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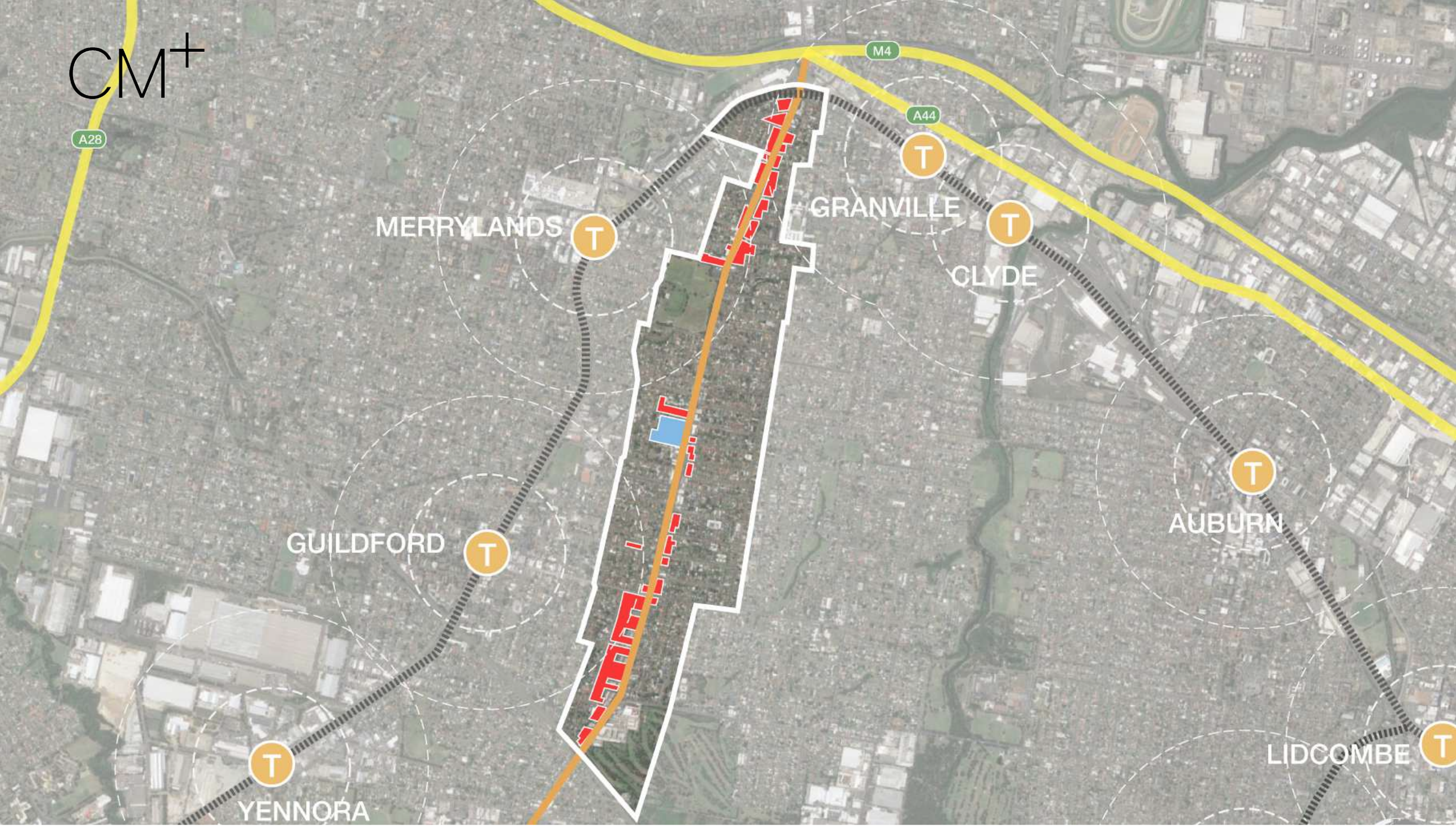

Prepared for: CUMBERLAND CITY COUNCIL

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Woodville Road Corridor Planning Framework
Shadow Study

Woodville Road Corridor - Shadow Study

Contents

Revision	Date	Description	By	Chk	Apr
01	27/11/2023	Final Draft	SS	BR	BR
DPHI GATEWAY DETERMINATION					
02	21/11/2024	Draft AMENDED Shadow Study Report	HB	HB	AL
03	29/11/2024	Final AMENDED Shadow Study Report	HB	HB	AL
04	05/12/2024	Final AMENDED Shadow Study Report v2	HB	HB	AL
05	09/01/2025	Graphic Update	HB	HB	AL

Prepared for: CUMBERLAND CITY COUNCIL

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1.0 Introduction

1.1 Introduction

This Shadow Study, prepared for Cumberland City Council (CCC) by Conybeare Morrison International (CM+), is a technical document presenting a visual model with written description of the sun and daylight access.

The purpose of the document is to assess how the expected massing of the proposed urban design form might affect the amount of sunlight that will be received by adjacent dwellings, public domain areas and private gardens. The assessment encompasses the effects on streets, residential proposed buildings, and the public realm, encompassing both public and private open spaces.

The study's modeling and analysis is of the 31 Planning Proposal sites situated in along Woodville Road - known as the Woodville Road Corridor (WRC).

The WRC comprises mixed-use development, high and low-rise residential structures, and public and private open spaces.

The predominant height for the proposed residential developments is 9 stories, while mixed-use developments are 10 stories. However, there is a maximum allowance of 12 stories specifically designated for the John Cootes site (Site 17) within the Merrylands East Precinct.

The range of tower heights within the proposed development range, are proposed such that the greater elevations are along Woodville Road and lower heights extend away from Woodville Rd to facilitate a smooth transition to the existing low-density residential development in the surrounding areas.

The detailed shadow diagrams along with urban design analysis for the draft planning framework are provided in the following chapters of this report.

1.2 Apartment Design Guide

The Apartment Design Guide (ADG) forms the basis for the analysis of solar analysis.

The key solar access criteria are:

- *Living rooms and private open spaces of at least 70% of apartments in a building receive a minimum of 2 hours direct sunlight between 9 a.m. and 3 p.m. at mid winter in the Sydney Metropolitan Area and in the Newcastle and Wollongong local government areas.*
- *A maximum of 15% of apartments in a building receive no direct sunlight between 9 a.m. and 3 p.m. at mid winter.*
- *Principal usable part of the communal open space achieves a minimum of 50% direct sunlight for a minimum of 2 hours between 9 a.m. and 3 p.m. on 21 June (the shortest day of sunlight per year).*

Note that it is advisable to have a minimum of 3 hours of sunlight to public/private garden space for growing plant material and lawns.

1.3 Shadow and Solar Access Modelling

WRC, the study area is delineated in Figure 1. The shadow analysis diagrams are based on three precinct areas:

1. Woodville North
2. Merrylands East
3. Woodville South

The massing model

The building envelopes delineated in this model for the 31 Planning Proposal sites are formulated to assess the plausible built form that can be achieved in accordance with the WRC planning controls.

Solar diagrams for each precinct depict:

- The winter solstice (shortest day of the year, 21 June).
- The summer solstice (longest day of the year, 22 December),
- The spring equinox (when day and night are equal, 21 September), representing the 'worst case,' 'best case,' and a medium scenario, respectively.

Shadows are cast from the modelled built form between 9 a.m. and 3 p.m. on all dates, with additional morning and evening hours captured during summer and spring to observe the sun and shade ratio throughout the day. The longest shadows cast by built form is the winter solstice.

The study utilised a geolocated Rhino model, subjected to shadow simulations at each hour from sunrise to sunset on the above mentioned dates.

Bonus scenarios have not been incorporated into the modelling process.

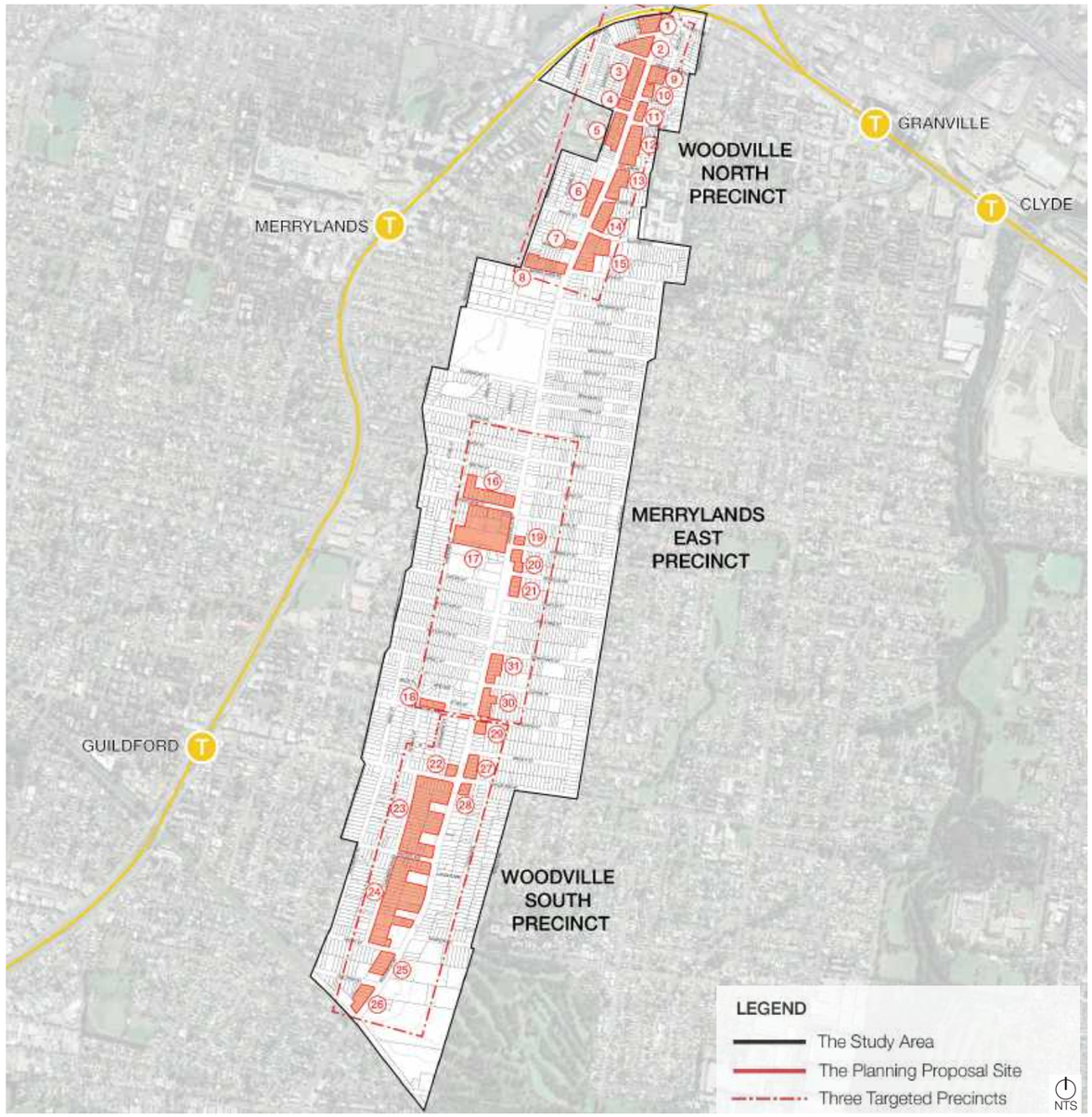

Figure 1: Woodville Road Corridor Key Plan

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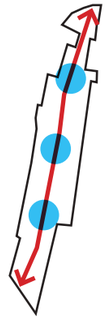

2.0 Shadow Analysis

This section provides the shadow analysis of the Woodville Road Corridor. The analysis is segmented by precinct, specifically:

1. Woodville North Precinct
2. Merrylands East Precinct
3. Woodville South Precinct

For each precinct, shadow diagrams for winter, summer, and spring are presented, accompanied by key findings pertaining to streets, open spaces, future residential proposed buildings, and associated implications.

Methodology

The shadow simulations are produced through a geolocated Rhino model. The results of this analysis are presented in pictorial format on the following pages. The Planning Proposal site boundaries and proposed public and private open spaces are shown the shadow simulations.

Based on the shadow simulations observations are made on;

- How proposed developments will impact streets and open spaces in winter, summer and spring.
- Are future residential development and communal open space capable to comply with ADG.

Granville Park

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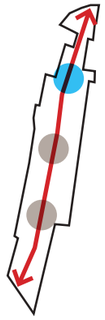

Woodville North Precinct

Shadow Impact Analysis for Winter Solstice

(21 June from 9 a.m. to 3 p.m.)

Observations made from the model:

Streets:

- Woodville Road receives full direct sunlight from 11 a.m. to 1 p.m.
- From 9 a.m. to 11 a.m. and 1 p.m. to 3 p.m., Woodville Road is affected by shade from the proposed development.
- The majority of east-west streets experience some degree of overshadowing from 9 a.m. to 3 p.m.
- Merrylands Road remains shaded throughout the day, from 9 a.m. to 4 p.m.

Public and Private Open Spaces:

- The proposed local park at site 2 is shaded from 9 a.m. to 10 a.m. and begins to receive direct sunlight from 11 a.m. to 3 p.m.
- All private open spaces receive a minimum of 2 hours of full sunlight on more then 50% of the open space area. The future proposed communal open space are capable of complying with ADG.
- The private open spaces on the west side of the proposed buildings are shaded in the morning and start to receive sunlight from noon, whereas the private open spaces on the east side of the proposed buildings receive sunlight in the morning and begin to shade from noon.

Future Residential Development:

- Proposed building envelopes for the Planning Proposal sites are able to achieve the required solar access in mid-winter to comply with ADG requirements.

Implications:

The presence of winter sun is desirable for both streets and open spaces across all climate zones in NSW. It significantly contributes to the utility and activity levels of such spaces. While open spaces receive sufficient sunlight to support activities, streets may experience colder conditions due to limited sun access.

Note: Outside of daylight savings.

Legend

- Planning Proposal Sites
- Public Open Space
- Private Open Space - Ground Level
- Private Open Space - On Structure
- (X) Planning Proposal Site Number

9 a.m. Winter Solstice

10 a.m. Winter Solstice

11 a.m. Winter Solstice

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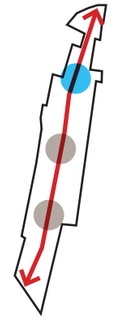
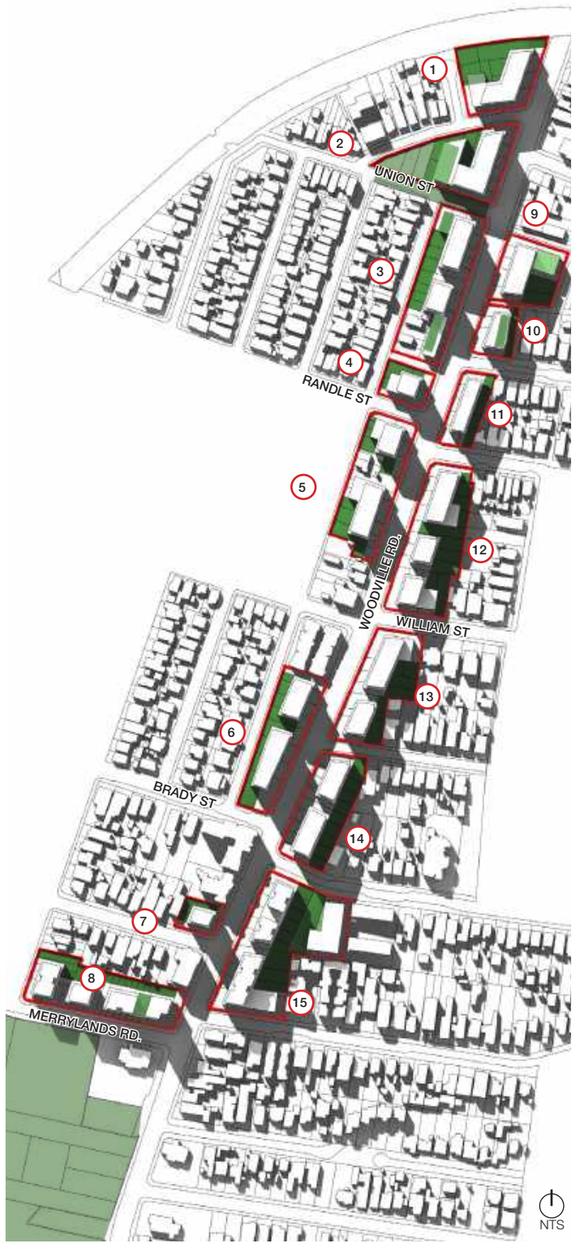


12 p.m. Winter Solstice

1 p.m. Winter Solstice



2 p.m. Winter Solstice

3 P.m. Winter Solstice

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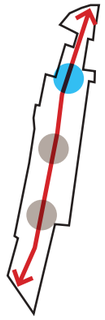


Woodville North Precinct

Shadow Impact Analysis for Summer Solstice

(22 December from 9 a.m. to 3 p.m.)

Observations made from the model:

Streets:

- Between 9 a.m. and 3 p.m., all streets, including Woodville Road, receive direct sunlight on both sides for about 4 to 5 hours.
- Majority of the Woodville Road is shaded in the morning at 9 a.m. due to proposed 9 stories developments.

Public and Private Open Spaces:

- The proposed local park (site 2) is exposed to direct sunlight from 9 a.m. to 3 p.m.
- The proposed open space at Union Street, Randle Street and Brady Street incorporated as part of the road closure receives direct sunlight from 9 a.m. to 3 p.m.
- All private open spaces receive approximately 4 hours of direct sunlight.
- Private open spaces to the east of the Woodville Road receive sunlight later in the afternoon compared to those on the west side, which benefit from morning sunlight.

Implications

Street trees in mitigating the impact of increased sunlight during summer, as heightened sun exposure contributes to a warmer micro-environment is a significant factor in achieving shade in the public domain during summer. The incorporation of shaded areas for seating and recreational activities is a further recommendation during detailed design of proposed open spaces.

The shading effect provided by building envelopes on private open spaces proves may offering relief during hot summer days when walking.

Note: During daylight savings.

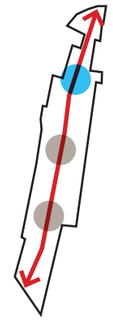
Legend

- Planning Proposal Sites
- Public Open Space
- Private Open Space - Ground Level
- Private Open Space - On Structure
- (X) Planning Proposal Site Number

9 a.m. Summer Solstice

10 a.m. Summer Solstice

11 a.m. Summer Solstice

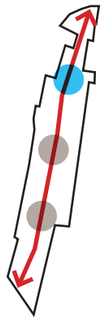


12 p.m. Summer Solstice

1 p.m. Summer Solstice

2 p.m. Summer Solstice

3 p.m. Summer Solstice



Woodville North Precinct

Shadow Impact Analysis for Summer Solstice

(22 December - 7 a.m. to 8 a.m. and 4 p.m. to 7 p.m.)

Extension of the model

The longer hours of solar access days during summer, from around 7 a.m. in the morning to 7 p.m. in the evening have an impact on external comfort and use of public space for longer hours, particularly with daylight saving.

Most areas receive 2 hours for sunlight between 7 a.m. and 9 a.m.
A consideration for walkable suburbs for school and public transport connections.

Observations made from the model:

Streets:

- All east-west-oriented streets receive direct sunlight during the morning hours from 7 a.m. and 8 a.m. as well as in evening from 4 p.m. to 6 p.m.
- The majority of the Woodville Road is shaded from 7 a.m. to 9 a.m. due to 9 stories proposed height of development.
- The western edge of the Woodville Road becomes shaded from 4 p.m. By 6 p.m., the majority of streets are overshadowed.

Public and Private Open Spaces:

- All public open spaces are exposed to direct sunlight from 4 p.m. till sunset.
- Between 7 a.m. to 9 a.m. the proposed local park is shaded due to 9 stories proposed height of development.
- All private open spaces, receive direct sunlight either in morning or evening depending on their location in respect to the proposed buildings. The private open spaces on the east side of proposed buildings receiving direct sunlight from the later afternoon, while those on the west side benefit from morning sunlight.

Implications

It is recommended that street trees and good street design for walkability considers warmer months . It's important to include shaded spots for sitting and fun activities when planning open spaces.

It is recommended that detailed design of built form includes street frontages that include cooler walking paths. These may be provided by awnings, shade structures and most importantly street tree canopy.

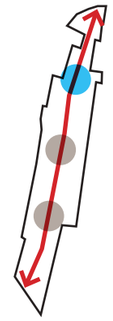
Note: During daylight savings.

Legend

- Planning Proposal Sites
- Public Open Space
- Private Open Space - Ground Level
- Private Open Space - On Structure
- (X) Planning Proposal Site Number

7 a.m. Summer Solstice

8 a.m. Summer Solstice



4 p.m. Summer Solstice

5 p.m. Summer Solstice

6 p.m. Summer Solstice

7 p.m. Summer Solstice

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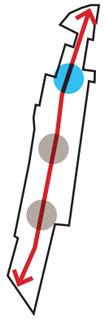

Woodville North Precinct

Shadow Impact Analysis for Spring Equinox

(21 September from 9 a.m. to 3 p.m.)

Observations made from the model:

Streets:

- Woodville Road remains unaffected by any shading from 9 a.m. to 2 p.m., with only minor shade on the eastern edge occurring at 3 p.m.
- The east-west streets experience shading from the proposed development between 9 a.m. and 3 p.m., with the maximum impact observed at 9 a.m. and the least at 3 p.m.

Public and Private Open Spaces:

- The proposed local park receives direct sunlight from 9 a.m. to 3 p.m. Minimal shadow impacts are observed on all public open spaces as part of road closures, except for Union Street.
- The public open space on the Union Street experiences some shade from 9 a.m. to 1 p.m. but receives full direct sunlight from 1 p.m. to 3 p.m.
- All private open spaces situated to the east of the proposed buildings receive direct sunlight from 9 a.m. to 1 p.m., while open spaces on the west of the developments receive direct sunlight from 11 a.m. to 3 p.m.

Implications

Both streets and open spaces enjoy favorable solar access from 9 a.m. to 3 p.m. The importance of shade extends beyond the summer months to include spring.

It is recommended that implementation of strategies that incorporate shade in open spaces and establishing a tree canopy on streets and in open spaces will enhance the usability of these areas.

Note: Outside of daylight savings.

Legend

- Planning Proposal Sites
- Public Open Space
- Private Open Space - Ground Level
- Private Open Space - On Structure
- (X) Planning Proposal Site Number

9 a.m. Spring Equinox

10 a.m. Spring Equinox

11 a.m. Spring Equinox

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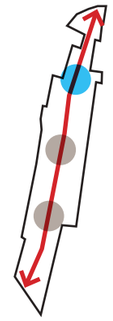
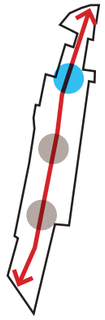


12 p.m. Spring Equinox

1 p.m. Spring Equinox

2 p.m. Spring Equinox

3 p.m. Spring Equinox



Woodville North Precinct

Shadow Impact Analysis for Spring Equinox

(21 September - 7 a.m. to 8 a.m. and 4 p.m. to 5 p.m.)

Extension of the model

Similar to summer, during spring days have additional sunlight from 7 a.m. to 5 p.m. The shadow diagrams are assessed for full access to sunlight during the day.

Observations made from the model:

Streets:

- Woodville Road experiences shading from 7 a.m. to 8 a.m. and 4 p.m. to 5 p.m.
- The east-west streets on the west side of Woodville Road are overshadowed from 7 a.m. to 8 a.m.
- The east-west streets on the east side of Woodville Road have minimal shadow impact from 7 a.m. to 8 a.m. and 4 p.m. to 5 p.m.

Public and Private Open Spaces:

- The proposed local park and Union Street are overshadowed from 7 a.m. to 8 a.m. and receive ample solar access from 4 p.m. to 5 p.m.
- The other two public open spaces as part of road closures remain unaffected by shadow impacts from 7 a.m. to 8 a.m. and 4 p.m. to 5 p.m.
- Private open spaces on the west side of the proposed buildings are overshadowed from 7 a.m. to 8 a.m., while those on the east side of the proposed buildings experience overshadowing from 4 p.m. to 5 p.m.

Implications

Both public and private spaces will experience a comfortable microclimate in the morning (7 a.m. to 8 a.m.) and evening (4 p.m. to 5 p.m.) based on the predicted solar access modelling.

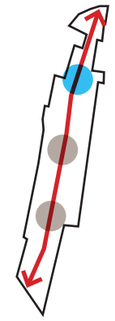
Note: Outside of daylight savings.

Legend

- Planning Proposal Sites
- Public Open Space
- Private Open Space - Ground Level
- Private Open Space - On Structure
- (X) Planning Proposal Site Number

7 a.m. Spring Equinox

8 a.m. Spring Equinox



4 p.m. Spring Equinox

5 p.m. Spring Equinox

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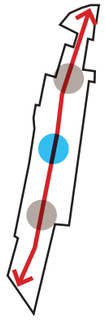


Merrylands East Precinct

Shadow Impact Analysis for Winter Solstice

(21 June from 9 a.m. to 3 p.m.)

Observations made from the model:

Streets:

- Woodville Road receives full direct sunlight from 11 a.m. to 1 p.m. with minor shading on the western edge persisting from 1 p.m. to 3 p.m.
- All streets, including Woodville Road, are subject to shading in the morning, starting at 9 a.m. and lasting until 11 a.m.
- Lansdowne Street remains shaded throughout the day, spanning from 9 a.m. to 3 p.m.
- The majority of east-west streets encounter varying degrees of shade throughout the day i.e. is from 9 a.m. to 3 p.m. but always receive greater than 2 hours direct sunlight.

Public and Private Open Spaces:

- The proposed public open space within the site 17 is shaded from 9 a.m. to 10 a.m. and begins to receive direct sunlight from 11 a.m. till 3 p.m.
- The proposed plaza and through-site link at site 17 is shaded through out the day.
- Public open space at site 18 receives direct sunlight from 9 a.m. to 3 p.m.
- All private open spaces receive a minimum of 2 hours of full sunlight on more then 50% of the open space area. The future proposed communal open space are capable of complying with ADG

Future Residential Development:

- Proposed building envelopes for the Planning Proposal sites are able to achieve the required solar access in mid-winter to comply with ADG requirements.

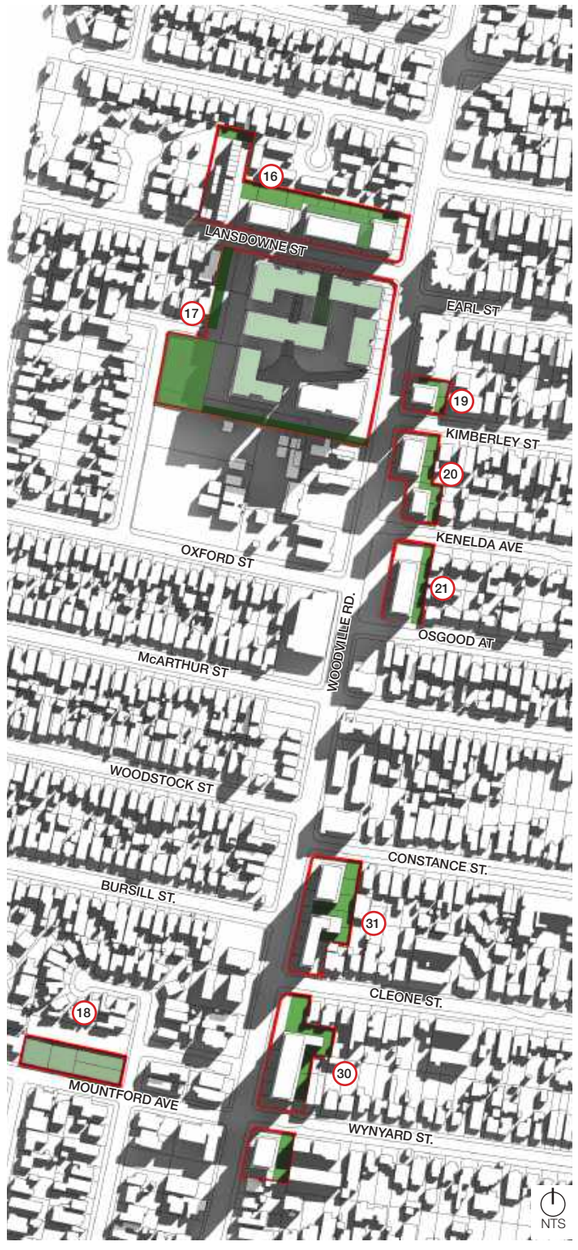
Implications:

The presence of winter sun is desirable for both streets and open spaces across all climate zones in NSW. It significantly contributes to the utility and activity levels of such spaces. While open spaces receive sufficient sunlight to support activities, plaza and site through link may experience colder conditions due to limited sun access.

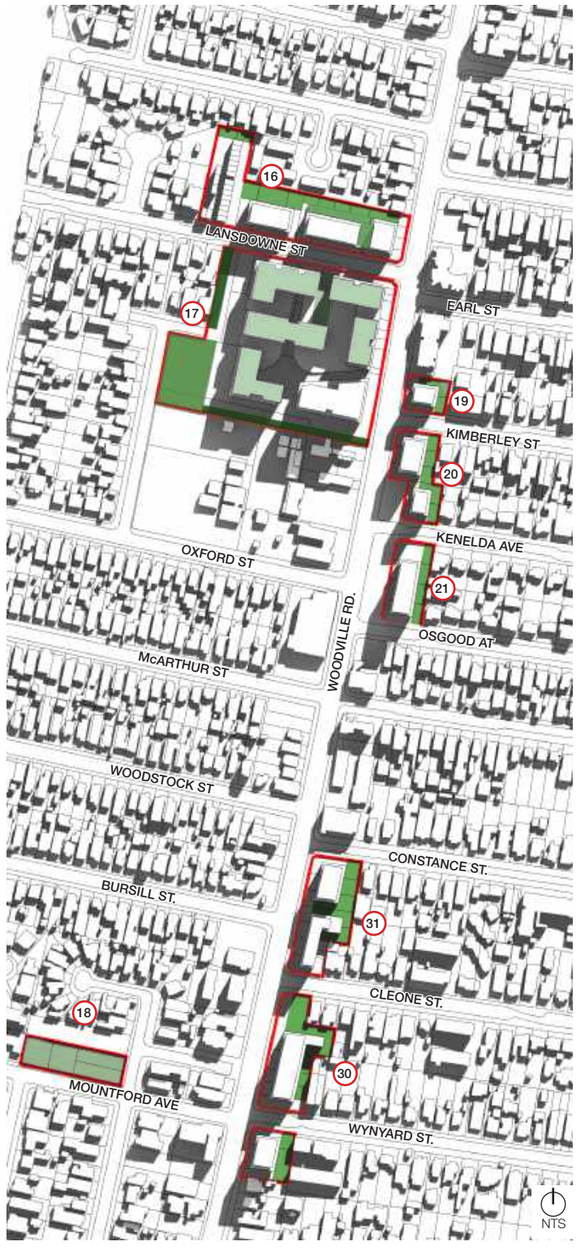
Note: Outside of daylight savings.

Legend

- Planning Proposal Sites
- Public Open Space
- Private Open Space - Ground Level
- Private Open Space - On Structure
- (X) Planning Proposal Site Number



9 a.m. Winter Solstice



10 a.m. Winter Solstice

11 a.m. Winter Solstice

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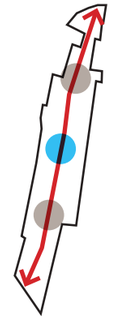

12 p.m. Winter Solstice

1 p.m. Winter Solstice

2 p.m. Winter Solstice

3 p.m. Winter Solstice

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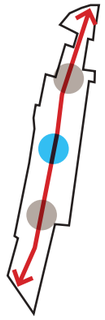

Merrylands East Precinct

Shadow Impact Analysis for Summer Solstice

(22 December from 9 a.m. to 3 p.m.)

Observations made from the model:

Streets:

- All streets, including Woodville Road, receive optimal direct sunlight on both sides of the street from 11 a.m. to 2 p.m.
- Minor shadows impact Woodville Road in the morning from 9 a.m. to 10 a.m. and in the afternoon from 3 p.m.

Public and Private Open Spaces:

- Public open spaces receive direct sunlight from 9 a.m. to 3 p.m.
- The proposed central courtyard/plaza and through-site link consistently receive ample sunlight throughout the day.
- All private open spaces benefit from approximately 4 hours of direct sunlight.
- Private open spaces situated west of proposed buildings experience shading from 9 a.m. to 11 a.m., east of proposed buildings are shaded at 3 p.m.

Implications

Street trees in mitigating the impact of increased sunlight during summer, as heightened sun exposure contributes to a warmer micro-environment is a significant factor in achieving shade in the public domain during summer. The incorporation of shaded areas for seating and recreational activities is a further recommendation during detailed design of proposed open spaces.

The shading effect provided by building envelopes on private open spaces proves may offering relief during hot summer days when walking.

Note: During daylight savings.

Legend

- Planning Proposal Sites
- Public Open Space
- Private Open Space - Ground Level
- Private Open Space - On Structure
- (X) Planning Proposal Site Number

9 a.m. Summer Solstice

10 a.m. Summer Solstice

11 a.m. Summer Solstice

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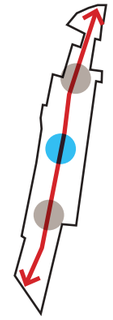

12 p.m. Summer Solstice

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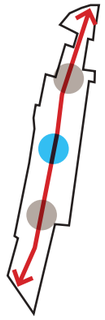


Merrylands East Precinct

Shadow Impact Analysis for Summer Solstice

(22 December - 7 a.m. to 8 a.m. and 4 p.m. to 7 p.m.)

Observations made from the model:

Streets:

- All east-west streets except Lansdowne Street, receive direct sunlight from 7 a.m. to 8 a.m. and from 4 p.m. to 6 p.m..
- Lansdowne Street is shaded at 7 a.m. to 8 a.m. and from 5 p.m. onward.
- The majority of Woodville Road along Planning Proposal sites experiences overshadowing due to proposed 12 to 9 stories development from 7 a.m. to 8 a.m. and from 4 p.m. to 7 p.m.

Public and Private Open Spaces:

- The proposed open space, central plaza, and through-site link at the site 17 are shaded in the morning from 7 a.m. to 9 a.m. but receive full sunlight from 4 p.m. to 7 p.m.
- The proposed local park at site 18 receives direct sunlight from 7 a.m. to 9 a.m. and from 4 p.m. to 7 p.m.
- Majority of the private open spaces are shaded from 7 a.m. to 9 a.m.
- The private open spaces situated on the west side of the proposed buildings receive sunlight from 4 p.m. to 7 p.m.

Implications

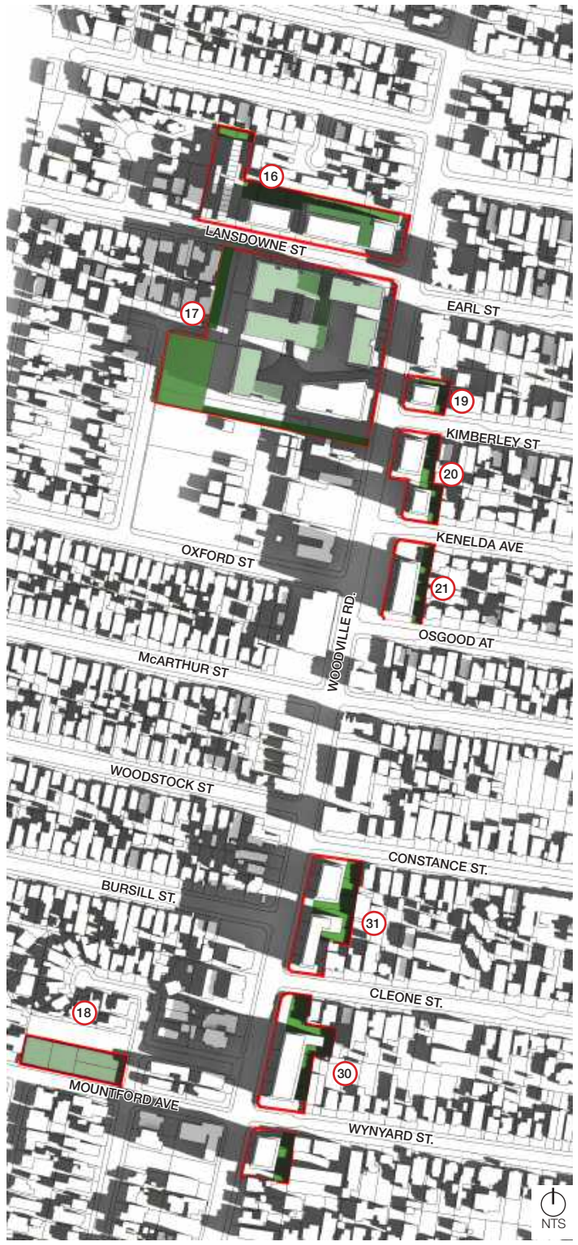
Both public and private spaces will experience a comfortable microclimate in the morning (7 a.m. to 9 a.m.) and evening (4 p.m. to 6 p.m.) based on the predicted solar access modelling.

The proposed central courtyard/plaza and through-site link at site 17 will have better microclimate compared to winters.

Note: Outside of daylight savings.

Legend

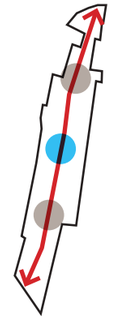
- Planning Proposal Sites
- Public Open Space
- Private Open Space - Ground Level
- Private Open Space - On Structure
- (X) Planning Proposal Site Number



7 a.m. Summer Solstice

8 a.m. Summer Solstice

CM+



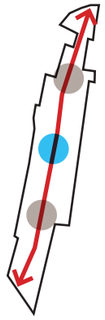
4 p.m. Summer Solstice

5 p.m. Summer Solstice

6 p.m. Summer Solstice

7 p.m. Summer Solstice

CM+



Merrylands East Precinct

Shadow Impact Analysis for Spring Equinox

(21 September from 9 a.m. to 3 p.m.)

Observations made from the model:

Streets:

- Lansdowne Street receives direct sunlight with minimal shading from 12 p.m. to 3 p.m. and is shaded from 9 a.m. to 11 a.m.
- All streets, including Woodville Road, receive ample sunlight from 9 a.m. to 11 a.m..
- Woodville Road is shaded from 2 p.m. to 3 p.m.

Public and Private Open Spaces:

- The proposed public open spaces at site 17 and site 18 receive direct sunlight from 9 a.m. to 3 p.m.
- The proposed central courtyard/plaza and through-site link at site 17 is shaded in different degrees from 9 a.m. to 3 p.m.
- All proposed private open spaces receive 3 to 4 hours of direct sunlight between 9 a.m. to 3 p.m.. The private open spaces on the east side of the proposed development are shaded from 1 p.m. to 3 p.m.

Implications

The proposed central courtyard/plaza and through-site link at site 17 will have better microclimate compared to winters.

It is recommended that implementation of strategies that incorporate shade in open spaces and establishing a tree canopy on streets and in open spaces will enhance the usability of these areas.

Note: Outside of daylight savings.

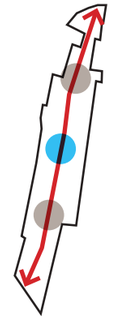
Legend

- Planning Proposal Sites
- Public Open Space
- Private Open Space - Ground Level
- Private Open Space - On Structure
- (X) Planning Proposal Site Number

9 a.m. Spring Equinox

10 a.m. Spring Equinox

11 a.m. Spring Equinox

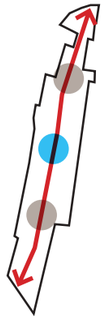


12 p.m. Spring Equinox

1 p.m. Spring Equinox

2 p.m. Spring Equinox

3 p.m. Spring Equinox



Merrylands East Precinct

Shadow Impact Analysis for Spring Equinox

(21 September - 7 a.m. to 8 a.m. and 4 p.m. to 5 p.m.)

Extension of the model

Similar to summer, during spring days have additional sunlight from 7 a.m. to 5 p.m. The shadow diagrams are assessed for full access to sunlight during the day.

Observations made from the model:

Streets:

- All east-west streets except Lansdowne Street receive direct sunlight from 7 a.m. to 8 a.m.
- Lansdowne Street is shaded from 7 a.m. to 8 a.m. and receives full sunlight from 4 p.m. to 5 p.m.
- Woodville Road experiences overshadowing due to proposed 10 to 9 stories development from 7 a.m. to 8 a.m. and from 4 p.m. to 5 p.m.

Public and Private Open Spaces:

- More then 50% of the area of the proposed open space, central plaza, and through-site links at site 17 are shaded from 7 a.m. to 8 a.m..
- More then 50% of the area of the proposed open space, central plaza, and through-site links at site 17 receive sunlight from 4 p.m. to 5 p.m
- All private open spaces are overshadowed, except for the private open space on site 16, which receives full sunlight.

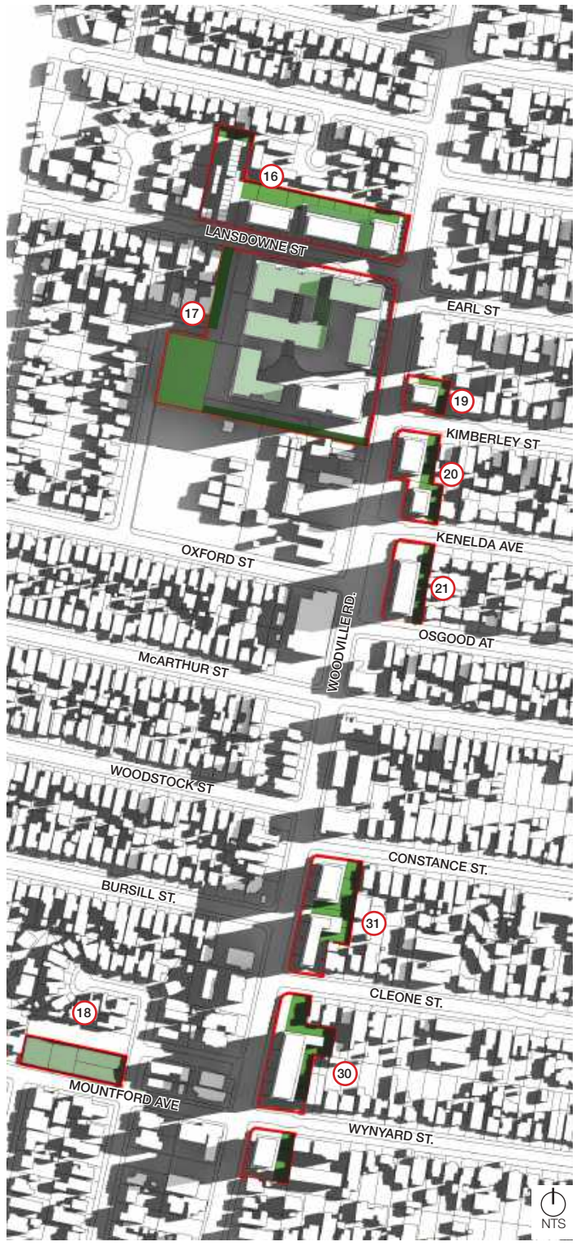
Implications

Both public and private spaces will experience a comfortable microclimate in the morning (7 a.m. to 9 a.m.) and evening (4 p.m. to 5 p.m.) based on the predicted solar access modelling.

Note: Outside of daylight savings.

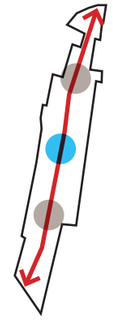
Legend

- Planning Proposal Sites
- Public Open Space
- Private Open Space - Ground Level
- Private Open Space - On Structure
- (X) Planning Proposal Site Number



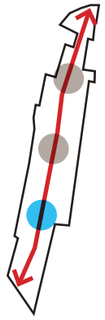
7 a.m. Spring Equinox

8 a.m. Spring Equinox



4 p.m. Spring Equinox

5 p.m. Spring Equinox



Woodville South Precinct

Shadow Impact Analysis for Winter Solstice

(21 June from 9 a.m. to 3 p.m.)

Observations made from the model:

Streets:

- Woodville Road benefits from full direct sunlight between 10 a.m. and 2 p.m., with minor shading on the western edge at 9 a.m. and from 2 p.m. to 3 p.m.
- Rhodes Ave and Henry Street experience overshadowing due to the 9 stories proposed development, resulting in limited solar access.
- Chamberlain Road and adjacent lots on the west of the road are overshadowed at 9 a.m. due to 10 to 9 stories proposed towers. The shade significantly diminishes at 10 a.m.. Chamberlain Road receives full direct sunlight from 11 a.m. to 3 p.m.

Public and Private Open Spaces:

- The proposed public open space at site 23 is shaded from 9 a.m. to 10 a.m. and begins to receive direct sunlight from 11 a.m. to 3 p.m.
- The proposed public open space at Rhodes Ave and at site 24 is shaded in some capacity through out the day. Approximately 50% area of the proposed open space receives sunlight between 11 a.m. to 3 p.m.
- All private open spaces receive a minimum of 2 hours of full sunlight on more then 50% of the open space area. The future proposed communal open space are capable of complying with ADG.

Future Residential Development:

- Proposed building envelopes for the Planning Proposal sites are able to achieve the required solar access in mid-winter to comply with ADG requirements.

Implications:

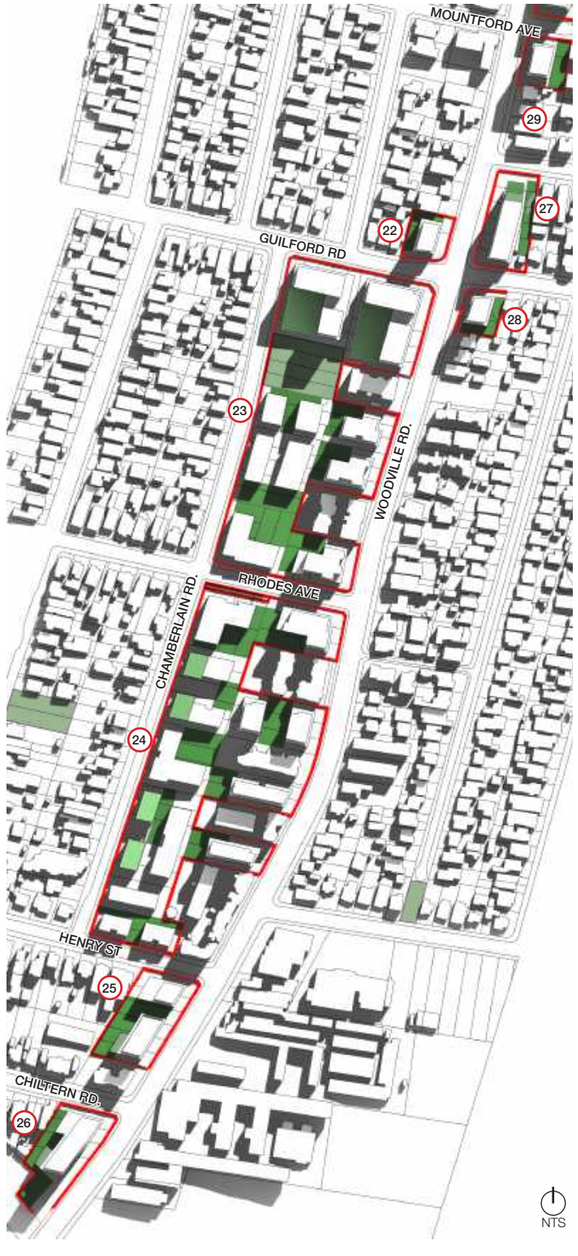
The presence of winter sun is desirable for both streets and open spaces across all climate zones in NSW. It significantly contributes to the utility and activity levels of such spaces. While open spaces receive sufficient sunlight to support activities, streets may experience colder conditions due to limited sun access.

Note: Outside of daylight savings.

Legend

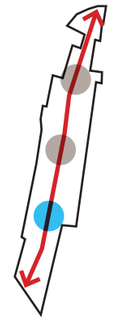
- Planning Proposal Sites
- Public Open Space
- Private Open Space - Ground Level
- Private Open Space - On Structure
- (X) Planning Proposal Site Number

9 a.m. Winter Solstice



10 a.m. Winter Solstice

11 a.m. Winter Solstice



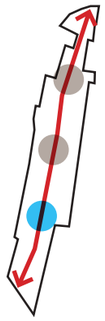
12 p.m. Winter Solstice

1 p.m. Winter Solstice

2 p.m. Winter Solstice

3 p.m. Winter Solstice

CM+



Woodville South Precinct

Shadow Impact Analysis for Summer Solstice

(22 December from 9 a.m. to 3 p.m.)

Observations made from the model:

Streets:

- Between 9 a.m. to 2 p.m., all streets, including Woodville Road, receive maximum direct sunlight on both sides.
- There is a minor shadow impact on western edge of the Woodville Road at 3 p.m..

Public and Private Open Spaces:

- The proposed public open space at site 23 and at Rhodes Ave receives direct sunlight from 9 a.m. to 3 p.m..
- All private open spaces receive direct sunlight from 11 a.m. to 3 p.m..

Implications:

Street trees in mitigating the impact of increased sunlight during summer, as heightened sun exposure contributes to a warmer micro-environment is a significant factor in achieving shade in the public domain during summer. The incorporation of shaded areas for seating and recreational activities is a further recommendation during detailed design of proposed open spaces.

The shading effect provided by building envelopes on private open spaces proves may offering relief during hot summer days when walking.

Note: During daylight savings.

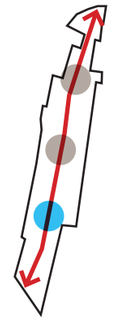
9 a.m. Summer Solstice

10 a.m. Summer Solstice

11 a.m. Summer Solstice

Legend

- Planning Proposal Sites
- Public Open Space
- Private Open Space - Ground Level
- Private Open Space - On Structure
- Planning Proposal Site Number

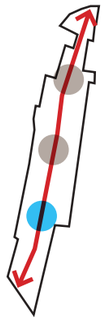


12 p.m. Summer Solstice

1 p.m. Summer Solstice

2 p.m. Summer Solstice

3 p.m. Summer Solstice



Woodville South Precinct

Shadow Impact Analysis for Summer Solstice

(22 December - 7 a.m. to 8 a.m. and 4 p.m. to 7 p.m.)

Extension of the model

The longer hours of solar access days during summer, from around 7 a.m. in the morning to 7 p.m. in the evening have an impact on external comfort and use of public space for longer hours, particularly with daylight saving.

Most areas receive 2 hours for sunlight between 7 a.m. and 9 a.m.
A consideration for walkable suburbs for school and public transport connections.

Observations made from the model:

Streets:

- At 7 a.m., Cumberland Road and adjacent lots experience substantial overshadowing, which diminishes significantly by 8 a.m.
- There is a minor shadow impact on east-west streets and Woodville Road at 7 a.m.
- All streets, except Cumberland Road, receive ample direct sunlight at 8 a.m. and 4 p.m.
- From 4 p.m. onwards, the eastern edge of Woodville Road begins to be overshadowed by developments, progressively increasing until 7 p.m.

Public and Private Open Spaces:

- The proposed local park at site 23 receives direct sunlight from 4 p.m. to 7 p.m.. At 7 a.m., more than half of the park area is shaded.
- The open space at Rhodes Ave receives direct sunlight at 8 a.m. and from 4 p.m. to 6 p.m.
- All private open spaces receive direct sunlight at 4 p.m. but begin to be shaded from 5 p.m. In the morning at 7 a.m., all private open spaces are heavily shaded.

Implications:

This suggests that open spaces will cool down and become comfortable in the morning and evening, providing the community with suitable conditions for utilisation.

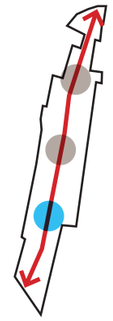
Note: During daylight savings.

Legend

- Planning Proposal Sites
- Public Open Space
- Private Open Space - Ground Level
- Private Open Space - On Structure
- (X) Planning Proposal Site Number

7 a.m. Summer Solstice

8 a.m. Summer Solstice



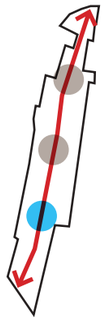
4 p.m. Summer Solstice

5 p.m. Summer Solstice

6 p.m. Summer Solstice

7 p.m. Summer Solstice

CM+



Woodville South Precinct

Shadow Impact Analysis for Spring Equinox

(21 September from 9 a.m. to 3 p.m.)

Observations made from the model:

Streets:

- Woodville Road receives direct sunlight from 10 a.m. to 2 p.m.. Due to proposed developments the eastern edge of Woodville Road is shaded at 9 a.m., while the western edge is shaded at 3 p.m..
- All east-west streets receive ample sunlight from 9 a.m. to 3 p.m.

Public and Private Open Spaces:

- The proposed public open space at site 23 receives direct sunlight from 9 a.m. to 3 p.m.
- The proposed public open space at Rhodes Ave and at site 24 receive direct sunlight on more then 50% of the open space area.
- All private open spaces receive more then 3 hours of sunlight between 9 a.m. to 3 p.m.. The private open spaces located to the west of the proposed building are shaded in the morning, whereas those situated to the east of the building are shaded in the evening.

Implications:

Both streets and open spaces enjoy favorable solar access from 9 a.m. to 3 p.m. The importance of shade extends beyond the summer months to include spring.

It is recommended that implementation of strategies that incorporate shade in open spaces and establishing a tree canopy on streets and in open spaces will enhance the usability of these areas.

Note: Outside of daylight savings.

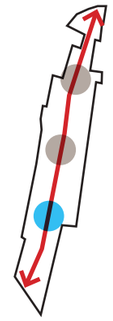
Legend

- Planning Proposal Sites
- Public Open Space
- Private Open Space - Ground Level
- Private Open Space - On Structure
- Planning Proposal Site Number

9 a.m. Spring Equinox

10 a.m. Spring Equinox

11 a.m. Spring Equinox



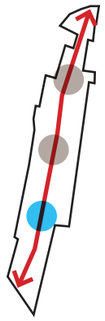
12 p.m. Spring Equinox

1 p.m. Spring Equinox

2 p.m. Spring Equinox

3 p.m. Spring Equinox

CM+



Woodville South Precinct

Shadow Impact Analysis for Spring Equinox

(21 September - 7 a.m. to 8 a.m. and 4 p.m. to 5 p.m.)

Extension of the model

Similar to summer, during spring days have additional sunlight from 7 a.m. to 5 p.m. The shadow diagrams are assessed for full access to sunlight during the day.

Observations made from the model:

Streets:

- The proposed 10 to 9 stories towers project elongated shadows toward the west at 7 a.m. to 8 a.m. and towards the east at 4 p.m. to 5 p.m. This overshadowing particularly impact Woodville Road and the adjacent east-west streets.

Public and Private Open Spaces:

- The proposed public open spaces at site 23, site 24 and Rhodes Ave are shaded from 7 a.m. to 8 a.m. but receive direct sunlight from 4 p.m. to 5 p.m..
- The private open spaces situated to the west of the proposed building experience shade in the morning, whereas those located to the east of the proposed building are shaded in the evening.

Implications

Both public and private spaces will experience a comfortable microclimate in the morning (7 a.m. to 9 a.m.) and evening (4 p.m. to 5 p.m.) based on the predicted solar access modelling.

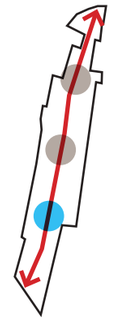
Note: Outside of daylight savings.

7 a.m. Spring Equinox

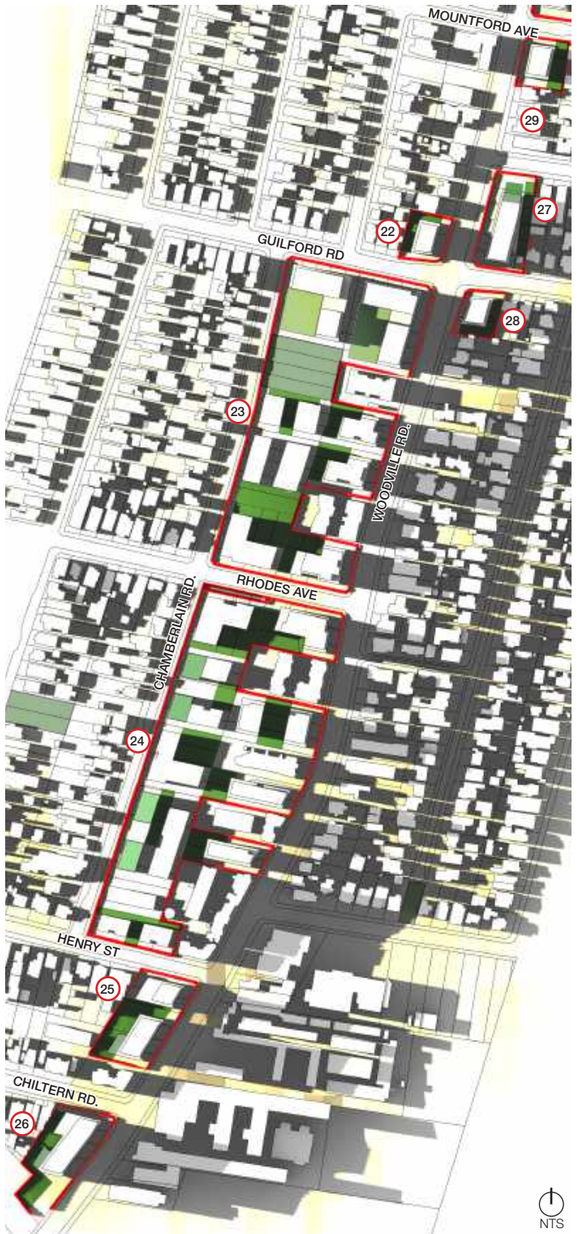
8 a.m. Spring Equinox

Legend

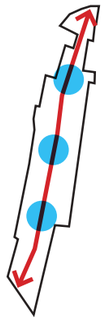
- Planning Proposal Sites
- Public Open Space
- Private Open Space - Ground Level
- Private Open Space - On Structure
- (X) Planning Proposal Site Number



4 p.m. Spring Equinox



5 p.m. Spring Equinox



3.0 Conclusion

This shadow analysis study was conducted to assess how the expected massing of the proposed urban design form in the Woodville North, Merrylands East, and Woodville South Precincts might have affected the amount of sunlight that would be received by streets, proposed residential buildings, and the open spaces, including both public and private open spaces.

The shadow simulations were produced through a geolocated Rhino model. The results of this analysis were presented in pictorial format with written analysis.

The model included plausible built form that can be achieved for the 31 Planning Proposal sites and surrounding existing development.

Solar diagrams for the winter solstice (21 June), the summer solstice (22 December), and the spring equinox (21 September), were produced for the 'worst case,' 'best case,' and a medium scenario, respectively.

Based on the shadow simulations observations were made on;

- How proposed developments will impact streets and open spaces in winter, summer and spring.
- If future residential development and communal open space were capable to comply with ADG.

During the winter solstice, the desirability of winter sun was evident for streets and open spaces, enhancing their utility and activity levels. While open spaces received sufficient sunlight to support activities, some streets may have experienced colder conditions due to limited sun access.

For the summer solstice, the importance of shade emerged as a critical factor in mitigating the impact of increased sunlight, particularly for creating a comfortable micro-environment.

Street trees in mitigating the impact of increased sunlight during summer, as heightened sun exposure contributed to a warmer micro-environment, were a significant factor in achieving shade in the public domain during summer. The incorporation of shaded areas for seating and recreational activities was a further recommendation during the detailed design of proposed open spaces.

The shading effect provided by building envelopes on private open spaces proved to offer relief during hot summer days when walking.

The analysis of the spring equinox highlighted the significance of favorable solar access from 9 a.m. to 3 p.m., extending the importance of shade beyond the summer months. It was recommended that the implementation of strategies that incorporated shade in open spaces and establishing a tree canopy on streets and in open spaces would enhance the usability of these areas.

Therefore, the results of the shadow study indicated that all new developments in the Woodville Road Corridor Planning Proposal sites should be capable of complying with ADG. The proposed new development would cast acceptable shadows and have access to good solar access in summer, winter, and spring.