BOWDEN-BROMPTON DPA INVESTIGATIONS

FINAL REPORT

PREPARED FOR | City of Charles Sturt

PREPARED BY | Fyfe Pty Ltd

ABN | 57 008 116 130

ADDRESS | Level 1, 124 South Tce, Adelaide SA 5000

CONTACT | Michael Osborn

TELEPHONE | office 61 8 8201 9600

FACSIMILE | 61 8 8201 9650

EMAIL | Michael.osborn@fyfe.com.au

DATE | 2/07/2018

REFERENCE | 65148-1

CONTENTS

		Page
1.	**INTRODUCTION**	**1**
1.1	Study Area and Locality	1
1.2	Purpose of the Investigation Report	2
1.3	Anticipated Yield	2
2.	**STRATEGIC CONTEXT**	**4**
2.1	State Strategies and Directions	4
2.2	Previous/Current Development Plan Amendments	16
2.3	Background Documentation and Analysis	17
3.	**SITE ANALYSIS INVESTIGATIONS**	**27**
3.1	Existing Uses and Ownership	27
3.2	Topography	30
3.3	Heritage	33
3.4	Existing Vegetation	35
3.5	Building Height	37
3.6	Site History and Environmental Assessment	40
3.7	Adjacent Zones and Land Uses	49
3.8	Transport	52
3.9	Stormwater	64
3.10	Service Infrastructure	69
3.11	Activity Centres	73
3.12	Social Infrastructure	73
4.	**CONSULTATION**	**85**
4.1	Engagement Process	85
4.2	Feedback Received	85
4.3	Summary of Issues	86

5. CONCEPT PLAN 83

5.1 Objectives 83
5.2 Key Principles 83
5.3 Infrastructure and Services 85
5.4 Transport System/Network 85
5.5 Open Space and Recreation Provision 89
5.6 Character and Built Form 93
5.7 Streetscapes 93
5.8 Environmentally Sustainable Development 96
5.9 Affordable Housing 96
5.10 Future Zoning 96
5.11 Industry Retreat 97
5.12 The Concept Plan 98

6. INFRASTRUCTURE 99

6.1 Summary of Infrastructure Requirements 99
6.2 Cost Estimates 99
6.3 Staging 100
6.4 Infrastructure Agreements 100

Contents of Feedback 1

LIST OF TABLES

Table 1.1 Yield Analysis 2
Table 2.1 SA Strategic Plan's Goals and Targets 4
Table 2.2 30 Year Plan for Greater Adelaide Policies 5
Table 2.3 Community Plan 9
Table 2.4 Transport Plan 10
Table 2.5 Service Planning Model 15
Table 2.6 Inner West Precinct 19
Table 3.1 Proposed Stormwater Detentions 66
Table 3.2 Surface area required for stormwater treatment 69
Table 3.3 Forecast population and age cohorts 75
Table 3.4 GPs and dentists 76
Table 3.5 Aged Care Facilities 77

Table 3.6	Primary Education	77
Table 3.7	Secondary Education	78
Table 3.8	Long Day Child Care and Preschools	79
Table 3.9	Community Facilities	80
Table 3.10	Open Space and Recreation	81

LIST OF FIGURES

Figure 1.1	Study Area with Zoning	1
Figure 2.1	Bowden Urban Village and Environs DPA Affected Area	16
Figure 3.1	Ownership	28
Figure 3.2	Marble & Cement (left) – Conroy (right)	29
Figure 3.3	HAAE (left) – Detmold (right)	29
Figure 3.4	Topography	31
Figure 3.5	100 year ARI Flood Map	32
Figure 3.6	Heritage	34
Figure 3.7	Existing Vegetation	36
Figure 3.8	Adjacent Building Heights	38
Figure 3.9	Existing Built Forms in the Locality	39
Figure 3.10	Pugholes (Locations as advised by Council)	43
Figure 3.11	Recommended Evaluation Distances for Air Quality and Noise Management	47
Figure 3.12	Adjacent Land Uses	50
Figure 3.13	Existing Road Hierarchy	53
Figure 3.14	Possible Future Road Network	55
Figure 3.15	Existing Public Transport Network	60
Figure 3.16	Existing Walking and Cycling Networks	62
Figure 3.17	Potential Future Cycling Connections	63
Figure 3.18	Pre-development sub-catchment plan	64
Figure 3.19	Indicative locations of the three stormwater detention basins	66
Figure 3.20	Underground stormwater detention in Ethelbert Square Reserve	67
Figure 3.21	Existing Gas Services	71
Figure 3.22	Existing Telecommunications	72
Figure 3.23	Existing Activity Centres	74
Figure 3.24	Existing Open Space and Recreation Spaces	82
Figure 4.1	Map Your Ideas	86
Figure 5.1	Stormwater Concept	86
Figure 5.2	Road Network	88
Figure 5.3	Pedestrian and Cycle Concept	90
Figure 5.4	Open Space Concept	91

Figure 5.5	Green Corridors	92
Figure 5.6	Proposed Building Heights	94
Figure 5.7	Street Hierarchy	95

APPENDICES

Appendix A	STORMWATER MANGEMENT MASTER PLAN BY FYFE
Appendix B	PEA
Appendix C	TRANSPORT INVESTIGATIONS REPORT BY CIRQA
Appendix D	SERVICES REPORT
Appendix E	COMMUNITY SESSION SUMMARY
Appendix F	EXAMPLE SURVEY
Appendix G	“MAP YOUR IDEAS” SUBMISSIONS
Appendix H	ORDER OF COST CONCEPT DESIGN COST ESTIMATE

1. INTRODUCTION

1.1 Study Area and Locality

The area to be investigated by these investigations is the land bound by:

- Hawker Street, to the north;
- Chief Street, to the west;
- Second Street and Sixth Street, to the south; and
- Gibson Street and Drayton Street, to the east.

The Study Area is shown by Figure 1.1 below.

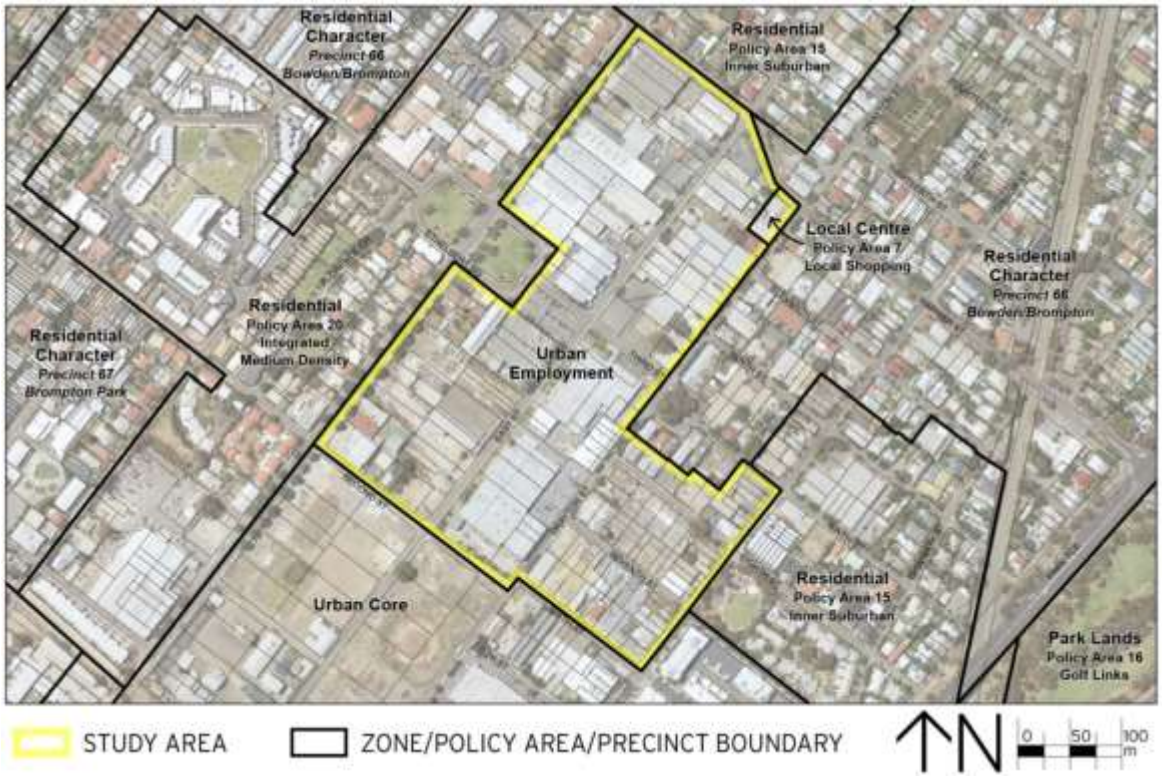


Figure 1.1 Study Area with Zoning

1.2 Purpose of the Investigation Report

The purpose of this report is to provide a comprehensive analysis of all relevant issues to ensure the suitability of the Study Area for alternative uses in the future, with such uses likely to be predominantly residential in nature.

The preparation of a future DPA will be supported by detailed analysis and investigations as documented in this Investigation Report.

1.3 Anticipated Yield

The Study Area includes approximately 11.43 hectares of land. The DPA is anticipated to support the future residential development of the Study Area, along with small scale commercial/retail uses. It is likely that commercial/retail uses will be of a nature and scale which services the local area.

Previous investigations undertaken to inform the Statement of Intent for the DPA anticipated a maximum yield of approximately 1,600 to 1,700 dwellings, to accommodate a population of up to approximately 3,320 persons.

This anticipated yield has been refined, in consultation with Council staff.

Table 1.1 provides a summary of the projected yield arising from a calculation of the land to be developed, which for the purposes of this exercise takes into account the provision of new roads and an assumed 'full' provision of public open space.

Table 1.1 Yield Analysis

Item	Land Take
Subject Land (excluding existing roads)	11.43 Ha
Less new roads/laneways (15%)	1.71 Ha
Total developable land	9.72 Ha
Public open space (POS) (12.5%)	1.22 Ha
Developable land (less POS)	8.5 Ha
Potential yield/population (180 du/Ha)	1,530 du
	2,601 people

Based on a density of 180 dwellings per hectare, the 8.5 hectares to be developed will result in a net yield of 1,530 dwellings. Based on an occupancy rate of 1.7 people/dwelling unit achieved in Bowden/RSA development to date (information provided by Council), this represents a future population of approximately 2,600 persons.

In terms of housing mix, it is anticipated that approximately 60% of the overall dwellings will be in the form of townhouses, with the remaining 40% consisting of apartment buildings. This equates to approximately 900 townhouses and 600 apartments.

These dwelling numbers have been used to inform the technical investigations undertaken and therefore the associated infrastructure implications arising.

2. STRATEGIC CONTEXT

2.1 State Strategies and Directions

This section discusses State and local planning and development strategies of relevance to the subject land.

2.1.1 South Australia's Strategic Plan

The South Australian Strategic Plan (2011) identifies the planning priorities, principles and policies necessary to achieve community and economic targets outlined by the South Australian Government. The key principles of the Plan that are relevant to the DPA are listed in Table 2.1.

Table 2.1 SA Strategic Plan's Goals and Targets

Goals	Target
We are committed to our towns and cities being well designed, generating great experiences and a sense of belonging.	*1. Urban spaces: Increase the use of public spaces by the community*
New developments are people friendly, with open spaces and parks connected by public transport and bikeways.	*2. Cycling: Double the number of people cycling in South Australia by 2020*
Everyone can afford to rent or buy a home.	*7. Affordable housing: South Australia leads the nation over the period to 2020 in the proportion of homes sold or built that are affordable by low and moderate income households*
We reduce our reliance on cars in the metropolitan area, by walking, cycling and increasing use of public transport.	*63. Use of public transport: Increase the use of public transport to 10% of metropolitan weekday passenger vehicle kilometres travelled by 2018*
We want Adelaide to grow up more than out	*68. Urban development: By 2036, 70% of all new housing in metropolitan Adelaide will be being built in established areas*
South Australia has reliable and sustainable water resources and is a leader in wastewater, irrigation, storm water and groundwater management	*73. Recycled stormwater South Australia has the system capacity to harvest up to 35 GL of stormwater per annum by 2025.* *74. South Australia has the system capacity to recycle up to 50GL of wastewater per annum by 2025*

2.1.2 30 Year Plan for Greater Adelaide

The Study Area is identified in the *30 Year Plan for Greater Adelaide*, as a potential regeneration area. *The 30-Year Plan for Greater Adelaide* is underpinned by 14 principles. The 30 Year Plan was updated in 2017.

The DPA will help to deliver the outcomes associated with the policies in Table 2.2.

Table 2.2 30 Year Plan for Greater Adelaide Policies

Policy Themes	Policy
Transit corridors, growth areas and activity centre	*P1 Deliver a more compact urban form by locating the majority of Greater Adelaide's urban growth within existing built-up areas by increasing density at strategic locations close to public transport.* *P2. Increase residential and mixed use development in the walking catchment of:* · *strategic activity centres* · *appropriate transit corridors* · *strategic railway stations.* *P3. Increase average gross densities of development within activity centres and transit corridor catchments from 15 to 25 dwellings per hectare to 35 dwellings per hectare.* *P5 Encourage medium rise development along key transport corridors, within activity centres and in urban renewal areas that support public transport use.* *P6 Promote urban renewal opportunities and maximise the use of government-owned land to achieve higher densities along transit corridors.*
Design quality	*P26. Develop and promote a distinctive and innovative range of building typologies for residential housing which responds to metropolitan Adelaide's changing housing needs, reflects its character and climate, and provides a diversity of price points.* *P27. Provide for transitions between higher density and multi-storey, mixed-use developments in activity centres, corridors and existing detached housing precincts.* *P28. Promote permeable, safe, attractive, accessible and connected movement networks (streets, paths, trails and greenways) in new growth areas and infill redevelopment areas that incorporate green infrastructure.* *P29.Encourage development that positively contributes to the public realm by ensuring compatibility with its surrounding context and provides active interfaces with streets and public open spaces.*

The 30-Year Plan for Greater Adelaide (2010) identified the Bowden Village as a priority transit oriented development, and generally described the subject land as 'potential regeneration areas (non-corridor)'. The *30-Year Plan for Greater Adelaide Update (*2017) does not provide significant additional detail in relation to the subject land, however refers to the recent collaboration between the Adelaide City Council, City of Charles Sturt and Renewal SA, in relation to the Adelaide Parklands upgrade directly across the Bowden development, which provides:

- Shared-use path link (Park Lands Trail);
- Youth space – skateable area;
- Nature play area;
- Future community gardens;
- Kick about area with picnic facilities and shelters;
- Petanque piste (bocce);

- Basketball court;
- Tennis court with fence & rebound wall; and
- Retained soccer pitches.

The above provides relevant context in terms of the supply of sport and recreation facilities in proximity to the Study Area.

2.1.3 Strategic Infrastructure Plan for South Australia 2005/06 – 2014-15

The Strategic Infrastructure Plan for South Australia guides and coordinates the State's approach to infrastructure provision. It provides an overarching framework for the planning and delivery of infrastructure by all government and private sector infrastructure providers.

Metropolitan Adelaide is forecast to need approximately an additional 137,000 dwellings by 2030. While of more relevance for the city centre and inner suburbs, the Plan also notes an increasing number of smaller sized households (one to two persons) triggering a demand for smaller housing types.

The Plan recognises the "need to make future housing and urban design more responsive to changing community preferences and demographic trends including disability access and environmental sustainability design principles", with a particular focus on affordability.

Of particular note are the following strategic priorities, in relation to housing:

- Incorporate affordability objectives within the planning system so that the development approval process supports an appropriate supply of affordable and high need housing;
- Encourage higher-density residential development in appropriate urban areas through planning for land use and infrastructure augmentation; and
- Promote energy efficiency and environmental sustainability in new residential developments.

2.1.4 North West Corridor Structure Plan – draft for consultation 2011

The base corridor identified in the Structure Plan incorporates the Study Area. It follows the main railway line from the City of Adelaide to Port Adelaide. The boundary of the corridor is formed by applying 800 metre radii to each of the stations along the route.

In these areas, the following urban design and land use guidelines are anticipated:

- *Walkable neighbourhoods which cluster to form towns / villages with relatively intense, mixed-use town centres that are capable of fostering a broad range of employment and social opportunities and services;*
- *Universal and sustainable housing design principles in growth areas, corridors and transit-oriented developments reflecting a diverse community at all stages of life;*

- *15% affordable housing located close to jobs, transport and services;*
- *Forms of urban development that:*
    - *Minimise non-renewable energy use and car dependence;*
    - *Encourage greater local self-containment;*
    - *Protect natural and cultural assets;*
    - *Minimise potential for impacts such as air and noise pollution;*
- *A higher density, mixed-use, vertically integrated core within 800 metres of mass transit corridors with densities decreasing as a transition to adjacent neighbourhoods;*
- *Ordering the structure of community and providing opportunities for people at different stages of life to be physically active by ensuring neighbourhoods are within a walkable distance of community parks, town squares and piazzas;*
- *High quality buildings integrated at ground level with street activation;*
- *Well-designed, multi-functional open spaces;*
- *Urban environments that are celebratory of local culture and participatory in their development;*
- *Accommodating the bulk of growth in designated areas (new growth areas, transit-oriented developments and transit corridors) and ensuring the edge of the new built form is integrated and complements the existing character of Greater Adelaide.*

In relation to movement and access, the key objectives are as follows:

- A mix of land-uses that provides easy access—visually and physically—and prioritises walking, cycling and mass transit to serve the daily needs of the local population;
- A movement network which has a highly-interconnected grid-based street network that:
- Clearly distinguishes between arterial routes and local streets;
- Establishes good internal and external access for residents;
- Maximises safety;
- Supports mass transit;
- Encourages walking and cycling;
- Public realm responses that create sufficient space to accommodate foot / cycle paths including off-road (for example, a network of greenways incorporating local indigenous trees), as well as on-road cycling routes to destinations;

- Protecting current and future Strategic transport routes, major road and rail freight routes, freight handling facilities and land for future upgrades—consistent with the new urban form.

Environmental assets should be preserved, and green buildings are encouraged with green roofs/walls.

Community infrastructure will provide accessible services in a coordinated, cost efficient and equitable manner.

Bowden Station is identified as Station 04. The Study Area is identified as a mixed use infill opportunity, and more particularly as Corridor (Mixed Infill), where the following is identified:

- Mixed use with residential on upper storeys (4-6) storeys;
- Sensitive interface treatment adjacent heritage character; and
- Reduced setbacks and parking provision at the rear for new development.

Gibson Street is identified as a 'high street' for future mixed use infill of retail and commercial, with residential above. Chief Street is identified as a key connection to Hawker Street, with opportunities to strengthen its role.

2.1.5 Inner Metro Rim Structure Plan 2012

The Study Area is contained within Sector Plan 14 of the Plan, and is identified as a "Corridor (Mixed Infill)" area, in order to encourage higher density development of several storeys, which is complementary to Bowden Centre adjacent, and to promote active street frontages. Residential density of 70+ dwellings per hectare is encouraged in such areas.

The Study Area is also traversed by north-south/east-west primary local networks to encourage local movements between neighbourhoods. The Chief Street intersection in particular is identified for infill development and increased streetscape character.

It is envisaged that a sensitive interface should be achieved adjacent to character areas. Further, harmony should be achieved with the Bowden Urban Village Master Plan.

Policy recommendations are as follows:

- Recommended Zone module: Urban Corridor Zone;
- High street policy area to apply in corridor areas identified as high streets;
- Boulevard policy areas to apply in parts where large buildings are setback from the main roads with space for landscaping;
- Business policy area to apply in areas where commercial activity is a focus;

- Transit living policy area to apply in areas where residential activity is a focus; and
- Include affordable housing and noise and air emissions overlays.

2.1.6 City of Charles Sturt Community Plan 2016-2027

The Community Plan 2016-2027 has the following relevant objectives, listed in Table 2.3.

Table 2.3 Community Plan

Goal	Objective
Our Community	*Provide accessible social infrastructure and services that engage our diverse community.*
Our Liveability	*An urban environment that is adaptive to a changing and growing City.* *City assets and infrastructure are developed and well maintained on a strategic and equitable basis.* *Create valued urban places that bring people together and reflect local character and identity.* *Drive an integrated, responsive transport system and network.* *Enhance the quality and diversity of open and public spaces.*
Our Environment	*Continue to implement climate change mitigation and adaptation solutions.* *Enhance the state of the City's environment and biodiversity.* *Lead and educate to reduce the City's impact on the environment and build resilience.*
Our Economy	*Support and enable local business prosperity and growth*

The DPA will support these objectives.

2.1.7 City of Charles Sturt Strategy for Walking and Cycling (2015)

The City of Charles Sturt Strategy for Walking and Cycling was prepared for Council by GTA Consultants in 2015. The Strategy aims to place walking and cycling at the heart of the transport network in the city. The Strategy describes a vision for walking and cycling, evaluates the existing walking and cycling network, and provides strategies for designing and implementing walking and cycling infrastructure in the city.

The Strategy provides the following evaluation of the existing walking and cycling network in the City:

- *Around the majority of the City of Charles Sturt, the footpath provision is of good quality and can be considered adequate for the anticipated level of use. The future upgrade program can be expected to address any that are of particularly poor quality.*
- *The City of Charles Sturt is generally poorly served by on-road bike lanes. Along arterial roads, other than Port Road and East Avenue, most bike lanes are only available as dedicated facilities for 1.5 hours either morning or evening peak, according to the peak direction of travel.*
- *There are currently no on road bike lanes within the City of Charles Sturt that provide physical separation between cyclists and traffic lanes.*

The Strategy identifies Bowden as a high priority for implementation of walking and cycling facilities due to the suburbs proximity to the Adelaide CBD, access to public transport and local destinations, and low levels of car ownership and use.

The Outer Harbour Greenway is identified as an opportunity to provide a continuous cycle and pedestrian route from the CBD to Outer Harbour.

The Strategy outlines the following Strategies and Actions relevant to the subject Bowden/Brompton precinct:

- *11.3 Creating Liveable Communities - Safe and Attractive Local Streets: Implement upgrades to footpaths, crossings and street lighting to accommodate specific needs and local conditions where there are high levels of vulnerable users, especially elderly and young children.*
- *11.4 Integrating the Networks - Connecting People to Places: Increase footpath widths to achieve as much separation from traffic as possible, as part of upgrade and maintenance schemes.*

2.1.8 City of Charles Sturt Transport Plan (2016)

The plan seeks to address the themes listed in Table 2.4 that are relevant to these investigations.

Table 2.4 Transport Plan

Theme	Objective
Protect our environment and minimise our ecological footprint	*1.1 Integrate environmentally sensitive design elements into infrastructure and open space planning* *1.5 Work with our community and cycling groups to develop legible and connected cycling routes that promote active and healthy recreational use* *1.9 Work with our community to develop projects and initiatives on local streets, such as beautifying local streets and spaces with plantings, artwork, etc. as community spaces* *1.19 Implement lower speeds (40 km/h) in place of traffic controls to reduce the impact on the natural environment*
Create a safe, healthy and supportive community which encourages participation, creativity and diversity	*2.1 Create vibrant streets that promote personal interaction and walking by using place making principles, including street art and creating destinations for communities* *2.6 Review footpaths and where desirable upgrade to shared use paths* *2.13 Create local identity through street design and place making principles, including street art and street furniture to support use of these spaces* *2.17 Advocate for replacement of bus shelters and increased seating facilities at stops to improve public transport amenity* *2.22 Review the provision of kerbside parking and redesign streets to create safe and inclusive streets for communities*
Build an economically thriving and competitive city	*3.1 Work with property owners to promote underutilised footpaths and public spaces for business opportunities, such as cafes, vendors and market stalls* *3.5 Establish bicycle support facilities and maintenance hubs in businesses 3.15 Advocate for public transport facilities and services to improve access and property investment* *3.21 In areas with high demand by customers for kerbside parking, provide equitable sharing of available space through time restrictions and paid parking*

Theme	Objective
Demonstrate effective leadership with strong community collaboration	*4.12 Develop a set of planning policies that give priority to urban development focused on liveable streets and places, and support transport choices*
Build healthy, functional and attractive neighbourhoods	*5.1 Work with the Department of Planning, Transport and Infrastructure to ensure the walking network includes convenient access across main roads and railway lines* *5.7 Review recreational and commuter routes to identify and protect existing open space for future cycling improvements* *5.16 Advocate for well serviced and modern vehicles to create a desirable transport service* *5.20 Review construction guidelines for alternative streetscapes to calm traffic, such as road narrowing and shared streets*

2.1.9 Charles Sturt Open Space Strategy 2025

The City of Charles Sturt Open Space Strategy 2025 (2015) comprises a *Background Report* and a *Directional Report.* The *Background Report* outlines and reviews research findings and considers the issues and opportunities for open space in the City. The Direction Report provides objectives and strategic direction for implementation.

The *Background Report* provides an analysis of the population character within the Bowden/Brompton DPA precinct as follows:

- *A good provision of quality open space will be required to support medium density development.*
- *New residents born overseas would benefit from places for people to gather and connect.*
- *Opportunities for active lifestyles required to support younger adults, including walking and bike riding.*
- *Potential demand for family oriented recreation spaces with play spaces, particularly for smaller children.*

The *Background Report* outlines the following open space issues relevant to the subject Bowden/Brompton precinct:

- *Some areas are lacking open space;*
- *Disconnected parcels of open space with few linear connection;*
- *Quality issues with some open space and potential to increase destination value;*
- *Poor streetscapes and footpaths in some area;*
- *The precinct will have higher densities and as such parks and reserves in this area could justify being a higher standard and the inner city character of the area could require a greater focus on creating open space connections and place making;*

- *Parts of the precinct are lacking destinations and opportunities for creating higher level parks and reserves in these areas should be considered.*

The *Direction Report* identifies the following opportunities relevant to the subject Bowden/Brompton precinct.

In relation to greenway opportunities:

- *Theme 4, Open Space Connections: Continue to support the State Government in the development of quality pathway and streetscape connections along the proposed Outer Harbour Greenway, with a particular focus on the inner city areas and improving linear connection (Medium Priority).*

In relation to streetscape opportunities:

- *Theme 4, Open Space Connections: Enhance streetscape connections through pathways and landscaping, with a particular focus on providing appealing streetscapes around destinations, sportsgrounds and through main roads - Chief Street (Medium Priority).*
- *Theme 4, Open Space Connections: Maintain and strengthen links to adjoining Council areas through pathway networks, safe road crossings and way finding, particularly to access adjoining open spaces - Adelaide Park Lands via Bowden Development (Medium Priority).*
- *Theme 6, Landscape Design and Innovation: Enhance streetscape design and diversity across the City to improve the amenity and walkability of streets, strengthen the connection between streets and open spaces and reinforce streetscapes as an extension of open space. Particular priorities include:*
    - *Between the transport corridors of Torrens Road and Port Road.*
    - *The landscape treatments of streets in new urban development areas to reduce the impact of higher density developments and reduce the associated Urban Heat Island Effect (UHIE) of hard surfaces.*

In relation to place making and place activation opportunities:

- *Theme 8, Place Making and Place Activation: As part of creating and activating recreation destination and regional open space, undertake place making initiatives that draw people to the places - Gibson Street Reserve (High Priority).*
- *Theme 8, Place Making and Place Activation: Within urban regeneration areas and redevelopment programmes, encourage place making opportunities and programmes that retain the area's sense of place, encourage social interaction and create a new sense of community. This could be considered in Bowden (Medium Priority).*

The following directions for specific parks and reserves are identified in the *Direction Report*:

- *Ethelbert Square, Recreation Park: As part of future residential development around Ethelbert Square and in the Bowden Development area, create a higher level park to support gatherings, events and activities.*
- *Bowden Development, Recreation Park: As part of the Bowden Development, aim to establish two larger higher level neighbourhood parks (with one reserve located on Chief Street) that will provide a local focus for play, gatherings and events. Good linear connections between these open spaces should also be considered.*
- *Open space links along Chief Street, Drayton Street and Sixth Avenue are also identified for development of improved open space connections.*

The *Direction Report* also identifies recommendations and actions for implementing the strategy. This includes funding considerations and opportunities, precinct plan directions, open space guidelines and an open space works matrix.

2.1.10 Inner West Precinct Place Making Framework (IWPPMW)

The IWPPMF identifies Ethelbert Square as a "breathing space", and notes the following opportunities.

In relation to open space:

- *1.2 Rezoning of lands to the southeast side of Ethelbert Square from industrial to residential and redevelop the square focusing on the removal of some parking, development of east/west pedestrian links (repairing the square) and increased levels of amenity that encourages community activation and increased residential development (high priority).*

It should also be noted that the framework considers the establishment of additional facilities in the adjacent Bowden Development (e.g. skate park and other purpose built facilities). Ethelbert Square is further identified as a potential event space:

- *5.2 Develop place making events within Ethelbert Square to suggest new approaches and activation that encourages a reunification of the square and a reduction in the impact of Chief Street at this location (linked to project 1.2) (high priority).*

In relation to "threads" and connections:

- *2.3 Improve the function of Hawker Street as a critical public space east/west through the precinct and seek to encourage the pedestrian/cycle amenity and function of the road through seating, landscape, paving, bike lanes and public art, while balancing public transport demands and the limitations of the road width (high priority).*
- *2.4 Develop Chief Street as a major public realm thread, building on the urban design proposals associated with the Bowden Development and the creation of a share use road corridor (medium priority).*

- *2.5 Develop McInnes, First and Second Streets as a continuous link that capitalises on the crossing point associated with South Road and Park Terrace (medium priority).*

In relation to developing place precincts (i.e. "destinations that have the potential to support social interaction and build communities"):

- *4.1 Explore opportunities to support the existing Place Precinct that is developing around the local centre on Hawker Street. Investigate policy changes that encourage the development of the precinct (outdoor dinner), streetscape upgrades and community involvement in future projects (high priority).*

Hawker Street is further identified as a potential event space:

- *5.3 Undertake events and programmes that increase the significance of Hawker Street and its Place Events and support existing businesses in order to create an important community centre for the Precinct (linked to project 2.3) (medium priority).*
- *5.7 Explore place making projects that encourage activation and connections between Chief Street, First Street and the developing open space of the Bowden Development, recognising the State heritage significance of the Gasworks Wall (potential of the wall as a canvass) (linked to projects 2.4, 2.5) (high priority).*

It is noted that the adjacent Bowden Development plays a key role in the area in terms of place making opportunities.

2.1.11 Planning for Social Infrastructure and Community Services for Urban Growth Areas – Service Planning Model

The report identifies key trends in relation to social planning. These include:

- New facilities in a centre should be easily accessible by public transport, connected to pedestrian and cycling networks, near open space, ideally at ground floor;
- New facilities centralised locations should be clustered with other activity generating uses (e.g. shops, other facilities);
- There is an increasingly important role of providing social gathering and meeting spaces in higher density residential areas with limited private open space;
- Community facilities should have a civic quality, sense of stability and level of amenity that marks them as an important place in the community;
- Co-location of community services is encouraged, involving shared use of buildings; and
- Multipurpose facilities are encouraged.

These trends will be considered during the preparation of these investigations and the DPA. In relation to facility hierarchy, the model identifies the following categories listed in Table 2.5.

Table 2.5 Service Planning Model

Level	Population Served	Facility Types
LGA Wide	*100,000+*	
District	*20,000-50,000*	*Major cultural or civic facilities – civic centre, performing arts, central library* *Major recreational and sporting facilities including major stadia* *Tertiary education such as TAFE, university* *Health services* *Higher order entertainment or leisure facilities*
Local	*5,000-10,000*	*Primary school* *Community hall or small community centre* *Child care centre or kindergarten* *Access point for family support, health care and other forms of support services*
Neighbourhood	*2,000-3,000*	*Space for informal meeting and gathering* *Space for local programs and activities such as playgroup, dance classes, etc.*

These investigations will project the future population growth in the Study Area, and potential future demand for community facilities.

The Study Area is located within the Eastern District, in close proximity to:

- Bowden Village: LGA wide cultural/performing arts centre, co-located with local level community meeting space; and
- Hindmarsh/Bowden Activity Centre: district library, multipurpose community centre, LGA wide cultural/performing arts centre.

The report acknowledges that Bowden Village and Hindmarsh/Bowden Activity Centre could be combined into a single community hub. It also recognises that:

> *Given the trends towards larger, more multipurpose facilities that support larger catchments it may be the case that future plans for social infrastructure may not include the creation of new neighbourhood, and perhaps even local level, community facilities.*

This can be implemented in the form of partnerships between schools, churches, sporting groups or other organisations.

2.2 Previous/Current Development Plan Amendments

2.2.1 Ministerial Bowden Urban Village and Environs DPA

The DPA was approved on 5 July 2012. The purpose of the DPA was to allow for the development of new housing and complementary retail and commercial buildings, open spaces and transport infrastructure on former industrial land in Bowden, adjacent to the study area for the Bowden-Brompton DPA.



Figure 2.1 Bowden Urban Village and Environs DPA Affected Area

The DPA created a new Urban Core Zone with a Main Street Policy Area to create a community hub and activity node for residents and businesses. It also introduced specific policies to address interface issues with adjoining industrial areas which incorporate the Study Area as shown on Figure 2.1.

2.2.2 Urban Employment Zone DPA

The DPA was gazetted on 31 October 2017. It incorporates the Study Area for the Brompton-Bowden DPA, identified as the Bowden, Brompton and Eighth Street precincts. These are categorised as secondary industrial precincts. Of relevance to the Brompton-Bowden DPA, the DPA sought to:

- Replace the City's Industry Zone with the Urban Employment Zone Module from the SAPPL; and
- Maintain the current Industry Interface Area with proposed amendments.

With the DPA approved, the whole of the Study Area has now been replaced by the Urban Employment Zone, with the exception of the Local Centre which was retained. The development of a wide range of activities including industry, commercial uses and retail, is anticipated.

The proposed Desired Character for the Zone states that:

> *In Brompton, a sense of enclosure is desired to Ethelbert Square and can be achieved with buildings fronting the Square of minimal or no setback and of appropriate scale and built form to provide a hard edge around the perimeter.*

Further:

> *Eighth Street, Bowden comprises workers cottages of historic value that display a distinct social and historical character and that are outstanding examples of the unique working class residential heritage found in the narrow streets in Bowden. The area acts as an interface between industry to the south and residential areas to the north. It is envisaged that the area should accommodate a variety of uses, such as small offices, consulting rooms, adaptation of historic housing or industry which is suited to an interface environment.*

2.3 Background Documentation and Analysis

2.3.1 Council Site Analysis Plans

Council undertook an initial high level site analysis when considering the proposal for a privately funded DPA. The analysis considered the following key points:

- Building height in adjacent areas: most of adjacent areas have height limits ranging between 2 and 3 storeys, with land to the south subject to height limits ranging between 3 and 8 storeys;
- The study area is adjacent to the Urban Core Zone to the south;
- Non-residential uses should be primarily provided along Hawker & Chief Streets;
- There are a range of considerations in relation to traffic movements, including road widening, intersection realignments, improved pedestrian and cyclist connections;

- The south-western and north-eastern corners of the study area adjoin historic areas and/or listed heritage places;
- The study area contains localised areas that are prone to flooding (predominantly south of Ethelbert Square and along the south-north axes);
- Bus stops exist on Hawker Street, with the Bowden Train Station located approximately 350 metres to the south of the study area and the tram stop approximately 450 metres south of the study area;
- Ethelbert Square was identified for potential upgrade, potentially involving public art, with additional pockets of open space proposed to the south of the study area as part of the RSA development;
- Enhanced linkages to and within the Study Area should be provided;
- Tree plantings should be maintained and/or provided on north-south axes;
- A number of potentially regulated or significant trees exist within the study area and should be retained if possible;
- Integration with the adjacent RSA Bowden development should be seamless; and
- EPA licensed activities exist within the study area (Detmold and Conroy's Smallgoods).

2.3.2 City of Charles Sturt Industrial Land Study (2008)

The Study Area is contained within the Inner East District, and is more particularly identified as the Bowden/Brompton Precinct. The precinct was identified as an area in transition following the decision by Clipsal to relocate.

Further, it was stated that:

- *"even if Clipsal were not relocating, the overall standard as an industrial precinct is sub-optimal, especially given its near city location, with very little modern development in evidence, poor internal access for large vehicles and significant areas of apparently under-utilized (and sometimes contaminated) land;*
- *if, on the other hand, it (the Clipsal site) is not retained as industrial land, then the industrial outlook for the whole precinct will be greatly diminished because it will lose critical mass and will be largely hidden away, with poor access;*
- *the (then) impending departure of Clipsal therefore provides a timely catalyst for a complete rethink of the current zoning."*

The need to reconsider the desired future use and character of the area was anticipated by this study, including rezoning "the entire precinct to either Mixed Use and/or for high density Residential".

2.3.3 Residential Yield Analysis Project (2013)

The Study Area is located within the Inner West Precinct (1), where a residential yield of approximately 1,973 dwellings (3,749 population) was identified. The highest residential density modelled for the whole of the project was applied to parts of this precinct (100 dwellings per hectare). Based on the yield, it was projected that 7.5 hectares of open space would be required.

It is also noted that:

> *Parts of the precinct also accommodate a significant number of non-residential activities, some of which are incompatible with residential development because of associated noise, other emissions, traffic generation etc. Accommodating infill residential and mixed use development in parts of this precinct, particularly in parts of Bowden, Ridleyton and Hindmarsh, will require careful planning*

The report also highlighted that portion of the Study Area (Bowden) was included in those suburbs that have lower level of public open space (i.e. less than 5% public open space, and less than 2 hectares per 1,000 people).

The Inner West Precinct was ranked as the first of eight precincts to be prioritised for future planning policy changes to accommodate infill residential development (based on the consideration of 13 assessment criteria). Strengths and weaknesses of the Inner West Precinct were identified as follows in Table 2.6.

Table 2.6 Inner West Precinct

Strengths	Weaknesses
• Excellent public transport • High potential yield • Proximity to CBD / employment • Underutilised land • Leverage off Bowden Village project	• Impacts from industry • Heritage • Other incompatible activities • Relatively poor level of other services

2.3.4 Brompton Village Rezoning Preliminary Infrastructure Investigations – Preliminary (2014) Fyfe Pty Ltd

Preliminary infrastructure investigations were undertaken to inform the potential for a rezoning of the Study Area.

It was identified that:

- The Study Area can be serviced by water (potable, waste & recycled), power, gas and telecommunications;

- Based on the costs provided in this report (SA Power Networks) and based on the understanding of the potential augmentation charges (SA Water) has applied in other similar instances, development was to be able to occur in a cost effective manner. Telecoms and gas reticulation connections were likely to be at no charge (except for the supply of the open common service trench).

These investigations have been reviewed and refined as part of this project.

2.3.5 Brompton Village Rezoning Transport Impact Assessment (2014) GTA Consultants

GTA Consultants were engaged in 2014 to prepare a Transport Impact Assessment (TIA) for the potential rezoning (and subsequent redevelopment) of the subject site from industrial to residential and commercial uses. The GTA assessment report detailed a review of the existing street network, public transport and non-vehicular accessibility, parking demands, access arrangements and the overall impact of the potential redevelopment on the existing transport networks.

The GTA assessment was based on the following potential development yields:

- 300 to 400 townhouses; plus
- 1,000 to 1,200 apartment dwellings; plus
- 3,000 m^2 of commercial gross floor area.

Based on these yields, the GTA assessment forecast that up to 5,800 vehicle trips per day could be generated following redevelopment of the site. In comparison to the existing/previous land uses, this was estimated to equate to the distribution of an additional 2,900 vehicle trips on the road network (within and surrounding the site).

Impact analysis was undertaken by GTA using SIDRA modelling software for key intersections within and adjacent the study area. The key findings of the GTA assessment were that:

- No upgrade of the Hawker Street/Chief Street was warranted as a result of the redevelopment of the subject site;
- An upgrade of the Park Terrace / Hawker Street intersection was required to accommodate general increases in traffic flows (including the development of the adjacent Bowden Urban Village). The upgrade, which included additional through lanes and extended turn lanes, has been undertaken since the preparation of the GTA assessment;
- No further upgrade of the South Road/Hawker Street intersection would be required (following completion of South Road upgrade works) to accommodate additional traffic generated by redevelopment of the subject site;
- No upgrade was warranted for the Torrens Road/Chief Street intersection as a result of the redevelopment (minor increases in delays for right turns were identified but considered to be within acceptable levels);
- Previous studies prepared for the Bowden Urban Village project identified that the intersections of Sixth Street/Park Terrace and Chief Street/Port Road would reach capacity by 2031 and require upgrade. The GTA assessment, however, considered the distribution of traffic associated with the redevelopment of the subject site to this intersection to be low and any upgrade requirements for the intersections should not be attributed to the subject site.

In addition to road network impacts, the GTA assessment also included consideration of walking and cycling considerations associated with the redevelopment of the site, namely it was recommended that:

- Footpaths be provided on both sides of existing and proposed roads to support a high level of walkability;
- Road design maximise connectivity for walking and cycling and include supporting infrastructure, such As seating and lighting;
- Cycling should generally be accommodated in a shared on-road environment with supporting low speed road design with supporting bicycle parking to be provided in key locations (such as the proposed commercial area);
- Allowance be made for a continuous off-road cycle path between Hawker Street and Second Street/Sixth Street; and
- Consideration should be given to the provision of an off-road cycle path between the proposed commercial area (near Hawker Street) and Gibson Street with connection to the BUV High Street.

GTA identified that a rate of 0.75 spaces per dwelling has been adopted for residential development within the Bowden Urban Village.

For commercial uses, the GTA identified a parking provision rate of 3 spaces per 100 m^2. Such a rate is consistent with parking provisions for commercial uses in areas of urban renewal and higher residential densities.

2.3.6 Preliminary Environmental Assessment – Proposed Brompton Village Rezoning Site (2014) Fyfe Pty Ltd

Fyfe investigated the potential for site contamination, air quality and/or noise constraints of properties in the Study Area to impact on a future mixed use/residential zoning of the area. The investigation was a limited desktop study supported by an inspection of the area from the road reserves.

The Study Area has had a long history of industrial use. It was found that 85% of the Study Area was occupied by six major commercial/industrial land holders, with the balance occupied by residential properties and smaller commercial/industrial properties.

A range of potential sources of soil and groundwater contamination were identified by the study, including above ground and underground fuel storage tanks, chemical storage areas, the use of chemicals, the generation of waste streams in the manufacturing processes, the possible use of imported fill material, and the possible burial of wastes including industrial wastes in excavations and in former pugholes. There was also the possibility of contaminated groundwater migrating into the study area from adjacent sites including the former Brompton Gas Works and the Gerard Industries/Clipsal properties.

The Department of Environment, Water and Natural Resources (DEWNR) is not likely to issues permits for taking groundwater for domestic purposes in the Study Area, although permits for drainage, monitoring and industrial purposes may be approved.

The report concluded that there was likely to be a range of contaminated soil and groundwater contamination issues present in the Study Area. It was not considered necessary to undertake further contamination assessment or remediation works prior to re-zoning. Rather it was considered that the established South Australian site contamination audit process that involves detailed site investigations and site contamination audits would be required at the development application stage where a change to a sensitive land use is proposed.

Potential for noise and air quality emissions from some of the industrial properties in or adjoining the Study Area has been identified which may impact on some future residential developments in the study area. Impacts from sources beyond the study area were considered to be relatively minor and not a major constraint on the redevelopment of the area. Some additional noise and/or odour control measures may need to be installed on some of the industrial processes in the Study Area if nearby residential developments were to be occupied whilst the industries remained operational in the Study Area.

The soil and groundwater contamination issues likely to be present were considered to be unlikely to preclude future residential uses of the Study Area, assuming the routine environmental planning and site contamination audit processes are followed.

Implications for the Study Area

It should be assumed that the Study Area is subject to at least some soil and groundwater contamination. The presence of any such contamination should be assessed and managed as an integral part of individual site development projects. Site contamination is unlikely to impose significant constraints on redevelopment concepts for the study area, other than a possibility that residential developments on former pughole sites may be undesirable.

2.3.7 Brompton Human Services Analysis (BHSA)(2014)

The BHSA concluded that the Study Area is well serviced by facilities located in the wider locality, with a range of public transport providing easy access to the CBD and range of facilities and services.

It was noted that demand for education will be accommodated within existing or future (i.e. new CBD high school) establishments;

It was stated that in respect to recreation, any additional demand should be accommodated within existing facilities. The Study also identified underutilised open space and opportunities for improved walking and cycling connections.

It was also stated that “only a couple of additional aged care packages will be required” (with no land use implications).

No demand was identified for additional community facilities or emergency services in the Study Area.

Redevelopment of the study area is likely to trigger demand for the following additional services, with such services ideally located within the study area:

- GP’s and some other allied medical and health professionals; and
- Child care.

2.3.8 Inner West Precinct Transport and Parking Plan (2015)

AECOM (with URPS) prepared the Inner West Precinct Transport and Parking Plan (IWPTPP) in 2015 for the City of Charles Sturt. The study included a review of transport and parking issues within Brompton, Bowden, Hindmarsh and Ovingham. In particular, the study considered the potential impacts associated with ongoing development and increased residential densities within these suburbs. The study identified that in the order of 5,500 new dwellings and 20,000 additional vehicle trips could be generated by infill development and urban renewal within the IWPTPP study area by 2031.

In order to manage increased pressures on the road network, the IWPTPP included a focus on the promotion of active and sustainable transport modes as well as an equity of access to on-street parking. The IWPTPP detailed six key themes in relation to ongoing transport strategies for the area, namely:

- Encourage walking and improve associated facilities/infrastructure;
- Encourage cycling and improve associated facilities/infrastructure;
- Encourage public transport use and improve associated facilities/infrastructure;
- Manage traffic, driver behaviour and vehicle control;
- Parking management; and
- Improve safety, amenity and social interaction.

Relevant to the subject Bowden/Brompton Study Area, the IWPTPP recommended that:

- Chief Street be reconstructed as a pedestrian boulevard (this related to a significant improvement to the pedestrian environment, however included retention of Chief Street as a key road connection);
- Footpaths within the precinct be widened to 1.5 metres;
- Cycling links should be established through the precinct;
- Consideration should be given to a bus route along Chief Street (however would be subject to significant works at the Chief Street road underpass associated with the rail line);
- The potential for a network of one-way streets should be investigated within Brompton;
- A car parking fund should be established for developers to provide contributions to in lieu of meeting statutory parking provision requirements;
- On-street parking control policies should be implemented; and
- Placemaking opportunities should be developed to improve safety and amenity within the precinct.

2.3.9 EPA advice on the Study Area and Adjacent Land (2016)

In a letter to the City of Charles Sturt dated April 2016, the EPA reviewed the Fyfe 2014 report and information they held on EPA licensed facilities in and adjacent to the Study Area.

In addition to the information presented in the Fyfe report, the EPA identified the potential for former pugholes to have been filled with uncontrolled wastes, including waste from the Brompton Gas Works.

The EPA noted that extensive soil and groundwater contamination exists across the Bowden/Brompton area as a result of historical and current potentially contaminating activities, and that the Study Area may have similar site contamination issues.

They recommended that the Fyfe 2014 report be updated to meet the scope of a Preliminary Site Investigation (PSI). Specifically the PSI should identify the potentially contamination land uses and activities (including historical activities) within the Study Area.

The EPA also recommended that the DPA should include measures to ensure that appropriate site contamination environmental assessment processes (including the need for a site contamination audit where required) are undertaken at the development application stage, particularly where a change to a more sensitive land use is proposed.

The EPA letter also included new information about the operation of five licensed activities in or near the Study Area.

The Conroy's Smallgoods business operates a smoker in an undercover area that is open to the environment. The smoker is an open fire pit where sawdust is smouldered. Odour (and possibly smoke) from this activity could potentially impact on future nearby residential developments. Noise generating activities were attributed to vehicle and forklift movements. About 30 complaints had been received by EPA since 2002, primarily in relation to odour.

The EPA has advised that Conroy's Smallgoods is located within the affected area and is licensed by the EPA for the activity of curing or drying works. The recommended evaluation distance in the Evaluation Distance publication is 500m due to the potential for nuisance odour and smoke issues when the product is smoked.

Smokers are used to produce the smallgoods and the EPA understands that the technology used is old and has not been upgraded. Consequently the EPA is concerned about the potential impact of fine particles from smoke on the health of sensitive receptors within the recommended evaluation distance.

The EPA recommends that the evaluation distance remain at 500m.

Whilst there is an advisory separation distance of 500 metres between the Conroy's facility and residential dwellings, EPA offers to work with Conroy's to improve their operations so that they could coexist with residential neighbours. In addition there would be a need for odour modelling to predict impacts on sensitive uses and a need for an acoustics report.

The Detmold facility has been the source of some odour complaints, the most recent being in 2015. The odours are thought to be sourced from chemicals used to clean flexographic printing plates used on the site. Whilst there is no recommended separation distance for facilities such as Detmold, the EPA identified mechanisms for noise and odour impacts to be considered should residential development approach the Detmold site.

Nearby facilities outside of the Study Area (Dominant Pty Ltd and Molnar Engineering Pty Ltd) to the west of the study area were considered by EPA to be sufficiently far from that study area as to be unlikely to impact on any proposed residential redevelopment. The EPA letter states that the EPA has worked with the SA Brewing Company Pty Ltd in recent years and odour reductions from the brewery of up to 90% have been

achieved. The EPA now considers that future residents in the study area would not experience unacceptable odour emissions from the brewery.

It is noted that the above advice was provided prior to the release of the "Evaluation Distances for Air Quality and Noise Management by the EPA in 2016.

2.3.10 Policy Implications for the Study Area

Based on the above, it is considered that the anticipated land use (i.e. mixed use/residential with commercial and retail) for the Study Area is consistent with previous work reviewed in this section.

While further investigations have been undertaken to inform this rezoning proposal, it is noted from previous studies that:

- The Study Area is adjacent residential areas, zoned as Urban Core, Residential and Residential Character;
- Non-residential uses should be primarily provided along Chief and Hawker Streets;
- The Study Area is an area in transition and rezoning the land to mixed use and/or high density residential is desirable;
- There are localised areas of flooding within the Study Area that should be addressed;
- Integration with the Renewal SA Bowden redevelopment should be seamless;
- EPA licenced activities exist within the Study Area that may limit or constrain new development until such a time as they are relocated;
- The Study Area has a long history of industrial use however these contamination issues are unlikely to preclude residential uses within the Study Area assuming routine environmental planning and contamination audit processes are followed;
- No new school and community services are considered necessary within the Study Area;
- Requirements for human services were likely to be relatively limited;
- No apparent issues are likely to exist in relation to civil infrastructure including water, sewer, gas, power and telecommunications.

Further implications for the Study Area are identified as part of the additional investigations undertaken in sections 3 and 4 of this report.

3. SITE ANALYSIS INVESTIGATIONS

3.1 Existing Uses and Ownership

The Study Area is approximately 11.44 hectares in size. It is predominantly occupied by under-utilised or former industrial facilities.

As shown by Figure 3.1 on the following page, there are six major industrial properties encompassing approximately 9.71 hectares of the Study Area, with the remainder of the Zone comprising smaller properties including commercial, industrial and residential land uses.

The six main land holdings include:

- Marble & Cement Group (Figure 3.2 left);
- Conroy Smallgoods Pty Ltd (Figure 3.2 right);
- HAAE Pty Ltd (Figure 3.3 left);
- Detmold Group (Figure 3.3 right);;
- Gerard Group; and
- Kennett Pty Ltd.

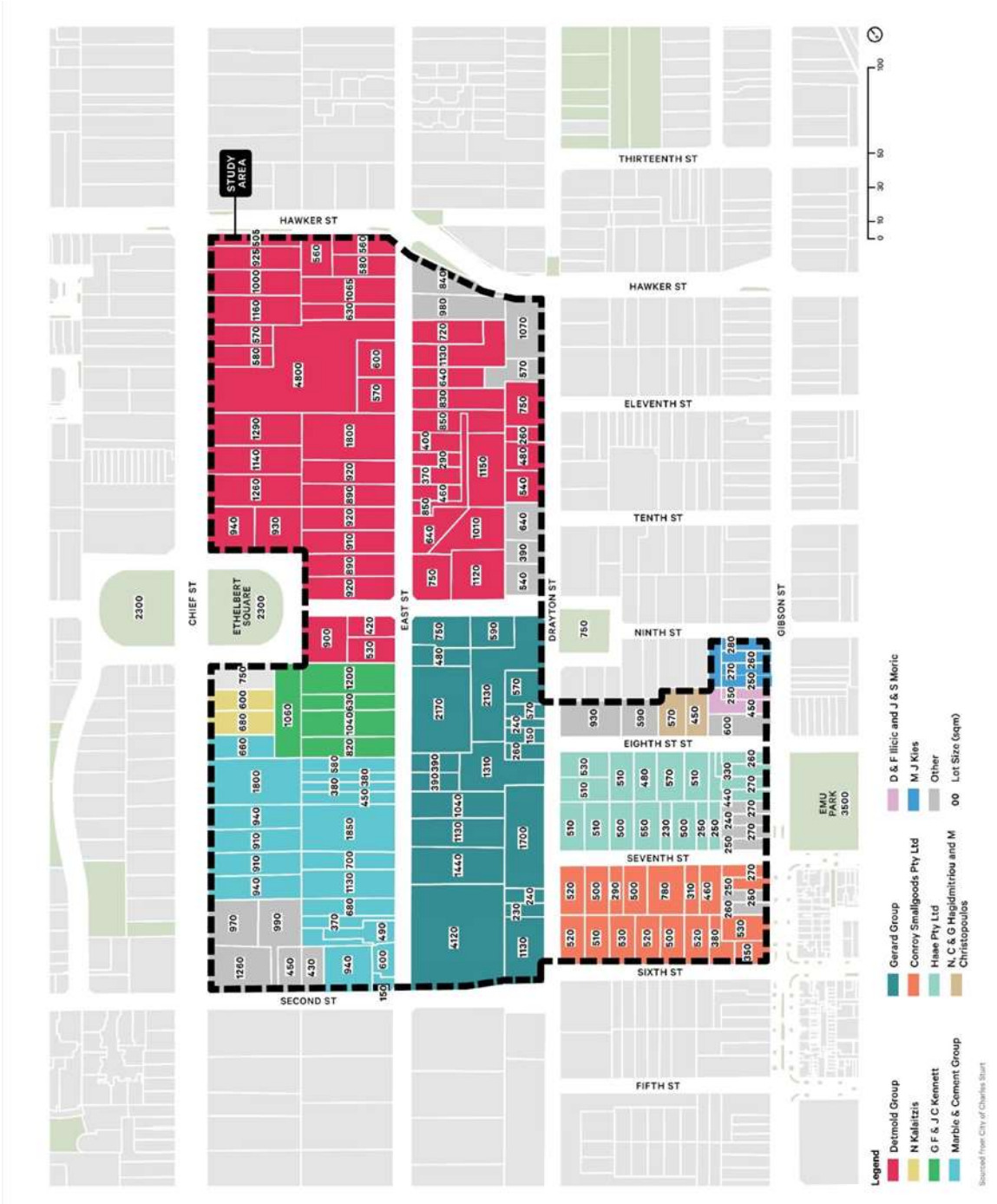


Figure 3.1 Ownership



Figure 3.2 Marble & Cement (left) – Conroy (right)



Figure 3.3 HAAE (left) – Detmold (right)

It is understood that Marble & Cement Group and HAAE Pty Ltd have now ceased operations, and that Detmold Group is looking to relocate within the next 3 years.

A small number of residential properties exist throughout the Study Area.

A small pocket within the northern portion of the Study Area at the corner of Drayton Street and Hawker Street, zoned Local Centre. It includes small scale commercial and retail tenancies.

Policy Implications for the Study Area

The Study Area has highly fragmented pattern of allotments, however ownership is highly consolidated.

Many of the uses within the Study Area have ceased, or signalled intention to vacate in the short to medium term, facilitating rezoning of the land within the Study Area.

Many of the buildings within the Study Area are at the end of their economic life.

Should the land be rezoned, these factors are considered to result in a rapid uptake of re-development opportunities.

3.2 Topography

As shown by Figure 3.4 on the following page, the land is generally flat, with a gentle fall towards the north-west. The existing surface level varies from approximately 19mAHD at the south-eastern corner of the site to approximately 15m AHD at the Hawker Street and Chief Street intersection.

Due to existing uses, the Study Area predominantly contains impervious surfaces. It drains mainly into 5 different locations located in Second Street, Gibson Street, Sixth Street, Third Street and Hawker Street.

Two areas of flooding exist, as described in the Stormwater Management Master Plan prepared by Fyfe (Appendix A), and as shown by Figure 3.5. The flows enter into the properties from East Street and Drayton Street.

Policy Implications for the Study Area

The Study Area is relatively flat and already highly impervious.

Flooding issues affecting the Study Area currently require the introduction of new stormwater infrastructure as part of any rezoning to support future new uses.

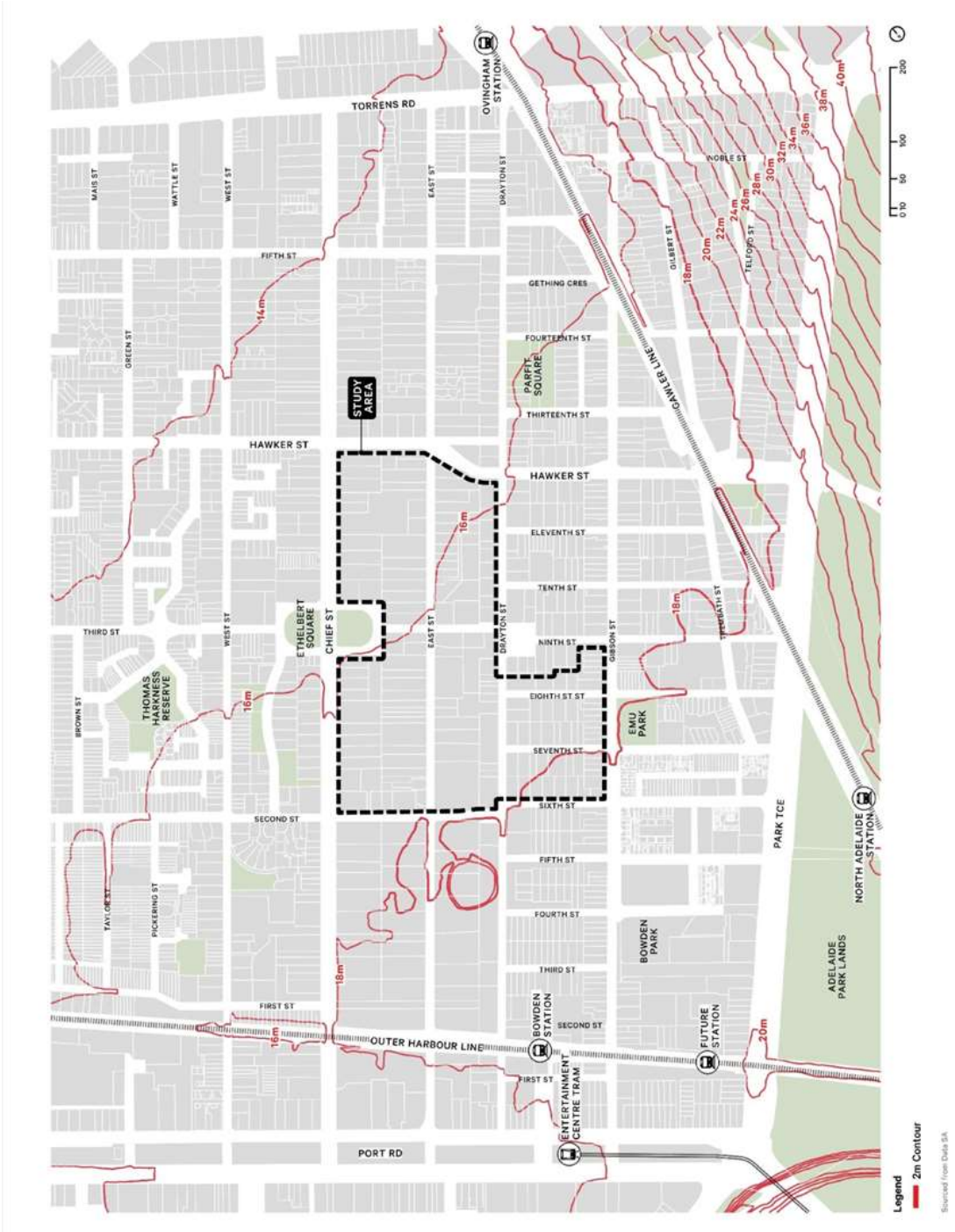


Figure 3.4 Topography



Figure 3.5 100 year ARI Flood Map

3.3 Heritage

As shown by Figure 3.6 on the following page, two properties are listed as a Local Heritage Place in the Study Area (78 Gibson Street and 29-39 Eighth Street Bowden).

A number of heritage listed properties directly adjoin the Study Area, mainly in the form of dwellings, as well as the following State Heritage Places:

- The Gaslight Tavern at the corner of Chief Street and Second Street;
- Former Way Memorial Bible Christian Church at the corner of Sixth Street and Drayton Street;
- Anglican Church of the Good Shepherd Missing, at the corner of Hawker Street and Drayton Street; and
- Attached dwellings at 69-77 Drayton Street, Bowden.

Another key heritage element is formed by the old Brompton Gas Works located between Chief Street and East Street, to the south of the Study Area.

Policy Implications for the Study Area

The Study Area contains a relatively small number of properties affected by heritage considerations.

Identified heritage properties are located at the edges of the Study Area.

Identified heritage properties are generally located on separate allotments and are not located within areas of large contiguous ownership where their retention may restrict general redevelopment of large parcels.

Identified heritage properties are already recorded in the Development Plan and afforded protection and do not require additional measures to ensure their retention.

The presence of these heritage places within the Study Area is not considered to be a barrier to rezoning.

Future development will need to by sympathetic to the identified State Heritage Places.

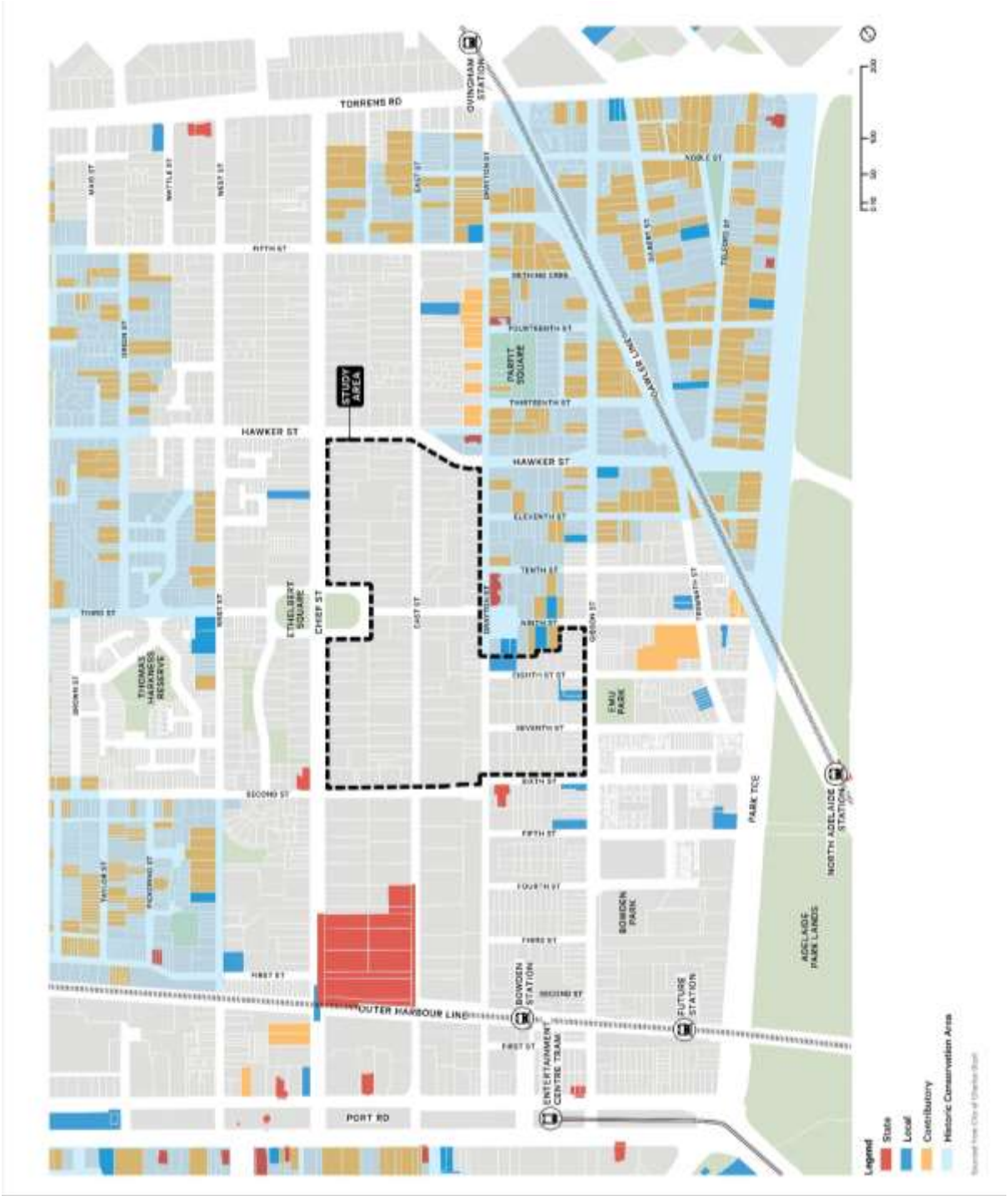


Figure 3.6 Heritage

3.4 Existing Vegetation

As shown by Figure 3.7, existing vegetation of note includes:

- Street trees and garden beds along Drayton Street (east and west), Gibson Street (east and west), Chief Street (east and west), Hawker Street (north and south); Ninth Street (north); Eleventh Street (north);
- Trees within private properties, some of which may be regulated and/or significant.

There are a total of five trees identified as potential Regulated or Significant Trees within the Study Area. These are located within private property and no access was possible to confirm the status of these trees.

Given the former industrial nature and the general lack of public open space within the Study Area, these trees are considered to be both notable and worthy of retention. They are located generally close to boundaries and are associated with either residential properties or small individual allotments within the Study Area not forming part of a larger consolidated site, with the exception of the tree adjacent eighth street.

In addition to these trees, there are two smaller plantings of trees associated with landscaping areas in front of buildings and builders yards along East Street. Whilst these trees are a notable element within the East Street streetscape where there are no street trees. These trees are not identified as either Regulated or Significant Trees.

Chief Street has a streetscape that is strongly characterised by a well-established planting of London Plane Trees. Drayton Street and the western end of Hawker Street also have street tree planting. These streets are notable within the Study Area as the only streets with any street tree planting.

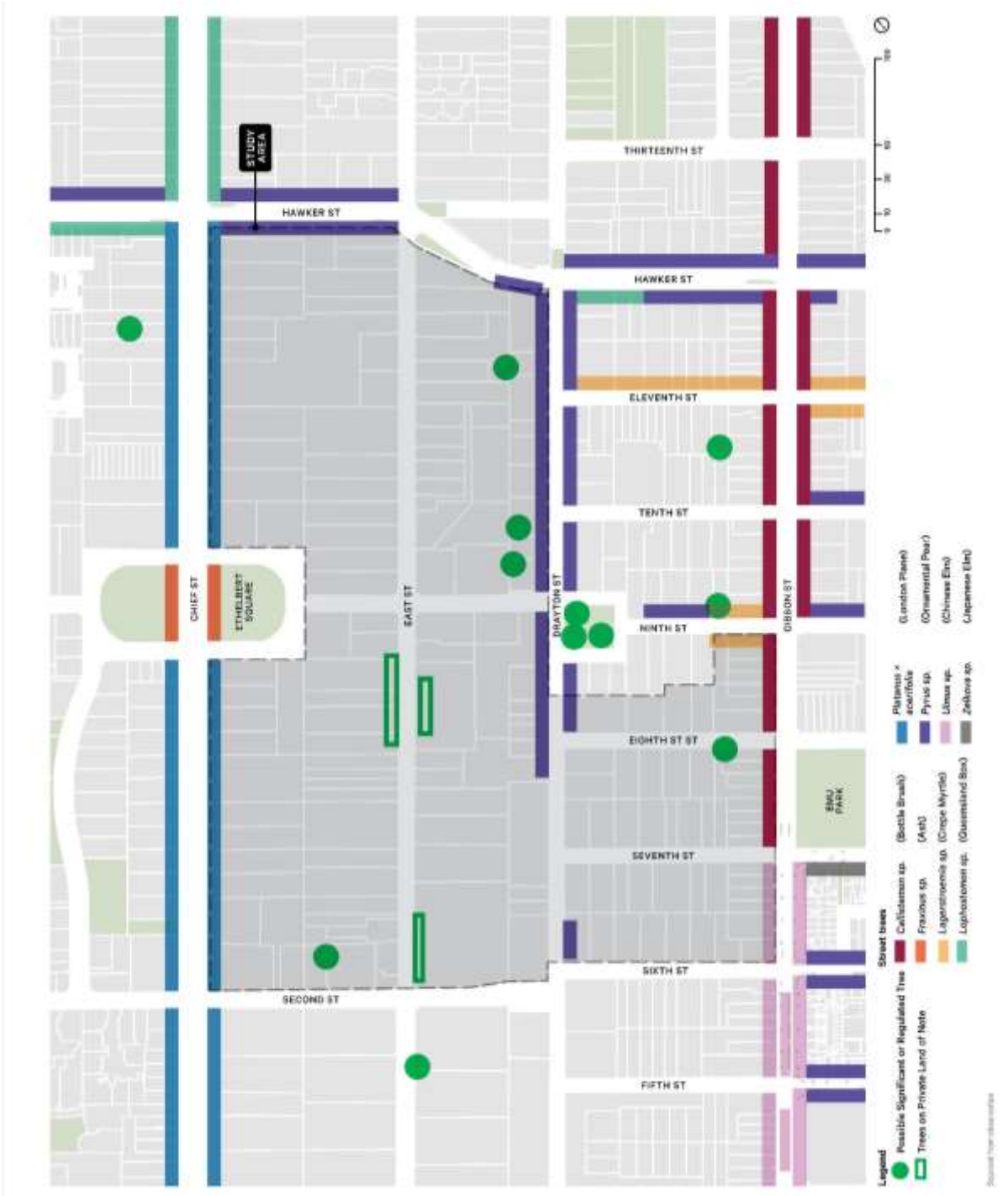


Figure 3.7 Existing Vegetation

Policy Implications for the Study Area

The Study Area contains a relatively small number of potential Regulated/Significant trees.

These trees are located at the edges of allotments and are generally on smaller individual allotments not forming part of a larger consolidated site.

The trees currently have protection under the provisions within the Development Plan, Development Act 1993 and Development Regulation 2008. No additional protections have been considered necessary for these trees given their location.

The street tree plantings in Chief Street and to a lesser extent in Drayton Street form an important element in the streetscape character and should be recognised in any future zone Desired Character statements. Notwithstanding this, any proposed road widening of Drayton Street will likely impact these trees and removal may be necessary. Any road widening proposal for Drayton Street needs to be balanced against tree removal. Road widening should include significant new street tree planning if this option is pursued.

The street tree plantings in Chief Street will likely assist (in part) taller buildings being able to be accommodated within the Study Area without detrimentally affecting the amenity of the existing properties to the north-west.

3.5 Building Height

Figure 3.8 on the following page shows the maximum building heights as anticipated by the current Development Plan on land surrounding the Study Area. In summary these heights are as follows:

- A maximum of 3 storeys, to the west of the Study Area;
- A maximum of 6 to 8 storeys, to the south;
- A maximum of 2 to 3 storeys, to the north and north east; and
- A maximum of 2 storeys, to the north and north-east.

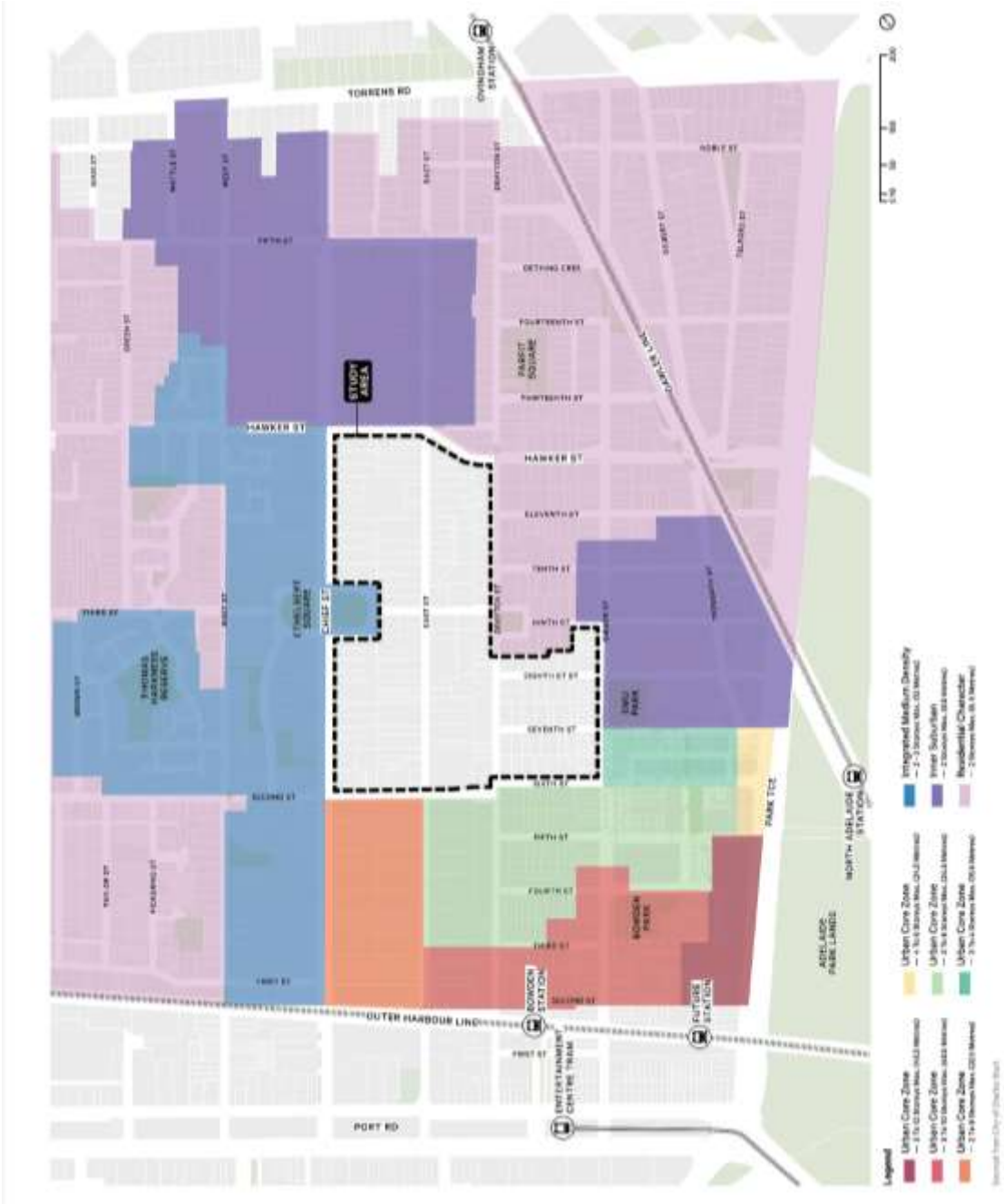


Figure 3.8 Adjacent Building Heights

Further, the existing zoning within the Study Area currently allows:

- A maximum of 12 metres (i.e. approximately 4 storeys) in the Urban Employment Zone, but 3 metres only (1 storey) adjacent another zone where residential uses are anticipated or adjacent a public reserve; and
- A maximum of 9 metres (i.e. approximately 3 storeys) in the Local Centre Zone.

Existing building forms that depict developments in the vicinity of the Study Area which reflect the currently envisaged building heights are shown by Figure 3.9 below.



Figure 3.9 Existing Built Forms in the Locality

The Study Area is located within Area D for Airport Building Heights, requiring a referral for all buildings and structures exceeding 45m above existing ground level. Consequently, the impact of airport building heights is unlikely to impact development within either the Study Area or the surrounding zones.

With the exception of Chief Street, the Study Area is characterised by narrow streets. As observed within the Renewal SA Bowden redevelopment adjacent the Study Area is has created a strong sense of enclosure with building heights of 4 storeys. This is illustrated in Figure 3.9.

It is considered that the focus of building heights within the locality will be within the Renewal SA Bowden redevelopment and the Study Area will need to have a satisfactory building height interface with the low scale development (2-3 storeys) to the north and north-west however opportunity exists for taller buildings at the southern end of the Study Area where buildings of six to eight storeys are envisaged in the adjoining zones.

Additionally, Chief Street has a width of approximately 20 metres. A building height to thoroughfare ratio of 1:2 would comfortably accommodate 10m tall buildings and a 1:1 ratio would permit 20m buildings. Given the width of Chief Street and the existing established street trees, buildings with a podium height of 10m (3 storeys) could be accommodated whilst maintaining an interface with the three storey buildings envisaged on the opposite side.

Policy Implications for the Study Area

Building height in the Study Area is generally limited to a maximum of 12 metres (i.e. approximately 4 storeys) in the Industry Zone, but 3 metres only (1 storey) adjacent another zone where residential uses are anticipated or adjacent a public reserve.

Building heights to the north and north east of the Study Area will be limited due to the narrow streets and two storey height limit in the Residential Character Zone.

Taller buildings could readily be accommodated in the southern part of the Study Area despite the narrow streets, with buildings of four to eight storeys contemplated.

Chief Street is notably wider than other streets within the Study Area. Given this width and the substantial street trees, buildings of greater than three storeys could be accommodated above a podium of 10 metres (3 storeys) in height.

3.6 Site History and Environmental Assessment

Fyfe prepared a Preliminary Environmental Assessment (PEA) to inform these investigations, provided at Appendix B. Specifically, the PEA considers existing EPA licensed and non-licenced activities in and adjacent to the Study Area, the nature of off-site impacts and associated evaluation distances, in relation to potential contamination, air quality and/or acoustic impacts.

A summary of existing activities is provided. It is noted that two of the existing businesses have ceased operations, namely the Marble and Cement Company and HAAE Engineering.

3.6.1 Site contamination

Potential sources of contamination are described in the PEA, and are listed below:

- Fuel storage and use;
- Chemical storage and use;
- Undefined industrial processes, including waste streams;
- Possible use of imported fill material of unknown origin;
- Possible buried wastes and/or backfilled pug holes; and
- Migration of impacted groundwater from adjacent properties.

A number of reports have been prepared for portion of the Study Area or areas in the locality. These have been obtained from the EPA, reviewed, and summarised in the PEA. These reports indicate that the Study Area has had a substantial history of industrial use, including (but not necessarily limited to):

- Gas works;
- Manufacturing (electrical components, bricks, paper, bedding/upholstery, boots, fibre and plaster);
- Metal fabrication and coating;
- Engineering;
- Foundries and foundry supplies;
- Dry cleaners/laundries;
- Motor mechanics;
- Concrete casting/washing, tanneries, blacksmiths and timber merchants.

Various chemicals and fuels have been used and/or stored on these industrial sites and uncontrolled filling of properties and historical pug holes has been undertaken with materials that could potentially have included contaminated gas works and/or foundry wastes.

Subsurface infrastructure, including old basements, footings, concrete pilings, USTs and various pits, as well as contaminated and geotechnically unstable fill materials have also been identified on a number of sites following the demolition of industrial infrastructure and/or during site remediation programs.

A series of pug holes were historically excavated across the Brompton-Bowden area as a source of clay for brick making activities. These pug holes were generally backfilled sometime prior to 1949 (i.e. prior to the first available aerial photograph).

Identified pug hole locations as advised by the city of Charles Sturt are shown by Figure 3.10 on the following page. Figure 3.10 indicates a single pug hole within the southern portion of the Study Area, between East, Drayton, Second and Third Streets, and a second pug hole in the north-western portion of the Study Area bordered by Chief, East, Hawker and Third Streets. These locations are approximate.

Policy Implications for the Study Area

It is expected that a range of soil and groundwater contamination issues, will be present, with a series of potential contaminants that may be present in the Study Area. Even if present in the Study Area, such contaminants in soil or groundwater, would not preclude redevelopment for more sensitive land uses.

Rather they would result in the need for assessment and management as is common in many brownfields redevelopments, with any cost implications incorporated into the project budgets.

The two pug holes are likely to represent the greatest challenge for development of the Study Area. The location of the two pug holes represents areas of heightened environmental risk, due to the possibility of contaminants being present to a considerable depth in a non-natural soil profile. The contaminants present in the pugholes could potentially include any industrial waste or contaminant. Site-specific investigations would be required which are not within the scope of these investigations.

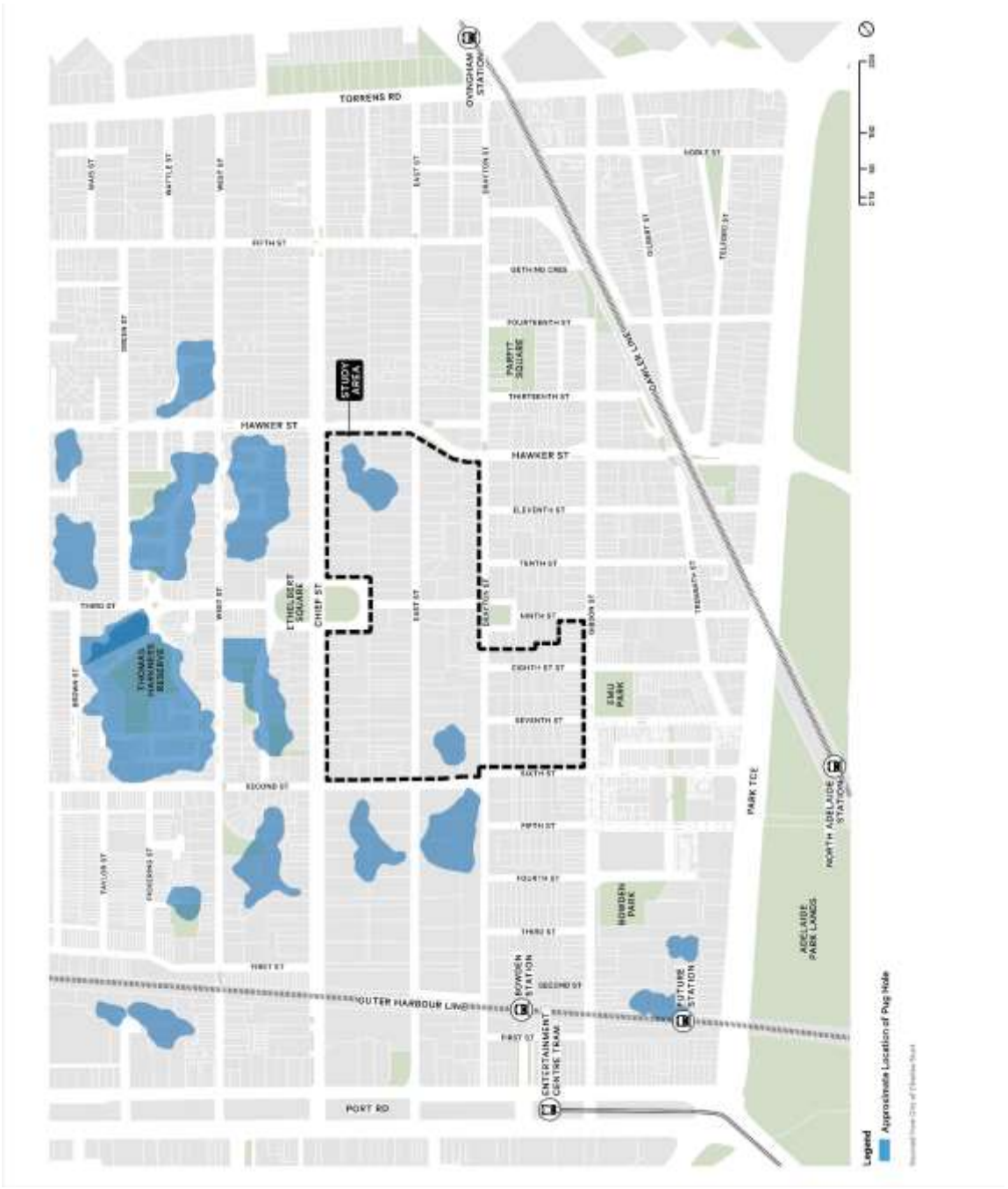


Figure 3.10 Pugholes (Locations as advised by Council)

3.6.2 Air Quality and Acoustics

As described in the PEA, established businesses within the Study Area seem to be down-sizing the intensity of their activities (if not ceasing operations). Replacement activities have generally been of a more benign nature, including storage, car parking, warehousing and commercial activities.

The EPA has considered adjusted evaluation distances for certain activities that are within the vicinity of the Study Area.

The sites in question are:

- Adelaide Brass Castings – 100 Gibson Street, Bowden; Not licensed by the EPA;
- Conroy's Smallgoods – Seventh Street, Bowden; EPA Licence 1269 (Curing or drying works);
- Detmold Packaging – Chief Street, Brompton; EPA Licence 252 (Activities producing listed wastes).

The EPA's Evaluation distances for effective air quality and noise management (2016) (Evaluation Distance publication) contains recommended evaluation distances between sensitive land uses and polluting activities. If development is proposed within those evaluation distances then the potential adverse impacts on sensitive land uses need to be assessed.

The EPA recommended evaluation distances for the sites in question are:

- Adelaide Brass Castings – 500m evaluation distance;
- Conroy's Smallgoods – 500m;
- Detmold Packaging – There is no evaluation distance for the activity of producing a listed waste, but there is the potential for activities undertaken at the site (when producing the listed waste) to result in odour and noise.

The EPA has examined the recommended evaluation distances for the sites to determine if they are able to be amended. The EPA's assessment of the recommended evaluation distances is based on:

- the knowledge and experience of the licence coordinators for the sites that are licensed by the EPA;
- the knowledge and experience of the EPA's air quality and noise specialist advisers;
- inspections undertaken on 7 February and 13 March 2018;
- information on their operations and casting techniques provided by Adelaide Brass Castings to the EPA through City of Charles Sturt.

The following information from the EPA provides adjusted evaluation distances for the sites and information explaining the reason for the distances.

Adelaide Brass Castings

Adelaide Brass Castings is a small foundry located approximately 100m outside the area affected by the DPA. It is not licensed by the EPA. The recommended evaluation distance, as identified in the Evaluation Distances publication, is 500m.

Although the EPA did not undertake a site visit, it did walk around the area on 7 February 2018. During the walk it noticed that there was a faint phenolic odour detectable within about 30m of Adelaide Brass Castings. The odour at the open door of what appeared to be the main part of the facility (perhaps pour room, mould breaking etc) was reasonably intense on first pass; however, the odour during the second pass by the open door, perhaps 15 minutes later, was detectable but nowhere near as intense as the first pass. Given the significant change between two odour observations at the open door, it could be assumed that some activity such as metal pouring or mould breaking was occurring at the start.

During the walk around the area a grinding noise coming from the site was heard. The sound was likely from grinding of the product after the casting had occurred. However, it is considered that noise from the site would not be heard within the area affected by the DPA.

From the information provided by Adelaide Brass Castings and from the walk around of the area by the EPA, it is considered that the evaluation distance for Adelaide Brass Castings could be adjusted from 500m to 100m.

Conroy's Smallgoods

Conroy's Smallgoods is located within the affected area and is licensed by the EPA for the activity of curing or drying works. The recommended evaluation distance in the Evaluation Distance publication is 500m due to the potential for nuisance odour and smoke issues when the product is smoked.

Smokers are used to produce the smallgoods and the EPA understands that the technology used is old and has not been upgraded. Consequently the EPA is concerned about the potential impact of fine particles from smoke on the health of sensitive receptors within the recommended evaluation distance.

The EPA recommends that the evaluation distance remain at 500m.

Detmold Packaging

Detmold Packaging produces packaging products and is licensed by the EPA for the activity of producing listed wastes. The site is located within the area affected by the DPA. There is no recommended evaluation distance for the activity of producing a listed waste, but there is the potential for activities undertaken at the site when producing the listed waste to result in odour and noise that would require evaluation.

Printing, which has the potential to produce odour, is undertaken at the site. However, it was noted during a site visit that there was a lack of odour throughout the site with the only prevalent odour being

immediately adjacent the ink mixing area. The lack of odour is likely due to almost all of the printing being undertaken using water-based inks, with non-water based inks being used in extremely small quantities. Printing is also undertaken inside the main buildings.

The EPA noted during the visit that there are some supplementary gas heating and associated flue stacks installed in some of the machines. However it did not appear that these heaters were particularly significant, so would not pose an impact much beyond the boundary of the Detmold site.

The EPA does not consider noise to be an issue at the site.

The observations made at the site suggest that the impacts from this facility currently are insignificant. However, given the gas heating systems for some of the printing machines, it would be prudent to set an adjusted evaluation distance of 30m from the site boundary.

These distances are shown by Figure 3.11 on the following page.

This indicates that there is some risk that there is the potential for some odour and/or noise air quality impacts to be experienced by future residents and other sensitive land uses within the Study Area.

It is noted that Detmold is planning to relocate to outside of the Study Area within approximately three years.

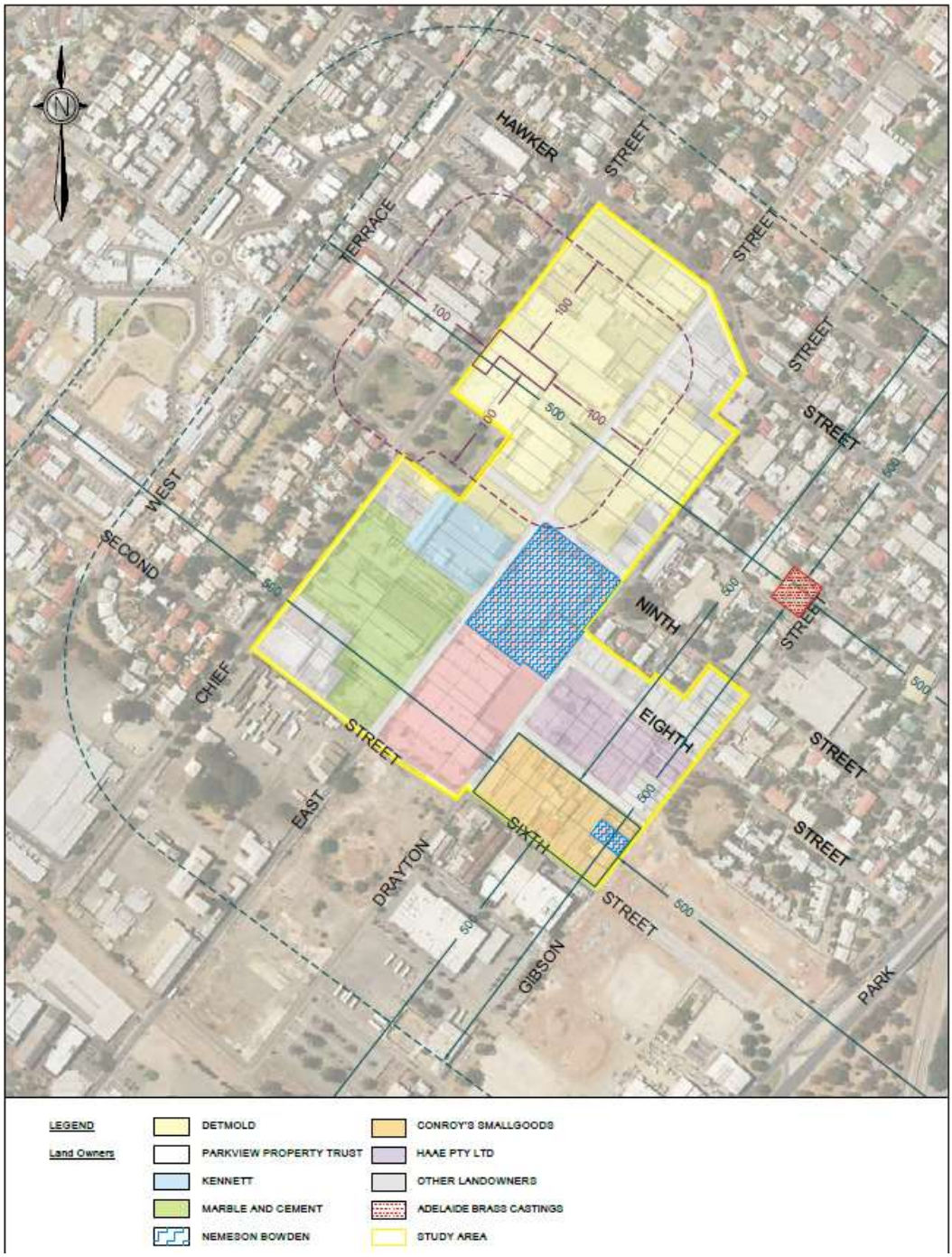


Figure 3.11 Recommended Evaluation Distances for Air Quality and Noise Management

Implications for Future Development

Based on a review of current industries and activities on, and within the vicinity of, the Study Area, it appears that there are several businesses operating in the area that could potentially impact on future residential redevelopment in terms of air quality issues. In most cases, however, the impacts are likely to be transitional in nature, in that they would only be experienced whilst new residential dwellings co-exist with existing industry that has not yet relocated.

While existing industries and activities in and within the vicinity of the Study Area may have the potential to generate noise emissions that could impact on future residential redevelopment of the area, impacts are likely to be manageable.

The finding that a facility has a recommended evaluation distance that covers part or all of the Study Area should not be interpreted to mean that that facility will impact on air and noise quality and noise within the entirety of that recommended evaluation distance. Rather, it means that site specific factors should be considered to determine what (if any) impacts there might be on air quality beyond the boundaries of the facility, and what (if any) distance those impacts may extend off-site from the facility.

Whilst it is possible that new developments may require specific acoustic treatments, this is expected to be limited in nature and extent and would require confirmation through further studies and considered as part of the Development Application for the proposal.

The EPA is supportive of the next phase of environmental investigations being undertaken at the development application stage of the area's redevelopment. That is, further investigations are not required at this time. The environmental investigations would involve updating the Fyfe 2014 *Preliminary Site Assessment* to that of a PSI in accordance with Schedule B2 of the *National Environment Protection (Assessment of Site Contamination) Measure* NEPM, 1999 (amended 2013). PSIs involving intrusive investigations of soil and groundwater sampling would be required when allotments are proposed to be redeveloped.

Where the redevelopment is to a more sensitive land use (such as residential) a site contamination audit may also be required.

The EPA recommends that requirements for odour modelling and acoustic reports should be specified in the Development Plan policy outcomes arising from any future DPA affecting the Study Area, so that potential impacts can be identified and managed at the development application stage.

The EPA has indicated that they could work with Conroy's Smallgoods to reduce their odorous emissions to the extent that their continued operation is consistent with redevelopments in the Study Area. This is however uncertain as there has been no discussion with Conroy's in relation to this issue. The EPA has advised that at this time the separation distance for Conroy's remains at 500m. Consequently, in order to facilitate the redevelopment of the Study Area, the preference is for Conroy's to significantly improve its

practices such that the recommended separation distance is substantially lowered or removed, or alternatively that Conroy's move from this site.

Policy Implications for the Study Area

Exiting developments within the Study Area have a number of separation distance recommendations.

Future planning policy should consider the introduction of the noise and air quality overlay for the Study Area.

Whilst redevelopment can occur whilst existing uses remain in the Study Area, the preference is for existing uses with separation distance recommendations to relocate.

3.7 Adjacent Zones and Land Uses

The Study Area is adjoined by the Residential Zone to the north, east (part) and west any by the Residential character Zone to the east (part). The Urban Core Zone adjoins to the south and south-east and the Residential Character Zone to the north east.

As shown by Figure 3.12 on the following page, land adjacent the Study Area is mainly comprised of the following uses:

- Single or two storey dwellings, predominantly to the north east and west, including recent or ongoing residential development (townhouses and residential flat buildings);
- To the south of the Study Area, the Renewal SA Bowden redevelopment is under way, in the area bound by Second Street, Park Terrace, Sixth Street, Seventh Street, Chief Street and the Outer Harbour Rail Corridor. Key features developed or to be developed include:
    - Terrace houses and apartments, a portion of which have been delivered;
    - Town Square;
    - Main Street;
    - Fresh food markets;
    - Restaurants and cafes;
    - Retail space, including Plant 4 markets and IGA; and
    - New and upgraded green spaces, parks, reserves and pedestrian links;
- Commercial or light industrial properties, predominantly to the east, of a height of 1 or 2 storeys or equivalent;

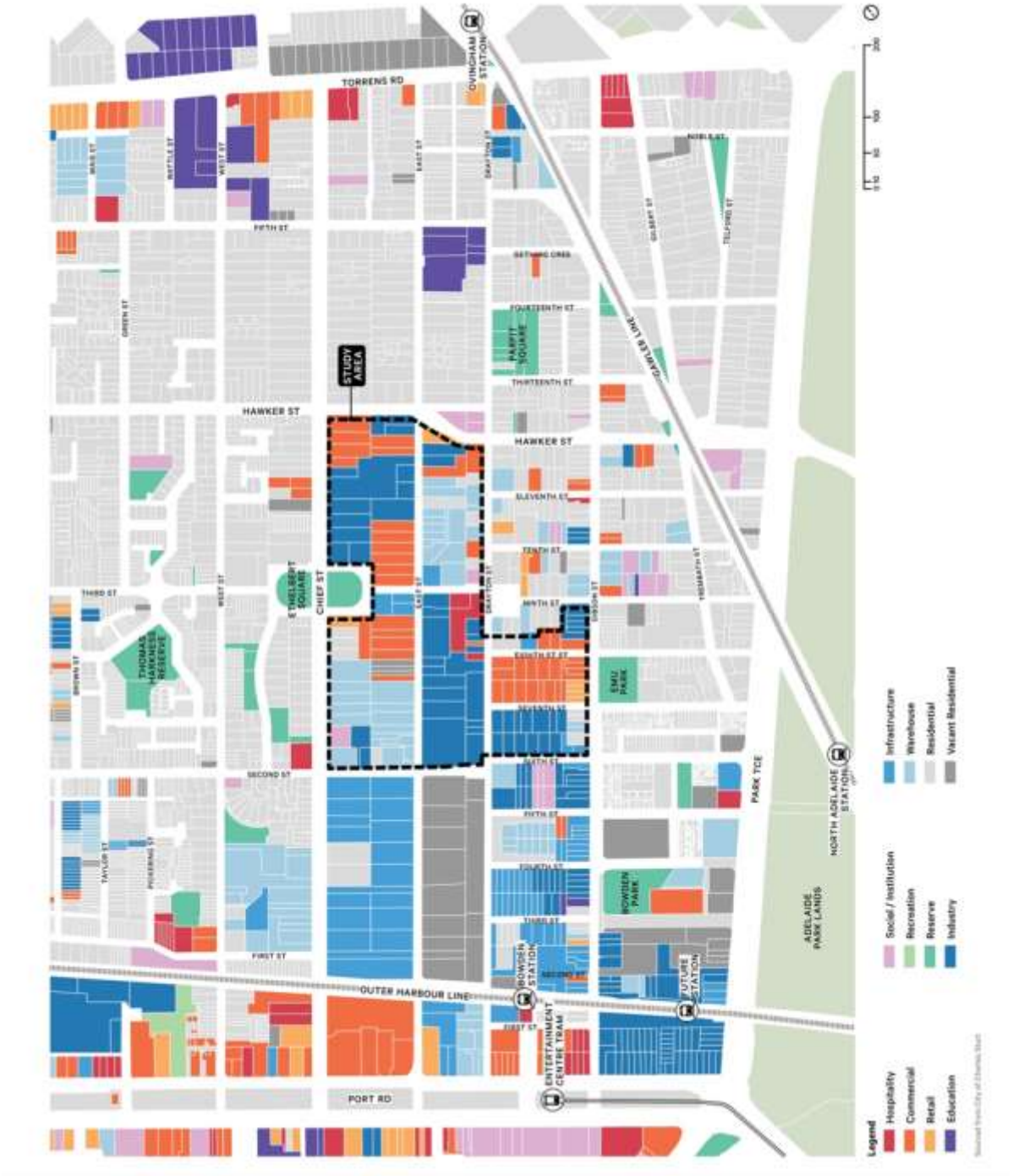


Figure 3.12 Adjacent Land Uses

- Church and community centre, to the north; and
- Retail, to the south-west of the Study Area.

It is expected that the Renewal SA Bowden redevelopment in particular will influence the future character of the Study Area. This is expected to be in a number of ways including public realm, street design, building height and introduction of complete streets.

The Renewal SA development has introduced buildings of greater than three storeys into relatively narrow streets which creates a sense of enclosure. The building heights established in this precinct are significantly greater than in surrounding areas and support the development of the Study Area at heights substantially taller than one to two storeys which characterise other parts of Bowden and Brompton.

The Renewal SA development has introduced street design aligned with the complete streets philosophy which treats the street network to enable safe access for all users, including pedestrians, cyclists and motorists whilst treating the street as a public space and integrating landscaping, building interfaces and public art into the street design.

Building design and the development of the public realm has been undertaken within the Renewal SA development with significant additional structures such as design review panels, urban design guidelines and delivery agreements to achieve planned outcomes.

Whilst the Renewal SA Bowden redevelopment will likely influence development within the Study Area, reliance on Development Plan provisions alone with no additional measures such as design guidelines, will mean that the overall resultant development within the Study Area may not deliver the same level of investment and quality of buildings and public realm.

Policy Implications for the Study Area

Development within the adjacent Renewal SA Bowden redevelopment has been undertaken to a high standard and delivered via a combination of Development Plan policy and additional measures such as design guidelines and development agreements.

Future planning policy will need to be prepared with highly detailed Desired Character statements to capture the elements of the adjacent area that are desirable to replicate in the Study Area.

It is desirable for future planning policy to capture elements from the adjacent Renewal SA Bowden development to assist in the Study Area being a seamless transition.

3.8 Transport

Cirqa has been commissioned to prepare transport investigations for the Study Area. Their report is found at **Appendix C**.

3.8.1 Existing Road network

Figure 3.13 on the following page identifies the location of the existing road network in the locality.

Key roads in the Study Area include:

- Chief Street, distributor road, comprising a single traffic lane in each direction separated by a painted median, with on street parallel parking and bicycle lanes on both sides. A 40km/h speed limit applies. Traffic data indicates daily traffic of 6,800 to 6,900 vehicles;
- Hawker Street, distributor road, comprising a single traffic lane in each direction, with limited on street parking. A 40km/h speed limit applies. Traffic data indicates daily traffic of 4,700 vehicles near the intersection with Chief Street;
- East Street, Drayton Street, Gibson Street, local streets with each single traffic lanes in each direction and parallel on street parking in various locations. They are all subject to 40 km/h. Traffic data indicates daily traffic of 500 to 1,500 on East Street, 0 to 500 on Drayton Street and 1,500 to 3,000 on Gibson Street. Gibson Street could therefore be classified as a minor collector road based on these volumes;
- Second Street and Sixth Street are local streets, each with single traffic lanes in each direction. On street parking is permitted in some locations, on one side only. They are both subject to 40 km/h. Traffic data indicates daily traffic of 1,500 to 3,000 vehicles and they can be classified as minor collector roads; and
- Third Street (and Ninth Street) is a local street with two way traffic movements and on street parking on one side. A 40km/h speed limit applies. Traffic data indicates daily traffic of 0 to 500 vehicles.

It is noted that the City of Charles Sturt has recently implemented a one-way flow in a number of streets, including portions of Eighth Street, Ninth Street, Tenth Street and Eleventh Street.

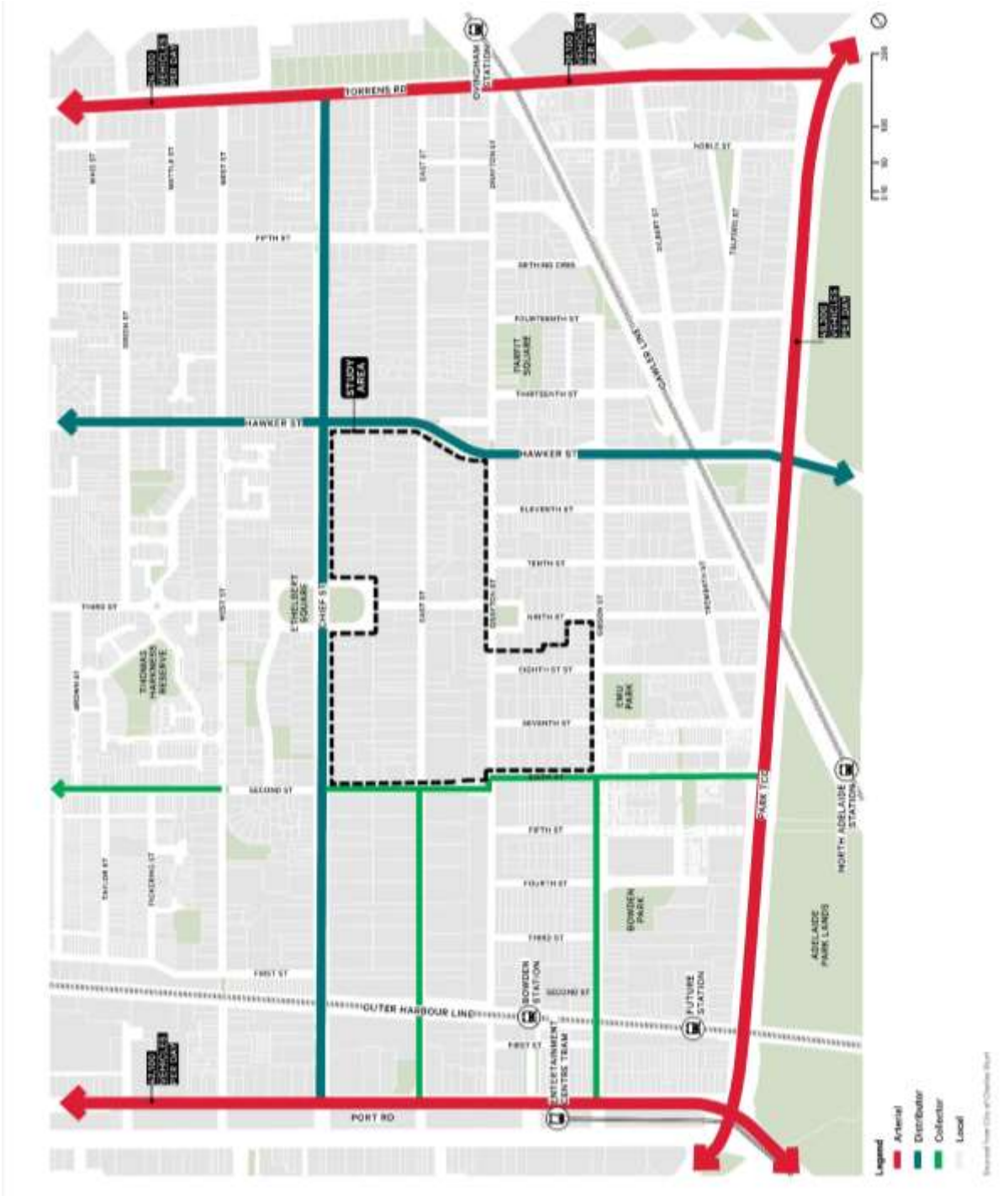


Figure 3.13 Existing Road Hierarchy

3.8.2 Future Road Network

It is anticipated that redevelopment of the Study Area would generally retain and improve the existing grid layout.

It is recommended that:

- Additional 'local road' connections be provided between Chief Street, East Street and Drayton Street (oriented north-west to south-east);
- Additional 'local roads' or 'laneways' be established south-west to north-east; and
- Additional vehicle connections to Chief Street are considered to be undesirable, however these streets should provide cyclist and pedestrian connections.

Those laneways provided parallel to the main road connections would enable future dwellings to be rear loaded with minimal crossovers on main roads, which will maximise pedestrian and cyclist movements, as well as on-street parking, landscaping and road safety.

This is shown by Figure 3.14 on the following page, and further described in Cirqa's report.

3.8.3 Traffic Generation and Impact on Capacity

Cirqa has undertaken an assessment of traffic generation. It is anticipated that the redevelopment of the Study Area could generated in the order of 5,445 additional daily trips and 375 additional peak hour trips, as compared to the existing situation.

Key elements of Cirqa's analysis are summarised below:

- It is desirable that development fronting Chief Street be rear loaded in order to minimise impact on Chief Street;
- Opportunities to widen Hawker Street (particularly adjacent the Study Area) should be explored to improve pedestrian provisions and indent bus stops where possible;
- It is desirable to allow for the future widening of Second Street, to allow improved pedestrian and cyclist facilities, and landscaping;
- The realignment of Second Street is also desirable to improve connectivity;
- East Street could be widened to improve road safety and amenity; and
- Drayton Street is recommended to be widened in order to accommodate anticipated volumes.

The capacity of Gibson Street is considered to be adequate.



Figure 3.14 Possible Future Road Network

Detailed analysis has also been undertaken for a number of key intersections surrounding the study area. Generally, the additional volumes associated with the potential redevelopment are relatively low. However, the ongoing Bowden Urban Village development and the closure of the East Street rail crossing (for vehicles) will put additional pressure on the intersections assessed. In particular, the following key outcomes of the assessment have been identified:

- The Chief Street/Port Road intersection is likely to experience capacity issues following full development of the subject area and Bowden Urban Village. The right turn lane on Port Road for movements into Chief Street should be extended (as previously recommended as part of the Bowden Urban Village project). The opportunity to provide a second left turn lane from Chief Street to Port Road should also be further explored, however this is likely to be difficult due to existing constraints. From a high level perspective, it is considered that upgrade works to improve the capacity would likely be required by 2025.
- As a result of the closure on East Street and the limited capacity at Chief Street/Port Road, there will be a significant increase in pressure on the intersection of Sixth Street/Park Terrace. The volumes distributed to the Sixth Street/Park Terrace intersection as a result of the redevelopment will be low. Therefore, it is considered that upgrade of this intersection is not directly required as a result of the potential redevelopment, but, nevertheless will ultimately be required (by 2031) to accommodate all of the developments discussed as well as general growth in volumes on the road network.
- An upgrade of the intersection of Chief Street/Second Street should be undertaken to enable safe and efficient accommodation of the additional traffic volumes. It has been recommended that a roundabout be implemented at the intersection, albeit this will require some property acquisition to achieve. The timing of such an upgrade will ultimately depend on staging of development of the subject area, however would be anticipated to be undertaken in conjunction with any stages in the western corner of the study area (which would have greatest impact on the intersection).
- No upgrade is required to accommodate the additional development volumes at the intersection of Chief Street/Hawker Street.
- The right turn movement at the intersection of Chief Street/Torrens Road has little or no capacity for additional volumes. While not solely required as a result of the development (general growth in traffic volumes would oversaturate the movement), the provision of a sheltered right turn lane for turns into Chief Street is warranted. Such an upgrade is considered desirable within the next three to five years (given the limited capacity that currently exists at the intersection).
- The recent upgrades to the Park Terrace/Hawker Street/War Memorial Drive would be sufficient to accommodate the additional volumes associated with the future development of the subject area with no further upgrade warranted.

- The intersection of Drayton Street/Sixth Street/Second Street should be realigned to more appropriately reflect the collector routes. This could be treated with a raised pavement (plateau) or a roundabout. This would desirably be undertaken in conjunction with development stages along southern section of the study area (along Drayton Street) and/or along Second Street.
- In addition, raised pavement (plateau) treatments could be implemented at key four-way intersections within the study area to minimise vehicle speeds and conflict potential for all road users at these locations. Such treatments could be implemented (subject to detailed design and further review by Council) as development staging proceeds through the study area.

In respect to on-street car parking, it is desirable to accommodate increased parking spaces within existing streets through road widening, as well as future streets (with the exception of laneways).

In respect to off-street car parking, Cirqa consider that:

- One space per apartment dwelling is reasonable, noting the location of the Study Area as well as public transport, walking and cycling networks;
- A slightly higher provision could be allocated to 3-bedroom (or more) apartments; and
- For townhouses, 1 space per dwelling with 2 bedrooms or less, 1.25 spaces per dwelling with 3 bedrooms or more, and 0.25 visitor space per dwelling, is considered to be an appropriate rate.

Policy Implications for the Study Area

It is recommended that:

- Additional 'local road' connections be provided internally between Chief Street, East Street and Drayton Street (oriented north-west to south-east);
- Additional 'local roads' or 'laneways' be established south-west to north-east; and
- Additional vehicle connections to Chief Street are considered to be undesirable, however these streets should provide cyclist and pedestrian connections.
- The intersection of Drayton Street/Sixth Street/Second Street should be realigned to more appropriately reflect the collector routes. This could be treated with a raised pavement (plateau) or a roundabout. This would desirably be undertaken in conjunction with development stages along southern section of the study area (along Drayton Street) and/or along Second Street.
- The links could be supplemented with either additional 'local roads' or 'laneways' oriented south-west to north-east. Laneways parallel to the main road connections (Drayton Street, East Street, Chief Street, Second Street and Hawker Street) would be desirable to allow future dwelling sites to be rear loaded with minimal direct access (crossovers) on these roads to maximise pedestrian, cyclist, on-street parking and general road safety.

- In addition, raised pavement (plateau) treatments could be implemented at key four-way intersections within the study area to minimise vehicle speeds and conflict potential for all road users at these locations. Such treatments could be implemented (subject to detailed design and further review by Council) as development staging proceeds through the study area.
- Allow for the future widening of Second Street. Such works would also allow improved pedestrian and cyclist facilities as well as landscaping opportunities. This should include a realignment of its intersection with Sixth Street to improve connectivity. The realignment of this intersection should take into account the 'dog-leg' of the south-west to north-east minor-collector route that is proposed (in background documents) to utilise Gibson Street (south of Sixth Street) and Drayton Street (north of Sixth Street).
- East Street is narrow with limited sight distance provisions at existing intersections. The verges are limited to footpaths with little or no landscaping. The footpaths on the south-western side are also restricted by Stobie Poles. It is considered that the redevelopment of the site presents an opportunity to widen the road cross section (boundary to boundary) and improve road safety (for all users) as well as general amenity.
- Drayton Street currently accommodates a relatively low traffic volume, however the additional volumes generated by redevelopment of the study area (as well as the Bowden Urban Village) will likely result in volumes in the order of 2,000 to 3,000 vpd. Such increases have already been reflected in its designation as a future minor collector road by Council. It is recommended that widening of the road be undertaken to ensure the additional volumes can be appropriately accommodated (and allow for improved pedestrian/cyclist provisions, landscaping and sight distance provisions).
- One space per apartment dwelling is reasonable, noting the location of the Study Area as well as public transport, walking and cycling networks;
- A slightly higher provision could be allocated to 3-bedroom (or more) apartments; and
- For townhouses, 1 space per dwelling with 2 bedrooms or less, 1.25 spaces per dwelling with 3 bedrooms or more, and 0.25 visitor space per dwelling, is considered to be an appropriate rate.

3.8.4 Public transport network

Figure 3.15 on the following page identifies the location of the existing public transport network in the locality.

A number of public transport opportunities exist in the vicinity of the Study Area, including:

- Train (Bowden, North Adelaide and Ovingham Railway Stations);
- Tram (Entertainment Centre);
- Bus with the following stops located within 1 kilometre of the Study Area:
    - Hawker Street stop 9 and 10; and
    - Port Road stop 7.

As identified during consultation, there may be opportunity to improve the level of service of the above lines, particularly inbound to the City. There could also be opportunity for increased bicycle “park’n’ride” facilities.

The relocation of the Bowden Station and the Entertainment Centre tram stop locations are located further from the Study Area compared with the Renewal SA Bowden redevelopment and are beyond a 400m radius for much of the Study Area and beyond an 800m radius for the northern part of the Study Area.

Hawker Street contains a number of bus routes including 251, 252, 253, 254 and 254N. This section of Hawker Street operates as a Go-Zone. This is a zone that offers convenient services approximately every 15 minutes between 7.30am and 6.30pm Monday to Friday and every 30 minutes at night, Saturday, Sunday and public holidays until 10pm. It is understood that there are capacity issues along this part of the bus network.

Opportunities for additional and/or alternative bus routes though the site have been considered. These have not been considered feasible due to clearance issues under the rail corridor along Chief Street and road with issues along the Second Street/Sixth Avenue corridor.

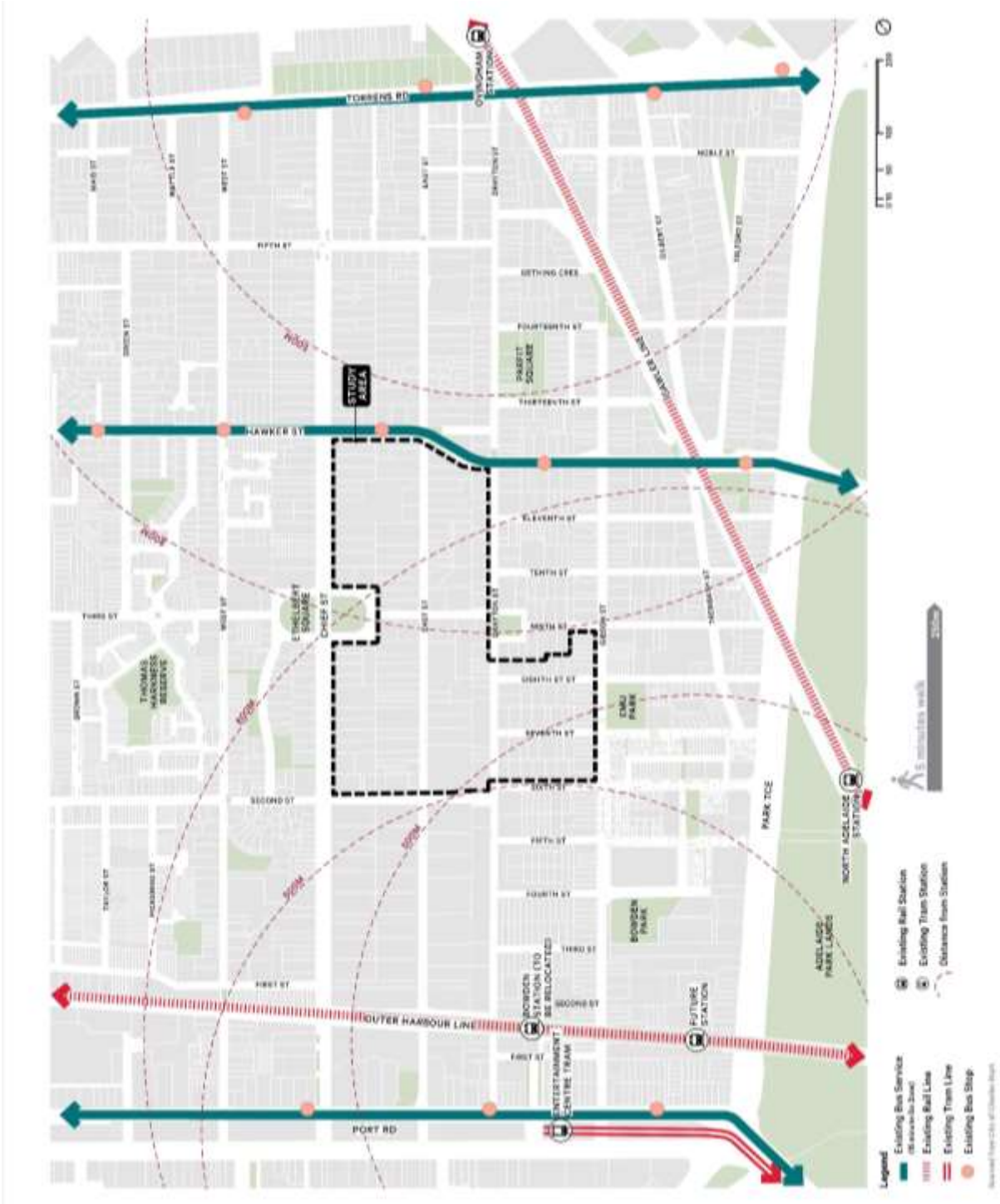


Figure 3.15 Existing Public Transport Network

Policy Implications for the Study Area

The Study Area is convenient for public transport access but is not as well serviced as the adjacent Urban Core Zone. This may signal that residential densities should be lower within the Study Area compared with the Urban Core Zone.

Whilst the Study Area is close to train, tram and bus services, better access within the Study Area to these facilities via road designs that facilitate cycling and walking will improve patronage of these facilities.

3.8.5 Walking and cycling

The Study Area is well serviced by walking and cycling networks, particularly due to the location adjacent the Parklands and close to the City. Figures 3.16 and 17 on the following pages show the existing and proposed networks.

Walking connections from the Study Area to the Park Lands are poor with no signage, narrow footpaths, no dedicated crossing over Park Terrace adjacent the Study Area and poor connections under Park Terrace.

Bicycle lanes are provided on Park Terrace, Port Road and Chief Street. While the majority of the Study Area does not contain bicycle lanes, bicycle movements are typically accommodated on street under a standard shared arrangement which is considered appropriate in a low-speed environment.

Policy Implications for the Study Area

It was noted during consultation however that the quality of walking and cycling infrastructure need to be improved for amenity but also safety reasons.

It is anticipated that cycling movements will be continue to be accommodated in a shared manner on-road. It is therefore essential that adequate vehicle speed limits be established in the Study Area. Speed limits within the adjacent Renewal SA Bowden redevelopment have been established at 40kph and an extension of this lower speed environment into the Study Area is considered to be an appropriate response.

As described in Cirqa's report, two future cycling connections have been identified, namely the Second Street/Sixth Street route and Eight Street. There is also an opportunity to realign the north-west/south-west cycling route to Eighth Street and improve connectivity to the Park Lands, as shown by Figure 3.17.

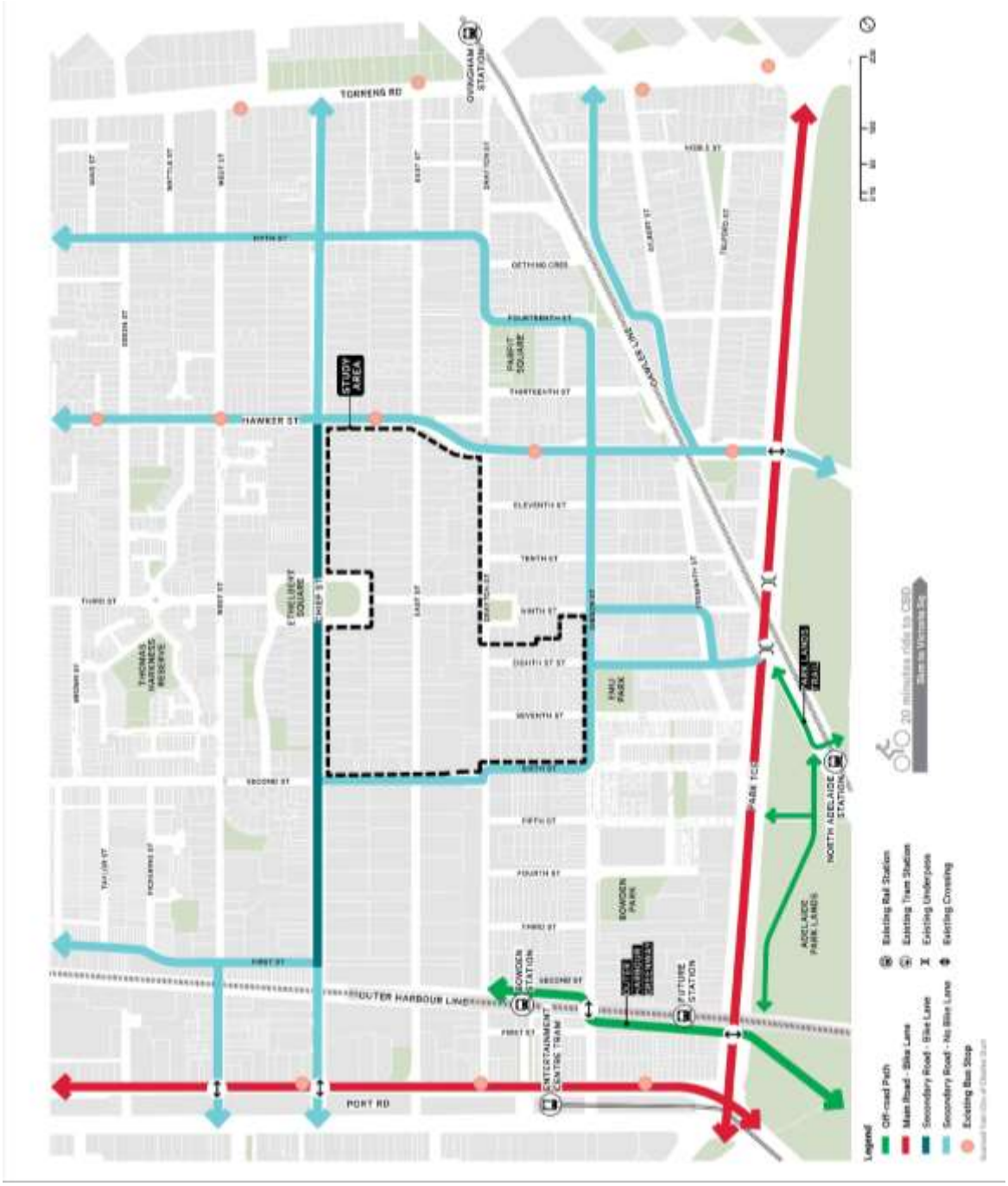


Figure 3.16 Existing Walking and Cycling Networks

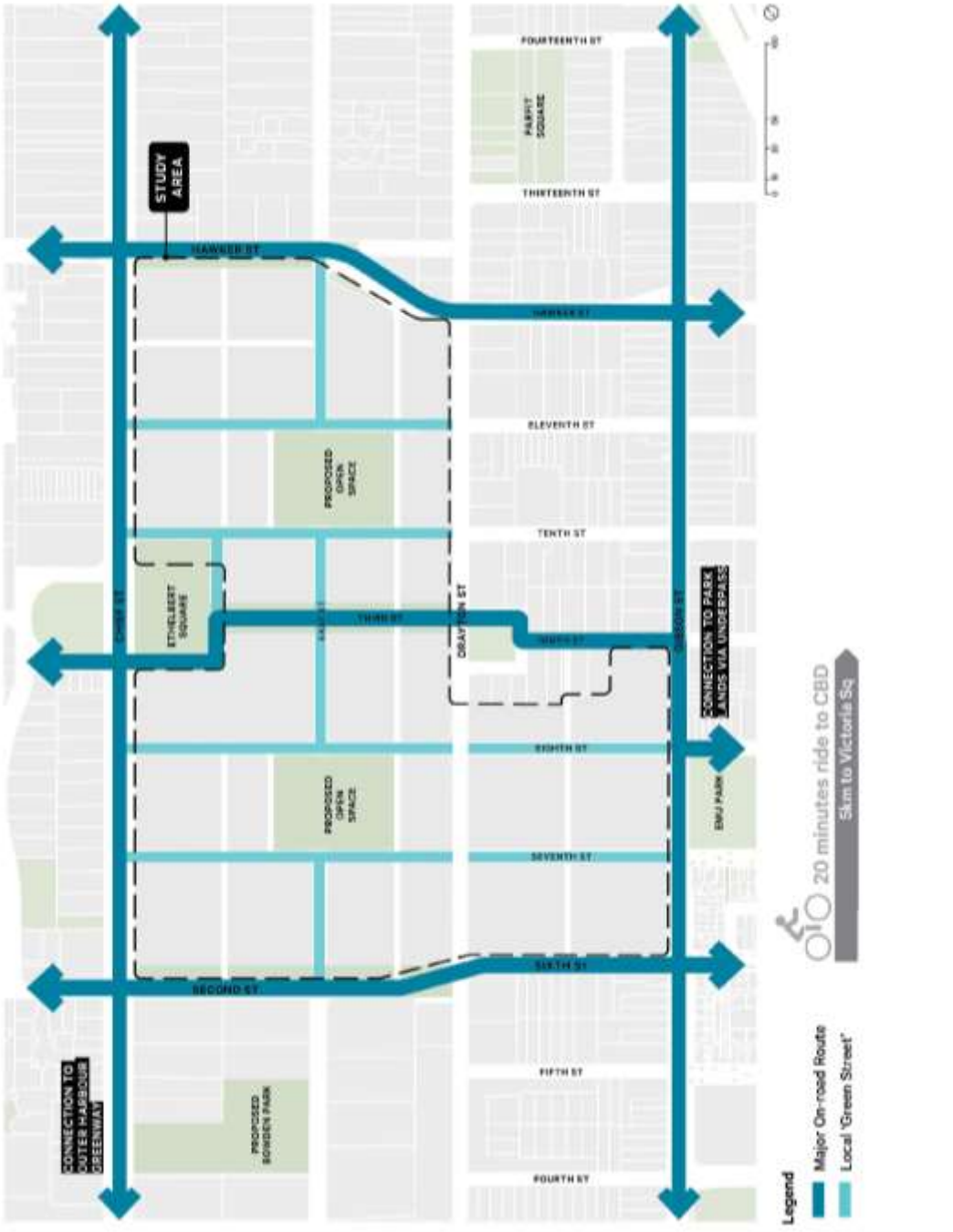


Figure 3.17 Potential Future Cycling Connections

3.9 Stormwater

Fyfe has prepared a Stormwater Management Master Plan (SMP) to inform these Investigations. The SMP is appended to this Report (refer **Appendix A**).

Key elements of the SMP are summarised below.

3.9.1 Existing Drainage System

As previously discussed, the Study Area comprises mainly industrial and commercial uses and contains a high proportion of impervious surfaces.

Existing stormwater drainage systems within the Study Area are located in Chief Street, Second Street, Sixth Street, Gibson Street, Drayton Street, Third Street, East Street and Hawker Street. Based on the aerial image and GIS drainage database, the Study Area is currently discharging into Council drainage systems at 8 different locations.

The catchment plan shown in Figure 3.18 below is based on the existing inlet pit locations.

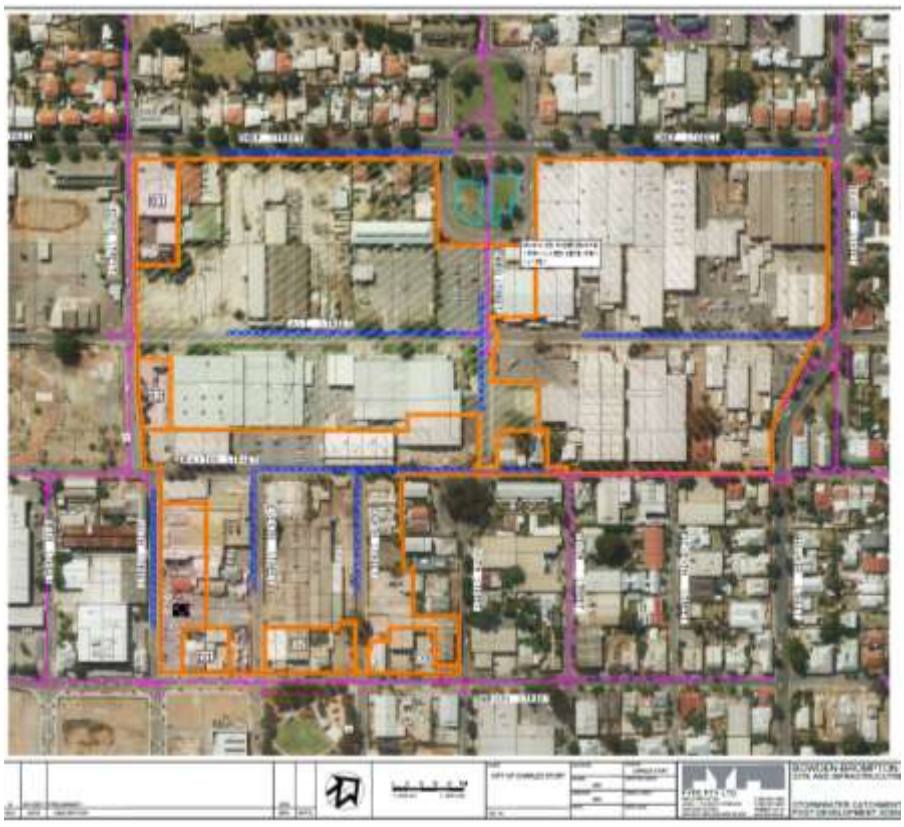


Figure 3.18 Pre-development sub-catchment plan

Future anticipated land uses are likely to generate less runoff for a 5 year ARI event as compared to the existing situation, as the resulting residential built form is likely to create less impervious areas.

Notwithstanding, there is currently limited stormwater infrastructure located within the Study Area. Internal drainage system is located only in Third Street and on the eastern end of East Street. As previously discussed, there are two localised areas of flooding. The flows enter into the properties from East Street and Drayton Street. From the preliminary hydraulic modelling, the over toppings are mainly due to insufficient inlet pit capacity. The extension and/or upgrade of the existing drainage system and addition of inlet pits will further improve the drainage condition within the Study Area.

Policy Implications for the Study Area

To improve the stormwater drainage condition of the Study Area, the construction of an underground network of pipes and pits will be required. Surface flows will need to be contained within the road network designed for a 100 year ARI event and the underground drainage network will need to be designed for a 5 year ARI event. The major drainage system up to 100 year ARI will need to be considered as a dual system consisting of the minor system and the road carriage ways as channels.

3.9.2 Stormwater Detention

As described in the SMP, stormwater runoff detention will be managed in several ways, including the following management solutions:

- Stormwater detention basins;
- Underground detention in Ethelbert Square reserve;
- Rainwater tanks;
- Underground tanks in car parking areas;
- Detention on road surface; and
- Underground large pipes/ box culverts.

Detention volumes proposed on road surface, underground pipes/culverts, rainwater tank and underground tanks, Ethelbert Square reserve and surface detention basins are described in Table 3.1.

Table 3.1 Proposed Stormwater Detentions

Catchment based on the main drainage system	Proposed detention system				
	Road surface, driveway and land scaped area (m^3)	Underground pipe/culverts in Council roads (m^3)	Rainwater tanks and underground storage in car parks (m^3)	Ethelbert Square reserve detention (m^3)	Required surface detention basin volume (m^3)
Second Street	20	54	15	-	261
Third Street	80	309	110	686	1315
Hawker Street	150	381	180	-	889

The key elements of the above are summarised as follows.

Detention basins

Three dry detention basins are proposed at the downstream of the internal drainage systems before discharging the controlled outflow rate to the existing Second Street, Third Street and Hawker Street drainage systems. The basins would occupy no more than 20 percentage of the available public open space, as per the Council Development Plan. The detention basins are proposed in the allocated open space locations shown below in Figure 3.19.

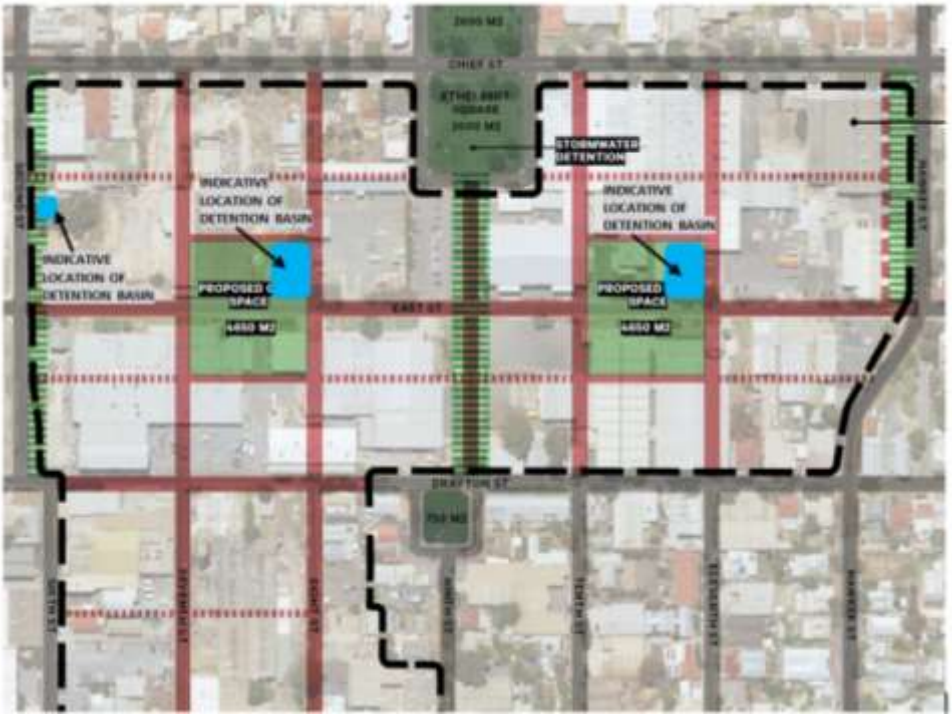


Figure 3.19 Indicative locations of the three stormwater detention basins

Ethelbert Square

There is a potential opportunity to install an underground detention system within Ethelbert Square reserve.

There are several underground services running through the middle of the reserve that includes a sewer main, high pressure gas and other minor services. A stormwater detention system can be installed either side of the services. The proposed locations for the stormwater detention within the reserve are indicatively shown in Figure 3.20.



Figure 3.20 Underground stormwater detention in Ethelbert Square Reserve

Installation of the detention system will not alter the use and visual amenity of the reserve.

Rainwater tanks

For apartment buildings within all 3 catchments, rainwater tanks may be used for stormwater detention. These tanks are expected to be located in car parking areas adjacent to provide detention and each building is expected to provide 1.5m^3 of detention. Council is not in favour of using rainwater tanks as a detention system for single dwellings.

Detention on road surface

This includes road reserve, landscaped and /or driveways, car parks. This is to be utilised once the underground detention systems exceed their storage limit and pits start to surcharge.

Large pipes/box culverts

Reinforced concrete box culvert is proposed in Sixth Street, Drayton Street, East Street, Seventh Street, Eighth Street and Third Street. The surface runoff from the catchments will drain into the system via inlet pits.

Policy Implications for the Study Area

Three dry detention basins are proposed. The basins would occupy no more than 20 percentage of the available public open space, as per the Council Development Plan. The detention basins are proposed in the allocated open space locations shown in Figure 3.19 on page 65.

For apartment buildings within all 3 catchments, rainwater tanks may be used for stormwater detention.

3.9.3 Stormwater Quality

The EPA standard for stormwater pollutant reduction performance targets to be achieved is:

- Total Suspended Solids (TSS) by 80%;
- Total Phosphorus (TP) by 60%;
- Total Nitrogen (TN) by 45%; and
- Gross Pollutants by 90%.

Principles of water sensitive urban design (WSUD) are proposed to be used to ensure that the runoff generated by the proposed development is treated within the site before discharging into the existing Council drainage network.

This will include:

- Gross Pollutant Trap (GPT), proposed at the downstream end of each underground drainage network before discharging into the detention basin;
- Vegetated Swale along the floor of the detention basins; and
- Bio-retention basin.

The approximate surface areas required for stormwater quality control are Table 3.2.

Table 3.2 Surface area required for stormwater treatment

Catchment based on the main drainage system	Surface area required for stormwater quality control/WSUD (excluding detention) (m^2)
Second Street	200
Third Street	500
Hawker Street	700

3.10 Service Infrastructure

Preliminary infrastructure investigations were undertaken by Fyfe. A Services Report is provided at **Appendix D**.

Key findings are summarised below.

3.10.1 Water and sewer

Water can be provided to this proposed redevelopment site subject to the following works being undertaken:

- No approach works to the development site will be required;
- All mains within this site, and abutting, will be required to be 200mm to meet high rise water demand and Fire Fighting requirements;
- Chief St currently has a 150mm water main which will be required to be upsized to 200mm;
- East St from Drayton to Second St currently has a 200mm water main so will be sufficient for the new development however from Second St to Hawker St it is only a 125mm water main and will need to be upsized to a 200mm;
- Second St currently has a 150mm water main and will need to be upsized to a 200mm;
- Third Ave currently has a 100mm water main and will need to be upsized to a 200mm;
- Hawker St currently has a 900mm transmission main which is gazetted not available for connection . There is also a 100mm main in Hawker St so subject to development design a connection may be able to be made to the transmission main but it is subject to further investigation when a development application is lodged;
- Drayton St currently has a 100mm water main and will need to be upgraded to a 200mm.

SA Water has advised that this is a high level assessment and will be reassessed when Lodged Land Development applications are received. SA Water systems are not designed for firefighting purposes so it will

be necessary for developers to ensure that the mains are sized appropriately, and can provide the required water demand, to satisfy the MFS requirements. Firefighting systems are typically designed as part of individual buildings and can be addressed on a site by site basis.

3.10.2 Power

SA Power Networks (SAPN) issued advice to Fyfe in 2018 (refer Appendix D), stating that the power mains in this location have sufficient capacity to supply the proposed development.

For the proposed development at Bowden, the development is likely to be supplied from our substation at Croydon. The zone substation threshold for this site is 4200kVA (10% of the substation capacity) and therefore unless a total of 4200kVA or more is connected in a rolling 5 year period, a residential developer will only pay the Residential Metro High Voltage Feeder augmentation rate outlined in SAPN's current connection policy ($231/kVA plus CPI). If 4200kVA or over is connected within 5 years, the expected additional augmentation rate of $268/kVA plus CPI will also apply.

SAPN has yet to confirm minimum setbacks required of built form to the relevant infrastructure. This will need to be confirmed during preliminary and/or detailed design.

SAPN has advised that initial stage connections (via 11kV reticulation) can be made from near the corner of Chief and Second St, this portion would be serviced by an existing 11kV overhead main along Second St, and near Gibson St, this would be serviced by an existing 11kV overhead main along Gibson St.

3.10.3 Gas

Figure 3.21 identifies the location of the existing gas infrastructure in the Study Area.



Figure 3.21 Existing Gas Services

At this time, it is envisaged that gas is available for the proposed development. APA will need to further assess potential requirements as development progresses.

3.10.4 Telecommunications

Figure 3.22 identifies the location of the existing telecommunications infrastructure adjacent to the Study Area.



Figure 3.22 Existing Telecommunications

NBN Co is deemed to be the relevant provider. Future anticipated uses and built form are likely to meet NBN Co's criteria for new developments. NBN Co recommends a submission be made as development proceeds.

NBN Co has advised that there will be Deployment Contribution costs to be paid by developers, as a requirement within the NBN New Developments Policy, for new developments.

3.11 Activity Centres

The Study Area is reasonably well serviced by district and local level centres as identified by Figure 3.23 on the following page, including one small Local Centre located within the Study Area.

It is noted that the Urban Core Zone (Bowden development) also includes activity centres with commercial and retail uses. Ultimately Renewal SA anticipate that approximately 5,000 square metres of commercial floor space and between approximately 5,000 and 8,000 square metres of retail floor space will be established as part of the Bowden development upon completion. This will largely be within immediate walking distance of the Study Area.

However, small scale business and retail opportunities should be envisaged in the Study Area, in order to create activity and enhance the innovative and entrepreneurial mindset that was described during community consultation, and encourage ground floor activation and the reuse of local shop fronts.

Policy Implications for the Study Area

The preferred location for any new activity centres is the corner of Chief Street and Hawker Street, to capitalise on the higher visibility and frequency of passing traffic along Hawker Street, as well as the proximity to public transport routes. This location will allow for separation from the Plant 4 retail facilities within the Renewal SA Bowden redevelopment.

In order to achieve this, it is anticipated that future zoning will enable the development of small scale retail and commercial floor space, ground floor activation and home businesses. This was well supported during the consultation process (refer Section 4).

3.12 Social Infrastructure

The Study Area is well serviced by existing key social infrastructure located outside of the Study Area, including child care centres, kindergartens, primary and secondary schools and local health facilities. Such area identified on Figure 3.23.

A Brompton Human Service Analysis (BHSA) was prepared in 2014 for the Study Area. A separate assessment was undertaken by Council in 2016.

The findings of both assessments have informed the following sections.



Figure 3.23 Existing Activity Centres

3.12.1 Project Demography

The 2014 BHSA was based on a yield of between 1,300 and 1,600 dwellings, representing approximately 2,690 to 3,320 persons.

The proposed yield as part of these investigations is approximately 1,530 dwellings, representing an approximate population of 2,600, based on an occupancy rate of 1.7 per dwelling.

The assumed development vision for the land is in the form of medium to high density residential development, comprising terrace homes and apartments.

For reference, the dwelling mix in the adjacent Bowden development is currently as follows:

- 1 bedroom: 21%;
- 2 bedrooms: 67%; and
- 3 bedrooms: 12%.

This mix will change as the Bowden development matures, particularly with the anticipated addition of more townhouses, however for the purpose of this assessment, it can be assumed that the future population of the Study Area will include a larger proportion of smaller and younger households than established low density areas.

Based on the above, the forecast population and age cohorts have been estimated based on analysis of comparable areas, as shown in Table 3.3.

Table 3.3 Forecast population and age cohorts

Age Group	Number
0-4	247
5-9	117
10-14	101
15-19	146
20-24	221
25-39	1066
40-59	460
60-74	151
+75	83

Council seeks to encourage walking, cycling and the use of public transport within the Study Area. Providing appropriate pre-conditions are facilitated, such could potentially minimise the number of motor vehicles per household in the Study Area. Proximity and accessibility to social services therefore becomes a relevant

consideration, and supports the need for an effective public transport network to best support future population densification.

3.12.2 Health

There are no health facilities within the Study Area, with the exception of a chiropractor.

The Study Area is within close proximity of the following public and private hospitals:

- Public: New Royal Adelaide Hospital, Queen Elizabeth Hospital; Women's and Children's Hospital; and
- Private: Calvary Hospital; Memorial Hospital.

These facilities are likely to absorb any future demand triggered by additional population in the Study Area.

A number of medical services also exist within the wider locality. These are detailed by suburb in Table 3.4.

Table 3.4 GPs and dentists

Services	Suburb	Number
GPs	North Adelaide	11
	Brompton	4
	Hindmarsh	12
	Renown Park	0
	Ovingham	0
Dentist	North Adelaide	7
	Brompton	0
	Hindmarsh	2
	Renown Park	0
	Ovingham	0

Should the future population numbers be achieved, and based on recognised standards, the Study Area could create theoretical future demand for an additional 2 GPs, and 1 dentist. Such demand is likely to be absorbed by existing practices. However, consulting rooms should be an anticipated land use in the Study Area in order to ensure that new consulting rooms can be established as required.

3.12.3 Aged Care

A number of aged care facilities exist in the Study Area and are listed in Table 3.5.

Table 3.5 Aged Care Facilities

Facility	Beds/Units	Vacancy
Ashman Grove (Brompton)	83	no
Anglicare SA (Brompton)	40	n/a (care for homeless people)
St Anna's Residential Aged Care (Brompton)	60	No
Helping Hand (North Adelaide)	155	Limited
St George's Park Nursing Home (Fitzroy)	32	No
Greek Home for the Aged (Ridleyton)	120	No
Clayton Residential Aged Care (Prospect)	61	Limited
Labrina Village Aged Care (Prospect)	40	n/a

The Australian Government manages the supply of home care packages and residential care by specifying a national provision target of subsidised operational aged care places for every 1,000 people aged 70 years or over, known as the aged care provision ratio. The provision ratio includes different types of care including home care, residential care and restorative care.

In 2015-16, the aged care provision ratio was 113.23, which included 79 residential care places. The ratio is set to grow from the current level to 125 by 2021–22, with a target of 78 residential care places for every 1,000 people aged 70 years or over.

Approximately 114 persons of 70 years of age or over can be projected in the Study Area. This represents theoretical demand for approximately 8 aged care places. This is likely to be accommodated in existing facilities and does not trigger demand for a new facility.

3.12.4 Education

Primary Education

The BHSA report identified the primary schools listed in Table 3.6.

Table 3.6 Primary Education

Primary School	Number enrolled
Bowden Brompton Community School	n/a (specialist education)
Brompton Primary School	151 – capacity of approximately 200
North Adelaide Primary School	320
Prospect Primary School	476

As per the previous findings, and based on recognised standards, the future population that is anticipated in the Study Area is unlikely to trigger demand for a new primary school, also noting a number of non-government establishments in Adelaide's inner suburbs, including the Immaculate Heart Of Mary's Primary School located just north of the Study Area.

Further, anticipated population numbers and particularly of primary school children, are unlikely to warrant the creation of a new primary school.

Secondary Education

The Study Area is located within the Woodville High School Zone, which is easily accessible for existing and future residents.

The previous report identified the secondary schools listed in Table 3.7.

Table 3.7 Secondary Education

Secondary School	Number enrolled	Vacancy
Bowden Brompton Community School	n/a (specialist education)	
Thebarton Senior College	n/a (specialist education)	
Woodville High School	875	The school reached 1,018 students in 2012. Theoretically there is vacancy for approximately 143 students

It is also noted that from 2019, the zone for schooling in the Adelaide CBD will be expanded to include the Study Area. Residents of the Study Area will therefore have zone rights for Adelaide High School and the future Adelaide Botanic High School which is to open in 2019 and will ultimately accommodate 1,250 students. Progressive enrolment will be as follows:

- 2019 - year levels 8 and 9;
- 2020 - year levels 8, 9 and 10;
- 2021 - year levels 8, 9, 10 and 11; and
- 2022 - year levels 8, 9, 10, 11 and 12.

As per the previous findings, and based on recognised standards, the future population that is anticipated in the Study Area is unlikely to trigger demand for a new secondary school, also noting a number of non-government establishments in Adelaide's inner suburbs.

3.12.5 Early Childhood Facilities

There are no existing child care centres or preschools in the Study Area. Table 3.8 below provides information about available long day child care services and preschools in adjoining suburbs.

Table 3.8 Long Day Child Care and Preschools

Facility	Capacity/vacancy
Child Care	
Brompton Children's Centre (Brompton)	80/yes
MacKinnon Parade Children's Centre (North Adelaide)	63/no
Good Start (Prospect)	54/yes
Prospect Community Child Care Centre (Prospect)	85/no
Daphne St CC & Specialist ELC (Prospect)	70/no
Where we grow early learning (Prospect)	74/yes
Lord Gowrie (Thebarton)	n/a/no
Preschools	
Barker Kindergarten (North Adelaide)	39/limited
Renown Park Children's Centre (Renown Park)	34/yes
St Helen's Park Kindergarten (Prospect)	90/limited
Blackfriars Priory School Early Learning Centre	60/no
The Learning Sanctuary	50/yes

It is estimated that up to 300 children aged 0-5 could be anticipated in the future in the Study Area.

Recognised standards typically identify demand for child care to be of approximately 60-75 places for every 4,000-6,000 persons.

Recognised standards also identify demand for a kindergarten to be of approximately 60 places for every 10,000 persons.

Based on this, a potential demand for up to 32 long day child care places could theoretically rise in the future, and demand for 15 kindergarten places.

It is noted that there are limited vacancies in the wider locality and future zoning should allow for the future establishment of child care facilities.

Based on discussions with Renewal SA, a child care facility might be established in the future as part of the Bowden Development, however this is cannot be confirmed at this stage. During the preparation of the DPA, another conversation with Renewal SA to investigate any further progress around this. Subject to this, a future rezoning of the Study Area could incorporate policies that envisage this type of use, identified as "pre-school" in the *Development Regulations 2008*.

3.12.6 Community

Existing community facilities are listed in Table 3.9 below.

Table 3.9 Community Facilities

Facility	Comments
Community Centres	
19 on Green (Brompton)	Playgroups, cooking classes. Recently transferred to Council ownership and re-opened. Still investigating opportunities for future activities.
The Arch Paterson Community Centre (Ridleyton)	Runs centre based programs
Counselling and social services	
Anglicare (Hindmarsh)	Head-office – range of support services
Uniting Care Wesley Bowden (Bowden)	Range of support services – co-located with Foodbank Community Foodhub
Offenders Aid & Rehabilitation Services (Brompton)	Range of support services
Libraries	
Hindmarsh Library (Hindmarsh)	Other services include art gallery, activity groups, training centre
Churches	
Activate Church/The Welcome Centre (Bowden)	Community building activities and programs in the local area – youth groups. Facility recently upgraded
St Nicholas Romanian Orthodox Church (Ovingham)	Various community activities and support
Sacred Heart Catholic Church (Hindmarsh)	Various community activities and support and assistance for refugee families
CityReach Baptist Church West (Bowden/Hindmarsh)	Various community activities and support (office and meeting place at different locations)
St Laurence's Catholic Church (North Adelaide)	Various community activities and support

We also note Plant 4 within the Bowden Village development has been designed to provide opportunities for arts and food, and become a community focal point. This project seeks to create transitions and complementary uses with the Bowden Village. Other communal facilities may be provided as part of the Gasworks stage of this development.

Existing Council strategies also anticipate that the Hindmarsh library/community hub and facilities at Bowden Village could be combined in the future in order to encourage multipurpose facilities that support larger catchments. Providing additional community facilities in the Study Area would seem to be a contradictory approach. As such, it is not anticipated that a standalone community facility is justified.

Policy Implications for the Study Area

It is appropriate to ensure that future zoning allows the development of community uses, including child care facilities, consulting rooms, aged care facilities, community centre and community meeting places of a small scale. This could also include 'community garden' which has been suggested during consultation.

3.12.7 Open Space and Recreation

Open space is land allocated for informal /passive recreation, play and unstructured physical activity. This may be in the form of parks, gardens, linear corridors, and nature reserves. Open spaces also provide formal outdoor sporting opportunities for the community, including playing fields, change rooms, grandstand and car parks. Some open spaces provide passive recreation opportunities, active recreation opportunities, or both.

Figure 3.24 on the following page identifies District Level open spaces (as defined by the Development Plan), together with Neighbourhood and Local open spaces.

There is no existing open space within the Study Area. The Study Area is serviced by key open space and recreation facilities via existing assets within a 1km radius as identified by Figure 3.27.

Table 3.10 below lists the reserves in the locality that provide passive and active recreation opportunities.

Table 3.10 Open Space and Recreation

Reserve	Level	Sporting Uses	Comments
Ethelbert Square	Neighbourhood		
Boucatt Reserve (Brompton)	Local	Basketball court	Seating, shelter
Gibson Street Reserve / Emu Park (Bowden)	Neighbourhood	Basketball court	Playground
Parfitt Square (Bowden)	Local		Playground, seating, shelter
Thomas Harkness Reserve (Brompton)	Local		Playground, seating, shelter
Bowden Park (Bowden)	Local		Picnic tables, playground, public/community art, seating, shelter
Kevin Taylor Park (Bowden)	Local		Seating
Mary Lee Park (Park Lands Park 27B – Fronting Park Tce between Second and Sixth Streets)	Local/District	Basketball Court, Tennis Court, Community Facilities, Soccer Pitches, West Adelaide Soccer Club	Playing courts are freely illuminated, car parking provided, Park Terrace Community Garden, BBQ shelter, picnic tables, seating
Future open space planned in Bowden/ Gasworks			
Parklands Park 2	District/regional	Adelaide Aquatic Centre	Playgrounds

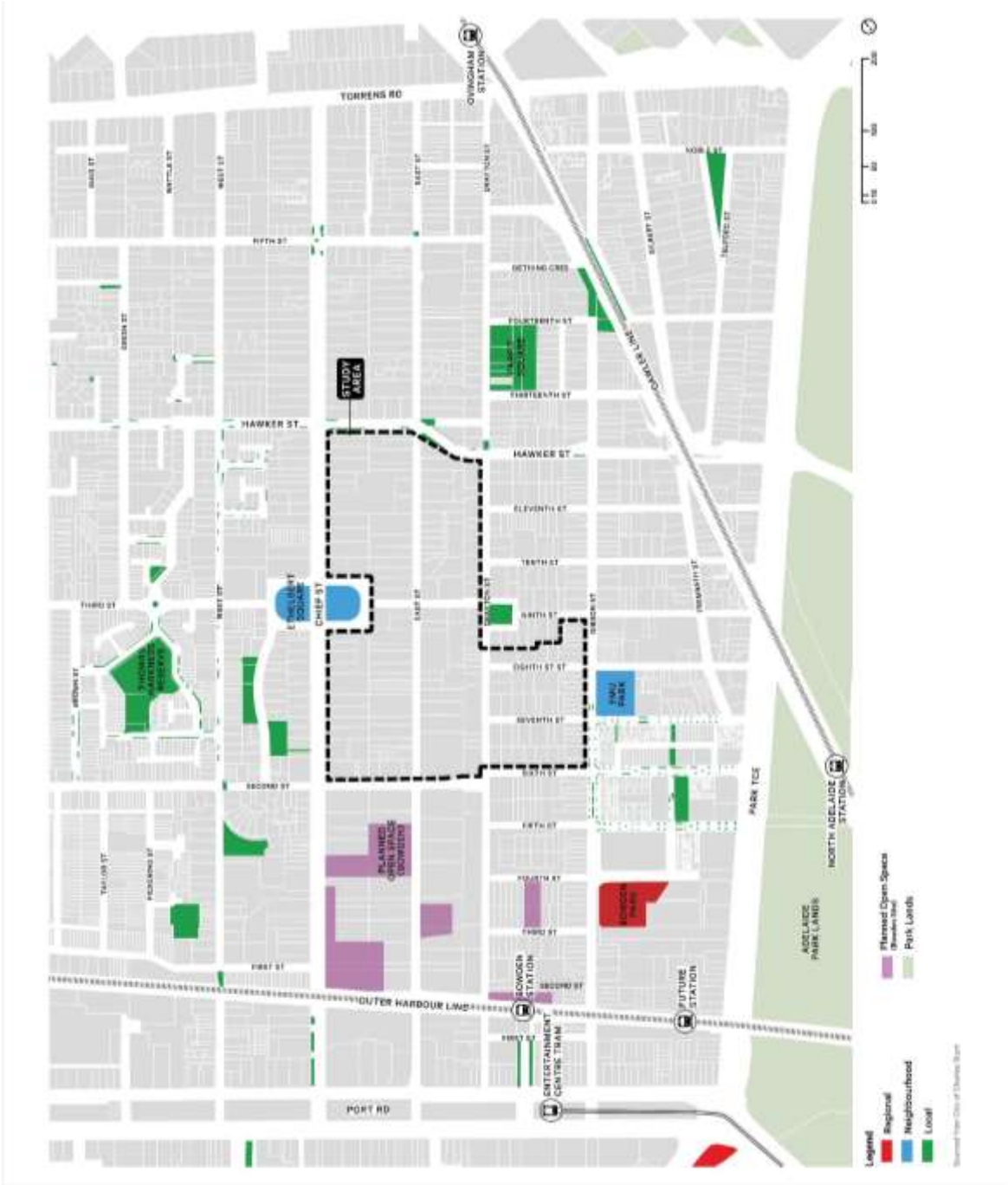


Figure 3.24 Existing Open Space and Recreation Spaces

Additional facilities are generally provided in the adjacent City of Adelaide, as well as Netball SA and Athletics SA in Mile End.

It is not considered that there is or will be a need for formal sporting uses/clubs. However, there may be future demand for informal/recreational community sporting uses. Basketball courts and lawn bowls were identified during consultation.

Developers of new allotments are required to either provide open space within the development area or make a financial contribution in lieu of land. Under the Act, 12.5% of a development site must be set aside as public open space as part of the subdivision process. Where open space is not provided, the developer is required to pay money in-lieu of providing open space as gazetted.

The *Best Practice Open Space in Higher Density Developments* Project was initiated by the City of Charles Sturt and funded through the Local Government Research and Development Fund. This study examined benchmark provisions of open space.

The South Australian legislative requirement of '12.5% of land for open space' relates to around 4 ha per 1,000 people in a lower density development area of 35 hectares (based on 15 dwellings per hectare and 1.9 persons per household). This figure is consistent with benchmarks used in the ACT (4ha) and Queensland (4-5ha) but greater than the NSW benchmark.

The study found that:

- A good distribution of quality and flexible open space is required. This includes ensuring open space is not inundated or unstable due to topography, drainage or stormwater management. Open space should not be 'left over' land or undevelopable land.
- It is recommended that people in higher density areas should be within a 3-5 minute walk or 250m – 300m from a park. There is need for a spread of parks and activity nodes that provide opportunities for frequent use (the idea of providing people with the opportunity for a 'quick stroll in the garden').
- The provision of up to 12.5% of land for open space is unlikely to be sufficient to meet the recreation, sport, social and environmental needs of people in higher density areas due to the smaller area of land being developed, i.e. the population size and demands are likely to be high but the provision of open space can only be 12.5% of the land which could be a low provision. New development areas require land for recreation, stormwater management, nature and connections, plus there should be access to sporting open space. Generally 12.5% will not be sufficient to cater for the required provision in a 'high density scenario'.
- Whilst high density urban developments could require more than 12.5% of land for open space, a balanced approach is required as too much open space could have negative impacts, including the need for taller buildings or higher housing costs to achieve viability. • Developments with less than 20 dwellings are likely to occur and this could result in contributions of funds rather than the allocation of open space. As a result, neighbourhoods could be left with a lack of or poorly planned open space.

Notably, the study found that the total provision of open space within a higher density urban development would ideally be around 2 hectares per 1,000 people or 25% of the development land (around 1 hectare per 1,000 people for Primary Open Space and around 1 hectare or more per 1,000 people for Contributory Open Space) based on best practice and case studies.

Policy Implications for the Study Area

The Study Area is expected to result in some 2600 people. Using the findings of the Best Practice Open Space in Higher Density Developments, an open space provision of 5 hectares could be expected, equating to some 44% of the Study Area.

This level of provision is not supported by the current Open Space Contribution Scheme, however it supports a recommendation that the full 12.5% provision of public open space (as estimated from a calculation of the total developable area) be provided, which equates to approximately 1.22 hectares of land.

The proposed allocation and location of open space in the Concept Plan supports both the total provision of open space, as well as the distribution of space within the Study Area that combines the provision of open space with the stormwater detention requirements.

4. CONSULTATION

4.1 Engagement Process

As part of the Investigations, the project team engaged with the community in order to identify local issues, and inform ideas and the future vision for the Study Area.

This engagement process was undertaken as part of the Technical Analysis stage of the project. The engagement process included:

- Preparation of an Information Brochure;
- Preparation of a project page for 'Yoursay Charles Sturt';
- Survey using 'Yoursay Charles Sturt' from 13/11 to 8/12;
- "Map your ideas" tool online, which enabled the community to pin comments on a map;
- Covering letter and Information Brochure distributed to landowners within and adjacent the affected area, and key community groups;
- Community information session; and
- Notice in the CCS Messenger column about community information session.

4.2 Feedback Received

4.2.1 Community Session

The session was held at '19 On Green' Community Centre, held on 28 November 2017, from 4 to 8pm.

Approximately 20 persons, predominantly home owners, attended the Community Session. Post-it notes were collected during the Session, which are appended to this Summary (**Appendix E**).

4.2.2 Survey forms

A total of 21 survey forms were completed in either of the following manners:

- Hard copies completed during/following the Community session (total of 6); and
- Online forms via Yoursay Charles Sturt (total of 15).

An example survey is provided at **Appendix F**.

4.2.3 Map Your Ideas

Comments that were pinned on the "Map Your Ideas" tool are shown by Figure 4.1 below. A total of 42 submissions were made.



Figure 4.1 Map Your Ideas

4.3 Summary of Issues

The submissions were generally supportive of the intent to rezone the Study Area for residential/mixed use purposes.

Key issues identified during consultation included:

- Traffic and car parking are current issues that have to be considered during the investigations in order to limit traffic, rat-running and speed, and promote safe movements, cycling and walking;
- Potential issues about heights were identified, including overlooking, loss of privacy, overshadowing, sightlines, which requires good urban design and policy considerations;
- There will be a need for public open space as density increases; and
- Amenity is currently poor, including footpaths, lighting, plantings/trees/landscaping etc.

Key opportunities can be summarised as follows:

- Mixed uses could be anticipated in the area, with residential (broad range of housing), shops, cafes, restaurants (of small scale)and local parks the key uses identified in the responses;
- Shops and commercial/employment uses are preferred on Hawker Street (including existing Centre Zone) and Chief Street (including Ethelbert Square), in areas accessible via public transport, and could also be provided at ground level of future residential development;
- There is an opportunity to promote the existing heritage/historic fabric and create policies that encourage future built form to reflect the industrial character of the area;
- Generally future development could complement the Renewal SA Bowden development, in terms of built form and atmosphere;
- Enhance the existing diversity and community feel;
- Setbacks should be encouraged in order to ensure open space/greening across the Study Area;
- Better amenity in general, including cycling, footpaths, trees, pedestrian crossings;
- Transition from lower densities to higher densities closer to Bowden and along edges of Study Area, with 4-5 storeys the preferred maximum;
- It is preferred that heights be limited adjacent existing residential areas;
- Walking and cycling infrastructure and safety is strongly encouraged; and
- Existing open space should be improved, and there could be additional open spaces provided.

5. CONCEPT PLAN

5.1 Objectives

The Concept Plan has been developed with the following key objectives:

Develop underutilised land

The site is occupied by a mix of under-utilised and/or former industrial uses, with some 85% of the overall site held by six major industrial. The Concept Plan should provide for the wholesale redevelopment of the site.

Address infrastructure issues

Infrastructure issues relating to physical infrastructure (eg stormwater and movement networks) and social infrastructure (community uses) shall be recognised and addressed by the Concept Plan.

Increase housing density

The Concept Plan shall provide for an increase in housing density within the site area.

Enhance open space provision

The Concept Plan shall recognise the comparatively low level of open space provision and provide for an enhanced quantum and quality of open space provision within the site area.

Provide housing choice

The Concept Plan shall provide for a wide range in housing choice.

Connect to existing urban context

The Concept Plan must ensure that the site is connected to and integrated with the existing urban context.

5.2 Key Principles

The Concept Plan is based on several overarching urban design principles that underpins the design outcome and ensures a strong robust structure that is sound and adaptable. These are as follows:

Environment

- Work with the existing and surrounding landscape, landform and climate conditions.
- Optimise solar orientation to maximise energy efficiency with east west and north south orientated roads.

Neighbourhood Character

- Establish a memorable sense of place that integrates with the existing surrounding community.
- Respond holistically to the existing and future context, within and beyond the site.
- Design housing and streetscapes to be cohesive but diverse.

Responsive

- Develop a market led design through the delivery of appropriate housing product and initiatives that respond to market drivers such as household formations, price points and social housing.

Prioritise Place

- Establish a vibrant public realm that extends throughout the development to connect with the broader community.
- Treat site water as an asset, conveying it throughout the public realm and employing best practice WSUD.
- Support a range of transport alternatives such as public transport, cycling and walking.
- Integrate new development into the surrounding urban context and its existing and future pattern and character.
- A respect for the landscape that recognises and builds on the existing character of the adjacent open space and local area.
- Ensure streetscapes form part of an extension to the overall landscape setting and structure.
- A landscape outcome that respects the prevailing climatic conditions.
- Integrate nature play within the landscape and water management solution.

Street Hierarchy

- Edge open space with streets and/or houses that provide a direct street address to the open space.
- Provide active laneways and slip lanes to reduce driveway impact to the proposed collector road.
- Provide a connected network of streets that are easy to navigate and promotes walkability and cycling.
- Provide safe well connected cycle and pedestrian networks that promote a healthy option for the community and assist to reduce car dependence.
- Provide strong access pedestrian links to the adjacent major transport corridor.

Responsive Housing

- Achieve lot dimensions that support a variety and viable housing types.
- Deliver a housing mix and density.
- Ensure affordable and diverse hosing choices.
- Deliver housing that provides opportunity for sustainable efficiency.
- Deliver diversity of design and built form.
- Provide for housing that not only relates to the streetscape but also is designed to help activate these streets as people places.

5.3 Infrastructure and Services

The Concept Plan incorporates the key findings of the Stormwater Management Plan. Specifically the Concept Plan includes:

- Incorporation of WSUD principles within the road profiles;
- Creation of three new stormwater dry detention basins within areas of open space;
- Installation of underground detention system within Ethelbert Square.

New and additional power, water, sewer and gas services are to be accommodated within the new and existing street network.

5.4 Transport System/Network

5.4.1 Access and Movement Principles

The major access and movement network derives from a number of key objectives and influences. These are:

- Legible integration and street patterns - Minimising the impact to existing networks;
- Orientation of roads with the respect to ESD principles.



Figure 5.1 Stormwater Concept

5.4.2 Road Network

The Concept Plan introduces a new road network that builds on a traffic impact assessment including review of existing road network capacity and potential upgrade requirements.

From a broader sense, it is anticipated that redevelopment of the study area would be based on retention and improvement of the existing and surrounding traditional grid layout. This will maximise permeability and accessibility for active transport modes, as well private motor vehicles.

it is recommended that additional 'local road' connections could be provided internally within the Study Area between Chief Street, East Street and Drayton Street (oriented north-west to south-east).The total number of vehicle connections to Chief Street should be minimised to limit conflict points on the street's walking and cycling network, however pedestrian and cyclist connections are still desirable (i.e. reflective of the grid network).

Restrictions on vehicle connections could be implemented with full closures prior to Chief Street (with alternative connections via the 'internal' road network) and/or limited access provisions, such as left-out or left-in only at select locations.

The links could be supplemented with either additional 'local roads' or 'laneways' oriented south-west to north-east. Laneways parallel to the main road connections (Drayton Street, East Street, Chief Street, Second Street and Hawker Street) would be desirable to allow future dwelling sites to be rear loaded with minimal direct access (crossovers) on these roads to maximise pedestrian, cyclist, on-street parking and general road safety.

Figure 5.2 illustrates the general layout recommended.

It is anticipated that the road network would be developed in a similar manner to the "Streets for People" approach within the nearby Bowden Urban Village (albeit "lessons learnt" through that project should be applied). On this basis, cycling would generally be accommodated in a shared manner on-road (with ability for cyclists to also utilise footpaths). The future road network should therefore be designed to minimise vehicle speeds (in line with the "Streets for People" approach).



Figure 5.2 Road Network

5.4.3 Public Transport

The Concept Plan recognises the public transport opportunities in the vicinity of the Study Area and whilst no new services are proposed within the site, the proposed road and pedestrian network allows for legible access to:

- Bowden, North Adelaide and Ovingham train stations;
- Tram (Entertainment Centre);
- Bus routes along Hawker Street and Port Road.

5.4.4 Pedestrian/Bike Paths

The Concept Plan seeks to improve the quality of walking and cycling infrastructure. New connections along the Second Street/Sixth Street route and along Eighth Street have been incorporated into the Plan.

5.5 Open Space and Recreation Provision

The Concept Plan introduces a number of open space provisions, located primarily in parallel with the provision of stormwater infrastructure and new road hierarchy. Open space provision achieves an overall provision of 12.5% and clusters the majority of the space into two new squares, allowing opportunity for new residential development to focus on these spaces. The open space provisions also include the retention and reinforcement of Ethelbert Square (along with the introduction of underground water retention) and new corridors along Second Street, Hawker Street and Third Street. These open space provisions are coupled with a landscaped street profile to improve overall amenity within the area and interface with surrounding roads and development.

The open space concepts provide for a total of 12,150 square metres of open space (equating to 12.5%) however this increases to 15,150 square metres (15.5%) including Ethelbert Square.



Figure 5.3 Pedestrian and Cycle Concept

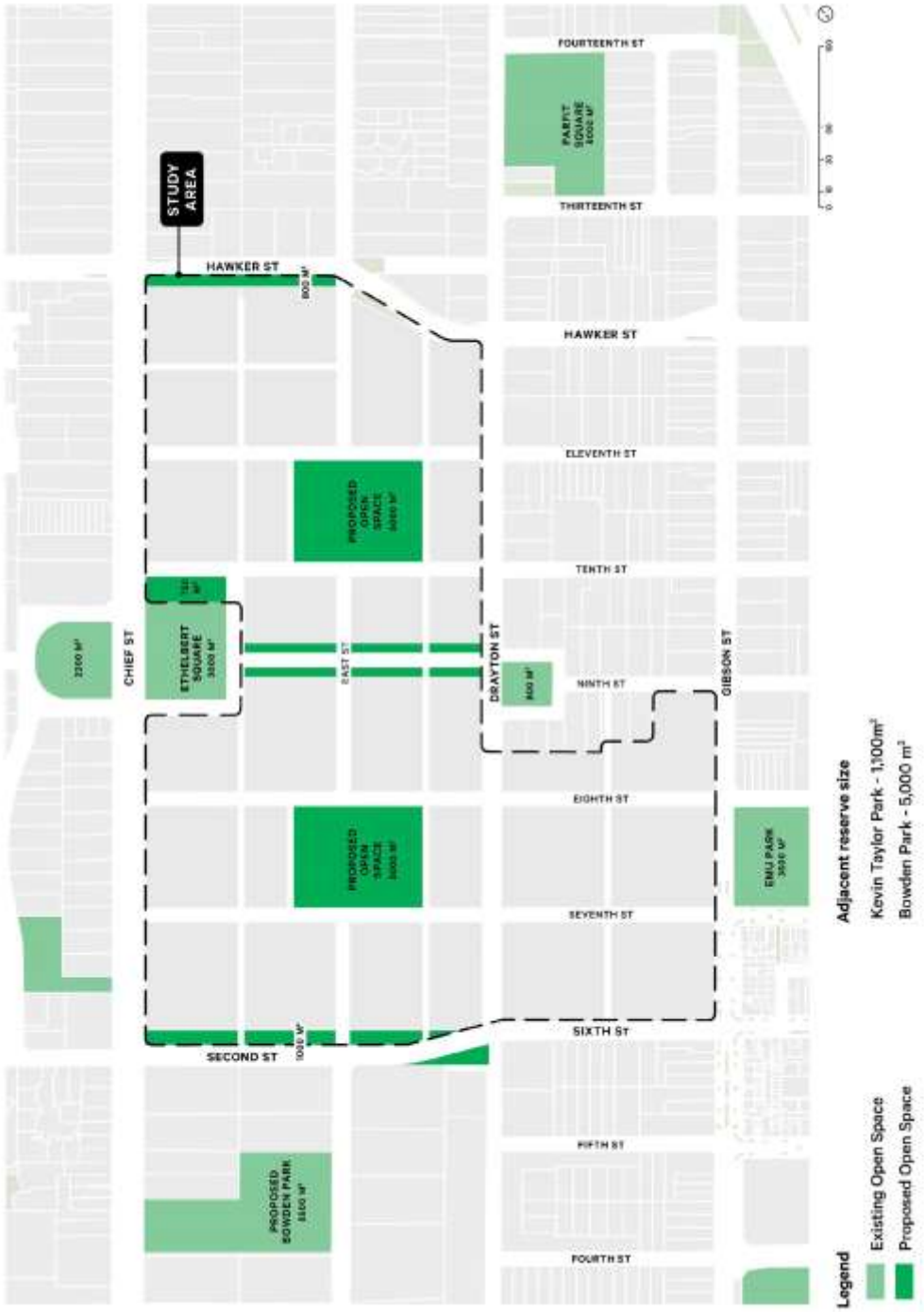


Figure 5.4 Open Space Concept

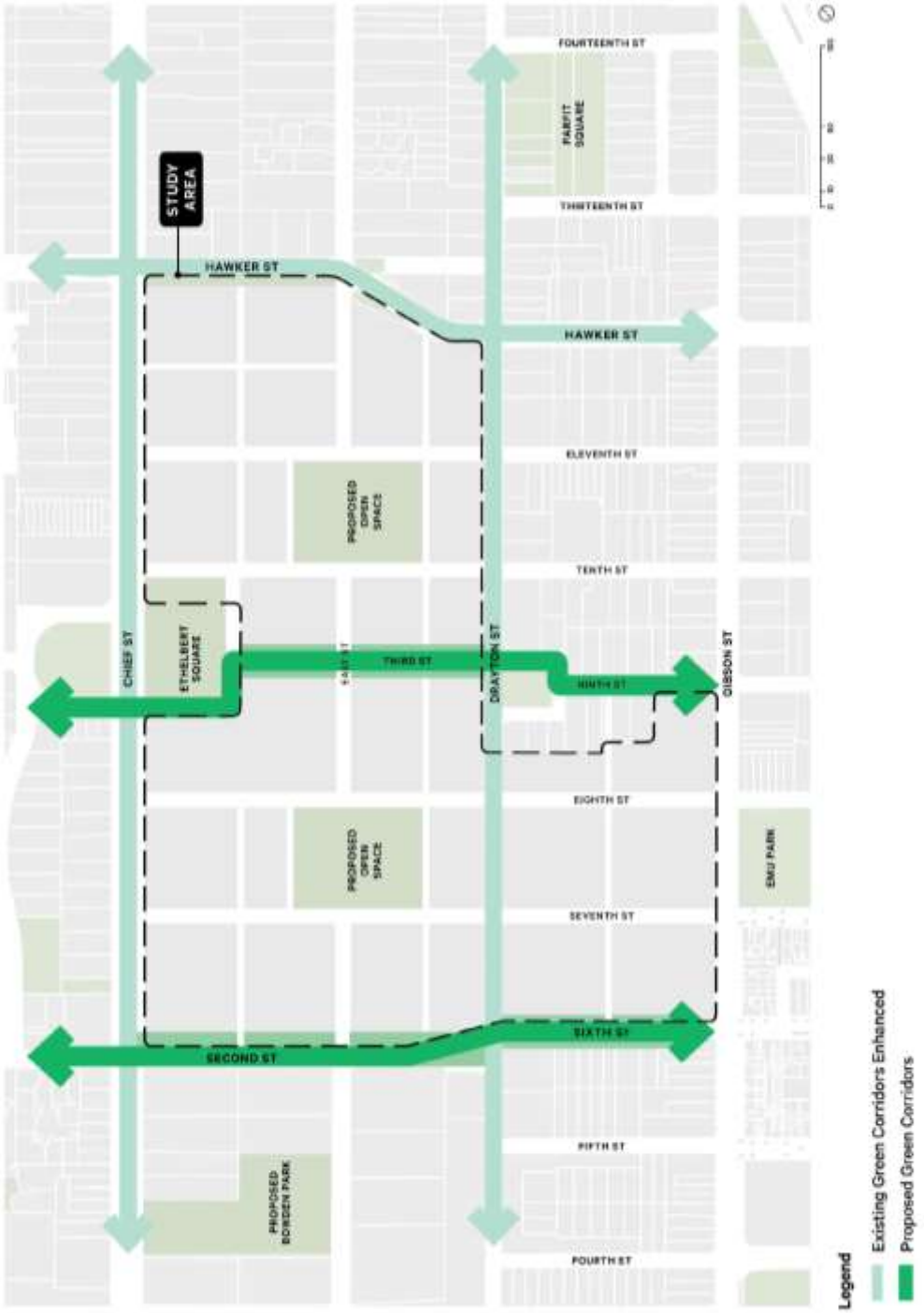


Figure 5.5 Green Corridors

5.6 Character and Built Form

The Concept Plan provides for a mix of land uses. It is noted that the adjacent Urban Core Zone (Bowden development) also includes activity centres with commercial and retail uses.

Whilst residential developments are expected to be the primary form of development within the Study Area, small scale business and retail opportunities should be envisaged, in order to create activity and enhance the innovative and entrepreneurial mindset that was described during community consultation, and encourage ground floor activation and the reuse of local shop fronts.

In order to achieve this, it is anticipated that future zoning will enable the development of small scale retail and commercial floor space, ground floor activation and home businesses.

The Concept Plan identifies a range of building heights in which mixed use developments are anticipated.

Setbacks within the existing Study Area are varied from closely setback dwellings from front boundaries to large industrial buildings constructed on property boundaries with little (if any) visual relief, modelling or articulation.

New setbacks within the Study Area should adopt those forming part of the Renewal SA Bowden development, and in particular, should have no minimum setbacks prescribed from primary frontages and side boundaries. Setbacks from secondary road frontages or rear access ways should have no minimum where the access way is 6.5 metres or more , or where the access way is less than 6.5 metres in width, the distance equal to the additional width required to make the access way 6.5 metres or more should be provided to ensure adequate manoeuvrability for vehicles

5.7 Streetscapes

A network of green streets providing a high level of accessibility will be established.

The quality of these streetscapes is crucial in providing a desirable outlook for homes and to create a context that is full of engagement and is a place where future residents are proud to live in.

Each road type will be characterised to provide legibility to the road network through themed landscaping. The desire character will be achieved through a range of selected species, level of planting maturity, placement frequency, patterning, street lighting and fencing.

The streetscape proposals will create a legible network of vehicular, pedestrian and bike linkages forming a hierarchy of streets that reinforce arrival and destination points, public realm and built form.

The main Collector Road will be designed to cater for cycle ways, major pedestrian networks and public transport. It will also in parts accommodate WSUD principles within the centre median. An extensive use of native and deciduous trees of local provenance will offer the potential to demonstrate biodiversity outcomes that will be regarded as a benchmark in landscape design.

Road profiles for each of the streets identified in the hierarchy above are found in the Cirqa report at **Appendix C**.

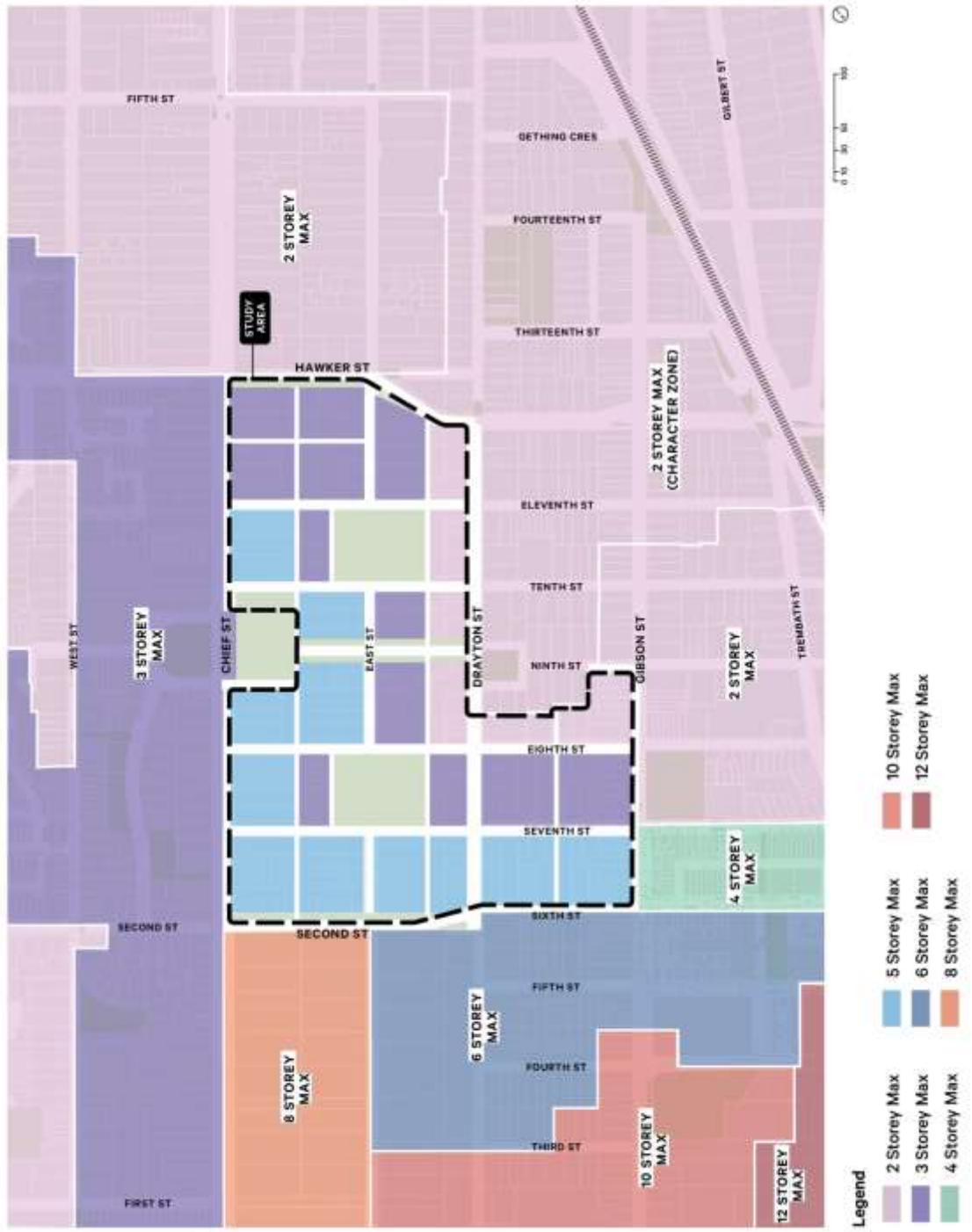


Figure 5.6 Proposed Building Heights



Figure 5.7 Street Hierarchy

5.8 Environmentally Sustainable Development

The Concept Plan has been design to maximise solar access through placement of road orientation to be on an approximate north - south and east west axis. This will ensure that homes can be fully designed to reach optimum solar management outcomes.

There are several main elements of the integrated water management strategy. These are:

- Provision of stormwater treatment within the landscape spaces through a series of wetland basins and swales.
- Provision of flood mitigation measures to protect surrounding residents from existing overland flows and increased flows from new development through proposed detention areas within the public open space. In addition opportunity exists to create the street and open space network as an integrated WSUD system. Some of the initiatives are:
    - Introduction of bio-retention measures through a mix of streetscape and Local Park bio retention rain gardens and median swales to provide for stormwater treatment and also to create "self-irrigating" green spaces along streetscapes. These can also form part of traffic management solutions for the site.

5.9 Affordable Housing

The provision of affordable housing is intended to apply within the redeveloped Study Area.

The Affordable Housing Overlay should apply over land within the Study Area when a rezoning process is undertaken to provide the potential for increased dwelling yield. As such, the overlay must be selected and mapped to apply to the whole of the new zone. The overlay is applicable to the Suburban Neighbourhood Zone (when applied to new areas), Urban Corridor Zone, Urban Core Zone and the Suburban Activity Node Zone.

5.10 Future Zoning

The City of Charles Sturt seeks a seamless transition from the adjoining Renewal SA Bowden development to the proposed new redeveloped Study Area.

In order to facilitate such a transition, a continuation of the Urban Core Zone is the preferred approach and this should be examined as part of any Development Plan Amendment process.

5.11 Industry Retreat

Since the re-zoning of the (adjacent) former Clipsal site to Urban Core Zone in 2012 the remaining Industry Zone in the Bowden/Brompton area has been 'land locked' with no direct access to / from an arterial road.

Existing EPA licenced and non-licenced activities in/adjacent to the study area, with associated off-site impacts and associated evaluation distances are likely to remain until the retreat of all industrial activities occurs from within the study area.

Industry retreat is expected to be managed principally by interim policy consideration and a shared coordinated provision of infrastructure.

Site specific infrastructure requirements (power, water, sewer, internal roads/laneways etc) can be readily managed on a site by site basis, however an integrated and coordinated management of stormwater, open space and primary road network improvements is required for redevelopment. Given the relatively small size of the affected area, land ownership arrangements and open space and stormwater management requirements, equitable cost sharing arrangements are necessary to coordinate redevelopment within the affected area. These are discussed in Section 6 of this report.

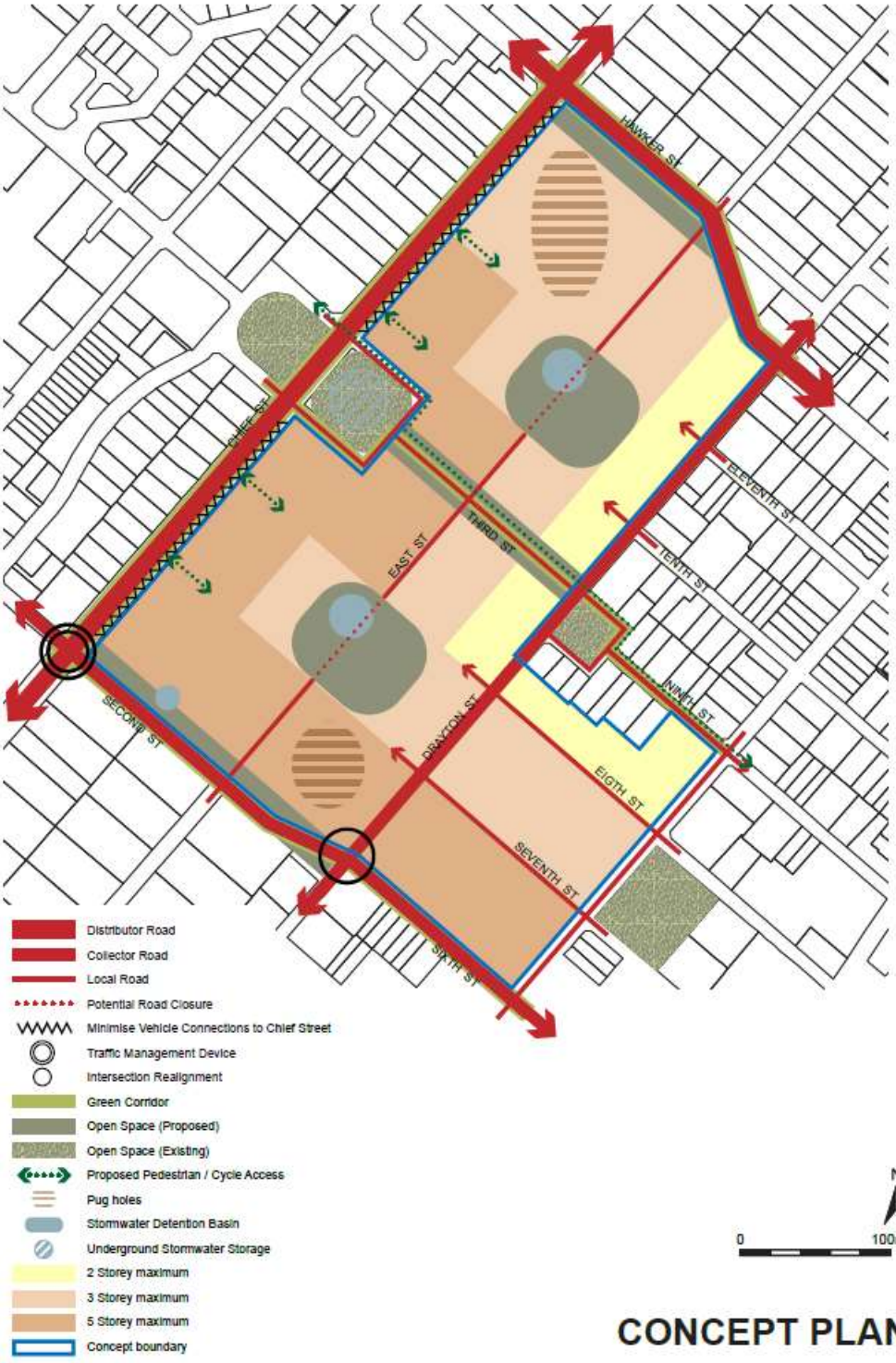
Whilst a rezoning of the land may serve as a catalyst for industry retreat, there is no coordinated plan for the holistic withdrawal of non-residential land uses. Policy is accordingly required manage systematic approach to industry 'retreat' and to allow infill development.

New policy is to address the presence of existing non-residential activities is required. This was included in the Renewal SA Bowden redevelopment. The inclusion of noise and emissions overlay into new zoning within the Study Area with corresponding planning policy can be one way of addressing industry retreat, allowing for incremental development that addresses the existing off site impacts within the area. Urban Core Principle of Development Control 14 applies to the Renewal SA Bowden redevelopment and states:

> *PDC14 At Bowden Urban Village, residential development and other sensitive uses likely to be adversely affected by odour emissions from established industrial activities should:*
>
> *(a) be avoided in those parts of the zone closest to the Thebarton brewery (being south of Fourth Street and east of Drayton Street) until those operations cease, or odour reduction control measures have been implemented (or will be implemented within an acceptable period) at the source such that the anticipated odour concentration is within acceptable limits*
>
> *(b) only encroach to within 100 metres of the odour sources associated with the smallgoods processing activities on Sixth Street where the odour concentration levels are unlikely to cause nuisance.*

A similar provision should be considered for any new zoning that applies to the Study Area.

5.12 The Concept Plan



6. INFRASTRUCTURE

6.1 Summary of Infrastructure Requirements

Infrastructure requirements for the Concept Plan are comprised of:

- Full reconstruction of all roads and footpaths;
- New in-ground services to new constructed roads;
- Minor modification of existing services in existing roads where reconstructed (no allowance to realign these services);
- Landscaping to new and existing roads (existing trees to Chief Street to be protected);
- Stormwater infrastructure;
- Detention basins;
- Reserves (landscaping) to new nominated open spaces.

6.2 Cost Estimates

Rider Levett Bucknall has prepared an Order of Cost Concept Design Cost Estimate based on the documents provided for the proposed Bowden Concept Plan. The detailed Cost Report which further defines the proposed scope of works and associated costs including the costs associated with the infrastructure requirements summarised in Section 6.1 as well as Design and Construction Contingencies and Professional Fees and Charges.

In summary, the Concept Design Estimate is $34.02 million broken down as follows:

Cost Item		
New Road Constructions		$7,700,559
Existing Road Upgrade		$8,735,758
Detention and Bio-Retention Basins		$2,076,700
Reserves		$8,123,750
	Estimated Net Cost	**$26,636,767**
Project Contingency		$4,865,000
Professional Fees and Charges		$2, 551,000
Escalation beyond end 2018		Excluded
Concept Design Estimate Total Cost (excl. GST)		**$34,024,767**

The Order of Cost Concept Design Cost Estimate is included in **Appendix H**.

6.3 Staging

No staging is identified in the development of the Concept Plan. The relatively small size of overall site and larger ownership parcels combined with a requirement for the holistic implementation of infrastructure is considered to limit staging opportunities.

The requirements for open space provision and stormwater infrastructure result in some parcels having a lesser development potential.

6.4 Infrastructure Agreements

6.4.1 Background

The Study Area has been selected as part of the Infrastructure Schemes Pilot Project (Pilot Project), which is designed to assist in providing a framework to resolve key infrastructure issues arising from the proposed rezoning.

Given the relatively small size of the affected area, land ownership arrangements and open space and stormwater management requirements, equitable cost sharing arrangements are necessary to coordinate redevelopment within the affected area.

The Pilot Project is being developed as part of the implementation by DPTI of the new Planning, Development and Infrastructure Act 2016 (PDI Act 2016), which was passed by Parliament in April 2016 and came into operation on 1 April 2017.

To ensure the best possible use of this new approach, an Infrastructure Schemes Pilot Project has been put in place to:

- Improve DPTI's understanding of the new legislative mechanism and associated suite of financial tools that can be used to deliver infrastructure;
- Test and feedback on the new approach across a breadth of scenarios.

As part of these pre-DPA investigations, it is required to advise on how infrastructure requirements, previously identified in Section 6.1, can best be provided in a timely, equitable and cost effective manner. This includes identifying the following:

- A preferred method(s) for achieving equitable cost sharing for such upgrades (both between the various land owners and between land owners, Council and/or the State Government);
- The optimum methods for achieving co-ordination in, and trigger points (eg allotment thresholds) for, the provision of such infrastructure to enable the orderly sequencing of development in a cost effective manner (eg how to achieve effective and sustainable stormwater management on upstream sites in the event that downstream sites continue to accommodate non-residential activities);

- The optimum provision of public open space throughout the subject land with consideration to the equitable distribution of costs and integration with the preferred stormwater management system and WSUD initiatives.

6.4.2 Methods for Infrastructure Provision

As part of these investigations, one method for achieving equitable cost sharing for infrastructure upgrades is identified as being through a Basic Infrastructure Scheme.

Under the Planning, Development and Infrastructure (PDI) Act, Infrastructure Schemes can be in the form of either a Basic or General Infrastructure Scheme. Provisions relating to the operation of Basic schemes are operational. General schemes are not yet in operation, however, clauses 30-31 of Schedule 8 provide for pilot schemes, subject to the same requirements, to be established as a transitional measure.

The purpose of Infrastructure Schemes is to establish and agree:

- What infrastructure will be provided;
- Standard to which it will be provided;
- Within what timeframe it will be delivered; and
- How it will be funded.

The Basic Infrastructure Scheme is particularly useful for the coordinated identification and delivery of infrastructure where there are complex land ownership arrangements, including where there are multiple land owners thereby precluding the need to use infrastructure deeds. It applies to a defined 'designated growth area' and provides the mechanism to ensure the delivery of infrastructure such as water, sewerage, gas, electricity, telecommunications, roads, bridges and stormwater management which is immediately needed to make a development liveable.

The Basic scheme will provide transparency and greater certainty to investors and communities around infrastructure funding arrangements by setting down what type of infrastructure will be provided within an area, who will fund it and when it will be delivered.

Infrastructure will be provided in step with the pace of development and delivered when actually needed, not at some time in the future.

A Basic Scheme will result in a one off charge placed on the land within the designated growth area payable at the time the benefit is realised when the land is subdivided or development is undertaken (sale of lot, building or construction work commences). There is therefore no need to pay the charge for a land owner who has no intention to develop the land.

Specifically, the Basic Scheme will:

- Allow infrastructure to be delivered in sequence with development outcomes;

- Replace the need for numerous infrastructure agreements with individual landowners;
- Prepare clear funding arrangements; and
- Allow for the equitable distribution and apportionment of the costs, noting the following principles:
    - Ensure that those who will gain financially from works will pay their fair share of the cost of the infrastructure;
    - All developers should contribute equally, some will contribute more;
    - Developers who contribute more should be fairly compensated; and
    - Developers can undertake works in kind instead of paying tax.

The provision of basic infrastructure and associated funding arrangements are limited to one or more of the situations:

- the basic infrastructure is necessary for purposes of proposed development (including associated rezoning) within the whole or part of the designated growth area;
- the basic infrastructure will service, support or promote significant development within the designated growth area;
- it is necessary or efficient to coordinate the design, construction and funding of basic infrastructure under a scheme because of the scale of the:
    - development that is proposed or to be undertaken within the designated growth area; or
    - the basic infrastructure that is to be provided (or both).

In this instance the proposed basic infrastructure requirements are necessary within the designated area, will promote significant development and are necessary to coordinate and construct the infrastructure, and in particular the new stormwater detention basins, and additional road network.

The details arising from the above will need to be negotiated between Council and the landowners, noting the potential for primary and secondary contributors, and the ability for land owners/developers to undertake work in kind. Such is particularly relevant for the Study Area, where significant stormwater infrastructure will be required, in locations which will impact on the future development capacity of land owned by various parties.

Roads, laneways ,intersection upgrades and the associated infrastructure of water, sewer, power, stormwater and gas can be funded under the agreement as these works are interdependent and required up-front to create the required road networks, access and stormwater systems for the resultant development within the Study Area.

Open space cannot be funded under this arrangement.

Immediate/primary contributors are identified as those directly adjoining and gaining access from roads.

Local external roads can be funded through the establishment of a transport infrastructure fund proportionally contributed to by Council and landholder beneficiaries and funded as development occurs.

6.4.3 Provision of public open space and stormwater integration

Stormwater and open space provisions are interwoven within the Concept Plan and are to be 100% funded between all land owners, proportionally.

Funding via an Infrastructure Scheme is complicated as the stormwater infrastructure (pipes, basins etc) can be funded however the funding and/or the provision of the open space cannot.

The provision of public open space throughout the subject land has been determined with consideration to the equitable distribution of costs and integration with the preferred stormwater management system and WSUD initiatives as well as achieving a level of provision commensurate with the 12.5% open space requirements for new development.

6.4.4 Proposal for Infrastructure Provision

The optimum methods for achieving co-ordination in, and trigger points (eg allotment thresholds) for, the provision of infrastructure needs to be considered in order to enable the orderly sequencing of development in a cost effective manner.

In terms of achieving coordination for the provision of infrastructure needs, some elements are required concurrently with development of the adjacent land, whilst others can be provided in the longer term. Whilst the opportunity exists for an Infrastructure Scheme, the required timing and relatively small size of the Study Area suggests that this approach is not necessary to facilitate redevelopment.

A proportional cost share arrangement is proposed depending on the cost item, trigger for requirement and location of works. Of the estimated total cost of $34.02M identified by Rider Levett Bucknall, an indicative estimated breakdown is as follows:

Land Owners/	$10.1M
State Government (Renewal SA/DPTI)	$1.1M
Council	$2.1M
Individual developers	$10.1M
Reserves	$10.3M
Rounding margin	+/-10%
Total	**$34.02m**

FYFE

APPENDIX A

STORMWATER MANGEMENT MASTER PLAN BY FYFE

STORMWATER MANAGEMENT MASTERPLAN

BOWDEN-BROMPTON DPA INVESTIGATIONS

Preliminary

65148

PREPARED FOR | City of Charles Sturt

PREPARED BY | Fyfe Pty Ltd

ABN | 57 008 116 130

ADDRESS | L1, 124 South Terrace, Adelaide SA 5000

CONTACT | Bicky Shakya, Senior Stormwater Engineer

TELEPHONE | office 61 8 8201 9600 direct 8201 9711

FACSIMILE | 61 8 8201 9650

EMAIL | bicky.shakya@fyfe.com.au

DATE | 21/05/2018

REFERENCE | 65148 (Revision D)

©Fyfe Pty Ltd, 2018

Proprietary Information Statement

The information contained in this document produced by Fyfe Pty Ltd is solely for the use of the Client identified on the cover sheet for the purpose for which it has been prepared and Fyfe Pty Ltd undertakes no duty to or accepts any responsibility to any third party who may rely upon this document.

All rights reserved. No section or element of this document may be removed from this document, reproduced, electronically stored or transmitted in any form without the written permission of Fyfe Pty Ltd.

Document Information

Prepared by: Bicky Shakya	Senior Stormwater Engineer, Fyfe Pty Ltd	Date: 21 May, 2018
Reviewed by: Steve Mitchell	Senior Engineer, Fyfe Pty Ltd	Date: 21 May, 2018
Approved by: John Hudson	Civil and Structures Manager	Date: 21 May, 2018
Client acceptance by:		Date:

Revision History

Revision	Revision Status	Date	Prepared	Reviewed	Approved
A	Preliminary	4.12.2017	BS	SJM	CRG
B	Preliminary	9.12.2017	BS	SJM	CRG
C	Preliminary	14.12.2017	BS	SJM	CRG
D	Final	21.05.2018	BS	SJM	JH

CONTENTS

Page

1. INTRODUCTION V

1.1 Background v

1.2 Design Basis v

2. PRE-DEVELOPMENT SCENARIO VI

2.1 Existing catchment assessment vi

2.2 Pre-development hydrology vii

2.3 Data source vii

2.4 Rainfall data viii

2.5 Parameters for Drains viii

2.6 Current Infrastructure capacity ix

2.7 Flood depth and extent x

3. POST-DEVELOPMENT HYDROLOGY XI

3.1 Proposed stormwater management strategy xii

4. STORMWATER QUALITY MANAGEMENT 1

LIST OF TABLES

Table 2.1 Sub-catchment areas and discharge locations vii
Table 2.2 Main drainage system and contributing sub-catchments vii
Table 2.3 Depression storage viii
Table 2.4 Pre-development impervious/pervious percentage for hydraulic modelling viii
Table 2.5 Main catchments and pre-development flow rates ix
Table 3.1 Comparison between pre-development and post-development flow rates xi
Table 3.2 Detention basin details xi
Table 3.3 Proposed surface detention depth xiii
Table 3.4 Detention in oversized pipes/culverts xiii
Table 3.5 Detention in Ethelbert Square Reserve xv
Table 3.6 Proposed stormwater detentions xvii

Table 3.7	Detention basin details	xvii
Table 4.1	Surface area required for stormwater treatment	2

LIST OF FIGURES

Figure 2.1	Pre-development sub-catchment plan	vi
Figure 2.2	100 year ARI Flood Map	x
Figure 3.1	Underground stormwater detention in Ethelbert Square Reserve	xiv
Figure 3.2	Modular type infiltration chamber and detention system	xv
Figure 3.3	Indicative locations of the three stormwater detention basins	xvi
Figure 4.1	Retrofitted bio-retention system in street	2

APPENDICES

Appendix A	Catchment plans

EXECUTIVE SUMMARY

The aim of this report is to investigate the capacity of the existing drainage system and future stormwater management requirements including post-development stormwater management and flood mitigation measures incorporating water sensitive urban design (WSUD) principles to accommodate future development. The investigation relates to a proposed re-zoning of an existing Urban Employment Zone in Bowden-Brompton.

Council has requested to restrict the 100 year average recurrence interval (ARI) flow rates to the 5 year ARI pre-development flow rates. Pre-development and post-development scenarios hydraulic modelling was undertaken for the site stormwater drainage system to determine the detentions required to restrict the 100 year ARI post-development flow rates to the permissible out flow rates.

The subject area comprises mainly of industrial and commercial uses and contains a high proportion of impervious surfaces, and drains mainly into 3 trunk drainage mains located in Second Street, Third Street and Hawker Street. There is currently limited stormwater infrastructure located within the subject site. Internal drainage system is located only in Third Street and on the eastern end of East Street. Council flood map for a 100 year ARI indicates at least two localised areas of flooding. The flows enter into the properties from East Street and Drayton Street. From the preliminary hydraulic modelling, the over toppings are mainly due to insufficient inlet pit capacity. The extension and/or upgrade of the existing drainage system and addition of inlet pits will further improve the drainage condition within the subject area.

For the post-development hydraulic modelling, it is assumed that the site will consist of mixed dwellings of approximately 60% townhouses and 40% apartments, and 12.5% of developable area will be public open space. It is assumed that the impervious area after the development will be approximately 75%. To improve the stormwater drainage condition of the site, the construction of an underground network of pipes and pits will be required. Surface flows will need to be contained within the road network designed for a 100 year ARI event and the underground drainage network will need to be designed for a 5 year ARI event. The major drainage system up to 100 year ARI will need to be considered as a dual system consisting of the minor system and the road carriage ways as channels.

The proposed stormwater detention systems to restrict the post-development flow rates to the permissible flow rates are as follow:

- Detention on road surface,
- Underground large pipes/ box culverts,
- Underground tanks in car parking areas,
- Rainwater tanks,
- Underground detention in Ethelbert Square reserve, and
- Stormwater detention basins.

The proposed detention volumes in several systems are shown in Table 1.

Table 1 Proposed stormwater detentions

Catchment based on the main drainage system	Proposed detention system				
	Road surface, driveway and land scaped area (m^3)	Underground pipe/culverts in Council roads (m^3)	Rainwater tanks and underground storage in car parks (m^3)	Ethelbert Square reserve detention (m^3)	Required surface detention basin volume (m^3)
Second Street	20	54	15	-	261
Third Street	80	309	110	686	1315
Hawker Street	150	381	180	-	889

The required surface area for detention basins are shown in Table 2. The basins are sized assuming 1.50m deep with 1(V):5(H) side batter and vertical gabion walls.

Table 2 Detention basin details

Catchment based on the main drainage system	Surface area for stormwater detention basin (m^2)
Second Street	450
Third Street	920
Hawker Street	920

Principles of water sensitive urban design (WSUD) are proposed to be used to ensure that the runoff generated by the proposed development is treated within the site before discharging into the existing Council drainage network. The adoption of WSUD principles will improve amenity while also providing environmental enhancement. The installation of WSUD devices such as rain gardens, road side bio-retention basins, sedimentation basins should be considered in the development of open space areas in order for the proposed development to enhance the amenity for the local community.

The approximate surface areas required for stormwater quality control are shown in Table 3.

Table 3 Surface area required for stormwater treatment

Catchment based on the main drainage system	Surface area required for stormwater quality control/WSUD (excluding detention) (m^2)
Second Street	200
Third Street	500
Hawker Street	700

1. INTRODUCTION

1.1 Background

The aim of this report is to investigate the capacity of the existing drainage system and future stormwater management requirements including post-development stormwater management and flood mitigation measures incorporating water sensitive urban design (WSUD) principles to accommodate development. The investigation relates to a proposed re-zoning of an existing Urban Employment Zone in Bowden-Brompton.

The initiatives aim to address formal policies required by the Council and, more specifically, address site specific drainage issues affecting local roadways and residents. Council has identified a number of current opportunities to further achieve outcomes for public and environmental benefit within the study area.

1.2 Design Basis

The stormwater management strategy for the site, as outlined in this document has been developed using guidelines contained in the following documents;

- Institution of Engineers Australia publication, "Australian Rainfall and Runoff";
- City of Charles Sturt Stormwater Management Plan development guidelines;
- Using MUSIC in Sydney's Drinking Water Catchment, A Sydney Catchment Authority Standard;
- Water sensitive urban design-creating more liveable and water sensitive cities in South Australia.
- More specifically, the stormwater drainage system has been designed with consideration of the requirements provided by the City of Charles Sturt;
- Minor underground stormwater drainage system is designed for a 0.2 Exceedance probability (EY) which is equivalent to the 5 year Average Recurrence Interval (ARI) Intensity Frequency Duration (IFD) post-development event;
- Major drainage system is designed for a 1% Annual Expedience Probability (AEP) which is equivalent to the 100 ARI IFD. All allotments to be protected from a 1% AEP flood event;
- 100 year ARI post-development flow rate from the study area to be restricted to a 5 year ARI pre-development condition;
- For major flow events, the product of the velocity and corresponding depth should not be higher than 0.40 m^2/s on roads, swales or any surface flow path.

2. PRE-DEVELOPMENT SCENARIO

2.1 Existing catchment assessment

The subject area comprises mainly of industrial and commercial uses and contains a high proportion of impervious surfaces. Existing stormwater drainage systems within the site are located in Chief Street, Second Street, Sixth Street, Gibson Street, Drayton Street, Third Street, East Street and Hawker Street. Based on the aerial image and GIS drainage database, the site is currently discharging into Council drainage systems at 8 different locations. The catchment plan shown in Figure 2.1 is based on the existing inlet pit locations. The approximate area for each sub-catchment is tabulated in Table 2.1.



Figure 2.1 Pre-development sub-catchment plan

Table 2.1 Sub-catchment areas and discharge locations

Sub-catchments	Discharge location	Catchment area (Ha)
A	Chief Street (south-western side of Ethelbert Square)	1.11
B1, B2	Second Street	0.34
C	Sixth Street	0.33
D1, D2, D3, D4	Gibson Street	0.55
E1, E2, E3, E4, E5, E6	East Street & Third Street drainage system	3.37
F1, F2, F3	Drayton Street & Hawker Street drainage system	3.10
G1, G2, G3	East Street & Hawker Street drainage system	2.69
H	Chief Street & Hawker Street drainage system	1.26

The sub-catchments drain mainly into 3 trunk drainage mains located in Second Street, Third Street and Hawker Street. The main drainage systems and their catchment areas are shown in Table 2.2.

Table 2.2 Main drainage system and contributing sub-catchments

Main drainage system location	Contributing sub-catchments	Catchment area (Ha)
Second St	B1, B2, C	0.674
Third St	A, E1, E2, E3, E4, E5, E6	4.483
Hawker St	D1, D2, D3, D4, F1, F2, F3, G1, G2, G3, H	7.597

2.2 Pre-development hydrology

The aim of the pre-development hydraulic assessment and modelling is to determine the 5 year ARI (0.2 Exceedance per year) pre-development flow rates generated from the catchments. As per the Council requirement, it is proposed to restrict the 100 year ARI (1% Annual Exceedance Probability) post-development flow rates to the 5 year ARI pre-development conditions before discharging into the main drainage systems. The hydrological assessment of the catchments was undertaken using the ILSAX hydrological model in DRAINS program.

2.3 Data source

The data sources used to undertake the pre-development catchment assessment are as follows:

- Aerial photography image of the site (Google image),
- 2m interval GIS contours,
- DCDB cadastral map,
- Stormwater drainage database available from Council,
- The Bureau of Meteorology website,

- ARR Data Hub.

2.4 Rainfall data

Drains require rainfall intensity data and temporal patterns. The 2016 rainfall IFD system is used to estimate the rainfall data. The 2016 IFDs replace both the ARR87 IFDs and the interim 2013 IFDs. The latest rainfall depths to be used in design and analysis procedures are obtained from the Bureau of Meteorology website (www.bom.gov.au/water/designRainfalls/revised-ifd/?year=2016) and temporal patterns are obtained from ARR Data Hub. IFD shows design rainfall depths for various frequencies, including 1 exceedance per year (1 EY), 0.2 EY, 0.5 EY and annual exceedance probabilities (AEP) of 50%, 20%, 10%, 5%, 2% and 1%. AEP is the probability of an event occurring in a year.

2.5 Parameters for Drains

The following assumptions were made in the development of the drainage model for the site.

2.5.1 Depression Storage

Depression storage is typically used to account for the initial loss in depth of rainfall that is assumed to be retained in depression on a catchment surface and is subject to evaporation. In the Ilsax hydrological model, this loss is subtracted after continuing infiltration losses because it is assumed to occur after infiltration. The depression storages considered for the project are tabulated in Table 2.3.

Table 2.3 Depression storage

Paved (impervious) area depression storage	1mm
Supplementary area depression storage	1mm
Grassed (pervious) area depression storage for settlements	5mm

2.5.2 Impervious Site Coverage

The proposed site is within an industrial area and mostly considered impervious. The adopted impervious and pervious percentages for the site are tabulated in Table 2.4.

Table 2.4 Pre-development impervious/pervious percentage for hydraulic modelling

Catchment type	% Impervious
Roof area	100
Sealed/paved area	80
Unsealed/compacted gravel pavement	40
Grassed/pervious area	0

The directly connected impervious areas and pre-development flow rates for the 3 main catchments are tabulated below in Table 2.5.

Table 2.5 Main catchments and pre-development flow rates

Catchment based on the main drainage system	Directly connected impervious area (%)	0.2EY Flow Rate (Permissible Flow rate out) (m^3/s)	1% AEP Flow rate (m^3/s)
Second Street	85%	0.081	0.179
Third Street	66%	0.372	1
Hawker Street	86%	0.756	1.75

2.6 Current Infrastructure capacity

There is currently limited stormwater infrastructure located within the subject area. Internal drainage system is located only in Third Street and on the eastern end of East Street. The preliminary hydraulic modelling indicated that the internal underground drainage systems are inadequate to capture and convey the minor and major events flows.

2.7 Flood depth and extent

Council flood map for a 100 year ARI indicates at least two localised areas of flooding (Figure 2.2). The flows enter into the properties from East Street and Drayton Street. The flood depth on allotment 38-40 and properties on the western side of Drayton Street vary from 50mm to 70mm and 50mm to 110mm respectively. Other than that, the 100 year ARI flood on most of the road sections is confined to within the road reserve boundary.



Figure 2.2 100 year ARI Flood Map

Source: https://intramaps.charlessturt.sa.gov.au/IntraMaps80/

From the preliminary hydraulic modelling, the over toppings are mainly due to insufficient inlet pit capacity. The extension and/or upgrade of the existing drainage system and addition of inlet pits will further improve the drainage condition with in the subject area.

3. POST-DEVELOPMENT HYDROLOGY

The aim of the post-development catchments modelling is to determine the post-development flow rates and stormwater detention volume to restrict the post-development flow rates to the 0.2EY pre-development conditions, and identify any infrastructure upgrades/ extensions to meet Council service standards for the future re-development of the site.

For the post-development hydraulic modelling, it is assumed that the site will consists of mixed dwellings of approximately 60% townhouses and 40% apartments, and 12.5% of developable area will be public open space area. It is assumed that the impervious area after the development will be 75% and pervious area will be approximately 25%.

The result of the pre and post-development scenarios hydraulic modellings indicate that attaining full development density, on the basis of the proposed land use, will likely generate less runoff for a 5 year ARI event than the existing industrial/commercial footprint. This is mainly due to the proposed development having less impervious area than the existing development. However, for a major storm event, runoffs from both pre and post-development scenarios are almost similar. The flow comparisons for all 3 main catchments are shown in Table 3.1.

Table 3.1 Comparison between pre-development and post-development flow rates

Catchment based on the main drainage system	0.2EY Flow Rate (m^3/s)		1% AEP Flow rate (m^3/s)	
	Pre-development	Post-development	Pre-development	Post-development
Second Street	0.081	0.057	0.179	0.175
Third Street	0.372	0.313	1	1.06
Hawker Street	0.756	0.530	1.75	1.80

The proposed drainage strategy is based on reducing the 100 year ARI peak post-development out flow rates to the 5 year ARI pre-development flow rates as per the requirements contained in City of Charles Sturt Stormwater Management Plan development guidelines. On-site stormwater detention system will be required to restrict the post-development flow rates to the prescribed condition. The required stormwater detentions for 3 main catchments are shown in Table 3.2.

Table 3.2 Detention basin details

Catchment based on the main drainage system	Required detention volume (m^3)
Second Street	350
Third Street	2500
Hawker Street	1600

3.1 Proposed stormwater management strategy

To improve the stormwater drainage condition of the site, the construction of an underground network of pipes and pits will be required. Surface flows will need to be contained within the road network designed for a 100 year ARI event and the underground drainage network will need to be designed for a 5 year ARI event. The major drainage system up to 100 year ARI will need be considered as a dual system consisting of the minor system and the road carriage ways as channels. Hydraulic calculations need to be undertaken to ensure that no allotment will be flooded as the result of the 100 year event.

The proposed finished floor levels (excluding under croft car parks) shall be constructed at least 300mm above the highest adjacent street water table or a minimum 150mm freeboard above 100 year ARI flood level, whichever is higher.

The design of the stormwater infrastructure will need to incorporate stormwater detentions to achieve the Council requirement to restrict the post-development flow rates to the prescribed flow rates. The proposed stormwater detention systems to restrict the post-development flow rates to the permissible flow rates are as follow:

- Detention on road surface,
- Underground large pipes/ box culverts,
- Underground tanks in car parking areas,
- Rainwater tanks,
- Underground detention in Ethelbert Square reserve, and
- Stormwater detention basins.

3.1.1 Detention on road surface

Detentions on road reserve, landscaped and/ or driveways and car parks are proposed for a 100 year ARI flood without inundating the private properties. This will be utilised once the underground detention systems exceed their storage limit and pits start to surcharge. As the topography of the site is relatively flat, it is proposed to seesaw the road profiles with sag points to achieve some surface detention and also to achieve minimum 0.5% road longitudinal grade.

For ponding on car parking area, it is assumed that 5% of the catchment area will be carparks.

In the interest of safety and amenity, surface detention shall be designed in a manner, which minimises inconvenience and nuisance. The proposed storage depth for different locations is shown in Table 3.3.

Table 3.3 Proposed surface detention depth

Location	Desirable maximum depth
Road surface	Minimum road boundary level or (Velocity x depth < 0.4 m/s^2)
Accessible landscaped area (tree pit, road side rain garden) / common area	300mm
Parking and driveway	100mm
Pedestrian area	50mm absolute maximum

Approximate surface detention storage volumes are calculated based on the above mentioned assumptions.

3.1.2 Underground large pipes/ box culverts

Large oversized underground stormwater pipes/ box culverts are proposed in the roads within the site for stormwater detentions. The size and depth of the pipes/culverts will be governed by the depth of the existing downstream drainage system. Reinforced concrete box culvert (RCBC) of 1200 (wide) x 600 (depth) is proposed in Sixth Street, Drayton Street, East Street, Seventh Street, Eight Street and Third Street. The surface runoff from the catchments will drain into the system via inlet pits. Outlet of each system will be fitted with flow control orifice to detain the maximum amount of flow in pipe and on the surface. The underground stormwater detentions are shown in Table 3.4.

Table 3.4 Detention in oversized pipes/culverts

Catchment based on the main drainage system	Underground stormwater detention in roads	Pipe size L x W x D	Detention volume (m^3)
Second Street	Sixth Street	75 x 1.2 x 0.60	54
		Total in Second Street catchment	**54**
Third Street	East Street	180 x 1.2 x 0.60	129
	Third Street	100 x 1.2 x 0.60	72
	Chief Street	150 x 1.2 x 0.60	108
		Total in Third Street catchment	**309**
Hawker Street	Seventh Street	75 x 1.2 x 0.60	54
	Eighth Street	75 x 1.2 x 0.60	54
	Drayton Street	200 x 1.2 x 0.60	144
	Third Street	100 x 1.2 x 0.60	72
	Chief Street	80 x 1.2 x 0.60	57
		Total in Hawker Street catchment	**381**

3.1.3 Rainwater tanks and underground tanks

Council is not in favour of using rainwater tanks as a detention system for single dwellings. However, for apartment buildings rainwater tanks may be used for stormwater detention. It is assumed that approximately 40% of development is expected to be 3-5 storey apartment buildings. These buildings are expected to have capacity in car parking areas to provide detention and each building is expected to provide 1.5m^3 of detention. Flow control orifice to be provided for above ground detention system whereas a pump out system with limited pumping rate will be required for underground systems.

3.1.4 Underground stormwater detention in Ethelbert Square Reserve

There is a potential opportunity to install an underground detention system within Ethelbert Square reserve. Council advised that they are supportive of further investigation.

There are several underground services that run through the middle of the reserve that includes sewer main, high pressure gas and other minor services. A stormwater detention system can be installed either side of the services. The proposed indicative locations for the stormwater detention within the reserve are shown in Figure 3.2.

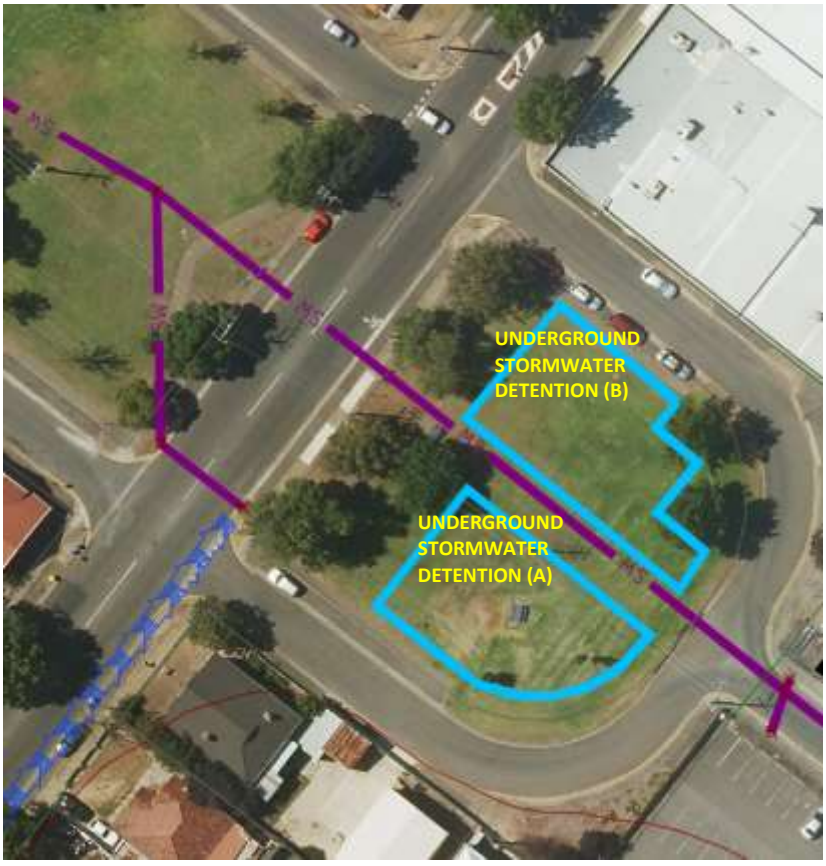


Figure 3.1 Underground stormwater detention in Ethelbert Square Reserve

A high-density polyethylene infiltration chamber modular underground stormwater storage system is proposed for detention. This system is environmentally progressive, technologically advanced and also has pollutant removal benefits. The chambers will have open bottom which provides maximum infiltration surface area. The infiltration of storm water recharges groundwater supplies, hence, maintaining a base flow.



Figure 3.2 Modular type infiltration chamber and detention system

Source: www.tritonsws.com

Installation of the detention system will not alter the use and visual amenity of the reserve. The internal drainage system from the site will be draining into the detention system and the permissible flow rate from the system will drain into the existing Council drainage system. The detention area and volume in the reserve is shown in Table 3.5.

Table 3.5 Detention in Ethelbert Square Reserve

Catchment based on the main drainage system	Underground stormwater detention	Surface area (m^2)	Detention volume (m^3)
Second Street	Detention A	480	336
	Detention B	500	350
		Total in detention volume	**686**

The use of the infiltration type detention system will require geotechnical investigation testing of the existing soil and if geotechnical testing does not allow the promotion of infiltration then alternatively, 2 underground concrete tanks or Hume Stormtrap can be installed for stormwater detention.

3.1.5 Stormwater detention basins

Stormwater detention basins will be required to detain the majority of the stormwater runoff generated from the site. 3 dry detention basins are proposed at the downstream of the internal drainage systems before discharging the controlled outflow rate to the existing Second Street, Third Street and Hawker Street drainage systems. The basins would occupy no more than 20 per cent of the available public open space, as per the Council Development Plan.

The detention basins depths will be governed by the existing drainage outlet invert levels. To determine the approximate surface area required for detention basins, it is assumed that the detention basins will be a maximum 1.5m deep with 1(V):5(H) side batter with some vertical walls if required. Stepped gabion walls are proposed on some basin banks to reduce the basin footprint. Vehicular access road shall be provided to basins for maintenance and cleaning purposes.

The detention basins are proposed in the allocated open space locations shown below in Figure 3.3.

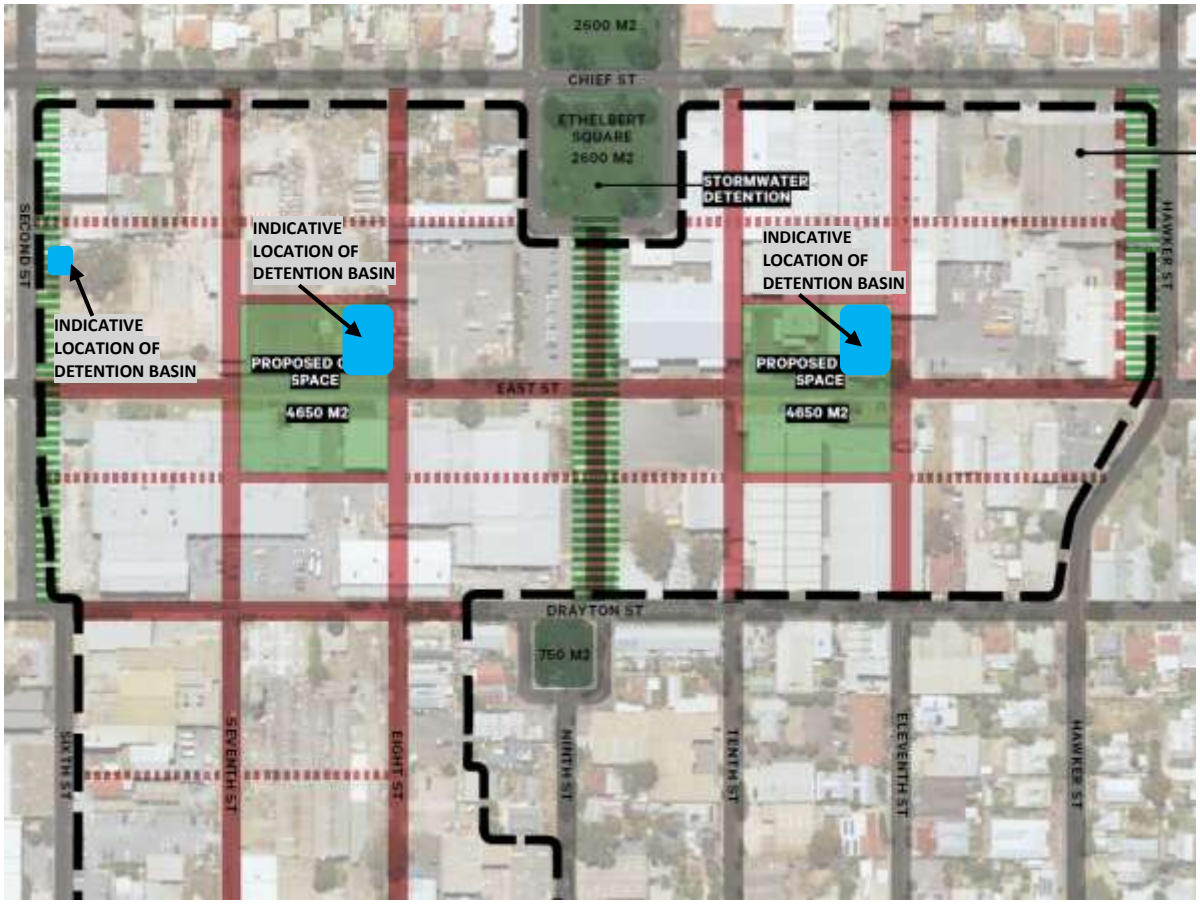


Figure 3.3 Indicative locations of the three stormwater detention basins

The summary of the detention volumes proposed on road surface, underground pipes/culverts, rainwater tank and underground tanks, Ethelbert Square reserve and surface detention basins are tabulated in Table 3.6.

Table 3.6 Proposed stormwater detentions

Catchment based on the main drainage system	Proposed detention system				
	Road surface, driveway and land scaped area (m^3)	Underground pipe/culverts in Council roads (m^3)	Rainwater tanks and underground storage in car parks (m^3)	Ethelbert Square reserve detention (m^3)	Required surface detention basin volume (m^3)
Second Street	20	54	15	-	261
Third Street	80	309	110	686	1315
Hawker Street	150	381	180	-	889

The detention basin surface area, depth and side batter proposed to achieve the volume as calculated in Table 3.6 above is shown in Table 3.7. The basin surface area can be reduced by reducing the basin batter slope by using gabion walls.

Table 3.7 Detention basin details

Catchment based on the main drainage system	Required detention volume (m^3)	Depth (m)	Side batter (V : H)	Surface area for detention basin (m^2)
Second Street	261	1.50	1 : 5 & vertical Gabion walls	450
Third Street	1315	1.50	1 : 5 & vertical Gabion walls	920
Hawker Street	889	1.50	1 : 5 & vertical Gabion walls	920

3.2 Proposed stormwater management strategy

3.2.1 Possible staging of development

The subject site is in multiple ownerships and it cannot be assumed that there will be a sequential development in accordance with optimum stormwater management requirement. To achieve effective stormwater management strategy, we propose the following sequence of construction and installation of stormwater management facilities/systems for all 3 catchments;

For apartment buildings within all 3 catchments, rainwater tanks may be used for stormwater detention. These tanks are expected to be located in car parking areas adjacent to provide detention and each building is expected to provide 1.5m^3 of detention. Flow control orifice to be provided for above ground detention system whereas a pump out system with limited pumping rate will be required for underground systems.

3.2.2 Development in Second Street catchment:

- The proposed underground drainage system and detention system in Sixed Street is required to be constructed prior to any development which drains on Sixth Street. The detention system is to detain the post-development flow rate to a 5 year ARI pre-development condition.
- Surface detention basin is to be constructed on the eastern side of Second Street to detain the post-development runoff from all the catchments draining to Second Street. The outlet from the basin is to be extended to the existing drainage system in Second Street.

3.2.3 Development in Third Street catchment:

- There is currently limited stormwater drainage infrastructure to capture and convey runoff within the catchment. The extent of the drainage system depends on the development location.
  The underground drainage system and detention system in the road reserve is to be constructed from the upstream end of the development to the proposed legal point of discharge.
  Should the development start from the upstream end, the drainage system is to be constructed for the whole length.
- If the detention required to achieve the Council requirement to restrict the post-development flow rate is still not enough, the stormwater detention system in Ethelbert Square reserve to be constructed as proposed. The outlet from the system is to be connected to Third Street drainage system.
- Underground oversized pipes in road reserve and detention in Ethelbert Reserve have limited stormwater detention capacity. A surface detention basin is to be constructed in proposed Third Street catchment reserve to accommodate any additional detention volume. Maximum 20% of the allocated open space can be used for stormwater detention system and other drainage purposes.
- Before discharging into the stormwater detention, WSUD features to be constructed/installed wherever feasible to achieve the EPA water quality requirements for the runoff generated from the development.

3.2.4 Development in Hawker Street catchment:

- As for the previous catchment, the extent of the drainage system depends on the development location. No existing drainage system is located in the catchment.
  Underground stormwater drainage system and detentions in road reserve is to be constructed from the upstream end of the development to the legal point of discharge (Hawker Street drainage system). The drainage system shall cater for the post-development scenario of its upstream catchments.
- Underground oversized pipes in road reserve has limited stormwater detention capacity. A surface detention basin is to be constructed in proposed Hawker Street catchment reserve to accommodate any additional detention volume. Maximum 20% of the allocated open space can be used for stormwater detention system and other drainage purposes.
- Before discharging into the stormwater detention, WSUD features to be constructed/installed wherever feasible to achieve the EPA water quality requirements for the runoff generated from the development.

4. STORMWATER QUALITY MANAGEMENT

The stormwater management strategy should include stormwater systems to minimise the discharge of sediment, suspended solids, organic matter, nutrients, litter and other contaminants to the stormwater system.

The Environmental Protection Authority (EPA) standard for stormwater pollutant reduction performance targets to be achieved is:

- Total Suspended Solids (TSS) by 80%
- Total Phosphorus (TP) by 60%
- Total Nitrogen (TN) by 45%
- Gross Pollutants by 90%

It is proposed to utilise the principal of water sensitive urban design (WSUD) to ensure that the runoff generated by the proposed development is treated within the site before discharging into the existing Council drainage network.

In many cases WSUD stormwater measures can enhance a landscape while providing treatment and flood conveyance. The intent is to slow flows down, provide filtration and sedimentation of stormwater that will prevent the majority of stormwater pollutants from leaving the study area.

The adoption of WSUD principles will improve amenity while also providing environmental enhancement. The installation of WSUD devices such as rain gardens, road side bio-retention basins, sedimentation basins should be considered in the development of open space areas in order for the proposed development to enhance the amenity for the local community.

To reduce both the peak and volume of runoff, there is the opportunity to implement elements of WSUD into new roads and integrate to the existing roadways.

WSUD features can be a high maintenance burden on asset owners and careful consideration should be given to what WSUD treatments are selected in the development area. Where possible a single type of WSUD treatment should be provided in the development and maintenance plans passed onto the asset owner at handover. The proposed WSUD elements for the site include:

- **Gross Pollutant Trap (GPT)**

  GPT is a device to capture and retain gross pollutants, litter, grit, sediments and associated oils by screening and rapid sedimentation. There are a variety of GPTs currently suitable for use in urban catchments including CDS unit, solid pollutant baskets, trash racks and in-ground GPTs. GPTs are typically the first line of defence when addressing stormwater quality because they target the coarsest pollutants. A GPT is proposed at the downstream and of each underground drainage network before discharging into the detention basin.

- **Vegetated Swale**

  Vegetated swales are proposed to be constructed along the floor of the detention basins. The vegetated swales are landscaped features that shall be designed to integrate with the overall layout of the Urban Renewal Plan, and will remove sediment and associated pollutants (eg. nutrients, oil, grease and heavy metals) from stormwater through sedimentation, infiltration and biological uptake. The vegetated swales will also convey low flows from the basin inlet to the outlet, to minimise the frequency of inundation of the floor of the detention basins.

- **Bio-retention basin**

  Bio-retention basins use ponding above a bio-retention surface to maximise the volume of runoff treated through the filtration media. Bio-retention basins operate by passing runoff through prescribed filtration media, commonly planted with vegetation that provides treatment through fine filtration, extended detention and some biological uptake. They also provide flow retardation and are particularly efficient at removing nutrients.



Figure 4.1 Retrofitted bio-retention system in street

Source: WSUD Engineering Procedure: Stormwater

The approximate surface areas required for stormwater quality control are indicated in Table 4.1.

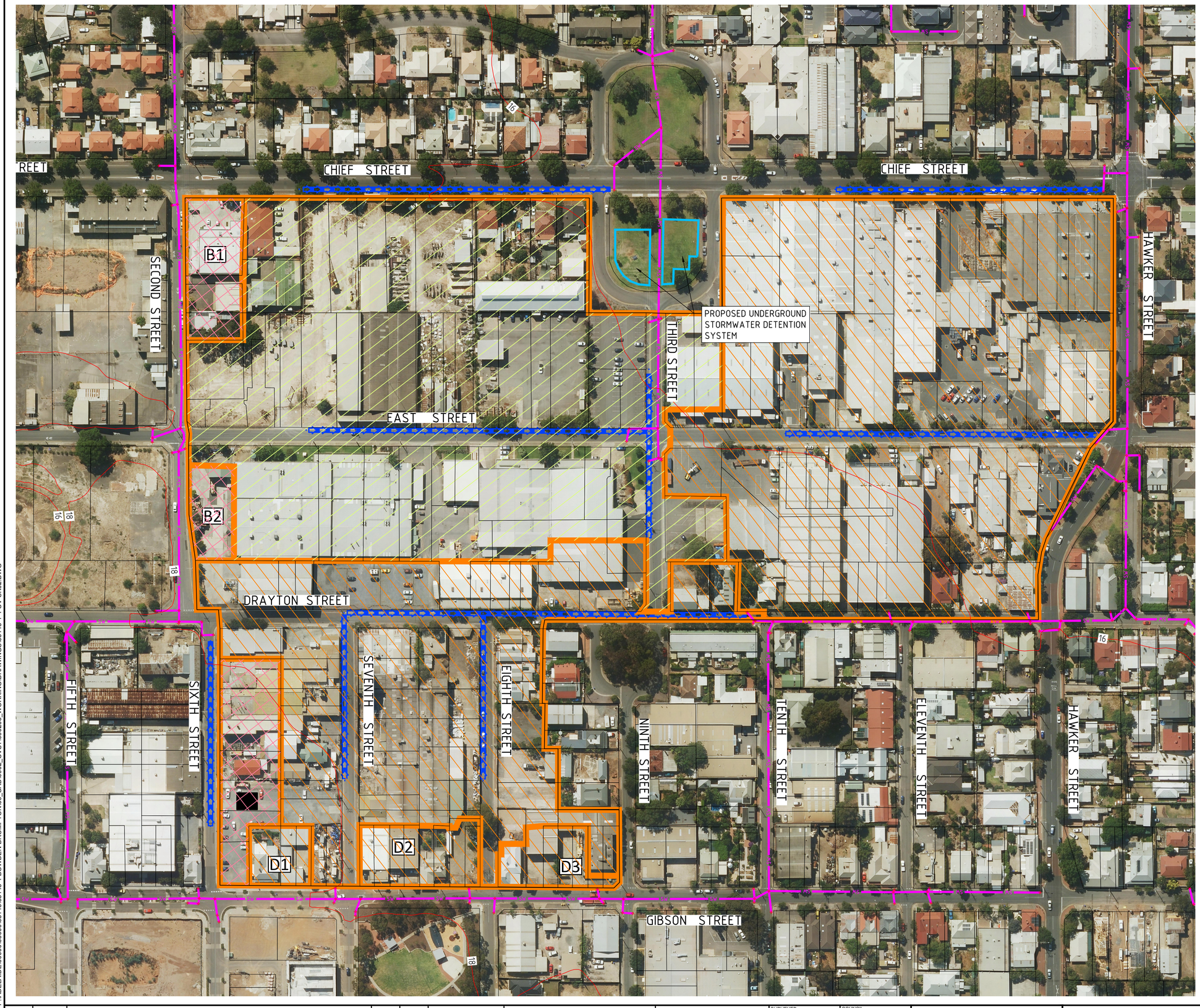
Table 4.1 Surface area required for stormwater treatment

Catchment based on the main drainage system	Surface area required for stormwater quality control/WSUD (excluding detention) (m^2)
Second Street	200
Third Street	500
Hawker Street	700



APPENDIX A

CATCHMENT PLANS



STORMWATER LEGEND

PROPOSED

- SITE BOUNDARY
- CATCHMENT BOUNDARY
- PROPOSED STORMWATER DRAINAGE SYSTEM/ OVERSIZED RCBC/PIPE FOR STORMWATER DETENTION
- SECOND STREET CATCHMENT
- THIRD STREET CATCHMENT
- HAWKER STREET CATCHMENT
- SW EXISTING STORMWATER DRAINAGE SYSTEM

PRELIMINARY COPY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

REV.	DATE	DESCRIPTION	DRN.	APP'D.
A	6/11/2017	PRELIMINARY	BXS	

0 10 20 30 40 50m
1 : 1000 (A1) 1 : 2000 (A3)

CLIENT: CITY OF CHARLES STURT
DEV. NO.

SURVEYED	COUNCIL CHARLES STURT
DRAWN BXS	DRAFTING CHECK
DESIGNED BXS	DESIGN CHECK
APP'D.	APP'D. DATE

FYFE PTY LTD
ABN 57 008 116 130
LEVEL 1, 124 SOUTH TERRACE
ADELAIDE SA 5000
GPO BOX 2450 ADELAIDE SA 5001
T (08) 8201 9600
F (08) 8201 9650
info@fyfe.com.au
www.fyfe.com.au

BOWDEN-BROMPTON DEVELOPMENT
SITE AND INFRASTRUCUTRE INVESTIGATION

STORMWATER CATCHMENT PLAN POST-DEVELOPMENT SCENARIO

CAD. REF 65148-1-4-CV-SK02.DWG
STATUS PRELIMINARY
DRAWING No. 65148-1-4-CV-SK02
REV A

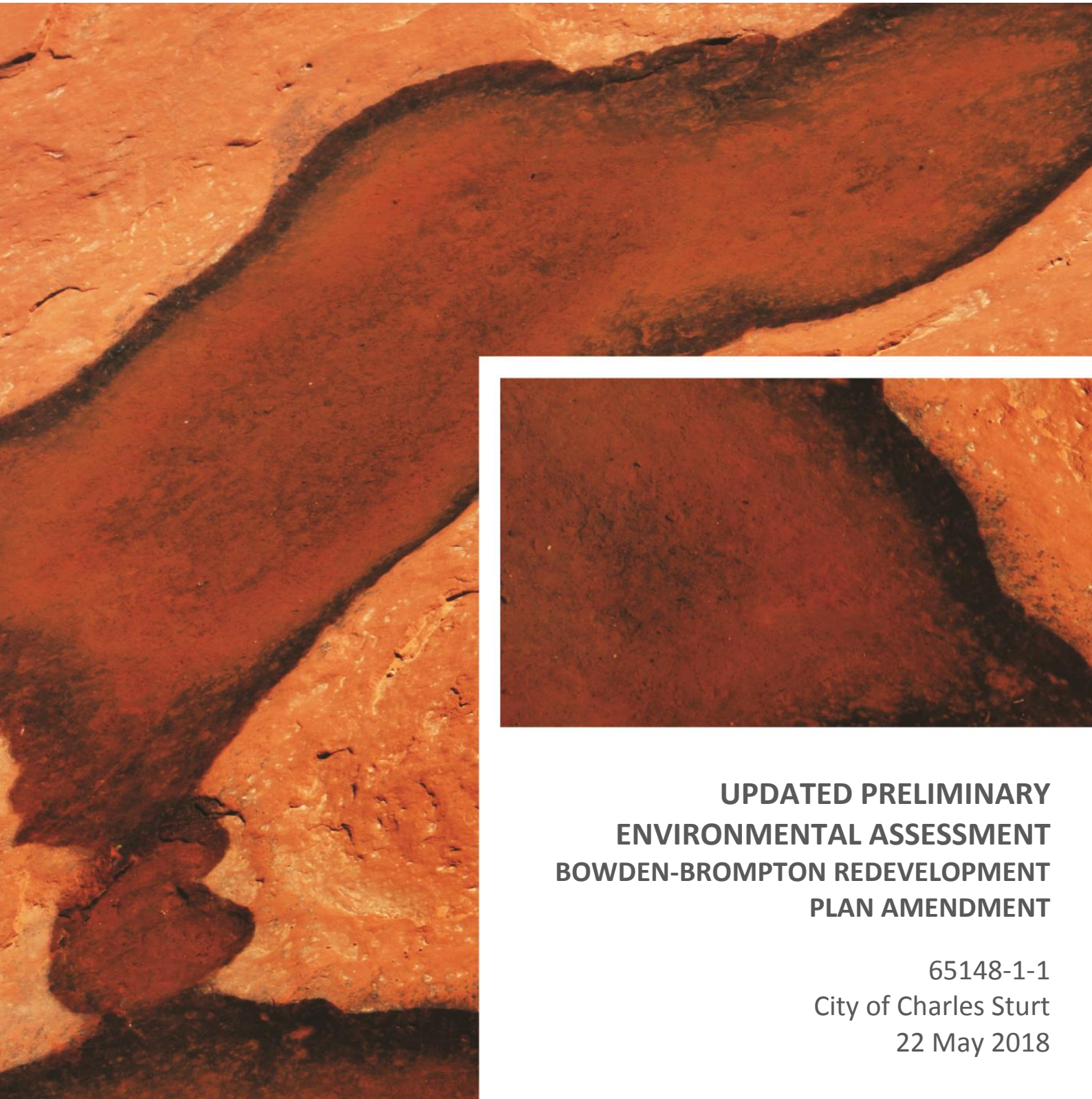
4/12/2017 10:25:33 AM P:\ADELAIDE\60000\65000\65148\65148-1 BOWDEN-BROMPTON\09_CAD\0902_CVST\0902203_WORKING\DRAWINGS\65148-1-4-CV-SK02.DWG



APPENDIX B

PEA

FYFE
Earth Partners
ENVIRONMENT
DEVELOPMENT
RESOURCES



UPDATED PRELIMINARY ENVIRONMENTAL ASSESSMENT

BOWDEN-BROMPTON REDEVELOPMENT PLAN AMENDMENT

65148-1-1
City of Charles Sturt
22 May 2018

UPDATED PRELIMINARY ENVIRONMENTAL ASSESSMENT

BOWDEN - BROMPTON REDEVELOPMENT PLAN AMENDMENT

Report

City of Charles Sturt

PREPARED FOR | City of Charles Sturt

PREPARED BY | Fyfe Pty Ltd

ABN | 57 008 116 130

ADDRESS | L3, 80 Flinders Street, Adelaide SA 5000

CONTACT | Marc Andrews

TELEPHONE | office 61 8 8201 9600 direct 08 8407 9794

FACSIMILE | 61 8 8201 9650

EMAIL | marc.andrews@fyfe.com.au

DATE | 22/05/2018

REFERENCE | 65148-1-1

©Fyfe Pty Ltd, 2018

Proprietary Information Statement

The information contained in this document produced by Fyfe Pty Ltd is solely for the use of the Client identified on the cover sheet for the purpose for which it has been prepared and Fyfe Pty Ltd undertakes no duty to or accepts any responsibility to any third party who may rely upon this document.

All rights reserved. No section or element of this document may be removed from this document, reproduced, electronically stored or transmitted in any form without the written permission of Fyfe Pty Ltd.

Document Information

Prepared by: Glenn Thiele	Principal Environmental Consultant	Date: 21 May 2018
Reviewed by: Marc Andrews	Environment Division Manager	Date: 22 May 2018
Approved by: Marc Andrews	Environment Division Manager	Date: 22 May 2018

Revision History

Revision	Revision Status	Date	Prepared	Reviewed	Approved
0	Draft	12/12/2017	GAT	MJA	MJA
1	Issued	22/5/2018	GAT	MJA	MJA

CONTENTS

Page

1. INTRODUCTION 1

1.1 Background 1
1.2 Aims 1

2. SITE CHARACTERISATION & SITE HISTORY INVESTIGATIONS 3

2.1 Methodology 3
2.2 Site characterisation 4
2.3 Physical setting 9
2.4 Additional information 11

3. HISTORICAL REVIEWS 17

3.1 Site contamination assessment reports 17
3.2 Air quality and acoustics 25

4. DISCUSSION 32

4.1 Site contamination 32
4.2 Air quality and acoustics 32

5. CONCLUSIONS & RECOMMENDATIONS 35

6. LIMITATIONS 36

7. REFERENCES 37

LIST OF TABLES

Table 2.1 Summary of site characterisation and site history research components 3
Table 2.2 Study Area identification details 4
Table 2.3 Potential sources of contamination identified during the walkover 9
Table 2.4 Surrounding land uses 9

LIST OF FIGURES

Figure 1	Site Location
Figure 2	Individual Land Holdings & Photograph Locations
Figure 3	Location of Former Groundwater Exclusion Zone, EPA Site Contamination Index Notifications & Safework SA Licenses
Figure 4	Location of Assessment & Audit Report Review Properties
Figure 5	Evaluation Distances for Air Quality and Noise Management

APPENDICES

Appendix A	Figures
Appendix B	Site Photographs
Appendix C	Groundwater Database
Appendix D	Safework SA Search
Appendix E	Pug Hole Plans
Appendix F	EPA Site Contamination Records

1. INTRODUCTION

Fyfe Pty Ltd (Fyfe) was commissioned by the City of Charles Sturt to undertake a site and infrastructure investigations to inform the preparation of a draft Development Plan Amendment (DPA), to prepare a Concept Plan and to advise on the provision of physical infrastructure in parts of Brompton and Bowden. This report addresses a component of that commission: namely the consideration of existing EPA licenced and non-licenced activities in and adjacent to the Study Area, the nature of off-site impacts and associated evaluation distances.

A plan showing the investigation area (the Bowden-Brompton Study Area – also referred to as the Study Area) is presented as Figure 1 (Appendix A).

The objective of the assessment is to identify potential site contamination, air quality and/or acoustic constraints associated with the site and surrounds which may have a bearing upon the proposed rezoning of the site from the current 'industry' to the proposed mixed use/residential zoning.

The investigation was not a Preliminary Site Investigation (PSI) as defined in the *National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended)* (referred to as the NEPM), as a PSI was not required by the client. The investigation does, however follow the methodology of the NEPM where applicable.

1.1 Background

Fyfe had previously undertaken a broadly similar investigation of the area on behalf of a number of the major industrial landholders. That report was entitled *Preliminary Environmental Assessment – Proposed Brompton Village Rezoning Site, South Australia, Final Report* for Connor Holmes and dated 14 July 2014. The 2014 report is referred to as the 2014 Preliminary Environmental Report in this document.

This 2017 report updates and re-presents much of the information in the 2014 Preliminary Environmental Report, but includes new information where available. It also includes information gained during site inspections of a number of the industrial properties.

1.2 Aims

This report has been prepared with the intention of identifying activities that may, or may reasonably be inferred to have been carried out on or near the Study Area, that have the potential to have caused site contamination and/or impact upon air quality and/or noise quality within the Study Area to a degree which may significantly limit the proposed future uses of the Study Area.

The general area of Bowden and Brompton is well known for its historical industrial land use. The location of this land and proximity to Adelaide, North Adelaide and major transport corridors now make this area worthy of consideration for mixed use development.

Redevelopment of the Bowden-Brompton Study Area to mixed use will require rezoning, and typically result in a change to a more sensitive land use. South Australia has a well developed regulatory system to ensure that any such land use change does not proceed until any site contamination is identified and managed appropriately to avoid unacceptable impacts to environmental and human health. This regulatory process includes statutory Site Contamination Audits, where applicable. The need to investigate, assess and remediate contaminated land is triggered in planning policy on an application to change land to a more sensitive use.

The objective of this assessment is to provide more certainty around the potential issues to be considered for future more sensitive land use. This information also provides an indication as to whether the environmental and human health risks associated with the redevelopment of this land are able to be adequately managed by the development approval process that will follow after the higher level process of rezoning the entire site. It is understood that statutory Site Contamination Audits of the Study Area would not be required prior to finalisation of the rezoning. However, audits of individual properties may be required at development approval stage, depending on the likely existence and extent of contamination and the proposed change in land use.

2. SITE CHARACTERISATION & SITE HISTORY INVESTIGATIONS

2.1 Methodology

The site characterisation and site history investigation components of this report have been prepared with reference to the following guideline documents:

- NEPM (1999) *National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended)*. National Environment Protection Council (NEPC)[1].
- Planning SA (2001) *Site Contamination*. Planning Advisory Notice 20.

The research components are detailed in Table 2.1.

Table 2.1 Summary of site characterisation and site history research components

Component	**Section of report**
Site characterisation	*Section 2.2*
Site identification	Section 2.2.1
Site walkover	Section 2.2.2
Physical Setting	*Section 2.3*
Adjacent land uses	Section 2.3.1
Regional geology	Section 2.3.2
Regional hydrogeology	Section 2.3.3
Additional information	*Section 2.4*
Safework SA search	Section 2.4.1
EPA preliminary advice – site contamination	Section 2.4.2
EPA preliminary advice – licensed activities	Section 2.4.3
Pug hole distribution plans	Section 2.4.4
Constraints on groundwater bore installation	Section 2.4.5
Public register notifications	Section 2.4.6

[1] *as amended in 2013*

2.2 Site characterisation

2.2.1 Site identification

Site identification details are provided in Table 2.2.

Table 2.2 Study Area identification details

Site Definition	**Refer to Figure 1 (Appendix A)**
Local Government Authority	City of Charles Sturt
Current Owner	Various owners: • Detmold 4.03 Ha (35.2%) • Parkview Property Trust and Nemeson Bowden 2.12 Ha (18.5%) • Marble and Cement 1.49 Ha (13.0%) • Kennett 0.48 Ha (4.2%) • Conroy 0.82 Ha (7.2%) • HAAE Engineering 0.77 Ha (6.7%) Other minor landowners 1.73 Ha (15.2%)
Zoning	Urban Employment
Current Land Use	Mixed use – commercial/industrial (predominantly) and residential
Proposed Land Use	Mixed use/residential
Land Area	Approximately 11.43 Ha

2.2.2 Site walkover

An experienced Environmental Engineer from Fyfe undertook a walkover of the Study Area on 15 and 16 November 2017. The walkover comprised traversing the streets within, and surrounding, the proposed site and recording observations from outside the boundaries of individual properties. Several of the larger industrial properties were briefly internally inspecting (after prior arrangements had been made with the businesses concerned).

The purpose of the walkover was to determine, as far as possible, the land uses/activities currently occurring within, and surrounding, the proposed development site and to identify potentially contaminating activities that could generate off-site noise, odour or air quality impacts and potential sources of contamination that could affect soil or groundwater.

The Study Area and surrounds is generally flat and the majority is sealed. The Study Area is approximately 11.43 ha in size and is enclosed by the following streets, as illustrated in Figure 1 (Appendix A):

- Chief Street
- Hawker Street
- Drayton Street
- Ninth Street
- Gibson Street
- Sixth Street; and
- Second Street.

As identified in Table 2.2, there are six major properties encompassing approximately 9.71 ha of the 11.43 ha site, which equals approximately 84.8 % of the Study Area. The remaining 1.73 ha (15.2%) is made up of other minor landholders, and includes commercial, industrial and residential land uses.

Figure 2 (Appendix A) illustrates the locations of the major stakeholders in the Study Area as well as the locations at which illustrative photographs, as included in Appendix B, were taken. Some of the photographs have been reproduced from the 2014 Preliminary Environmental Report (where the 2017 inspection showed there to be no substantive change in the area photographed).

The Bowden-Brompton Study Area

Heatcraft Brompton (formerly Prompt Air) (Photograph 1) is one of the 'other minor landholders', located in the western corner of the site at the intersection of Chief and Second Streets. Prompt Air appears to be a commercial property with likely associated storage and warehousing capabilities. The nature, scale and impacts of its operations do not appear to have changed significantly since the previous inspection in 2014.

Harvie Norris General Engineers (Photograph 2) is located to the south-east of Prompt Air, along Second Street. The large shed visible on the property is likely to be used for the undertaking of various engineering activities. Although there is a potential for various contaminating activities to be undertaken on the property, none were observed or confirmed during the walkover. The nature, scale and impacts of its operations do not appear to have changed significantly since the previous inspection in 2014.

A residential allotment (Photograph 3) is located to the south-east of the Harvie Norris General Engineers site. This residential allotment is surrounded by industrial land uses.

The **Marble and Cement Company** (Photograph 4) property, located in the central western portion of the property, consists of mainly vacant open areas with some scattered material storage (including inert building wastes) and an above ground fuel storage tank (AST), the latter located adjacent to a shed near the centre of the property (Photograph 5). The AST was located on a concrete hardstand but was not within a bunded area. Fyfe inspected the site accompanied by a representative of The Marble and Cement Company. It was (in 2017) no longer an operating business, and Fyfe was advised that there was no intention of resuming the activities of the business.

During the 2017 inspection Fyfe could hear machinery type noises emanating from one of the adjoining properties but could not identify which one.

The **Park View Property Trust** property is located in the approximate central area of the Study Area, bounded by Drayton, East and Third Streets and the Nemeson Bowden property on Second Street. This property is occupied by Bell Total Logistics Pty Ltd (BTL) (Photograph 8) and by *Hughes Chauffeur Cars and Coaches*. BTL is a logistics business that operates a fleet of trucks and a warehouse at the site.

The BTL business was inspected by Fyfe and observed to involve typical warehousing and trucking activities, with the only potential off-site impacts being due to the operation of trucks and forklifts.

Similarly the car and coach business appeared to undertake activities associated with the garaging and cleaning of vehicles.

The **Nemeson Bowden** property is occupied by *Custom Cartons*, a printing and packaging business. The Custom Cartons operation is a cardboard printing and carton manufacturing facility. It is likely that dangerous goods and/or hazardous materials are stored on the property, given the hazardous chemicals signage located on the site perimeter fence. The details of possible hazardous chemicals use/storage could not be confirmed from the walkover.

Relatively continuous noise was associated with the operation of manufacturing machinery at the Custom Cartons site but appeared to be drowned out on the street by passing traffic. Noise was also associated with loading and truck movements in the loading bay (Photograph 6), located adjacent to Second Street, as well as an extraction system (Photograph 7) located within the loading bay area, the latter resulting in intermittent noise which was evident above the continuous noise associated with the manufacturing process.

The **Conroy's Smallgoods** property is located in the southern portion of the Study Area and operates under EPA licence 1269.

The main operations include boning, cutting and mincing; mixing sausage fillings and filling skins; curing hams and bacons in brine; cooking and smoking. Waste materials generated include skin, fat and bone wastewater from curing, cooking and cleaning products. The site has a boiler, smoke rooms and a large number of refrigeration rooms.

Numerous flue systems (air exhaust infrastructure), as illustrated in Photographs 10 and 11, were observed. It is likely that the flues are associated with factory ventilation and cooking processes and supporting equipment such as refrigeration and steam generation (Photograph 10) during the walkover. In addition there are likely to be vents to atmosphere from tanks and pits containing wastes or wastewaters (Photographs 12 and 13) and from cooling towers.

It is understood that the meat smoking operations are performed by burning (smouldering) sawdust in an area which is under cover, but open to the atmosphere.

A slight smallgoods-type odour was noted adjacent to the site during the 2014 walkover and a cooking type odour was evident during the 2017 inspection.

Near-constant noise, likely associated with the operation of the refrigeration equipment and other mechanical processes, was evident above the background traffic noise. For example, a wastewater treatment system, including pumps (Photographs 12 and 13) is located close to the Sixth Street property boundary.

The south-eastern portion of the Conroy's Smallgoods property (corner of Gibson and Sixth Streets) is largely used for car parking (Photograph 14).

The **Detmold** property constitutes the majority of the northern portion of the Study Area. This is a packaging manufacturing facility. Some of the packaging that is manufactured is for foodstuffs, and hence the site is maintained to the standards of cleanliness and hygiene that are required of food processing facilities.

Printing of the packaging material is done using water based inks only: no solvent based printing occurs on the site. There is a wastewater treatment plant on the site, although it did not generate any discernible odours when inspected in 2017.

The manufacturing portion of the site is located adjacent to Chief Street (Photographs 16 and 17). The rest of the site mostly consists of warehousing facilities and associated loading/unloading infrastructure as well as offices (Photographs 18 to 20).

Whilst there are internal areas where hearing protection is required to be worn. The noise levels emanating from the manufacturing facility during the walkover were audible but less noticeable than that of passing traffic, including cars and trucks as well as trains from the nearby rail corridors and the occasional plane passing overhead (flight path).

A dangerous goods shed (Photograph 21) is located on the western side of East Street and a breather pipe, which extends from behind the shed to above the roof of the adjacent warehouse, potentially indicates the location of an underground fuel storage tank (UST) or similar. Located on the East Street side of the dangerous goods shed, two apparent pieces of air exhaust infrastructure (Photograph 22) extend to above the height of the warehouse. During the walkover, no visible exhaust streams were evident from the Detmold property and no odour issues were identified.

The Detmold property includes numerous loading areas (Photograph 23) and access roads. Truck movements surrounding, and through the site, resulted in intermittent noise levels typical of this type of activity.

The former **HAAE Engineering** is located to the north-east of the Conroy's Smallgoods site, across Seventh Street. The property is mostly enclosed by a tall green fence, except for the Drayton and Seventh Street corner where a building is located on the boundary.

During both the 2014 and 2017 inspections no activity was observed at the HAAE property and it appeared to be closed. Remaining infrastructure, which includes a multi-level building (Photograph 24), is likely to be associated with historical industrial activities.

The **Kennett Builders** site (which can be seen through the Detmold car parking area in Photograph 25) hosts a range of number of transportable office buildings and appeared to comprise a storage (lay-down) area. There are also several concrete walled bays used for the storage of goods and materials.

In 2014 **Resin Sands** was located at the intersection of Gibson and Ninth Streets, in the eastern corner of the site. At the time of the 2014 walkover, no site activities were visible. In 2017 this property was occupied instead by Wicked Campers – a commercial motor vehicle business (Photograph 26). Activities at this property are now assumed to relate to the storage and cleaning of motor vehicles.

There were a number of residential dwellings located on the northern side of Eighth Street (within the Study Area) and numerous commercial/industrial businesses operating out of premises located along Gibson Street (within and surrounding the site), the latter including **P.A.J Agencies** (Photograph 27).

To the east of the Detmold property, **Cantech Precision Engineering** (Photograph 28) and **City Plastics** (Photograph 27) are located on the eastern side of East Street, and the former **BE Optical** (Photograph 30) and former **Palais Restaurant** are located on Hawker Street (between East and Drayton Streets).

Three additional commercial properties are located on the western side of Drayton Street, to the north of Third Street. These include the **Velocette Sports Club** (Photograph 31), located on the corner of Third and Drayton Streets, and an adjoining property, to the north-east along Drayton Street, which host air exhaust infrastructure (Photograph 32) but is of unknown use. No discernible odours or noises (i.e. above background levels) were observed. **Pre-Press Print & Web** is located further to the north-east, along Drayton Street. This business appears to be a digital business and so unlikely to use any significant quantity of chemicals, or to generate noise or odourous emissions.

Surrounding area

During the walkover, no odours were observed that are likely to be associated with the West End Brewery, located on Port Road approximately 700 m to the south of the Study Area.

Numerous site contamination assessments have been completed for the Brompton Gas Works property located to the immediate south-west of the rezoning site. Identified contamination issues include impacted groundwater, which appears to have a north-easterly flow direction towards the Study Area. Further information on the gas works property is included in Section 3.

Bowden Motor Repairs, Cementaid and the former Eclipse Sheet Metal facility are located on the western side of Chief Street, opposite the northern corner of the site. The site contamination status of these properties is unknown but there is a potential for them to represent sources of contamination that could impact upon the Study Area.

Summary of potential sources of contamination

A summary of the potential sources of contamination to soil or groundwater, as identified during the walkover, is provided in Table 2.3.

Table 2.3 Potential sources of contamination identified during the walkover

Potential Contaminating activity/sources of contamination	Location
Fuel storage and use	The presence of USTs and ASTs has been identified on the Marble and Cement Company and Detmold properties, respectively. Fuel storage and use is also considered possible on all additional commercial/industrial properties
Chemical storage and use	Likely on most, if not all, commercial/industrial properties
Various (as yet undefined) industrial processes, including waste streams	Likely on most, if not all, commercial/industrial properties
Possible use of imported fill materials of unknown origin (potentially including industrial wastes generated from within, and surrounding, the site)	Entire Study Area
Possible buried wastes and/or backfilled pug holes (potentially including industrial wastes generated from within, and surrounding, the site)	Entire Study Area but most likely in areas identified on historical pug hole plans (refer to Section 2.4.2, Figure 2 and Appendix E)
Migration of impacted groundwater from adjacent properties, including (but not necessarily limited to) the former Brompton Gas Works and Gerard Industries/Clipsal (currently identified as the Bowden Urban Village site) properties	Potential for entire site to be impacted although off-site sources are most likely to impact boundary areas immediately down hydraulic gradient of source areas

2.3 Physical setting

2.3.1 Adjacent land uses

At the time of the walkover, the immediately surrounding land uses were as detailed in Table 2.4.

Table 2.4 Surrounding land uses

North	Mainly residential but including some commercial/industrial properties (e.g. Bowden Motor Repairs, Cementaid)
West	Mainly residential, but including some commercial/industrial properties (e.g. Gaslight Tavern, Ashman Grove Residential Aged Care and ACE Shopfitters Pty Ltd) and public open space
South	Mixed use including residential, commercial/industrial (e.g. former Brompton Gas Works, Gas Services SA, Andrew's Airport Parking), Bowden Urban Village (former Gerard Industries/Clipsal property) and public open space
East	Mainly residential but including some commercial/industrial properties

2.3.2 Regional geology

The Adelaide 1:250,000 geological map sheet (South Australian Department of Mines and Energy, 1969) indicates that the region is underlain by the Quaternary Pleistocene aged Pooraka Formation, consisting of pale red-brown sandy clay containing carbonate of the Loveday soil and gravel lenses near ranges.

2.3.3 Regional hydrogeology

A summary of the Department of Environment, Water and Natural Resources (DEWNR, 2017) groundwater database (Appendix C) indicates that there are seven registered groundwater bores located in the Study Area. In terms of their primary use, six of the groundwater bores were listed as having been installed for the purpose of observation/monitoring/investigation. The purpose of the seventh bore was not recorded but it was stated to have been abandoned.

Based on information contained in the database, the bores were mostly drilled to depths of between 15 and 19 m below ground level (BGL), with the now abandoned bore having been drilled to a maximum depth of 120 m. The bores were mainly drilled between 1992 and 2000, except for two bores that had been installed on the Detmold property in August 2017. No date was provided for the drilling of the abandoned bore.

Standing water levels (SWLs) recorded for three of the bores ranged from approximately 12 to 14.6 mBGL. Groundwater salinity and electrical conductivity (EC), recorded for two bores, ranged from 1,428 mg/L to 2,517 mg/L total dissolved solids (TDS) and 2,579 µS/cm to 4,510 µS/cm, respectively. The measured pH provided for a single bore was 7.2 and the same bore had a yield of 0.56 litres/second.

A further 92 bores were identified outside the boundaries, but within a 0.5 km radius of the Study Area. In terms of their primary use, 64 were observation/investigation/monitoring bores (of which seven had been backfilled), two were listed as drainage bores, one as a domestic bore and one as an irrigation bore. In addition to the seven identified backfilled bores, an additional five backfilled bores had no primary use listed. Nine bores had an unknown latest status and a further eight had no purpose or latest status listed.

Based on the information contained in the database, the following information was obtained for the registered off-site bores:

- The drill date was provided for 90 of the 99 wells and ranged from 1914 to 2017.
- The maximum drill depth was provided for 75 of the 76 bores and ranged from 1.5 m to 105.16 mBGL. It is noted that the 1.5 m drill depth bore has been backfilled. Two bores were reported to have maximum depths of 2.74 m.
- Standing water levels were provided for 55 bores and varied from 0 to 32 mBGL. The next shallowest SWL recorded was 3.23 mBGL.
- Salinity and EC data were provided for 17 of the bores. Salinity ranged from 899 mg/L to 9,015 mg/L TDS whereas EC ranged from 1,631 µS/cm to 15,500 µS/cm.
- Measured pH values (6.8 to 7.6) were provided for 11 bores.
- Measured yield values of 0.01 to 0.56 L/second were provided for four bores.

No information was provided regarding the soil profiles into which the on- and off-site bores were installed.

2.4 Additional information

2.4.1 SafeWork SA search

A search of the SafeWork SA dangerous substances licensing database was undertaken in the 2014 report to determine if there was any relevant information for the site and its surrounds (i.e. including Chief, East, Hawker, Drayton, Gibson, Second, Third, Sixth, Seventh, Eighth and Ninth Streets as well as Ethelbert Square). A copy of the SafeWork SA search is provided in Appendix D.

In that report one licence for an 8 kL underground liquid storage tank was identified for 39 Hawker Street, located approximately 140 m to the north-west of the study area. And two above ground (108 kL and 505 kL) gas cylinders were identified on Drayton Street.

Additional dangerous substances licences were also identified in the 2014 report either in the Study Area or within the surrounding areas, two of which are located on East Street (nos. 19 and 18-24, shown as B and C on Figure 3, Appendix A) and three on Chief Street (nos. 15, 45 and 70, shown as A, D and E on Figure 3, Appendix A). Details for these dangerous substance licences were unable to be provided by SafeWork SA as written consent from the site owner was required before releasing the information. However, it appears that, in terms of on-site locations, the licences may relate to the Prompt Air, Gerard Corporation (now Parkview Property Trust) and the Detmold properties.

2.4.2 EPA preliminary advice – site contamination

Fyfe was provided with a copy of a letter from the South Australian Environment Protection Authority (EPA) to Mr John Tagliaferri, Senior Town Planner, City of Charles Sturt dated 13 April 2016 and entitled *EPA Preliminary Advice: Potential Brompton Residential DPA* (EPA Letter). The letter was a review of Fyfe's 2014 Preliminary Environmental Report of the Bowden-Brompton Study Area, supplemented with additional information that was held by EPA.

The EPA letter stated that the report had not been undertaken in accordance with Schedule B2 of the NEPM, but did not acknowledge that the scope of the report was to undertake a preliminary environmental assessment and was not designed to be a preliminary site investigation as defined in the NEPM. Nevertheless the EPA Letter noted the provision of environmental information relating to the Study Area and surrounds, the inspection of the area and the Safework SA dangerous goods information.

The EPA Letter provided a copy of a map attributed to Woodward Clyde that showed the locations of pug holes in the Study Area. Whilst this map was additional to the maps available to the 2014 Preliminary Environmental Report, a close examination of it showed that it did not provide any new information or identify any pug holes not previously known to be in the Study Area.

The EPA Letter did state that the pug holes had been created when the clays present were excavated for brick production, and that they were subsequently backfilled with uncontrolled wastes, including wastes from the former Brompton Gas Works.

EPA records were held for two assessments undertaken at The Marble and Cement Company Pty Ltd site in 1991. Those assessments were stated to be limited soil assessments, and concluded that the property was suitable for commercial/industrial development. The EPA held no other site contamination records for properties in the Study Area, although they did have records for several site contamination audits undertaken on land surrounding the Study Area. Those investigations had identified extensive soil and groundwater contamination across the area as a result of historical and current potentially contaminating activities. The EPA considered that the Study Area may have similar site contamination issues to those observed in the surrounding area.

The EPA Letter stated that the site contamination environmental assessment processes (which include the statutory environmental process) should be required at the development application stage – and especially where a change to a more sensitive use is proposed.

2.4.3 EPA preliminary advice – licensed activities

In addition to considering the potential for site contamination in the Study Area, the EPA Letter also presented a review of activities in the general area that were licensed by the EPA (under Schedule 1 of the *Environment Protection Act 1993)*.

Two licenses were held for activities within the Study Area, and a further three licenses were held for businesses located just outside of the Study Area.

Conroy's Smallgoods Pty Ltd holds an EPA licence for curing and drying works. The EPA Letter considered odour from the smoker may potentially impact on future residential high rise buildings that (may) adjoin the site. The EPA Letter also considered there to be the potential for noise to be generated by delivery vehicles, waste collection vehicles and forklifts.

EPA records indicate that 30 complaints have been made in relation to Conroy's Smallgoods operations since 2002. The majority of complaints were made in relation to odour impacts.

The EPA publication *Evaluation Distances for Effective Air Quality and Noise Management* (2016) lists a 'recommended evaluation distance' of 200 meters for curing or drying works with a capacity of up to 250 kg/hr, and a distance of 500 metres where more than 250 kg/hr of material is processed. No minimum separation distance is recommended in the EPA publication and the listing of the recommended evaluation distances means that a site specific assessment should be undertaken of possible air impacts at locations within the evaluation distance of the site, should there be a need to consider locating sensitive land uses within that recommended evaluation distance.

Fyfe understands that Conroy's Smallgoods processes in excess of 250 kg/hr of material, and so the recommended evaluation distance is 500 metres. This means that a site specific assessment would be required to determine potential noise and air quality impacts in the Study Area.

Previously the EPA *Guidelines for Separation Distances (2007)* recommended a separation distance of 100 metres for air (including odour) from curing or drying works and a sensitive receiver (residential dwelling). This recommended separation distance is designed to protect potential residents from being exposed to odour nuisances.

The EPA Letter was issued before the publication of the 2016 document, and their assessment (which was based on the 2007 document) concluded that redevelopments in the Study Area could potentially locate future residents within this 100 metre separation distance and there would be the potential that such residents may at times experience air quality (odour) and noise impacts due to the activities on the site.

The EPA Letter also stated that it considered that it would be possible for the operations of the facility to be improved so that the facility would be able to coexist with adjacent land users.

Detmold Pty Ltd is licensed by the EPA for the listed wastes that it produces. The EPA Letter states that the EPA has received complaints due to odours emanating from the site. The odours were thought to be due to the use of cleaning chemicals on the printing presses and printing plates.

The EPA *Evaluation Distances for Effective Air Quality and Noise Management* (2016) lists an 'evaluation distance' of 100 meters for chemical storage and warehouse facilities (if there is storage but not blending or mixing of chemicals).

The history of complaints shows that there is the potential for future nearby residents to be impacted by activities at the site. Nevertheless the EPA Letter then stated that it considered that air quality impacts could be prevented through the consideration of noise and odour impacts on future developments at the land division or residential development application stage. In any event, Detmold officers advised Fyfe during the 2017 inspection that Detmold was developing a new site for their activities that is outside of the Study Area, and they expect to relate to that new location within the next three years.

The EPA also identified four other premises in the area, which could potentially impact on the Study Area:

- Dominant Pty Ltd - 12 Coglin Street Brompton SA (520 m north-west of the Study Area)
- Molnar Engineering Pty Ltd - 16-20 Coglin Street, Brompton (now closed) (440 m north-west of the Study Area)
- SA Brewing Company Pty Ltd – 107 Port Road Thebarton (600 m south of the Study Area)
- Adelaide Brass Castings Pty Ltd - 100 Gibson St, Bowden (280 m north of the Study Area).

The EPA concluded that first three of the above premises are located sufficiently far from the Study Area to make it unlikely that they would impact on the air quality in the Study Area. This assessment by EPA was

based on the 2007 publication and their experiences with the emissions and impacts histories of the businesses.

The activities undertaken by the Adelaide Brass Castings Pty Ltd were considered by EPA to have the potential to impact on air quality in the Study Area. The EPA Letter concluded that air quality impacts (termed interface issues) would need to be considered by the DPA investigations to ensure the appropriate management of noise and odour impacts on future land uses in the Study Area.

The EPA Letter does not mention that any air quality related complaints have been received regarding Adelaide Brass Castings Pty Ltd.

The EPA Letter concludes by recommending that a land use survey be undertaken to consider the:

> "…existing industrial activities likely to cause odour and/or noise complaints from existing EPA licensed and non – licensed activities. The land use survey should then be cross referenced against the *EPA Guidelines for Separation Distances 2007*. Such investigations could then be used to determine what activities may require design solutions to mitigate noise or air quality impacts. Conclusions from investigations could then be reflected in planning policy. The EPA considers that the proposed planning policy should also provide mechanisms to address interface issues during the transition period as sensitive uses are introduced into the area in proximity to industrial uses."

The EPA also expected that the DPA would include the need for acoustics reports to be prepared at the land division or residential development application stage, and to address the need for odour modelling of the odour generated by Existing EPA licensed (including Conroy's Smallgoods Pty Ltd.) and non-licensed activities in order to assess the potential odour impacts these existing facilities may have on the proposed rezoning proposal, allowing for residential land uses.

Should the trend since at least 2014 continue, of industrial activities in the Study Area closing down (Marble and Cement Company, HAAE) or planning to relocate form the Study Area (Detmold), and the sites becoming vacant pending redevelopment or for more benign activities (the Resin Sands site being now occupied by a Wicked Campers depot), then the number and intensity of noise and odour/dust emitting activities in the Study Area will continue to reduce. Consideration of the EPA recommended evaluation distances will be applicable only while industries and activities covered by the 2016 EPA publication are in or near the Study Area.

2.4.4 Pug hole distribution plans

A series of pug holes were historically excavated across the Brompton-Bowden area as a source of clay for brick making activities. These pug holes were generally backfilled sometime prior to 1949 (i.e. prior to the first available aerial photograph).

An undated plan of identified pug hole locations within the Bowden-Brompton area, as produced by the Hindmarsh Development Committee, has been included in Appendix E. It indicates that a single pug hole has

been identified within the western portion of the Study Area, between East, Drayton, Second and Third Streets.

Another pug hole map, obtained from Coffey Partners International (1990) *Resource Development Brompton Gas Works Preliminary Environmental Assessment* (as obtained from the SA EPA Public Register) and also included in Appendix E, identifies a second pug hole in the north-eastern portion of the Study Area: bordered by Chief, East, Hawker and Third Streets. A third map (provided with the EPA 2016 Letter) is also provided in Appendix E.

A consolidation of these maps has been prepared by Fyfe (Figure 2). It shows the two pug holes known to have been located in the Study Area, and a number of the nearby pug holes.

The veracity of the information provided in the two pug hole distribution plans cannot be confirmed without intrusive site data, and the boundaries of the pug holes should be taken as approximate.

2.4.5 Constraints on groundwater bore installation

In 2001, the (former) Department for Water Resources established a *Groundwater Exclusion Zone*, whereby no permits were to be issued for the construction of new bores (with the exception of investigation/ monitoring bores) to depths of less than 50 mBGL. This zone was bounded by Port Road, Park Terrace, Trembath Street, Ninth Street, Third Street (bounded by the northern side of Ethelbert Square), West Street, Second Street, Pickering Street, First Street and West Street to Port Road. It included the former Gerard Industries/Clipsal property (currently identified as the Bowden Urban Village), the former Brompton Gas Works site (also identified, over time, as the SAGASCO, Boral and Origin Energy site) and the western portion of the Study Area. The former Groundwater Exclusion Zone is shown on Figures 3 and 4 (Appendix A).

A 2017 discussion with a representative of DEWNR indicated that they no longer limit the issuing of bore permits on the basis of the 2001 *Groundwater Exclusion Zone* boundaries. Instead, based on contaminated bore information provided by the SA EPA, DEWNR has established a GIS-based Contaminated Sites Layer that identifies point sources of groundwater contamination. In assessing applications for new bore permits, DEWNR will use this information to determine the use/s for which individual bores may be installed. Whereas the use of groundwater for domestic purposes is likely to be excluded, bores may be approved (for example) for drainage, monitoring and/or industrial uses.

2.4.6 Public register notifications

The Site Contamination Index located on the SA EPA website (http://www.epa.sa.gov.au/what_we_do/public_register_directory/site_contamination_index) lists the following notifications of site contamination of underground water (pursuant to Section 83A of the *Environment Protection Act 1993*) within the Bowden-Brompton area; associated potentially contaminating activities (PCAs), in accordance with Schedule 1 of the *Environment Protection Regulations 2009*, are also listed (where identified):

- various allotments bounded by Park Terrace, Seventh Street, Drayton Street and First Street, Bowden (i.e. Bowden Urban Village site): electrical or electronics component manufacture; listed substances storage
- 301 Port Road, Brompton: service stations
- 50-58 Hawker Street, Brompton: landfill sites
- 30 Third Street, Brompton: waste depots
- 53 Wood Avenue, Brompton: PCAs not recorded

In addition, information supplied by the SA EPA Public Register indicates that the Land Management Corporation submitted a Section 83A notification in June 2010 for the former Clipsal site, Park Terrace Bowden, identifying the presence of elevated cyanide and trichloroethene (TCE) in groundwater. This notification was updated in November 2010 with the nomination of additional groundwater contaminants, including metals (arsenic, chromium, cobalt, lead, manganese, molybdenum, nickel, selenium, zinc), sulphate, ammonia, nitrate, C_6-C_{36} total recoverable hydrocarbons (TRH), naphthalene, benzene, 1,1-dichloroethene and cis-1,2-dichloroethene.

The SA EPA Site Contamination Index also lists the following notifications of the commencement of a Site Contamination Audit (audit), some of which have been completed and, depending on their proximity to the Study Area, are discussed in Section 3.

- various allotments bounded by Park Terrace, Eighth Street, Drayton Street and First Street, Bowden (i.e. Bowden Urban Village site): electrical or electronics component manufacture; listed substances storage – two audit reports discussed in Section 3 (audit on-going for other portions)
- 16-18 Ninth Street, Bowden: fill or soil importation, metal coating, finishing or spray painting, metal forging
- various road titles, Bowden: fill or soil importation
- 2 Seventh Street, Bowden: fill or soil importation – audit report discussed in Section 3
- 50-58 Hawker Street, Brompton: landfill sites – audit report completed
- Site 9 Pickering Street, Brompton: 50-58 Hawker Street, Brompton: fill or soil importation, waste depots – audit report discussed in Section 3
- 30 Third Street, Brompton: PCAs not recorded – audit report completed
- 53 Wood Avenue, Brompton: fill or soil importation, landfill sites – audit report completed
- 17-33 Coglin Avenue, Brompton: fill or soil importation, metal coating, finishing or spray painting – audit report completed
- 46-48 Hawker Street, Brompton: PCAs not recorded
- 67-69 Coglin Street, Brompton: fill or soil importation
- 85 Torrens Road, Brompton: fill or soil importation
- 120 Chief Street, Brompton: PCAs not recorded

The approximate locations of these properties, relative to the Study Area, are shown on Figure 3 (Appendix A).

3. HISTORICAL REVIEWS

3.1 Site contamination assessment reports

In order to understand the nature of site contamination that is present in the Brompton-Bowden area, in the vicinity of the Study Area, a number of reports obtained from the South Australian EPA Public Register have been reviewed, as summarised in the following sections. A plan showing the approximate locations of the various properties, relative to the Brompton Village Rezoning site, is included as Figure 4 (Appendix A).

The locations of sites in the broader area that EPA holds contaminated site records on were included in an attachment to the EPA Letter, and are reproduced in Appendix F.

3.1.1 Site history report – East and Chief Street properties, Brompton

The following report was prepared for a part of the Study Area that was occupied by the Marble and Cement Company as well as a number of residences:

- Fouroulis Nominees Pty Ltd (2007) *Site History Report: 16-24 East Street, 26-30 East Street, 32 East Street, 33A Chief Street, Brompton SA*, report to Horizon Property Developments dated 3 July 2007.

The area addressed by this report is located in the south-western corner of the Study Area, bordered by East Street and Chief Street.

The Marble and Cement Company was stated to have been operating at its Brompton location (18-24 East Street) for more than 50 years. Site activities primarily comprised the washing and/or storage of various stone products (including marble, limestone, concrete, sand and aggregates) as well as concrete casting and sand blasting. Fuel (diesel, petrol), oil/grease and chemicals (hydrochloric acid, thinners, plasticisers, colour additives, adhesives/stains and sealers) were stored and used at the site. Fuel storage infrastructure located within the factory building was identified as including two (poorly bunded) diesel above ground storage tanks (ASTs), with a total volume of approximately 2 kL, as well as a 2.2 kL petrol UST. Evidence of surface soil staining was noted in the refuelling area adjacent to the ASTs. The UST, and its associated fuel dispensing bowser, was stated to have been disused for approximately eight years (i.e. since late 1990s). The factory building also hosted a series of settlement pits that received wash down waters prior to their discharge to sewer, with wash down (using hydrochloric acid) occurring directly on the ground surface. An area of imported fill material, of unknown origin, was identified in the northern corner of the site and asbestos containing materials (ACM) were present in site buildings (i.e. the factory roof). A single groundwater monitoring well identified on the site was thought to have a SWL of approximately 14.5 mBGL but no groundwater monitoring results were provided.

The Marble and Cement Company also owned a vacant allotment at 32 East Street although use of this site (if any) was not specified.

The allotments identified at 26-28 East Street and 33A Chief Street were considered to have been used only for residential purposes since the land was first developed. Whereas the East Street property hosted three unoccupied cottages, which appeared to have been constructed in the 1800s, 33A Chief Street hosted a single occupied residence. The area to the rear of the East Street cottages was in use for vehicle parking purposes.

Historical ownership information indicated that the occupations of the property owners included carpenter, iron worker, blacksmith, boot maker, engineer, cement worker, iron worker, fitter, gas worker and wood merchant. Given the general industrial nature of the Brompton area, it was considered that these occupations may have been practiced over time on the various properties.

Potential contaminants identified in the report included metals, TRH, BTEX (benzene, toluene, ethylbenzene, xylenes) compounds, polycyclic aromatic hydrocarbons (PAHs), chlorine compounds, pesticides and herbicides. In addition, the possibility of buried wastes was discussed.

3.1.2 Environmental Site Assessment reports – Bowden Industrial Estate

The following two reports were prepared for the Bowden Industrial Estate, located to the immediate south-west of the Study Area and approximating the area known as the Bowden Urban Village.

- Wallbridge & Gilbert Pty Ltd (1998) *Site Investigation at Bowden for Gerard Industries*, report to Gerard Industries dated 15 July 1998.
- AEC Environmental Pty Ltd (2008) *Additional Environmental investigation: Bowden Industrial Estate, Park Terrace, Bowden, South Australia*, report to Land Management Corporation dated September 2008.

The Wallbridge & Gilbert (1998) report pertained to two portions of the former Gerard Industries site, one of which was located between Drayton, Gibson, Second and Third Streets whereas the other was bounded by Gibson, Fourth and Fifth Streets, as well as Boral Energy (former gas works) land to the north. Both areas were in use as car parks at the time of the investigations. Previous land uses were identified as including residential, possibly with associated backyard industries, and apparent backfilled pug holes (described as deep excavations) were identified in both areas. The soil results indicated that lead and PAH concentrations were elevated in site fill materials.

The AEC Environmental (2008) report detailed the results of both soil (imported fill) and groundwater investigations across the Bowden Industrial Estate. Fill materials, encountered to depths of up to 2.3 mBGL, contained elevated concentrations of metals (chromium, manganese, nickel, tin and zinc), benzo(a)pyrene and total PAH (although only a limited laboratory analytical program was undertaken). Groundwater was encountered at depths of 16.1 to 16.8 mBGL and was inferred to flow in a general easterly direction. Identified groundwater impacts included elevated concentrations of metals (cobalt, manganese, nickel, zinc) and C_{10}-C_{36} TRH. Preliminary modelling of vapour intrusion risks associated with previously detected elevated benzene concentrations beneath the former Brompton Gas Works site (identified as the Origin Energy site),

as well as previously detected elevated TCE concentrations beneath the Gerard Industries (Clipsal) site, did not identify any unacceptable risks to indoor air.

3.1.3 Site Contamination Audit Reports – Bowden Urban Village Stages 1 and 2

A series of Site Contamination Audit Reports (SCARs) have been prepared for areas of Bowden identified as follows:

- Bowden Urban Village Stage 1: bounded by Gibson Street, Sixth Street, Seventh Avenue and Park Terrace and located to the immediate east of the southern portion of the Study Area– URS Pty Ltd (2012) *Site Contamination Audit Report: Bowden Urban Village Stage 1*, report to Urban Renewal Authority (EPA Reference 60340, 05/17917) dated 18 May 2012.
- Bowden Urban Village Stage 2: bounded by Gibson Street, Sixth Street, Fifth Street and Park Terrace (with the exception of the Trembath Street road reserve) and located to the immediate south of the southern corner of the Study Area– AECOM Pty Ltd (2014) *Site Contamination Audit Report: Bowden Urban Village Stage 2*, report to Urban Renewal Authority (EPA Reference 60340, 05/17917) dated 11 April 2014.
- Bowden Urban Village Stage 1: Trembath Street road reserve – AECOM Pty Ltd (2013) *Site Contamination Audit Report: Bowden Urban Village Stage 2 (Trembath Street Road Reserve)*, report to Urban Renewal Authority (EPA Reference 61087, 05/21148) dated 29 October 2013.

The history of land use for the Stage 1 audit site indicated that it had been predominantly residential until the 1940s, with non-residential uses including a grocery/general store, kindergarten, fabrication, finishing and coating of metal, general freight storage/distribution and electrical components manufacture (i.e. Gerard Industries), the latter occupying a broader property that also included the Stage 2 audit site. The stage 2 audit site had also been predominantly residential until the 1960s, with subsequent industrial uses including paper manufacturing, general engineering, motor trimmers and electrical components manufacture (i.e. Gerard Industries). As a whole, the broader Gerard Industries site, also identified as the Clipsal site and including areas to the west and south-west of the Stage 1 and 2 audit sites, included features such as cyanide baths and metal washing areas, a number of USTs, oil sumps, hoist, servicing pit/s, areas of possible soluble oil contamination from swarf storage, a zinc plating area and a historical metal fabrication plant. Potential contaminants were identified as including metals, TRH, PAH, BTEX, phenols, cyanide, nitrate, sulphide/sulphates, phosphates, thiocyanates, polychlorinated biphenyls (PCBs), organochlorine pesticides (OCPs), chlorinated hydrocarbons and asbestos containing materials (ACM).

Several small pug holes were reported to have been scattered around the original residential cottages and were progressively filled as the area became more industrial. In addition, a number of gasometers, as well as the Brompton Gas Works property, were formerly located to the west of both the Gerard Industries site and the Brompton Village Rezoning site. The Brompton Gas Works, located directly across Second Street from the Study Area and bounded by Drayton and Chief Streets, was stated to represent a known source of groundwater contamination in this area as well as the source of much of the contaminated fill material used

on surrounding properties. Other former surrounding land uses (i.e. with the capacity to cause contamination), located along Drayton Street to the north and north-west of the Stage 1 and 2 audit sites and possibly coinciding with part of the Brompton Village Rezoning site, were reported to include a boot maker/repairer, the Favourite Continental Biscuit Manufacturers and a foundry. Across Seventh Street, to the north-east of the Clipsal site and east to south-east of the Study Area, former industrial land use activities included a tannery, a boot factory, metal and machine merchants, a laundry and gas producers. Potential contaminants associated with the surrounding industrial area were identified as including metals, TRH, PAH, BTEX, phenols, cyanide, nitrate, ammonia, sulphide/sulphates, phosphates, thiocyanates, PCBs, OCPs, chlorinated hydrocarbons, formaldehyde and ACM.

Fill materials of unknown origin (but possibly including waste from the nearby Brompton Gas Works site), containing ash, cinders, slag and building rubble as well as fragments of ACM, were identified on the Stage 1 and 2 audit sites. Analyte concentrations that exceeded the adopted health-based and/or ecological screening criteria, included metals (arsenic, copper, manganese, mercury, lead, vanadium and zinc), benzo(a)pyrene, total PAH and OCPs, some of which (e.g. manganese and vanadium) were considered representative of background conditions. The fill material was considered unsuitable from a chemical and aesthetic perspective to remain on parts of the former Clipsal site and was also considered geotechnically unsuitable for proposed redevelopment options. Subsurface concrete and brick structures were intercepted during the soil remediation program and deep concrete piles, extending to a depth of approximately 6 mBGL, were cut off at 2 mBGL and left in situ.

Groundwater was present beneath the Stage 1 and 2 audit sites at depths of between approximately 17 and 19.5 mBGL and was interpreted to flow in a south-easterly to north-easterly direction. The salinity of the uppermost aquifer ranged from 700 to 2,100 mg/L TDS and groundwater results were compared to criteria for freshwater aquatic ecosystem protection and potable use, although neither of these were considered to be realistic beneficial uses.

Groundwater investigations identified the presence of elevated concentrations of ammonia and manganese, relative to adopted screening criteria, both of which are considered to have derived from the former Brompton Gas Works site, located to the west and north-west. Elevated groundwater nitrate, chloride and selenium concentrations were considered to be representative of background conditions whereas elevated nitrite was concluded to have resulted from natural nitrification/denitrification processes involving ammonia and/or nitrate. Although TCE was not detected within groundwater beneath the Stage 1 audit site, solvent use on the adjoining portion of the Clipsal site to the south-west was reported to have resulted in a TCE plume beneath this area, with the plume considered to have reached a steady state condition.

The Stage 1 and 2 audit sites were proposed to be redeveloped for a combination of medium to high density residential, commercial and public open space uses and were largely remediated. An area of remnant contaminated fill material, containing waste materials (including ACM) as well as elevated concentrations of metals (cadmium, copper, lead, mercury and zinc), OCPs (aldrin and dieldrin) and PAH compounds, was

located adjacent to Fifth Street (i.e. between Gibson Street and Kevin Taylor Lane) and required on-going management via an auditor-approved Environmental Management Plan (EMP).

3.1.4 Preliminary Environmental Assessment reports – Former ASC Site

The area located between Seventh, Eighth, Gibson and Trembath Streets, to the immediate south-east of the Study Area and north-east of the Bowden Urban Village Stage 1 site, has been identified as the former ASC site in the following reports:

- Hosking Oborn Freeman & Fox Pty Ltd and Johnstone Environmental Technology Pty Ltd (1991) *Remediation of the ASC Site, Bowden, South Australia – Technical Proposal*, report to Department of Environment and Planning dated January 1991.
- Hosking Oborn Freeman & Fox Pty Ltd and Johnstone Environmental Technology Pty Ltd (1991) *Remediation of the ASC Site, Bowden, South Australia – Working Paper No. 1*, report to Department of Environment and Planning dated March 1991.
- Hosking Oborn Freeman & Fox Pty Ltd and Johnstone Environmental Technology Pty Ltd (1991) *Remediation of the ASC Site, Bowden, South Australia – Remediation Options*, report to Department of Environment and Planning dated April 1991.

The western half of the property is stated to have been used historically for the breaking of batteries and metal castings, burning of insulated copper wire, general scrap metal recovery, washing/recycling of 44 gallon drums and re-treading of truck/tractor tyres. Dry cleaners, launderers, industrial cleaners, prefabricated (asbestos cement) panel manufacturers, bedding/upholstery manufacturers and plumbers were also identified as having historically owned/occupied parts of the site.

Historical site activities were considered to have resulted in soil metal (arsenic, cadmium, copper, lead, zinc), TRH, toluene and xylenes contamination and, prior to site remediation, pitch/asphaltic material (i.e. old battery casings) and building rubble were reported to have been spread across the site.

The measured depth to groundwater was approximately 14 mBGL and groundwater contaminants were identified as including arsenic, chromium and lead.

3.1.5 Site Contamination Audit report –Site 9 Pickering Street, Brompton

The following SCAR was issued for a site on Pickering Street, located approximately 250 m to the west of the Brompton Village Rezoning site:

- GHD Pty Ltd (2010) *Site 9 Brompton Redevelopment South Australia: Site Contamination Audit Report*, report to Kinsmen Developments Pty Ltd (EPA Reference 60142) dated 16 March 2010.

The history of site ownership, dating back to 1892, indicated that it had been owned by a brick maker, blacksmith, packer and wood merchant. A pug hole was also located on the site. Potential contaminants were

identified as including metals, TRH, PAH, monocyclic aromatic hydrocarbons (MAH), phenols, cyanide, sulphate, PCBs, OCPs, organophosphate pesticides (OPPs) and chlorinated hydrocarbons.

The area surrounding the audit site was reported to include numerous additional backfilled pug holes and to have a history of industrial use, including activities such as brick makers, wood/timber merchants, motor mechanics, fibre and plaster manufacturer and a chaff mill. Potential contaminants associated with the surrounding industrial area were identified as including metals, TRH, PAH, MAH, phenols, cyanide, ammonia, acids, PCBs, OCPs, OPPs, chlorinated hydrocarbons, pentachlorophenol, formaldehyde, chloroform, dioxins and ACM.

Pug hole backfill materials comprised sands, clays, silts, demolition waste, ash, slag, foundry sands and industrial wastes, the latter including ferric, ferro-cyanide and elemental sulphur. Theses wastes were considered to have been sourced from the former Brompton Gas Works and were primarily characterised by elevated concentrations of cyanide and PAH compounds.

Groundwater within the uppermost aquifer, located at a depth of approximately 13.5 to 16 mBGL, was interpreted to flow in a north-easterly direction and had measured salinity values of 1,000 to 7,500 mg/L TDS. Beneath the audit site, groundwater was found to be contaminated with metals (cadmium, cobalt, copper, manganese, molybdenum, nickel, zinc), naphthalene, cyanide, sulphate, fluoride, ammonia and nitrate. At least some of the contaminants (including ammonia, sulphate and nitrate) were considered to be (at least partially) site-derived (i.e. from the pug hole backfill material) although they were also detected off-site (i.e. in a hydraulic cross-gradient direction). Detectable hydrocarbon concentrations within site groundwater were considered to be derived from an off-site source, whereby phase separated hydrocarbon (PSH) was present to the north-east (and cross-gradient) of the site (i.e. Florence Crescent), and elevated concentrations of MAH compounds, as well as cis 1,2-dichloroethene and phenols, were also detected in surrounding off-site wells. Elevated concentrations of additional metals (antimony, arsenic, chromium and lead) were present in surrounding wells.

The audit site was proposed to be developed for a combination of medium density residential and public open space, the latter pertaining to the area occupied by the pug hole which was capped with an approximately 0.15 m thick layer of concrete to minimise future access as well as surface water infiltration.

3.1.6 Environmental Site Assessment reports – Brompton Gas Works Site

The following reports prepared for the Brompton Gas Works site which occupied part of an area between Port Road, Second Street, West Street and Gibson Street in Brompton, to the immediate south-west of the Study Area, have been reviewed as part of this assessment:

- Coffey Partners International (1990) *Resource Development Brompton Gas Works Preliminary Environmental Assessment*, report to Resource Development Pty Ltd dated 17 July 1990.
- Woodward-Clyde Pty Ltd (1996) *Summary of Q1, Q2 and Tertiary Aquifer Monitoring, SAGASCO Brompton Site*, report to The South Australian Gas Company dated 20 October 1996.

- Woodward-Clyde Pty Ltd (1997) *Summary Environmental Report, SAGASCO Depot, Brompton, Volumes 1 and 2,* report to The South Australian Gas Company dated 9 May 1997.
- Woodward-Clyde Pty Ltd (1998) *Groundwater Flow & Solute Transport Modelling of the Q1 Aquifer*, Boral Energy, Brompton, South Australia, report to Boral Energy dated 19 June 1998.
- Woodward-Clyde Pty Ltd (1998) *Site History and Phase II Soil Investigation – SAGASCO Property Adjacent to Railway Line, Brompton, South Australia*, report to The South Australian Gas Company dated 18 December 1998.
- Woodward-Clyde Pty Ltd (1998) *Groundwater Modelling Summary Report*, Brompton, report to Boral Energy dated 30 October 1998.
- Woodward-Clyde Pty Ltd (1998) *Summary Report of Q1, Q2, Q3, Q4 and Tertiary Aquifer Monitoring*, 1998 Boral Energy Brompton, report to Boral Energy dated 1 December 1998.
- AECOM (2009) *Brompton Former Gasworks - Site Data Report*, report to Origin Energy dated 23 June 2009.
- AECOM (2010) *Brompton Former Gasworks – Preliminary Risk Assessment*, report to Origin Energy dated 26 February 2010.
- AEC Environmental Pty Ltd (2011) *Groundwater Monitoring Event: Former Brompton Gasworks Site, Brompton, South Australia*, report to Land Management Corporation, dated 25 April 2011.

These reports, which primarily concentrated on the state of groundwater within Quaternary and Tertiary aquifers beneath the former gas works site and in the immediately surrounding area, indicated that the gas works were originally commissioned in 1862 as a coal distillation plant and dismantled during the 1960s, subsequent to the introduction of natural gas. Part of the site, located between Port Road and the rail line, was only purchased by SAGASCO in the 1990s. The remainder of the site hosted a range of infrastructure, including gas holders (gasometers), tar and liquor tanks, a liquor well, oil and tar tanks, retort houses, condenser areas, purifying houses, tar plants, washer areas, sulphate house, settling tank, paint factory, glass works and servicing/storage areas. Infrastructure was primarily located on the western half of that portion of the site located between Chief Street and East Street, east of the railway line, and (to a lesser extent) to the south of East Street. The site also contained five pug holes that were excavated during the late 1800s-early 1900s and subsequently backfilled with uncontrolled waste. Potential site contaminants were identified as including ammonia, sulphates, sulphides, cyanide, thiocyanates, pyridine, phenols, cresols, hydrocarbons, benzene, toluene, PAH compounds and ACM.

Site soils in the vicinity of former gasworks infrastructure areas, which included an upper layer of fill material characterised by the presence of waste materials (e.g. ash, cinders, coke and demolition rubble), contained elevated concentrations of petroleum hydrocarbons, PAH compounds, phenols, cyanide, thiocyanates, ammonia and metals (lead, mercury, nickel), as well as detectable asbestos. Some of the soil impacts (e.g. hydrocarbons and cyanide) extended to substantial depths within the natural soil profile (i.e. > 10 mBGL).

The results of the groundwater investigations undertaken between 1996 and 1998 and again in 2009 within the Quaternary (Q1, Q2, Q3 and Q4) and uppermost Tertiary (T1) aquifers beneath the former Brompton Gas

Works site, and within the immediately surrounding area (in some cases), were interpreted to indicate that gas works activities, as well as the historical localised disposal of gas works by-products/waste, had resulted in groundwater metal (arsenic, cadmium, chromium, mercury, lead, nickel, zinc), TRH, BTEX, PAH, phenols, cyanide, sulphate and ammonia impacts (i.e. to varying degrees within the different aquifers). Three separate contaminant plumes were identified within the Q1 aquifer. Mounding within the vicinity of a duck pond on the former gas works site (i.e. located on the edge of a former pug hole and used for stormwater disposal) was interpreted to have resulted in a radial flow direction (i.e. located to the west and south-west of the Study Area) and to represent a possible driving force for the movement of groundwater within the uppermost Q1 aquifer. The Study Area was therefore located immediately (hydraulically) down-gradient of the gas works property and Q1 aquifer contaminant plumes (which included phenols, TRH, PAH and ammonia) were considered to extend beneath it.

The latest groundwater monitoring event, undertaken by AEC Environmental in 2011 across the area of the Brompton-Bowden 2001 *Groundwater Exclusion Zone* (refer to Section 2.2.7) , involved the sampling of the same five Quaternary and Tertiary aquifers. Groundwater flow direction in the Quaternary aquifers was inferred to be in a north to north-easterly direction whereas flow in the Tertiary aquifer was towards the south-east. Measured depths to groundwater were as follows: Q1 aquifer – approximately 11.2 to 15.9 mBGL, Q2 aquifer – approximately 14.2 to 15.5 mBGL, Q3 aquifer – approximately 15.5 to 16.7 mBGL, Q4 aquifer – approximately 14.2 to 16.5 mBGL, Tertiary aquifer – approximately 18.1 to 24 mBGL. Elevated analyte concentrations, relative to adopted screening criteria, within one or more of the Quaternary aquifers across the exclusion zone included metals (arsenic, chromium, iron, molybdenum, selenium, zinc), ammonia, sulphate, nitrate, cyanide, total PAH, phenol, BTEX and C_6-C_{36} TRH. By comparison, the Tertiary aquifer contained elevated concentrations of metals (molybdenum, selenium), ammonia, nitrate, cyanide and total PAH.

Of the bores identified by AEC Environmental in 2011, three Q1 aquifer bores (Q1-116, Q1-117 and Q1-123) were located within the north-western quadrant of the Study Area (i.e. between Second, East, Third and Chief Streets) – none of these were sampled. A Q1 aquifer bore (Q1-122) as well as nested bores (Q2-004, Q4-004, and TER-T4, intersecting the Q2, Q4 and Tertiary aquifers, respectively) were also located on the northern boundary of this portion of the site, adjoining Chief Street. The results obtained for these off-site bores indicated that groundwater within the Quaternary aquifers contained elevated concentrations of metals (chromium, zinc), ammonia and cyanide whereas only elevated total PAH was detected within the Tertiary bore. An additional Q3 aquifer bore (Q3-001), located on the former Brompton Gas Works property to the west (across Second Street and presumably up-gradient) of the Study Area, contained elevated concentrations of zinc, benzene, xylenes, C_6-C_{36} TRH and total PAH relative to the adopted screening criteria.

3.1.7 Site Contamination Audit Report – 11 Eighth Street, Bowden

The following SCAR was issued for a site located immediately south-east of the Study Area:

- AEC Environmental Pty Ltd (2009) *Site Audit Report: 11 Eighth Street Bowden, SA*, report to Land Management Corporation dated 9 February 2009.

Known historical uses of this property included residential (prior to 1920s), machine shop, foundry, cabinet maker/joinery and metal finishers, the latter prior to its vacation in 1986.

Site investigations indicated that fill materials contained a range of wastes (including bricks, porcelain, cinders and coke) as well as elevated concentrations of metals (arsenic, cadmium, copper, lead, nickel, zinc), sulphate, benzo(a)pyrene and total PAH. Groundwater beneath the site contained elevated concentrations of boron, manganese, selenium and zinc, relative to adopted screening criteria, although boron and selenium were considered representative of background conditions. Detectable concentrations of various volatile organic compounds (VOCs), including 1,1-dichloroethene, 1,1-dichloroethane, cis-1,2-dichloroethene and TCE, were also present in groundwater.

Site fill materials were remediated (i.e. excavated for off-site disposal) and the site was signed off for residential land use.

3.1.8 Summary – Site Contamination

In summary, a review of the environmental assessment and audit reports prepared for properties located around the Study Area indicate that that the area has had a substantial history of industrial use, including (but not necessarily limited to) gas works, manufacturing (electrical components, bricks, paper, bedding/upholstery, boots, fibre and plaster), metal fabrication and coating, engineering, foundries foundry supplies, dry cleaners/laundries, motor mechanics, concrete casting/washing, tanneries, blacksmiths and timber merchants. Various chemicals and fuels have been used and/or stored on these industrial sites and uncontrolled filling of properties and historical pug holes has been undertaken with materials that could potentially have included contaminated gas works and/or foundry wastes. Subsurface infrastructure, including old basements, footings, concrete pilings, USTs and various pits, as well as contaminated and geotechnically unstable fill materials have also been identified on a number of sites following the demolition of industrial infrastructure and/or during site remediation programs.

3.2 Air quality and acoustics

With respect to acoustic (noise) and air quality issues relevant to the future residential redevelopment of the Study Area, the following need to be considered:

- the nature of the existing activities in the Study Area and how noise and air emissions may impact on more sensitive land uses that progressively replace the existing commercial and industrial businesses – over time it is assumed that the industrial and commercial enterprises will be replaced by residential and other more sensitive developments, so that eventually there may be no remaining industrial or commercial activities and as a result, this concern will no longer exist;

- the nature of the existing activities in areas immediately surrounding the site – there can be no assumptions about these businesses moving away and it is also possible that new businesses will establish, as permitted by planning regulations; and
- the ongoing operation of these activities in and near the Study Area. In the three years since 2014 there is a trend for businesses that may generate noise or air emissions to close down or plan to close down (not necessarily for these reasons) and for their sites to either remain vacant pending redevelopment, or to be used for activities that generate fewer noise emissions and discharges to atmosphere.

These three aspects will be considered by firstly identifying, and then discussing, the nature of the businesses on and near the Study Area.

Fyfe's assessment of potential noise and air quality impacts has been based on an inspection of the area and a review of existing reports and publically available information. It considers the information presented in the EPA Letter (see Section 2.4.3), the EPA *Guidelines for Separation Distances (2007)* and the 2016 EPA publication *Evaluation Distances for Effective Air Quality and Noise Management*.

3.2.1 EPA guidelines

The EPA publication *Evaluation Distances for Effective Air Quality and Noise Management* (EPA 2016) outlines a process for evaluating the distances from source sites over which potential air quality and noise impacts may be experience. The publication tabulates a range of industrial activities and assigns them 'recommended evaluation distances'. In some instances the publication also lists recommended minimum distances in recognition of those activities that there may be some residual environmental risk even with the implementation of best management processes and technologies.

In cases where a sensitive area or proposed development falls outside of a recommended evaluation distance, then it can be assumed that the industrial activity will not impact on air quality or noise levels at or beyond that distance, and no further assessment is required.

However if a sensitive area or proposed development falls inside of a recommended evaluation distance, then an assessment should be undertaken to determine the environmental risks at the location in question. Such an assessment should consider a range of factors, including the scale of the operations, any complaints history, local topographical and meteorological characteristics and any air quality or noise modelling, the known impacts of the existing or similar plants, the type and performance of emission control technologies, systems for managing residual emissions (such as noise barriers) and the long-term management and maintenance of any environmental mitigation measures present.

The inclusion of an area within a recommended evaluation distance does not mean that a sensitive development should not occur at that location. Rather, it just signifies the need for a site-specific consideration of the factors the factors listed above. An outcome of that site specific consideration will be a

conclusion that either the environmental risks are acceptable, or that they are unacceptable unless further works are implemented.

Fyfe has identified properties in or near the Study Area and used the information in EPA 2016 to identify properties and activities that have a recommended evaluation distances that covers part or all of the Study Area. These businesses are shown in Figure 5 in Appendix A.

This Figure shows that the entire Study Area falls within a recommended evaluation distance of 500 metres from Conroy's Smallgoods. Therefore an assessment of these properties should be undertaken in accordance with EPA 2016. In the absence of such assessments, Fyfe provides some preliminary considerations of the likely air quality and noise impact risks that may be experienced in the Study Area in the following sections of this report.

The presence of proposed sensitive land use within a recommended evaluation distance from a source site will require that each application address the noise and emission impacts on the proposed development within their respective applications.

3.2.2 Review of existing reports

Air quality

The following reports were reviewed to assess potential air quality issues that could affect the site:

- Tonkin Consulting (2007) Potential Air Pollution Impacts Related to the Proposed Rezoning of the Current Clipsal Site in Bowden from Industrial to Mixed Use, dated October 2007.
- EML Air Pty Ltd (2011a) Odour Modelling, Land Management Corporation, Rezoning Bowden, Adelaide, South Australia – Ausplume Modelling of Kettle Exhaust SA Brewery (Normal Production Rates), dated August 2011.
- EML Air Pty Ltd (2011b) Odour Modelling, Land Management Corporation, Rezoning Bowden, Adelaide, South Australia – Ausplume Modelling of Kettle Exhaust SA Brewery (Maximum Production Rates), dated August 2011.

The Tonkin Consulting (2007) report considered the potential sources of emissions to air from all of the businesses located on the former Clipsal site, as they had the potential to impact on the proposed rezoning of the site for more sensitive uses. It also considered a number of potential emission sources external to the site.

Of relevance to the Study Area was the identification of the South Australian Brewing Company site in Thebarton, located approximately 700 m to the south. The SA EPA (2007) *Guidelines for Separation Distances* shows that a 1 km separation distance is recommended between large capacity breweries and residential sites. This means that approximately one half of the Brompton Site is within the 1 km buffer distance recommended by the EPA. It is noted that the 1 km buffer distance is a recommendation only and that activity and location specific factors may exist that warrant a variation to the recommendation. In addition,

the Tonkin Consulting (2007) report found that there was no record of odour complaints relating to the brewery, even though there are residential properties located within 300 m (to the south) of the brewery.

The two EML reports looked in detail at the odorous emissions from the brewery. They found that computer modelling of the dispersion of odorous emissions showed that the entire Clipsal site could potentially experience occasional odour levels above the applicable criteria. Although the Study Area is located further from the brewery than the Clipsal site, the computer modelling in the EML reports indicated that potential odour events could also occasionally affect the Brompton site. However, both the frequency and the intensity of such incidents would be less than that predicted to occur on the Clipsal site. In fact, a review of the EML (2011a) report shows that, under normal brewery operating conditions, the Brompton site would be unlikely to be impacted by odour levels or frequencies in excess of applicable odour criteria. EML also modelled a maximum production rate emission scenario, which indicated that the entire Study Area could be subject to unacceptable odour events at times.

Since the date of the odour modelling studies of the brewery it is understood that substantial emission reduction measures have been implemented by SA Breweries and the EPA no longer considers that the Study Area would be subject to unacceptable odour levels attributable to brewery operations (EPA Letter).

Acoustic assessment (noise)

The following reports were reviewed to assess potential noise issues that could affect the site:

- Sonus Pty Ltd (2011) *Transit Oriented Development (TOD) Bowden Urban Village Environmental Noise Assessment*, dated April 2011.
- Sonus Pty Ltd (2007) *Clipsal Site Development Plan Amendment – Environmental Noise Assessment*, dated October 2007.

The Sonus (2011) report was concerned with the Bowden Urban Village area, located to the south of the Study Area. It identified the likely need for noise treatment packages to be applied to new residential developments in parts of the Bowden Urban Village in order to meet established noise quality criteria. Treatments were needed, and most extensive, closest to the railway line/train station, and the Park Terrace arterial roadway. Some treatments were also considered in the Sonus (2011) report to be necessary in areas adjoining some of the industrial facilities in the Study Area.

Given that Study Area is located further from the main transport noise sources than was the Bowden Urban Village, it is considered that the Study Area will be unlikely to be subject to unacceptable noise levels from these sources. Further, the redevelopment of the Study Area would remove at least one noise source (Conroy's Smallgoods) that would otherwise impact onto the Bowden Urban Village area to the south. Fyfe's assessment of the area surrounding the proposed Study Area has shown that there does not appear to be other substantial noise sources that could impact on the site to any significant extent. Therefore, it is concluded that any noise impacts on future residential developments on the site will be of a lower magnitude than the potential noise impacts identified for the adjoining Bowden Urban Village.

The Sonus (2011) report for the Bowden Urban Village area found that some relatively modest noise treatments of residential dwellings would be required at some locations in order to comply with noise standards. Within the Study Area the Noise and Air Emissions Overlay is intended to apply in the event of any rezoning to mixed use zones—e.g. Urban Core, Urban Corridor and Suburban Activity Node. This will ensure that the Minister's Specification SA 78B for the Construction Requirements for the Control of External Sound will be activated.

The Sonus (2007) report provided an environmental noise assessment of a proposed redevelopment of the broader Clipsal site, located to the south of the Study Area, and beyond the area specifically addressed in the Sonus (2011) report. Although the Sonus (2007) report concluded that a range of noise attenuation treatments would be needed for residential dwellings constructed on the Clipsal site, given the greater distance of the area under consideration from the Study Area, the Sonus (2011) report on the Bowden Urban Village area is considered more relevant to this study, and the Sonus (2007) report is not considered further.

3.2.3 Review of available information

Study Area

As described in Section 2.2.2, the following businesses are located within the boundaries of the Study Area:

Detmold is the single largest (by area) business in the Study Area. It is a packaging manufacturing business and we understand that they are currently developing a new facility at a different location that they expect to relocate to within approximately three years. In recent years Detmold has relocated the majority of its carton converting machinery elsewhere. Its paper converting plant remains in full production on the Brompton site.

Paper converting involves the manufacture of paper products from manufactured paper. This process can potentially:

- generate noise impacts due to the mechanical equipment involved;
- have the need for dust controls to capture and dispose of paper fibres released during cutting and handling activities;
- result in solvent (including odorous) emissions from the printing and equipment cleaning activities involved;
- include wastewater treatment, with possible associated odours; and
- result in noise emissions from printing and paper handling equipment, pumps, fans, motors, compressors, vehicles and forklifts.

The **Nemeson Bowden** site operates as a carton printing and manufacturing plant (as Custom Cartons) and did not indicate what their plans at the site are, although during the 2017 assessment they advised Fyfe that as tenants of the property they occupy they realise they are subject to the decisions of the property owner regarding their ongoing tenancy. Activities and impacts are considered to be similar to that of Detmold, but of a smaller scale.

Kennett operates a property on East Street that is largely a hard stand and storage area. It has little developed infrastructure and, in its present use, would not be the source of off-site noise or air emissions. Fyfe is not aware of their plans for the site, although it is noted that the site has little infrastructure that would constrain any relocation plans.

The **Marble and Cement Company** has a sizeable landholding that has frontages to East, Second and Chief Streets. This business has ceased operations (since the 2014 study) and is currently not used (apart from the storage of equipment from the previous business. There are no plans to redevelop the site for an industrial use, therefore other parts of the Study Area are not expected to be impacted by activities on this site.

Conroy's Smallgoods has operated at its present location since 1976, manufacturing meat and smallgoods products. Fyfe is not aware of Conroy's plans for the site, although it is noted that the site has considerable infrastructure that would constrain any relocation plans.

They occupy almost the entire block bounded by Drayton, Seventh, Gibson and Sixth Streets. Smallgoods manufacturing has the potential to generate odours emissions from cooking processes, the meat smoking process, wastewater and waste storage. Some enhanced odour management, including odour capture and control equipment may be required to maintain off-site odour levels at acceptable standards. The encroachment of residential areas could be expected to make odour collection and treatment controls more critical to avoid unacceptable off-site impacts.

The EPA Letter noted that EPA thought that such improvements would be achieved through the collaborative efforts of EPA and Conroy's Smallgoods.

The property known as **HAAE** occupies almost the entire block bounded by Drayton, Seventh, Gibson and Eighth Streets. The nature of the activities undertaken on the site are unclear although it is understood to have previously been an iron foundry operating as BTR Engineering Products, Ferrous Division.

During both the 2014 and 2017 inspections by Fyfe there were no external signs of the site being operational or in use. An employee of Conroy's Smallgoods (that fronts Seventh Street opposite the HAAE site) advised Fyfe that he had never observed any activity on the HAAE site in at least the 18 months prior to November 2017.

Fyfe concludes that this site is no longer operational.

Another (smaller) property was occupied in 2014 by **Resin Sands** located near the corner of Gibson and Ninth Streets. It is assumed that this business prepared or blended resins for the foundry industry. These activities had the potential to generate dust and odorous emissions. Some air handling plant was evident on this property, supporting the view that capture and containment of particulate matter was required by this business to maintain dust levels at acceptable standards. However, during the 2017 inspection it was noted that this business was no longer present. Instead the site was used as a depot by a motor vehicle rental company, and no off-site noise or air quality impacts would now be expected.

Off-site

The area to the south of the Study Area is largely occupied by residential properties. Between 2003 and 2007, odour complaints were received by the City of Charles Sturt in relation to the Bowden Metal Finishing business (an electroplating factory), located at 16-18 Ninth Street. As shown on Figure 3 (Appendix A), this property is located within 50 m of the Study Area, although observations made during the site walkover indicate that the electroplating works have been demolished and the property is currently vacant. It is also understood that the property is currently being assessed (subject to audit) for possible future residential development.

The Adelaide Brass Casting Co. operates a foundry on Gibson Street and Tenth Street, approximately 70 m east of the Study Area. It is understood that several odour complaints had been made to the City of Charles Sturt in the period 2004 to 2007 in relation to this facility. It is observed, however, that existing residential dwellings are much closer to this business (i.e. directly across Gibson Street), than the Study Area.

Also to the north, Eclipse Sheet Metal was located at 60A Chief Street, immediately opposite the Study Area. This business could represent a potential source of noise from grinding and cutting equipment, crane operations and banging of steel. However, it is noted that the property has been sold and, during the site walkover, it was noticed that the Eclipse Sheet Metal business appeared to be a closed.

Other land holdings on the north and west of Chief Street include residential properties and retail/commercial businesses.

To the south of the site, former industrial land is progressively being redeveloped as part of the Bowden Urban Village project. Land on the south-eastern side of the site is a mix of residential and smaller commercial/industrial premises.

4. DISCUSSION

4.1 Site contamination

To date, very little site contamination assessment has been undertaken on the various properties that form part of the Study Area. However, numerous potential sources of contamination have been identified for the site and surrounding areas based on the extensive industrial history of the Bowden-Brompton area.

While on-site activities (e.g. storage and use of fuels and chemicals, industrial processes and associated waste disposal practices, historical backfilling of areas/pug holes with uncontrolled fill and/or waste burial) may have resulted in soil, soil vapour, groundwater and/or surface water impacts, off-site groundwater contamination that could extend beneath the site has also been identified as emanating from a number of sources, most notably the (inferred hydraulically up-gradient to cross-gradient) former Gerard Industries/Clipsal and Brompton Gas Works sites. The potential contaminants are varied in nature, including (but not necessarily limited to) metals, hydrocarbons, cyanide, organic solvents, phenols, petroleum hydrocarbons and nutrients. In addition, asbestos containing materials are likely to be present within site infrastructure and/or imported (uncontrolled) fill materials and buried wastes.

Even if present in the Study Area, such contaminants in soil or groundwater, would not preclude redevelopment for more sensitive land uses. Rather they would result in the need for assessment and management as is common in many brownfields redevelopments, with any cost implications incorporated into the project budgets.

The implications for the redevelopment of the Study Area are that the locations of the two pug holes represent areas of heightened environmental risk, due to the possibility of contaminants being present to a considerable depth in a non-natural soil profile. The contaminants present in the pug holes could potentially include any industrial waste or contaminant.

In order to obtain more specific information on the contamination status of properties in the Study Area then further, site-specific investigations would be required. This would include undertaking Preliminary Site Investigations (DSIs) and Detailed Site Investigations (DSIs) in accordance with the Schedule B2 of the *National Environment Protection (Assessment of Site Contamination) Measure NEPM, 1999 (as amended)*. The investigations would identify the potentially contaminating land uses and activities within the individual sites and the nature and extent of any contamination, along with any risks to human health and the environment.

4.2 Air quality and acoustics

Based on a review of current industries and activities on, and within the vicinity of, the Study Area, it appears that there are several businesses operating in the area that could potentially impact on future residential redevelopment in terms of air quality issues. In most cases, however, the impacts are likely to be transitional

in nature, in that they would only be experienced whilst new residential dwellings co-exist with existing industry that has not yet relocated.

The clear trend in the area is for established businesses to be down-sizing the intensity of their activities and even ceasing the use of their industrial facilities within the Study Area. Even since the 2014 study two of the major sites (Marble and Cement Company and HAAE Pty Ltd) and one smaller site (Resin Sands) have ceased operating. Replacement activities have generally been of a more benign nature, including storage, car parking, warehousing and commercial activities.

The South Australian Brewing Company site represents one facility in the area that is likely to have a long-term future operational status, with part of the Study Area located within the SA EPA (2016) recommended 1 km investigation distance. However, given the lack of odour complaints associated with this facility historically and recent initiatives at the site to further reduce off-site impacts (EPA 2016), the brewery is considered unlikely to impact on the Study Area in the future.

There are, however, three properties in or near the study area that have EPA recommended evaluation distances that encompass part or all of the Study Area:

- Conroy's Smallgoods is located within the Study Area and has an EPA recommended evaluation distance of 500 metres and this encompasses the entire Study Area.
- The Detmold facility is located within the Study Area however there is no evaluation distance for the activity of producing a listed waste, but there is the potential for activities undertaken at the site (when producing the listed waste) to result in odour and noise..
- Adelaide Brass Castings is located outside of the Study Area but has an EPA recommended evaluation distance of 500 metres and this encompasses the entire Study Area.

Of these three businesses, Fyfe understands that Detmold plans to relocate to outside of the Study Area within approximately three years.

The finding that a facility has a recommended evaluation distance that covers part or all of the Study Area should not be interpreted to mean that that facility will impact on air quality within the entirety of that recommended evaluation distance. Rather it means that site specific factors should be considered in the assessment of development applications within the affected area to determine what (if any) impacts there might be on air quality, and what (if any) distance those impacts may extend off-site from the facility.

Whilst it is beyond the scope of this study to prepare such submissions, Fyfe makes the following observations that are likely to be factors in considering reductions in separation distances.

- Fyfe understands that Conroy's Smallgoods currently has no plans to relocate their business, although this may be re-evaluated in three to four years.

- There is a history of odour complaints attributed to Conroy's Smallgoods. Should nothing else change it would be reasonable to expect an increase in the number of complaints should the number of residential dwellings in the Study Area increase.
- There are a variety of odour and noise mitigation measures available to Conroy's Smallgoods that would be able to reduce off-site impacts on air quality.
- The EPA 2016 Letter expresses the view that the Conroy's facility would be able to coexist with adjacent [future] land users.
- The Detmold facility does not have a recommended evaluation distance however it is located within the Study Area, and the business plans to relocate to a new location within the short to medium term.
- Adelaide Brass Castings Pty Ltd is located outside the Study Area with a recommended separation distance of 500m. There are currently residential dwellings within 20 metres of the factory (on the south side of Gibson Street), and to the north between the Adelaide Brass Casting site and the Study Area. Further investigations of the specific operation, facilities and air pollution control equipment used by this business would be required as part of the assessment of new sensitive proposals within the Study Area.

Existing industries and activities in and within the vicinity of the Study Area may have the potential to generate noise emissions that could impact on future residential redevelopment of the area. However, any impacts are likely to be manageable and, in some cases, the impacts may be transitional (i.e. in that they would only be experienced whilst new residential dwellings co-exist with existing industry that has not yet relocated). It is expected that any rezoning of the Study Area will include the application of the Noise and Air Emissions Overlay.

5. CONCLUSIONS & RECOMMENDATIONS

The majority of the Study Area appears to have had a history of industrial use although scattered residential and commercial properties are also present. This is typical of the broader Bowden-Brompton area where commercial/industrial facilities are gradually being replaced with urban mixed-used (commercial, residential and public open space) developments, the majority of which have been preceded by a period of site assessment followed by specific remediation and/or management measures.

Although there is a lack of information regarding the history of land use and the contamination status of the individual properties that comprise the Study Area, it is expected that a range of soil and groundwater contamination issues will be present. These are likely to include the infilling of two pug holes in the Study Area with wastes that could potentially include gasworks wastes from the former Brompton Gas Works and other uncontrolled industrial wastes. In addition a number of the industrial sites have the potential to have soil and/or groundwater that is contaminated with substances such as petroleum hydrocarbons, metals, PAHs, chlorinated solvents and BTEX compounds.

The two pug hole areas are likely to present the greatest challenges for redevelopment, due to the likely depth of the wastes present, the probable inclusion of gas works residues within the wastes and the non-natural geotechnical properties of the materials placed in the pug holes.

Given the proposed change in land use of the majority of the Study Area (e.g. from commercial/industrial to residential), it is understood that the area will need to be rezoned to enable such development to occur. It is also considered that many of the properties will need to be subject to Site Contamination Audit, in accordance with Division 4 of Part 10A of the *Environment Protection Act 1993*. The EPA has suggested that this process can be specified in the DPA to be required at the development application stage – particularly where a change to a more sensitive land uses is proposed.

Two businesses that would previously have had the potential to impact on sensitive land uses in the Study Area are no longer operating (Marble and Cement Co and HAAE). Future uses of their sites would not impact on future off-site land uses if redeveloped in line with the proposed re-zoning.

Three properties in or near the Study Area have EPA recommended evaluation distances that encompass some or all of the Study Area. This indicates that there is some risk that there is the potential for some odour and/or noise air quality impacts to be experienced by future residents and other sensitive users of the Study Area. One of these three businesses (Detmold) is known to have plans to relate to outside of the Study Area within the short to medium term.

The EPA has recommended 500m separation distances remain for Adelaide Brass Castings and Conroy's Smallgoods affecting the Study Area. It is noted that EPA in their 2016 letter to the City of Charles Sturt offered to work collaboratively with industry to identify sources of off-site air quality impacts and to implement pollution reduction strategies with the businesses concerned.

6. LIMITATIONS

Fyfe has prepared this Preliminary Environmental Assessment for the use of the City of Charles Sturt ('the Client'), in accordance with the usual care and thoroughness of the consulting profession. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report.

The methodology adopted and sources of information used by Fyfe are outlined in this report. Fyfe has made no independent verification of this information beyond the agreed scope of works and Fyfe assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to Fyfe was false.

This report is based on the information provided by City of Charles Sturt and reviewed at the time of preparation. Fyfe disclaims responsibility for any changes that may have occurred after this time. This Preliminary Environmental Assessment should be read in full. No responsibility is accepted for use of any part of this Preliminary Environmental Assessment in any other context or for any other purpose or by third parties. This Preliminary Environmental Assessment does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

7. REFERENCES

AEC Environmental Pty Ltd (2008) *Additional Environmental investigation: Bowden Industrial Estate, Park Terrace, Bowden, South Australia*, dated September 2008.

AEC Environmental Pty Ltd (2009) *Site Audit Report: 11 Eighth Street Bowden, SA*, dated 9 February 2009.

AEC Environmental Pty Ltd (2011) *Groundwater Monitoring Event: Former Brompton Gasworks Site, Brompton, South Australia*, dated 25 April 2011.

AECOM (2009) *Brompton Former Gasworks - Site Data Report*, dated 23 June 2009.

AECOM (2010) *Brompton Former Gasworks – Preliminary Risk Assessment*, dated 26 February 2010.

AECOM Pty Ltd (2013) *Site Contamination Audit Report: Bowden Urban Village Stage 2 (Trembath Street Road Reserve*, dated 29 October 2013.

AECOM Pty Ltd (2014) *Site Contamination Audit Report: Bowden Urban Village Stage 2*, dated 11 April 2014.

Coffey Partners International (1990) *Resource Development Brompton Gas Works Preliminary Environmental Assessment*, dated 17 July 1990.

EML Air Pty Ltd (2011a) *Odour Modelling, Land Management Corporation, Rezoning Bowden, Adelaide, South Australia – Ausplume Modelling of Kettle Exhaust SA Brewery (Normal Production Rates)*, dated August 2011.

EML Air Pty Ltd (2011b) *Odour Modelling, Land Management Corporation, Rezoning Bowden, Adelaide, South Australia – Ausplume Modelling of Kettle Exhaust SA Brewery (Maximum Production Rates)*, dated August 2011.

Environment Protection Act 1993.

Environment Protection Regulations 2009.

Fyfe Pty Ltd (2014) Preliminary Environmental Assessment Proposed Brompton Village Rezoning Site, South Australia, dated 14 July 2017)

Fouroulis Nominees Pty Ltd (2007) *Site History Report: 16-24 East Street, 26-30 East Street, 32 East Street, 33A Chief Street, Brompton SA*, dated 3 July 2007.

GHD Pty Ltd (2010) *Site 9 Brompton Redevelopment South Australia: Site Contamination Audit Report*, dated 16 March 2010.

Hosking Oborn Freeman & Fox Pty Ltd and Johnstone Environmental Technology Pty Ltd (1991) *Remediation of the ASC Site, Bowden, South Australia – Technical Proposal*, dated January 1991.

Hosking Oborn Freeman & Fox Pty Ltd and Johnstone Environmental Technology Pty Ltd (1991) *Remediation of the ASC Site, Bowden, South Australia – Working Paper No. 1*, dated March 1991.

Hosking Oborn Freeman & Fox Pty Ltd and Johnstone Environmental Technology Pty Ltd (1991) *Remediation of the ASC Site, Bowden, South Australia – Remediation Options*, dated April 1991.

NEPM (1999) *National Environment Protection (Assessment of Site Contamination) Measure*. National Environment Protection Council, Australia.

Planning SA (2001) *Site Contamination*. Planning Advisory Notice 20.

Sonus Pty Ltd (2007) *Clipsal Site Development Plan Amendment – Environmental Noise Assessment*, dated October 2007.

Sonus Pty Ltd (2011) *Transit Oriented Development (TOD) Bowden Urban Village Environmental Noise Assessment*, dated April 2011.

South Australian Department of Mines and Energy (1969) *1: 250,000 Adelaide Geological Map Sheet*.

South Australian Environment Protection Authority (2007) *Guidelines for Separation Distances*, December 2007.

South Australian Environment Protection Authority (2016) *Evaluation Distances for Effective Air Quality and Noise Management*, August 2016.

Standards Australia (2005) *Guide to the Sampling and Investigation of Potentially Contaminated Soil Part 1: Non-Volatile and Semi-Volatile Compounds*. AS4482.1-2005 Homebush NSW.

Tonkin Consulting (2007) *Potential Air Pollution Impacts Related to the Proposed Rezoning of the Current Clipsal Site in Bowden from Industrial to Mixed Use*, dated October 2007.URS Pty Ltd (2012) *Site Contamination Audit Report:*

Wallbridge & Gilbert Pty Ltd (1998) *Site Investigation at Bowden for Gerard Industries*, dated 15 July 1998.

Woodward-Clyde Pty Ltd (1996) *Summary of Q1, Q2 and Tertiary Aquifer Monitoring, SAGASCO Brompton Site*, dated 20 October 1996.

Woodward-Clyde Pty Ltd (1997) *Summary Environmental Report, SAGASCO Depot, Brompton, Volumes 1 and 2*, dated 9 May 1997.

Woodward-Clyde Pty Ltd (1998) *Groundwater Flow & Solute Transport Modelling of the Q1 Aquifer, Boral Energy, Brompton, South Australia*, dated 19 June 1998.

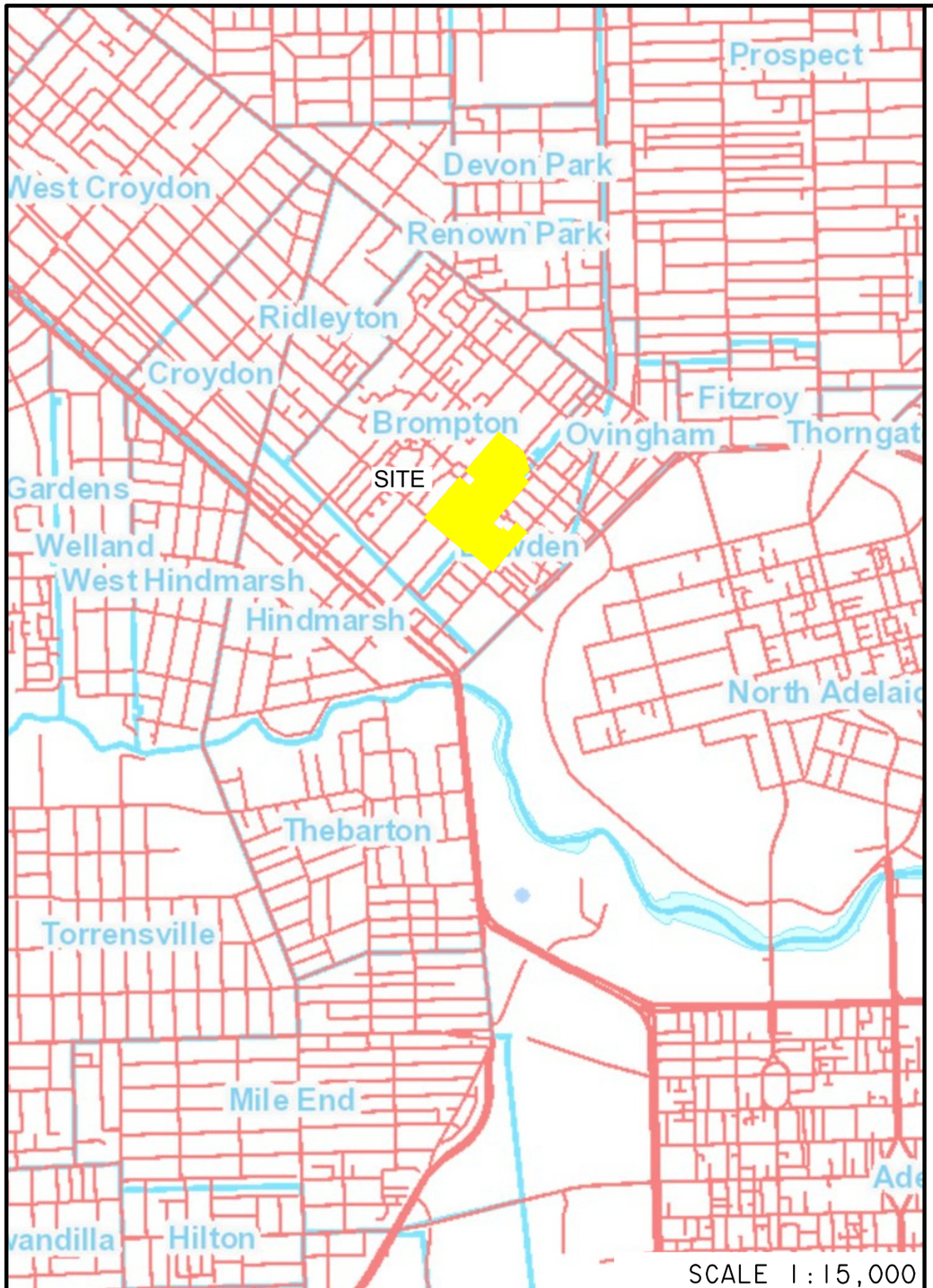
Woodward-Clyde Pty Ltd (1998) *Site History and Phase II Soil Investigation – SAGASCO Property Adjacent to Railway Line, Brompton, South Australia*, dated 18 December 1998.

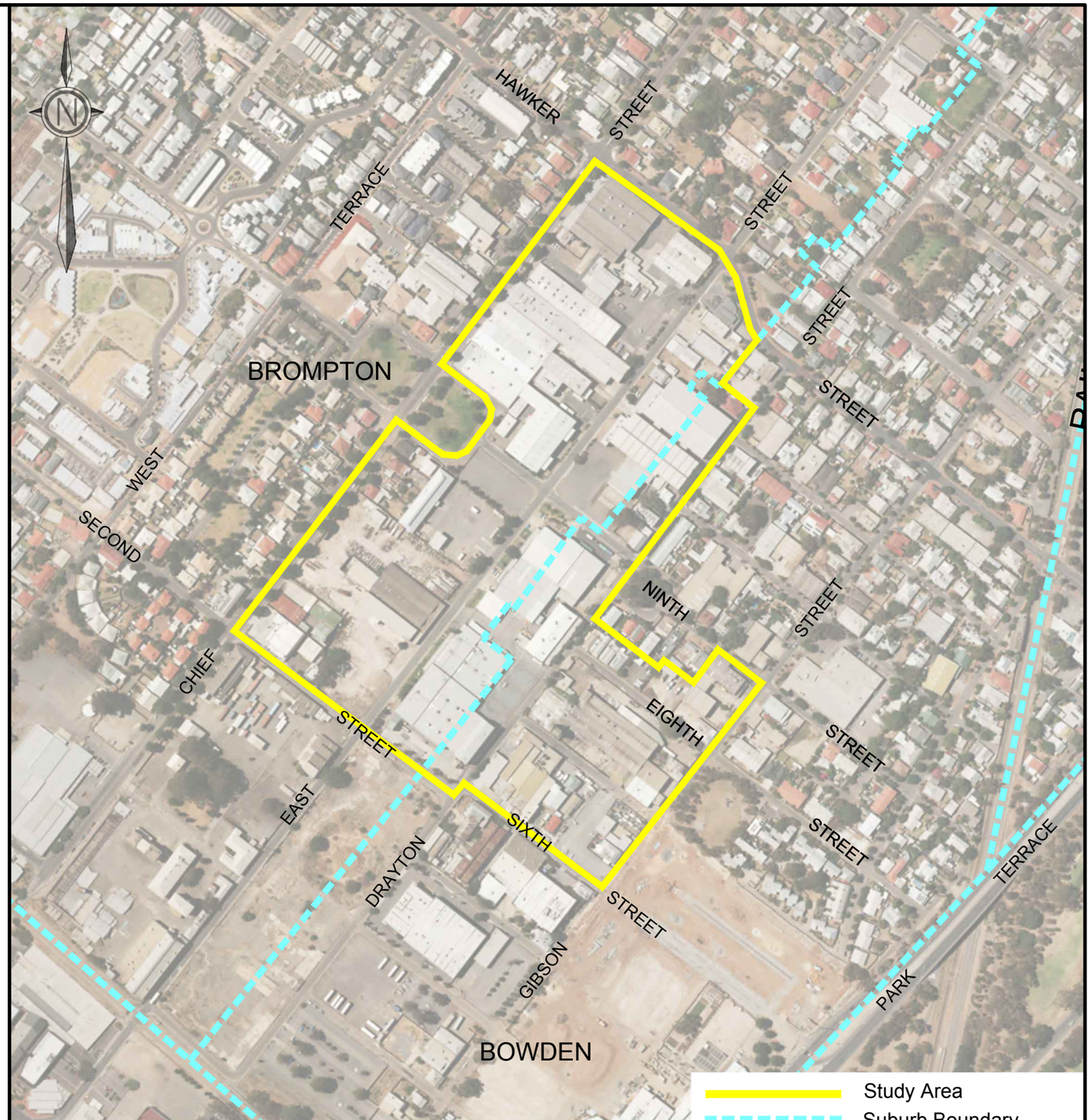
Woodward-Clyde Pty Ltd (1998) *Groundwater Modelling Summary Report, Brompton*, dated 30 October 1998.

Woodward-Clyde Pty Ltd (1998) *Summary Report of Q1, Q2, Q3, Q4 and Tertiary Aquifer Monitoring, 1998 Boral Energy Brompton*, dated 1 December 1998.

APPENDIX A

FIGURES





ORIGINAL SIZE A3

FYFE Earth Partners
ACN 008 116 130

FYFE Earth Partners
ENVIRONMENT DEVELOPMENT RESOURCES

LEVEL 1, 124 SOUTH TERRACE, ADELAIDE , SA, 5000
GPO BOX 2450 ADELAIDE SA 5001
TEL (08) 8201 9600
FAX (08) 8201 9650
E-mail info @ fyfe.com.au

0 100 200 300 400

SCALE 1: 4000

LEVEL DATUM :	N/A	INSTRUCTION: 65148/1/9	
LEVEL AUTHORITY :	N/A	COUNCIL :CHARLES STURT	
CO-ORD DATUM :	MGA94	DRAWING	65148-1-9-SV-BA1-R0

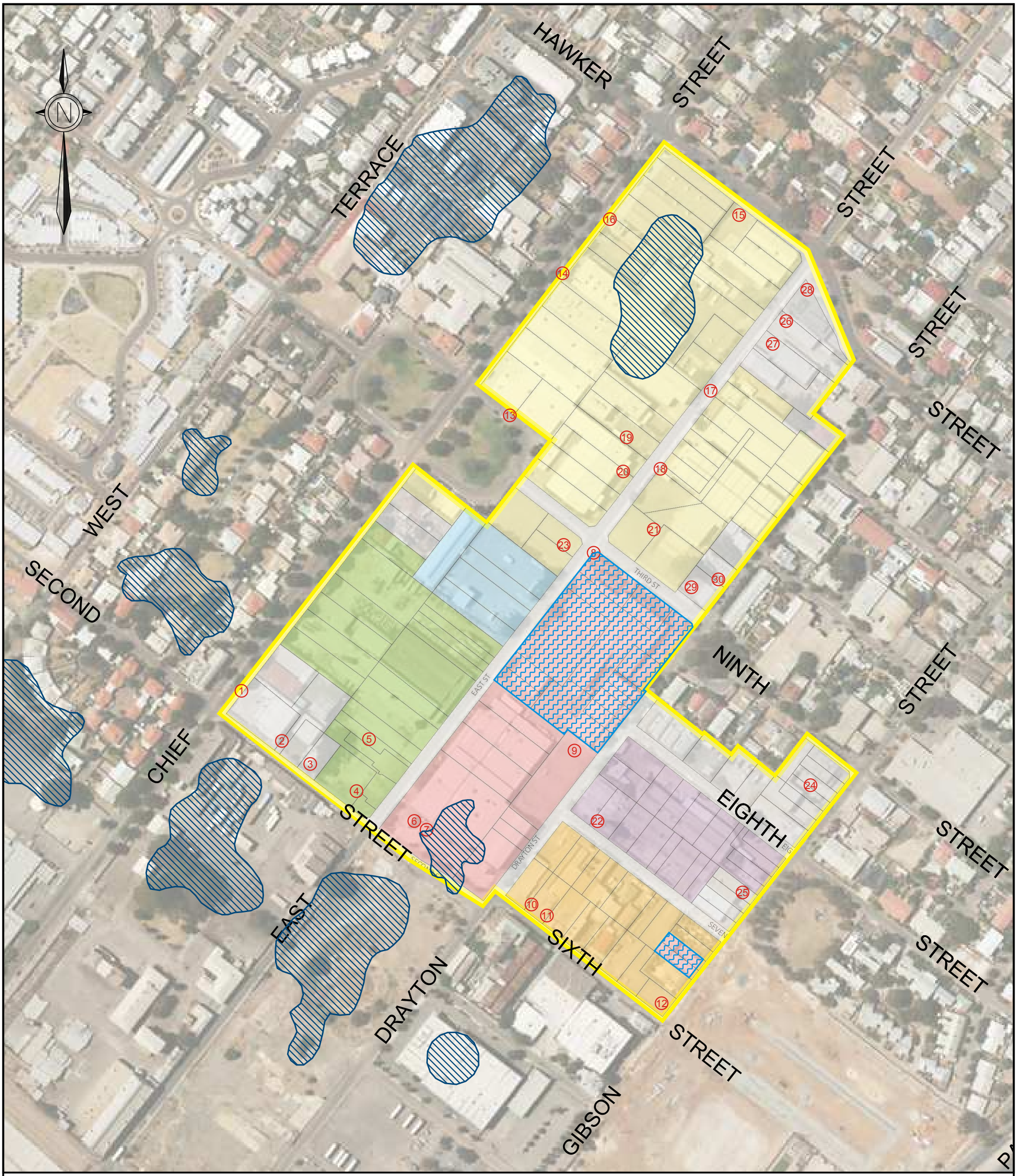
UPDATED PRELIMINARY ENVIRONMENTAL ASSESSMENT

FIGURE 1 - SITE LOCATION

DATE 13/12/2017

SHEET 1 OF 5

REV. 0



LEGEND

Land Owners

- DETMOLD
- PARKVIEW PROPERTY TRUST
- KENNETT
- MARBLE AND CEMENT
- NEMESON BOWDEN
- CONROY'S SMALLGOODS
- HAAE PTY LTD
- OTHER LANDOWNERS
- STUDY AREA

APPROXIMATE LOCATION OF FORMER PUG HOLE

⑤ LOCATION OF PHOTOGRAPH

ORIGINAL SIZE A3

FYFE Earth Partners
ACN 008 116 130

FYFE Earth Partners
ENVIRONMENT DEVELOPMENT RESOURCES

LEVEL 1, 124 SOUTH TERRACE, ADELAIDE , SA, 5000
GPO BOX 2450 ADELAIDE SA 5001
TEL (08) 8201 9600
FAX (08) 8201 9650
E-mail info @ fyfe.com.au

0 25 50 75 100 125

SCALE 1: 2500

INSTRUCTION: 65148/1/9

COUNCIL: CHARLES STURT

DRAWING: 65148-1-9-SV-BA1-R0

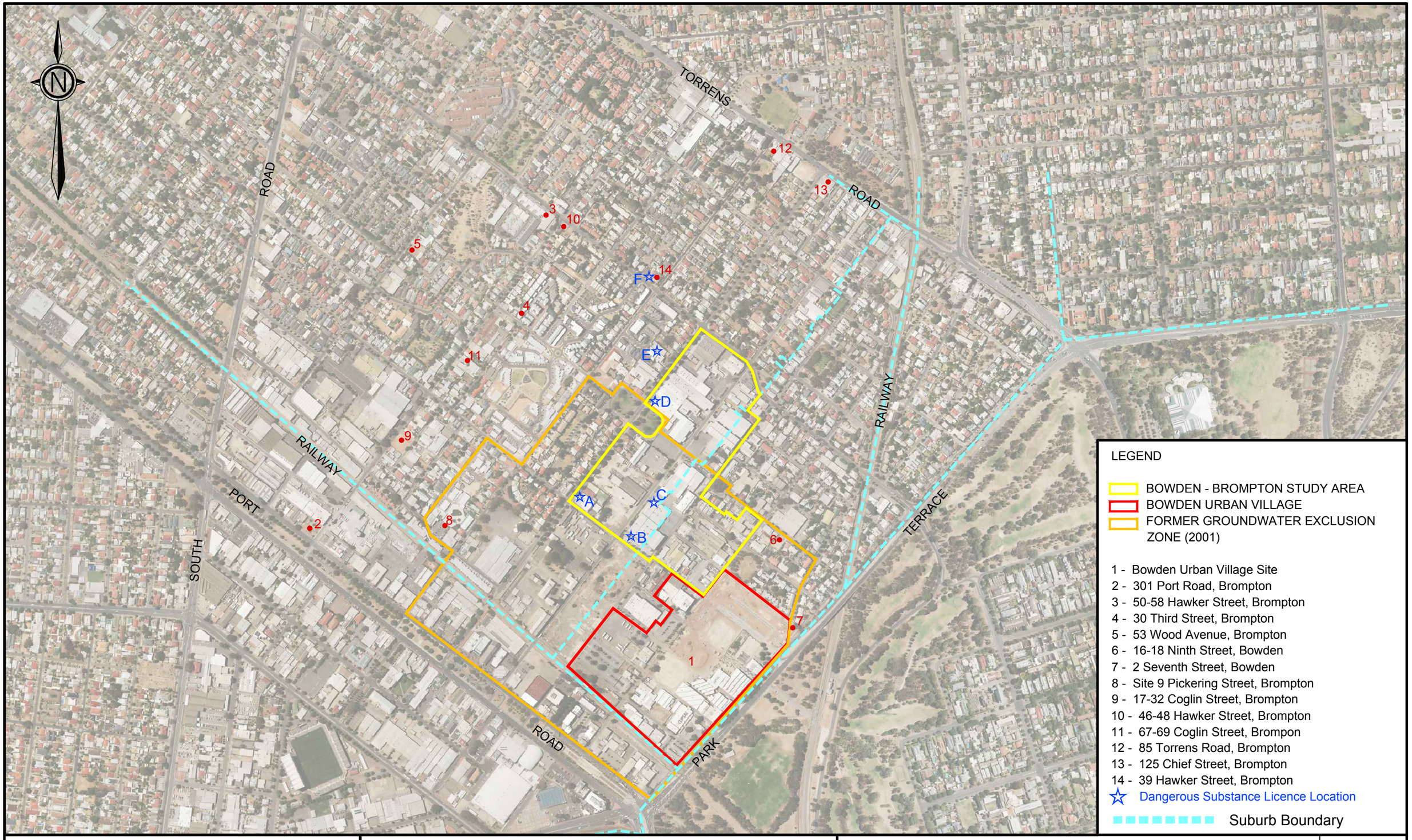
UPDATED PRELIMINARY ENVIRONMENTAL ASSESSMENT

FIGURE 2 - INDIVIDUAL LAND HOLDINGS AND PHOTOGRAPH LOCATIONS

DATE 13/12/2017

SHEET 2 OF 5

REV. 0



ORIGINAL SIZE A3

FYFE Earth Partners
ACN 008 116 130

FYFE Earth Partners
ENVIRONMENT DEVELOPMENT RESOURCES

LEVEL 1, 124 SOUTH TERRACE, ADELAIDE , SA, 5000
GPO BOX 2450 ADELAIDE SA 5001
TEL (08) 8201 9600
FAX (08) 8201 9650
E-mail info @ fyfe.com.au

0 100 200 300 400

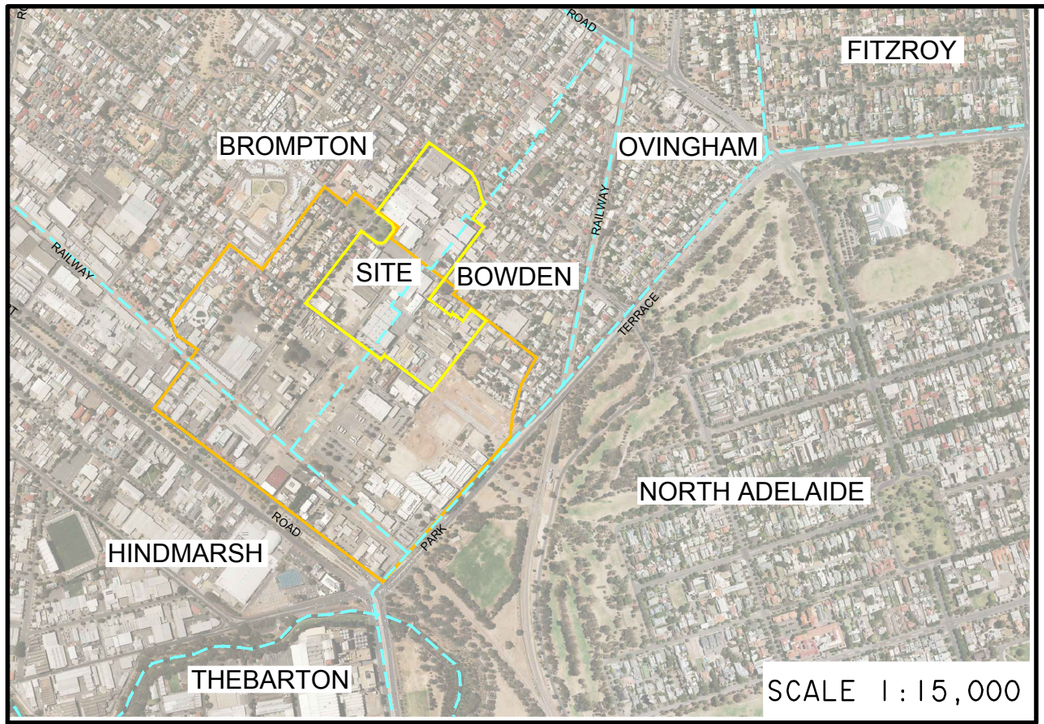
SCALE 1: 8000

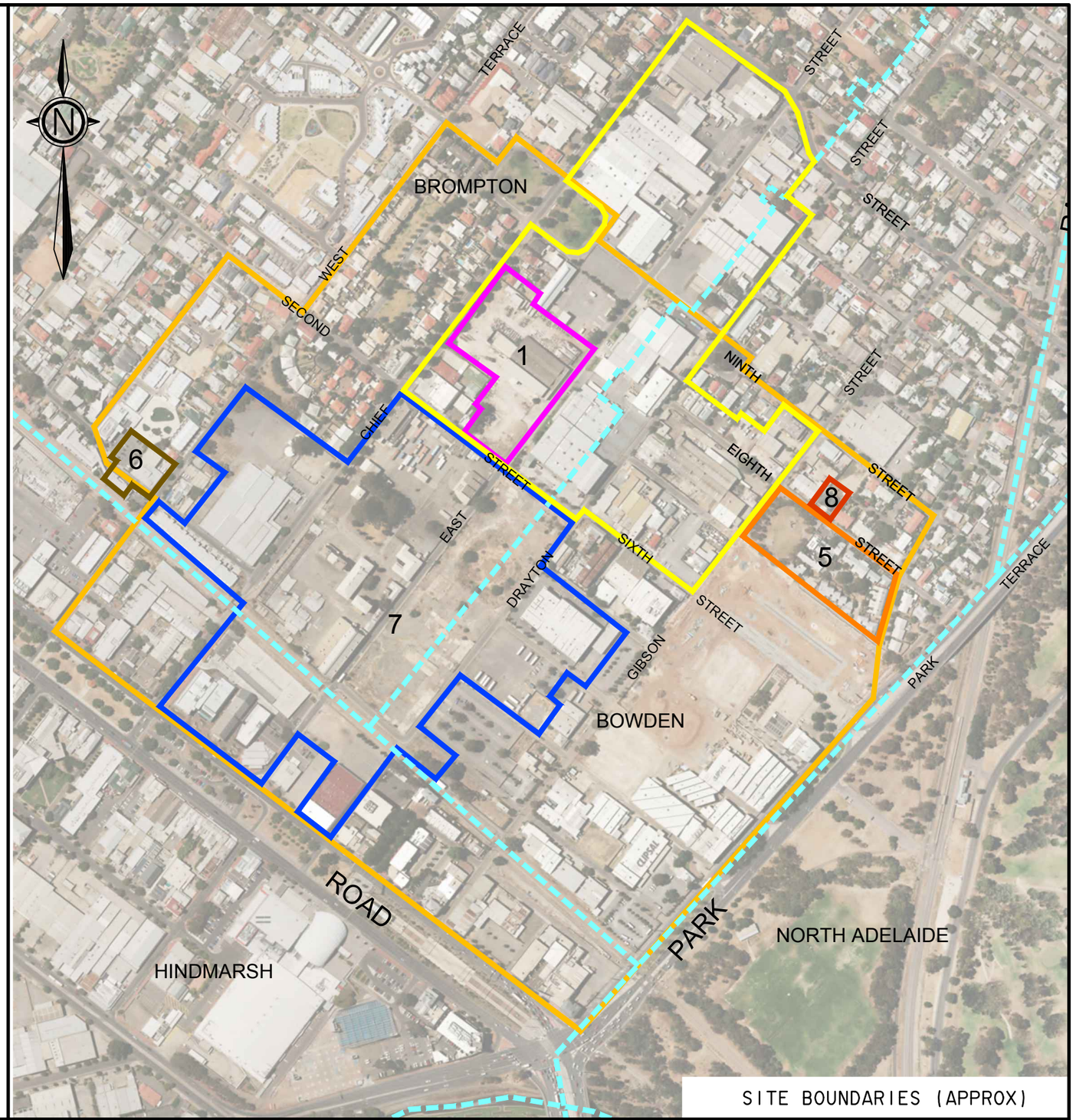
LEVEL DATUM :	N/A	INSTRUCTION: 65148/1/9	
LEVEL AUTHORITY :	N/A	COUNCIL :CHARLES STURT	
CO-ORD DATUM :	MGA94	DRAWING	65148-1-9-SV-BA1-R0

UPDATED PRELIMINARY ENVIRONMENTAL ASSESSMENT

FIGURE 3 - LOCATION OF FORMER GROUNDWATER EXCLUSION ZONE EPA SITE CONTAMINATION INDEX NOTIFICATIONS AND SAFEWORK SA LICENSES

DATE 13/12/2017
SHEET 3 OF 5
REV. 0





- Bowden - Brompton Study Area
- Former Groundwater Exclusion Zone (2001)
- 1 Marble & Cement Co. properties
- 5 Former ASC site
- 6 Site 9 Pickering St. Brompton
- 7 Brompton Gas Works Site
- 8 11 Eigth St. Bowden

Suburb Boundary

ORIGINAL SIZE A3

FYFE Earth Partners
ACN 008 116 130

FYFE Earth Partners
ENVIRONMENT DEVELOPMENT RESOURCES

LEVEL 1, 124 SOUTH TERRACE, ADELAIDE , SA, 5000
GPO BOX 2450 ADELAIDE SA 5001
TEL (08) 8201 9600
FAX (08) 8201 9650
E-mail info @ fyfe.com.au

0 100 200 300 400

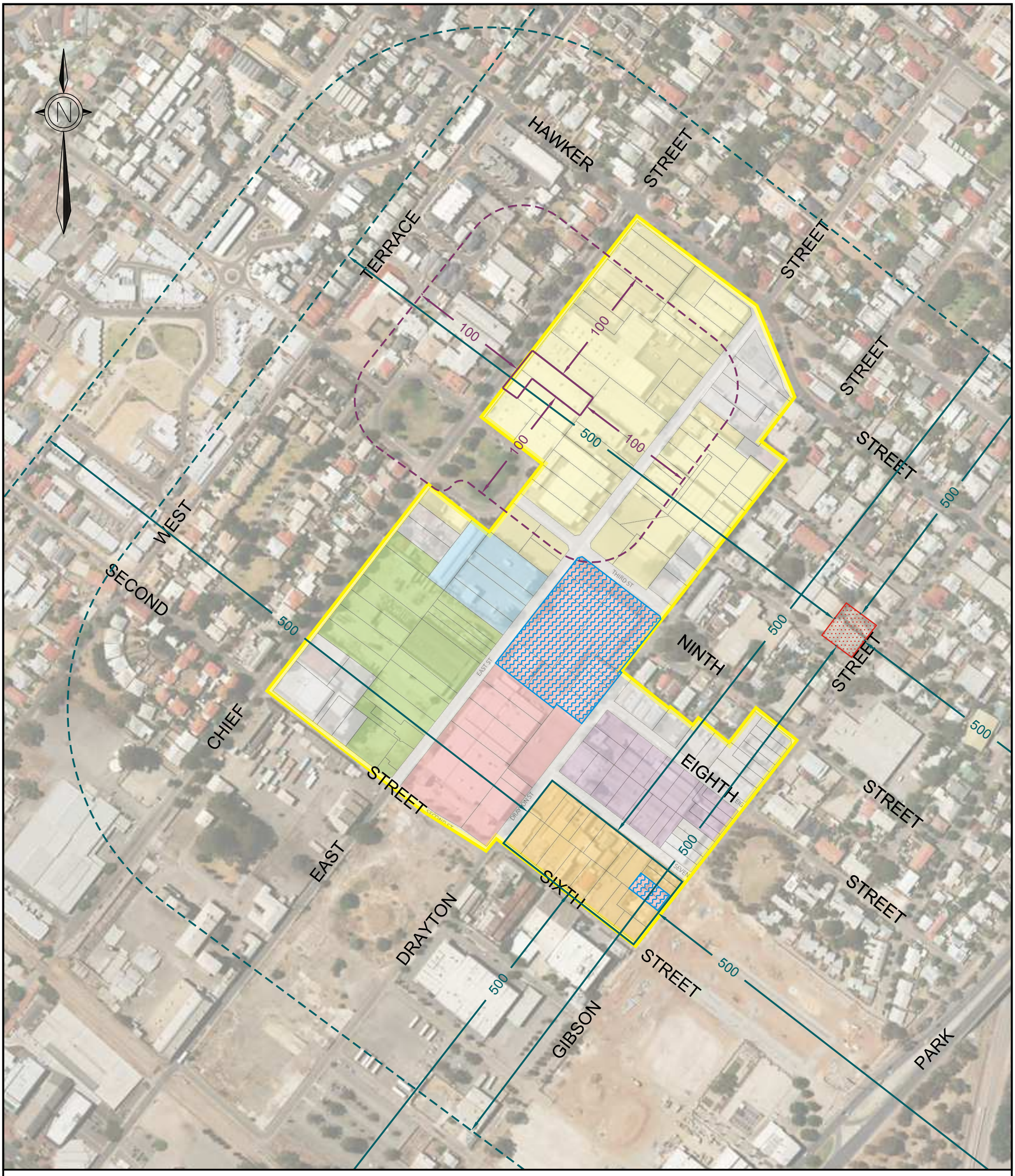
SCALE 1: 5000

LEVEL DATUM :	N/A	INSTRUCTION: 65148/1/9	
LEVEL AUTHORITY :	N/A	COUNCIL :CHARLES STURT	
CO-ORD DATUM :	MGA94	DRAWING	65148-1-9-SV-BA1-R0

UPDATED PRELIMINARY ENVIRONMENTAL ASSESSMENT

FIGURE 4 - LOCATION OF ASSESSMENT AND AUDIT REPORT REVIEW PROPERTIES

DATE 13/12/2017
SHEET 4 OF 5
REV. 0



LEGEND

Land Owners

- DETMOLD
- PARKVIEW PROPERTY TRUST
- KENNETT
- MARBLE AND CEMENT
- NEMESON BOWDEN
- CONROY'S SMALLGOODS
- HAAE PTY LTD
- OTHER LANDOWNERS
- ADELAIDE BRASS CASTINGS
- STUDY AREA

ORIGINAL SIZE A3

FYFE Earth Partners
ACN 008 116 130

FYFE Earth Partners
ENVIRONMENT DEVELOPMENT RESOURCES

LEVEL 1, 124 SOUTH TERRACE, ADELAIDE , SA, 5000
GPO BOX 2450 ADELAIDE SA 5001
TEL (08) 8201 9600
FAX (08) 8201 9650
E-mail info @ fyfe.com.au

0 30 60 90 120 150

SCALE 1: 3000

INSTRUCTION: 65148/1/9

COUNCIL: CHARLES STURT

DRAWING: 65148-1-9-SV-BA1-R0

UPDATED PRELIMINARY ENVIRONMENTAL ASSESSMENT

FIGURE 5 - RECOMMENDED EVALUATION DISTANCES FOR AIR QUALITY AND NOISE MANAGEMENT

DATE 13/12/2017

SHEET 5 OF 5

REV. 0

APPENDIX B

SITE PHOTOGRAPHS



Photograph 1: View of the Prompt Air property, taken facing south-east from Chief Street



Photograph 2: View of the Harvie Norris General Engineers property, taken facing north-east from Second Street



Photograph 3: View of a residential dwelling, taken facing north-east from Second Street,



Photograph 4: View of the Marble and Cement Company property, taken facing north-east from Second Street,



Photograph 5 View of the Marble and Cement Company property, taken facing north-west from East Street,



Photograph 6: View of the Custom loading bay area, taken facing north-east from Second Street,



Photograph 7: View of the Custom Cartons air exhaust infrastructure, taken facing north from Second Street



Photograph 8: View of the Park View Property Trust (BTL Logistics) property, taken facing south-east from Third Street (towards the intersection of Third and East Street)



Photograph 9: View of the Park View Property Trust (Hughes Chauffeur and car parking) property, taken facing north-west from Drayton Street



Photograph 10: View of the Conroy's Smallgoods property, taken facing south-east on Sixth Street



Photograph 11 View of the Conroy's Smallgoods property, taken facing north-west on Sixth Street



Photograph 12b View of the Conroy's Smallgoods property, taken facing north-west on Sixth Street



Photograph 13c View of the Conroy's Smallgoods property, taken facing north-west on Sixth Street



Photograph 14: View of the Conroy's Smallgoods property, taken facing north from Gibson Street



Photograph 15: View of the Detmold packaging property, taken facing north from Ethelbert Square



Photograph 16: View of the Detmold packaging property, taken facing south-west



Photograph 17: View of the Detmold packaging property, taken facing south-west from Hawker Street



Photograph 18: View of the Detmold packaging property, taken facing north-east from Chief Street



Photograph 19: View of the Detmold packaging property, taken facing south-east from East Street



Photograph 20: View of the Detmold packaging property, taken facing north-east from East Street



Photograph 21: View of the Detmold Packaging property dangerous goods shed and inferred breather pipe, taken facing north-west from East Street



Photograph 22: View of the Detmold Packaging property, looking towards a warehouse with two air exhaust infrastructure items (flues or similar), taken facing south-west from East Street



Photograph 23: View of a loading facility and warehouse on the Detmold packaging property, taken facing east from the intersection of East and Third Streets



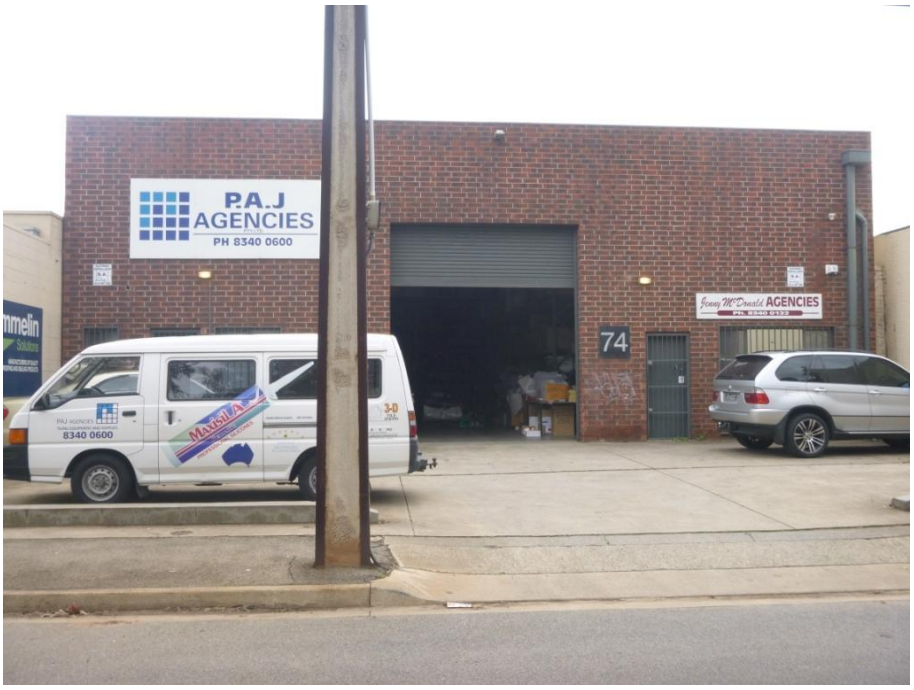
Photograph 24: View of the HAAE Engineering (left of photograph) and Conroy's Smallgoods (properties, taken facing east from Drayton Street looking up Seventh Street (source:Google Street View Dec 2015)



Photograph 25: Looking through the Detmold property (car park) towards the Kennett property, taken facing south from Third Street



Photograph 26: View of the Wicked Campers depot, taken facing north-east from Gibson Street



Photograph 27: View of the P.A.J. Agencies property, taken facing north-east from Gibson Street



Photograph 28: View of the Cantech Precision Engineering property, taken facing south from East Street



Photograph 29: View of the City Plastics property, taken facing south from East Street



Photograph 30: View of the BE Optical store, taken facing south-east from Hawker Street



Photograph 31: View through the rear of the Velocette Sports Club property, taken facing south-west from Third Street



Photograph 32: View of the Velocette Sports Club (left of photograph) and adjacent (right of photograph) properties, taken facing south-west from Drayton Street – an air discharge stack can be seen to the rear of the adjacent property (approximate centre of photograph)

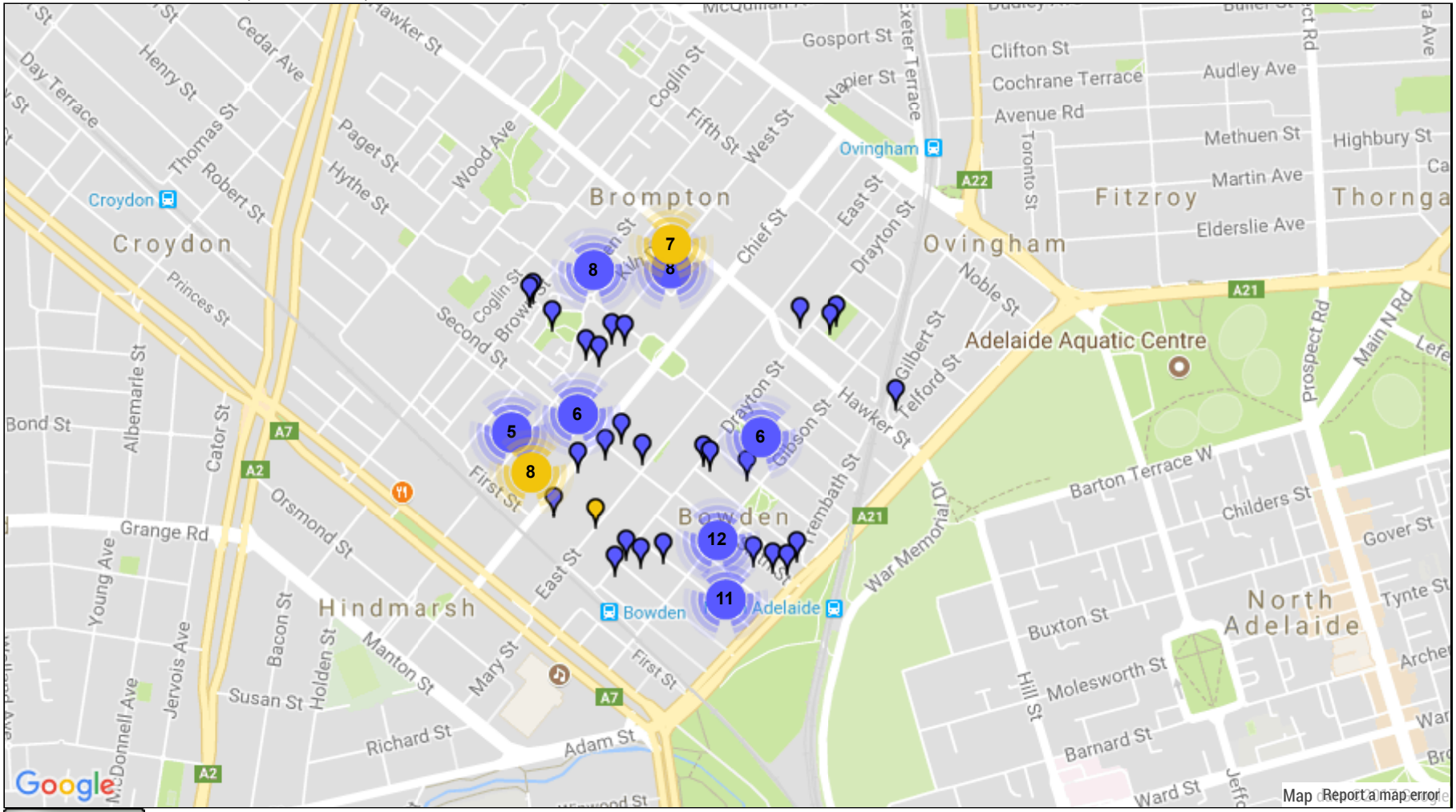
APPENDIX C

GROUNDWATER DATABASE

Government of South Australia

WaterConnect

Circle Centre -34.90138,138.57841, Radius 0.5km



Except where otherwise noted this work is licensed under a Creative Commons Attribution 3.0 Australia License © Crown in right of the State of South Australia

WaterConnect

Groundwater Data Report

Government of South Australia
Department of Environment, Water and Natural Resources

Circle Centre -34.90138,138.57841, Radius 0.5km

Unit No	Max Depth (m)	Latest Depth (m)	TDS (mg/L)	TDS Date	Aquifer	Date	Status	Cased To (m)	SWL (m)	SWL Date	Yield (L/sec)	Yield Date	Purpose	Permit No
6628-694	16.46	16.46	3631	26/11/1914	Qpah									
6628-7524	12.5	12.5			Qpah	27/05/1964	UKN							
6628-7525	7.32	7.32			Qpah	27/05/1964	UKN							
6628-7526	5.18	5.18			Qpah	27/05/1964	UKN							
6628-7531	5.49	5.49			Qpah	28/05/1964	UKN							
6628-7532	3.66	3.66			Qpah	28/05/1964	UKN							
6628-7533	2.74	2.74			Qpah	28/05/1964	UKN							
6628-7534	4.57	4.57			Qpah	28/05/1964	UKN							
6628-7535	63.09	63.09	1459	16/11/1914	Qpah	16/11/1914	UKN							
6628-7536	105.16	105.16	899	16/06/1949	Qpah		UKN	76.2	9.14	16/06/1949				
6628-8792	2.74	2.74			Qpah	03/04/1969								
6628-8793	8.84	8.84			Qpah	03/04/1969								
6628-8794	7.01	7.01			Qpah	03/04/1969								
6628-8795	8.84	8.84			Qpah	03/04/1969								
6628-8796	8.84	8.84			Qpah	03/04/1969								
6628-8797	4.27	4.27			Qpah	03/04/1969								
6628-8798	7.32	7.32			Qpah	03/04/1969								
6628-15516	14	14	2534	19/03/1991	Qpah	19/03/1991		10	10.3	19/03/1991	1	19/03/1991	OBS	95729
6628-15517	13	12	1922	18/03/1991	Qpah	15/03/1991		10	10	15/03/1991			OBS	95728
6628-15518	1.5	0			Qpah	14/03/1991	BKF		0				OBS	95727
6628-15519	4	0			Qpah	14/03/1991	BKF		0				OBS	95727
6628-16154	17	17	9015	18/09/1992	Qpah	17/06/1992		17	15.5	18/09/1992			OBS	27858
6628-16155	16	16	1428	18/09/1992	Qpah	18/06/1992		16	14.5	18/09/1992			OBS	27859
6628-16156	17	17	2058	18/09/1992	Qpah	16/06/1992		17	15.5	18/09/1992			OBS	27860
6628-17126	15	15			Qpah	21/02/1995	OPR	8.5					DRN	34270
6628-17127	15	15			Qpah	21/02/1995		8.2					DRN	34271
6628-17837	18	18	3431	11/03/1996	Qpah	11/03/1996		18					DOM	37171
6628-18055	15	15	2369	06/12/1995	Qpah	27/11/1995		15					OBS	36395
6628-18056	15.5	15.5	1289	06/12/1995	Qpah	27/11/1995		15.5					OBS	36396
6628-18057	14.8	14.8	1945	06/12/1995	Qpah	27/11/1995		14.8					OBS	36397
6628-18058	8.75	8.75			Qpah	28/11/1995		8.75					OBS	36398
6628-18285	18	18	1334	29/11/1995	Qpah	29/11/1995		17.3	12.46	29/11/1995			INV	40405
6628-18286	16	16	1664	29/11/1995	Qpah	29/11/1995		16	12.73	29/11/1995			INV	40419
6628-18610	40.5	40	983	16/09/1996	Qpah	16/09/1996		40	32	16/09/1996	0.56	16/09/1996	OBS	38485
6628-18614	19	18.5	2517	10/09/1996	Qpah	10/09/1996		18.5	12	10/09/1996	0.56	10/09/1996	OBS	38483
6628-18698	16	16			Qpah			16					INV	42614
6628-19055	16	15.5			Qpah	08/05/1998		15	13	08/05/1998			MON	45106

Unit No	Max Depth (m)	Latest Depth (m)	TDS (mg/L)	TDS Date	Aquifer	Date	Status	Cased To (m)	SWL (m)	SWL Date	Yield (L/sec)	Yield Date	Purpose	Permit No
6628-19569	120	0			Tomw(T1)		ABD							49909
6628-20057	16	16			Qpah	24/03/1999		16	12.65	24/03/1999			MON	48293
6628-20058	16	16			Qpah	16/03/1999		16	3.25	16/03/1999			MON	48294
6628-20059	16	16			Qpah	15/03/1999		16	12.5	15/03/1999			MON	48295
6628-20060	16	16			Qpah	16/03/1999		16	11.5	16/03/1999			MON	48296
6628-20061	16	16			Qpah	04/03/1999		16	10.84	04/03/1999			MON	48297
6628-20062	16	15			Qpah	24/03/1999		15	3.27	24/03/1999			MON	48298
6628-20063	16	0			Qpah	18/03/1999	BKF		3.26	18/03/1999			MON	114767
6628-20064	16	14			Qpah	25/03/1999		14	3.23	25/03/1999			MON	48300
6628-20065	16	13.5			Qpah	16/03/1999		13.5	3.27	16/03/1999			MON	48301
6628-20323	15	15			Qpah	03/04/2000		15					MON	52450
6628-20324	15	15			Qpah	18/03/2000		15					MON	52430
6628-20361	15	15			Qpah	29/05/2000		12	14.6	29/05/2000			INV	52802
6628-21368	18	18			Qpah	25/03/2003		12	14	25/03/2003	0.01	25/03/2003	INV	61569
6628-22072	5	0			Qpah		BKF							61772
6628-22073	18	0			Qpah		BKF							61773
6628-22447	15.5	15.5			Qpah	19/10/2005		9.5	13.01	19/10/2005			MON	110745
6628-22448	14	14			Qpah	19/10/2005		8	10.48	19/10/2005			MON	110746
6628-22450	15.5	15.5			Qpah	18/10/2005		9.5	12.96	18/10/2005			MON	110748
6628-22583					Qpah		BKF							114766
6628-22788	5	0			Qpah		BKF							114769
6628-23156	103.5	103.5	1608	01/10/2007	Qpah	20/09/2007		105.5					INV	130624
6628-24630	20	0			Qpah	23/09/2008	BKF						INV	164483
6628-25004	20.5	20.5			Qpah	04/11/2009		14.5	15.5	04/11/2009			INV	183334
6628-25005	20	20			Qpah	04/11/2009		14	16.5	04/11/2009			INV	183332
6628-25006	20	20			Qpah	05/11/2009		20	16.5	05/11/2009				183331
6628-25007	20	20			Qpah	05/11/2009		14	16.5	05/11/2009			INV	183333
6628-25008	20	20			Qpah	06/11/2009		14	16.5	06/11/2009			INV	183337
6628-25010	20	20			Qpah	09/11/2009		14	16.5	09/11/2009			INV	183328
6628-25045	20	20			Qpah	03/02/2010		14	15.7	03/02/2010			INV	183335
6628-25046	20	0			Qpah	02/02/2010	BKF		15.5	02/02/2010			INV	257263
6628-25193	20	20			Qpah	06/05/2010		14	16	06/05/2010			INV	188393
6628-25194	20	20			Qpah	06/05/2010		14	15.8	06/05/2010			INV	188395
6628-25712	20	20			Qpah	19/04/2011		14	16.3	19/04/2011			INV	198217
6628-25713	20	20			Qpah	19/04/2011		20	16.3	19/04/2011			INV	198216
6628-25715	20	20			Qpah	20/04/2011		14	16.5	20/04/2011				198218
6628-26784	20	20			Qpah	27/02/2013		14	16.4	27/02/2013			IRR	219489
6628-26785	21	20			Qpah	27/02/2013		14	16.4	27/02/2013			INV	219490
6628-26786	21	20			Qpah	27/02/2013		14	16.3	27/02/2013			INV	219522
6628-26787	21	20			Qpah	28/02/2013		14					INV	219487
6628-26788	21	20			Qpah	28/02/2013		14	16.3	28/02/2013			INV	219526
6628-26790	21	20			Qpah	05/03/2013		20	16.3	05/03/2013			INV	219486

Unit No	Max Depth (m)	Latest Depth (m)	TDS (mg/L)	TDS Date	Aquifer	Date	Status	Cased To (m)	SWL (m)	SWL Date	Yield (L/sec)	Yield Date	Purpose	Permit No
6628-26791	21	20			Qpah	06/03/2013		14	16.3	06/03/2013			INV	219491
6628-26792	21	20			Qpah	06/03/2013		14	16.3	06/03/2013			INV	219524
6628-26793	21	20			Qpah	07/03/2013		20	16.3	07/03/2013			INV	219488
6628-26794	21	20			Qpah	05/03/2013		14	16.3	05/03/2013			INV	219523
6628-26892	20	20			Qpah	20/03/2013		14	16.4	20/03/2013			INV	220078
6628-26899	20	20			Qpah	28/05/2013		14	17.2	28/05/2013			INV	220091
6628-26900	20	20			Qpah	28/05/2013		14	17.3	28/05/2013			INV	220092
6628-26902	20	20			Qpah	28/05/2013		14	17.2	28/05/2013			INV	220090
6628-27411	18	18			Qpah	29/04/2014		12	16	29/04/2014			INV	231395
6628-27565	24	0			Qpah		BKF							182102
6628-27734	20	20			Qpah	06/05/2015		14	17	06/05/2015			INV	245749
6628-27906	15	14			Qpah	25/08/2015		8					INV	251274
6628-28096	12.5	12.5			Qpah	02/12/2015		9.5					INV	254760
6628-29129	18	18				28/09/2017		15					INV	293707
6628-29130	18	18				28/09/2017		15					INV	293708
6628-29131	18	18				28/09/2017		15					INV	293709
6628-29158	13	13				23/08/2017		10					INV	293979
6628-29159	15	15				24/08/2017		12					INV	291723
6628-29161	20	0				26/09/2017	BKF						INV	293492
6628-29162	20	0				27/09/2017	BKF						INV	293493

99 records

Except where otherwise noted this work is licensed under a Creative Commons Attribution 3.0 Australia License
© Crown in right of the State of South Australia



APPENDIX D

SAFEWORK SA SEARCH

Government of South Australia
SafeWork SA

Department of the Premier and Cabinet

Licensing Unit

Level 4, World Park A,
33 Richmond Road
Keswick SA 5035

GPO Box 465
Adelaide SA 5001

DX 715 Adelaide

Phone (08) 8303 0400
Fax (08) 8303 9903

ABN 50-560-588-327

www.safework.sa.gov.au

13 May 2014

Ross Fitzgerald
FYFE Earth Partners
Level 3 – 80 Flinders Street
ADELAIDE SA 5000

Dear Ross,

DANGEROUS SUBSTANCES LICENCE SEARCH

RE: 39 HAWKER STREET, BROMPTON SA 5007

According to the records available to SafeWork SA, please see listed below all current and/or historical items located within the specified search criteria.

Class	Quantity	Storage Type
8.8	KL	Liquid Tank Underground External

Yours sincerely

JTieste

Janet Tieste
MANAGER
LICENSING UNIT
SAFEWORK SA

Government of South Australia
SafeWork SA

Department of the Premier and Cabinet

Licensing Unit

Level 4, World Park A,
33 Richmond Road
Keswick SA 5035

GPO Box 465
Adelaide SA 5001

DX 715 Adelaide

Phone (08) 8303 0400
Fax (08) 8303 9903

ABN 50-560-588-327

www.safework.sa.gov.au

13 May 2014

Ross Fitzgerald
FYFE Earth Partners
Level 3 – 80 Flinders Street
ADELAIDE SA 5000

Dear Ross,

DANGEROUS SUBSTANCES LICENCE SEARCH

RE: DRAYTON STREET, BROMPTON SA 5007

According to the records available to SafeWork SA, please see listed below all historical items located within the specified search criteria.

Class	Quantity	Storage Type
108	KL	Gas Cylinder Aboveground External
505	KL	Gas Tank Aboveground External

Yours sincerely

JTieste

Janet Tieste
MANAGER
LICENSING UNIT
SAFEWORK SA

Government of South Australia
SafeWork SA

Department of the Premier and Cabinet

Licensing Unit

Level 4, World Park A,
33 Richmond Road
Keswick SA 5035

GPO Box 465
Adelaide SA 5001

DX 715 Adelaide

Phone (08) 8303 0400
Fax (08) 8303 9903

ABN 50-560-588-327

www.safework.sa.gov.au

27 May 2014

Ross Fitzgerald
FYFE
Level 3 – 80 Flinders Street
ADELAIDE SA 5000

Dear Ross,

DANGEROUS SUBSTANCES LICENCE SEARCH

RE: EIGHTH STREET, BROMPTON SA 5007

According to the records available to SafeWork SA, the site listed above has no licenced items.

Yours sincerely

JTieste

Janet Tieste
MANAGER
LICENSING UNIT
SAFEWORK SA

Government of South Australia
SafeWork SA

Department of the Premier and Cabinet

Licensing Unit

Level 4, World Park A,
33 Richmond Road
Keswick SA 5035

GPO Box 465
Adelaide SA 5001

DX 715 Adelaide

Phone (08) 8303 0400
Fax (08) 8303 9903

ABN 50-560-588-327

www.safework.sa.gov.au

27 May 2014

Ross Fitzgerald
FYFE
Level 3 – 80 Flinders Street
ADELAIDE SA 5000

Dear Ross,

DANGEROUS SUBSTANCES LICENCE SEARCH

RE: ETHELBERT SQUARE, BROMPTON SA 5007

According to the records available to SafeWork SA, the site listed above has no licenced items.

Yours sincerely

Janet Tieste
MANAGER
LICENSING UNIT
SAFEWORK SA

Government of South Australia
SafeWork SA

Department of the Premier and Cabinet

Licensing Unit

Level 4, World Park A,
33 Richmond Road
Keswick SA 5035

GPO Box 465
Adelaide SA 5001

DX 715 Adelaide

Phone (08) 8303 0400
Fax (08) 8303 9903

ABN 50-560-588-327

www.safework.sa.gov.au

13 May 2014

Ross Fitzgerald
FYFE Earth Partners
Level 3 – 80 Flinders Street
ADELAIDE SA 5000

Dear Ross,

DANGEROUS SUBSTANCES LICENCE SEARCH

RE:GIBSON STREET, BROMPTON SA 5007

According to the records available to SafeWork SA, the site listed above has no licenced items.

Yours sincerely

JTieste

Janet Tieste
MANAGER
LICENSING UNIT
SAFEWORK SA

Government of South Australia
SafeWork SA

Department of the Premier and Cabinet

Licensing Unit

Level 4, World Park A,
33 Richmond Road
Keswick SA 5035

GPO Box 465
Adelaide SA 5001

DX 715 Adelaide

Phone (08) 8303 0400
Fax (08) 8303 9903

ABN 50-560-588-327

www.safework.sa.gov.au

13 May 2014

Ross Fitzgerald
FYFE Earth Partners
Level 3 – 80 Flinders Street
ADELAIDE SA 5000

Dear Ross,

DANGEROUS SUBSTANCES LICENCE SEARCH

RE: NINTH STREET, BROMPTON SA 5007

According to the records available to SafeWork SA, the site listed above has no licenced items.

Yours sincerely

JTieste

Janet Tieste
MANAGER
LICENSING UNIT
SAFEWORK SA

Government of South Australia
SafeWork SA

Department of the Premier and Cabinet

Licensing Unit

Level 4, World Park A,
33 Richmond Road
Keswick SA 5035

GPO Box 465
Adelaide SA 5001

DX 715 Adelaide

Phone (08) 8303 0400
Fax (08) 8303 9903

ABN 50-560-588-327

www.safework.sa.gov.au

13 May 2014

Ross Fitzgerald
FYFE Earth Partners
Level 3 – 80 Flinders Street
ADELAIDE SA 5000

Dear Ross,

DANGEROUS SUBSTANCES LICENCE SEARCH

RE: SECOND STREET, BROMPTON SA 5007

According to the records available to SafeWork SA, the site listed above has no licenced items.

Yours sincerely

JTieste

Janet Tieste
MANAGER
LICENSING UNIT
SAFEWORK SA

Government of South Australia
SafeWork SA

Department of the Premier and Cabinet

Licensing Unit

Level 4, World Park A,
33 Richmond Road
Keswick SA 5035

GPO Box 465
Adelaide SA 5001

DX 715 Adelaide

Phone (08) 8303 0400
Fax (08) 8303 9903

ABN 50-560-588-327

www.safework.sa.gov.au

27 May 2014

Ross Fitzgerald
FYFE
Level 3 – 80 Flinders Street
ADELAIDE SA 5000

Dear Ross,

DANGEROUS SUBSTANCES LICENCE SEARCH

RE: SEVENTH STREET, BROMPTON SA 5007

According to the records available to SafeWork SA, the site listed above has no licenced items.

Yours sincerely

Janet Tieste
MANAGER
LICENSING UNIT
SAFEWORK SA

Government of South Australia
SafeWork SA

Department of the Premier and Cabinet

Licensing Unit

Level 4, World Park A,
33 Richmond Road
Keswick SA 5035

GPO Box 465
Adelaide SA 5001

DX 715 Adelaide

Phone (08) 8303 0400
Fax (08) 8303 9903

ABN 50-560-588-327

www.safework.sa.gov.au

13 May 2014

Ross Fitzgerald
FYFE Earth Partners
Level 3 – 80 Flinders Street
ADELAIDE SA 5000

Dear Ross,

DANGEROUS SUBSTANCES LICENCE SEARCH

RE: SIXTH STREET, BROMPTON SA 5007

According to the records available to SafeWork SA, the site listed above has no licenced items.

Yours sincerely

JTieste

Janet Tieste
MANAGER
LICENSING UNIT
SAFEWORK SA

Government of South Australia
SafeWork SA

Department of the Premier and Cabinet

Licensing Unit

Level 4, World Park A,
33 Richmond Road
Keswick SA 5035

GPO Box 465
Adelaide SA 5001

DX 715 Adelaide

Phone (08) 8303 0400
Fax (08) 8303 9903

ABN 50-560-588-327

www.safework.sa.gov.au

27 May 2014

Ross Fitzgerald
FYFE
Level 3 – 80 Flinders Street
ADELAIDE SA 5000

Dear Ross,

DANGEROUS SUBSTANCES LICENCE SEARCH

RE: THIRD STREET, BROMPTON SA 5007

According to the records available to SafeWork SA, the site listed above has no licenced items.

Yours sincerely

Janet Tieste
MANAGER
LICENSING UNIT
SAFEWORK SA

From: Phillips, Deborah (DPC)
To: Ross Fitzgerald
Subject: RE: 63987 Dangerous Goods Search
Date: Tuesday, 27 May 2014 8:01:51 AM

□i □oss

□here are acti□e □S □icences at the following sites□

15 Chief Street
□5 Chief Street
70 Chief Street
19 □ast Street
18-2□ □ast Street

You will need to obtain written permission from the licence holders for us to release the details at those sites.

□ e will complete the searches of the other sites as soon as we can.

□**egards**

Debbie P□illi□s
Senior Administrati□e □fficer □□h□□61 8 8303 0□00

□□**in**□ □□□ **Print** □1 ream of paper □ 6□ of a tree and 5.□kg C□2 in the atmosphere □3 sheets of A□ paper □ 1 litre of water

---

From: Ross Fitzgerald [mailto:Ross.Fitzgerald@fyfe.com.au]
Sent: Monday, 26 May 2014 2:29 PM
To: DPC:SWSA High Risk Work
Cc: Phillips, Deborah (DPC)
Subject: FW: 63987 Dangerous Goods Search

Dear Manager and/or Debbie,

Further to our discussion (with Debbie), would I please be able to expand the Dangerous Substances Licence Search to include the whole area which includes the additional following streets, located in Brompton, South Australia (and as outlined in the attached sketch plan):

- Third Street
- Seventh Street
- Eighth Street
- Ethelbert Square
- East Street
- Chief Street.

Should you have any queries, please do not hesitate to contact me on 0447 906 175.

Kind regards,
Ross

From: Ross Fitzgerald
Sent: Monday, 5 May 2014 11:21 AM

To: 'DPC:SWSA High Risk Work'
Subject: 63987 Dangerous Goods Search

Dear Manager,

Could I please request a Dangerous Substances Licence Search for the area encompassed by the following streets, located in Brompton, South Australia (and as outlined in the attached sketch plan):

- Chief Street
- Hawker Street
- Drayton Street
- Ninth Street
- Gibson Street
- Sixth Street
- Second Street

Should you have any queries, please do not hesitate to contact me on 0447 906 175.

Kind regards,
Ross

Ross Fitzgerald | Senior Environmental Engineer

FYFE Earth Partners

DIRECT: 08 8201 9788 | M: 0447 906 175 | E: Ross.Fitzgerald@fyfe.com.au

Level 3, 80 Flinders Street Adelaide SA 5000 | T: 08 8201 9600 | F: 08 8201 9650 | www.fyfe.com.au

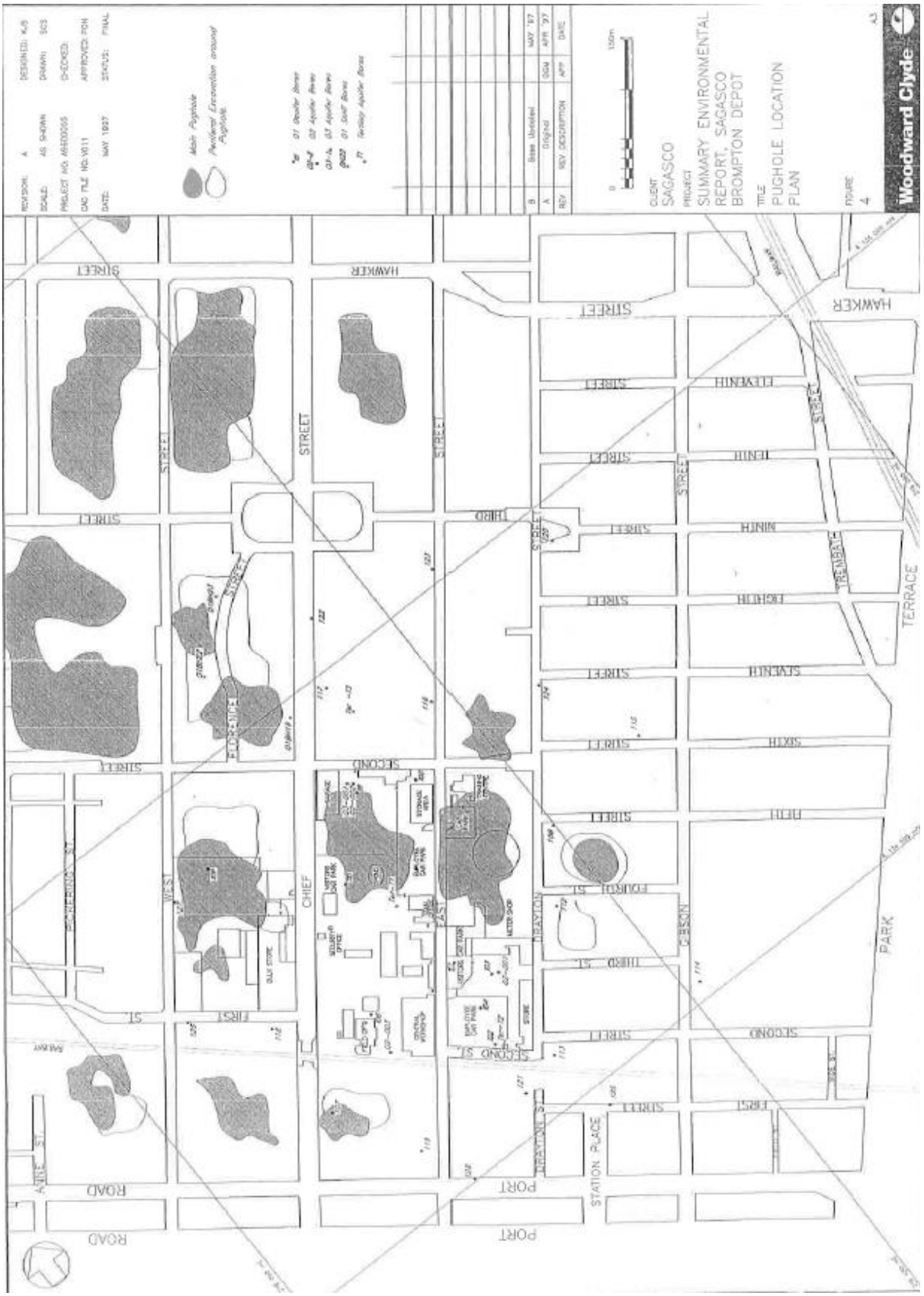
ADELAIDE | ALICE SPRINGS | BALLERA | BRISBANE | CHINCHILLA | COOLUM | DALBY | DARWIN | MOOMBA | ROMA | SPRINGWOOD

N□□□C□ - □he information in this e-mail/attachment□s□is confidential and intended for the named recipient/s only. □f you are not the intended recipient, you must not use, disclose, read, forward, copy or retain any of the information. □f this e-mail is recei□ed in error, please delete it and notify the sender by return e-mail or telephone. Neither □yfe □ty □td nor the sender accepts any responsibility for any □iruses or any other harmful software that may be contained in this e-mail or its attachments. □t is your responsibility to ensure that your systems ha□e ade□uate protection against □iruses or any other harmful software.

APPENDIX E

PUG HOLE PLANS

□□□□C□□E□□ □: P□□ □□LE □ □P

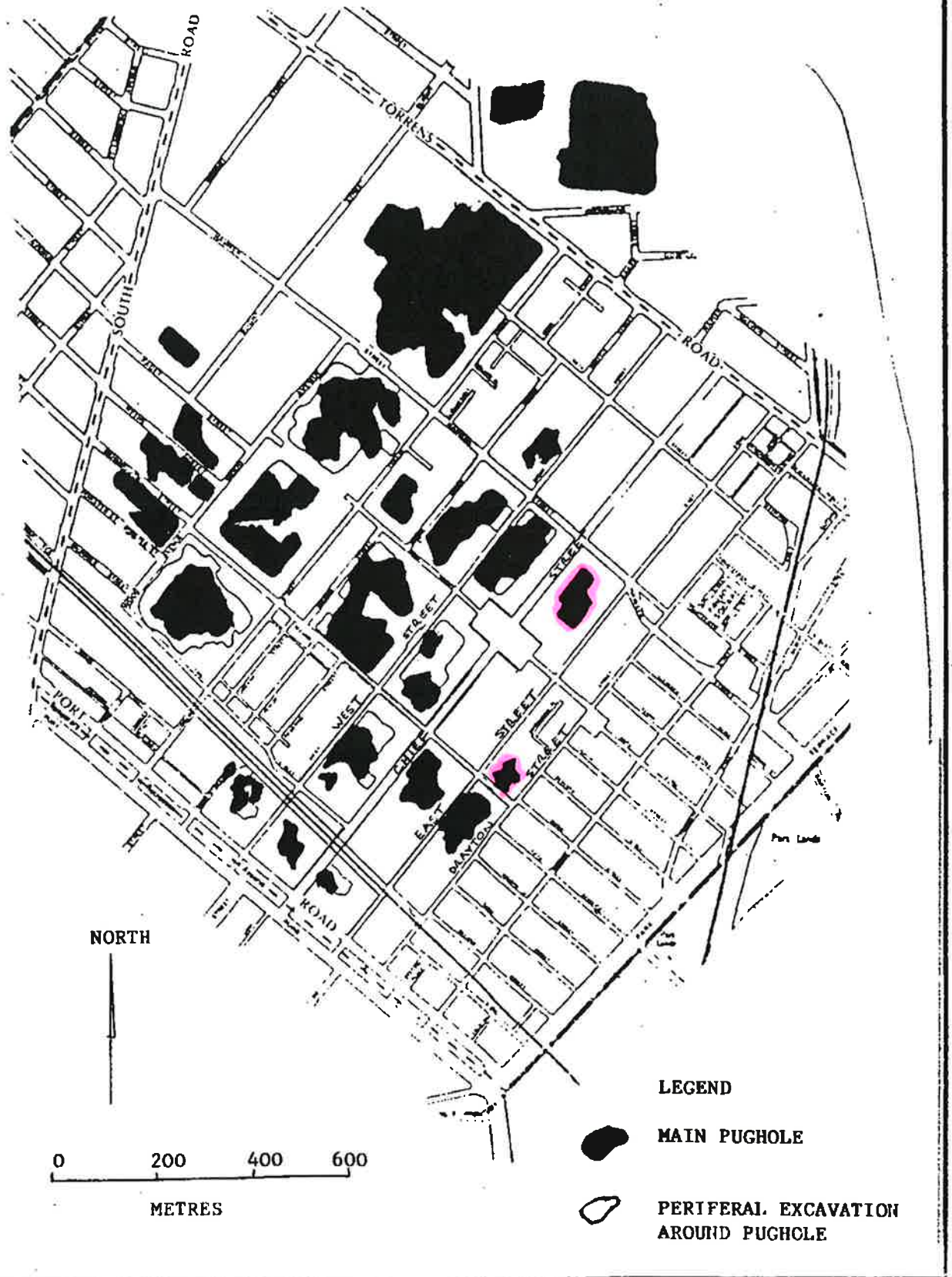

Woodward Clyde
SUMMARY ENVIRONMENTAL REPORT, SAGASCO BROMPTON DEPOT
PUGHOLE LOCATION PLAN
SAGASCO
FIGURE 4
STREET
HAWKER
TERRACE
PARK
ROAD
PORT
STATION PLACE

PUG HOLES



HINDMARSH DEVELOPMENT
Your Local and State Governments working together

HINDMARSH DEVELOPMENT COMMITTEE



Coffey Partners International Pty Ltd Consulting Engineers in the geotechnical sciences Incorporated in NSW

drawn	ARP
approved	
date	26/6/90
scale	AS SHOWN

RESOURCE DEVELOPMENT PTY LTD
BROMPTON GASWORKS ENVIRONMENTAL ASSESSMENT
LOCATION OF PUGHOLES (CLAY MINES) IN THE HINDMARSH COUNCIL AREA. 1836-1986

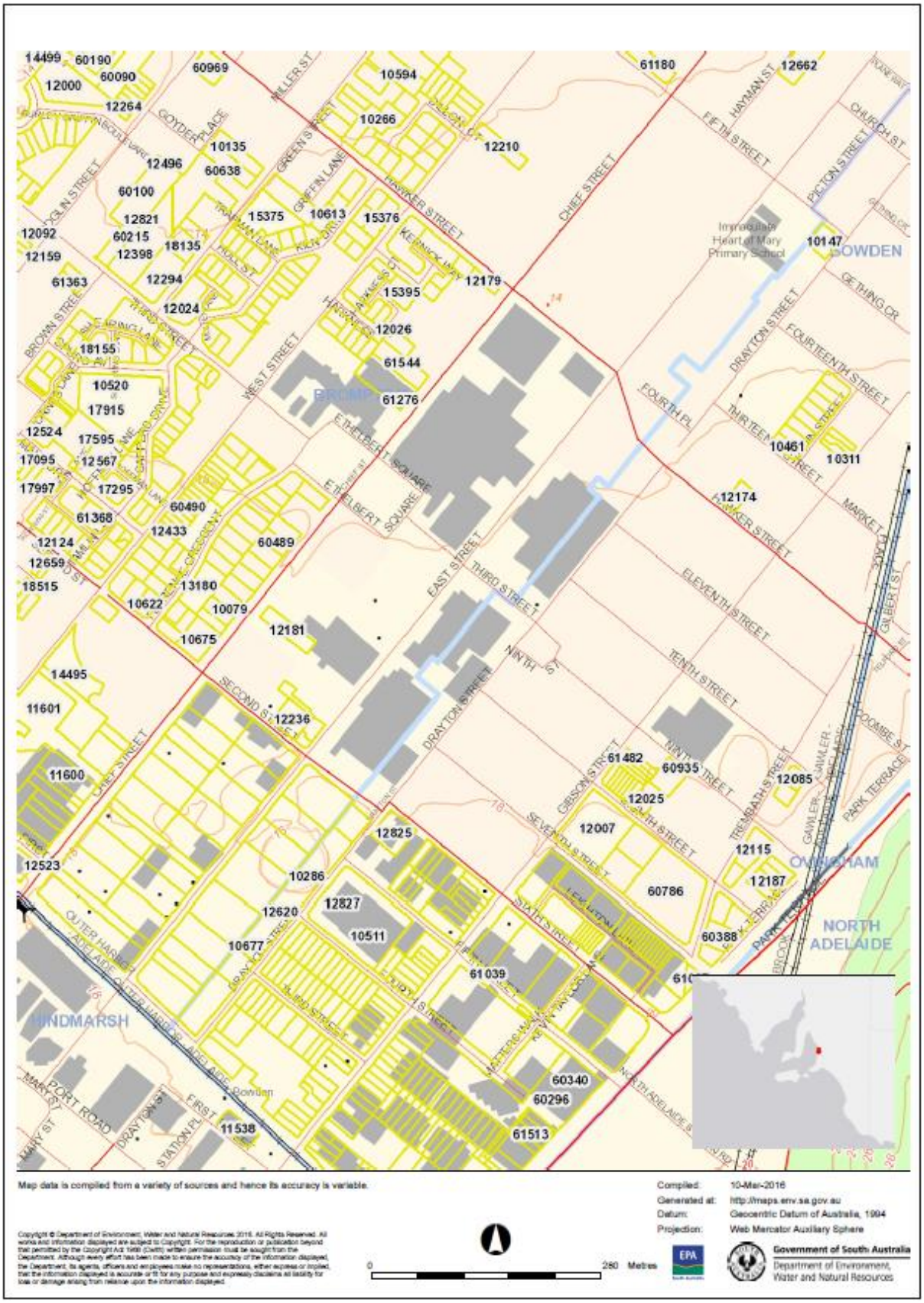
COFFEY

drawing no: A2114/1- 5

job no: A2114/1

APPENDIX F

EPA SITE CONTAMINATION RECORDS


14499
60190
60090
12000
12264
60969
10594
61180
12662
10266
12210
10135
12496
60638
60100
12821
15375
10613
15376
12092
60215
18135
12159
12398
12294
12179
61363
15395
12024
12026
18155
61544
10520
61276
17915
12524
17595
12567
17095
17997
17295
60490
61368
12433
60489
12124
12659
18515
13180
10622
10079
10675
12181
14495
11601
12236
11600
61482
60935
12085
12025
12007
12825
12523
12115
10286
12187
12827
60786
12620
10511
10677
60388
61039
60340
60296
61513
11538
SOWDEN
NORTH ADELAIDE
HINDMARSH
OVINGHAM
Immaculate Heart of Mary Primary School
HAYMAN ST
FIFTH STREET
CHURCH ST
PETON STREET
HARKER STREET
CHIEF STREET
GREEN'S STREET
GREFFN LANE
KERNICK ST
DRAYTON STREET
FOURTEENTH STREET
GETHING CR
WEST STREET
BROWN STREET
ETHELBERT SQUARE
EAST STREET
THIRD STREET
ELEVENTH STREET
TENTH STREET
NINTH ST
SECOND STREET
GIBSON STREET
TREMBATH STREET
SEVENTH STREET
SIXTH STREET
PARK TERRACE
OUTER HARBOR
PORT ROAD
DRAYTON ST
FIRST
STATION PL
MARY ST
Map data is compiled from a variety of sources and hence its accuracy is variable.
Compiled: 10-Mar-2016
Generated at: http://maps.env.sa.gov.au
Datum: Geocentric Datum of Australia, 1994
Projection: Web Mercator Auxiliary Sphere
0
280 Metres
EPA
Government of South Australia
Department of Environment, Water and Natural Resources

FYFE

APPENDIX C

TRANSPORT INVESTIGATIONS REPORT BY CIRQA



BOWDEN / BROMPTON DEVELOPMENT PLAN AMENDMENT

TRANSPORT INVESTIGATIONS

CIRQA™

DISCLAIMER

The information and data contained within this document are the property of CIRQA Pty Ltd and copyright. This document and the information contained therein is for the use of the authorised Client noted below. The document may not be used, copied, reproduced or modified in whole or in part for any purpose other than for which it was supplied by CIRQA Pty Ltd. CIRQA Pty Ltd accepts no responsibility or liability to any other party who may use or rely upon this document or the information contained therein.

DOCUMENT CONTROL

Report title:	Bowden / Brompton Transport Investigations
Project number:	17148
Client:	City of Charles Sturt
Client contact:	John Tagliaferri

Version	Date	Details/status	Prepared by	Approved by
1.0	15 Dec 17	Draft	TAW/BNW	BNW
1.1	15 Dec 17		TAW/BNW	BNW
1.2	15 Dec 17		TAW/BNW	BNW
1.3	19 Dec 17	For Council comment	TAW/BNW	BNW
2.0	28 Mar 18		TAW/BNW	BNW
2.1	28 Mar 18	Final	TAW/BNW	BNW
2.2	04 Jul 18	Updated cross-sections	TAW/BNW	BNW

CIRQA Pty Ltd
info@cirqa.com.au
cirqa.com.au
39 Carrington Street, Adelaide SA 5000
PO BOX 144, Glenside SA 5065
ABN 12 681 029 983

TABLE OF CONTENTS

1. INTRODUCTION 1

2. BACKGROUND 2

2.1 STUDY AREA 2

2.2 DEMOGRAPHIC DATA 3

2.3 LITERATURE REVIEW 4

2.3.1 CITY OF CHARLES STURT TRANSPORT PLAN 2016–2031 4

2.3.2 CITY OF CHARLES STURT STRATEGY FOR WALKING AND CYCLING 6

2.3.3 INNER WEST PRECINCT TRANSPORT AND PARKING PLAN 6

2.3.4 BROMPTON VILLAgE REZONING TRANSPORT IMPACT ASSESSMENT 7

3. TRANSPORT INFRASTRUCTURE 10

3.1 ROAD NETWORK 10

3.2 ROAD HIERARCHY 12

3.3 PUBLIC TRANSPORT 14

3.4 ACTIVE TRANSPORT 15

4. REZONING AND REDEVELOPMENT 18

4.1 REZONING 18

4.2 DEVELOPMENT YIELDS 18

4.3 TRANSPORT NETWORK PROVISIONS 18

5. TRAFFIC IMPACT ANALYSIS 24

5.1 TRAFFIC GENERATION 24

5.2 TRAFFIC DISTRIBUTION 24

6. TRAFFIC IMPACT 28

6.1 GENERAL TRAFFIC IMPACT 28

6.2 INTERSECTION ANALYSIS 33

6.2.1 CHIEF STREET/PORT ROAD 34

6.2.2 SIXTH STREET/PARK TERRACE 34

6.2.3 CHIEF STREET/HAWKER STREET 35

6.2.4 CHIEF STREET/TORRENS ROAD 35

6.2.5 PARK TERRACE/HAWKER STREET/WAR MEMORIAL DRIVE 36

7. PARKING PROVISIONS 37
7.1 OFF-STREET PARKING 37
7.2 ON-STREET PARKING 38
7.3 CAR SHARE SCHEMES 39
8. SUMMARY 41

APPENDIX A – SIDRA ANALYSIS OUTPUT

APPENDIX B – ROAD CROSS SECTIONS

APPENDIX C – INTERSECTION UPGRADE CONCEPTS

1. INTRODUCTION

CIRQA has been engaged by the City of Charles Sturt to provide transport impact investigations for the proposed Bowden/Brompton Development Plan Amendment (DPA). Specifically, CIRQA's investigations relate to the proposed rezoning of land (from industrial to residential) between Chief Street, Hawker Street, Drayton Street, Ninth Street, Gibson Street, Second Street and Sixth Street.

This report includes assessment of the potential traffic generation associated with the potential rezoning and redevelopment of the subject land, the associated impact on the adjacent existing road network, active and sustainable transport provisions and consideration of appropriate infrastructure upgrades/ requirements.

2. BACKGROUND

2.1 STUDY AREA

The subject site is located approximately 3.5 km north-west of Adelaide's Central Business District (CBD). The site is bounded by Chief Street to the north-west, Hawker Street and Ninth Street to the north-east, Drayton Street and Gibson Street to the south-east, and Sixth Street and Second Street to the south-west. Figure 1 illustrates the subject site and adjacent road network.

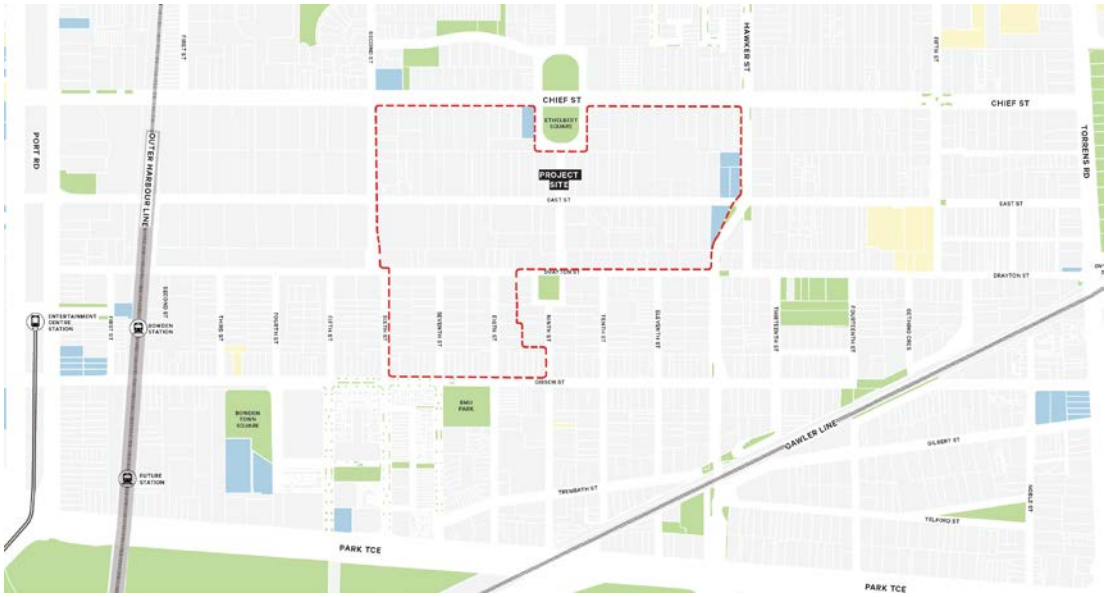


Figure 1 – Subject site and adjacent road network (Source: Oxigen, 2017)

The City of Charles Sturt's Development Plan (consolidated 31 October 2017) identifies that the site is currently located within an 'Urban Employment' Zone. The primary purpose of this zone is to provide employment opportunities through both commercial and industrial land uses. A small pocket of 'Local Centre' Zone is located in the eastern corner of the site.

Council's Development Plan identifies land immediately adjacent the subject site as 'Residential' (north-west, north and south-east of the site), 'Residential Character' (east) and 'Urban Core' (south and south-west).

Given that the site is primarily bounded by residential zones (and in particular, the Bowden Urban Village to the south-west), it is proposed to rezone the subject area to enable (primarily) residential-based development. It is envisaged that the rezoning would provide complimentary residential development that transitions from the adjacent Bowden Urban Village (modern high-density residential) to nearby historic and residential zones (low-medium density residential).

2.2 DEMOGRAPHIC DATA

Demographic data (relevant to transport considerations) has been obtained from the Australian Bureau of Statistics' 2016 Census (based on the ".id" online population service). Figures 2 to 3 summarise key demographic data relating to car ownership and transport mode choice (for journeys to work). Given the limited residential development within the immediate study area, data from the broader "Brompton and District" statistical area has been utilised.

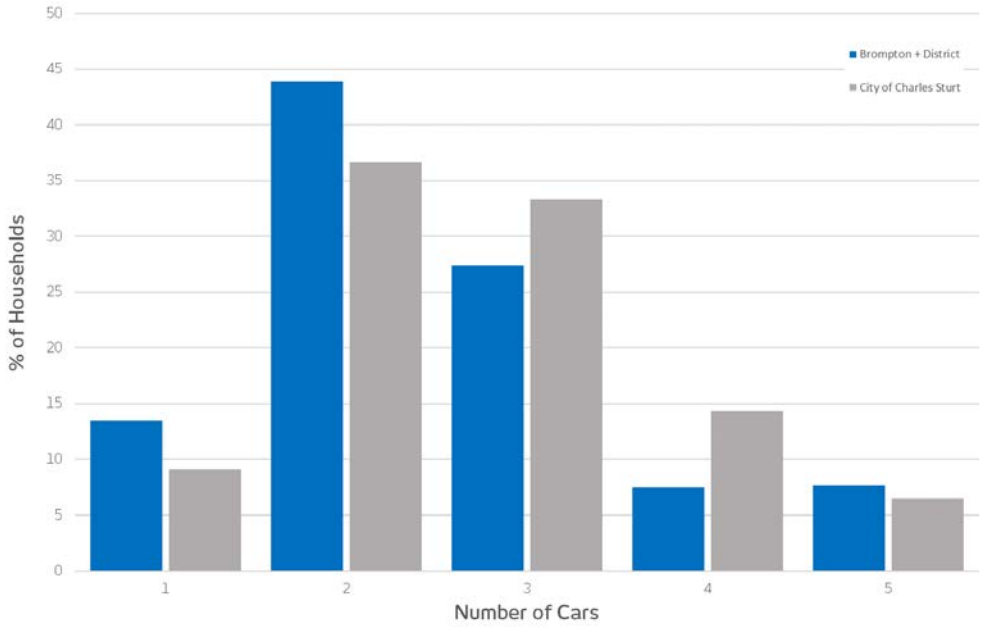


Figure 2 – 2016 car ownership for Brompton and District (Source: ABS Census)

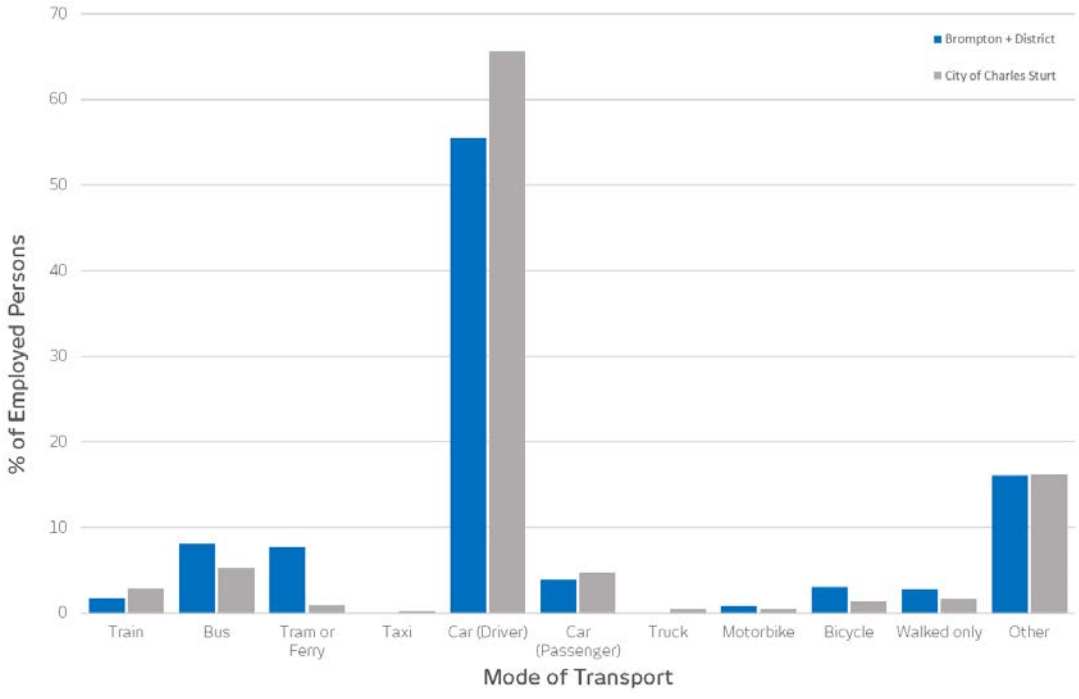


Figure 3 – 2016 Mode of transport for journeys to work (Source: ABS Census)

The above demographic indicates that there is a lower level of car ownership and use within the "Brompton and District" statistical area compared to the whole of the City of Charles Sturt. The data also indicates a higher level of active and sustainable transport use within the area (compared to the overall City of Charles Sturt). This is reflective of the sites proximity to public transport services, walking and cycling networks and the Adelaide CBD.

2.3 LITERATURE REVIEW

A number of relevant documents have been reviewed as part of the preparation of the transport investigations. The following sections summarise the key findings, outcomes and recommendations of the relevant background information.

2.3.1 CITY OF CHARLES STURT TRANSPORT PLAN 2016–2031

The Transport Plan (2016–2031) was prepared by the City of Charles Sturt in response to increasing population demands and associated impacts on the Council's transport network. The Plan seeks to achieve a safe, high capacity, easy to use and responsive transport system. In particular, the Plan identifies the following objectives:

- *"Providing a greater choice of travel modes*
- *Distributing goods and services more efficiently*
- *Improving road safety*
- *Reducing the environmental impacts of the transport system*
- *Fostering medium density mixed-use developments*
- *Creating more attractive and lively suburban centres*
- *Protecting the freight routes needed to grow employment opportunities".*

Community consultation formed a key process in the development of the Transport Plan. The key consultation outcomes relevant to the subject study area were:

- *"Public transport services are too slow and infrequent, however the amount of stops are thought to be adequate"*
- *"Crossing facilities on major roads are not sufficient"*
- *"The majority of road users will use private motor vehicles for trips greater than 2.5 km"*
- *"Cycling rated the least important mode of transport for work trips"*

- *"Despite low cycling priority, more off-road shared pedestrian and cycling use paths were the highest requested area for infrastructure spending".*

The Plan set specific targets in relation to both modal shift and road safety outcomes. In relation to modal shift, the targets were focussed on reduced car dependency with increased levels of walking, cycling and public transport use desired by 2031. Figure 4 illustrates the existing (2016) and targeted (2031) modal share proportions.

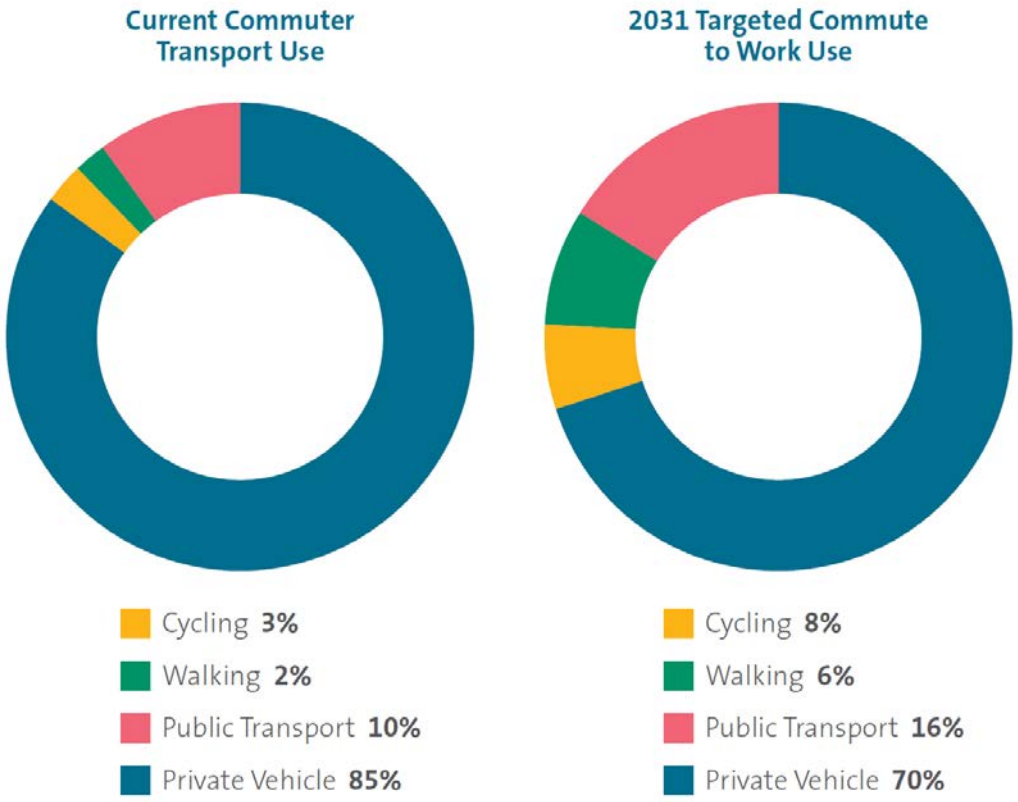


Figure 4 – Existing (2016) and targeted (2031) modal share

In relation to road safety, the Transport Plan identifies a desired reduction in injury crashes of 30% by 2020 (in line with the State Government's "Towards Zero Together – South Australia's Road Safety Strategy 2020"). To achieve this target the Transport Plan identifies that the City of Charles Sturt will review speed limits, target road safety funding to areas with greatest benefit, undertake road safety reviews, work with schools, consider future traffic demands and ensure new road safety treatments are designed to accommodate future traffic growth.

The Transport Plan identifies the existing road hierarchy within the City of Charles Sturt (including future roads or classification changes). The road hierarchy is detailed further in Section 3.2.

In line with the objectives and targets noted above, the Transport Plan then provides detailed strategies for the ongoing management of the City of Charles Sturt's transport networks. These strategies are grouped into the following key themes:

- *"Theme Area 1: Protect our environment and minimise our ecological footprint";*
- *"Theme Area 2: Create a safe, healthy and supportive community which encourages participation, creativity and diversity";*
- *"Theme Area 3: Build an economically thriving and competitive city";*
- *"Theme Area 4: Demonstrate effective leadership with strong community collaboration"; and*
- *"Theme Area 5: Build healthy, functional and attractive neighbourhoods".*

2.3.2 CITY OF CHARLES STURT STRATEGY FOR WALKING AND CYCLING

The City of Charles Sturt's "Strategy for Walking and Cycling" was prepared in 2015 (prior to the Transport Plan). The Strategy is, however, reflective of similar targets of increased walking and cycling (and public transport use) with reduced dependency on private motor vehicles.

The Strategy documents the value of cycling including a focus on health, social, environmental and economic benefits. The Strategy identifies a clear vision that "*...undertaking a walking or cycling trip becomes the natural instinct for many local trips and as part of longer trips by public transport*".

A detailed review of background documents, demographic data, existing and future infrastructure provisions for walking and cycling is included in the Strategy. Of particular relevance to the subject investigations, the Strategy identifies a desire to create liveable communities with safe and attractive local streets and for increased connectivity between existing networks.

2.3.3 INNER WEST PRECINCT TRANSPORT AND PARKING PLAN

AECOM (with URPS) prepared the Inner West Precinct Transport and Parking Plan (IWPTPP) in 2015 for the City of Charles Sturt. The study included a review of transport and parking issues within Brompton, Bowden, Hindmarsh and Ovingham. In particular, the study considered the potential impacts associated with ongoing development and increased residential densities within these suburbs. The study identified that in the order of 5,500 new dwellings and 20,000 additional vehicle trips could be generated by infill development and urban renewal within the IWPTPP study area by 2031.

In order to manage increased pressures on the road network, the IWPTPP included a focus on the promotion of active and sustainable transport modes as

well as an equity of access to on-street parking. The IWPTPP detailed six key themes in relation to ongoing transport strategies for the area, namely:

- encourage walking and improve associated facilities/infrastructure;
- encourage cycling and improve associated facilities/infrastructure;
- encourage public transport use and improve associated facilities/ infrastructure;
- manage traffic, driver behaviour and vehicle control;
- parking management; and
- improve safety, amenity and social interaction.

Relevant to the subject Bowden/Brompton Precinct, the IWPTPP recommended that:

- Chief Street be reconstructed as a pedestrian boulevard (this related to a significant improvement to the pedestrian environment, however included retention of Chief Street as a key road connection);
- footpaths within the precinct be widened to 1.5 m;
- cycling links should be established through the precinct;
- consideration should be given to a bus route along Chief Street (however would be subject to significant works at the Chief Street road underpass associated with the rail line);
- the potential for a network of one-way streets should be investigated within Brompton;
- a car parking fund should be established for developers to provide contributions in lieu of meeting statutory parking provision requirements;
- on-street parking control policies should be implemented; and
- placemaking opportunities should be developed to improve safety and amenity within the precinct.

2.3.4 BROMPTON VILLAGE REZONING TRANSPORT IMPACT ASSESSMENT

GTA Consultants were engaged in 2014 to prepare a Transport Impact Assessment for the potential rezoning (and subsequent redevelopment) of the subject site from industrial to residential and commercial uses. The GTA assessment report detailed a review of the existing street network, public transport and non-vehicular accessibility, parking demands, access arrangements and the overall impact of the potential redevelopment on the existing transport networks.

The GTA assessment was based on the following potential development yields:

- 300 to 400 townhouses; plus
- 1,000 to 1,200 apartment dwellings; plus
- 3,000 m² of commercial gross floor area.

Based on these yields, the GTA assessment forecast that up to 5,800 vehicle trips per day could be generated following redevelopment of the site. In comparison to the existing/previous land uses, this was estimated to equate to the distribution of an additional 2,900 vehicle trips on the road network (within and surrounding the site).

Impact analysis was undertaken by GTA using SIDRA modelling software for key intersections within and adjacent the study area. The key findings of the GTA assessment were that:

- no upgrade of the Hawker Street/Chief Street was warranted as a result of the redevelopment of the subject site;
- an upgrade of the Park Terrace/Hawker Street intersection was required to accommodate general increases in traffic flows (including the development of the adjacent Bowden Urban Village). The upgrade, which included additional through lanes and extended turn lanes, has been undertaken since the preparation of the GTA assessment;
- no further upgrade of the South Road/Hawker Street intersection would be required (following completion of South Road upgrade works) to accommodate additional traffic generated by redevelopment of the subject site;
- no upgrade was warranted for the Torrens Road/Chief Street intersection as a result of the redevelopment (minor increases in delays for right turns were identified but considered to be within acceptable levels);
- previous studies prepared for the Bowden Urban Village project identified that the intersections of Sixth Street/Park Terrace and Chief Street/Port Road would reach capacity by 2031 and require upgrade. The GTA assessment, however, considered the distribution of traffic associated with the redevelopment of the subject site to this intersection to be low and any upgrade requirements for the intersections should not be attributed to the subject site.

In addition to road network impacts, the GTA assessment also included consideration of walking and cycling considerations associated with the redevelopment of the site, namely it was recommended that:

- footpaths be provided on both sides of existing and proposed roads to support a high level of walkability;
- road design maximises connectivity for walking and cycling and include supporting infrastructure, such as seating and lighting;
- cycling should generally be accommodated in a shared on-road environment with supporting low speed road design and bicycle parking to be provided in key locations (such as the proposed commercial area);
- allowance be made for a continuous off-road cycle path between Hawker Street and Second Street/Sixth Street; and
- consideration should be given to the provision of an off-road cycle path between the proposed commercial area (near Hawker Street) and Gibson Street with connection to the Bowden Urban Village High Street.

A brief discussion on off-street parking provision was also included in the GTA assessment. GTA identified that a rate of 0.75 spaces per dwelling has been adopted for residential development within the Bowden Urban Village. The GTA assessment provided no commentary on the appropriateness of this rate. It should be noted that while this rate is still reflected in the Development Plan requirements, Renewal SA's design guidelines have recently recommended an increased parking provision rate due to issues experienced in relation to the 0.75 spaces per dwelling rate (based on a more recent study of residential parking provisions prepared by CIRQA for Renewal SA). Further discussion on parking provisions for the subject area is provided in Section 7 below.

For commercial uses within the subject area, the GTA report identified a parking provision rate of 3 spaces per 100 m². Such a rate is consistent with parking provisions for commercial uses in areas of urban renewal and higher residential densities.

3. TRANSPORT INFRASTRUCTURE

3.1 ROAD NETWORK

The subject site is well connected by an array of existing roads, forming a traditional grid network. All roads intersecting with the subject site include distributor/collector roads and local streets, all of which are under the care and control of the City of Charles Sturt. Key roads in the vicinity of the subject site are described as follows:

- Chief Street is a distributor road bounding the north-west of the site. Chief Street comprises a single traffic lane in each direction, separated by a 1.5 m wide (approximate) painted median. On-street (indented) parallel parking is provided on both sides of Chief Street, with adjacent bicycle lanes on both sides. Sealed footpaths are also provided on both sides of Chief Street. A 40 km/h speed limit applies. Council traffic data indicates average daily traffic (vehicular) volumes of 7.000 vehicles per day (vpd) at its north-eastern end and 6,900 vpd at its south-western end.
- Hawker Street is defined as a distributor road by Council's Development Plan. Bounding the north-eastern edge of the site, Hawker Street comprises a single traffic lane in each direction, with limited on-street parallel parking on both sides. Sealed footpaths are provided on both sides of Hawker Street. Hawker Street is subject to a 40 km/h speed limit. Council traffic data indicates a daily traffic volume of approximately 7,000 vpd (near its intersection with Chief Street).
- East Street, Drayton Street and Gibson Street are all local streets within the subject site (all aligned in a north-east/south-west orientation). Each street contains a single traffic lane in each direction, with parallel on-street parking permitted in various locations along their entireties. All streets contain a sealed footpath on both sides and are all subject to 40 km/h speed limits. Council data indicates traffic volumes of approximately 780 vpd on Drayton Street, 530 vpd on East Street and 1,900 vpd on Gibson Street. On this basis, Drayton Street and East Street would (under their current operation) be classified as 'local streets'. However, Gibson Street functions as a 'minor collector' route.
- Second Street and Sixth Street are local streets within the subject site, aligned in a north-west/south-east orientation. Both streets contain a single traffic lane in each direction with sealed footpaths on both sides. On-street parking is permitted in various locations of both streets, albeit only on one side. This is due to the narrow nature of the carriageways. Both streets are subject to a 40 km/h speed limit. Council data identifies a traffic volume in the order of 1,500 vpd on Sixth Street, albeit the IWTPP indicates up between 1,500 to 3,000 vpd along Sixth Street and Second Street. Such volumes are in line with a classification as a 'minor collector' road.

- Third Street (and Ninth Street) is a narrow local street oriented in a north-west/south-east direction. Third Street bisects the study area and provides a connection between Ethelbert Square (a public reserve) and Ninth Street (to the south-east of the study area). Third Street accommodates two-way traffic movements and on-street parking (parallel) on its north-eastern side. Sealed footpaths are provided on both sides of Third Street. A 40 km/h speed limit applies. The IWPTPP identifies a daily traffic volume in the order of 0 to 500 vpd on Third Street ('local road' classification). While Third Street is not identified as forming part of the BikeDirect cycling network, Ninth Avenue east of Gibson Street (to Trembath Street) is identified as a secondary (cycling) road (with a connection to an underpass at Park Terrace (via Trembath Street and Eighth Street). In addition, the section of Ninth Street between Drayton Street and Trembath Street has recently been restricted to one-way flow only (discussed further below).

In the broader vicinity of the subject site, key collector and arterial roads provide connectivity to key employment, recreation and educational centres including the CBD, western beaches, Port Adelaide and nearby metropolitan suburbs. A description of key nearby collector and arterial roads is as follows:

- Park Terrace is a major arterial under the care and control of DPTI. Within the vicinity of the site, Part Terrace contains three traffic lanes in each direction, separated by a raised concrete median. Park Terrace forms part of the inner-city ring route surrounding North Adelaide and the Adelaide CBD. Park Terrace is subject to a 60 km/h speed limit. DPTI data indicates a daily traffic volume of 49,300 vpd is experienced on Park Terrace (in the vicinity of the subject site).
- Port Road is a major arterial road under the care and control of DPTI. Port Road provides connectivity between Adelaide and Port Adelaide as well as numerous residential and industrial areas. Near the site, Port Road contains three traffic lanes in each direction, separated by a large 35 m wide (approximate) median. Parking areas are provided within the median of Port Road in numerous locations along its entirety. A 60 km/h speed limit applies on Port Road. DPTI data indicates a daily traffic volume of 37,200 vpd is experienced on Port Road (in the vicinity of the subject site).
- Torrens Road is an arterial under the care and control of DPTI. Within the vicinity of the site, Torrens Road is subject to a 60 km/h speed limit. Torrens Road generally comprises two traffic lanes in each direction, with on-street parking provided in various locations outside of bicycle lane and clearway times. Torrens Road is aligned parallel to Port Road and provides connectivity between North Adelaide and Port Adelaide. DPTI data indicates a daily traffic volume of 24,600 vpd is experienced on Port Road (in the vicinity of the subject site).

Figure 5 summarises the above existing traffic volumes on the subject road network.

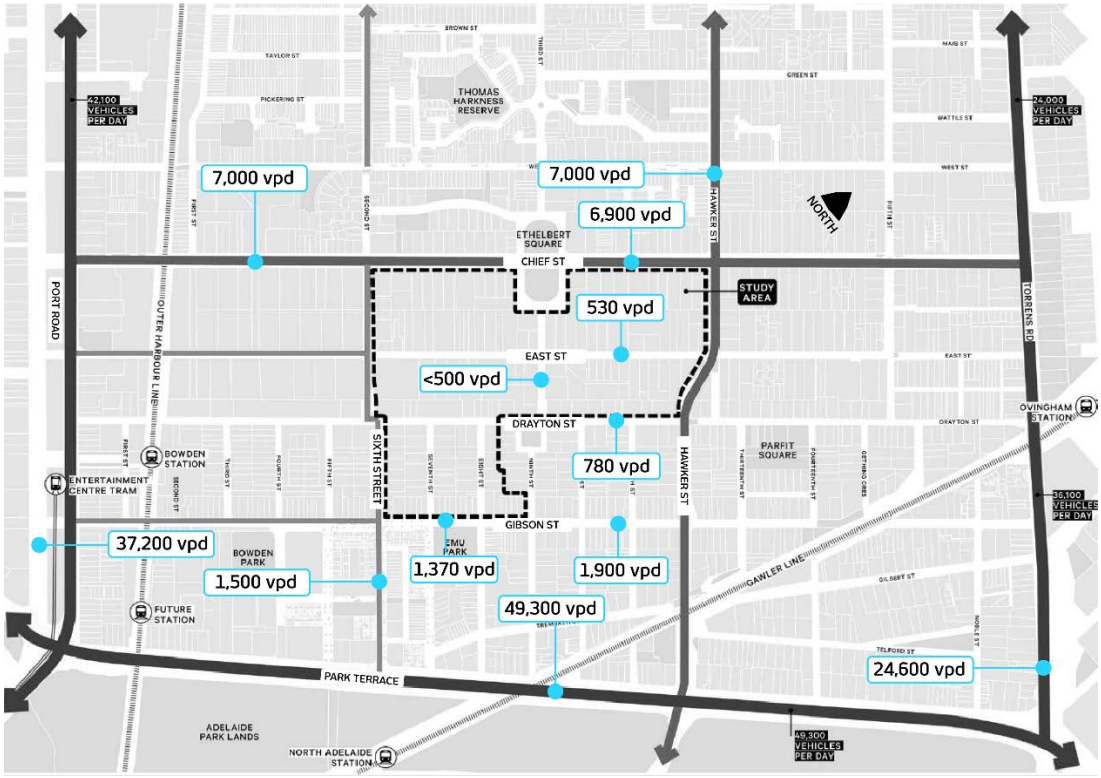


Figure 5 - Existing traffic volumes on the subject road network

3.2 ROAD HIERARCHY

Taking into account the existing traffic volumes and functions of the subject roads, the IWPTPP identified a road hierarchy for the study area and surrounds. Figure 6 provides an excerpt of the road hierarchy plan as it relates to the study area.

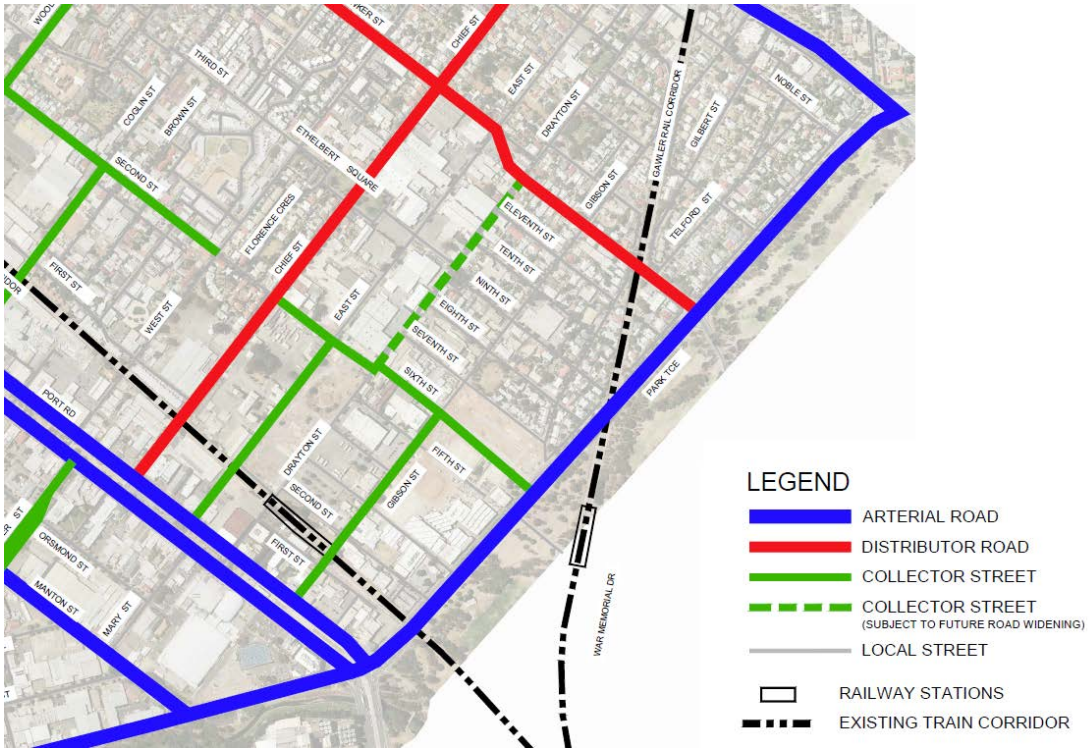


Figure 6 – Existing road hierarchy within and surrounding the study area (Source: IWPTPP, AECOM)

Since the preparation of the IWPTPP, however, the Torrens Rail Junction Project has resulted in the closure of the rail corridor crossing on East Street. This would be likely to reduce future volumes on East Street and reduce its classification from 'collector street (or road)' to 'local road/street'.

In addition to the above, it is noted that the City of Charles Sturt has recently (December 2017) implemented a one-way flow arrangement in a number of streets to the south-east of the study area. Specifically, the following arrangements have been implemented:

- Eighth Street – one-way from Trembath Street to Drayton Street (north-west bound);
- Ninth Street – one-way from Drayton Street to Trembath Street (south-east bound);
- Tenth Street – one-way from Trembath Street to Gibson Street (north-west bound); and
- Eleventh Street – one-way from Drayton Street to Trembath Street (north-west bound).

3.3 PUBLIC TRANSPORT

Numerous public transport services (bus, light rail and rail) operate within the vicinity of the subject site. Specifically, the following key stops are located within 1 km of the subject site:

- **Hawker Street** (bus) – Stop 9 (north and south) and Stop 10 (north and south);
- **Port Road** (bus) – Stop 7 (north and south);
- **Port Road** (tram) – Stop Tram Entertainment Centre;
- **Bowden Railway Station** (train);
- **North Adelaide Railway Station** (train); and
- **Ovingham Railway Station** (train).

Figure 7 identifies the bus, train and tram stops and services in close proximity to the study area. The diagram also indicates approximate distances between the subject site and key nearby stations. This is based on the 400 m and 800 m walking distances typically associated with bus and train/tram stops, respectively.

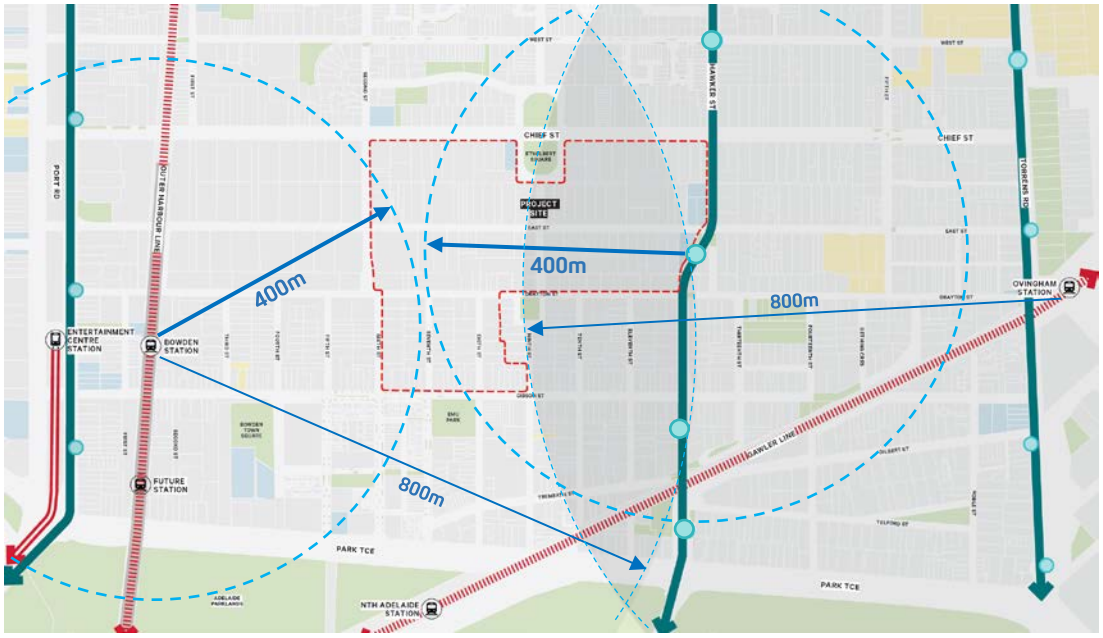


Figure 7 – Public transport routes and stops in the vicinity of the site
(Source: after Oxigen, 2017)

Services in the vicinity of the site are generally high frequency. However, community comments have suggested that trips inbound to the City (CBD) are often at or nearing capacity. There may be opportunity to improve the level of service through future liaison with the Public Transport Division of DPTI. Similarly,

while the train stations and tram stops are all within a relatively walkable distance, there may be opportunities for increased bicycle "park 'n' ride" provisions to further support use of public transport in the area.

3.4 ACTIVE TRANSPORT

Due to the site's proximity to the Park Lands and Adelaide CBD, the subject site is well serviced by active transport modes (walking and cycling). Within Bowden and Brompton, sealed footpaths are generally provided on both sides of roadways, with kerb ramps at the various intersections. Footpaths widths are restricted, however, on some streets due to the presence of Stobie Poles (and relatively narrow verges).

Within the Bowden and Brompton area, bicycle movements are typically accommodated on-street under a standard shared arrangement. Such an arrangement is considered appropriate within a low-speed environment such as the subject site (albeit the potential for a relatively high number of commercial movements associated with the industrial uses is noted). Cyclist movements are also permitted on the footpath network, albeit uncommon.

In the broader vicinity, bicycle lanes are provided on Park Terrace, Port Road and Chief Street. A future 'Greenway' is also proposed adjacent the Outer Harbour rail line, providing pedestrian and cyclist connectivity between Adelaide and Port Adelaide, via the existing off-road shared paths within the Adelaide Park Lands.

Figure 8 illustrates key facilities of the existing walking and cycling networks within and adjacent the study area.

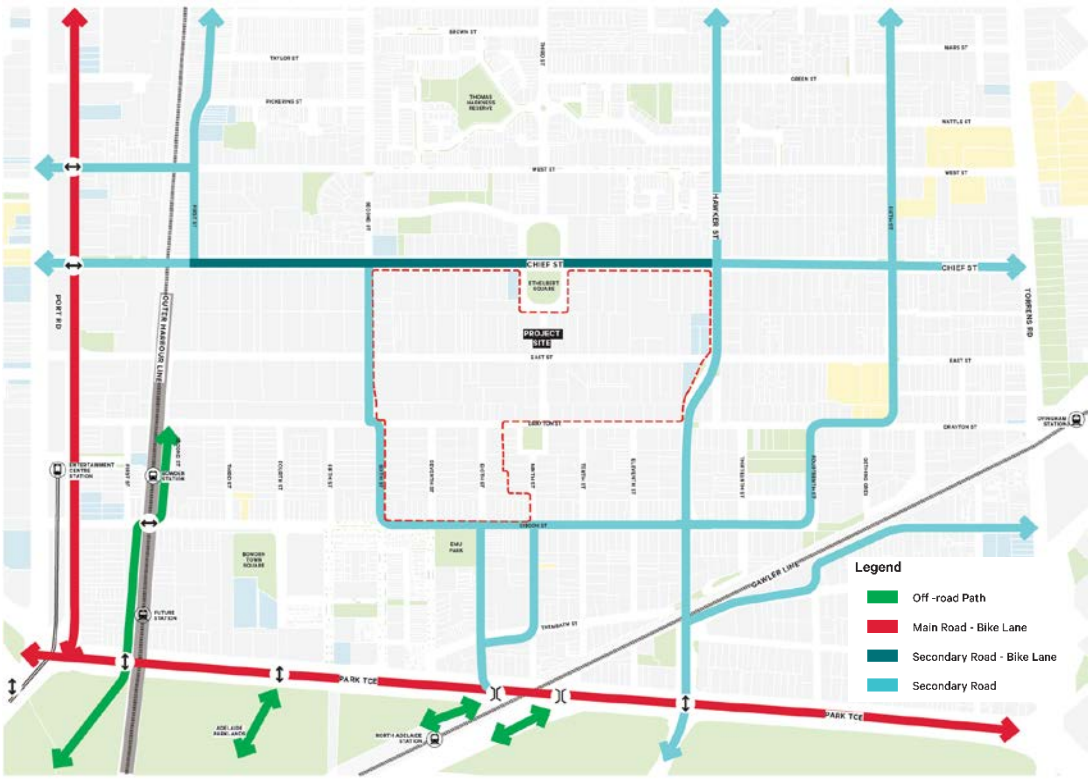


Figure 8 – Existing cycling network (Source: Oxigen, 2017)

In addition to Figure 8, the IWPTPP identified the existing and proposed cycling and walking networks within and surrounding the subject site. Most notably, the ITWPP ought to formalise the 'Greenways' route to the south-west of the site as well as provide a new cycling connection along Ninth Street and Third Street. Walking improvements identified by the IWPTPP were primarily focussed along key south-west to north-east streets (albeit the study pre-dated the rezoning proposal and largely based on the existing road network and property boundaries).

Figures 9 and 10 illustrate the ITWPP walking and cycling networks for the subject area.

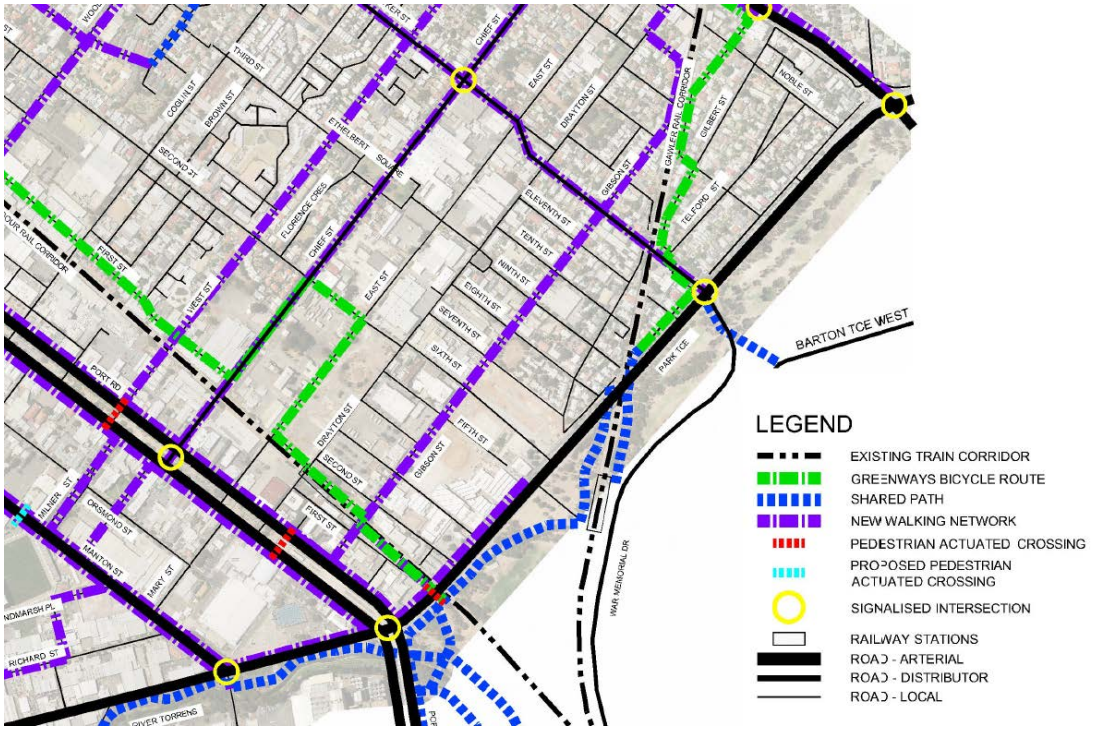


Figure 9 - IWPTPP walking network (source: after AECOM, 2015)

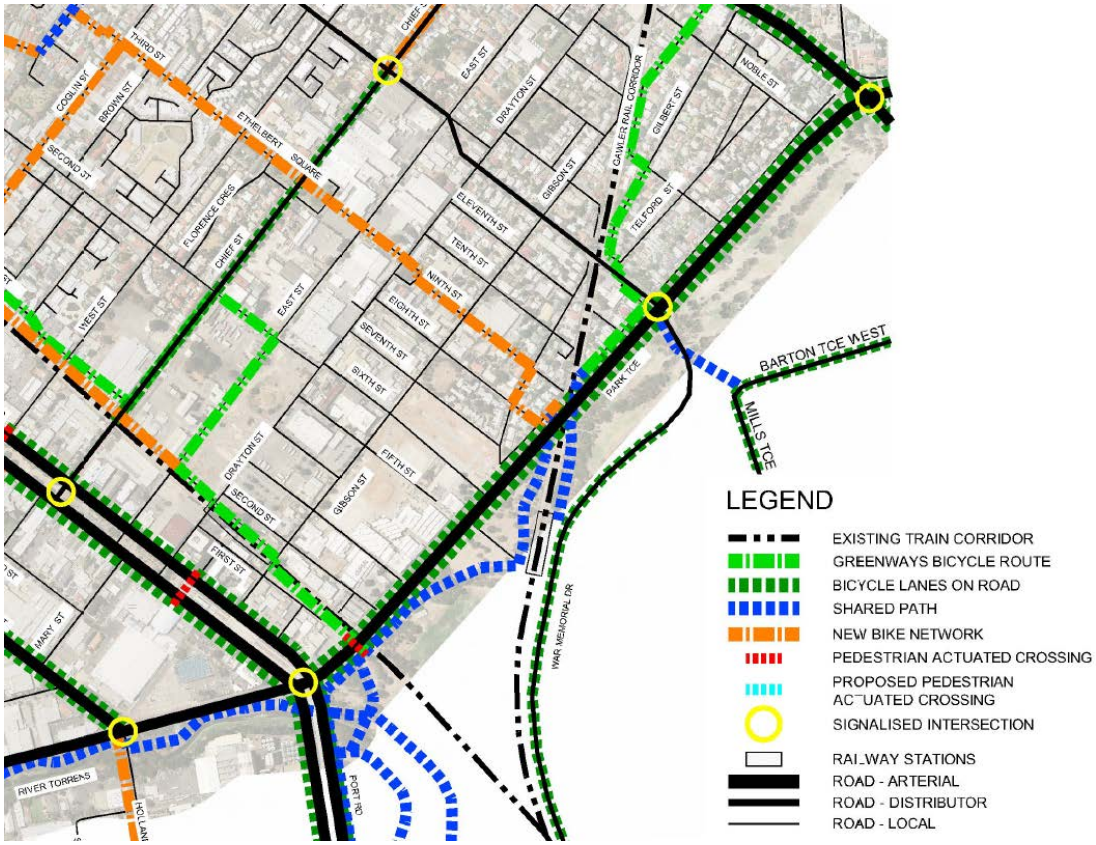


Figure 10 - PTPP cycling network within and surrounding subject site

4. REZONING AND REDEVELOPMENT

4.1 REZONING

The subject site comprises approximately 11.43 hectares of land (114,300 m²) excluding existing roads. It is proposed to rezone the subject site from Urban Employment Zone (primarily industrial use) to residential/mixed use zone. The rezoning will facilitate the future redevelopment of the study area for primarily residential dwellings with a small level of supporting commercial/retail uses.

4.2 DEVELOPMENT YIELDS

The subject site currently comprises in the order of 114,300 m² of industrial land uses plus a small level of commercial and residential development.

For the purposes of the transport investigations (and broader DPA investigations), it has been assumed that the redevelopment of the area will ultimately comprise removal of the existing industrial land uses and accommodation of the following (potential) development yields:

- 900 townhouses; and
- 600 apartment dwellings.

For the purposes of the assessment, it has been assumed that the level of commercial/retail use will be of a similar order to the existing provisions. Nonetheless, the traffic generation assessment associated with the proposed dwellings will include (and form the majority of) trips associated with supporting commercial/retail development.

4.3 TRANSPORT NETWORK PROVISIONS

A traffic impact assessment including review of existing road network capacity and potential upgrade requirements is detailed in Sections 5 and 6. From a broader sense, it is anticipated that redevelopment of the study area would be based on retention and improvement of the existing and surrounding traditional grid layout. This will maximise permeability and accessibility for active transport modes, as well private motor vehicles.

In order to improve on the existing layout, it is recommended that additional 'local road' connections be provided between Chief Street, East Street and Drayton Street (oriented north-west to south-east). The number of vehicle connections to Chief Street should be minimised to limit conflict points on the street's walking and cycling network, however pedestrian and cyclist connections are still desirable (i.e. reflective of the grid network). Restrictions on vehicle connections could be implemented with full closures prior to Chief Street (with alternative connections via the 'internal' road network) and/or limited access provisions,

such as left-out or left-in only at select locations. It is noted that Council's preference is for minimisation of the number of vehicle connections to Chief Street.

The links could be supplemented with either additional 'local roads' or 'laneways' oriented south-west to north-east. Laneways parallel to the main road connections (Drayton Street, East Street, Chief Street, Second Street and Hawker Street) would be desirable to allow future dwelling sites to be rear loaded with minimal direct access (crossovers) on these roads to maximise pedestrian, cyclist, on-street parking and general road safety.

Figure 11 illustrates the general layout recommended (albeit this would be subject to more detailed analysis and broader considerations).

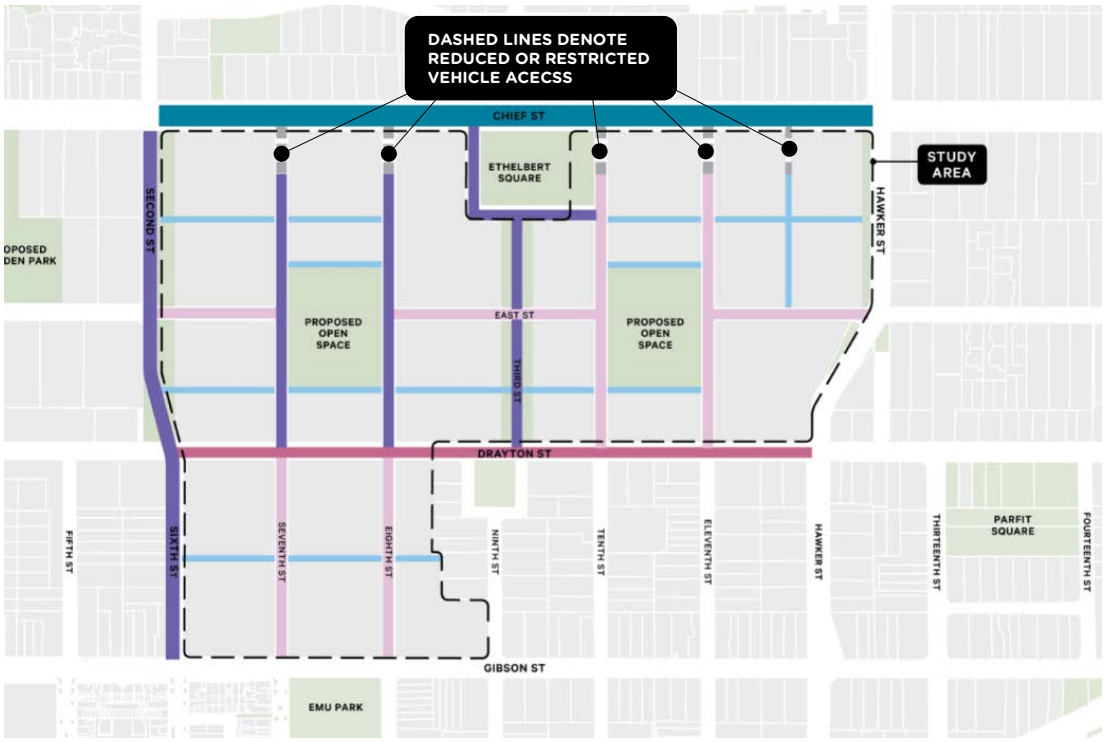


Figure 11 – High-level road network for redevelopment of the study area (source: after Oxigen, 2018)

It is anticipated that the road network would be developed in a similar manner to the "Streets for People" approach within the nearby Bowden Urban Village (albeit "lessons learnt" through that project should be applied). On this basis, cycling would generally be accommodated in a shared manner on-road (with ability for cyclists to also utilise footpaths). The future road network should therefore be designed to minimise vehicle speeds (in line with the "Streets for People" approach).

In addition to the general accommodation of cycling movements within the study area, a key future cycling connection has been identified along the Second Street/Sixth Street 'minor collector' route. A shared path provided on the eastern side of the collector route could be utilised by surrounding residents to access bicycle facilities on Chief Street (including a potential shared path) and the Outer Harbour Greenway (shared path).

The high level of accessibility by walking and cycling will assist in reducing the reliance of residents (both existing and future) on private motor vehicles. The walking and cycling networks will provide a highly permeable network not only for commute trips but also to/from local destinations within and surrounding the study area. These networks will also provide direct connectivity between the study area and the numerous public transport services in the vicinity of the site. An assessment of local destinations and public transport stops was prepared as part of the IWPTPP study and is illustrated in Figure 12 below. The networks and connectivity to these destinations identified in the IWPTPP study will be further strengthened by the increased level of permeability through the study area.

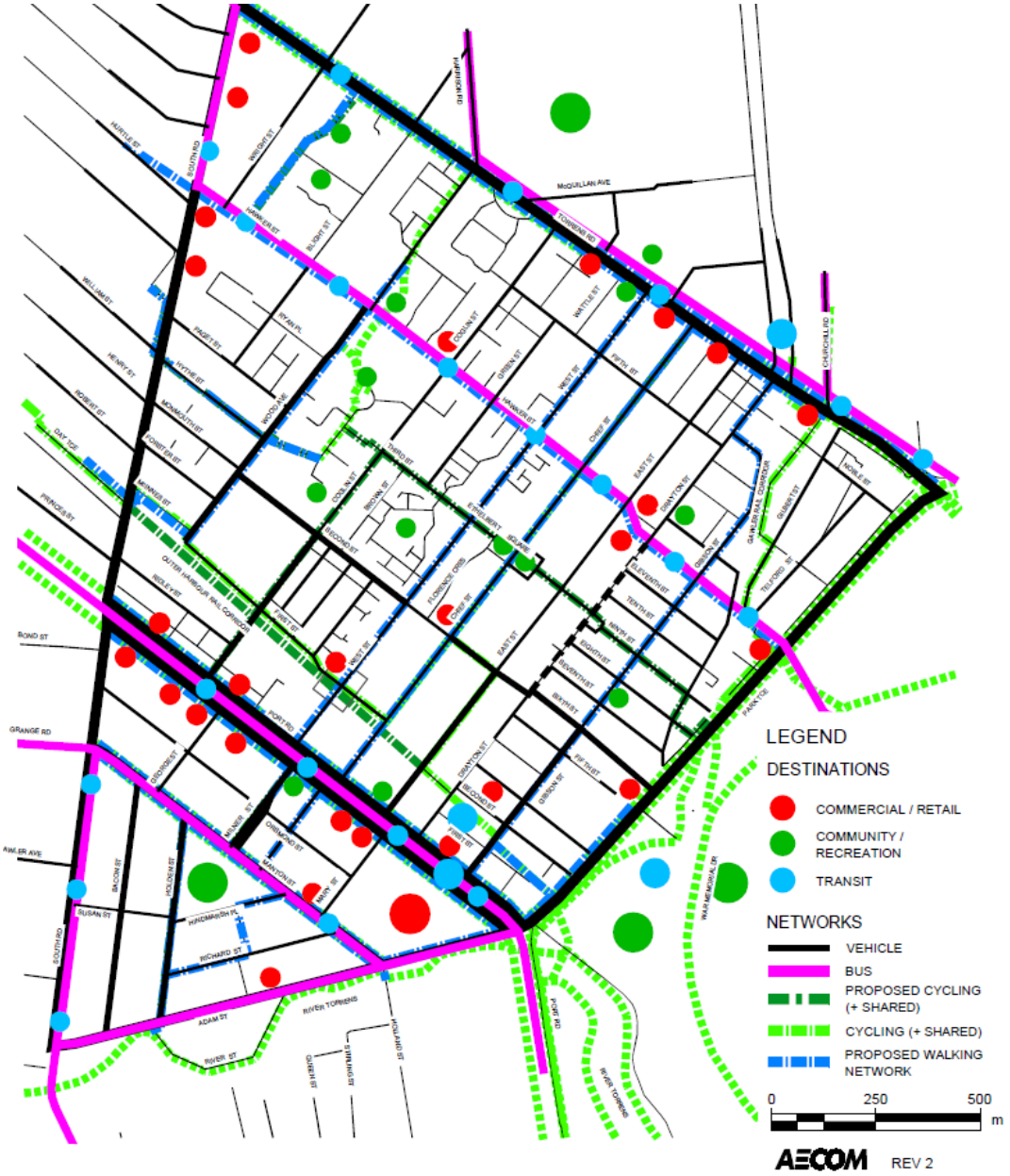


Figure 12 - Networks and destinations map (Source: IWPTPP, AECOM)

The provision of public transport facilities and services is also a key consideration in the reduction on the reliance on private motor vehicles. As detailed above, a high number of public transport services currently operate within the vicinity of the study area. The demographic data indicates that almost 17% of commute trips are undertaken via public transport (albeit a lesser proportion would be anticipated to be associated with other trips purposes). Given the number and variety of public transport services within the vicinity of the site (and the proximity to the CBD), there is potential for a higher proportion of trips to be undertaken via public transport. For instance, inner rim suburbs in Melbourne and Sydney have between 22% to 38% of commute trips being undertaken by public transport.

There are a variety of ways to improve and increase public transport services and encourage greater patronage, including (but not limited to):

- provision of increased public transport capacity, either by increasing the number of routes, the spatial distribution/catchment of routes, frequency, the hours of operation or a combination of the above;
- improved coordination between the various public transport modes as well as active transport modes (bicycle lockers at stations, 'bikes on buses' racks, etc.);
- minimise delays to existing services (for instance, by the installation of bus priority lanes);
- improve comfort, safety and amenity of existing (and future) services (cleaner facilities, reduced crowding, etc.);
- improve amenity and safety at train/tram stations and bus stops (this could include co-location of retail uses, such as small convenience stores, at stations);
- review fares for public transport services;
- improve wayfinding signage to direct users to public transport stops;
- undertake promotional/marketing programs and improve patron information; and
- ensure all public transport services and facilities accommodate people with disabilities, mobility impairments and other special needs.

Given the number of existing routes servicing the study area, it is anticipated that the addition of new routes is generally unlikely within the short to medium term. However, with increased residential population in the area and surrounds, the existing routes will need increased capacity (i.e. increased frequencies or use of higher capacity buses/trains) to accommodate increased patronage from residents. This will be particularly important during the morning commute peak period as the study area is near the 'end of the line' for City bound services and available capacity likely to be limited.

Consideration has also been given to potential public transport improvements to service the study area (and surrounds), including the potential use of Chief Street as a bus route. However, the existing underpass would require significant upgrade works to accommodate buses (due to existing head height restrictions) and the lowering of the carriageway would be difficult without impacting adjacent intersections. Alternative routes within the study area as potential diversions/loops associated with existing services (such as those on Hawker Street) have also been considered. This may be possible (subject to further discussion with the Public Transport Division of DPTI), however would require

buses to turn corners which currently have limited space. There may be opportunity as part of the redevelopment to accommodate bus movements, however this would require further exploration with DPTI. Nevertheless, it is noted that there are already a relatively high number of public transport routes in close walking and cycling proximity to the study area. The issues raised by the community suggest that the routes are not the issue, but the available capacity of the services on those routes. It is therefore considered desirable that further liaison be undertaken with DPTI in relation to public transport servicing of the area with a view to increasing capacity for the study area and surrounds (particularly in relation to bus services).

5. TRAFFIC IMPACT ANALYSIS

5.1 TRAFFIC GENERATION

The NSW Roads and Maritime Services' "*Guide to Traffic Generating Developments*" (the RMS Guide) (and its subsequent updates) are documents commonly used by traffic consultants in order to determine appropriate traffic generation rates for various land uses. Relevant to the subject site and the proposed DPA, the following traffic generation rates are applicable (where ranges are identified in the RMS Guide and its updates, the higher of the values has been adopted):

- Industry – 5 daily trips per 100 m² and 1 peak hour trip per 100 m²;
- Medium-density residential (townhouses) – 6.5 daily trips per dwelling and 0.65 peak hour trips per dwelling; and
- High-density residential (apartments) – 3.14 daily trips per dwelling and 0.41 peak hour trips per dwelling.

Based upon the above rates, it is anticipated that the 'Urban Employment' Zone (existing) and 'Residential' Zone (future) could generate the following approximate daily traffic volumes:

- Urban Employment – 2,860 vehicle trips per day (570 peak hour movements); and
- Residential – 7,730 vehicle trips per day (830 peak hour movements).

The redevelopment of the subject site could therefore generate in the order of 4,870 additional daily trips and 260 additional peak hour trips. Notwithstanding this, it is understood that a proportion of existing industrial sites within the study area are no longer in operation (approximately 20%). While under the current zoning there would be potential for full utilisation of the site, the recent traffic count data would be expected to reflect the reduced occupancy rate. The following assessment therefore assumes that the existing Urban Employment (Industrial) uses are generated traffic at 80% of the above forecast. As a result, the following assessment is based on an additional 5,445 daily trips and 375 peak hour trips. These forecasts excludes additional movements generated by ongoing development of the Bowden Urban Village, albeit previous forecasts identified by PB have been included in the ultimate volumes adopted below.

5.2 TRAFFIC DISTRIBUTION

A high-level traffic distribution has been undertaken for the above forecast existing and potential/future traffic volumes. The distribution analysis has focussed on the movement of traffic to/from the key intersections surrounding

the study area, namely the Hawker Street/Park Terrace, Sixth Street/Park Terrace, Chief Street/Port Road, Chief Street/Hawker Street and Chief Street/Torrens Road intersections.

Table 1 summarises the assumed distribution of movements to/from the above intersections as well as an allowance for a small proportion of trips to be undertaken via alternative roads/intersections (as well as an additional proportion of trips which may remain internal to the area). The distribution to/from Chief Street/Torrens Road is not included in this table, as volumes assigned to this intersection have simply been based on the movements through the Chief Street/Hawker Street that would head to/from Torrens Road. The table identifies the overall general distribution of movements assumed, followed by the associated proportion then distributed to each key intersection.

Table 1 – Distribution assumptions to key intersections and alternative routes

	Overall Distribution	Park/ Hawker	Park/ Sixth	Port/ Chief	Chief/ Hawker	Alternate Routes
North	15%	15%	0%	15%	55%	15%
East	20%	50%	20%	0%	20%	10%
South	40%	40%	10%	50%	0%	0%
West	25%	0%	0%	60%	5%	35%

On the basis of the above assumptions, peak hour trip assignments to each intersection have been determined for both the existing (urban employment/industrial) and future (residential) scenarios as summarised in Table 2.

Table 2 – Peak hour trip movement assigned to each intersection

	Park/ Hawker	Park/ Sixth	Port/ Chief	Chief/ Hawker	Alternate Routes
Existing	125	40	170	65	60
Future	235	70	310	115	110

The above forecasts have then been distributed based on the anticipated inbound and outbound proportions during the am and pm peak period. It is noted that the break-down of peak hour trips would differ for the existing employment/industrial uses compared to the potential residential development. The assessment has been based on the following inbound/outbound proportions for the two scenarios:

- Employment/industrial – 80% inbound/20% outbound in the am peak hour and vice-versa in the pm peak hour; and

- **Residential** – 30% inbound/70% outbound in am peak hour and vice-versa in the pm peak hour.

The forecast volumes distributed to/from the various intersections (on the basis of the above assumptions) are summarised in Table 3.

Table 3 – Distribution of inbound and outbound peak trips to each intersection

	Park/ Hawker		Park/ Sixth		Port/ Chief		Chief/ Hawker		Alternate Routes	
	In	Out	In	Out	In	Out	In	Out	In	Out
Employment/Industrial Scenario										
am	100	25	30	10	135	35	50	15	50	10
pm	25	100	10	30	35	135	15	50	10	50
Residential Scenario										
am	70	165	20	50	95	220	35	80	35	80
pm	165	70	50	20	220	95	80	35	80	35

The intersection analysis detailed in Section 6 below utilises the above forecasts with further distribution to individual turning movements (based on existing turn proportions and the broader distribution assumptions). The resulting traffic volumes are included in the analysis outputs sheets in Appendix A.

Figure 13 summarises the future daily traffic volumes forecast for the subject road network on the basis of the above assessment and assumptions. Streets within the study area with no volume shown are anticipated to have volumes less than 1,000 vpd.

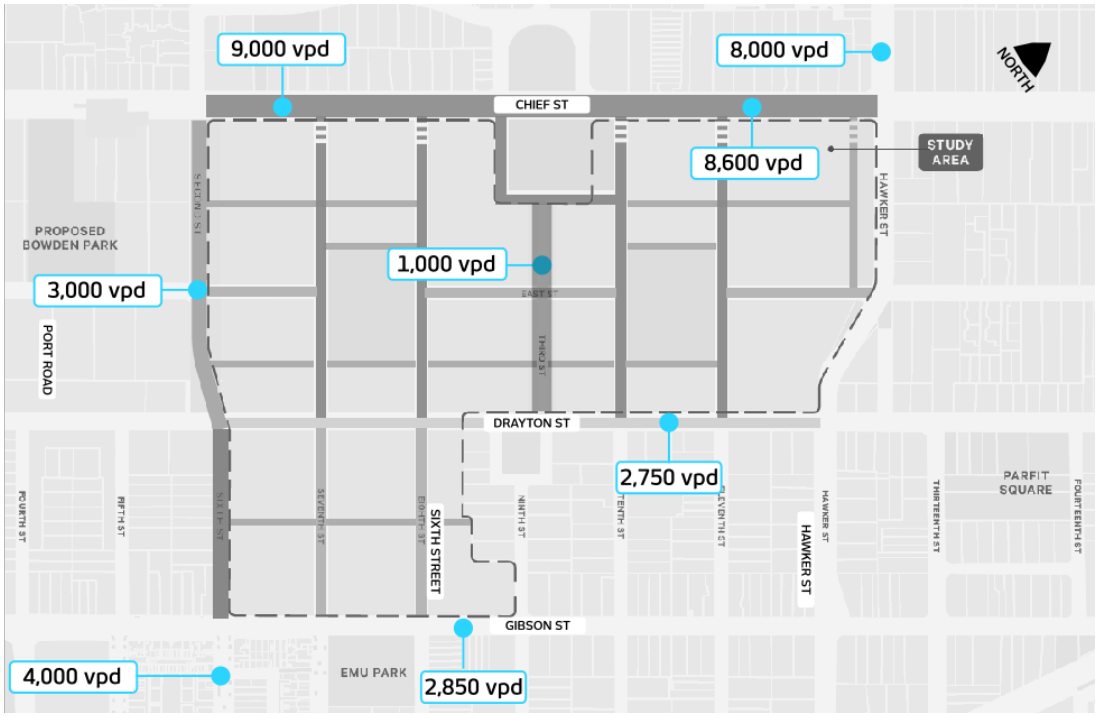


Figure 13 - Forecast future daily traffic volumes on the subject road network

6. TRAFFIC IMPACT

6.1 GENERAL TRAFFIC IMPACT

Taking into account the distribution of the additional daily trips, consideration has been given to the high-level impact on capacity and conditions on the key roads within the study area. Impacts will ultimately be dependent on the future road network layout, however for the purposes of the assessment it has been assumed that the recommended grid layout will be adopted. On this basis, the following high-level impacts have been identified (with associated recommendations where required):

- Chief Street is currently classified as a distributor road. Such roads typically carry in the order 6,000 to 12,000 vpd. Based on existing traffic volumes (approximately 7,000 vpd), it is anticipated that future volumes would increase by approximately 2,000 vpd (as a result of the redevelopment of the study area). The resulting future traffic volume (in the order of 9,000 vpd) would be within the range typically associated with the classification of a 'distributor' road. However, the existing traffic counts do not include the impact of the closure of East Street (at the rail corridor) which would be likely to result in additional volumes being distributed to Chief Street. With additional movements as a result of the closure of East Street and ongoing development in the Bowden Urban Village, Chief Street would be likely to exceed the typical level associated with its road classification.

  Traffic volumes would still be able to be accommodated mid-block (i.e. general lane capacity would not be exceeded), however increased queues and delays would be experienced at intersections (particularly those with Port Road and Hawker Street). It is therefore desirable (as noted above) that development fronting Chief Street be rear loaded.

  Turning movements at intersections with Chief Street and side streets within the study area would be likely to warrant separated right turn lanes (based on the Austroads' guidelines). However, from a capacity perspective, preliminary SIDRA assessment indicates that such treatments would not be required to accommodate the flows (i.e. turning movements would not result in excessive queuing and delays if undertaken from the through lane). There may be benefit in retaining the status quo of right turns being undertaken from the through lane in that it would generally encourage a lower speed environment along Chief Street. A preliminary cross section for Chief Street has been identified by Oxigen (refer Appendix B), however the ultimate cross section should be assessed further separate to this study.

  In addition to the above, the increase in traffic volumes at the existing four-way intersection of Chief Street and Second Street would warrant improved treatment of the intersection. The most effective treatment to safely and efficiently accommodate the future traffic volumes would be a roundabout.

Figure 11 illustrates a high level concept layout for such a treatment. Further design work will be required to confirm the roundabout layout, including consideration of pedestrian, cyclist and heavy vehicle movements as well as required extent of property acquisition and ultimate road cross sections adopted.

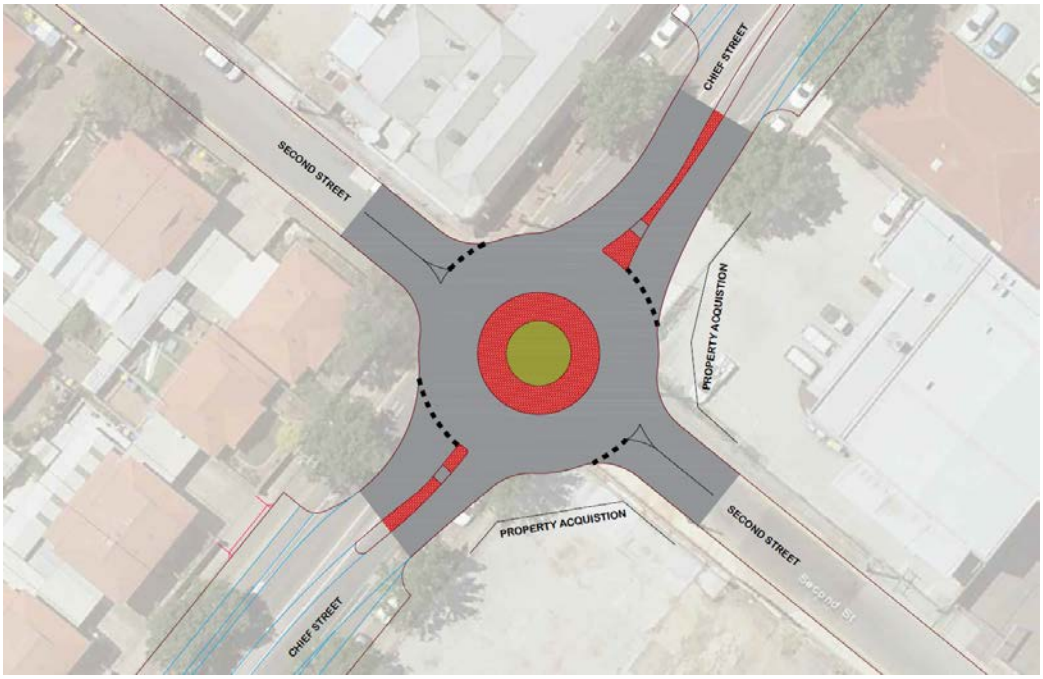


Figure 14 - Roundabout concept for the Chief Street/Second Street intersection

- Hawker Street is defined as a distributor road with current traffic volumes in the order of 7,000 vpd. Traffic volumes generated by the redevelopment of the study area are forecast to increase movements on Hawker Street by approximately 1,500 vpd. The future traffic volumes would therefore remain within the general capacity of the road. Notwithstanding this, opportunities to widen Hawker Street (particularly adjacent the study area) should be explored to improve pedestrian provisions and indent bus stops where possible. Furthermore, it is desirable that development on Hawker Street be rear loaded.
- Second Street (and Sixth Street) currently function as a minor collector route within and adjacent the study area. However, with the closure of East Street and increased development within the study area and surrounds, it is considered that the importance of this link will increase. It is forecast that, as a result of the redevelopment of the study area, volumes on Second Street/Sixth Street could increase to in the order of 4,000 vpd. The route will also be a key connection within the walking and cycling networks. It is therefore considered desirable to allow for the future widening of Second Street as part of the study area's redevelopment. Such works would also allow improved pedestrian and cyclist facilities as well as landscaping opportunities. This should include a realignment of its intersection with Sixth

Street to improve connectivity. The realignment of this intersection should take into account the 'dog-leg' of the south-west to north-east minor-collector route that is proposed (in background documents) to utilise Gibson Street (south of Sixth Street) and Drayton Street (north of Sixth Street). The primary priority would however remain for flows along Second Street and Sixth Street (which would not be reflected by retention of the existing staggered arrangement). The options for the intersection realignment would therefore comprise either (a) a roundabout, (b) a four-way intersection with priority assigned to either set of opposite approaches or (c) two 'realigned T-intersections'. The roundabout treatment would be likely to most appropriately accommodate traffic flows at the intersection, however such a treatment is relatively uncommon within the study area and surrounds (and results in a relatively awkward road alignment for the approaches). Figures 15 and 16 illustrate the potential roundabout and four-way intersection treatments for the intersection. These have generally been based on any road widening requirement (property acquisition) being achieved within the study area. Both treatments are high level only and subject to further design review, including consideration of pedestrian, cyclist and commercial vehicle movements. The raised pavement treatment could also be supplemented with additional measures, such as raised medians and pedestrian refuges. It should be noted that the detailed design of these treatments will also need to reflect the ultimate road cross sections implemented in the respective streets.

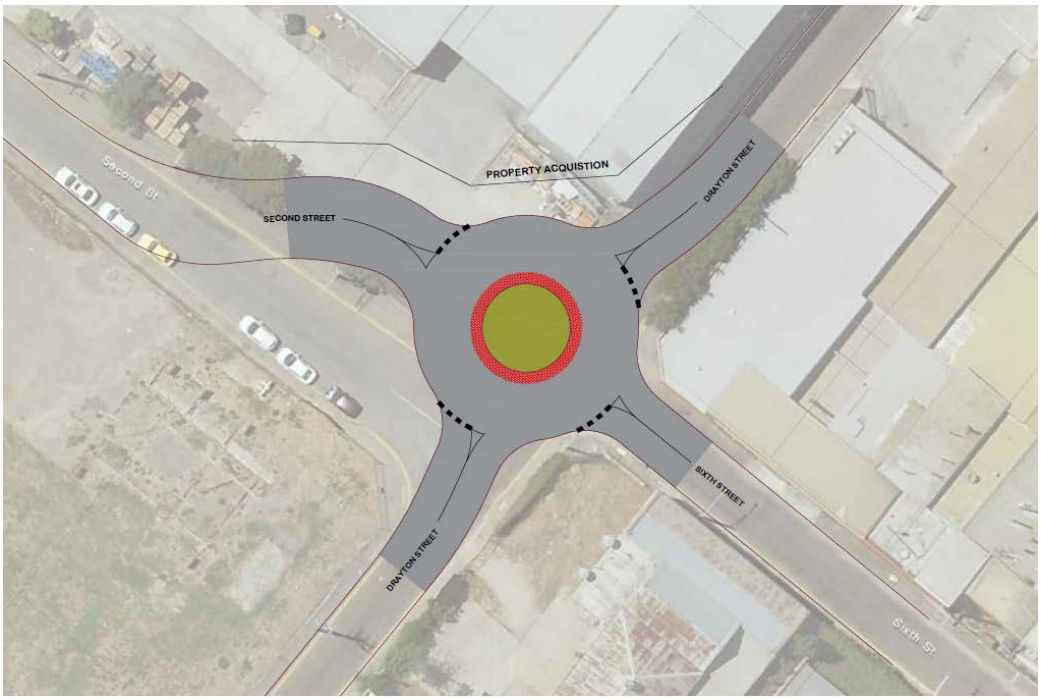


Figure 15 - Roundabout concept for Drayton Street/Second Street/Sixth Street

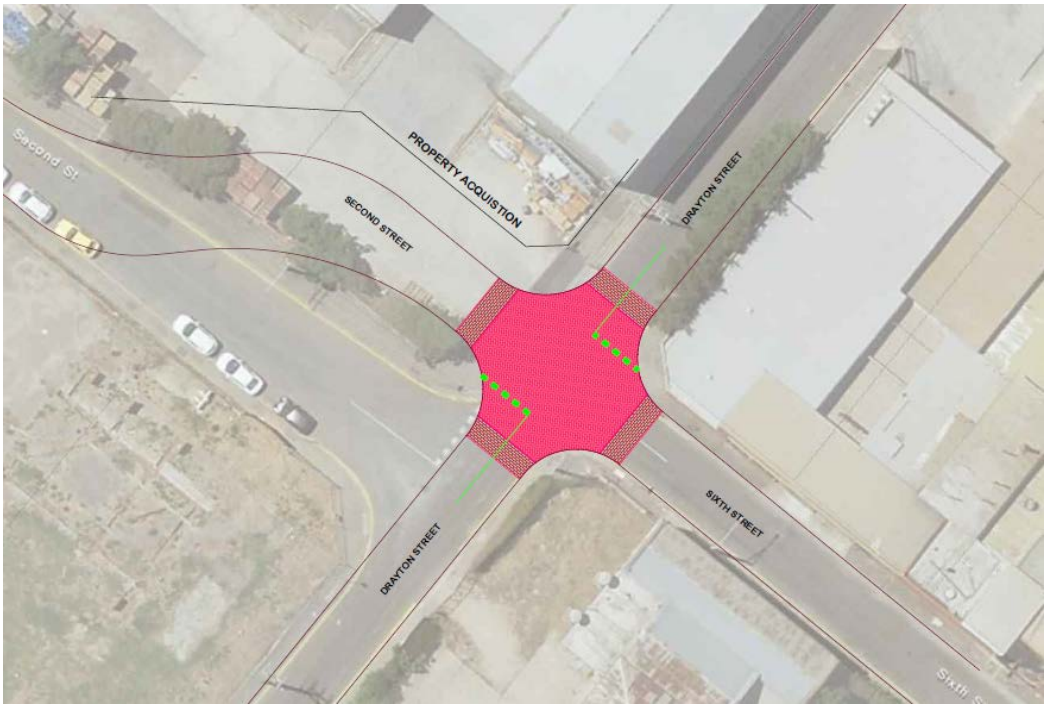


Figure 16 - Raised pavement treatment for Drayton Street/Second Street/Sixth Street intersection

- East Street will experience a reduction in volumes as a result of the closure of its south-western rail corridor crossing. Base line volumes (post-closure) would generally be expected to be relatively low (less than 100 vpd). The distribution of additional movements as a result of the redevelopment is anticipated to be in the order of 1,000 vpd to East Street. This would result in volumes on East Street remaining within the level typically associated with a local road. Such future volumes would generally be adequately accommodated without significant capacity impacts (queues, delays etc. would be within acceptable levels). Notwithstanding this, the cross section of East Street is narrow with limited sight distance provisions at existing intersections. The verges are limited to footpaths with little or no landscaping. The footpaths on the south-western side are also restricted by Stobie Poles. It is considered that the redevelopment of the site presents an opportunity to widen the road cross section (boundary to boundary) and improve road safety (for all users) as well as general amenity. There may also be an opportunity to realign the south-western approach of East Street at its intersection with Hawker Street to allow accommodation of additional movements (potentially left-out, in addition to the existing left-in/right-in movements). This could improve accessibility for East Street and also provide a more balanced distribution of the additional volumes. Right-out movements could potentially be physically achievable as well, however are not considerable desirable from a safety perspective given the traffic volume on Hawker Street and potential limitations to sight distance provisions.

- Drayton Street currently accommodates a relatively low traffic volume, however the additional volumes generated by redevelopment of the study area (as well as the Bowden Urban Village) will likely result in volumes in the order of 2,000 to 3,000 vpd. Such increases have already been reflected in its designation as a future minor collector road by Council. As noted in the IWPTPP, it is recommended that widening of the road be undertaken to ensure the additional volumes can be appropriately accommodated (and allow for improved pedestrian/cyclist provisions, landscaping and sight distance provisions).
- Gibson Street currently functions as a local road adjacent the study area (albeit is classed as a minor collector further west). It is anticipated that volumes would increase to approximately 2,750 to 3,000 vpd as a result of the study area's redevelopment. Such volumes are within the range typically associated with a minor collector road.

In addition to the above comments, it is noted that there are a number of existing and proposed four-way intersections within the study area. Such a layout is reflective of the grid network in the nearby Bowden Urban Village and provides optimised connectivity for pedestrians and cyclists into, out of and within the study area. Four-way intersections are, however, often associated with higher conflict potential. It is therefore desirable that traffic controls be implemented at key four-way intersections to minimise vehicle speeds and conflict potential. Given the relatively restricted road reserve widths, the installation of roundabouts would likely be cost prohibitive (due to property acquisition requirements in addition to relatively high capital costs). It is therefore considered that raised pavement treatments (plateaus) could be implemented in key locations to address this issue.

On the basis of the above, Figure 17 provides a high level indication of potential treatments within the study area. There would be potential for additional measures to be implemented in the future if required (such as additional raised pavement treatments). However, it is considered that this represents a general minimum level of traffic control measures for the study area to accommodate existing and additional movements.

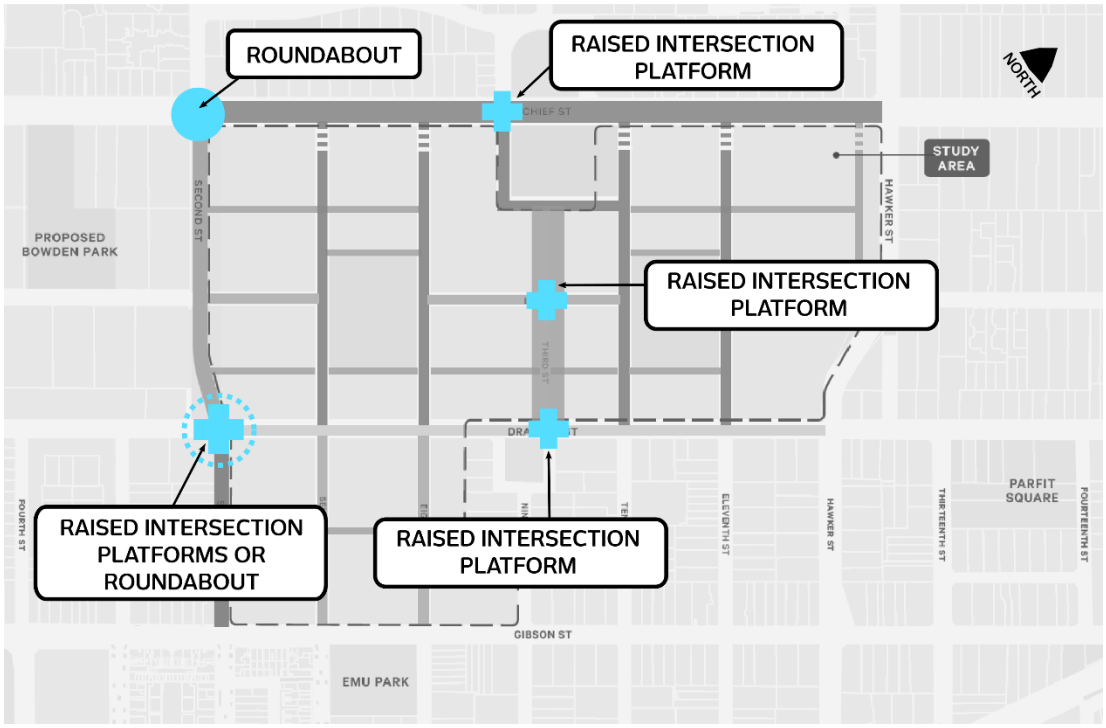


Figure 17 - Potential intersection treatments within the study area

In addition, high quality street design (in line with the principles of 'Streets for People') would also assist in lowering vehicle speeds and providing a safer road environment for all road users. Appendix B provides the high level concepts for potential road cross sections prepared by Oxigen (with input from CIRQA) that are reflective of the desired outcomes for the study area's street design and the proposed road hierarchy. These include consideration of potential road reserve widening and property acquisition requirements to achieve the desired outcomes. It is noted that two different cross sections have been prepared for the Sixth Street and Second Street collector route (that also differ from the existing cross section to the east of the study area). It would be desirable to apply a more consistent approach along the length of this collector route. Nevertheless, the options provide indicative solutions that can be explored further during future stages of development and depending on ultimate road widening undertaken.

6.2 INTERSECTION ANALYSIS

On the basis of the traffic generation and distribution analysis detailed in Section 5, SIDRA intersection modelling of the potential future traffic volumes has been undertaken for the key intersections. The modelling has been based on existing traffic count data with the Employment/Industrial forecast movements subtracted and the future residential forecasts added in. In addition, where the Parsons Brinckerhoff *"Bowden Urban Village – Traffic and Parking Study"* identified additional traffic volumes would be distributed to the subject intersection, these have also been included in the analysis.

Detailed intersection analysis results are provided in Appendix A and the key results summarised in the following subsections.

6.2.1 CHIEF STREET/PORT ROAD

The SIDRA analysis indicates that the additional volumes distributed to the Chief Street/Port Road intersection as a result of the redevelopment of the study area would be relatively easily accommodated with the existing volumes. However, including allowance for traffic generated by the ultimate Bowden Urban Village (and consideration of the closure of East Street at the rail corridor), the Chief Street approach to the intersection becomes oversaturated during the am peak period.

The SIDRA analysis indicates queues in the order of 600 m would be experienced in the am peak hour on Chief Street. In reality, it is likely that should such conditions be experienced, a proportion of drivers would redistribute to alternative routes (such as Sixth Street/Park Terrace or Field Street/Coglin Street). Nevertheless, opportunities to improve the capacity of the Chief Street/Port Road intersection should be explored. Desirably a second left turn on the Chief Street approach should be added, however there is limited verge width and this would likely require acquisition of the adjacent property and/or reduction in footpath widths. It would also be desirable to restrict parking.

It is also noted that the right turn lane on Port Road would require lengthening. This was also identified in the Parsons Brinckerhoff Bowden Urban Village report but has not been undertaken. It is difficult to identify specific timing of such upgrades as it would be dependent on the staging of development of the subject area as well as the Bowden Urban Village (for which previous analysis was only based on a single future design year – 2031). However, based on available information and the SIDRA analysis undertaken, it is anticipated that such treatments would be required by approximately 2025. A preliminary concept has been prepared illustrating a potential upgrade and is included in Appendix C (albeit is subject to DPTI/Council review).

6.2.2 SIXTH STREET/PARK TERRACE

There is no recent traffic count data available for the intersection of Sixth Street and Park Terrace. Nevertheless, it is forecast that only 30 additional peak hour movements would be distributed to/from this intersection as a result of the redevelopment of the study area. Any future upgrade requirement would have little relationship to the additional volumes generated by the subject redevelopment.

Notwithstanding the above, it is noted the SIDRA modelling in the Parsons Brinckerhoff report for the Bowden Urban Village indicated the Sixth Street approach to Park Terrace would have a low Level of Service and excessive delays.

The Aimsun modelling prepared by Parsons Brinckerhoff, however, suggested that the adjacent Pedestrian Actuated Crossing (partially installed but not yet fully implemented) would generate gaps in the traffic stream and assist drivers in exiting Sixth Street more efficiently. These findings however were prepared on the basis that East Street would remain open at the rail corridor. The closure of this road (at the rail corridor) will be likely to result in a redistribution of a relatively high number of movements from the Bowden Urban Village. A proportion would be likely to 'shift' to Chief Street, however this has limited capacity as noted above. There would therefore also be likely to be a relatively high number of movements redistributed (from the Parsons Brinckerhoff forecasts) to intersections on Park Terrace, in particular its intersection with Sixth Street. While this has not been modelled in detail, it is considered likely that this intersection will require signalisation in the future to adequately accommodate movements associated with the Bowden Urban Village (as well surrounding areas including the study area). A preliminary upgrade concept has been prepared and is included in Appendix C (albeit is subject to further analysis and DPTI/Council review).

6.2.3 CHIEF STREET/HAWKER STREET

The SIDRA analysis indicates that the additional volumes distributed to the intersection of Chief Street and Hawker Street will be readily accommodated (even with the inclusion of Bowden Urban Village forecasts). Levels of Service for each approach would be 'C', with the exception of the north-western Hawker Street approach which would be 'D' in both peak hours. The Degrees of Saturation, queues and average delays for each approach would be within reasonable levels with no specific upgrade requirements.

6.2.4 CHIEF STREET/TORRENS ROAD

The intersection of Chief Street/Torrens Road will generally operate satisfactorily with the additional volumes distributed to it. However, in the pm peak hour, the right turn movement from Torrens Road (north-west) into Chief Street will have a Level of Service of 'F' with a Degree of Saturation of 0.94. Given there is no separated right turn lane, vehicles undertaking this right turn movement also restrict one of the through lanes. Additional growth in traffic volumes on the road network would put additional pressure on the intersection's capacity.

Should queues and delays associated with the right turn movement become excessive, it is likely that a proportion of drivers would redistribute to earlier right turn opportunities (such as Coglin Street or West Street, which would reduce the impact on the Chief Street/Torrens Road intersection. Nevertheless, while not solely warranted as a result of redevelopment of the study area, it would be desirable, that consideration be given to the provision of a sheltered right turn lane to improve the intersection capacity (as well as safety). This would further reinforce Chief Street as the distributor route rather than alternative lower order roads. Such an upgrade would desirably undertaken in the short-term (within

three to five years) given there is little capacity for any increase in volumes associated with the right turn into Chief Street. A preliminary concept has been prepared illustrating a potential upgrade and is included in Appendix C (albeit is subject to DPTI/Council review).

6.2.5 PARK TERRACE/HAWKER STREET/WAR MEMORIAL DRIVE

The SIDRA analysis indicates that there is adequate capacity at the Park Terrace/ Hawker Street/War Memorial Drive intersection to accommodate the forecast additional volumes (as well as the Bowden Urban Village traffic). However, the intersection will be approaching capacity with Degrees of Saturation in the order of 0.90 to 0.95 for most movements. Delays and queues on the major approaches will be relatively high, however not dissimilar to existing conditions. No upgrade requirements are identified as being warranted as part of redevelopment of the study area, however there would be limited capacity at the intersection for future growth on the road network following development of the site.

7. PARKING PROVISIONS

7.1 OFF-STREET PARKING

The provision of both on-street and off-street parking as part of the redevelopment of the site is an important transport consideration. Parking issues have been experienced within the nearby Bowden Urban Village project due to relatively low off-street parking provision and an initial lack of on-street parking restrictions (with long-term, resident parking occurring on-street). It is important to achieve a balance between restricting parking (to encourage use of active and sustainable transport modes) without resulting in significant undersupply and overflow of on-street demand to surrounding areas.

Council's Development Plan identifies a variety of parking provision requirements for residential land uses (depending on location/zone and type of dwelling). At the lower end of the provision range, dwellings within the Bowden Urban Village (irrespective of type) have a requirement for 0.75 spaces per dwelling and no visitor parking requirement. At the higher end of the range, a rate of 2 spaces per detached or semi-detached dwelling applies generally. For group, row and residential flat buildings within 1 km of a District Centre (as is the study area), the parking provision is dependent on dwelling size, as summarised in Table 4.

Table 4 – Group, row and flat building parking provisions

Dwelling size	Average spaces required
3+ bedrooms or >130 m²	1.25 spaces per dwelling
2 bedrooms or 75 to 130 m²	1.0 spaces per dwelling
1 bedroom or < 75 m²	1.0 spaces per dwelling
Visitor parking	0.25 spaces per dwelling

The requirement of 0.75 spaces per apartment for the Bowden Urban Village is extremely low. Of note, CIRQA undertook a detailed study of apartment dwelling parking provisions for Renewal SA (in relation to the Bowden Urban Village project). The CIRQA study, which included economic analysis from JLL, identified that:

- developments within the Bowden Urban Village were generally not meeting the 0.75 spaces per dwelling rate (this will put increased pressure on future stages of the site to provide at even lower, and unrealistic, rates to get the overall site average to the target level);
- comparable developments within Adelaide's Inner Rim had an average parking provision rate of 1.2 spaces per dwelling. Lower rates were identified for comparable interstate developments (of 0.9 to 1.0 spaces per dwelling), but were notably still higher than the 0.75 spaces per dwelling desired in the Bowden Urban Village;

- while the general intent of a low parking provision rate is considered appropriate (reduced reliance on private motor vehicles), application of a very low rate risks the marketability/, saleability and viability of the developments (particularly in comparison to other market offerings in comparable locations);
- insufficient on-street parking management prior to sale/occupation of dwellings has led to a proportion of residents 'expecting' that a second private vehicle can be accommodated on-street; and

As a result of the Bowden Urban Village study, it was suggested that a range in the provision rate between 0.75 to 1.0 spaces per dwelling would be more appropriate. Such a range would still be lower than other comparable developments in Adelaide, provide increased flexibility and yet also encourage lower reliance on private motor vehicles. Furthermore, it was considered that other measures (such as increased public transport services/infrastructure, car share systems and improved active transport networks) could be implemented to assist in the minimisation of resident reliance on private motor vehicles. The above range is considered appropriate for application to the subject area.

In addition, CIRQA prepared a similar study for PEET Limited's apartment developments at Lightsview which reviewed ABS statistics relating to car ownership in apartments within Adelaide. The Lightsview study identified that, on average, there are 1.02 vehicles per apartment dwelling (CBD apartments were excluded from the study, given the low parking rates would have skewed the results). This data suggested a rate of 1.0 space per apartment dwelling was appropriate. Given the reasonable level of accessibility by active and sustainable transport modes within the study area, this suggests the range previously identified above for parking provision is likely to be appropriate. Consideration could, however, be given to a slightly higher provision for 3-bedroom (or more) apartment dwellings (potentially off-set by provision rates below 1 space per dwelling for studios or one-bedroom dwellings).

In relation to townhouses, it is considered that the requirements in Table 4 would generally be appropriate given the study area locality and transport accessibility considerations.

7.2 ON-STREET PARKING

It would desirable to accommodate increased provision of on-street parking within the existing streets (through widening as noted above). This could be achieved in a similar manner to the indented on-street parking within the Bowden Urban Village. New roads formed as a result of the redevelopment should also allow for on-street parking (with the exception of laneways). It is considered that on-street parking management controls should be considered during the early

phases on any development proposals. If considered necessary to control long-term resident parking on-street, parking restrictions should be applied early on as part of any redevelopment works to ensure purchasers are aware that on-street parking is not desirable/permitted (i.e. controls should be installed before parking problems are experienced, if possible).

7.3 CAR SHARE SCHEMES

Car sharing is a term utilised to describe vehicle rental services which provide a substitute for private vehicle ownership. Car sharing differs from traditional car rentals in that the services are decentralised, member based and (often) self-service. Car share vehicles are typically stored within on-street (dedicated) spaces spread throughout urban and suburban locations. Pick-up and drop-off by members is automated (albeit some alternative models do exist) and services are often priced per minute and/or hour. The most successful car share scheme in Australia is "Go Get", albeit other services do exist. "Go Get" is currently implemented within the Bowden Urban Village (with two existing spaces) and more proposed as the development progresses. "Car Next Door" (an alternative form of car share based on sharing of vehicles between neighbours) has also recently been increasing in popularity in Australia (albeit is not currently available in Adelaide).

It is commonly accepted that car sharing for most households is not cost-effective for regular commuting trips. However, car sharing provides an affordable arrangement for occasional use of a motor vehicle and, where successfully implemented, allows households to reduce their vehicle ownership. For instance, where residents undertake their commute trips by active or sustainable modes, car share schemes provide convenient access to a motor vehicle for non-commute trips such as recreational weekend trips or bulky goods shopping. Car sharing has also been associated with reduced reliance on motor vehicle use as car share users are more likely to undertake trips by alternative modes and only utilise motor vehicles when needed.

The implementation of car share schemes has been highly successfully interstate, particularly in Sydney and Melbourne (where reductions in household car ownership have since been observed). Car share schemes are also being increasingly integrated into new high density developments to reduce the need for off-street resident parking whilst maintaining a reasonable level of convenient transport for residents.

A number of studies have been undertaken in respect to the overall impact of car share schemes in Australia. The studies have suggested that that one car share vehicle could result in a reduction in the need for 7 to 13 private vehicles. A recent study prepared by SGS Economics of the "Go Get" scheme for the City of Sydney identified that there were 22 members per parking space provided for a car share

vehicle. Even at the lower end of the above range of parking rates, it can be seen that car sharing has significant potential to reduce household vehicle ownership.

It is understood that eight on-street car share parking spaces are proposed within the Bowden Urban Village. Provision of a similar number of spaces within the subject study area would be supportable and beneficial in reducing reliance on private motor vehicles. Spaces would generally be evenly distributed throughout the study area, however could have a greater 'focus' in areas of higher density development. High density developments (apartment buildings) within the study area could also include on-site car share spaces for residents which would also be beneficial in minimising vehicle ownership rates and parking provision requirements.

8. SUMMARY

The subject rezoning within Brompton and Bowden will facilitate the future redevelopment of the study area for residential development. It is anticipated that in the order of 1,500 dwellings (townhouses and apartments) could be developed within the overall site.

The redevelopment presents an opportunity to improve transport provisions within the study area and improve connectivity for the broader community. As part of the redevelopment, it has been recommended that a continuation of the existing grid network with new roads and laneways be undertaken. A number of the existing streets should be widened to improve accommodation of all transport modes and provide additional landscaping/streetscaping opportunities. The City of Charles Sturt's road hierarchy should be reinforced with appropriate street design. In particular, dwellings fronting the distributor and collector roads should desirably be rear loaded to minimise conflict points and maximise capacity on these roads.

Opportunities to improve walking and cycling connectivity would be presented by the redevelopment of the site. Generally, it is anticipated that a "Streets for People" approach (similar to that in the Bowden Urban Village) would be adopted. A new bicycle network connection could be reinforced via Eighth Street to provide a more direct connection between the area and Park Lands trails. Consideration has also been given to public transport provisions. While additional routes have been considered, increased servicing of existing routes would be preferred in the first instance.

An assessment has been undertaken of the additional (vehicular) traffic volumes that could be generated by the redevelopment. The assessment indicates that an additional 5,445 daily trips and 375 peak hour trips could be generated by rezoning and subsequent redevelopment of the study area. The impact assessment suggests that Drayton Street and Second Street will increase in function to minor collector and distributor roads, respectively.

Detailed analysis has also been undertaken for a number of key intersections surrounding the study area. Generally, the additional volumes associated with the potential redevelopment are relatively low. However, the ongoing Bowden Urban Village development and the closure of the East Street rail crossing (for vehicles) will put additional pressure on the intersections assessed. In particular, the following key outcomes of the assessment have been identified:

- The Chief Street/Port Road intersection is likely to experience capacity issues following full development of the subject area and Bowden Urban Village. The right turn lane on Port Road for movements into Chief Street should be extended (as previously recommended as part of the Bowden

Urban Village project). The opportunity to provide a second left turn lane from Chief Street to Port Road should also be further explored, however this is likely to be difficult due to existing constraints. From a high level perspective, it is considered that upgrade works to improve the capacity would likely be required by 2025.

- As a result of the closure on East Street and the limited capacity at Chief Street/Port Road, there will be a significant increase in pressure on the intersection of Sixth Street/Park Terrace. The volumes distributed to the Sixth Street/Park Terrace intersection as a result of the redevelopment will be low. Therefore, it is considered that upgrade of this intersection is not directly required as a result of the potential redevelopment, but, nevertheless will ultimately be required (by 2031) to accommodate all of the developments discussed as well as general growth in volumes on the road network.
- An upgrade of the intersection of Chief Street/Second Street should be undertaken to enable safe and efficient accommodation of the additional traffic volumes. It has been recommended that a roundabout be implemented at the intersection, albeit this will require some property acquisition to achieve. The timing of such an upgrade will ultimately depend on staging of development of the subject area, however would be anticipated to be undertaken in conjunction with any stages in the western corner of the study area (which would have greatest impact on the intersection).
- No upgrade is required to accommodate the additional development volumes at the intersection of Chief Street/Hawker Street.
- The right turn movement at the intersection of Chief Street/Torrens Road has little or no capacity for additional volumes. While not solely required as a a result of the development (general growth in traffic volumes would oversaturate the movement), the provision of a sheltered right turn lane for turns into Chief Street is warranted. Such an upgrade is considered desriable within the next three to five years (given the limited capacity that currently exists at the intersection).
- The recent upgrades to the Park Terrace/Hawker Street/War Memorial Drive would be sufficient to accommodate the additional volumes associated with the future development of the subject area with no further upgrade warranted.
- The intersection of Drayton Street/Sixth Street/Second Street should be realigned to more appropriately reflect the collector routes. This could be treated with a raised pavement (plateau) or a roundabout. This would desirably be undertaken in conjunction with development stages along southern section of the study area (along Drayton Street) and/or along Second Street.

- In addition, raised pavement (plateau) treatments could be implemented at key four-way intersections within the study area to minimise vehicle speeds and conflict potential for all road users at these locations. Such treatments could be implemented (subject to detailed design and further review by Council) as development staging proceeds through the study area.

APPENDIX A

SIDRA ANALYSIS OUTPUT

INTERSECTION SUMMARY

Site: Chief/Hawker AM - Exist

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Intersection Performance - Hourly Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Travel Speed (Average)	31.0	km/h	2.4	km/h	30.0	km/h
Travel Distance (Total)	1810.2	veh-km/h	6.1	ped-km/h	2178.3	pers-km/h
Travel Time (Total)	58.3	veh-h/h	2.6	ped-h/h	72.5	pers-h/h
Demand Flows (Total)	1476	veh/h	211	ped/h	1771	pers/h
Percent Heavy Vehicles (Demand)	4.2	%				
Degree of Saturation	0.706		0.011			
Practical Spare Capacity	27.5	%				
Effective Intersection Capacity	2091	veh/h				
Control Delay (Total)	13.05	veh-h/h	1.25	ped-h/h	16.91	pers-h/h
Control Delay (Average)	31.8	sec	21.4	sec	34.4	sec
Control Delay (Worst Lane)	41.3	sec				
Control Delay (Worst Movement)	43.8	sec	22.3	sec	43.8	sec
Geometric Delay (Average)	1.1	sec				
Stop-Line Delay (Average)	30.7	sec				
Idling Time (Average)	27.4	sec				
Intersection Level of Service (LOS)	LOS C		LOS C			
95% Back of Queue - Vehicles (Worst Lane)	27.1	veh				
95% Back of Queue - Distance (Worst Lane)	195.2	m				
Queue Storage Ratio (Worst Lane)	0.27					
Total Effective Stops	1152	veh/h	126	ped/h	1508	pers/h
Effective Stop Rate	0.78	per veh	0.60	per ped	0.85	per pers
Proportion Queued	0.86		0.60		0.93	
Performance Index	319.0		3.3		322.2	
Cost (Total)	1332.84	$/h	63.04	$/h	1395.88	$/h
Fuel Consumption (Total)	166.7	L/h				
Carbon Dioxide (Total)	396.6	kg/h				
Hydrocarbons (Total)	0.031	kg/h				
Carbon Monoxide (Total)	0.230	kg/h				
NOx (Total)	0.593	kg/h				

Level of Service (LOS) Method: Delay (HCM 2000).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Intersection Performance - Annual Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Demand Flows (Total)	708,379	veh/y	101,053	ped/y	850,055	pers/y
Delay	6,266	veh-h/y	600	ped-h/y	8,119	pers-h/y
Effective Stops	552,794	veh/y	60,343	ped/y	723,696	pers/y
Travel Distance	868,880	veh-km/y	2,951	ped-km/y	1,045,607	pers-km/y
Travel Time	27,995	veh-h/y	1,230	ped-h/y	34,824	pers-h/y
Cost	639,764	$/y	30,258	$/y	670,022	$/y
Fuel Consumption	80,019	L/y				
Carbon Dioxide	190,388	kg/y				
Hydrocarbons	15	kg/y				
Carbon Monoxide	110	kg/y				
NOx	285	kg/y				

SIDRA INTERSECTION 6.1 | Copyright © 2000-2015 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: Chief/Hawker AM - Exist

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Hawker St (SE)											
4	L2	61	5.7	0.387	32.2	LOS C	10.2	75.1	0.77	0.71	32.5
5	T1	134	5.7	0.387	28.7	LOS C	10.2	75.1	0.77	0.71	30.2
6	R2	47	5.7	0.387	32.3	LOS C	10.2	75.1	0.77	0.71	29.6
Approach		242	5.7	0.387	30.3	LOS C	10.2	75.1	0.77	0.71	30.8
NorthEast: Chief St (NE)											
7	L2	77	3.3	0.706	33.1	LOS C	27.1	195.2	0.88	0.80	29.8
8	T1	479	3.3	0.706	29.7	LOS C	27.1	195.2	0.88	0.80	32.1
9	R2	16	3.3	0.706	33.2	LOS C	27.1	195.2	0.88	0.80	29.4
Approach		572	3.3	0.706	30.2	LOS C	27.1	195.2	0.88	0.80	31.8
NorthWest: Hawker St (NW)											
10	L2	56	5.2	0.705	33.2	LOS C	23.6	172.4	0.88	0.81	29.4
11	T1	285	5.2	0.705	29.8	LOS C	23.6	172.4	0.88	0.81	29.9
12	R2	154	5.2	0.705	33.4	LOS C	23.6	172.4	0.88	0.81	32.0
Approach		495	5.2	0.705	31.3	LOS C	23.6	172.4	0.88	0.81	30.6
SouthWest: Chief St (SW)											
1	L2	15	2.3	0.419	43.7	LOS D	8.2	58.8	0.88	0.75	30.3
2	T1	117	2.3	0.419	40.3	LOS D	8.2	58.8	0.88	0.75	29.9
3	R2	36	2.3	0.419	43.8	LOS D	8.2	58.8	0.88	0.75	30.2
Approach		167	2.3	0.419	41.3	LOS D	8.2	58.8	0.88	0.75	30.0
All Vehicles		1476	4.2	0.706	31.8	LOS C	27.1	195.2	0.86	0.78	31.0

Level of Service (LOS) Method: Delay (HCM 2000).
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	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P2	SouthEast Full Crossing	53	22.3	LOS C	0.1	0.1	0.61	0.61
P3	NorthEast Full Crossing	53	20.5	LOS C	0.1	0.1	0.58	0.58
P4	NorthWest Full Crossing	53	22.3	LOS C	0.1	0.1	0.61	0.61
P1	SouthWest Full Crossing	53	20.5	LOS C	0.1	0.1	0.58	0.58
All Pedestrians		211	21.4	LOS C			0.60	0.60

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.

INTERSECTION SUMMARY

Site: Chief/Hawker AM - Exist+DPA + BUV

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Intersection Performance - Hourly Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Travel Speed (Average)	30.7	km/h	2.4	km/h	29.8	km/h
Travel Distance (Total)	1968.0	veh-km/h	6.1	ped-km/h	2367.8	pers-km/h
Travel Time (Total)	64.0	veh-h/h	2.6	ped-h/h	79.4	pers-h/h
Demand Flows (Total)	1595	veh/h	211	ped/h	1914	pers/h
Percent Heavy Vehicles (Demand)	4.1	%				
Degree of Saturation	0.730		0.011			
Practical Spare Capacity	23.2	%				
Effective Intersection Capacity	2183	veh/h				
Control Delay (Total)	14.81	veh-h/h	1.25	ped-h/h	19.03	pers-h/h
Control Delay (Average)	33.4	sec	21.4	sec	35.8	sec
Control Delay (Worst Lane)	43.8	sec				
Control Delay (Worst Movement)	46.3	sec	22.3	sec	46.3	sec
Geometric Delay (Average)	1.1	sec				
Stop-Line Delay (Average)	32.3	sec				
Idling Time (Average)	28.9	sec				
Intersection Level of Service (LOS)	LOS C		LOS C			
95% Back of Queue - Vehicles (Worst Lane)	27.5	veh				
95% Back of Queue - Distance (Worst Lane)	198.1	m				
Queue Storage Ratio (Worst Lane)	0.28					
Total Effective Stops	1270	veh/h	126	ped/h	1649	pers/h
Effective Stop Rate	0.80	per veh	0.60	per ped	0.86	per pers
Proportion Queued	0.88		0.60		0.95	
Performance Index	353.2		3.3		356.4	
Cost (Total)	1490.32	$/h	63.04	$/h	1553.36	$/h
Fuel Consumption (Total)	181.8	L/h				
Carbon Dioxide (Total)	432.3	kg/h				
Hydrocarbons (Total)	0.034	kg/h				
Carbon Monoxide (Total)	0.250	kg/h				
NOx (Total)	0.637	kg/h				

Level of Service (LOS) Method: Delay (HCM 2000).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Intersection Performance - Annual Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Demand Flows (Total)	765,474	veh/y	101,053	ped/y	918,568	pers/y
Delay	7,111	veh-h/y	600	ped-h/y	9,132	pers-h/y
Effective Stops	609,473	veh/y	60,343	ped/y	791,711	pers/y
Travel Distance	944,659	veh-km/y	2,951	ped-km/y	1,136,541	pers-km/y
Travel Time	30,734	veh-h/y	1,230	ped-h/y	38,111	pers-h/y
Cost	715,354	$/y	30,258	$/y	745,612	$/y
Fuel Consumption	87,248	L/y				
Carbon Dioxide	207,518	kg/y				
Hydrocarbons	16	kg/y				
Carbon Monoxide	120	kg/y				
NOx	306	kg/y				

SIDRA INTERSECTION 6.1 | Copyright © 2000-2015 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: Chief/Hawker AM - Exist+DPA + BUV

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Hawker St (SE)											
4	L2	72	5.7	0.444	33.0	LOS C	12.1	88.5	0.79	0.73	32.3
5	T1	153	5.7	0.444	29.5	LOS C	12.1	88.5	0.79	0.73	30.0
6	R2	54	5.7	0.444	33.1	LOS C	12.1	88.5	0.79	0.73	29.4
Approach		278	5.7	0.444	31.1	LOS C	12.1	88.5	0.79	0.73	30.6
NorthEast: Chief St (NE)											
7	L2	76	3.3	0.717	33.3	LOS C	27.5	198.1	0.89	0.80	29.7
8	T1	484	3.3	0.717	29.9	LOS C	27.5	198.1	0.89	0.80	32.0
9	R2	16	3.3	0.717	33.4	LOS C	27.5	198.1	0.89	0.80	29.4
Approach		576	3.3	0.717	30.4	LOS C	27.5	198.1	0.89	0.80	31.7
NorthWest: Hawker St (NW)											
10	L2	55	5.2	0.730	35.0	LOS C	24.1	176.3	0.90	0.82	28.9
11	T1	281	5.2	0.730	31.6	LOS C	24.1	176.3	0.90	0.82	29.5
12	R2	156	5.2	0.730	35.1	LOS D	24.1	176.3	0.90	0.82	31.7
Approach		492	5.2	0.730	33.1	LOS C	24.1	176.3	0.90	0.82	30.3
SouthWest: Chief St (SW)											
1	L2	23	2.3	0.613	46.2	LOS D	13.0	93.1	0.94	0.80	29.9
2	T1	178	2.3	0.613	42.8	LOS D	13.0	93.1	0.94	0.80	29.5
3	R2	48	2.3	0.613	46.3	LOS D	13.0	93.1	0.94	0.80	29.8
Approach		249	2.3	0.613	43.8	LOS D	13.0	93.1	0.94	0.80	29.6
All Vehicles		1595	4.1	0.730	33.4	LOS C	27.5	198.1	0.88	0.80	30.7

Level of Service (LOS) Method: Delay (HCM 2000).
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	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P2	SouthEast Full Crossing	53	22.3	LOS C	0.1	0.1	0.61	0.61
P3	NorthEast Full Crossing	53	20.5	LOS C	0.1	0.1	0.58	0.58
P4	NorthWest Full Crossing	53	22.3	LOS C	0.1	0.1	0.61	0.61
P1	SouthWest Full Crossing	53	20.5	LOS C	0.1	0.1	0.58	0.58
All Pedestrians		211	21.4	LOS C			0.60	0.60

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.

INTERSECTION SUMMARY

Site: Chief/Hawker PM - Exist

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Intersection Performance - Hourly Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Travel Speed (Average)	31.5	km/h	2.4	km/h	30.4	km/h
Travel Distance (Total)	1697.0	veh-km/h	6.1	ped-km/h	2042.5	pers-km/h
Travel Time (Total)	53.9	veh-h/h	2.6	ped-h/h	67.3	pers-h/h
Demand Flows (Total)	1407	veh/h	211	ped/h	1689	pers/h
Percent Heavy Vehicles (Demand)	3.9	%				
Degree of Saturation	0.598		0.012			
Practical Spare Capacity	50.5	%				
Effective Intersection Capacity	2353	veh/h				
Control Delay (Total)	11.51	veh-h/h	1.26	ped-h/h	15.07	pers-h/h
Control Delay (Average)	29.4	sec	21.5	sec	32.1	sec
Control Delay (Worst Lane)	34.1	sec				
Control Delay (Worst Movement)	36.3	sec	24.8	sec	36.3	sec
Geometric Delay (Average)	1.0	sec				
Stop-Line Delay (Average)	28.4	sec				
Idling Time (Average)	25.3	sec				
Intersection Level of Service (LOS)	LOS C		LOS C			
95% Back of Queue - Vehicles (Worst Lane)	21.7	veh				
95% Back of Queue - Distance (Worst Lane)	154.9	m				
Queue Storage Ratio (Worst Lane)	0.16					
Total Effective Stops	1031	veh/h	126	ped/h	1363	pers/h
Effective Stop Rate	0.73	per veh	0.60	per ped	0.81	per pers
Proportion Queued	0.81		0.60		0.88	
Performance Index	286.6		3.3		289.8	
Cost (Total)	1364.52	$/h	63.21	$/h	1427.73	$/h
Fuel Consumption (Total)	153.0	L/h				
Carbon Dioxide (Total)	363.2	kg/h				
Hydrocarbons (Total)	0.028	kg/h				
Carbon Monoxide (Total)	0.206	kg/h				
NOx (Total)	0.510	kg/h				

Level of Service (LOS) Method: Delay (HCM 2000).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Intersection Performance - Annual Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Demand Flows (Total)	675,537	veh/y	101,053	ped/y	810,644	pers/y
Delay	5,525	veh-h/y	603	ped-h/y	7,232	pers-h/y
Effective Stops	494,978	veh/y	60,343	ped/y	654,317	pers/y
Travel Distance	814,560	veh-km/y	2,951	ped-km/y	980,422	pers-km/y
Travel Time	25,891	veh-h/y	1,233	ped-h/y	32,302	pers-h/y
Cost	654,969	$/y	30,339	$/y	685,308	$/y
Fuel Consumption	73,417	L/y				
Carbon Dioxide	174,351	kg/y				
Hydrocarbons	13	kg/y				
Carbon Monoxide	99	kg/y				
NOx	245	kg/y				

SIDRA INTERSECTION 6.1 | Copyright © 2000-2015 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: Chief/Hawker PM - Exist

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Hawker St (SE)											
4	L2	27	5.7	0.598	35.2	LOS D	18.4	134.7	0.86	0.77	32.0
5	T1	296	5.7	0.598	31.8	LOS C	18.4	134.7	0.86	0.77	29.6
6	R2	69	5.7	0.598	35.4	LOS D	18.4	134.7	0.86	0.77	29.0
Approach		393	5.7	0.598	32.7	LOS C	18.4	134.7	0.86	0.77	29.7
NorthEast: Chief St (NE)											
7	L2	58	3.3	0.410	31.8	LOS C	11.0	79.4	0.77	0.70	29.9
8	T1	162	3.3	0.410	28.4	LOS C	11.0	79.4	0.77	0.70	32.2
9	R2	41	3.3	0.410	31.9	LOS C	11.0	79.4	0.77	0.70	29.6
Approach		261	3.3	0.410	29.7	LOS C	11.0	79.4	0.77	0.70	31.4
NorthWest: Hawker St (NW)											
10	L2	51	5.2	0.423	36.2	LOS D	10.6	77.7	0.82	0.73	28.7
11	T1	142	5.2	0.423	32.7	LOS C	10.6	77.7	0.82	0.73	29.3
12	R2	43	5.2	0.423	36.3	LOS D	10.6	77.7	0.82	0.73	31.5
Approach		236	5.2	0.423	34.1	LOS C	10.6	77.7	0.82	0.73	29.6
SouthWest: Chief St (SW)											
1	L2	89	2.3	0.591	27.3	LOS C	21.7	154.9	0.78	0.72	33.6
2	T1	388	2.3	0.591	23.9	LOS C	21.7	154.9	0.78	0.72	33.3
3	R2	40	2.3	0.591	27.4	LOS C	21.7	154.9	0.78	0.72	33.5
Approach		518	2.3	0.591	24.7	LOS C	21.7	154.9	0.78	0.72	33.3
All Vehicles		1407	3.9	0.598	29.4	LOS C	21.7	154.9	0.81	0.73	31.5

Level of Service (LOS) Method: Delay (HCM 2000).
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	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P2	SouthEast Full Crossing	53	18.2	LOS B	0.1	0.1	0.55	0.55
P3	NorthEast Full Crossing	53	24.8	LOS C	0.1	0.1	0.64	0.64
P4	NorthWest Full Crossing	53	18.2	LOS B	0.1	0.1	0.55	0.55
P1	SouthWest Full Crossing	53	24.8	LOS C	0.1	0.1	0.64	0.64
All Pedestrians		211	21.5	LOS C			0.60	0.60

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.

INTERSECTION SUMMARY

Site: Chief/Hawker PM - Exist+DPA + BUV

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Intersection Performance - Hourly Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Travel Speed (Average)	31.1	km/h	2.4	km/h	30.1	km/h
Travel Distance (Total)	1853.9	veh-km/h	6.1	ped-km/h	2230.8	pers-km/h
Travel Time (Total)	59.6	veh-h/h	2.6	ped-h/h	74.1	pers-h/h
Demand Flows (Total)	1531	veh/h	211	ped/h	1837	pers/h
Percent Heavy Vehicles (Demand)	3.9	%				
Degree of Saturation	0.624		0.013			
Practical Spare Capacity	44.3	%				
Effective Intersection Capacity	2454	veh/h				
Control Delay (Total)	13.24	veh-h/h	1.26	ped-h/h	17.15	pers-h/h
Control Delay (Average)	31.2	sec	21.5	sec	33.6	sec
Control Delay (Worst Lane)	38.0	sec				
Control Delay (Worst Movement)	40.1	sec	25.4	sec	40.1	sec
Geometric Delay (Average)	1.1	sec				
Stop-Line Delay (Average)	30.1	sec				
Idling Time (Average)	26.9	sec				
Intersection Level of Service (LOS)	LOS C		LOS C			
95% Back of Queue - Vehicles (Worst Lane)	22.9	veh				
95% Back of Queue - Distance (Worst Lane)	163.4	m				
Queue Storage Ratio (Worst Lane)	0.16					
Total Effective Stops	1156	veh/h	126	ped/h	1512	pers/h
Effective Stop Rate	0.76	per veh	0.60	per ped	0.82	per pers
Proportion Queued	0.83		0.60		0.90	
Performance Index	321.7		3.3		324.9	
Cost (Total)	1497.59	$/h	63.28	$/h	1560.87	$/h
Fuel Consumption (Total)	168.3	L/h				
Carbon Dioxide (Total)	399.7	kg/h				
Hydrocarbons (Total)	0.031	kg/h				
Carbon Monoxide (Total)	0.228	kg/h				
NOx (Total)	0.562	kg/h				

Level of Service (LOS) Method: Delay (HCM 2000).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Intersection Performance - Annual Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Demand Flows (Total)	734,653	veh/y	101,053	ped/y	881,583	pers/y
Delay	6,357	veh-h/y	604	ped-h/y	8,233	pers-h/y
Effective Stops	554,709	veh/y	60,343	ped/y	725,994	pers/y
Travel Distance	889,865	veh-km/y	2,951	ped-km/y	1,070,789	pers-km/y
Travel Time	28,607	veh-h/y	1,235	ped-h/y	35,563	pers-h/y
Cost	718,845	$/y	30,373	$/y	749,218	$/y
Fuel Consumption	80,787	L/y				
Carbon Dioxide	191,869	kg/y				
Hydrocarbons	15	kg/y				
Carbon Monoxide	109	kg/y				
NOx	270	kg/y				

SIDRA INTERSECTION 6.1 | Copyright © 2000-2015 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: Chief/Hawker PM - Exist+DPA + BUV

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Hawker St (SE)											
4	L2	33	5.7	0.624	37.0	LOS D	18.8	137.7	0.88	0.78	31.7
5	T1	289	5.7	0.624	33.6	LOS C	18.8	137.7	0.88	0.78	29.2
6	R2	68	5.7	0.624	37.1	LOS D	18.8	137.7	0.88	0.78	28.6
Approach		391	5.7	0.624	34.5	LOS C	18.8	137.7	0.88	0.78	29.3
NorthEast: Chief St (NE)											
7	L2	65	3.3	0.492	32.3	LOS C	14.3	103.0	0.80	0.73	29.9
8	T1	217	3.3	0.492	28.8	LOS C	14.3	103.0	0.80	0.73	32.1
9	R2	46	3.3	0.492	32.4	LOS C	14.3	103.0	0.80	0.73	29.5
Approach		328	3.3	0.492	30.0	LOS C	14.3	103.0	0.80	0.73	31.4
NorthWest: Hawker St (NW)											
10	L2	58	5.2	0.540	40.0	LOS D	13.6	99.2	0.88	0.78	27.8
11	T1	163	5.2	0.540	36.5	LOS D	13.6	99.2	0.88	0.78	28.4
12	R2	59	5.2	0.540	40.1	LOS D	13.6	99.2	0.88	0.78	30.7
Approach		280	5.2	0.540	38.0	LOS D	13.6	99.2	0.88	0.78	28.9
SouthWest: Chief St (SW)											
1	L2	91	2.3	0.617	28.4	LOS C	22.9	163.4	0.80	0.74	33.4
2	T1	397	2.3	0.617	24.9	LOS C	22.9	163.4	0.80	0.74	33.0
3	R2	44	2.3	0.617	28.5	LOS C	22.9	163.4	0.80	0.74	33.3
Approach		532	2.3	0.617	25.8	LOS C	22.9	163.4	0.80	0.74	33.1
All Vehicles		1531	3.9	0.624	31.2	LOS C	22.9	163.4	0.83	0.76	31.1

Level of Service (LOS) Method: Delay (HCM 2000).
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	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P2	SouthEast Full Crossing	53	17.6	LOS B	0.1	0.1	0.54	0.54
P3	NorthEast Full Crossing	53	25.4	LOS C	0.1	0.1	0.65	0.65
P4	NorthWest Full Crossing	53	17.6	LOS B	0.1	0.1	0.54	0.54
P1	SouthWest Full Crossing	53	25.4	LOS C	0.1	0.1	0.65	0.65
All Pedestrians		211	21.5	LOS C			0.60	0.60

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.

INTERSECTION SUMMARY

Site: Park/Hawker AM - Exist

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Intersection Performance - Hourly Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Travel Speed (Average)	40.7	km/h	2.1	km/h	40.4	km/h
Travel Distance (Total)	6527.0	veh-km/h	4.2	ped-km/h	7836.6	pers-km/h
Travel Time (Total)	160.2	veh-h/h	1.9	ped-h/h	194.2	pers-h/h
Demand Flows (Total)	4819	veh/h	105	ped/h	5783	pers/h
Percent Heavy Vehicles (Demand)	5.1	%				
Degree of Saturation	0.873		0.088			
Practical Spare Capacity	3.1	%				
Effective Intersection Capacity	5521	veh/h				
Control Delay (Total)	49.25	veh-h/h	1.06	ped-h/h	60.16	pers-h/h
Control Delay (Average)	36.8	sec	36.2	sec	37.5	sec
Control Delay (Worst Lane)	71.4	sec				
Control Delay (Worst Movement)	71.4	sec	54.3	sec	71.4	sec
Geometric Delay (Average)	0.7	sec				
Stop-Line Delay (Average)	36.1	sec				
Idling Time (Average)	31.5	sec				
Intersection Level of Service (LOS)	LOS D		LOS D			
95% Back of Queue - Vehicles (Worst Lane)	44.3	veh				
95% Back of Queue - Distance (Worst Lane)	323.9	m				
Queue Storage Ratio (Worst Lane)	0.41					
Total Effective Stops	4080	veh/h	79	ped/h	4975	pers/h
Effective Stop Rate	0.85	per veh	0.75	per ped	0.86	per pers
Proportion Queued	0.88		0.75		0.90	
Performance Index	424.3		2.4		426.7	
Cost (Total)	4653.08	$/h	47.94	$/h	4701.02	$/h
Fuel Consumption (Total)	656.4	L/h				
Carbon Dioxide (Total)	1562.5	kg/h				
Hydrocarbons (Total)	0.133	kg/h				
Carbon Monoxide (Total)	1.672	kg/h				
NOx (Total)	3.086	kg/h				

Level of Service (LOS) Method: Delay (HCM 2000).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Intersection Performance - Annual Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Demand Flows (Total)	2,313,095	veh/y	50,526	ped/y	2,775,714	pers/y
Delay	23,642	veh-h/y	508	ped-h/y	28,879	pers-h/y
Effective Stops	1,958,277	veh/y	37,978	ped/y	2,387,912	pers/y
Travel Distance	3,132,975	veh-km/y	1,998	ped-km/y	3,761,568	pers-km/y
Travel Time	76,894	veh-h/y	935	ped-h/y	93,209	pers-h/y
Cost	2,233,478	$/y	23,013	$/y	2,256,490	$/y
Fuel Consumption	315,051	L/y				
Carbon Dioxide	749,984	kg/y				
Hydrocarbons	64	kg/y				
Carbon Monoxide	803	kg/y				
NOx	1,481	kg/y				

MOVEMENT SUMMARY

Site: Park/Hawker AM - Exist

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	OD Mov	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 per veh	Average Speed km/h
SouthEast: War Memorial Dr (SE)											
1	L2	54	4.2	0.065	18.5	LOS B	1.4	10.5	0.52	0.67	48.8
2	T1	109	4.2	0.346	51.1	LOS D	5.8	41.7	0.93	0.76	29.1
3	R2	58	4.2	0.642	71.4	LOS E	3.6	26.3	1.00	0.79	27.3
Approach		221	4.2	0.642	48.5	LOS D	5.8	41.7	0.85	0.75	32.6
NorthEast: Park Tce (NE)											
4	L2	92	5.2	0.873	49.9	LOS D	44.2	323.0	0.97	0.99	34.1
5	T1	2123	5.2	0.873	40.4	LOS D	44.3	323.9	0.96	0.96	40.4
6	R2	71	5.2	0.675	70.6	LOS E	4.4	32.2	1.00	0.81	25.2
Approach		2285	5.2	0.873	41.7	LOS D	44.3	323.9	0.96	0.96	39.6
NorthWest: Hawker St (NW)											
7	L2	53	5.0	0.742	61.7	LOS E	13.7	99.9	1.00	0.97	26.9
8	T1	191	5.0	0.742	58.5	LOS E	13.7	99.9	1.00	0.97	27.4
9	R2	28	5.0	0.317	66.7	LOS E	1.7	12.6	1.00	0.72	30.2
Approach		272	5.0	0.742	60.0	LOS E	13.7	99.9	1.00	0.94	27.6
SouthWest: Park Tce (SW)											
10	L2	8	5.2	0.663	29.8	LOS C	27.3	200.0	0.78	0.72	41.4
11	T1	1839	5.2	0.663	22.2	LOS C	27.6	202.0	0.76	0.69	47.4
12	R2	194	5.2	0.865	71.2	LOS E	12.6	92.3	1.00	0.96	32.3
Approach		2041	5.2	0.865	26.9	LOS C	27.6	202.0	0.79	0.72	45.4
All Vehicles		4819	5.1	0.873	36.8	LOS D	44.3	323.9	0.88	0.85	40.7

Level of Service (LOS) Method: Delay (HCM 2000).
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 per ped
P3	NorthWest Full Crossing	53	18.2	LOS B	0.1	0.1	0.55	0.55
P4	SouthWest Full Crossing	53	54.3	LOS E	0.2	0.2	0.95	0.95
All Pedestrians		105	36.2	LOS D			0.75	0.75

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.

INTERSECTION SUMMARY

Site: Park/Hawker AM - Exist + Dev + BUV

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Intersection Performance - Hourly Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Travel Speed (Average)	35.5	km/h	2.1	km/h	35.3	km/h
Travel Distance (Total)	6986.6	veh-km/h	4.2	ped-km/h	8388.1	pers-km/h
Travel Time (Total)	196.5	veh-h/h	2.0	ped-h/h	237.8	pers-h/h
Demand Flows (Total)	5173	veh/h	105	ped/h	6207	pers/h
Percent Heavy Vehicles (Demand)	5.1	%				
Degree of Saturation	0.962		0.088			
Practical Spare Capacity	-6.5	%				
Effective Intersection Capacity	5374	veh/h				
Control Delay (Total)	77.39	veh-h/h	1.09	ped-h/h	93.96	pers-h/h
Control Delay (Average)	53.9	sec	37.4	sec	54.5	sec
Control Delay (Worst Lane)	89.2	sec				
Control Delay (Worst Movement)	89.2	sec	54.3	sec	89.2	sec
Geometric Delay (Average)	0.7	sec				
Stop-Line Delay (Average)	53.2	sec				
Idling Time (Average)	47.6	sec				
Intersection Level of Service (LOS)	LOS D		LOS D			
95% Back of Queue - Vehicles (Worst Lane)	58.7	veh				
95% Back of Queue - Distance (Worst Lane)	428.9	m				
Queue Storage Ratio (Worst Lane)	0.54					
Total Effective Stops	5182	veh/h	81	ped/h	6300	pers/h
Effective Stop Rate	1.00	per veh	0.77	per ped	1.01	per pers
Proportion Queued	0.94		0.77		0.95	
Performance Index	553.3		2.4		555.7	
Cost (Total)	5927.82	$/h	48.76	$/h	5976.58	$/h
Fuel Consumption (Total)	754.4	L/h				
Carbon Dioxide (Total)	1794.9	kg/h				
Hydrocarbons (Total)	0.159	kg/h				
Carbon Monoxide (Total)	1.893	kg/h				
NOx (Total)	3.539	kg/h				

Level of Service (LOS) Method: Delay (HCM 2000).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Intersection Performance - Annual Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Demand Flows (Total)	2,482,863	veh/y	50,526	ped/y	2,979,435	pers/y
Delay	37,148	veh-h/y	524	ped-h/y	45,102	pers-h/y
Effective Stops	2,487,583	veh/y	38,822	ped/y	3,023,921	pers/y
Travel Distance	3,353,591	veh-km/y	1,998	ped-km/y	4,026,307	pers-km/y
Travel Time	94,335	veh-h/y	951	ped-h/y	114,154	pers-h/y
Cost	2,845,355	$/y	23,405	$/y	2,868,760	$/y
Fuel Consumption	362,111	L/y				
Carbon Dioxide	861,551	kg/y				
Hydrocarbons	76	kg/y				
Carbon Monoxide	909	kg/y				
NOx	1,699	kg/y				

SIDRA INTERSECTION 6.1 | Copyright © 2000-2015 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: Park/Hawker AM - Exist + Dev + BUV

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	OD Mov	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 per veh	Average Speed km/h
SouthEast: War Memorial Dr (SE)											
1	L2	55	4.2	0.064	20.5	LOS C	1.6	11.5	0.55	0.67	47.8
2	T1	91	4.2	0.229	45.4	LOS D	4.4	32.1	0.87	0.73	30.4
3	R2	58	4.2	0.642	71.4	LOS E	3.6	26.3	1.00	0.79	27.3
Approach		203	4.2	0.642	46.1	LOS D	4.4	32.1	0.82	0.73	33.5
NorthEast: Park Tce (NE)											
4	L2	92	5.2	0.962	82.0	LOS F	58.7	428.9	1.00	1.20	26.2
5	T1	2140	5.2	0.962	70.5	LOS E	58.7	428.9	1.00	1.19	32.5
6	R2	58	5.2	0.647	71.5	LOS E	3.6	26.6	1.00	0.79	25.0
Approach		2289	5.2	0.962	71.0	LOS E	58.7	428.9	1.00	1.18	32.1
NorthWest: Hawker St (NW)											
7	L2	81	5.0	0.924	81.2	LOS F	26.1	190.9	1.00	1.21	23.6
8	T1	294	5.0	0.924	78.0	LOS E	26.1	190.9	1.00	1.21	24.0
9	R2	44	5.0	0.493	67.7	LOS E	2.7	19.8	1.00	0.74	30.1
Approach		419	5.0	0.924	77.5	LOS E	26.1	190.9	1.00	1.16	24.6
SouthWest: Park Tce (SW)											
10	L2	8	5.2	0.782	34.2	LOS C	34.5	252.1	0.89	0.82	40.0
11	T1	2038	5.2	0.782	26.9	LOS C	34.7	253.7	0.86	0.79	45.4
12	R2	215	5.2	0.959	89.2	LOS F	16.1	118.1	1.00	1.08	29.0
Approach		2261	5.2	0.959	32.9	LOS C	34.7	253.7	0.88	0.82	43.0
All Vehicles		5173	5.1	0.962	53.9	LOS D	58.7	428.9	0.94	1.00	35.5

Level of Service (LOS) Method: Delay (HCM 2000).
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 per ped
P3	NorthWest Full Crossing	53	20.5	LOS C	0.1	0.1	0.58	0.58
P4	SouthWest Full Crossing	53	54.3	LOS E	0.2	0.2	0.95	0.95
All Pedestrians		105	37.4	LOS D			0.77	0.77

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.

INTERSECTION SUMMARY

Site: Park/Hawker PM - Exist

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Intersection Performance - Hourly Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Travel Speed (Average)	40.7	km/h	2.1	km/h	40.3	km/h
Travel Distance (Total)	6842.4	veh-km/h	4.2	ped-km/h	8215.1	pers-km/h
Travel Time (Total)	168.3	veh-h/h	2.0	ped-h/h	203.9	pers-h/h
Demand Flows (Total)	5108	veh/h	105	ped/h	6130	pers/h
Percent Heavy Vehicles (Demand)	5.1	%				
Degree of Saturation	0.802		0.075			
Practical Spare Capacity	12.2	%				
Effective Intersection Capacity	6367	veh/h				
Control Delay (Total)	51.17	veh-h/h	1.10	ped-h/h	62.51	pers-h/h
Control Delay (Average)	36.1	sec	37.8	sec	36.7	sec
Control Delay (Worst Lane)	70.3	sec				
Control Delay (Worst Movement)	70.3	sec	53.3	sec	70.3	sec
Geometric Delay (Average)	1.0	sec				
Stop-Line Delay (Average)	35.1	sec				
Idling Time (Average)	30.4	sec				
Intersection Level of Service (LOS)	LOS D		LOS D			
95% Back of Queue - Vehicles (Worst Lane)	35.5	veh				
95% Back of Queue - Distance (Worst Lane)	259.7	m				
Queue Storage Ratio (Worst Lane)	0.31					
Total Effective Stops	4317	veh/h	82	ped/h	5263	pers/h
Effective Stop Rate	0.85	per veh	0.78	per ped	0.86	per pers
Proportion Queued	0.90		0.78		0.92	
Performance Index	439.0		2.4		441.4	
Cost (Total)	4881.81	$/h	49.06	$/h	4930.87	$/h
Fuel Consumption (Total)	686.9	L/h				
Carbon Dioxide (Total)	1634.9	kg/h				
Hydrocarbons (Total)	0.139	kg/h				
Carbon Monoxide (Total)	1.741	kg/h				
NOx (Total)	3.201	kg/h				

Level of Service (LOS) Method: Delay (HCM 2000).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Intersection Performance - Annual Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Demand Flows (Total)	2,452,042	veh/y	50,526	ped/y	2,942,450	pers/y
Delay	24,561	veh-h/y	530	ped-h/y	30,004	pers-h/y
Effective Stops	2,072,317	veh/y	39,244	ped/y	2,526,025	pers/y
Travel Distance	3,284,374	veh-km/y	1,998	ped-km/y	3,943,247	pers-km/y
Travel Time	80,774	veh-h/y	957	ped-h/y	97,886	pers-h/y
Cost	2,343,268	$/y	23,550	$/y	2,366,819	$/y
Fuel Consumption	329,726	L/y				
Carbon Dioxide	784,731	kg/y				
Hydrocarbons	67	kg/y				
Carbon Monoxide	836	kg/y				
NOx	1,537	kg/y				

SIDRA INTERSECTION 6.1 | Copyright © 2000-2015 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: Park/Hawker PM - Exist

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	OD Mov	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 per veh	Average Speed km/h
SouthEast: War Memorial Dr (SE)											
1	L2	198	4.2	0.231	17.2	LOS B	5.6	40.5	0.55	0.71	49.3
2	T1	268	4.2	0.802	54.2	LOS D	15.5	112.6	0.97	0.92	28.4
3	R2	176	4.2	0.780	65.6	LOS E	10.8	78.2	1.00	0.89	28.5
Approach		642	4.2	0.802	45.9	LOS D	15.5	112.6	0.85	0.85	33.9
NorthEast: Park Tce (NE)											
4	L2	61	5.2	0.789	40.5	LOS D	33.2	242.5	0.92	0.86	37.4
5	T1	1888	5.2	0.789	31.7	LOS C	33.5	244.7	0.90	0.83	43.5
6	R2	86	5.2	0.723	70.3	LOS E	5.4	39.4	1.00	0.84	25.2
Approach		2036	5.2	0.789	33.6	LOS C	33.5	244.7	0.91	0.84	42.4
NorthWest: Hawker St (NW)											
7	L2	135	5.0	0.666	51.7	LOS D	10.3	75.1	0.98	0.99	28.7
8	T1	94	5.0	0.666	48.5	LOS D	10.3	75.1	0.98	0.99	29.2
9	R2	39	5.0	0.434	67.4	LOS E	2.4	17.4	1.00	0.73	30.1
Approach		267	5.0	0.666	52.9	LOS D	10.3	75.1	0.98	0.95	29.1
SouthWest: Park Tce (SW)											
10	L2	28	5.2	0.802	40.2	LOS D	35.3	258.1	0.92	0.86	38.2
11	T1	2020	5.2	0.802	31.3	LOS C	35.5	259.7	0.90	0.84	43.7
12	R2	115	5.2	0.769	69.5	LOS E	7.2	52.4	1.00	0.88	32.7
Approach		2163	5.2	0.802	33.4	LOS C	35.5	259.7	0.91	0.84	42.8
All Vehicles		5108	5.1	0.802	36.1	LOS D	35.5	259.7	0.90	0.85	40.7

Level of Service (LOS) Method: Delay (HCM 2000).
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 per ped
P3	NorthWest Full Crossing	53	22.3	LOS C	0.1	0.1	0.61	0.61
P4	SouthWest Full Crossing	53	53.3	LOS E	0.2	0.2	0.94	0.94
All Pedestrians		105	37.8	LOS D			0.78	0.78

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.

INTERSECTION SUMMARY

Site: Park/Hawker PM - Exist + Dev + BUV

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Intersection Performance - Hourly Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Travel Speed (Average)	31.3	km/h	2.1	km/h	31.1	km/h
Travel Distance (Total)	7455.9	veh-km/h	4.2	ped-km/h	8951.3	pers-km/h
Travel Time (Total)	238.4	veh-h/h	2.0	ped-h/h	288.1	pers-h/h
Demand Flows (Total)	5578	veh/h	105	ped/h	6693	pers/h
Percent Heavy Vehicles (Demand)	5.1	%				
Degree of Saturation	0.999		0.044			
Practical Spare Capacity	-9.9	%				
Effective Intersection Capacity	5586	veh/h				
Control Delay (Total)	110.56	veh-h/h	1.09	ped-h/h	133.77	pers-h/h
Control Delay (Average)	71.4	sec	37.4	sec	71.9	sec
Control Delay (Worst Lane)	95.4	sec				
Control Delay (Worst Movement)	100.9	sec	48.7	sec	100.9	sec
Geometric Delay (Average)	1.0	sec				
Stop-Line Delay (Average)	70.3	sec				
Idling Time (Average)	63.6	sec				
Intersection Level of Service (LOS)	LOS E		LOS D			
95% Back of Queue - Vehicles (Worst Lane)	68.7	veh				
95% Back of Queue - Distance (Worst Lane)	502.7	m				
Queue Storage Ratio (Worst Lane)	0.44					
Total Effective Stops	6404	veh/h	82	ped/h	7767	pers/h
Effective Stop Rate	1.15	per veh	0.78	per ped	1.16	per pers
Proportion Queued	0.98		0.78		0.99	
Performance Index	656.3		2.4		658.7	
Cost (Total)	7288.87	$/h	48.77	$/h	7337.65	$/h
Fuel Consumption (Total)	853.1	L/h				
Carbon Dioxide (Total)	2028.7	kg/h				
Hydrocarbons (Total)	0.186	kg/h				
Carbon Monoxide (Total)	2.103	kg/h				
NOx (Total)	3.934	kg/h				

Level of Service (LOS) Method: Delay (HCM 2000).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Intersection Performance - Annual Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Demand Flows (Total)	2,677,389	veh/y	50,526	ped/y	3,212,867	pers/y
Delay	53,069	veh-h/y	525	ped-h/y	64,208	pers-h/y
Effective Stops	3,073,843	veh/y	39,455	ped/y	3,728,067	pers/y
Travel Distance	3,578,843	veh-km/y	1,998	ped-km/y	4,296,610	pers-km/y
Travel Time	114,427	veh-h/y	952	ped-h/y	138,265	pers-h/y
Cost	3,498,659	$/y	23,411	$/y	3,522,070	$/y
Fuel Consumption	409,512	L/y				
Carbon Dioxide	973,798	kg/y				
Hydrocarbons	89	kg/y				
Carbon Monoxide	1,010	kg/y				
NOx	1,888	kg/y				

MOVEMENT SUMMARY

Site: Park/Hawker PM - Exist + Dev + BUV

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: War Memorial Dr (SE)											
1	L2	204	4.2	0.228	19.8	LOS B	6.2	44.9	0.58	0.71	48.2
2	T1	380	4.2	0.973	85.5	LOS F	29.3	212.6	0.99	1.22	23.0
3	R2	176	4.2	0.616	57.6	LOS E	9.8	71.3	0.98	0.81	30.4
Approach		760	4.2	0.973	61.4	LOS E	29.3	212.6	0.88	0.99	29.6
NorthEast: Park Tce (NE)											
4	L2	61	5.2	0.919	64.8	LOS E	48.1	351.7	1.00	1.10	29.9
5	T1	1983	5.2	0.919	55.0	LOS D	48.1	351.7	0.99	1.07	36.2
6	R2	122	5.2	0.909	79.8	LOS E	8.4	61.2	1.00	1.01	23.7
Approach		2166	5.2	0.919	56.7	LOS E	48.1	351.7	0.99	1.07	35.2
NorthWest: Hawker St (NW)											
7	L2	119	5.0	0.559	51.8	LOS D	9.6	69.9	0.95	0.97	28.6
8	T1	82	5.0	0.559	48.6	LOS D	9.6	69.9	0.95	0.97	29.2
9	R2	35	5.0	0.387	67.1	LOS E	2.1	15.4	1.00	0.73	30.2
Approach		236	5.0	0.559	53.0	LOS D	9.6	69.9	0.96	0.94	29.1
SouthWest: Park Tce (SW)											
10	L2	28	5.2	0.999	100.9	LOS F	68.7	502.7	1.00	1.31	26.3
11	T1	2248	5.2	0.999	89.7	LOS F	68.7	502.7	1.00	1.30	29.0
12	R2	139	5.2	0.931	83.1	LOS F	9.8	71.7	1.00	1.05	30.0
Approach		2416	5.2	0.999	89.5	LOS F	68.7	502.7	1.00	1.29	29.0
All Vehicles		5578	5.1	0.999	71.4	LOS E	68.7	502.7	0.98	1.15	31.3

Level of Service (LOS) Method: Delay (HCM 2000).
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	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P3	NorthWest Full Crossing	53	26.1	LOS C	0.1	0.1	0.66	0.66
P4	SouthWest Full Crossing	53	48.7	LOS E	0.2	0.2	0.90	0.90
All Pedestrians		105	37.4	LOS D			0.78	0.78

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.

INTERSECTION SUMMARY

Site: Port/Chief (NE) AM - Exist

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Phase Times)

Intersection Performance - Hourly Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Travel Speed (Average)	42.3	km/h	2.3	km/h	41.2	km/h
Travel Distance (Total)	2754.3	veh-km/h	5.0	ped-km/h	3310.1	pers-km/h
Travel Time (Total)	65.1	veh-h/h	2.2	ped-h/h	80.3	pers-h/h
Demand Flows (Total)	2668	veh/h	158	ped/h	3202	pers/h
Percent Heavy Vehicles (Demand)	3.8	%				
Degree of Saturation	0.856		0.016			
Practical Spare Capacity	5.2	%				
Effective Intersection Capacity	3119	veh/h				
Control Delay (Total)	18.85	veh-h/h	1.15	ped-h/h	23.77	pers-h/h
Control Delay (Average)	25.4	sec	26.2	sec	26.7	sec
Control Delay (Worst Lane)	52.8	sec				
Control Delay (Worst Movement)	52.8	sec	32.3	sec	52.8	sec
Geometric Delay (Average)	1.0	sec				
Stop-Line Delay (Average)	24.5	sec				
Idling Time (Average)	21.2	sec				
Intersection Level of Service (LOS)	LOS C		LOS C			
95% Back of Queue - Vehicles (Worst Lane)	21.9	veh				
95% Back of Queue - Distance (Worst Lane)	160.3	m				
Queue Storage Ratio (Worst Lane)	0.86					
Total Effective Stops	1814	veh/h	103	ped/h	2279	pers/h
Effective Stop Rate	0.68	per veh	0.65	per ped	0.71	per pers
Proportion Queued	0.74		0.65		0.77	
Performance Index	208.8		2.8		211.6	
Cost (Total)	1965.89	$/h	54.79	$/h	2020.68	$/h
Fuel Consumption (Total)	268.3	L/h				
Carbon Dioxide (Total)	637.0	kg/h				
Hydrocarbons (Total)	0.054	kg/h				
Carbon Monoxide (Total)	0.697	kg/h				
NOx (Total)	1.050	kg/h				

Level of Service (LOS) Method: Delay (HCM 2000).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Intersection Performance - Annual Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Demand Flows (Total)	1,280,842	veh/y	75,789	ped/y	1,537,010	pers/y
Delay	9,047	veh-h/y	552	ped-h/y	11,409	pers-h/y
Effective Stops	870,650	veh/y	49,371	ped/y	1,094,152	pers/y
Travel Distance	1,322,040	veh-km/y	2,418	ped-km/y	1,588,866	pers-km/y
Travel Time	31,240	veh-h/y	1,069	ped-h/y	38,557	pers-h/y
Cost	943,627	$/y	26,298	$/y	969,925	$/y
Fuel Consumption	128,800	L/y				
Carbon Dioxide	305,750	kg/y				
Hydrocarbons	26	kg/y				
Carbon Monoxide	335	kg/y				
NOx	504	kg/y				

MOVEMENT SUMMARY

Site: Port/Chief (NE) AM - Exist

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
NorthEast: Chief St (NE)											
4	L2	363	0.9	0.856	52.8	LOS D	20.8	146.9	0.90	0.91	32.2
25	T1	316	0.9	0.740	36.9	LOS D	15.4	108.6	0.86	0.76	28.3
Approach		679	0.9	0.856	45.4	LOS D	20.8	146.9	0.88	0.84	30.8
NorthWest: Port Rd (NW)											
7	L2	87	0.9	0.559	22.5	LOS C	21.8	159.0	0.68	0.64	46.6
8	T1	1718	5.4	0.559	16.9	LOS B	21.9	160.3	0.68	0.62	48.1
29	R2	11	5.4	0.559	22.5	LOS C	21.9	160.1	0.68	0.61	26.2
Approach		1816	5.2	0.559	17.2	LOS B	21.9	160.3	0.68	0.62	47.9
SouthWest: Chief St (SW)											
31	T1	163	0.9	0.259	31.9	LOS C	7.0	49.3	0.78	0.64	30.5
32	R2	11	5.3	0.070	50.3	LOS D	0.5	3.9	0.87	0.69	23.7
Approach		174	1.2	0.259	33.0	LOS C	7.0	49.3	0.79	0.65	29.9
All Vehicles		2668	3.8	0.856	25.4	LOS C	21.9	160.3	0.74	0.68	42.3

Level of Service (LOS) Method: Delay (HCM 2000).
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	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	SouthEast Full Crossing	53	32.3	LOS D	0.1	0.1	0.73	0.73
P2	NorthEast Full Crossing	53	14.0	LOS B	0.1	0.1	0.48	0.48
P3	NorthWest Full Crossing	53	32.3	LOS D	0.1	0.1	0.73	0.73
All Pedestrians		158	26.2	LOS C			0.65	0.65

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.

SIDRA INTERSECTION 6.1 | Copyright © 2000-2015 Akcelik and Associates Pty Ltd | sidrasolutions.com

INTERSECTION SUMMARY

Site: Port/Chief (NE) AM - Exist+DPA + BUV

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Phase Times)

Intersection Performance - Hourly Values								
Performance Measure	**Vehicles**			**Pedestrians**			**Persons**	
Travel Speed (Average)	14.4	km/h		2.3	km/h		14.3	km/h
Travel Distance (Total)	3143.7	veh-km/h		5.0	ped-km/h		3777.4	pers-km/h
Travel Time (Total)	217.6	veh-h/h		2.2	ped-h/h		263.4	pers-h/h
Demand Flows (Total)	3096	veh/h		158	ped/h		3715	pers/h
Percent Heavy Vehicles (Demand)	3.4	%						
Degree of Saturation	1.543			0.016				
Practical Spare Capacity	-41.7	%						
Effective Intersection Capacity	2007	veh/h						
Control Delay (Total)	164.73	veh-h/h		1.15	ped-h/h		198.82	pers-h/h
Control Delay (Average)	191.6	sec		26.2	sec		192.7	sec
Control Delay (Worst Lane)	580.6	sec						
Control Delay (Worst Movement)	580.6	sec		32.3	sec		580.6	sec
Geometric Delay (Average)	1.4	sec						
Stop-Line Delay (Average)	190.2	sec						
Idling Time (Average)	182.9	sec						
Intersection Level of Service (LOS)	LOS F			LOS C				
95% Back of Queue - Vehicles (Worst Lane)	141.1	veh						
95% Back of Queue - Distance (Worst Lane)	995.4	m						
Queue Storage Ratio (Worst Lane)	0.74							
Total Effective Stops	3576	veh/h		103	ped/h		4394	pers/h
Effective Stop Rate	1.16	per veh		0.65	per ped		1.18	per pers
Proportion Queued	0.80			0.65			0.83	
Performance Index	592.3			2.8			595.1	
Cost (Total)	7127.14	$/h		54.79	$/h		7181.93	$/h
Fuel Consumption (Total)	497.9	L/h						
Carbon Dioxide (Total)	1177.1	kg/h						
Hydrocarbons (Total)	0.119	kg/h						
Carbon Monoxide (Total)	1.065	kg/h						
NOx (Total)	1.253	kg/h						

Level of Service (LOS) Method: Delay (HCM 2000).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Intersection Performance - Annual Values								
Performance Measure	**Vehicles**			**Pedestrians**			**Persons**	
Demand Flows (Total)	1,485,979	veh/y		75,789	ped/y		1,783,175	pers/y
Delay	79,069	veh-h/y		552	ped-h/y		95,435	pers-h/y
Effective Stops	1,716,465	veh/y		49,371	ped/y		2,109,129	pers/y
Travel Distance	1,508,958	veh-km/y		2,418	ped-km/y		1,813,167	pers-km/y
Travel Time	104,449	veh-h/y		1,069	ped-h/y		126,408	pers-h/y
Cost	3,421,028	$/y		26,298	$/y		3,447,326	$/y
Fuel Consumption	238,992	L/y						
Carbon Dioxide	565,028	kg/y						
Hydrocarbons	57	kg/y						
Carbon Monoxide	511	kg/y						
NOx	601	kg/y						

MOVEMENT SUMMARY

Site: Port/Chief (NE) AM - Exist+DPA + BUV

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
NorthEast: Chief St (NE)											
4	L2	662	0.9	1.543	580.6	LOS F	141.1	995.4	1.00	2.04	5.9
25	T1	458	0.9	1.298	375.4	LOS F	76.2	537.4	1.00	2.17	4.8
Approach		1120	0.9	1.543	496.7	LOS F	141.1	995.4	1.00	2.09	5.5
NorthWest: Port Rd (NW)											
7	L2	96	0.9	0.562	22.5	LOS C	22.0	160.0	0.68	0.64	46.5
8	T1	1718	5.4	0.562	17.0	LOS B	22.0	161.4	0.68	0.62	48.1
29	R2	11	5.4	0.562	22.5	LOS C	22.0	161.3	0.68	0.62	26.2
Approach		1824	5.2	0.562	17.3	LOS B	22.0	161.4	0.68	0.62	47.9
SouthWest: Chief St (SW)											
31	T1	141	0.9	0.224	31.5	LOS C	6.0	42.0	0.77	0.63	30.7
32	R2	11	5.3	0.162	69.5	LOS E	0.6	4.7	1.00	0.66	19.5
Approach		152	1.2	0.224	34.1	LOS C	6.0	42.0	0.78	0.63	29.4
All Vehicles		3096	3.4	1.543	191.6	LOS F	141.1	995.4	0.80	1.16	14.4

Level of Service (LOS) Method: Delay (HCM 2000).
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	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	SouthEast Full Crossing	53	32.3	LOS D	0.1	0.1	0.73	0.73
P2	NorthEast Full Crossing	53	14.0	LOS B	0.1	0.1	0.48	0.48
P3	NorthWest Full Crossing	53	32.3	LOS D	0.1	0.1	0.73	0.73
All Pedestrians		158	26.2	LOS C			0.65	0.65

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.

INTERSECTION SUMMARY

Site: Port/Chief (NE) PM - Exist

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Phase Times)

Intersection Performance - Hourly Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Travel Speed (Average)	43.8	km/h	2.3	km/h	42.4	km/h
Travel Distance (Total)	2268.0	veh-km/h	5.0	ped-km/h	2726.6	pers-km/h
Travel Time (Total)	51.8	veh-h/h	2.2	ped-h/h	64.4	pers-h/h
Demand Flows (Total)	2247	veh/h	158	ped/h	2697	pers/h
Percent Heavy Vehicles (Demand)	3.8	%				
Degree of Saturation	0.515		0.016			
Practical Spare Capacity	74.6	%				
Effective Intersection Capacity	4360	veh/h				
Control Delay (Total)	13.71	veh-h/h	1.15	ped-h/h	17.60	pers-h/h
Control Delay (Average)	22.0	sec	26.2	sec	23.5	sec
Control Delay (Worst Lane)	39.4	sec				
Control Delay (Worst Movement)	39.4	sec	32.3	sec	39.4	sec
Geometric Delay (Average)	0.8	sec				
Stop-Line Delay (Average)	21.2	sec				
Idling Time (Average)	18.3	sec				
Intersection Level of Service (LOS)	LOS C		LOS C			
95% Back of Queue - Vehicles (Worst Lane)	18.0	veh				
95% Back of Queue - Distance (Worst Lane)	131.7	m				
Queue Storage Ratio (Worst Lane)	1.84					
Total Effective Stops	1418	veh/h	103	ped/h	1804	pers/h
Effective Stop Rate	0.63	per veh	0.65	per ped	0.67	per pers
Proportion Queued	0.69		0.65		0.73	
Performance Index	162.0		2.8		164.8	
Cost (Total)	1522.33	$/h	54.79	$/h	1577.12	$/h
Fuel Consumption (Total)	217.7	L/h				
Carbon Dioxide (Total)	517.0	kg/h				
Hydrocarbons (Total)	0.043	kg/h				
Carbon Monoxide (Total)	0.570	kg/h				
NOx (Total)	0.851	kg/h				

Level of Service (LOS) Method: Delay (HCM 2000).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Intersection Performance - Annual Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Demand Flows (Total)	1,078,737	veh/y	75,789	ped/y	1,294,484	pers/y
Delay	6,580	veh-h/y	552	ped-h/y	8,448	pers-h/y
Effective Stops	680,621	veh/y	49,371	ped/y	866,117	pers/y
Travel Distance	1,088,624	veh-km/y	2,418	ped-km/y	1,308,766	pers-km/y
Travel Time	24,849	veh-h/y	1,069	ped-h/y	30,888	pers-h/y
Cost	730,720	$/y	26,298	$/y	757,018	$/y
Fuel Consumption	104,518	L/y				
Carbon Dioxide	248,144	kg/y				
Hydrocarbons	21	kg/y				
Carbon Monoxide	274	kg/y				
NOx	408	kg/y				

SIDRA INTERSECTION 6.1 | Copyright © 2000-2015 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: Port/Chief (NE) PM - Exist

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
NorthEast: Chief St (NE)											
4	L2	145	0.9	0.242	37.3	LOS D	6.2	43.7	0.77	0.77	37.1
25	T1	194	0.9	0.307	32.5	LOS C	8.4	59.6	0.79	0.66	30.2
Approach		339	0.9	0.307	34.5	LOS C	8.4	59.6	0.79	0.71	33.9
NorthWest: Port Rd (NW)											
7	L2	157	0.9	0.488	21.5	LOS C	17.9	129.5	0.64	0.63	46.6
8	T1	1415	5.4	0.488	15.9	LOS B	18.0	131.7	0.64	0.59	48.6
29	R2	11	5.4	0.488	21.5	LOS C	18.0	131.6	0.64	0.57	26.4
Approach		1582	5.0	0.488	16.5	LOS B	18.0	131.7	0.64	0.59	48.2
SouthWest: Chief St (SW)											
31	T1	316	0.9	0.515	35.0	LOS D	14.9	104.8	0.86	0.74	29.1
32	R2	11	5.3	0.038	39.4	LOS D	0.5	3.4	0.77	0.68	27.1
Approach		326	1.0	0.515	35.2	LOS D	14.9	104.8	0.86	0.74	29.0
All Vehicles		2247	3.8	0.515	22.0	LOS C	18.0	131.7	0.69	0.63	43.8

Level of Service (LOS) Method: Delay (HCM 2000).
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	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	SouthEast Full Crossing	53	32.3	LOS D	0.1	0.1	0.73	0.73
P2	NorthEast Full Crossing	53	14.0	LOS B	0.1	0.1	0.48	0.48
P3	NorthWest Full Crossing	53	32.3	LOS D	0.1	0.1	0.73	0.73
All Pedestrians		158	26.2	LOS C			0.65	0.65

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.

SIDRA INTERSECTION 6.1 | Copyright © 2000-2015 Akcelik and Associates Pty Ltd | sidrasolutions.com

INTERSECTION SUMMARY

Site: Port/Chief (NE) PM - Exist+DPA + BUV

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Phase Times)

Intersection Performance - Hourly Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Travel Speed (Average)	42.0	km/h	2.3	km/h	40.8	km/h
Travel Distance (Total)	2588.5	veh-km/h	5.0	ped-km/h	3111.2	pers-km/h
Travel Time (Total)	61.6	veh-h/h	2.2	ped-h/h	76.2	pers-h/h
Demand Flows (Total)	2615	veh/h	158	ped/h	3138	pers/h
Percent Heavy Vehicles (Demand)	3.4	%				
Degree of Saturation	0.819		0.016			
Practical Spare Capacity	9.8	%				
Effective Intersection Capacity	3191	veh/h				
Control Delay (Total)	18.14	veh-h/h	1.15	ped-h/h	22.92	pers-h/h
Control Delay (Average)	25.0	sec	26.2	sec	26.3	sec
Control Delay (Worst Lane)	43.7	sec				
Control Delay (Worst Movement)	43.7	sec	32.3	sec	43.7	sec
Geometric Delay (Average)	1.1	sec				
Stop-Line Delay (Average)	23.9	sec				
Idling Time (Average)	20.9	sec				
Intersection Level of Service (LOS)	LOS C		LOS C			
95% Back of Queue - Vehicles (Worst Lane)	28.5	veh				
95% Back of Queue - Distance (Worst Lane)	201.4	m				
Queue Storage Ratio (Worst Lane)	3.53					
Total Effective Stops	1849	veh/h	103	ped/h	2322	pers/h
Effective Stop Rate	0.71	per veh	0.65	per ped	0.74	per pers
Proportion Queued	0.74		0.65		0.78	
Performance Index	202.1		2.8		204.9	
Cost (Total)	1819.69	$/h	54.79	$/h	1874.48	$/h
Fuel Consumption (Total)	254.9	L/h				
Carbon Dioxide (Total)	604.5	kg/h				
Hydrocarbons (Total)	0.052	kg/h				
Carbon Monoxide (Total)	0.665	kg/h				
NOx (Total)	0.925	kg/h				

Level of Service (LOS) Method: Delay (HCM 2000).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Intersection Performance - Annual Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Demand Flows (Total)	1,255,074	veh/y	75,789	ped/y	1,506,088	pers/y
Delay	8,707	veh-h/y	552	ped-h/y	11,001	pers-h/y
Effective Stops	887,532	veh/y	49,371	ped/y	1,114,410	pers/y
Travel Distance	1,242,472	veh-km/y	2,418	ped-km/y	1,493,385	pers-km/y
Travel Time	29,590	veh-h/y	1,069	ped-h/y	36,577	pers-h/y
Cost	873,450	$/y	26,298	$/y	899,748	$/y
Fuel Consumption	122,343	L/y				
Carbon Dioxide	290,146	kg/y				
Hydrocarbons	25	kg/y				
Carbon Monoxide	319	kg/y				
NOx	444	kg/y				

MOVEMENT SUMMARY

Site: Port/Chief (NE) PM - Exist+DPA + BUV

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
NorthEast: Chief St (NE)											
4	L2	143	0.9	0.239	37.2	LOS D	6.1	43.0	0.77	0.76	37.1
25	T1	169	0.9	0.269	32.0	LOS C	7.3	51.4	0.78	0.65	30.4
Approach		313	0.9	0.269	34.4	LOS C	7.3	51.4	0.78	0.70	34.2
NorthWest: Port Rd (NW)											
7	L2	363	0.9	0.553	22.4	LOS C	21.2	152.0	0.67	0.73	45.3
8	T1	1415	5.4	0.553	16.8	LOS B	21.5	157.5	0.67	0.63	48.0
29	R2	11	5.4	0.553	22.4	LOS C	21.5	157.3	0.67	0.61	26.2
Approach		1788	4.5	0.553	18.0	LOS B	21.5	157.5	0.67	0.65	47.3
SouthWest: Chief St (SW)											
31	T1	503	0.9	0.819	43.7	LOS D	28.5	201.4	0.98	0.92	25.8
32	R2	11	5.3	0.035	38.5	LOS D	0.5	3.3	0.77	0.68	27.4
Approach		514	1.0	0.819	43.5	LOS D	28.5	201.4	0.97	0.92	25.8
All Vehicles		2615	3.4	0.819	25.0	LOS C	28.5	201.4	0.74	0.71	42.0

Level of Service (LOS) Method: Delay (HCM 2000).
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	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	SouthEast Full Crossing	53	32.3	LOS D	0.1	0.1	0.73	0.73
P2	NorthEast Full Crossing	53	14.0	LOS B	0.1	0.1	0.48	0.48
P3	NorthWest Full Crossing	53	32.3	LOS D	0.1	0.1	0.73	0.73
All Pedestrians		158	26.2	LOS C			0.65	0.65

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.

SIDRA INTERSECTION 6.1 | Copyright © 2000-2015 Akcelik and Associates Pty Ltd | sidrasolutions.com

INTERSECTION SUMMARY

Site: Port/Chief (SW) AM - Exist

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Phase Times)

Intersection Performance - Hourly Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Travel Speed (Average)	44.9	km/h	2.0	km/h	43.5	km/h
Travel Distance (Total)	1811.9	veh-km/h	3.5	ped-km/h	2177.8	pers-km/h
Travel Time (Total)	40.3	veh-h/h	1.7	ped-h/h	50.1	pers-h/h
Demand Flows (Total)	1789	veh/h	105	ped/h	2147	pers/h
Percent Heavy Vehicles (Demand)	4.1	%				
Degree of Saturation	0.544		0.018			
Practical Spare Capacity	65.4	%				
Effective Intersection Capacity	3289	veh/h				
Control Delay (Total)	9.76	veh-h/h	0.98	ped-h/h	12.69	pers-h/h
Control Delay (Average)	19.6	sec	33.5	sec	21.3	sec
Control Delay (Worst Lane)	39.0	sec				
Control Delay (Worst Movement)	39.0	sec	34.6	sec	39.0	sec
Geometric Delay (Average)	1.2	sec				
Stop-Line Delay (Average)	18.5	sec				
Idling Time (Average)	16.0	sec				
Intersection Level of Service (LOS)	LOS B		LOS D			
95% Back of Queue - Vehicles (Worst Lane)	15.7	veh				
95% Back of Queue - Distance (Worst Lane)	110.5	m				
Queue Storage Ratio (Worst Lane)	1.93					
Total Effective Stops	1076	veh/h	79	ped/h	1369	pers/h
Effective Stop Rate	0.60	per veh	0.75	per ped	0.64	per pers
Proportion Queued	0.64		0.75		0.67	
Performance Index	87.9		2.2		90.1	
Cost (Total)	1089.46	$/h	42.63	$/h	1132.09	$/h
Fuel Consumption (Total)	170.9	L/h				
Carbon Dioxide (Total)	406.4	kg/h				
Hydrocarbons (Total)	0.034	kg/h				
Carbon Monoxide (Total)	0.448	kg/h				
NOx (Total)	0.702	kg/h				

Level of Service (LOS) Method: Delay (HCM 2000).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Intersection Performance - Annual Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Demand Flows (Total)	858,947	veh/y	50,526	ped/y	1,030,737	pers/y
Delay	4,686	veh-h/y	470	ped-h/y	6,093	pers-h/y
Effective Stops	516,269	veh/y	37,767	ped/y	657,290	pers/y
Travel Distance	869,709	veh-km/y	1,695	ped-km/y	1,045,347	pers-km/y
Travel Time	19,355	veh-h/y	832	ped-h/y	24,057	pers-h/y
Cost	522,942	$/y	20,463	$/y	543,404	$/y
Fuel Consumption	82,016	L/y				
Carbon Dioxide	195,073	kg/y				
Hydrocarbons	16	kg/y				
Carbon Monoxide	215	kg/y				
NOx	337	kg/y				

SIDRA INTERSECTION 6.1 | Copyright © 2000-2015 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: Port/Chief (SW) AM - Exist

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	OD Mov	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 per veh	Average Speed km/h
SouthEast: Port Rd (SE)											
2	T1	1289	5.3	0.429	14.9	LOS B	15.1	110.5	0.59	0.53	49.4
3	R2	174	0.9	0.164	18.3	LOS B	4.7	32.9	0.50	0.74	37.5
Approach		1463	4.8	0.429	15.3	LOS B	15.1	110.5	0.58	0.55	48.4
NorthEast: Chief St (NE)											
6	R2	326	0.9	0.544	39.0	LOS D	15.7	110.4	0.87	0.83	29.2
Approach		326	0.9	0.544	39.0	LOS D	15.7	110.4	0.87	0.83	29.2
All Vehicles		1789	4.1	0.544	19.6	LOS B	15.7	110.5	0.64	0.60	44.9

Level of Service (LOS) Method: Delay (HCM 2000).
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 per ped
P1	SouthEast Full Crossing	53	34.6	LOS D	0.1	0.1	0.76	0.76
P3	NorthWest Full Crossing	53	32.3	LOS D	0.1	0.1	0.73	0.73
All Pedestrians		105	33.5	LOS D			0.75	0.75

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.

INTERSECTION SUMMARY

Site: Port/Chief (SW) PM - Exist

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Phase Times)

Intersection Performance - Hourly Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Travel Speed (Average)	45.6	km/h	2.0	km/h	44.3	km/h
Travel Distance (Total)	2272.8	veh-km/h	3.5	ped-km/h	2730.9	pers-km/h
Travel Time (Total)	49.9	veh-h/h	1.7	ped-h/h	61.6	pers-h/h
Demand Flows (Total)	2211	veh/h	105	ped/h	2653	pers/h
Percent Heavy Vehicles (Demand)	4.2	%				
Degree of Saturation	0.587		0.018			
Practical Spare Capacity	53.3	%				
Effective Intersection Capacity	3766	veh/h				
Control Delay (Total)	11.62	veh-h/h	0.98	ped-h/h	14.92	pers-h/h
Control Delay (Average)	18.9	sec	33.5	sec	20.2	sec
Control Delay (Worst Lane)	36.2	sec				
Control Delay (Worst Movement)	36.2	sec	34.6	sec	36.2	sec
Geometric Delay (Average)	1.1	sec				
Stop-Line Delay (Average)	17.8	sec				
Idling Time (Average)	15.1	sec				
Intersection Level of Service (LOS)	LOS B		LOS D			
95% Back of Queue - Vehicles (Worst Lane)	23.5	veh				
95% Back of Queue - Distance (Worst Lane)	172.2	m				
Queue Storage Ratio (Worst Lane)	1.12					
Total Effective Stops	1416	veh/h	79	ped/h	1777	pers/h
Effective Stop Rate	0.64	per veh	0.75	per ped	0.67	per pers
Proportion Queued	0.66		0.75		0.69	
Performance Index	105.9		2.2		108.1	
Cost (Total)	1398.39	$/h	42.63	$/h	1441.02	$/h
Fuel Consumption (Total)	214.8	L/h				
Carbon Dioxide (Total)	511.2	kg/h				
Hydrocarbons (Total)	0.042	kg/h				
Carbon Monoxide (Total)	0.562	kg/h				
NOx (Total)	0.927	kg/h				

Level of Service (LOS) Method: Delay (HCM 2000).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Intersection Performance - Annual Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Demand Flows (Total)	1,061,052	veh/y	50,526	ped/y	1,273,263	pers/y
Delay	5,577	veh-h/y	470	ped-h/y	7,161	pers-h/y
Effective Stops	679,458	veh/y	37,767	ped/y	853,117	pers/y
Travel Distance	1,090,964	veh-km/y	1,695	ped-km/y	1,310,852	pers-km/y
Travel Time	23,941	veh-h/y	832	ped-h/y	29,561	pers-h/y
Cost	671,226	$/y	20,463	$/y	691,688	$/y
Fuel Consumption	103,117	L/y				
Carbon Dioxide	245,352	kg/y				
Hydrocarbons	20	kg/y				
Carbon Monoxide	270	kg/y				
NOx	445	kg/y				

SIDRA INTERSECTION 6.1 | Copyright © 2000-2015 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: Port/Chief (SW) PM - Exist

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	OD Mov	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 per veh	Average Speed km/h
SouthEast: Port Rd (SE)											
2	T1	1680	5.3	0.587	16.7	LOS B	23.5	172.2	0.67	0.60	48.4
3	R2	326	0.9	0.522	19.6	LOS B	9.7	68.3	0.55	0.76	36.7
Approach		2006	4.6	0.587	17.2	LOS B	23.5	172.2	0.65	0.63	47.1
NorthEast: Chief St (NE)											
6	R2	204	0.9	0.341	36.2	LOS D	9.0	63.7	0.81	0.79	30.3
Approach		204	0.9	0.341	36.2	LOS D	9.0	63.7	0.81	0.79	30.3
All Vehicles		2211	4.2	0.587	18.9	LOS B	23.5	172.2	0.66	0.64	45.6

Level of Service (LOS) Method: Delay (HCM 2000).
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 per ped
P1	SouthEast Full Crossing	53	34.6	LOS D	0.1	0.1	0.76	0.76
P3	NorthWest Full Crossing	53	32.3	LOS D	0.1	0.1	0.73	0.73
All Pedestrians		105	33.5	LOS D			0.75	0.75

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.

INTERSECTION SUMMARY

Site: Torrens/Chief AM - Exist

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Intersection Performance - Hourly Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Travel Speed (Average)	50.4	km/h	1.5	km/h	49.1	km/h
Travel Distance (Total)	3565.0	veh-km/h	3.5	ped-km/h	4281.5	pers-km/h
Travel Time (Total)	70.7	veh-h/h	2.3	ped-h/h	87.2	pers-h/h
Demand Flows (Total)	2391	veh/h	105	ped/h	2869	pers/h
Percent Heavy Vehicles (Demand)	4.6	%				
Degree of Saturation	0.578		0.088			
Practical Spare Capacity	55.7	%				
Effective Intersection Capacity	4134	veh/h				
Control Delay (Total)	8.83	veh-h/h	1.59	ped-h/h	12.18	pers-h/h
Control Delay (Average)	13.3	sec	54.3	sec	15.3	sec
Control Delay (Worst Lane)	58.2	sec				
Control Delay (Worst Movement)	58.2	sec	54.3	sec	58.2	sec
Geometric Delay (Average)	1.3	sec				
Stop-Line Delay (Average)	12.0	sec				
Idling Time (Average)	9.8	sec				
Intersection Level of Service (LOS)	LOS B		LOS E			
95% Back of Queue - Vehicles (Worst Lane)	19.8	veh				
95% Back of Queue - Distance (Worst Lane)	144.2	m				
Queue Storage Ratio (Worst Lane)	0.17					
Total Effective Stops	1197	veh/h	100	ped/h	1537	pers/h
Effective Stop Rate	0.50	per veh	0.95	per ped	0.54	per pers
Proportion Queued	0.51		0.95		0.54	
Performance Index	155.8		2.9		158.7	
Cost (Total)	1839.08	$/h	57.60	$/h	1896.68	$/h
Fuel Consumption (Total)	289.4	L/h				
Carbon Dioxide (Total)	688.5	kg/h				
Hydrocarbons (Total)	0.054	kg/h				
Carbon Monoxide (Total)	0.750	kg/h				
NOx (Total)	1.169	kg/h				

Level of Service (LOS) Method: Delay (HCM 2000).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Intersection Performance - Annual Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Demand Flows (Total)	1,147,452	veh/y	50,526	ped/y	1,376,943	pers/y
Delay	4,238	veh-h/y	762	ped-h/y	5,848	pers-h/y
Effective Stops	574,630	veh/y	48,105	ped/y	737,661	pers/y
Travel Distance	1,711,194	veh-km/y	1,695	ped-km/y	2,055,127	pers-km/y
Travel Time	33,937	veh-h/y	1,124	ped-h/y	41,848	pers-h/y
Cost	882,760	$/y	27,648	$/y	910,408	$/y
Fuel Consumption	138,902	L/y				
Carbon Dioxide	330,463	kg/y				
Hydrocarbons	26	kg/y				
Carbon Monoxide	360	kg/y				
NOx	561	kg/y				

SIDRA INTERSECTION 6.1 | Copyright © 2000-2015 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: Torrens/Chief AM - Exist

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Torrens Rd (SE)											
4	L2	337	4.6	0.403	16.1	LOS B	13.0	94.7	0.51	0.66	38.1
5	T1	733	4.6	0.403	5.8	LOS A	13.0	94.7	0.38	0.39	56.3
Approach		1069	4.6	0.403	9.0	LOS A	13.0	94.7	0.42	0.47	51.8
NorthWest: Torrens Rd (NW)											
11	T1	1015	4.8	0.578	7.9	LOS A	19.8	144.2	0.48	0.46	55.4
12	R2	103	4.8	0.578	23.9	LOS C	10.3	75.4	0.69	0.68	45.6
Approach		1118	4.8	0.578	9.3	LOS A	19.8	144.2	0.50	0.48	54.3
SouthWest: RoadName											
1	L2	80	3.2	0.352	56.6	LOS E	4.4	31.7	0.96	0.76	35.6
3	R2	123	3.2	0.543	58.2	LOS E	7.0	50.3	0.99	0.79	23.4
Approach		203	3.2	0.543	57.6	LOS E	7.0	50.3	0.97	0.78	29.3
All Vehicles		2391	4.6	0.578	13.3	LOS B	19.8	144.2	0.51	0.50	50.4

Level of Service (LOS) Method: Delay (HCM 2000).
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	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P4	NorthWest Full Crossing	53	54.3	LOS E	0.2	0.2	0.95	0.95
P1	SouthWest Full Crossing	53	54.3	LOS E	0.2	0.2	0.95	0.95
All Pedestrians		105	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.

SIDRA INTERSECTION 6.1 | Copyright © 2000-2015 Akcelik and Associates Pty Ltd | sidrasolutions.com

INTERSECTION SUMMARY

Site: Torrens/Chief AM - Exist+DPA +BUV

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Intersection Performance - Hourly Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Travel Speed (Average)	49.0	km/h	1.5	km/h	47.8	km/h
Travel Distance (Total)	3645.2	veh-km/h	3.5	ped-km/h	4377.8	pers-km/h
Travel Time (Total)	74.4	veh-h/h	2.3	ped-h/h	91.6	pers-h/h
Demand Flows (Total)	2460	veh/h	105	ped/h	2952	pers/h
Percent Heavy Vehicles (Demand)	4.5	%				
Degree of Saturation	0.615		0.088			
Practical Spare Capacity	46.3	%				
Effective Intersection Capacity	3999	veh/h				
Control Delay (Total)	10.94	veh-h/h	1.55	ped-h/h	14.67	pers-h/h
Control Delay (Average)	16.0	sec	52.9	sec	17.9	sec
Control Delay (Worst Lane)	55.0	sec				
Control Delay (Worst Movement)	55.0	sec	54.3	sec	55.0	sec
Geometric Delay (Average)	1.4	sec				
Stop-Line Delay (Average)	14.6	sec				
Idling Time (Average)	12.1	sec				
Intersection Level of Service (LOS)	LOS B		LOS E			
95% Back of Queue - Vehicles (Worst Lane)	23.5	veh				
95% Back of Queue - Distance (Worst Lane)	171.3	m				
Queue Storage Ratio (Worst Lane)	0.19					
Total Effective Stops	1361	veh/h	99	ped/h	1732	pers/h
Effective Stop Rate	0.55	per veh	0.94	per ped	0.59	per pers
Proportion Queued	0.57		0.94		0.61	
Performance Index	173.3		2.8		176.1	
Cost (Total)	1966.76	$/h	56.59	$/h	2023.34	$/h
Fuel Consumption (Total)	303.2	L/h				
Carbon Dioxide (Total)	721.3	kg/h				
Hydrocarbons (Total)	0.057	kg/h				
Carbon Monoxide (Total)	0.780	kg/h				
NOx (Total)	1.230	kg/h				

Level of Service (LOS) Method: Delay (HCM 2000).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Intersection Performance - Annual Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Demand Flows (Total)	1,180,800	veh/y	50,526	ped/y	1,416,960	pers/y
Delay	5,249	veh-h/y	742	ped-h/y	7,041	pers-h/y
Effective Stops	653,086	veh/y	47,473	ped/y	831,176	pers/y
Travel Distance	1,749,702	veh-km/y	1,695	ped-km/y	2,101,337	pers-km/y
Travel Time	35,733	veh-h/y	1,104	ped-h/y	43,983	pers-h/y
Cost	944,043	$/y	27,161	$/y	971,204	$/y
Fuel Consumption	145,549	L/y				
Carbon Dioxide	346,202	kg/y				
Hydrocarbons	27	kg/y				
Carbon Monoxide	374	kg/y				
NOx	591	kg/y				

SIDRA INTERSECTION 6.1 | Copyright © 2000-2015 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: Torrens/Chief AM - Exist+DPA +BUV

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Torrens Rd (SE)											
4	L2	339	4.6	0.424	18.2	LOS B	14.2	103.4	0.56	0.68	37.0
5	T1	733	4.6	0.424	7.4	LOS A	14.2	103.4	0.44	0.43	55.5
Approach		1072	4.6	0.424	10.8	LOS B	14.2	103.4	0.47	0.51	50.9
NorthWest: Torrens Rd (NW)											
11	T1	1015	4.8	0.615	10.1	LOS B	23.5	171.3	0.55	0.52	54.3
12	R2	104	4.8	0.615	28.7	LOS C	10.9	79.6	0.77	0.73	44.0
Approach		1119	4.8	0.615	11.8	LOS B	23.5	171.3	0.57	0.54	53.1
SouthWest: RoadName											
1	L2	105	3.2	0.366	52.9	LOS D	5.6	40.4	0.94	0.77	36.4
3	R2	164	3.2	0.586	55.0	LOS D	9.1	65.5	0.98	0.81	24.0
Approach		269	3.2	0.586	54.2	LOS D	9.1	65.5	0.96	0.79	30.0
All Vehicles		2460	4.5	0.615	16.0	LOS B	23.5	171.3	0.57	0.55	49.0

Level of Service (LOS) Method: Delay (HCM 2000).
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	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P4	NorthWest Full Crossing	53	51.5	LOS E	0.2	0.2	0.93	0.93
P1	SouthWest Full Crossing	53	54.3	LOS E	0.2	0.2	0.95	0.95
All Pedestrians		105	52.9	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.

SIDRA INTERSECTION 6.1 | Copyright © 2000-2015 Akcelik and Associates Pty Ltd | sidrasolutions.com

INTERSECTION SUMMARY

Site: Torrens/Chief PM - Exist

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Intersection Performance - Hourly Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Travel Speed (Average)	45.0	km/h	1.7	km/h	44.1	km/h
Travel Distance (Total)	3935.9	veh-km/h	3.5	ped-km/h	4726.7	pers-km/h
Travel Time (Total)	87.5	veh-h/h	2.1	ped-h/h	107.1	pers-h/h
Demand Flows (Total)	2647	veh/h	105	ped/h	3177	pers/h
Percent Heavy Vehicles (Demand)	4.4	%				
Degree of Saturation	0.855		0.088			
Practical Spare Capacity	5.3	%				
Effective Intersection Capacity	3097	veh/h				
Control Delay (Total)	18.75	veh-h/h	1.37	ped-h/h	23.87	pers-h/h
Control Delay (Average)	25.5	sec	46.8	sec	27.0	sec
Control Delay (Worst Lane)	67.0	sec				
Control Delay (Worst Movement)	67.0	sec	54.3	sec	67.0	sec
Geometric Delay (Average)	1.2	sec				
Stop-Line Delay (Average)	24.3	sec				
Idling Time (Average)	20.9	sec				
Intersection Level of Service (LOS)	LOS C		LOS E			
95% Back of Queue - Vehicles (Worst Lane)	34.8	veh				
95% Back of Queue - Distance (Worst Lane)	253.4	m				
Queue Storage Ratio (Worst Lane)	0.28					
Total Effective Stops	1890	veh/h	93	ped/h	2360	pers/h
Effective Stop Rate	0.71	per veh	0.88	per ped	0.74	per pers
Proportion Queued	0.75		0.88		0.78	
Performance Index	235.9		2.6		238.5	
Cost (Total)	2349.18	$/h	52.21	$/h	2401.39	$/h
Fuel Consumption (Total)	352.5	L/h				
Carbon Dioxide (Total)	838.3	kg/h				
Hydrocarbons (Total)	0.068	kg/h				
Carbon Monoxide (Total)	0.897	kg/h				
NOx (Total)	1.447	kg/h				

Level of Service (LOS) Method: Delay (HCM 2000).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Intersection Performance - Annual Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Demand Flows (Total)	1,270,737	veh/y	50,526	ped/y	1,524,884	pers/y
Delay	9,000	veh-h/y	657	ped-h/y	11,456	pers-h/y
Effective Stops	906,998	veh/y	44,519	ped/y	1,132,916	pers/y
Travel Distance	1,889,251	veh-km/y	1,695	ped-km/y	2,268,796	pers-km/y
Travel Time	41,980	veh-h/y	1,019	ped-h/y	51,395	pers-h/y
Cost	1,127,605	$/y	25,062	$/y	1,152,667	$/y
Fuel Consumption	169,181	L/y				
Carbon Dioxide	402,405	kg/y				
Hydrocarbons	33	kg/y				
Carbon Monoxide	431	kg/y				
NOx	694	kg/y				

SIDRA INTERSECTION 6.1 | Copyright © 2000-2015 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: Torrens/Chief PM - Exist

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Torrens Rd (SE)											
4	L2	163	4.6	0.543	25.1	LOS C	20.2	147.0	0.71	0.69	34.9
5	T1	1012	4.6	0.543	15.7	LOS B	21.0	152.5	0.65	0.60	51.5
Approach		1175	4.6	0.543	17.0	LOS B	21.0	152.5	0.66	0.62	49.8
NorthWest: Torrens Rd (NW)											
11	T1	869	4.8	0.736	16.5	LOS B	34.8	253.4	0.75	0.70	51.4
12	R2	131	4.8	0.839	67.0	LOS E	9.3	67.8	0.98	1.02	34.1
Approach		1000	4.8	0.839	23.1	LOS C	34.8	253.4	0.78	0.74	48.0
SouthWest: RoadName											
1	L2	108	3.2	0.217	39.4	LOS D	4.9	35.1	0.81	0.74	39.4
3	R2	364	3.2	0.855	55.2	LOS E	22.0	158.1	0.97	0.95	24.0
Approach		473	3.2	0.855	51.6	LOS D	22.0	158.1	0.93	0.90	28.4
All Vehicles		2647	4.4	0.855	25.5	LOS C	34.8	253.4	0.75	0.71	45.0

Level of Service (LOS) Method: Delay (HCM 2000).
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	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P4	NorthWest Full Crossing	53	39.3	LOS D	0.1	0.1	0.81	0.81
P1	SouthWest Full Crossing	53	54.3	LOS E	0.2	0.2	0.95	0.95
All Pedestrians		105	46.8	LOS E			0.88	0.88

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.

SIDRA INTERSECTION 6.1 | Copyright © 2000-2015 Akcelik and Associates Pty Ltd | sidrasolutions.com

INTERSECTION SUMMARY

Site: Torrens/Chief PM - Exist+DPA + BUV

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Intersection Performance - Hourly Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Travel Speed (Average)	40.6	km/h	1.6	km/h	39.9	km/h
Travel Distance (Total)	4036.4	veh-km/h	3.5	ped-km/h	4847.2	pers-km/h
Travel Time (Total)	99.4	veh-h/h	2.2	ped-h/h	121.5	pers-h/h
Demand Flows (Total)	2729	veh/h	105	ped/h	3275	pers/h
Percent Heavy Vehicles (Demand)	4.4	%				
Degree of Saturation	1.032		0.088			
Practical Spare Capacity	-12.8	%				
Effective Intersection Capacity	2644	veh/h				
Control Delay (Total)	28.76	veh-h/h	1.42	ped-h/h	35.93	pers-h/h
Control Delay (Average)	37.9	sec	48.4	sec	39.5	sec
Control Delay (Worst Lane)	149.8	sec				
Control Delay (Worst Movement)	149.8	sec	54.3	sec	149.8	sec
Geometric Delay (Average)	1.4	sec				
Stop-Line Delay (Average)	36.6	sec				
Idling Time (Average)	33.1	sec				
Intersection Level of Service (LOS)	LOS D		LOS E			
95% Back of Queue - Vehicles (Worst Lane)	33.3	veh				
95% Back of Queue - Distance (Worst Lane)	239.6	m				
Queue Storage Ratio (Worst Lane)	0.33					
Total Effective Stops	2023	veh/h	95	ped/h	2523	pers/h
Effective Stop Rate	0.74	per veh	0.90	per ped	0.77	per pers
Proportion Queued	0.73		0.90		0.75	
Performance Index	268.7		2.7		271.4	
Cost (Total)	2730.91	$/h	53.40	$/h	2784.31	$/h
Fuel Consumption (Total)	371.5	L/h				
Carbon Dioxide (Total)	883.4	kg/h				
Hydrocarbons (Total)	0.074	kg/h				
Carbon Monoxide (Total)	0.936	kg/h				
NOx (Total)	1.481	kg/h				

Level of Service (LOS) Method: Delay (HCM 2000).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Intersection Performance - Annual Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Demand Flows (Total)	1,310,147	veh/y	50,526	ped/y	1,572,177	pers/y
Delay	13,805	veh-h/y	680	ped-h/y	17,246	pers-h/y
Effective Stops	971,235	veh/y	45,363	ped/y	1,210,845	pers/y
Travel Distance	1,937,464	veh-km/y	1,695	ped-km/y	2,326,652	pers-km/y
Travel Time	47,736	veh-h/y	1,042	ped-h/y	58,325	pers-h/y
Cost	1,310,838	$/y	25,633	$/y	1,336,471	$/y
Fuel Consumption	178,325	L/y				
Carbon Dioxide	424,048	kg/y				
Hydrocarbons	35	kg/y				
Carbon Monoxide	449	kg/y				
NOx	711	kg/y				

SIDRA INTERSECTION 6.1 | Copyright © 2000-2015 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: Torrens/Chief PM - Exist+DPA + BUV

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Torrens Rd (SE)											
4	L2	199	4.6	0.533	23.3	LOS C	19.8	144.3	0.68	0.68	35.5
5	T1	1012	4.6	0.533	13.5	LOS B	20.1	146.0	0.61	0.57	52.4
Approach		1211	4.6	0.533	15.1	LOS B	20.1	146.0	0.62	0.59	50.4
NorthWest: Torrens Rd (NW)											
11	T1	869	4.8	0.698	13.7	LOS B	31.6	230.5	0.69	0.64	52.7
12	R2	162	4.8	1.032	149.8	LOS F	18.2	132.5	1.00	1.31	23.6
Approach		1032	4.8	1.032	35.1	LOS D	31.6	230.5	0.74	0.74	43.7
SouthWest: RoadName											
1	L2	114	3.2	0.259	43.2	LOS D	5.4	38.8	0.85	0.75	38.5
3	R2	374	3.2	1.009	118.0	LOS F	33.3	239.6	1.00	1.23	15.7
Approach		487	3.2	1.009	100.5	LOS F	33.3	239.6	0.97	1.12	20.6
All Vehicles		2729	4.4	1.032	37.9	LOS D	33.3	239.6	0.73	0.74	40.6

Level of Service (LOS) Method: Delay (HCM 2000).
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	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P4	NorthWest Full Crossing	53	42.6	LOS E	0.2	0.2	0.84	0.84
P1	SouthWest Full Crossing	53	54.3	LOS E	0.2	0.2	0.95	0.95
All Pedestrians		105	48.4	LOS E			0.90	0.90

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.

SIDRA INTERSECTION 6.1 | Copyright © 2000-2015 Akcelik and Associates Pty Ltd | sidrasolutions.com

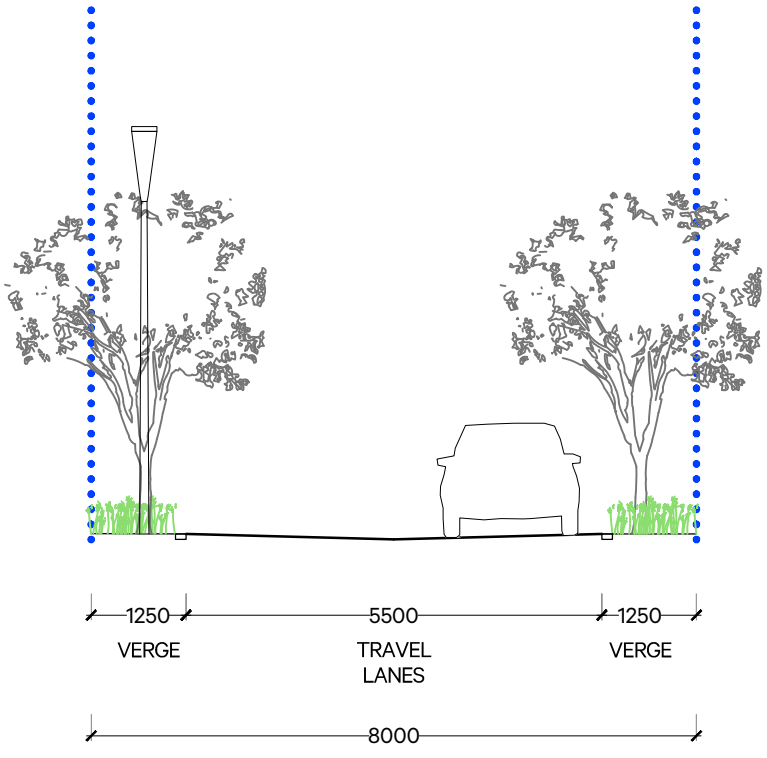
APPENDIX B

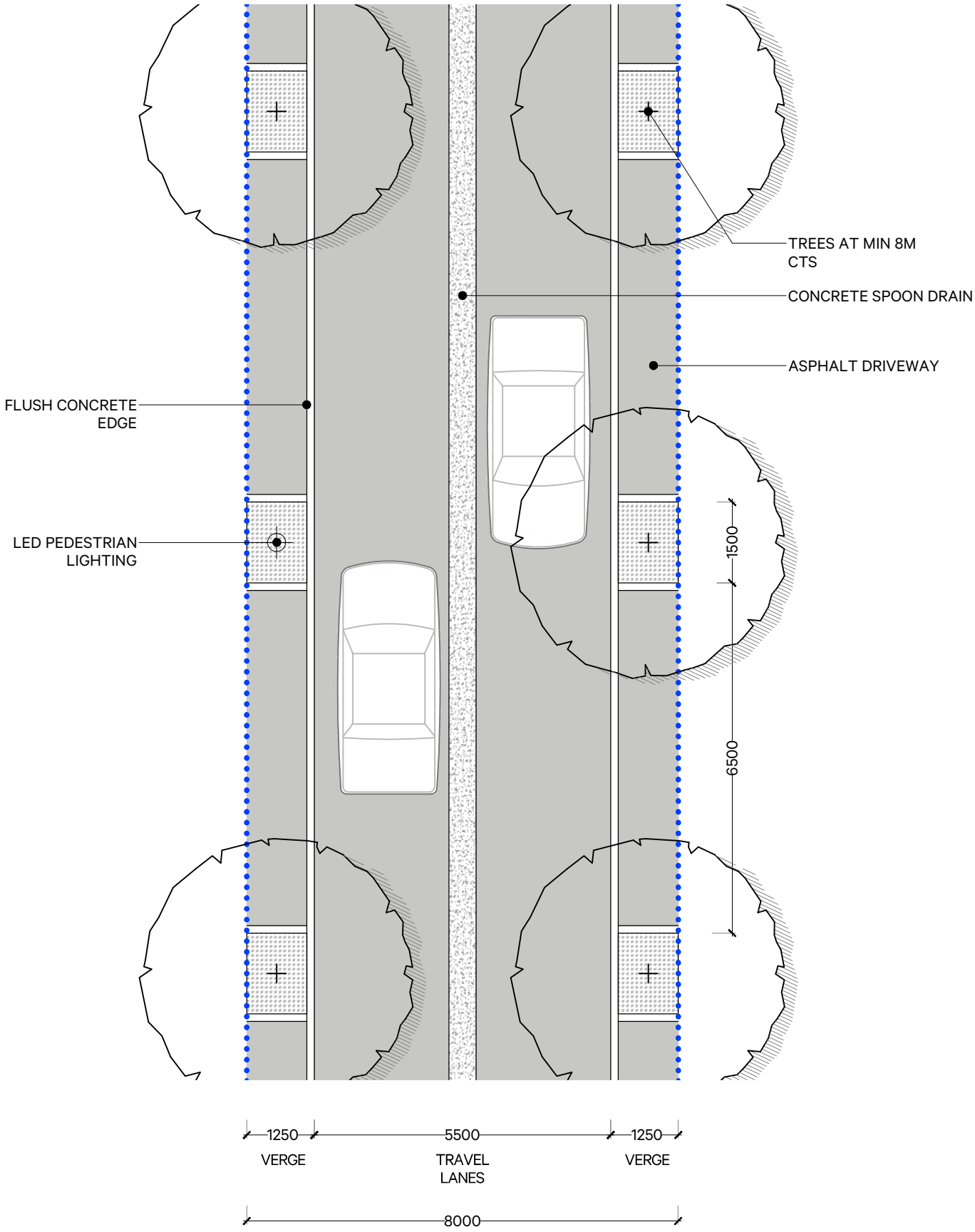
ROAD CROSS SECTIONS



Legend

- **1.1 Laneway**
  Typical New Lanes
- **2.1 Local Street (parking both sides)**
  Typical New Streets, Second St, Third St & Sixth St
- **2.2 Local Street (parking one side)**
  East St, Seventh St, Eighth St, Tenth St & Eleventh St
- **2.3 Local Street**
  Drayton St
- **3.1 Distributor**
  Chief St
- Pedestrian + Cycle Only Access



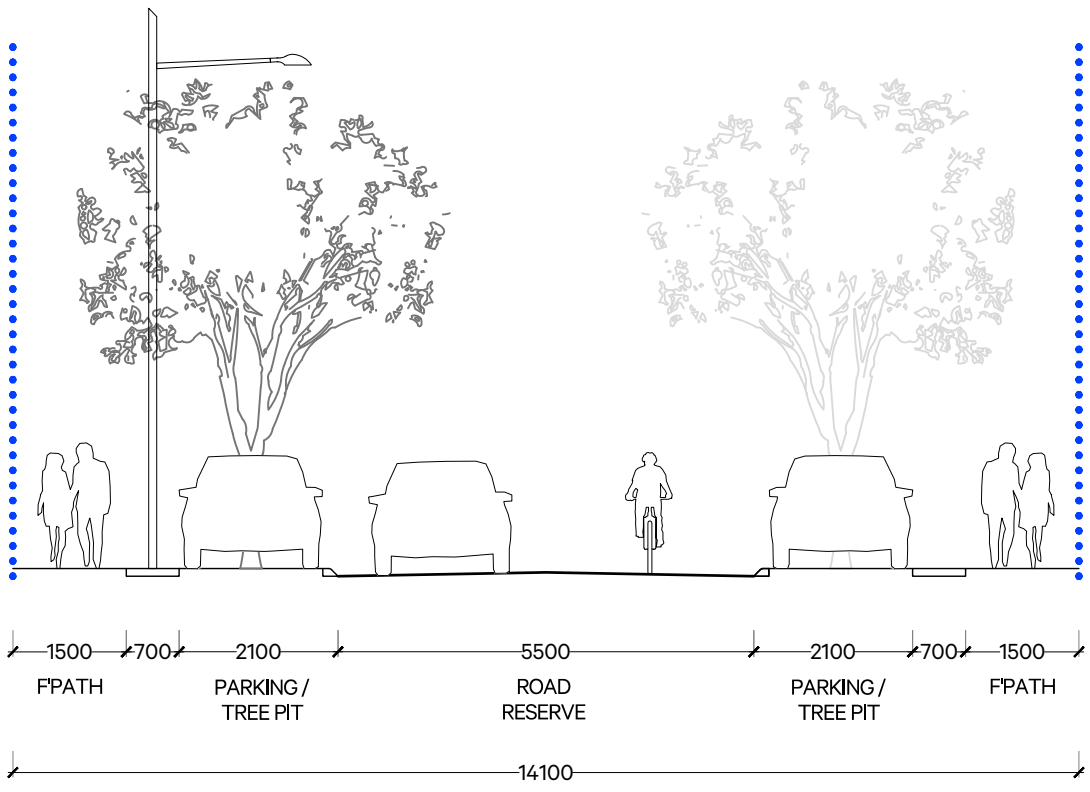


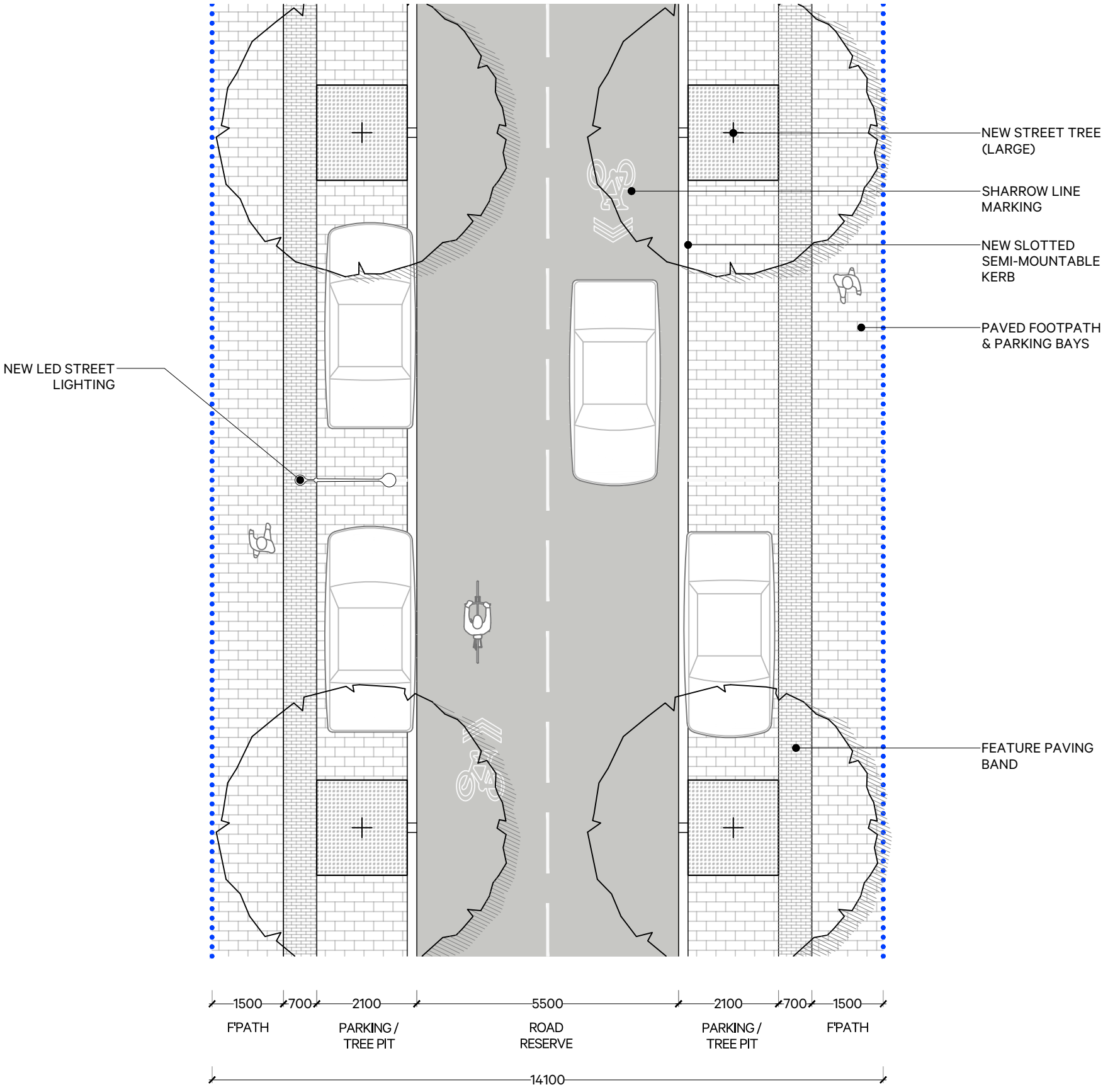
1.1 Laneway

Typical New Lanes

SCALE
1:100 (A3)
0 1 2 3 4m

oxigen	Project **BOWDEN DPA**	Project number **17.068**	Revision **D**	Date **04.07.18**



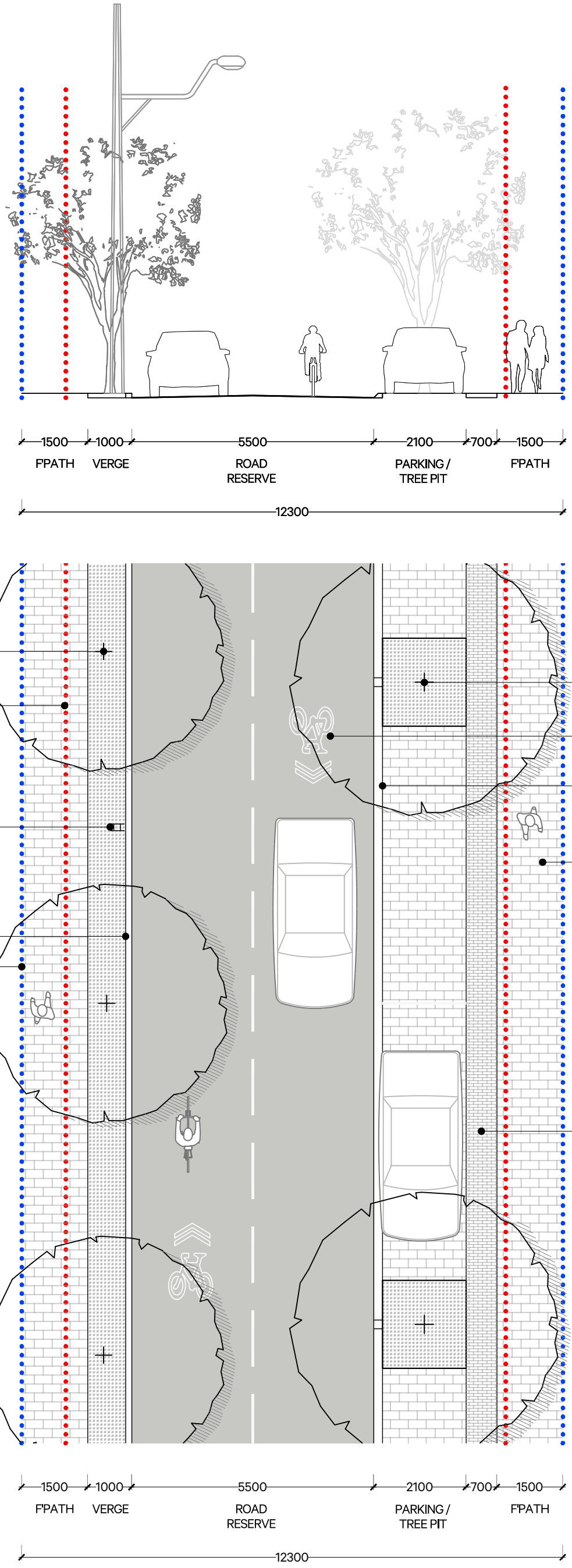


2.1 Local Street

Typical New Streets, Second St, Third St & Sixth St

SCALE
1:100 (A3)
0 1 2 3 4m

oxigen	Project **BOWDEN DPA**	Project number **17.068**	Revision **D**	Date **04.07.18**

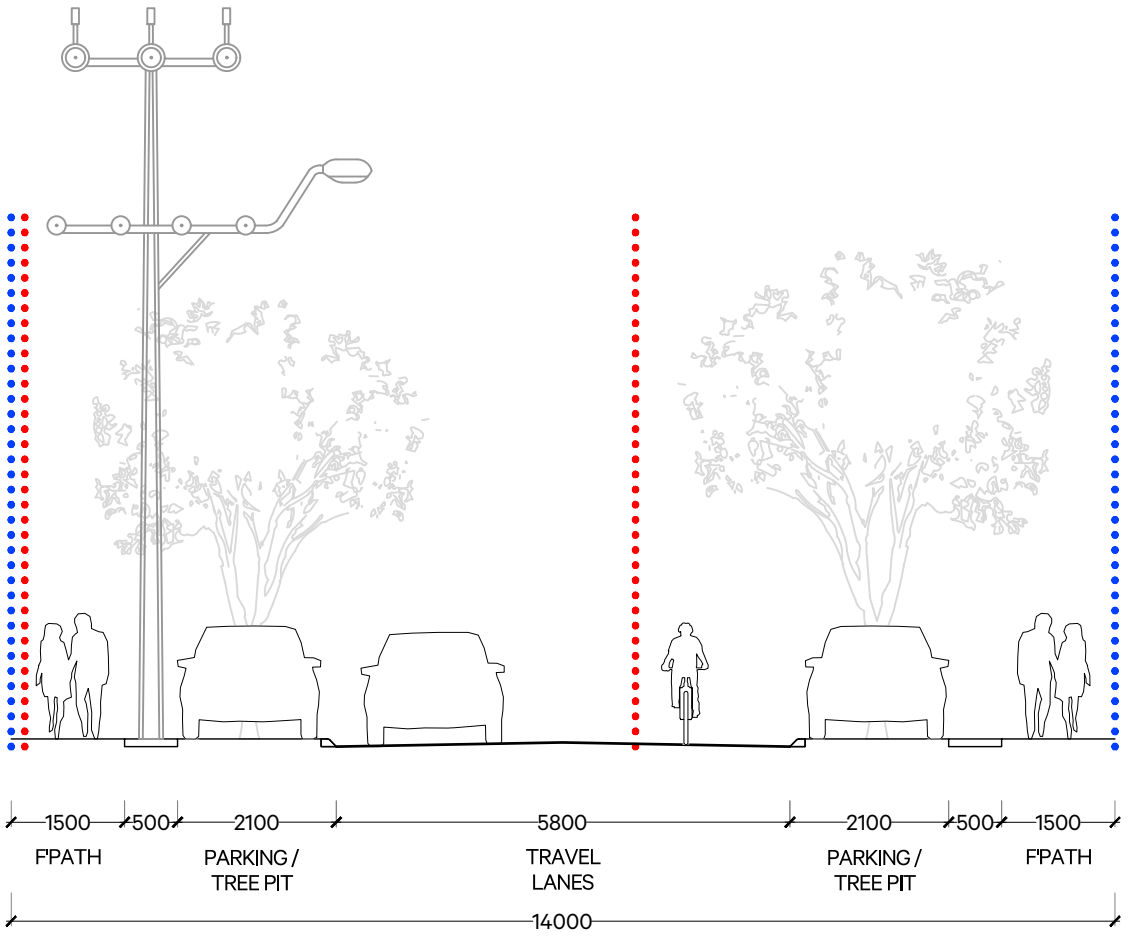


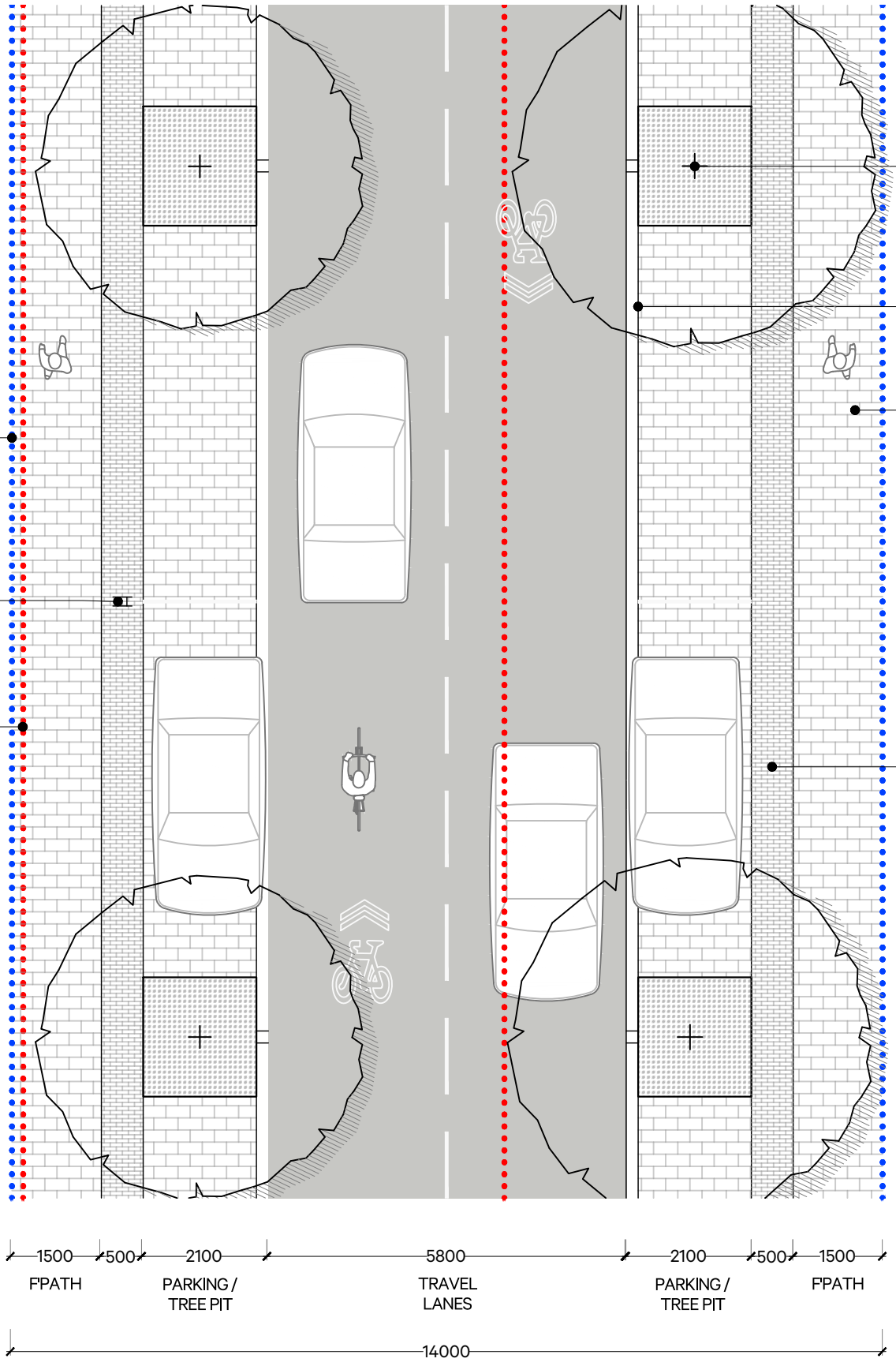
2.2 Local Street

East St, Seventh St, Eighth St, Tenth St & Eleventh St

SCALE
1:100 (A3)
0 1 2 3 4m

oxigen	Project **BOWDEN DPA**	Project number **17.068**	Revision **D**	Date **04.07.18**



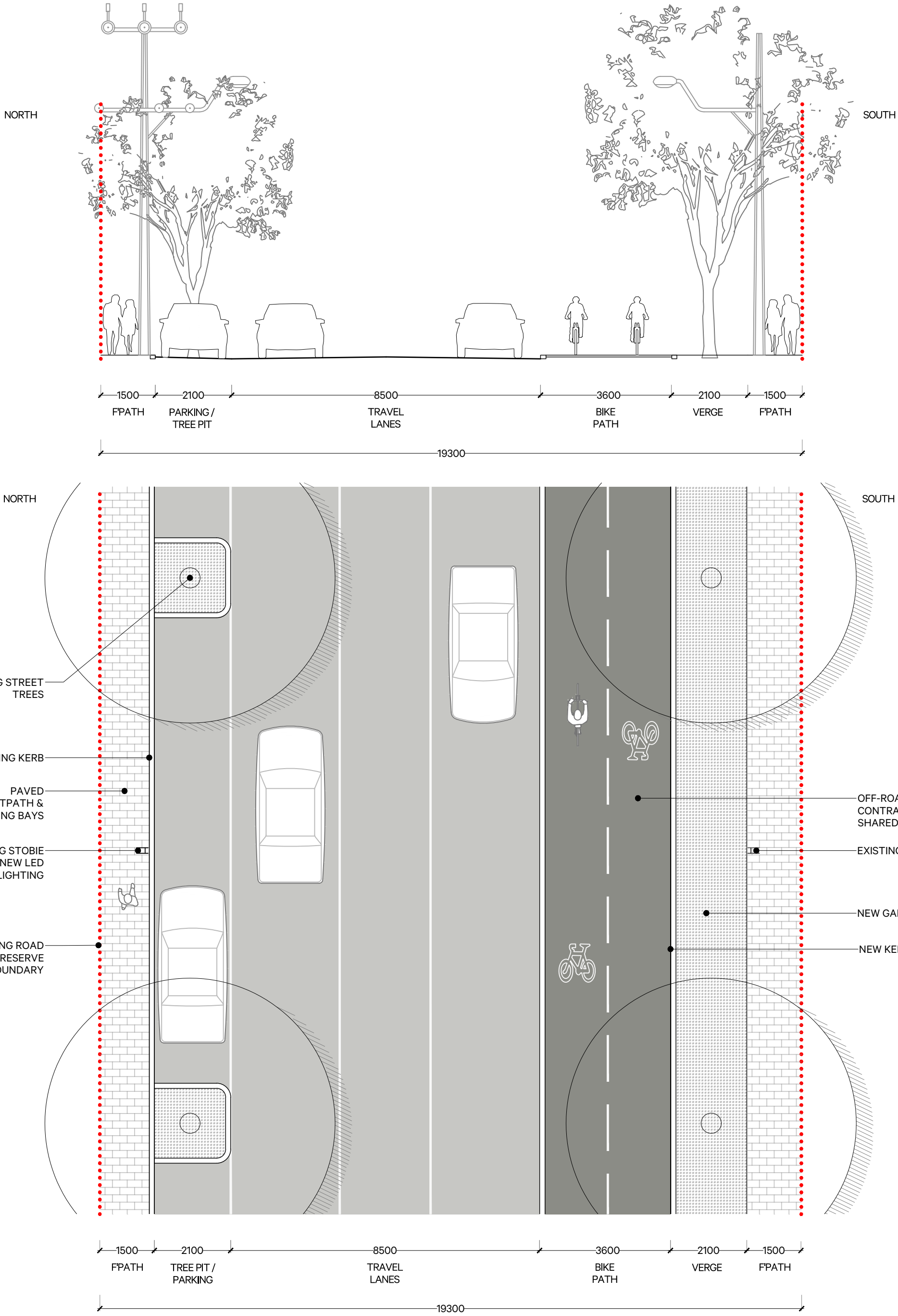


2.3 Local Street

Drayton St

SCALE
1:100 (A3)
0 1 2 3 4m

oxigen	Project **BOWDEN DPA**	Project number **17.068**	Revision **D**	Date **04.07.18**



3.1 Distributor

Chief St

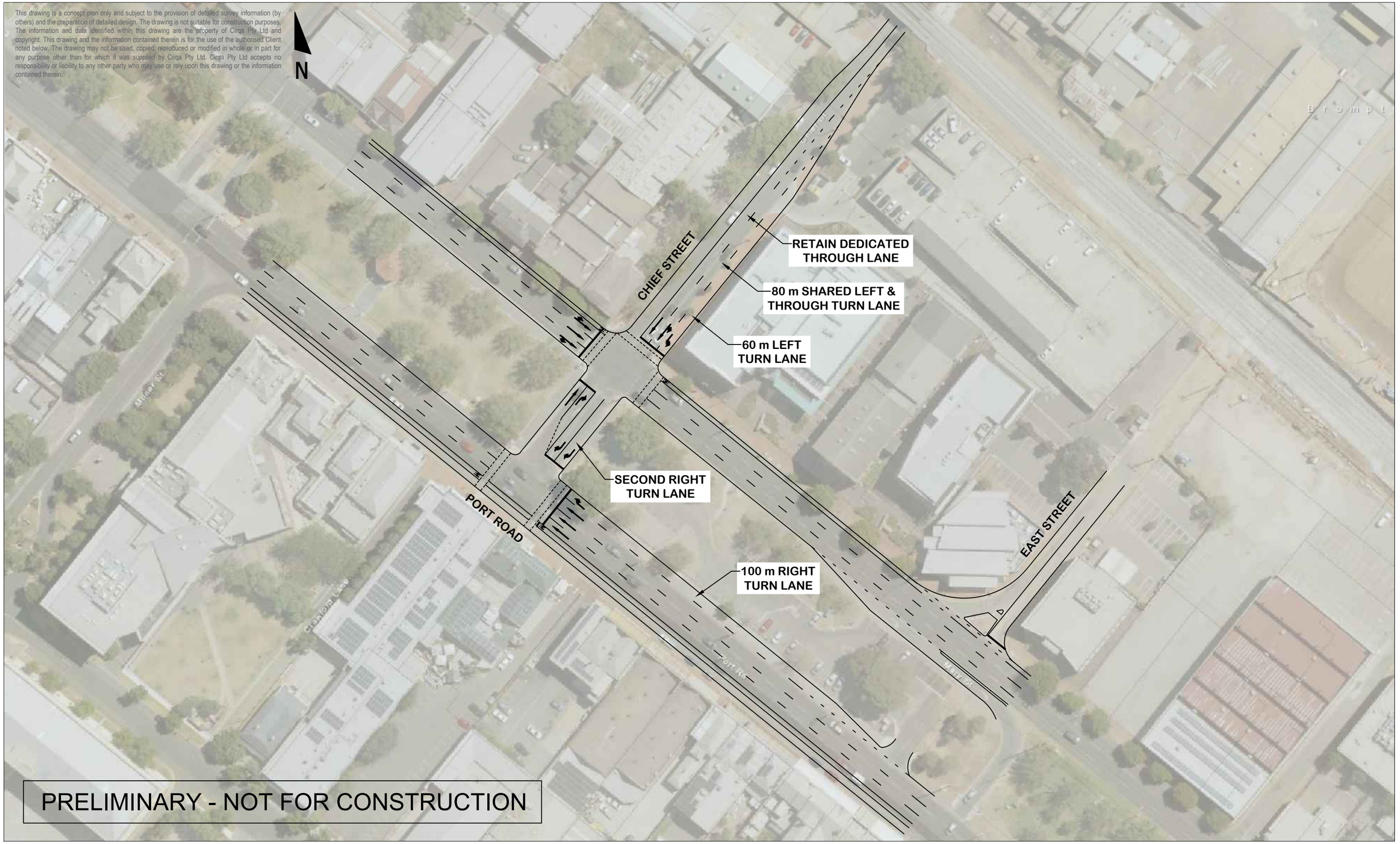
SCALE
1:100 (A3)
0 1 2 3 4m

oxigen	Project **BOWDEN DPA**	Project number **17.068**	Revision **D**	Date **04.07.18**

APPENDIX C

INTERSECTION UPGRADE CONCEPTS

This drawing is a concept plan only and subject to the provision of detailed survey information (by others) and the preparation of detailed design. The drawing is not suitable for construction purposes. The information and data identified within this drawing are the property of Cirqa Pty Ltd and copyright. This drawing and the information contained therein is for the use of the authorised Client noted below. The drawing may not be used, copied, reproduced or modified in whole or in part for any purpose other than for which it was supplied by Cirqa Pty Ltd. Cirqa Pty Ltd accepts no responsibility or liability to any other party who may use or rely upon this drawing or the information contained therein.



PRELIMINARY - NOT FOR CONSTRUCTION

PORT ROAD/CHIEF STREET INTERSECTION

CONCEPT DESIGN

PROJECT NO: 18128 **SCALE** 1:1000 (A3)
DRAWING: 01_SH01 **DATE:** 17/05/2018
REVISION: - **DRAWN:** TAW

CIRQA

This drawing is a concept plan only and subject to the provision of detailed survey information (by others) and the preparation of detailed design. The drawing is not suitable for construction purposes. The information and data identified within this drawing are the property of Cirqa Pty Ltd and copyright. This drawing and the information contained therein is for the use of the authorised Client noted below. The drawing may not be used, copied, reproduced or modified in whole or in part for any purpose other than for which it was supplied by Cirqa Pty Ltd. Cirqa Pty Ltd accepts no responsibility or liability to any other party who may use or rely upon this drawing or the information contained therein.

N

60 m SEPARATED RIGHT TURN LANE

TORRENS ROAD

60 m SHARED LEFT & RIGHT TURN LANE

CHIEF STREET

DIVERGE TO 3 LANES IN ORDER TO MATCH TO RAILWAY APPROACH

PRELIMINARY - NOT FOR CONSTRUCTION

TORRENS ROAD/CHIEF STREET INTERSECTION

CONCEPT DESIGN

PROJECT NO: 18128
DRAWING: 02_SH01
REVISION: -

SCALE 1:1,000 (A3)
DATE: 17/05/2018
DRAWN: TAW

CIRQA

This drawing is a concept plan only and subject to the provision of detailed survey information (by others) and the preparation of detailed design. The drawing is not suitable for construction purposes. The information and data identified within this drawing are the property of Cirqa Pty Ltd and copyright. This drawing and the information contained therein is for the use of the authorised Client noted below. The drawing may not be used, copied, reproduced or modified in whole or in part for any purpose other than for which it was supplied by Cirqa Pty Ltd. Cirqa Pty Ltd accepts no responsibility or liability to any other party who may use or rely upon this drawing or the information contained therein.

N

SIXTH STREET

LEFT TURN LANE
TO BE SIGNALISED

LEFT TURN LANE TO BE SIGNALISED
(RETAIN EXISTING LENGTH)

RIGHT TURN LANE TO BE SIGNALISED
(RETAIN EXISTING LENGTH)

THROUGH TRAFFIC TO
REMAIN UNSIGNALISED

PARK TERRACE

U-TURN FACILITY
TO REMAIN

PRELIMINARY - NOT FOR CONSTRUCTION

PARK TERRACE/SIXTH STREET INTERSECTION

CONCEPT DESIGN

PROJECT NO: 18128
DRAWING: 01_SH01
REVISION: -

SCALE 1:1000 (A3)
DATE: 17/05/2018
DRAWN: JJB

CIRQA



APPENDIX D

SERVICES REPORT

BOWDEN-BROMPTON DPA INVESTIGATIONS

PRELIMINARY INFRASTRUCTURE INVESTIGATIONS

PRELIMINARY

65148-1 REV B

PREPARED FOR | City of Charles Sturt Council

PREPARED BY | Fyfe Pty Ltd

ABN | 57 008 116 130

ADDRESS | L1, 124 South Terrace, Adelaide 5000

CONTACT | Steve Mitchell, Principal Civil Engineer

TELEPHONE | office 61 8 8201 9600 direct 61 8 8201 9704

FACSIMILE | +61 8 8201 9650

EMAIL | steve.mitchell@fyfe.com.au

DATE | 22/05/2018

REFERENCE | 65148-1

©Fyfe Pty Ltd, 2018

Proprietary Information Statement

The information contained in this document produced by Fyfe Pty Ltd is solely for the use of the Client identified on the cover sheet for the purpose for which it has been prepared and Fyfe Pty Ltd undertakes no duty to or accepts any responsibility to any third party who may rely upon this document.

All rights reserved. No section or element of this document may be removed from this document, reproduced, electronically stored or transmitted in any form without the written permission of Fyfe Pty Ltd.

Document Information

Prepared by: Rosie Vakasilimi	Graduate Civil Engineer, Fyfe Pty Ltd	Date: 22 May 2018
Reviewed by: Steve Mitchell	Principal Civil Engineer, Fyfe Pty Ltd	Date: 22 May 2018
Approved by: John Hudson	Civil and Structures Manager, Fyfe Pty Ltd	Date: 22 May 2018
Client acceptance by:		Date:

Revision History

Revision	Revision Status	Date	Prepared	Reviewed	Approved
A	Issued For Review	15/12/17	REV	SJM	CRG
B	Issued	22/05/18	REV	SJM	JH

FYFE

CONTENTS

Page

1. INTRODUCTION 1

2. REFERENCE INFORMATION 2

3. PRELIMINARY ENGINEERING INFRASTRUCTURE INVESTIGATIONS 3

3.1 Power Supply, SA Power Networks (SAPN) 3
3.2 Potable Water Supply, SA Water 5
3.3 Wastewater Supply, SA Water 7
3.4 Recycled Water Supply, SA Water 9
3.5 Telecommunications 11
3.6 APA Group Gas Supply 12

4. SUMMARY 14

5. CONCLUSION 16

LIST OF FIGURES

Figure 1-1 Study Area 1
Figure 3-1 Wastewater Supply 8
Figure 3-2 Recycled Water Supply 10
Figure 3-3 NBN roll out map for the Bowden area 11
Figure 3-4 Gas Supply 13
Figure 4-1 Gas, Sewer and Water layout 15

APPENDICES

Appendix A Correspondence from SA Water – WASTE, POTABLE & RECYCLED WATER
Appendix B Correspondence with SA Power networks
Appendix C TELECOMS & APA GAS
Appendix D Dial Before You Dig

1. INTRODUCTION

The City of Charles Sturt Council has engaged Fyfe Pty Ltd to undertake a preliminary infrastructure investigation to guide the redevelopment of part of the Brompton area as shown in Figure 1-1. This infrastructure investigation comprises of:

- SA Water – Potable, Waste and Recycled Water
- SA Power local power capacity and potential requirements
- APA Group local capacity and potential requirements
- NBN/Telstra local network requirements
- Local area Stormwater network capacity and potential requirements

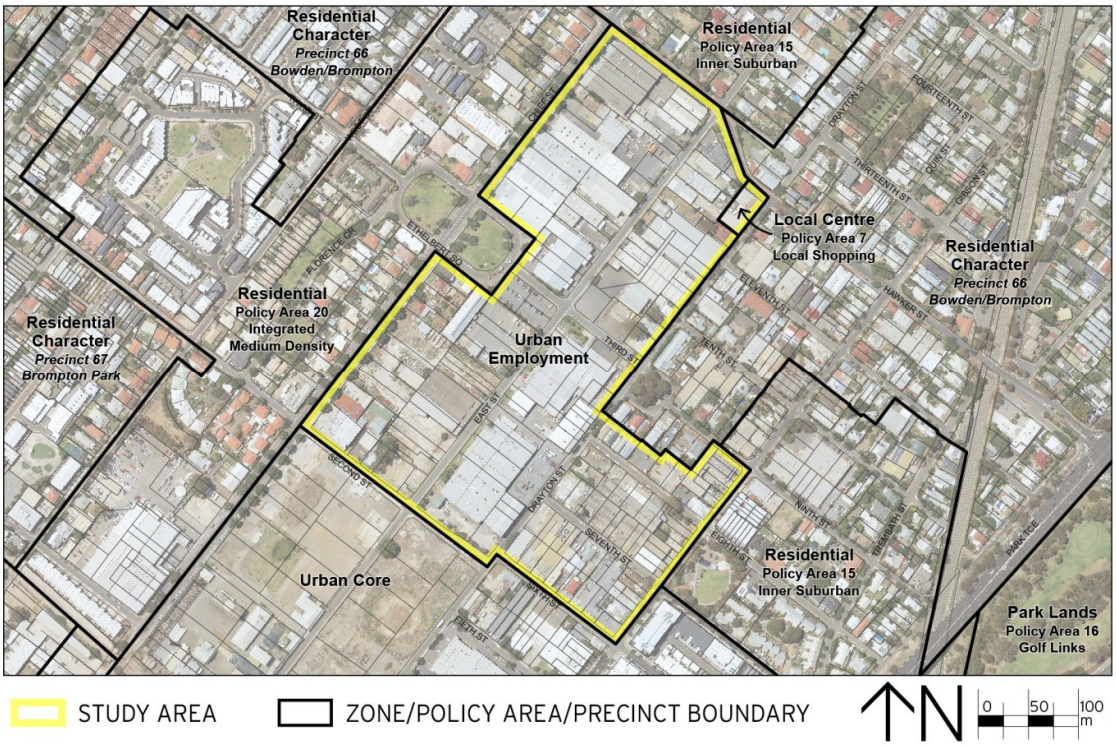


Figure 1-1 Study Area

2. REFERENCE INFORMATION

The findings of these preliminary investigations are premised on the content and communications within the following correspondence:

- The proposed development plan with current projected yield of : 1,530 dwellings with approximately 60% being townhouses and the remaining 40% apartments,
- Correspondence from SA Water, for potable, waste and recycled water, Appendix A.
- Correspondence from SA Power Networks (SAPN), Appendix B.
- Preliminary communications with NBN Co and APA Group. Appendix C.

3. PRELIMINARY ENGINEERING INFRASTRUCTURE INVESTIGATIONS

The following outlines preliminary engineering infrastructure investigation advice currently available from the relevant authorities:

3.1 Power Supply, SA Power Networks (SAPN)

SA Power Networks (SAPN) issued advice to Fyfe on 30th April 2014 (refer Appendix B), stating that the power mains in this location have sufficient capacity to supply the proposed development. SAPN has issued further advice to what was previously advised in 2014.

The following are from an infrastructure investigation that was conducted in 2014 summarising the available power mains in this location available to the development:

- Augmentation charges, in relation to the nearby Croydon substation, are proposed to be:
  - Up to 2100 kVA: Current standard charge will apply
  - Over 2100 kVA (in a 3 year rolling period): the augmentation rate per kVA will be based on an individual calculation
  - Rate pricing is likely to shift (for loads greater than 70 kVA, courtesy of the Australian Regulator Mechanism as of 1 July 2015. This shift is not expected to be significant in scale.
- The scope of augmentation works would include (1) the upgrade of the Croydon 66/11kV substation and (2) installation of (x3) 11kV feeders from this substation to the proposed development footprint.
- SAPN will likely pay for the substation upgrades and the future 11kV extensions upfront and thereafter collect augmentation rates from developer(s).
- The augmentation rate comprises of the elements noted within the SA Power letter within Appendix B and includes the standard augmentation rate of $154/kVA.
- It is assumed that all headworks outside the site will be covered by augmentation charges. SAPN has not categorically confirmed this at this time.
- SAPN has yet to confirm minimum setbacks required of built form to the relevant infrastructure. This will need to be confirmed during preliminary and/or detailed design.
- SAPN has advised that initial stage connections (via 11kV reticulation) can be made from near the corner of Chief and Second St, this portion would be serviced by an existing 11kV overhead main along Second St, and near Gibson St, this would be serviced by an existing 11kV overhead main along Gibson St.

The following is recent advice provided by SAPN to Fyfe on 7th February 2018 as follows:



For the proposed development at Bowden, the development is likely to be supplied from our substation at Croydon. The zone substation threshold for this site is 4200kVA (10% of the substation capacity) and therefore unless a total of 4200kVA or more is connected in a rolling 5 year period, a residential developer will only pay the Residential Metro High Voltage Feeder augmentation rate outlined in our current connection policy ($231/kVA plus CPI). If 4200kVA or over is connected within 5 years, the expected additional augmentation rate of $268/kVA plus CPI will also apply.

3.2 Potable Water Supply, SA Water

SA Water issued advice to Fyfe on 8 May 2014 (refer Appendix A), with further advice issued by SA Water early 2018. The main details of the advised issued in 2014 are summarised below:

- The area surrounding the proposed footprint is supplied by Ex 300 CICL and Ex 250 CICS mains in series through the parklands. These are supplied by the North Adelaide network of mains, which consist mainly of Ex 150 mains and which do not have enough capacity to service both the adjacent Bowden Urban Village and this Brompton village.
- It is currently envisaged that a new DN 375 PVC-O approach main will likely be required from the EL 103 zone supply (via the Ex 1100 inlet main to the North Adelaide EL 51 Tank), through the parklands to link-up to the Ex 355 PE main in North Adelaide (Station Road) adjacent to Park Terrace. Such a new feed is likely to have the capacity to supply approximately 8000 services.
- Some existing mains within the proposed village footprint will likely need to be upgraded or abandoned to suit the final layout of the proposed development. The section of Ex 100AC/CICL main along Drayton Road will need to be upgraded to a minimum of DN 150. Any new main will need to be a minimum of DN 150, to support the proposed higher density and commercial areas, along with the need for fire fighting capacity. It must be noted however that the local reticulated water supply system is not designed to meet fire protection requirements. An application for a flow test/network analysis adjacent to the site will need to be made in due course by the hydraulics designer and the fire protection system will then need to be designed accordingly.
- This proposed development footprint abuts existing mains on Chief Street (Ex.150 AC), Gibson Street (Ex.250 PVC-O/200 CICL) which can also be extended to supply this development.
- An Ex.125 CICL main in East Terrace which traverses the site will need to be re-laid in DN 150 PVC-O main.
- Augmentation currently required is envisaged to be: (1) construction of approximately 505 m of DN 150 PVC-O main in East Street (shown A – B) to replace the Ex.125 CICL main, and (2) construction of approximately 440 m of DN 150 PVC-O main in Drayton Street (shown C – D) to replace the EX.100 AC/CICL main.
- Estimated model pressures experienced by the proposed development are within an acceptable pressure range.

The following is recent advice issued by SA Water to Fyfe on the 9th March 2018 as follows:

Water can be provided to this proposed redevelopment site subject to the following works being undertaken:

- *No approach works to the development site will be required;*
- *All mains within this site, and abutting, will be required to be 200mm to meet high rise water demand and Fire Fighting requirements;*
- ***Chief St** currently has a 150mm water main which will be required to be upsized to 200mm;*

- ***East St*** *from Drayton to Second St currently has a 200mm water main so will be sufficient for the new development however from Second St to Hawker St it is only a 125mm water main and will need to be upsized to a 200mm;*
- ***Second St*** *currently has a 150mm water main and will need to be upsized to a 200mm;*
- ***Third Ave*** *currently has a 100mm water main and will need to be upsized to a 200mm;*
- ***Hawker St*** *currently has a 900mm transmission main which is gazetted not available for connection. There is also a 100mm main in Hawker St so subject to development design a connection may be able to be made to the transmission main but it is subject to further investigation when a development application is lodged; and*
- ***Drayton St*** *currently has a 100mm water main and will need to be upgraded to a 200mm.*

3.3 Wastewater Supply, SA Water

SA Water previously issued advice to Fyfe on 8 May 2014 (refer Appendix A and Figure 3-1) based on the concept plan proposed for 300 detached dwellings, 1,400 apartments and 3,000m^2 of retail/commercial space. SA Water has not issued further advice in regards to wastewater for the new proposed concept. The main details from the advice issued in 2014 are summarised below:

- The proposed development footprint generally gravitates to the north-east via Ex.150, Ex.225 & Ex.300 sewer mains, which discharge to an oviform (oval-shaped) sewer with an equivalent nominal diameter of DN 700 (at 0.01 % grade).
- The oviform main which traverses the proposed development footprint, in East Street, cannot be relocated due to this minimal grade. This portion of sewer should either be retained within a road reserve (as per now) or in a 10m wide easement that can be accessed by SA Water at all times.
- Existing mains within the proposed development footprint will likely need to be upgraded or abandoned to suit the final layout of the development. Any new main will likely need to be a minimum of DN 225 to accommodate the higher density and commercial areas.
- Network analysis indicates that the Ex.700 sewer has sufficient capacity to service the proposed development.

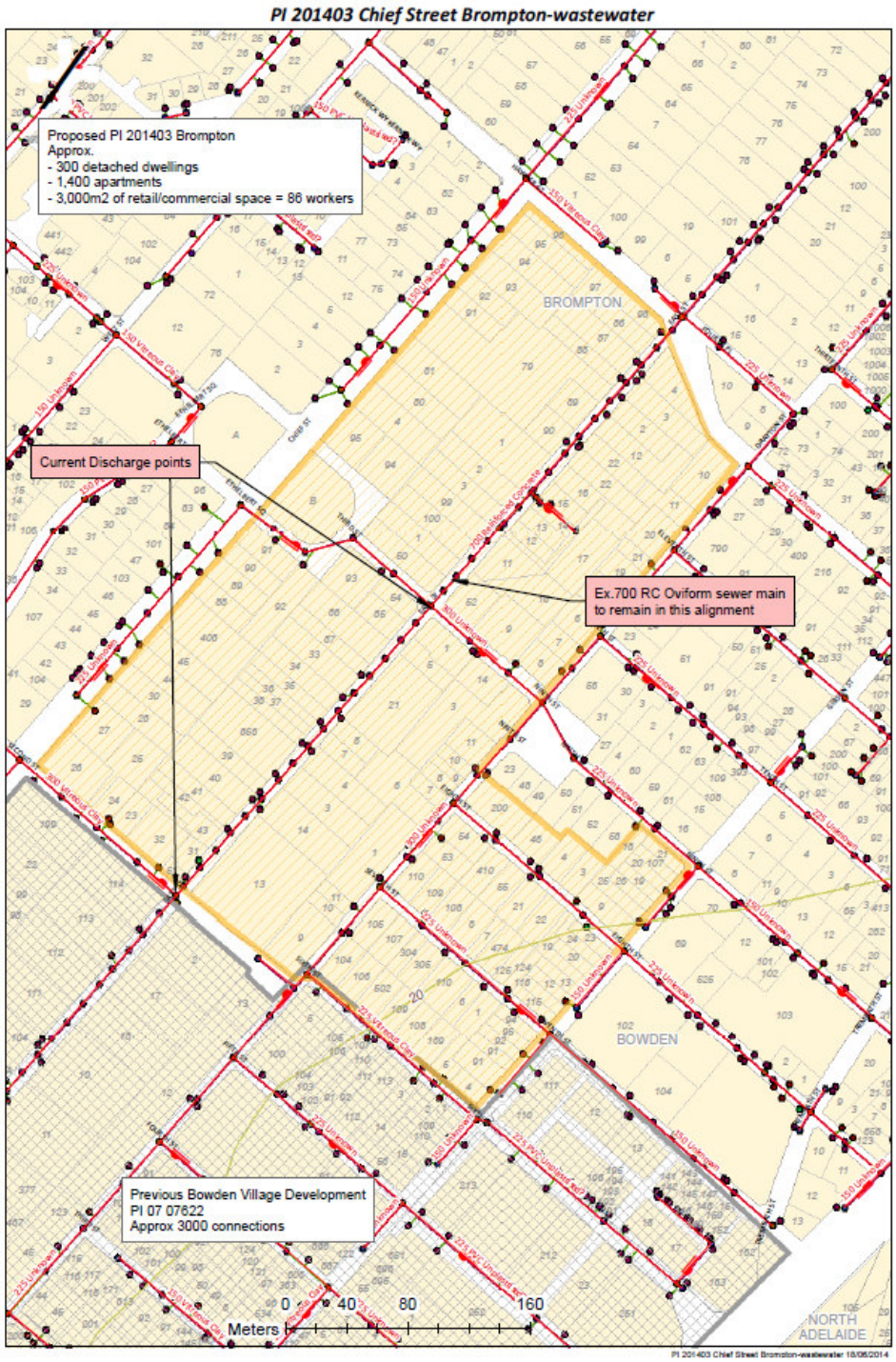


Figure 3-1 Wastewater Supply

3.4 Recycled Water Supply, SA Water

SA Water previously issued advice to Fyfe on 8 May 2014 (refer Appendix A and Figure 3-2) based on the concept plan proposed for 300 detached dwellings, 1,400 apartments and 3,000m^2 of retail/commercial space. SA Water has yet to issue further advice in regards to recycled water for the new proposed concept. The main details from the advice issued in 2014 are summarised below:

- Recycled water has been installed in nearby Gibson St as part of adjacent Bowden Urban Village, and so is available to for this proposed development footprint.
- The recycled water scheme can support some of the demand for the potable water supply, and vice versa. As there will likely be approximately 1,800 connections, and no information was supplied in this regard, it is assumed the supply dynamics will be similar to the Mawson Lakes recycled water scheme, which includes gardens, other external uses and toilet flushing.
- The demand assumption will need to be reviewed when more details are available.
- Initial network analysis suggests however that the GAP scheme can adequately supply the proposed yield requirements.

A link to the potable water supply is recommended to ensure redundancy and security of supply, and backflow prevention will also be required.

IN Summary for Sections 3.2, 3.3 and 3.4:

Generally with regard to the advice previously and recently afforded by SA Water, for potable, waste and recycled water, it would ultimately be incorporated into SA Water's response to an SOI/DPA amendment. The Corporation's requirements would be confirmed upon receipt of the development application from the Development Assessment Commission (DAC), including any potential augmentation and/or headworks charges.

At this time, as advised by SA Water, it is unlikely augmentation charges would be applied to waste or recycled water (but this needs to be further confirmed in due course). It is likely however that either an augmentation charge or 50% material costs will be paid for (and applied) by SA Water, for potable water.

This is an assessment SA Water is unable to make at this time and will further advise in due course, based on a commercial case. Trade Waste requirements have also not been addressed in this response.



Figure 3-2 Recycled Water Supply

3.5 Telecommunications

On the basis of the current NBN Co process, if a new or proposed development meets the requirements of the NBN New Developments Policy (i.e. it is within the fibre rollout footprint and has more than 100 premises to be developed over three years)(see Figure 3-3). NBN Co is deemed to be the relevant provider.

This development currently meets these criteria, as advised in writing by NBN Co (refer Appendix C and D for Dial Before You Dig information). NBN Co recommends a submission be made when the development proceeds. The relevant territory manager will then liaise with the planning team to identify if any changes which can or need to be made to further support development. Accordingly, as the project progresses, NBN Co should be kept informed so it may assess and update planning details within its business case.

NBN Co has advised that there will be Deployment Contribution costs to be paid by developers, as a requirement within the NBN New Developments Policy, for new developments (refer Appendix C), standard rate $400/premises for multi-dwelling units and $600/premises for single dwelling units. No inference on augmentation costs can be made at this time by NBN Co for this investigation.

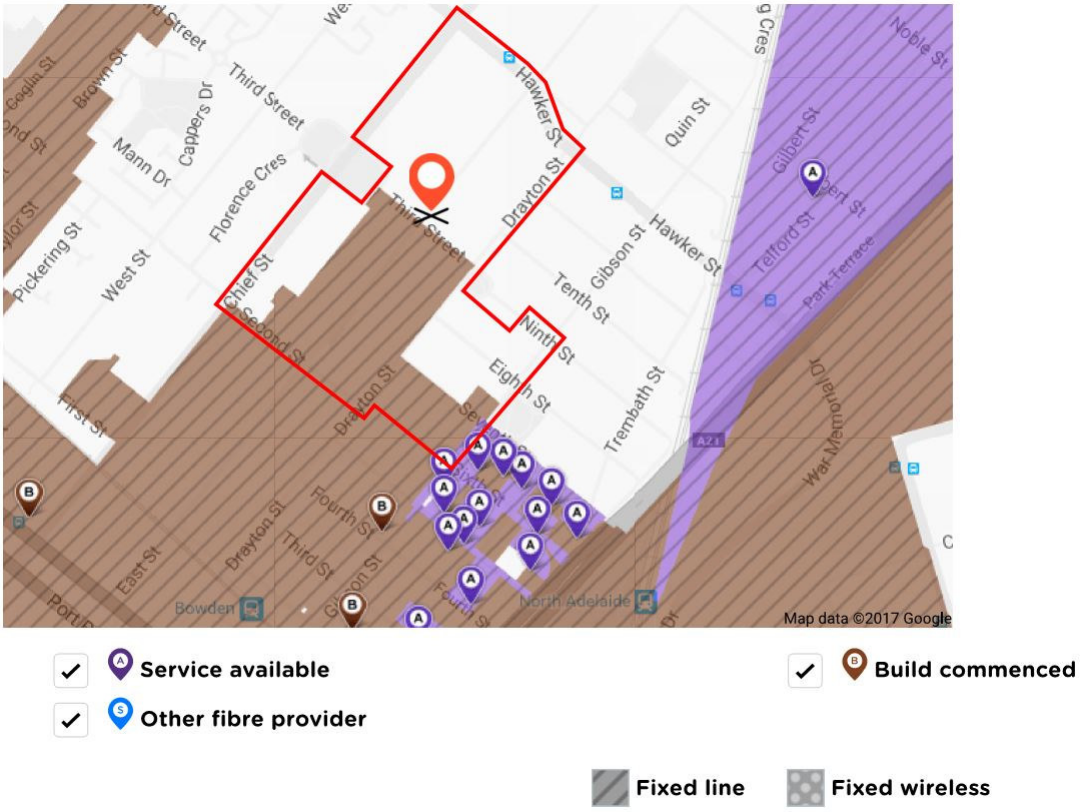


Figure 3-3 NBN roll out map for the Bowden area

3.6 APA Group Gas Supply

APA Group issued advice to Fyfe on 30th November 2017 (refer Appendix C), stating that the gas mains in this location have sufficient capacity to supply the development. The following information was provided by APA Group back in 2014 of the available gas infrastructure within the area that has the capacity to provide service to the site currently:

- APA Group has an existing high pressure network (blue); refer to Figure 3-4, in the vicinity of the site which has the capacity to support the projected 1,530 residential connections along with the retail/commercial areas.
- There are 'high pressure' gas pipes in Chief, Drayton, Hawker and Gibson St, as advised by APA. It is likely best these road levels are maintained (but at least not lowered) but this needs investigation. It is important to note that not lowering the levels of these streets will likely avoid major expenditure with regard to the adjustment of any of these pipe alignments.
- APA Group proposed approximately 2km of low pressure pipe reticulation to be installed (yellow).

With the provision of more detailed design information, and more details in regard to actual gas loads needed, APA will be able to further evaluate total project requirements in detail and provide an in-principle commitment upon verifying the proposed footprint and yield is commercially viable. Included within Appendix D is APA Group's GIS plan showing the existing mains associated with Brompton.

At this time, it is envisaged that gas is available for the proposed development. APA will need to further assess the potential requirements, to prove up the commercial case, upon footprint details being confirmed in due course of the development progressing.

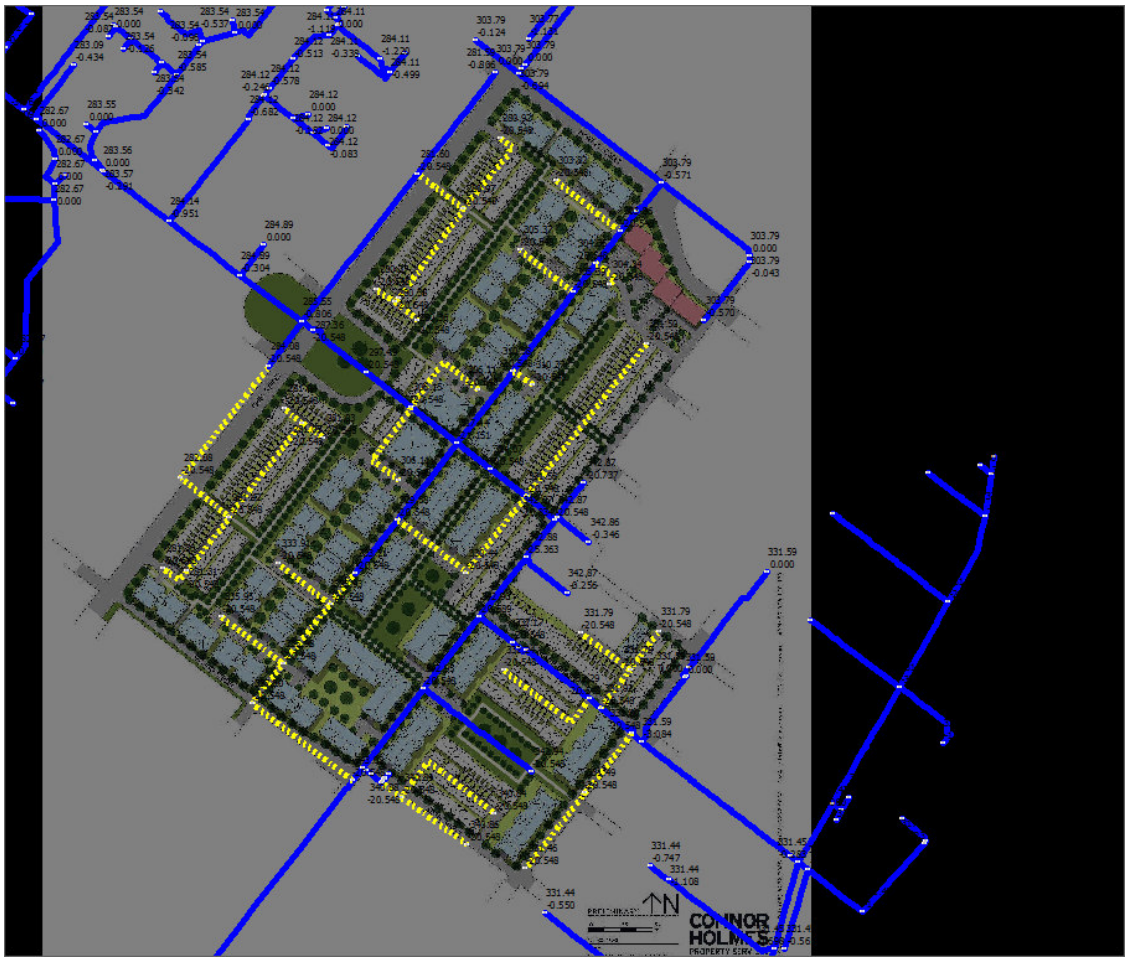


Figure 3-4 Gas Supply

4. SUMMARY

Advice received from SA Water is that:

- the existing 700ϕ sewer main (dark blue line, Figure 4-1) cannot be relocated due to it being at the minimum grade, but it does have sufficient capacity to service the proposed development.
- Augmentation of water mains with the following dimension DN 150 PVC-O (light blue line, Figure 4-1) is required to replace Ex. 125 CICL main on East Street, and Ex. 100 AC/CICL main on Drayton Street to accommodate the proposed development, and
- Ex 250 PVC-O/200CICL along Gibson Street can be extended to also supply the proposed development, refer Figure 4-1.

Advice from APA Group is that:

- the high pressure gas mains (red line, Figure 4-1) has sufficient capacity to support the proposed 1,530 residential connections,
- it was recommended that road levels along Chief, Drayton, Hawker and Gibson Street are not lowered to avoid major expenditure with regards to the adjustment of these pipe alignments.



Figure 4-1 Gas, Sewer and Water layout

5. CONCLUSION

On the basis of enquiries to date, and advice offered accordingly by the relevant service authorities, the subject land can be serviced by water (potable, waste & recycled), power, gas and telecommunications.

Based on the costs provided in this report (SA Power Networks) and our understanding of the potential augmentation charges (SA Water) has applied in other similar instances, development should be able to occur in a cost effective manner. Telecoms and gas reticulation connections are likely to be at no charge (except for the supply of the open common service trench).

A more detailed feasibility should occur at such time that a more detailed proposal is developed, at which time the relevant authorities will be able to provide more accurate (actual) augmentation costs.

FYFE

APPENDIX A

CORRESPONDENCE FROM SA WATER – WASTE, POTABLE & RECYCLED WATER

Rosie Vakasilimi

From: Snoswell, Debbie <Debbie.Snoswell@sawater.com.au>
Sent: Friday, 9 March 2018 9:07 AM
To: Rosie Vakasilimi
Cc: Steve Mitchell; Bicky Shakya
Subject: RE: Brompton Rezoning - SA Water Response
Attachments: Figure 10 - Concept Plan Brompton Urban Village.pdf

Hi Rosie,

Apologies for the delay in getting this information to you. We have reviewed the development site and have identified what size water mains are currently in place and what they will need to be sized when development proceeds. Please find below SA Water's response to the Water requirements required for the Brompton redevelopment:

Water:

Water can be provided to this proposed redevelopment site subject to the following works being undertaken:

- No approach works to the development site will be required
- All mains within this site, and abutting, will be required to be 200mm to meet high rise water demand and Fire Fighting requirements
- **Chief St** currently has a 150mm water main which will be required to be upsized to 200mm
- **East St** from Drayton to Second St currently has a 200mm water main so will be sufficient for the new development however from Second St to Hawker St it is only a 125mm water main and will need to be upsized to a 200mm
- **Second St** currently has a 150mm water main and will need to be upsized to a 200mm
- **Third Ave** currently has a 100mm water main and will need to be upsized to a 200mm
- **Hawker St** currently has a 900mm transmission main which is gazetted not available for connection . There is also a 100mm main in Hawker St so subject to development design a connection may be able to be made to the transmission main but it is subject to further investigation when a development application is lodged.
- **Drayton St** currently has a 100mm water main and will need to be upgraded to a 200mm

This is a high level assessment and will be reassessed when Lodged Land Development applications are received. Our systems are not designed for firefighting purposes so it will be necessary for developers to ensure that the mains are sized appropriately, and can provide the required water demand, to satisfy the MFS requirements. Land Developers consulting engineers and/or hydraulics engineers will be able to undertake the required tests to determine the firefighting requirements.

I hope this information addresses your query and should you require anything further please do not hesitate to contact me. Thanks and have a great weekend.

Kind regards,

DEBBIE SNOSWELL
Account Manager, Land Development
SA Water
T 8 7424 1133
F 8 7003 1227
M 0416 245 296
E debbie.snoswell@sawater.com.au

Follow us on:

Facebook, Instagram, LinkedIn,
Twitter, YouTube, Flickr

www.sawater.com.au

250 Victoria Square/Tarntanyangga, Adelaide SA 5000
GPO Box 1751, Adelaide SA 5001

From: Rosie Vakasilimi [mailto:Rosie.Vakasilimi@fyfe.com.au]
Sent: Wednesday, 7 March 2018 3:49 PM
To: Snoswell, Debbie
Cc: Steve Mitchell; Bicky Shakya
Subject: RE: Brompton Rezoning - SA Water Response

Hi Debbie,

Hope you're having a good week.
Would it be possible to have SA Water's response by tomorrow?
Thank you.

Kind regards,
Rosie Vakasilimi
Fyfe Pty Ltd
T +61 8 8201 9609

From: Snoswell, Debbie [mailto:Debbie.Snoswell@sawater.com.au]
Sent: Monday, 26 February 2018 1:31 PM
To: Rosie Vakasilimi
Cc: Steve Mitchell; Bicky Shakya
Subject: RE: Brompton Rezoning - SA Water Response

Hi Rosie,

Followed up this morning and hassled the Planning department to get it to me today! Fingers crossed that it happens and I can get it to you as soon as I receive it. Thanks

Kind regards,

DEBBIE SNOSWELL
Account Manager, Land Development
SA Water
T 8 7424 1133
F 8 7003 1227
M 0416 245 296
E debbie.snoswell@sawater.com.au

Follow us on:
Facebook, Instagram, LinkedIn,
Twitter, YouTube, Flickr

www.sawater.com.au

250 Victoria Square/Tarntanyangga, Adelaide SA 5000
GPO Box 1751, Adelaide SA 5001

From: Rosie Vakasilimi [mailto:Rosie.Vakasilimi@fyfe.com.au]
Sent: Monday, 26 February 2018 1:19 PM
To: Snoswell, Debbie
Cc: Steve Mitchell; Bicky Shakya
Subject: RE: Brompton Rezoning - SA Water Response

Hi Debbie,

Hope you had a good weekend.
Just following up on the SA Water response to the water assessment, can we be expecting it by early this week?

Kind regards,
Rosie Vakasilimi
Fyfe Pty Ltd
T +61 8 8201 9609

From: Snoswell, Debbie [mailto:Debbie.Snoswell@sawater.com.au]
Sent: Monday, 19 February 2018 10:28 AM
To: Rosie Vakasilimi
Subject: RE: Brompton Rezoning - SA Water Response

I am hoping for early this week – I will keep pushing the Planning team. Thanks

Kind regards,

DEBBIE SNOSWELL
Account Manager, Land Development
SA Water
T 8 7424 1133
F 8 7003 1227
M 0416 245 296
E debbie.snoswell@sawater.com.au

Follow us on:
Facebook, Instagram, LinkedIn,
Twitter, YouTube, Flickr

www.sawater.com.au

250 Victoria Square/Tarntanyangga, Adelaide SA 5000
GPO Box 1751, Adelaide SA 5001

From: Rosie Vakasilimi [mailto:Rosie.Vakasilimi@fyfe.com.au]
Sent: Monday, 19 February 2018 10:21 AM
To: Snoswell, Debbie
Subject: RE: Brompton Rezoning - SA Water Response

Thank you Debbie. When do you think you will be able to send through the water assessment?

Rosie Vakasilimi
Fyfe Pty Ltd
T +61 8 8201 9609

From: Snoswell, Debbie [mailto:Debbie.Snoswell@sawater.com.au]
Sent: Saturday, 17 February 2018 3:31 PM
To: Rosie Vakasilimi
Subject: Brompton Rezoning - SA Water Response

Hi Rosie,

I have been pushing our Treatment and Network Planning team for a response and they have completed the Wastewater Assessment but the Water is not quite complete. I have decided to send to you what I can so far and I will update the water when it is received.

Please see attached information and if you have any questions or wish to discuss please do not hesitate to contact me.

Kind regards,

DEBBIE SNOSWELL
Account Manager, Land Development
SA Water
T 8 7424 1133
F 8 7003 1227
M 0416 245 296
E debbie.snoswell@sawater.com.au

Follow us on:
Facebook, Instagram, LinkedIn,
Twitter, YouTube, Flickr

www.sawater.com.au

250 Victoria Square/Tarntanyangga, Adelaide SA 5000
GPO Box 1751, Adelaide SA 5001

Be green - read on the screen

_____

South Australian Water Corporation disclaimer
This e-mail and any attachments to it may be confidential and/or subject to legal professional privilege. If you are not the intended recipient you may not disclose or use the information contained in the message in any way. If received in error please delete all copies and contact the sender by return e-mail. No warranty is made that any attachments are free from viruses. It is the recipient's responsibility to establish its own protection against viruses and other damage.

NOTICE - The information in this e-mail/attachment(s) is confidential and intended for the named recipient/s only. If you are not the intended recipient, you must not use, disclose, read, forward, copy or retain any of the information. If this e-mail is received in error, please delete it and notify the sender by return e-mail or telephone. Neither Fyfe Pty Ltd nor the sender accepts any responsibility for any viruses or any other harmful software that may be contained in this e-mail or its attachments. It is your responsibility to ensure that your systems have adequate protection against viruses or any other harmful software.
Be green - read on the screen

_____

South Australian Water Corporation disclaimer
This e-mail and any attachments to it may be confidential and/or subject to legal professional privilege. If you are not the intended recipient you may not disclose or use the information contained in the message in any way. If received in error please delete all copies and contact the sender by return e-mail. No warranty is made that any attachments are free from viruses. It is the recipient's responsibility to establish its own protection against viruses and other damage.

NOTICE - The information in this e-mail/attachment(s) is confidential and intended for the named recipient/s only. If you are not the intended recipient, you must not use, disclose, read, forward, copy or retain any of the information. If this e-mail is received in error, please delete it and notify the sender by return e-mail or telephone. Neither Fyfe Pty Ltd nor the sender accepts any responsibility for any viruses or any other harmful software that may be contained in this e-mail or its attachments. It is your responsibility to ensure that your systems have adequate protection against viruses or any other harmful software.
Be green - read on the screen

_____

South Australian Water Corporation disclaimer

This e-mail and any attachments to it may be confidential and/or subject to legal professional privilege. If you are not the intended recipient you may not disclose or use the information contained in the message in any way. If received in error please delete all copies and contact the sender by return e-mail. No warranty is made that any attachments are free from viruses. It is the recipient's responsibility to establish its own protection against viruses and other damage.

NOTICE - The information in this e-mail/attachment(s) is confidential and intended for the named recipient/s only. If you are not the intended recipient, you must not use, disclose, read, forward, copy or retain any of the information. If this e-mail is received in error, please delete it and notify the sender by return e-mail or telephone. Neither Fyfe Pty Ltd nor the sender accepts any responsibility for any viruses or any other harmful software that may be contained in this e-mail or its attachments. It is your responsibility to ensure that your systems have adequate protection against viruses or any other harmful software.

Be green - read on the screen

_____

South Australian Water Corporation disclaimer

This e-mail and any attachments to it may be confidential and/or subject to legal professional privilege. If you are not the intended recipient you may not disclose or use the information contained in the message in any way. If received in error please delete all copies and contact the sender by return e-mail. No warranty is made that any attachments are free from viruses. It is the recipient's responsibility to establish its own protection against viruses and other damage.

T +61 8 8201 9609

From: Andrew Watson
Sent: Monday, 23 October 2017 10:22 AM
To: Rosie Vakasilimi
Subject: FW: Brompton Rezoning

Andrew Watson
Fyfe Pty Ltd
T +61 8 8201 9660
M +61 404 050 194

From: Field, Peter [mailto:Peter.Field@sawater.com.au]
Sent: Thursday, 8 May 2014 9:40 AM
To: George Boumis
Cc: Bridger, Mark; Tyson, Sharyn; Lazzaro, Joe; Smallwood, Wendy; Hayde, Patrick; Iliescu, Peter; Bressan, Flavio
Subject: FW: Brompton Rezoning

George,
In response to your query below, I provide the following preliminary advice:

Water Supply
The surrounding area is mostly supplied by an Ex.300 CICL and Ex.250 CICS mains that are laid in series through the parklands. This feed is supplied by the North Adelaide network of mains, which consist mostly of Ex.150 mains, and this does not have enough capacity to service both the adjacent Bowden Development and this Brompton site.

Investigations done for the Bowden Development confirmed that a new DN 375 PVC-O approach main was required from the EL 103 zone supply (via the Ex.1100 inlet main to the North Adelaide EL 51 Tank) through the parklands to link-up to the Ex.355 PE main in North Adelaide Station Road adjacent to Park Terrace (ref Figure 1). This new feed has the capacity to supply approx 8000 services.

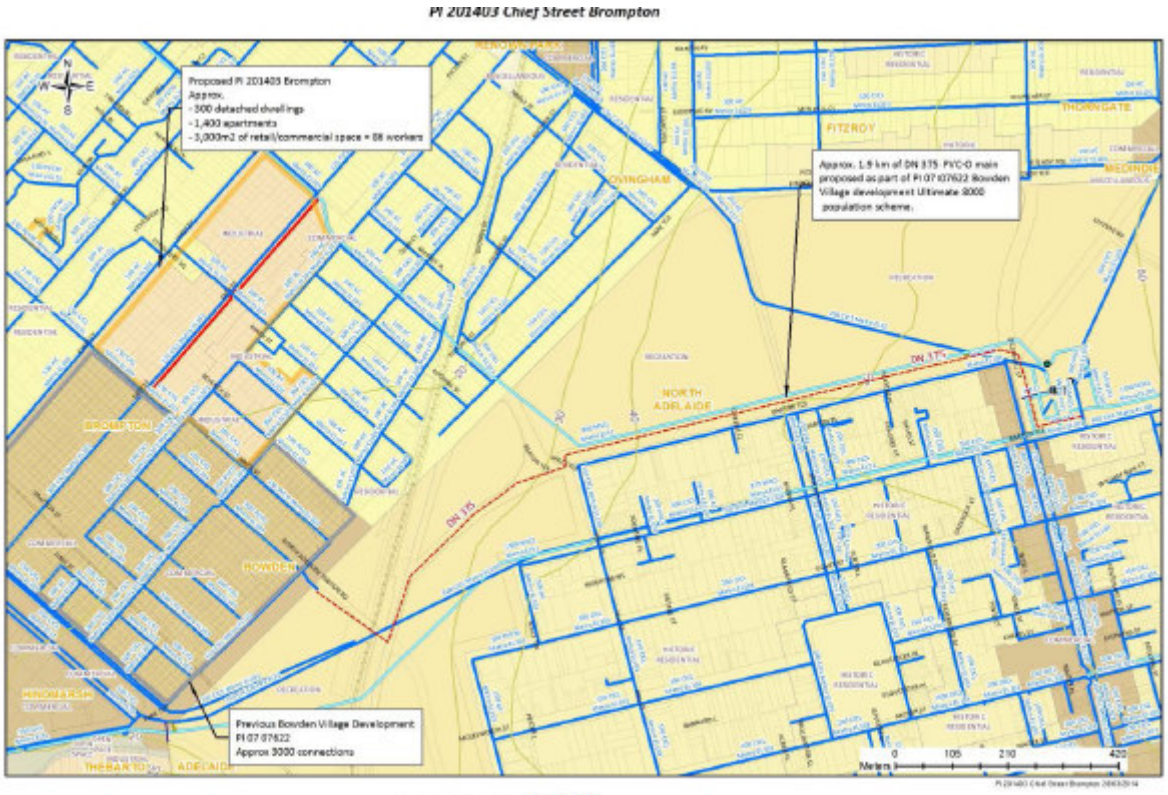


Figure 1.

Existing mains within the site may need to be upgraded and abandoned to suit the final layout of the development as it proceeds. The section of Ex.100AC/CICL main along Drayton Road will require being upsized to a minimum of DN 150 to accommodate the Retail/Commercial development fronting the road. Minimum size of any new main shall be DN 150 to accommodate higher density and commercial developments along with the need for firefighting capacity.(it must be noted that the reticulate water supply system is not designed to meet fire protection requirements)

This site will abut existing mains on Chief Street (Ex.150 AC), Gibson Street (Ex.250 PVC-O/200 CICL) which can be extended to supply this development.

An Ex.125 CICL main in East Terrace which traverses the site will need to be re-laid in DN 150 PVC-O main. Augmentation required:

- Construction of approx. 505 m of DN 150 PVC-O main in East Street (shown A – B) to replace the Ex.125 CICL main.

- Construction of approx. 440 m of DN 150 PVC-O main in Drayton Street (shown C – D) to replace the EX.100 AC/CICL main

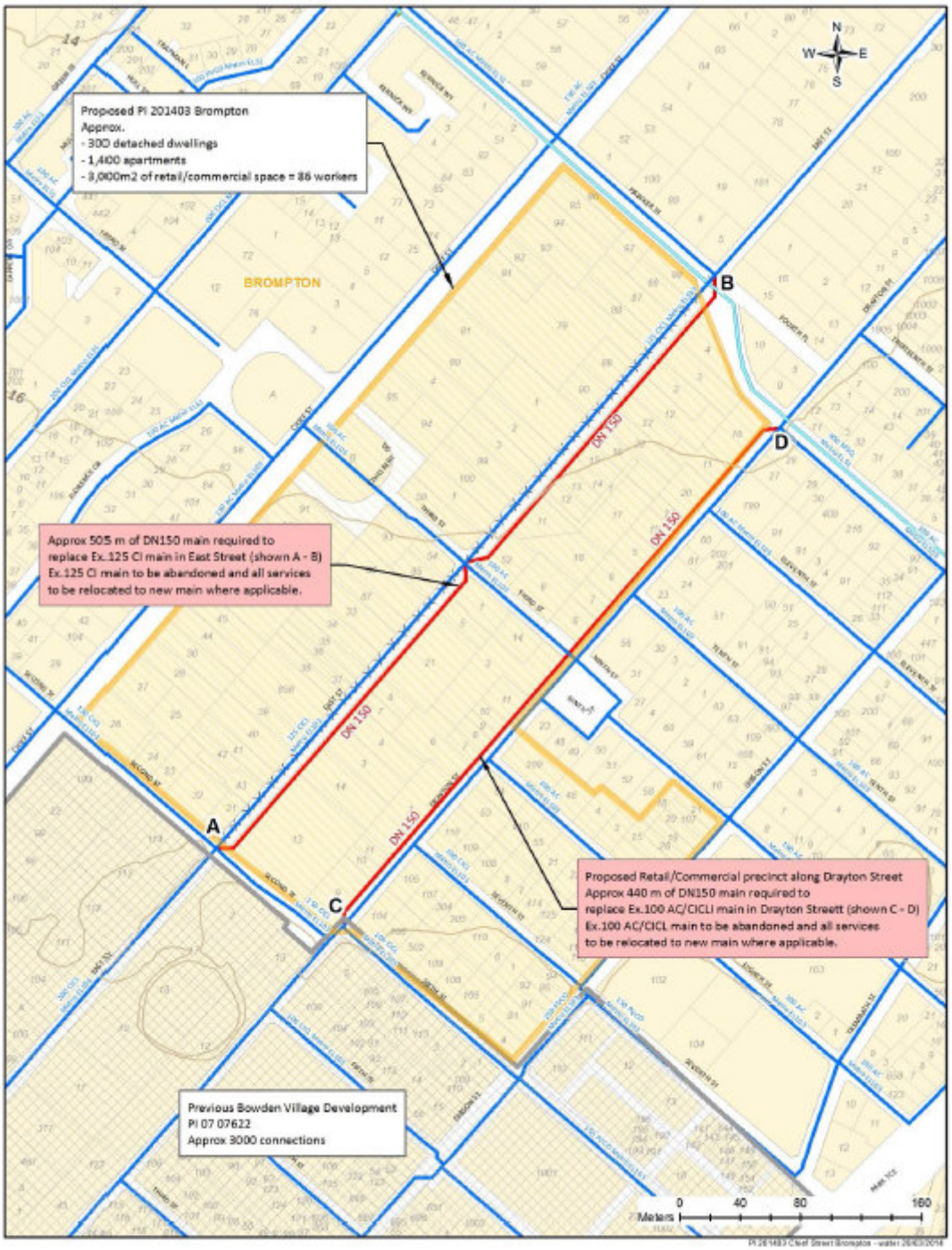


Figure 2.

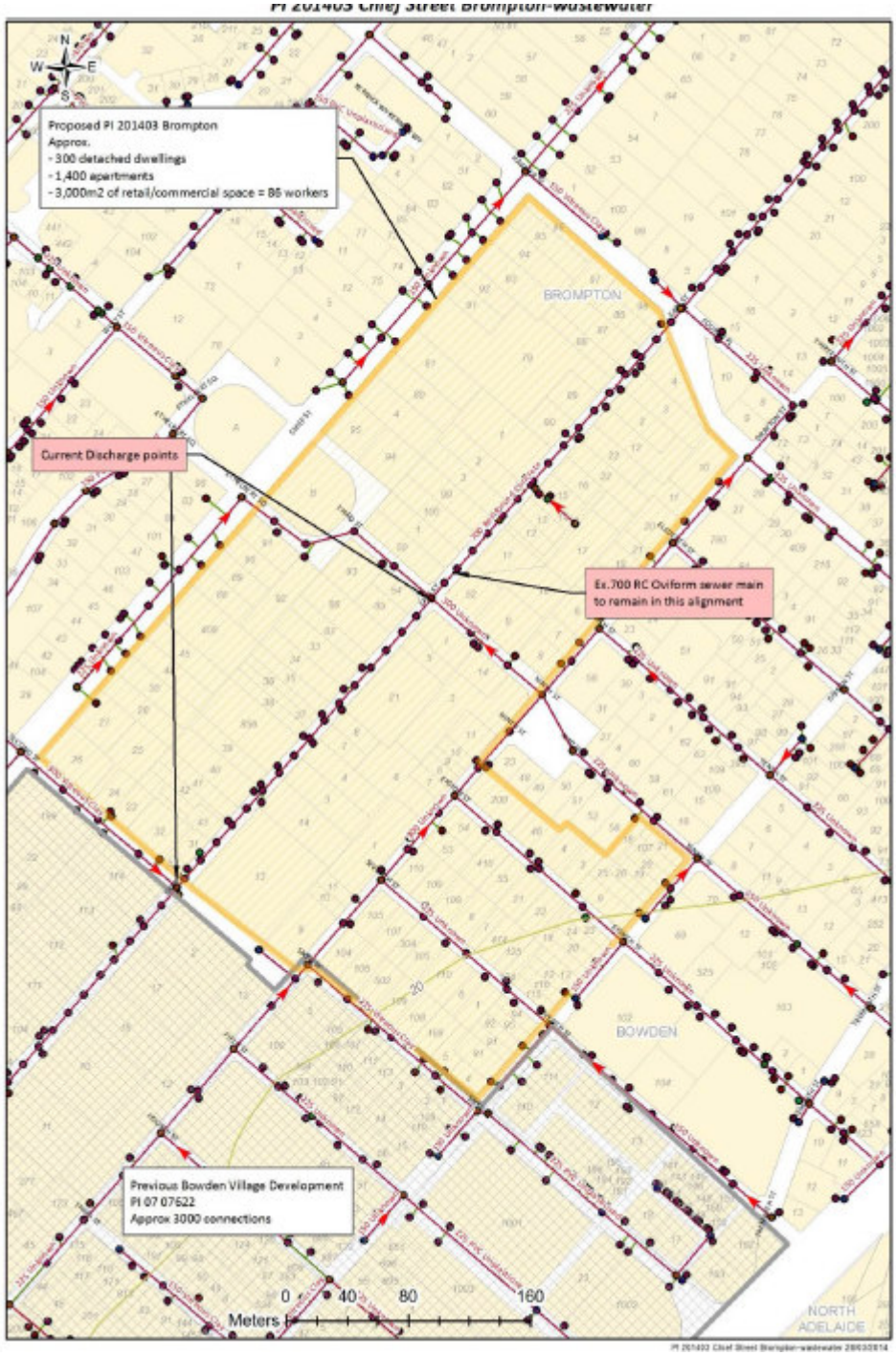
Estimated model pressures experienced by the proposed development are within an acceptable pressure range.

Sewerage Services

The site generally gravitates to the north east by Ex.150, Ex.225 & Ex.300 sewer mains which discharge to an Oviform sewer with an equivalent nominal diameter of DN700 with 0.01 % grade.

The oviform main that traverses the site in East Street **cannot** be relocated due to the minimal grade. This sewer should be either retained in a roadway, as now, or in a 10m wide easement that can be readily accessed by SA Water at all times.

Existing mains within the site may need to be upgraded and abandoned to suit the final layout of the development as it proceeds. A minimum size of any new main shall be DN 225 to accommodate the higher density and commercial developments.



Network analysis indicates that the Ex.700 sewer has sufficient capacity to service the proposed development.

Recycled water

Recycled water has been constructed in Gibson St within the adjoining Bowden development, and is therefore available to the Brompton site.

The recycled water scheme will take some of the demand from the potable water supply if taken up. It is assumed that the potable water supply will back up the recycled water scheme.

There will be approx. 1,800 connections, however there is no other information, consequently, it is assumed that the supply requirements will be similar to the Mawson Lakes recycled water scheme, which has gardening, other external uses and toilet flushing.

The demand assumption will need to be reviewed when more details are available.



Initial network analysis suggests that the GAP scheme can adequately supply the abovementioned demands.

A link to the potable water supply is recommended to ensure security of supply. (Backflow prevention would also be required).

General

The above preliminary information would be incorporated in SA Water's response to an SOI / DPA amendment.

The Corporation's requirements would be confirmed upon receipt of the development application from the Development Assessment Commission (DAC).

Trade Waste requirements have not been addressed in this response.

Regards,

Peter Field
Major Development Proposals & Client Manager
P 7424 1132
0418 825 997

From: George Boumis
Sent: Friday, 28 March 2014 12:04 PM
To: 'Field, Peter'
Cc: Bridger, Mark
Subject: RE: Brompton Rezoning

Hi Peter

From what I can deduce from some of the high level commentary at this end, Drayton St is meant to evolve into a retail core for the whole of the Brompton Bowden area including the TOD adjacent to our subject footprint. And so I suggest you assume for this to be the case at least for now until I can tell you any more either way.

Specifically with regard to our subject footprint though, a small retail/office/commercial precinct is meant to sit along Hawker Street as well (however this is only meant to be modest in size and capacity requirements), and which is identified in the attached (also previously provided to you) as the 'main street precinct'. Perhaps by cross-referencing other plans previously sent to you with this plan, you can make abit more sense of the proposed densities along these two alignments however admittedly it's not always easy to see the rationale.

I think for now this is all we have however I am happy to chat further over the phone with you if you want to hash anything out and consider that way is more effective to do so, please call me if so, regards

George Boumis | Senior Civil Engineer - Land Development

FYFE Earth Partners

www.fyfe.com.au
Level 3, 80 Flinders Street, Adelaide SA 5000 | T: 08 8201 9600 | F: 08 8201 9779

ADELAIDE | ALICE SPRINGS | BALLERA | BRISBANE | CHINCHILLA | COOLUM | DALBY | DARWIN | GLEN OSMOND | MOOMBA | ROMA | SPRINGWOOD

From: Field, Peter [mailto:Peter.Field@sawater.com.au]
Sent: Thursday, 27 March 2014 7:57 AM
To: George Boumis
Cc: Bridger, Mark
Subject: RE: Brompton Rezoning

George,
Would you be able to confirm where the Commercial/retail precinct is within the overall staging / development as this will determine the main size requirements (ie: minimum of DN150mm).

Thanks

Regards,

Peter Field
Major Development Proposals & Client Manager
P 7424 1132
0418 825 997

From: George Boumis [mailto:George.Boumis@fyfe.com.au]
Sent: Wednesday, 12 March 2014 12:09 PM
To: Field, Peter
Subject: RE: Brompton Rezoning

Gday Peter

The below are the best numbers we have at present, ie the indicative concept(s) is/are envisaged to deliver the following:

1. c.300 detached dwellings/townhouses in a 2-3 storey configuration;
2. c.1,400 apartments in 4-6 storey buildings;
3. c.3,000m2 of retail, office and commercial space;
4. a dwelling density of 125 dwellings/hectare (gross) and 180 dwellings/hectare (net).

Trust this assists, any qu though let me know. When do you think you may be able to get something to me? thanks

George Boumis | Senior Civil Engineer - Land Development

FYFE Earth Partners

www.fyfe.com.au
Level 3, 80 Flinders Street, Adelaide SA 5000 | T: 08 8201 9600 | F: 08 8201 9779

ADELAIDE | ALICE SPRINGS | BALLERA | BRISBANE | CHINCHILLA | COOLUM | DALBY | DARWIN | GLEN OSMOND | MOOMBA | ROMA | SPRINGWOOD

From: Field, Peter [mailto:Peter.Field@sawater.com.au]
Sent: Tuesday, 11 March 2014 8:51 AM
To: George Boumis
Subject: FW: Brompton Rezoning

George,
Would you be able to provide approx lot / apartment yields?

Regards,

Peter Field
Major Development Proposals & Client Manager
P 7424 1132
0418 825 997

From: George Boumis [mailto:George.Boumis@fyfe.com.au]
Sent: Thursday, 6 March 2014 3:34 PM
To: Snoswell, Debbie
Subject: Brompton Rezoning

Hi Debbie

I also need input from you asap re the proposed master plans attached, re the recent Brompton rezoning. Please note this is highly confidential at this stage as well. Current proposed staging is as per last attachment.

On behalf of the client group I need input from SA Water as to the (1) capacity available, (2) likely augmentation rate(s) within available and beyond available capacity, and (3) any likely headworks contributions if these may apply, for all these aspects:

(1) potable water, (2) wastewater and (3) recycled water (if and as this may apply, ie GAP?)

I infer that the former/current industrial usage of this area over the long term and that this is earmarked to wind down and evolve via this change of use, will also re-introduce capacity into the local network?

If you would please send this off to your network people to endeavour to provide comment/input back to me within the coming fortnight if possible, it would greatly assist the investigation process/timing at this end.

Of course please call to discuss if and as need, regards

George Boumis | Senior Civil Engineer - Land Development

FYFE Earth Partners

www.fyfe.com.au
Level 3, 80 Flinders Street, Adelaide SA 5000 | T: 08 8201 9600 | F: 08 8201 9779

ADELAIDE | ALICE SPRINGS | BALLERA | BRISBANE | CHINCHILLA | COOLUM | DALBY | DARWIN | GLEN OSMOND | MOOMBA | ROMA | SPRINGWOOD

NOTICE - The information in this e-mail/attachment(s) is confidential and intended for the named recipient/s only. If you are not the intended recipient, you must not use, disclose, read, forward, copy or retain any of the information. If this e-mail is received in error, please delete it and notify the sender by return e-mail or telephone. Neither Fyfe Pty Ltd nor the sender accepts any responsibility for any viruses or any other harmful software that may be contained in this e-mail or its attachments. It is your responsibility to ensure that your systems have adequate protection against viruses or any other harmful software.
Be green - read on the screen

_____
South Australian Water Corporation disclaimer
This e-mail and any attachments to it may be confidential and/or subject to legal professional privilege. If you are not the intended recipient you may not disclose or use the information contained in the message in any way. If received in error please delete all copies and contact the sender by return e-mail. No warranty is made that any attachments are free from viruses. It is the recipient's responsibility to establish its own protection against viruses and other damage.

NOTICE - The information in this e-mail/attachment(s) is confidential and intended for the named recipient/s only. If you are not the intended recipient, you must not use, disclose, read, forward, copy or retain any of the information. If this e-mail is received in error, please delete it and notify the sender by return e-mail or telephone. Neither Fyfe Pty Ltd nor the sender accepts any responsibility for any viruses or any other harmful software that may be contained in this e-mail or its attachments. It is your responsibility to ensure that your systems have adequate protection against viruses or any other harmful software.
Be green - read on the screen

_____
South Australian Water Corporation disclaimer
This e-mail and any attachments to it may be confidential and/or subject to legal professional privilege. If you are not the intended recipient you may not disclose or use the information contained in the message in any way. If received in error please delete all copies and contact the sender by return e-mail. No warranty is made that any attachments are free from viruses. It is the recipient's responsibility to establish its own protection against viruses and other damage.

NOTICE - The information in this e-mail/attachment(s) is confidential and intended for the named recipient/s only. If you are not the intended recipient, you must not use, disclose, read, forward, copy or retain any of the information. If this e-mail is received in error, please delete it and notify the sender by return e-mail or telephone. Neither Fyfe Pty Ltd nor the sender accepts any responsibility for any viruses or any other harmful software that may be contained in this e-mail or its attachments. It is your responsibility to ensure that your systems have adequate protection against viruses or any other harmful software.

NOTICE - The information in this e-mail/attachment(s) is confidential and intended for the named recipient/s only. If you are not the intended recipient, you must not use, disclose, read, forward, copy or retain any of the information. If this e-mail is received in error, please delete it and notify the sender by return e-mail or telephone. Neither Fyfe Pty Ltd nor the sender accepts any responsibility for any viruses or any other harmful software that may be contained in this e-mail or its attachments. It is your responsibility to ensure that your systems have adequate protection against viruses or any other harmful software.
Be green - read on the screen

_____
South Australian Water Corporation disclaimer
This e-mail and any attachments to it may be confidential and/or subject to legal professional privilege. If you are not the intended recipient you may not disclose or use the information contained in the message in any way. If received in error please delete all copies and contact the sender by return e-mail. No warranty is made that any attachments are free from viruses. It is the recipient's responsibility to establish its own protection against viruses and other damage.



APPENDIX B

CORRESPONDENCE WITH SA POWER NETWORKS

Rosie Vakasilimi

From: Quyen Hoang <Quyen.Hoang@sapowernetworks.com.au>
Sent: Wednesday, 7 February 2018 11:46 AM
To: Rosie Vakasilimi
Cc: Mitchell Ogilvy
Subject: RE: Proposed Bromtpon Urban Village Development SAPN Indicative Response

Hi Rosie,

Please find information that may be helpful regarding how residential/commercial developments are treated at SA Power Networks along with information specific to Bowden.
Due to augmentation rule changes, all previous discussions and advice prior to this have now been superseded.

To ensure there is sufficient capacity in our network, SA Power Networks annually prepares load forecasts for the coming 10 years on all of our Connection Points, Sub-transmission lines, Substations and Feeders. These forecasts take into account historical growth rates, predicted growth at a state level as well as known local customer load increases (including residential sub-divisions). Details on our load forecasting process as well as the capacity and load forecasts for many of our assets are published annually in our Distribution Annual Planning Report which is available online here:
https://www.sapowernetworks.com.au/centric/industry/our_network/annual_network_plans/distribution_annual_planning_report.jsp

Where constraints are identified as a result of our load forecasting, SA Power Networks plans to either augment our infrastructure or reduce demand through a non-network option (e.g. demand management) prior to an overload of our assets occurring.

Developers contribute towards the cost of augmenting our network in accordance with our Connection Policy, a useful fact sheet which outlines how developers contribute is available here:
https://www.sapowernetworks.com.au/public/download.jsp?id=8598

For the proposed development at Bowden, the development is likely to be supplied from our substation at Croydon. The zone substation threshold for this site is 4200kVA (10% of the substation capacity) and therefore unless a total of 4200kVA or more is connected in a rolling 5 year period, a residential developer will only pay the Residential Metro High Voltage Feeder augmentation rate outlined in our current connection policy ($231/kVA plus CPI). If 4200kVA or over is connected within 5 years, the expected additional augmentation rate of $268/kVA plus CPI will also apply.

If you have any further questions regarding the proposed development at Bowden or customer connection charges in general please contact the relevant area Customer Solutions Manager.

Regards,

Queenie Hoang
Network Project Manager

Direct: 08 8404 5498
queenie.hoang@sapowernetworks.com.au
---
1 Anzac Highway, Keswick SA 5035
www.sapowernetworks.com.au

From: Rosie Vakasilimi [mailto:Rosie.Vakasilimi@fyfe.com.au]
Sent: Tuesday, 6 February 2018 11:34 AM
To: Mitchell Ogilvy <Mitchell.Ogilvy@sapowernetworks.com.au>
Cc: Bicky Shakya <bicky.shakya@fyfe.com.au>; Steve Mitchell <Steve.Mitchell@fyfe.com.au>
Subject: RE: Proposed Bromtpon Urban Village Development SAPN Indicative Response

Hi Mitchell,

Just following up on the below emails.
Could we please get a response from SAPN by the end of this week.

Kind regards,

Rosie Vakasilimi
Fyfe Pty Ltd

T +61 8 8201 9609

From: Mitchell Ogilvy [mailto:Mitchell.Ogilvy@sapowernetworks.com.au]
Sent: Wednesday, 24 January 2018 10:11 AM
To: Rosie Vakasilimi
Cc: Bicky Shakya; Steve Mitchell
Subject: RE: Proposed Bromtpon Urban Village Development SAPN Indicative Response

Hi Rosie,

Sorry for the delay, I will follow up the relevant people to give you a response as soon as possible.

Regards,

Mitchell Ogilvy
Network Project Officer - Adelaide

Direct: 08 8404 4560
Mobile: 0400 582 188
mitchell.ogilvy@sapowernetworks.com.au

Level 5, 1 Anzac Highway, KESWICK SA 5035
www.sapowernetworks.com.au

From: Rosie Vakasilimi [mailto:Rosie.Vakasilimi@fyfe.com.au]
Sent: Wednesday, 24 January 2018 10:06 AM
To: Mitchell Ogilvy <Mitchell.Ogilvy@sapowernetworks.com.au>
Cc: Bicky Shakya <bicky.shakya@fyfe.com.au>; Steve Mitchell <Steve.Mitchell@fyfe.com.au>
Subject: FW: Proposed Bromtpon Urban Village Development SAPN Indicative Response

Hi Mitchel,

Just following up on the RFI for the Bowden DPA, could we get a response from SAPN by the end of this week if possible?
Thank you.

Kind regards,

Rosie Vakasilimi
Fyfe Pty Ltd

T +61 8 8201 9609

From: Rosie Vakasilimi
Sent: Friday, 12 January 2018 8:52 AM
To: 'Mitchell Ogilvy'
Cc: Steve Mitchell; Bicky Shakya
Subject: FW: Proposed Bromtpon Urban Village Development SAPN Indicative Response

Hi Mitchell,

Just following up on the email below, how soon can we expect a response?
If you have any queries please contact me.

Thank you,

Rosie Vakasilimi
Fyfe Pty Ltd

T +61 8 8201 9609

From: Rosie Vakasilimi
Sent: Friday, 5 January 2018 10:52 AM
To: 'Mitchell Ogilvy'
Cc: Sophie Le Mauff; Bicky Shakya
Subject: FW: Proposed Bromtpon Urban Village Development SAPN Indicative Response

Hi Mitchell,

Just following up on the email below, if you could give me an update on where things are and how soon we might expect an answer from SAPN that would be great.
Thank you.

Kind regards,

Rosie Vakasilimi
Fyfe Pty Ltd

T +61 8 8201 9609

From: Rosie Vakasilimi
Sent: Monday, 18 December 2017 9:46 AM
To: 'Mitchell Ogilvy'
Subject: FW: Proposed Bromtpon Urban Village Development SAPN Indicative Response

Hi Mitchell,

Hope you had a good weekend.
Just following up on the email below.
Thank you.

Kind regards,

Rosie Vakasilimi
Fyfe Pty Ltd

T +61 8 8201 9609

From: Rosie Vakasilimi
Sent: Thursday, 14 December 2017 12:08 PM
To: 'Mitchell Ogilvy'
Subject: RE: Proposed Bromtpon Urban Village Development SAPN Indicative Response

Hi Mitchell,

Just wondering if Andrew was back, and if he could shoot me a quick email.
Thank you

Kind regards,

Rosie Vakasilimi
Fyfe Pty Ltd

T +61 8 8201 9609

From: Rosie Vakasilimi
Sent: Tuesday, 12 December 2017 11:56 AM
To: 'Mitchell Ogilvy'
Cc: Bicky Shakya; Steve Mitchell
Subject: FW: Proposed Bromtpon Urban Village Development SAPN Indicative Response

Hi Mitchell,

Hope you had a good weekend.
Just following up on the email below, if you could also get me in touch with the contact on this RFI that would be great.
If you need more clarification just contact me.
Thank you.

Kind regards,

Rosie Vakasilimi
Fyfe Pty Ltd

T +61 8 8201 9609

From: Rosie Vakasilimi
Sent: Friday, 1 December 2017 12:20 PM
To: 'Mitchell Ogilvy'
Cc: Bicky Shakya; Steve Mitchell
Subject: RE: Proposed Bromtpon Urban Village Development SAPN Indicative Response

Hi Mitchell,

I was just wondering, with the information previously advised to us from an infrastructure investigation that was done in 2014, would the same still apply to the development plan amendment today? This is what was advised in 2014 in regards to the same site:

- Up to 2100 kVA (the current capacity at the Croydon substation): Current Standard Charge of $154/kVA, plus CPI each year.
- Over 2100 kVA : the actual rate per kVA will need to be confirmed based on the development rate and remaining capacity in network at time of application to SA Power however it will likely be in the range of $154/kVA to $677/kVA.
- Rate pricing is likely to shift (for loads greater than 70 kVA, courtesy of the Australian Regulator Mechanism as of 1 July 2015. This shift is not expected to be significant in scale.
- SAPN has advised that a development rate that does not exceed a maximum of 2100kVA in a 3 year 'rolling' period will be charged at the standard augmentation rate of $154/kVA. However if the rate of development exceeds this maximum threshold (in a 3 year period), the augmentation rate per kVA will be based on an individual calculation and within the likely range of $154/kVA to $677/kVA.
- The scope of augmentation works would include (1) the upgrade of the Croydon 66/11kV substation and (2) installation of (x3) 11kV feeders from this substation to the proposed development footprint.

The proposed number of dwelling units has decreased by about 170du compared to the investigation conducted in 2014. As this is a pre-investigation for a development amendment plan, there is no timeframe of when development might occur, however, as a part of the investigation, we would like to know if the SAPN has the capacity to provide service to the development given the above information? Attached is a plan of the study area.
Thank you.

Kind regards,

Rosie Vakasilimi
Fyfe Pty Ltd

T +61 8 8201 9609

From: Mitchell Ogilvy [mailto:Mitchell.Ogilvy@sapowernetworks.com.au]
Sent: Thursday, 30 November 2017 10:24 AM
To: Rosie Vakasilimi
Cc: Bicky Shakya; Steve Mitchell
Subject: RE: Proposed Bromtpon Urban Village Development SAPN Indicative Response

Hi Rosie,

I will discuss the following with the relevant manager and see if someone can give you a call.

Regards,

Mitchell Ogilvy
Network Project Officer - Adelaide

Direct: 08 8404 4560

Mobile: 0400 582 188
mitchell.ogilvy@sapowernetworks.com.au

Level 2, 1 Anzac Highway, KESWICK SA 5035
www.sapowernetworks.com.au





From: Rosie Vakasilimi [mailto:Rosie.Vakasilimi@fyfe.com.au]
Sent: Thursday, 30 November 2017 9:26 AM
To: Mitchell Ogilvy <Mitchell.Ogilvy@sapowernetworks.com.au>
Cc: Bicky Shakya <bicky.shakya@fyfe.com.au>; Steve Mitchell <Steve.Mitchell@fyfe.com.au>
Subject: RE: Proposed Bromtpon Urban Village Development SAPN Indicative Response

Hi Mitchell,

Thank you for passing this on, I was just wondering if there was anyone I could contact to see what the progress is. We need the information by early tomorrow latest.
Thank you

Kind regards,

Rosie Vakasilimi
Fyfe Pty Ltd

T +61 8 8201 9609

From: Mitchell Ogilvy [mailto:Mitchell.Ogilvy@sapowernetworks.com.au]
Sent: Friday, 24 November 2017 2:08 PM
To: Rosie Vakasilimi
Cc: Steve Mitchell; Bicky Shakya
Subject: RE: Proposed Bromtpon Urban Village Development SAPN Indicative Response

Hi Rosie,

Thank you for the following. Due to the complexity & size, I have forwarded your request to our Strategic Projects Team and they will be in contact shortly.

Let me know if you have any issues and I can follow up.

Regards,

Mitchell Ogilvy
Network Project Officer - Adelaide

Direct: 08 8404 4560
Mobile: 0400 582 188
mitchell.ogilvy@sapowernetworks.com.au

Level 2, 1 Anzac Highway, KESWICK SA 5035
www.sapowernetworks.com.au





From: Rosie Vakasilimi [mailto:Rosie.Vakasilimi@fyfe.com.au]
Sent: Friday, 24 November 2017 1:09 PM
To: Mitchell Ogilvy <Mitchell.Ogilvy@sapowernetworks.com.au>
Cc: Steve Mitchell <Steve.Mitchell@fyfe.com.au>; Bicky Shakya <bicky.shakya@fyfe.com.au>
Subject: RE: Proposed Bromtpon Urban Village Development SAPN Indicative Response

Hi Mitchell,

I apologise for getting back to you late.
As this is a pre-investigation for a Development Plan Amendment (DPA) – there is no timeframe for the development. I have attached a brochure with the details of the Bowden Rezoning DPA. As for rough load estimates this is what we have,

- 918 townhouses at 8kVA per townhouse = 7.3MVA
- 612 apartments at 8kVA per apartment = 4.9MVA
- Roughly allowed for 1000m2 of commercial space

If there is any more information you require please let me know.
Thank you.

Rosie Vakasilimi
Fyfe Pty Ltd

T +61 8 8201 9609

From: Mitchell Ogilvy [mailto:Mitchell.Ogilvy@sapowernetworks.com.au]
Sent: Wednesday, 22 November 2017 12:11 PM
To: Rosie Vakasilimi
Subject: RE: Proposed Bromtpon Urban Village Development SAPN Indicative Response

Hi Rosie,

Apologies if the information is in the email trail somewhere, but what information do you require exactly? What do SAPN have to respond to specifically?

Regards,

Mitchell Ogilvy
Network Project Officer - Adelaide

Direct: 08 8404 4560
Mobile: 0400 582 188
mitchell.ogilvy@sapowernetworks.com.au

Level 2, 1 Anzac Highway, KESWICK SA 5035
www.sapowernetworks.com.au





From: Rosie Vakasilimi [mailto:Rosie.Vakasilimi@fyfe.com.au]
Sent: Wednesday, 22 November 2017 12:07 PM
To: Mitchell Ogilvy <Mitchell.Ogilvy@sapowernetworks.com.au>
Cc: Steve Mitchell <Steve.Mitchell@fyfe.com.au>; Bicky Shakya <bicky.shakya@fyfe.com.au>
Subject: RE: Proposed Bromtpon Urban Village Development SAPN Indicative Response

Hi Mitchell,

Could I please have SAPNs response the Bowden Rezoning development RFI before Wednesday next week, we need to pass on the responses to council soon.
Thank you.

Kind regards,

Rosie Vakasilimi
Fyfe Pty Ltd

T +61 8 8201 9609

From: Mitchell Ogilvy [mailto:Mitchell.Ogilvy@sapowernetworks.com.au]
Sent: Thursday, 2 November 2017 2:40 PM
To: Rosie Vakasilimi
Cc: Bicky Shakya; Steve Mitchell
Subject: RE: Proposed Bromtpon Urban Village Development SAPN Indicative Response

Hi Rosie,

As discussed, individual properties with load /connection point requests will be assessed at the time of application which will determine the rate of augmentation. It essentially depends on size of load that is requested that incurs augmentation. If there are all separate individual applications made by different developers, they will be dealt with separately on augmentation.

Hopefully this makes sense. Don't hesitate to give me another call if we need to discuss further.

Regards,

Mitchell Ogilvy
Network Project Officer - Adelaide

Direct: 08 8404 4560
Mobile: 0400 582 188
mitchell.ogilvy@sapowernetworks.com.au

Level 2, 1 Anzac Highway, KESWICK SA 5035
www.sapowernetworks.com.au





From: Rosie Vakasilimi [mailto:Rosie.Vakasilimi@fyfe.com.au]
Sent: Wednesday, 1 November 2017 12:22 PM
To: Mitchell Ogilvy <Mitchell.Ogilvy@sapowernetworks.com.au>
Cc: Bicky Shakya <bicky.shakya@fyfe.com.au>; Steve Mitchell <Steve.Mitchell@fyfe.com.au>
Subject: RE: Proposed Bromtpon Urban Village Development SAPN Indicative Response

Hi Mitchell,

We are working on behalf of the City of Charles Sturt council, apologise for confusing it with Renewal SA.
As discussed I have attached the correspondence we had with SAPN, a plan location of the site and the proposed number of residents for the site (this is still a preliminary figure).
Thank you for explaining how the augmentation pricing works now with SAPN, just to make sure I understood correctly, the augmentation price is associated with the threshold and this will be given out once the development is underway, once we've determined the load we require for the site. In regards to the feeder, that is separate from the threshold and will be handled by SAPN. Let me know if something is not correct.
If there's anything more you need please let me know.

Kind regards,

Rosie Vakasilimi
Fyfe Pty Ltd

T +61 8 8201 9609

From: Mitchell Ogilvy [mailto:Mitchell.Ogilvy@sapowernetworks.com.au]
Sent: Wednesday, 1 November 2017 11:46 AM
To: Rosie Vakasilimi
Subject: RE: Proposed Bromtpon Urban Village Development SAPN Indicative Response

Hi Rosie,

Could you please give me a call to discuss. I need more information to understand what you require.

Regards,

Mitchell Ogilvy
Network Project Officer - Adelaide

Direct: 08 8404 4560
Mobile: 0400 582 188
mitchell.ogilvy@sapowernetworks.com.au

Level 2, 1 Anzac Highway, KESWICK SA 5035
www.sapowernetworks.com.au





From: Rosie Vakasilimi [mailto:Rosie.Vakasilimi@fyfe.com.au]
Sent: Tuesday, 31 October 2017 3:33 PM
To: James Case <James.Case@sapowernetworks.com.au>
Cc: Bicky Shakya <bicky.shakya@fyfe.com.au>; Steve Mitchell <Steve.Mitchell@fyfe.com.au>
Subject: FW: Proposed Bromtpon Urban Village Development SAPN Indicative Response

Hi James,

I was informed by Tim Pritchard that you would be able to assist me with the this request. Could you let me know how soon we will be hearing a response from SAPN in regards to the following request, we would appreciate a quick response.
Thank you.

Kind regards,

Rosie Vakasilimi
Fyfe Pty Ltd

T +61 8 8201 9609

From: Timothy Pritchard [mailto:Timothy.Pritchard@enerven.com.au]
Sent: Wednesday, 25 October 2017 10:31 AM
To: Rosie Vakasilimi
Cc: Bicky Shakya; James Case; Andrew Haines; Pat Howard
Subject: RE: Proposed Bromtpon Urban Village Development SAPN Indicative Response

Hi Rosie,

I apologise in the delay in getting back to you. I am no longer in a role where I can provide you with a response.

I have passed your request on to our Customer Solutions Manager for the Adelaide region, James Case.

James should be able to assist you with this request.

Kind regards,

Tim Pritchard
Asset Management Engineer

Direct: 8404 9637
timothy.pritchard@sapowernetworks.com.au
---
1 Anzac Highway, Keswick SA 5053
www.sapowernetworks.com.au

SA Power Networks

From: Rosie Vakasilimi [mailto:Rosie.Vakasilimi@fyfe.com.au]
Sent: Wednesday, 25 October 2017 10:06 AM
To: Timothy Pritchard <Timothy.Pritchard@enerven.com.au>
Cc: Bicky Shakya <bicky.shakya@fyfe.com.au>
Subject: FW: Proposed Bromtpon Urban Village Development SAPN Indicative Response

Hi Tim,

Due to the urgency of this development, can you please let me know how soon can we expect an answer from SAPN. The sooner would be greatly appreciated.

Thank you,

Rosie Vakasilimi
Fyfe Pty Ltd

T +61 8 8201 9609

From: Rosie Vakasilimi
Sent: Monday, 23 October 2017 4:25 PM
To: 'Timothy.Pritchard@sapowernetworks.com.au'
Cc: Bicky Shakya
Subject: FW: Proposed Bromtpon Urban Village Development SAPN Indicative Response

Hi Tim,

In regards to my earlier email regarding the Brompton Rezoning development, I have attached a Word document showing changes that have been made to the proposed residential density. If you could please look through these changes and advise us on whether there will be changes to SAPNs' previous advise, or point me in the direction of someone who can look into this, that would be great.

Thank you,

Rosie Vakasilimi
Fyfe Pty Ltd

T +61 8 8201 9609

From: Rosie Vakasilimi
Sent: Monday, 23 October 2017 10:43 AM
To: 'Timothy.Pritchard@sapowernetworks.com.au'
Cc: Bicky Shakya
Subject: Proposed Bromtpon Urban Village Development SAPN Indicative Response

Hi Tim,

Since your last discussion with us in regards to the Brompton Rezoning development, there have been a few changes made that I am listing below,

1. A dwelling density of 85-100 detached dwellings/ha (net) with approximately 760-900 dwellings;
2. 65%-80% townhouses with 35%-20% apartments; and
3. 3,000m2 of retail, office and commercial space.

I have attached the previous RFI email response, to illustrate the changes being made this time around, mainly the decrease in the number of apartments being proposed for the development. The rest of the information mentioned in the previous email will remain the same.
I would appreciate SAPN's advice on whether the change being made affect what was previously advised for this development, and if they do, what will the changes be.
Please don't hesitate to get in contact with me to discuss anything in relation to this development
Thank you.

Rosie Vakasilimi
Fyfe Pty Ltd

T +61 8 8201 9609

From: Andrew Watson
Sent: Monday, 23 October 2017 10:21 AM
To: Rosie Vakasilimi
Subject: FW: Proposed Bromtpon Urban Village Development SAPN Indicative Response

Andrew Watson
Fyfe Pty Ltd

T +61 8 8201 9660
M +61 404 050 194

From: Timothy Pritchard [mailto:Timothy.Pritchard@sapowernetworks.com.au]
Sent: Thursday, 1 May 2014 8:09 AM
To: George Boumis
Cc: Pat Howard
Subject: RE: Proposed Bromtpon Urban Village Development SAPN Indicative Response

Hi George,

That is correct, it is a rolling 3 year period, so as long as the development rate remains below the threshold in any 3 year period, the standard augmentation charge applies.

Regards,

Tim Pritchard
Graduate Engineer
Strategic Projects

Direct: 08 8404 4854
Facsimile: 08 8292 0014
timothy.pritchard@sapowernetworks.com.au
---
1 Anzac Highway, Keswick SA 5001
www.sapowernetworks.com.au

From: George Boumis [mailto:George.Boumis@fyfe.com.au]
Sent: Wednesday, 30 April 2014 3:30 PM
To: Timothy Pritchard

Cc: Pat Howard; Charles Donovan
Subject: RE: Proposed Bromtpon Urban Village Development SAPN Indicative Response

Thanks Tim, the only clarification at this time is whether the below threshold is a rolling threshold over each 3 year period, ie as long as the development rate remains within the applicable threshold in any 3 year period, it is the standard augmentation rate at that time that will apply, correct?
Please advise, regards

George Boumis | Snr Civil Engineer/Project Manager - Land Development

FYFE Earth Partners

www.fyfe.com.au
Level 3, 80 Flinders Street, Adelaide SA 5000 | T: 08 8201 9600 | F: 08 8201 9779

ADELAIDE | ALICE SPRINGS | BALLERA | BRISBANE | CHINCHILLA | COOLUM | DALBY | DARWIN | GLEN OSMOND | MOOMBA | ROMA | SPRINGWOOD

From: Timothy Pritchard [mailto:Timothy.Pritchard@sapowernetworks.com.au]
Sent: Wednesday, 30 April 2014 12:53 PM
To: George Boumis
Cc: Pat Howard; Charles Donovan
Subject: Proposed Bromtpon Urban Village Development SAPN Indicative Response

Hi George,

Please find attached response to your request for an indicative estimate of the augmentation works associated with the proposed Brompton Urban Village Development.

Please note the threshold for Croydon Substation is 2100kVA and hence you can uptake a maximum of 2100kVA in a three year period and be charged at the standard augmentation rate, currently $149 per kVA. However, if you exceed this amount in a 3 year period, the augmentation rate per kVA will based on an individual calculation.

If you have any queries regarding the response, feel free to contact me.

Regards,

Tim Pritchard
Graduate Engineer
Strategic Projects

Direct: 08 8404 4854
Facsimile: 08 8292 0014
timothy.pritchard@sapowernetworks.com.au
---
1 Anzac Highway, Keswick SA 5001
www.sapowernetworks.com.au

****
This email and any file attachments are highly confidential. If you have received this email in error please notify the sender and delete the email. You should note the contents of the email do not necessarily represent the views of SA Power Networks, nor can we guarantee that the email is free of any malicious code. If you have any doubts about the source or authenticity of the email, please contact us on 13 12 61.
****

NOTICE - The information in this e-mail/attachment(s) is confidential and intended for the named recipient/s only. If you are not the intended recipient, you must not use, disclose, read, forward, copy or retain any of the information. If this e-mail is received in error, please delete it and notify the sender by return e-mail or telephone. Neither Fyfe Pty Ltd nor the sender accepts any responsibility for any viruses or any other harmful software that may be contained in this e-mail or its attachments. It is your responsibility to ensure that your systems have adequate protection against viruses or any other harmful software.

NOTICE - The information in this e-mail/attachment(s) is confidential and intended for the named recipient/s only. If you are not the intended recipient, you must not use, disclose, read, forward, copy or retain any of the information. If this e-mail is received in error, please delete it and notify the sender by return e-mail or telephone. Neither Fyfe Pty Ltd nor the sender accepts any responsibility for any viruses or any other harmful software that may be contained in this e-mail or its attachments. It is your responsibility to ensure that your systems have adequate protection against viruses or any other harmful software.
****
This email and any file attachments are highly confidential. If you have received this email in error please notify the sender and delete the email. You should note the contents of the email do not necessarily represent the views of Enerven, nor can we guarantee that the email is free of any malicious code. If you have any doubts about the source or authenticity of the email, please contact us on 13 12 61.
****

NOTICE - The information in this e-mail/attachment(s) is confidential and intended for the named recipient/s only. If you are not the intended recipient, you must not use, disclose, read, forward, copy or retain any of the information. If this e-mail is received in error, please delete it and notify the sender by return e-mail or telephone. Neither Fyfe Pty Ltd nor the sender accepts any responsibility for any viruses or any other harmful software that may be contained in this e-mail or its attachments. It is your responsibility to ensure that your systems have adequate protection against viruses or any other harmful software.
****
This email and any file attachments are highly confidential. If you have received this email in error please notify the sender and delete the email. You should note the contents of the email do not necessarily represent the views of SA Power Networks, nor can we guarantee that the email is free of any malicious ode. If you have any doubts about the source or authenticity of the email, please contact us on 13 12 61.
****

NOTICE - The information in this e-mail/attachment(s) is confidential and intended for the named recipient/s only. If you are not the intended recipient, you must not use, disclose, read, forward, copy or retain any of the information. If this e-mail is received in error, please delete it and notify the sender by return e-mail or telephone. Neither Fyfe Pty Ltd nor the sender accepts any responsibility for any viruses or any other harmful software that may be contained in this e-mail or its attachments. It is your responsibility to ensure that your systems have adequate protection against viruses or any other harmful software.
****
This email and any file attachments are highly confidential. If you have received this email in error please notify the sender and delete the email. You should note the contents of the email do not necessarily represent the views of SA Power Networks, nor can we guarantee that the email is free of any malicious ode. If you have any doubts about the source or authenticity of the email, please contact us on 13 12 61.
****

NOTICE - The information in this e-mail/attachment(s) is confidential and intended for the named recipient/s only. If you are not the intended recipient, you must not use, disclose, read, forward, copy or retain any of the information. If this e-mail is received in error, please delete it and notify the sender by return e-mail or telephone. Neither Fyfe Pty Ltd nor the sender accepts any responsibility for any viruses or any other harmful software that may be contained in this e-mail or its attachments. It is your responsibility to ensure that your systems have adequate protection against viruses or any other harmful software.

NOTICE - The information in this e-mail/attachment(s) is confidential and intended for the named recipient/s only. If you are not the intended recipient, you must not use, disclose, read, forward, copy or retain any of the information. If this e-mail is received in error, please delete it and notify the sender by return e-mail or telephone. Neither Fyfe Pty Ltd nor the sender accepts any responsibility for any viruses or any other harmful software that may be contained in this e-mail or its attachments. It is your responsibility to ensure that your systems have adequate protection against viruses or any other harmful software.
****
This email and any file attachments are highly confidential. If you have received this email in

error please notify the sender and delete the email. You should note the contents of the email do not necessarily represent the views of SA Power Networks, nor can we guarantee that the email is free of any malicious ode. If you have any doubts about the source or authenticity of the email, please contact us on 13 12 61.
****

NOTICE - The information in this e-mail/attachment(s) is confidential and intended for the named recipient/s only. If you are not the intended recipient, you must not use, disclose, read, forward, copy or retain any of the information. If this e-mail is received in error, please delete it and notify the sender by return e-mail or telephone. Neither Fyfe Pty Ltd nor the sender accepts any responsibility for any viruses or any other harmful software that may be contained in this e-mail or its attachments. It is your responsibility to ensure that your systems have adequate protection against viruses or any other harmful software.
****

This email and any file attachments are highly confidential. If you have received this email in error please notify the sender and delete the email. You should note the contents of the email do not necessarily represent the views of SA Power Networks, nor can we guarantee that the email is free of any malicious ode. If you have any doubts about the source or authenticity of the email, please contact us on 13 12 61.
****

NOTICE - The information in this e-mail/attachment(s) is confidential and intended for the named recipient/s only. If you are not the intended recipient, you must not use, disclose, read, forward, copy or retain any of the information. If this e-mail is received in error, please delete it and notify the sender by return e-mail or telephone. Neither Fyfe Pty Ltd nor the sender accepts any responsibility for any viruses or any other harmful software that may be contained in this e-mail or its attachments. It is your responsibility to ensure that your systems have adequate protection against viruses or any other harmful software.
****

This email and any file attachments are highly confidential. If you have received this email in error please notify the sender and delete the email. You should note the contents of the email do not necessarily represent the views of SA Power Networks, nor can we guarantee that the email is free of any malicious code. If you have any doubts about the source or authenticity of the email, please contact us on 13 12 61.
****

NOTICE - The information in this e-mail/attachment(s) is confidential and intended for the named recipient/s only. If you are not the intended recipient, you must not use, disclose, read, forward, copy or retain any of the information. If this e-mail is received in error, please delete it and notify the sender by return e-mail or telephone. Neither Fyfe Pty Ltd nor the sender accepts any responsibility for any viruses or any other harmful software that may be contained in this e-mail or its attachments. It is your responsibility to ensure that your systems have adequate protection against viruses or any other harmful software.
****

This email and any file attachments are highly confidential. If you have received this email in error please notify the sender and delete the email. You should note the contents of the email do not necessarily represent the views of SA Power Networks, nor can we guarantee that the email is free of any malicious code. If you have any doubts about the source or authenticity of the email, please contact us on 13 12 61.
****

FYFE

APPENDIX C

TELECOMS & APA GAS

Confidential

25/10/2017

Email: Rosie.Vakasilimi@fyfe.com.au

Dear Rosie,

Brompton Rezoning

Thank you for considering **nbn** for the delivery of network infrastructure to Brompton.

We can confirm that the project is within the **nbn** fixed line footprint and can be serviced via **nbn**.

The purpose of this estimate is to provide you with early planning information and indicative costs to consider before applying for **nbn**™ network infrastructure via the online application form.

Based on the information you have provided on the location and size of the project we have calculated the below estimate.

DEPLOYMENT CONTRIBUTIONS

MDU $400 per premises/ SDU $600 per premises (GST inc)

BACKHAUL ESTIMATE

To be provided once the location of the stage one Headworks location is confirmed.

Explanation of Costs

Backhaul charges apply to the distance of infrastructure required to connect the development to the **nbn**™ *access infrastructure. For new developments where there is no existing* **nbn**™ *access infrastructure (i.e. Fibre Access Node) charges will apply for this installation.*

It is important to note that this is an estimate only.

The estimate has been calculated on current infrastructure costs, the distance of your development from the existing **nbn**™ network and is based on the premise count and the location of the first stage that will require service.

Actual amounts charged by **nbn** may change between now and the point when you ultimately enter into a contract for **nbn** to connect your development. For example, costs may reduce over time as additional network is rolled out. Conversely, costs may increase if the details, premise count or staging of your development changes. In any case, a new estimate will be provided prior to work commencing.

Once you have reviewed the above estimate please contact me to discuss the next steps.

I look forward to working with you to deliver quality telecommunication services to this development.

Yours sincerely

Jodie Lunn
Account Manager SA/NT
M +61 412 050 773 | **E** jodielunn@nbnco.com.au

©2015 nbn co limited | ABN 86 136 533 741

Rosie Vakasilimi

From: Holden, David <david.holden@apa.com.au>
Sent: Thursday, 30 November 2017 2:51 PM
To: Rosie Vakasilimi
Cc: Kramer, Zofia; Abbott, Rick
Subject: FW: 65148-1 Bowden Rezoning Development
Attachments: Yield analysis V2.docx

Hi Rosie

Thank you for your enquiry. Indicatively the gas mains in this area have sufficient capacity to accommodate the gas loads for this proposed development. However to present a formal offer APA require a CAD drawing of the pegging plans and details of the master plan (e.g. location and number of proposed apartment developments, commercial space and other types of other dwellings.

Please contact myself or Zofia Kramer once this information has been finalised.

Regards

David Holden
Gas Development Representative – Networks Commercial

APA Group – Operator for Australian Gas Networks
330 Grange Road
Kidman Park SA 5032

d +61 08 8159 1918
m +61 0408 456 684
e david.holden@apa.com.au
w www.apa.com.au

From: Rosie Vakasilimi [mailto:Rosie.Vakasilimi@fyfe.com.au]
Sent: Friday, 17 November 2017 9:51 AM
To: Dedecke, Sharon
Cc: Bicky Shakya; Steve Mitchell
Subject: 65148-1 Bowden Rezoning Development

Hi Sharon,

I spoke to the planners working on this development and their response was because it is still very early in the planning, they have yet to establish the details yet. What I can tell you is that 60% of dwelling units (1530 in total) will be townhouses (about 918) and the remaining 40% will be apartments (about 612). We have yet to establish how many apartment blocks there will be. In regards to the commercial space, there will be a mixed area of small scale retail and commercial space, factories are not being proposed for this development, but the existing factories on site will remain on site.
I have attached the yield analysis for you. If you have any other queries, please contact me.

Kind regards,
Rosie Vakasilimi | Graduate Civil Engineer

F +61 8 8201 9650
E Rosie.Vakasilimi@fyfe.com.au

Adelaide SA 5000
www.fyfe.com.au
Follow Fyfe Pty Ltd on LinkedIn

NOTICE - The information in this e-mail/attachment(s) is confidential and intended for the named recipient/s only. If you are not the intended recipient, you must not use, disclose, read, forward, copy or retain any of the information. If this e-mail is received in error, please delete it and notify the sender by return e-mail or telephone. Neither Fyfe Pty Ltd nor the sender accepts any responsibility for any viruses or any other harmful software that may be contained in this e-mail or its attachments. It is your responsibility to ensure that your systems have adequate protection against viruses or any other harmful software.

This email and any attachment is confidential, may be subject to legal privilege, and is for the use of the intended recipient only. If received in error, please notify APA by reply and delete the email. If you are not the intended recipient, any use, interference with, disclosure or copying of this material is prohibited. Views expressed are those of the author and not APA. APA does not guarantee nor accept liability for the reliability, completeness or confidentiality of any email communication, nor its freedom from harmful viruses or software.

APA handles personal information in accordance with relevant privacy laws and our privacy policy is accessible on APA's website.

Rosie Vakasilimi

From: Rosie Vakasilimi
Sent: Monday, 23 October 2017 4:24 PM
To: 'Kramer, Zofia'
Cc: Bicky Shakya
Subject: FW: Potential Brompton Rezoning
Attachments: Brompton Gas Mains.pdf; Yield analysis V2.docx

Hi Zofia,

In regards to my earlier email regarding the Brompton Rezoning development, I have attached a Word document showing changes that have been made to the proposed residential density. If you could please look through these changes and advise us on whether there will be changes to APA Gas' previous advise, or point me in the direction of someone who can look into this, that would be great.

Thank you,
Rosie Vakasilimi
Fyfe Pty Ltd
T +61 8 8201 9609

From: Rosie Vakasilimi
Sent: Monday, 23 October 2017 10:46 AM
To: 'Kramer, Zofia'
Cc: Bicky Shakya
Subject: FW: Potential Brompton Rezoning

Hi Zofia,

Since APA Gas' last discussion with us in regards to the Brompton Rezoning development, there have been a few changes made that I am listing below,

1. A dwelling density of 85-100 detached dwellings/ha (net) with approximately 760-900 dwellings;
2. 65%-80% townhouses with 35%-20% apartments; and
3. 3,000m2 of retail, office and commercial space.

I have attached the previous RFI email response, to illustrate the changes being made this time around, mainly the decrease in the number of apartments being proposed for the development. The rest of the information mentioned in the previous email will remain the same.
I would appreciate APA Gas' advice on whether the change being made affects what was previously advised for this development, and if they do, what will the changes be.
Please don't hesitate to get in contact with me to discuss anything in relation to this development
Thank you.

Kind regards,
Rosie Vakasilimi
Fyfe Pty Ltd
T +61 8 8201 9609

From: Andrew Watson
Sent: Monday, 23 October 2017 10:24 AM
To: Rosie Vakasilimi
Subject: FW: Potential Brompton Rezoning

Andrew Watson
Fyfe Pty Ltd
T +61 8 8201 9660
M +61 404 050 194

From: Keogh, Peter [mailto:peter.keogh@apa.com.au]
Sent: Tuesday, 20 May 2014 9:18 AM
To: George Boumis
Subject: RE: Potential Brompton Rezoning

Hi George .

As the plans are in PDF it's difficult to overlay however below is showing our existing high pressure network (blue) and the proposed reticulation (yellow).

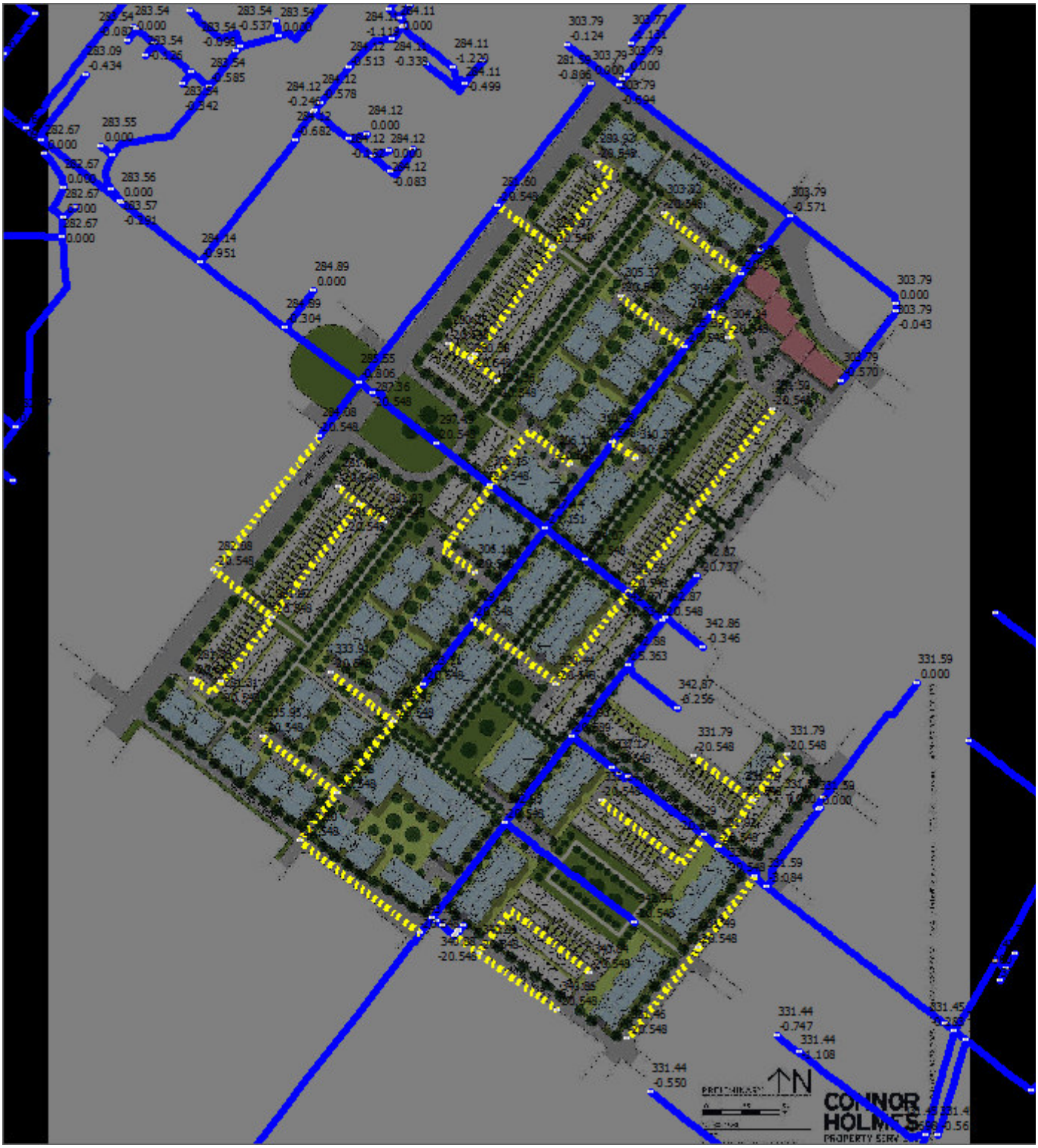
Based on the concept we would need lay approx. 2.0km off pipe and the existing high pressure network should be able to support the approx. 1700 connections plus the retail/commercial.

Once we have a CAD file and we will need more details on the gas loads so we can evaluate Total Project in detail.

Attached also is a copy of our GIS plan showing the existing mains around Brompton.

We need to arrange a time to meet.

Cheers



Peter Keogh
Natural Gas Marketing
APA Group
Level 7 , 30 Currie St
Adelaide 5000
T 08 8113 9181
F 08 8113 9020
M 0419 819 854

From: George Boumis [mailto:George.Boumis@fyfe.com.au]
Sent: Friday, 16 May 2014 4:36 PM
To: Keogh, Peter
Subject: Potential Brompton Rezoning
Importance: High

Hi Peter

Hope all is well. Sending you this to re-open this discussion pursuant to our meeting say 4-6 weeks ago now. The below are the best numbers we have at present re potential allotment yield, ie the indicative concept(s) attached is/are envisaged to deliver the following:

1. c.300 detached dwellings/townhouses in a 2-3 storey configuration;
2. c.1,400 apartments in 4-6 storey buildings;
3. c.3,000m2 of retail, office and commercial space;
4. a dwelling density of 125 dwellings/hectare (gross) and 180 dwellings/hectare (net).

From what I can deduce from some of the high level commentary at this end, Drayton St is meant to evolve into a retail core for the whole of the Brompton Bowden area including the TOD adjacent to our subject footprint. At this time, a small retail/ office/commercial precinct is meant to sit along Hawker Street as well (however this is only meant to be modest in size and capacity requirements), and which is identified in the attached as the 'main street precinct'.

Please note all this is still highly confidential at this stage as well. Current proposed staging is as per the last attachment. I infer that the former/current industrial usage of this area over the long term, and that this is earmarked to wind down and evolve via this change of use, may also re-introduce capacity into any the local existing network?

In the main, any future engineering works involved would focus on not changing road levels or major services/assets relating to the overall footprint, regardless, could you provide a clear indication of where major and minor APA service alignments are and whether APA deems this a commercial business case to the extent that no developer contributions would be required (and if this is the case in what context)?.

Please call to discuss if and as need asap of course or advise via reply with any qu/comments, we need a strong indication of APA's position within the coming fortnight if possible, regards

George Boumis | Senior Civil Engineer - Land Development

FYFE Earth Partners

www.fyfe.com.au
Level 3, 80 Flinders Street, Adelaide SA 5000 | T: 08 8201 9600 | F: 08 8201 9779

ADELAIDE | ALICE SPRINGS | BALLERA | BRISBANE | CHINCHILLA | COOLUM | DALBY | DARWIN | GLEN OSMOND | MOOMBA | ROMA | SPRINGWOOD

NOTICE - The information in this e-mail/attachment(s) is confidential and intended for the named recipient/s only. If you are not the intended recipient, you must not use, disclose, read, forward, copy or retain any of the information. If this e-mail is received in error, please delete it and notify the sender by return e-mail or telephone. Neither Fyfe Pty Ltd nor the sender accepts any responsibility for any viruses or any other harmful software that may be contained in this e-mail or its attachments. It is your responsibility to ensure that your systems have adequate protection against viruses or any other harmful software.

APA Group – Delivering Australia's energy

This message (including attachments) may be confidential or privileged. If you received it in error, you may not disclose or use it - please notify us then delete it. We do not guarantee the reliability, completeness or confidentiality of any email communication, or its freedom from harmful viruses or software.

FYFE

APPENDIX D

DIAL BEFORE YOU DIG

Government of South Australia

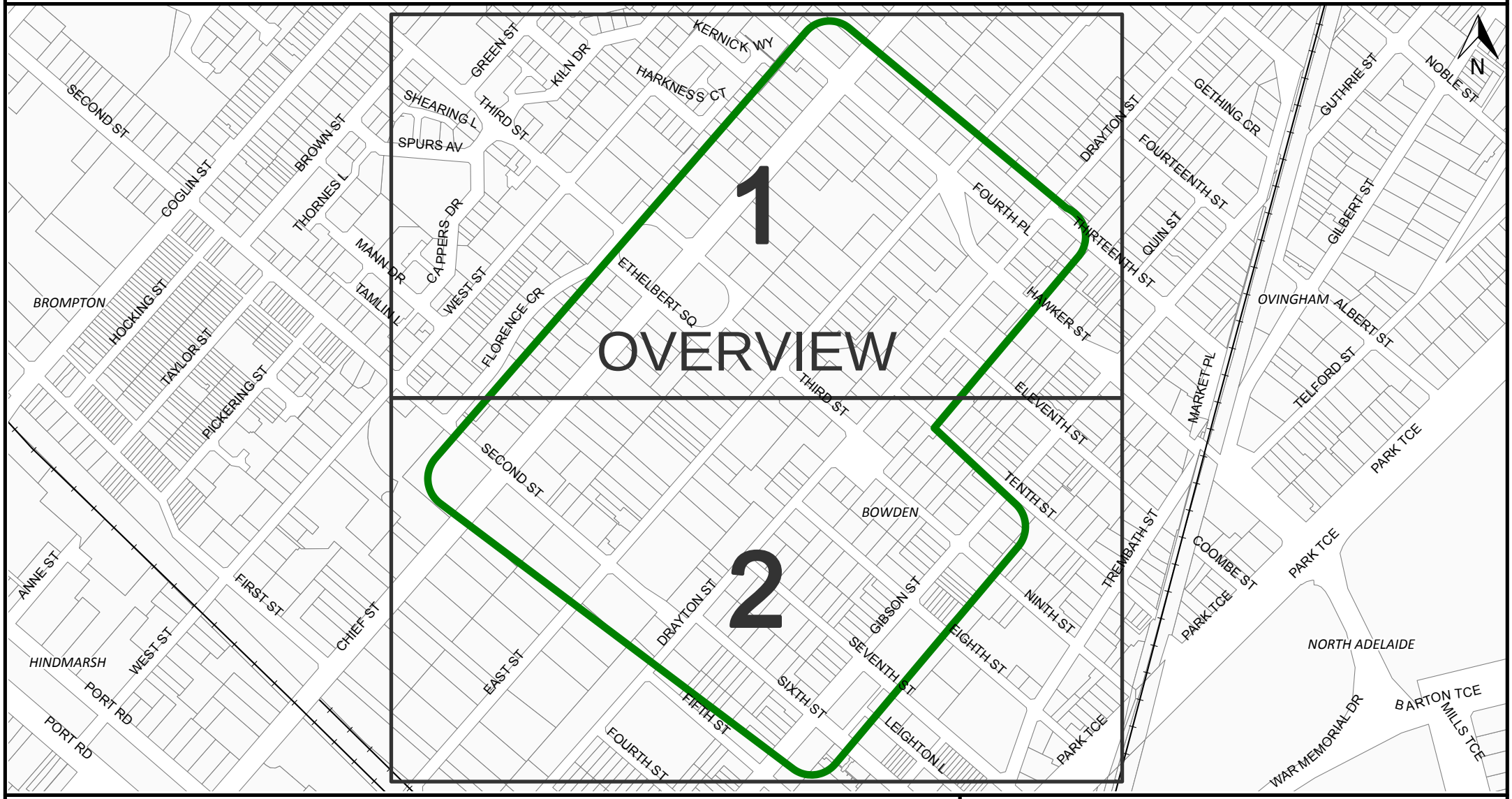
SA Water

South Australian Water Corporation

RECYCLED WATER RETICULATION

DBYD Sequence No: **65303461**

DIAL BEFORE YOU DIG www.1100.com.au



- Recycled Water Main
- Recycled Water Connection
- Recycled Water Valve
- CP Anode/Cathode Cables
- CP Electricity Supply Cables
- CP = Cathodic Protection
- CP Facility
- CP Anode Bed Outlines
- Land Parcels
- Railway

Scale @ A4: 1:5119

This advice and/or information is given for your private use only. The accuracy of the advice and information is not guaranteed and no responsibility is accepted by the crown, the South Australian Water Corporation or their officers, agents or servants for any loss or damage caused by reliance upon this advice and/or information, as a result of any error, omission, incorrect description or statement therein whether caused by negligence or otherwise.

Government of South Australia

SA Water

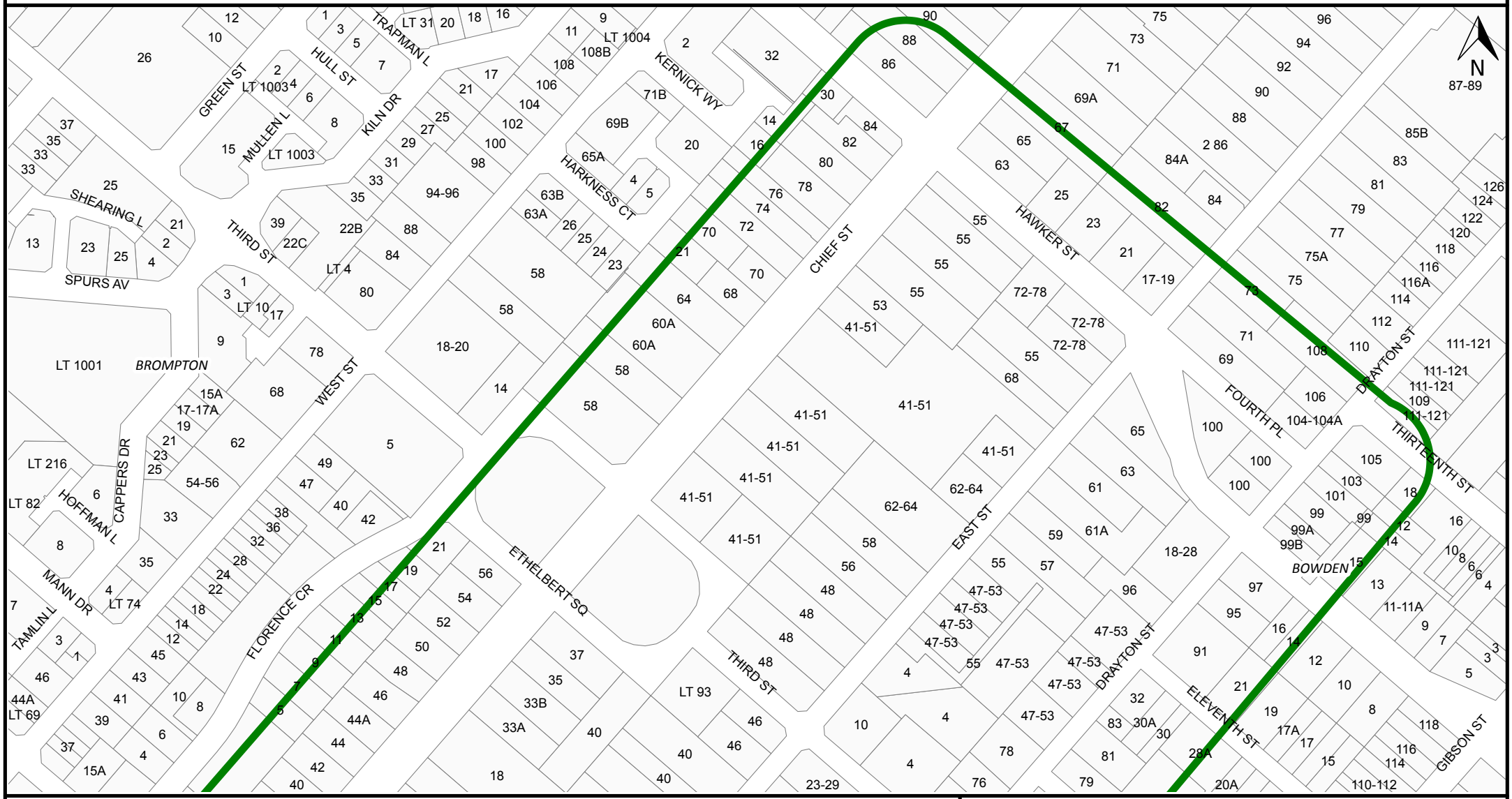
South Australian Water Corporation

RECYCLED WATER RETICULATION

DBYD Sequence No: **65303461**

Map Tile: 1

DIAL BEFORE YOU DIG www.1100.com.au



- Recycled Water Main
- Recycled Water Connection
- Recycled Water Valve
- CP Anode/Cathode Cables
- CP Electricity Supply Cables
- CP = Cathodic Protection
- CP Facility
- CP Anode Bed Outlines
- Land Parcels
- Railway

Scale @ A4: 1:2500

This advice and/or information is given for your private use only. The accuracy of the advice and information is not guaranteed and no responsibility is accepted by the crown, the South Australian Water Corporation or their officers, agents or servants for any loss or damage caused by reliance upon this advice and/or information, as a result of any error, omission, incorrect description or statement therein whether caused by negligence or otherwise.

Government of South Australia

SA Water

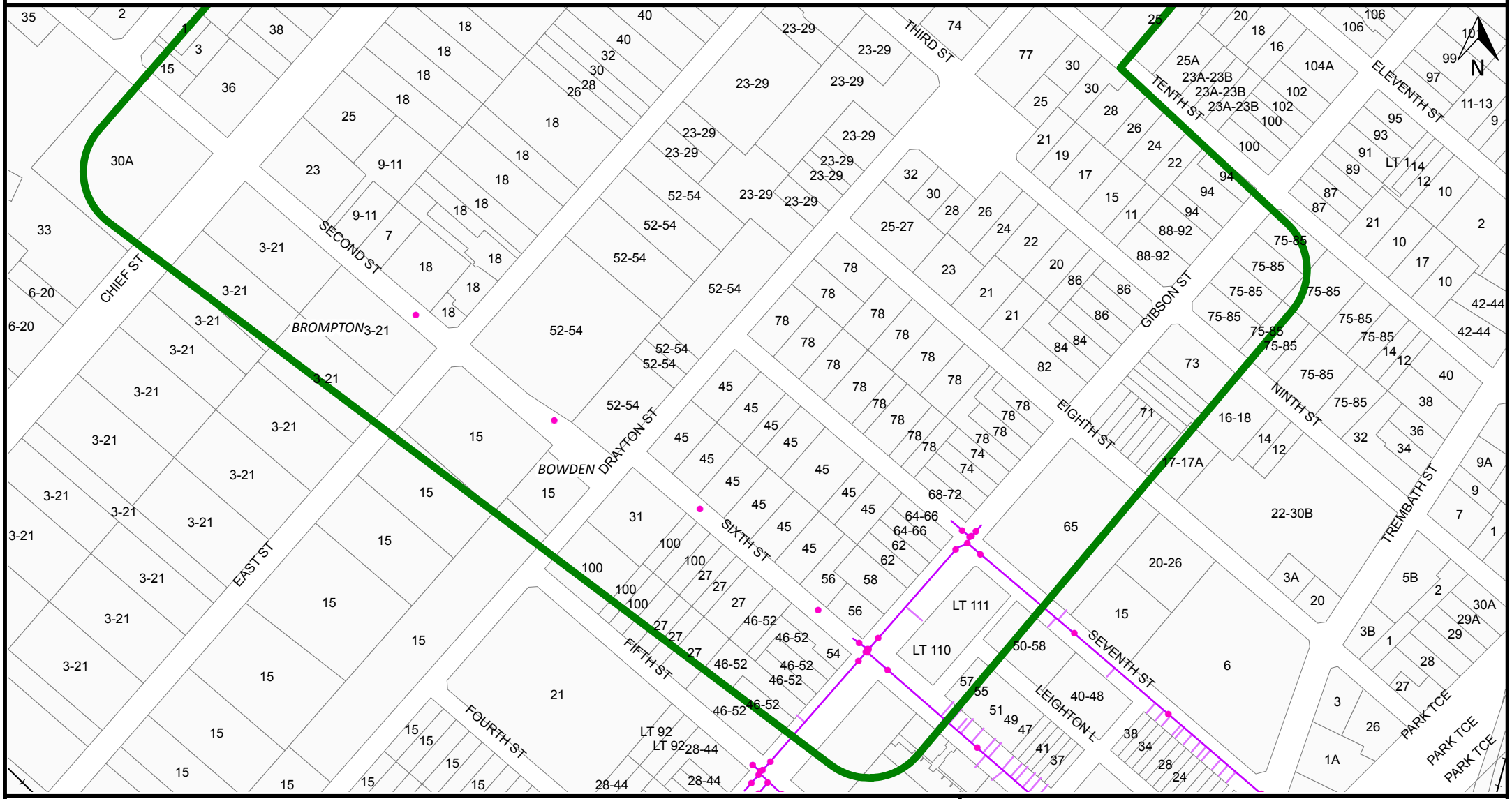
South Australian Water Corporation

RECYCLED WATER RETICULATION

DBYD Sequence No: **65303461**

Map Tile: 2

DIAL BEFORE YOU DIG www.1100.com.au

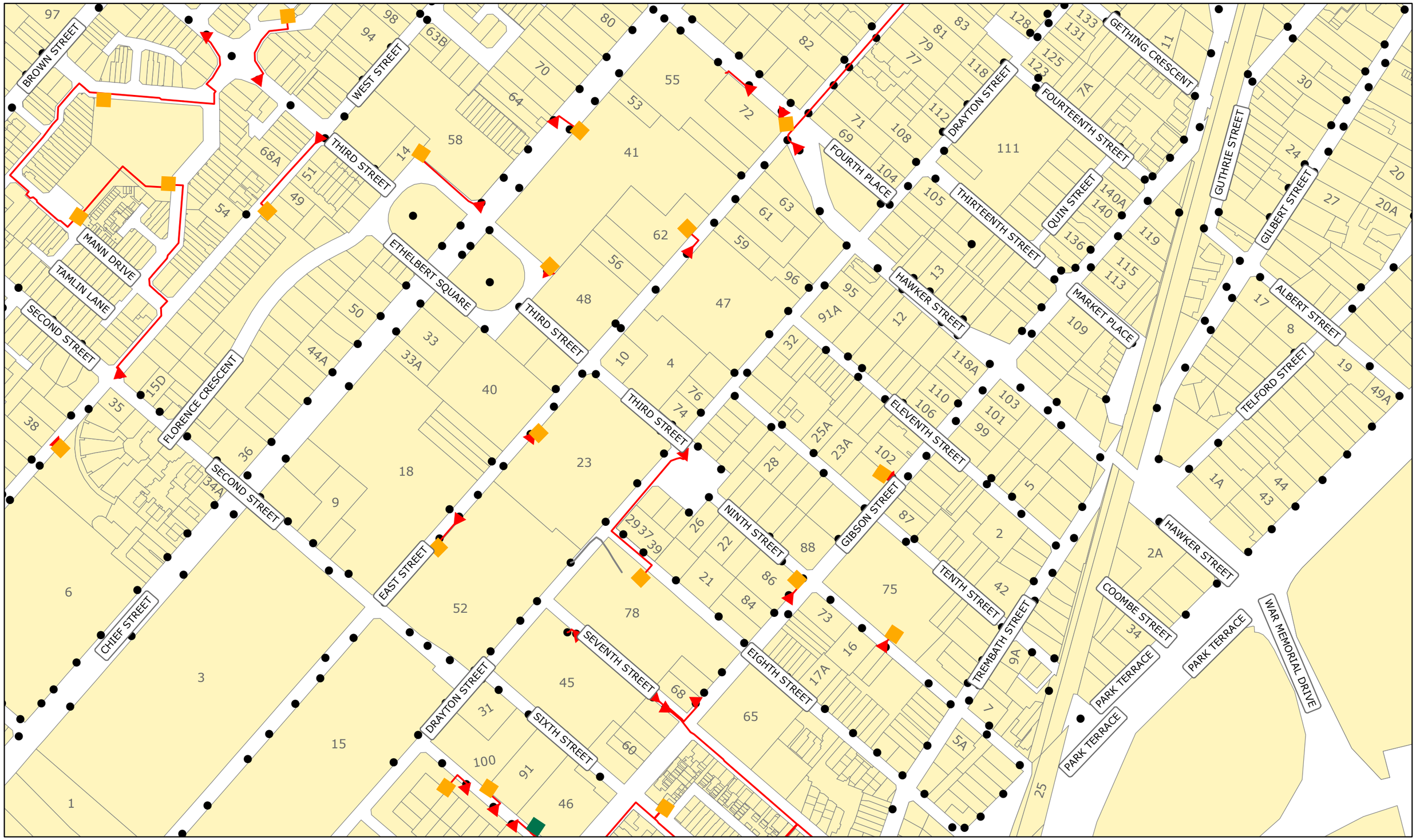


- Recycled Water Main
- Recycled Water Connection
- Recycled Water Valve
- CP Anode/Cathode Cables
- CP Electricity Supply Cables
- CP = Cathodic Protection
- CP Facility
- CP Anode Bed Outlines
- Land Parcels
- Railway

Scale @ A4: 1:2500

This advice and/or information is given for your private use only. The accuracy of the advice and information is not guaranteed and no responsibility is accepted by the crown, the South Australian Water Corporation or their officers, agents or servants for any loss or damage caused by reliance upon this advice and/or information, as a result of any error, omission, incorrect description or statement therein whether caused by negligence or otherwise.

Dial Before You Dig Request - SA Power Networks High Voltage Underground Assets



Transformer Cubicle
Switching Cubicle
7.6kV Cable Exit
11kV Cable Exit
19kV Cable Exit
Not In Service HV Cable
7.6kV Cable
11kV Cable
19kV Cable
Electricity Pole

Meters
0
180

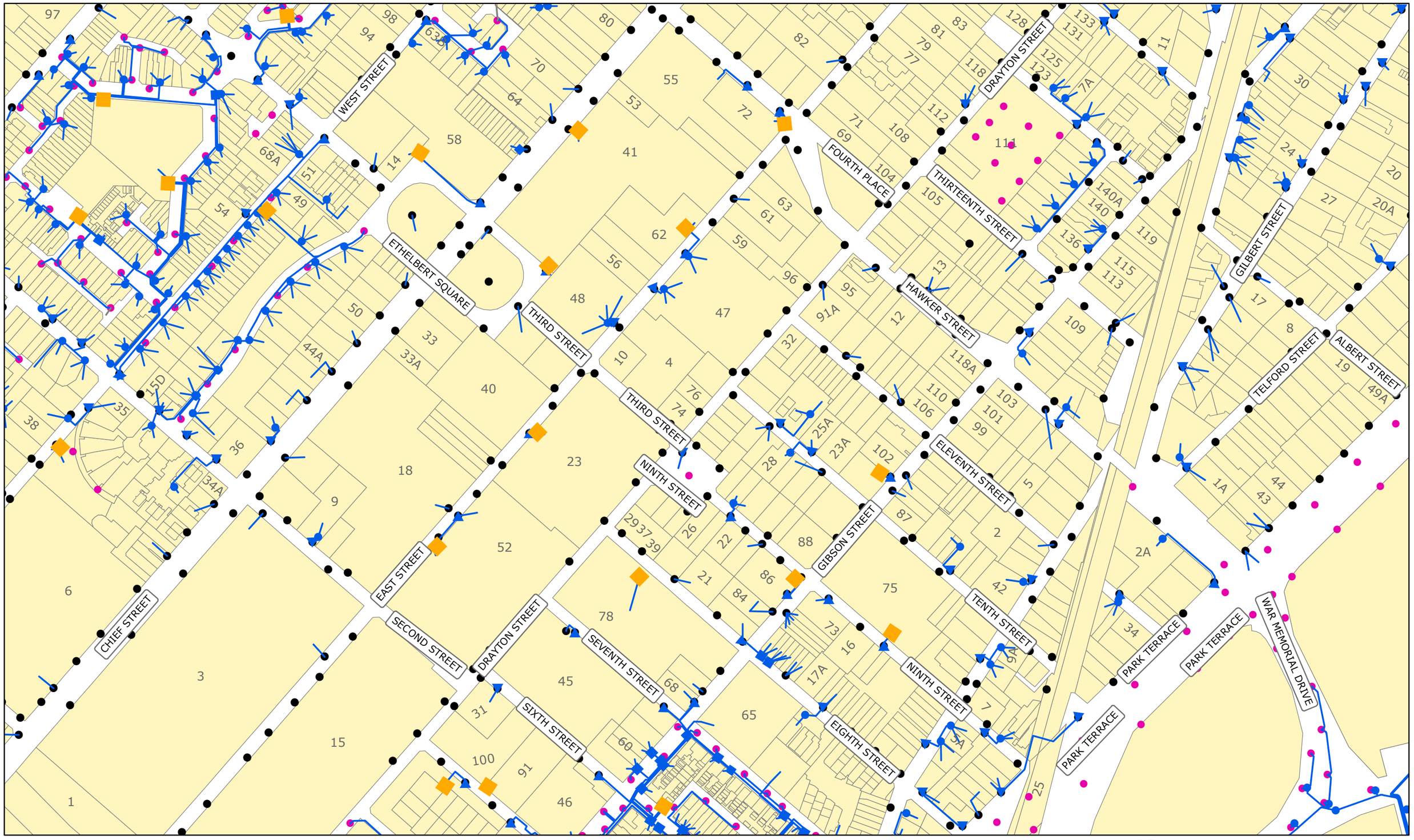
N

SA Power Networks

16/10/2017 08:16 AM

Disclaimer: The Plan/Sketch is supplied at your request and is subject to your agreement that SA Power Networks shall not be liable or responsible for the correctness or otherwise of any such information supplied pursuant to this request. Upon acceptance of this condition SA Power Networks grants you permission to use the Plan/Sketch as a guide to the location of SA Power Networks assets. The Plan/Sketch must be returned to SA Power Networks if you fail to accept the conditions of use.

Dial Before You Dig Request - SA Power Networks Low Voltage Underground Assets



Transformer Cubicle
Switching Container
Service Pillar/Pit
Electricity Pole
Light Column
Not In Service LV Cable Exit
In Service LV Cable Exit
Not In Service LV Cable
In Service LV Cable

Meters
0
180

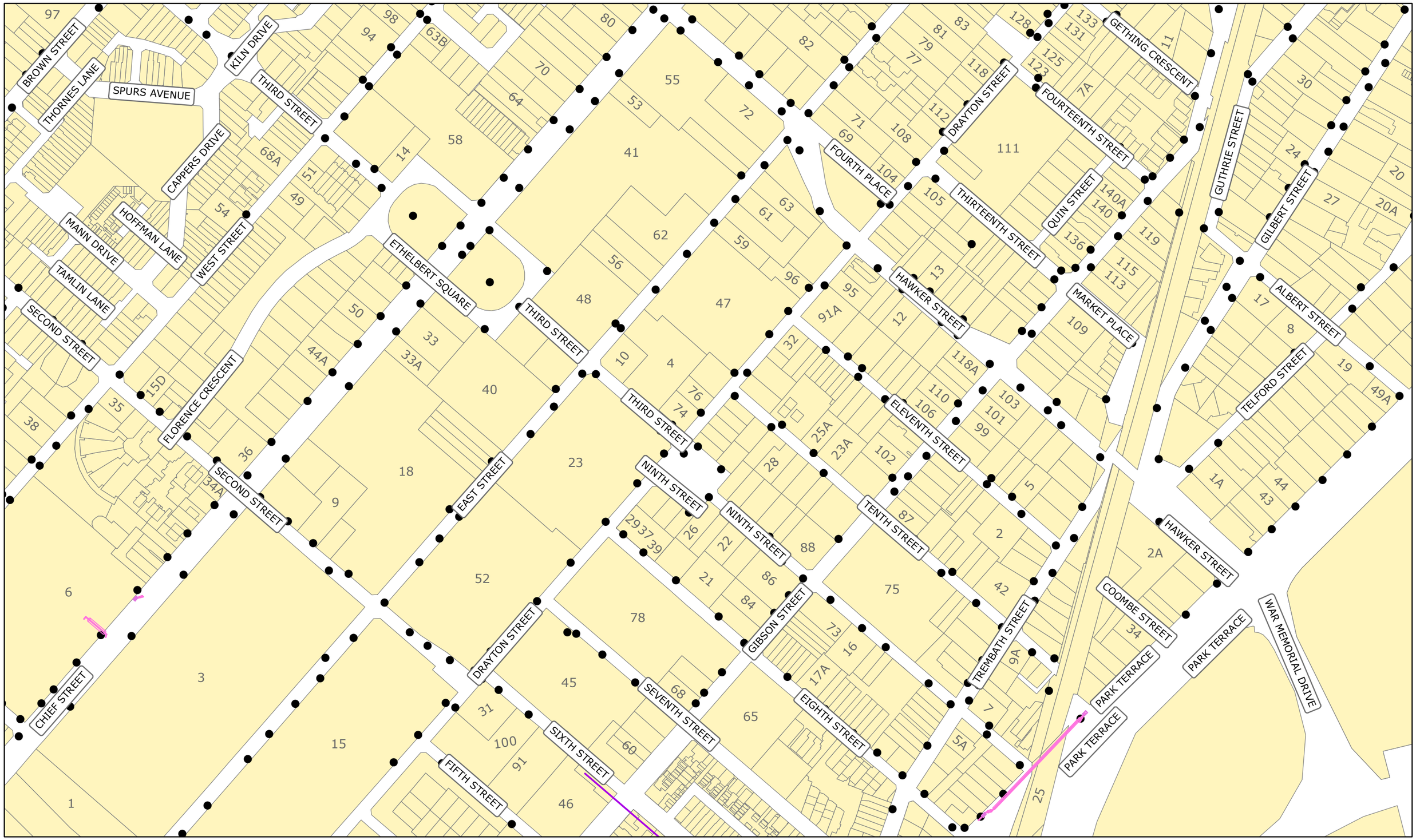
N

SA Power Networks

Disclaimer: The Plan/Sketch is supplied at your request and is subject to your agreement that SA Power Networks shall not be liable or responsible for the correctness or otherwise of any such information supplied pursuant to this request. Upon acceptance of this condition SA Power Networks grants you permission to use the Plan/Sketch as a guide to the location of SA Power Networks assets. The Plan/Sketch must be returned to SA Power Networks if you fail to accept the conditions of use.

16/10/2017 08:16 AM

Dial Before You Dig Request - SA Power Networks Underground Communications Cables



Fibre Optic Cable
Fibre Manhole/Pit
Pilot Cable
Pilot Manhole/Pit
Electricity Pole

Meters
0
180

N

SA Power Networks

Disclaimer: The Plan/Sketch is supplied at your request and is subject to your agreement that SA Power Networks shall not be liable or responsible for the correctness or otherwise of any such information supplied pursuant to this request. Upon acceptance of this condition SA Power Networks grants you permission to use the Plan/Sketch as a guide to the location of SA Power Networks assets. The Plan/Sketch must be returned to SA Power Networks if you fail to accept the conditions of use.

16/10/2017 08:16 AM

Important information and conditions of use for users of underground services information supplied by SA Power Networks

Indicative information only

The accompanying information is intended only to indicate the presence of SA Power Networks' underground services and/or to convey general indicative information in respect of the location marked on the plans. The information does not necessarily provide current, comprehensive or accurate description or location of the underground services or associated infrastructure.

The information may also describe or indicate the presence of underground services or infrastructure not owned by SA Power Networks, for example, electrical services connected to an SA Power Networks' service point. SA Power Networks takes no responsibility for services or infrastructure that is not owned or operated by SA Power Networks or the accuracy or completeness of their description or location in the accompanying information.

Obtaining more technical information from Network for planning or engineering design (non-digging) projects can be arranged through the SA Power Networks Builders and Contractors Electrical Service Line on 1300 650 014.

Identifying the location of underground services

Working near or around live electrical cables can be hazardous. An on-site assessment is strongly recommended prior to undertaking ANY works and is necessary to determine the location of the underground services. This can be undertaken by SA Power Networks or an alternative professional locating service provider. Enquiries can be made about SA Power Networks' cable location service by telephoning (08) 8292 0218.

Restrictions may apply in regard to your excavation particularly if your excavation is greater than 300mm below ground level and less than 3.0m from an SA Power Networks asset. Further explanation regarding restricted exclusion zones can be found at *http://www.sapowernetworks.com.au/public/download.jsp?id=1775* OR search sapowernetworks.com.au for NICC 404 and by referring to the figures on pages 10, 11 or 12.

Underground services in the vicinity of any proposed earthworks must be located by hand digging (pot-holing) prior to the commencement of the works. Persons conducting works will be held responsible for any resulting loss or damage to the services or associated infrastructure.

Working near high voltage 66kV underground cables

Persons intending to conduct earthworks in the vicinity of an SA Power Networks high voltage 66kV underground cable MUST first obtain a site-specific clearance by contacting the SA Power Networks Cable Management Technical Officer on 0403 582 130 or 0403 582 174.

Basis of information supply

The accompanying information is supplied at the request of, and is only provided for use by, the requestor. The information is valid for 30 days from the date of issue.

SA Power Networks, its employees, agents and contractors shall accept no responsibility for any inaccuracy or incompleteness in the information provided or liability in respect of any personal injury, death, loss or damage to any real or personal property or otherwise that arises out of or in connection with, directly or indirectly, the provision of or reliance upon the information.

It is the requestor's responsibility to ensure that the information provided accords with the area depicted on the requestor's Dial Before You Dig request. The information provided should not be used in respect of any area outside of the area depicted on the Dial Before You Dig request. SA Power Networks does not warrant that the information is suitable for the requestor's intended purposes.

Any use of the accompanying information is subject to the requestor's agreement to the conditions contained in this document. Upon acceptance of these conditions, SA Power Networks grants the requestor permission to use the information. The information must be returned to SA Power Networks if the conditions are not accepted.

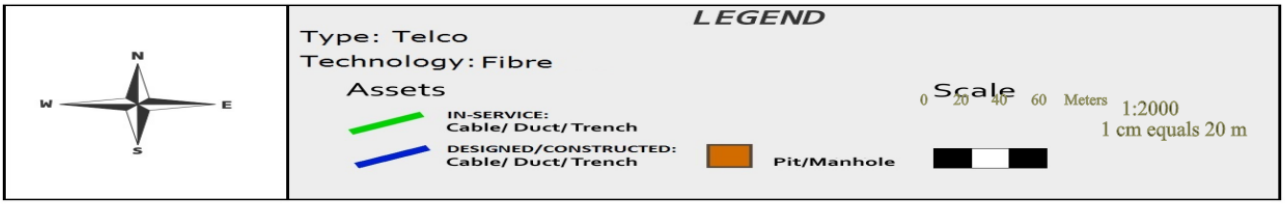
Important note: It is an offence under the Electricity Act 1996 (SA) to cause damage to or interfere with electrical infrastructure

Indicative Plans

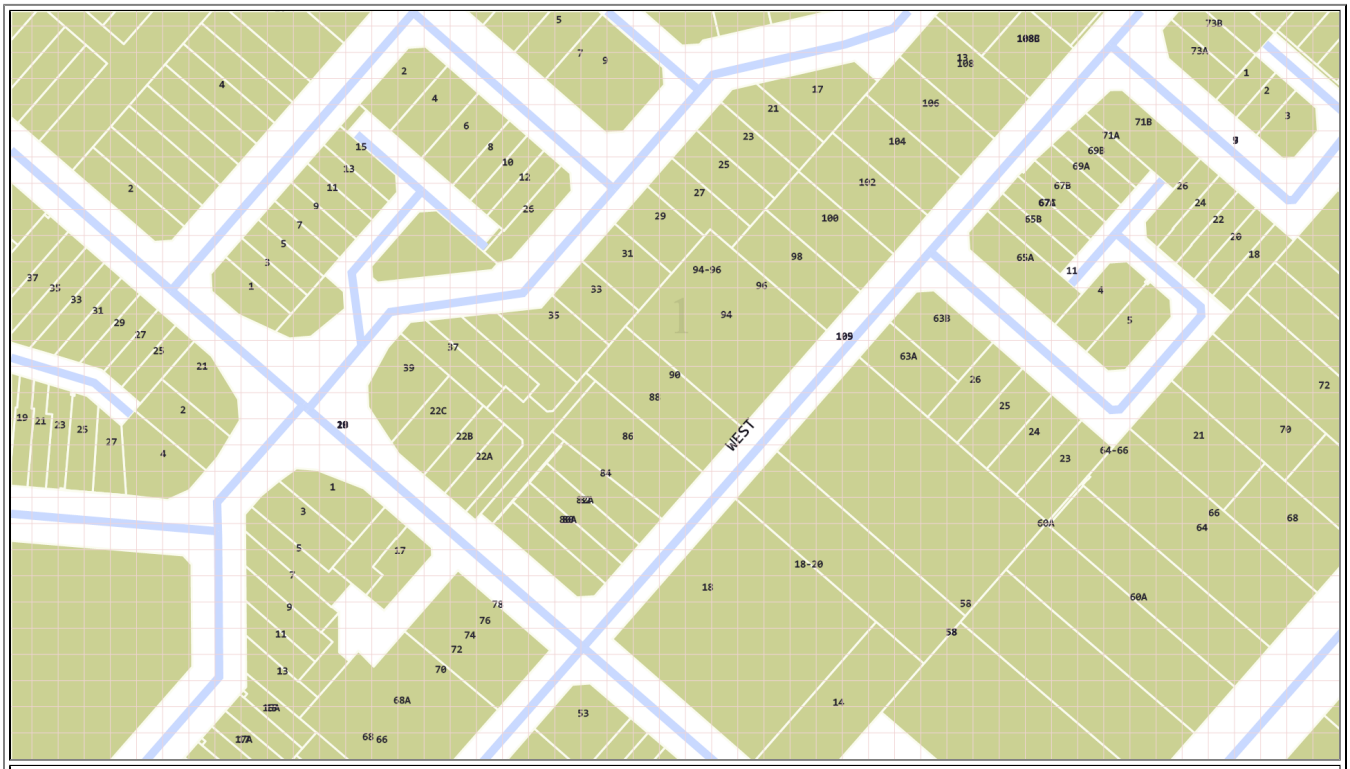
Issue Date:	13/10/2017
Location:	Chief Street,Brompton,SA-5007

DIAL BEFORE YOU DIG www.1100.com.au

1	5
2	6
3	7
4	8



© 2015 nbn co limited | ABN 86 136 533 741
Email info@nbn.com.au Web nbn.com.au



N
W
E
S

LEGEND

Type: Telco
Technology: Fibre
Assets

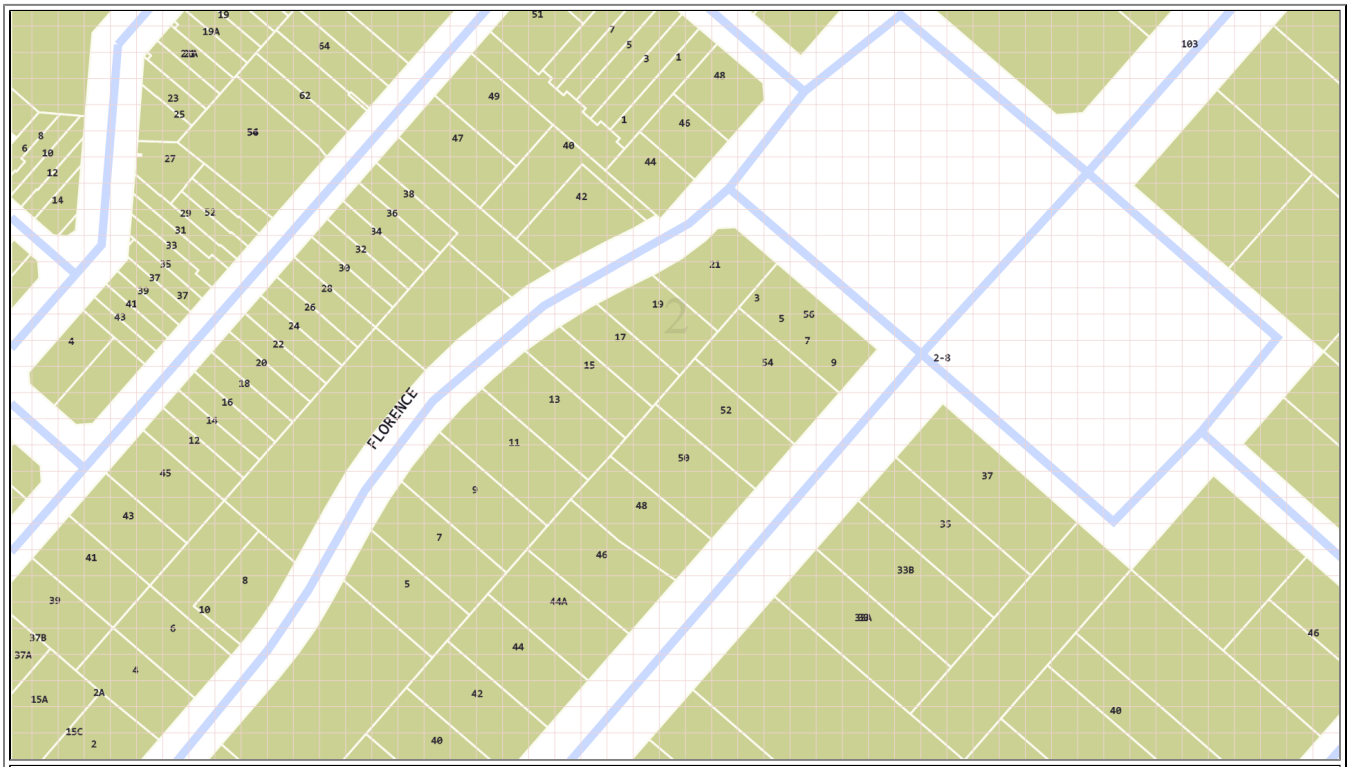
IN-SERVICE:
Cable/ Duct/ Trench

DESIGNED/CONSTRUCTED:
Cable/ Duct/ Trench

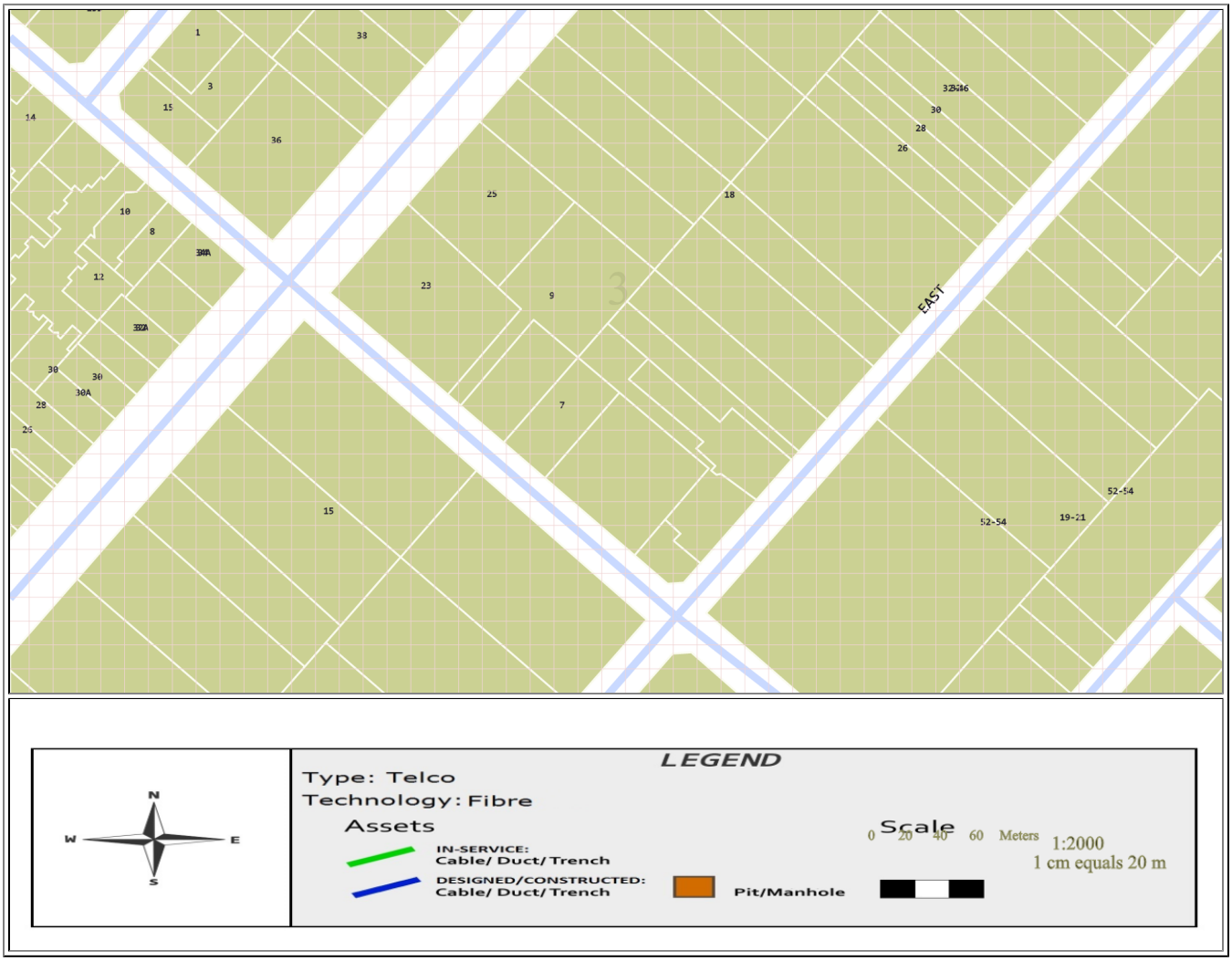
Pit/Manhole

Scale
0 20 40 60 Meters
1:2000
1 cm equals 20 m

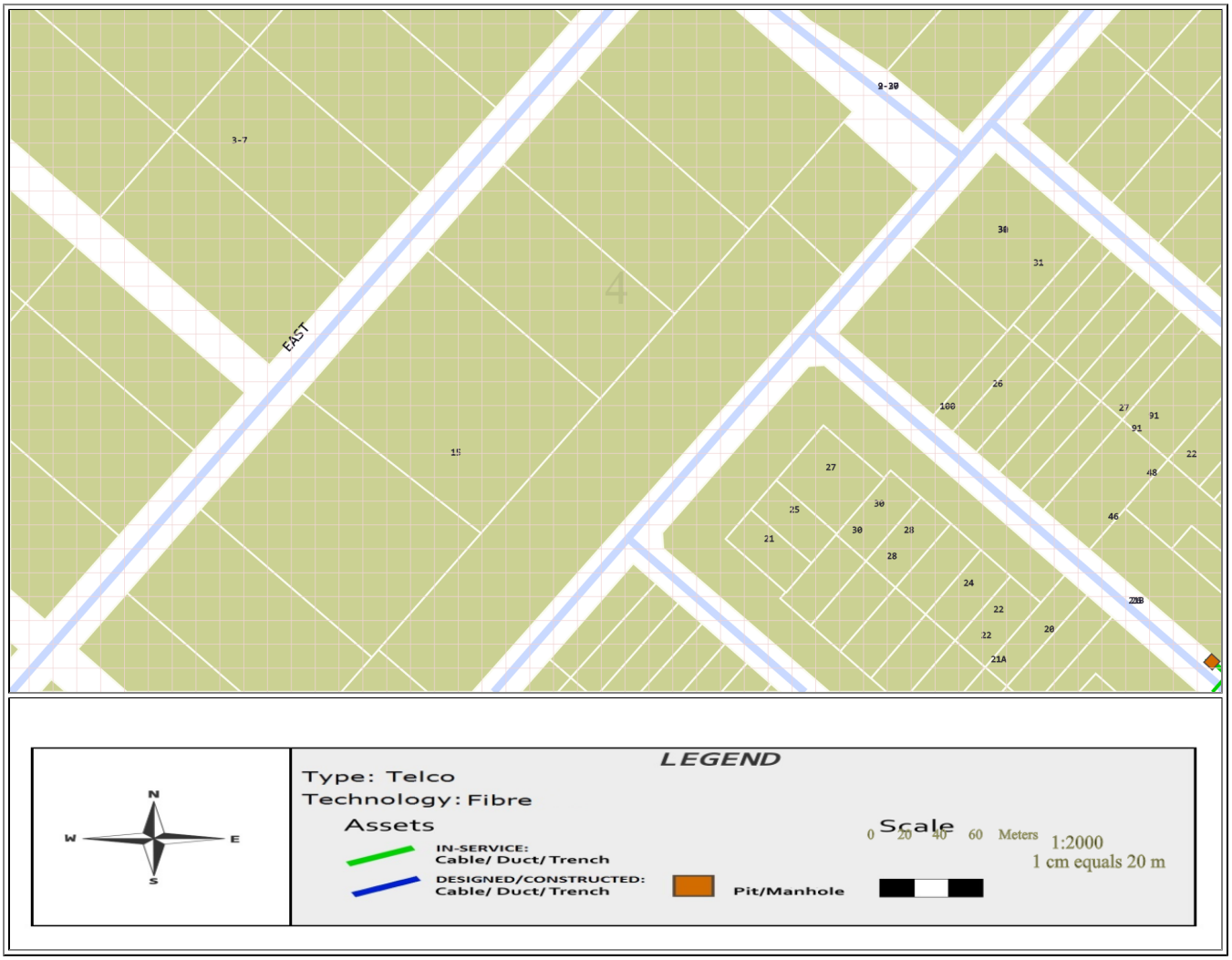
© 2015 nbn co limited | ABN 86 136 533 741



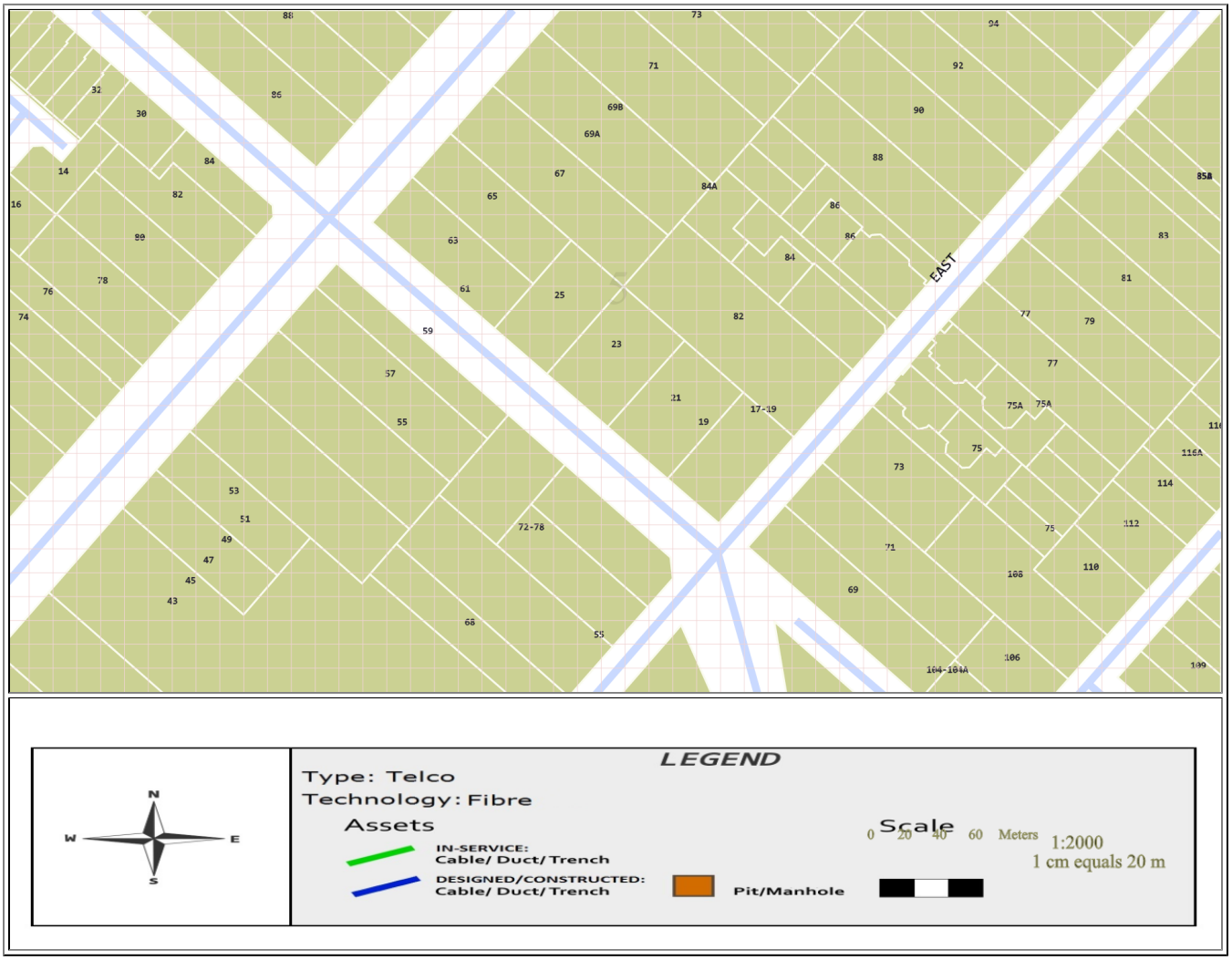
© 2015 nbn co limited | ABN 86 136 533 741
Email info@nbn.com.au Web nbn.com.au



© 2015 nbn co limited | ABN 86 136 533 741
Email info@nbn.com.au Web nbn.com.au



© 2015 nbn co limited | ABN 86 136 533 741
Email info@nbn.com.au Web nbn.com.au



© 2015 nbn co limited | ABN 86 136 533 741
Email info@nbn.com.au Web nbn.com.au



LEGEND

Type: Telco

Technology: Fibre

Assets

IN-SERVICE:
Cable/ Duct/ Trench

DESIGNED/CONSTRUCTED:
Cable/ Duct/ Trench

Pit/Manhole

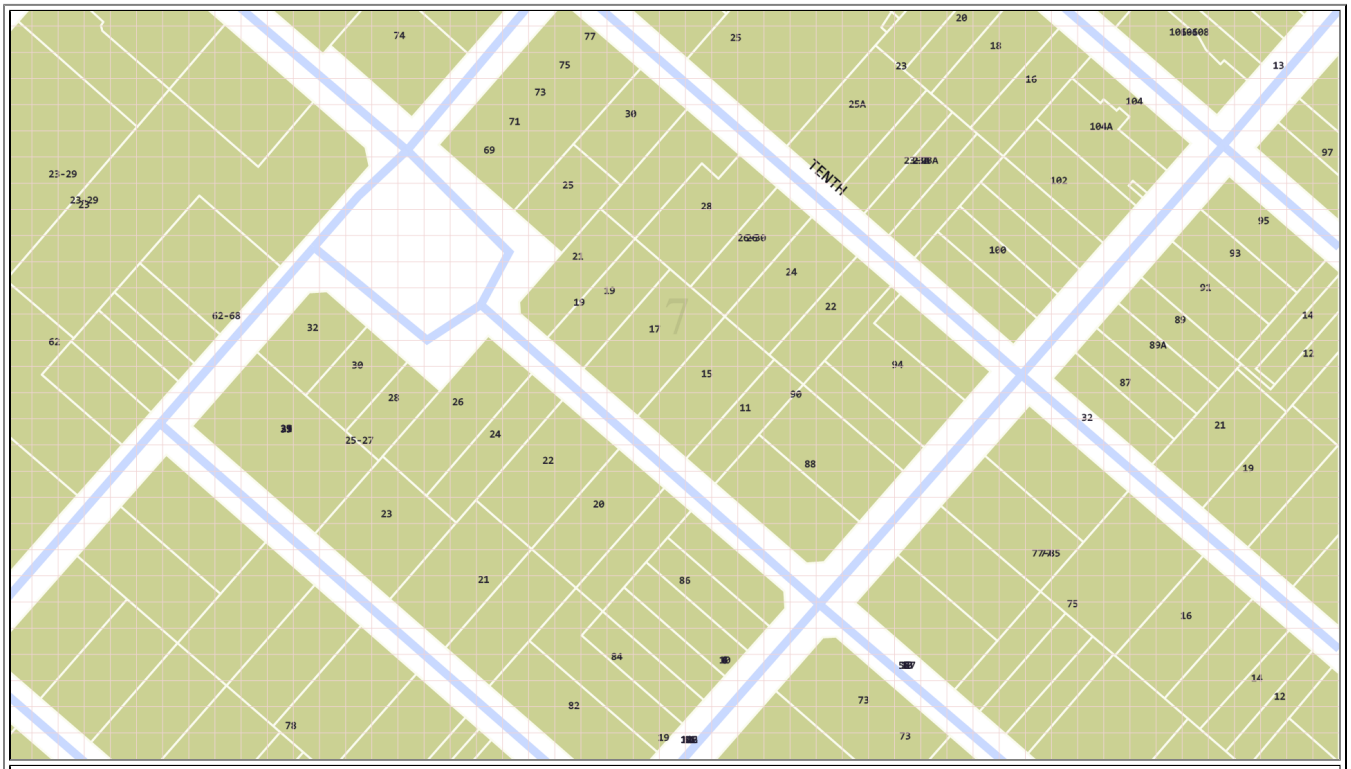
Scale

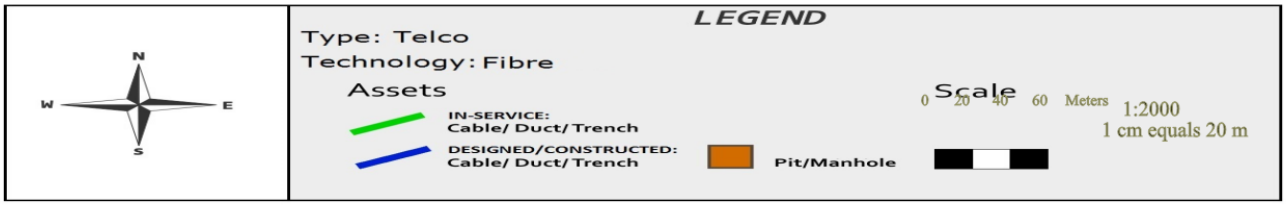
0 20 40 60 Meters

1:2000

1 cm equals 20 m

© 2015 nbn co limited | ABN 86 136 533 741





© 2015 nbn co limited | ABN 86 136 533 741
Email info@nbn.com.au Web nbn.com.au

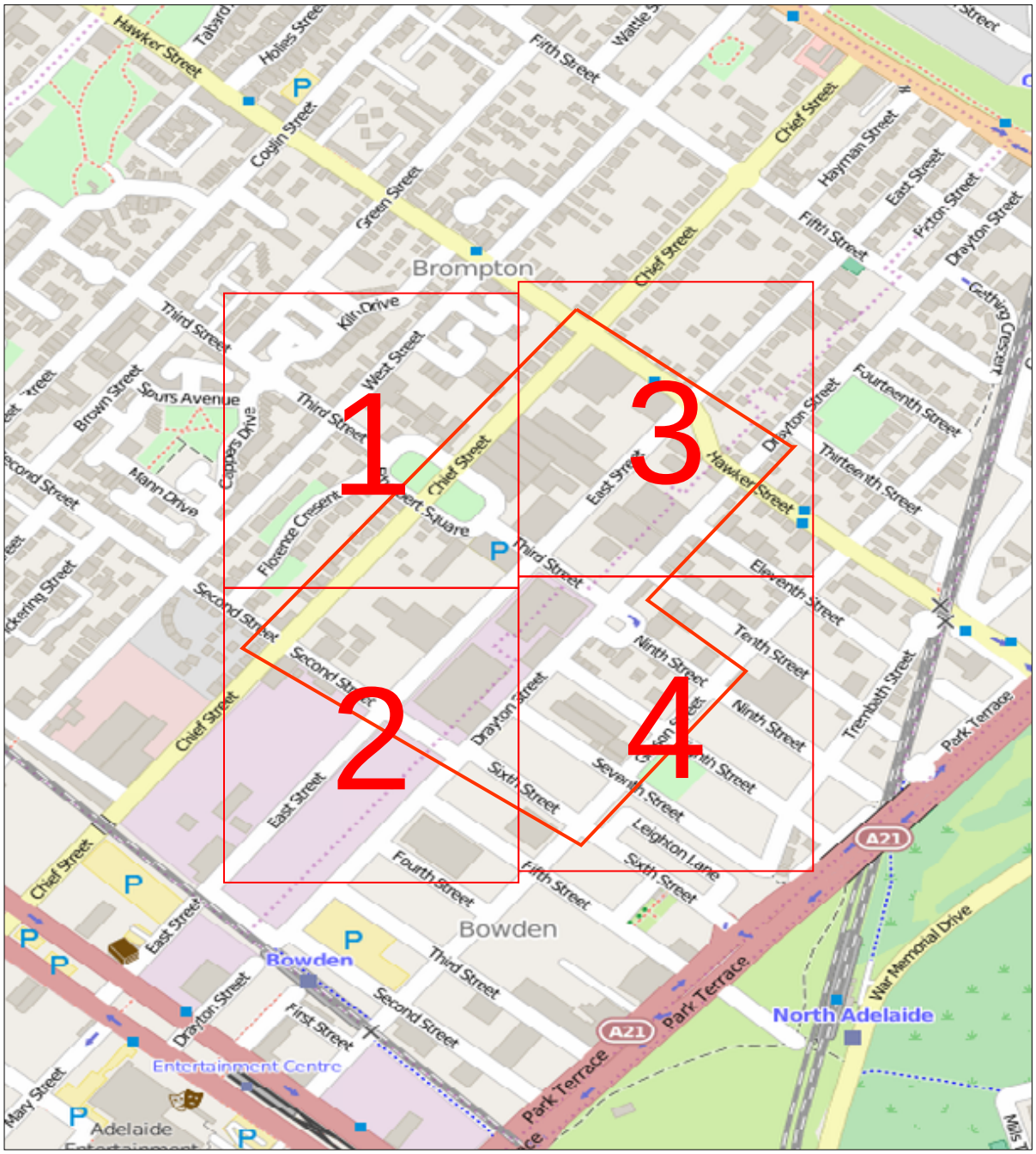


Emergency Contacts

You must immediately report any damage to **nbn™** network that you are/become aware of. Notification may be by telephone - 1800 626 329.

© 2015 nbn co limited | ABN 86 136 533 741

Site Address	Chief Street Brompton 5007	**Sequence No**	65303460
Name	Ms Rosie Vakasilimi		
Email	rosie.vakasilimi@fyfe.com.au		



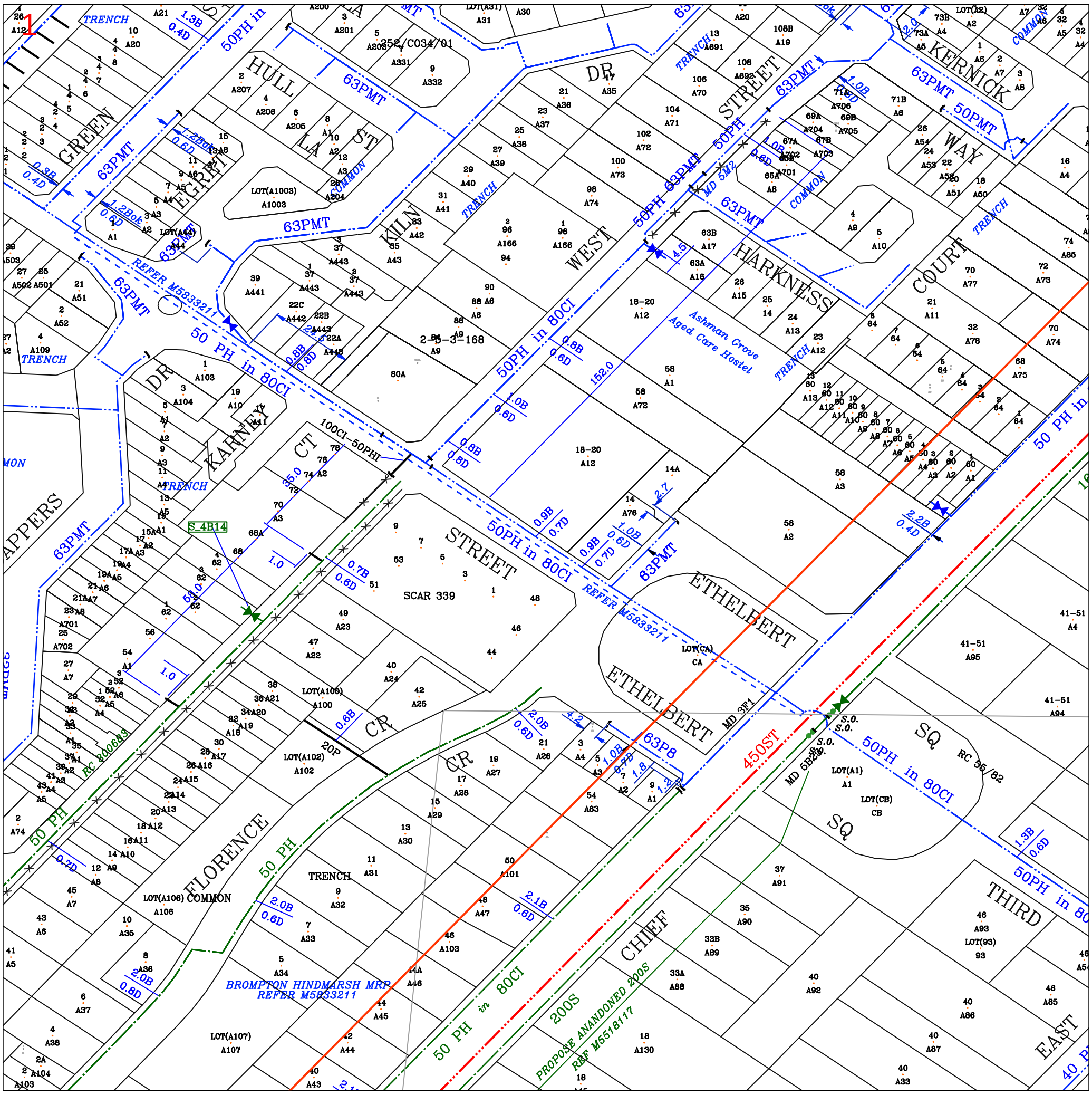
Scale 1: 6000	NORTH	Enquiry Area Map Key Area

DIAL BEFORE YOU DIG www.1100.com.au The Essential First Step

operated by apa

Site Address	Chief Street Brompton 5007	**Sequence No**	65303460
Email	rosie.vakasilimi@fyfe.com.au	**Map Reference**	UbdAde 105M16,105N15,105N16,105P15,105P16,117M1,117N1,117N2

Before you commence any works you are required to complete the attached 'Work In The Vicinity Of Critical Gas Assets' request form and forward this to APA asap



ITEM	SYMBOL	TERMS	ITEM	SYMBOL
LOW PRESSURE 1.2 - 1.7kPa		B = BOUNDARY	DIAL BEFORE YOU DIG REQUESTED AREA	
MEDIUM PRESSURE 35 - 100kPa		D = DEPTH	PRIORITY MAIN COVERAGE	
HIGH PRESSURE 70 - 350kPa		Bok = BACK OF KERB		
TRANSMISSION PRESSURE 900 - 15000kPa		Fok = FRONT OF KERB		
PROPOSED MAIN (COLOUR BY PRESSURE)				
ABANDONED MAIN				

Map Key

1 3
2 4

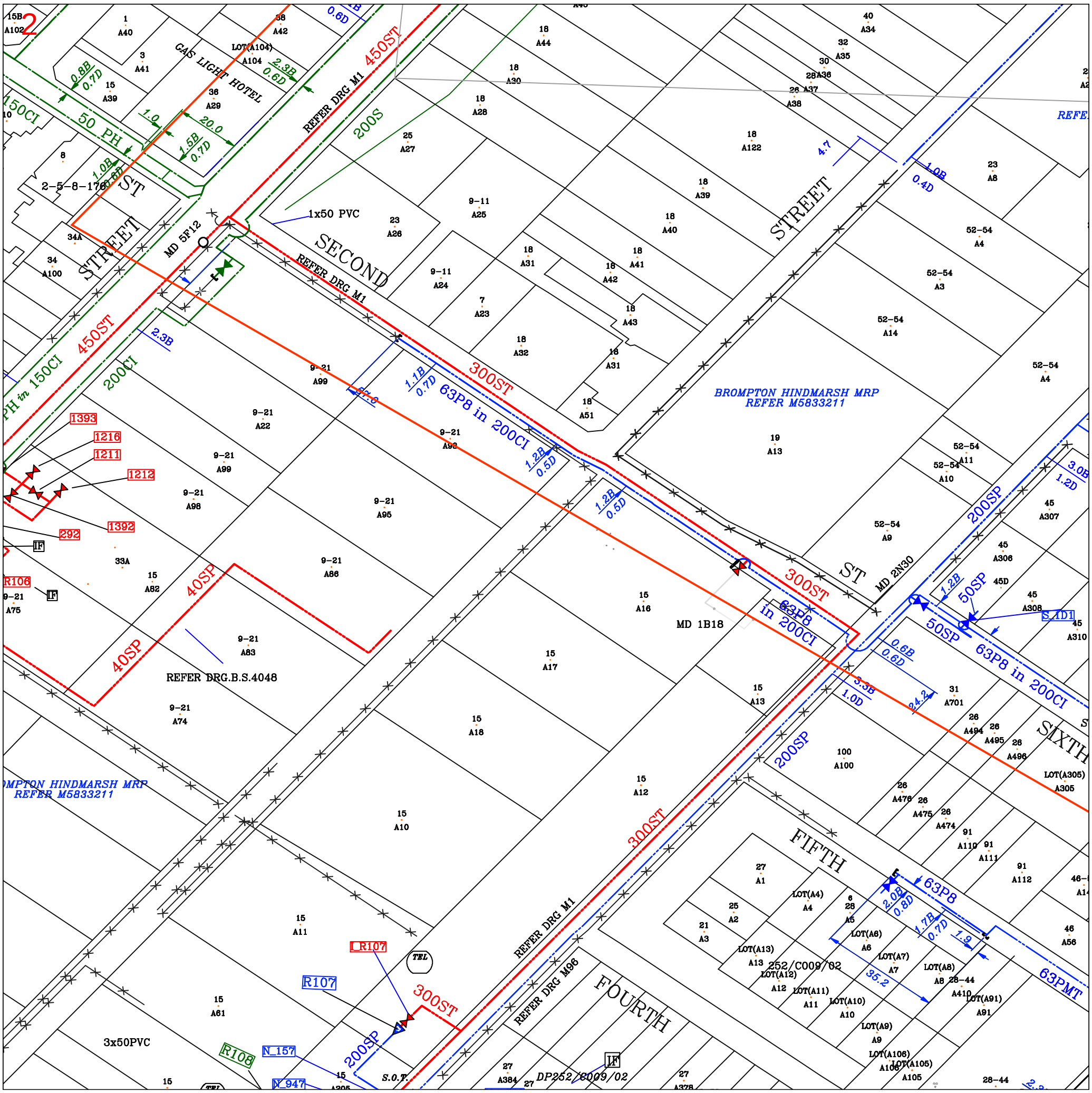
Scale 1:1000

0 0.01km

NORTH

Site Address	Chief Street Brompton 5007	**Sequence No**	65303460
Email	rosie.vakasilimi@fyfe.com.au	**Map Reference**	UbdAde 105M16,105N15,105N16,105P15,105P16,117M1,117N1,117N2

Before you commence any works you are required to complete the attached 'Work In The Vicinity Of Critical Gas Assets' request form and forward this to APA asap



ITEM	SYMBOL	TERMS	ITEM	SYMBOL
LOW PRESSURE 1.2 - 1.7kPa		B = BOUNDARY	DIAL BEFORE YOU DIG REQUESTED AREA	
MEDIUM PRESSURE 35 - 100kPa		D = DEPTH	PRIORITY MAIN COVERAGE	
HIGH PRESSURE 70 - 350kPa		Bok = BACK OF KERB		
TRANSMISSION PRESSURE 900 - 15000kPa		Fok = FRONT OF KERB		
PROPOSED MAIN (COLOUR BY PRESSURE)				
ABANDONED MAIN				

Map Key

1 3
2 4

Scale 1:1000

0 0.01km

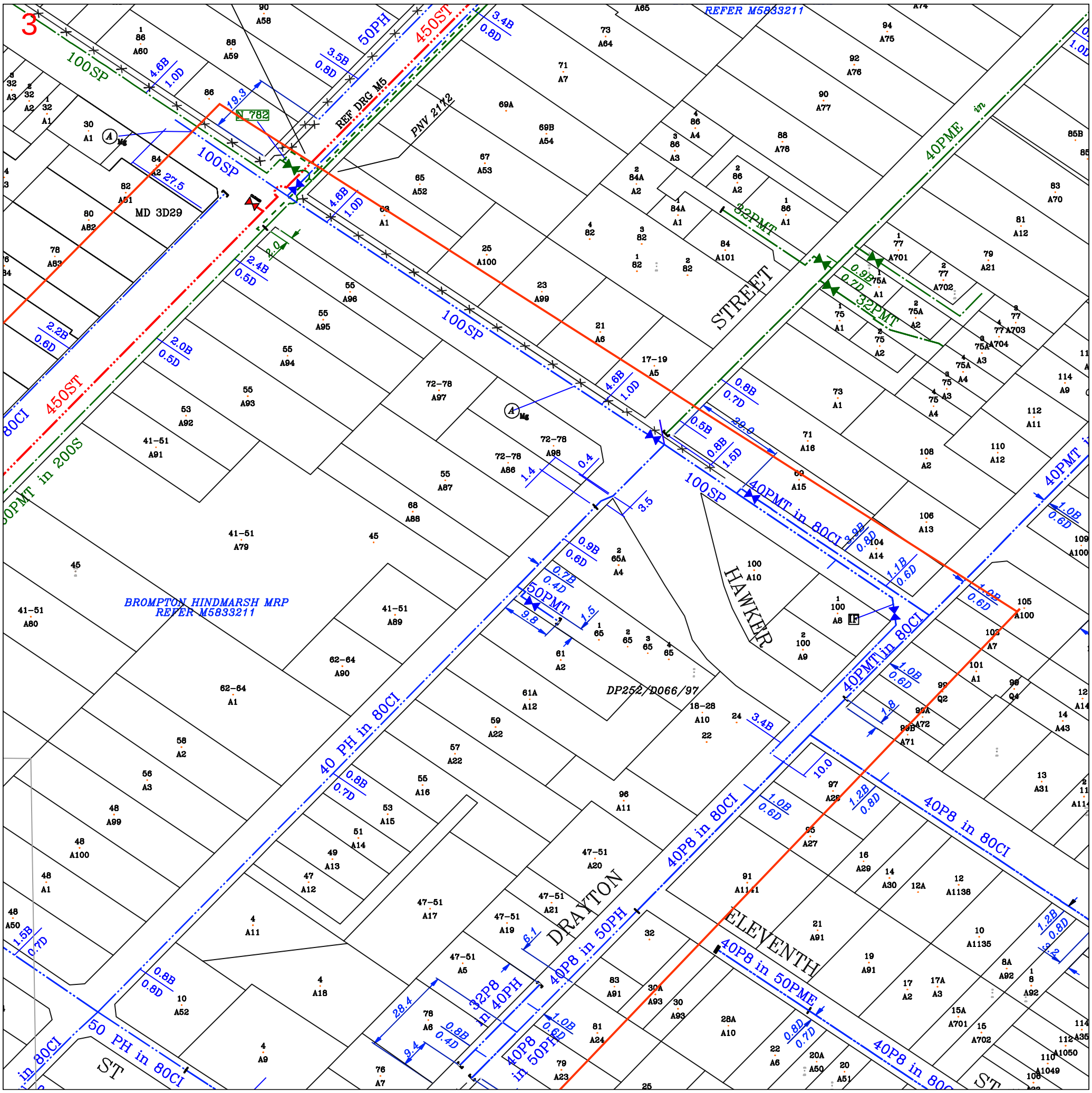
NORTH

DIAL BEFORE YOU DIG www.1100.com.au The Essential First Step

operated by apa

Site Address	Chief Street Brompton 5007	**Sequence No**	65303460
Email	rosie.vakasilimi@fyfe.com.au	**Map Reference**	UbdAde 105M16,105N15,105N16,105P15,105P16,117M1,117N1,117N2

Before you commence any works you are required to complete the attached 'Work In The Vicinity Of Critical Gas Assets' request form and forward this to APA asap



ITEM	SYMBOL	TERMS	ITEM	SYMBOL
LOW PRESSURE 1.2 - 1.7kPa		B = BOUNDARY	DIAL BEFORE YOU DIG REQUESTED AREA	
MEDIUM PRESSURE 35 - 100kPa		D = DEPTH	PRIORITY MAIN COVERAGE	
HIGH PRESSURE 70 - 350kPa		Bok = BACK OF KERB		
TRANSMISSION PRESSURE 900 - 15000kPa		Fok = FRONT OF KERB		
PROPOSED MAIN (COLOUR BY PRESSURE)				
ABANDONED MAIN				

Map Key

1	3
2	4

Scale 1:1000

0 0.01km

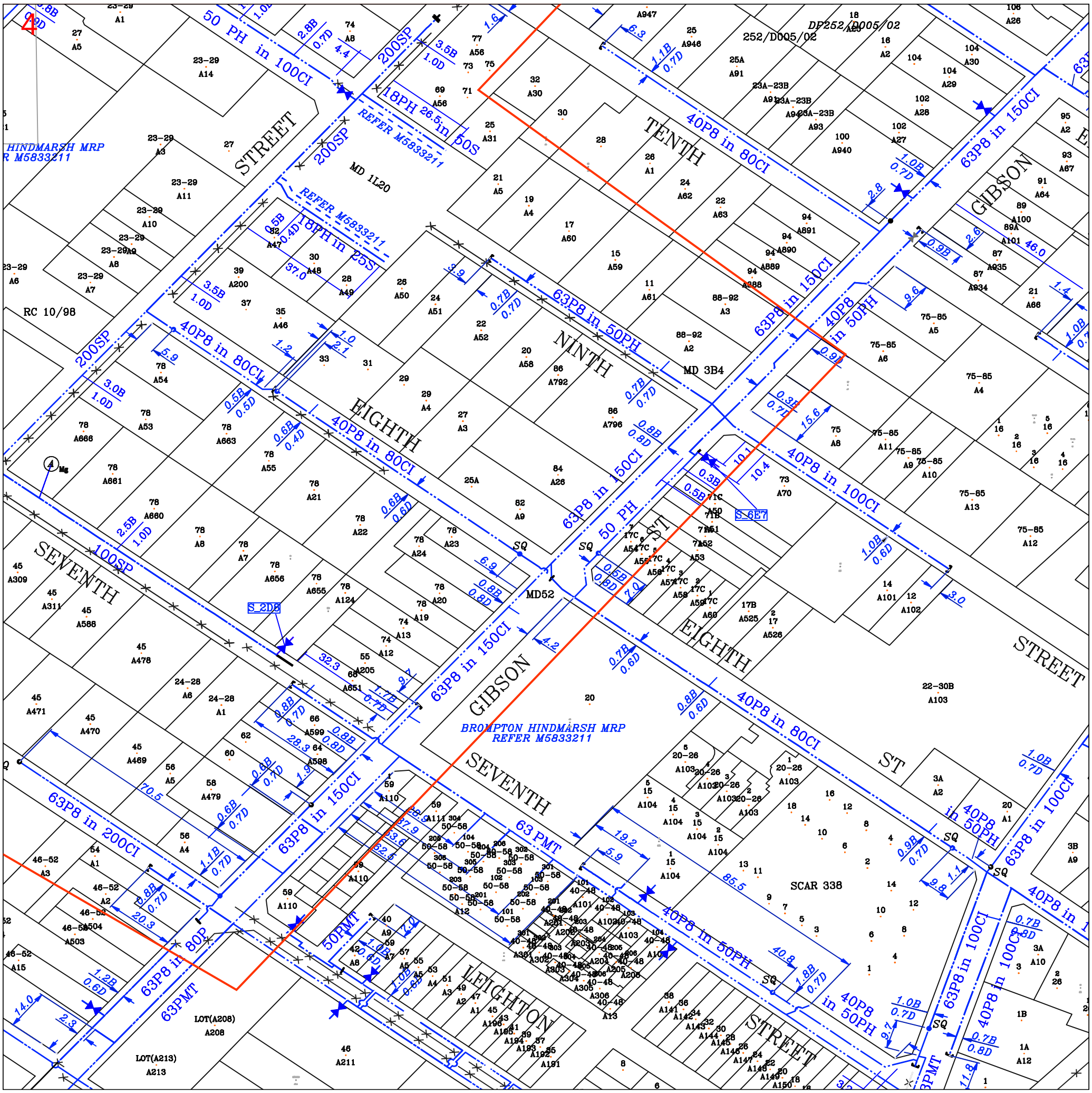
NORTH

DIAL BEFORE YOU DIG www.1100.com.au The Essential First Step

operated by apa

Site Address	Chief Street Brompton 5007	**Sequence No**	65303460
Email	rosie.vakasilimi@fyfe.com.au	**Map Reference**	UbdAde 105M16,105N15,105N16,105P15,105P16,117M1,117N1,117N2

Before you commence any works you are required to complete the attached 'Work In The Vicinity Of Critical Gas Assets' request form and forward this to APA asap



ITEM	SYMBOL	TERMS	ITEM	SYMBOL
LOW PRESSURE 1.2 - 1.7kPa		B = BOUNDARY	DIAL BEFORE YOU DIG REQUESTED AREA	
MEDIUM PRESSURE 35 - 100kPa		D = DEPTH	PRIORITY MAIN COVERAGE	
HIGH PRESSURE 70 - 350kPa		Bok = BACK OF KERB		
TRANSMISSION PRESSURE 900 - 15000kPa		Fok = FRONT OF KERB		
PROPOSED MAIN (COLOUR BY PRESSURE)				
ABANDONED MAIN				

Map Key

1 3
2 4

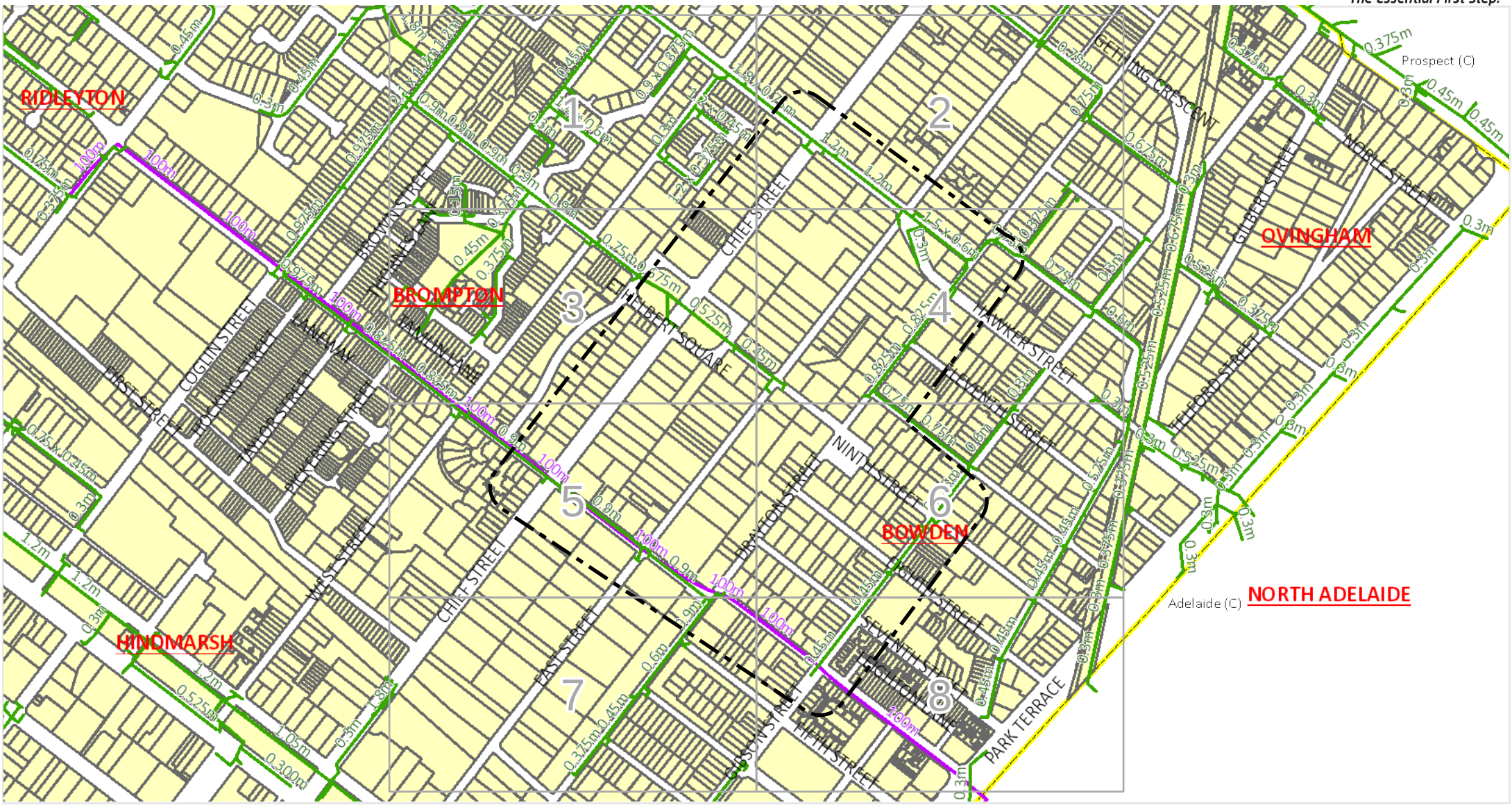
Scale 1:1000

0 0.01km

NORTH

Sequence No: 65303456
Job No: 13096100
Location: Chief Street, Brompton, SA 5007

DIAL BEFORE YOU DIG www.1100.com.au
The Essential First Step.



Legend | Scale: 1:6150 | Overview

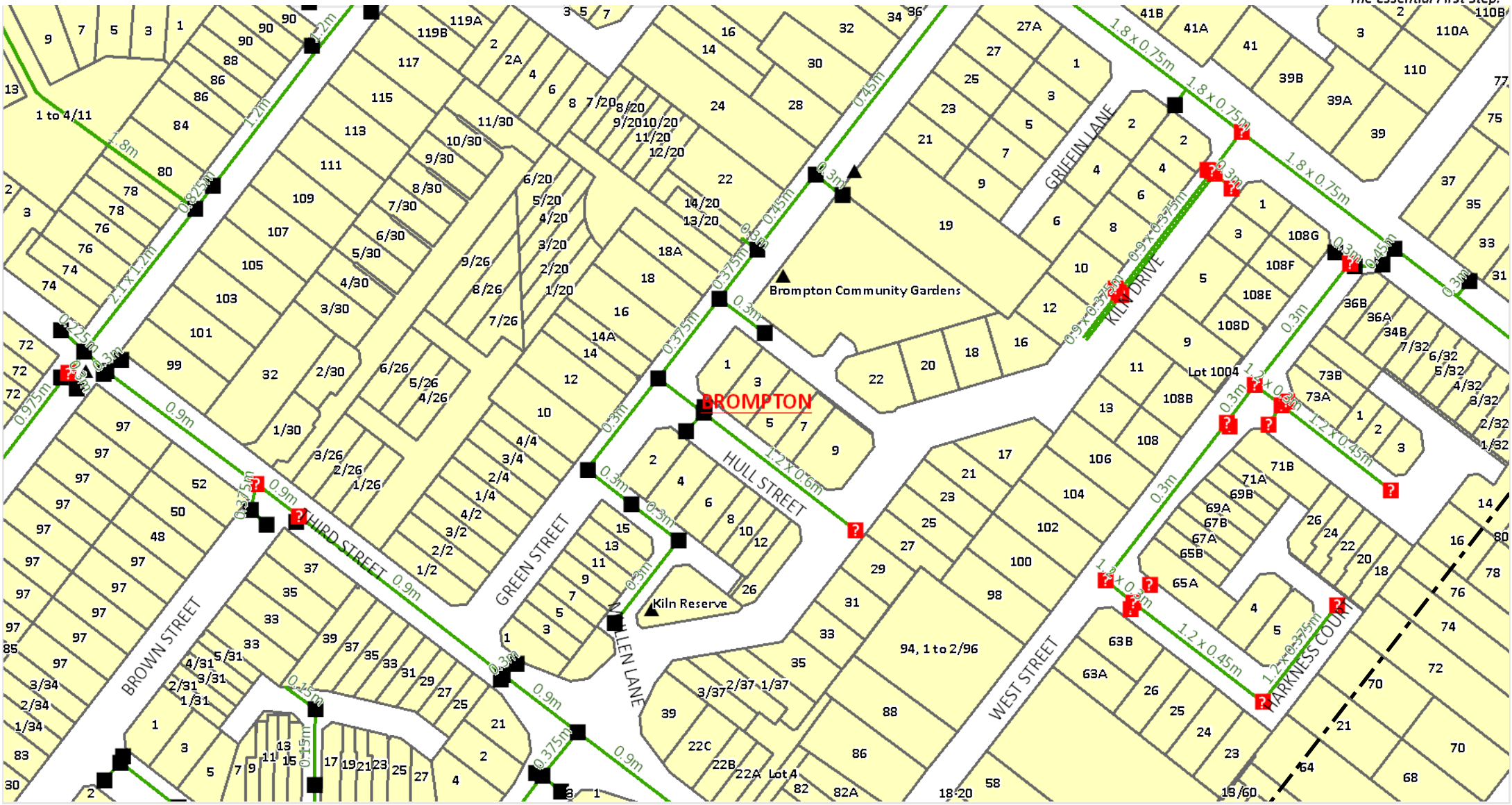
- DBYD Enquiry Area
- Stormwater Pits
- Unconfirmed Pits
- Stormwater Drains
- Gross Pollutant Trap
- Valve
- Water Meter
- RW Supply Main
- RW Supply Connection
- Communications & Electrical
- Cadastre
- Council Boundary
- State Council Boundaries

N

DISCLAIMER: While every care is taken by City of Charles Sturt to ensure the accuracy of this data, City of Charles Sturt makes no representation or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaim all responsibility and all liability (including without limitation in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which may be incurred as a result of the data being inaccurate or incomplete in any way and for any reason. **Exact positions of any assets shown on this map report should be confirmed on site.**

Sequence No: 65303456
Job No: 13096100
Location: Chief Street, Brompton, SA 5007

DIAL BEFORE YOU DIG www.1100.com.au
The Essential First Step.



Legend | Scale: 1:1500 | Tile No: 1

City of Charles Sturt

- DBYD Enquiry Area
- Stormwater Pits
- Unconfirmed Pits
- Stormwater Drains
- Gross Pollutant Trap
- Valve
- Water Meter
- RW Supply Main
- RW Supply Connection
- Communications & Electrical
- Cadastre
- Council Boundary
- State Council Boundaries

N

DISCLAIMER: While every care is taken by City of Charles Sturt to ensure the accuracy of this data, City of Charles Sturt makes no representation or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaim all responsibility and all liability (including without limitation in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which may be incurred as a result of the data being inaccurate or incomplete in any way and for any reason. **Exact positions of any assets shown on this map report should be confirmed on site.**

Sequence No: 65303456
Job No: 13096100
Location: Chief Street, Brompton, SA 5007

DIAL BEFORE YOU DIG www.1100.com.au
The Essential First Step.



Legend | Scale: 1:1500 | Tile No: 2

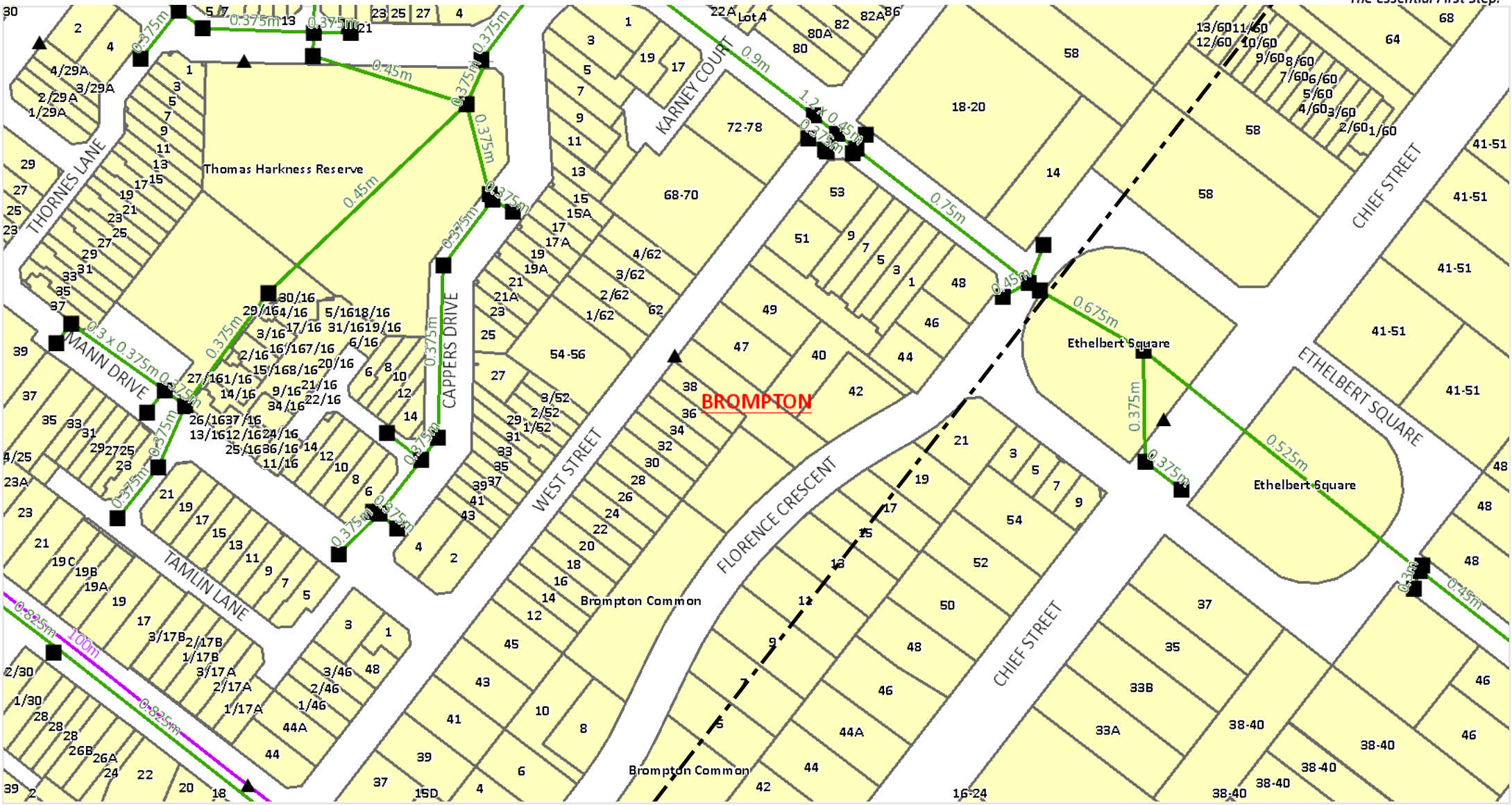
- DBYD Enquiry Area
- Stormwater Pits
- Unconfirmed Pits
- Stormwater Drains
- Gross Pollutant Trap
- Valve
- Water Meter
- RW Supply Main
- RW Supply Connection
- Communications & Electrical
- Cadastre
- Council Boundary
- State Council Boundaries

N

DISCLAIMER: While every care is taken by City of Charles Sturt to ensure the accuracy of this data, City of Charles Sturt makes no representation or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaim all responsibility and all liability (including without limitation in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which may be incurred as a result of the data being inaccurate or incomplete in any way and for any reason. **Exact positions of any assets shown on this map report should be confirmed on site.**

Sequence No: 65303456
Job No: 13096100
Location: Chief Street, Brompton, SA 5007

DIAL BEFORE YOU DIG www.1100.com.au
The Essential First Step.



Legend | Scale: 1:1500 | Tile No: 3

City of Charles Sturt

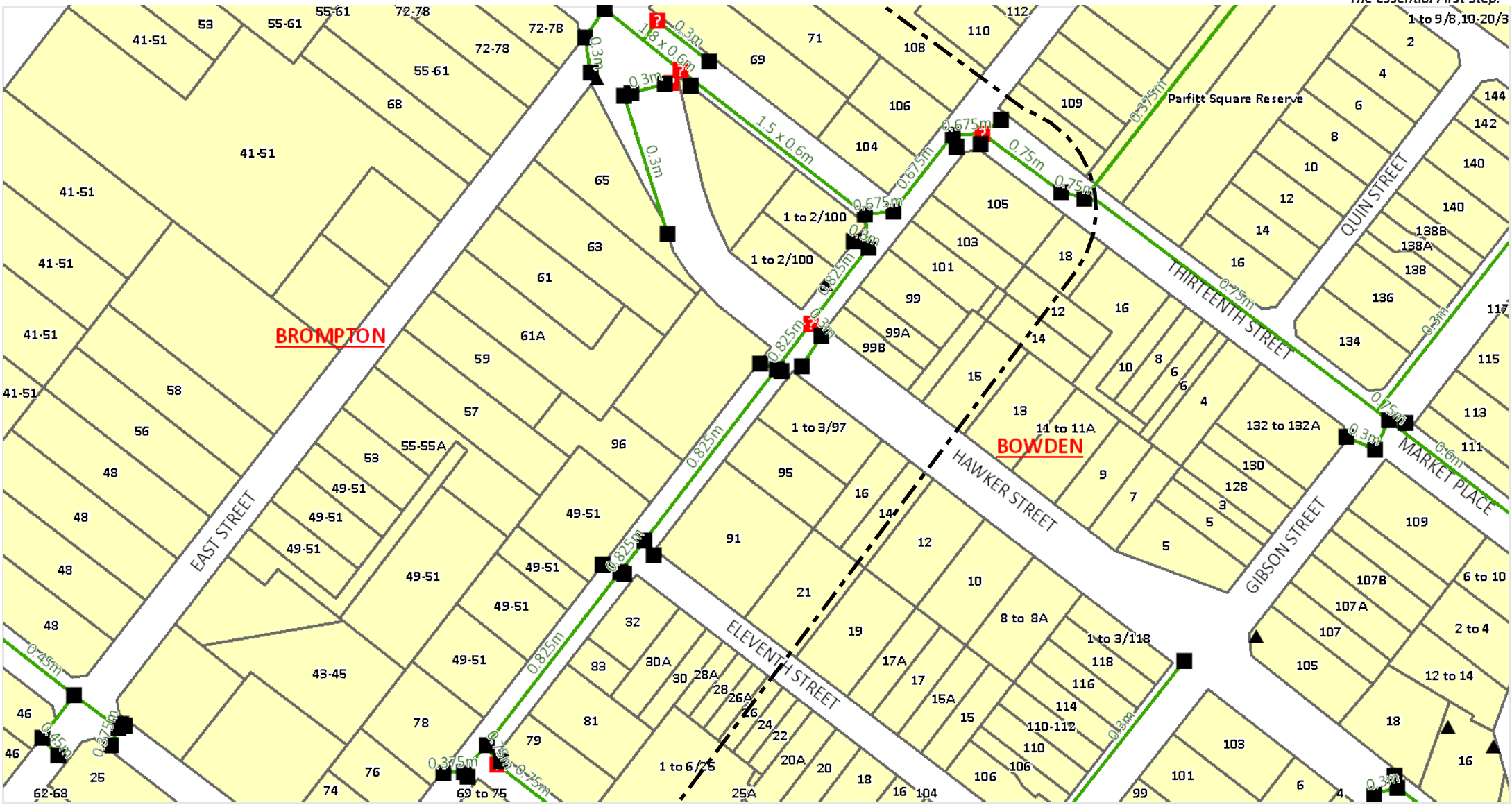
- DBYD Enquiry Area
- Stormwater Pits
- Unconfirmed Pits
- Stormwater Drains
- Gross Pollutant Trap
- Valve
- Water Meter
- RW Supply Main
- RW Supply Connection
- Communications & Electrical
- Cadastre
- Council Boundary
- State Council Boundaries

N

DISCLAIMER: While every care is taken by City of Charles Sturt to ensure the accuracy of this data, City of Charles Sturt makes no representation or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaim all responsibility and all liability (including without limitation in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which may be incurred as a result of the data being inaccurate or incomplete in any way and for any reason. **Exact positions of any assets shown on this map report should be confirmed on site.**

Sequence No: 65303456
Job No: 13096100
Location: Chief Street, Brompton, SA 5007

DIAL BEFORE YOU DIG www.1100.com.au
The Essential First Step.



Legend | Scale: 1:1500 | Tile No: 4

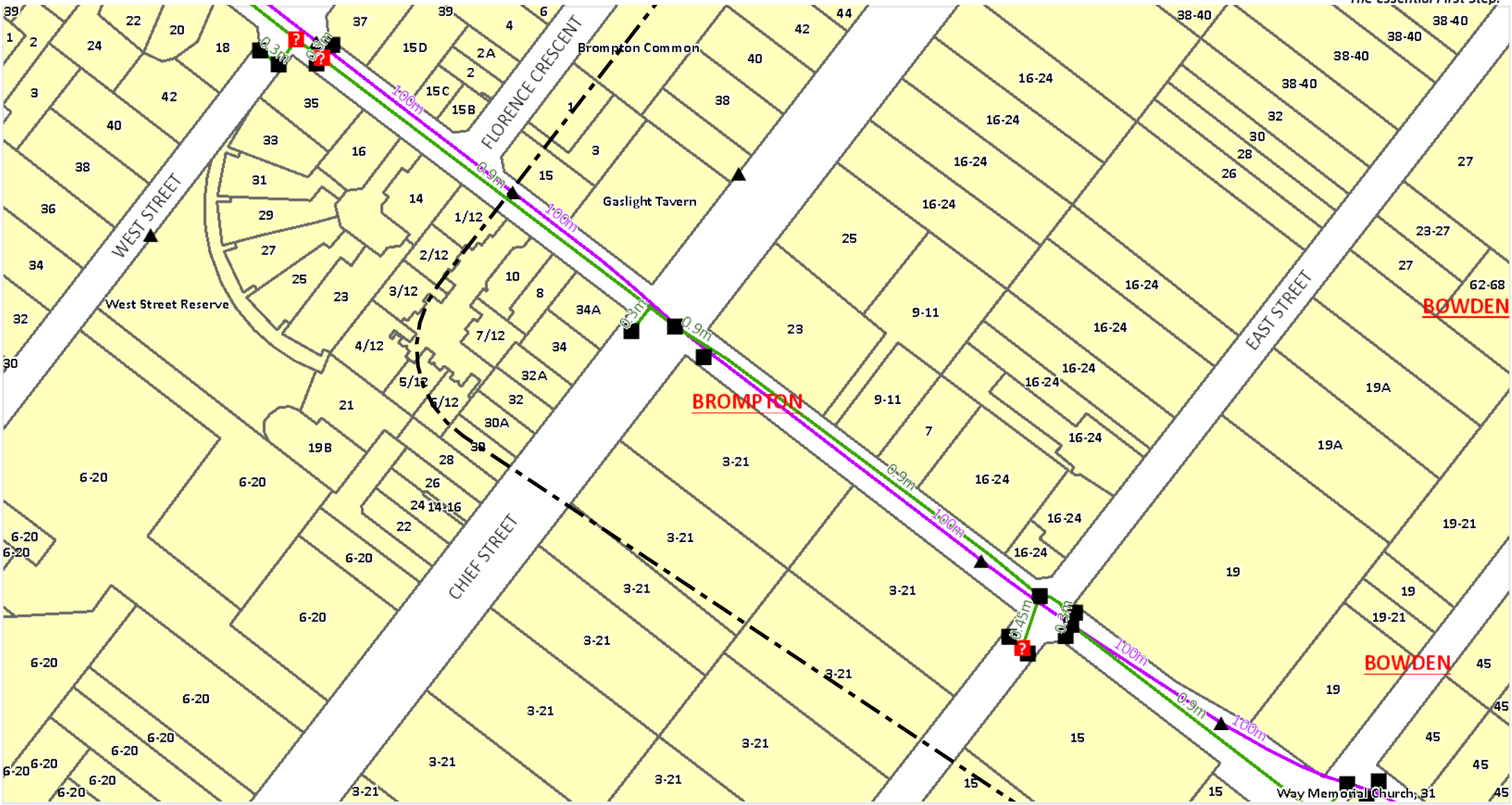
- DBYD Enquiry Area
- Stormwater Pits
- Unconfirmed Pits
- Stormwater Drains
- Gross Pollutant Trap
- Valve
- Water Meter
- RW Supply Main
- RW Supply Connection
- Communications & Electrical
- Cadastre
- Council Boundary
- State Council Boundaries

N

DISCLAIMER: While every care is taken by City of Charles Sturt to ensure the accuracy of this data, City of Charles Sturt makes no representation or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaim all responsibility and all liability (including without limitation in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which may be incurred as a result of the data being inaccurate or incomplete in any way and for any reason. **Exact positions of any assets shown on this map report should be confirmed on site.**

Sequence No: 65303456
Job No: 13096100
Location: Chief Street, Brompton, SA 5007

DIAL BEFORE YOU DIG www.1100.com.au
The Essential First Step.



Legend | Scale: 1:1500 | Tile No: 5

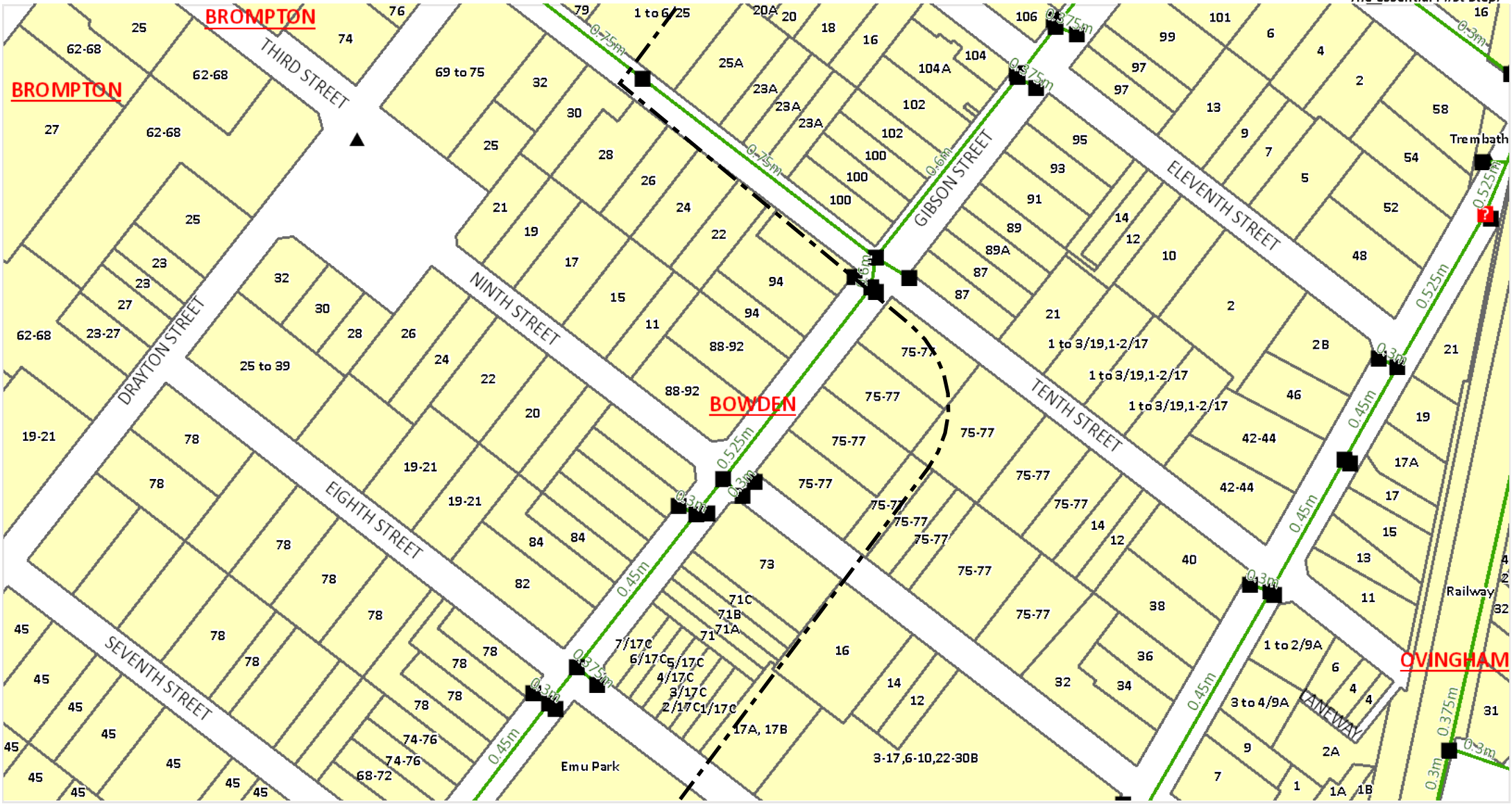
- DBYD Enquiry Area
- Stormwater Pits
- Unconfirmed Pits
- Stormwater Drains
- Gross Pollutant Trap
- Valve
- Water Meter
- RW Supply Main
- RW Supply Connection
- Communications & Electrical
- Cadastre
- Council Boundary
- State Council Boundaries

N

DISCLAIMER: While every care is taken by City of Charles Sturt to ensure the accuracy of this data, City of Charles Sturt makes no representation or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaim all responsibility and all liability (including without limitation in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which may be incurred as a result of the data being inaccurate or incomplete in any way and for any reason. **Exact positions of any assets shown on this map report should be confirmed on site.**

Sequence No: 65303456
Job No: 13096100
Location: Chief Street, Brompton, SA 5007

DIAL BEFORE YOU DIG www.1100.com.au
The Essential First Step.



Legend | Scale: 1:1500 | Tile No: 6

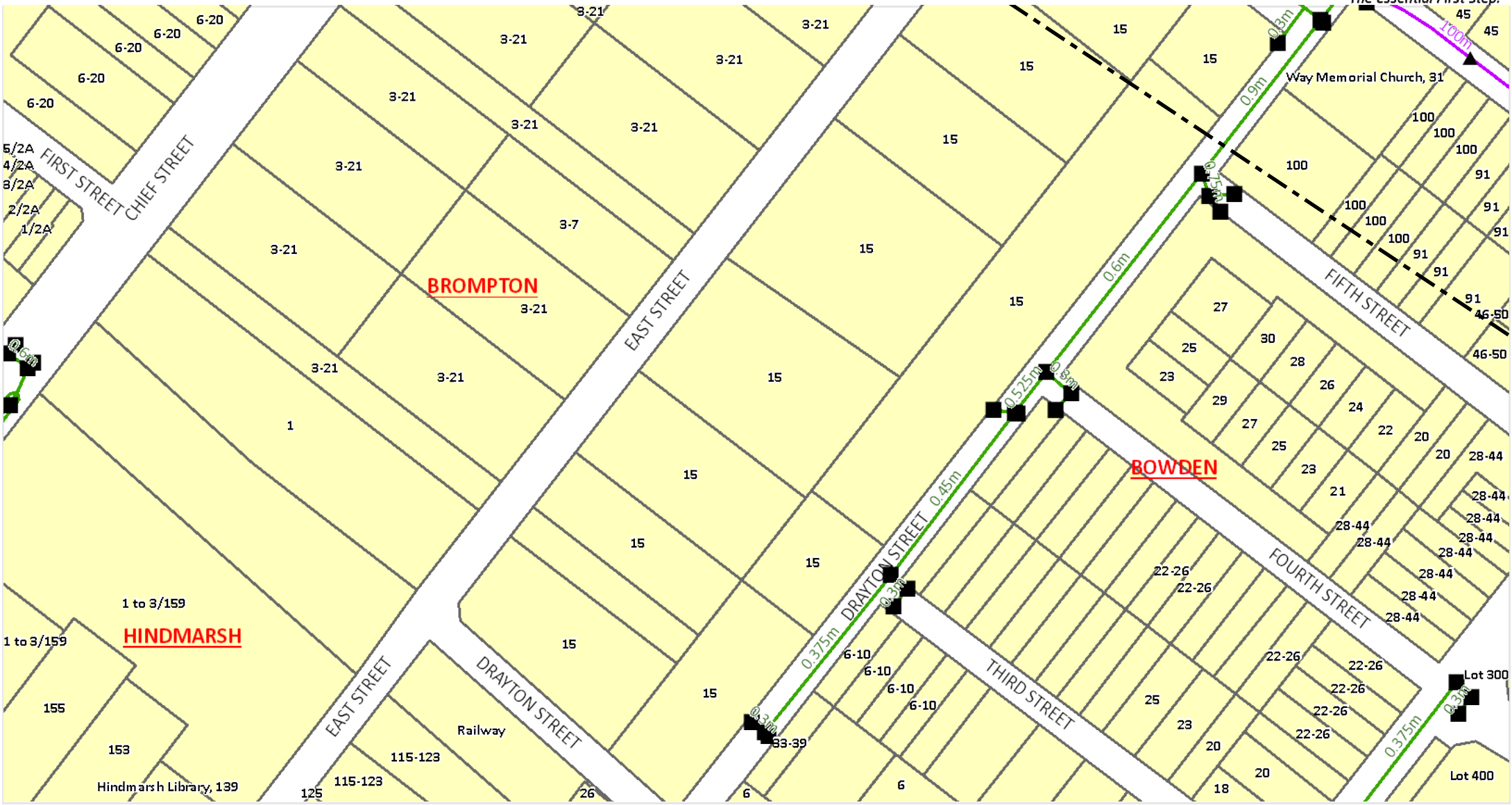
- DBYD Enquiry Area
- Stormwater Pits
- Unconfirmed Pits
- Stormwater Drains
- Gross Pollutant Trap
- Valve
- Water Meter
- RW Supply Main
- RW Supply Connection
- Communications & Electrical
- Cadastre
- Council Boundary
- State Council Boundaries

N

DISCLAIMER: While every care is taken by City of Charles Sturt to ensure the accuracy of this data, City of Charles Sturt makes no representation or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaim all responsibility and all liability (including without limitation in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which may be incurred as a result of the data being inaccurate or incomplete in any way and for any reason. **Exact positions of any assets shown on this map report should be confirmed on site.**

Sequence No: 65303456
Job No: 13096100
Location: Chief Street, Brompton, SA 5007

DIAL BEFORE YOU DIG www.1100.com.au
The Essential First Step.



Legend | Scale: 1:1500 | Tile No: 7

- DBYD Enquiry Area
- Stormwater Pits
- Unconfirmed Pits
- Stormwater Drains
- Gross Pollutant Trap
- Valve
- Water Meter
- RW Supply Main
- RW Supply Connection
- Communications & Electrical
- Cadastre
- Council Boundary
- State Council Boundaries

N

DISCLAIMER: While every care is taken by City of Charles Sturt to ensure the accuracy of this data, City of Charles Sturt makes no representation or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaim all responsibility and all liability (including without limitation in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which may be incurred as a result of the data being inaccurate or incomplete in any way and for any reason. **Exact positions of any assets shown on this map report should be confirmed on site.**

Sequence No: 65303456
Job No: 13096100
Location: Chief Street, Brompton, SA 5007

DIAL BEFORE YOU DIG www.1100.com.au
The Essential First Step.



Legend | Scale: 1:1500 | Tile No: 8

- DBYD Enquiry Area
- Stormwater Pits
- Unconfirmed Pits
- Stormwater Drains
- Gross Pollutant Trap
- Valve
- Water Meter
- RW Supply Main
- RW Supply Connection
- Communications & Electrical
- Cadastre
- Council Boundary
- State Council Boundaries

N

DISCLAIMER: While every care is taken by City of Charles Sturt to ensure the accuracy of this data, City of Charles Sturt makes no representation or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaim all responsibility and all liability (including without limitation in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which may be incurred as a result of the data being inaccurate or incomplete in any way and for any reason. **Exact positions of any assets shown on this map report should be confirmed on site.**



APPENDIX E

COMMUNITY SESSION SUMMARY

Bowden-Brompton Rezoning Proposal

Post-it Notes collected at Community Information Session – November 2017

- Enough private open space for people to hang their washing
- Widen Chief Street – allow for footpaths and outdoor seating
- Narrow Chief Street – don't widen road!
- Retain historic street pattern (Grid)
- Places for the elderly to sit – regular 'pit stops'
- Urban garden as a meeting place for people – integrated throughout the urban area – and open so the places are safe, and encourage 'share carts' to build community spirit and inclusion
- Turn Gas Light Pub into a coffee shop/café
- Fruit trees as street trees along streets
- Return Ethelbert Square in to one space
- Wide and smooth footpaths through the area – easy for walking

Survey Responses

21 October 2017 - 19 November 2017

Feedback Form

Your Say Charles Sturt

Project: Charles Sturt is investigating the rezoning of industrial land at Bowden - Brompton

engagement hq by Bang the Table

VISITORS

11

CONTRIBUTORS			RESPONSES		
4			4		
4	0	0	4	0	0
Registered	Unverified	Anonymous	Registered	Unverified	Anonymous

Respondent No: 1
Login: Sammy Tee
Email: tan_troed@hotmail.com

Responded At: Nov 13, 2017 18:40:12 pm
Last Seen: Nov 13, 2017 07:51:03 am
IP Address: 66.249.82.189

Q1. **What is your interest in this project?**
resident

Q2. **Please select your age category**
40-54

Q3. **What land uses do you consider desirable in the Study Area**
Residential
Shops, cafes and restaurants
Local parks, gardens and playgrounds

Q4. **Where in the Study Area do you think shops, offices, consulting rooms, light industry and other employment based activities should be located?**

As I live over the road from the proposed site the final outcome will affect me greatly. I am in support of residential housing but only townhouse high density style living. I am opposed to social housing as Brompton has enough. I would also like a cafe or restaurant available. I moved to this area as thought there were more cafes etc in the area. If Bowden could do something like Queen Street in Croydon that would be great. The area of Hawker/Chief could really do this.

Q5. **What additional facilities do you think may be required to support an increased number of dwellings and residents? (e.g. shops, parks)**

As per above more food places. I don"t think we need a supermarket as we have Foodland on Hawker and Plant 4 but since The Greek Taverna closed besides pubs we are limited for food choices.

Q6. **What building heights do you think are appropriate in the Study Area?**

No higher than 2 storey townhouses. Bowden has high rises but I believe this would look out of character in Brompton.

Q7. **Are there particular locations where a higher form might be more appropriate than others? If so, where?**

Not in Brompton

Q8. **What sort of public open space (e.g. local parks, play spaces, recreation, sport facilities, event spaces) would you like to see in the Study Area and where?**

We already have the square near this area so not sure another park is needed. Maybe a small green area would be good but not too large. I am opposed to a rec centre as there is a gym on Hawker St and other facilities nearby.

Q9. **Do you think the existing street network (including walking and cycling) could be improved? If so, how?**

Absolutely. The pavement along Chief Street is a disgrace. It needs an urgent upgrade. Especially opposite the proposed site. There's such nice trees on this street but the crap pavements make walking unappealing.

Q10. **What are the key assets and positive characteristics of the Study Area that you would like to see retained or enhanced?**

No light industrial for the study area. Residential townhouse style housing with some cafes or restaurants. Footpaths to be upgraded.

Q11. **Do you have other comments or ideas?**

not answered

Q12. **Do you feel the information provided was easy to understand?**	Yes
Q13. **I feel I had adequate notice to get involved with the consultation**	Strongly agree
Q14. **I was satisfied that I was provided with adequate opportunities to have my say**	Strongly agree

Q15. **How could the consultation/activity be improved?**

not answered

Respondent No: 2
Login: Sarah Lennon
Email: sarah_lennon007@hotmail.com

Responded At: Nov 13, 2017 21:21:49 pm
Last Seen: Nov 13, 2017 10:19:39 am
IP Address: 49.178.41.186

Q1. **What is your interest in this project?**
resident

Q2. **Please select your age category**
25-39

Q3. **What land uses do you consider desirable in the Study Area**
Residential
Shops, cafes and restaurants

Q4. **Where in the Study Area do you think shops, offices, consulting rooms, light industry and other employment based activities should be located?**

Chief street, Gibson Street and Hawker Street would both be fine for some commercial activity. Principally residential.

Q5. **What additional facilities do you think may be required to support an increased number of dwellings and residents? (e.g. shops, parks)**

not answered

Q6. **What building heights do you think are appropriate in the Study Area?**

Up to 6 stories, anything within 50 meters of existing residential property 3 stories, less than 20 meters from existing residential property two stories.

Q7. **Are there particular locations where a higher form might be more appropriate than others? If so, where?**

See above

Q8. **What sort of public open space (e.g. local parks, play spaces, recreation, sport facilities, event spaces) would you like to see in the Study Area and where?**

Nil, there are parks in adjoining areas, including more to come at the old gas works site.

Q9. **Do you think the existing street network (including walking and cycling) could be improved? If so, how?**

Not with one way streets, ridiculous idea that makes traffic congestion worse, greater pollution from cars having to drive around in circles. Loved by a minority group of vocal whiners.

Q10. **What are the key assets and positive characteristics of the Study Area that you would like to see retained or enhanced?**

All historic buildings, especially along Gibson street to be retained, even those is poor repair are to be retained and restored

Q11. **Do you have other comments or ideas?**

not answered

Q12. **Do you feel the information provided was easy to understand?**
Yes

Q13.	**I feel I had adequate notice to get involved with the consultation**	Agree
Q14.	**I was satisfied that I was provided with adequate opportunities to have my say**	Agree

Q15. **How could the consultation/activity be improved?**

not answered

Respondent No: 3
Login: David&Lilly
Email: davidey@hotmail.com

Responded At: Nov 15, 2017 12:34:20 pm
Last Seen: Nov 15, 2017 01:42:47 am
IP Address: 101.185.15.148

Q1. **What is your interest in this project?**

business

Q2. **Please select your age category**

55-64

Q3. **What land uses do you consider desirable in the Study Area**

Residential
Shops, cafes and restaurants
Community facilities
Local parks, gardens and playgrounds

Q4. **Where in the Study Area do you think shops, offices, consulting rooms, light industry and other employment based activities should be located?**

Along Chief and hawker only

Q5. **What additional facilities do you think may be required to support an increased number of dwellings and residents? (e.g. shops, parks)**

Car parking facilities Open space - parks, sport facilities, public art, market spaces Shops -create a village feel area Cafes, restaurants etc

Q6. **What building heights do you think are appropriate in the Study Area?**

Below what has been established in bowden - old clips also site

Q7. **Are there particular locations where a higher form might be more appropriate than others? If so, where?**

Edge only of Chief and hawker streets

Q8. **What sort of public open space (e.g. local parks, play spaces, recreation, sport facilities, event spaces) would you like to see in the Study Area and where?**

Create a corridor of green (mixed use - what you have suggested in your question eg., including wide green walk street and street parking) linking up to bowden /clipsal area / port road/robe tce.

Q9. **Do you think the existing street network (including walking and cycling) could be improved? If so, how?**

Yes. Upgrade footpaths in keeping with heritage - widen, better design with foot, car traffic, parking, greening up streets.

Q10. **What are the key assets and positive characteristics of the Study Area that you would like to see retained or enhanced?**

Creative community vibe, community gardens, continuance of greening up area, public art and sculpture, sense of history thru materials and architecture. Retain heritage shop fronts and utilize spaces.

Q11. **Do you have other comments or ideas?**

not answered

Q12.	**Do you feel the information provided was easy to understand?**	Yes
Q13.	**I feel I had adequate notice to get involved with the consultation**	Agree
Q14.	**I was satisfied that I was provided with adequate opportunities to have my say**	Unsure

Q15. **How could the consultation/activity be improved?**

Feedback on our / public feedback

Respondent No: 4
Login: nathanadams
Email: info@nathanadams.net

Responded At: Nov 16, 2017 13:01:25 pm
Last Seen: Nov 16, 2017 02:10:58 am
IP Address: 150.101.54.174

Q1. **What is your interest in this project?**

resident

Q2. **Please select your age category**

25-39

Q3. **What land uses do you consider desirable in the Study Area**

Residential
Shops, cafes and restaurants
Offices
Consulting rooms (e.g. doctor's surgery)
Light industry and other employment based activities
Community facilities
Local parks, gardens and playgrounds

Q4. **Where in the Study Area do you think shops, offices, consulting rooms, light industry and other employment based activities should be located?**

Mixed across the study area, but with a higher concentration near Hawker Street and Second Street

Q5. **What additional facilities do you think may be required to support an increased number of dwellings and residents? (e.g. shops, parks)**

not answered

Q6. **What building heights do you think are appropriate in the Study Area?**

Similar densities to stage one of the Bowden development, 2-4 levels across most of the study area, with some locations with a further increase.

Q7. **Are there particular locations where a higher form might be more appropriate than others? If so, where?**

Adjoining the Bowden development and also along Chief St

Q8. **What sort of public open space (e.g. local parks, play spaces, recreation, sport facilities, event spaces) would you like to see in the Study Area and where?**

Mix of different parks and play spaces, so that there is a variety of facilities, and different play spaces for kids of varying ages,

Q9. **Do you think the existing street network (including walking and cycling) could be improved? If so, how?**

On street parking on many of the streets in the study area make them tight to navigate, and many of the footpaths are narrow. The current proposal of one way streets will make this easier to address.

Q10. **What are the key assets and positive characteristics of the Study Area that you would like to see retained or enhanced?**

Maintain some industrial buildings for adaptive reuse to help add character to the area

Q11. **Do you have other comments or ideas?**

The area should complement the Bowden development, and act as a bridge of the urban form between that and the surrounding "older" areas of Brompton and Bowden. I think it's important that some around the clock activity is maintained (through shops, cafes, and even light manufacturing - such as furniture makers or micro-breweries), in contrast to the residential only areas surrounding.

Q12. **Do you feel the information provided was easy to understand?**	Yes
Q13. **I feel I had adequate notice to get involved with the consultation**	Agree
Q14. **I was satisfied that I was provided with adequate opportunities to have my say**	Agree

Q15. **How could the consultation/activity be improved?**

not answered



APPENDIX F

EXAMPLE SURVEY

Bowden-Brompton Rezoning Proposal – Feeback Form

The City of Charles Sturt is undertaking preliminary investigations into the rezoning of land at Bowden-Brompton from industry to a mix of residential and commercial. We invite your views and ideas at this early stage of the investigations process. Community feedback will inform the drafting of the Development Plan Amendment.

Have Your Say!

To provide your feedback please complete the Feedback Form online at https://www.yoursaycharlessturt.com.au

Alternatively send your Feedback Form to Council by dropping it into the Civic Centre at 72 Woodville Rd, Woodville or Hindmarsh Library at 139 Port Road, Hindmarsh; posting it to City of Charles Sturt, PO Box 1, Woodville SA 5011, or emailing it to ghouse@charlessturt.sa.gov.au

Feedback is due **by Friday 8 December 2017**

Your Details

Please provide your name and address should we need to contact you regarding your feedback *(By completing this form, you consent to the City of Charles Sturt collecting, retaining and using the personal information provided by you in line with Council's Privacy Policy)*

Name: _____

(Mr/Mrs/Miss/Ms/Dr) *(First Name)* *(Surname)*

Address: _____

Email: _____

Phone: _____

Business Owner / Home Owner / Tenant _____

Age Category

❑ Under 18 ❑ 18-24 ❑ 25-39 ❑ 40-54 ❑ 55-64 ❑ 65 plus

Council's emailed newsletter

Would you like to receive Council's Diamond Bytes emailed newsletter to be kept up to date with activities and projects within the City? ❑ Yes ❑ No (Please provide your email address above)

City of Charles Sturt 72 Woodville Road, Woodville, South Australia 5011 **T** 08 8408 1111 **F** 08 8408 1122 **www**.charlessturt.sa.gov.au

Your Feedback

1. **What land uses do you consider desirable in the Study Area? (tick desirable land uses)**

   - ❑ Residential
   - ❑ Shops, cafes and restaurants
   - ❑ Offices
   - ❑ Consulting rooms (e.g. doctor's surgery)
   - ❑ Light industry and other employment based activities
   - ❑ Community facilities
   - ❑ Local parks, gardens and playgrounds
   - ❑ Other (please specify)

   _____

2. **Where in the Study Area do you think shops, offices, consulting rooms, light industry and other employment based activities should be located?**

   _____

   _____

   _____

3. **What additional facilities do you think may be required to support an increased number of dwellings and residents? (e.g. shops, parks)**

   _____

   _____

   _____

4. **What building heights do you think are appropriate in the Study Area?**

   _____

   _____

5. **Are there particular locations where a higher form might be more appropriate than others? If so, where?**

   _____

   _____

   _____

6. **What sort of public open space (e.g. local parks, play spaces, recreation, sport facilities, event spaces) would you like to see in the Study Area and where?**

   _____

   _____

7. **Do you think the existing street network (including walking and cycling) could be improved? If so, how?**

_____

_____

8. **What are the key assets and positive characteristics of the Study Area that you would like to see retained or enhanced?**

_____

_____

_____

9. **Do you have any other comments or ideas?**

_____

_____

_____

Consultation Process

We appreciate the time you have taken to complete this feedback form. In order to continuously improve our consultation processes, it would be appreciated if the following questions are completed:

a) Do you feel the information provided was easy to understand?

❑ Yes ❑ No

Please explain why/why not

_____

_____

_____

b) I feel I had adequate notice to get involved with the consultation

❑ Strongly Agree ❑ Agree ❑ Unsure ❑ Disagree ❑ Strongly disagree

c) I was satisfied that I was provided with adequate opportunities to have my say

❑ Strongly Agree ❑ Agree ❑ Unsure ❑ Disagree ❑ Strongly disagree

d) How could the consultation/activity be improved?

_____

_____

_____

Bowden-Brompton Study Area

The City of Charles Sturt is undertaking preliminary investigations into the rezoning of land at Bowden-Brompton from industry to a mix of residential and commercial. The Study Area is defined on the map below.





APPENDIX G

"MAP YOUR IDEAS" SUBMISSIONS

Contents of Feedback

This Section provides a summary of feedback received for all questions. Additional commentary is provided where relevant to include comments pinned via the "Map Your Ideas" tool.

Question 1: What land uses do you consider desirable in the Study Area?

Question 1 was a multi-option question. Responses to Question 1 are reproduced in Table 4.1 below.

Table 6.1 Comments Received – Survey – Question 1 (online + hard copies)

Question 1 What land uses do you consider desirable in the Study Area	Number
Residential	20
Shops cafes and restaurants	18
Offices	11
Consulting rooms eg doctors surgery	13
Light industry and other employment based activities	6
Community facilities	15
Local parks gardens and playgrounds	17

It is evident that the highest level of response (above 80%) was given to:

- Residential;
- Shops, cafes and restaurants; and
- Local parks, gardens and playgrounds.

In excess of 50% of respondents also selected consulting rooms, offices and community facilities.

It is evident that the lowest level of response was given to:

- Light industry and other employment based activities.

People who attended the Community Session generally agreed with the overall vision for the area (i.e. change of zoning to allow for residential mixed uses, rather than industry).

Question 2: Where in the Study Area do you think shops, offices, consulting rooms, light industry and other employment based activities should be located?

Hawker Street, subject to parking and public transport opportunities and Chief Street were the main suggested locations, particularly Ethelbert Square or the corner of Hawker and Chief streets, and the existing Centre Zone. It is noted that one submission considered that Chief Street should not be identified for shops or similar non-residential uses.

Gibson Street, Drayton Street, Second Street, and the Port Road end of the Study Area were all mentioned once in various submissions. It was mentioned in some submissions that appropriate areas were those that were easily accessible via public transport and private vehicles (i.e. larger roads).

As discussed above, only few submissions (3) considered light industry to be appropriate.

One submission suggested that employment based activities could be provided across the Study Area at ground level.

Question 3: What additional facilities do you think may be required to support an increased number of dwellings and residents? (e.g. shops, parks)

Facilities that were proposed are listed below:

- Shops (small scale) particularly food/pubs/cafés and convenience retail;
- Community gathering areas;
- Community facilities including sheds, gardens, shared storage etc;
- Amphitheatre (outdoor);
- Green spaces, open spaces, public art, market areas, sport facilities;
- Small/home business opportunities; and
- Shopping centre (one occurrence).

Some submissions suggested a town square concept similar to Bowden, as well as a Village feel, and generally, children/family friendly environments.

This question also raised comments in relation to a need for improved networks and movements:

- Increased public transport;
- Bicycle lanes;
- Walking connections; and
- Car parking facility.

Question 4: What building heights do you think are appropriate in the Study Area?

Very different responses were received for this question, with some submissions considering that two storeys should be the limit in most of the Study Area, while others considered that densities up to 4 or 6 storeys would be appropriate. The minimum height mentioned is 1 storey. The maximum height mentioned is 10 storeys.

Only a few submissions provided definite and categorical responses to this question (i.e. one maximum height for the whole of the Study Area). These responses are as follows:

- 1 storey (1 submission);
- 2 storeys (3 submissions);

- 3 storeys (1 submission);
- 8 storeys (1 submission); and
- 7-10 storeys (1 submission).

A majority of submissions, however, identified different heights for different portions of the Study Area. This is detailed in Table 4.2 below.

Table 6.2 Preferred Heights by Location

Height	2 storeys	3 storeys	4 storeys	5 storeys	6 storeys
Potential Location	Adjacent existing residential areas Adjacent heritage Within 20 metres of existing residential Along Chief and Hawker Drayton Street Main roads	Within 50 metres of existing residential Western side of Drayton Street	Narrow streets	Park Terrace Port Road	Generally (except within 50 metres of existing residential) For commercial/ business uses

While Bowden style high density developments is considered to be "out of character in Brompton" by one submission, it was considered by a number of respondents that the Study Area warranted higher densities due to the Bowden precedence and its location (close to the City). Generally feedback received suggests that there could be a transition from lower densities near existing lower density residential areas, to higher densities closer to Bowden, with 4-5 storeys the preferred maximum.

Potential issues about heights were also identified:

- Overlooking and loss of privacy;
- Lack of 'horizon sightlines'; and
- Overshadowing (including of open space).

Question 5: Are there particular locations where a higher form might be more appropriate than others? If so, where?

Responses included:

- Port Road;
- Park Terrace;
- Eastern side of East Street;
- Chief Street;

- Hawker Street;
- Second Street;
- Third Street;
- Adjacent Bowden development;
- Surrounding open space;
- Along railway line; and
- Away from shops.

This can be summarised as the edges (or surrounds) of the Study Area and areas adjacent the Bowden development. However a limited number of submissions also suggested that higher forms should be established in the centre of the Study Area (i.e. not directly adjacent existing residential).

Question 6: What sort of public open space (e.g. local parks, play spaces, recreation, sport facilities, event spaces) would you like to see in the Study Area and where?

- A majority of submissions considered that additional open space should be provided in the following forms:
- Smaller pocket parks (comparable to Emu Park);
- Play spaces for children;
- Seating, picnic, green meeting areas and community event spaces;
- Sporting activities (basketball courts, lawn bowls);
- 'Urban garden'; and
- More planting, trees and shade.

A couple of submissions were against additional sporting uses.

The following locations were suggested for additional open space:

- Centre of the Study Area;
- Western border of the Study Area;
- Ethelbert Square (for more sporting uses);
- Existing reserve Drayton/Ninth Street could be linked with more open space:
- One in western portion of Study Area (former Precinct 26) and one in western portion of Study Area (former Precinct 25);
- Corner of East and Second streets; and
- Second Street.

A limited number of submissions (approximately 4), considered that little or no open space was needed in the area, with Ethelbert Square and a variety of parks and play spaces already established or being planned in the wider area. Existing parks and facilities (e.g. community centres, gardens) could be used and intensified with additional resources. Ethelbert Square was suggested for sporting uses e.g. basketball court, lawn bowl, and playground.

Generally it was suggested that Ethelbert Square should be improved.

A number of submissions also mentioned the following:

- Greening along streets and buildings, including fruit trees;
- Seating including 'pit stops' for elderly people along streets; and
- Creating green, walking and cycling connections within and out of the Study Area.

Question 7: Do you think the existing street network (including walking and cycling) could be improved? If so, how?

It was considered by most submissions that:

- There are current traffic issues across the Study Area;
- These have been intensified by the Bowden redevelopment;
- These are likely to be intensified by the subject development unless appropriately considered.
- Key issues include:
    - Peak time traffic;
    - On-street parking/lack of off-street car parking;
    - Poor walking and cycling amenity;
    - Rat-running; and
    - Narrow streets leading to congestion and/or difficulty to manoeuvre with on-street car parking.

Potential solutions were suggested and included:

- Movements in the Study Area should be local traffic;
- Walking and cycling should be improved and made safer, including via the upgrade of footpaths and connections to open space, public transport and services, and improvements to pedestrian crossings;
- One-way traffic systems in some streets (although these are also not recommended in some submissions);
- Upgrade of Chief Street;
- Future development could provide rear access;
- Appropriate road marking;

- Addressing speed limits;
- Bringing tramline to Ethelbert Square; and
- Widening of some streets such as Drayton Street, Chief Street, Hawker Street (although it is noted that Chief Street could also be narrowed).

During the Community Session, it was also reported that footpaths required attention, as they were difficult for some users (including prams, persons with disabilities, etc).

Question 8: What are the key assets and positive characteristics of the Study Area that you would like to see retained or enhanced?

Key positive characteristics are described as follows:

- Diversity of uses;
- Small businesses as opposed to big brands;
- Social diversity, sense of community;
- Historic and heritage fabric, including local shop front homes and some industrial structures;
- Community gardens and green amenity, including Ethelbert Square.

Question 9: Do you have other comments or ideas?

The following additional comments were made:

- The social nature and diversity should be retained;
- A broad range of housing types should be proposed;
- There is opportunity to create a cohesive and creative community, with an 'entrepreneurial' spirit;
- One comment was made about sill heights, which would be preferred at 1.7 metres (instead of 1.5 metres);
- The proposal should not result in gentrification and exclusion of existing residents and lower income groups; and
- The proposal should seek to complement Bowden and create a transition.



APPENDIX H

ORDER OF COST CONCEPT DESIGN COST ESTIMATE

RLB | Rider Levett Bucknall

Rider Levett Bucknall SA Pty Ltd
ABN 96 008 129 324

Level 1, 8 Leigh Street
Adelaide SA 5000
Australia

Tel: +61 8 8100 1200
Fax: +61 8 8100 1288
Email: adelaide@au.rlb.com

3 July 2018

Fyfe Pty Ltd
Level 1,
124 South Terrace
ADELAIDE SA 5000

Attention: Mr David Bills

Dear David

BOWDEN – SITE INFRASTRUCTURE INVESTIGATION AMD CONCEPT PLAN
DPA | ORDER OF COSTCONCEPT DESIGN ESTIMATES (REVISED)

As requested, we have prepared a revised Order of Cost Concept Design Cost Estimate based on the documents provided for the proposed Bowden DP.

We refer you to the attached detailed Cost Report which further defines the proposed scope of works and associated costs.

We summarise the Concept Design Estimates as follows;

BOWDEN DPA ORDER OF COST ESTIMATE		
New Road Constructions		$7,700,559
Existing Road Upgrade		$8,735,758
Detention and Bio-Retention Basins		$2,076,700
Reserves		$8,123,750
	Estimated Net Cost	**$26,636,767**
Project Contingency		$4,865,000
Professional Fees and Charges		$2,551,000
Escalation beyond end 2018		Excluded
Concept Design Estimate Total Cost (excl. GST)		**$34,024,767**

This Order of Cost Concept Design Estimates is based upon measured quantities to which we have applied rates and conditions we currently believe applicable as at July 2018.

We have assumed that the project will be competitively tendered to a suitable sized and experienced Civil Contractor under standard industry contract conditions.

BASIS OF ESTIMATE

This Concept Design Estimates is based on the following documentation *(or unless scope has been specifically excluded)* provided to our office;

Documents prepared by Oxigen Landscape Architects:

- Bowden DPA Report — Workshop 02
- Preliminary Sections — Revision B
- Intersection Details — -

Documents prepared by Fyfe Landscape Architects:

- Services Authority Summary — -
- Stormwater Management Master Plan — Preliminary

In the preparation of the Concept Design Estimates we have assumed and allowed for the following scope of works;

New Road Constructions

- Construction of new roads based on cross section details provided including the following;
    - Earthworks
    - Asphalt Road Pavements
    - Minor concrete works
    - Stormwater Drainage
    - Verge Landscaping including tree plantings
    - Street Lighting
    - Services Infrastructure (water, sewer, telecommunication, electrical and CST)
    - Contractors Preliminaries and Overheads

Existing Road Upgrade

- Demolition and removal of existing road pavements
- Re-construction of existing roads based on cross section details provided including the following;
    - Earthworks
    - Asphalt Road Pavements
    - Minor concrete works
    - Stormwater Drainage
    - Verge Landscaping including tree plantings
    - Street Lighting Upgrade
    - Minor alterations to existing Services Infrastructure (water, sewer, telecommunication and electrical)
    - Contractors Preliminaries and Overheads

BASIS OF ESTIMATE (cont.)

Detention Basins

- Construction of two new Detention Basins (Basin A and B) for a total volume of 686m^3
- Contractors Preliminaries and Overheads

Reserves

- Allowance for construction of large public reserves to selected locations with scope of works including for;
    - Earthworks
    - Trails and Pavements
    - Furniture and Structures
    - Soft Landscaping including irrigation
    - Lighting and general services provisions
    - Contractors Preliminaries and Overheads
- Allowance for construction of smaller reserves to selected locations proving less public amenity than the main reserves noted above

PROJECT EXCLUSIONS

The Preliminary Design Estimate specially excludes the following items which may require further consideration when preparing an overall Project feasibility study;

- Demolition and Removal of existing Buildings and Structures
- Low level contaminated soil removal or soil remediation
- Rock excavation
- New or relocation of existing services within existing Roads
- Recycled Water supply and distribution
- Services Augmentations Costs
- Finance Costs and Holding Charges
- Escalation beyond late 2018
- Goods and Services Taxation

We again refer you to the detailed cost report which identities further specific project exclusions.

We trust this report is of assistance, however should you require any further information or clarification please do not hesitate to contact our office.

Yours faithfully,

Giulio Altamura

Giulio Altamura
Director
Rider Levett Bucknall
giulio.altamura@au.rlb.com
Encl.

F:\Project Files\18519\Cost Planning\18519 - 180604 - DPA Order of Cost Estimate.docx