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Consulting Engineers

COCKBURN CENTRAL NORTH DEVELOPMENT AREA

DRAINAGE SCHEME REVIEW

City of Cockburn

24259
REVISION D
JUNE 2026

DOCUMENT CONTROL DATA

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		Synopsis	Review of the Drainage Strategy for Cockburn Central North Development Area

Reference: 24259
Client: City of Cockburn

Revision Table

Ver	Description	Date	Authorised
A	85% Complete Report (Draft)	26/06/2025	AR
B	100% Complete Report	11/12/2025	DW
C	Update Report to City requirements	10/06/2026	DW
D	Final Report	25/06/2026	DW

Distribution Table

Date	Version	Distribution
26/06/2025	A	David King: City of Cockburn
11/12/2025	B	David King: City of Cockburn
10/06/2026	C	David King: City of Cockburn
25/06/2026	D	David King: City of Cockburn

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1 EXECUTIVE SUMMARY

David Wills and Associates (DWA) have previously undertaken an Arterial Drainage Scheme Review for Cockburn Central and Solomon Road Development Areas, dated November 2005. Since then, approximately 24% of the Cockburn Central North Development Area has been developed.

DWA have been commissioned by the City of Cockburn to review the Drainage Strategy for the Cockburn Central North Development Area. This area was formerly known as the Muriel Court Catchment.

In the Drainage Strategy for the Development Area, the following design elements are included:

1. Lot filling to provide sufficient separation to the groundwater which will allow the infiltration of the excess stormwater to be promoted.

2. Limit the required on-site stormwater disposal to smaller storm events and utilise the POS areas for the major storm events, while recharging the groundwater table.

   It is proposed that all lots install soakwells with a storage capacity of 2.1 cubic metres per 100 square metres of roof and paved areas, providing storage for runoff generated by a 5 minute, 1 in 20 year storm event.

   Storm events in excess of this recurrence shall be designed to flow off the lot and onto the street. This additional flow is to be contained within the storage systems in the Public Open Space areas.

3. Use of subsoil drainage systems to control the rise in the Regional Groundwater levels during periods of above agreed average values.

The Regional Groundwater levels have been adjusted based on DWER groundwater monitoring bores and used to design the drainage system and lot fill.

Three basins are proposed to be constructed within the Development Area, to contain the 1 in 100 year ARI storm events of critical duration from the surrounding catchment areas. An outfall will be provided to each basin, which will ultimately direct flows to Lake Yangebup. The stormwater runoff from the northern and western catchment area basins will be directed via an upgraded stormwater drainage system within the proposed Ngort Drive (Semple Court Realignment). The stormwater runoff from the southeastern catchment basin will be directed to the North Lake Road stormwater drainage system to the south.

To control the groundwater table within the Development Area, it is recommended that subsoil drainage be installed along the western side of the southeastern Public Open Space.

2 INTRODUCTION

2.1 General

David Wills and Associates (DWA) have been commissioned by the City of Cockburn to review the Drainage Strategy for Development Area 19 – Muriel Court and Cockburn Central North (Muriel Court) Local Structure Plan. This catchment area will be referred to as the Cockburn Central North Catchment in this report.

DWA has previously undertaken an Arterial Drainage Scheme Review of the Cockburn Central Development Area in November 2005.

A District Water Management Plan was undertaken in 2008 by Cardno BSD, and a Local Water Management Strategy (LWMS) was undertaken by ENV Australia Pty Ltd in 2011. Since then, development within the area has occurred in accordance with the LWMS.

2.2 Purpose

This report has been prepared to assist the City of Cockburn in re-assessing the LWMS, and to provide recommendations for changes that will support improved outcomes for developers seeking to develop the area.

The review will include an assessment of lot fill requirements, stormwater drainage infrastructure, and groundwater control levels.

3 BACKGROUND

3.1 Documents Received

This report is based on the following documents provided by the City of Cockburn:

1. ENV Australia "Development Area 19 (Muriel Court) Local Water Management Strategy"
2. Structerre Consulting "Geotechnical Investigation for Lot 40 Verna Court and Lot 41 Semple Court, Cockburn Central"
3. Douglas Partners "Geotechnical and Preliminary Acid Sulphate Soil Investigation for Lots 2, 7, 30, 31, 50 and 52 Muriel Court, Cockburn Central"
4. Structerre Consulting "Geotechnical Investigation for Lots 30, 31 and 32 Verna Court, Cockburn Central"
5. Perth Geotechnics "Geotechnical Investigation at Lots 11 and 12 Muriel Court, Cockburn".

3.2 Existing Cockburn Central North Development Area

The Cockburn Central North Development Area is approximately 79 hectares, located approximately 16 km south of the Perth Central Business District east of the Kwinana Freeway, and is shown below in Figure 1.

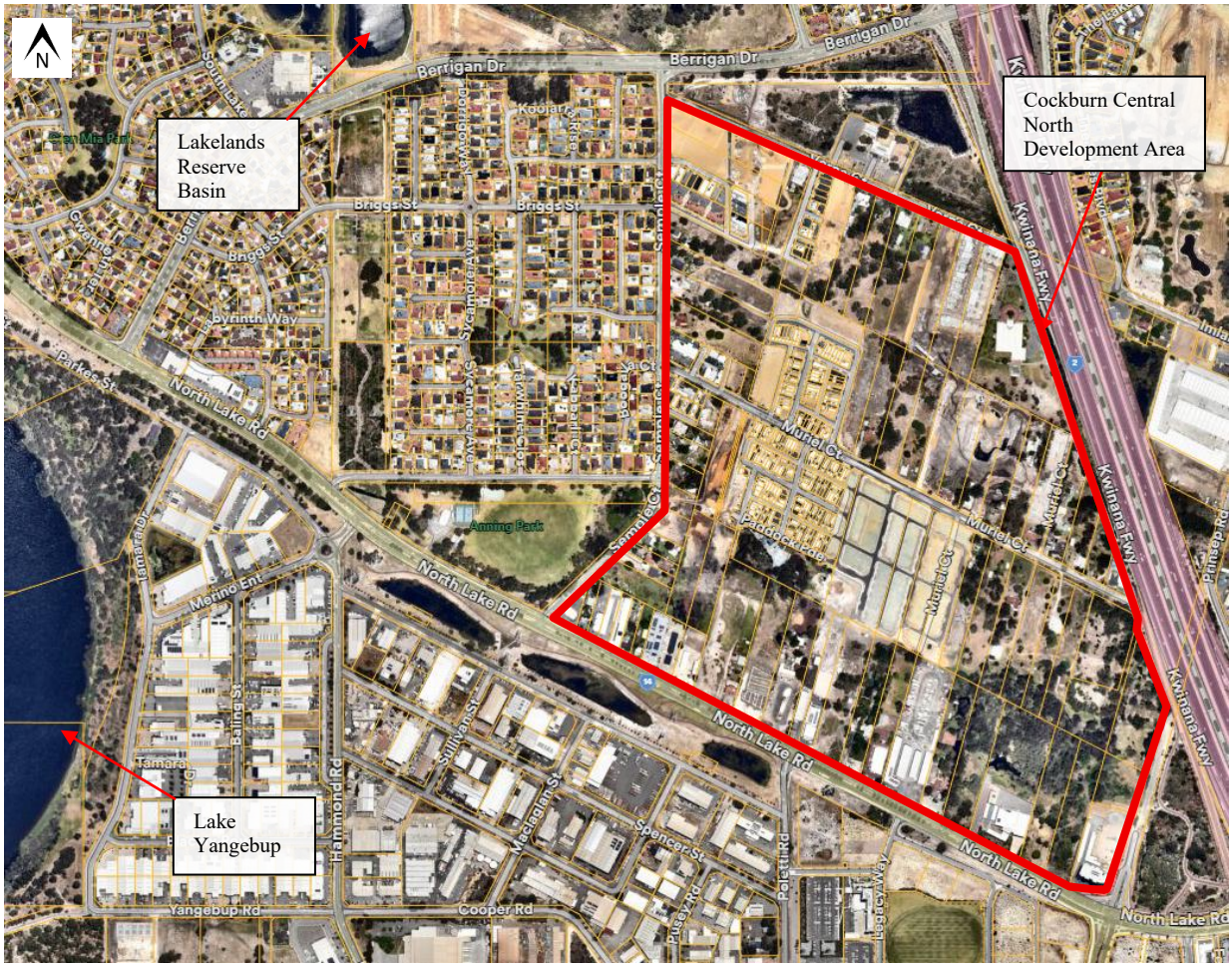

Figure 1 – City of Cockburn Development Area 19 – Muriel Court: Cockburn Central North Development Area (Nearmap image dated March 2025)

The structure plan developed for the Cockburn Central North Development is to have a mix of residential densities, a centrally located Local Centre, and an Office Zone with an integrated residential precinct along North Lake Road.

Approximately 24% of the area has been developed over the past 15 years, primarily with residential lots concentrated in the central parts of the Development Area.

The lack of an integrated drainage system has hampered the urban development of the larger lots bounded by North Lake Road, Semple Court and Berrigan Drive over the last 20 to 25 years. The proposed residential area east of Semple Court consists of much smaller fragmented land holdings, which imposes additional constraints to the development of the land without an intregrated drainage approach.

3.2.1 Stormwater Drainage and Groundwater Characteristics

High rainfall events in the early to mid 1970's without formal outfall drainage systems resulted in water logging of portions of this area.

There are several mitigating factors which will assist in providing a degree of security in the effectiveness of the stormwater drainage system for the Cockburn Central North catchment. These include:

1. As part of the Water Corporation's Southern Lakes Main Drainage system, stormwater pumps to control in the rise of Yangebup Lake above a predetermined level have been provided since the winter of 2002.

   Once the water level in Lake Yangebup rises above 16.50m AHD, the pumps operate and discharge the excess stormwater/groundwater into Cockburn Sound. The regional groundwater will continue to rise once Lake Yangebup pumps commence to operate, but this occurs in a more controlled way and for a much shorter duration.

   By controlling the water level in Lake Yangebup, this will also assist in preventing the rise of the groundwater in the vicinity of the Cockburn Central North development.

2. The Water Corporation has installed a series of potable water supply groundwater extraction bores within the Cockburn Central North development area and the urban areas to the east, north and south. The removal of this groundwater resource reduces the regional groundwater levels. Although the bores cannot be used to control the rise of the groundwater, it will help mitigate the successive rise in the groundwater level during a series of wet winters.

Traditionally, the disposal of stormwater runoff within the Cockburn Central North catchment is by infiltration. Previous stormwater strategies have directed a portion of the overflow from the Development Area to be discharged northwards to the Lakelands Reserve Basin. The City has advised that the Lakelands Reserve Basin is nearing full capacity and, during major storm events, overflows to the south towards Lake Yangebup.

To upgrade the system to cater for the additional flows from Cockburn Central North, significant upgrading of existing infrastructure would be required. Therefore, the drainage strategy for the Area has been reassessed and proposed drainage works required to service the road network area will be used to augment the lot and POS drainage system. The proposed strategy for this area will be to formalise the drainage overflow paths and direct them to Public Open Space (POS) so the flows from Cockburn Central North will be directed to Lake Yangebup in a controlled manner.

Each lot will be required to install soakwells, with overflow onto the roads and into the POS, maximising infiltration into the regional groundwater to implement sound water resource management principles. This will also assist in improving water quality discharging to Lake Yangebup.

The stormwater runoff generated from the lots fronting North Lake Road discharge to the North Lake Road stormwater drainage system, which will not be modified in this Drainage Strategy.

3.2.2 Geotechnical Information

Perth Geological Mapping for the site is provided in Figure 2 below, which indicates the area consists of sands with pockets of sandy silt.

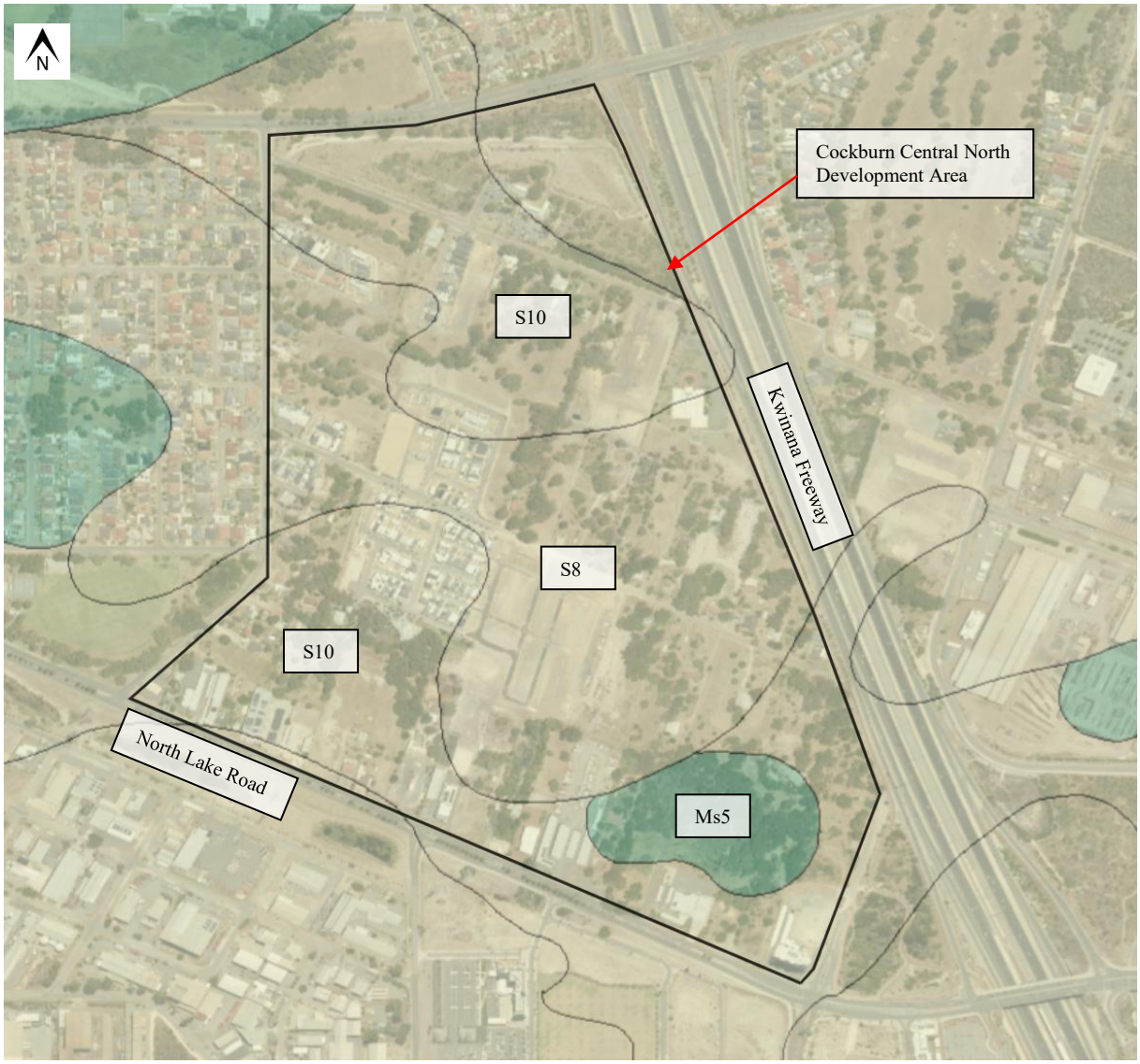

Figure 2 – Perth Geological Mapping (GeoVIEW.WA)

- S8: Sand - white to pale grey at surface yellow at depth, fine to medium-grained
- S10: Sand - as S8 over sandy clay to clayey sand of the Guildford Formation
- Ms5: Sandy silt - dark brownish grey silt with disseminated fine-grained quartz sand.

Various Geotechnical Investigations have been undertaken within the Development Area. A summary of reviewed reports is provided in Figure 3 below.

#	WAPC Reference	Company	Document date	Address
1	WAPC 200212	Structerre	December 2024	Lot 40 Verna & Lot 41 Semple
2	WAPC 155969 & 157088	Emerge Associates	March 2018	Multiple developed lots
3	WAPC 200865	Structerre	January 2019	Lots 30-32 Verna Court
4	WAPC 200908	Perth Geotechnics	January 2025	Lot 11 & 12 Muriel Court

Figure 3 – Locations of Geotechnical Investigations within Cockburn Central North Development Area (courtesy of City of Cockburn)

A summary of the geotechnical investigations is as follows:

Table 1 – Review of Geotechnical Investigations

Report No.	*Groundwater depth*	*Encountered soils*	*Permeability Testing*	*Site classif-ication*
1	None encountered to 2.5m depth	• Topsoil and Sand to investigated depth of 2.5m.	4.8m/day to 18.7m/day	A
2	1.2m to 3.2m	• Topsoil to a depth of 0.1m to 0.15m. • Uncontrolled sand fill up to a depth of 0.2m to 2m in some test pits. • Sand below topsoil to a depth of 2m to investigated depth of 3.2m. • Areas of coffee rock at 2m to 2.9m depth. • On-site drainage is suitable where there is adequate clearance to groundwater table or coffee rock.	Design permeability of 1 x 10^{-4} m/s (8.6m/day) for in situ sand,0.5 x 10^{-4} m/s (4.3m/day) for uncontrolled sand fill.	P
3	1m to 2.2m depth	• Topsoil to 0.1m depth • Sand fill to an average depth of 0.7m • Natural sand to an average depth of 3.4m • Silty Sands / Sandy Silts at depths of 1.5m to 4.5m (varies throughout site) • The site is suitable for limited on site disposal of stormwater runoff subject to the proposed development.	2m/day to 15.5m/day	A & S
4	1.2m to 1.4m depth	• Gravelly Sand and Sand to 2.2m depth	1.4m/day to 1.9m/day	A

Based on the geotechnical investigations and the Perth Geological Mapping, a majority of the site is suitable for the disposal of stormwater by infiltration, subject to the control of the level of the groundwater table.

The area of sandy silt is in the location of the proposed southeast Public Open Space (POS), which will not be suitable for infiltration. The existing natural remnant vegetation should be retained to the greatest extent possible. The suitability of infiltration for the surrounding lots would need to be confirmed with a geotechnical investigation. Sand fill will be required on the adjacent lots to provide freeboard for the 1 in 100 year ARI (1% AEP) critical duration storm event and enable the lot soakwells to function.

4 REVIEW OF CURRENT LOCAL WATER MANAGEMENT STRATEGY

A review of the ENV Australia "Development Area 19 (Muriel Court) Local Water Management Strategy" has been undertaken. Aspects within the LWMS in relation to the stormwater drainage and groundwater management are summarized and commented below:

Table 2 – Review of LWMS

Design requirement of the LWMS	*DWA Comment*
Design the drainage system to retain all runoff on-site during a 1 in 1 year storm event as well as a 1 in 100 year storm event.	The requirement is vague and will be replaced by specifying a specific volume of storage per impervious area of the lot. All runoff from roofs and impervious surfaces during a 1 in 20 year, 5 minute duration storm event is to be stored within the lot. This is equivalent to 2.1 cubic metres per 100 square metres of impervious area (or 21mm depth per square metre). Impervious areas shall include all roofs, driveways and all paved surfaces. This design requirement will help recharge the groundwater and reduce storage requirements within the POS.
Base of bioretention areas to be set at Average Annual Maximum Groundwater Levels (Control Groundwater Levels).	This design requirement may vary during the design phase. If the bioretention area is vegetated, it may be prudent to lower this level so the vegetation is viable over summer.
Provide at least 1.5m clearance from lot level to Average Annual Maximum Groundwater Levels (Control Groundwater Levels).	This design requirement will remain applicable.
All stormwater from all lots is to be infiltrated on the lot for all events up to 100 year 24 hr ARI storm event. The 1 in 1 year ARI storm will be fully infiltrated on-site. The drainage concept design includes an infiltration bioretention area, a proposed swale at Muriel Court and side entry pits and manholes with open bases and to increase infiltration locally.	Infiltration within each lot for a 1 in 100 year ARI event is excessive and will not be required. Instead, the stormwater drainage will be designed to retain a 1 in 20 year, 5 minute duration storm within the soakwells from impervious areas. All excess flows will then be directed to the City's drainage system via overland flow. The POS basins will be designed to contain the 1 in 100 year ARI storm event from the entire catchment. The outflow will discharge to Lake Yangebup via the major drainage system in North Lake Road. The absence of a swale at Muriel Court does not impact basin sizes.
Provide bioretention areas sized at a minimum of 2% of the directly connected impervious area to maintain stormwater quality.	This design requirement may remain applicable. It is assumed that the concept design of the bioretention areas provided in the ENV LWMS will be retained and further developed at detailed design stage. It is unknown what impervious area is considered, but it is assumed to be road surface only. The lot area will have been pretreated by the lot soakwells.

Disease Vector and Nuisance Insect Management: The system will be designed to ensure that detained immobile stormwater is fully infiltrated in a time period not exceeding 96 hours. Permanent water bodies are not proposed on the site.	This design requirement may remain applicable and will be dependent on the design of the biofilters. Peak groundwater levels may prevail for several weeks.

5 REVIEW OF REGIONAL GROUNDWATER LEVELS

5.1 General

One of the major constraints to the development of the stormwater drainage strategy for the total catchment is the trends in the Regional Groundwater Levels, which set the minimum lot fill levels.

To validate the Regional Groundwater Levels to be adopted for the area, a series of Department of Water and Environmental Regulation (DWER) monitoring bores in the area were reviewed. A plan showing the available groundwater information for the Development Area and the location of the DWER groundwater bores is provided in Drawing 24259-C01 in Appendix A.

To validate the accuracy of using 10 year averages for groundwater levels, three bores within the area with +25 years record (before 1997 to 2024) were identified. A graph of the groundwater bore water levels is provided in Appendix B. Long term groundwater monitoring bore records show a mild decreasing trend over 20 years from 2003.

The 25 year average excludes the years of 2001, 2002, 2003 and 2004 as they were abnormally dry, with the 2001 winter estimated to be greater than a 1 in 50 year drought event. The incorporation of these values would significantly lower the average Regional Groundwater level values.

5.2 Average Annual Maximum Groundwater Levels for the Structure Planning Area

As an additional comparison, the DWER Gnangara Jandakot Water Table Elevation Contours – 2019 Maximum are also provided in Table 3. The DWER 2019 groundwater levels are estimated based on the maximum recorded groundwater levels recorded in October 2019.

The ten and twenty-five year record of Annual Average Maximum Groundwater Levels (to be the Control Groundwater Level) recorded in the catchment between 1999 and 2024 has been calculated and tabulated in Table 3 below. All levels are measured in Australian Height Datum (AHD).

Table 3: Annual Average Maximum Groundwater levels in groundwater monitoring bores contiguous to the Development Area

Borehole Reference (DWER ID)	Ground Level (m AHD)	Average Maximum GWL (m AHD)		DWER GW Atlas 1997 GWL (m AHD)	Comparison of "25 year Average Max GWL" to "DWER 1997 GWL"	DWER 2019 Max GWL (m AHD)	Comparison of "10 year Average Max GWL" to "DWER 2019 Max GWL"
		10 Year Average (2014–2024)	25 Year Average (1999-2024)				
61 410 199	22.6	20.3	20.25	19.6	25 yr Avg is 0.65m higher than DWER 1997 GWL	20.2	10 yr Avg is 0.1m higher than DWER 2019 Max GWL
61 410 195	34	22.32	22.41	24	25 yr Avg is 1.59m lower than DWER 1997 GWL	22.9	10 yr Avg is 0.58m lower than DWER 2019 Max GWL
61 410 232	27	24.21	24.14	25	25 yr Avg is 0.82m lower than DWER 1997 GWL	24.3	10 yr Avg is 0.09m lower than DWER 2019 Max GWL

The 10 year average and the 25 year average values are very similar, and therefore the analysis of the groundwater levels will be based on the 10 year average values to improve the reliability of the location of the contours, and removes the abnormally dry years of 2001 to 2004.

The Department of Environment Groundwater Atlas 2004 has not been used as a comparison, as it was designed to help householders establish groundwater bores. It included data from 2001 to 2004 to set the groundwater levels to the lower level which ensured bores would not be affected by the low groundwater levels in a drought and cause the bore to "run out of water".

The DWER Groundwater Atlas 1997 maximum groundwater levels are provided in Table 3. It can be seen that on average, the 10 year Average Maximum Groundwater Levels vary from 0.7m above to 1.68m below the groundwater levels given in the DWER Groundwater Atlas 1997. This is an acceptable variation as there are several major influences that significantly impact on the groundwater levels on a regional basis over the District Planning Area:

1. The 1997 Groundwater Atlas was developed by the Water Corporation who were responsible for the Licensing of Plumbers at the time. The groundwater contours were based on maximum groundwater levels taken from early 1950's onwards, and were used to set the minimum invert levels of leach drains. The groundwater contours were built in the 1970's before any formal drainage systems were constructed in the study area and before Water Corporation groundwater production bores were installed.
2. Since the 1970s, the average rainfall for Perth has been slowly declining.
3. The Water Corporation installed a series of groundwater extraction bores (Jandakot Groundwater Scheme Stage 2) for the Perth water supply in the late 1980s. Within the Structure Planning Area, there are 3 production bores located around the Development Area. The bores have contributed to the lowering of the groundwater levels.

   As part of the Water Corporation Operating License for groundwater extraction, the Department of Water and Environmental Regulation has placed conditions on the operating criteria for the production bores. If the production bores lower the groundwater below acceptable limits, the extraction rates are to be reduced at specific bores to limit the impact on the regional groundwater levels.
4. The development of urban areas to the east (Treeby), west and south of the study area has required the construction of a formalised stormwater drainage system which has assisted in controlling and limiting the rise of the groundwater table.

Comparing the groundwater levels found in the previous geotechnical reports, the current groundwater levels are similar to the DWER 2019 maximum groundwater levels.

Table 3 shows that the 10 year average maximum groundwater levels range from 0.58m below to 0.1m above the 2019 DWER groundwater levels. Because the 2019 DWER levels are within 3% of the 10 year average maximum levels, they have been adopted as the design criteria and designated as the "Control Groundwater Levels" for the Cockburn Central North Development Area.

The Control Groundwater Levels have been added to the graph in Appendix B as a comparison to the plotted historical data.

The drainage strategy ensures that groundwater levels do not rise above this point, except during infrequent storm events when the Regional Groundwater Level is already elevated. The system is designed to reduce the groundwater back to the controlled level in less than 72 hours. This approach supports a more practical and cost-effective design with reduced environmental impact.

6 KEY DESIGN PHILOSOPHIES

In developing the Drainage Strategy for the Development Area, there are three key design philosophies used in the approach:

1. On-site lot storage to ensure adequate storage is provided in all future development that is very easy to specify and apply.

2. Lot filling to provide sufficient separation to the groundwater table which will allow the infiltration of the excess stormwater to be promoted.

3. Limit the required on-site stormwater disposal to smaller storm events and utilise the POS areas for the major storm events, whilst ensuring the recharging of the groundwater table during all storm events.

4. Use of subsoil drainage systems to control the rise in the Regional Groundwater Levels during periods of above average rainfall.

6.1 On-Site Lot Storage

To assist with recharging the groundwater and limit flows to the three POS's within the study area, each new lot created shall provide 2.1 cubic metres of storage for all roof and paved areas with the lot. This figure is based on the runoff generated from a 1 in 20 year ARI storm event of 5 minutes duration.

The lot storage must be contained in soakwells with an open base or similar arrangements so the water is recharged back into the Regional Groundwater table.

The top of the base of the soakwell must be +0.5m above the control groundwater level to remove standing water issues.

For greater storm events, the site shall be designed to enable the excess stormwater to discharge onto the road pavement and flows into the POS area.

The road drainage system must be designed to convey this flow, which will be lagged behind the peak road runoff.

6.2 Lot Filling

The Arterial Drainage strategy for this area is based on the use of Local Authority drainage infrastructure to manage stormwater runoff. In areas where a minimum separation is specified between the final lot level and the Controlled Groundwater Level, limited on-site infiltration may still occur, with the balance of stormwater runoff flowing overland to the Local Authority drainage network.

By directing the excess lot-generated stormwater to the Local Authority drainage system, the strategy simplifies the lot drainage design and enables a coordinated approach to stormwater management.

The revised approach provides several benefits:

1. Shifting the responsibility for stormwater disposal via infiltration from individual lots to the City's drainage network reduces complexity and costs for Developers. This approach

enables more effective control of stormwater flows and levels, particularly during major storm events.

2. The drainage system is designed to collect and convey stormwater from the catchment to Lake Yangebup, with consideration for managing groundwater levels and environmental outcomes. Stormwater from major events will be conveyed through a combination of surface and subsoil systems, with detention and staged discharge designed to reduce peak flows and minimise downstream impacts.

3. Roads and POS areas shall be designed to be set below adjacent lot levels, in line with best practice drainage principles. This ensures effective surface flow management and provides temporary storage during extreme rainfall events.

   The 1 in 100 year ARI flood level shall be set a minimum of 0.3 metres below the lowest finished floor level, unless otherwise specified by the Local Authority.

6.3 Drainage System

All stormwater collected from the roads will be conveyed to the POS to promote infiltration at the compensating basins.

The entire drainage system, including the basin storage, shall be designed to store the 1 in 100 year Average Recurrence Interval (ARI) storm event of critical duration and ensure minimum freeboard requirements are met.

The peak outflow from each basin has been set and is based on the Cardno BSD DWMS.

The base of the soakwells throughout the system should be open to aid in recharging of the groundwater table.

6.4 Subsoil Drainage

To assist in providing a control in the rise of the Regional Groundwater table in the Southeastern Catchment, a subsoil drainage system is to be constructed at least 0.2m to 0.4m below the Control Groundwater Level in the designated area shown on drawing 24259-C-12 in Appendix C.

The maximum groundwater level is controlled by the proposed control pipes for each catchment area. The subsoil drains are to be set at a lower level than the control pipes and will therefore operate under submerged conditions, allowing groundwater to be discharged through the control pipes.

In the POS areas, it is recommended that the invert levels of the bioretention areas are set 0.2m to 0.3m below the Control Groundwater Level, and the top of the bioretention areas are set in the order of 0.1m to 0.3m above the Control Groundwater Level.

7 PROPOSED ARTERIAL DRAINAGE CONCEPT DESIGN

The Cockburn Central North Development Area is divided into three main catchment areas which flow into a POS where flows are stored and compensated to reduce the peak flow. Each catchment area will contain one central basin. Refer Figure 4 below.

Figure 4 – Catchment Areas in Cockburn Central North Development Area

The major proportion of the new major arterial road shown as "Ngort Drive" in the Muriel Court Local Structure Plan, and residential area to the west, have stormwater flows that are not compensated. This is possible without increasing the peak discharge in the connection to Lake Yangebup due to the delay in the peak flows from the connecting POS basins.

The levels of the groundwater control infrastructure and basins will be set based on the Control Groundwater Levels.

The proposed drainage concept design is described below and provided in Appendix C. The numbering of each catchment area has been kept in line with the previous ENV LWMS for ease of comparison.

The basins volumes designed below vary from the ENV LWMS volumes, due to the following differences:

a) Change in lot design criteria, from retaining all runoff on-site during 1 in 1 year and 1 in 100 year storm events (ENV design criteria) to retaining runoff up to a 1 in 20 year, 5 minute duration storm event with excess flows directed to the City's drainage system (DWA design criteria).

b) Bank storage within the basin walls has been allowed for in the DWA design. Further details in relation to bank storage are provided in Section 7.1.

c) The ENV critical storm duration of 72 hours is greater than the DWA-calculated critical storm duration of approximately 12 hours.

7.1 Common Design Requirements

All lots shall be required to provide a suitably designed infiltration system for a minimum of 2.1 cubic metres per 100 square metres of roof and paving (21mm of stormwater runoff from the impervious area. This is equivalent to a 1 in 20 year ARI storm event of 5 minutes duration). The base of the soakwell shall be open to promote infiltration.

For each catchment, a weighted runoff coefficient has been determined, to reflect the various surface types, including road reserves, permeable areas within lots and POS, and impermeable lot surfaces. Calculations for the weighted runoff coefficient are provided below for each catchment area. The runoff coefficient usually specified by the City of 0.9 does not apply in this study, as the 0.9 relates to runoff from the lots and road reserves to the road drainage system only. The values used are detailed in Sections 7.2, 7.3 and 7.4. At the time of detailed design, the parameters should be confirmed as the hydraulic arrangement of the drainage system will be known.

The minimum fill level for the urban lots shall be 1.5 meters above the Control Groundwater Level. The centreline of all road formations shall be a minimum of 1.2 meters above the Control Groundwater Level.

For storm events exceeding the 1 in 20 year ARI of 5 minute duration, the stormwater runoff from the lots will discharge onto the road system and into the Local Authority pipe and basin system.

The Local Authority drainage system will consist of open-base side entry pits and manholes, designed to promote local infiltration and serve as localised groundwater control points.

The POS basins are sized to store a 1 in 100 year ARI storm of critical duration with a minimum of 300mm freeboard to the house finished floor levels. Suggestions are provided for the Maximum 1 in 100 year Top Water Levels in the basins and are to be confirmed in the detailed design.

The invert of the compensating basin outlet control pipe is set below the Control Groundwater Level so groundwater is prevented from rising significantly during a major storm as the control effect of the pipe occurs.

The biofilters within the POS areas will assist with managing local groundwater water quality and will be determined at detailed design stage.

As the basins are contiguous in permeable sands, both natural and imported, the allowance of a 20% "bank storage" in accordance with the Water Corporation's Urban Main Drainage Design Standard (DS 66) has been assumed. The effect of the lot soakwells has also been included in the storage calculations. The Net Detention Storage Volumes of the basins (i.e. required basin storage volume, net of bank storage) are detailed below.

The control outlet pipes from each basin have been designed to be 450mm diameter with an orifice (size to be determined at detailed design stage) to promote infiltration and biofiltration occurring at the POS areas. An orifice is required to provide adequate control of the flows. The control pipe lengths and invert levels have been designed based on the maximum 100 year Top Water Level. These lengths are sensitive to the final Top Water Level and should be reviewed during the detailed design phase.

The outfall for the northern and western catchment areas will be directed to the proposed Ngort Drive (Semple Court Realignment) and directed south to North Lake Road and Lake Yangebup. This section of the drainage system is further detailed below in Sections 7.5 and 7.6.

The outfall for the southeastern catchment area will be directed south to the existing drainage system south of North Lake Road.

7.2 Northern Catchment Area 2

This urban catchment area is 29.0 hectares and contains residential lots zoned with a Residential Density Code of R25, R40, R60, as well as Local Centre lots zoned with a density of R80.

A relatively large proportion of the natural surface of the catchment area is greater than 1.8m above the Control Groundwater Level, and additional fill will not be required.

Based on the 2005 Cardno BSD recommendations, the outflow will be limited to a maximum of 9.6 L/s/impervious hectare, or 200 L/s at the design Top Water Level (TWL) of the basin.

The outfall will be directed to the proposed Ngort Drive (Semple Court Realignment), and directed south to North Lake Road and Lake Yangebup. This section of the drainage system is further detailed below in Sections 7.5 and 7.6.

The weighted runoff co-efficient and impervious area has been calculated as follows:

Table 4: Northern Catchment Area 2 – Impervious Area and Weighted Run-off Co-efficient Calculations

Location	*Area (ha)*	*Run-off co-efficient*	*Impervious Area*
POS	3.15	0.1	0.32
Major Road to POS	0.65	0.8	0.52
Roads	3.22	0.75	2.42
Lanes	1.02	0.9	0.92
Lots	20.96	0.6	12.57
Total	**29.0**		**16.75**
Weighted Run-off Co-efficient:		**0.58**	

The total Northern Catchment Area of 29.0ha does not include the Muriel Court and Semple Court catchment areas of 2.47ha, which will not discharge into the northern basin, and will be directed along the Ngort Drive realignment drainage system.

The approximate size of the basin has been determined based on the following design parameters:

Table 5: Northern Catchment Area 2 Basin 2 Concept Design

Catchment Area		29.0 ha
Weighted Runoff Co-efficient		0.58
Time of Concentration (inflow to basin)		20 minutes
Approximate Existing Ground Level of POS		24.0
Control Groundwater Level		22.4
Peak Outflow to Lake Yangebup from basin		200 L/s
Slope of Banks of Basin		1 in 6
1 in 10 year ARI storm event	Net Detention Storage Volume	2,800m^3
	Critical Duration	7 hr
1 in 100 year ARI storm event	Net Detention Storage Volume	8,550m^3
	Critical Duration	12 hr
	Maximum Top Water Level	23.5
Outlet control	Diameter	450mm with orifice
	Maximum Length	15m

7.3 Western Catchment Area 1

Western Catchment Area 1 is 24.96 hectares and contains residential lots zoned with a Residential Density Code of R25 and R40.

Based on the 2005 Cardno BSD recommendations, the peak outflow from the basin will be limited to 160 L/s.

The outflow pipe from the Catchment Area 1 basin is proposed to discharge westward to the Ngort Drive (Semple Court Realignment) drainage system, and directed south towards Lake Yangebup. This section of the drainage system is detailed below in Sections 7.5 and 7.6. Between the outlet control and the compensating basin, the pipe shall be at a 525mm minimum diameter pipe falling towards the basin. The street drainage can connect into this pipe to carry the short duration storms from the road.

The weighted runoff co-efficient and impervious area has been calculated as follows:

Table 8: Western Catchment Area 1 – Impervious Area and Weighted Run-off Co-efficient Calculations

Location	*Area (ha)*	*Run-off co-efficient*	*Impervious Area*
POS	1.65	0.1	0.17
Roads	3.9	0.75	2.93
Lanes	0.73	0.9	0.66
Lots	18.68	0.6	11.21
Total	**24.96**		**14.97**
Weighted Run-off Co-efficient:		**0.60**	

The size of the basin has been determined based on the following design parameters:

Table 9: Western Catchment Area 1 Basin 1 Concept Design

Catchment Area		24.96 ha
Weighted Runoff Co-efficient		0.60
Time of Concentration		20 minutes
Approximate Existing Ground Level of POS		24.0
Control Groundwater Level		22.5
Peak Outflow to Lake Yangebup from Basin		160 L/s
Slope of Banks of Basin		1 in 6
1 in 10 year ARI storm event	Net Detention Storage Volume	2,550m^3
	Critical Duration	7 hr
1 in 100 year ARI storm event	Net Detention Storage Volume	7,700m^3
	Critical Duration	12 hr
	Maximum Top Water Level	23.5
Outlet control	Diameter	450mm with orifice
	Maximum Length	40m

7.4 Southeast Catchment Area 3

This urban catchment area is 22.15 hectares and contains residential lots zoned with a Residential Density Code of R80, R160, as well as Mixed Business lots zoned with a density of R160.

A suitable location for the stormwater basin is within the proposed POS area, which contains existing native vegetation. Groundwater levels in this area can pond above the existing ground level due to the clay pan that this area is located in.

To minimise impact on existing vegetation, groundwater levels should be maintained as close as practicable to existing conditions, while still allowing surrounding development of the POS area.

Based on the groundwater contours, the groundwater is flowing from east to west, and the vegetation within the basin area is to be maintained. Therefore the groundwater control is proposed along the western and southern sides of the POS only, using a 225mm diameter subsoil drainage pipe.

The subsoil drain invert level should be set approximately 0.2–0.3 m below the outlet control invert level to ensure the subsoil drain remains submerged, allowing groundwater to freely enter the pipe. Once groundwater rises to the outlet control level, flow will discharge through the outlet pipe at the controlled rate. This ensures that discharge is governed by the outlet control rather than being restricted by the ability of groundwater to enter the subsoil drain. The location of the subsoil drainage along the western and southern sides provides localised groundwater interception, reducing the amount of fill required to the western and southern lots, while optimising water levels in the POS.

This basin will be land locked and will store a 1 in 100 year ARI storm of critical duration with a minimum of 300mm freeboard, with an outfall directed to the existing pipe and open swale system along the southern verge of North Lake Road via a proposed road.

The North Lake Road drainage system was upgraded in 2014, from the vicinity of Legacy Way (approximately 600m west of the Freeway) to Berrigan Drive, discharging into Lake Yangebup. At the proposed connection point, the North Lake Road drainage system consists of three 750mm diameter slotted pipes laid in blue metal, installed to assist in controlling the groundwater table.

As there are clay soils within the southeastern catchment, groundwater is perched above the clay soil layer, which limits the extent of groundwater drawdown from the North Lake Road drainage system.

Connection of the proposed subsoil drain from the southeastern catchment basin to the North Lake Road drainage system is expected to assist in managing groundwater levels within the southeastern catchment.

Based on the 2005 Cardno BSD recommendations, the peak outflow from the POS will be 155L/s.

The outlet control is a section of 450mm diameter pipe with an orifice located to the south of the basin and shall be 50m long. Between the upstream control pipe manhole and the compensating basin, the pipe connecting shall be at least a 450mm diameter pipe falling towards the basin. The street drainage can connect into this pipe and upstream control pipe manhole to carry the storms from the road and lots without impacting on the control outlet flow regime.

In the longer duration storms, the water stored in the basin can flow to the control outlet pipe with minimal head loss to assist in controlling the rise of the regional groundwater table.

The weighted runoff co-efficient and impervious area has been calculated as follows:

Table 6: Southeastern Catchment Area 3 – Impervious Area and Weighted Run-off Co-efficient Calculations

Location	*Area (ha)*	*Run-off co-efficient*	*Impervious Area*
POS	2.03	0.8	0.2
Roads	3.22	0.75	2.42
Lanes	0.4	0.9	0.36
Lots	16.5	0.6	9.9
Total	**22.15**		**12.9**
Weighted Run-off Co-efficient:		**0.65**	

The size of the basin has been determined based on the following design parameters:

Table 7: Southeast Catchment Area 3 Basin 3 Concept Design

Catchment Area		22.15 ha
Weighted Runoff Co-efficient		0.65
Time of Concentration		20 minutes
Approximate Existing Ground Level of POS		24.0
Control Groundwater Level		24.0
Peak Outflow		155 L/s
Slope of Banks of Basin		1 in 6
1 in 10 year ARI storm event	Net Detention Storage Volume	5,530m^3
	Critical Duration	8 hr
1 in 100 year ARI storm event	Net Detention Storage Volume	9,210m^3
	Critical Duration	20 hr
	Maximum Top Water Level	24.7
Outlet control	Diameter	450mm with orifice
	Maximum Length	50m

To achieve the required freeboard for the POS, additional lot and road fill may be required in this catchment to preserve the vegetation and achieve required freeboards.

A biofilter may be required but the current natural vegetation in future POS area may fulfill this role and would be subject to further discussion. The outflow pit from the basin will consist of

a 1200mm diameter pit fitted with a Webforge grated lid set at R.L 23.85, being 100mm below the basin invert level, to control groundwater levels within the basin, while providing adequate storage for a 1 in 100 year storm event.

The Control Groundwater Level may vary south of the Southeastern Catchment Area 3, due to the change in ground conditions and existing subsoil drainage in North Lake Road. The POS area is situated within an area of highly silty soils with limited infiltration capacity. Sandy soils with greater infiltration capacity are present in adjacent areas of the site.

7.5 Ngort Drive (Semple Court Realignment)

The realignment of Semple Court, shown as "Ngort Drive" in the Muriel Court Local Structure Plan, will be a new major road constructed between Berrigan Drive and North Lake Road. This road will require new stormwater drainage infrastructure to be installed and will provide the outfall for Catchment Areas 1 and 2.

The concept design of this drainage system has been completed to ensure the viability of the approach. The following philosophy has been adopted:

1. The area north of Verna Court is assumed to be directed to the Berrigan Drive drainage catchment area for disposal.

   This catchment area can be modified at a future date if more storage is provided within the Northern Catchment POS basin.

2. The northern portion of the new Ngort Drive from Verna Court to the southern boundary of the Northern Catchment POS area, and the residential area to the west of this section of new Ngort Drive up to Semple Court, can be directed into the Northern Catchment POS basin.

3. South of this point, the lots and road are connected directly into the new Ngort Drive drainage system. This will not have a major impact on the Ngort Drive drainage system, as the peak discharge from the Northern POS will occur from a storm of 12 hours duration, well after the Ngort Drive stormwater runoff has been discharged. The runoff from the lots and road system will be less than 15% of the design value for the Ngort Drive drainage system.

   The road drainage system has to be located below the control levels of the outlet from each of the basins. The outlet control from the basins is specified above in Sections 7.2 and 7.3 to ensure that the hydraulic control requirements are met. The invert level of the control is set below the Control Groundwater Level so there is an outflow occurring to prevent an excessive increase of water levels in the POS areas.

   Refer to Appendix C for the concept design of the Ngort Road drainage system.

The drainage system for the northern and western catchments of the Development Area will be directed to the proposed Ngort Drive (Semple Court Realignment) drainage system and conveyed southwards to North Lake Road.

The location and detail of the pipeline from the Ngort Drive / North Lake Road intersection to Lake Yangebup Regional Park has not been resolved as part of this brief and will be addressed at detailed design stage.

The existing open channel west of Semple Court within the Anning Park Reserve may be incorporated into the Ngort Drive drainage system as a high level overflow, and developed as a landscaped open channel, providing an opportunity for upgrade as part of the Developers Contribution Area (DCA). This will be resolved at detailed design stage.

The Anning Park Reserve channel is located within the Reserve and runs along the western side of Ngort Drive, and the northern side of North Lake Road, crossing North Lake Road at the intersection of Thomas Street and North Lake Road. The stormwater then discharges into the open drain in the southern verge of North Lake Road.

The invert of the channel within Anning Park Reserve would be set to the Control Groundwater Level, with sections of the channel would be excavated below this level to create small open bodies of water during winter that would help sustain the vegetation in summer. It would also assist in nutrient stripping.

Alternatively, a base flow pipe could be installed below the channel to carry nominal base flows within the system. To reduce the scale of this open channel, a base flow pipe of 375mm to 600mm diameter could be constructed under the channel. The base flow pipe should be sized to only overflow 3 to 6 times per year. The swale drains shall be designed with vegetation to assist in nutrient removal during storm events, and would be determine at detailed design.

The swale drain with base flow channel shall be constructed with a base width of a minimum of 1.5m and a bank side slope of 1 in 6 to 1 in 10. The side slopes of the channels should be varied to give an aesthetic effect of the drain.

Due to the difference in gradient between the swale channel and base flow pipe, it is recommended the base of the swale drain should be constructed at approximately 1 in 1000 to minimise velocity, and maximise storage. The minimum cover on the base flow pipe shall be 0.3m. This value can be amended during the detailed design phase and is given as guidance only. To assist in achieving the cover, the base flow pipe can be installed under the banks, rather than the bed of the channel.

The channel into Lake Yangebup may be set at the required invert level to create reedy beds which will assist with the nutrient uptake and the collection of floating debris. There is an opportunity for the City of Cockburn to construct an interesting and vibrant environmentally significant wetland in this portion of the drainage system. The design of the channel would require careful consideration to encourage a variety of plant species to grow.

With the construction of the swales and compensating basins, it is estimated that the peak discharge into Lake Yangebup would only increase marginally above the current flow rates, although the area connected to the system is significantly increased.

7.6 Contingency Groundwater Control System Options

Various infrastructure has been constructed that will reduce the rise of the groundwater, including:

1. The water level in Yangebup Lake is being controlled by the Water Corporation which has constructed an outfall pump station to limit the rise in the water level in this lake. Together with the Beeliar Lakes drainage system, this also helps control the rise of the Regional Groundwater, and
2. Swale drainage and drainage infrastructure in North Lake Road.
3. The Control Groundwater Level represents a peak value, which is expected to be reached only during a series of wet years, typically occurring once every three to five years.

8 CONCLUSIONS

This report has redefined the catchment areas within the Cockburn Central North Development Area and provided a concept drainage design for the future Ngort Drive (Semple Court Realignment).

All lots shall be required to provide a suitably designed infiltration system for a minimum of 2.1 cubic metres per 100 square metres of roof and paving (21mm of stormwater from the impervious area, which is equivalent to a 1 in 20 year ARI storm event of 5 minutes duration.

For storm events exceeding the 1 in 20 year ARI of 5 minute duration, the stormwater runoff will discharge to the Local Authority pipe and POS basin system.

The Control Groundwater Level has been set by outlet control pipes providing a discharge point for the basins in the POS areas. These outlet control pipes are set below the Control Groundwater Level so groundwater can be collected. These levels have been set and are shown in drawings 24259-C02, 24259-C11, 24259-C12 and 24259-C13.

The minimum fill level for the urban lots shall be 1.5m above the Control Groundwater Level. The centreline of all road formations shall be a minimum of 1.2m above the Control Groundwater Level.

Subsoil drainage is to be installed along the western side of the southeastern POS area (Southeastern Catchment Area 3), to control the groundwater table to the west of the basin.

The above recommendations have been developed to provide a more practical and efficient approach to stormwater management and groundwater considerations in the development of Cockburn Central north Development Area, while maintaining planning and environmental objectives. It is anticipated that implementation of the recommendations outlined within this report will assist both the City and future Developers in facilitating development within the area.

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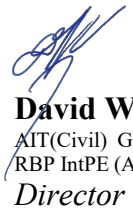

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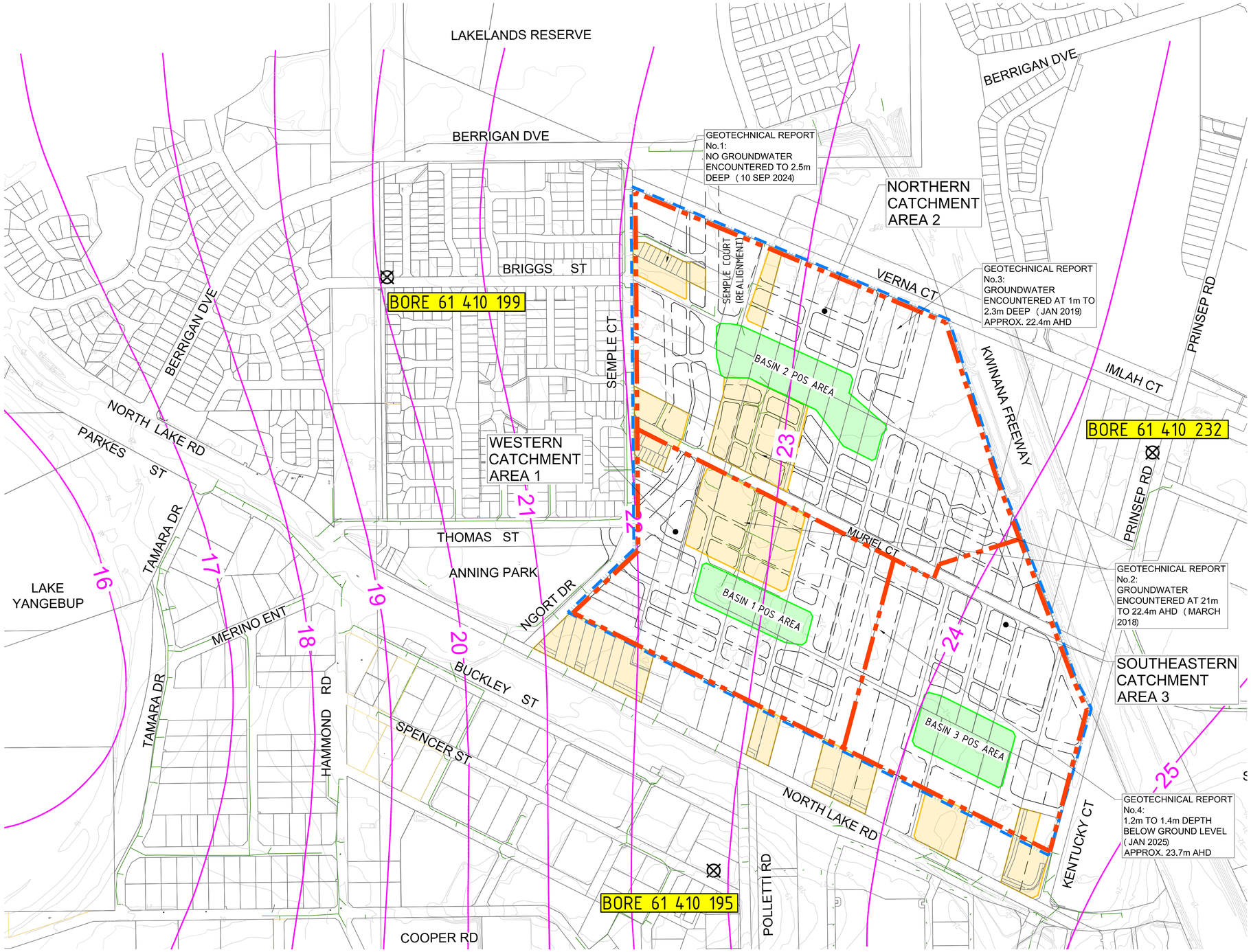
DWA Drawing 24259-C01: Groundwater Level Table Monitoring Bore



LEGEND:

- COCKBURN CENTRAL NORTH DEVELOPMENT AREA BOUNDARY
- 24 — CONTROL GWL
- CATCHMENT AREA
- EXISTING DRAIN
- DEVELOPED AREA
- POS
- BORE 61 410 232 — BORE LOCATION AND NUMBER
- OUTLET CONTROL PIPE

BOREHOLE REFERENCE (DWER ID)	GROUND LEVEL	AVERAGE MAXIMUM GWL	
		10 YEAR AVERAGE (2014-2024)	25 YEAR AVERAGE (1999 - 2024)
61 410 199	22.6	20.30	20.25
61 410 195	34	22.32	22.41
61 410 232	27	24.21	24.14

metres
0 80 160 240 320 m
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scales quoted apply to original drawing scale
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PROJECT INFORMATION: COCKBURN CENTRAL NORTH (MURIEL COURT) LOCAL WATER MANAGEMENT STRATEGY

GROUNDWATER TABLE MONITORING BORE

AUTHORISED BY: D. Wills 10/06/2026
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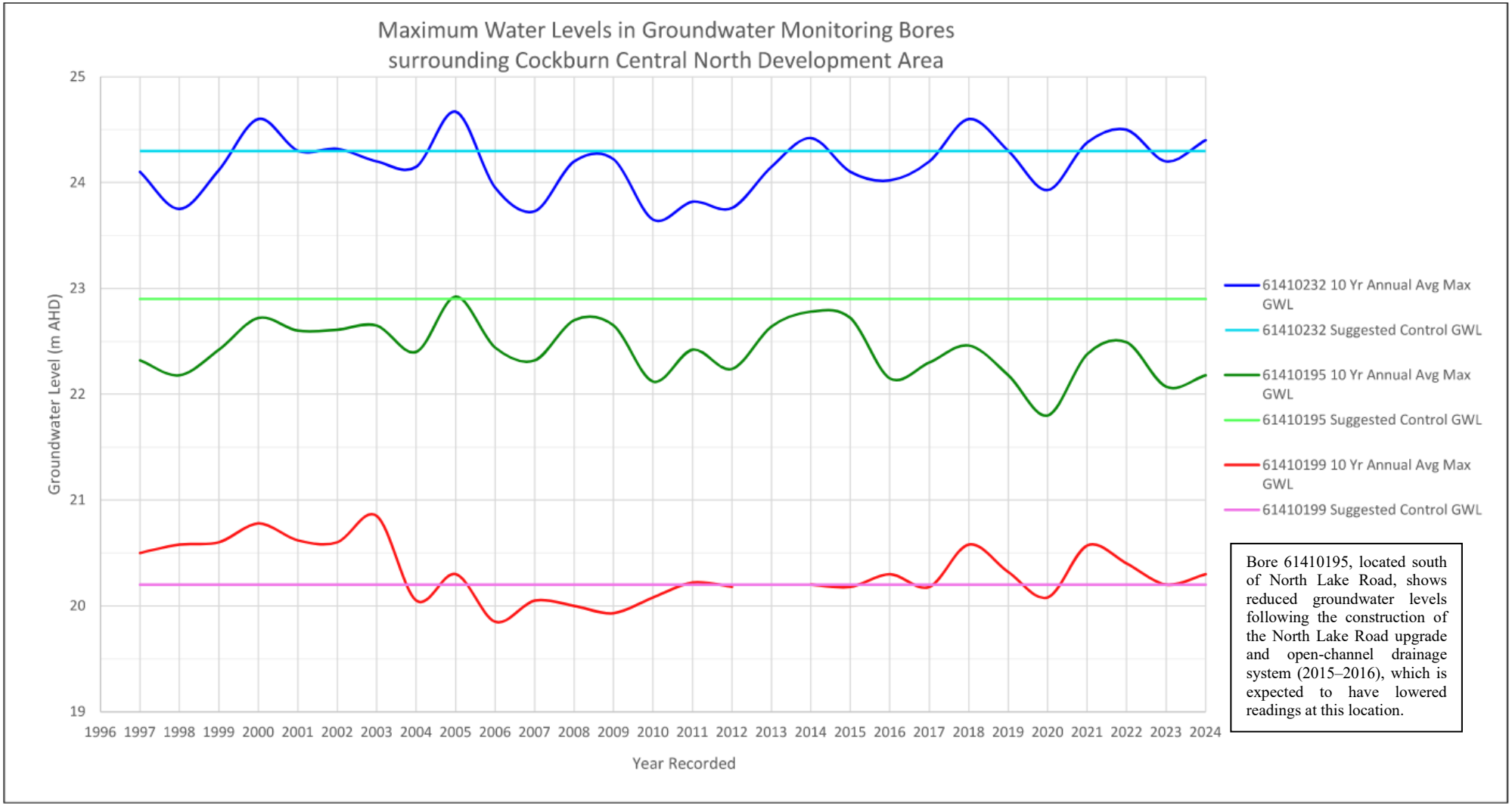
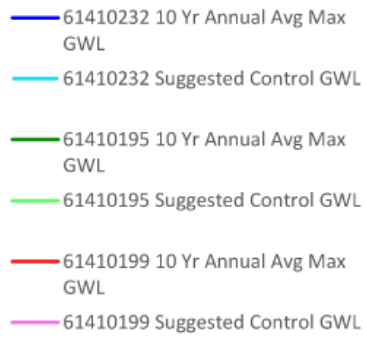

Maximum Water Levels in Groundwater Monitoring Bores
surrounding Cockburn Central North Development Area
Groundwater Level (m AHD)
25
24
23
22
21
20
19
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024
Year Recorded
61410232 10 Yr Annual Avg Max GWL
61410232 Suggested Control GWL
61410195 10 Yr Annual Avg Max GWL
61410195 Suggested Control GWL
61410199 10 Yr Annual Avg Max GWL
61410199 Suggested Control GWL
Bore 61410195, located south of North Lake Road, shows reduced groundwater levels following the construction of the North Lake Road upgrade and open-channel drainage system (2015–2016), which is expected to have lowered readings at this location.

25 YEAR MAXIMUM WATER LEVELS IN GROUNDWATER MONITORING BORES – TABLE 1

Year	61410232 10 Yr Annual Avg Max GWL	61410232 Suggested Control GWL	61410195 10 Yr Annual Avg Max GWL	61410195 Suggested Control GWL	61410199 10 Yr Annual Avg Max GWL	61410199 Suggested Control GWL
1997	24.1	24.3	9.7	22.9	20.5	20.2
1998	23.75	24.3	9.7	22.9	20.58	20.2
1999	24.12	24.3	9.7	22.9	20.6	20.2
2000	24.6	24.3	9.7	22.9	20.78	20.2
2001	24.3	24.3	9.7	22.9	20.62	20.2
2002	24.32	24.3	9.7	22.9	20.6	20.2
2003	24.2	24.3	9.7	22.9	20.85	20.2
2004	24.15	24.3	9.7	22.9	20.05	20.2
2005	24.67	24.3	9.7	22.9	20.3	20.2
2006	23.95	24.3	9.7	22.9	19.85	20.2
2007	23.73	24.3	9.7	22.9	20.05	20.2
2008	24.2	24.3	9.7	22.9	20	20.2
2009	24.22	24.3	9.7	22.9	19.93	20.2
2010	23.65	24.3	9.7	22.9	20.08	20.2
2011	23.82	24.3	9.7	22.9	20.22	20.2
2012	23.76	24.3	9.7	22.9	20.18	20.2
2013	24.15	24.3	9.7	22.9		20.2
2014	24.42	24.3	9.7	22.9	20.2	20.2
2015	24.1	24.3	9.7	22.9	20.18	20.2
2016	24.02	24.3	9.7	22.9	20.3	20.2
2017	24.2	24.3	9.7	22.9	20.18	20.2
2018	24.6	24.3	9.7	22.9	20.58	20.2
2019	24.3	24.3	9.7	22.9	20.32	20.2
2020	23.93	24.3	9.7	22.9	20.08	20.2
2021	24.38	24.3	9.7	22.9	20.57	20.2
2022	24.5	24.3	9.7	22.9	20.4	20.2
2023	24.2	24.3	9.7	22.9	20.2	20.2
2024	24.4	24.3	9.7	22.9	20.3	20.2



DWA Drawings:

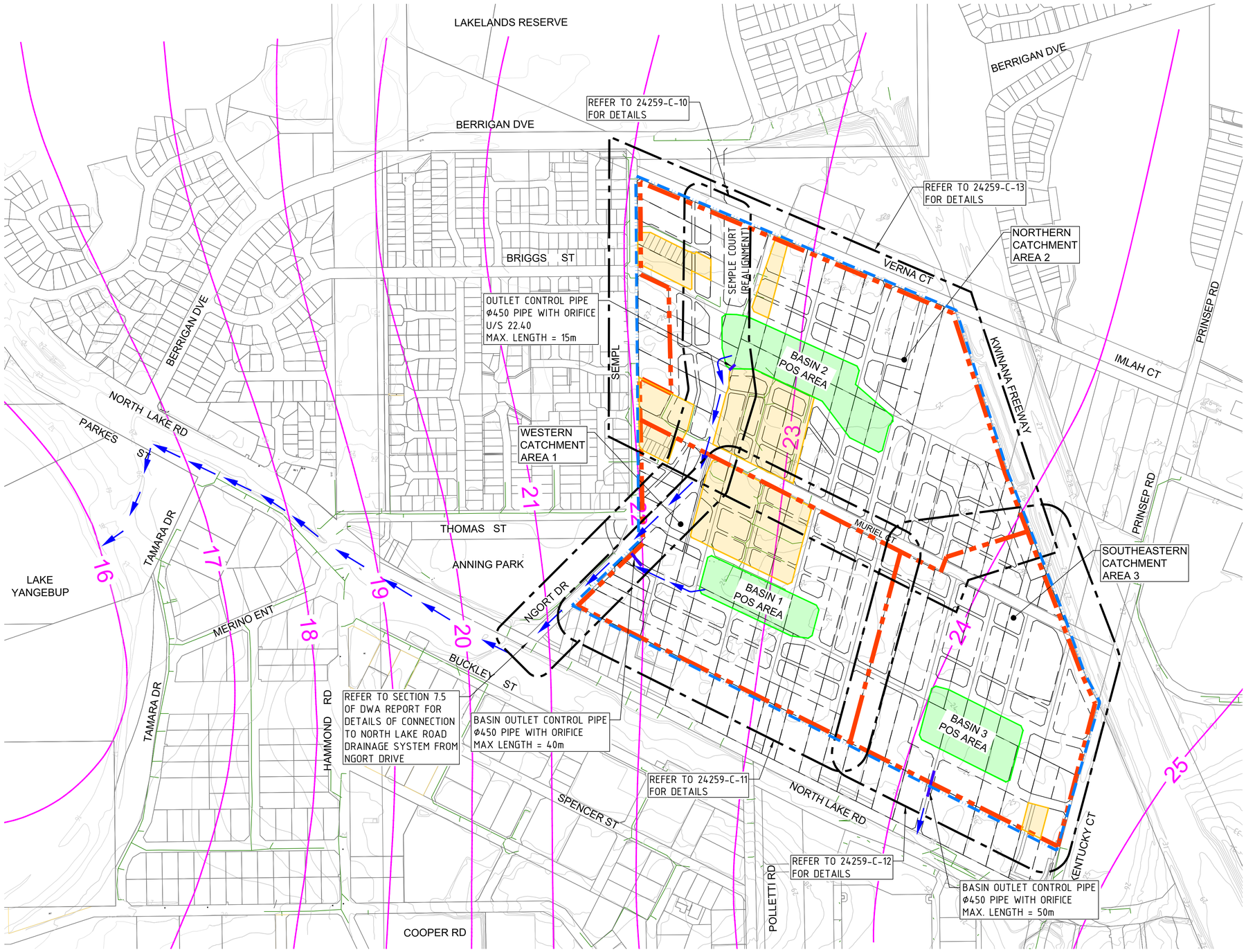
24259-C-02: Drainage Review – Catchments and Basins

24259-C-10: Ngort Drive (Semple Court Realignment) – Concept Drainage Design

24259-C-11: Western Catchment Area Details

24259-C-12: Southeast Catchment Area Details

24259-C-13: Northern Catchment Area Details



LEGEND:

- COCKBURN CENTRAL NORTH DEVELOPMENT AREA BOUNDARY
- 24 — CONTROL GWL
- CATCHMENT AREA
- EXISTING DRAIN
- DEVELOPED AREA
- POS
- 24 — EXISTING GROUND CONTOURS
- OVERFLOW ROUTE
- OUTLET CONTROL PIPE
- REFERENCE AREA TO ASSOCIATED DETAILED DRAWING

NOTE : OUTLET CONTROL PIPE TO BE 450mm DIAMETER WITH ORIFICE PLATE OF DIAMETER TO BE DETERMINED AT DETAILED DESIGN STAGE. BAFFLE TO BE INSTALLED AT UPSTREAM END OF PIPE.

metres 0 80 160 240 320 m

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scales quoted apply to original drawing scale

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C	20/05/2026	ISSUED FOR INFORMATION	DA	AR	AR	DW
D	10/06/2026	ISSUED FOR INFORMATION	KB	AR	AR	DW
E	24/06/2026	ISSUED FOR INFORMATION	KB	AR	AR	DW

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PROJECT INFORMATION

COCKBURN CENTRAL NORTH (MURIEL COURT) LOCAL WATER MANAGEMENT STRATEGY

PROPOSED DRAINAGE CATCHMENTS AND COMPENSATING BASINS

AUTHORISED BY: D. Wills 24/06/2026
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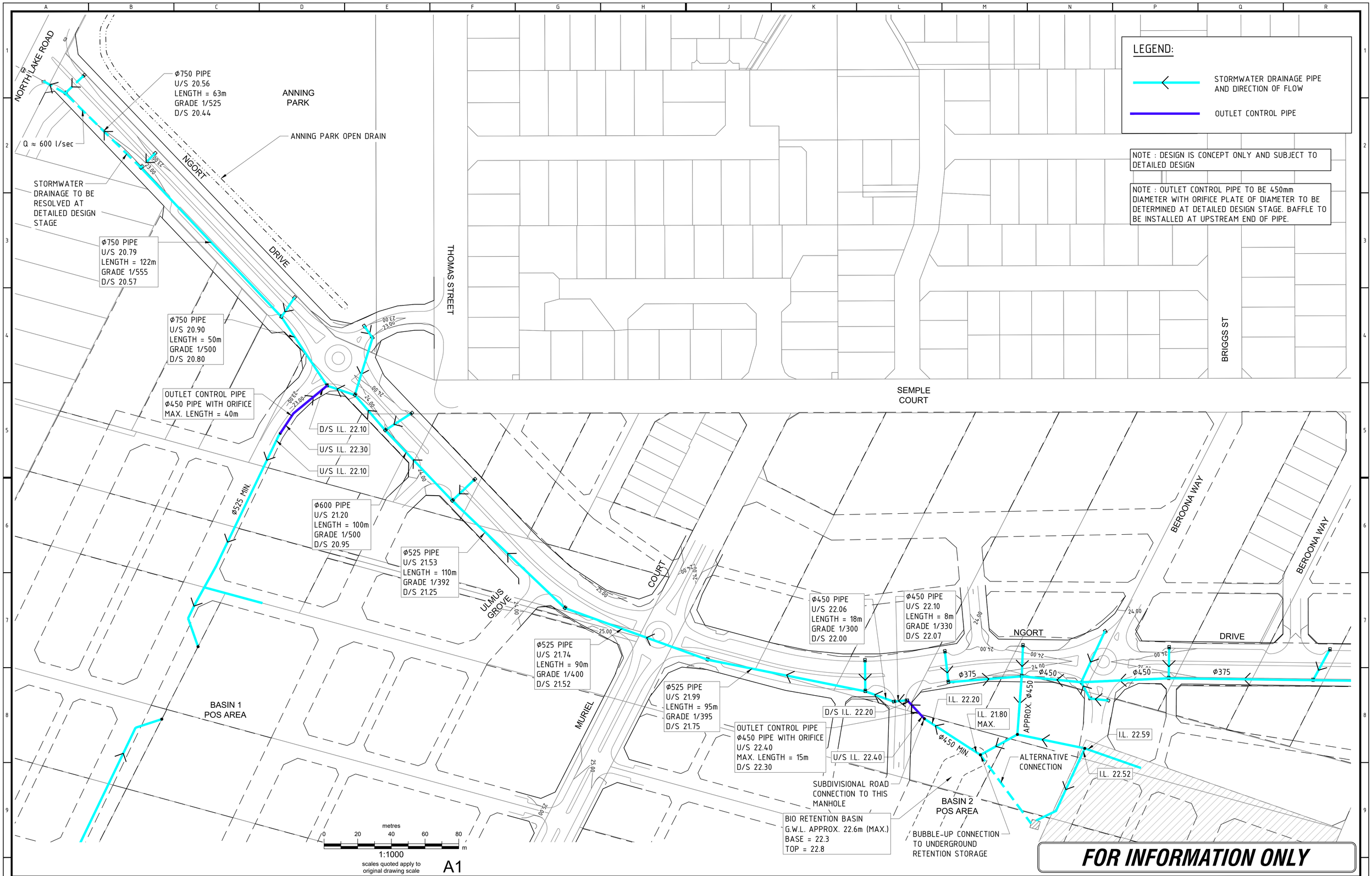

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PROJECT INFORMATION

COCKBURN CENTRAL NORTH (MURIAL COURT) LOCAL WATER MANAGEMENT STRATEGY

NGORT DRIVE (SEMPLE COURT REALIGNMENT) - CONCEPT DRAINAGE DESIGN

AUTHORISED BY: D. Wills 24/06/2026
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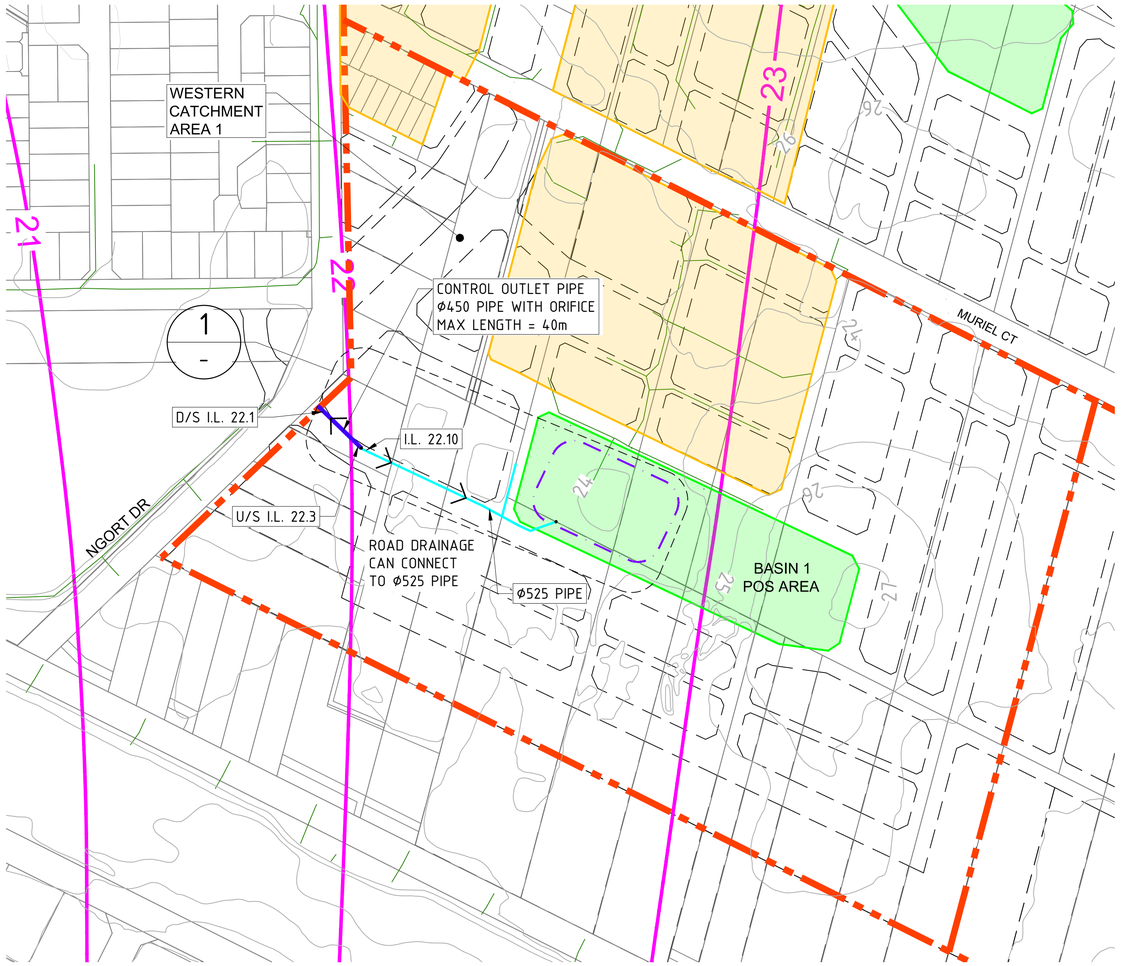

WESTERN CATCHMENT AREA

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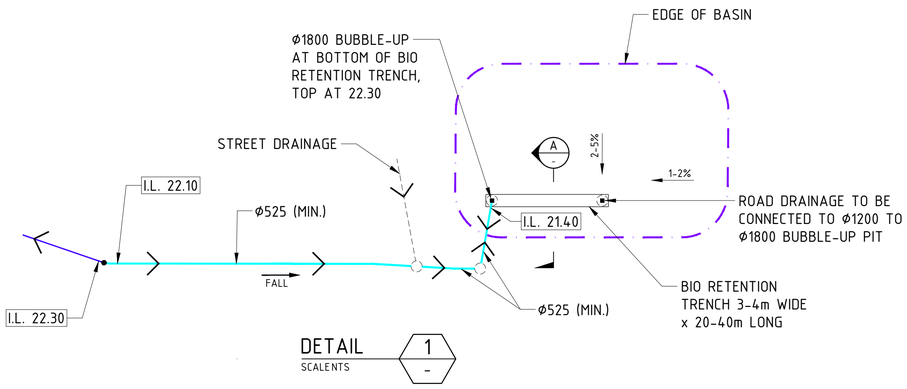
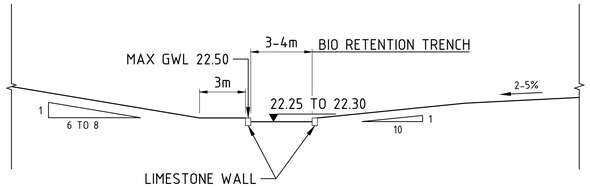


DETAIL 1 / - SCALE NTS



SECTION A / - SCALE NTS

LEGEND:

- 24 — CONTROL GWL
- CATCHMENT AREA
- EXISTING DRAIN
- DEVELOPED AREA
- POS
- 24 — EXISTING GROUND CONTOURS
- STORMWATER DRAINAGE PIPE AND DIRECTION OF FLOW
- OUTLET CONTROL PIPE
- INDICATIVE BASIN LOCATION

WESTERN CATCHMENT AREA 1 BASIN 1 CONCEPT DESIGN		
CATCHMENT AREA		24.96 ha
WEIGHTED RUNOFF CO-EFFICIENT		0.60
TIME OF CONCENTRATION		20 minutes
APPROXIMATE EXISTING GROUND LEVEL OF POS		24.0
CONTROL GROUNDWATER LEVEL		22.5
PEAK OUTFLOW TO LAKE YANGEBUP FROM BASIN		160 L/s
SLOPE OF BANKS OF BASIN		1 in 6
1 IN 10 YEAR ARI STORM EVENT	NET DETENTION STORAGE VOLUME	2,550m³
	CRITICAL DURATION	7 hr
1 IN 100 YEAR ARI STORM EVENT	NET DETENTION STORAGE VOLUME	7,700m³
	CRITICAL DURATION	12 hr
	MAXIMUM TOP WATER LEVEL	23.5
OUTLET CONTROL	DIAMETER	450mm
	MAXIMUM LENGTH	40m

NOTE:

CONTROL GROUNDWATER LEVELS SOUTH OF THE DEVELOPMENT AREA MAY VARY DUE TO CHANGE IN GROUND CONDITIONS AND THE EXISTING SUBSOIL DRAINAGE SYSTEM IN NORTH LAKE ROAD.

NOTE:

CONTROL POINT IS AT THE CONNECTION INTO NGORT DRIVE DRAINAGE SYSTEM. THE CONTROL PIPE LENGTH IS VERY SENSITIVE TO THE FINAL TWL.

NOTE:

OUTLET CONTROL PIPE TO BE 450mm DIAMETER WITH ORIFICE PLATE OF DIAMETER TO BE DETERMINED AT DETAILED DESIGN STAGE. BAFFLE TO BE INSTALLED AT UPSTREAM END OF PIPE.

metres
0 40 80 120 160 m
1:2000
scales quoted apply to original drawing scale
A1

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REV	DATE	ISSUE / REVISION DESCRIPTION	DRN	CH DRN	DES ENG	AUTH
A	11/12/2025	ISSUED FOR INFORMATION	DA	AR	AR	DW
B	20/05/2026	ISSUED FOR INFORMATION	DA	AR	AR	DW
C	10/06/2026	ISSUED FOR INFORMATION	KB	AR	AR	DW
D	24/06/2026	ISSUED FOR INFORMATION	KB	AR	AR	DW

DRAWING REFERENCES

DRAWING NUMBER	DRAWING TITLE / DESCRIPTION

NORTH

CLIENT INFORMATION

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PROJECT INFORMATION

COCKBURN CENTRAL NORTH (MURIEL COURT)
LOCAL WATER MANAGEMENT STRATEGY

WESTERN CATCHMENT AREA 1 DETAILS

AUTHORISED BY: D. Wills 24/06/2026
David Wills
AIT(Civil) GradDipB FIEAust CPEng EngExec NER

CLIENT REF --- SCALE AS SHOWN @A1

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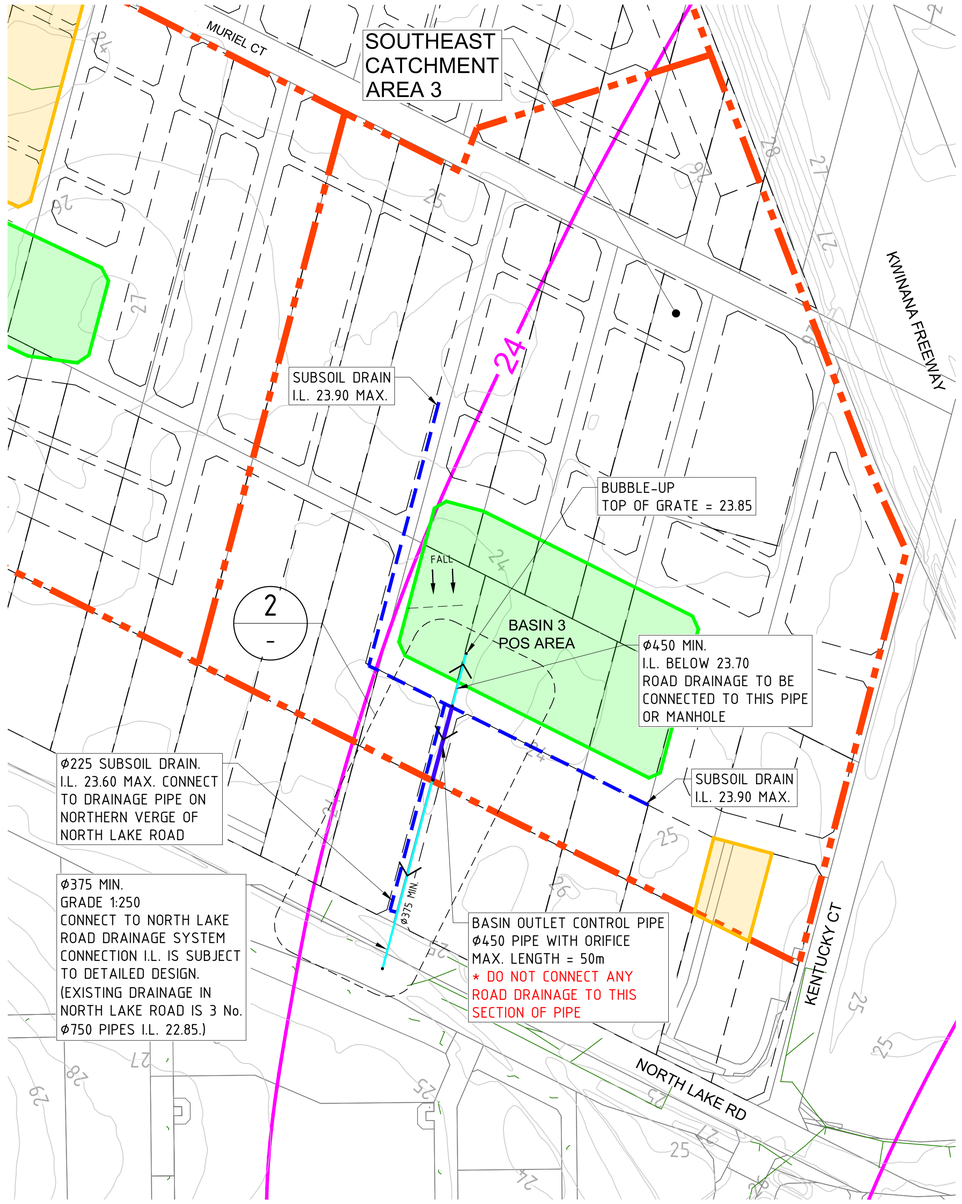
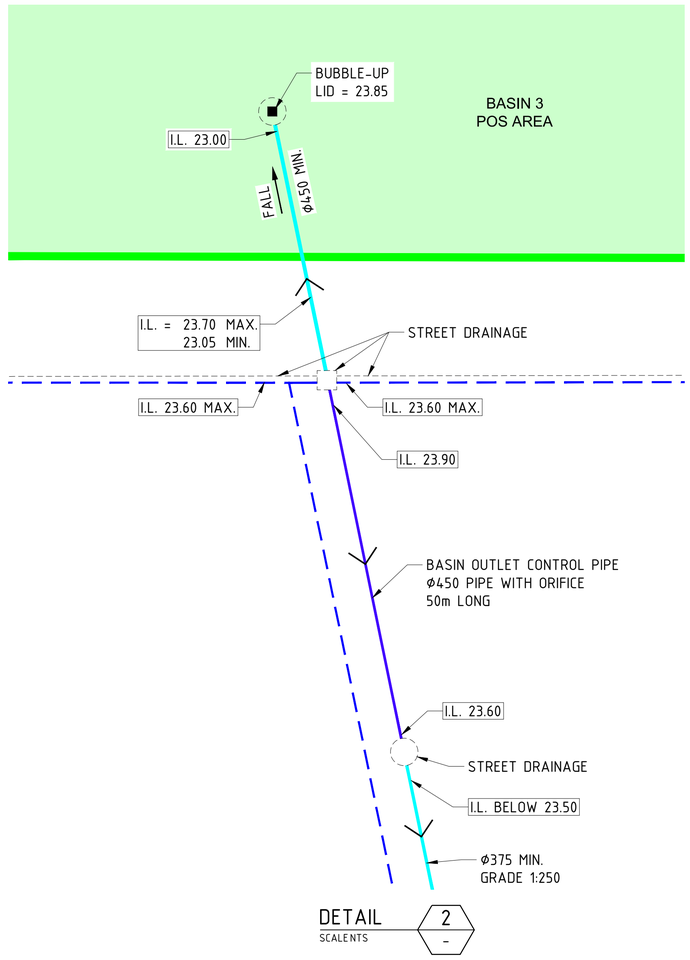


SOUTHEASTERN CATCHMENT AREA

SCALE 1:2000



DETAIL 2

SCALENTS -

LEGEND:

- 24 — CONTROL GWL
- CATCHMENT AREA
- EXISTING DRAIN
- DEVELOPED AREA
- POS
- 24 — EXISTING GROUND CONTOURS
- ϕ225 SUBSOIL DRAINS TO BE INSTALLED WITHIN THIS AREA SET I.L. MIN. 0.4m BELOW CONTROL GWL CONTOUR
- STORMWATER DRAINAGE PIPE AND DIRECTION OF FLOW
- OUTLET CONTROL PIPE

SOUTHEASTERN CATCHMENT AREA 3 BASIN 3 CONCEPT DESIGN		
CATCHMENT AREA		22.15 ha
WEIGHTED RUNOFF CO-EFFICIENT		0.65
TIME OF CONCENTRATION		20 minutes
APPROXIMATE EXISTING GROUND LEVEL OF POS		24.0
CONTROL GROUNDWATER LEVEL		24.0
PEAK OUTFLOW TO LAKE YANGEBUP FROM BASIN		155 L/s
SLOPE OF BANKS OF BASIN		1 in 6
1 IN 10 YEAR ARI STORM EVENT	NET DETENTION STORAGE VOLUME	5,530m³
	CRITICAL DURATION	8 hr
1 IN 100 YEAR ARI STORM EVENT	NET DETENTION STORAGE VOLUME	9,210m³
	CRITICAL DURATION	20 hr
	MAXIMUM WATER LEVEL	24.7
OUTLET CONTROL	DIAMETER	450mm
	MAXIMUM LENGTH	50m

NOTE:
CONTROL GROUNDWATER LEVELS SOUTH OF SOUTHEAST CATCHMENT AREA 3 MAY VARY DUE TO CHANGE IN GROUND CONDITIONS AND THE EXISTING SUBSOIL DRAINAGE SYSTEM IN NORTH LAKE ROAD

NOTE:
OUTLET CONTROL PIPE TO BE 450mm DIAMETER WITH ORIFICE PLATE OF DIAMETER TO BE DETERMINED AT DETAILED DESIGN STAGE. BAFFLE TO BE INSTALLED AT UPSTREAM END OF PIPE.

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PROJECT INFORMATION: COCKBURN CENTRAL NORTH (MURIEL COURT) LOCAL WATER MANAGEMENT STRATEGY

SOUTHEASTERN CATCHMENT AREA 3 DETAILS

AUTHORISED BY: D. Wills 24/06/2026
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CLIENT REF ---

SCALE AS SHOWN @A1

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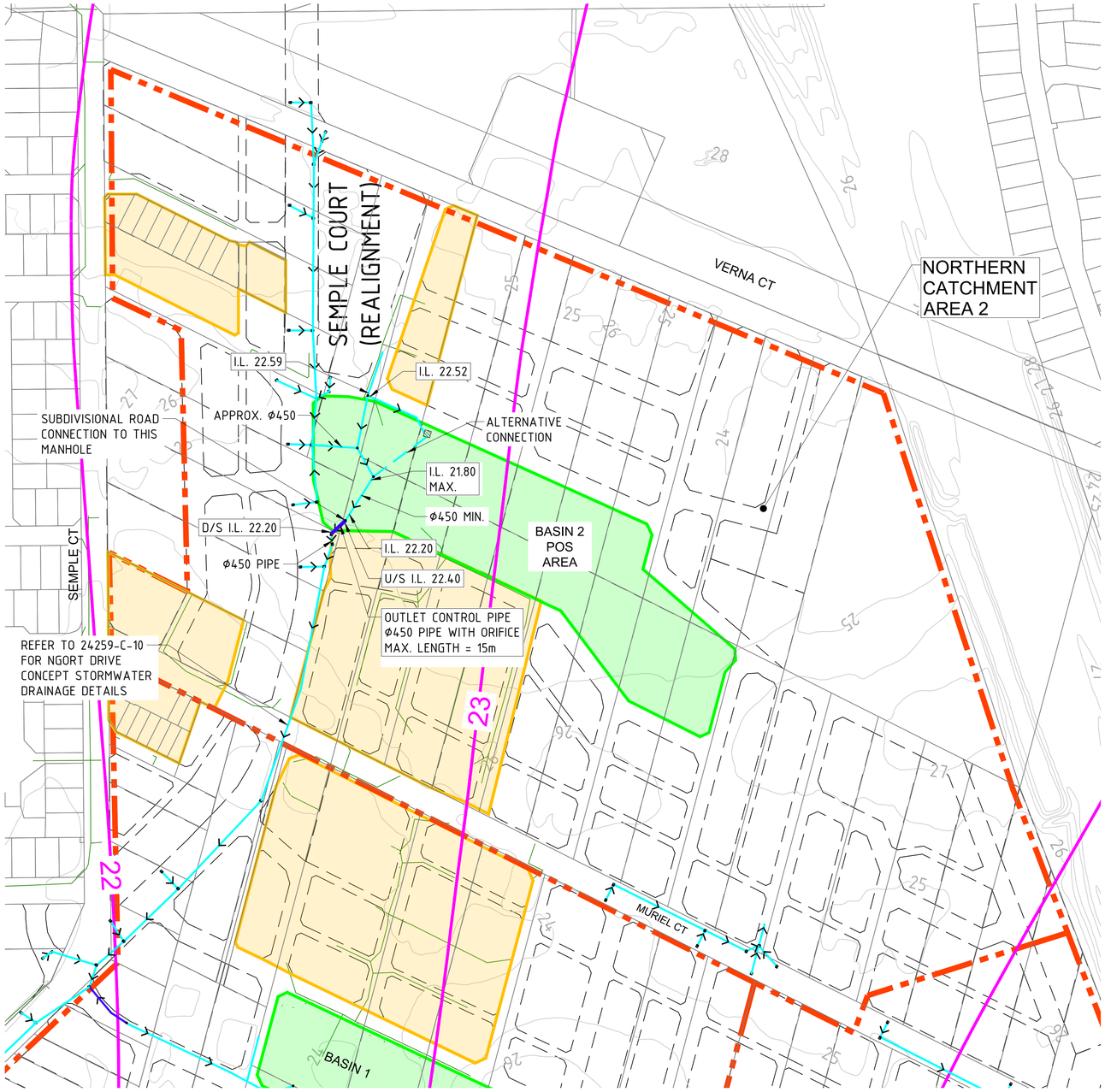

LEGEND:

- 24 — CONTROL GWL
- CATCHMENT AREA
- EXISTING DRAIN
- DEVELOPED AREA
- POS
- 24 — EXISTING GROUND CONTOURS
- ϕ225 SUBSOIL DRAINS TO BE INSTALLED WITHIN THIS AREA SET I.L. MIN. 0.4m BELOW CONTROL GWL CONTOUR
- STORMWATER DRAINAGE PIPE AND DIRECTION OF FLOW
- OUTLET CONTROL PIPE

NORTHERN CATCHMENT AREA 2 BASIN 2 CONCEPT DESIGN		
CATCHMENT AREA		29.00 ha
WEIGHTED RUNOFF CO-EFFICIENT		0.58
TIME OF CONCENTRATION (INFLOW TO BASIN)		20 minutes
APPROXIMATE EXISTING GROUND LEVEL OF POS		24.0
CONTROL GROUNDWATER LEVEL		22.4
PEAK OUTFLOW TO LAKE YANGEBUP FROM BASIN		200 L/s
SLOPE OF BANKS OF BASIN		1 in 6
1 IN 10 YEAR ARI STORM EVENT	NET DETENTION STORAGE VOLUME	2,800m³
	CRITICAL DURATION	7 hr
1 IN 100 YEAR ARI STORM EVENT	NET DETENTION STORAGE VOLUME	8,550m³
	CRITICAL DURATION	12 hr
	MAXIMUM WATER LEVEL	23.5
OUTLET CONTROL	DIAMETER	450mm
	MAXIMUM LENGTH	15m

NOTE:
CONTROL GROUNDWATER LEVELS SOUTH OF THE DEVELOPMENT AREA MAY VARY DUE TO CHANGE IN GROUND CONDITIONS AND THE EXISTING SUBSOIL DRAINAGE SYSTEM IN NORTH LAKE ROAD.

NOTE:
OUTLET CONTROL PIPE TO BE 450mm DIAMETER WITH ORIFICE PLATE OF DIAMETER TO BE DETERMINED AT DETAILED DESIGN STAGE.
BAFFLE TO BE INSTALLED AT UPSTREAM END OF PIPE.

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PROJECT INFORMATION: COCKBURN CENTRAL NORTH (MURIEL COURT) LOCAL WATER MANAGEMENT STRATEGY

NORTHERN CATCHMENT AREA 2 DETAILS

AUTHORISED BY: D. Wills 24/06/2026
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