60 hectares[62] of open space, comprising 11 local parks, five sporting facilities and one district sporting facility.[63] These parks and sporting facilities will serve the revised total projected population of 42,483 people resulting from development in the Box Hill Precinct.

In addition to the land in the plan, the precinct includes 0.66 hectares of open space in Turnbull Reserve, which serves 934 existing residents. This results in a total of 62.26 hectares of open space in the precinct.

Table 6.2 shows the cost of open space in the plan, and Figure 6.1 shows the location of open space in CP15 (2020).

Table 6.2 Open space costs in CP15 (2020) ($Jun2019)

Item	Cost of land	Cost of embellishment	Total cost
Local parks			
11 local parks[a]	45,086,190	8,673,816	53,760,006
Sporting facilities			
One district facility including six playing fields, 10 multi-purpose courts and a playground	49,243,623	26,611,113	75,854,736
Five sporting facilities including 13 playing fields, 12 multi-purpose courts and playgrounds	75,991,205	70,580,451	146,571,655
Total	**170,321,018**	**105,865,380**	**276,186,397**

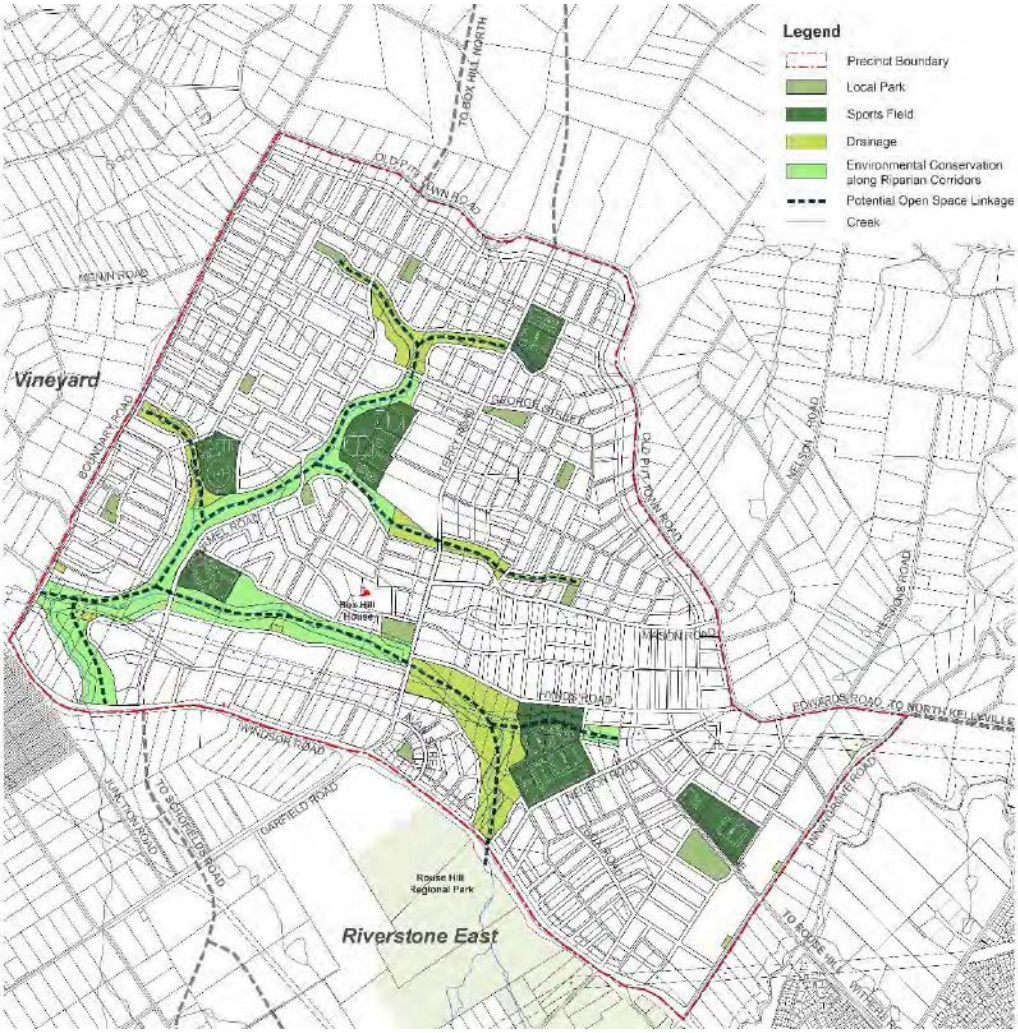
a The land cost includes the cost of 10 new local parks and embellishment cost includes the cost of 11 parks including the existing Turnbull Reserve.

Source: The Hills Shire Council, Works Schedule, February 2020.

62 The plan states that CP15 (2020) includes 62.60 hectares of open space, however, the council has confirmed this should be amended to 61.60 hectares. Information from The Hills Shire Council, 16 March 2020.

63 The plan includes land for 10 local parks and embellishment for 11 local parks (the additional park is an existing park in the precinct – Turnbull Reserve). The council has identified that it will be embellishing these parks at a varying levels (we note that local, urban and suburban parks are included under the category of local parks in the council's Recreation Strategy) and that it plans to embellish one of the parks (LP08) to a district park level. Information from The Hills Shire Council, 16 April 2020.

Figure 6.1 Location of open space land and works in CP15 (2020)



Source: Box Hill Growth Centre Precincts Development Control Plan March 2018, p 91.

6.2 Criterion 1: Essential works

We found that the land and embellishment in CP15 (2020) are consistent with the essential works list in the Practice Note.[64] The embellishment items in CP15 (2020) are set out in Table 6.3.

We note that the council has included road verges in open space embellishment. Verges are transport infrastructure and should ideally be categorised as transport works in contributions plans. We made a draft recommendation for the council to transfer road verges from open space to the transport category. The council opposed this recommendation, stating that the change would not affect costs in the plan, but would add unnecessary administrative complexity.[65] We have not maintained this recommendation in our final assessment.

64 Department of Planning and Environment, *Local Infrastructure Contributions Practice Note*, December 2019.
65 THSC submission to Draft Report, p 2.

In principle, costs should be appropriately categorised because of the potential impact on contribution rates arising from different apportionment approaches in the different infrastructure categories. For example, transport works costs are apportioned to residential and non-residential development, while open space costs are apportioned to residential development only.

We agree with the council that transferring costs from open space to the transport category has no impact on total costs in the plan. We also note that the impact on contribution rates is not material in this instance, relative to the administrative complexity for the council in making the change. This may not be the case for all contributions plans.

Table 6.3 Open space embellishment items in CP15 (2020)

Items consistent with the essential works list
Local parks (11 parks, a total of 12.43 hectares) Nine parks will include: Pathways, playground, fencing, shelter and seating, bins, drinking water, water connections, signage, landscaping and tree planting for all local parks. For selected parks, shade structure, public amenities, dog off-leash areas, outdoor fitness equipment, BBQ, park lighting depending on the local park classification.[a] One park will include: All of the above embellishments plus on-site car parking, dog off-leash area, public amenities, outdoor fitness equipment, BBQ facilities and park lighting.
Sporting facility (BHPF01, 5.16 hectares) Grassed athletics track, football pitch bounded by athletics track, jump, throw and vault facilities, multi-purpose field, amenities building, car park, local playground, sports ground floodlighting, park furniture, BBQ, 2.5m wide cycleway, site establishment works, planting and turfing.
Sporting facility (BHPF02, 5.57 hectares) Australian Rules football field, multi-purpose field, local playground, park furniture, BBQ, car park, amenities building, local playground, sports ground floodlighting, 2.5m wide cycleway, 1.5m wide pedestrian path, site establishment works, planting and turfing.
Sporting facility (BHPF03, 10.37 hectares) Two soccer fields, two cricket fields, 12 tennis courts, local playground, park furniture, BBQ, car park, amenities building, 2.5m wide cycleway, 1.5m wide pedestrian path, site establishment works, planting and turfing.
Sporting facility (BHPF04, 5.37 hectares) One rugby field, one cricket field, local playground, park furniture, BBQ, car park, amenities building, sports field lighting 2.5m wide cycleway, 1.5m wide pedestrian path, site establishment works, planting and turfing.
Sporting facility (BHPF06, 7.88 hectares) One soccer field, one cricket field, local playground, park furniture, BBQ, car park, amenities building, sports field lighting 2.5m wide cycleway, 1.5 m wide pedestrian path, site establishment works, planting and turfing.
District sporting facility (BHPF05, 15.45 hectares) Two baseball fields, two soccer fields, two cricket fields, netball multi-purpose court, district playground, park furniture, BBQ, car park, amenities building, 2.5m wide cycleway, 1.5m wide pedestrian path, boardwalk and bridge over riparian corridor, kick-about passive open space.

a The council's 2019 Recreation Strategy specifies a hierarchy of local parks – basic park, local park, local suburban and local urban. The hectares are for 10 local parks (the other park is an existing park, and the land for this park is not included in the plan).

Source: AECOM study, Information from The Hills Shire Council, 16 April 2020 and The Hills Shire Council Recreation Strategy, October 2019.

6.3 Criterion 2: Nexus

Based on information from the council and our analysis, we consider nexus is established for open space land and embellishment in the plan. However, we note that the overall provision of open space is low.

We found that:

- The council has added 0.16 hectares of open space to the plan, increasing the land area for an existing local park (LP08). The land area for this park increased when the precinct was rezoned in August 2016.[66]

- The provision of 1.45 hectares of open space per 1,000 new residents is below the Growth Centres' benchmark of 2.83 hectares per 1,000 residents. However, the council considers the overall provision of land for recreation is appropriate.[67]
- The council has identified 44.27 hectares of water management land which may be suitable for recreation, but it has not included this land or its potential embellishment in the open space provision in CP15 (2020).[68] If this was included as open space, it would increase the rate of provision to 2.49 hectares per 1,000 residents.

6.3.1 Nexus is established for open space land but the overall rate of provision is low

The plan includes 61.60 hectares of open space land, comprising 11.77 hectares of land for local/district open space and 49.82 hectares for sporting facilities.

Our previous assessments of CP15 have made varying recommendations on the provision of land in the plan, with changes reflecting updated population estimates and the availability of land which could potentially be used for open space. Our previous assessments and recommendations are summarised in Box 6.1.

Box 6.1 Changes in open space land in CP15

Our 2014 assessment found that nexus was established between open space land in CP15 and the expected development in the Box Hill Precinct. We found the open space provision of 59.60 hectares in CP15 was low, but that the open space met the requirements identified in the technical studies. We recommended that the open space land for Turnbull Reserve should be excluded from the plan as it served existing residents. We noted that there were likely to be other opportunities for passive open space in the precinct in the future, particularly on drainage land.

Our 2016 assessment found that the 62.60 hectares of open space land in the plan was excessive, when taking into account 44.27 hectares of available stormwater land considered suitable as passive open space. We recommended the removal of 23.28 hectares of open space in the plan and the associated embellishment costs. The Minister did not accept this recommendation.

Our 2018 assessment considered that an expected increase in population may justify the inclusion of all land zoned for open space. We recommended the council confirm whether the quantity of open space land and associated embellishment in the plan meets the needs of the projected population.

Source: IPART's assessment of CP15 Box Hill Precinct, December 2014, Assessment of CP15 Box Hill Precinct, March 2016 and Assessment of CP15 Box Hill Precinct, October 2018.

66 The 'Box Hill Employment Land' rezoning, which came into force on 22 August 2016, increased the area of land zoned RE1 in this park from 32,935 square metres to 34,500 square metres. The revised land area in CP15 (2020) seeks to amend the incorrect area included in the current version of the plan. Information from The Hills Shire Council, 22 July 2020.

67 CP15 (2020), p 24.

68 CP15 (2020), p 24.

The council has made small increases to open space provision in the plan over time, but these increases are marginal relative to the increase in the projected population of the precinct. The projected additional population in the current plan is 42,483 people compared with an anticipated additional population of 30,687 people in CP15 (2018).[69] For the increased population, the overall rate of open space provision is 1.45 hectares per 1,000 people.[70] This provision is low compared with the Growth Centres' benchmark rate of 2.83 hectares per 1,000 people. However, the council considers the level of provision is appropriate.[71]

The plan identifies water management land that could be suitable for passive recreation. This land is not included in the plan as open space, but the council notes that if it were included open space provision would increase to 2.49 hectares per 1,000 new residents.

We also note that the council intends to build a community centre within Bligh Reserve (District Sporting Facility 5).[72] This could reduce the total area of open space in the plan, as the land on which the community facility is to be constructed should be re-classified as community facilities land in the plan. As the council does not yet own all land for Bligh Reserve, there are no fixed timeframes for the completion of master planning work. If the planning for this community centre proceeds and its location in Bligh Park is confirmed, the council should update the plan and provision of open space accordingly.[73]

6.3.2 Nexus for open space embellishment is established through technical studies and the council's recreation strategy

The council relies on the technical studies listed in Table 6.4 and its October 2019 Recreation Strategy to establish nexus for the embellishment of local parks and sporting facilities.[74] Based on embellishments we have considered reasonable in similar facilities and plans, we consider nexus is established for the embellishments in the plan.

Table 6.4 Technical studies establishing nexus for open space in CP15 (2020)

Author	Title	Date
Urbis	Demographics and Social Infrastructure Assessment: Box Hill and Box Hill Industrial Precincts	Feb 2011
AECOM	Traffic Management and Open Space Strategic Design and Cost Estimates	Jan 2014

Note: The Urbis Study was commissioned by the then Department of Planning and Environment to inform the open space needs of the Box Hill Precinct during the precinct planning process.

69 The population in CP15 (2018) was unchanged from 2016.

70 This estimate relates to the land and population in CP15 (2020) only (ie, it does not include the existing population in the Box Hill Precinct, or the existing provision of land in Turnbull Reserve). The total value for the precinct, including the existing population (934 people) and land (0.66 hectares), results in provision of 1.43 hectares per 1,000 people.

71 CP15 (2020), p 24.

72 Council business papers, Ordinary meeting, 28 April 2020.The council removed the cost of the indoor recreation facility (community facility) from the plan based on our 2016 recommendation. It now intends to fund the cost of the facility outside CP15 (2020), through the sale of council owned land.

73 The council business papers note that Precinct and Contributions Planning for Box Hill Precinct had anticipated that a community facility would be located at the future Bligh Reserve and, as such, the dimensions and area of this future reserve are sufficient to accommodate this, while still meeting its requirements for open space in Box Hill.

74 Recreation Strategy, The Hills Shire Council, October 2019.

We note that the plan includes embellishment costs for Turnbull Reserve, which is an existing local park in the precinct that serves the needs of existing residents.[75] The land for Turnbull Reserve is not included in the plan.

The council notes that the embellishment costs in CP15 (2020) for Turnbull Reserve will provide for additional recreational demand resulting from the adjoining high density development.[76] Noting the relatively low provision of open space in the precinct, and that we find the costs of local parks are reasonable on a per square metre basis (see section 6.4), we consider that nexus is established for including these additional embellishment costs in the plan.

6.4 Criterion 3: Reasonable cost (embellishment only)

To date, the council's actual costs for open space embellishment reflect 0.5% of the total cost of open space embellishment in the plan. As such, the costs in the plan are based on estimated rather than actual costs. We found:

- The council's approaches to estimating embellishment costs (council estimates from delivering similar parks, and AECOM cost estimates based on detailed strategic designs)[77] are unchanged from our previous assessment. We consider our previous finding that these approaches are reasonable is still relevant.
- The per square metre embellishment cost estimates for local parks are reasonable, based on comparison with costs in similar plans we have assessed as reasonable.
- The per square metre embellishment cost estimates for sporting facilities (excluding embellishments we have classified as transport works)[78] are reasonable, based on comparison with costs for similar facilities we have assessed as reasonable. The council has adjusted the costs of the sporting facilities in response to our previous assessments of the plan, removing the indoor recreation facility from the district sporting facility and the 'sundry unmeasured items' from all facilities. The council has also removed the cost of water quality drainage basins, which are funded through stormwater management works in the contributions plan.

6.5 Criterion 5: Apportionment

CP15 (2020) apportions all open space land and embellishment costs to the net additional residential population of the Box Hill Precinct on a per person basis. The council assumes that the need for open space is generated only by the residential development in the precinct. We consider this approach is reasonable.

75 IPART, Assessment of CP15 Box Hill Precinct, December 2014.
76 Information from The Hills Shire Council, 20 May 2020.
77 AECOM, Traffic Management and Open Space Strategic Design and Cost Estimates, Jan 2014.
78 The per square metre embellishment costs used for this analysis exclude the cost of road verges, bridges and cycleways. In this instance, we have not recommended the council transfer the cost of these items to the transport category. However, we have excluded these costs from our calculations on a per square metre basis, consistent with our approach in other open space assessments.

7 Plan administration

CP15 (2020) includes $5.58 million for plan preparation and administration.

Our assessment of the plan administration costs in CP15 (2020) is:

- **Criterion 1: Essential works** – Plan administration costs are consistent with the essential works list.
- **Criterion 2: Nexus** – There is nexus between plan administration costs and development in the Box Hill Precinct.
- **Criterion 3: Reasonable cost** – It is reasonable to estimate plan administration costs using 1.5% of the total cost of works over the lifecycle of the plan. This estimate should be updated to reflect the revised cost of works based on IPART's recommendations on CP15 (2020).
- **Criterion 5: Apportionment** – The apportionment of plan administration costs between residential and non-residential development is reasonable.

Based on our findings and recommendations to adjust the total costs of works in CP15 (2020), we estimate the cost of plan administration would decrease by $182,800 (3.3%).

Our findings and recommendation for plan administration costs in CP15 (2020) are summarised in Table 7.1.

Table 7.1 IPART-recommended adjustments for plan administration in CP15 (2020) ($Jun2019)

Criterion	Findings	Recommendation	Works
Total costs in plan			**5,576,907**
Essential works	Plan administration is on the essential works list		
Nexus	Nexus is established		
Reasonable cost	Calculating costs using IPART's benchmark of 1.5% of works costs is reasonable	Reduce administration costs to be 1.5% of the revised cost of works	*-182,800*
Apportionment	Approach is reasonable		
Total IPART-recommended cost adjustment			**-182,800**
Total IPART-assessed reasonable cost			**5,394,107**

Source: The Hills Shire Council, Works Schedule, February 2020 and IPART calculations.

7.1 Criterion 1: Essential works

Plan preparation and administration costs are consistent with the essential works list.

7.2 Criterion 2: Nexus

We consider there is nexus between plan preparation and administration activities and the expected development in the Box Hill Precinct.

7.3 Criterion 3: Reasonable cost

CP15 (2020) includes a cost of $5.58 million for plan administration, which is 1.5% of the total cost of works in the plan. The use of 1.5% of the total cost of works is consistent with IPART's *Local Infrastructure Benchmark Cost Report* (April 2014), and we consider this is reasonable.

Given our other recommendations to change the costs of works in CP15 (2020), the council should update its plan administration costs to equate to 1.5% of the revised cost of works.

Recommendation

10 Revise the cost of plan administration for CP15 (2020) to reflect 1.5% of the adjusted cost of works.

7.4 Criterion 5: Apportionment

In CP15 (2020), the council first apportions plan administration costs between residential and non-residential development on an NDA basis. Costs are then apportioned amongst:

- Residential development on a per-person basis
- Non-residential development on a per square metre of GFA basis.

We consider this approach is reasonable.

8 Cross category considerations

This chapter presents our assessment of criteria which apply across multiple infrastructure categories:

- Criterion 3: Reasonable cost (in relation to the cost of land and the council's financial model)
- Criterion 4: Timing of infrastructure delivery
- Criterion 6: Consultation
- Criterion 7: Other matters.

Our assessment is that:

- **Criterion 3: Reasonable cost (land)** - The cost of land is reasonable.
- **Criterion 3: Reasonable cost (financial model) –** The council's approach to using escalation factors is reasonable for administration costs, but unreasonable for land and works costs. The escalation factors for land and works are calculated using a simple linear average of four quarters of annual change in each respective index, and we consider that the council should instead use a geometric average, which will better account for compound annual average growth.
- **Criterion 4: Timing of infrastructure delivery -** The council's approach to forecasting the timing of infrastructure delivery appears reasonable.
- **Criterion 6: Consultation –** The council's consultation on the draft plan was reasonable.
- **Criterion 7: Other matters –** The council should review the plan within five years and consider options to better map and show the location of infrastructure in the plan.

8.1 Criterion 3: Reasonable cost – land

CP15 (2020) includes $304.74 million for land acquisition, as shown in Table 8.1. This represents 44.7% of the total costs in the plan. The council has acquired around 31.6% of the land area in the plan. We found the cost of land in CP15 (2020) is reasonable.

Table 8.1 Land areas and costs in CP15 (2020) ($Jun2019)

Category	Total area (ha)	Total cost	Area acquired (ha)	Area yet to be acquired (ha)
Transport	20.9	51,665,809	4.4	16.5
Stormwater	46.0	82,752,997	10.5	35.5
Open space	61.6	170,321,018	25.6	36.0
Community services	-	-	-	-
Total	**128.5**	**304,739,824**	**40.6**	**88.0**

Source: CP15 Works Schedule and IPART analysis.

8.1.1 The council's approaches to costing land are reasonable

The council uses different approaches to costing land, depending on whether it has already acquired the land or whether it is yet to acquire the land:

- **Land already acquired in the plan -** The cost of the land already acquired in CP15 (2020) is the actual cost of each acquisition, that is, the sum of the nominal (non-indexed) costs. The council does not index the actual cost of land to the base year of the plan because the council uses a nominal cash flow model (net present value approach) to calculate contributions. We consider this is reasonable.[79]
- **Land yet to be acquired in the plan –** The council estimates the cost by:
  - Applying the average market values (dollars per square metre) for different categories of unconstrained land, as advised by its qualified valuer in 2017, based on its assumptions about the underlying zonings of the land.
  - Applying the average value for flood constrained land as required by the Minister.[80]
  - Adding an allowance of 1.5% to cover the amount that the council may have to pay in association with land acquisition costs, such as: legal and conveyancing fees; survey fees; and/or compensation payments to land-owners for compulsory acquisition of their land.

We found that the council's application of the average market values advised by its valuer reflects the underlying zonings and constraints applying to land in the plan.

The allowance applied to land costs in CP15 (2020) is the same as other plans we have assessed recently from The Hills Shire Council.[81] We consider this allowance is reasonable.

Overall, we consider that the estimated cost of land that the council is yet to acquire is reasonable.

8.2 Criteria 3 and 4: Reasonable cost and timing - the council's financial model

The council uses a NPV approach to calculate the contribution rates in CP15 (2020). The council submitted two models which separately calculate developer contributions for residential and non-residential development.

The base period of the plan and model is June 2019. In updating the base year of the plan, the council has amended the starting point of the model but assumed that development will continue to occur over the same 25 year period to 2037.

79 It may be reasonable for the council to index the cost of land already acquired by CPI to the base period of the model. This approach may be consistent with the EP&A regulation, but in practice is likely to only slightly change the contribution rate.

80 Minister for Planning, Letter to The Hills Shire Council, August 2019.

81 Including for CP12 – Balmoral Road, CP13 – North Kellyville and CP17 – Castle Hill North.

We examined the council's approach and the assumptions it has made in the models and assessed its approach to modelling contribution rates against:

- Criterion 3 (Reasonable costs)
- Criterion 4 (Timeframe).[82]

8.2.1 Timing of expenditure is based on the council's expected staging of infrastructure

The council's NPV model includes assumptions about the timing of expenditure, which are based on its forecasts of when infrastructure and associated land acquisitions are required in order to facilitate development of the precinct.

The council assumes development will occur over 25 years to 2037 and reflects this assumption in the model. Its assumptions around the delivery of infrastructure for incomplete works are largely unchanged since our 2016 assessment of the plan. The council has updated its delivery timetable for works that have been delivered and made minor amendments to when it expects to deliver the remaining works.

The council's approach to forecasting the timing of infrastructure delivery appears reasonable. We asked the council if it would like to revise its infrastructure delivery timetable and modelling assumptions given potential impacts of the Covid-19 pandemic. The council has not changed its infrastructure delivery timetable or modelling assumptions for CP15 (2020).

8.2.2 Timing of revenue is determined by the council's assumed development path

The council's assumed timing for receipt of contributions revenue is based on its expected profile of development over the duration of the plan. We refer to this as the 'development path.'

The council's assumed development path for the Box Hill Precinct is similar to the assumed development path we have seen in other contributions plans, in particular the council's Contributions Plan No. 17 – Castle Hill North, where the council also assumed a 'double-peak' in development applications. We consider this approach is reasonable.

82 We assessed this criterion in relation to the council's assumptions about the timing of development and timeframe for delivery of infrastructure in its NPV model.

8.2.3 The council escalates the costs of land and works from June 2019 onwards

The council derives escalation factors from all land and works costs by calculating average annual growth over a 15-year period (June 2004 to June 2019) of several representative ABS indices. For administration costs, the council assumes an escalation factor of 2.5%, which represents the midpoint of the Reserve Bank of Australia's inflation target of 2-3%.

We consider the council's approach is reasonable for administration costs, but not reasonable for land and works costs. The escalation factors for land and works are calculated using a simple linear average of four quarters of annual change in each respective index. The annual change figures are then summed and averaged to calculate the council's escalation factors. This method does not properly account for the effects of compounding on the time series.

The council should instead use a geometric average, which will better account for compound annual average growth. This recommendation is consistent with recommendations in our recent assessment of the council's CP12, CP13 and CP17. Table 8.2 compares the council's approach with our recommended approach.

Table 8.2 Cost escalation factors for land and works

Type of infrastructure	Index used	15-year simple-average to June 2019[a]	15-year compound (geometric)-average to June 2019
Land costs	ABS Established House Price Index – Sydney	4.55%	4.22%
Open space works	ABS PPI for non-residential building construction – New South Wales	2.85%	2.74%
Stormwater and transport works	ABS PPI for road and bridge construction – New South Wales	3.25%	3.15%

a These are the escalation factors used in the NPV models for CP15 (2020). They are based on the simple average method.

Note: PPI = producer price index.

Source: ABS index values for the relevant indices and IPART calculations.

Recommendation

11 Recalculate all escalation factors using a compound annual average growth rate formula instead of a simple average formula.

8.2.4 The council's revenue escalation factor of 2.5% is reasonable

The council uses a rate of 2.5% to escalate future revenues, which represents the midpoint of the Reserve Bank of Australia's inflation target of 2-3%. The future value of revenues are then discounted to present values using the discount rate in the model.

We consider the council's method of escalating revenues and the use of a 2.5% factor is reasonable, and is consistent with guidance in our 2018 Technical Paper.[83]

83 IPART, *Modelling for local infrastructure contributions in a present value framework*, August 2018, p 11.

8.2.5 The council should update its discount rate to 3.2%

The council uses IPART's local government discount rate of 3.7% (published in August 2019) to discount all the escalated cash flows to their present values at the base period. This was consistent with the recommendation in our Technical Paper to use the IPART calculated discount rate, at the time the council exhibited the plan.[84]

However, we recommend the council should update the model to use the latest available discount rate of 3.2%, which was published in August 2020. The next update to the Local Government Cost Index will occur in February 2021.

Recommendation

12 Update the discount rate in the financial model to 3.2%, which is the latest available Local Government Discount Rate.

8.3 Criterion 6: Consultation

We consider the council's process for CP15 (2020) satisfies the consultation criterion.

The council publicly exhibited the draft plan from 17 December 2019 to 7 February 2020, and received one submission from Calibre Consulting on behalf of Mogul Stud Pty, Jundu Pty Ltd and DH Box Hill Pty Ltd, who collectively own around half the developable residential land in the precinct.

The council appears to have considered the submission in detail and amended the plan in response to the submission. For example, the submission noted the double counting of half-width roads fronting non-developable land which had already been delivered in the precinct. The council removed the double-counted roads from the plan before submitting it to us for assessment; which reduced costs in the plan compared with the plan that was exhibited.

8.4 Criterion 7: Other matters

Our assessment of the CP15 (2020) has identified two other relevant matters:

- The frequency of plan review
- The adequacy of maps within the contributions plan that show the location of proposed infrastructure.

We found that, given the stage of development in the Box Hill Precincts, the council should comprehensively review the plan within the next five years. We also found that the council should update the plan to ensure that the maps showing locations of infrastructure are accurate and accessible.

84 IPART, *Modelling for local infrastructure contributions in a present value framework*, August 2018, p 5.

Recommendations

13 Comprehensively review the plan within the next five years to ensure assumptions about the scope, cost and apportionment of land and works reflect the progress of development in the precinct.

14 Update the plan to ensure that the maps showing locations of infrastructure are accurate and accessible.

8.4.1 The council should review CP15 within the next five years

This is our fourth review of CP15 since 2014. We consider regular review of the plan is important to ensure planning assumptions and expectations are updated and reflected in the plan. As development progresses in the Box Hill Precincts, the council should continue to monitor the need for the plan to be reviewed. We consider a review cycle of three years is reasonable for early stage plans, and every five years for plans where development has progressed and the planning assumptions are more certain.

We recommend the council review CP15 within five years.

8.4.2 The council should update CP15 to include accurate and accessible infrastructure maps

The *Environmental Planning and Assessment Regulation 2000* provides that contributions plans must include a map or maps that show the specific public amenities and services proposed to be provided by the council.[85] CP15 (2020) includes 14 maps that show the locations of most, but not all, of the infrastructure in the plan.[86] For example, the maps do not show the location of proposed half-width roads adjoining non-developable land.

We have also found that the presentation of these maps makes it difficult to identify the location of infrastructure in the plan. We recommend the council review and update the maps in CP15 (2020) to ensure that all infrastructure is included and that the maps are accessible for stakeholders.

85 *Environmental Planning and Assessment Regulation 2000*, clause 27(1)(h).
86 CP15 (2020), pp 55-68.

A Summary of recommendations

Table A.1 Summary of recommendations – CP15 (2020) works and plan administration ($Jun2019)

	Cost in plan	IPART-recommended adjustment	IPART-assessed reasonable cost
Transport works	**180,953,757**		
Remove the cost of upgrading intersection BHT18 and include the cost of a pedestrian crossing only		-5,100,000	
Increase the cost of intersection BHT17		346,740	
Reduce contingency allowance for half-width roads		-1,889,008	
Reduce the cost of the Northern Connection Road if funded through the SIC		*Not costed*	
Revise cost estimates for two-lane roundabouts		-2,952,464	
Revise cost estimates for signalised intersections		-22,246,060	
Apportion 67% of the Northern Connection Road cost to CP15		1,947,443	
Apportion 81.7% of the cost of upgrading Boundary Road to the plan		17,706,650	
			168,767,058
Stormwater management works	**84,974,681**		
No adjustments			
			84,974,681
Open space embellishment	**105,865,380**		
No adjustments			
			105,865,380
Plan administration	**5,576,907**		
Reduce administration costs to be 1.5% of the revised cost of works		-182,800	
			5,394,107
Total works	**371,793,817**	**-12,186,699**	**359,607,118**
Total works and administration	**377,370,724**	**-12,369,499**	**365,001,225**

Source: CP15 (2020) Works Schedule and IPART analysis.

Table A.2 Summary of recommendations – CP15 (2020) land costs ($Jun2019)

	Cost in plan	IPART-recommended adjustment	IPART-assessed reasonable cost
Transport land	**51,665,809**		
Remove the cost of land for upgrading intersection BHT18		-402,778	
			51,263,031
Stormwater management land	**82,752,997**		
Remove 17,248m^2 of additional land that is not required for stormwater infrastructure		-5,127,556	
			-77,625,441
Open space embellishment	**170,321,018**		
No adjustments			
			170,321,018
Total land	**304,739,824**	**-5,530,334**	**299,209,489**

Source: CP15 (2020) Works Schedule and IPART analysis.

B Terms of reference

INDEPENDENT PRICING AND REGULATORY TRIBUNAL ACT 1992

TERMS OF REFERENCE

Reviewable Contributions Plans - *Environmental Planning and Assessment Act 1979*

I, GLADYS BEREJIKLIAN MP, Premier, under section 9 of the *Independent Pricing and Regulatory Tribunal Act 1992* approve provision, by the Independent Pricing and Regulatory Tribunal (**IPART**), of services to the Minister for Planning with respect to reviewing Reviewable Contributions Plans, in accordance with the following terms of reference.

Background

The Environmental Planning and Assessment (Local Infrastructure Contributions) Direction 2012 contemplates that a Council may submit a Contributions Plan to IPART for review, where the Plan would (but for the Direction) authorise a contribution under section 7.11 of the EP&A Act that exceeds the maximum amount that the Direction allows to be imposed as a contribution in relation to residential development.

The Minister for Planning may also refer any contributions plan to IPART for review where the Minister considers there is merit in having an independent assessment.

Services

On and from the date that these terms of reference are issued to IPART, IPART is to review each Reviewable Contributions Plan submitted to it and provide the Minister for Planning and the relevant Council with a report on its review.
In providing the services, IPART must:

(a) review the relevant Reviewable Contributions Plan in accordance with the assessment criteria set out in the Practice Note, including whether the public amenities and services to which the Contributions Plan relates are on the essential works list (if any) set out in the Practice Note;

(b) consider, in its review of the Reviewable Contributions Plan, whether the estimate of the costs of providing those public amenities and services, as set out in the Plan , are reasonable;

(c) publish a report of its review on its website; and

(d) provide a copy of the report to the Minister for Planning and the relevant Council.

Consultation

In conducting a review under these terms of reference, IPART must:

(a) consult with the Department of Planning and Environment (NSW);

(b) consult with the relevant Council and any other person IPART considers appropriate; and

(c) consider any criteria set out in the Practice Note (in addition to any other matters IPART considers relevant).

Definitions

Contributions Plan means a contributions plan or draft contributions plan prepared by the relevant Council for the purposes of imposing conditions under section 7.11 of the EP&A Act.

Council has the same meaning as it has in the *Local Government Act 1993*.

EP&A Act means the *Environmental Planning and Assessment Act 1979*.

Practice Note means the "Revised Local Development Contributions Practice Note: For the assessment of Local Contributions Plans by IPART" issued by the Department of Planning and Environment and dated January 2018, as amended or replaced from time to time.

Reviewable Contributions Plan means a Contributions Plan submitted to IPART as contemplated by the *Environmental Planning and Assessment (Local Infrastructure Contributions) Direction 2012* or referred to it by the Minister for Planning.

C Overview of contributions plans and their assessment

C.1 What are contributions plans?

In NSW, local councils are primarily responsible for providing local or community infrastructure required to meet the additional demand for services and facilities generated by new development in their local government area. Councils can levy developers for local infrastructure contributions to fund the costs of providing this infrastructure.

However, to do so, a council must prepare a contributions plan which sets out:

- The local infrastructure required to meet the demand associated with development in a specific area
- The estimated cost of the land, works and administration required to provide this infrastructure
- The contribution rates for different types of development which the council proposes to levy on developers.[87]

C.2 What is IPART's role?

IPART's assessment functions for local infrastructure contributions plans are based on terms of reference issued by the Premier under section 9 of the *Independent Pricing and Regulatory Tribunal Act 1992* (see Appendix B).

We assess contributions plans from councils that propose to levy contributions above $30,000 per residential lot or dwelling in identified greenfield areas and $20,000 per residential lot or dwelling in other areas. From 1 July 2020, and IPART-reviewed contributions plan entitles the council to levy the full contribution amount in accordance with the adopted plan.

In undertaking our assessment, we publish a Draft Report including our draft recommendations on the land, works and administration in the plan, and invite submissions from stakeholders. We consider all submissions in the preparation of our Final Report.

When we have completed our assessment of the contributions plan, our Final Report is submitted to the Minister for Planning and Public Spaces (the Minister). If appropriate, the Minister (or his Nominee) will request the council to amend its contributions plan by actioning some or all of the recommendations in the Final Report. Once the council has made the requested amendments, the plan becomes an IPART-reviewed plan and the council may levy contributions in accordance with the adopted plan.

87 A consent authority may impose a condition under section 7.11 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) only if it is in accordance with a contributions plan. The *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) makes provision for or with respect to the preparation and approval of contributions plans, including the format, structure and subject-matter of plans.

C.3 How do we assess contributions plans?

As required by the terms of reference, we assess contributions plans in accordance with the criteria set out in the *Local Infrastructure Contributions Practice Note* (Practice Note) issued by DPIE.[88] The criteria require us to assess whether:

1. The public amenities and public services in the plan are on the essential works list.
2. There is reasonable nexus between the proposed public amenities and public services in the plan and the development.[89]
3. The proposed development contribution is based on a reasonable estimate of the cost of the proposed public amenities and public services.
4. The proposed public amenities and public services can be provided within a reasonable timeframe.
5. The proposed development contribution is based on a reasonable apportionment of costs.
6. The council has conducted appropriate community liaison and publicity in preparing the contributions plan.
7. The plan complies with other matters we consider relevant.

We also assess whether the plan contains the information required by Clause 27 of the *Environmental Planning and Assessment Regulation 2000*. A summary of our assessment of CP15 (2020) against these requirements is provided at Appendix D.

C.4 What is the aim of our assessment?

Broadly, our assessments are intended to bring greater transparency and accountability to setting local development contributions. More specifically, in conducting the assessment and making our recommendations, we aim to ensure the plan reflects the reasonable costs of providing necessary local infrastructure to support the new development.

If costs in the plan are too high (ie, higher than the reasonable costs of infrastructure with a nexus to the development), developers will pay too much for local infrastructure. Development could be unduly impeded if the costs in the plan are too high and not aligned with the benefits provided by essential local infrastructure. On the other hand, if costs in the plan are too low (ie, lower than the reasonable costs of infrastructure with a nexus to the development), then the new development would effectively be subsidised by the council's ratepayers or necessary infrastructure may not be able to be provided.

Contributions that reflect the reasonable costs of local infrastructure provision are important for reasons of both efficiency and equity. They are necessary to:

88 Department of Planning and Environment, Practice Note – Local Infrastructure Contributions, January 2019. The January 2019 Practice Note replaces the January 2018 Practice Note – Local Infrastructure Contributions. The 2019 revision clarifies the timing of when a council can adopt a contributions plan (particularly where the draft plan proposes a rate above the maximum cap amount in the Direction). The assessment criteria for our review remain the same.

89 Nexus ensures that there is a connection between the land and facilities in a contributions plan and the demand for them arising from the new development.

- Signal the costs of developing different areas – which, in turn, can assist in ensuring that development occurs where it should (ie, where the benefits of the development are greater than its costs)
- Ensure that there are sufficient funds available to deliver the infrastructure necessary for the new development area
- Ensure that developers do not pay too much for infrastructure or that, on the other hand, other parties (such as a council's ratepayers) do not have to fund any shortfall between the actual costs of providing local infrastructure and the revenue received from development consents.

In the context of CP15 (2020), our assessment recognises that the release area is around seven years into its 25 year development period, with most development yet to occur.[90]

90 At the time of application, the council advised that 16.0% of residential development and 10.2% of non-residential development had been approved and/or constructed: The Hills Shire Council, Application for assessment of a local infrastructure contributions plan, p 4.

D Assessment against information requirements in the EP&A Regulation

Clause 27 of the *Environmental Planning and Assessment Regulation 2000* requires certain information to be included in a contributions plan. As part of our assessment we have checked that CP15 (2020) contains the information required by this clause of the Regulation. A summary of this analysis is provided in the table below.

Table D.1 Assessment against information requirements in the EP&A Regulation

Subclause		Location in CP
1(a)	Purpose of the plan.	Section 2.4
1(b)	Land to which the plan applies.	Section 2.3
1(c)	The relationship between the expected types of development in the area to which the plan applies and the demand for additional public amenities and services to meed that development.	Sections 3.1, 3.2, 3.3, 3.4, 3.5 & 3.6.
1(d)	The formulas to be used for determining the section 7.11 contributions required for different categories of public amenities and services.	Section 2.20
1(e)	The section 7.11 contribution rates for different types of development, as specified in a schedule in the plan.	Section 1, Table 10 & Table 11
1(g)	The council's policy concerning the timing of the payment of monetary section 7.11 contributions section, section 7.12 levies and the imposition of section 7.11 conditions or section 7.12 conditions that allow deferred or periodic payment.	Section 2.11 & 2.12
1(h)	A map showing the specific public amenities and services proposed to be provided by the council, supported by a works schedule that contains an estimate of their cost and staging (whether by reference to dates or thresholds).	Section 4, Part D, Figure 6 (Sheets 1-14) & Section 3.8 (works schedule), Table 8 & Table 9
1(i)	If the plan authorises monetary section 7.11 contributions or section 7.12 levies paid for different purposes to be pooled and applied progressively for those purposes, the priorities for the expenditure of the contributions or levies, particularised by reference to the works schedule.	Section 2.18
1A	Despite subclause (1)(g), a contributions plan made after the commencement of this subclause that makes provision for the imposition of conditions under section 7.11 contributions and section 7.12 levies in accordance with those conditions is to be made before the commencement of any building work or subdivision work authorised by the certificate.	Section 2.14
2	In determining the section 7.11 contribution rates or section 7.12 levy percentages for different types of development, the council must take into consideration the conditions that may be imposed under section 4.17(6)(b) of the Act or section 97(1)(b) of the *Local Government Act 1993*.	Section 2.5

Subclause		Location in CP
3	A contributions plan must not contain a provision that authorises monetary section 7.11 contributions or section 7.12 levies paid for different purposes to be pooled and applied progressively for those purposes unless the council is satisfied that the pooling and progressive application of the money paid will not unreasonably prejudice the carrying into effect, within a reasonable time, of the purposes for which the money was originally paid.	Section 2.18

E Traffic modelling provided by the council to support changes to intersections

THE HILLS SHIRE COUNCIL
3 Columbia Court, Norwest NSW 2153
PO Box 7064, Norwest 2153
ABN 25 034 494 656 | DX 9966 Norwest

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		Name	[redacted]	[redacted]	[redacted]

INFORMATION FOR ASSESSMENT OF CP15 (2020)

IPART requested THSC to provide additional information on the previous responses on CP15. The questions and THSC responses are mentioned below:

Question 5: Please provide information (i.e. technical study, traffic modelling, etc.) to support the change of BHT09 from a signalised intersection to a roundabout.

In continuation to Question 5, the following four intersections were also part of the similar discussion and require response from the council.

- BHT07 – Gardiner Drive / Mt Carmel Drive;
- BHT08 – Brahman Street / Mt Carmel Drive; and
- BHT09 – George Street / Mt Carmel Drive

Response: For BHT07, BHT08 and BHT09 the roundabouts would be sufficient than the traffic signals as originally anticipated during the precinct planning. The summary of the intersection modelling analysis for all three intersections for year 2036 is shown below and the supporting documents are presented in Appendix 1. All the intersections as a roundabout are performing well at a level of service A for the year 2036 AM and PM Peak.

Intersection Modelling Summary (Year 2036)			
Intersections	Type of Intersection analysed	Level Of Service AM Peak	Level Of Service PM Peak
BHT07 – Gardiner Drive / Mt Carmel Drive	Roundabout	A	A
BHT08 – Brahman Street / Mt Carmel Drive	Roundabout	A	A
BHT09 – George Street / Mt Carmel Drive	Roundabout	A	A

Roundabout to Signal

- BHT17– Prosper Street / Mt Carmel Drive

  BHT17 performed well within desired level of service as a roundabout for year 2036 for AM peak; however, it is failing in PM peak and therefore it should be established as a signalized intersection.

Intersection Modelling Summary (Year 2036)			
Intersections	Type of Intersection	Level Of Service AM Peak	Level Of Service PM Peak
BHT17– Prosper Street / Mt Carmel Drive	Signals [1]	D	D

[1] - New Intersection control proposed.

Question 6-13: intersection treatment at the following locations with the evidence to support the explanations.

- BHT20: Signals at Grandhill Parkway /The Water Lane; near the SW corner of Park6 (BHPF06)
- BHT21: Roundabout at Grandhill Parkway /Box Road;
- BHR05: Signals at Mt Carmel Drive/Old Pitt Town Road/Valetta Drive;
- BHR06: Signals at Boundary Road/George Street;
- BHR07: Signals at Boundary Road/Brahman Road; and
- BHR08: Roundabout at The Water Lane/Outback Street

Response: For BHT20, BHT21, BHR05, BHR06, BHR07 and BHR08 intersection modelling summary for year 2036 is presented below and the relevant supporting documents are presented in **Appendix 2.**

The traffic modelling shows that these intersections will operate at desired LOS for both peak period in Year 2036.

Intersection Modelling Summary (Year 2036)			
Intersections	Type of Intersection analysed	Level Of Service AM Peak	Level Of Service PM Peak
BHT20: Grandhill Parkway /The Water Lane	Signals	D	D
BHT21: Grandhill Parkway/Box Road	Roundabout	A	A
BHR05: Mt Carmel Drive/Old Pitt Town Road/Valetta Drive	Signals	B	B
BHR06: Boundary Road/George Street	Signals	B	B
BHR07: Boundary Road/ Brahman Road	Signals	B	B
BHR08: The Water Lane/Outback Street	Roundabout	A	A

In relation to Question 17: IPART requires the supporting studies/ justification for the intersection designs mentioned in Table 2 of the information request document. These intersections are listed below:

- BHT10 –Terry Road/Hynds Road — CALIBRE
- BHT11 –Terry Road/Mason Road — ACE/CALIBRE
- BHT12 –Terry Road/George Street — CALIBRE
- BHT13 –Mason Road/The Water Lane — MWH
- BHT14 –Hynds Road/The Water Lane — JEM
- BHT15 - Nelson Road/The Water Lane — JEM

- BHT18 –Terry Road and High Street — ACE/CALIBRE
- BHT20 - Grandhill Parkway/The Water Lane — JEM
- BHR02 –Mason Road/Old Pitt Town Road — CADDMANN
- BHR06 – Boundary Road/George Street — OPUS
- BHR07 – Boundary Road/Brahman Road — OPUS
- BHR08 –The Water Lane/Outback Street — CADMANN
- BHRU02B – Road upgrade of Terry Road (Town Centre to Mason Road Bypass) — CALIBRE
- BHRU08A – Road upgrade of The Water Lane (Nelson Rd to Annangrove Rd) — JEM
- BHRU08B - Road upgrade of The Water Lane (Mason Road to Hynds Road) — JEM
- ARU1 – Upgrade of Annangrove Road — JEM
- NKB01A – Edwards Road Bridge — OPUS

Response: For all the above intersection, the intersection modelling summary for year 2036 is presented below and the relevant supporting documents are presented in **Appendix 3.**

Intersection Modelling Summary (Year 2036)			
Intersections	Type of Intersection analysed	Level Of Service AM Peak	Level Of Service PM Peak
BHT10 – Terry Road/ Hynds Road	Signals	B	C
BHT11 – Terry Road/Mason Road	Signals	E	F
BHT12 – Terry Road/George Street	Signals	B	D
BHT13 – Mason Road/The Water Lane	Signals	B	D
BHT14 – Hynds Road/The Water Lane	Signals	B	B
BHT15 - Nelson Road/The Water Lane	Signals	D	E
BHT18 – Terry Road and High Street	Priority Control (Left In Left Out)[1]	A	A
BHT20 - Grandhill Parkway/The Water Lane	Signals	D	D
BHR02 – Mason Road/Old Pitt Town Road	Roundabout	A	A
BHR06 – Boundary Road/George Street	Signals	B	B
BHR07 –Boundary Road/Brahman Road	Signal	B	B
BHR08 – The Water Lane/Outback Street	Roundabout	A	A

BHT07 – Gardiner Drive / Mt Carmel Drive	Roundabout	A	A
BHRU02B – Road upgrade of Terry Road and Mason Road Bypass	Road Upgrade	Link V/C Ratio[2]	Link V/C Ratio[2]
1BHRU08A – Road upgrade of The Water Lane (Nelson Rd to Annangrove Rd) BHRU08A_1 The Water Lane/Terrain Street BHRU08A_2 The Water Lane/Mirage Street BHRU08A_3 The Water Lane/Scenary Street	Road Upgrade Priority Control (Left In Left Out) Priority Control (Left In Left Out) Priority Control (Left In Left Out)	Link V/C Ratio[2] A A A	Link V/C Ratio[2] A A A
BHRU08B - Road upgrade of The Water Lane (Mason Road to Hynds Road)	Road Upgrade	Link V/C Ratio[2]	Link V/C Ratio[2]
ARU1 – Upgrade of Annangrove Road Annangrove/Water Lane/Withers Road	Road Upgrade Signal	Link V/C Ratio[2] C	Link V/C Ratio[2] B
NKB01A – Edwards Road Bridge	-	-	-

[1] - New Intersection control proposed.

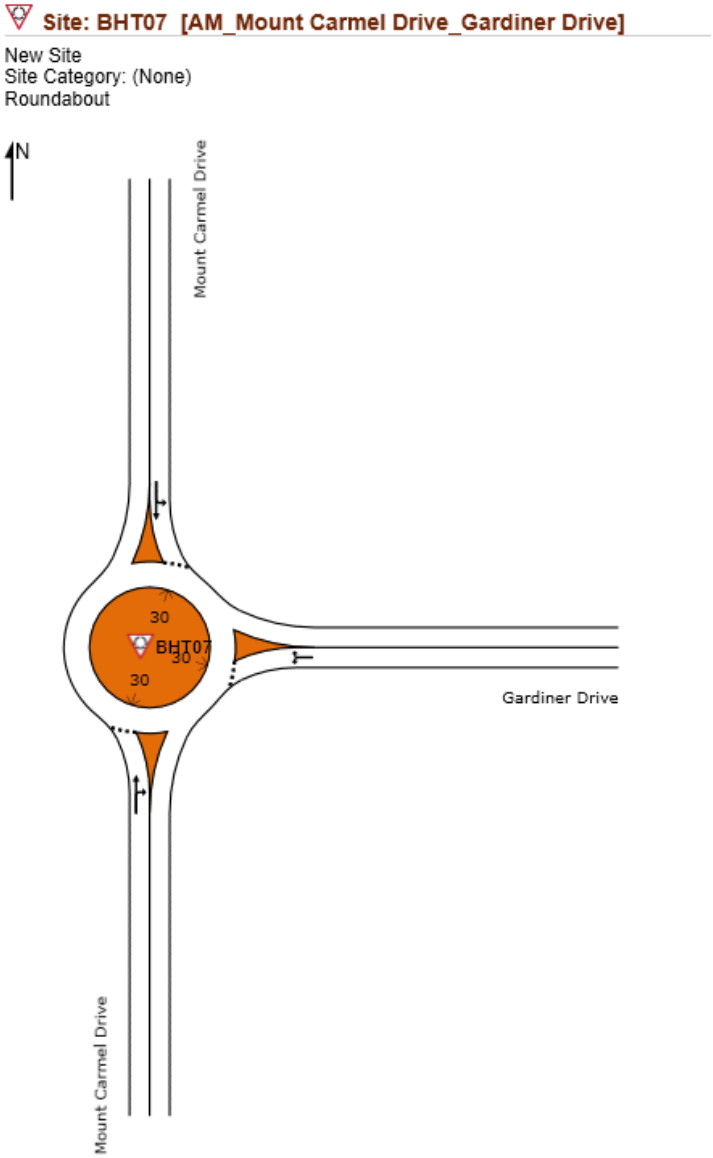
[2]- Link V/C ratio presented in Appendix3

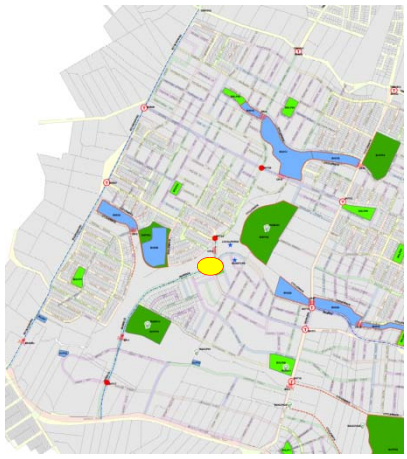
Appendix 1

Evidence and supporting documents for Question 5

Response for Intersections: BHT07, BHT08, BHT09 and BHT17

BHT07 – Gardiner Drive / Mt Carmel Drive





Intersection BHT07 -

MOVEMENT SUMMARY

Site: BHT07 [AM_Mount Carmel Drive_Gardiner Drive]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Mount Carmel Drive												
2	T1	148	0.0	0.194	4.4	LOS A	1.4	9.9	0.45	0.53	0.45	55.5
3	R2	95	0.0	0.194	10.1	LOS A	1.4	9.9	0.45	0.53	0.45	56.6
Approach		243	0.0	0.194	6.6	LOS A	1.4	9.9	0.45	0.53	0.45	56.0
East: Gardiner Drive												
4	L2	581	0.0	0.730	10.1	LOS A	10.3	72.1	0.93	0.99	1.23	45.7
6	R2	166	0.0	0.730	15.3	LOS B	10.3	72.1	0.93	0.99	1.23	44.0
Approach		747	0.0	0.730	11.2	LOS A	10.3	72.1	0.93	0.99	1.23	45.5
North: Mount Carmel Drive												
7	L2	61	0.0	0.350	4.0	LOS A	2.8	19.4	0.35	0.40	0.35	53.1
8	T1	445	0.0	0.350	4.1	LOS A	2.8	19.4	0.35	0.40	0.35	57.1
Approach		506	0.0	0.350	4.1	LOS A	2.8	19.4	0.35	0.40	0.35	56.8
All Vehicles		1497	0.0	0.730	8.1	LOS A	10.3	72.1	0.66	0.71	0.81	50.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

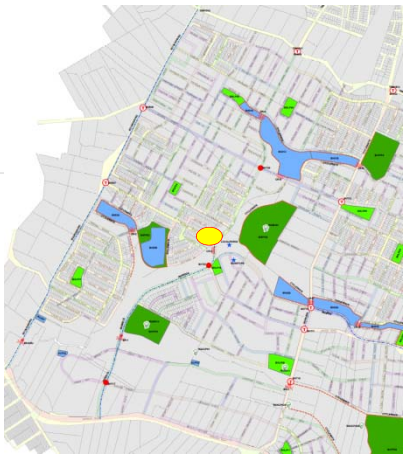
Site: BHT07 [PM_Mount Carmel Drive_Gardiner Drive]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Mount Carmel Drive												
2	T1	518	0.0	0.600	4.3	LOS A	6.7	46.8	0.45	0.50	0.45	55.4
3	R2	388	0.0	0.600	9.9	LOS A	6.7	46.8	0.45	0.50	0.45	56.5
Approach		906	0.0	0.600	6.7	LOS A	6.7	46.8	0.45	0.50	0.45	55.9
East: Gardiner Drive												
4	L2	219	0.0	0.233	3.1	LOS A	1.7	11.7	0.43	0.48	0.43	47.9
6	R2	83	0.0	0.233	8.3	LOS A	1.7	11.7	0.43	0.48	0.43	48.7
Approach		302	0.0	0.233	4.6	LOS A	1.7	11.7	0.43	0.48	0.43	48.1
North: Mount Carmel Drive												
7	L2	201	0.0	0.341	5.9	LOS A	2.5	17.4	0.67	0.63	0.67	51.6
8	T1	157	0.0	0.341	6.1	LOS A	2.5	17.4	0.67	0.63	0.67	56.1
Approach		358	0.0	0.341	6.0	LOS A	2.5	17.4	0.67	0.63	0.67	54.1
All Vehicles		1566	0.0	0.600	6.1	LOS A	6.7	46.8	0.49	0.53	0.49	53.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

BHT08 – Brahman Street / Mt Carmel Drive

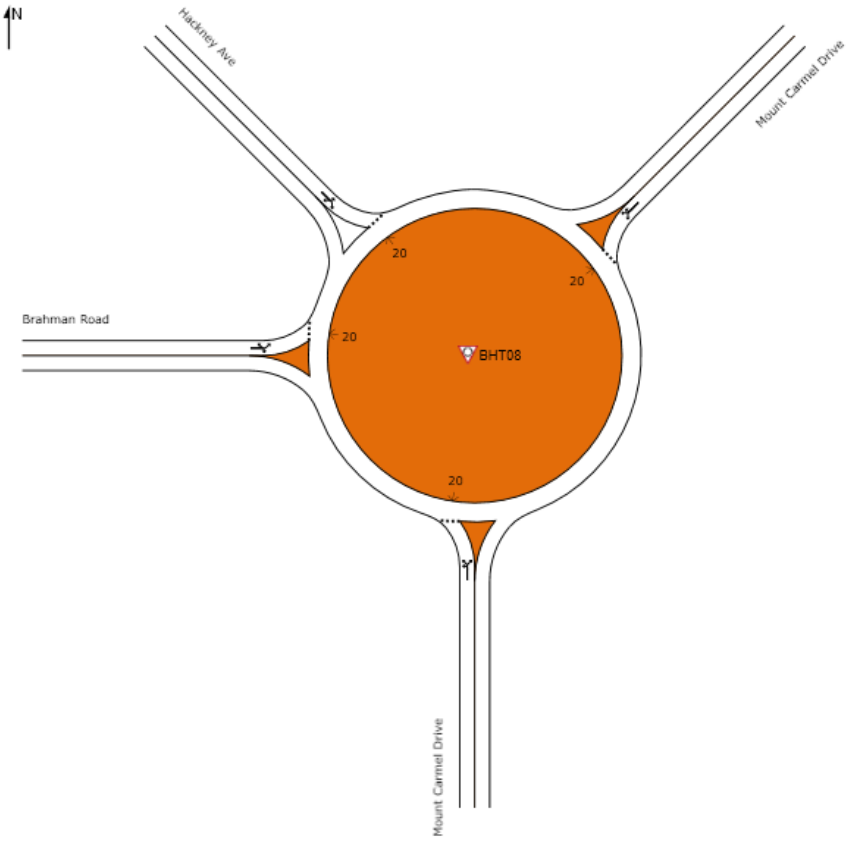


Intersection BHT08 -

SITE LAYOUT

Site: BHT08 [AM_Mount Carmel Drive_Brahman Road]

New Site
Site Category: (None)
Roundabout



Organisation: THE HILLS SHIRE COUNCIL | Created: Thursday, 11 June 2020 3:53:59 PM
Project: \\ROAMING\Redirected\gsingh\Documents\THSC\PROJECTS\MOUNT CARMEL STUDY\ANALYSIS\SIDRA ANALYSIS\BHT08_Mt Carmel_Brahman Road.sip8

MOVEMENT SUMMARY

Site: BHT08 [AM_Mount Carmel Drive_Brahman Road]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Mount Carmel Drive												
1	L2	186	0.0	0.218	4.1	LOS A	1.5	10.8	0.22	0.51	0.22	54.2
1a	L1	5	0.0	0.218	4.0	LOS A	1.5	10.8	0.22	0.51	0.22	49.0
3a	R1	123	0.0	0.218	8.0	LOS A	1.5	10.8	0.22	0.51	0.22	52.6
Approach		315	0.0	0.218	5.6	LOS A	1.5	10.8	0.22	0.51	0.22	53.6
NorthEast: Mount Carmel Drive												
24a	L1	261	0.0	0.280	5.5	LOS A	1.9	13.2	0.53	0.58	0.53	52.1
26a	R1	38	0.0	0.280	9.4	LOS A	1.9	13.2	0.53	0.58	0.53	55.5
26	R2	5	0.0	0.280	10.5	LOS A	1.9	13.2	0.53	0.58	0.53	52.7
Approach		304	0.0	0.280	6.0	LOS A	1.9	13.2	0.53	0.58	0.53	52.8
NorthWest: Hackney Ave												
27	L2	16	0.0	0.033	6.0	LOS A	0.2	1.3	0.54	0.61	0.54	49.9
29a	R1	11	0.0	0.033	9.8	LOS A	0.2	1.3	0.54	0.61	0.54	46.1
29b	R3	5	0.0	0.033	11.9	LOS A	0.2	1.3	0.54	0.61	0.54	54.4
Approach		32	0.0	0.033	8.3	LOS A	0.2	1.3	0.54	0.61	0.54	50.1
West: Brahman Road												
10b	L3	5	0.0	0.218	3.9	LOS A	1.4	9.8	0.37	0.58	0.37	45.2
10a	L1	33	0.0	0.218	3.3	LOS A	1.4	9.8	0.37	0.58	0.37	46.8
12	R2	235	0.0	0.218	8.1	LOS A	1.4	9.8	0.37	0.58	0.37	46.5
Approach		273	0.0	0.218	7.5	LOS A	1.4	9.8	0.37	0.58	0.37	46.5
All Vehicles		923	0.0	0.280	6.4	LOS A	1.9	13.2	0.38	0.56	0.38	50.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

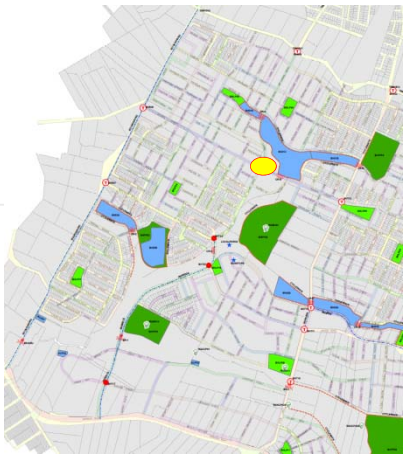
Site: BHT08 [PM_Mount Carmel Drive_Brahman Road]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Mount Carmel Drive												
1	L2	263	0.0	0.385	4.0	LOS A	3.3	23.2	0.20	0.52	0.20	53.9
1a	L1	16	0.0	0.385	3.9	LOS A	3.3	23.2	0.20	0.52	0.20	48.5
3a	R1	322	0.0	0.385	7.9	LOS A	3.3	23.2	0.20	0.52	0.20	52.2
Approach		601	0.0	0.385	6.1	LOS A	3.3	23.2	0.20	0.52	0.20	53.0
NorthEast: Mount Carmel Drive												
24a	L1	231	0.0	0.242	5.5	LOS A	1.6	11.5	0.55	0.58	0.55	52.1
26a	R1	19	0.0	0.242	9.4	LOS A	1.6	11.5	0.55	0.58	0.55	55.5
26	R2	5	0.0	0.242	10.5	LOS A	1.6	11.5	0.55	0.58	0.55	52.8
Approach		255	0.0	0.242	5.9	LOS A	1.6	11.5	0.55	0.58	0.55	52.6
NorthWest: Hackney Ave												
27	L2	1	0.0	0.014	7.2	LOS A	0.1	0.6	0.65	0.64	0.65	47.2
29a	R1	5	0.0	0.014	11.1	LOS A	0.1	0.6	0.65	0.64	0.65	42.5
29b	R3	5	0.0	0.014	13.2	LOS A	0.1	0.6	0.65	0.64	0.65	52.1
Approach		12	0.0	0.014	11.7	LOS A	0.1	0.6	0.65	0.64	0.65	48.7
West: Brahman Road												
10b	L3	21	0.0	0.282	5.5	LOS A	1.8	12.8	0.59	0.69	0.59	44.6
10a	L1	11	0.0	0.282	4.9	LOS A	1.8	12.8	0.59	0.69	0.59	46.3
12	R2	253	0.0	0.282	9.7	LOS A	1.8	12.8	0.59	0.69	0.59	45.9
Approach		284	0.0	0.282	9.2	LOS A	1.8	12.8	0.59	0.69	0.59	45.8
All Vehicles		1152	0.0	0.385	6.9	LOS A	3.3	23.2	0.38	0.58	0.38	50.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

BHT09 – George Street / Mt Carmel Drive

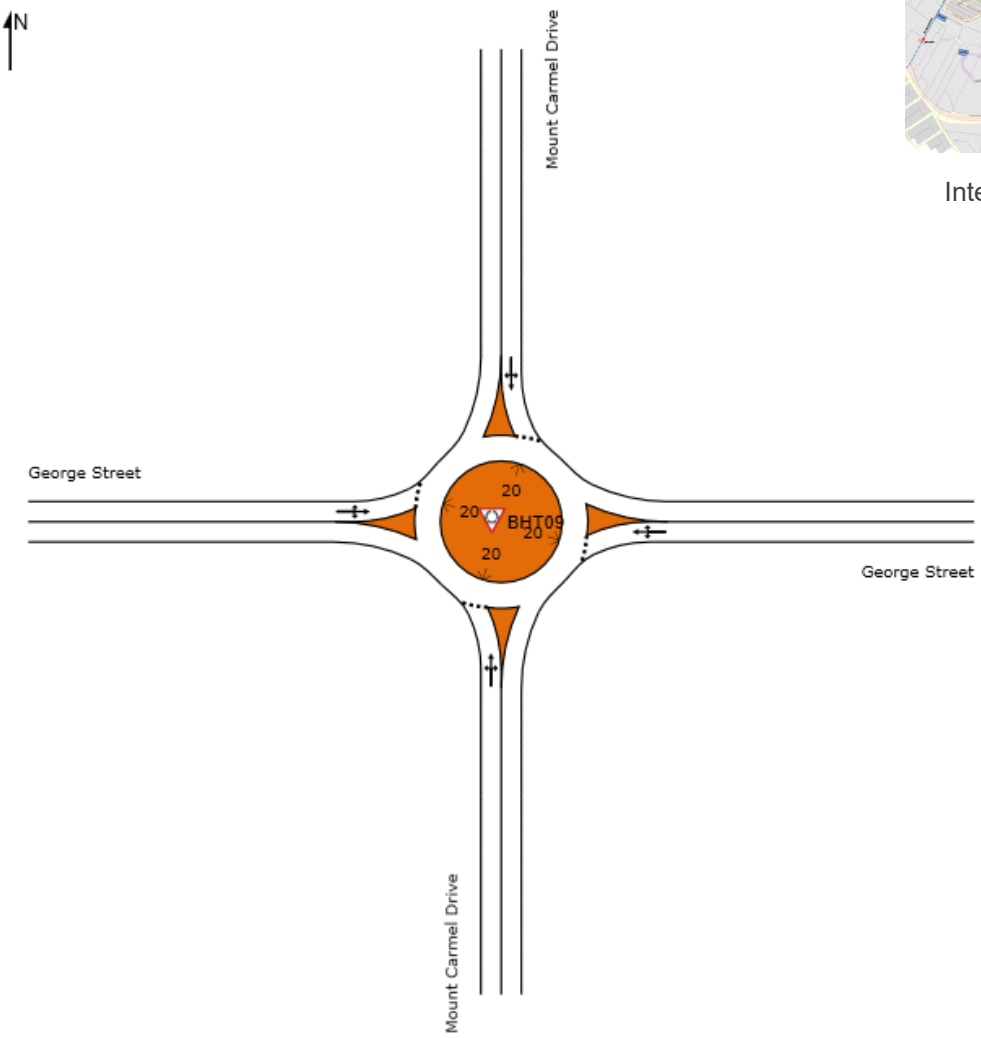


Intersection BHT09 -

SITE LAYOUT

Site: BHT09 [AM_Mount Carmel Drive_George St]

New Site
Site Category: (None)
Roundabout



MOVEMENT SUMMARY

Site: BHT09 [AM_Mount Carmel Drive_George St]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Mount Carmel Drive												
1	L2	28	0.0	0.133	4.4	LOS A	0.8	5.5	0.31	0.52	0.31	54.7
2	T1	76	0.0	0.133	4.8	LOS A	0.8	5.5	0.31	0.52	0.31	55.9
3	R2	67	0.0	0.133	9.4	LOS A	0.8	5.5	0.31	0.52	0.31	54.4
Approach		172	0.0	0.133	6.5	LOS A	0.8	5.5	0.31	0.52	0.31	55.2
East: George Street												
4	L2	75	0.0	0.124	3.2	LOS A	0.7	5.2	0.25	0.40	0.25	47.2
5	T1	75	0.0	0.124	3.2	LOS A	0.7	5.2	0.25	0.40	0.25	48.8
6	R2	19	0.0	0.124	7.7	LOS A	0.7	5.2	0.25	0.40	0.25	49.0
Approach		168	0.0	0.124	3.7	LOS A	0.7	5.2	0.25	0.40	0.25	48.2
North: Mount Carmel Drive												
7	L2	13	0.0	0.063	4.3	LOS A	0.4	2.5	0.27	0.47	0.27	55.5
8	T1	54	0.0	0.063	4.7	LOS A	0.4	2.5	0.27	0.47	0.27	56.5
9	R2	15	0.0	0.063	9.3	LOS A	0.4	2.5	0.27	0.47	0.27	57.1
Approach		81	0.0	0.063	5.5	LOS A	0.4	2.5	0.27	0.47	0.27	56.5
West: George Street												
10	L2	25	0.0	0.043	3.6	LOS A	0.2	1.7	0.36	0.44	0.36	48.1
11	T1	19	0.0	0.043	3.6	LOS A	0.2	1.7	0.36	0.44	0.36	48.5
12	R2	8	0.0	0.043	8.2	LOS A	0.2	1.7	0.36	0.44	0.36	48.6
Approach		53	0.0	0.043	4.3	LOS A	0.2	1.7	0.36	0.44	0.36	48.3
All Vehicles		474	0.0	0.133	5.1	LOS A	0.8	5.5	0.29	0.46	0.29	52.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

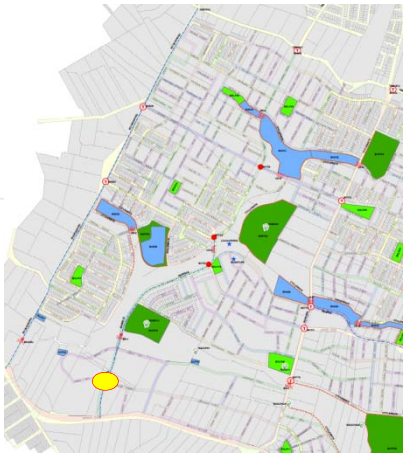
Site: BHT09 [PM_Mount Carmel Drive_George St]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Mount Carmel Drive												
1	L2	24	0.0	0.240	4.3	LOS A	1.6	11.5	0.29	0.43	0.29	55.5
2	T1	299	0.0	0.240	4.6	LOS A	1.6	11.5	0.29	0.43	0.29	56.7
3	R2	11	0.0	0.240	9.3	LOS A	1.6	11.5	0.29	0.43	0.29	55.5
Approach		334	0.0	0.240	4.8	LOS A	1.6	11.5	0.29	0.43	0.29	56.6
East: George Street												
4	L2	44	0.0	0.094	4.0	LOS A	0.6	3.9	0.44	0.53	0.44	46.1
5	T1	21	0.0	0.094	4.1	LOS A	0.6	3.9	0.44	0.53	0.44	47.9
6	R2	42	0.0	0.094	8.6	LOS A	0.6	3.9	0.44	0.53	0.44	48.1
Approach		107	0.0	0.094	5.8	LOS A	0.6	3.9	0.44	0.53	0.44	47.4
North: Mount Carmel Drive												
7	L2	57	0.0	0.195	4.6	LOS A	1.3	9.2	0.38	0.48	0.38	55.4
8	T1	174	0.0	0.195	5.0	LOS A	1.3	9.2	0.38	0.48	0.38	56.4
9	R2	17	0.0	0.195	9.6	LOS A	1.3	9.2	0.38	0.48	0.38	57.1
Approach		247	0.0	0.195	5.2	LOS A	1.3	9.2	0.38	0.48	0.38	56.2
West: George Street												
10	L2	16	0.0	0.133	4.8	LOS A	0.8	5.6	0.54	0.58	0.54	47.5
11	T1	84	0.0	0.133	4.9	LOS A	0.8	5.6	0.54	0.58	0.54	47.7
12	R2	37	0.0	0.133	9.4	LOS A	0.8	5.6	0.54	0.58	0.54	47.8
Approach		137	0.0	0.133	6.1	LOS A	0.8	5.6	0.54	0.58	0.54	47.7
All Vehicles		825	0.0	0.240	5.3	LOS A	1.6	11.5	0.38	0.48	0.38	53.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

BHT17– Prosper Street / Mt Carmel Drive

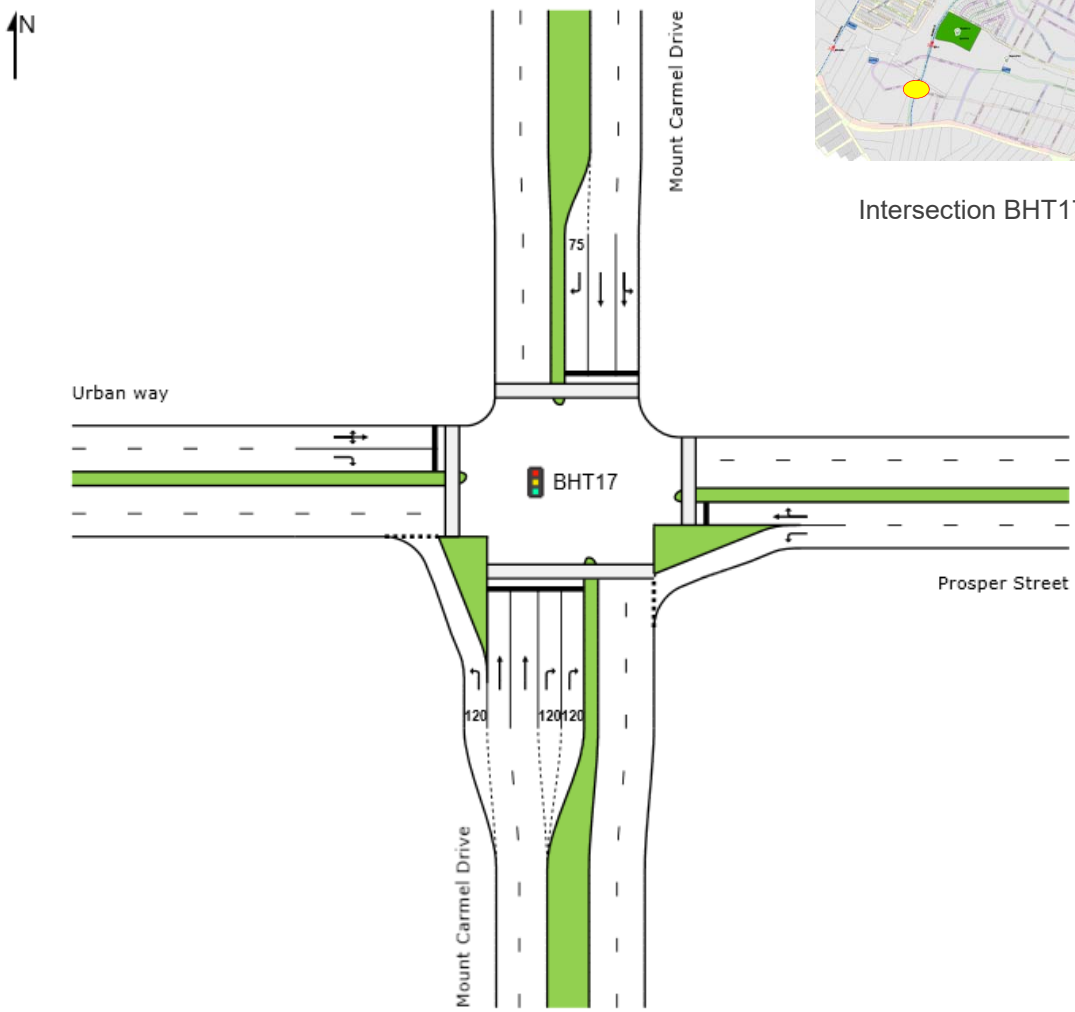


Intersection BHT17 -

SITE LAYOUT

Site: BHT17 [AM_Mt Carmel Drive_Prosper Street]

New Site
Site Category: (None)
Signals - Fixed Time Isolated



MOVEMENT SUMMARY

Site: BHT17 [AM_Mt Carmel Drive_Prosper Street]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Mount Carmel Drive												
1	L2	804	0.0	0.546	6.9	LOS A	9.2	64.5	0.27	0.64	0.27	46.4
2	T1	233	0.0	0.228	43.8	LOS D	6.3	44.3	0.83	0.67	0.83	30.2
3	R2	805	0.0	0.843	65.0	LOS E	28.2	197.4	1.00	0.92	1.12	18.5
Approach		1842	0.0	0.843	37.0	LOS C	28.2	197.4	0.66	0.77	0.71	26.6
East: Prosper Street												
4	L2	82	0.0	0.068	11.6	LOS A	1.6	11.2	0.35	0.63	0.35	42.3
5	T1	26	0.0	0.109	55.5	LOS D	1.9	13.1	0.90	0.67	0.90	20.2
6	R2	5	0.0	0.109	61.1	LOS E	1.9	13.1	0.90	0.67	0.90	26.8
Approach		114	0.0	0.109	24.0	LOS B	1.9	13.1	0.50	0.65	0.50	33.1
North: Mount Carmel Drive												
7	L2	99	0.0	0.858	64.5	LOS E	33.1	232.0	1.00	0.99	1.33	25.6
8	T1	840	0.0	0.858	57.8	LOS E	33.1	232.0	0.99	0.97	1.21	26.0
9	R2	87	0.0	0.165	45.5	LOS D	4.4	31.0	0.79	0.75	0.79	28.7
Approach		1026	0.0	0.858	57.4	LOS E	33.1	232.0	0.98	0.96	1.19	26.1
West: Urban way												
10	L2	5	0.0	0.206	63.1	LOS E	3.3	22.9	0.93	0.72	0.93	23.0
11	T1	26	0.0	0.206	58.5	LOS E	3.3	22.9	0.93	0.72	0.93	18.0
12	R2	74	0.0	0.206	63.0	LOS E	3.3	22.9	0.93	0.74	0.93	17.2
Approach		105	0.0	0.206	61.9	LOS E	3.3	22.9	0.93	0.73	0.93	17.8
All Vehicles		3087	0.0	0.858	44.1	LOS D	33.1	232.0	0.77	0.83	0.87	26.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	53	64.3	LOS F	0.2	0.2	0.96	0.96
P2	East Full Crossing	53	64.3	LOS F	0.2	0.2	0.96	0.96
P3	North Full Crossing	53	64.3	LOS F	0.2	0.2	0.96	0.96
P4	West Full Crossing	53	64.3	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		211	64.3	LOS F			0.96	0.96

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: BHT17 [PM_Mt Carmel Drive_Prosper Street]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 130 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Mount Carmel Drive												
1	L2	16	0.0	0.010	6.2	LOS A	0.1	0.6	0.14	0.57	0.14	47.4
2	T1	726	0.0	0.849	40.7	LOS C	19.2	134.6	1.00	0.94	1.16	31.3
3	R2	43	0.0	0.054	33.2	LOS C	0.8	5.7	0.82	0.69	0.82	27.6
Approach		785	0.0	0.849	39.6	LOS C	19.2	134.6	0.97	0.92	1.12	31.3
East: Prosper Street												
4	L2	815	0.0	0.758	24.0	LOS B	30.9	216.1	0.81	0.89	0.92	32.8
5	T1	11	0.0	0.328	52.6	LOS D	5.6	39.4	0.93	0.77	0.93	19.7
6	R2	88	0.0	0.328	58.2	LOS E	5.6	39.4	0.93	0.77	0.93	26.4
Approach		914	0.0	0.758	27.7	LOS B	30.9	216.1	0.82	0.88	0.92	31.5
North: Mount Carmel Drive												
7	L2	68	0.0	0.742	66.2	LOS E	8.9	62.4	1.00	0.93	1.48	24.9
8	T1	239	0.0	0.742	63.5	LOS E	9.8	68.6	1.00	0.89	1.25	24.5
9	R2	68	0.0	0.368	66.3	LOS E	4.2	29.3	0.98	0.76	0.98	23.3
Approach		376	0.0	0.742	64.5	LOS E	9.8	68.6	1.00	0.87	1.24	24.4
West: Urban way												
10	L2	92	0.0	0.844	57.3	LOS E	29.7	207.8	1.00	0.94	1.11	23.7
11	T1	11	0.0	0.844	52.7	LOS D	29.7	207.8	1.00	0.94	1.11	18.7
12	R2	815	0.0	0.844	57.2	LOS E	29.7	207.8	1.00	0.94	1.11	18.2
Approach		917	0.0	0.844	57.1	LOS E	29.7	207.8	1.00	0.94	1.11	18.9
All Vehicles		2992	0.0	0.849	44.5	LOS D	30.9	216.1	0.94	0.91	1.07	25.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	53	59.3	LOS E	0.2	0.2	0.96	0.96
P2	East Full Crossing	53	59.3	LOS E	0.2	0.2	0.96	0.96
P3	North Full Crossing	53	59.3	LOS E	0.2	0.2	0.96	0.96
P4	West Full Crossing	53	35.2	LOS D	0.1	0.1	0.91	0.91
All Pedestrians		211	53.3	LOS E			0.94	0.94

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

Appendix 2

Evidence and supporting documents for Questions 6-13

Intersections

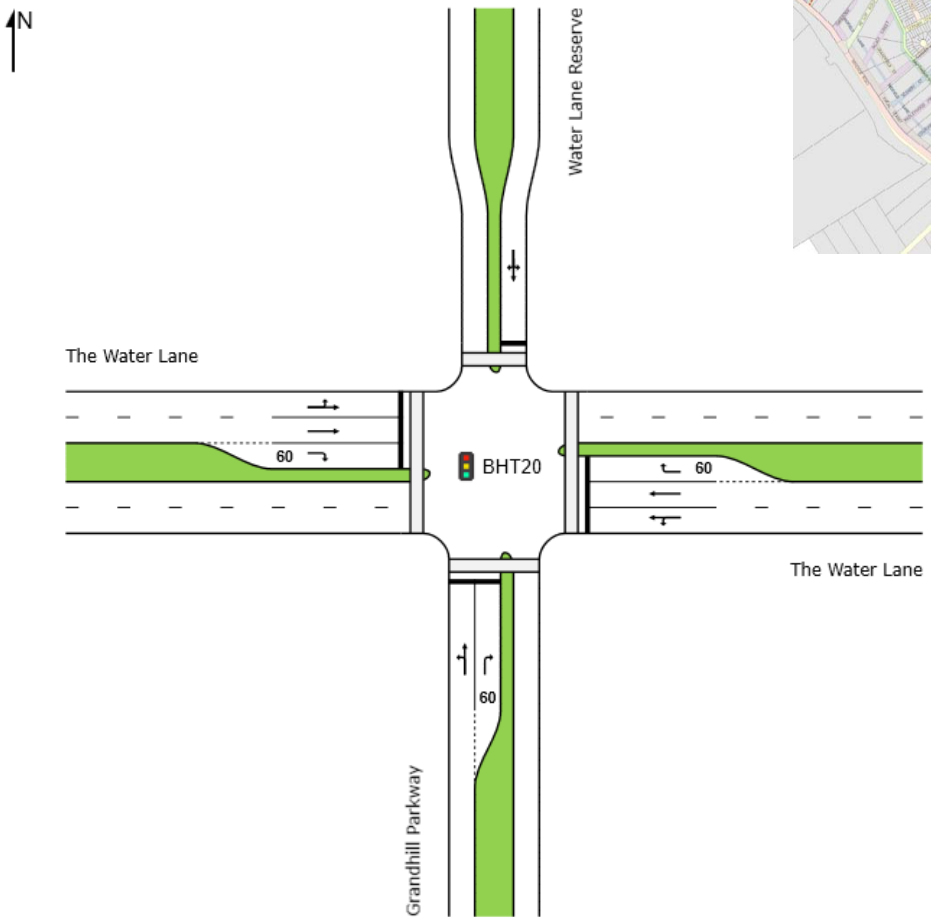
BHT20, BHT21, BHR05, BHR06, BHR07 and BHR08

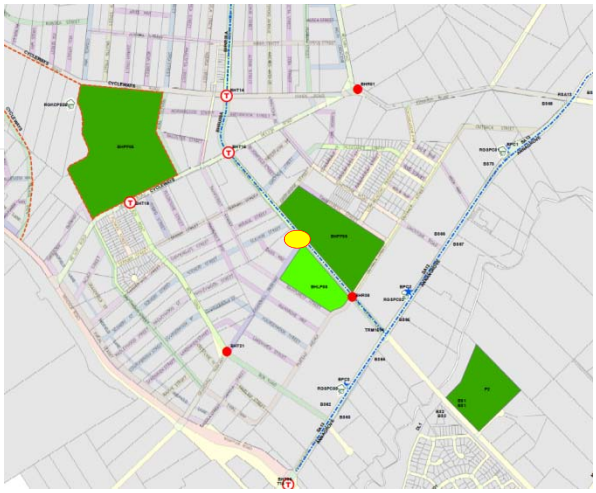
BHT20: Grandhill Parkway /The Water Lane

SITE LAYOUT

Site: BHT20 [AM_Water Lane_Grandhill Parkway]

New Site
Site Category: (None)
Signals - Fixed Time Isolated





Intersection BHT20 -

MOVEMENT SUMMARY

Site: BHT20 [AM_Water Lane_Grandhill Parkway]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 110 seconds (Site Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Grandhill Parkway												
1	L2	126	2.0	0.567	52.2	LOS D	8.6	61.2	0.98	0.80	0.98	15.3
2	T1	42	2.0	0.567	47.6	LOS D	8.6	61.2	0.98	0.80	0.98	18.5
3	R2	181	2.0	0.617	52.6	LOS D	9.3	66.4	0.99	0.81	0.99	20.8
Approach		349	2.0	0.617	51.8	LOS D	9.3	66.4	0.98	0.81	0.98	18.8
East: The Water Lane												
4	L2	72	2.0	0.694	40.7	LOS C	20.1	143.0	0.94	0.82	0.94	24.9
5	T1	765	2.0	0.694	35.9	LOS C	20.1	143.0	0.94	0.81	0.94	22.7
6	R2	36	2.0	0.115	47.2	LOS D	1.7	11.8	0.89	0.72	0.89	21.9
Approach		873	2.0	0.694	36.7	LOS C	20.1	143.0	0.93	0.81	0.93	22.8
North: Water Lane Reserve												
7	L2	25	2.0	0.379	50.5	LOS D	5.6	39.8	0.94	0.76	0.94	21.7
8	T1	55	2.0	0.379	45.9	LOS D	5.6	39.8	0.94	0.76	0.94	19.3
9	R2	34	2.0	0.379	50.5	LOS D	5.6	39.8	0.94	0.76	0.94	16.1
Approach		114	2.0	0.379	48.3	LOS D	5.6	39.8	0.94	0.76	0.94	19.0
West: The Water Lane												
10	L2	34	2.0	0.909	58.2	LOS E	35.0	249.1	1.00	1.08	1.25	14.7
11	T1	964	2.0	0.909	53.7	LOS D	35.0	249.1	0.98	1.07	1.25	17.9
12	R2	278	0.0	0.882	64.1	LOS E	16.9	118.2	1.00	0.99	1.31	13.1
Approach		1276	1.6	0.909	56.1	LOS D	35.0	249.1	0.98	1.06	1.27	16.8
All Vehicles		2612	1.8	0.909	48.7	LOS D	35.0	249.1	0.96	0.93	1.10	18.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Pedestrian ped	Back of Queue Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	53	49.3	LOS E	0.2	0.2	0.95	0.95
P2	East Full Crossing	53	49.3	LOS E	0.2	0.2	0.95	0.95
P3	North Full Crossing	53	49.3	LOS E	0.2	0.2	0.95	0.95
P4	West Full Crossing	53	49.3	LOS E	0.2	0.2	0.95	0.95
All Pedestrians		211	49.3	LOS E			0.95	0.95

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: BHT20 [PM_Water Lane_Grandhill Parkway]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Grandhill Parkway												
1	L2	221	2.0	0.879	67.9	LOS E	17.8	127.0	1.00	0.99	1.28	12.6
2	T1	53	2.0	0.879	63.3	LOS E	17.8	127.0	1.00	0.99	1.28	15.5
3	R2	126	2.0	0.399	53.4	LOS D	6.7	47.8	0.94	0.78	0.94	20.6
Approach		400	2.0	0.879	62.7	LOS E	17.8	127.0	0.98	0.93	1.17	15.5
East: The Water Lane												
4	L2	215	2.0	0.884	49.0	LOS D	43.5	309.4	1.00	0.99	1.13	22.2
5	T1	1179	2.0	0.884	44.1	LOS D	43.5	309.4	0.98	0.99	1.11	20.1
6	R2	49	2.0	0.348	64.0	LOS E	2.9	20.5	0.99	0.74	0.99	18.3
Approach		1443	2.0	0.884	45.5	LOS D	43.5	309.4	0.99	0.98	1.11	20.4
North: Water Lane Reserve												
7	L2	47	2.0	0.486	56.0	LOS D	7.7	55.0	0.96	0.79	0.96	20.3
8	T1	55	2.0	0.486	51.4	LOS D	7.7	55.0	0.96	0.79	0.96	17.9
9	R2	39	2.0	0.486	55.9	LOS D	7.7	55.0	0.96	0.79	0.96	14.9
Approach		141	2.0	0.486	54.2	LOS D	7.7	55.0	0.96	0.79	0.96	18.0
West: The Water Lane												
10	L2	47	2.0	0.340	29.9	LOS C	10.9	77.4	0.72	0.65	0.72	22.9
11	T1	506	2.0	0.340	25.6	LOS B	11.0	78.4	0.73	0.63	0.73	26.8
12	R2	126	0.0	0.875	74.3	LOS F	8.3	58.3	1.00	0.99	1.40	11.8
Approach		680	1.6	0.875	35.0	LOS C	11.0	78.4	0.78	0.70	0.85	22.3
All Vehicles		2664	1.9	0.884	45.9	LOS D	43.5	309.4	0.93	0.89	1.05	19.8

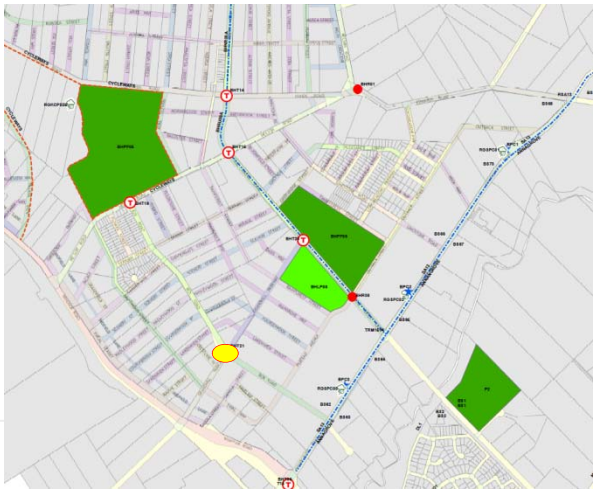
Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	53	54.3	LOS E	0.2	0.2	0.95	0.95
P2	East Full Crossing	53	54.3	LOS E	0.2	0.2	0.95	0.95
P3	North Full Crossing	53	54.3	LOS E	0.2	0.2	0.95	0.95
P4	West Full Crossing	53	54.3	LOS E	0.2	0.2	0.95	0.95
All Pedestrians		211	54.3	LOS E			0.95	0.95

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

BHT21: Grandhill Parkway/Box Road

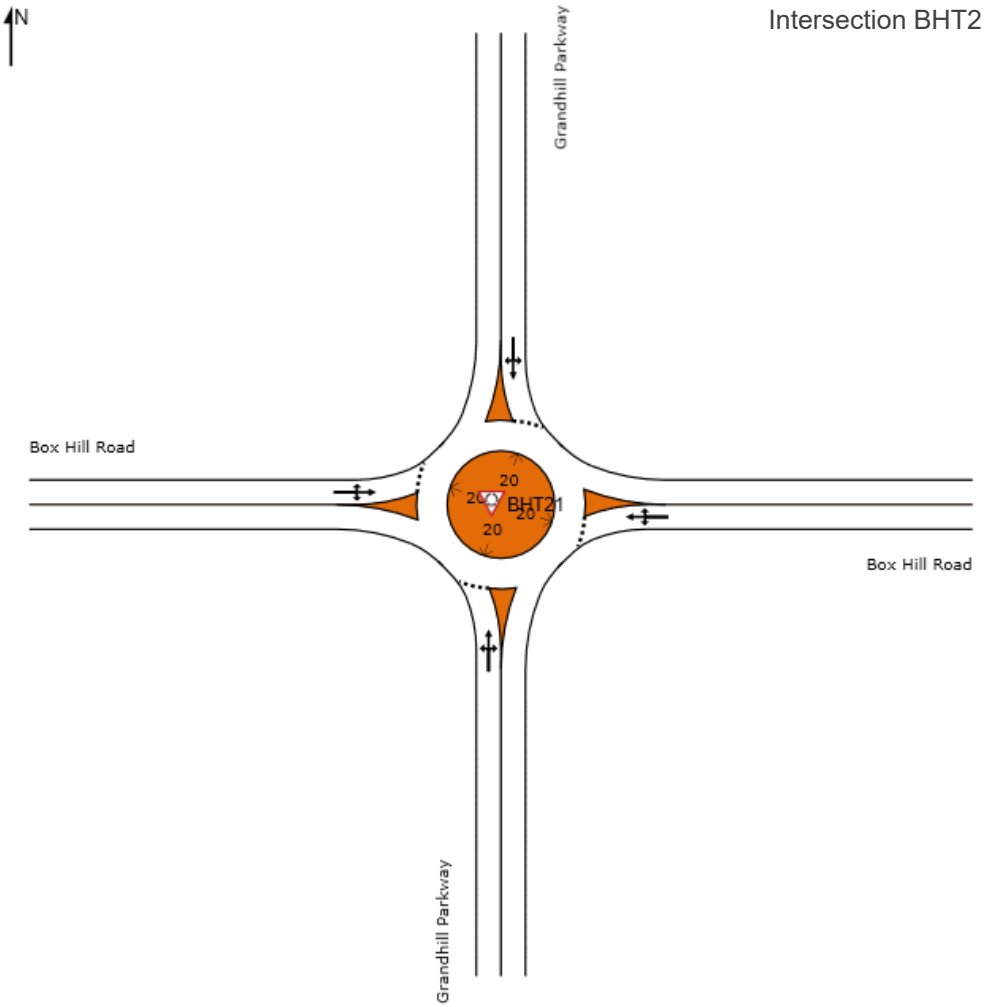


Intersection BHT21 -

SITE LAYOUT

Site: BHT21 [AM_Grandhill Parkway_Box Hill Road]

New Site
Site Category: (None)
Roundabout



MOVEMENT SUMMARY

Site: BHT21 [AM_Grandhill Parkway_Box Hill Road]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Grandhill Parkway												
1	L2	116	2.0	0.262	7.2	LOS A	1.6	11.6	0.67	0.75	0.67	49.8
2	T1	21	2.0	0.262	7.4	LOS A	1.6	11.6	0.67	0.75	0.67	51.3
3	R2	95	2.0	0.262	12.0	LOS A	1.6	11.6	0.67	0.75	0.67	51.2
Approach		232	2.0	0.262	9.2	LOS A	1.6	11.6	0.67	0.75	0.67	50.5
East: Box Hill Road												
4	L2	25	2.0	0.348	5.1	LOS A	2.4	17.4	0.50	0.59	0.50	50.9
5	T1	246	2.0	0.348	5.4	LOS A	2.4	17.4	0.50	0.59	0.50	53.7
6	R2	135	2.0	0.348	10.0	LOS A	2.4	17.4	0.50	0.59	0.50	53.6
Approach		406	2.0	0.348	6.9	LOS A	2.4	17.4	0.50	0.59	0.50	53.5
North: Grandhill Parkway												
7	L2	218	2.0	0.441	7.2	LOS A	3.1	22.4	0.74	0.79	0.74	51.5
8	T1	26	2.0	0.441	7.5	LOS A	3.1	22.4	0.74	0.79	0.74	51.3
9	R2	158	2.0	0.441	12.1	LOS A	3.1	22.4	0.74	0.79	0.74	52.7
Approach		402	2.0	0.441	9.2	LOS A	3.1	22.4	0.74	0.79	0.74	52.0
West: Box Hill Road												
10	L2	194	2.0	0.502	5.7	LOS A	3.8	27.2	0.59	0.61	0.59	52.9
11	T1	364	2.0	0.502	5.9	LOS A	3.8	27.2	0.59	0.61	0.59	54.2
12	R2	22	2.0	0.502	10.6	LOS A	3.8	27.2	0.59	0.61	0.59	52.7
Approach		580	2.0	0.502	6.0	LOS A	3.8	27.2	0.59	0.61	0.59	53.7
All Vehicles		1620	2.0	0.502	7.5	LOS A	3.8	27.2	0.62	0.67	0.62	52.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

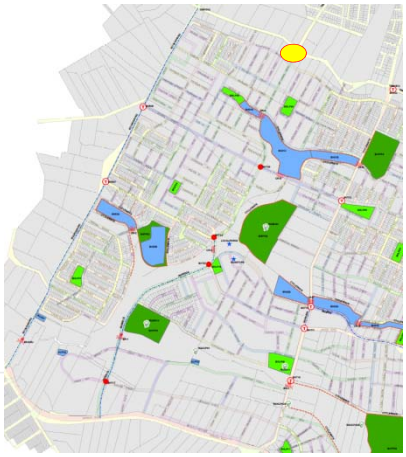
Site: BHT21 [PM_Grandhill Parkway_Box Hill Road]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Grandhill Parkway												
1	L2	67	2.0	0.356	9.4	LOS A	2.6	18.3	0.87	0.89	0.87	48.0
2	T1	62	2.0	0.356	9.7	LOS A	2.6	18.3	0.87	0.89	0.87	49.3
3	R2	102	2.0	0.356	14.3	LOS A	2.6	18.3	0.87	0.89	0.87	49.2
Approach		232	2.0	0.356	11.6	LOS A	2.6	18.3	0.87	0.89	0.87	48.9
East: Box Hill Road												
4	L2	121	2.0	0.686	8.0	LOS A	8.0	56.7	0.82	0.79	0.92	49.5
5	T1	440	2.0	0.686	8.2	LOS A	8.0	56.7	0.82	0.79	0.92	52.4
6	R2	177	2.0	0.686	12.8	LOS A	8.0	56.7	0.82	0.79	0.92	52.3
Approach		738	2.0	0.686	9.3	LOS A	8.0	56.7	0.82	0.79	0.92	52.0
North: Grandhill Parkway												
7	L2	223	2.0	0.582	11.0	LOS A	5.6	40.1	0.91	0.99	1.11	49.1
8	T1	64	2.0	0.582	11.2	LOS A	5.6	40.1	0.91	0.99	1.11	48.4
9	R2	154	2.0	0.582	15.9	LOS B	5.6	40.1	0.91	0.99	1.11	50.2
Approach		441	2.0	0.582	12.7	LOS A	5.6	40.1	0.91	0.99	1.11	49.4
West: Box Hill Road												
10	L2	202	2.0	0.690	8.6	LOS A	7.9	56.6	0.81	0.82	0.95	51.4
11	T1	438	2.0	0.690	8.9	LOS A	7.9	56.6	0.81	0.82	0.95	52.6
12	R2	89	2.0	0.690	13.5	LOS A	7.9	56.6	0.81	0.82	0.95	50.8
Approach		729	2.0	0.690	9.4	LOS A	7.9	56.6	0.81	0.82	0.95	52.1
All Vehicles		2140	2.0	0.690	10.3	LOS A	8.0	56.7	0.84	0.85	0.96	51.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

BHR05: Mt Carmel Drive/Old Pitt Town Road/Valetta Drive

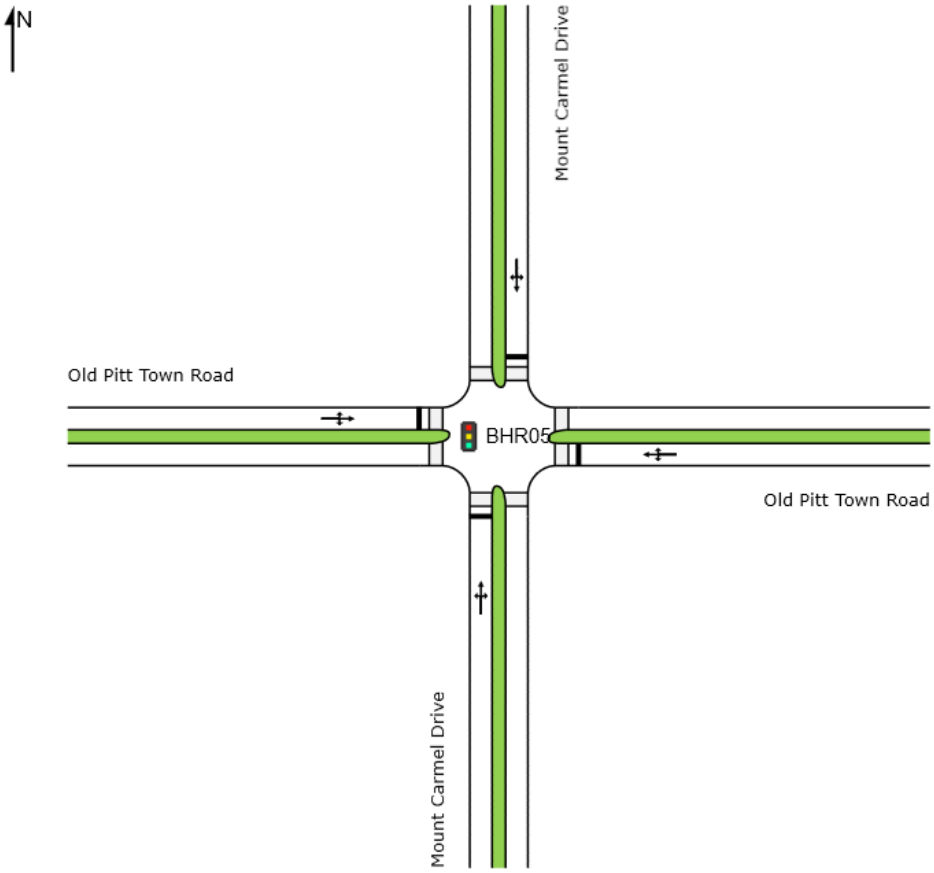


Intersection BHR05 -

SITE LAYOUT

Site: BHR05 [AM_Mount Carmel Drive_Old Pitt Town Road]

New Site
Site Category: (None)
Signals - Fixed Time Isolated



MOVEMENT SUMMARY

Site: BHR05 [AM_Mount Carmel Drive_Old Pitt Town Road]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Mount Carmel Drive												
1	L2	25	2.0	0.360	43.5	LOS D	5.2	36.8	0.91	0.75	0.91	39.4
2	T1	65	2.0	0.360	38.0	LOS C	5.2	36.8	0.91	0.75	0.91	40.6
3	R2	29	2.0	0.360	43.4	LOS D	5.2	36.8	0.91	0.75	0.91	35.1
Approach		120	2.0	0.360	40.5	LOS C	5.2	36.8	0.91	0.75	0.91	39.2
East: Old Pitt Town Road												
4	L2	15	2.0	0.411	13.9	LOS A	10.8	76.7	0.53	0.50	0.53	43.6
5	T1	409	2.0	0.411	9.3	LOS A	10.8	76.7	0.53	0.50	0.53	45.4
6	R2	34	2.0	0.411	13.9	LOS A	10.8	76.7	0.53	0.50	0.53	45.0
Approach		458	2.0	0.411	9.8	LOS A	10.8	76.7	0.53	0.50	0.53	45.3
North: Mount Carmel Drive												
7	L2	29	2.0	0.505	46.7	LOS D	6.4	45.7	0.95	0.79	0.95	38.6
8	T1	40	2.0	0.505	41.2	LOS C	6.4	45.7	0.95	0.79	0.95	39.2
9	R2	72	2.0	0.505	46.6	LOS D	6.4	45.7	0.95	0.79	0.95	41.3
Approach		141	2.0	0.505	45.1	LOS D	6.4	45.7	0.95	0.79	0.95	40.2
West: Old Pitt Town Road												
10	L2	39	2.0	0.507	13.3	LOS A	15.0	107.0	0.54	0.52	0.54	46.3
11	T1	560	2.0	0.507	8.8	LOS A	15.0	107.0	0.54	0.52	0.54	45.7
12	R2	26	2.0	0.507	13.3	LOS A	15.0	107.0	0.54	0.52	0.54	45.0
Approach		625	2.0	0.507	9.2	LOS A	15.0	107.0	0.54	0.52	0.54	45.7
All Vehicles		1344	2.0	0.507	16.0	LOS B	15.0	107.0	0.61	0.56	0.61	44.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P11	South Stage 1	53	44.3	LOS E	0.1	0.1	0.94	0.94
P12	South Stage 2	53	44.3	LOS E	0.1	0.1	0.94	0.94
P21	East Stage 1	53	44.3	LOS E	0.1	0.1	0.94	0.94
P22	East Stage 2	53	44.3	LOS E	0.1	0.1	0.94	0.94
P31	North Stage 1	53	44.3	LOS E	0.1	0.1	0.94	0.94
P32	North Stage 2	53	44.3	LOS E	0.1	0.1	0.94	0.94
P41	West Stage 1	53	44.3	LOS E	0.1	0.1	0.94	0.94
P42	West Stage 2	53	44.3	LOS E	0.1	0.1	0.94	0.94
All Pedestrians		421	44.3	LOS E			0.94	0.94

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

MOVEMENT SUMMARY

Site: BHR05 [PM_Mount Carmel Drive_Old Pitt Town Road]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Mount Carmel Drive												
1	L2	18	2.0	0.323	50.8	LOS D	2.9	21.0	0.96	0.75	0.96	37.0
2	T1	23	2.0	0.323	45.3	LOS D	2.9	21.0	0.96	0.75	0.96	38.1
3	R2	22	2.0	0.323	50.7	LOS D	2.9	21.0	0.96	0.75	0.96	32.5
Approach		63	2.0	0.323	48.8	LOS D	2.9	21.0	0.96	0.75	0.96	36.0
East: Old Pitt Town Road												
4	L2	100	2.0	0.744	18.3	LOS B	27.4	194.8	0.76	0.72	0.76	41.2
5	T1	637	2.0	0.744	13.8	LOS A	27.4	194.8	0.76	0.72	0.76	43.4
6	R2	75	2.0	0.744	18.3	LOS B	27.4	194.8	0.76	0.72	0.76	43.1
Approach		812	2.0	0.744	14.7	LOS B	27.4	194.8	0.76	0.72	0.76	43.2
North: Mount Carmel Drive												
7	L2	15	2.0	0.742	53.3	LOS D	9.5	67.6	1.00	0.89	1.13	37.3
8	T1	116	2.0	0.742	47.7	LOS D	9.5	67.6	1.00	0.89	1.13	37.8
9	R2	58	2.0	0.742	53.2	LOS D	9.5	67.6	1.00	0.89	1.13	40.0
Approach		188	2.0	0.742	49.9	LOS D	9.5	67.6	1.00	0.89	1.13	38.5
West: Old Pitt Town Road												
10	L2	87	2.0	0.692	17.5	LOS B	24.5	174.4	0.71	0.68	0.71	44.8
11	T1	628	2.0	0.692	12.9	LOS A	24.5	174.4	0.71	0.68	0.71	43.8
12	R2	57	2.0	0.692	17.5	LOS B	24.5	174.4	0.71	0.68	0.71	43.2
Approach		773	2.0	0.692	13.8	LOS A	24.5	174.4	0.71	0.68	0.71	43.9
All Vehicles		1836	2.0	0.744	19.1	LOS B	27.4	194.8	0.77	0.72	0.78	42.6

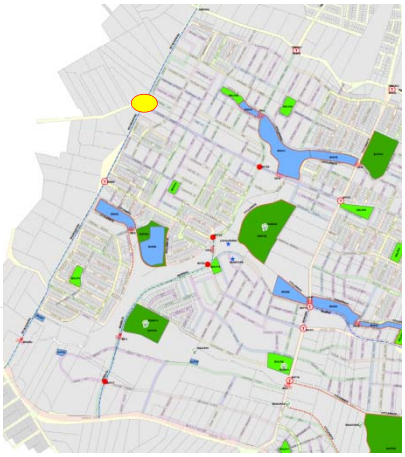
Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P11	South Stage 1	53	44.3	LOS E	0.1	0.1	0.94	0.94
P12	South Stage 2	53	44.3	LOS E	0.1	0.1	0.94	0.94
P21	East Stage 1	53	44.3	LOS E	0.1	0.1	0.94	0.94
P22	East Stage 2	53	44.3	LOS E	0.1	0.1	0.94	0.94
P31	North Stage 1	53	44.3	LOS E	0.1	0.1	0.94	0.94
P32	North Stage 2	53	44.3	LOS E	0.1	0.1	0.94	0.94
P41	West Stage 1	53	44.3	LOS E	0.1	0.1	0.94	0.94
P42	West Stage 2	53	44.3	LOS E	0.1	0.1	0.94	0.94
All Pedestrians		421	44.3	LOS E			0.94	0.94

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

BHR06: Boundary Road/George Street

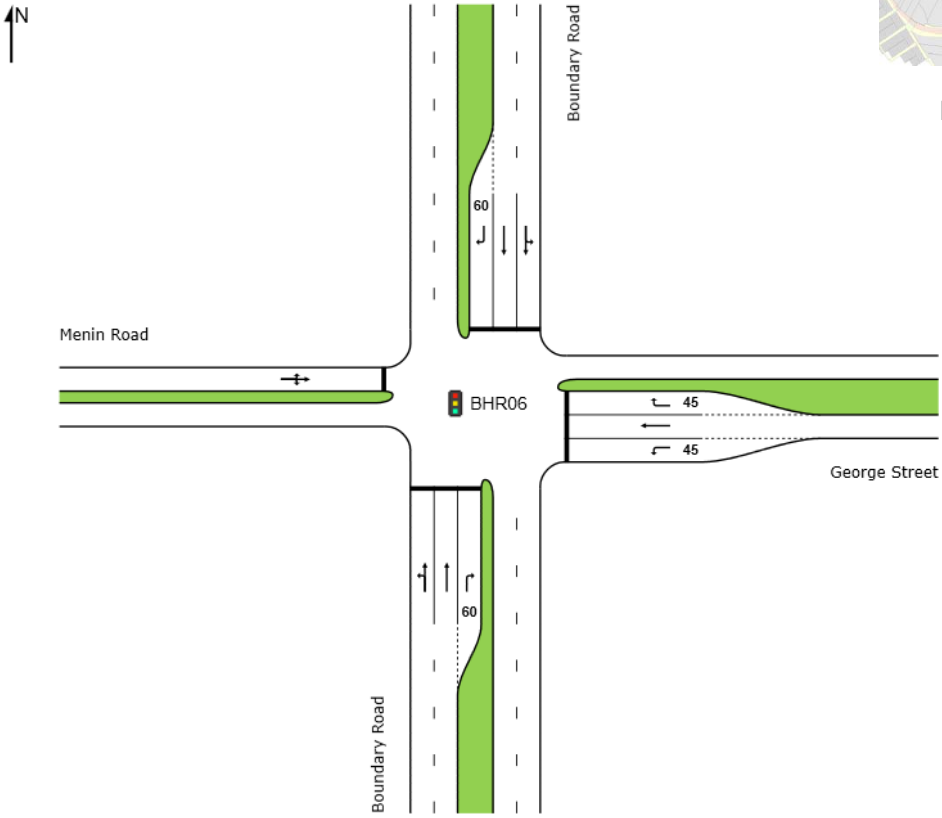


Intersection BHR06 -

SITE LAYOUT

Site: BHR06 [PM_Boundary Road_George Street_1]

New Site
Site Category: (None)
Signals - Fixed Time Isolated



MOVEMENT SUMMARY

Site: BHR06 [AM_Boundary Road_George Street_1]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Boundary Road												
1	L2	41	2.0	0.230	21.7	LOS B	6.2	43.8	0.62	0.57	0.62	45.8
2	T1	398	2.0	0.230	16.1	LOS B	6.2	44.2	0.62	0.54	0.62	47.2
3	R2	21	2.0	0.049	24.2	LOS B	0.6	4.3	0.62	0.67	0.62	42.5
Approach		460	2.0	0.230	17.0	LOS B	6.2	44.2	0.62	0.55	0.62	46.8
East: George Street												
4	L2	67	2.0	0.089	24.4	LOS B	2.0	14.4	0.65	0.69	0.65	37.2
5	T1	40	2.0	0.050	19.4	LOS B	1.2	8.4	0.64	0.48	0.64	39.6
6	R2	11	2.0	0.019	24.5	LOS B	0.3	2.2	0.64	0.64	0.64	37.4
Approach		118	2.0	0.089	22.7	LOS B	2.0	14.4	0.65	0.62	0.65	38.0
North: Boundary Road												
7	L2	16	2.0	0.220	21.6	LOS B	5.9	41.8	0.62	0.54	0.62	46.2
8	T1	404	2.0	0.220	16.1	LOS B	5.9	41.9	0.62	0.53	0.62	47.4
9	R2	58	2.0	0.139	25.0	LOS B	1.8	12.5	0.65	0.72	0.65	41.7
Approach		478	2.0	0.220	17.3	LOS B	5.9	41.9	0.62	0.55	0.62	46.6
West: Menin Road												
10	L2	32	2.0	0.233	26.7	LOS B	4.4	31.2	0.71	0.72	0.71	36.6
11	T1	16	2.0	0.233	22.1	LOS B	4.4	31.2	0.71	0.72	0.71	36.9
12	R2	86	2.0	0.233	26.6	LOS B	4.4	31.2	0.71	0.72	0.71	36.8
Approach		134	2.0	0.233	26.1	LOS B	4.4	31.2	0.71	0.72	0.71	36.8
All Vehicles		1189	2.0	0.233	18.7	LOS B	6.2	44.2	0.63	0.58	0.63	44.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: BHR06 [PM_Boundary Road_George Street_1]

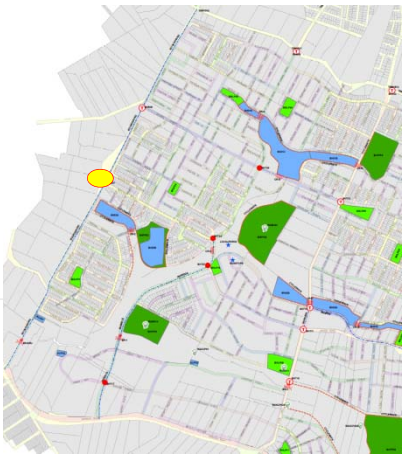
New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Boundary Road												
1	L2	126	2.0	0.324	19.7	LOS B	9.2	65.4	0.61	0.61	0.61	46.3
2	T1	553	2.0	0.324	14.2	LOS A	9.4	66.7	0.61	0.56	0.61	48.2
3	R2	75	2.0	0.143	20.7	LOS B	2.0	14.3	0.58	0.70	0.58	44.3
Approach		754	2.0	0.324	15.7	LOS B	9.4	66.7	0.60	0.58	0.60	47.5
East: George Street												
4	L2	11	2.0	0.016	27.0	LOS B	0.3	2.3	0.68	0.64	0.68	36.2
5	T1	36	2.0	0.051	22.8	LOS B	1.1	8.1	0.69	0.52	0.69	38.2
6	R2	16	2.0	0.038	30.5	LOS C	0.5	3.8	0.72	0.66	0.72	35.3
Approach		62	2.0	0.051	25.5	LOS B	1.1	8.1	0.70	0.58	0.70	37.1
North: Boundary Road												
7	L2	11	2.0	0.162	18.3	LOS B	4.2	29.9	0.54	0.47	0.54	48.2
8	T1	331	2.0	0.162	12.8	LOS A	4.2	30.0	0.54	0.46	0.54	49.5
9	R2	42	2.0	0.123	23.8	LOS B	1.2	8.8	0.62	0.71	0.62	42.3
Approach		383	2.0	0.162	14.1	LOS A	4.2	30.0	0.55	0.49	0.55	48.6
West: Menin Road												
10	L2	66	2.0	0.328	30.4	LOS C	6.8	48.5	0.78	0.73	0.78	35.5
11	T1	52	2.0	0.328	25.8	LOS B	6.8	48.5	0.78	0.73	0.78	35.8
12	R2	72	2.0	0.328	30.3	LOS C	6.8	48.5	0.78	0.73	0.78	35.7
Approach		189	2.0	0.328	29.1	LOS C	6.8	48.5	0.78	0.73	0.78	35.7
All Vehicles		1388	2.0	0.328	17.6	LOS B	9.4	66.7	0.62	0.58	0.62	45.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

BHR07: Boundary Road/ Brahman Road

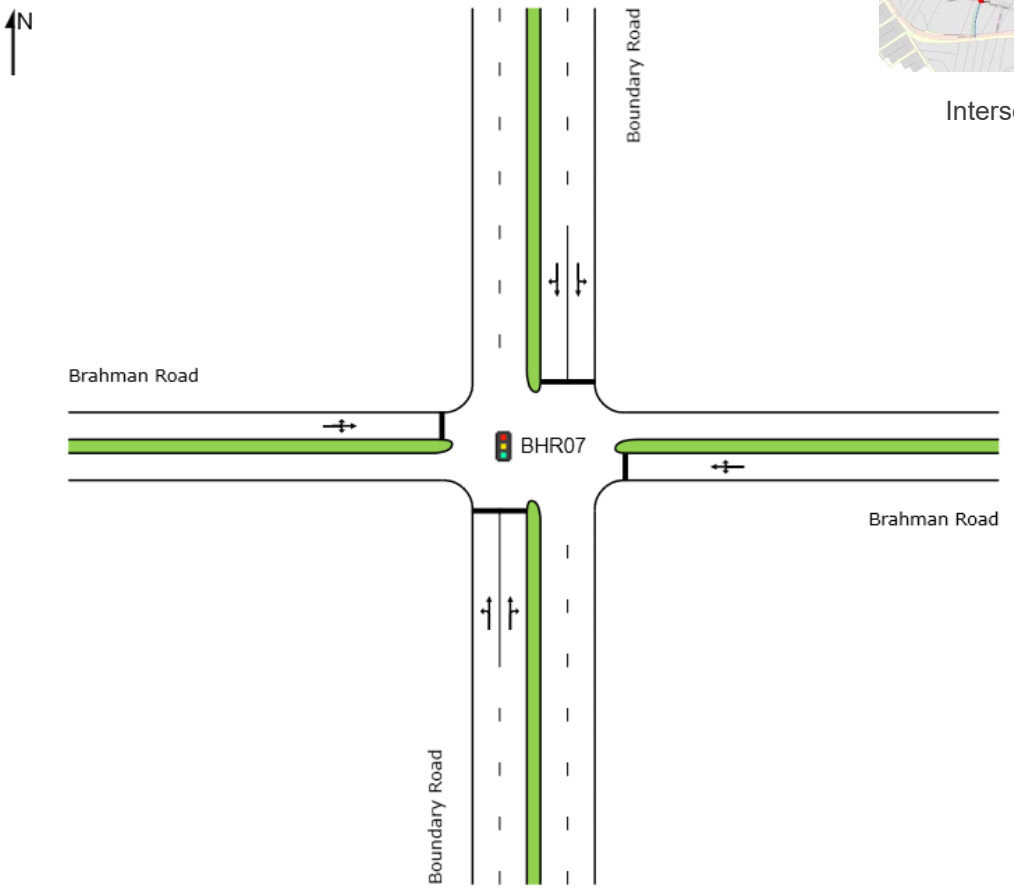


Intersection BHR07 -

SITE LAYOUT

Site: BHR07 [AM_Boundary Road_Brahman Road]

New Site
Site Category: (None)
Signals - Fixed Time Isolated



MOVEMENT SUMMARY

Site: BHR07 [AM_Boundary Road_Brahman Road]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Boundary Road												
1	L2	51	2.0	0.315	20.8	LOS B	8.9	63.6	0.62	0.57	0.62	46.3
2	T1	382	2.0	0.315	17.1	LOS B	8.9	63.6	0.65	0.60	0.65	46.1
3	R2	68	2.0	0.315	27.2	LOS B	6.1	43.3	0.72	0.67	0.72	42.3
Approach		501	2.0	0.315	18.9	LOS B	8.9	63.6	0.66	0.61	0.66	45.5
East: Brahman Road												
4	L2	23	2.0	0.363	29.3	LOS C	8.1	57.9	0.77	0.70	0.77	36.5
5	T1	145	2.0	0.363	24.7	LOS B	8.1	57.9	0.77	0.70	0.77	36.8
6	R2	60	2.0	0.363	29.3	LOS C	8.1	57.9	0.77	0.70	0.77	36.5
Approach		228	2.0	0.363	26.4	LOS B	8.1	57.9	0.77	0.70	0.77	36.7
North: Boundary Road												
7	L2	124	2.0	0.369	21.3	LOS B	10.7	76.4	0.65	0.63	0.65	45.5
8	T1	328	2.0	0.369	17.4	LOS B	10.7	76.4	0.67	0.65	0.67	45.4
9	R2	103	2.0	0.369	27.9	LOS B	6.4	45.7	0.74	0.71	0.74	41.5
Approach		556	2.0	0.369	20.2	LOS B	10.7	76.4	0.68	0.66	0.68	44.6
West: Brahman Road												
10	L2	18	2.0	0.176	28.0	LOS B	3.8	26.9	0.72	0.63	0.72	37.1
11	T1	80	2.0	0.176	23.4	LOS B	3.8	26.9	0.72	0.63	0.72	37.4
12	R2	16	2.0	0.176	28.0	LOS B	3.8	26.9	0.72	0.63	0.72	37.1
Approach		114	2.0	0.176	24.8	LOS B	3.8	26.9	0.72	0.63	0.72	37.3
All Vehicles		1399	2.0	0.369	21.1	LOS B	10.7	76.4	0.69	0.64	0.69	42.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: BHR07 [PM_Boundary Road_Brahman Road]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Boundary Road												
1	L2	112	2.0	0.500	22.7	LOS B	16.0	113.7	0.71	0.66	0.71	45.0
2	T1	615	2.0	0.500	18.6	LOS B	16.0	113.7	0.73	0.68	0.73	45.1
3	R2	109	2.0	0.500	26.6	LOS B	11.6	82.4	0.76	0.71	0.76	42.7
Approach		836	2.0	0.500	20.2	LOS B	16.0	113.7	0.73	0.68	0.73	44.8
East: Brahman Road												
4	L2	68	2.0	0.501	32.4	LOS C	11.1	79.3	0.84	0.77	0.84	35.0
5	T1	116	2.0	0.501	27.8	LOS B	11.1	79.3	0.84	0.77	0.84	35.3
6	R2	103	2.0	0.501	32.4	LOS C	11.1	79.3	0.84	0.77	0.84	35.1
Approach		287	2.0	0.501	30.5	LOS C	11.1	79.3	0.84	0.77	0.84	35.1
North: Boundary Road												
7	L2	65	2.0	0.236	20.0	LOS B	6.3	45.1	0.59	0.57	0.59	46.4
8	T1	333	2.0	0.236	16.2	LOS B	6.3	45.1	0.62	0.57	0.62	46.7
9	R2	19	2.0	0.236	23.7	LOS B	5.4	38.3	0.65	0.57	0.65	44.9
Approach		417	2.0	0.236	17.2	LOS B	6.3	45.1	0.62	0.57	0.62	46.6
West: Brahman Road												
10	L2	36	2.0	0.468	33.4	LOS C	9.5	67.9	0.84	0.76	0.84	34.8
11	T1	109	2.0	0.468	28.9	LOS C	9.5	67.9	0.84	0.76	0.84	35.0
12	R2	99	2.0	0.468	33.4	LOS C	9.5	67.9	0.84	0.76	0.84	34.8
Approach		244	2.0	0.468	31.4	LOS C	9.5	67.9	0.84	0.76	0.84	34.9
All Vehicles		1784	2.0	0.501	22.7	LOS B	16.0	113.7	0.74	0.68	0.74	41.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

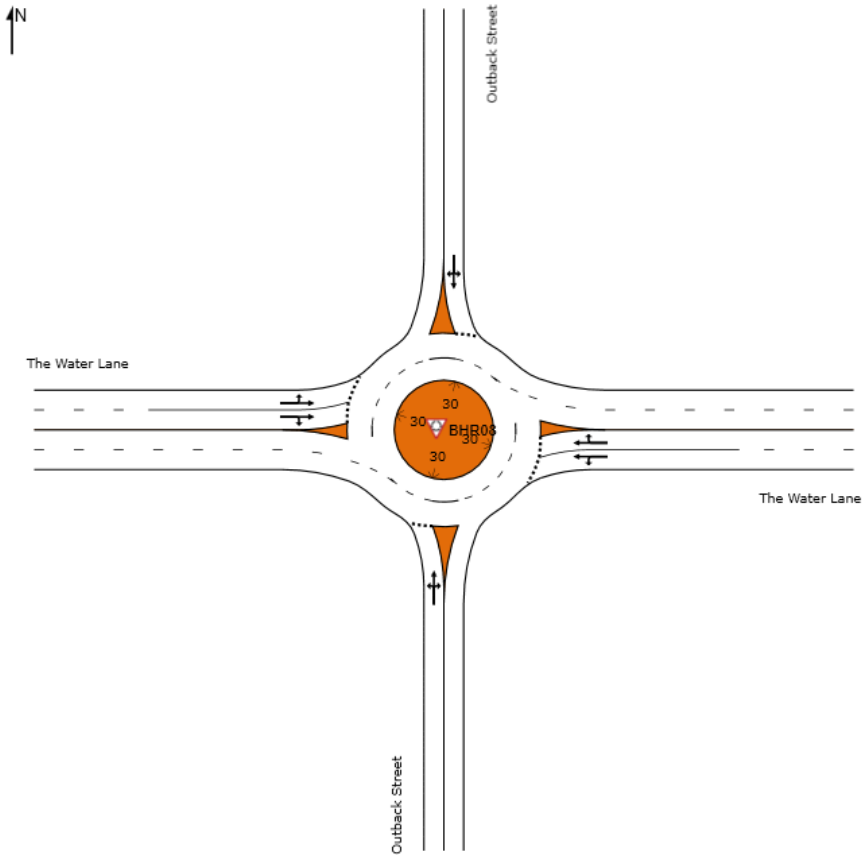
BHR08: The Water Lane/Outback Street

Intersection BHR08 -

SITE LAYOUT

Site: BHR08 [AM_Water Lane_Outback Street]

New Site
Site Category: (None)
Roundabout



MOVEMENT SUMMARY

Site: BHR08 [AM_Water Lane_Outback Street]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Outback Street												
1	L2	57	2.0	0.219	5.3	LOS A	1.0	6.9	0.64	0.69	0.64	43.5
2	T1	80	2.0	0.219	5.0	LOS A	1.0	6.9	0.64	0.69	0.64	45.1
3	R2	25	2.0	0.219	10.5	LOS A	1.0	6.9	0.64	0.69	0.64	46.4
Approach		162	2.0	0.219	6.0	LOS A	1.0	6.9	0.64	0.69	0.64	44.6
East: The Water Lane												
4	L2	141	2.0	0.430	3.7	LOS A	2.7	19.0	0.48	0.41	0.48	44.0
5	T1	792	2.0	0.430	3.3	LOS A	2.7	19.0	0.49	0.44	0.49	47.1
6	R2	118	2.0	0.430	8.9	LOS A	2.6	18.6	0.50	0.48	0.50	46.8
Approach		1051	2.0	0.430	4.0	LOS A	2.7	19.0	0.49	0.44	0.49	46.7
North: Outback Street												
7	L2	22	2.0	0.162	5.4	LOS A	0.7	5.0	0.64	0.73	0.64	41.4
8	T1	53	2.0	0.162	5.1	LOS A	0.7	5.0	0.64	0.73	0.64	43.9
9	R2	43	2.0	0.162	10.5	LOS A	0.7	5.0	0.64	0.73	0.64	45.9
Approach		118	2.0	0.162	7.1	LOS A	0.7	5.0	0.64	0.73	0.64	44.2
West: The Water Lane												
10	L2	189	2.0	0.460	3.5	LOS A	3.0	21.1	0.45	0.40	0.45	45.1
11	T1	807	2.0	0.460	3.1	LOS A	3.0	21.1	0.46	0.43	0.46	47.1
12	R2	174	2.0	0.460	8.7	LOS A	2.9	20.7	0.47	0.48	0.47	47.2
Approach		1171	2.0	0.460	4.0	LOS A	3.0	21.1	0.46	0.43	0.46	46.8
All Vehicles		2501	2.0	0.460	4.3	LOS A	3.0	21.1	0.49	0.47	0.49	46.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: BHR08 [PM_Water Lane_Outback Street]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Outback Street												
1	L2	126	2.0	0.439	8.0	LOS A	2.4	17.1	0.81	0.94	0.94	41.0
2	T1	47	2.0	0.439	7.7	LOS A	2.4	17.1	0.81	0.94	0.94	41.8
3	R2	68	2.0	0.439	13.1	LOS A	2.4	17.1	0.81	0.94	0.94	43.0
Approach		242	2.0	0.439	9.4	LOS A	2.4	17.1	0.81	0.94	0.94	41.6
East: The Water Lane												
4	L2	63	2.0	0.596	5.2	LOS A	5.1	36.2	0.69	0.58	0.74	42.4
5	T1	1180	2.0	0.596	4.9	LOS A	5.1	36.2	0.70	0.62	0.76	45.8
6	R2	72	2.0	0.596	10.7	LOS A	5.0	35.7	0.70	0.67	0.78	45.5
Approach		1315	2.0	0.596	5.3	LOS A	5.1	36.2	0.70	0.62	0.76	45.6
North: Outback Street												
7	L2	100	2.0	0.451	5.4	LOS A	2.4	17.4	0.64	0.76	0.70	41.5
8	T1	158	2.0	0.451	5.2	LOS A	2.4	17.4	0.64	0.76	0.70	44.0
9	R2	137	2.0	0.451	10.6	LOS A	2.4	17.4	0.64	0.76	0.70	46.0
Approach		395	2.0	0.451	7.1	LOS A	2.4	17.4	0.64	0.76	0.70	44.1
West: The Water Lane												
10	L2	102	2.0	0.266	3.2	LOS A	1.5	10.5	0.36	0.35	0.36	45.7
11	T1	489	2.0	0.266	2.8	LOS A	1.5	10.5	0.37	0.38	0.37	47.8
12	R2	88	2.0	0.266	8.3	LOS A	1.4	10.3	0.37	0.42	0.37	47.9
Approach		680	2.0	0.266	3.5	LOS A	1.5	10.5	0.37	0.38	0.37	47.5
All Vehicles		2632	2.0	0.596	5.5	LOS A	5.1	36.2	0.61	0.61	0.67	45.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

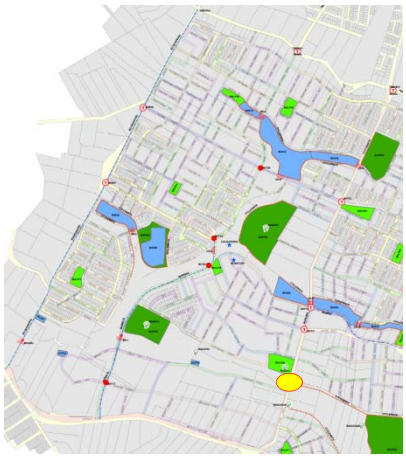
Appendix 3

Evidence and supporting documents for Question 17

Intersections

BHT10, BHT11, BHT12, BHT13, BHT14, BHT15, BHT18, BHT20, BHR07, BHR08, BHT07, BHR02, BHR06, BHR07, BHR08, BHT07,BHRU02B, BHRU08A, BHRU08B and ARU1

BHT10 – Terry Road/ Hynds Road

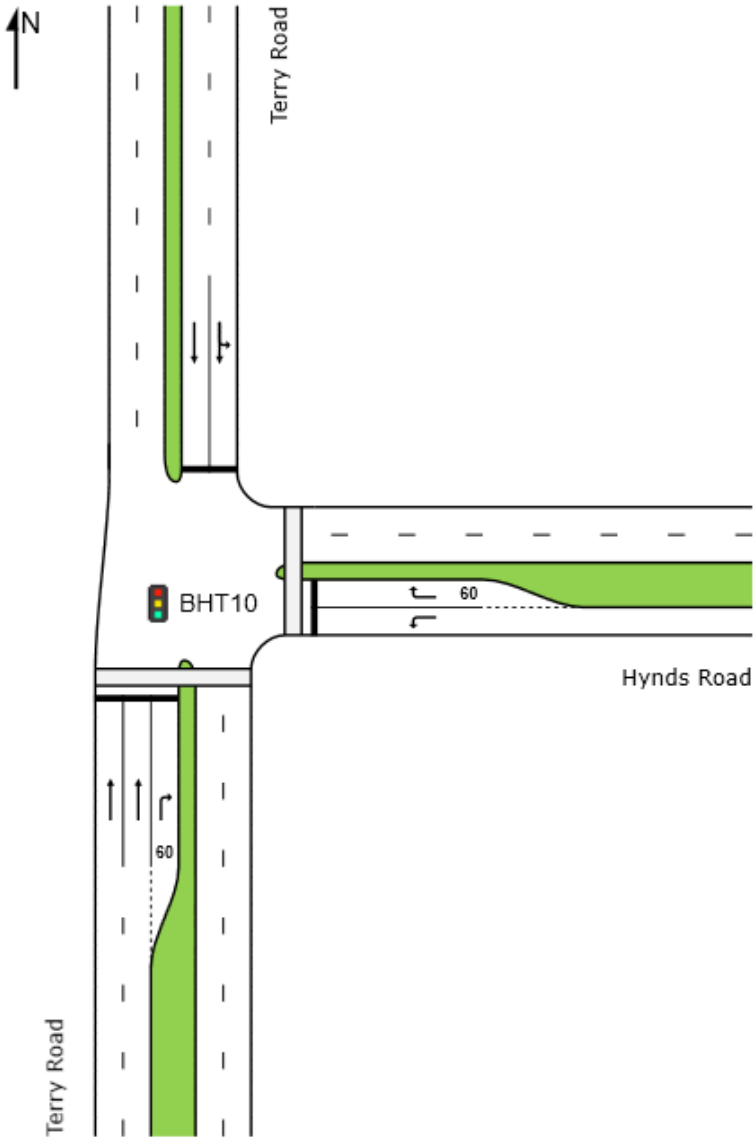


Intersection BHT10 -

SITE LAYOUT

Site: BHT10 [AM_Terry Road_Hynds Road]

New Site
Site Category: (None)
Signals - Fixed Time Isolated



MOVEMENT SUMMARY

Site: BHT10 [AM_Terry Road_Hynds Road]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Terry Road												
2	T1	675	2.0	0.262	7.0	LOS A	6.5	46.0	0.43	0.37	0.43	53.8
3	R2	62	2.0	0.339	52.8	LOS D	3.0	21.0	0.97	0.75	0.97	31.6
Approach		737	2.0	0.339	10.8	LOS A	6.5	46.0	0.47	0.41	0.47	50.8
East: Hynds Road												
4	L2	541	2.0	0.848	42.2	LOS C	26.8	191.1	0.96	0.94	1.11	31.5
6	R2	63	2.0	0.164	39.7	LOS C	2.5	18.1	0.86	0.74	0.86	32.2
Approach		604	2.0	0.848	41.9	LOS C	26.8	191.1	0.95	0.92	1.08	31.6
North: Terry Road												
7	L2	63	0.0	0.855	33.3	LOS C	39.6	277.4	0.94	0.92	1.02	40.3
8	T1	1637	0.0	0.855	28.0	LOS B	39.8	278.4	0.94	0.92	1.02	41.0
Approach		1700	0.0	0.855	28.2	LOS B	39.8	278.4	0.94	0.92	1.02	41.0
All Vehicles		3041	0.9	0.855	26.7	LOS B	39.8	278.4	0.83	0.80	0.90	40.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94
P2	East Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94
All Pedestrians		105	44.3	LOS E			0.94	0.94

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: BHT10 [PM_Terry Road_Hynds Road]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Terry Road												
2	T1	1847	2.0	0.765	7.8	LOS A	31.6	224.8	0.59	0.55	0.59	53.2
3	R2	462	2.0	0.929	56.8	LOS E	25.5	181.8	0.80	0.99	1.22	30.6
Approach		2309	2.0	0.929	17.6	LOS B	31.6	224.8	0.63	0.64	0.72	46.3
East: Hynds Road												
4	L2	75	2.0	0.063	11.3	LOS A	1.3	9.2	0.38	0.63	0.38	42.9
6	R2	73	2.0	0.264	46.1	LOS D	3.2	22.9	0.92	0.75	0.92	30.5
Approach		147	2.0	0.264	28.5	LOS B	3.2	22.9	0.65	0.69	0.65	35.7
North: Terry Road												
7	L2	62	2.0	0.925	64.4	LOS E	25.0	178.1	1.00	1.13	1.40	29.9
8	T1	760	2.0	0.925	58.9	LOS E	25.0	178.1	1.00	1.13	1.40	30.4
Approach		822	2.0	0.925	59.3	LOS E	25.0	178.1	1.00	1.13	1.40	30.4
All Vehicles		3279	2.0	0.929	28.5	LOS C	31.6	224.8	0.73	0.76	0.89	40.5

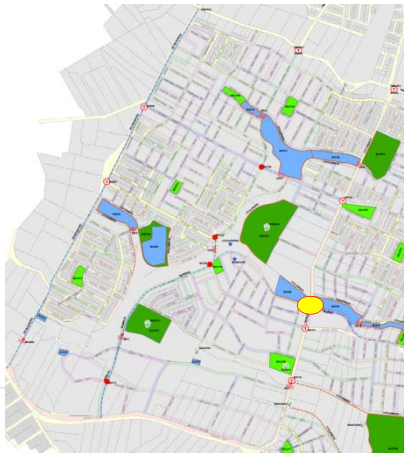
Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94
P2	East Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94
All Pedestrians		105	44.3	LOS E			0.94	0.94

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

BHT11 – Terry Road/Mason Road

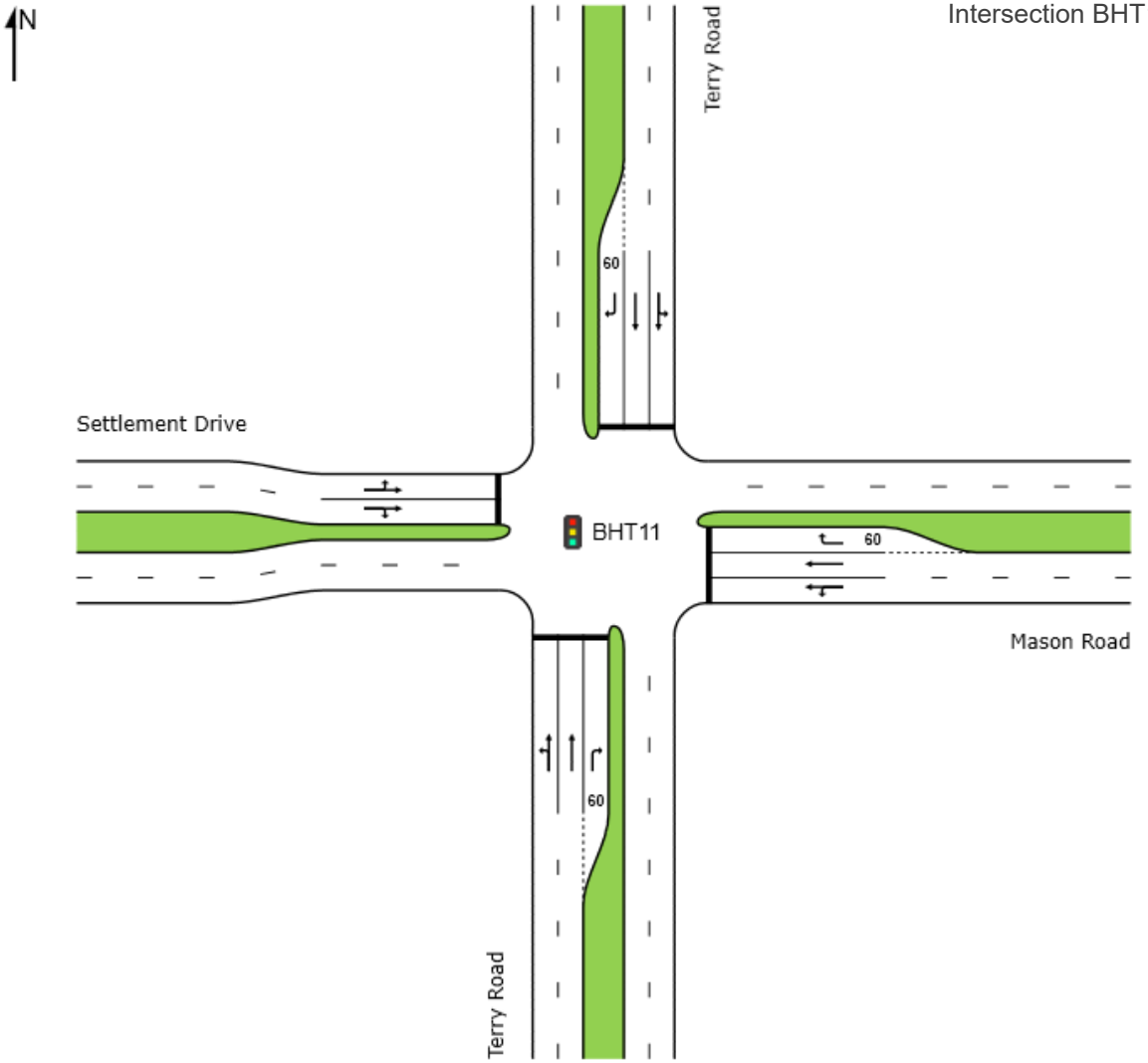


SITE LAYOUT

Site: BHT11 [AM_Terry Road_Mason Road]

New Site
Site Category: (None)
Signals - Fixed Time Isolated

Intersection BHT11 -



MOVEMENT SUMMARY

Site: BHT11 [AM_Terry Road_Mason Road]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 75 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Terry Road												
1	L2	37	2.0	0.240	14.5	LOS B	4.7	33.7	0.54	0.50	0.54	50.5
2	T1	478	2.0	0.240	9.0	LOS A	4.8	34.0	0.54	0.48	0.54	52.1
3	R2	98	2.0	0.947	55.8	LOS D	4.3	30.7	1.00	1.01	1.88	31.0
Approach		613	2.0	0.947	16.8	LOS B	4.8	34.0	0.61	0.56	0.75	46.9
East: Mason Road												
4	L2	112	2.0	0.530	30.7	LOS C	8.8	63.0	0.90	0.78	0.90	40.6
5	T1	454	2.0	0.530	25.1	LOS B	9.0	64.2	0.90	0.76	0.90	42.1
6	R2	238	2.0	1.187	221.5	LOS F	26.5	188.5	1.00	1.87	3.44	12.6
Approach		803	2.0	1.187	84.0	LOS F	26.5	188.5	0.93	1.09	1.65	24.9
North: Terry Road												
7	L2	223	2.0	0.982	63.1	LOS E	62.9	448.1	1.00	1.34	1.58	30.1
8	T1	1485	2.0	0.982	59.2	LOS E	62.9	448.1	0.88	1.26	1.52	30.3
9	R2	492	2.0	1.111	165.1	LOS F	49.2	350.3	1.00	1.63	2.78	15.9
Approach		2200	2.0	1.111	83.2	LOS F	62.9	448.1	0.92	1.35	1.81	25.2
West: Settlement Drive												
10	L2	49	2.0	0.584	31.1	LOS C	10.1	71.6	0.91	0.78	0.91	41.0
11	T1	295	2.0	0.584	26.4	LOS B	10.1	71.6	0.92	0.79	0.92	41.3
12	R2	94	2.0	0.584	38.7	LOS C	4.6	32.4	0.97	0.81	1.01	36.7
Approach		438	2.0	0.584	29.6	LOS C	10.1	71.6	0.93	0.79	0.94	40.2
All Vehicles		4054	2.0	1.187	67.5	LOS E	62.9	448.1	0.87	1.12	1.52	28.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: BHT11 [PM_Terry Road_Mason Road]

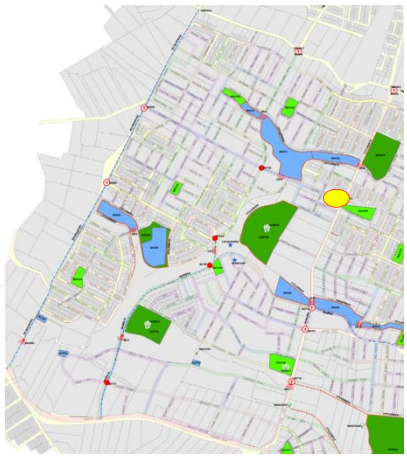
New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 150 seconds (Site Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Terry Road												
1	L2	117	2.0	1.397	408.8	LOS F	167.3	1191.0	1.00	1.94	2.85	7.2
2	T1	1488	2.0	1.397	412.7	LOS F	167.3	1191.0	1.00	2.14	2.86	7.3
3	R2	196	2.0	0.560	34.3	LOS C	8.1	57.9	0.91	0.81	0.91	37.8
Approach		1801	2.0	1.397	371.3	LOS F	167.3	1191.0	0.99	1.99	2.65	8.0
East: Mason Road												
4	L2	154	2.0	0.921	83.3	LOS F	32.4	230.8	1.00	1.07	1.47	25.7
5	T1	515	2.0	0.921	78.7	LOS F	32.4	230.8	0.98	1.06	1.39	26.0
6	R2	473	2.0	1.424	453.5	LOS F	97.0	690.7	1.00	1.72	2.97	6.9
Approach		1141	2.0	1.424	234.6	LOS F	97.0	690.7	0.99	1.33	2.05	12.0
North: Terry Road												
7	L2	117	2.0	0.664	49.2	LOS D	27.1	193.0	0.91	0.81	0.91	33.9
8	T1	611	2.0	0.664	41.9	LOS C	27.1	193.0	0.87	0.76	0.87	35.3
9	R2	408	2.0	1.540	532.8	LOS F	79.9	569.2	1.00	1.69	3.27	5.7
Approach		1136	2.0	1.540	219.2	LOS F	79.9	569.2	0.92	1.10	1.73	12.3
West: Settlement Drive												
10	L2	159	2.0	1.382	416.9	LOS F	82.2	585.5	1.00	2.08	2.86	7.4
11	T1	585	2.0	1.382	411.2	LOS F	82.2	585.5	1.00	2.09	2.86	7.4
12	R2	80	2.0	1.382	416.7	LOS F	78.8	561.2	1.00	2.09	2.86	7.4
Approach		824	2.0	1.382	412.9	LOS F	82.2	585.5	1.00	2.09	2.86	7.4
All Vehicles		4902	2.0	1.540	311.2	LOS F	167.3	1191.0	0.98	1.65	2.33	9.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

BHT12 – Terry Road/George Street

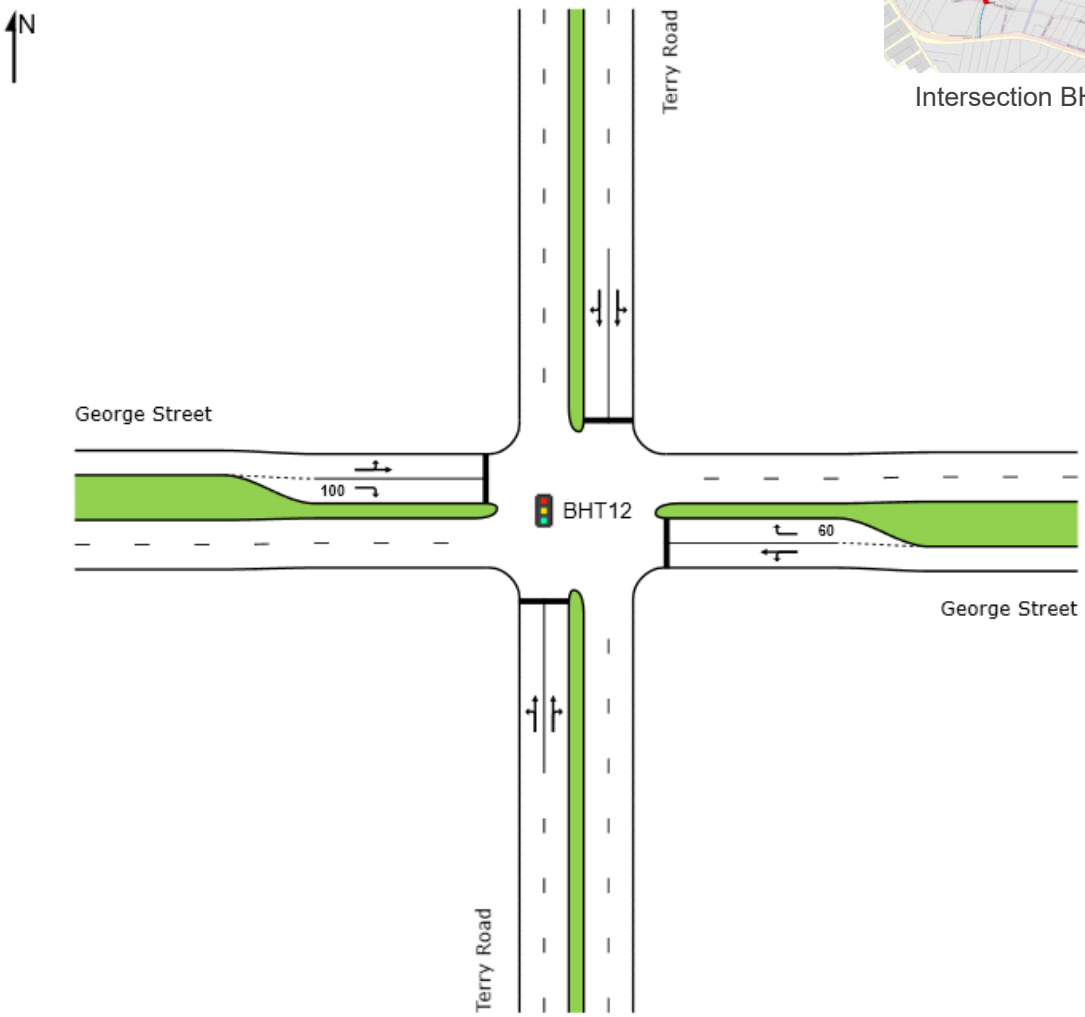


Intersection BHT12 -

SITE LAYOUT

Site: BHT12 [AM_Terry Road_George Street]

New Site
Site Category: (None)
Signals - Fixed Time Isolated



MOVEMENT SUMMARY

Site: BHT12 [AM_Terry Road_George Street]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 70 seconds (Site Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Terry Road												
1	L2	137	2.0	0.812	32.9	LOS C	18.7	132.9	0.97	0.96	1.13	39.9
2	T1	439	2.0	0.812	28.5	LOS B	18.7	132.9	0.98	0.97	1.16	40.1
3	R2	106	2.0	0.812	43.4	LOS D	6.2	44.2	1.00	1.01	1.43	35.0
Approach		682	2.0	0.812	31.7	LOS C	18.7	132.9	0.98	0.97	1.20	39.2
East: George Street												
4	L2	116	2.0	0.201	20.8	LOS B	3.2	22.8	0.72	0.71	0.72	38.9
5	T1	21	2.0	0.201	16.2	LOS B	3.2	22.8	0.72	0.71	0.72	39.2
6	R2	21	2.0	0.061	27.8	LOS B	0.6	4.1	0.81	0.69	0.81	35.9
Approach		158	2.0	0.201	21.1	LOS B	3.2	22.8	0.73	0.71	0.73	38.5
North: Terry Road												
7	L2	21	2.0	0.660	15.6	LOS B	17.2	122.7	0.71	0.65	0.71	50.2
8	T1	1349	2.0	0.660	9.9	LOS A	17.2	122.7	0.75	0.67	0.75	51.5
9	R2	26	2.0	0.660	15.3	LOS B	13.3	94.8	0.79	0.68	0.79	50.2
Approach		1397	2.0	0.660	10.0	LOS A	17.2	122.7	0.75	0.67	0.75	51.4
West: George Street												
10	L2	9	2.0	0.070	27.7	LOS B	0.8	5.9	0.81	0.63	0.81	37.2
11	T1	21	2.0	0.070	23.1	LOS B	0.8	5.9	0.81	0.63	0.81	37.5
12	R2	269	2.0	0.803	38.3	LOS C	10.1	72.0	1.00	0.97	1.26	32.6
Approach		300	2.0	0.803	36.9	LOS C	10.1	72.0	0.98	0.93	1.21	33.0
All Vehicles		2537	2.0	0.812	19.7	LOS B	18.7	132.9	0.84	0.78	0.92	43.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: BHT12 [PM_Terry Road_George Street]

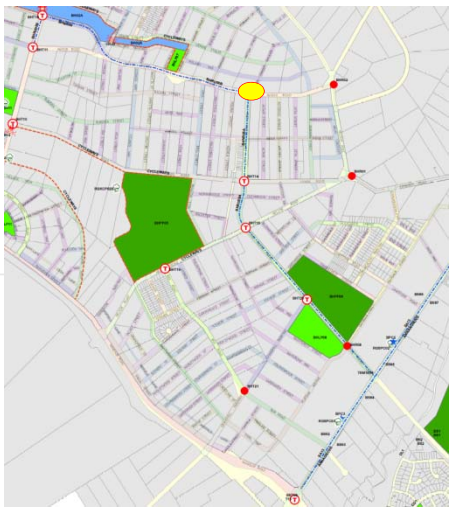
New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Terry Road												
1	L2	221	2.0	0.931	42.9	LOS D	72.0	512.4	0.97	1.02	1.12	36.1
2	T1	1406	2.0	0.931	42.0	LOS C	72.0	512.4	0.98	1.05	1.21	35.1
3	R2	257	2.0	0.931	56.0	LOS D	48.6	345.9	1.00	1.10	1.37	31.8
Approach		1884	2.0	0.931	44.0	LOS D	72.0	512.4	0.99	1.05	1.22	34.7
East: George Street												
4	L2	189	2.0	0.278	25.6	LOS B	7.4	53.0	0.70	0.73	0.70	36.9
5	T1	21	2.0	0.278	21.0	LOS B	7.4	53.0	0.70	0.73	0.70	37.2
6	R2	21	2.0	0.057	40.6	LOS C	0.9	6.6	0.78	0.69	0.78	31.9
Approach		232	2.0	0.278	26.5	LOS B	7.4	53.0	0.71	0.72	0.71	36.4
North: Terry Road												
7	L2	13	2.0	0.799	56.9	LOS E	20.3	144.7	1.00	0.93	1.10	32.0
8	T1	566	2.0	0.799	53.5	LOS D	20.3	144.7	1.00	0.93	1.12	31.9
9	R2	15	2.0	0.799	62.3	LOS E	15.1	107.3	1.00	0.93	1.15	30.5
Approach		594	2.0	0.799	53.8	LOS D	20.3	144.7	1.00	0.93	1.12	31.8
West: George Street												
10	L2	14	2.0	0.069	39.6	LOS C	1.5	10.7	0.78	0.63	0.78	33.0
11	T1	21	2.0	0.069	35.0	LOS C	1.5	10.7	0.78	0.63	0.78	33.3
12	R2	234	2.0	0.906	74.8	LOS F	16.6	118.1	1.00	1.04	1.41	24.6
Approach		268	2.0	0.906	69.9	LOS E	16.6	118.1	0.97	0.99	1.32	25.4
All Vehicles		2978	2.0	0.931	47.0	LOS D	72.0	512.4	0.97	1.00	1.17	33.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

BHT13 – Mason Road/The Water Lane

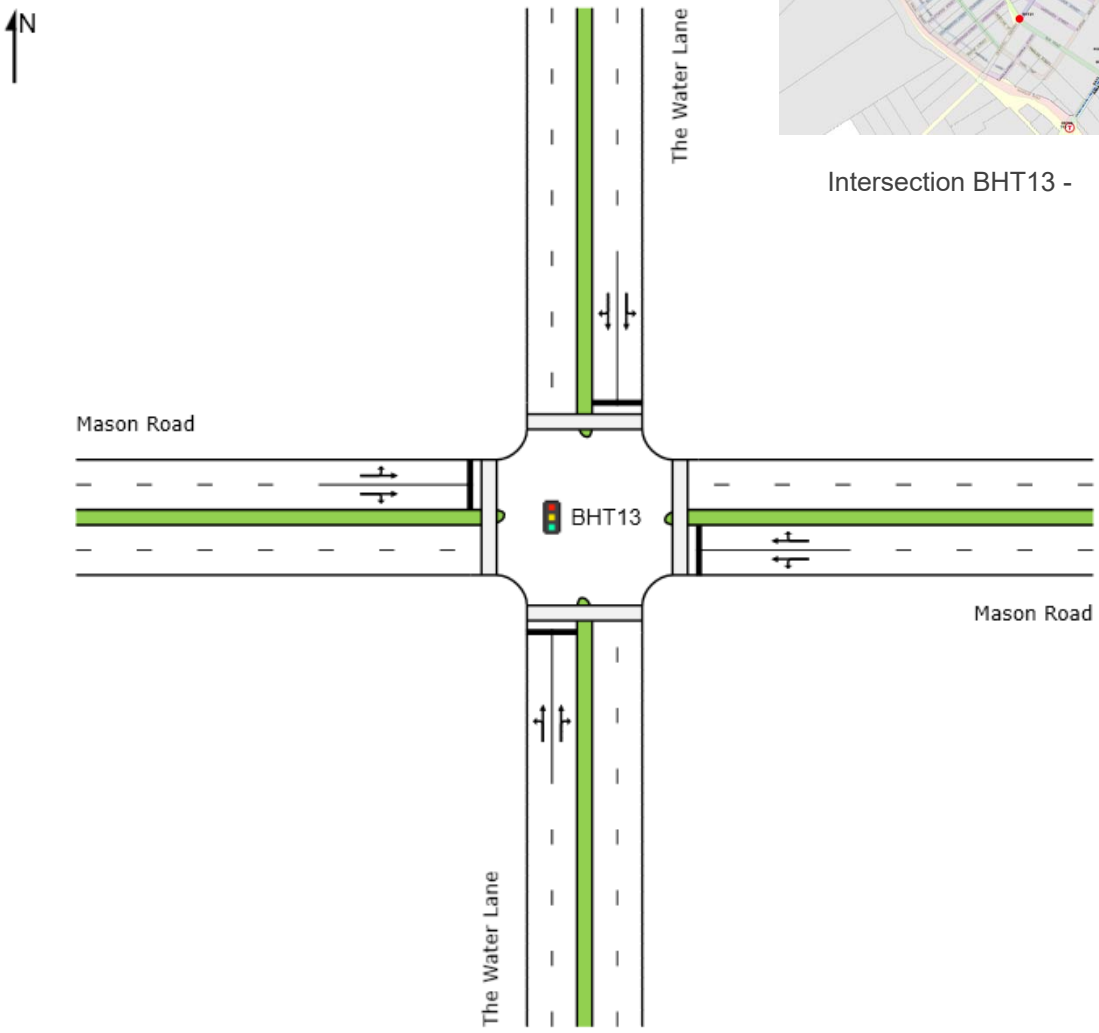


Intersection BHT13 -

SITE LAYOUT

Site: BHT13 [AM_Mason Road_Water Lane]

New Site
Site Category: (None)
Signals - Fixed Time Isolated



MOVEMENT SUMMARY

Site: BHT13 [AM_Mason Road_Water Lane]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: The Water Lane												
1	L2	89	2.0	0.449	44.1	LOS D	7.4	52.4	0.93	0.78	0.93	35.1
2	T1	126	2.0	0.449	40.1	LOS C	7.4	52.4	0.94	0.78	0.94	35.2
3	R2	59	2.0	0.449	48.1	LOS D	4.9	34.8	0.95	0.77	0.95	33.7
Approach		275	2.0	0.449	43.1	LOS D	7.4	52.4	0.94	0.78	0.94	34.8
East: Mason Road												
4	L2	79	2.0	0.534	14.1	LOS A	16.8	119.4	0.54	0.53	0.54	50.9
5	T1	616	2.0	0.534	8.5	LOS A	16.8	119.4	0.54	0.53	0.54	52.2
6	R2	189	2.0	0.548	24.7	LOS B	6.6	46.9	0.74	0.79	0.74	41.8
Approach		884	2.0	0.548	12.5	LOS A	16.8	119.4	0.58	0.58	0.58	49.4
North: Galileo Street												
7	L2	82	2.0	0.402	43.7	LOS D	6.5	46.3	0.92	0.77	0.92	35.2
8	T1	68	2.0	0.402	38.2	LOS C	6.5	46.3	0.92	0.77	0.92	35.8
9	R2	95	2.0	0.527	51.8	LOS D	4.6	32.5	0.98	0.79	0.98	31.9
Approach		245	2.0	0.527	45.3	LOS D	6.5	46.3	0.94	0.78	0.94	34.0
West: Mason Road												
10	L2	147	2.0	0.534	14.1	LOS A	16.7	119.0	0.54	0.55	0.54	50.5
11	T1	568	2.0	0.534	8.9	LOS A	16.7	119.0	0.55	0.56	0.55	51.3
12	R2	177	2.0	0.534	23.9	LOS B	6.8	48.4	0.72	0.77	0.72	42.5
Approach		893	2.0	0.534	12.7	LOS A	16.7	119.0	0.58	0.60	0.58	49.2
All Vehicles		2297	2.0	0.548	19.8	LOS B	16.8	119.4	0.66	0.63	0.66	44.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94
P2	East Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94
P3	North Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94
P4	West Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94
All Pedestrians		211	44.3	LOS E			0.94	0.94

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: BHT13 [PM_Mason Road_Water Lane]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: The Water Lane												
1	L2	241	2.0	0.827	44.7	LOS D	24.7	175.5	0.99	0.95	1.11	35.0
2	T1	256	2.0	0.827	39.1	LOS C	24.7	175.5	0.99	0.95	1.11	35.6
3	R2	366	2.0	1.102	166.0	LOS F	38.3	273.0	1.00	1.41	2.34	15.7
Approach		863	2.0	1.102	94.5	LOS F	38.3	273.0	0.99	1.15	1.63	23.1
East: Mason Road												
4	L2	173	2.0	0.674	22.1	LOS B	24.5	174.5	0.76	0.73	0.76	45.3
5	T1	651	2.0	0.674	19.9	LOS B	24.5	174.5	0.79	0.75	0.80	44.4
6	R2	91	2.0	0.674	42.5	LOS D	9.1	64.5	0.94	0.85	1.00	35.7
Approach		914	2.0	0.674	22.6	LOS B	24.5	174.5	0.80	0.75	0.81	43.5
North: Galileo Street												
7	L2	92	2.0	0.293	33.1	LOS C	6.4	45.9	0.79	0.72	0.79	39.3
8	T1	84	2.0	0.293	27.5	LOS B	6.4	45.9	0.79	0.72	0.79	40.0
9	R2	79	2.0	0.692	59.3	LOS E	4.2	29.6	1.00	0.84	1.18	30.0
Approach		255	2.0	0.692	39.3	LOS C	6.4	45.9	0.86	0.76	0.91	36.0
West: Mason Road												
10	L2	177	2.0	0.743	23.3	LOS B	28.9	205.4	0.82	0.77	0.82	44.8
11	T1	615	2.0	0.743	17.7	LOS B	28.9	205.4	0.82	0.77	0.82	45.8
12	R2	195	2.0	1.089	165.4	LOS F	20.5	146.0	1.00	1.44	2.43	15.8
Approach		986	2.0	1.089	47.9	LOS D	28.9	205.4	0.85	0.90	1.13	33.2
All Vehicles		3018	2.0	1.102	52.8	LOS D	38.3	273.0	0.88	0.91	1.16	31.7

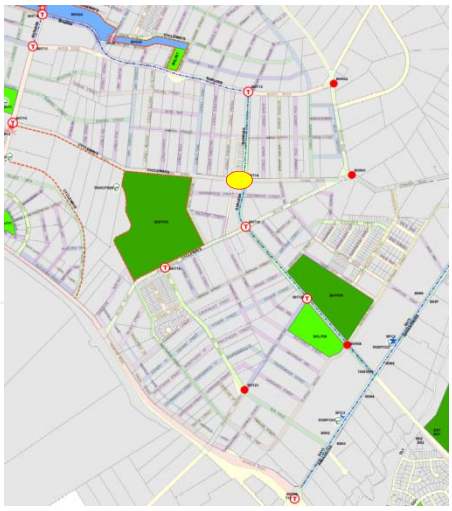
Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94
P2	East Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94
P3	North Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94
P4	West Full Crossing	53	44.3	LOS E	0.1	0.1	0.94	0.94
All Pedestrians		211	44.3	LOS E			0.94	0.94

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

BHT14 – Hynds Road/The Water Lane

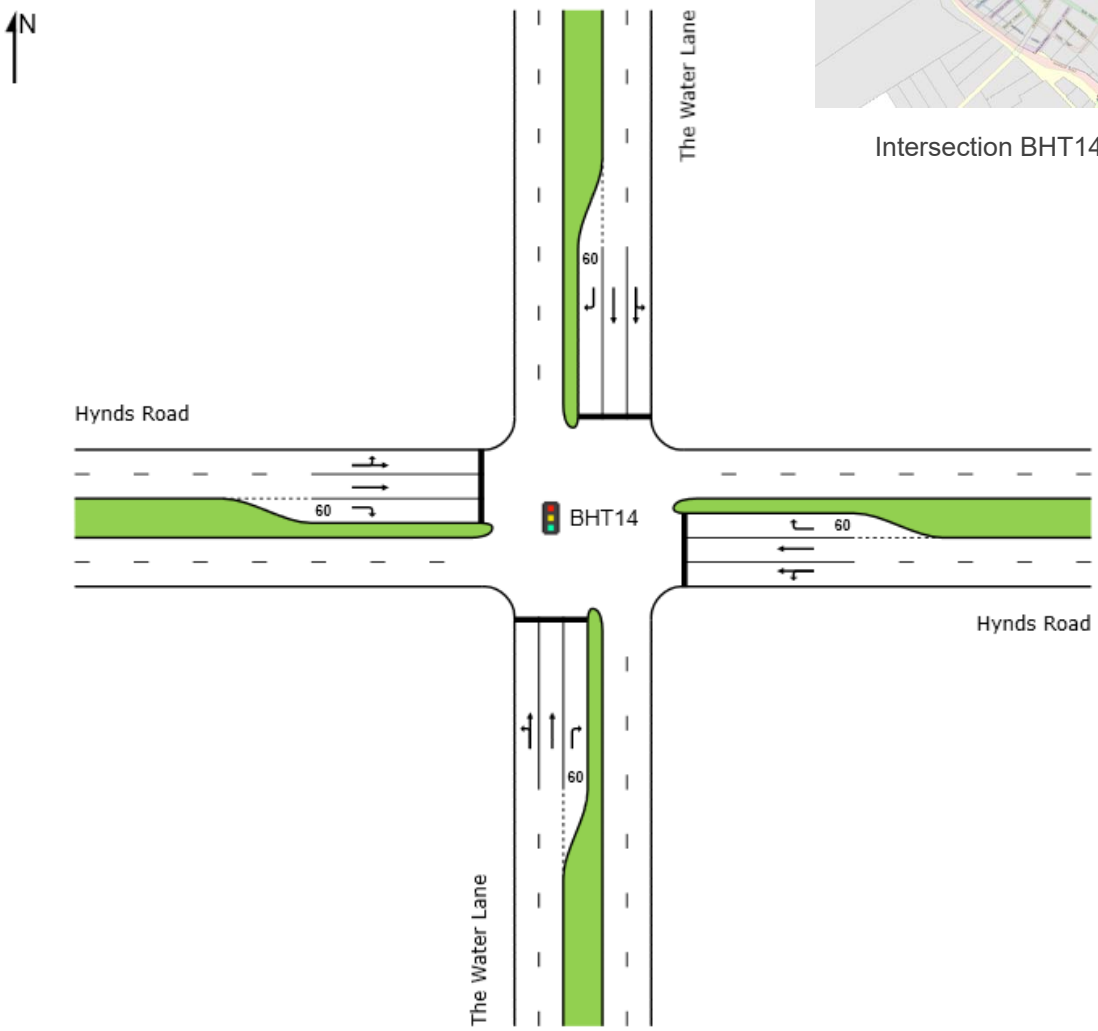


Intersection BHT14 -

SITE LAYOUT

Site: BHT14 [AM_The Water Lane_Hynds Road]

New Site
Site Category: (None)
Signals - Fixed Time Isolated



MOVEMENT SUMMARY

Site: BHT14 [AM_The Water Lane_Hynds Road]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: The Water Lane												
1	L2	158	2.0	0.269	32.8	LOS C	5.7	40.9	0.79	0.77	0.79	38.3
2	T1	161	2.0	0.261	27.1	LOS B	5.8	41.5	0.78	0.64	0.78	41.6
3	R2	21	2.0	0.062	34.3	LOS C	0.8	5.4	0.76	0.70	0.76	37.9
Approach		340	2.0	0.269	30.2	LOS C	5.8	41.5	0.78	0.71	0.78	39.7
East: Hynds Road												
4	L2	189	2.0	0.264	17.6	LOS B	6.8	48.7	0.55	0.65	0.55	46.5
5	T1	371	2.0	0.264	12.1	LOS A	7.1	50.3	0.55	0.52	0.55	49.5
6	R2	84	2.0	0.112	16.6	LOS B	1.9	13.6	0.50	0.69	0.50	46.3
Approach		644	2.0	0.264	14.3	LOS A	7.1	50.3	0.54	0.58	0.54	48.2
North: The Water Lane												
7	L2	25	2.0	0.205	32.1	LOS C	4.4	31.6	0.77	0.65	0.77	40.5
8	T1	226	2.0	0.205	26.6	LOS B	4.5	31.9	0.77	0.63	0.77	41.6
9	R2	58	2.0	0.190	37.3	LOS C	2.3	16.0	0.82	0.74	0.82	36.7
Approach		309	2.0	0.205	29.0	LOS C	4.5	31.9	0.78	0.65	0.78	40.5
West: Hynds Road												
10	L2	26	2.0	0.032	15.9	LOS B	0.7	5.1	0.47	0.60	0.47	47.2
11	T1	42	2.0	0.032	10.3	LOS A	0.7	5.3	0.47	0.40	0.47	50.8
12	R2	79	2.0	0.186	21.2	LOS B	2.2	15.6	0.59	0.72	0.59	43.7
Approach		147	2.0	0.186	17.2	LOS B	2.2	15.6	0.53	0.60	0.53	46.2
All Vehicles		1441	2.0	0.269	21.5	LOS B	7.1	50.3	0.65	0.63	0.65	44.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: BHT14 [PM_The Water Lane_Hynds Road]

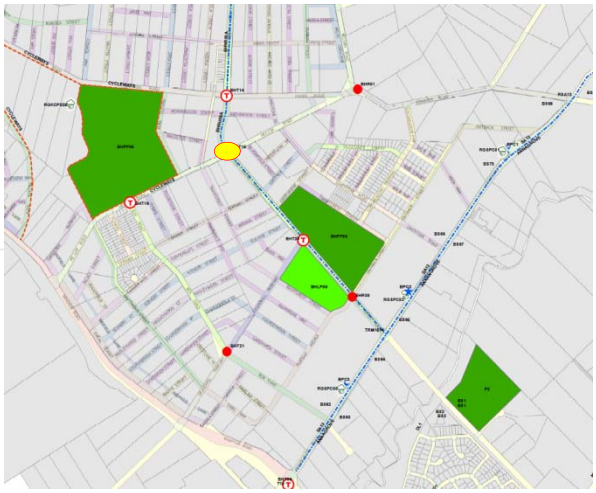
New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: The Water Lane												
1	L2	47	2.0	0.468	30.0	LOS C	12.7	90.2	0.80	0.70	0.80	41.6
2	T1	653	2.0	0.468	24.4	LOS B	12.8	90.8	0.80	0.70	0.80	42.7
3	R2	89	2.0	0.257	32.6	LOS C	3.3	23.3	0.77	0.76	0.77	38.5
Approach		789	2.0	0.468	25.7	LOS B	12.8	90.8	0.79	0.70	0.79	42.1
East: Hynds Road												
4	L2	26	2.0	0.076	19.8	LOS B	1.8	12.7	0.56	0.54	0.56	46.3
5	T1	116	2.0	0.076	14.3	LOS A	1.8	13.0	0.56	0.48	0.56	48.1
6	R2	232	2.0	0.477	27.3	LOS B	8.1	57.9	0.76	0.79	0.76	40.8
Approach		374	2.0	0.477	22.7	LOS B	8.1	57.9	0.68	0.68	0.68	43.2
North: The Water Lane												
7	L2	32	2.0	0.260	27.7	LOS B	6.4	45.5	0.72	0.63	0.72	42.7
8	T1	358	2.0	0.260	22.2	LOS B	6.4	45.8	0.72	0.61	0.72	43.8
9	R2	63	2.0	0.285	38.8	LOS C	2.6	18.3	0.84	0.76	0.84	36.1
Approach		453	2.0	0.285	24.9	LOS B	6.4	45.8	0.74	0.63	0.74	42.5
West: Hynds Road												
10	L2	189	2.0	0.211	21.0	LOS B	5.2	37.0	0.60	0.73	0.60	43.7
11	T1	116	2.0	0.123	14.7	LOS B	3.0	21.5	0.57	0.46	0.57	48.4
12	R2	221	2.0	0.364	23.3	LOS B	6.8	48.6	0.67	0.76	0.67	42.7
Approach		526	2.0	0.364	20.6	LOS B	6.8	48.6	0.63	0.69	0.63	44.2
All Vehicles		2142	2.0	0.477	23.7	LOS B	12.8	90.8	0.72	0.68	0.72	42.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

BHT15 - Nelson Road/The Water Lane

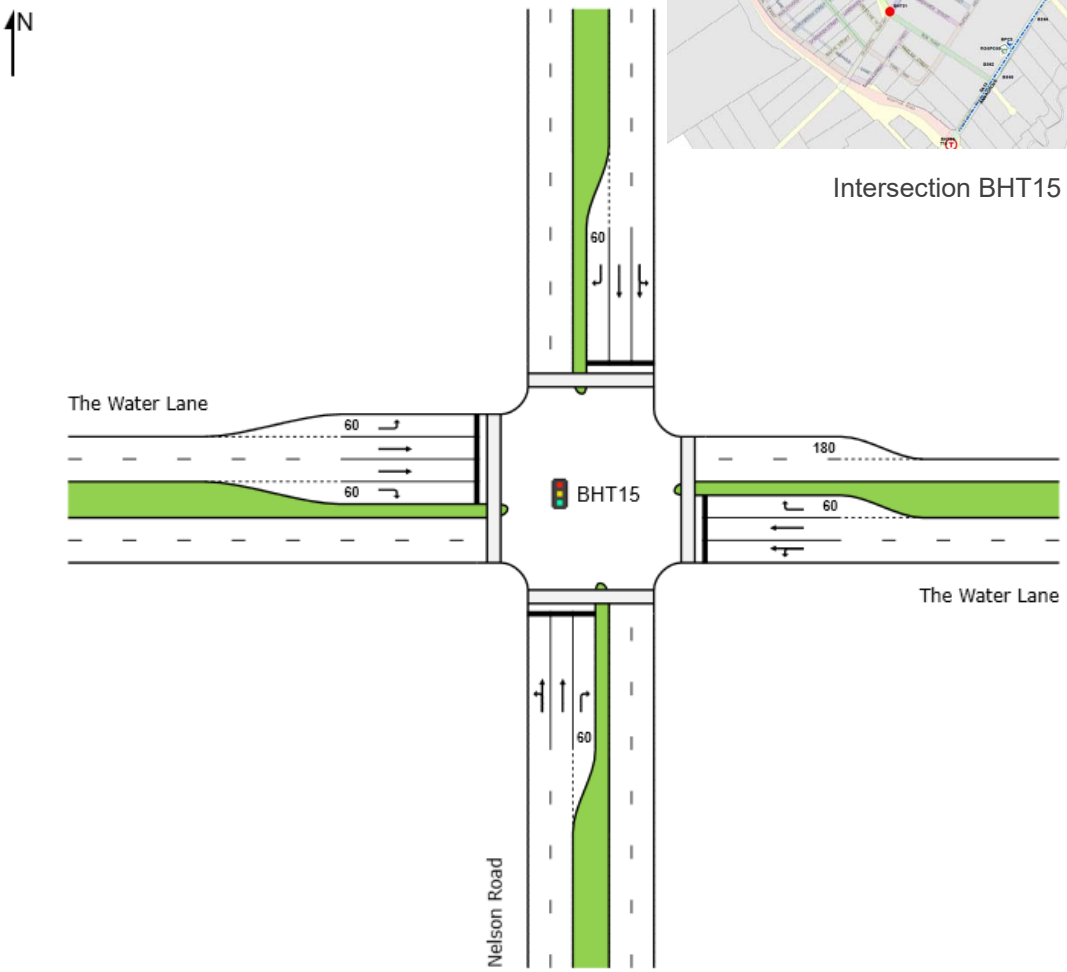


Intersection BHT15 -

SITE LAYOUT

Site: BHT15 [AM_Nelson Road_The Water Lane]

New Site
Site Category: (None)
Signals - Fixed Time Isolated



MOVEMENT SUMMARY

Site: BHT15 [AM_Nelson Road_The Water Lane]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 77 seconds (Site Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Nelson Road												
1	L2	11	2.0	0.123	24.4	LOS B	1.0	6.9	0.85	0.66	0.92	39.8
2	T1	83	2.0	0.123	24.0	LOS B	1.5	10.4	0.85	0.65	0.89	42.9
3	R2	342	2.0	0.959	64.9	LOS E	18.3	130.0	1.00	1.15	1.71	23.7
Approach		436	2.0	0.959	56.1	LOS D	18.3	130.0	0.97	1.05	1.54	26.9
East: The Water Lane												
4	L2	352	2.0	0.809	38.3	LOS C	16.2	115.6	0.99	0.94	1.16	31.4
5	T1	303	2.0	0.809	38.1	LOS C	16.2	115.6	1.00	0.95	1.24	23.7
6	R2	237	2.0	0.830	46.3	LOS D	9.9	70.7	1.00	0.96	1.31	28.5
Approach		892	2.0	0.830	40.4	LOS C	16.2	115.6	1.00	0.95	1.23	28.4
North: Nelson Road												
7	L2	395	2.0	0.928	42.8	LOS D	17.1	121.8	1.00	1.10	1.55	29.8
8	T1	399	2.0	0.928	48.2	LOS D	17.1	121.8	1.00	1.14	1.57	33.3
9	R2	26	2.0	0.079	34.3	LOS C	0.8	6.0	0.86	0.70	0.86	32.9
Approach		820	2.0	0.928	45.2	LOS D	17.1	121.8	1.00	1.11	1.53	31.8
West: The Water Lane												
10	L2	42	2.0	0.055	19.9	LOS B	0.9	6.7	0.62	0.69	0.62	39.8
11	T1	476	2.0	0.793	38.6	LOS C	9.6	68.5	1.00	0.94	1.23	23.8
12	R2	32	2.0	0.111	36.5	LOS C	1.0	7.5	0.89	0.71	0.89	31.9
Approach		549	2.0	0.793	37.1	LOS C	9.6	68.5	0.96	0.91	1.16	25.6
All Vehicles		2697	2.0	0.959	43.7	LOS D	18.3	130.0	0.99	1.01	1.36	28.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	53	32.8	LOS D	0.1	0.1	0.92	0.92
P2	East Full Crossing	53	32.8	LOS D	0.1	0.1	0.92	0.92
P3	North Full Crossing	53	32.8	LOS D	0.1	0.1	0.92	0.92
P4	West Full Crossing	53	32.8	LOS D	0.1	0.1	0.92	0.92
All Pedestrians		211	32.8	LOS D			0.92	0.92

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: BHT15 [PM_Nelson Road_The Water Lane]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 150 seconds (Site Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Nelson Road												
1	L2	21	2.0	0.237	52.5	LOS D	4.0	28.8	0.91	0.73	0.99	27.7
2	T1	126	2.0	0.237	54.2	LOS D	4.7	33.4	0.91	0.72	0.95	31.7
3	R2	269	2.0	0.978	110.2	LOS F	25.5	181.2	1.00	1.06	1.50	16.8
Approach		417	2.0	0.978	90.3	LOS F	25.5	181.2	0.97	0.94	1.31	20.9
East: The Water Lane												
4	L2	297	2.0	0.736	41.2	LOS C	36.9	262.9	0.89	0.83	0.89	31.2
5	T1	727	2.0	0.736	33.3	LOS C	36.9	262.9	0.82	0.74	0.82	25.5
6	R2	547	2.0	0.973	86.8	LOS F	47.0	334.3	0.86	1.01	1.23	19.8
Approach		1572	2.0	0.973	53.4	LOS D	47.0	334.3	0.84	0.85	0.97	23.6
North: Nelson Road												
7	L2	128	2.0	0.380	40.1	LOS C	7.0	50.0	0.90	0.78	0.90	30.7
8	T1	106	2.0	0.380	61.1	LOS E	7.0	50.0	0.95	0.76	0.95	29.9
9	R2	42	2.0	0.192	70.5	LOS E	2.8	20.0	0.94	0.74	0.94	22.6
Approach		277	2.0	0.380	52.8	LOS D	7.0	50.0	0.93	0.76	0.93	28.9
West: The Water Lane												
10	L2	68	2.0	0.133	48.5	LOS D	3.7	26.3	0.78	0.74	0.78	27.6
11	T1	421	2.0	0.920	87.4	LOS F	17.8	126.8	1.00	1.04	1.36	13.5
12	R2	38	2.0	0.172	70.2	LOS E	2.5	18.0	0.93	0.73	0.93	22.5
Approach		527	2.0	0.920	81.1	LOS F	17.8	126.8	0.97	0.98	1.26	15.8
All Vehicles		2793	2.0	0.978	64.1	LOS E	47.0	334.3	0.89	0.88	1.07	22.0

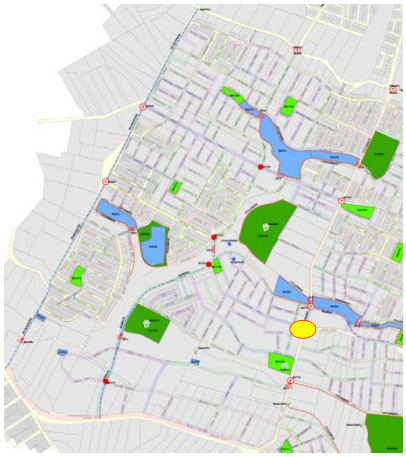
Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Pedestrian ped	Back of Queue Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	53	69.3	LOS F	0.2	0.2	0.96	0.96
P2	East Full Crossing	53	69.3	LOS F	0.2	0.2	0.96	0.96
P3	North Full Crossing	53	69.3	LOS F	0.2	0.2	0.96	0.96
P4	West Full Crossing	53	69.3	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		211	69.3	LOS F			0.96	0.96

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

BHT18 – Terry Road and High Street

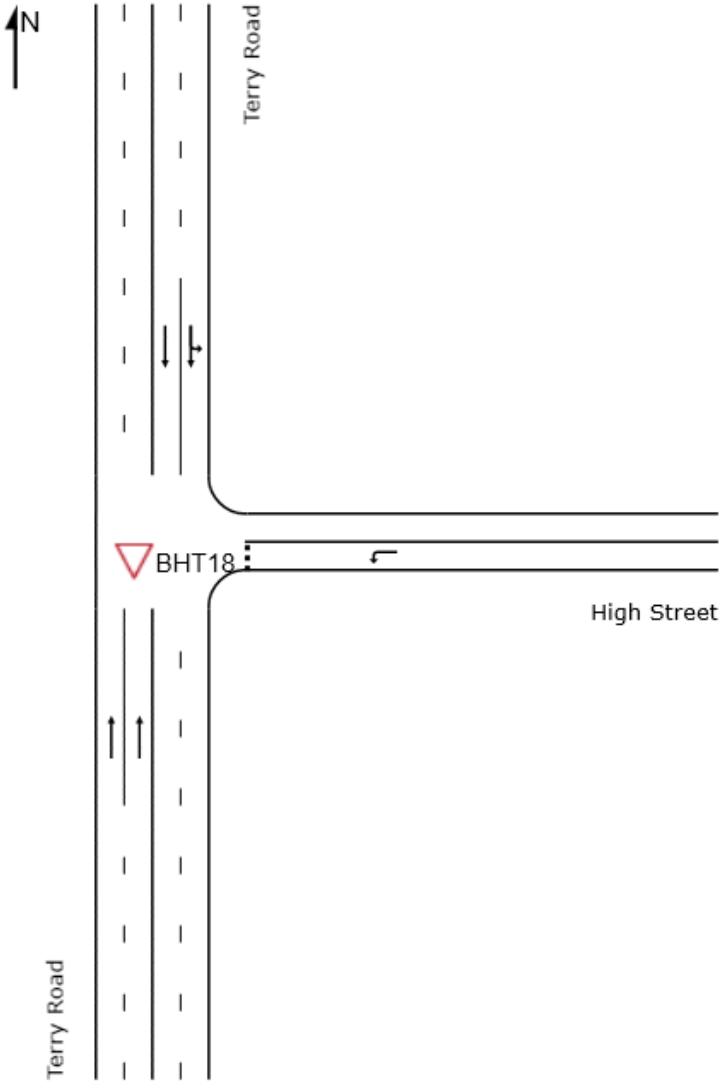


Intersection BHT18 -

SITE LAYOUT

Site: BHT18 [AM_Terry Road_High Street]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)



MOVEMENT SUMMARY

Site: BHT18 [AM_Terry Road_High Street]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Terry Road												
2	T1	613	2.0	0.159	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		613	2.0	0.159	0.0	NA	0.0	0.0	0.00	0.00	0.00	60.0
East: High Street												
4	L2	144	2.0	0.109	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	53.5
Approach		144	2.0	0.109	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	53.5
North: Terry Road												
7	L2	1564	2.0	0.854	6.0	LOS A	0.0	0.0	0.00	0.57	0.00	52.9
8	T1	126	2.0	0.066	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		1691	2.0	0.854	5.5	NA	0.0	0.0	0.00	0.53	0.00	53.4
All Vehicles		2447	2.0	0.854	4.2	NA	0.0	0.0	0.00	0.40	0.00	54.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: BHT18 [PM_Terry Road_High Street]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Terry Road												
2	T1	1801	2.0	0.468	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
Approach		1801	2.0	0.468	0.1	NA	0.0	0.0	0.00	0.00	0.00	59.9
East: High Street												
4	L2	205	2.0	0.155	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	53.5
Approach		205	2.0	0.155	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	53.5
North: Terry Road												
7	L2	660	2.0	0.360	5.6	LOS A	0.0	0.0	0.00	0.58	0.00	53.5
8	T1	184	2.0	0.096	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		844	2.0	0.360	4.4	NA	0.0	0.0	0.00	0.45	0.00	54.8
All Vehicles		2851	2.0	0.468	1.7	NA	0.0	0.0	0.00	0.17	0.00	57.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

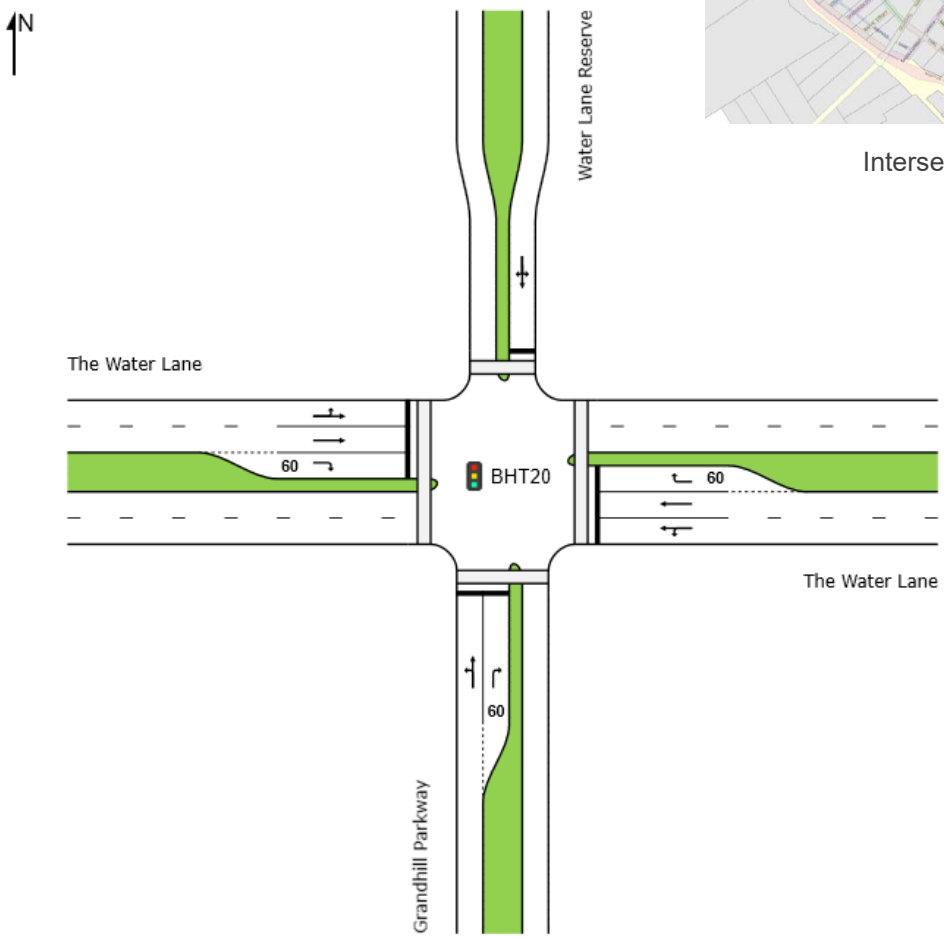
BHT20 - Grandhill Parkway/The Water Lane

Intersection BHT20 -

SITE LAYOUT

Site: BHT20 [AM_Water Lane_Grandhill Parkway]

New Site
Site Category: (None)
Signals - Fixed Time Isolated



MOVEMENT SUMMARY

Site: BHT20 [AM_Water Lane_Grandhill Parkway]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 110 seconds (Site Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Grandhill Parkway												
1	L2	126	2.0	0.567	52.2	LOS D	8.6	61.2	0.98	0.80	0.98	15.3
2	T1	42	2.0	0.567	47.6	LOS D	8.6	61.2	0.98	0.80	0.98	18.5
3	R2	181	2.0	0.617	52.6	LOS D	9.3	66.4	0.99	0.81	0.99	20.8
Approach		349	2.0	0.617	51.8	LOS D	9.3	66.4	0.98	0.81	0.98	18.8
East: The Water Lane												
4	L2	72	2.0	0.694	40.7	LOS C	20.1	143.0	0.94	0.82	0.94	24.9
5	T1	765	2.0	0.694	35.9	LOS C	20.1	143.0	0.94	0.81	0.94	22.7
6	R2	36	2.0	0.115	47.2	LOS D	1.7	11.8	0.89	0.72	0.89	21.9
Approach		873	2.0	0.694	36.7	LOS C	20.1	143.0	0.93	0.81	0.93	22.8
North: Water Lane Reserve												
7	L2	25	2.0	0.379	50.5	LOS D	5.6	39.8	0.94	0.76	0.94	21.7
8	T1	55	2.0	0.379	45.9	LOS D	5.6	39.8	0.94	0.76	0.94	19.3
9	R2	34	2.0	0.379	50.5	LOS D	5.6	39.8	0.94	0.76	0.94	16.1
Approach		114	2.0	0.379	48.3	LOS D	5.6	39.8	0.94	0.76	0.94	19.0
West: The Water Lane												
10	L2	34	2.0	0.909	58.2	LOS E	35.0	249.1	1.00	1.08	1.25	14.7
11	T1	964	2.0	0.909	53.7	LOS D	35.0	249.1	0.98	1.07	1.25	17.9
12	R2	278	0.0	0.882	64.1	LOS E	16.9	118.2	1.00	0.99	1.31	13.1
Approach		1276	1.6	0.909	56.1	LOS D	35.0	249.1	0.98	1.06	1.27	16.8
All Vehicles		2612	1.8	0.909	48.7	LOS D	35.0	249.1	0.96	0.93	1.10	18.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Pedestrian ped	Back of Queue Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	53	49.3	LOS E	0.2	0.2	0.95	0.95
P2	East Full Crossing	53	49.3	LOS E	0.2	0.2	0.95	0.95
P3	North Full Crossing	53	49.3	LOS E	0.2	0.2	0.95	0.95
P4	West Full Crossing	53	49.3	LOS E	0.2	0.2	0.95	0.95
All Pedestrians		211	49.3	LOS E			0.95	0.95

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: BHT20 [PM_Water Lane_Grandhill Parkway]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Grandhill Parkway												
1	L2	221	2.0	0.879	67.9	LOS E	17.8	127.0	1.00	0.99	1.28	12.6
2	T1	53	2.0	0.879	63.3	LOS E	17.8	127.0	1.00	0.99	1.28	15.5
3	R2	126	2.0	0.399	53.4	LOS D	6.7	47.8	0.94	0.78	0.94	20.6
Approach		400	2.0	0.879	62.7	LOS E	17.8	127.0	0.98	0.93	1.17	15.5
East: The Water Lane												
4	L2	215	2.0	0.884	49.0	LOS D	43.5	309.4	1.00	0.99	1.13	22.2
5	T1	1179	2.0	0.884	44.1	LOS D	43.5	309.4	0.98	0.99	1.11	20.1
6	R2	49	2.0	0.348	64.0	LOS E	2.9	20.5	0.99	0.74	0.99	18.3
Approach		1443	2.0	0.884	45.5	LOS D	43.5	309.4	0.99	0.98	1.11	20.4
North: Water Lane Reserve												
7	L2	47	2.0	0.486	56.0	LOS D	7.7	55.0	0.96	0.79	0.96	20.3
8	T1	55	2.0	0.486	51.4	LOS D	7.7	55.0	0.96	0.79	0.96	17.9
9	R2	39	2.0	0.486	55.9	LOS D	7.7	55.0	0.96	0.79	0.96	14.9
Approach		141	2.0	0.486	54.2	LOS D	7.7	55.0	0.96	0.79	0.96	18.0
West: The Water Lane												
10	L2	47	2.0	0.340	29.9	LOS C	10.9	77.4	0.72	0.65	0.72	22.9
11	T1	506	2.0	0.340	25.6	LOS B	11.0	78.4	0.73	0.63	0.73	26.8
12	R2	126	0.0	0.875	74.3	LOS F	8.3	58.3	1.00	0.99	1.40	11.8
Approach		680	1.6	0.875	35.0	LOS C	11.0	78.4	0.78	0.70	0.85	22.3
All Vehicles		2664	1.9	0.884	45.9	LOS D	43.5	309.4	0.93	0.89	1.05	19.8

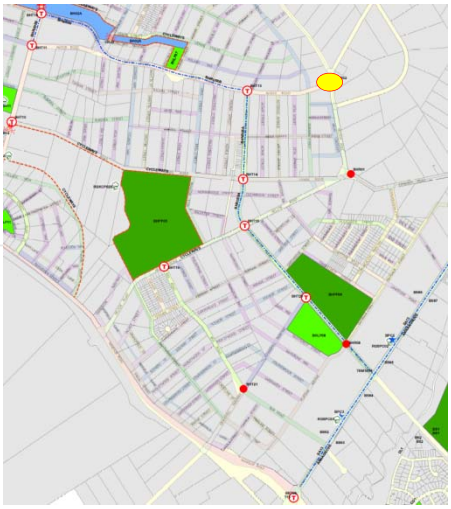
Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	53	54.3	LOS E	0.2	0.2	0.95	0.95
P2	East Full Crossing	53	54.3	LOS E	0.2	0.2	0.95	0.95
P3	North Full Crossing	53	54.3	LOS E	0.2	0.2	0.95	0.95
P4	West Full Crossing	53	54.3	LOS E	0.2	0.2	0.95	0.95
All Pedestrians		211	54.3	LOS E			0.95	0.95

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

BHR02 – Mason Road/Old Pitt Town Road

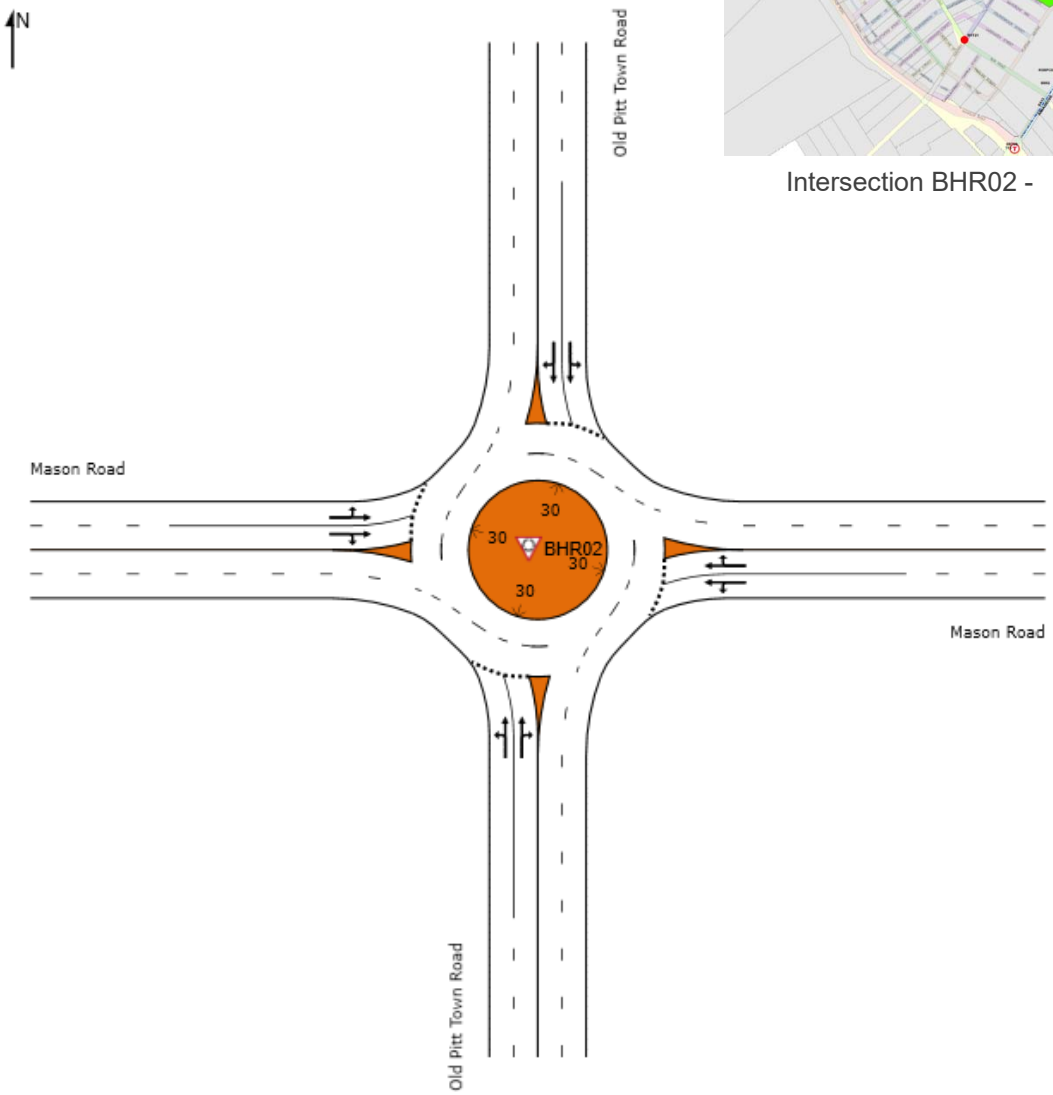


Intersection BHR02 -

SITE LAYOUT

Site: BHR02 [AM_Mason Road_Old Pitt Town Road]

New Site
Site Category: (None)
Roundabout



MOVEMENT SUMMARY

Site: BHR02 [AM_Mason Road_Old Pitt Town Road]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Old Pitt Town Road												
1	L2	116	2.0	0.284	6.1	LOS A	1.5	10.4	0.67	0.66	0.67	53.4
2	T1	265	2.0	0.284	6.3	LOS A	1.5	10.4	0.67	0.71	0.67	54.3
3	R2	95	2.0	0.284	12.4	LOS A	1.4	9.8	0.68	0.77	0.68	53.6
Approach		476	2.0	0.284	7.5	LOS A	1.5	10.4	0.67	0.71	0.67	53.9
East: Mason Road												
4	L2	124	2.0	0.426	6.1	LOS A	2.4	17.2	0.67	0.64	0.70	53.3
5	T1	427	2.0	0.426	6.2	LOS A	2.4	17.2	0.67	0.70	0.71	54.3
6	R2	237	2.0	0.426	12.4	LOS A	2.3	16.7	0.68	0.84	0.73	52.9
Approach		788	2.0	0.426	8.0	LOS A	2.4	17.2	0.67	0.73	0.72	53.7
North: Old Pitt Town Road												
7	L2	124	2.0	0.376	5.6	LOS A	2.0	14.4	0.61	0.58	0.61	53.6
8	T1	384	2.0	0.376	5.6	LOS A	2.0	14.4	0.61	0.63	0.61	54.7
9	R2	239	2.0	0.376	11.6	LOS A	1.9	13.9	0.62	0.76	0.62	53.3
Approach		747	2.0	0.376	7.5	LOS A	2.0	14.4	0.61	0.66	0.61	54.0
West: Mason Road												
10	L2	213	2.0	0.357	5.6	LOS A	1.9	13.5	0.60	0.61	0.60	53.8
11	T1	388	2.0	0.357	5.7	LOS A	1.9	13.5	0.60	0.65	0.60	54.7
12	R2	114	2.0	0.357	11.6	LOS A	1.8	12.9	0.61	0.68	0.61	54.4
Approach		715	2.0	0.357	6.6	LOS A	1.9	13.5	0.60	0.64	0.60	54.4
All Vehicles		2726	2.0	0.426	7.4	LOS A	2.4	17.2	0.64	0.69	0.65	54.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

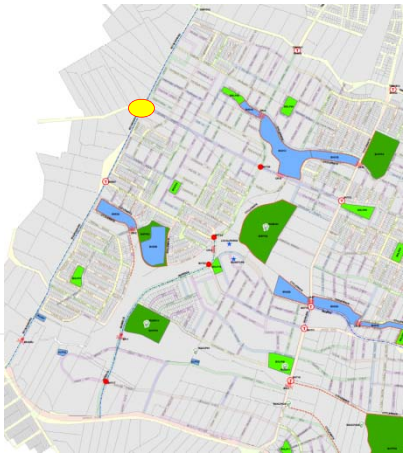
Site: BHR02 [PM_Mason Road_Old Pitt Town Road]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Old Pitt Town Road												
1	L2	156	2.0	0.437	6.5	LOS A	2.6	18.6	0.72	0.71	0.77	53.1
2	T1	513	2.0	0.437	6.8	LOS A	2.6	18.6	0.72	0.75	0.79	54.3
3	R2	80	2.0	0.437	12.9	LOS A	2.5	17.7	0.72	0.79	0.80	54.0
Approach		748	2.0	0.437	7.4	LOS A	2.6	18.6	0.72	0.75	0.79	54.0
East: Mason Road												
4	L2	84	2.0	0.448	7.3	LOS A	2.8	19.9	0.76	0.77	0.85	52.8
5	T1	358	2.0	0.448	7.3	LOS A	2.8	19.9	0.76	0.79	0.85	54.0
6	R2	264	2.0	0.448	13.9	LOS A	2.6	18.6	0.76	0.94	0.87	51.5
Approach		706	2.0	0.448	9.7	LOS A	2.8	19.9	0.76	0.85	0.86	52.9
North: Old Pitt Town Road												
7	L2	116	2.0	0.471	6.7	LOS A	3.0	21.3	0.75	0.72	0.82	52.9
8	T1	451	2.0	0.471	6.8	LOS A	3.0	21.3	0.75	0.77	0.83	53.9
9	R2	221	2.0	0.471	13.1	LOS A	2.8	20.1	0.75	0.89	0.85	52.6
Approach		787	2.0	0.471	8.6	LOS A	3.0	21.3	0.75	0.80	0.84	53.4
West: Mason Road												
10	L2	227	2.0	0.580	8.0	LOS A	4.3	30.7	0.79	0.88	0.96	52.7
11	T1	446	2.0	0.580	8.2	LOS A	4.3	30.7	0.79	0.91	0.97	53.4
12	R2	314	2.0	0.580	14.6	LOS B	4.0	28.8	0.79	0.99	0.99	51.5
Approach		987	2.0	0.580	10.2	LOS A	4.3	30.7	0.79	0.93	0.98	52.6
All Vehicles		3229	2.0	0.580	9.0	LOS A	4.3	30.7	0.76	0.84	0.87	53.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

BHR06 – Boundary Road/George Street

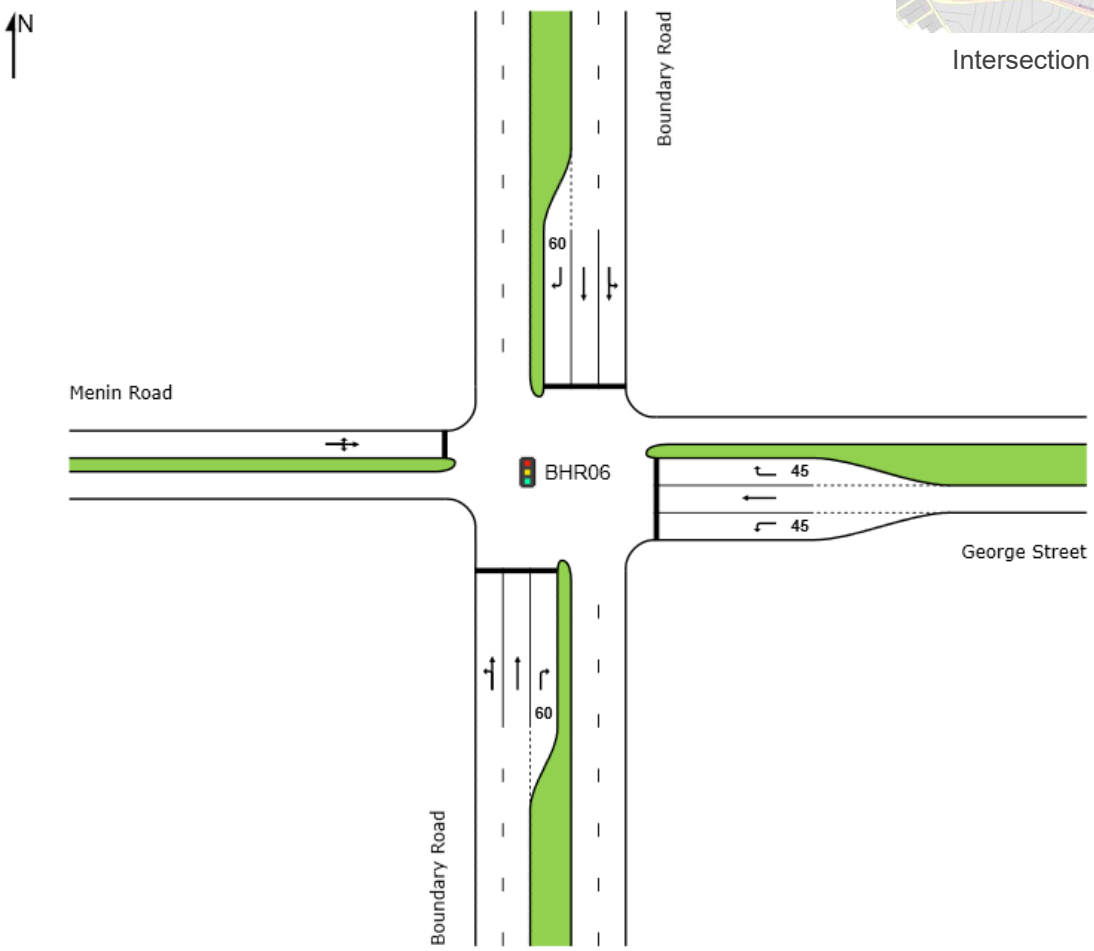


Intersection BHR06 -

SITE LAYOUT

Site: BHR06 [PM_Boundary Road_George Street_1]

New Site
Site Category: (None)
Signals - Fixed Time Isolated



MOVEMENT SUMMARY

Site: BHR06 [AM_Boundary Road_George Street_1]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Boundary Road												
1	L2	41	2.0	0.230	21.7	LOS B	6.2	43.8	0.62	0.57	0.62	45.8
2	T1	398	2.0	0.230	16.1	LOS B	6.2	44.2	0.62	0.54	0.62	47.2
3	R2	21	2.0	0.049	24.2	LOS B	0.6	4.3	0.62	0.67	0.62	42.5
Approach		460	2.0	0.230	17.0	LOS B	6.2	44.2	0.62	0.55	0.62	46.8
East: George Street												
4	L2	67	2.0	0.089	24.4	LOS B	2.0	14.4	0.65	0.69	0.65	37.2
5	T1	40	2.0	0.050	19.4	LOS B	1.2	8.4	0.64	0.48	0.64	39.6
6	R2	11	2.0	0.019	24.5	LOS B	0.3	2.2	0.64	0.64	0.64	37.4
Approach		118	2.0	0.089	22.7	LOS B	2.0	14.4	0.65	0.62	0.65	38.0
North: Boundary Road												
7	L2	16	2.0	0.220	21.6	LOS B	5.9	41.8	0.62	0.54	0.62	46.2
8	T1	404	2.0	0.220	16.1	LOS B	5.9	41.9	0.62	0.53	0.62	47.4
9	R2	58	2.0	0.139	25.0	LOS B	1.8	12.5	0.65	0.72	0.65	41.7
Approach		478	2.0	0.220	17.3	LOS B	5.9	41.9	0.62	0.55	0.62	46.6
West: Menin Road												
10	L2	32	2.0	0.233	26.7	LOS B	4.4	31.2	0.71	0.72	0.71	36.6
11	T1	16	2.0	0.233	22.1	LOS B	4.4	31.2	0.71	0.72	0.71	36.9
12	R2	86	2.0	0.233	26.6	LOS B	4.4	31.2	0.71	0.72	0.71	36.8
Approach		134	2.0	0.233	26.1	LOS B	4.4	31.2	0.71	0.72	0.71	36.8
All Vehicles		1189	2.0	0.233	18.7	LOS B	6.2	44.2	0.63	0.58	0.63	44.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: BHR06 [PM_Boundary Road_George Street_1]

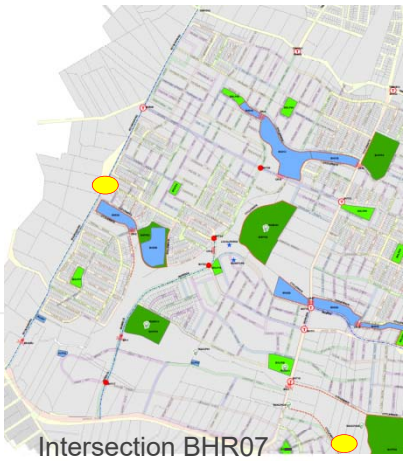
New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Boundary Road												
1	L2	126	2.0	0.324	19.7	LOS B	9.2	65.4	0.61	0.61	0.61	46.3
2	T1	553	2.0	0.324	14.2	LOS A	9.4	66.7	0.61	0.56	0.61	48.2
3	R2	75	2.0	0.143	20.7	LOS B	2.0	14.3	0.58	0.70	0.58	44.3
Approach		754	2.0	0.324	15.7	LOS B	9.4	66.7	0.60	0.58	0.60	47.5
East: George Street												
4	L2	11	2.0	0.016	27.0	LOS B	0.3	2.3	0.68	0.64	0.68	36.2
5	T1	36	2.0	0.051	22.8	LOS B	1.1	8.1	0.69	0.52	0.69	38.2
6	R2	16	2.0	0.038	30.5	LOS C	0.5	3.8	0.72	0.66	0.72	35.3
Approach		62	2.0	0.051	25.5	LOS B	1.1	8.1	0.70	0.58	0.70	37.1
North: Boundary Road												
7	L2	11	2.0	0.162	18.3	LOS B	4.2	29.9	0.54	0.47	0.54	48.2
8	T1	331	2.0	0.162	12.8	LOS A	4.2	30.0	0.54	0.46	0.54	49.5
9	R2	42	2.0	0.123	23.8	LOS B	1.2	8.8	0.62	0.71	0.62	42.3
Approach		383	2.0	0.162	14.1	LOS A	4.2	30.0	0.55	0.49	0.55	48.6
West: Menin Road												
10	L2	66	2.0	0.328	30.4	LOS C	6.8	48.5	0.78	0.73	0.78	35.5
11	T1	52	2.0	0.328	25.8	LOS B	6.8	48.5	0.78	0.73	0.78	35.8
12	R2	72	2.0	0.328	30.3	LOS C	6.8	48.5	0.78	0.73	0.78	35.7
Approach		189	2.0	0.328	29.1	LOS C	6.8	48.5	0.78	0.73	0.78	35.7
All Vehicles		1388	2.0	0.328	17.6	LOS B	9.4	66.7	0.62	0.58	0.62	45.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

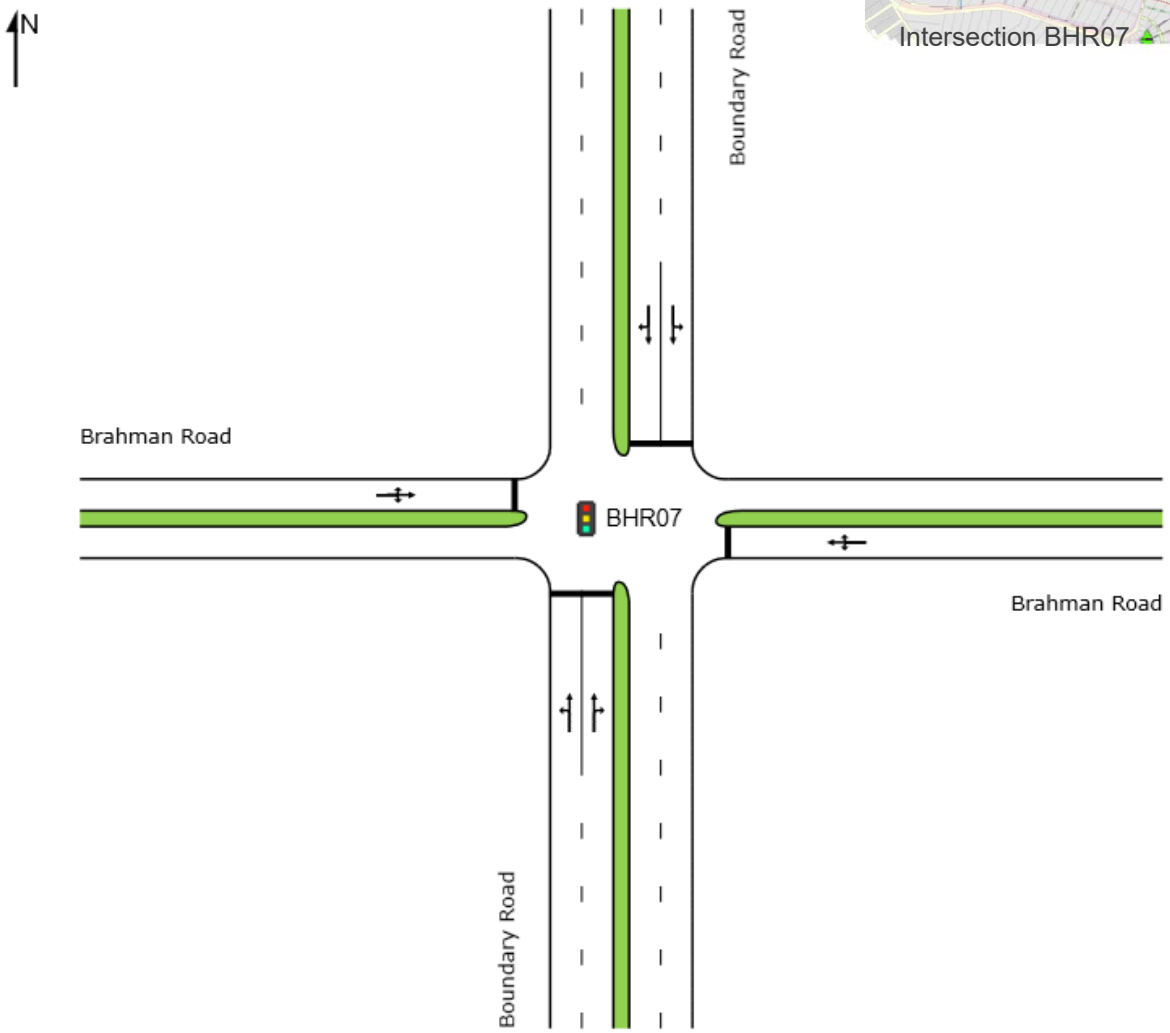
BHR07 – Boundary Road/Brahman Road



SITE LAYOUT

Site: BHR07 [AM_Boundary Road_Brahman Road]

New Site
Site Category: (None)
Signals - Fixed Time Isolated



MOVEMENT SUMMARY

Site: BHR07 [AM_Boundary Road_Brahman Road]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Boundary Road												
1	L2	51	2.0	0.315	20.8	LOS B	8.9	63.6	0.62	0.57	0.62	46.3
2	T1	382	2.0	0.315	17.1	LOS B	8.9	63.6	0.65	0.60	0.65	46.1
3	R2	68	2.0	0.315	27.2	LOS B	6.1	43.3	0.72	0.67	0.72	42.3
Approach		501	2.0	0.315	18.9	LOS B	8.9	63.6	0.66	0.61	0.66	45.5
East: Brahman Road												
4	L2	23	2.0	0.363	29.3	LOS C	8.1	57.9	0.77	0.70	0.77	36.5
5	T1	145	2.0	0.363	24.7	LOS B	8.1	57.9	0.77	0.70	0.77	36.8
6	R2	60	2.0	0.363	29.3	LOS C	8.1	57.9	0.77	0.70	0.77	36.5
Approach		228	2.0	0.363	26.4	LOS B	8.1	57.9	0.77	0.70	0.77	36.7
North: Boundary Road												
7	L2	124	2.0	0.369	21.3	LOS B	10.7	76.4	0.65	0.63	0.65	45.5
8	T1	328	2.0	0.369	17.4	LOS B	10.7	76.4	0.67	0.65	0.67	45.4
9	R2	103	2.0	0.369	27.9	LOS B	6.4	45.7	0.74	0.71	0.74	41.5
Approach		556	2.0	0.369	20.2	LOS B	10.7	76.4	0.68	0.66	0.68	44.6
West: Brahman Road												
10	L2	18	2.0	0.176	28.0	LOS B	3.8	26.9	0.72	0.63	0.72	37.1
11	T1	80	2.0	0.176	23.4	LOS B	3.8	26.9	0.72	0.63	0.72	37.4
12	R2	16	2.0	0.176	28.0	LOS B	3.8	26.9	0.72	0.63	0.72	37.1
Approach		114	2.0	0.176	24.8	LOS B	3.8	26.9	0.72	0.63	0.72	37.3
All Vehicles		1399	2.0	0.369	21.1	LOS B	10.7	76.4	0.69	0.64	0.69	42.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: BHR07 [PM_Boundary Road_Brahman Road]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Boundary Road												
1	L2	112	2.0	0.500	22.7	LOS B	16.0	113.7	0.71	0.66	0.71	45.0
2	T1	615	2.0	0.500	18.6	LOS B	16.0	113.7	0.73	0.68	0.73	45.1
3	R2	109	2.0	0.500	26.6	LOS B	11.6	82.4	0.76	0.71	0.76	42.7
Approach		836	2.0	0.500	20.2	LOS B	16.0	113.7	0.73	0.68	0.73	44.8
East: Brahman Road												
4	L2	68	2.0	0.501	32.4	LOS C	11.1	79.3	0.84	0.77	0.84	35.0
5	T1	116	2.0	0.501	27.8	LOS B	11.1	79.3	0.84	0.77	0.84	35.3
6	R2	103	2.0	0.501	32.4	LOS C	11.1	79.3	0.84	0.77	0.84	35.1
Approach		287	2.0	0.501	30.5	LOS C	11.1	79.3	0.84	0.77	0.84	35.1
North: Boundary Road												
7	L2	65	2.0	0.236	20.0	LOS B	6.3	45.1	0.59	0.57	0.59	46.4
8	T1	333	2.0	0.236	16.2	LOS B	6.3	45.1	0.62	0.57	0.62	46.7
9	R2	19	2.0	0.236	23.7	LOS B	5.4	38.3	0.65	0.57	0.65	44.9
Approach		417	2.0	0.236	17.2	LOS B	6.3	45.1	0.62	0.57	0.62	46.6
West: Brahman Road												
10	L2	36	2.0	0.468	33.4	LOS C	9.5	67.9	0.84	0.76	0.84	34.8
11	T1	109	2.0	0.468	28.9	LOS C	9.5	67.9	0.84	0.76	0.84	35.0
12	R2	99	2.0	0.468	33.4	LOS C	9.5	67.9	0.84	0.76	0.84	34.8
Approach		244	2.0	0.468	31.4	LOS C	9.5	67.9	0.84	0.76	0.84	34.9
All Vehicles		1784	2.0	0.501	22.7	LOS B	16.0	113.7	0.74	0.68	0.74	41.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

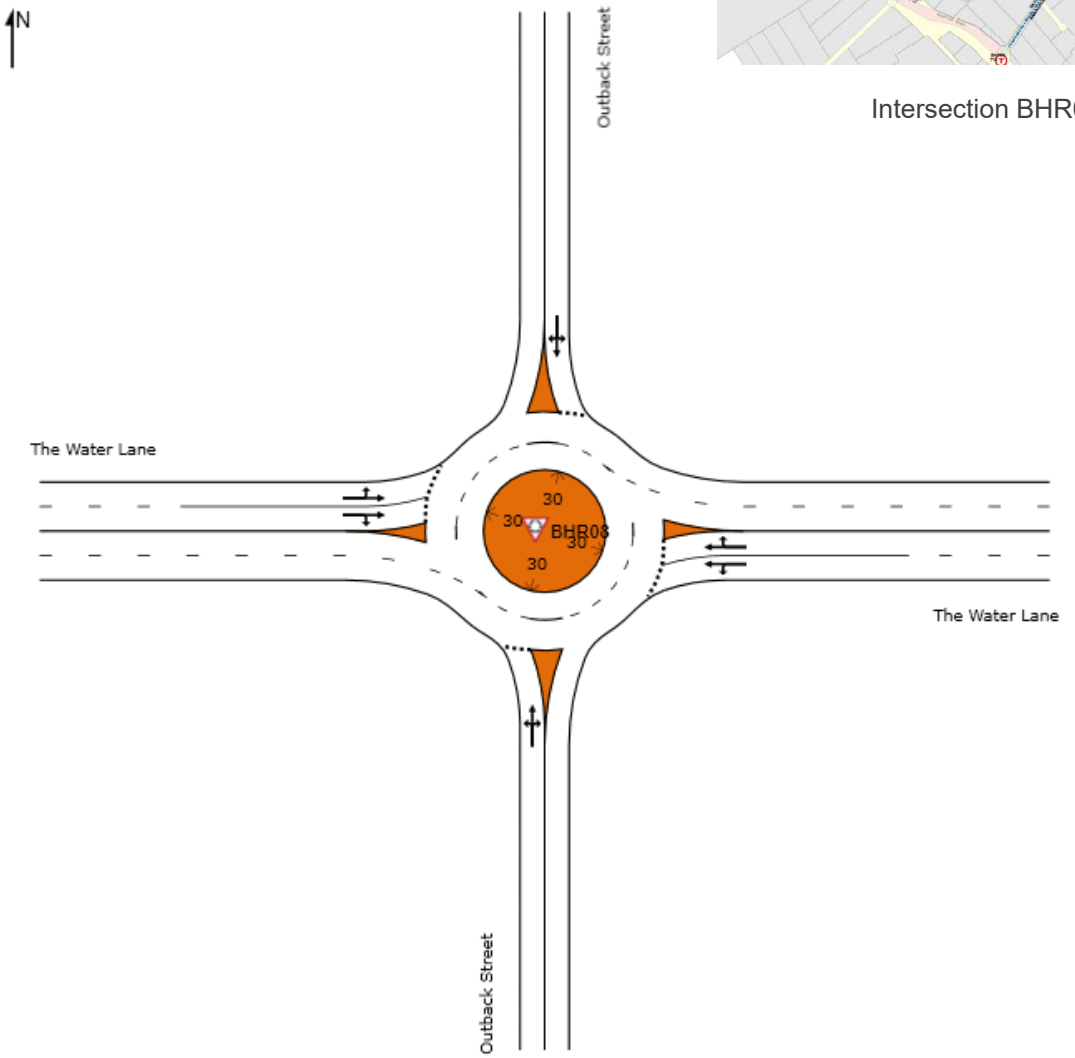
BHR08 – The Water Lane/Outback Street

Intersection BHR08 -

SITE LAYOUT

Site: BHR08 [AM_Water Lane_Outback Street]

New Site
Site Category: (None)
Roundabout



MOVEMENT SUMMARY

Site: BHR08 [AM_Water Lane_Outback Street]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Outback Street												
1	L2	57	2.0	0.219	5.3	LOS A	1.0	6.9	0.64	0.69	0.64	43.5
2	T1	80	2.0	0.219	5.0	LOS A	1.0	6.9	0.64	0.69	0.64	45.1
3	R2	25	2.0	0.219	10.5	LOS A	1.0	6.9	0.64	0.69	0.64	46.4
Approach		162	2.0	0.219	6.0	LOS A	1.0	6.9	0.64	0.69	0.64	44.6
East: The Water Lane												
4	L2	141	2.0	0.430	3.7	LOS A	2.7	19.0	0.48	0.41	0.48	44.0
5	T1	792	2.0	0.430	3.3	LOS A	2.7	19.0	0.49	0.44	0.49	47.1
6	R2	118	2.0	0.430	8.9	LOS A	2.6	18.6	0.50	0.48	0.50	46.8
Approach		1051	2.0	0.430	4.0	LOS A	2.7	19.0	0.49	0.44	0.49	46.7
North: Outback Street												
7	L2	22	2.0	0.162	5.4	LOS A	0.7	5.0	0.64	0.73	0.64	41.4
8	T1	53	2.0	0.162	5.1	LOS A	0.7	5.0	0.64	0.73	0.64	43.9
9	R2	43	2.0	0.162	10.5	LOS A	0.7	5.0	0.64	0.73	0.64	45.9
Approach		118	2.0	0.162	7.1	LOS A	0.7	5.0	0.64	0.73	0.64	44.2
West: The Water Lane												
10	L2	189	2.0	0.460	3.5	LOS A	3.0	21.1	0.45	0.40	0.45	45.1
11	T1	807	2.0	0.460	3.1	LOS A	3.0	21.1	0.46	0.43	0.46	47.1
12	R2	174	2.0	0.460	8.7	LOS A	2.9	20.7	0.47	0.48	0.47	47.2
Approach		1171	2.0	0.460	4.0	LOS A	3.0	21.1	0.46	0.43	0.46	46.8
All Vehicles		2501	2.0	0.460	4.3	LOS A	3.0	21.1	0.49	0.47	0.49	46.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

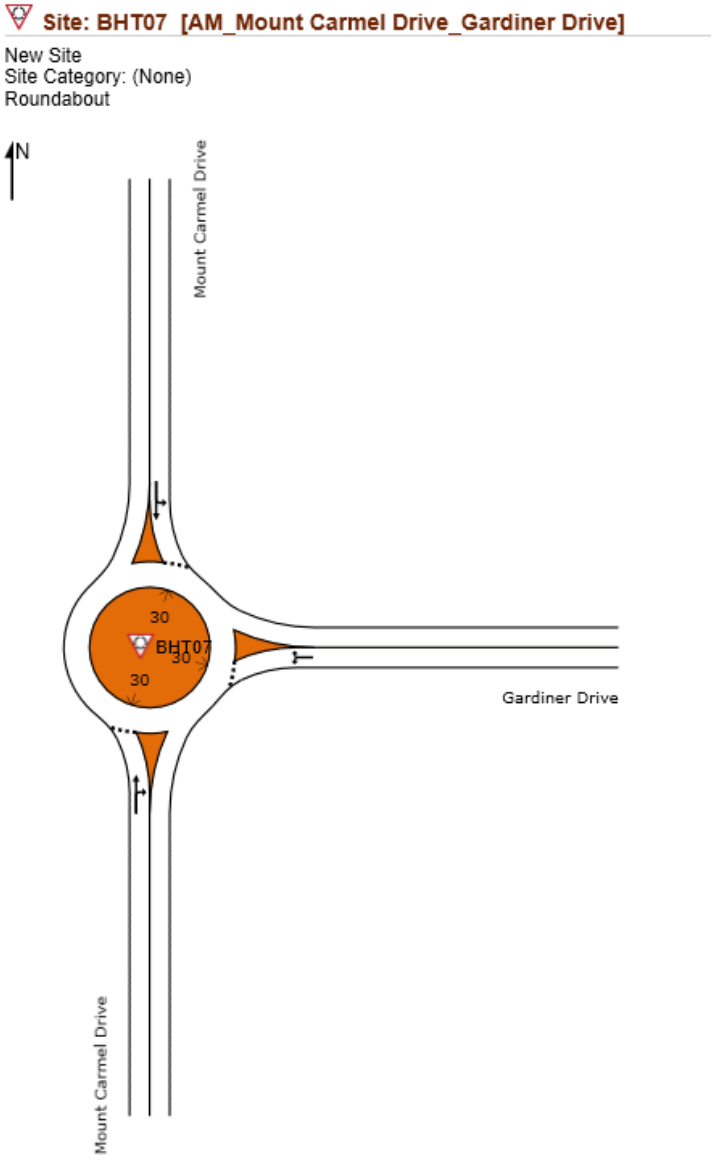
Site: BHR08 [PM_Water Lane_Outback Street]

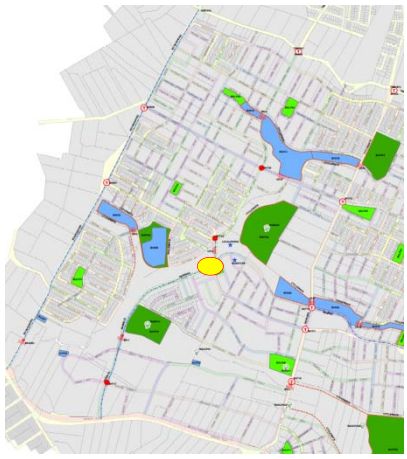
New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Outback Street												
1	L2	126	2.0	0.439	8.0	LOS A	2.4	17.1	0.81	0.94	0.94	41.0
2	T1	47	2.0	0.439	7.7	LOS A	2.4	17.1	0.81	0.94	0.94	41.8
3	R2	68	2.0	0.439	13.1	LOS A	2.4	17.1	0.81	0.94	0.94	43.0
Approach		242	2.0	0.439	9.4	LOS A	2.4	17.1	0.81	0.94	0.94	41.6
East: The Water Lane												
4	L2	63	2.0	0.596	5.2	LOS A	5.1	36.2	0.69	0.58	0.74	42.4
5	T1	1180	2.0	0.596	4.9	LOS A	5.1	36.2	0.70	0.62	0.76	45.8
6	R2	72	2.0	0.596	10.7	LOS A	5.0	35.7	0.70	0.67	0.78	45.5
Approach		1315	2.0	0.596	5.3	LOS A	5.1	36.2	0.70	0.62	0.76	45.6
North: Outback Street												
7	L2	100	2.0	0.451	5.4	LOS A	2.4	17.4	0.64	0.76	0.70	41.5
8	T1	158	2.0	0.451	5.2	LOS A	2.4	17.4	0.64	0.76	0.70	44.0
9	R2	137	2.0	0.451	10.6	LOS A	2.4	17.4	0.64	0.76	0.70	46.0
Approach		395	2.0	0.451	7.1	LOS A	2.4	17.4	0.64	0.76	0.70	44.1
West: The Water Lane												
10	L2	102	2.0	0.266	3.2	LOS A	1.5	10.5	0.36	0.35	0.36	45.7
11	T1	489	2.0	0.266	2.8	LOS A	1.5	10.5	0.37	0.38	0.37	47.8
12	R2	88	2.0	0.266	8.3	LOS A	1.4	10.3	0.37	0.42	0.37	47.9
Approach		680	2.0	0.266	3.5	LOS A	1.5	10.5	0.37	0.38	0.37	47.5
All Vehicles		2632	2.0	0.596	5.5	LOS A	5.1	36.2	0.61	0.61	0.67	45.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

BHT07 – Gardiner Drive / Mt Carmel Drive





Intersection BHT07 -

MOVEMENT SUMMARY

Site: BHT07 [AM_Mount Carmel Drive_Gardiner Drive]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Mount Carmel Drive												
2	T1	148	0.0	0.194	4.4	LOS A	1.4	9.9	0.45	0.53	0.45	55.5
3	R2	95	0.0	0.194	10.1	LOS A	1.4	9.9	0.45	0.53	0.45	56.6
Approach		243	0.0	0.194	6.6	LOS A	1.4	9.9	0.45	0.53	0.45	56.0
East: Gardiner Drive												
4	L2	581	0.0	0.730	10.1	LOS A	10.3	72.1	0.93	0.99	1.23	45.7
6	R2	166	0.0	0.730	15.3	LOS B	10.3	72.1	0.93	0.99	1.23	44.0
Approach		747	0.0	0.730	11.2	LOS A	10.3	72.1	0.93	0.99	1.23	45.5
North: Mount Carmel Drive												
7	L2	61	0.0	0.350	4.0	LOS A	2.8	19.4	0.35	0.40	0.35	53.1
8	T1	445	0.0	0.350	4.1	LOS A	2.8	19.4	0.35	0.40	0.35	57.1
Approach		506	0.0	0.350	4.1	LOS A	2.8	19.4	0.35	0.40	0.35	56.8
All Vehicles		1497	0.0	0.730	8.1	LOS A	10.3	72.1	0.66	0.71	0.81	50.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

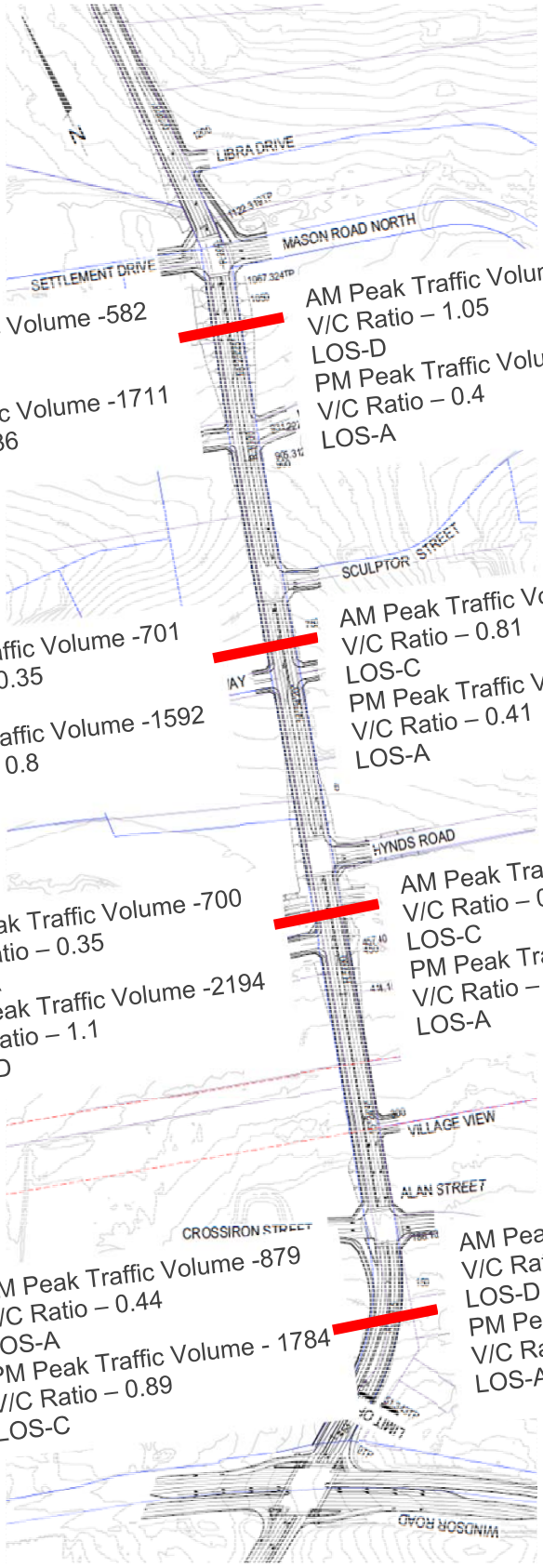
Site: BHT07 [PM_Mount Carmel Drive_Gardiner Drive]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Mount Carmel Drive												
2	T1	518	0.0	0.600	4.3	LOS A	6.7	46.8	0.45	0.50	0.45	55.4
3	R2	388	0.0	0.600	9.9	LOS A	6.7	46.8	0.45	0.50	0.45	56.5
Approach		906	0.0	0.600	6.7	LOS A	6.7	46.8	0.45	0.50	0.45	55.9
East: Gardiner Drive												
4	L2	219	0.0	0.233	3.1	LOS A	1.7	11.7	0.43	0.48	0.43	47.9
6	R2	83	0.0	0.233	8.3	LOS A	1.7	11.7	0.43	0.48	0.43	48.7
Approach		302	0.0	0.233	4.6	LOS A	1.7	11.7	0.43	0.48	0.43	48.1
North: Mount Carmel Drive												
7	L2	201	0.0	0.341	5.9	LOS A	2.5	17.4	0.67	0.63	0.67	51.6
8	T1	157	0.0	0.341	6.1	LOS A	2.5	17.4	0.67	0.63	0.67	56.1
Approach		358	0.0	0.341	6.0	LOS A	2.5	17.4	0.67	0.63	0.67	54.1
All Vehicles		1566	0.0	0.600	6.1	LOS A	6.7	46.8	0.49	0.53	0.49	53.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

BHRU02B – Road upgrade of Terry Road and Mason Bypass



Considering: Lane capacity = 1000 vehicles per lane per hour

BHRU08A – Road upgrade of The Water Lane (Nelson Rd to Annangrove Rd)

Intersections already discussed earlier in The Water Lane (Nelson to Annangrove Road) are:

BHT15 - Nelson Road/The Water Lane

BHT20 - Grandhill Parkway/The Water Lane

BHR08 – The Water Lane/Outback Street

The other intersection upgrades within this segment are shown below:

BHRU08A_1 The Water Lane/Terrain Street

Intersection BHRU08A_1 -

MOVEMENT SUMMARY

Site: BHRU08A [AM_Water Lane_Terrain Street]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Terrain Street												
1	L2	65	2.0	0.073	7.4	LOS A	0.3	1.9	0.42	0.66	0.42	43.8
Approach		65	2.0	0.073	7.4	LOS A	0.3	1.9	0.42	0.66	0.42	43.8
East: The Water Lane												
4	L2	65	2.0	0.232	4.4	LOS A	0.0	0.0	0.00	0.09	0.00	51.8
5	T1	826	2.0	0.232	0.0	LOS A	0.0	0.0	0.00	0.04	0.00	58.9
Approach		892	2.0	0.232	0.3	NA	0.0	0.0	0.00	0.04	0.00	58.3
North: GreyBox Street												
7	L2	68	2.0	0.099	8.9	LOS A	0.3	2.4	0.52	0.76	0.52	35.6
Approach		68	2.0	0.099	8.9	LOS A	0.3	2.4	0.52	0.76	0.52	35.6
West: The Water Lane												
10	L2	37	2.0	0.315	5.6	LOS A	0.0	0.0	0.00	0.04	0.00	54.9
11	T1	1176	2.0	0.315	0.0	LOS A	0.0	0.0	0.00	0.02	0.00	59.3
Approach		1213	2.0	0.315	0.2	NA	0.0	0.0	0.00	0.02	0.00	59.1
All Vehicles		2238	2.0	0.315	0.7	NA	0.3	2.4	0.03	0.07	0.03	56.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: BHRU08A [PM_Water Lane_Terrain Street]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Terrain Street												
1	L2	108	2.0	0.196	10.8	LOS A	0.7	4.9	0.63	0.84	0.63	39.9
Approach		108	2.0	0.196	10.8	LOS A	0.7	4.9	0.63	0.84	0.63	39.9
East: The Water Lane												
4	L2	34	2.0	0.389	4.4	LOS A	0.0	0.0	0.00	0.03	0.00	53.0
5	T1	1463	2.0	0.389	0.0	LOS A	0.0	0.0	0.00	0.01	0.00	59.5
Approach		1497	2.0	0.389	0.1	NA	0.0	0.0	0.00	0.01	0.00	59.4
North: GreyBox Street												
7	L2	22	2.0	0.023	7.0	LOS A	0.1	0.6	0.38	0.60	0.38	38.0
Approach		22	2.0	0.023	7.0	LOS A	0.1	0.6	0.38	0.60	0.38	38.0
West: The Water Lane												
10	L2	79	2.0	0.214	5.6	LOS A	0.0	0.0	0.00	0.12	0.00	53.5
11	T1	740	2.0	0.214	0.0	LOS A	0.0	0.0	0.00	0.05	0.00	58.3
Approach		819	2.0	0.214	0.5	NA	0.0	0.0	0.00	0.06	0.00	57.6
All Vehicles		2446	2.0	0.389	0.8	NA	0.7	4.9	0.03	0.07	0.03	56.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

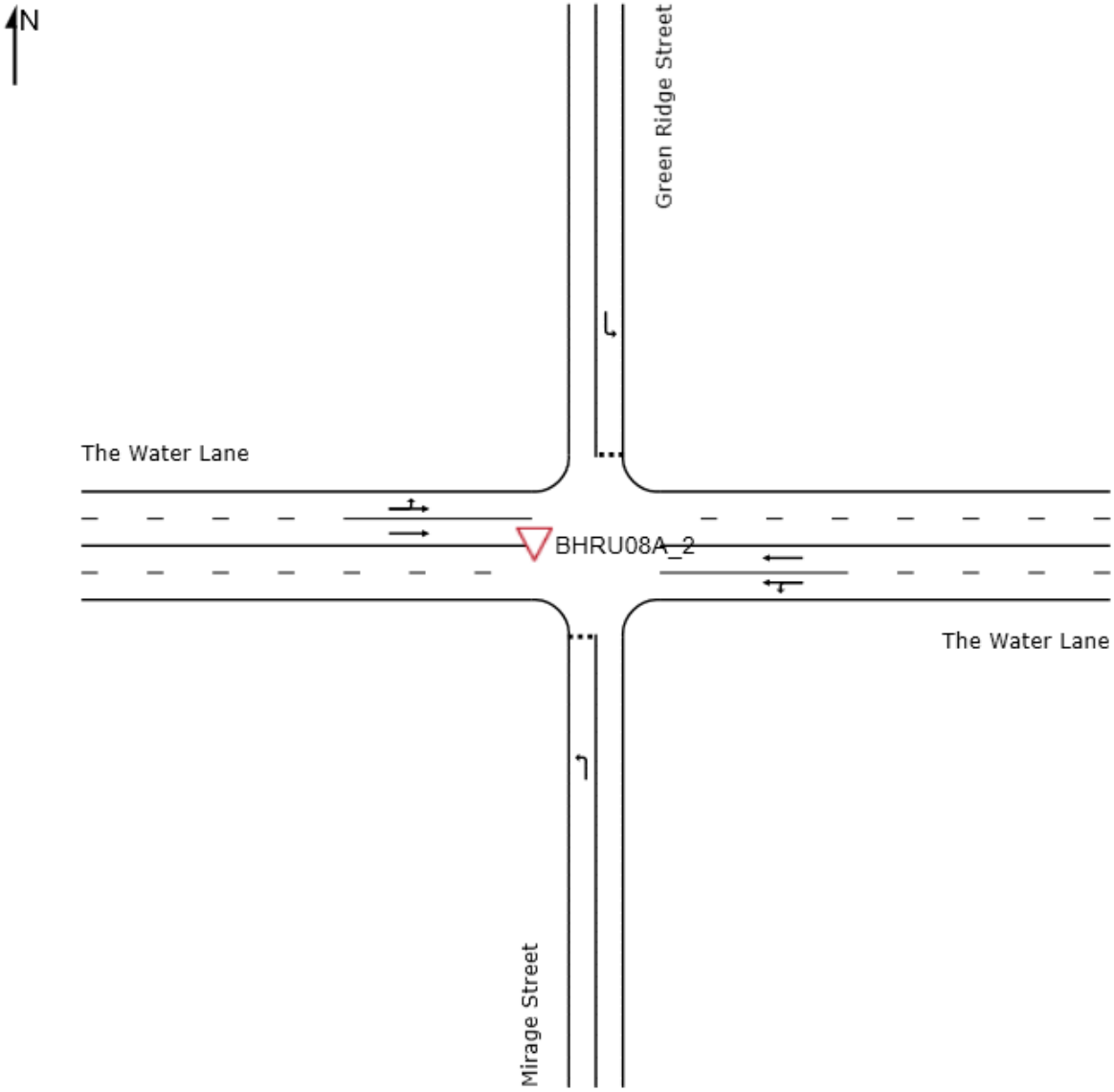
BHRU08A_2 The Water Lane/Mirage Street

Intersection BHRU08A_2 -

SITE LAYOUT

Site: BHRU08A_2 [AM_Water Lane_Mirage Street]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)



MOVEMENT SUMMARY

Site: BHRU08A_2 [AM_Water Lane_Mirage Street]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Mirage Street												
1	L2	53	2.0	0.060	7.5	LOS A	0.2	1.5	0.43	0.66	0.43	43.7
Approach		53	2.0	0.060	7.5	LOS A	0.2	1.5	0.43	0.66	0.43	43.7
East: The Water Lane												
4	L2	47	2.0	0.231	4.4	LOS A	0.0	0.0	0.00	0.06	0.00	52.3
5	T1	839	2.0	0.231	0.0	LOS A	0.0	0.0	0.00	0.03	0.00	59.2
Approach		886	2.0	0.231	0.2	NA	0.0	0.0	0.00	0.03	0.00	58.8
North: Green Ridge Street												
7	L2	68	2.0	0.101	9.0	LOS A	0.4	2.5	0.53	0.77	0.53	35.4
Approach		68	2.0	0.101	9.0	LOS A	0.4	2.5	0.53	0.77	0.53	35.4
West: The Water Lane												
10	L2	37	2.0	0.324	5.6	LOS A	0.0	0.0	0.00	0.04	0.00	54.9
11	T1	1207	2.0	0.324	0.0	LOS A	0.0	0.0	0.00	0.02	0.00	59.4
Approach		1244	2.0	0.324	0.2	NA	0.0	0.0	0.00	0.02	0.00	59.1
All Vehicles		2252	2.0	0.324	0.6	NA	0.4	2.5	0.03	0.06	0.03	57.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: BHRU08A_2 [PM_Water Lane_Mirage Street]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Mirage Street												
1	L2	116	2.0	0.189	10.0	LOS A	0.7	4.8	0.59	0.82	0.59	40.8
Approach		116	2.0	0.189	10.0	LOS A	0.7	4.8	0.59	0.82	0.59	40.8
East: The Water Lane												
4	L2	78	2.0	0.380	4.4	LOS A	0.0	0.0	0.00	0.06	0.00	52.2
5	T1	1381	2.0	0.380	0.0	LOS A	0.0	0.0	0.00	0.03	0.00	59.1
Approach		1459	2.0	0.380	0.2	NA	0.0	0.0	0.00	0.03	0.00	58.7
North: Green Ridge Street												
7	L2	11	2.0	0.011	6.7	LOS A	0.0	0.3	0.35	0.57	0.35	38.2
Approach		11	2.0	0.011	6.7	LOS A	0.0	0.3	0.35	0.57	0.35	38.2
West: The Water Lane												
10	L2	93	2.0	0.199	5.6	LOS A	0.0	0.0	0.00	0.15	0.00	53.0
11	T1	669	2.0	0.199	0.0	LOS A	0.0	0.0	0.00	0.06	0.00	57.9
Approach		762	2.0	0.199	0.7	NA	0.0	0.0	0.00	0.07	0.00	57.0
All Vehicles		2347	2.0	0.380	0.9	NA	0.7	4.8	0.03	0.09	0.03	56.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

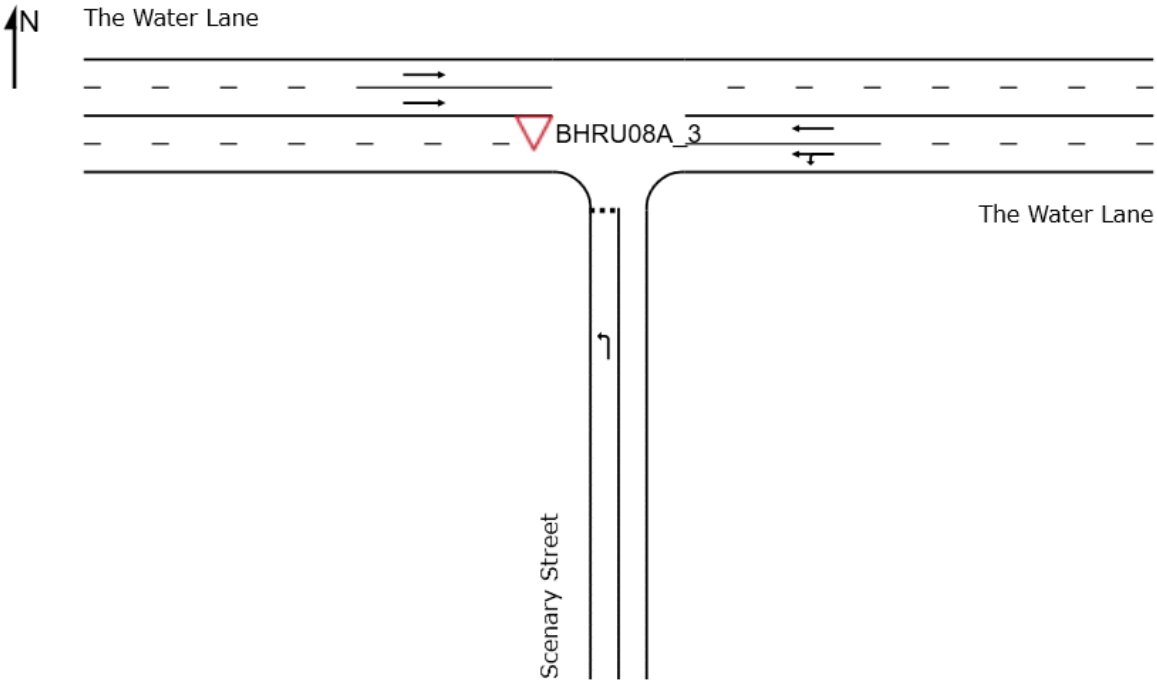
BHRU08A_3 The Water Lane/Scenary Street

Intersection BHRU08A_3 -

SITE LAYOUT

Site: BHRU08A_3 [AM_Water Lane_Scenary Street]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)



MOVEMENT SUMMARY

Site: BHRU08A_3 [AM_Water Lane_Scenary Street]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Scenary Street												
1	L2	52	2.0	0.059	7.4	LOS A	0.2	1.5	0.42	0.65	0.42	43.8
Approach		52	2.0	0.059	7.4	LOS A	0.2	1.5	0.42	0.65	0.42	43.8
East: The Water Lane												
4	L2	57	2.0	0.232	4.4	LOS A	0.0	0.0	0.00	0.07	0.00	52.0
5	T1	835	2.0	0.232	0.0	LOS A	0.0	0.0	0.00	0.03	0.00	59.0
Approach		892	2.0	0.232	0.3	NA	0.0	0.0	0.00	0.04	0.00	58.5
West: The Water Lane												
11	T1	1276	2.0	0.331	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
Approach		1276	2.0	0.331	0.0	NA	0.0	0.0	0.00	0.00	0.00	59.9
All Vehicles		2219	2.0	0.331	0.3	NA	0.2	1.5	0.01	0.03	0.01	58.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: BHRU08A_3 [PM_Water Lane_Scenary Street]

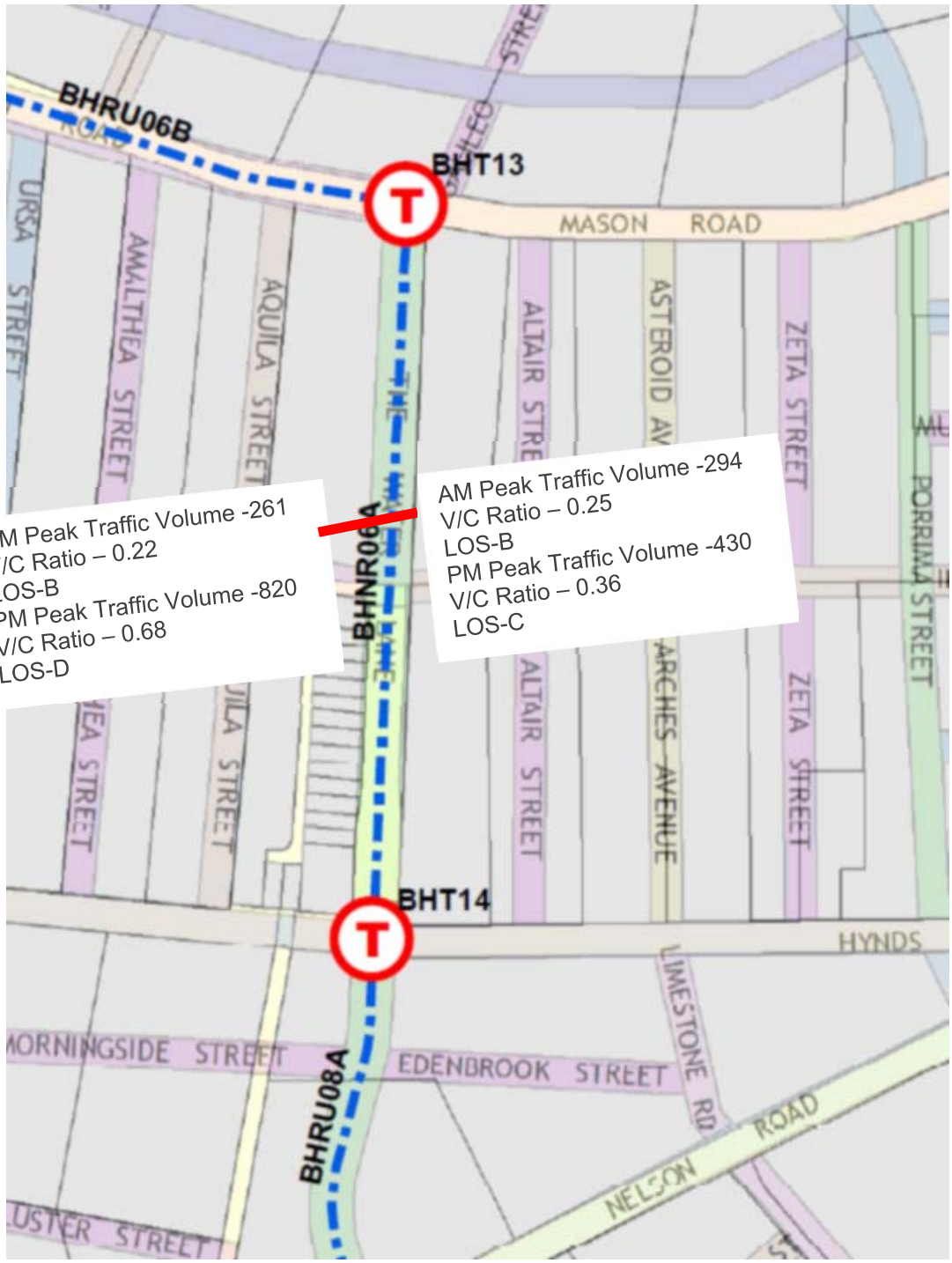
New Site
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Scenary Street												
1	L2	116	2.0	0.187	9.9	LOS A	0.7	4.7	0.58	0.82	0.58	40.9
Approach		116	2.0	0.187	9.9	LOS A	0.7	4.7	0.58	0.82	0.58	40.9
East: The Water Lane												
4	L2	57	2.0	0.364	4.4	LOS A	0.0	0.0	0.00	0.05	0.00	52.6
5	T1	1343	2.0	0.364	0.0	LOS A	0.0	0.0	0.00	0.02	0.00	59.3
Approach		1400	2.0	0.364	0.2	NA	0.0	0.0	0.00	0.02	0.00	59.0
West: The Water Lane												
11	T1	680	2.0	0.177	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		680	2.0	0.177	0.0	NA	0.0	0.0	0.00	0.00	0.00	60.0
All Vehicles		2196	2.0	0.364	0.6	NA	0.7	4.7	0.03	0.06	0.03	57.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

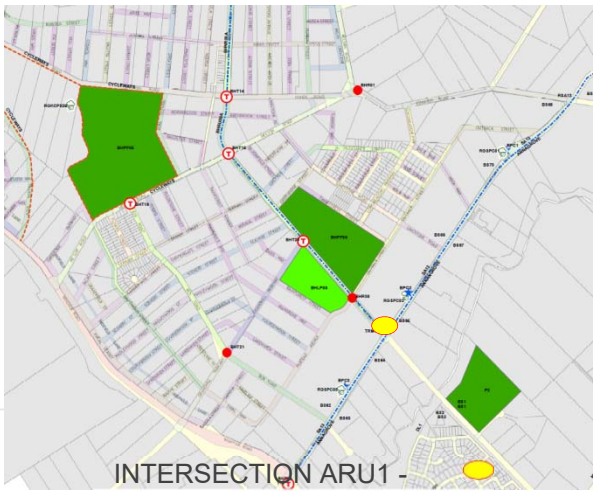
BHRU08B - Road upgrade of The Water Lane (Mason Road to Hynds Road)



Considering: Lane capacity = 600 vehicles per lane per hour

ARU1 – Upgrade of Annangrove Road

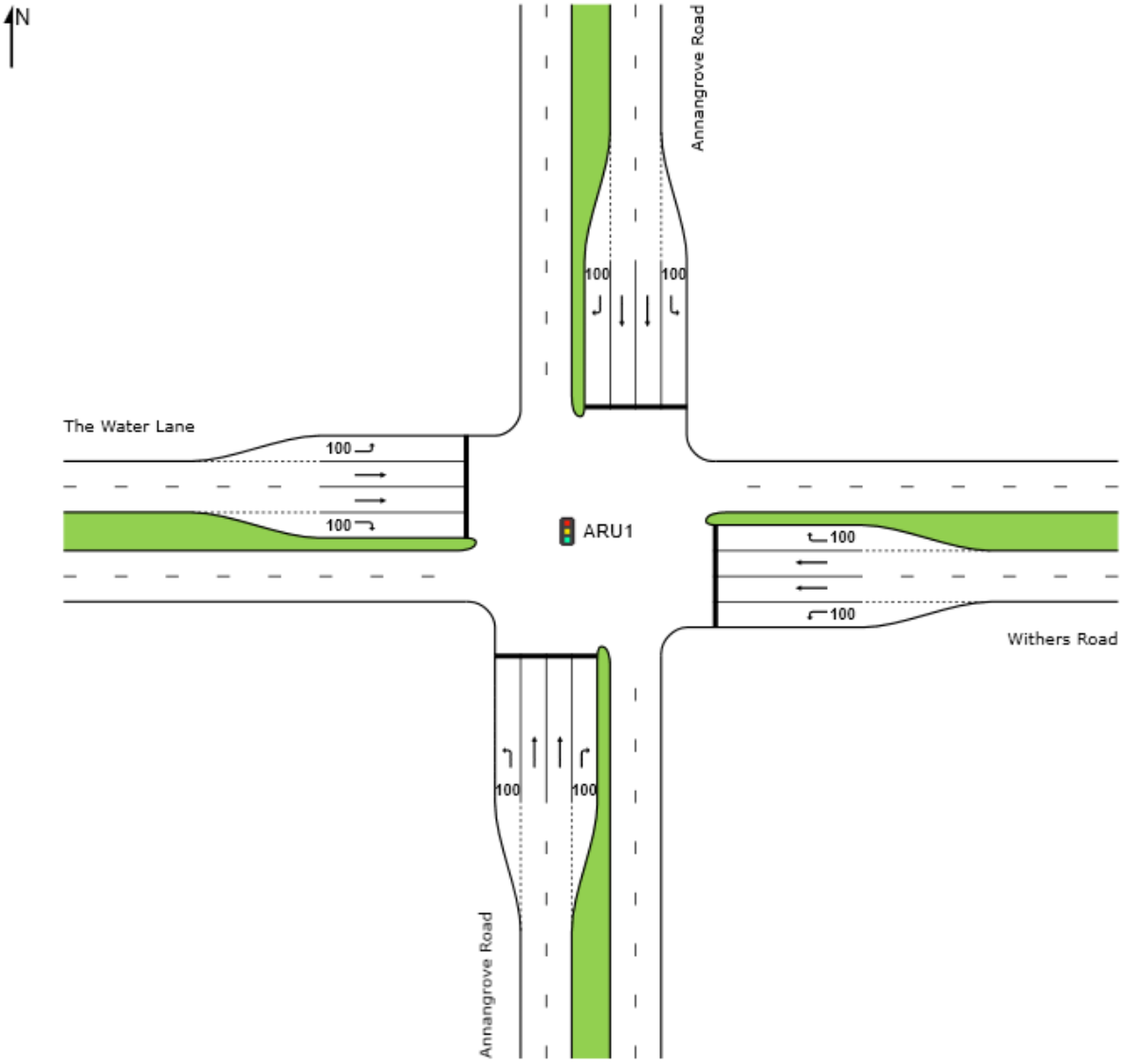
ARU1 - The Water Lane/Annangrove Road



SITE LAYOUT

Site: ARU1 [AM_Water Lane_Annangrove Road]

New Site
Site Category: (None)
Signals - Fixed Time Isolated



MOVEMENT SUMMARY

Site: ARU1 [AM_Water Lane_Annangrove Road]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Annangrove Road												
1	L2	340	2.0	0.389	24.5	LOS B	10.8	77.1	0.70	0.78	0.70	44.1
2	T1	717	2.0	0.391	19.0	LOS B	11.4	81.2	0.70	0.61	0.70	51.9
3	R2	241	2.0	1.025	123.2	LOS F	22.1	157.4	1.00	1.38	2.05	29.6
Approach		1298	2.0	1.025	39.8	LOS C	22.1	157.4	0.76	0.80	0.95	43.7
East: Withers Road												
4	L2	280	2.0	0.351	26.7	LOS B	9.2	65.8	0.72	0.78	0.72	48.6
5	T1	603	2.0	0.360	21.2	LOS B	10.0	71.1	0.73	0.62	0.73	46.7
6	R2	84	2.0	0.299	34.1	LOS C	3.2	22.7	0.79	0.76	0.79	46.7
Approach		967	2.0	0.360	23.9	LOS B	10.0	71.1	0.73	0.68	0.73	47.4
North: Annangrove Road												
7	L2	29	2.0	0.034	21.2	LOS B	0.8	5.5	0.57	0.67	0.57	50.4
8	T1	816	2.0	0.444	19.6	LOS B	13.4	95.4	0.73	0.63	0.73	51.7
9	R2	107	2.0	0.507	34.9	LOS C	4.4	31.2	0.84	0.79	0.84	40.5
Approach		953	2.0	0.507	21.3	LOS B	13.4	95.4	0.73	0.65	0.73	50.6
West: The Water Lane												
10	L2	300	2.0	0.376	26.0	LOS B	10.0	71.4	0.73	0.77	0.73	38.4
11	T1	316	2.0	0.188	19.4	LOS B	4.8	34.2	0.67	0.55	0.67	41.0
12	R2	239	2.0	1.026	122.1	LOS F	21.8	155.4	1.00	1.45	2.05	21.0
Approach		855	2.0	1.026	50.4	LOS D	21.8	155.4	0.78	0.88	1.08	31.8
All Vehicles		4073	2.0	1.026	33.9	LOS C	22.1	157.4	0.75	0.75	0.88	43.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: ARU1 [PM_Water Lane_Annangrove Road]

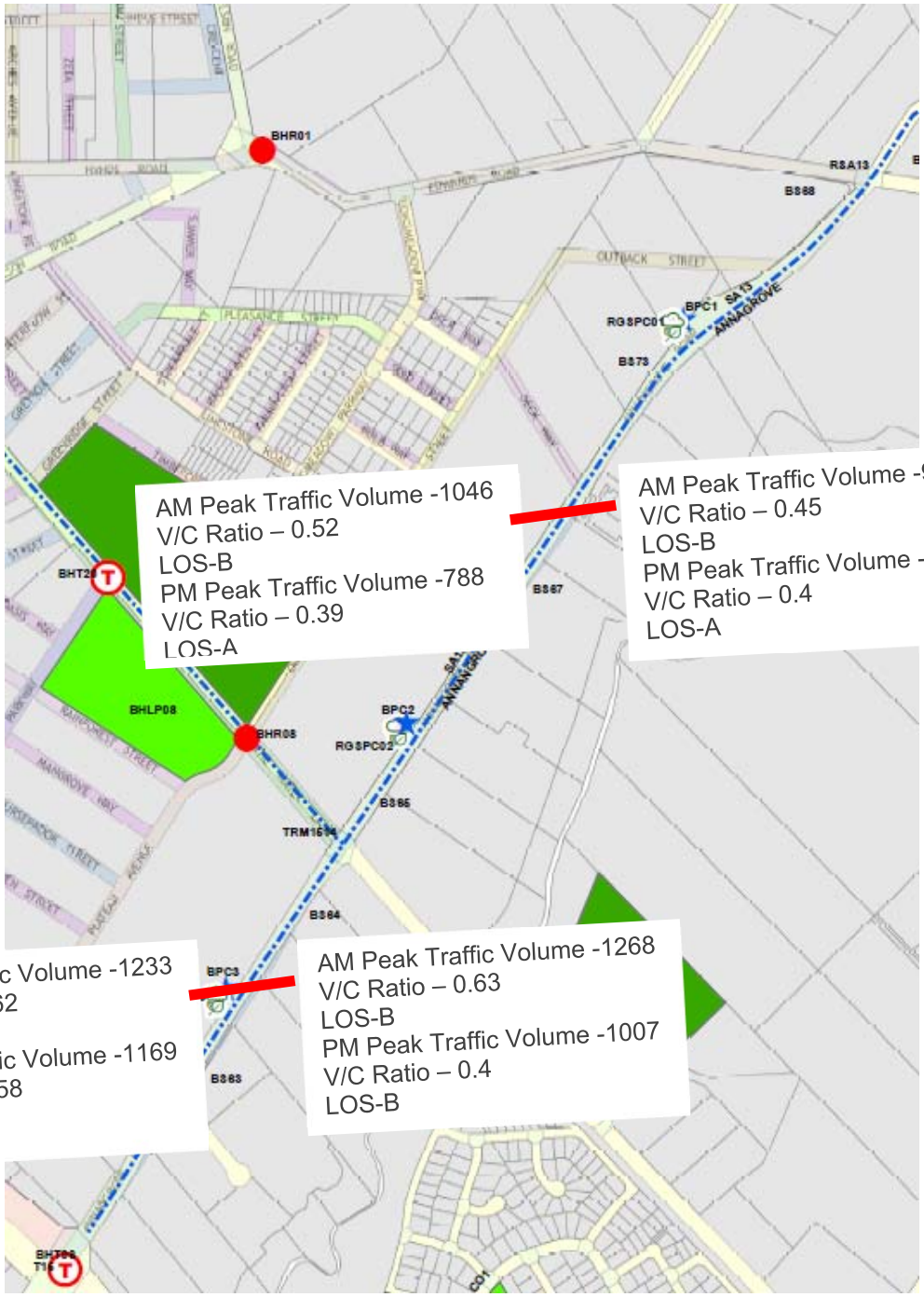
New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Annangrove Road												
1	L2	331	2.0	0.471	31.4	LOS C	12.3	87.6	0.81	0.81	0.81	41.3
2	T1	707	2.0	0.479	25.9	LOS B	13.2	93.9	0.82	0.70	0.82	49.5
3	R2	193	2.0	0.883	64.4	LOS E	11.8	83.9	1.00	1.08	1.47	39.1
Approach		1231	2.0	0.883	33.4	LOS C	13.2	93.9	0.84	0.79	0.92	45.7
East: Withers Road												
4	L2	207	2.0	0.214	19.9	LOS B	5.5	39.1	0.58	0.73	0.58	50.9
5	T1	858	2.0	0.422	16.3	LOS B	12.9	92.0	0.67	0.59	0.67	49.2
6	R2	60	2.0	0.137	22.6	LOS B	1.7	12.1	0.61	0.70	0.61	50.4
Approach		1125	2.0	0.422	17.3	LOS B	12.9	92.0	0.65	0.62	0.65	49.7
North: Annangrove Road												
7	L2	62	2.0	0.088	27.4	LOS B	2.0	13.9	0.68	0.71	0.68	48.3
8	T1	651	2.0	0.441	25.5	LOS B	11.9	84.8	0.80	0.69	0.80	49.6
9	R2	126	2.0	0.747	51.5	LOS D	6.6	47.2	0.98	0.93	1.21	35.2
Approach		839	2.0	0.747	29.5	LOS C	11.9	84.8	0.82	0.73	0.85	47.6
West: The Water Lane												
10	L2	62	2.0	0.064	17.7	LOS B	1.5	10.7	0.53	0.66	0.53	41.4
11	T1	416	2.0	0.204	14.2	LOS A	5.5	38.9	0.58	0.49	0.58	43.1
12	R2	202	2.0	0.918	72.9	LOS F	14.2	101.3	1.00	1.21	1.61	27.6
Approach		680	2.0	0.918	32.0	LOS C	14.2	101.3	0.70	0.72	0.88	36.8
All Vehicles		3875	2.0	0.918	27.6	LOS B	14.2	101.3	0.76	0.71	0.82	45.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Annangrove Link V/C ratio



AM Peak Traffic Volume -1046
V/C Ratio – 0.52
LOS-B
PM Peak Traffic Volume -788
V/C Ratio – 0.39
LOS-A

AM Peak Traffic Volume -905
V/C Ratio – 0.45
LOS-B
PM Peak Traffic Volume -797
V/C Ratio – 0.4
LOS-A

AM Peak Traffic Volume -1233
V/C Ratio – 0.62
LOS-B
PM Peak Traffic Volume -1169
V/C Ratio – 0.58
LOS-B

AM Peak Traffic Volume -1268
V/C Ratio – 0.63
LOS-B
PM Peak Traffic Volume -1007
V/C Ratio – 0.4
LOS-B

Considering: Lane capacity = 1000 vehicles per lane per hour