LOCAL PLANNING SCHEME AMENDMENT REQUEST

Lot 106 (No.62) Cheriton Road, Gingin

ROWE GROUP

OUR REF: 9929 11/12/2025

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2. Indicative Concept Plan
3. Environment Assessment Report
4. Site and Soil Evaluation
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1. Introduction

1.1 Purpose of Scheme Amendment Request

Rowe Group acts on behalf of the landowner of Lot 106 (No.62) Cheriton Road, Gingin (**subject site** or **site**) with respect to the above.

The subject site is legally described as follows:

LOT NUMBER	VOLUME / FOLIO	DEPOSTIED PLAN	AREA	PROPRIETOR
106	1984/189	85529	26.017ha	Fairlands Farm Pty Ltd

Copies of the Certificates of Title are included as **Attachment 1**.

This SAR seeks Council's support, pursuant to Section 75 of the *Planning and Development Act 2005* (**PD Act**), to amend the Shire of Gingin Local Planning Scheme No.9 (**LPS9**). The purpose of this Scheme Amendment Request is to rezone the subject site from 'General Rural' to 'Rural Living' (RL1).

1.2 Consultation

The following is a detailed summary of consultations undertaken as part of the Scheme Amendment request

1.2.1 Shire of Gingin

A meeting with senior planning staff at the Shire via teleconference occurred on 28 August 2024 to discuss the proposed rezoning and intent. A preliminary Concept Plan was also presented for the site to demonstrate how it could accommodate a '*Rural Living*' (1 ha) subdivision as well as vehicle access.

The Shire subsequently offered its preliminary support to rezone the site given its intended classification within the Shire's Local Planning Strategy. Furthermore its proximity to the Gingin townsite, the southern abutting Lot 105 Cheriton Road (zoned 'Special Use 9' to accommodate a lifestyle village and supporting uses) and surrounding residential-zoned lots (ranging between R2 to R10) to the wider south make the subject site a desirable location for a subdivision that is consistent with its surrounds.

At this juncture, the Shire also viewed the proposal as representing a suitable "transition" between the aforementioned surrounding lots and the existing '*Rural Living*' ('*RL4*' - minimum 4 ha lot size) lots to the north. Accordingly, subject to the relevant technical reporting being undertaken, and as any future subdivision will likely be undertaken in a single stage, a subdivision without a structure plan would be supported in the rezoning proposal.

1.2.2 Department of Planning, Lands and Heritage

Rowe Group discussed the proposal via telephone with senior planning staff at the DPLH on 3 September 2024. DPLH provided subsequent advice via return email on 4 September 2024. In its response, DPLH advised of its general support for a rezoning proposal and concurred with the Shire's position that a structure plan would not be required. As above, the latter of which is on the basis that the relevant technical reporting (i.e. site and soil evaluation, drainage, environmental) is undertaken in support of the Concept Plan and overall rezoning proposal.

2. Description of Site

2.1 Location

The subject site is approximately 26ha in area and is located approximately 900m north of the Gingin main townsite. The site is also situated approximately 550m north of the Gingin District High School and immediately adjoins the Gingin Brook along its eastern boundary. The site gradually falls from Cheriton Road to the west, towards the Gingin Brook to the east. The undulation affords scenic views of the rural valleys towards Mooliabeenee and beyond.

Refer **Figure 1 – Regional Location**.

The subject site is situated within the Gingin townsite and bound by Cheriton Road on its western boundary, and Edgar Street to its east. While both roads are gazetted roads, only Cheriton Road is sealed where it abuts the subject property.

Refer **Figure 2 – Local Location.**

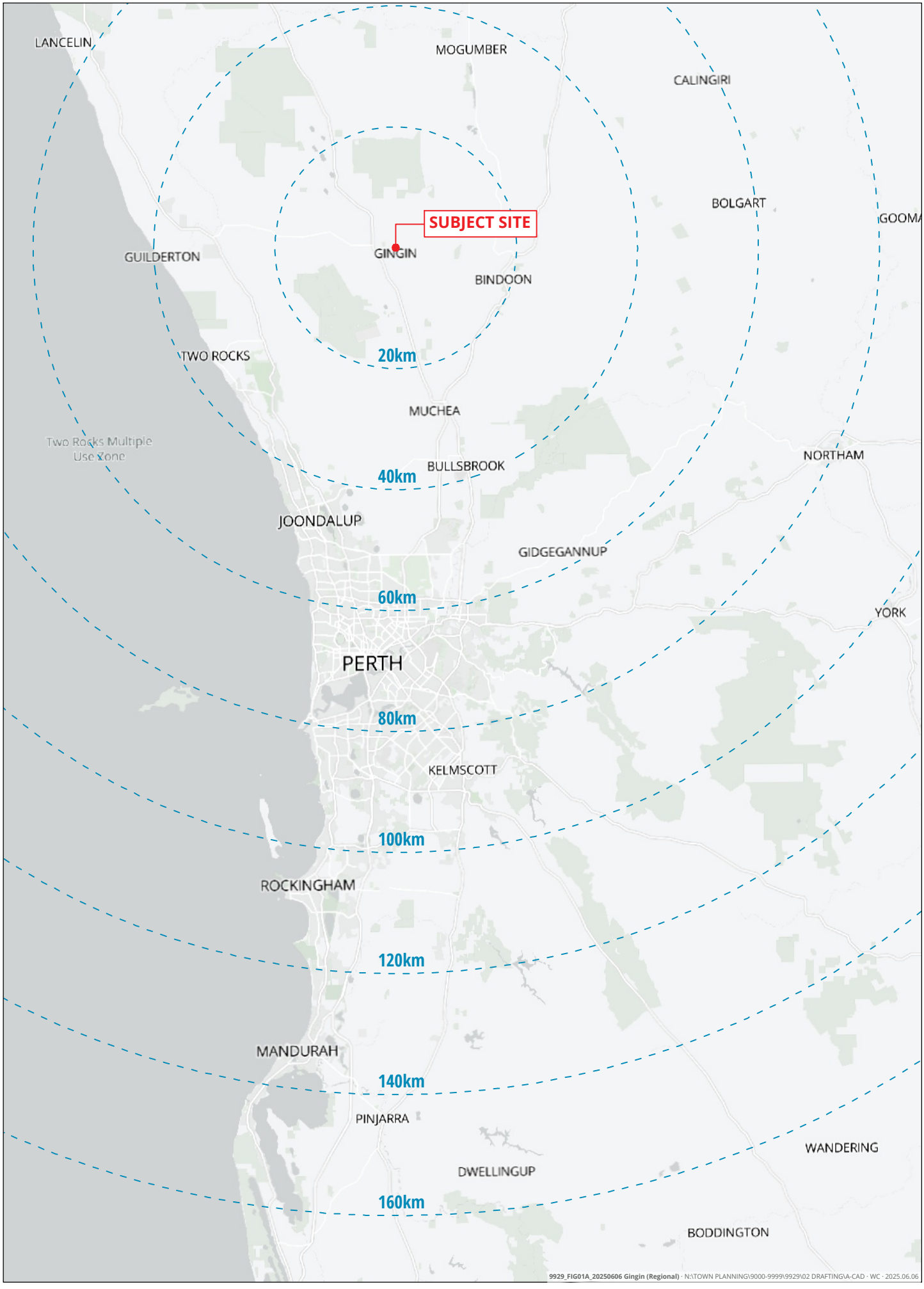
2.2 Existing Improvements

The site has historically been used as an olive orchard since circa late 1990s, with an existing dwelling and supporting infrastructure (outbuilding and water tank) built at approximately the same time as the orchards were first installed. Aside from the existing agricultural land-use, the site is generally cleared of vegetation except for a small amount of natural regrowth in the south-east corner and along a portion of the south-west frontage of the site.

2.3 Existing Services

The site is currently serviced by reticulated (scheme) water, mains electricity, and telecommunications, all of which are available at the subject site. Reticulated sewerage is not available in this locality, consistent with the Shire of Gingin where only selected coastal townsites are sewered. Therefore, the site relies on an approved on-site effluent disposal system. The existing service provision is adequate to support the proposed amendment.

A registered power transmission easement traverses the property in a near north-south direction, providing corridor access for Western Power's overhead electricity infrastructure. The easement accommodates high-voltage distribution lines and associated maintenance requirements, ensuring uninterrupted regional power supply. Development within this corridor is restricted in accordance with Western Power's safety and access provisions, and the easement does not adversely impact the balance of the site's developable area.



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FIGURE 1

REGIONAL LOCATION

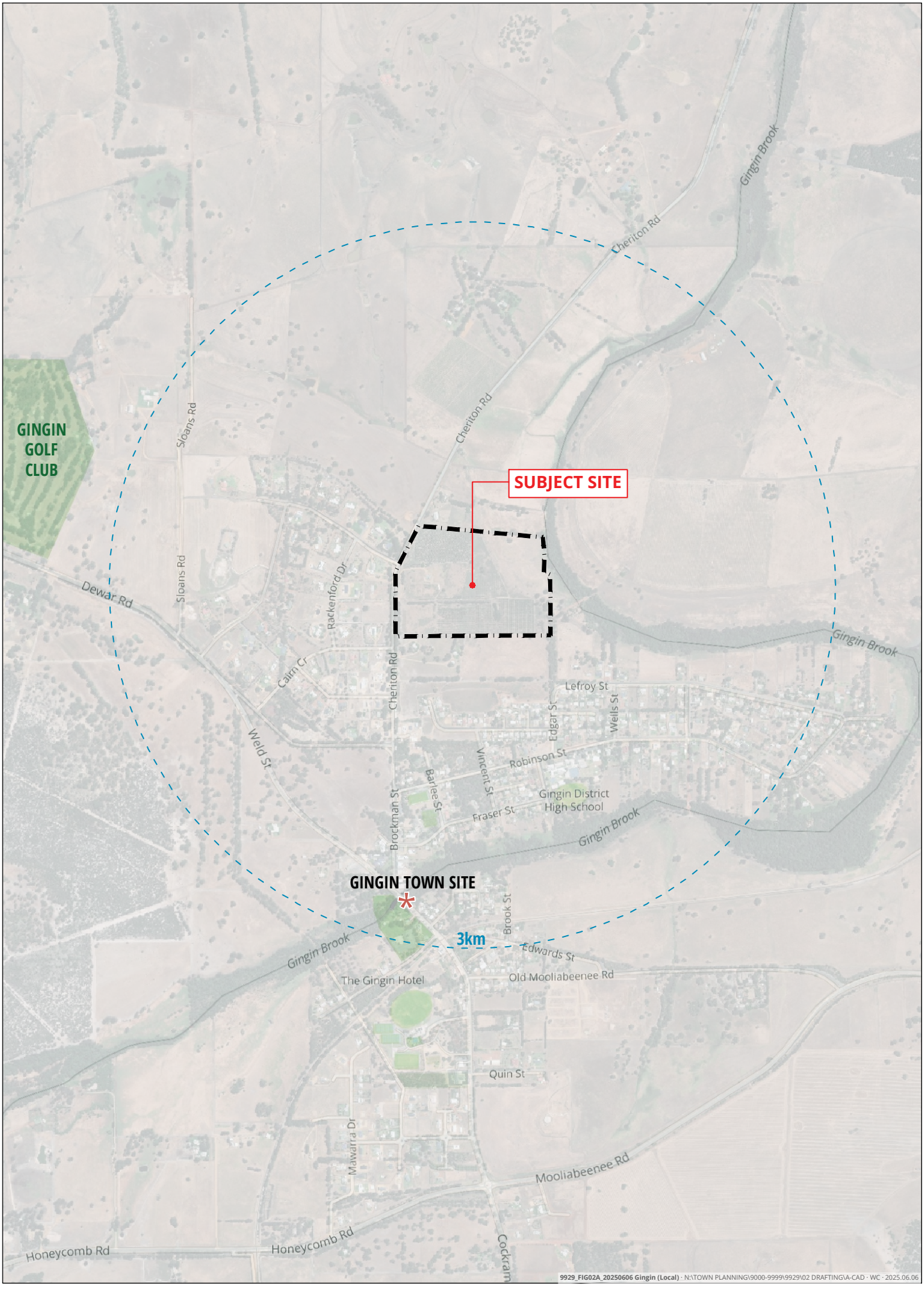


FIGURE 2
LOCAL CONTEXT

3. Scheme Amendment Proposal

3.1 Current Zoning

3.1.1 Shire of Gingin Local Planning Scheme No.9

The subject size is zoned '*General Rural*', pursuant to LPS9. The land has historically been used for agricultural purposes, as described above, which is consistent with its current zoning.

There are two Special Control Areas (**SCA**) that extend within portions of the subject site, as follows:

- '*Special Control Area No. 1 – River Environs Management Area*' – which relates to the healthy functioning of Gingin Brook; and
- '*Special Control Area No. 2 – Public Drinking Water Areas'* – which seeks to protect the town's primary water supply.

Both SCAs contain specific clauses within Part 5 of LPS9, neither of which would be detrimentally affected by a change in zoning of the site.

An amendment to LPS9 is requested for the following reasons:

- No ongoing planning purpose – the subject site can no longer operate its rural use economically due to both its total lot area and its designation as a sewage sensitive location.
- Strategic purpose –The Shire of Gingin Local Planning Strategy identifies the site for future urban expansion.
- The Gingin Regional Land Supply Assessment (2018) identifies the subject site as a possible urban expansion area.

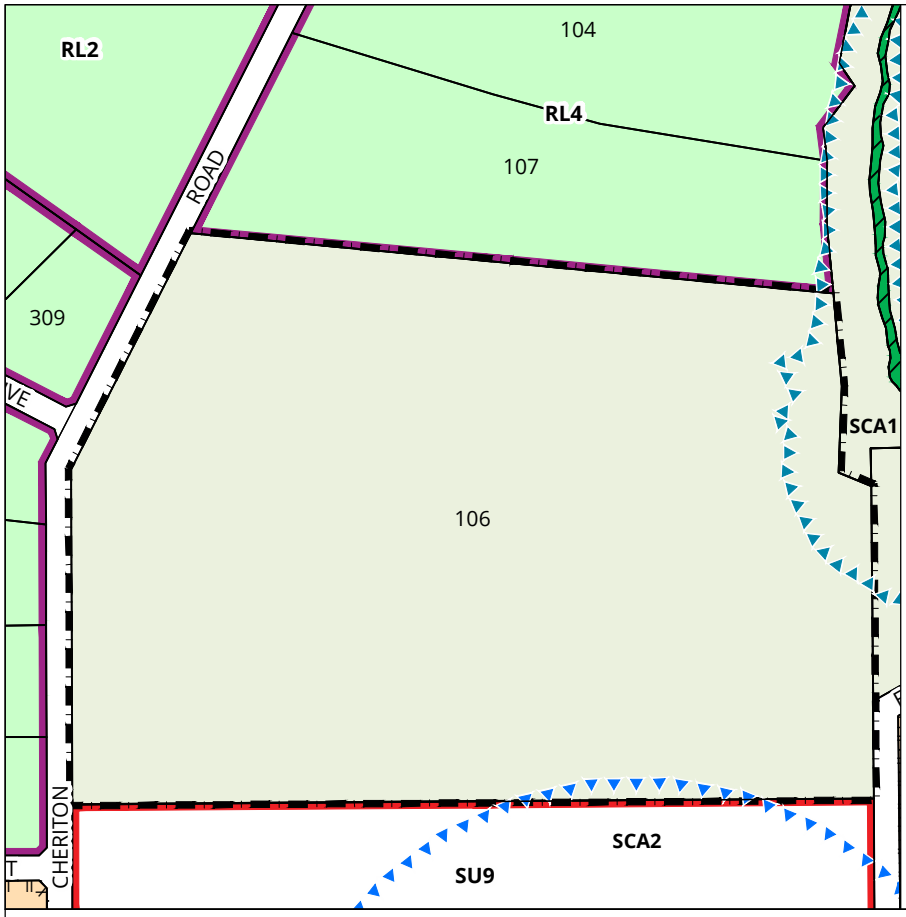
3.2 Local Planning Scheme Amendment Proposal

This SAR proposes to rezone the subject site from 'General Rural' to 'Rural Living' with a density coding of 'RL1' being a minimum one hectare lots.

In relation to the rezoning to 'Rural Living' aspect of the proposal, the objectives of the Rural Living Zone as described in Clause 3.2.6 of LPS9 are to:

a) protect the rural environment and landscape;
b) accommodate single dwellings at very low densities on individual allotments beyond the urban areas;
c) restrict and limit the removal of natural vegetation and encourage revegetation where appropriate;
d) prevent threats to the amenity of the zone and impacts on wildlife and native vegetation caused by the grazing of livestock;
e) avoid increased fire risk to life and property through inappropriately located and designed land use, subdivision and development; and
f) provide for a suitable level of physical and community infrastructure.

Refer to **Figure 3 – LPS Existing and Proposed Zoning Map.**



LEGEND

- SUBJECT SITE

LOCAL SCHEME RESERVES

- PARKS AND RECREATION

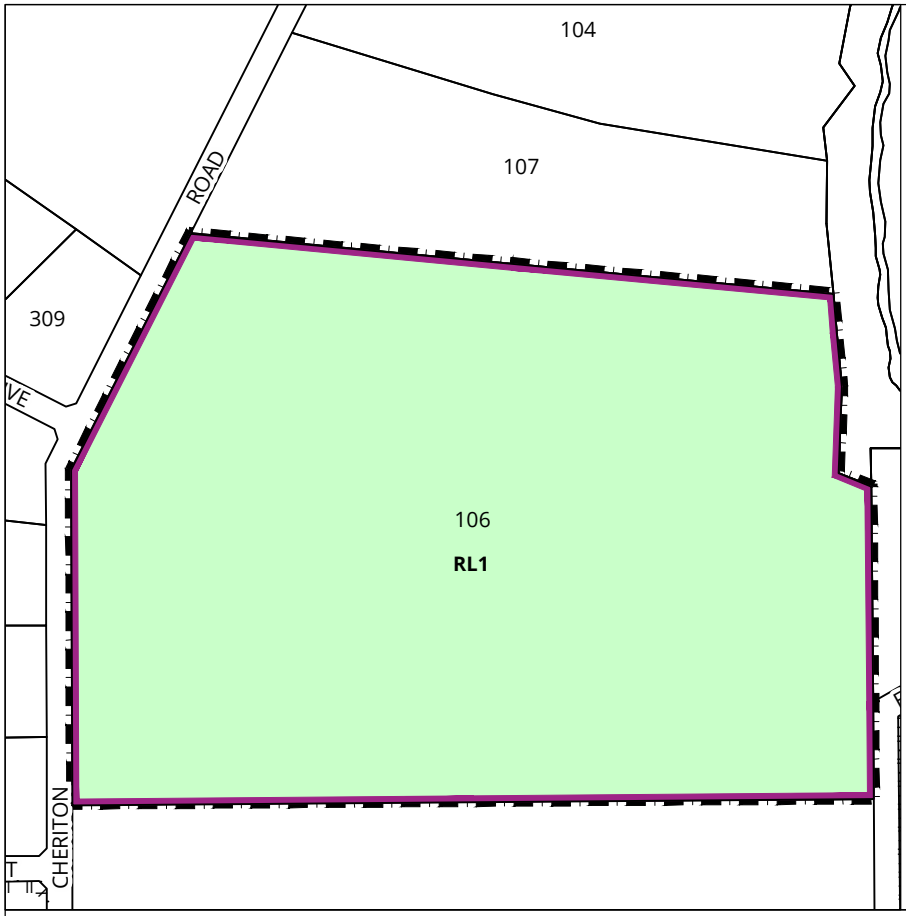
LOCAL SCHEME ZONES

- GENERAL RURAL
- RURAL LIVING
- SPECIAL USE

OTHER CATEGORIES

- **R20** R CODES
- **RL1** RURAL LIVING
- **SU1** SPECIAL USE AREA
- **SCA1** RIVER ENVIRONS AREA
- **SCA2** PUBLIC DRINKING WATER SOURCE

EXISTING ZONING



LEGEND

- SUBJECT SITE

LOCAL SCHEME ZONES

- RURAL LIVING

OTHER CATEGORIES

- **RL1** RURAL LIVING

PROPOSED ZONING

9929_FIG07A_20250606 Gingin (LPS Rezoning Plan) · N:\TOWN PLANNING\9000-9999\9929\02 DRAFTING\A-CAD · WC · 2025.06.09

0 200 m

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N

FIGURE 3

PROPOSED SHIRE OF GINGIN LOCAL PLANNING SCHEME No. 9 ZONING

3.3 Concept Plan Revisions

An indicative concept plan has been prepared to support the Scheme Amendment application, as a point of reference (see **Attachment 2)**.

While the concept plan is not intended to form part of the Scheme Amendment, it provides an indication of how a future subdivision layout can both respond to the site's complexities, while also providing beneficial improvements to existing civil engineering constraints (stormwater redirection and quality improvement into the Gingin Brook, road reserve normalisation) within the vicinity of the subject site.

In response to the Shire's and the DPLH's feedback regarding the Indicative Concept Plan, revisions to the original concept plan were made by:

- Shifting of the internal road alignment from the northern boundary to the southern boundary;
- Addition of two drainage reserves to:
  - better align the stormwater drainage from Cheriton Road to the Gingin Brook catchment; and
  - Significantly improve water quality through natural drainage lines to Gingin Brook.
- Addition of an emergency access way on the south-eastern corner of the site for bushfire access to Edgar Street; and
- Reconfiguring the lots accordingly.

The indicative concept plan demonstrates how a successful subdivision can improve the locality, and provides demonstrable justification that a rezoning of the subject site is appropriate.

4. Planning Justification

4.1 Planning and Development (Local Planning Schemes) Regulations 2015

Part 4 of Schedule 2 of the *Planning and Development (Local Planning Schemes) Regulations 2015* (**LPS Regulations**) establishes the Deemed Provisions relating to statutory framework and rationale for the preparation of Local Structure Plans. These plans serve as the primary planning instrument for informing future subdivision, zoning, and development of land within a designated area.

For amendments to a local planning scheme, Regulation 35(2) of Part 5 of the LPS Regulations requires the resolution of the local government to specify whether, in its opinion, the amendment is a basic, standard or complex amendment, and to also include an explanation for forming its opinion.

The proposed Scheme Amendment is considered to be a 'standard' amendment for the following reasons:

- The amendment is consistent with the Shire of Gingin Local Planning Strategy.
- The amendment will have minimal impact on land in the scheme area that is not the subject of this amendment.
- The amendment does not result in any significant environmental, social, economic or governance impacts on the land in the scheme area.
- The amendment would not be consistent with a 'basic' or 'complex' amendment classification.

4.1.1 No Structure Plan

This Scheme Amendment Request does not provide for a Structure Plan mechanism with LPS9 to facilitate subdivision of the subject site.

Clause 15 'Deemed Provisions' within the LPS Regulations provides the statutory basis for when and how a Structure Plan may be prepared. Specifically Clause 15 states:

> ***"15. When a Structure Plan may be prepared***
>
> *A structure plan in respect of an area of land in the Scheme area may be prepared if —*
>
> *(a) the area is —*
>
> *(i) all or part of a zone identified in this Scheme as an area suitable for urban or industrial development; and*
>
> *(ii) identified in this Scheme as an area requiring a structure plan to be prepared before any future subdivision or development is undertaken; or*
>
> *(b) a State planning policy requires a structure plan to be prepared for the area; or*
>
> *(c) the Commission considers that a structure plan for the area is required for the purposes of orderly and proper planning"*

In this instance, the proposal seeks to rezone and develop a single property, and where any subdivision of the land subsequent to its rezoning would be undertaken within a single stage. It furthermore does not propose to construct any essential service infrastructure that is not already immediately available at the site.

PLANNING AND DEVELOPMENT ACT 2005

RESOLUTION TO ADOPT AMENDMENT TO LOCAL PLANNING SCHEME

SHIRE OF GINGIN LOCAL PLANNING SCHEME NO. 9

AMENDMENT NO. 29

Resolved that the Local Government pursuant to section 75 of the *Planning and Development Act 2005*, amend the above Local Planning Scheme by:

1. Rezoning Lot 106 Cheriton Road, Gingin from 'General Rural' to 'Rural Living' (RL 1).
2. Amend the Scheme Map accordingly.

The amendment is standard under the provisions of the *Planning and Development (Local Planning Schemes) Regulations* 2015 for the following reason(s):

1. It aligns with the Shire's Local Planning Strategy 2012, as the subject land is identified as 'potential urban';
2. It will have minimal impact on land in the Scheme area that is not the subject of the amendment;
3. It may not result in any significant environmental, social, economic or governance impacts on land in the Scheme area; and
4. It is not considered a complex or basic amendment.

Dated this ____Seventeenth___ day of ___March___ 2026

_____

(Chief Executive Officer)

Given the above, this Scheme Amendment Request seeks a modification to the Scheme map only. No text modifications are required.

4.2 Local Planning Strategy

Figures 2 and 3 of the Shire's *Local Planning Strategy* (**LP Strategy**) identifies the site for 'Future Urban' and '*Potential urban subject to planning studies*' respectively. Moreover, Section 2.3.3.1 of the LP Strategy refers to the objectives for the Gingin Townsite, which reference the area being mapped within the *Gingin Townsite and Rural Surrounds Structure Plan*.

This structure plan, prepared in 2012, and endorsed by the Western Australian Planning Commission (**WAPC**) in 2014, sets out the planning framework for the Gingin Townsite and surrounds until 2031. Section 4.2.5 of the endorsed structure plan is particularly relevant to the subject site. This section identifies the lot for Rural Living zoning, with minimum lot sizes of 1ha.

4.3 Government Sewerage Policy

The Government Sewerage Policy (2019) (**GSP**) establishes the State's framework for ensuring that wastewater is managed in a manner that protects public health, groundwater resources, waterways and the broader environment. Its intent is to guide where deep sewerage is required, where on-site effluent disposal may be permitted, and the conditions under which unsewered subdivision or development can proceed. The policy sets minimum site capability standards relating to soil permeability, land slope, flood risk, groundwater clearance and setbacks from sensitive water resources, and introduces stricter controls within Sewage Sensitive Areas to safeguard drinking water supplies and vulnerable environments. In the context of scheme amendments, the policy provides the regulatory basis for determining whether proposed lot sizes, land capability and effluent management systems are appropriate to support sustainable on-site wastewater treatment.

In this instance, the subject site is located within an established sewage sensitive location. Accordingly, this application is supported by a Site and Soil Evaluation. This is described further in section 5 below.

4.4 State Planning Policy 2.5 – Rural Planning

State Planning Policy 2.5 (**SPP2.5**) provides the State framework for protecting rural land, guiding land-use change, and supporting sustainable rural communities. The policy seeks to ensure that rural land is managed to maintain agricultural productivity, protect environmental values, and avoid incompatible land-use conflict.

The proposed amendment to rezone the subject land from Rural to Rural Living is consistent with the intent and provisions of SPP2.5 for the following reasons:

1. **Protection of Agricultural Land**

   The subject land is not identified as priority or strategic agricultural land and does not contribute significantly to broadacre or intensive agricultural production. Rezoning will not result in the fragmentation or loss of land required for ongoing agricultural purposes.

2. **Appropriate Location for Rural Living**

   SPP2.5 supports Rural Living development where there is demonstrated demand, suitable land capability, and proximity to existing or planned services. The land is appropriately located relative to established rural-living subdivisions within the Shire of Gingin, and the rezoning represents a logical extension of existing settlement patterns, consistent with the LP Strategy.

3. **Land Capability and Environmental Considerations**

   The site is capable of supporting Rural Living development without significant environmental impact. Identified constraints such as drainage, vegetation, or landscape values can be effectively managed through subsequent structure planning, subdivision, and development controls.

4. **Minimisation of Land-Use Conflict**

   The proposal will not introduce incompatible land uses into an area of active rural production. The rezoning will maintain acceptable separation from agricultural activities and is expected to reduce the potential for conflict inherent in mixed-use rural areas.

5. **Alignment with Strategic Planning**

   The proposal aligns with the strategic direction of the LP Strategy, which identifies opportunities for rural-living growth in appropriate locations. The subject Scheme Amendment request supports orderly and proper planning by providing a controlled transition between rural and rural-residential land uses.

Overall, the rezoning is consistent with the objectives and policy measures of SPP2.5, as it provides for managed rural-living development with a density of RL1 and in a location that will not compromise rural land values, agricultural productivity, or the broader rural landscape.

4.5 State Planning Policy 2.7 - Public Drinking Water Source and Draft SPP2.9 – Water Resources

Generally speaking, *State Planning Policy 2.7 - Public Drinking Water Source* (**SPP2.7**) applies as the formative policy relating to water management in water sensitive locations. However, *draft State Planning Policy 2.9* – Water Resources (**SPP2.9**) remains a seriously entertained document, able to be applied in the correct context (Clause 4 of SPP2.9). Both policies seek to protect and improve the State's water resources.

A review of the site in context of SPP2.9 reveals the site is located within 1km of a significant wetland. A small portion of the site is also located within the Gingin Water Reserve (see **Figure 4**).

The indicative concept plan has taken into consideration water sensitive design, and appropriate on-site wastewater management, demonstrating the subject site is capable of an increase in residential density. Furthermore, the preliminary design affords greater protection of the Gingin Brook by locating its key entry road in a location that manages upstream run-off. It is expected that nutrient stripping plant media will be planted within the open V-drains to enhance water quality and flow entering the Gingin Brook.

4.6 State Planning Policy 3.7 - Bushfire

State Planning Policy 3.7 (SSP3.7) nominally applies at the eastern end of the site, immediately abutting the Gingin Brook (See Figure 5). The indicative layout has taken into consideration the location of the bushfire prone area, and attempted to minimise the impacts associated with assets within bushfire prone areas. It is noted that the indicative layout does not yet provide building envelope locations, however in combination with SPP2.7 and SPP2.9, the setback requirements from the brook will likely place any habitable building outside of the fire-prone areas. Where this is not achievable, any future application for subdivision will be supported by a Bushfire Management Plan, in accordance with the provisions of SPP3.7.

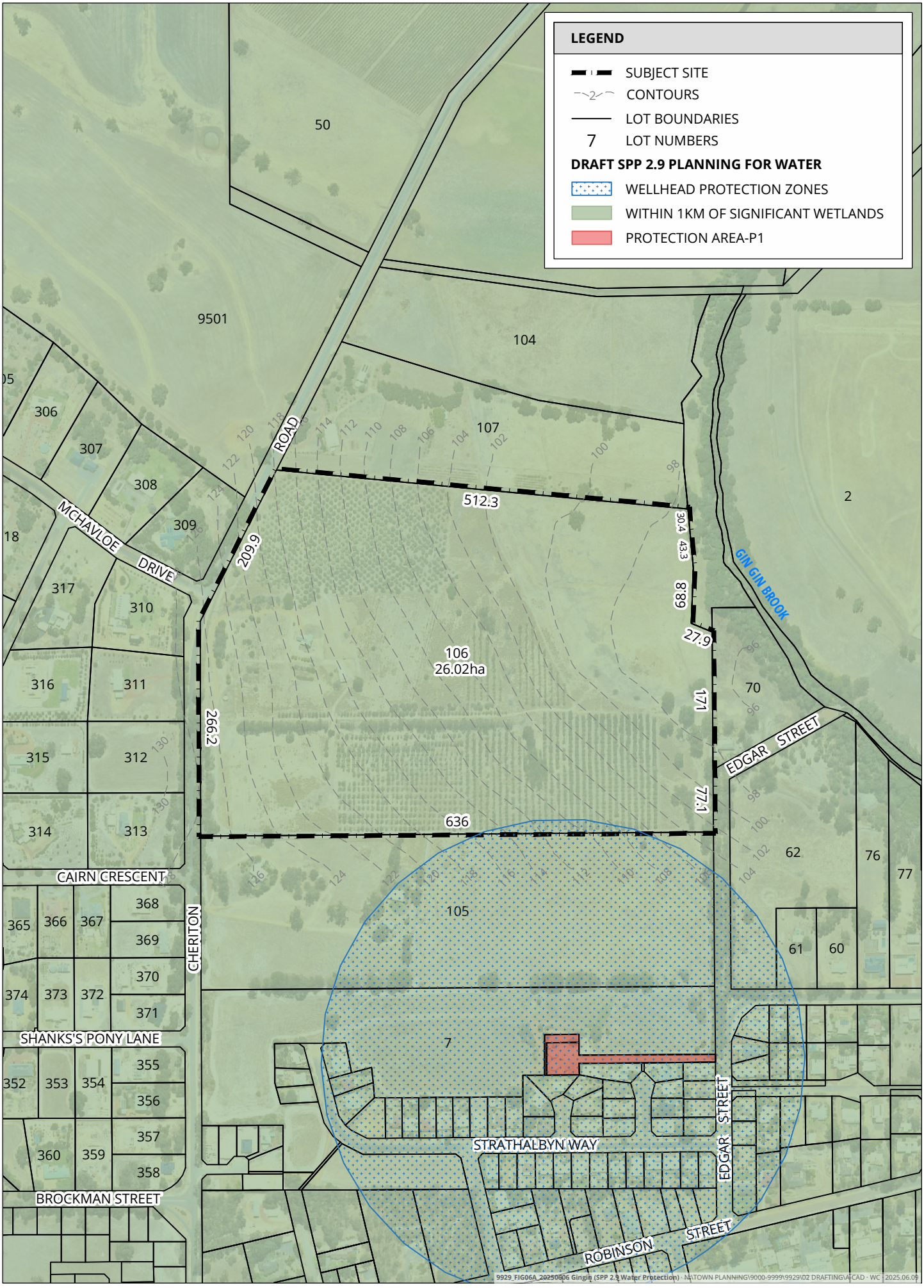
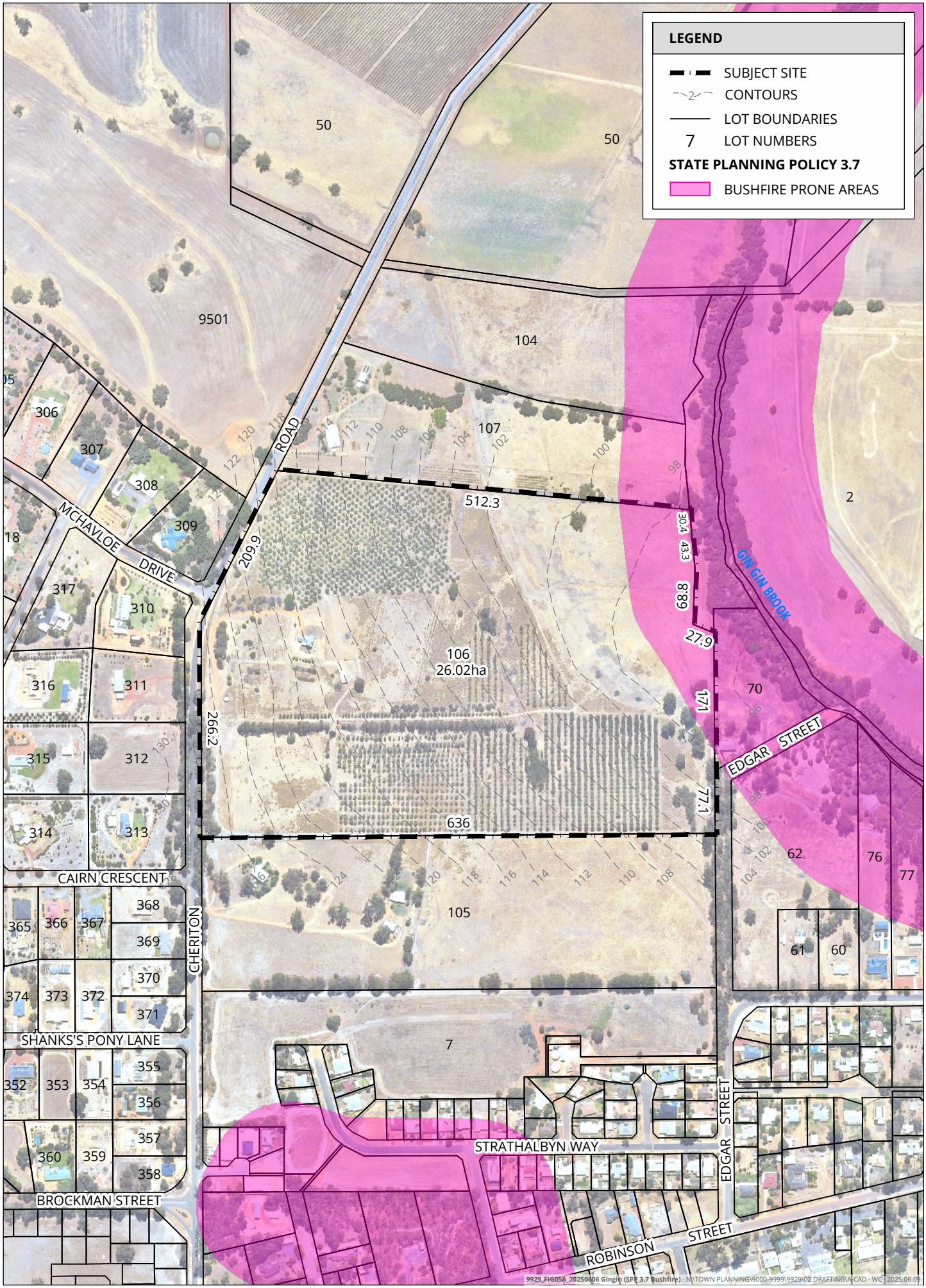


FIGURE 4

DRAFT SPP 2.9 PLANNING FOR WATER



0 200 m

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FIGURE 5

STATE PLANNING POLICY 3.7 - BUSHFIRE PRONE AREAS

4.7 Aboriginal Heritage

It is noted a small portion of the subject site is located with Aboriginal Heritage Place ID 40276. Place ID 40276 is a lodged Aboriginal heritage place located within, and associated with, Gingin Brook. The site holds multiple cultural values, identified as a traditional camp, hunting place, plant resource area, water source, and a location connected to Creation/Dreaming narratives. The place is not culturally sensitive or restricted, and no access restrictions apply. The recorded boundary is considered reliable. Although the place currently holds a lodged status under the Aboriginal Heritage Act, it is acknowledged as a heritage consideration within the locality.

As part of this Scheme Amendment request for the subject site, due regard has been given to the presence of Place ID 40276. The proposed amendment does not entail works within the identified boundary of the heritage place and is not expected to adversely impact its cultural values. Notwithstanding this, any future development arising from the amendment would be undertaken in accordance with the requirements of the *Aboriginal Heritage Act 1972*, including appropriate consultation and avoidance or mitigation measures where necessary.

5. Environmental Attributes, Assessment, and Management

5.1 Overview

This section summarises the environmental assessment processes undertaken under both Commonwealth and State legislation, along with key management considerations. In 2024, Bailey Environmental Services was engaged to undertake a series of environmental investigations, including an Environmental Assessment Report (**EAR**) (**Attachment 3**); Site and Soil Evaluation (**SSE**) (**Attachment 4**); and a Local Water Management Strategy (**LWMS**) (**Attachment 5**).

5.1.1 Environmental Assessment Report

Soil investigations within the EAR confirm variable profiles ranging from sandy surfaces to clayey subsoils, with generally high phosphorus retention indices and satisfactory permeability rates consistent with the requirements of SPP2.9 and the GSP, as described above. Groundwater occurs at shallow depth only in the lower eastern portion of the site, consistent with the DBCA-mapped Multiple Use palusplain. This constraint can be effectively managed through appropriate lot design, controlled effluent system placement (ATUs), and limited use of fill to achieve required clearances.

5.1.2 Water and Wastewater Management

In accordance with the water-sensitive urban design principles of 'Better Urban Water Management', in the event the site is subdivided, the EAR outlines a stormwater regime that maintains pre-development hydrological function and protects the ecological values of Gingin Brook. The drainage strategy comprises distributed bioretention basins, vegetated swales, and on-lot infiltration measures sized to retain and treat the majority of runoff (particularly the first 15mm), thereby meeting WAPC objectives for managing peak flows, nutrient reduction and water quality improvement. A shallow paddock drain currently traversing the site will be required to be realigned and protected via a drainage easement and rehabilitated as a "living stream," providing additional sediment and nutrient interception consistent with SPP 2.9 outcomes. All wastewater will be managed through secondary treatment systems with nutrient-stripping capability, meeting minimum setbacks from Gingin Brook as required under both the GSP and Water Quality Protection Note 70.

5.1.3 Vegetation Management

The development footprint does not require clearing of any native vegetation, and the retention of mature Marri trees ensures protection of potential black-cockatoo foraging and roosting habitat, responding to biodiversity considerations under SPP2.9. Construction-phase impacts can be managed through appropriate conditions of subdivision approval, addressing erosion, sedimentation, dust, noise, and containment of hazardous materials. Fencing along the interface with the Gingin Brook foreshore reserve will prevent uncontrolled access and protect riparian values, consistent with the intent of the Shire's River Environs Management Area (SCA1).

Overall, the EAR concludes that the proposed Scheme Amendment is environmentally suitable and capable of achieving compliance with relevant WAPC policies, provided that the recommended water management, effluent disposal, vegetation protection and foreshore management measures are implemented through subsequent subdivision and detailed design processes.

5.1.4 Site and Soil Evaluation

Consistent with the EAR, the SSE provides a clear, technically robust appraisal of the subject site's land capability for on-site effluent disposal and demonstrates alignment with AS1547:2012 and the GSP. The SSE

documents an extensive field investigation program by including deep test pitting, permeability testing and soil laboratory analysis. The site contains predominantly sandy to sandy-loam profiles with moderate to high permeability and generally high phosphorus retention. While shallow groundwater and seasonally waterlogged soils occur in the lower eastern portion of the site, the assessment identifies that these constraints can be effectively managed through controlled placement of fill and the use of nutrient-removing secondary treatment systems (again, ATUs), as required in Sewage Sensitive Areas. Importantly, the analysis shows that all proposed lots retain sufficient unconstrained land outside the 100-metre Gingin Brook setback to accommodate compliant land application areas, and that the site is not subject to inundation in a 1-in-10-year event. Overall, the SSE provides a sound evidentiary basis confirming that the intensification of subdivision can sustainably support on-site wastewater management subject to standard design and approval conditions.

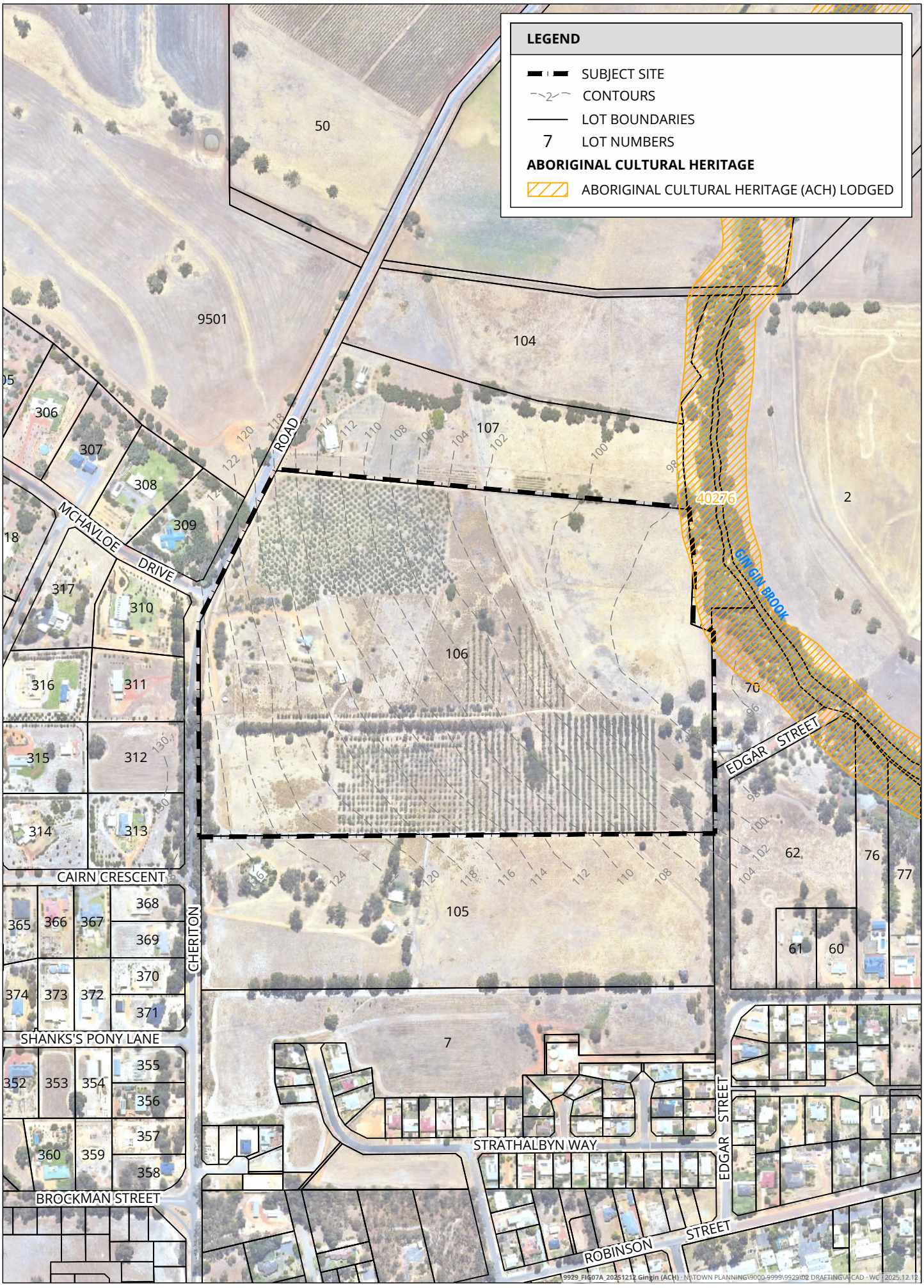
5.1.5 Local Water Management Strategy

The Draft LWMS for the subject site provides a comprehensive framework for managing surface water, groundwater and wastewater in support of the proposed rezoning to Rural Living. The strategy confirms the site's favourable pre-development conditions, being moderately sloping terrain, high-PRI soils, adequate permeability and largely cleared land. The LWMS outlines a water-sensitive design approach consistent with SPP 2.9, Liveable Neighbourhoods, Better Urban Water Management and the GSP.

Stormwater will be managed through distributed bioretention basins, vegetated swales and a rehabilitated “living stream” within a drainage easement, ensuring that post-development peak flows and nutrient loads to Gingin Brook are no greater than pre-development levels. Groundwater will be protected via appropriate fill, subsoil drainage where required, and the use of nutrient-removing secondary treatment systems mandated for Sewage Sensitive Areas. The LWMS demonstrates that the subdivision can be implemented without increasing flood risk, degrading water quality or impacting wetland or brook environments, and provides a clear pathway for detailed design through a future Urban Water Management Plan.

5.2 Conclusion

Together, the EAR, SSE, and LWMS provide a coherent and technically robust evidence base demonstrating that the subject site is environmentally capable for rezoning from ‘General Rural’ to ‘Rural Living’ (RL1). The EAR in particular confirms that the site’s soils, vegetation, hydrology and proximity to Gingin Brook can be managed without generating unacceptable environmental impacts, while the SSE verifies that all proposed lots contain adequate unconstrained land, compliant soil conditions and achievable groundwater separation to support on-site effluent disposal in accordance with the GSP. Complementing these, the LWMS outlines a comprehensive drainage and water-quality protection framework that ensures post-development flows and nutrient loads will not exceed pre-development conditions and that sensitive receptors, in particular the Gingin Brook, can be demonstrably safeguarded.



0 200 m

SCALE @ A4: 1:6000

FIGURE 6

ABORIGINAL CULTURAL HERITAGE

6. Conclusion

The proposed rezoning of the site is consistent with the Shire's Local Planning Strategy, and the Gingin Townsite & Rural Surrounds Structure Plan. The proposed Scheme Amendment will provide consistency with the orderly and proper planning of the locality while also assisting in improving water quality into the Gingin Brook.

On the basis of the provided information, we request the initiation of this Scheme Amendment as a '*standard*' amendment. In accordance with the LPS Regulations, it would then be subject to public consultation prior to further consideration by the Shire.

COUNCIL ADOPTION FOR ADVERTISING

This Standard Amendment was adopted by resolution of the Council of the Shire of Gingin at the Ordinary Meeting of the Council held on the 17 March 2026.

.....
MAYOR/ SHIRE PRESIDENT

.....
CHIEF EXECUTIVE OFFICER

COUNCIL RECOMMENDATION

This Amendment is recommended for support by resolution of the Shire of Gingin at the Ordinary Meeting of the Council held on the ..... and the Common Seal of the Shire of Gingin was hereunto affixed by the authority of a resolution of the Council in the presence of:

.....
MAYOR/ SHIRE PRESIDENT

.....
CHIEF EXECUTIVE OFFICER

WAPC ENDORSEMENT (r.63)

.....
DELEGATED UNDER S.16 OF
THE P&D ACT 2005

DATE .....

APPROVAL GRANTED

.....
MINISTER FOR PLANNING

DATE .....

ATTACHMENT 1

CERTIFICATE OF TITLE

WESTERN AUSTRALIA

TITLE NUMBER	
Volume	Folio
1984	**189**

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 106 ON DIAGRAM 85529

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

FAIRLANDS FARM PTY LTD OF 28 ROSCOMMON ROAD, FLOREAT

(T K614705) REGISTERED 4/6/2008

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. T1011/1899 EASEMENT BENEFIT SEE TRANSFER 1011/1899. REGISTERED 1/1/1899.
2. T2114/1913 EASEMENT BENEFIT AS TO PORTION ONLY SEE TRANSFER 2114/1913 AND VOL 1984 FOL 189. REGISTERED 1/1/1913.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required. Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

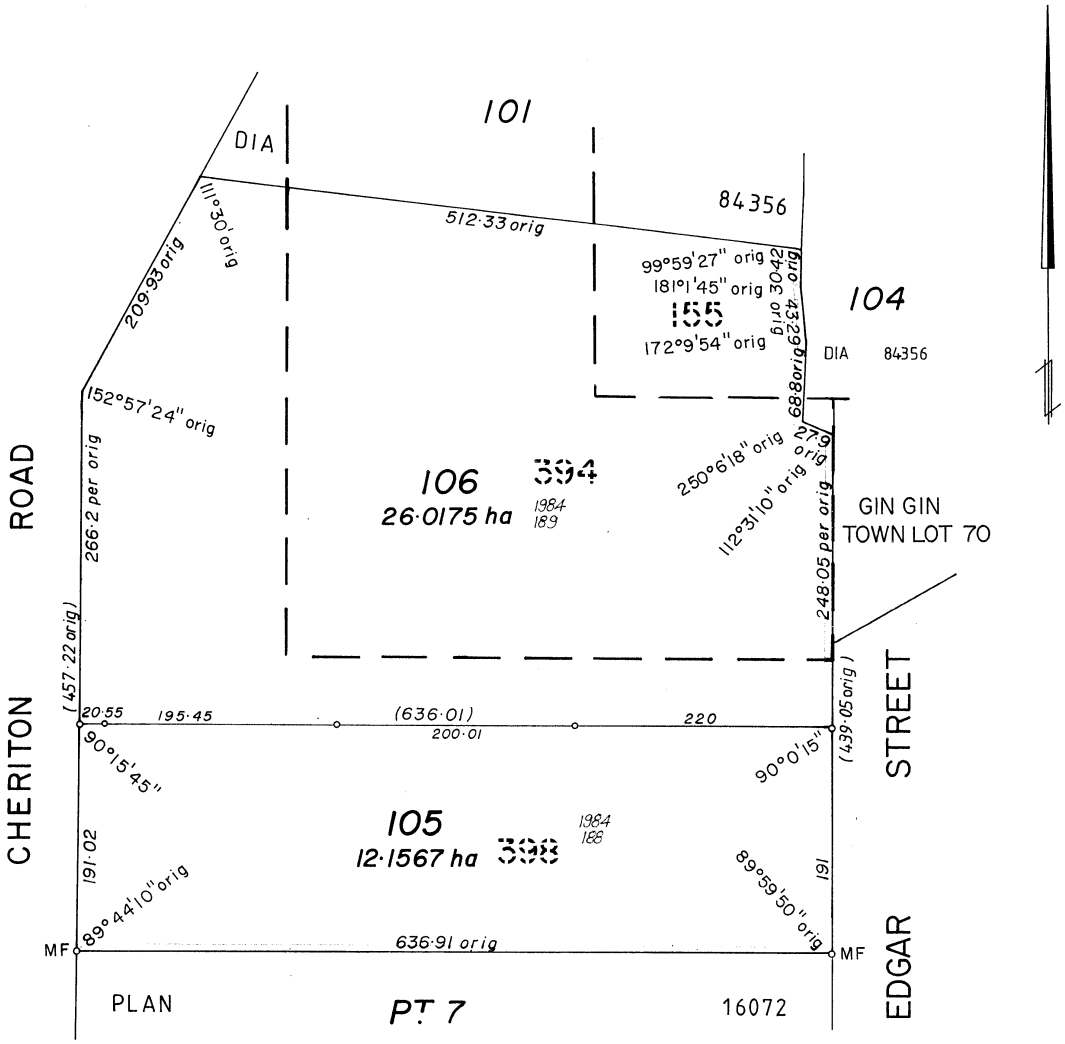
The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	1984-189 (106/D85529)
PREVIOUS TITLE:	1984-187
PROPERTY STREET ADDRESS:	62 CHERITON RD, GINGIN.
LOCAL GOVERNMENT AUTHORITY:	SHIRE OF GINGIN

LANDGATE COPY OF ORIGINAL NOT TO SCALE 05/12/2024 12:52 PM Request number: 67523858

Landgate
www.landgate.wa.gov.au

LAND DESCRIPTION	ON	CERTIFICATE OF TITLE	FIELD BOOK	DIA 85529
LOT 102 OF SWAN LOCs 155, 394 & 398; & LOT 103 OF SWAN LOCs 394 & 398	PLAN DIAGRAM 84356 INDEX BG36(2) 16·13, (10) 3·2 PUBLIC	VOLUME FOLIO 1962 252 1962 253 NOW 1984 187	65299	TOTAL AREA 38·1742 ha



SURVEYOR'S CERTIFICATE

REG 54 I L. C. KAUTHER hereby certify that:

(a) this plan of survey is a correct and accurate representation of the survey carried out by me personally/under my own personal supervision, inspection and field check, and recorded in field books lodged for the purposes of this plan of survey;

(b) the measurements are in strict accordance with the Licensed Surveyors (Guidance of Surveyors) Regulations 1961 and in particular regulations 23 and 34 of those regulations; and

(c) this survey and this plan of survey are in strict accordance with the requirements of the Licensed Surveyors (Guidance of Surveyors) Regulations 1961 and the relevant law in relation to which it is lodged.

Licensed Surveyor 3·11·93 Date

REG 55D I ..... hereby certify that:

(a) this plan is correct and was prepared under my supervision and is the result of calculations from measurements made by me personally/under my own personal supervision, inspection and field check as recorded in the field books lodged for the purposes of this plan;

(b) the measurements are in strict accordance with the requirements of the Licensed Surveyors (Guidance of Surveyors) Regulations 1961 and in particular regulations 23 and 34 of those regulations; and

(c) this plan of survey conforms with the relevant in relation to which it is lodged

Licensed Surveyor Date

APPROVED BY
STATE PLANNING COMMISSION

FILE 91208

For Chairman

DATE 26-11-93

PLANNING AND URBAN DEVELOPMENT
26 NOV 1993
FILE 91208

LODGED

DATE 4·11·93

FEE PAID $253

ASSESSMENT NO 37743

EXAMINED J. Del Bonetto 24/11/93

DOCKET PLAN/~~DIAGRAM~~ 19282

CERTIFIED CORRECT b.g.Brinton 26.11.93

F.S.C. No. .....

DOLA
Department of LAND ADMINISTRATION

SCALE 1:4000

ALL DISTANCES ARE IN METRES

IN ORDER FOR DEALINGS

SUBJECT TO .....

b.g.Brinton 26.11.93
for Inspector of Plans and Surveys Date

APPROVED 21.12.93 Date

Inspector of Plans and Surveys

OFFICE OF TITLES
DIAGRAM
85529

LANDGATE COPY OF ORIGINAL NOT TO SCALE 05/12/2024 12:52 PM Request number: 67523858

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ATTACHMENT 2

INDICATIVE CONCEPT PLAN



SUBDIVISION CONCEPT
LOT 106 (No. 62) CHERITON ROAD
GINGIN

Figure 1

DRAFT

N

0 100 m
SCALE @ A3: 1:2500

9929-CON-02-A

DRAWN: WC
DATE CREATED: 2024.09.11
PROJECTION: MGA50 GDA94
CADASTRE: LANDGATE
AERIAL: LANDGATE 2023 MARCH

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ROWE GROUP DESIGN

ATTACHMENT 3

ENVIRONMENTAL ASSESSMENT REPORT

LOT 106 (No. 62) CHERITON ROAD, GINGIN

ENVIRONMENTAL ASSESSMENT REPORT

Prepared for

Fairlands Farm Pty Ltd
23 Kilkenny Rd
FLOREAT WA 6014

Report No. J24041c
10 September 2025

BAYLEY ENVIRONMENTAL SERVICES
30 Thomas Street
SOUTH FREMANTLE WA 6162

Sundowner Nominees Pty Ltd as trustee for the Bayley Cook Family Trust ABN 20 822 598 897
trading as Bayley Environmental Services

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D	Site & Soil Evaluation

1.0 INTRODUCTION

1.1 Background

Fairlands Farm Pty Ltd has submitted an application to the Shire of Gingin to amend the zoning of Lot 106 Cheriton Rd, Gingin from General Rural to Rural use. In support of the proposed rezoning, a Concept Plan demonstrating how the 26.02ha site could be subdivided into 22 Rural Living (RL1) lots ranging in size from 1ha to 1.2ha has been prepared. The lots will be supplied with scheme water, underground telecommunications and power and will employ on-site effluent disposal. Figure 1 shows the proposed Concept Plan. Figure 2 shows an aerial view of the site and its surroundings.

2.0 PRE-DEVELOPMENT ENVIRONMENT

2.1 Climate

2.1.1 Rainfall

Gingin has a strongly seasonal rainfall, with most of the annual rain falling between May and September in association with winter cold fronts. Occasional heavy falls may occur from summer thunderstorms. The long-term average annual rainfall for RAAF Gingin (located 13km south-west of the site) is 637.7mm, of which 78% falls between the months of May and September.

Figure 3 shows a rainfall occurrence chart for RAAF Gingin.

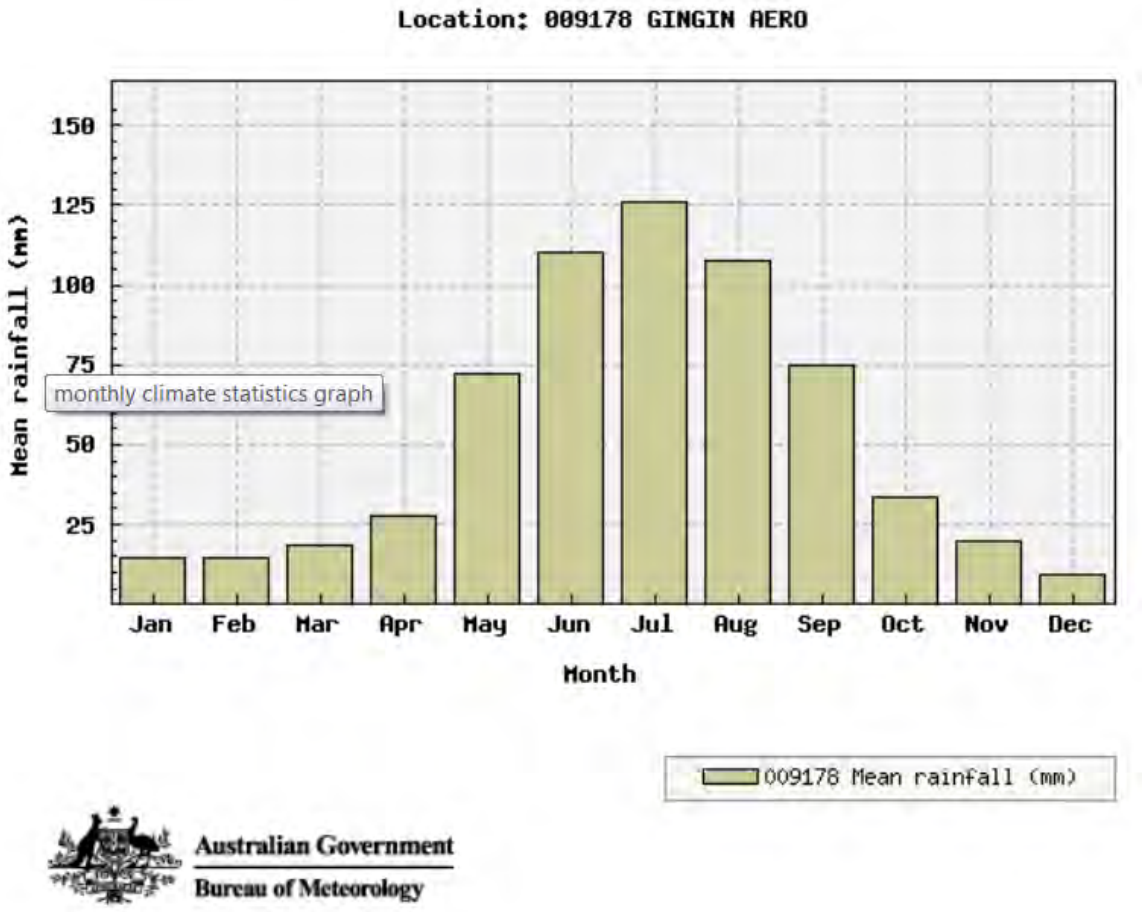


Figure 3 RAAF Gingin Mean Rainfall

2.1.2 Evaporation

Evaporation at Perth Airport, the closest station for which data are available, totals 5.7m in an average year and ranges from 2.1mm/day in July to 10.2mm/day in January. Average evaporation exceeds average rainfall from September to April. Figure 4 shows mean daily evaporation for Perth Airport.

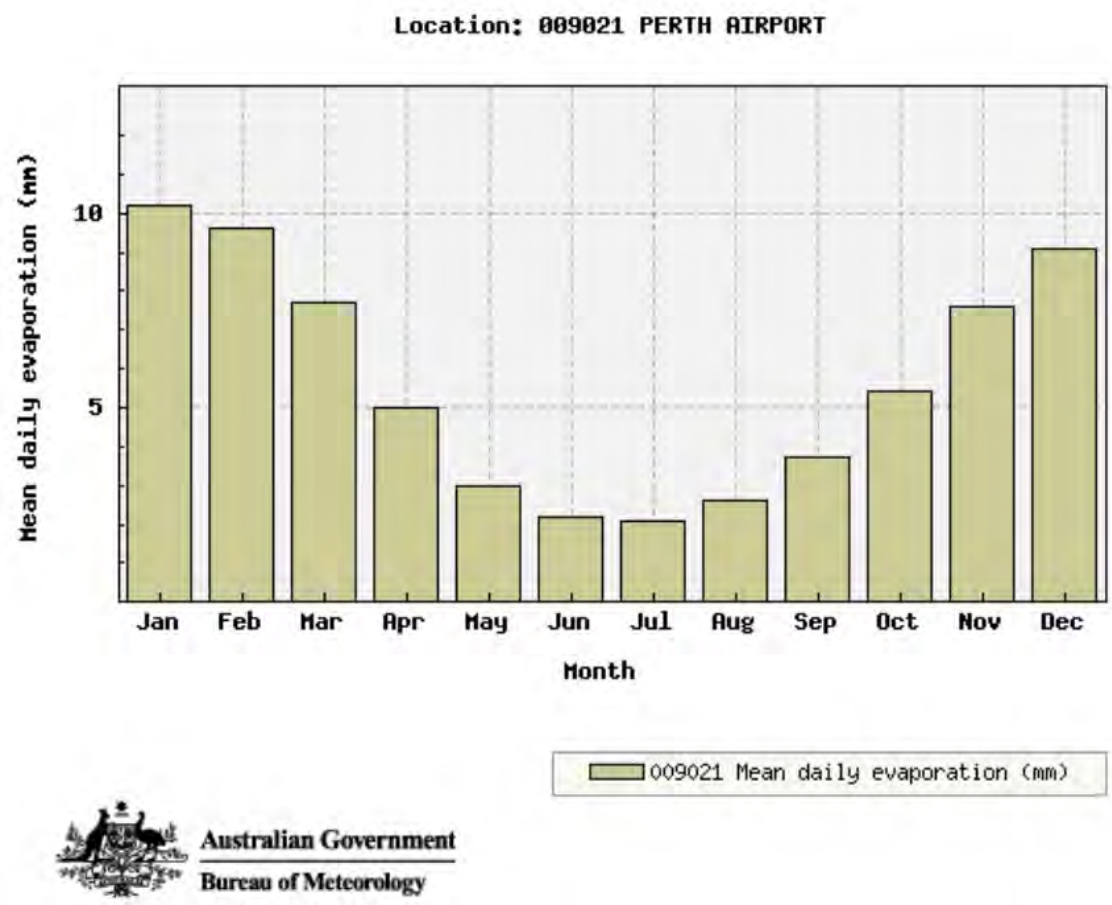


Figure 4 Perth Airport Mean Daily Evaporation

2.2 Physiography

2.2.1 Topography

The site lies on the east-facing western side of the Gingin Brook valley on the northern edge of the Gingin Townsite. The elevation of the site ranges from 97m AHD in the north-east near the Brook to 134m in the south-west corner. The slope varies from about 1% in the north-east to 8% in the west and averages 5.5% across most of the site. Figure 5 shows topographic contours over the site.

2.2.2 Geology and Soils

The Geological Survey of Western Australia (Hocking *et al.*, 1975) maps the site as Colluvium (Qpo): a Quaternary-aged varicoloured (white-cream-brown), poorly sorted, poorly rounded sand which was formerly an eluvial (weathered in-situ) horizon overlying laterite which has been partly redistributed. A small area in the south-west of the site is mapped as Laterite (Czl): typically a ferruginous, pisolitic, siliceous laterite forming layers from 1.5m to 3m thick and associated with eluvial quartz sand, overlying a weathered rock zone which can be up to 30m thick.

Figure 5 shows the GSWA mapping. Test pitting to 2.5-3m at 12 locations across the site (Figure 5) found a profile that generally matched the GSWA mapping. Appendix A shows soil logs from the test pits.

2.2.3 Acid Sulphate Soils

ASS-risk mapping by the DBCA shows the site as Class 3 (Nil to Low risk of ASS within 3m of the ground surface). The soils of the site are elevated and have had no recent marine influence. The age and origin of the soils and the absence of a shallow water table over most of the site indicate that acid sulphate soils are unlikely to be present. The nearest mapped high ASS risk zone is a wetland 3.3km south of the site.

Development of the site is not expected to involve any excavation deeper than about 2m (for installation of effluent systems) or dewatering. Any ASS present is therefore unlikely to be disturbed. No further ASS assessment is considered necessary.

2.2.4 Phosphorus Retention Index

The strongly coloured and/or clayey soils of the site are expected to have a high to very high PRI. Analysis by the CSBP Soil Laboratory of samples from 0.5m and/or 1m depth at four locations (CH2, CH6, CH8, CH10 – Figure 5) gave PRI values ranging from 8.0 to 123.8, with a mean of 56.8 and a median of 27.2.

PRI is a measure of the ability of a soil to adsorb and retain phosphorus from solution. A high PRI indicates that the soil is unlikely to leach phosphorus to the water table. Typical ranges for PRI values in soils are as follows:

PRI Range	*Rating*	*Typical soils*
0 – 0.5	Very Low	Bassendean Sand
2 – 4	Low – Moderate	Karrakatta Sands
5 – 12	Moderate – High	Cottesloe Sands
12 – 20	High	Crushed Limestone, Limesand
20 – 1000+	Very High	Clay

2.2.5 Soil Permeability

Constant-head permeability tests in accordance with AS1547:2012 were carried out at 0.5m depth at five locations as shown on Figure 5. Appendix B shows the detailed test results.

The tests gave saturated hydraulic conductivities (Ks) ranging from 0.5m/day to 40m/day, with a mean of 16m/day and a median of 12.5m/day. The lowest value of 0.5m/day was recorded from the low part of the site in clayey sand.

2.2.6 Soil Geotechnical Analysis

Soil samples collected at 0.5m and 1.0m from test pit CHT8 in the north-east corner of the site (Figure 5) were analysed by the CSBP Soil Laboratory for geotechnical parameters including particle size distribution, dispersion index, exchangeable cations and exchangeable sodium percentage (sodicity). Table 2.2 shows the results of the analysis. The soil profile at CHT8 was typical of the profile in the lower parts of the site.

Table 2.2 Soil Analysis

Sample (Figure 5)	*Particle Size*		*Soil Type*	*Dispersion Index (range 0-16)*	*Exchangeable Sodium %*
CHT8 0.5m	Clay (<2µm) Silt (2-20µm) Sand (20-2000µm)	16.11% 15.67% 68.22%	Sandy loam	14	5.4
CHT8 1.0m	Clay (<2µm) Silt (2-20µm) Sand (20-2000µm)	26.22% 13.14% 60.64%	Sandy clay loam	10	13.6

The soil analyses show that the soils in the lower lying parts of the site are predominantly non-sodic (Exchangeable Sodium % <6) to moderately sodic (ESP >15), highly dispersive sandy loams overlying sandy clay loams.

2.3 Hydrology

2.3.1 Surface Drainage

There is no defined natural surface drainage on the site. The sandy surface soils of the majority of the site (above about 102m AHD) mean that runoff would occur only over short distances under very heavy rainfall conditions. The lower eastern part of the site has heavier soils and a shallower water table, and may generate surface runoff in a 1-year ARI storm event or less.

The major surface hydrological feature of the area is Gingin Brook, a tributary of the Moore River, which flows north between 20m and 200m east of the site. Surface pools associated with the Brook occurred 15m from the site boundary in October 2024.

A shallow constructed drain runs from the mid-northern boundary south and then east through the north-east of the lot to Gingin Brook. This drain extends upstream across other properties to its source 2km upstream of Lot 106. The drain has a catchment of about 163ha but is dammed by at least eight farm dams, so it would be unlikely to carry large flows. This drain will be diverted into an easement along the northern lot boundaries as part of the subdivision works, with intensive planting undertaken to turn it into a “living stream” to provide treatment of the water prior to discharge into Gingin Brook.

Figure 6 shows the catchments upstream of the site.

2.3.2 Groundwater

Groundwater Occurrence and Flows
There is no published groundwater level information available for the subject site or its surrounds. Given the topography of the site and surroundings, groundwater would likely exist as localised aquifers in creek and river valleys and possibly as seasonal subsurface seepage above impermeable layers on slopes.

Groundwater was present at a depth of 1.14m below ground in test pit CHT7 in the east of the site (Figure 4) on 29 October 2024. No usable DWER bores are available in the near vicinity of Lot 106 to enable this level to be compared with long-term averages. However, the topography, soils and presence of wetland vegetation (sedges) in the vicinity of CHT7 suggests that the water table would reach the ground surface in this area during wet winters. Groundwater measurements in midwinter will be necessary to more accurately determine the maximum groundwater level and the need for fill in areas below 100m AHD.

Measurements in early August 2025 of bores installed in four test pits (Figure 4) found groundwater at depths of 0.55m in test pit CHT7 and 1.92m in test pit CHT8. Test pits CHT2 and CHT6 were dry to depths of 2.91m and 2.6m respectively. Simultaneous measurements in a number of DWER bores across the southern Perth region gave readings that were a median of 0.5m below the long-term maximum groundwater level (MGL). These bores are distant from the site and in a different geological and topographic setting, so can only be used as a rough guide to groundwater levels at the site. However, they support the initial assessment that the MGL could reach the ground surface in the lowest parts of the site.

2.3.3 Wetlands

The DBCA maps the lower-lying eastern part of the site below about 101m AHD as Multiple Use category palusplain (seasonally waterlogged plain). This appears to correspond with the topography and vegetation in the area.

Gingin Brook is mapped as Conservation category palusplain, although its profile suggests that it is a watercourse rather than a palusplain. Figure 5 shows the DBCA wetland mapping.

2.4 Vegetation

The subject site is cleared of native vegetation except for scattered mature trees (most or all Marri *Corymbia calophylla*) located along the south-western boundary with Cheriton Road and in the south-east corner. There are also non-local eucalypts in planted shelter belts in the south of the site. Two Olive (*Olea europaea*) groves are located in the north-west and south of the site, totalling about 9ha.

There is no riparian or groundwater-dependent vegetation on the site except for some sedges in the east of the site. To the east, Gingin Brook supports a fringing woodland of paperbarks (*Melaleuca preissiana*).

2.5 Fauna and Habitats

The subject land provides no significant fauna habitat except for those species able to utilise open cleared paddocks. It is unlikely that any native mammals would be dependent on the site.

2.6 Land Use

2.6.1 Current and Previous Land Uses

The subject land is currently used for broad acre sheep and cattle grazing. Historical Landgate aerial photography shows that the land has been cleared and grazed at least since 1981. Olives have been grown on the site since the 1990s. The lower north-eastern part of the site (below about 101m AHD) appears to have been used for cropping, possibly of potatoes, in the 1980s.

There is no visual or other evidence on site or on aerial photographs of any contamination or potentially contaminating land uses.

2.6.2 Neighbouring Land Uses

The subject land is bounded to the west, north, south-east an south by mixed land uses including broad acre grazing, small rural lots and rural living lots. The Gingin town site is located 250m to the south. The north-eastern boundary is bordered by a Crown Reserve (R43683) associated with Gingin Brook.

3.0 ENVIRONMENTAL IMPACTS AND MANAGEMENT

3.1 Water Quality Protection

3.1.1 Surface Water

Potential Impacts
Development of the site as proposed could affect surface water quality in Gingin Brook by:

- sediment transport, particularly during construction;
- nutrient runoff from stock and fertilisers applied to paddocks and gardens;
- pesticide runoff from paddocks and gardens; and
- runoff of hydrocarbons and other contaminants from roads.

Management
Management measures to protect surface water quality are detailed in the LWMS (Appendix C). They include:

- All road runoff from storms up to 15mm (approximately a 1-year ARI, 1-hour storm) will be captured and infiltrated in a series of vegetated roadside swales. This will capture an estimated 98.5% of runoff and entrained contaminants.

- All runoff from private lots from storms up to 15mm will be retained within the lots.

- The keeping of stock on private lots will be subject to Council approval in line with stocking rate recommendations of the Department of Agriculture (van Gool *et al.*, 2000).

- Erosion and sediment transport during construction will be managed under a Construction Management Plan to be prepared and implemented to the satisfaction of the Shire of Gingin by the construction contractor.

- All on-site effluent disposal will be by means of nutrient-removing secondary treatment systems located at least 100m from Gingin Brook.

3.1.2 Groundwater

Potential Impacts
Groundwater quality could be adversely affected by nutrients, pathogens and household chemicals contained in domestic effluent.

Management
All on-site effluent disposal will be by means of nutrient-removing secondary treatment systems located at least 100m from Gingin Brook. This, and the size of the lots (minimum 1ha), will mean that the risk to groundwater quality is minimised.

A Site and Soil Evaluation (SSE) report has been prepared for the site, containing the results of soil test pitting, permeability testing, geotechnical analysis and winter groundwater measurements. The SSE concludes that the site is capable of supporting on-site effluent disposal on 1ha lots, and presents conceptual locations and layouts of effluent disposal systems. The SSE is attached in Appendix D.

3.2 Vegetation Protection

Potential Impacts
The subject site is cleared of native vegetation except for scattered mature trees (most or all Marri *Corymbia calophylla*) located along the south-western boundary with Cheriton Road and in the south-east corner. No clearing of native vegetation will be required for the subdivision or development of the site.

Management
All existing native trees on the site will be retained in the subdivision of the site. Any lot purchaser who wishes to remove any native tree following subdivision will need to obtain approval from the Shire of Gingin and/or a clearing permit from the DWER.

3.3 Fauna and Habitat Protection

Potential Impacts
Fauna habitat on the site is largely limited to cleared paddocks, olive groves and the remaining mature Marri trees. The Marris are expected to provide feeding and possibly roosting habitat for black cockatoos. The fauna habitat values of the site are expected to increase following subdivision, as lot owners plant screening vegetation and gardens.

Management
The existing mature Marri trees on the site will be retained during future subdivision. Any lot purchaser who wishes to remove any native tree following subdivision will need to obtain approval from the Shire of Gingin and/or a clearing permit from the DWER.

3.4 Construction Impacts

Potential Impacts
The construction of future subdivision will involve minimal earthworks due to the large size of the lots. Subdivision works will be mainly confined to the construction of roads, drainage and fences and the installation of water, power and telecommunications.

The project site is within 50m of houses on some neighbouring lots, so management of noise and dust during construction will be important. A conservative approach will be taken in order to minimise the potential for nuisance.

Management
The developer will implement a Construction Management Plan for the development dealing with dust management, erosion and sediment control, containment of environmental hazardous materials (chiefly fuel and oils) and spill response.

3.5 Foreshore Management

Potential Impacts
The development area adjoins the foreshore of Gingin Brook for about 170m on the north-east boundary of the site. This part of the foreshore is a Crown Reserve (R43683) vested in the Shire of Gingin. For the remainder of the eastern boundary the site is separated from Gingin Brook by freehold rural land.

The development of the site as proposed will bring an increased human presence to the site, which could have impacts on the foreshore including human traffic, domestic dogs, fire and litter.

Management
The developer of any future subdivision will fence the eastern boundary of the site adjoining the Gingin Brook foreshore reserve with dog-proof (e.g. ringlock) fencing. No access will be provided from the development to the foreshore reserve. Management of the foreshore reserve itself is not within the power of the developer.

4.0 REFERENCES

Government of Western Australia (2019). *Government Sewerage Policy.* Dept of Planning, Lands & Heritage, Perth.

Hocking R.M., Marcos G.W. & Archer R.H. (1975). *Gingin Urban Geology Sheet 2035 II.* 1:50,000 Urban Geology Series. Geological Survey of Western Australia, Perth.

van Gool D., Angell K. & Stephens L. (2000). *Stocking Rate Guidelines for Rural Small Holdings.* Department of Agriculture, Perth.

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Figures



SUBDIVISION CONCEPT
LOT 106 (No. 62) CHERITON ROAD
GINGIN

Figure 1

DRAFT

N

0 100 m
SCALE @ A3: 1:2500

9929-CON-02-A

DRAWN: WC
DATE CREATED: 2024.09.11
PROJECTION: MGA50 GDA94
CADASTRE: LANDGATE
AERIAL: LANDGATE 2023 MARCH

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ROWE GROUP DESIGN



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Figure 2

THE SITE AND SURROUNDINGS

bayley environmental services

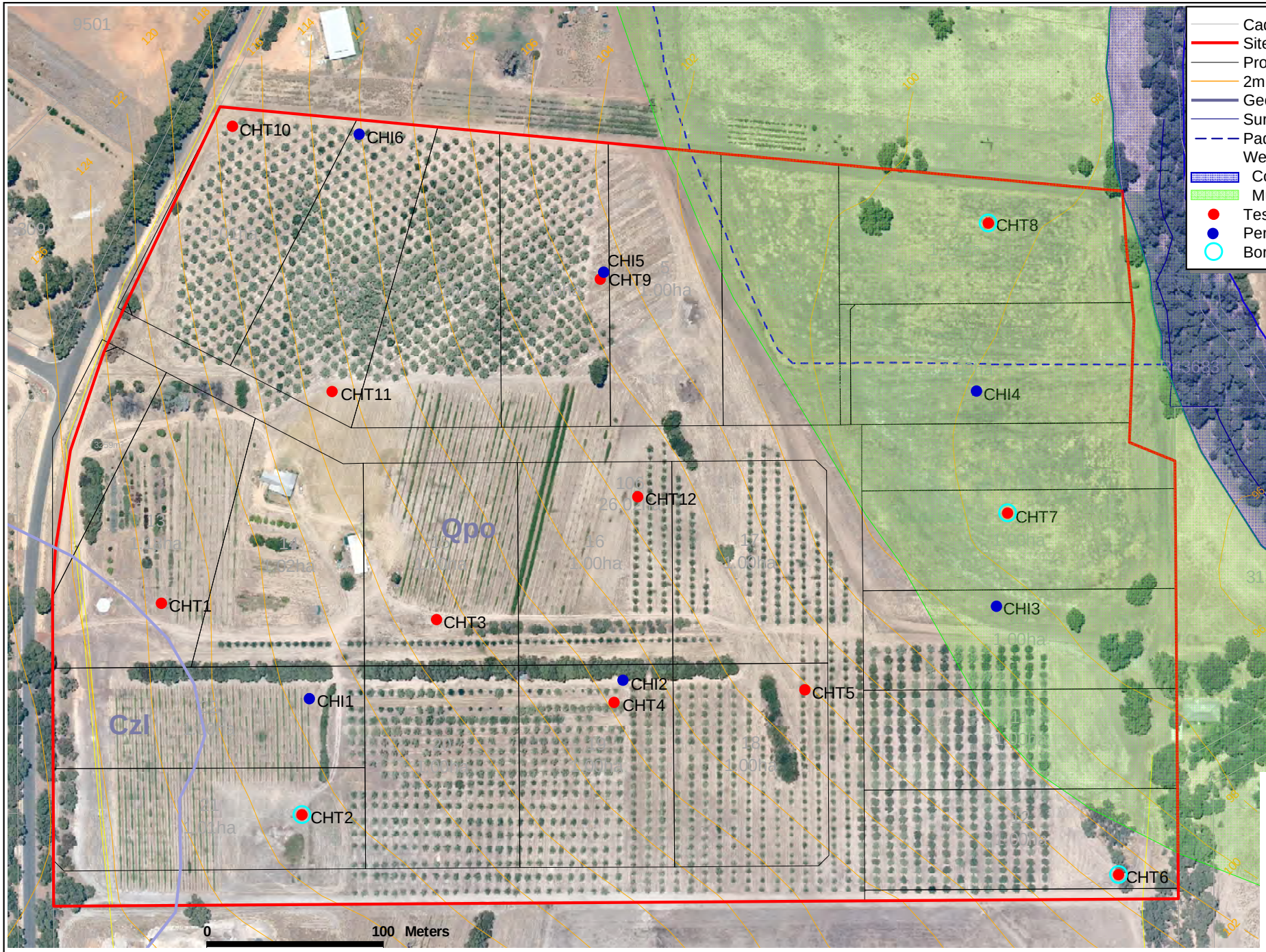
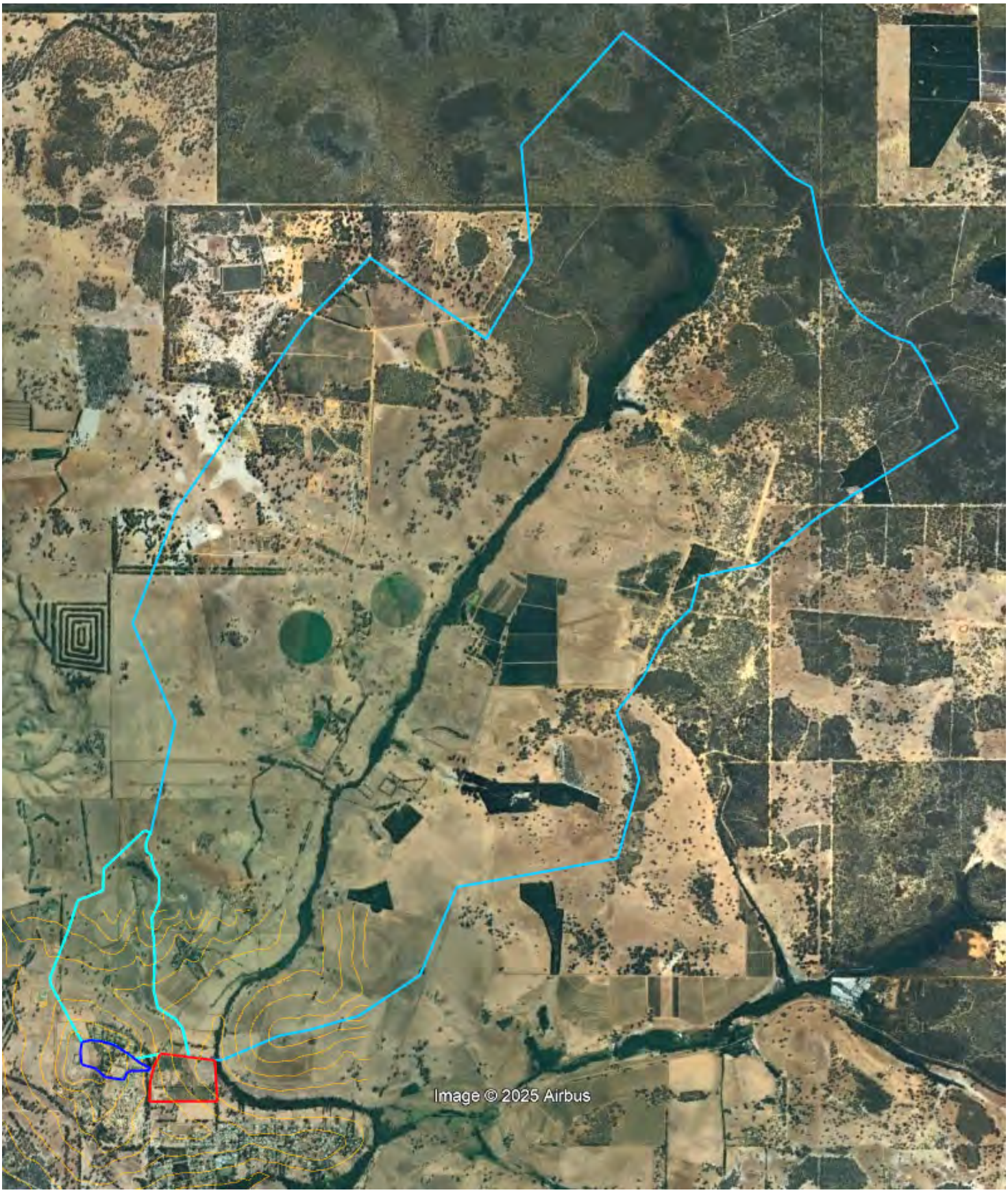


Figure 5

ENVIRONMENTAL FEATURES

bayley environmental services



0 2 km

Subject site
10m topo contour
McHavloe Dr catchment
Paddock drain catchment
Gingin Brook catchment

Figure 6

CATCHMENTS

bayley environmental services

Appendix A

Soil Logs

SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT1
EASTING:	395881
NORTHING:	6532558
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.5
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.1	Brown topsoil		
0.1 - 2.2	Orange slightly clayey sand		
2.2 - 2.5	Orange slightly clayey sand with ironstones to 50mm		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT2
EASTING:	395921
NORTHING:	6532827
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	3.1
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.1	Brown topsoil		
0.1 - 1.0	Orange-brown slightly gravelly sand		
1 - 1.8	Orange gravelly clayey sand		
1.8 - 3.1	Red/orange/brown mottled well structured sandy clay		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT3
EASTING:	395978
NORTHING:	6532677
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.5
REFUSAL (Y/N):	Y
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.2	Brown topsoil		
0.2 - 1.2	Orange to orange-yellow sand		
1.2 - 2.4	Orange gravelly sandy clay, cemented from 1.5m		
2.4 - 2.5	Orange well structured lateritic gravelly clay		
2.5	Refusal on laterite		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT4
EASTING:	396150
NORTHING:	6532618
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	3.0
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.1	Brown topsoil		
0.1 - 2.0	Orange sand		
2.0 - 3.0	Orange/red mottled well structured gravelly sandy clay		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT5
EASTING:	395961
NORTHING:	6532438
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	3.0
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.2	Brown topsoil		
0.2 - 0.5	Orange-brown sand		
0.5 - 2.2	Orange sand		
2.2 - 3.0	Orange-yellow sand, becoming paler		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT6
EASTING:	396036
NORTHING:	6532548
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.8
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.2	Brown topsoil		
0.2 - 0.5	Brown sand		
0.5 - 2.3	Orange/red/brown mottled gravelly sandy clay with ironstone rocks to 100mm		
2.3 - 2.8	Hard orange-yellow gravelly clayey sand		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT7
EASTING:	396137
NORTHING:	6532501
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	3.0
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	1.0

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.2	Brown topsoil		
0.2 - 1.0	Brown sand		
1.0 - 1.2	Dark brown peaty sand, wet		
1.2 - 2.0	Dark brown/green/dark orange mottled well structured sandy clay		
2.0 - 2.5	Dark green gritty clay with minor orange mottling, poorly structured		
2.5 - 3.0	Greenish-grey sandy clay, poorly structured, wet		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT8
EASTING:	396245
NORTHING:	6532508
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	3.0
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 -0.1	Dark brown topsoil		
0.1 - 1.0	Dark brown sand		
1.0 - 1.5	Brown/dark brown dully mottled, moderately structured sandy clay		
1.5 - 2.0	Dull orange/dark brown/green mottled poorly structured sandy clay		
2.0 - 2.2	Dull brown slightly mottled poorly structured sandy clay with occasional ironstone nodules		
2.2 - 3.0	Orange/brown/grey mottled well-structured sandy clay with soft laterite nodules		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT9
EASTING:	396422
NORTHING:	6532404
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.9
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.1	Brown topsoil		
0.1 - 0.5	Orange-brown sand		
0.5 - 2.9	Orange sand		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT10
EASTING:	396359
NORTHING:	6532608
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.8
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.1	Yellow-brown sand		
0.1 - 2.8	Orange sand		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT11
EASTING:	396348
NORTHING:	6532773
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.8
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.2	Pale grey-brown topsoil		
0.2 - 2.0	Orange sand		
2.0 - 2.8	Dark orange/pale orange mottled well structured slightly lateritic sandy clay		







SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT12
EASTING:	396130
NORTHING:	6532742
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.8
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.1	Dark brown topsoil		
0.1 - 0.8	Yellow-brown sand		
0.8 - 2.8	Orange sand		





Appendix B

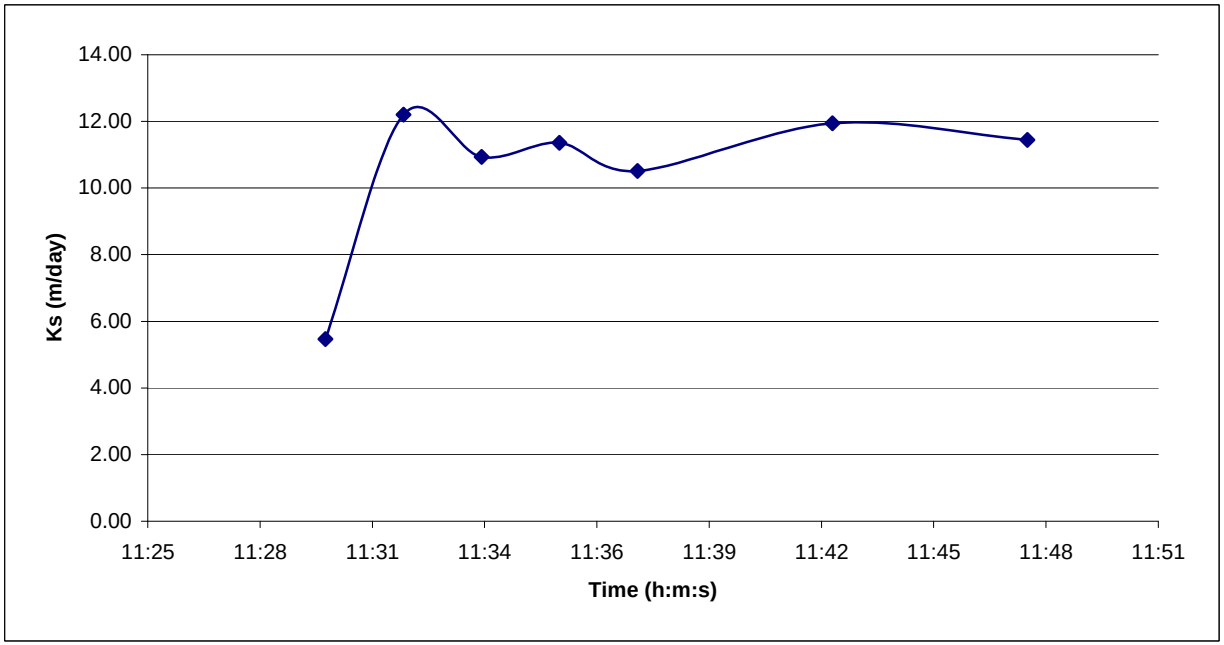
Permeability Test Results

SOIL PERMEABILITY TEST

Site No.	CHI1	Orange sand
Date	29/10/24	
Easting	395964	
Northing	6532504	
Depth	0.5	

Time (h:m:s)	Weight (kg)	Change in Weight (kg)	Ks (m/d)
11:28:00	44		
11:30:00	42.7	1.3	**5.47**
11:32:00	39.8	2.9	**12.20**
11:34:00	37.2	2.6	**10.94**
11:36:00	34.5	2.7	**11.36**
11:38:00	32	2.5	**10.52**
11:43:00	24.9	7.1	**11.95**
11:48:00	18.1	6.8	**11.44**
		18.1	

H =	25
r =	**4.5**



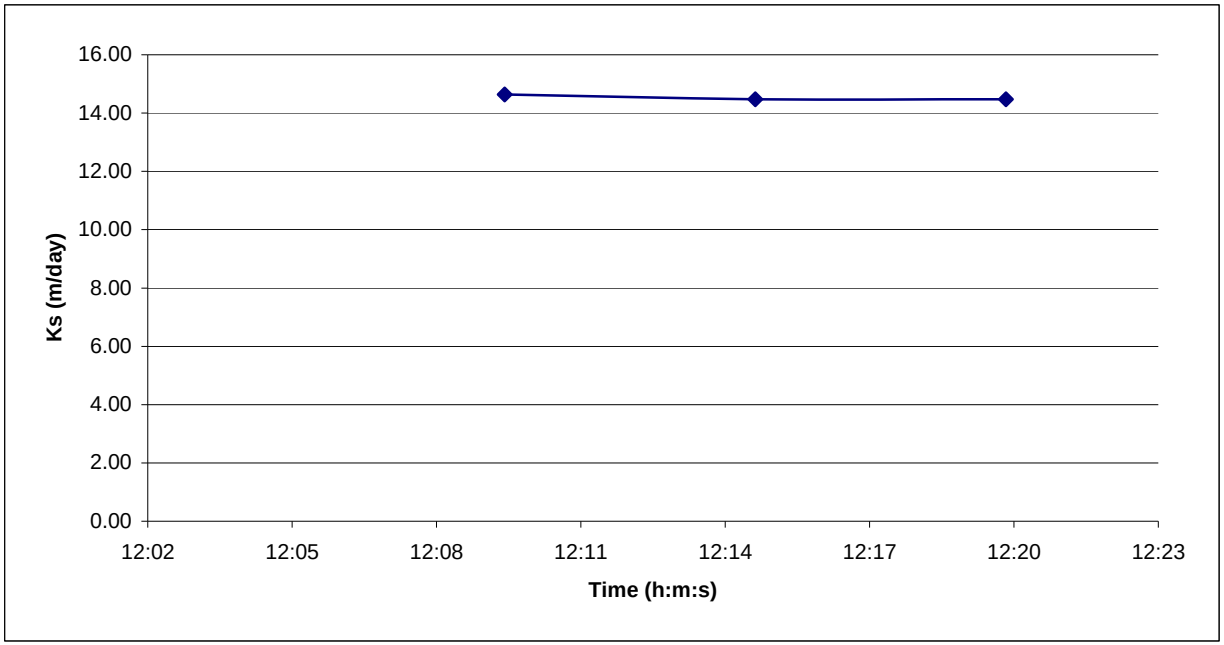
Ks = 11 m/day

SOIL PERMEABILITY TEST

Site No.	CHI2	Orange sand
Date	29/10/24	
Easting	396142	
Northing	6532513	
Depth	0.5	

Time (h:m:s)	Weight (kg)	Change in Weight (kg)	Ks (m/d)
12:05:00	46.3		
12:10:00	37.6	8.7	**14.64**
12:15:00	29	8.6	**14.47**
12:20:00	20.4	8.6	**14.47**
		20.4	

H =	25
r =	**4.5**



Ks = 14 m/day

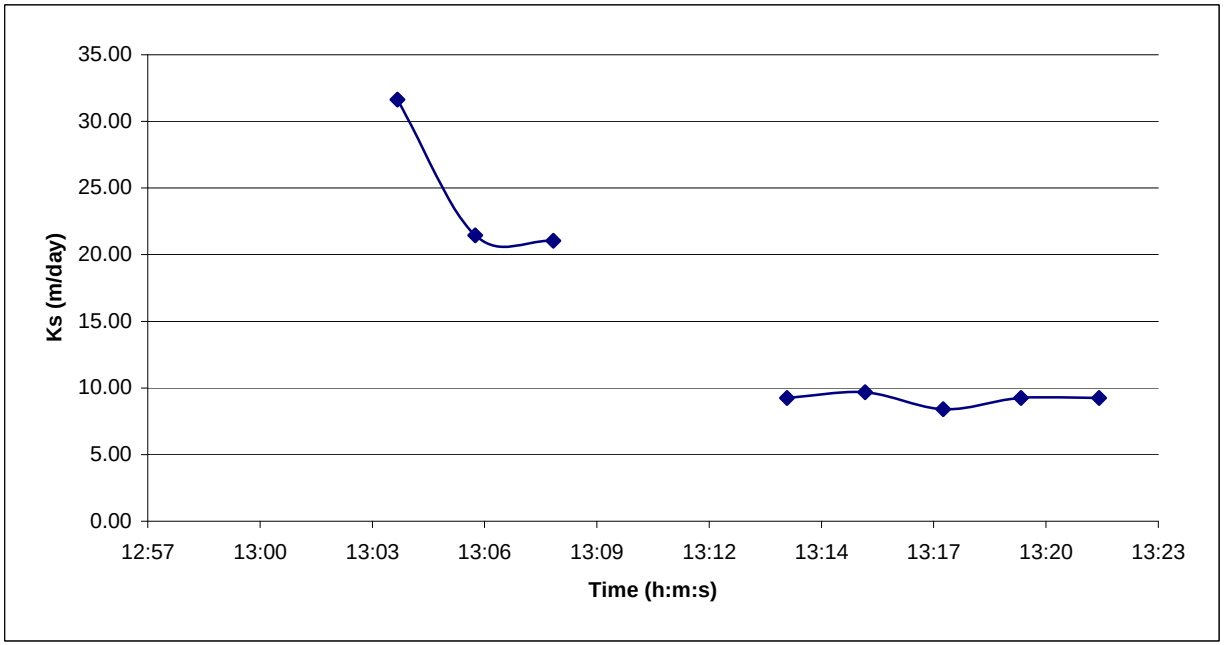
SOIL PERMEABILITY TEST

Site No.	CHI3
Date	29/10/24
Easting	396353
Northing	6532556
Depth	0.5

Dark brown clayey sand over black sandy/peaty clay

Time (h:m:s)	Weight (kg)	Change in Weight (kg)	Ks (m/d)
12:59:00	41.9		
13:04:00	23.1	18.8	**31.63**
13:06:00	18	5.1	**21.45**
13:08:00	13	5	**21.03**
13:12:00	40.6		
13:14:00	38.4	2.2	**9.25**
13:16:00	36.1	2.3	**9.68**
13:18:00	34.1	2	**8.41**
13:20:00	31.9	2.2	**9.25**
13:22:00	29.7	2.2	**9.25**
		29.7	

H =	25
r =	**4.5**



Ks = 9 m/day

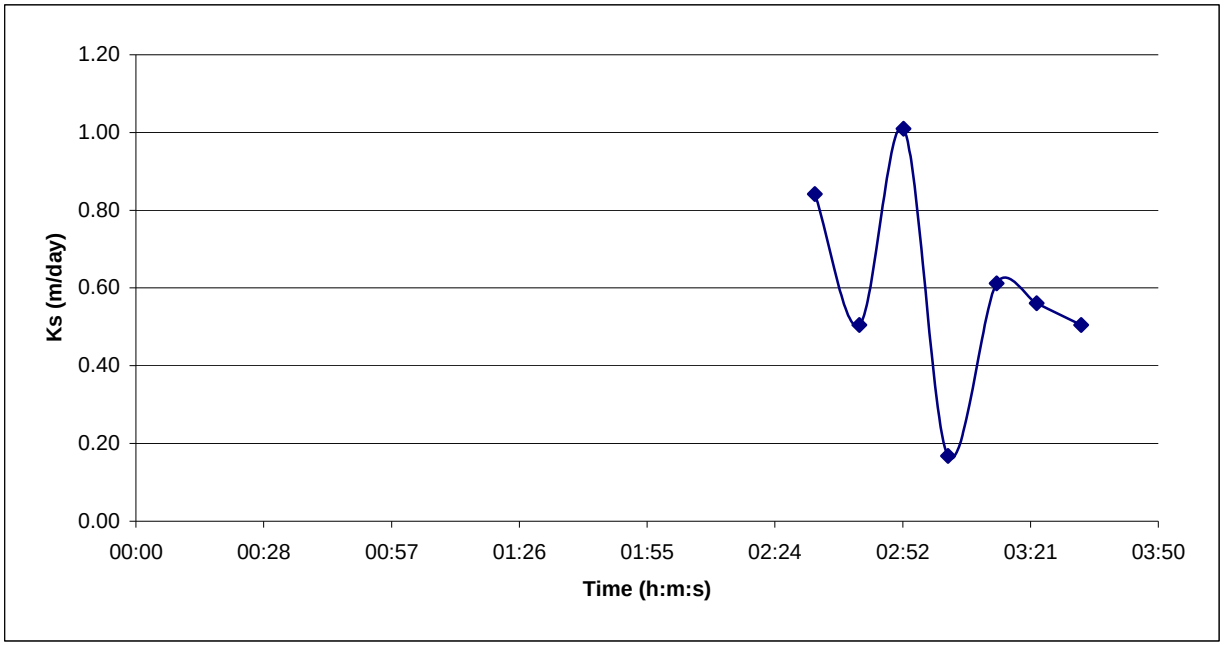
SOIL PERMEABILITY TEST

Site No.	CHI4
Date	29/10/24
Easting	396342
Northing	6532677
Depth	0.5

Dark grey clayey sand over sandy clay

Time (h:m:s)	Weight (kg)	Change in Weight (kg)	Ks (m/d)
02:28:00	40.7		
02:33:00	40.2	0.5	**0.84**
02:43:00	39.6	0.6	**0.50**
02:53:00	38.4	1.2	**1.01**
03:03:00	38.2	0.2	**0.17**
03:14:00	37.4	0.8	**0.61**
03:23:00	36.8	0.6	**0.56**
03:33:00	36.2	0.6	**0.50**
		36.2	

H =	25
r =	**4.5**



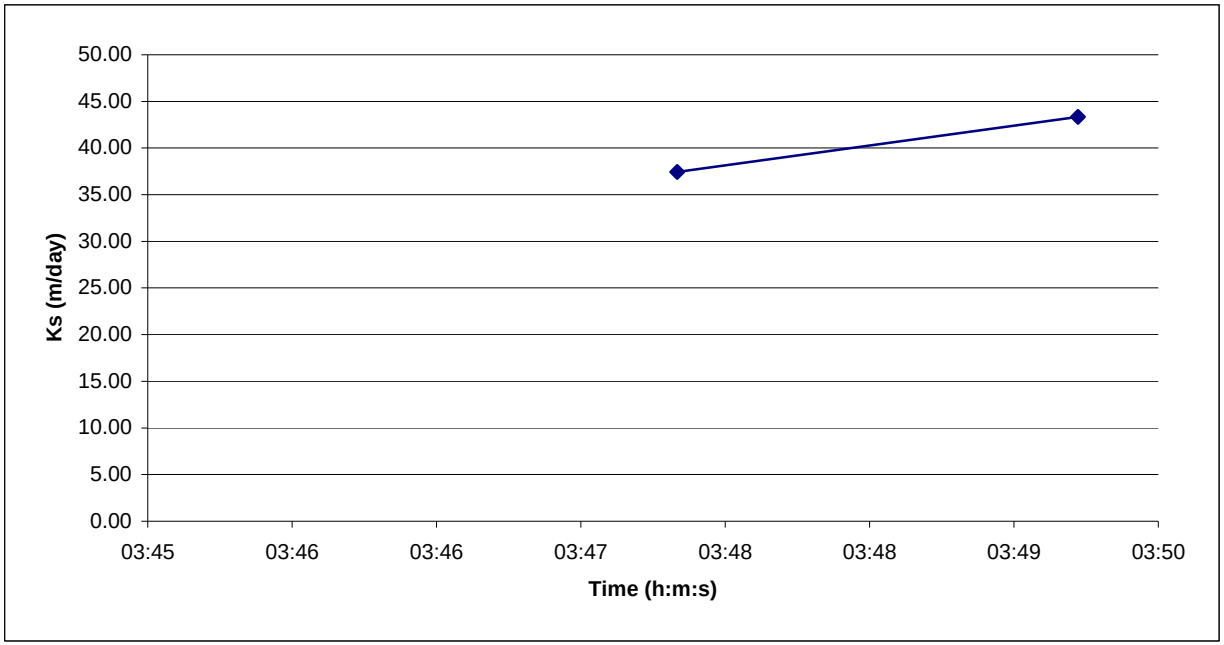
Ks = 0.5 m/day

SOIL PERMEABILITY TEST

Site No.	CHI5	Dark orange-brown sand
Date	29/10/24	
Easting	396131	
Northing	6532743	
Depth	0.5	

Time (h:m:s)	Weight (kg)	Change in Weight (kg)	Ks (m/d)
03:46:00	33.1		
03:48:00	24.2	8.9	**37.44**
03:50:00	13.9	10.3	**43.33**
		13.9	

H =	25
r =	**4.5**



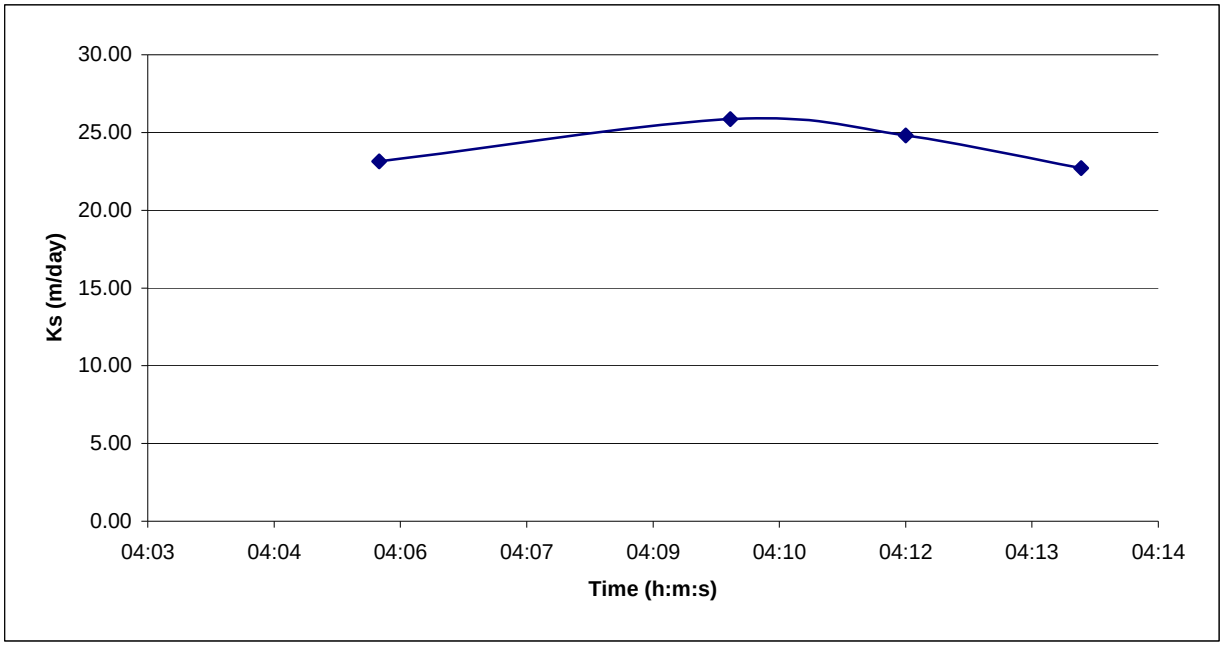
Ks = 40 m/day

SOIL PERMEABILITY TEST

Site No.	CHI6	Orange sand
Date	29/10/24	
Easting	395993	
Northing	6532822	
Depth	0.5	

Time (h:m:s)	Weight (kg)	Change in Weight (kg)	Ks (m/d)
04:04:00	41.2		
04:06:00	35.7	5.5	**23.14**
04:10:00	23.4	12.3	**25.87**
04:12:00	17.5	5.9	**24.82**
04:14:00	12.1	5.4	**22.72**
		12.1	

H =	25
r =	**4.5**



Ks = 22 m/day

Appendix C

Local Water Management Strategy

LOT 106 (No. 62) CHERITON ROAD, GINGIN

LOCAL WATER MANAGEMENT STRATEGY

Prepared for

Fairlands Farm Pty Ltd
23 Kilkenny Rd
FLOREAT WA 6014

Report No. J24041b
10 September 2025

BAYLEY ENVIRONMENTAL SERVICES
30 Thomas Street
SOUTH FREMANTLE WA 6162

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1.0 INTRODUCTION

1.1 Background

Fairlands Farm Pty Ltd has submitted an application to the Shire of Gingin to amend the zoning of Lot 106 Cheriton Rd, Gingin from General Rural to Rural use. In support of the proposed rezoning, a Concept Plan demonstrating how the 26.02ha site could be subdivided into 22 Rural Living (RL1) lots ranging in size from 1ha to 1.2ha has been prepared. The lots will be supplied with scheme water, underground telecommunications and power and will employ on-site effluent disposal. Figure 1 shows the proposed Concept Plan. Figure 2 shows an aerial view of the site and its surroundings.

1.2 Relevant Statutes, Policies and Guidelines

1.2.1 State Planning Policy 2.9

State Planning Policy 2.9: *Water Resources* (WAPC, 2006) lists the following key principles for total water cycle management:

- Consideration of all water sources (including wastewater) in water planning, maximising the value of water resources.
- Integration of water and land use planning.
- Sustainable and equitable use of all water sources, having consideration of the needs of all water users including the community, industry and the environment.
- Integration of water use and natural water processes.
- A whole-of-catchment integration of natural resource use and management.

SPP 2.9 also lists the following general objectives for water-sensitive urban design:

- To manage a water regime.
- To maintain and, where possible, enhance water quality.
- To encourage water conservation.
- To enhance water-related environmental values.
- To enhance water-related recreational and cultural values.

1.2.2 Liveable Neighbourhoods

Element 5 of *Liveable Neighbourhoods* Edition 3 (WAPC, 2004) identifies specific objectives and requirements for Urban Water Management. These are based on Best Planning Practices which are defined as the best practical approach for achieving water resource management objectives within an urban framework.

1.2.3 Better Urban Water Management

Better Urban Water Management (WAPC, 2008) sets out the following objectives for water sensitive urban design:

Water Conservation

- Consumption of 100kL/p/yr including less than 40-60 kL/p/yr scheme water.

Water Quantity

- Ecological Protection – Maintain pre-development flow rates and volumes for the 1 year ARI event. Maintain or restore desirable environmental flows and/or hydrological cycles.

- Flood Management – Maintain pre-development flow rates and volumes for the 100 year ARI event.

Water Quality

- Maintain pre-development nutrient outputs (if known) or meet relevant water quality guidelines (e.g. ANZECC & ARMCANZ, 2000).

- Treat all runoff in the drainage network prior to discharge consistent with the Stormwater Management Manual.

- As compared to a development that does not actively manage stormwater quality, achieve:
  - at least 80% reduction of Total Suspended Solids;
  - at least 60% reduction of Total Phosphorus;
  - at least 45% reduction of Total Nitrogen; and
  - at least 70% reduction of gross pollutants.

Mosquitoes and Midges

- Design detention structures so that, between the months of November and May, stormwater is fully infiltrated within 96 hours.

- Design permanent water bodies (where accepted by DoW) to maximise predation of mosquito larvae by native fauna.

1.2.4 Shire of Gingin Local Planning Scheme No. 9

The subject site is zoned as General Rural under the Shire of Gingin LPS No. 9. Under the proposal, the site will be rezoned to Rural Living 1 (RL1).

The LPS contains two Special Control Areas (SCAs) that impinge on the site:

- *SCA1 – River Environs Management Area*

SCA1 covers land close to Gingin Brook, extending 8-62m into four lots in the north-east of the site (Figure 1). It contains the following development standards and considerations:

"a) More intensive development such as residential, industrial or rural residential subdivision, will generally not be supported within the River Environs Management Area.

b) Development applications for land within the River Environs Management Area should not be approved where it could reasonably be expected that the development may result in;
- an obstruction to major river flows and increase flood levels upstream;
- the removal of or damage to riparian vegetation or other nearby vegetation which influences the waterway; or
- harm to water quality or habitat values of the waterway.

c) Public works or community facilities may be permitted within the River Environs Management Area, subject to advice from the Department of Water that such public works can be designed and located in a manner so as to minimise flood risk, property damage and obstruction to river flow.

d) For those areas within the River Environs Management Area where the Department of Water has identified the flood plain boundary, development will be subject to a minimum habitable floor level of 0.5m above the predicted 1 in 100-year flood level."

All proposed developments on the site including roads, houses and effluent land application areas are outside of SCA1 and are not constrained by the SCA.

- *SCA2 – Public Drinking Water Supply Area*

SCA2 extends up to 16m into a road reserve and one proposed lot in the south of the site (Figure 1). The purpose of the SCA is to protect Gingin's bore water supply.

SCA2 prohibits polluting land uses such as piggeries and abattoirs. Any proposals involving intensive agriculture, application of fertilisers or pesticides, chemical storage or substantially increased runoff are to be referred to the DWER.

All proposed developments on the site except for a small section of road are outside of SCA2 and will have no effect on the SCA.

1.2.5 Government Sewerage Policy 2019

The Government Sewerage Policy (2019) requires that all new residential development should be deep-sewered unless it is exempt for one of several reasons. For exempt developments, the policy establishes minimum site capability requirements and density limits. Provisions of the policy that are relevant in this case include:

- Large lot subdivision (minimum lot size 2,000m^2; density R5 equivalent or less) in the outer metropolitan area may be undertaken without deep sewerage provided the responsible authorities are satisfied that no significant environmental impact is likely and there is no further opportunity for subdivision without sewerage.

- Land used for on-site effluent disposal must meet the following requirements:
  - The slope must be less than 20% (1 in 5) and the land shall be engineered to prevent runoff.
  - The site should not be subject to inundation or flooding at a probability greater than once in 10 years.
  - In loams and heavy soils, the discharge point of the effluent disposal system should be at least 0.6m above the highest groundwater level.
  - The discharge point should not be within 100m of a waterway, a significant wetland or a drain that discharges directly into a waterway or significant wetland without treatment. Smaller setbacks may be approved where the relevant agencies are satisfied that the reduced setback will not have significant impact on the environment or public health.

- In areas identified as Sewage Sensitive Areas (SSA) the following additional requirements apply:
  - a minimum lot size of 1ha, unless an existing WAPC-approved rezoning or structure plan provides for a higher lot density;
  - a minimum 1.5m clearance from the effluent discharge point to the highest groundwater table; and
  - use of secondary treatment systems with nutrient removal capability.

1.2.6 Water Quality Protection Note (WQPN) 70: *Wastewater treatment and disposal – domestic systems* (DWER, 2016)

WQPN 70 sets out the DWER's advice regarding domestic on-site effluent disposal in public drinking water source areas or near other sensitive water resources. The key recommendation relevant to this case is that effluent disposal systems should be located at least 100m from waterways and wetlands and outside the area subject to flooding by a 10-year ARI flood event.

The Note provides that smaller setbacks may be considered on a case-by-case basis in low-risk situations.

1.2.7 DoW Interim Guideline: Developing a Local Water Management Strategy

The DoW LWMS guideline was published in 2008 and sets out the DoW's preferred format and content for LWMS documents. The guideline expands on the LWMS guidance provided in *Better Urban Water Management* (2008).

This LWMS has been prepared in accordance with the principles set out in the DoW guideline.

1.3 Scope of This Report

The scope of this report is to:

- Document the existing environment of the site in relation to soils, drainage, erosion, watercourses, groundwater and water-dependent ecosystems.
- Briefly describe the proposed development in relation to water management.
- Address relevant regulatory requirements and design criteria for setbacks to watercourses, groundwater management and drainage.
- Describe the strategies to be implemented for water conservation, watercourse protection, groundwater management and stormwater drainage.
- Outline the proposed water monitoring program.

2.0 PRE-DEVELOPMENT ENVIRONMENT

2.1 Climate

2.1.1 Rainfall

Gingin has a strongly seasonal rainfall, with most of the annual rain falling between May and September in association with winter cold fronts. Occasional heavy falls may occur from summer thunderstorms. The long-term average annual rainfall for RAAF Gingin (located 13km south-west of the site) is 637.7mm, of which 78% falls between the months of May and September.

Figure 3 shows a rainfall occurrence chart for RAAF Gingin. Table 2.1 shows rainfall intensity, frequency and duration for Gingin.

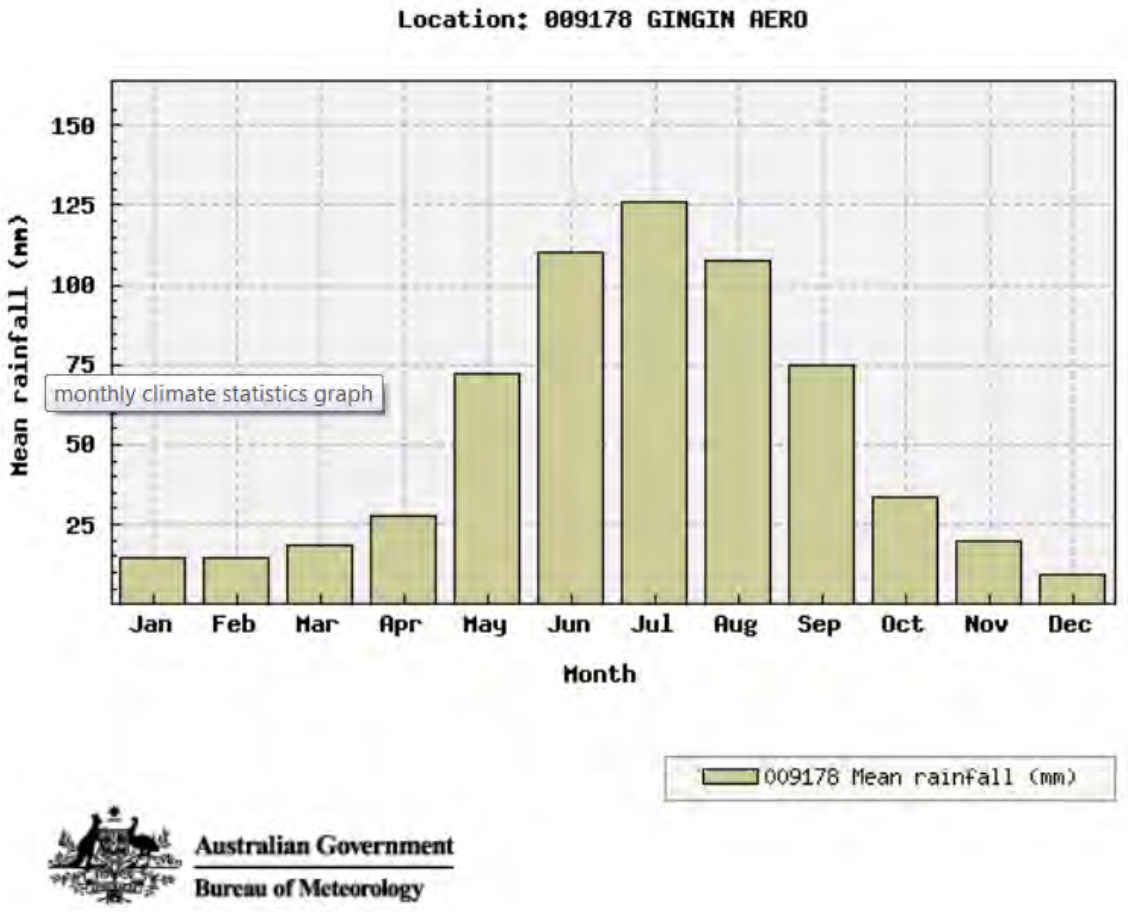


Figure 3 RAAF Gingin Mean Rainfall

IFD Design Rainfall Depth (mm)

Issued: 06 December 2024

Rainfall depth for Durations, Exceedance per Year (EY), and Annual Exceedance Probabilities (AEP).
FAQ for New ARR probability terminology

	Annual Exceedance Probability (AEP)						
Duration	**63.2%**	**50%#**	**20%***	**10%**	**5%**	**2%**	**1%**
1 min	1.41	1.59	2.20	2.65	3.13	3.80	4.36
2 min	2.45	2.74	3.73	4.46	5.22	6.34	7.27
3 min	3.30	3.71	5.07	6.07	7.12	8.67	9.95
4 min	4.02	4.52	6.21	7.46	8.77	10.7	12.3
5 min	4.62	5.21	7.19	8.65	10.2	12.4	14.2
10 min	6.78	7.67	10.7	12.9	15.2	18.5	21.2
15 min	8.22	9.29	12.9	15.6	18.4	22.3	25.5
20 min	9.31	10.5	14.6	17.6	20.7	25.2	28.8
25 min	10.2	11.5	16.0	19.2	22.7	27.5	31.5
30 min	11.0	12.4	17.1	20.6	24.3	29.5	33.8
45 min	12.9	14.5	19.9	24.0	28.3	34.4	39.5
1 hour	14.4	16.1	22.2	26.7	31.4	38.4	44.2
1.5 hour	16.8	18.8	25.7	31.0	36.7	45.1	52.2
2 hour	18.7	20.9	28.7	34.6	41.1	50.7	59.1
3 hour	21.9	24.4	33.5	40.6	48.4	60.3	70.7
4.5 hour	25.6	28.5	39.2	47.7	57.3	72.0	84.9
6 hour	28.5	31.8	43.7	53.5	64.5	81.4	96.5
9 hour	33.1	36.9	50.9	62.4	75.6	95.9	114
12 hour	36.7	40.9	56.3	69.2	83.9	107	127
18 hour	42.0	46.7	64.3	78.8	95.4	121	144
24 hour	45.9	51.0	69.9	85.4	103	130	154

Note:
The 50% AEP IFD **does not** correspond to the 2 year Average Recurrence Interval (ARI) IFD. Rather it corresponds to the 1.44 ARI.

Table 2.1 Rainfall Intensity for Gingin

2.2 Physiography

2.2.1 Topography

The site lies on the east-facing western side of the Gingin Brook valley on the northern edge of the Gingin Townsite. The elevation of the site ranges from 97m AHD in the north-east near the Brook to 134m in the south-west corner. The slope is linear and slightly convergent, varying from about 1% in the north-east to 8% in the west and averaging 5.5% across most of the site. Figure 4 shows topographic contours over the site.

2.2.2 Geology and Soils

The Geological Survey of Western Australia (Hocking *et al.*, 1975) maps the site as Colluvium (Qpo): a Quaternary-aged varicoloured (white-cream-brown), poorly sorted, poorly rounded sand which was formerly an eluvial (weathered in-situ) horizon overlying laterite which has been partly redistributed. A small area in the south-west of the site is mapped as Laterite (Czl): typically a ferruginous, pisolitic, siliceous laterite forming layers from 1.5m to 3m thick and associated with eluvial quartz sand, overlying a weathered rock zone which can be up to 30m thick.

Figure 4 shows the GSWA mapping. Test pitting to 2.5-3m at 12 locations across the site (Figure 4) found a profile that generally matched the GSWA mapping. Appendix A shows soil logs from the test pits.

2.2.3 Acid Sulphate Soils

ASS-risk mapping by the DBCA shows the site as Class 3 (Nil to Low risk of ASS within 3m of the ground surface). The soils of the site are elevated and have had no recent marine influence. The age and origin of the soils and the absence of a shallow water table over most of the site indicate that acid sulphate soils are unlikely to be present. The nearest mapped high ASS risk zone is a wetland 3.3km south of the site.

Development of the site is not expected to involve any excavation deeper than about 2m (for installation of effluent systems) or dewatering. Any ASS present is therefore unlikely to be disturbed. No further ASS assessment is considered necessary.

2.2.4 Phosphorus Retention Index

The strongly coloured and/or clayey soils of the site are expected to have a high to very high PRI. Analysis by the CSBP Soil Laboratory of samples from 0.5m and/or 1m depth at four locations (CH2, CH6, CH8, CH10 – Figure 4) gave PRI values ranging from 8.0 to 123.8, with a mean of 56.8 and a median of 27.2.

PRI is a measure of the ability of a soil to adsorb and retain phosphorus from solution. A high PRI indicates that the soil is unlikely to leach phosphorus to the water table. Typical ranges for PRI values in soils are as follows:

PRI Range	*Rating*	*Typical soils*
0 – 0.5	Very Low	Bassendean Sand
2 – 4	Low – Moderate	Karrakatta Sands
5 – 12	Moderate – High	Cottesloe Sands
12 – 20	High	Crushed Limestone, Limesand
20 – 1000+	Very High	Clay

2.2.5 Soil Permeability

Constant-head permeability tests in accordance with AS1547:2012 were carried out at 0.5m depth at five locations as shown on Figure 4. Appendix B shows the detailed test results.

The tests gave saturated hydraulic conductivities (Ks) ranging from 0.5m/day to 40m/day, with a mean of 16m/day and a median of 12.5m/day. The lowest value of 0.5m/day was recorded from the low part of the site in clayey sand.

2.2.6 Soil Geotechnical Analysis

Soil samples collected at 0.5m and 1.0m from test pit CHT8 in the north-east corner of the site (Figure 4) were subjected to analysis by the CSBP Soil Laboratory for geotechnical parameters including particle size distribution, dispersion index, exchangeable cations and exchangeable sodium percentage (sodicity). Table 2.2 shows the results of the analysis. The soil profile at CHT8 was typical of the profile in the lower parts of the site.

Table 2.2 Soil Analysis

Sample (Figure 4)	*Particle Size*		*Soil Type*	*Dispersion Index (range 0-16)*	*Exchangeable Sodium %*
CHT8 0.5m	Clay (<2µm) Silt (2-20µm) Sand (20-2000µm)	16.11% 15.67% 68.22%	Sandy loam	14	5.4
CHT8 1.0m	Clay (<2µm) Silt (2-20µm) Sand (20-2000µm)	26.22% 13.14% 60.64%	Sandy clay loam	10	13.6

The soil analyses show that the soils in the lower lying parts of the site are predominantly non-sodic (Exchangeable Sodium % <6) to moderately sodic (ESP >15), highly dispersive sandy loams overlying sandy clay loams.

2.3 Hydrology

2.3.1 Surface Drainage

There is no defined natural surface drainage on the site. The sandy surface soils of the majority of the site (above about 102m AHD) mean that runoff would occur only over short distances under very heavy rainfall conditions. The lower eastern part of the site has heavier soils and a shallower water table, and may generate surface runoff in a 1-year ARI storm event or less.

The major surface hydrological feature of the area is Gingin Brook, a tributary of the Moore River, which flows north between 20m and 200m east of the site. Surface pools

associated with the Brook occurred as close as 15m from the site boundary in October 2024.

A shallow constructed drain runs from the mid-northern boundary south and then east through the north-east of the lot to Gingin Brook. This drain extends upstream across other properties to its source 2km upstream of Lot 106. The drain has a catchment of about 163ha but is dammed by at least eight farm dams, so it would be unlikely to carry large flows. This drain will be diverted into an easement along the northern lot boundaries as part of any future subdivision works, with intensive planting undertaken to turn it into a "living stream" to provide treatment of the water prior to discharge into Gingin Brook.

Figure 5 shows the catchments upstream of the site.

2.3.2 Groundwater

Groundwater Occurrence and Flows

There is no published groundwater level information available for the subject site or its surrounds. Given the topography of the site and surroundings, groundwater would likely exist as localised aquifers in creek and river valleys and possibly as seasonal subsurface seepage above impermeable layers on slopes.

Groundwater was present at a depth of 1.14m below ground in test pit CHT7 in the east of the site (Figure 4) on 29 October 2024. No usable DWER bores are available in the near vicinity of Lot 106 to enable this level to be compared with long-term averages. However, the topography, soils and presence of wetland vegetation (sedges) in the vicinity of CHT7 suggests that the water table would reach the ground surface in this area during wet winters. Groundwater measurements in midwinter will be necessary to more accurately determine the maximum groundwater level and the need for fill in areas below 100m AHD.

Measurements in early August 2025 of bores installed in four test pits (Figure 4) found groundwater at depths of 0.55m in test pit CHT7 and 1.92m in test pit CHT8. Test pits CHT2 and CHT6 were dry to depths of 2.91m and 2.6m respectively. Simultaneous measurements in a number of DWER bores across the southern Perth region gave readings that were a median of 0.5m below the long-term maximum groundwater level (MGL). These bores are distant from the site and in a different geological and topographic setting, so can only be used as a rough guide to groundwater levels at the site. However, they support the initial assessment that the MGL could reach the ground surface in the lowest parts of the site.

Groundwater Resources

The subject site is within the following subareas under the Gingin Groundwater Allocation Plan (DoW, 2015):

- Surficial aquifer - Gingin Townsite Subarea

- Mirrabooka and Fractured Rock aquifers – Southern Scarp Subarea (but not within either aquifer)
- Leederville, Leederville-Parmelia, Lesueur and Cattamarra aquifers – Cowalla Subarea
- Yarragadee aquifer – Chandala Subarea.

Only the surficial aquifer is relevant to private groundwater abstraction on the site.

The Gingin Groundwater Allocation Plan allocates 5,000 ML/yr for licensable supply from the surficial aquifer within the Gingin Townsite Subarea. Groundwater abstraction from the surficial aquifer within the plan area is permitted without a licence under Section 25A of the *Rights in Water & Irrigation Act 1914* provided that the water is used only for:

- fire fighting;
- stock watering (non-intensive); or
- household and domestic garden and lawn irrigation not exceeding 0.2ha.

Regardless of the exemption of domestic use from licensing, construction of any bore within the site will require a licence under Section 26D of the RIWI Act.

2.3.3 Wetlands

The DBCA maps the lower-lying eastern part of the site below about 101m AHD as Multiple Use category palusplain (seasonally waterlogged plain). This appears to correspond with the topography and vegetation in the area.

Gingin Brook is mapped as Conservation category palusplain, although its profile suggests that it is a watercourse rather than a palusplain. Figure 4 shows the DBCA wetland mapping.

2.4 Vegetation

The subject site is cleared of native vegetation except for scattered mature trees (most or all Marri *Corymbia calophylla*) located along the south-western boundary with Cheriton Road and in the south-east corner. There are also non-local eucalypts in planted shelter belts in the south of the site. Two Olive (*Olea europaea*) groves are located in the north-west and south of the site, totalling about 9ha.

There is no riparian or groundwater-dependent vegetation on the site except for some sedges in the east of the site. To the east, Gingin Brook supports a fringing woodland of paperbarks (*Melaleuca preissiana*).

2.5 Fauna and Habitats

The subject land provides no significant fauna habitat except for those species able to utilise open cleared paddocks. It is unlikely that any native mammals would be dependent on the site.

2.6 Land Use

2.6.1 Current and Previous Land Uses

The subject land is currently used for broad acre sheep and cattle grazing. Historical Landgate aerial photography shows that the land has been cleared and grazed since at least 1981. Olives have been grown on the site since the 1990s. The lower north-eastern part of the site (below about 101m AHD) appears to have been used for cropping, possibly of potatoes, in the 1980s.

There is no visual or other evidence on site or on aerial photographs of any contamination or potentially contaminating land uses.

2.6.2 Neighbouring Land Uses

The subject land is bounded to the west, north and east by mixed land uses including broad acre grazing, small rural lots and rural living lots. The Gingin town site is located 250m to the south.

3.0 WATER USE SUSTAINABILITY

3.1 Water Supply

The development will be supplied with potable water provided by the Water Corporation.

Groundwater is available at shallow depth within the subject land, although its yield, quality and suitability for irrigation may vary. Over much of the site, groundwater of suitable salinity for irrigation of gardens will be available.

In accordance with the amended *Building Regulations 1989*, all new homes within the development will incorporate the following features:

- Minimum 4 stars WELS rated tap fittings, except bath outlets and garden taps.
- Minimum 3 stars WELS rated shower heads.
- Minimum 4 stars WELS rated dual flush toilets.
- Covers on all private swimming pools.
- All internal hot water pipes installed in accordance with AS/NZS 3500:2003.
- Maximum run of pipe from hot water system to outlet not exceeding 20 metres length or 2 litres of internal volume.

The design and installation of water wise initiatives such as rainwater tanks, grey water reuse systems and water efficient fixtures and fittings will be promoted as part of the marketing of the estate to ensure such initiatives can be implemented by homeowners.

3.2 POS Irrigation

No irrigated public open space is proposed within the site.

3.3 Wastewater Management

All lots in the subdivision will employ on-site effluent disposal. The Site & Soil Evaluation (BES, 2024) showed that all proposed building envelopes are suitable, in terms of soil permeability, slope and setbacks from watercourses, for on-site effluent disposal. Some lots in the east of the site will require filling to provide the necessary clearance to groundwater.

As the site is within a Sewage Sensitive Area (SSA) under the Government Sewerage Policy (GSP), all lots within the subdivision will be required to employ secondary effluent treatment systems with phosphorus removal capability.

Grey water reuse may be implemented by individual lot owners. Any person wishing to install a grey water reuse system must lodge an Application to Construct or Install an Apparatus for the Treatment of Sewage with the Shire of Gingin.

4.0 SURFACE WATER MANAGEMENT

4.1 Principles and Objectives

The Concept Plan aims to comply with the principles and objectives for stormwater management identified in the *Stormwater Management Manual for WA* (DoE, 2004) and *Better Urban Water Management* (WAPC, 2008).

The drainage system will be designed to maintain surface flow rates and volumes within and from the developed site at or below their pre-development levels, and as far as possible to maintain the existing flow paths. The priorities for managing the various sizes of flow event will be as follows:

- 1 year ARI — Retain and infiltrate all flows as close to source as possible. Maintain pre-development flow rates and volumes. Minimise export of nutrients and sediments.
- 5 year ARI — Detain water prior to discharge. Maintain pre-development flow rates and volumes. Maintain amenity and serviceability. Prevent scouring and damage.
- 100 year ARI — Maintain pre-development flow rates and volumes. Prevent flooding and damage.

The drainage design presented here is conceptual and will be refined during the detailed design stage as part of any future subdivision.

4.2 Drainage Management System

4.2.1 Lot Drainage

Runoff from private lots may be increased by the partial replacement of vegetated surfaces with roofs and paved areas. This is expected to be balanced by the capture of roof runoff in rainwater tanks or soak wells and the interception of runoff from driveways and other paved areas by lawns and gardens.

Storms up to 15mm are not expected to generate any runoff from private lots or open space. Runoff from larger storms will flow into the road drainage system or open space areas along existing flow paths.

4.2.2 Road Drainage

Road reserves will occupy an estimated 2.26ha within the development (8.7% of the total area). The paved area of the internal road network will constitute about 2.6% of

the total site area. All roads within the development will be kerbed. These will generally be semi-mountable kerbs.

Road runoff from storms up to 15mm will be captured and infiltrated in a series of small, linked infiltration basins located at approximately 50-65m intervals along both sides of the road reserves, with the spacing dependent on the slope of the road and the area of catchment being drained. The basins will also capture and detain the flow from critical storms up to 100-year ARI (1% AEP), releasing it at no more than the pre-development rate.

The basins will nominally be sized with base dimensions of 2m x 2m and top dimensions of 5m x 5m, with a total depth of 0.5m and a maximum water depth of 0.3m. Detailed sizing and siting of the basins will be carried out in the detailed design stage of future subdivision and reported in the UWMP. Figure 6 shows the conceptual layout of the drainage network. Figure 7 shows a conceptual plan and profile of the basins.

Runoff from larger and longer-duration storms, incorporating runoff from both roads and lots, will progressively overtop the basins and flow via open swales and/or pavement flow along the road reserves to the vegetated Drainage/PAW reserve in the east of the site, from where it will flow overland into Gingin Brook. The peak flows in storms up to 100-year ARI will be no greater than the pre-development flow rates. There will therefore be no requirement for dedicated compensating basins to attenuate the flow prior to it leaving the site. The peak flow rates entering Gingin Brook from the site will be no greater following development than before.

Preliminary calculations using the Rational Method (Engineers Australia, 1987) suggest that v-shaped swale drains up to 0.32m deep will be sufficient to carry the 100-year combined road and lot overflows from the basins.

Table 5.1 summarises the parameters adopted in the preliminary drainage calculations and the overall runoff and retention/detention volumes. The detailed flow calculations are set out in Appendix C.

Detailed design including selection, sizing and location of retention structures will be undertaken as part of future detailed subdivision design and reported in the UWMP.

Table 5.1 Drainage Parameters

1 yr 1 hr rainfall	15mm				
Basins					
Base dimensions (m)	2 x 2				
Top dimensions (m)	5 x 5				
Depth (m)	0.5				
Maximum water depth	0.3				
Side slopes	1:2				
Base permeability (m/d)	6				
Runoff coefficients	*1 yr (15mm)*	*5 yr*		*100 yr*	
		Pre Dev	*Post Dev*	*Pre Dev*	*Post Dev*
Road pavement	0.8	0.28	0.85	0.36	1
Road verge	0.1	0.28	0.48	0.36	0.6
Lots	0	0.28	0.28	0.36	0.36
Basins	1	0.28	1	0.36	1
Open space	0	0.28	0.28	0.36	0.36
Effective Impervious Area	7434	72897	80223	93542	102123
Flows					
Peak flow (L/sec)	31	882	969	2299	2508
Total flow (m^3)	112		909		2299
Storage required (m^3)	112		33		74
Effective storage (m^3)	174		120		120

4.2.3 Through Drainage

McHavloe Drive Drainage

McHavloe Drive provides access to a Rural Living subdivision opposite the subject site on the east of Cheriton Road. A catchment area of approximately 14.2ha (Figure 5) drains via roadside swales along McHavloe Drive into Cheriton Road. McHavloe Drive and its adjoining streets were constructed between 2003 and 2006, apparently without any detention or attenuation in the roadside drains. Since then, flows in the drains have filled the drains in the lower end of McHavloe Drive with sediment.

Video footage supplied by the Shire of Gingin show high runoff volumes flowing down McHavloe Drive, across Cheriton Road and into the nearby part of Lot 106. Calculations using the Rational Method (Engineers Australia, 1987) suggest that flows of up to 1179 litres per second could enter the subject site from McHavloe Drive in a critical 100 year ARI (1% AEP) storm event. This runoff must be conveyed through the site in a manner that does not cause flooding of lots or damage to the drainage infrastructure or roads.

It is proposed that a drainage reserve or easement be created opposite McHavloe Drive at the northern entrance to the subject site, with a swale constructed to carry the storm runoff from McHavloe Drive into the northern roadside drains and down to the Drainage/PAW reserve, from where it will flow into Gingin Brook. The flows from McHavloe drive will not be detained or attenuated within the site, but simply conveyed to the eastern end and Gingin Brook. Figure 6 shows the conceptual layout of the

drainage reserve/easement and roadside swales. Appendix C shows the detailed flow calculations.

The roadside swale on the southern side of the northern road will be sized to accommodate the extra flow from McHavloe Drive. The layout and sizing of the swales will be refined during a future subdivision design stage and reported in the UWMP.

Paddock Drain
The paddock drain that enters the site on the mid-northern boundary will be realigned into an easement along the northern boundary, exiting the site at the north-eastern corner from where it will flow into Gingin Brook. The swale will be densely planted with native species at the time of subdivision to control the flow, minimise erosion and remove sediments and nutrients from the water before it exits the site. Figure 6 shows the conceptual alignment of the drain and easement.

4.3 Surface Water Quality Management

The drainage system will be designed to maximise on-site retention of nitrogen and phosphorus. This will be achieved by:

- Retaining and infiltrating all lot runoff from storms up to 15mm (approx. 1-year ARI) within the lots.

- Infiltrating all road runoff from storms up to 15mm (estimated by the DWER to carry more than 99% of total flows and nutrients) in vegetated bioretention swales and with a tested average soil PRI of 56.8.

- Detaining runoff from storms between 15mm and 100-year ARI (1% AEP) to allow suspended particles to settle.

4.4 Maintenance

The drainage system has been designed to require minimal maintenance. The following will be required to ensure that the system continues to function as designed:

- Regular (possibly annual) cleaning of side entry pits and inlet pits. More frequent cleaning may be required during the construction phase.

- Tending and maintenance of Drainage/PAW reserve, swales and other vegetated drainage features to remove litter, control weeds and encourage the growth of native species.

- Pruning, mulching or removal of vegetation in bioretention basins as necessary to maintain ground fuel loads below 8 tonnes/ha.

5.0 GROUNDWATER MANAGEMENT

5.1 Groundwater Levels

Development of the site will have little or no effect on winter groundwater levels, although abstraction of groundwater via private bores for irrigation of lawns and gardens may draw down groundwater levels in summer and may lead to lower groundwater levels in the early part of winter.

Subsoil drains may be employed beneath house pads and road embankments in the lower part of the site to prevent groundwater rise into filled areas. Drainage swales and subsoil drains will be set with their inverts at least 300mm above the AAMGL, thereby minimising the impact of the development on maximum groundwater levels.

5.2 Groundwater Quality

The relationship between nutrient inputs and exports is complex, especially in the case of phosphorus, which travels through the soil profile as a “front” in a complex series of adsorption and desorption reactions. Nitrogen is subject to denitrification and mineralisation in the soil and groundwater. As a result, nutrient exports from the site at present will be a reflection of nutrient inputs over the last several decades, modified by soil hydrology and nutrient retention capacity.

The aim of nutrient management will be to limit nutrient inputs to the site so that nutrient outputs are minimised. The primary source of groundwater-borne nutrients will be soluble garden fertilisers. With low-phosphorus garden fertilisers being strongly promoted under the State government’s Fertiliser Action Plan, most garden fertilisers for sale in hardware and garden stores contain little or no phosphorus.

Measures available to minimise nutrient inputs and exports in the development will include:

- regular street sweeping to remove accumulated contaminants;
- selection of native species with low water and fertiliser requirements for public open space, drainage and landscape areas;
- community education on water wise gardening and fertiliser use; and
- community education on management of pet wastes.

6.0 LANDSCAPING STRATEGY

Landscaping of the site will focus on the use of local native species with low water demand. Plantings will be limited to the Drainage/PAW reserves, drainage easements and bioretention basins.

The bioretention basins, easements and Drainage/PAW reserve will be densely vegetated with local species selected with reference to the Monash University (2014) *Vegetation Guidelines for Stormwater Biofilters in the South-West of Western Australia*. Together with the high-PRI soils of the site, this will ensure a high quality of water entering Gingin Brook.

Fertiliser use will be minimal. New tube stock plantings may (depending on the results of pre-planting soil testing) be fertilised with slow-release nitrogen and phosphorus tablets on establishment and thereafter will be unfertilised. The plantings will not be irrigated after the establishment phase.

The Drainage/PAW reserve will be designed as passive open space, with landscaping focussed on native sedges, low shrubs and scattered trees. Trees will be spaced at least 15m apart so as to maintain a 10m canopy separation.

The total area to be planted will be approximately one hectare. If this area were irrigated at the DWER's recommended rate for POS (4,750 KL/ha/yr) during the establishment phase, approximately 4.75ML of water would be required to irrigate the new plantings for one year.

The irrigation requirements for landscape establishment will most likely be met by by tanker or scheme water. Because there will be no ongoing irrigation past the establishment phase, there will be no need for any bores to be operated or maintained by the Shire of Gingin.

The density of planting will be controlled to keep flammable ground fuel loads below 8 tonnes/ha.

7.0 IMPLEMENTATION AND FURTHER MANAGEMENT PLANS

Future subdivision of the subject land will be carried out in accordance with the general water management principles set out in this LWMS.

An Urban Water Management Plan (UWMP) is expected to be required as a condition of any future subdivision approval. The UWMP will present a detailed design of the stormwater drainage system.

The developer will maintain the drainage system and landscape plantings outlined in this LWMS for two years after the completion of subdivision works. At the end of that time the responsibility for management will pass to the Shire of Gingin, subject to the Shire's acceptance of the works.

8.0 REFERENCES

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Figures



SUBDIVISION CONCEPT
LOT 106 (No. 62) CHERITON ROAD
GINGIN

Figure 1

DRAFT

N

0 100 m
SCALE @ A3: 1:2500

9929-CON-02-A

DRAWN: WC
DATE CREATED: 2024.09.11
PROJECTION: MGA50 GDA94
CADASTRE: LANDGATE
AERIAL: LANDGATE 2023 MARCH

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ROWE GROUP DESIGN



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Figure 2

THE SITE AND SURROUNDINGS

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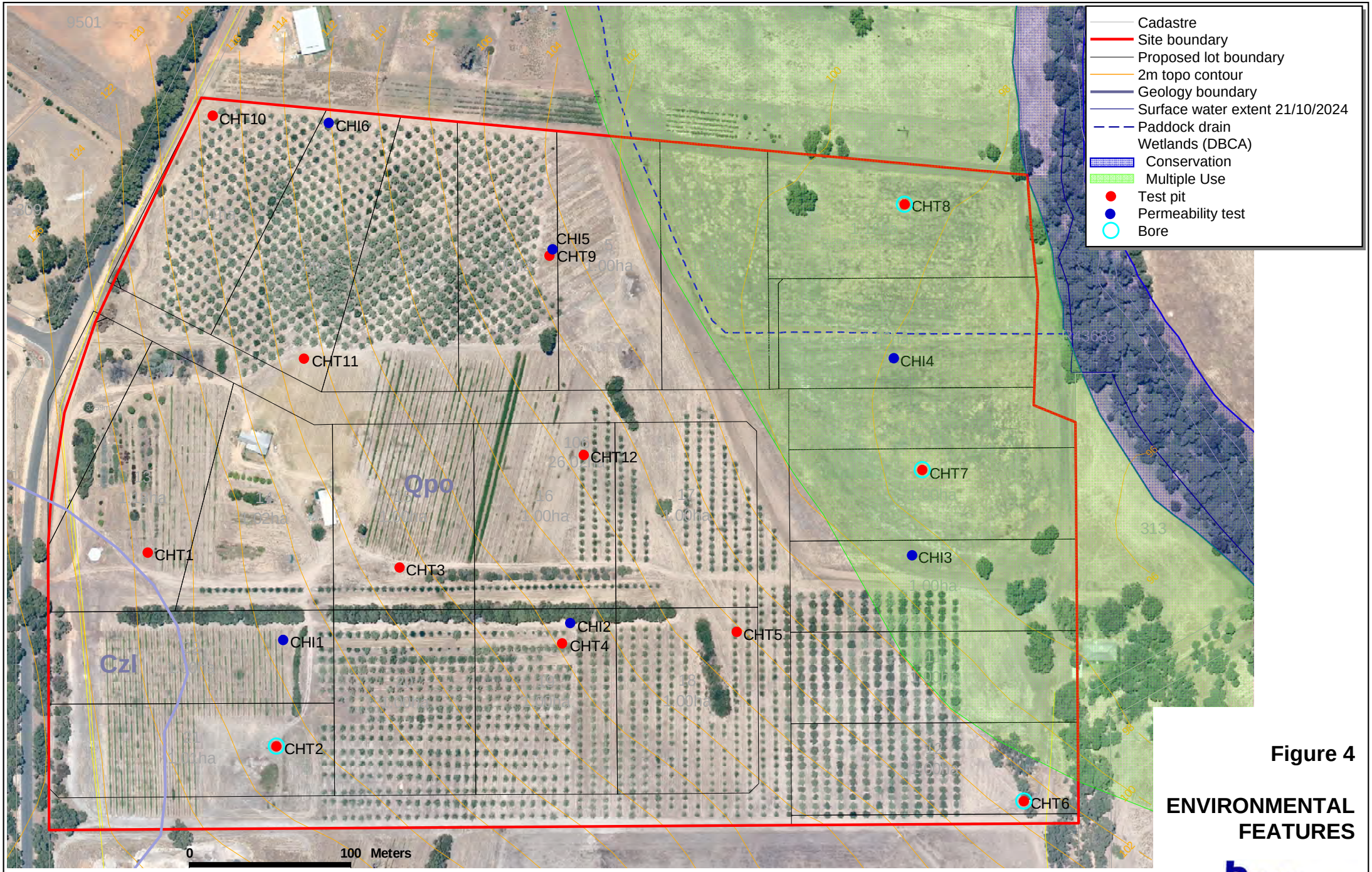
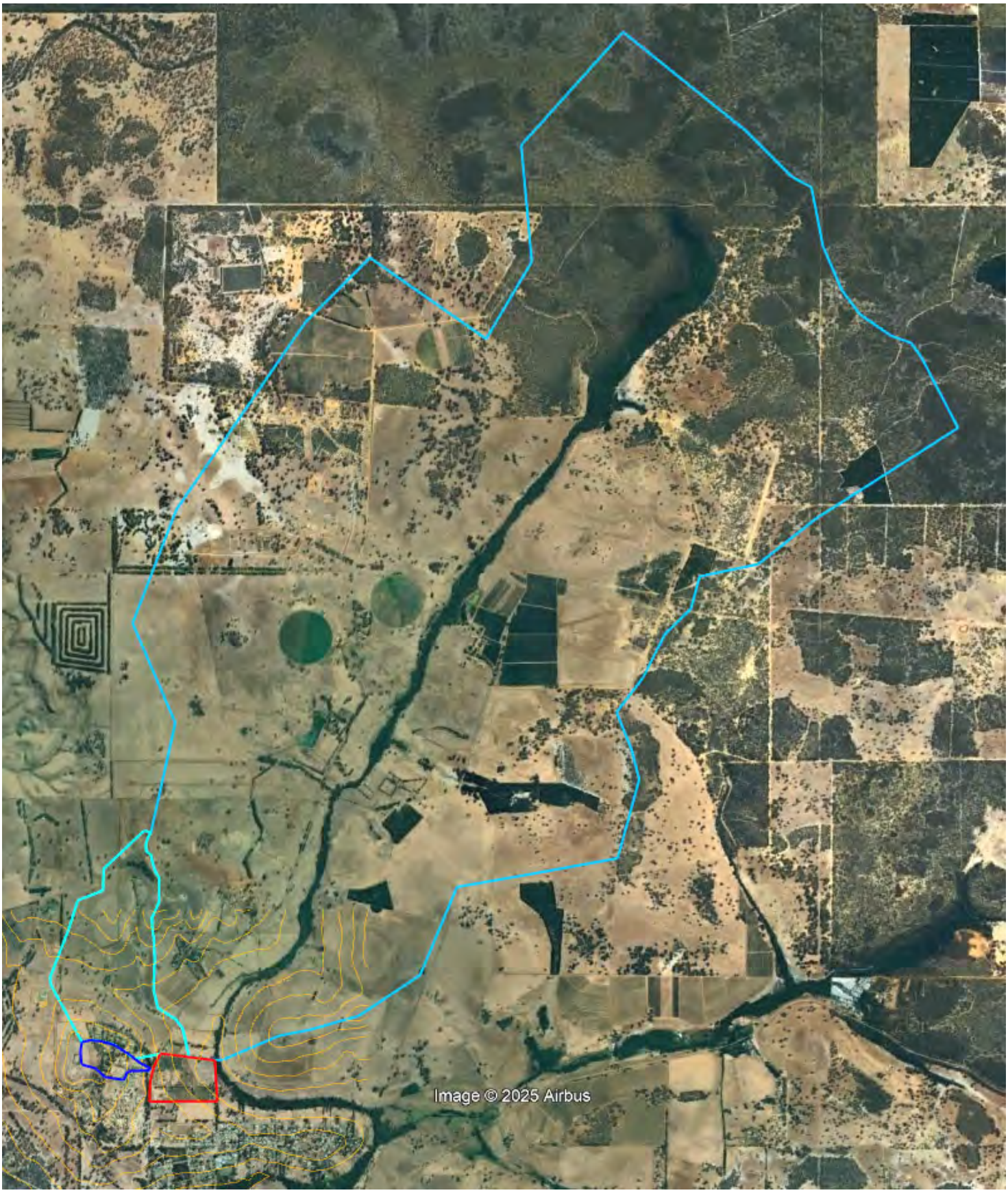


Figure 4

ENVIRONMENTAL FEATURES

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0 2 km

Subject site
10m topo contour
McHavloe Dr catchment
Paddock drain catchment
Gingin Brook catchment

Figure 5

CATCHMENTS

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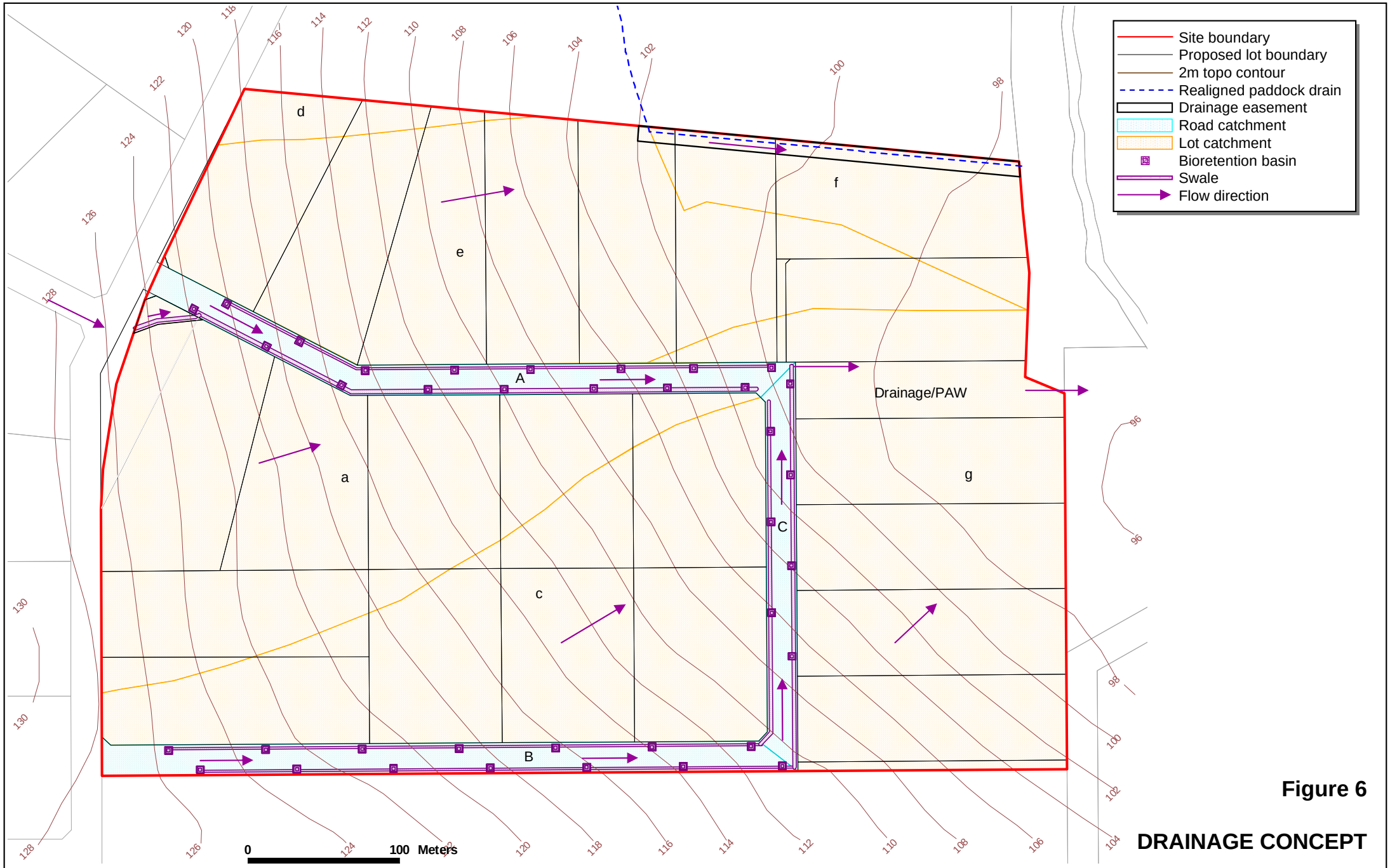


Figure 6

DRAINAGE CONCEPT

bayley environmental services

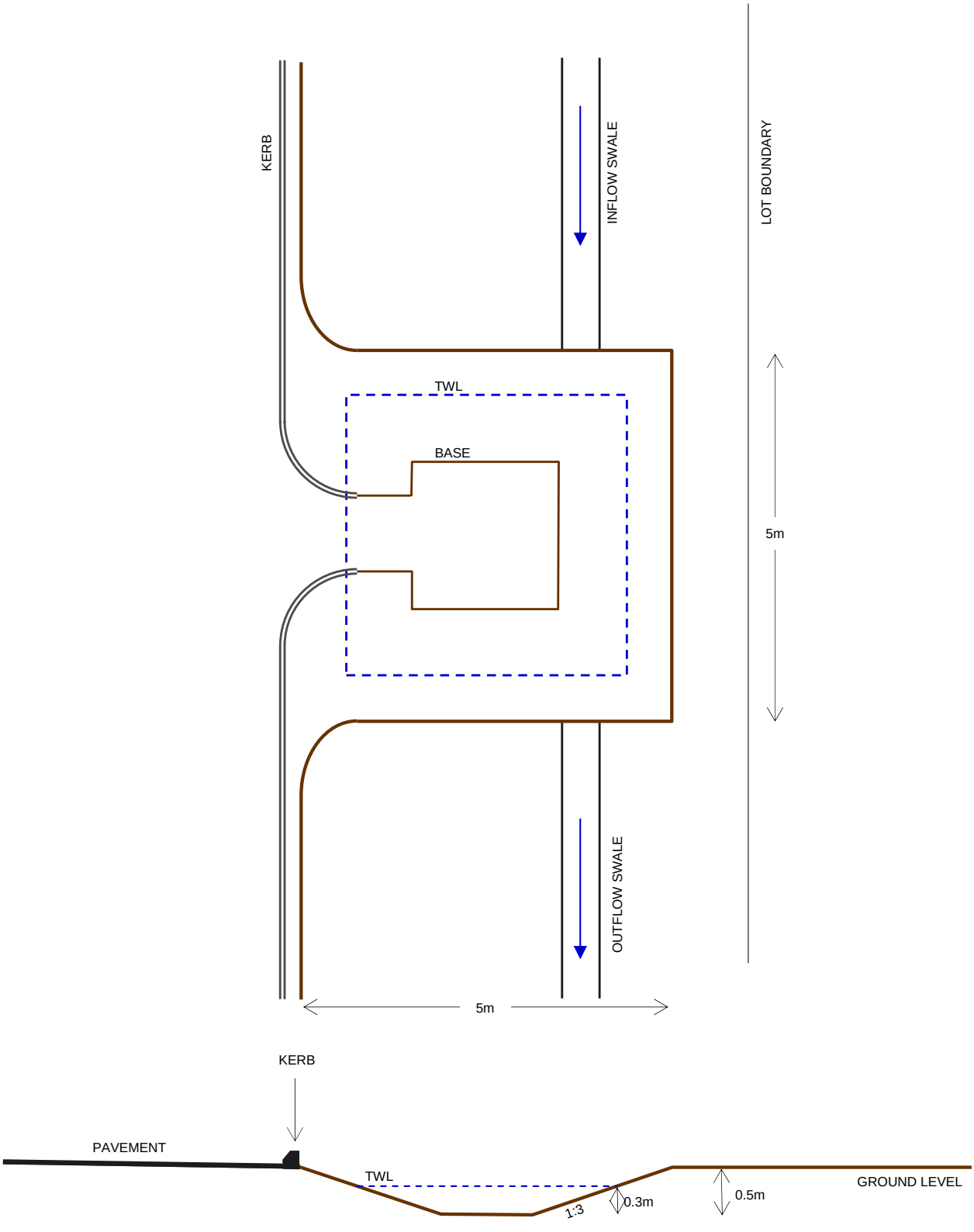


Figure 7

BASIN CONCEPT

bayley environmental services

Appendix A

Soil Logs

SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT1
EASTING:	395881
NORTHING:	6532558
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.5
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.1	Brown topsoil		
0.1 - 2.2	Orange slightly clayey sand		
2.2 - 2.5	Orange slightly clayey sand with ironstones to 50mm		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT2
EASTING:	395921
NORTHING:	6532827
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	3.1
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.1	Brown topsoil		
0.1 - 1.0	Orange-brown slightly gravelly sand		
1 - 1.8	Orange gravelly clayey sand		
1.8 - 3.1	Red/orange/brown mottled well structured sandy clay		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT3
EASTING:	395978
NORTHING:	6532677
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.5
REFUSAL (Y/N):	Y
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.2	Brown topsoil		
0.2 - 1.2	Orange to orange-yellow sand		
1.2 - 2.4	Orange gravelly sandy clay, cemented from 1.5m		
2.4 - 2.5	Orange well structured lateritic gravelly clay		
2.5	Refusal on laterite		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT4
EASTING:	396150
NORTHING:	6532618
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	3.0
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.1	Brown topsoil		
0.1 - 2.0	Orange sand		
2.0 - 3.0	Orange/red mottled well structured gravelly sandy clay		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT5
EASTING:	395961
NORTHING:	6532438
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	3.0
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.2	Brown topsoil		
0.2 - 0.5	Orange-brown sand		
0.5 - 2.2	Orange sand		
2.2 - 3.0	Orange-yellow sand, becoming paler		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT6
EASTING:	396036
NORTHING:	6532548
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.8
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.2	Brown topsoil		
0.2 - 0.5	Brown sand		
0.5 - 2.3	Orange/red/brown mottled gravelly sandy clay with ironstone rocks to 100mm		
2.3 - 2.8	Hard orange-yellow gravelly clayey sand		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT7
EASTING:	396137
NORTHING:	6532501
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	3.0
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	1.0

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.2	Brown topsoil		
0.2 - 1.0	Brown sand		
1.0 - 1.2	Dark brown peaty sand, wet		
1.2 - 2.0	Dark brown/green/dark orange mottled well structured sandy clay		
2.0 - 2.5	Dark green gritty clay with minor orange mottling, poorly structured		
2.5 - 3.0	Greenish-grey sandy clay, poorly structured, wet		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT8
EASTING:	396245
NORTHING:	6532508
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	3.0
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 -0.1	Dark brown topsoil		
0.1 - 1.0	Dark brown sand		
1.0 - 1.5	Brown/dark brown dully mottled, moderately structured sandy clay		
1.5 - 2.0	Dull orange/dark brown/green mottled poorly structured sandy clay		
2.0 - 2.2	Dull brown slightly mottled poorly structured sandy clay with occasional ironstone nodules		
2.2 - 3.0	Orange/brown/grey mottled well-structured sandy clay with soft laterite nodules		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT9
EASTING:	396422
NORTHING:	6532404
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.9
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.1	Brown topsoil		
0.1 - 0.5	Orange-brown sand		
0.5 - 2.9	Orange sand		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT10
EASTING:	396359
NORTHING:	6532608
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.8
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.1	Yellow-brown sand		
0.1 - 2.8	Orange sand		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT11
EASTING:	396348
NORTHING:	6532773
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.8
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.2	Pale grey-brown topsoil		
0.2 - 2.0	Orange sand		
2.0 - 2.8	Dark orange/pale orange mottled well structured slightly lateritic sandy clay		







SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT12
EASTING:	396130
NORTHING:	6532742
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.8
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.1	Dark brown topsoil		
0.1 - 0.8	Yellow-brown sand		
0.8 - 2.8	Orange sand		





Appendix B

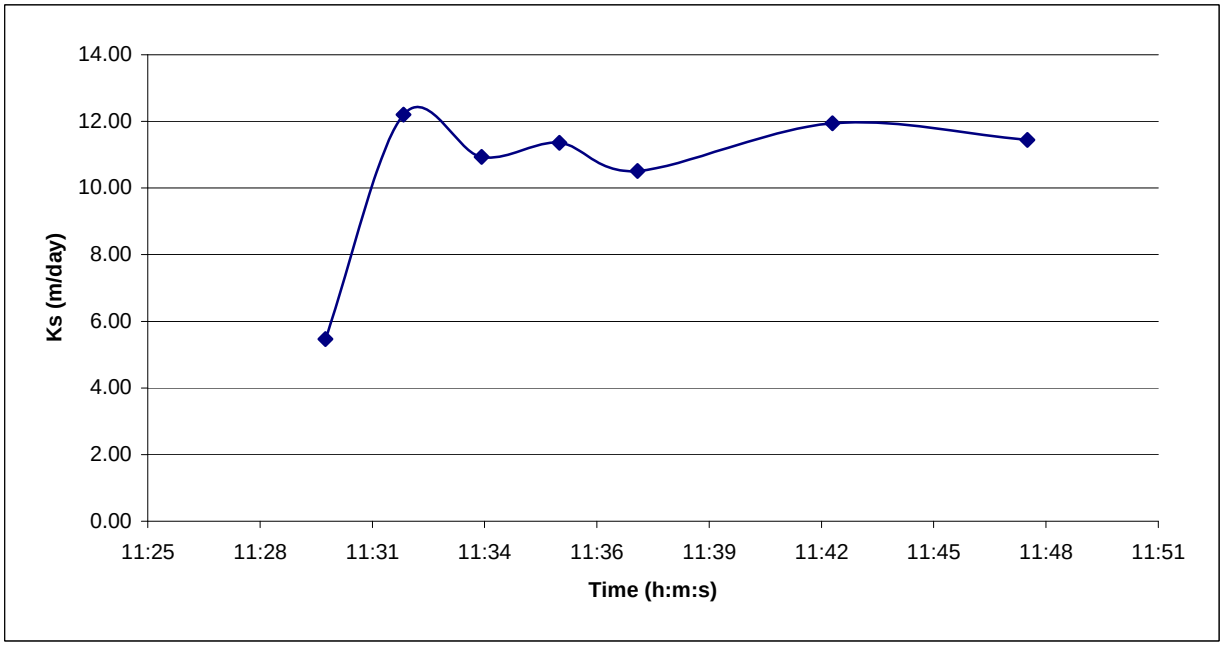
Permeability Test Results

SOIL PERMEABILITY TEST

Site No.	CHI1	Orange sand
Date	29/10/24	
Easting	395964	
Northing	6532504	
Depth	0.5	

Time (h:m:s)	Weight (kg)	Change in Weight (kg)	Ks (m/d)
11:28:00	44		
11:30:00	42.7	1.3	**5.47**
11:32:00	39.8	2.9	**12.20**
11:34:00	37.2	2.6	**10.94**
11:36:00	34.5	2.7	**11.36**
11:38:00	32	2.5	**10.52**
11:43:00	24.9	7.1	**11.95**
11:48:00	18.1	6.8	**11.44**
		18.1	

H =	25
r =	**4.5**



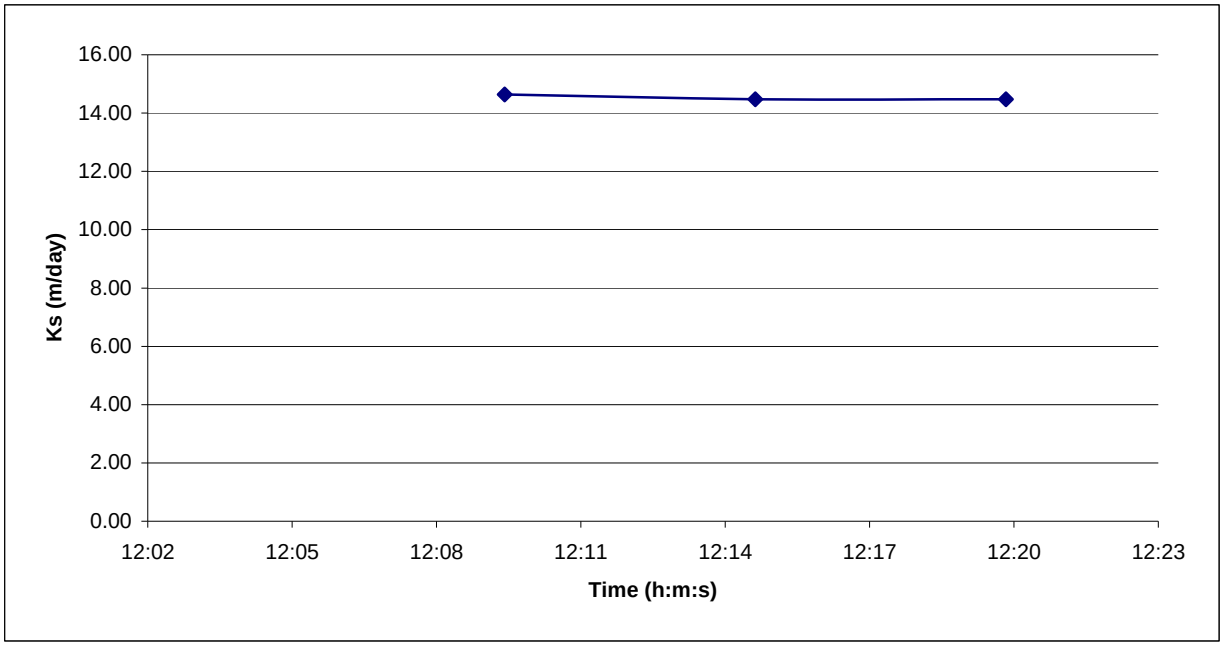
Ks = 11 m/day

SOIL PERMEABILITY TEST

Site No.	CHI2	Orange sand
Date	29/10/24	
Easting	396142	
Northing	6532513	
Depth	0.5	

Time (h:m:s)	Weight (kg)	Change in Weight (kg)	Ks (m/d)
12:05:00	46.3		
12:10:00	37.6	8.7	**14.64**
12:15:00	29	8.6	**14.47**
12:20:00	20.4	8.6	**14.47**
		20.4	

H =	25
r =	**4.5**



Ks = 14 m/day

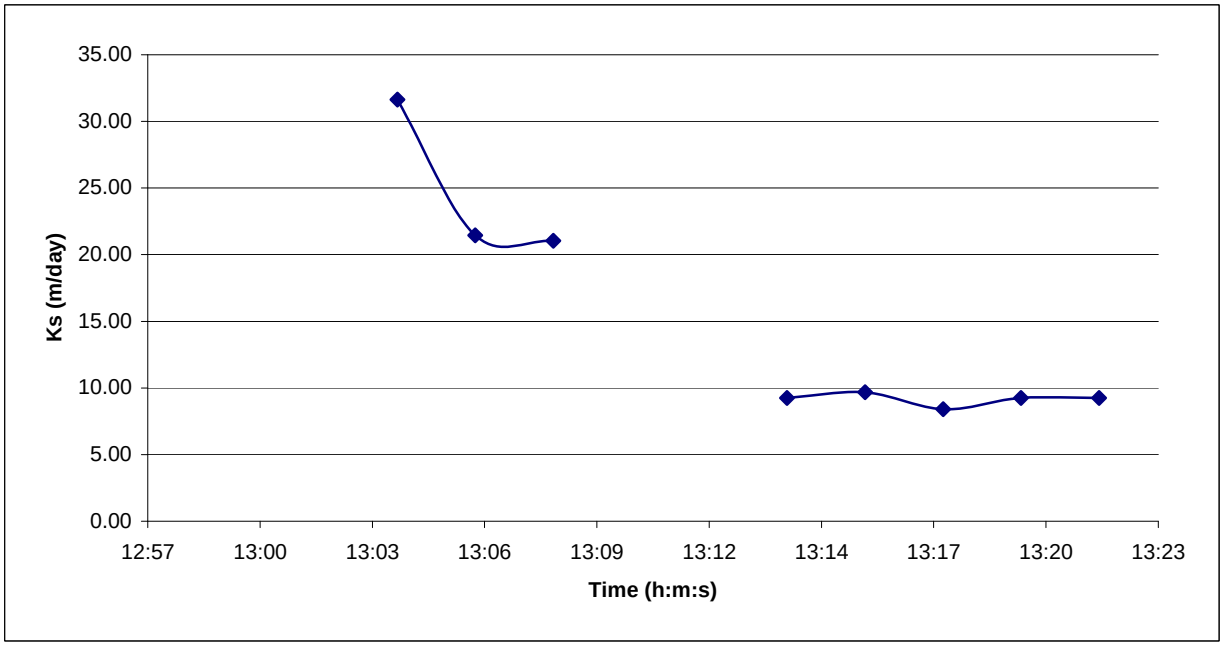
SOIL PERMEABILITY TEST

Site No.	CHI3
Date	29/10/24
Easting	396353
Northing	6532556
Depth	0.5

Dark brown clayey sand over black sandy/peaty clay

Time (h:m:s)	Weight (kg)	Change in Weight (kg)	Ks (m/d)
12:59:00	41.9		
13:04:00	23.1	18.8	**31.63**
13:06:00	18	5.1	**21.45**
13:08:00	13	5	**21.03**
13:12:00	40.6		
13:14:00	38.4	2.2	**9.25**
13:16:00	36.1	2.3	**9.68**
13:18:00	34.1	2	**8.41**
13:20:00	31.9	2.2	**9.25**
13:22:00	29.7	2.2	**9.25**
		29.7	

H =	25
r =	**4.5**



Ks = 9 m/day

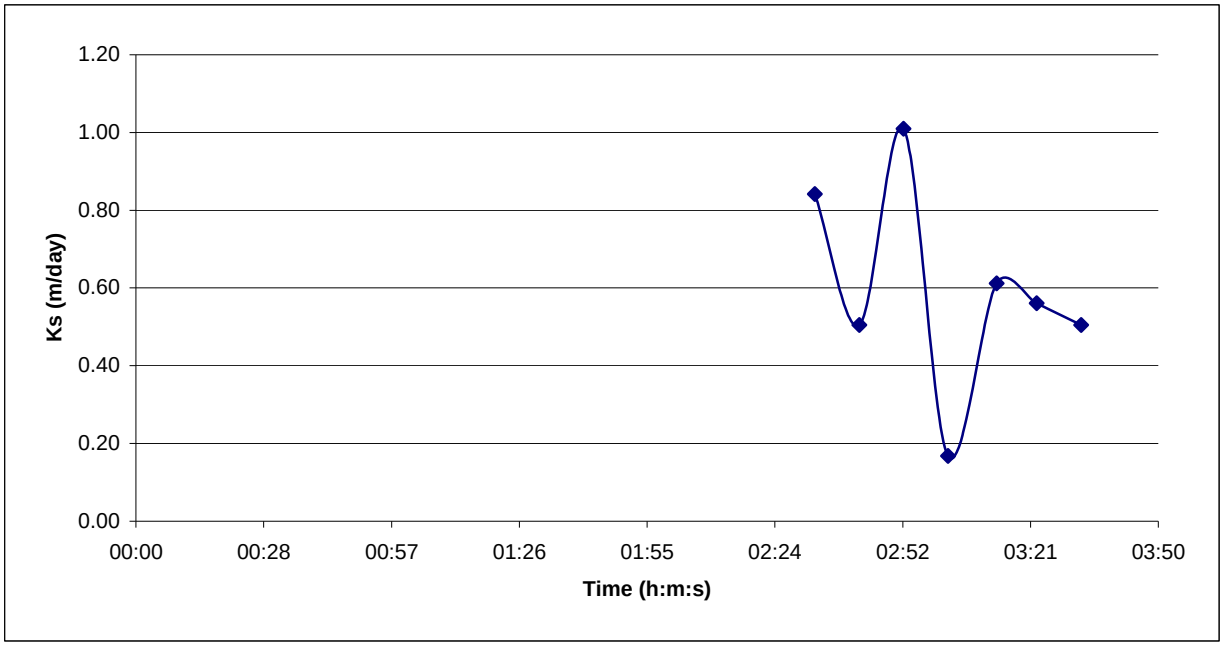
SOIL PERMEABILITY TEST

Site No.	CHI4
Date	29/10/24
Easting	396342
Northing	6532677
Depth	0.5

Dark grey clayey sand over sandy clay

Time (h:m:s)	Weight (kg)	Change in Weight (kg)	Ks (m/d)
02:28:00	40.7		
02:33:00	40.2	0.5	**0.84**
02:43:00	39.6	0.6	**0.50**
02:53:00	38.4	1.2	**1.01**
03:03:00	38.2	0.2	**0.17**
03:14:00	37.4	0.8	**0.61**
03:23:00	36.8	0.6	**0.56**
03:33:00	36.2	0.6	**0.50**
		36.2	

H =	25
r =	**4.5**



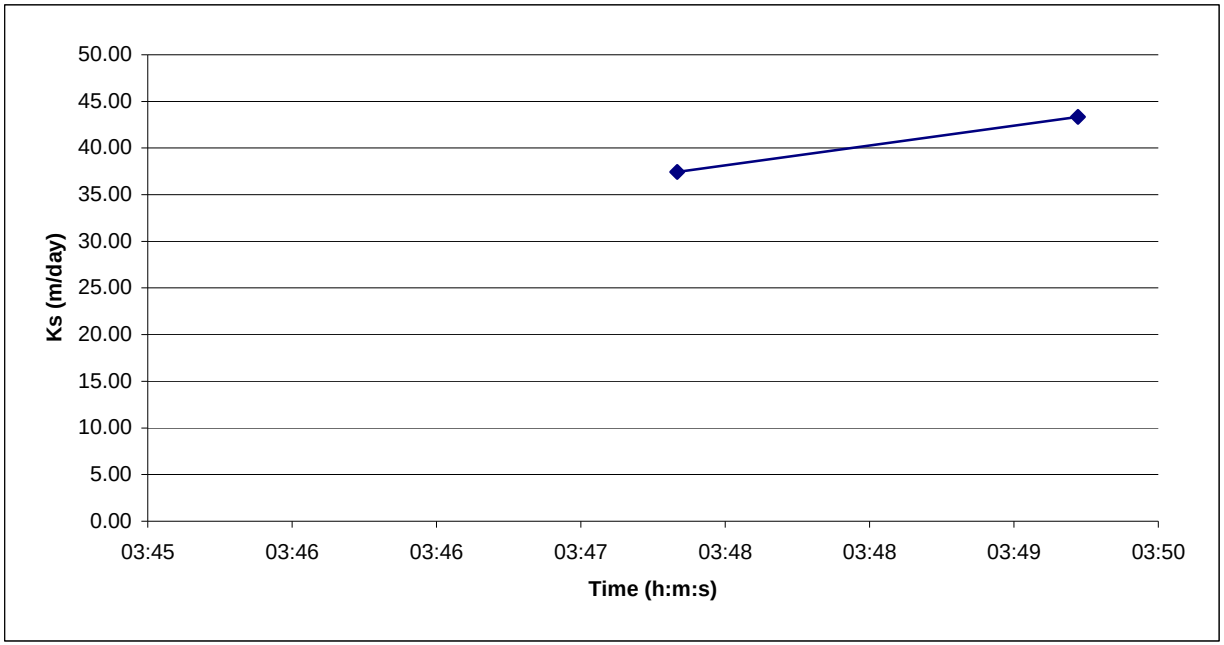
Ks = 0.5 m/day

SOIL PERMEABILITY TEST

Site No.	CHI5	Dark orange-brown sand
Date	29/10/24	
Easting	396131	
Northing	6532743	
Depth	0.5	

Time (h:m:s)	Weight (kg)	Change in Weight (kg)	Ks (m/d)
03:46:00	33.1		
03:48:00	24.2	8.9	**37.44**
03:50:00	13.9	10.3	**43.33**
		13.9	

H =	25
r =	**4.5**



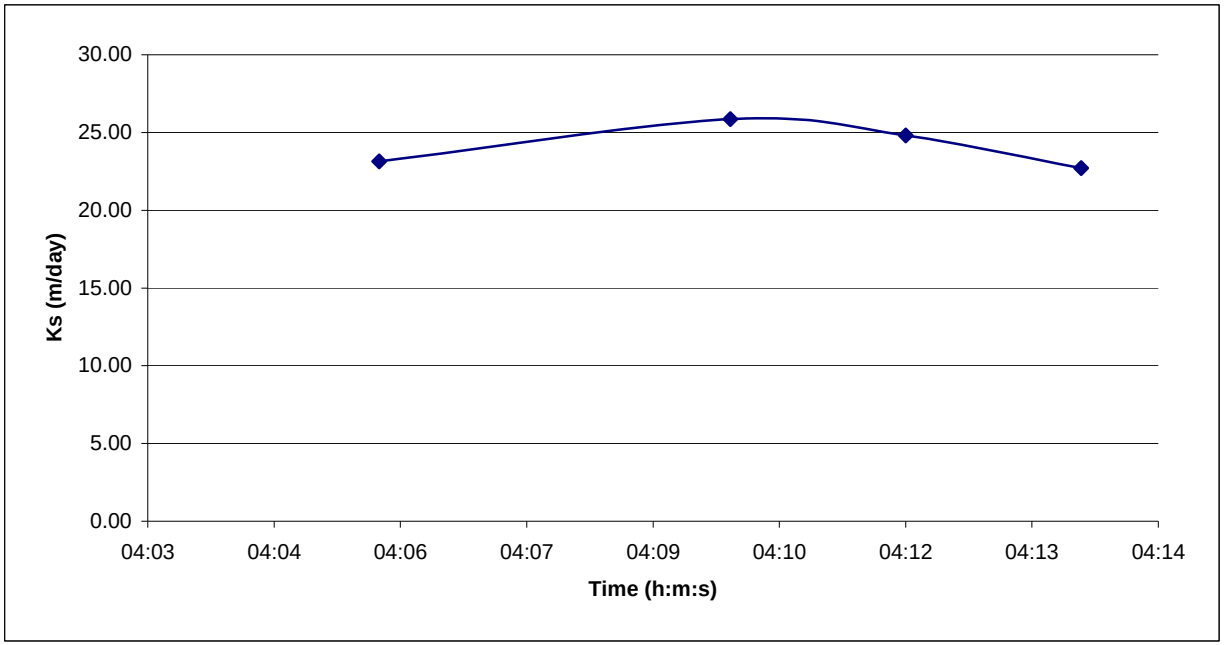
Ks = 40 m/day

SOIL PERMEABILITY TEST

Site No.	CHI6	Orange sand
Date	29/10/24	
Easting	395993	
Northing	6532822	
Depth	0.5	

Time (h:m:s)	Weight (kg)	Change in Weight (kg)	Ks (m/d)
04:04:00	41.2		
04:06:00	35.7	5.5	**23.14**
04:10:00	23.4	12.3	**25.87**
04:12:00	17.5	5.9	**24.82**
04:14:00	12.1	5.4	**22.72**
		12.1	

H =	25
r =	**4.5**



Ks = 22 m/day

Appendix C

Drainage Calculations

15mm STORM FLOWS

Rainfall (mm)	15	15mm storm
Cr Cleared	0	
Cr Forested	0	
Cr Basin	1	
Cr Lots	0	
Cr Pavement	0.8	
Cr Verge	0.1	
Permeability k (m/hr)	0.25	6.0 m/day
Basin freeboard (m)	0.20	

Catchment	Cleared/Lots	Forested	Basin	Pavement	Verge	Total	Ai	Q (L/s)	Vinflow (m3)
Gingin Brook Upstream	28700000	11050000	0	0	0	39750000	0	0.00	0.0
McHavloe St	120033	0	0	7425	15424	142882	7482	31.20	112.3
A north	0	0	82	1281	3599	4962	1467	6.12	22.0
A south	53308	0	82	1281	3599	58270	1467	6.12	22.0
B	0	0	133	2670	6128	8931	2882	12.02	43.3
C	52286	0	83	1482	3509	57360	1619	6.75	24.3
d	3847	0	0	0	0	3847	0	0.00	0.0
e	57450	0	0	0	0	57450	0	0.00	0.0
f	14767	0	0	0	0	14767	0	0.00	0.0
g	54253	0	0	0	0	54253	0	0.00	0.0

Basin Sizing

Catchment	Storm Event	Depth	Available Depth	Effective Depth	Side Slopes (1:x)	No. Basins	No. Soakwells	Base Width	Base Length	Top Width (m)	Top Length (m)	Top Area (m2)	Volume	Effective Volume	Water Depth (m)	Inundated Area (m2)	1yr 1hr Volume Check	100yr Volume Check	%Ai
Gingin Brook Upstream																			
McHavloe St	1					0	0						0	0		0			
A north	1	0.5	0.30	0.55	3	8	0	2	2	5.0	5.0	25	21	38	0.20	82	ok	ok	2.3
A south	1	0.5	0.30	0.55	3	8	0	2	2	5.0	5.0	25	21	38	0.20	82	ok	ok	2.3
B	1	0.5	0.30	0.55	3	13	5	2	2	5.0	5.0	25	38	66	0.20	133	ok	ok	2.2
C	1	0.5	0.30	0.55	3	7	0	2	2	5.0	5.0	25	18	33	0.24	83	ok	ok	2.4
d	1																		
e	1																		
f	1																		
g	1																		

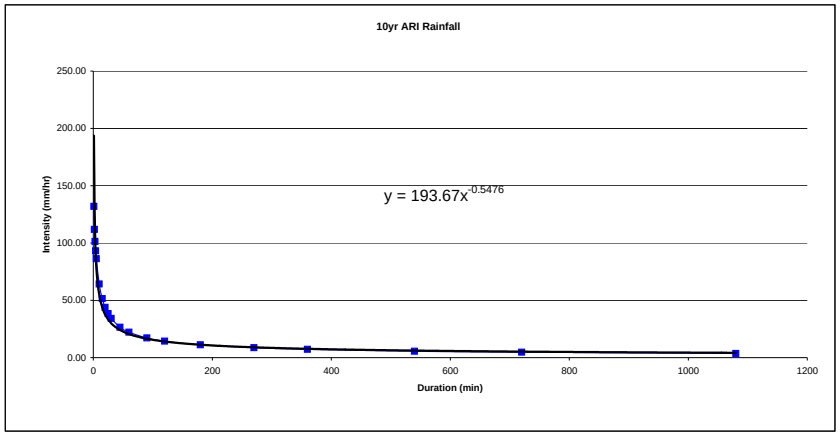
5 YEAR ARI CRITICAL FLOWS

CATCHMENT	AREAS (m2)					EFFECTIVE AREAS (m2)			TIME OF CONCENTRATION PRE DEVELOPMENT					TIME OF CONCENTRATION POST-DEVELOPMENT					CRITICAL STORM INTENSITY (mm/h)		FLOW			STORAGE		
	Cleared/Lots	Forested	Basin	Pavement	Verge	Total	Pre	Post	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope (m/km)	TC (mln)	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope	TC (mln)	Pre-Dev	Post-Dev	Pre Dev	Post Dev	Total Flow (m3)	Storage Req (m3)	Effective Storage (m3)	Volume Check
Gingin Brook Upstream	28700000	11050000	0	0	0	39750000	10246000	10246000	11582	231	104	10.97	329.7	11582	231	104	10.97	329.7	8.1	8.1	23034.25	23034.25	455698.35	0.00	0.00	
McHavloe St	120033	0	0	7425	15424	142882	40155	47324	921	160	126	36.92	35.8	921	160	126	36.92	35.2	27.3	27.5	304.51	362.12	765.13	19.36	0.00	
A north	0	0	82	1281	3599	4962	1417	2898	420	123	100	54.76	21.1	420	123	100	54.76	19.6	36.5	37.9	14.36	30.55	35.97	10.10	26.11	ok
A south	53308	0	82	1281	3599	58270	16343	17825	488	128	100	57.38	19.0	488	128	100	57.38	18.8	38.6	38.8	175.32	192.13	217.14	1.66	25.89	ok
B	0	0	133	2670	6128	8931	2557	5344	430	127.5	111	38.37	21.8	430	127.5	111	38.37	20.3	35.8	37.3	25.41	55.30	67.33	19.67	47.74	ok
C	52286	0	83	1482	3509	57360	16092	17667	249	110.5	100	42.17	10.3	249	110.5	100	42.17	10.2	53.9	54.2	241.06	266.01	163.29	1.44	20.51	ok
d	3847	0	0	0	0	3847	1077	1077	184	119	106	70.65	9.0	184	119	106	70.65	9.0	58.1	58.1	17.38	17.38	9.40			
e	57450	0	0	0	0	57450	16086	16086	570	123	97	45.61	23.3	570	123	97	45.61	23.3	34.6	34.6	154.43	154.43	215.63			
f	14767	0	0	0	0	14767	4135	4135	276	102	97	18.12	15.5	276	102	97	18.12	15.5	43.1	43.1	49.54	49.54	46.15			
g	54253	0	0	0	0	54253	15191	15191	305	110	96.5	44.26	12.6	305	110	96.5	44.26	12.6	48.4	48.4	204.07	204.07	154.28			

Runoff Coefficients	Pre-Dev	Post-Dev
Cr Cleared/Lots	0.28	0.28
Cr Forested	0.2	0.2
Cr Basin	0.3	1
Cr Pavement	0.3	0.85
Cr Verge	0.28	0.48

Rainfall IFD

Event	Duration (mins)	Intensity (mm/hr)	Event Rainfall (mm)
1 min	1	132.00	2.2
2 min	2	111.90	3.73
3 min	3	101.40	5.07
4 min	4	93.15	6.21
5 min	5	86.28	7.19
10 min	10	64.20	10.7
15 min	15	51.60	12.9
20 min	20	43.80	14.6
25 min	25	38.40	16
30 min	30	34.20	17.1
45 min	45	26.53	19.9
1 hr	60	22.20	22.2
1.5 hr	90	17.13	25.7
2 hr	120	14.35	28.7
3 hr	180	11.17	33.5
4.5 hr	270	8.71	39.2
6 hr	360	7.28	43.7
9 hr	540	5.66	50.9
12 hr	720	4.69	56.3
18 hr	1080	3.57	64.3



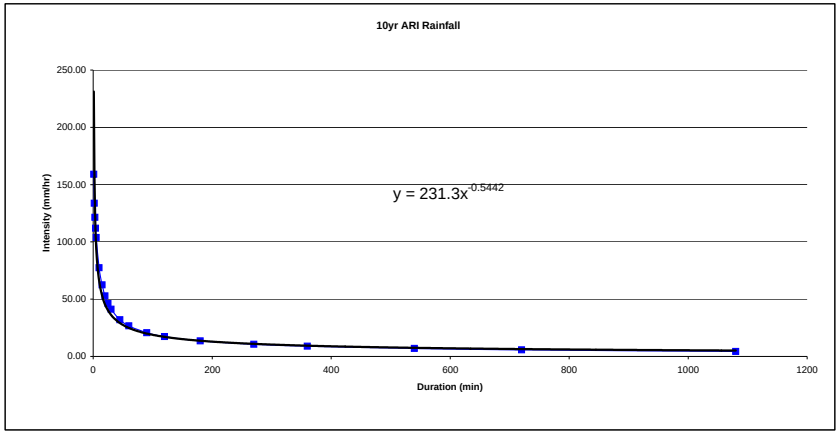
10 YEAR ARI CRITICAL FLOWS

CATCHMENT	AREAS (m2)					EFFECTIVE AREAS (m2)			TIME OF CONCENTRATION PRE DEVELOPMENT					TIME OF CONCENTRATION POST-DEVELOPMENT					CRITICAL STORM INTENSITY (mm/h)		FLOW			STORAGE		
	Cleared/Lots	Forested	Basin	Pavement	Verge	Total	Pre	Post	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope (m/km)	TC (mln)	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope	TC (mln)	Pre-Dev	Post-Dev	Pre Dev	Post Dev	Total Flow (m3)	Storage Req (m3)	Effective Storage (m3)	Volume Check
Gingin Brook Upstream	28700000	11050000	0	0	0	39750000	10820000	10820000	11582	231	104	10.97	327.9	11582	231	104	10.97	327.9	9.9	9.9	29717.37	29717.37	584717.85	0.00	0.00	
McHavloe St	120033	0	0	7425	15424	142882	42865	50404	921	160	126	36.92	35.6	921	160	126	36.92	35.0	33.1	33.4	394.37	467.84	982.31	24.23	0.00	
A north	0	0	82	1281	3599	4962	1489	3034	420	123	100	54.76	21.0	420	123	100	54.76	19.5	44.1	45.9	18.25	38.68	45.33	12.64	26.09	ok
A south	53308	0	82	1281	3599	58270	17481	19027	488	128	100	57.38	18.9	488	128	100	57.38	18.7	46.8	47.0	227.05	248.27	278.77	2.04	25.85	ok
B	0	0	133	2670	6128	8931	2679	5600	430	127.5	111	38.37	21.7	430	127.5	111	38.37	20.2	43.3	45.1	32.22	70.10	84.95	24.81	47.70	ok
C	52286	0	83	1482	3509	57360	17208	18857	249	110.5	100	42.17	10.3	249	110.5	100	42.17	10.2	65.2	65.5	311.45	343.00	209.18	1.77	20.49	ok
d	3847	0	0	0	0	3847	1154	1154	184	119	106	70.65	9.0	184	119	106	70.65	9.0	70.1	70.1	22.49	22.49	12.09			
e	57450	0	0	0	0	57450	17235	17235	570	123	97	45.61	23.1	570	123	97	45.61	23.1	41.9	41.9	200.48	200.48	278.02			
f	14767	0	0	0	0	14767	4430	4430	276	102	97	18.12	15.4	276	102	97	18.12	15.4	52.2	52.2	64.23	64.23	59.42			
g	54253	0	0	0	0	54253	16276	16276	305	110	96.5	44.26	12.5	305	110	96.5	44.26	12.5	58.5	58.5	264.38	264.38	198.49			

Runoff Coefficients	Pre-Dev	Post-Dev
Cr Cleared/Lots	0.3	0.3
Cr Forested	0.2	0.2
Cr Basin	0.3	1
Cr Pavement	0.3	0.9
Cr Verge	0.3	0.5

Rainfall IFD

Event	Duration (mins)	Intensity (mm/hr)	Event Rainfall (mm)
1 min	1	159.00	2.65
2 min	2	133.80	4.46
3 min	3	121.40	6.07
4 min	4	111.90	7.46
5 min	5	103.80	8.65
10 min	10	77.40	12.9
15 min	15	62.40	15.6
20 min	20	52.80	17.6
25 min	25	46.08	19.2
30 min	30	41.20	20.6
45 min	45	32.00	24
1 hr	60	26.70	26.7
1.5 hr	90	20.67	31
2 hr	120	17.30	34.6
3 hr	180	13.53	40.6
4.5 hr	270	10.60	47.7
6 hr	360	8.92	53.5
9 hr	540	6.93	62.4
12 hr	720	5.77	69.2
18 hr	1080	4.38	78.8



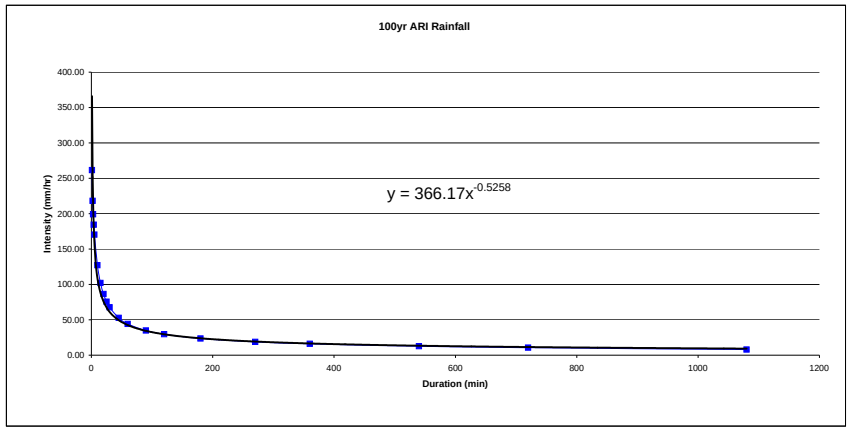
100 YEAR ARI CRITICAL FLOWS

CATCHMENT	AREAS (m2)					EFFECTIVE AREAS (m2)			TIME OF CONCENTRATION PRE DEVELOPMENT					TIME OF CONCENTRATION POST-DEVELOPMENT					CRITICAL STORM INTENSITY (mm/h)		FLOW			STORAGE		
	Cleared/Lots	Forested	Basin	Pavement	Verge	Total	Pre	Post	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope (m/km)	TC (min)	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope	TC (min)	Pre-Dev	Post-Dev	Pre Dev (L/sec)	Post Dev (L/sec)	Total Flow (m3)	Storage Req (m3)	Effective Storage (m3)	Volume Check
Gingin Brook Upstream	28700000	11050000	0	0	0	39750000	13094500	13094500	11582	231	104	10.97	321.7	11582	231	104	10.97	321.7	17.6	17.6	63977.37	63977.37	1235026.51	0.00	0.00	
McHavloe St	120033	0	0	7425	15424	142882	51438	59891	921	160	126	36.92	34.9	652	160	126	52.15	22.7	56.5	70.9	807.77	1178.96	1607.47	159.34	0.00	
A north	0	0	82	1281	3599	4962	1786	3522	420	123	100	54.76	20.6	420	123	100	54.76	19.2	74.6	77.3	37.03	75.67	87.37	22.78	26.00	ok
A south	53308	0	82	1281	3599	58270	20977	22713	488	128	100	57.38	18.5	488	128	100	57.38	18.4	78.9	79.2	459.68	499.80	551.34	3.55	25.76	ok
B	0	0	133	2670	6128	8931	3215	6480	430	127.5	111	38.37	21.3	430	127.5	111	38.37	19.9	73.2	76.0	65.40	136.76	163.32	44.46	47.56	ok
C	52286	0	83	1482	3509	57360	20650	22493	249	110.5	100	42.17	10.1	249	110.5	100	42.17	10.0	108.7	109.2	623.51	682.24	408.80	3.03	20.45	ok
d	3847	0	0	0	0	3847	1385	1385	184	119	106	70.65	8.8	184	119	106	70.65	8.8	116.7	116.7	44.91	44.91	23.70			
e	57450	0	0	0	0	57450	20682	20682	570	123	97	45.61	22.7	570	123	97	45.61	22.7	70.9	70.9	407.41	407.41	554.76			
f	14767	0	0	0	0	14767	5316	5316	276	102	97	18.12	15.1	276	102	97	18.12	15.1	87.7	87.7	129.55	129.55	117.70			
g	54253	0	0	0	0	54253	19531	19531	305	110	96.5	44.26	12.3	305	110	96.5	44.26	12.3	97.9	97.9	531.22	531.22	391.63			

Runoff Coefficients	Pre-Dev	Post-Dev
Cr Cleared/Lots	0.36	0.36
Cr Forested	0.25	0.25
Cr Basin	0.36	1
Cr Pavement	0.36	1
Cr Verge	0.36	0.6

Rainfall IFD

Event	Duration (mins)	Intensity (mm/hr)	Event Rainfall (mm)
1 min	1	261.60	4.36
2 min	2	218.10	7.27
3 min	3	199.00	9.95
4 min	4	184.50	12.3
5 min	5	170.40	14.2
10 min	10	127.20	21.2
15 min	15	102.00	25.5
20 min	20	86.40	28.8
25 min	25	75.60	31.5
30 min	30	67.60	33.8
45 min	45	52.67	39.5
1 hr	60	44.20	44.2
1.5 hr	90	34.80	52.2
2 hr	120	29.55	59.1
3 hr	180	23.57	70.7
4.5 hr	270	18.87	84.9
6 hr	360	16.08	96.5
9 hr	540	12.67	114
12 hr	720	10.58	127
18 hr	1080	8.00	144



5 YEAR ARI CUMULATIVE FLOWS

CATCHMENT	Contributing Segments	AREAS (m2)						EFFECTIVE AREAS (m2)		FLOW	Overflow through site	
		Cleared/Lots	Forested	Basin	Pavement	Verge	Total	Pre	Post		Slope	Depth in 1:2 V-Drain
A north	A north	0	0	82	1281	3599	4962	1417	2898	14.36	0.0549	0.09
A south	McHavloe St, A south	173341	0	82	8706	19023	201152	56498	65149	537.44	0.0551	0.31
B	B	0	0	133	2670	6128	8931	2557	5344	25.41	0.0376	0.11
C	B,C	52286	0	216	4152	9637	66291	18649	23011	266.47	0.0444	0.26

100 YEAR ARI CUMULATIVE FLOWS

CATCHMENT	Contributing Segments	AREAS (m2)						EFFECTIVE AREAS (m2)		FLOW	Overflow through site		
		Cleared/Lots	Forested	Basin	Pavement	Verge	Total	Pre	Post		Slope	Depth in 1:2 V-Drain	Drain Width (inc 200mm freeboard)
A north	A north	0	0	82	1281	3599	4962	1786	3522	37.03	0.0549	0.12	1.3
A south	McHavloe St, A south	173341	0	82	8706	19023	201152	72415	82604	1638.64	0.0551	0.49	2.0
B	B	0	0	133	2670	6128	8931	3215	6480	65.40	0.0376	0.16	1.4
C	B,C	52286	0	216	4152	9637	66291	23865	28973	688.91	0.0444	0.37	2.3

Appendix D

Site & Soil Evaluation

LOT 106 (No. 62) CHERITON ROAD, GINGIN

SITE AND SOIL EVALUATION

Prepared for

Fairlands Farm Pty Ltd
23 Kilkenny Rd
FLOREAT WA 6014

Report No. J24041
10 September 2025

BAYLEY ENVIRONMENTAL SERVICES
30 Thomas Street
SOUTH FREMANTLE WA 6162

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1.0 INTRODUCTION

1.1 Background

Fairlands Farm Pty Ltd proposes to rezone Lot 106 Cheriton Rd, Gingin for Rural Living use. In support of the proposed rezoning, a Concept Plan demonstrating how the 26.02ha site could be subdivided into 22 Rural Living (RL1) lots ranging in size from 1ha to 1.2ha has been prepared. All lots will employ on-site effluent disposal. Figure 1 shows the proposed Concept Plan. Figure 2 shows an aerial view of the site and its surroundings.

Bayley Environmental Services was commissioned in October 2024 to prepare a Site & Soil Evaluation (SSE) for the proposed development. The SSE included:

- test pitting to 2.5-3m depth at 12 locations across the site using a 600mm auger;
- geotechnical analysis of selected soil samples;
- constant-head permeability testing to 0.5m depth at six locations;
- site survey noting landforms, surface soils, hydrology and vegetation;
- measurement of depth to groundwater in early August 2025;
- collation of published information on landforms, soils and land capability; and
- assessment of the site's capability for effluent disposal in accordance with AS1547:2012 – *Onsite Domestic Wastewater Management* and the *Government Sewerage Policy 2019*.

1.2 Qualifications and Experience of Assessor

This Site & Soil Evaluation has been prepared by Phillip Bayley, an Environmental Scientist with 40 years' experience in the field including 35 years as a private consultant. Phillip Bayley has undertaken over 70 site & soil evaluations and land capability assessments for onsite effluent disposal since 2006.

The investigations and analyses presented in this report are in accordance with Australian Standard AS1547:2012 – *Onsite Domestic Wastewater Management* and the *Government Sewerage Policy 2019.*

2.0 EXISTING ENVIRONMENT

2.1 Climate

Gingin has a strongly seasonal rainfall, with most of the annual rain falling between May and September in association with winter cold fronts. Occasional heavy falls may occur from summer thunderstorms. The long-term average annual rainfall for RAAF Gingin (located 13km south-west of the site) is 637.7mm, of which 78% falls between the months of May and September.

Figure 3 shows a rainfall occurrence chart for RAAF Gingin.

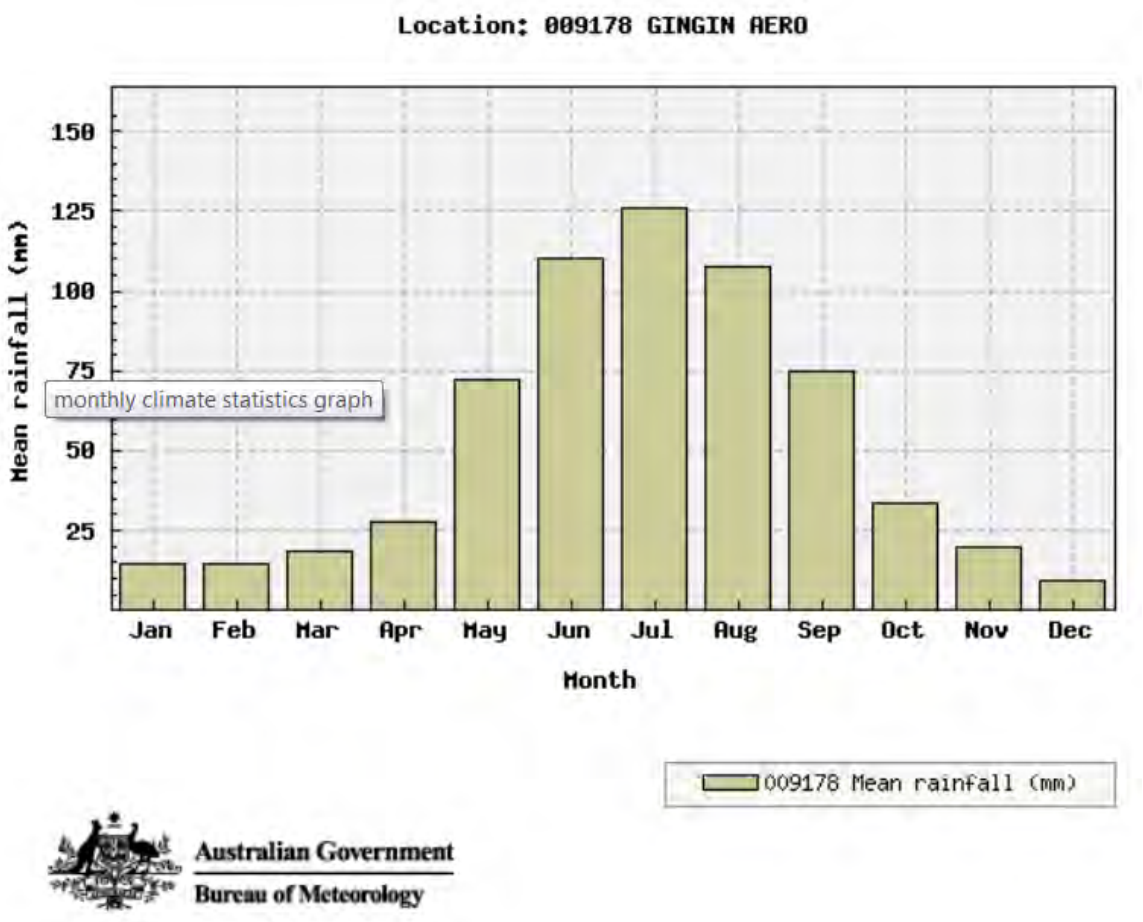


Figure 3 RAAF Gingin Mean Rainfall

2.2 Physiography

2.2.1 Topography

The site lies on the east-facing western side of the Gingin Brook valley on the northern edge of the Gingin Townsite. The elevation of the site ranges from 97m AHD in the north-east near the Brook to 134m in the south-west corner. The slope is linear and

slightly convergent, varying from about 1% in the north-east to 8% in the west and averaging 5.5% across most of the site. Figure 4 shows topographic contours over the site.

2.2.2 Geology and Soils

The Geological Survey of Western Australia (Hocking *et al.*, 1975) maps of the site as Colluvium (Qpo): a Quaternary-aged varicoloured (white-cream-brown), poorly sorted, poorly rounded sand which was formerly an eluvial (weathered in-situ) horizon overlying laterite which has been partly redistributed. A small area in the south-west of the site is mapped as Laterite (Czl): typically a ferruginous, pisolitic, siliceous laterite forming layers from 1.5m to 3m thick and associated with eluvial quartz sand, overlying a weathered rock zone which can be up to 30m thick.

Figure 4 shows the GSWA mapping. Test pitting to 2.5-3m at 12 locations across the site (Figure 4) found a profile that generally matched the GSWA mapping. Appendix A shows soil logs from the test pits.

2.2.3 Acid Sulphate Soils

ASS-risk mapping by the DBCA shows the site as Class 3 (Nil to Low risk of ASS within 3m of the ground surface). The soils of the site are elevated and have had no recent marine influence. The age and origin of the soils and the absence of a shallow water table over most of the site indicate that acid sulphate soils are unlikely to be present. The nearest mapped high ASS risk zone is a wetland 3.3km south of the site.

Development of the site is not expected to involve any excavation deeper than about 2m (for installation of effluent systems) or dewatering. Any ASS present is therefore unlikely to be disturbed. No further ASS assessment is considered necessary.

2.2.4 Phosphorus Retention Index

The strongly coloured and/or clayey soils of the site are expected to have a high to very high PRI. Analysis by the CSBP Soil Laboratory of samples from 0.5m and/or 1m depth at four locations (CHT2, CHT6, CHT8, CHT10 – Figure 4) gave PRI values ranging from 8.0 to 123.8, with a mean of 56.8 and a median of 27.2.

2.2.5 Soil Permeability

Constant-head permeability tests in accordance with AS1547:2012 were carried out to 0.5m depth at five locations as shown on Figure 4. Appendix B shows the detailed test results.

The tests gave saturated hydraulic conductivities (Ks) ranging from 0.5m/day to 40m/day, with a mean of 16m/day and a median of 12.5m/day. The lowest value of 0.5m/day was recorded in the low part of the site (CHI4) in clayey sand.

2.2.6 Soil Geotechnical Analysis

Soil samples collected at 0.5m and 1.0m from test pit CHT8 in the north-east corner of the site (Figure 4) was analysed by the CSBP Soil Laboratory for geotechnical parameters including particle size distribution, dispersion index, exchangeable cations and exchangeable sodium percentage (sodicity). Table 2.1 shows the results of the analysis. The soil profile at CHT8 was typical of the profile in the lower parts of the site.

Table 2.1 Soil Analysis

Sample (Figure 4)	*Particle Size*		*Soil Type*	*Dispersion Index (range 0-16)*	*Exchangeable Sodium %*
CHT8 0.5m	Clay (<2µm) Silt (2-20µm) Sand (20-2000µm)	16.11% 15.67% 68.22%	Sandy loam	14	5.4
CHT8 1.0m	Clay (<2µm) Silt (2-20µm) Sand (20-2000µm)	26.22% 13.14% 60.64%	Sandy clay loam	10	13.6

The soil analyses show that the soils in the lower lying parts of the site are predominantly non-sodic (Exchangeable Sodium % <6) to moderately sodic (ESP >15), highly dispersive sandy loams overlying sandy clay loams.

2.2.7 Soil Category

The results of the test pitting and infiltration tests place the soils of the higher part of the site (above 104m AHD) in Soil Category 1 (Gravels and Sands) according to AS1547:2012. The soils in the lower part are conservatively assigned to Category 3 (Loams) given their clayey subsoil and lower permeability.

The high dispersivity of the low-lying soils suggests that special measures, perhaps including gypsum addition, may be justified to improve their characteristics for effluent disposal.

2.3 Hydrology

2.3.1 Surface Drainage

There is no defined natural surface drainage on the site. The sandy surface soils of the majority of the site (above about 102m AHD) mean that runoff would occur only over short distances under very heavy rainfall conditions. The lower eastern part of the site has heavier soils and a shallower water table, and may generate surface runoff in a 1-year ARI storm event or less.

A shallow constructed drain runs from the mid-northern boundary south and then east through the north-east of the lot to Gingin Brook. This drain extends upstream across other properties to its source 2km upstream of Lot 106. The drain has a catchment of

about 165ha but is dammed by at least eight farm dams, so it would be unlikely to carry large flows. It is recommended that this drain be diverted into an easement along a lot boundary into a road reserve as part of the subdivision, with intensive planting undertaken to turn it into a "living stream" to provide treatment of the water prior to discharge into Gingin Brook.

The major surface hydrological feature of the area is Gingin Brook, which flows south to north between 20m and 200m east of the site. Surface pools associated with the Brook occurred as close as 15m from the site boundary in October 2024.

Figure 5 shows the catchments upstream of the site.

2.3.2 Groundwater

There is no published groundwater information available for the subject land. Given the topography of the site and surroundings, groundwater would likely exist as localised aquifers in creek and river valleys and possibly as seasonal perched water tables above impermeable layers on slopes.

Groundwater was present at a depth of 1.14m below ground in test pit CHT7 in the east of the site (Figure 4) on 29 October 2024. No usable DWER bores are available in the near vicinity of Lot 106 to enable this level to be compared with long-term averages. However, the topography, soils and presence of wetland vegetation (sedges) in the vicinity of CHT7 suggests that the water table would reach the ground surface in this area during wet winters.

Measurements in early August 2025 of bores installed in four test pits (Figure 4) found groundwater at depths of 0.55m in test pit CHT7 and 1.92m in test pit CHT8. Test pits CHT2 and CHT6 were dry to depths of 2.91m and 2.6m respectively. Simultaneous measurements in a number of DWER bores across the southern Perth region gave readings that were a median of 0.5m below the long-term maximum groundwater level (MGL). These bores are distant from the site and in a different geological and topographic setting, so can only be used as a rough guide to groundwater levels at the site. However, they support the initial assessment that the MGL could reach the ground surface in the lowest parts of the site.

2.4 Wetlands

The DBCA maps the lower-lying eastern part of the site below about 101m AHD as Multiple Use category palusplain (seasonally waterlogged plain). This appears to correspond with the topography and vegetation in the area.

Gingin Brook is mapped as Conservation category palusplain, although its profile suggests that it is a watercourse rather than a palusplain. Figure 4 shows the DBCA wetland mapping.

3.0 ON-SITE EFFLUENT DISPOSAL

3.1 Statutory and Policy Constraints

Lot 106 and its surroundings are mapped as a Sewage Sensitive Area (SSA) under the Government Sewerage Policy by virtue of its location within 1km of a significant wetland (Gingin Brook). The GSP imposes additional requirements on effluent disposal within SSAs including:

- a minimum lot size of 1ha;
- a minimum clearance to groundwater of 1.5m; and
- a requirement for secondary effluent treatment systems.

A small area on the southern boundary is within a Wellhead Protection Zone around the Gingin town water supply bore. The WPZ extends only 10m into the corner of one proposed lot (Figure 6) and will not significantly constrain effluent disposal on the lot.

The site meets the lot size requirement of the GSP, with all proposed lots having an area of at least 1ha. Land Application Areas (LAAs) below 102m AHD will require filling to achieve the minimum 1.5m depth to groundwater. A requirement for nutrient-removing secondary treatment systems is expected to be a condition of subdivision approval.

3.2 Wetland and Watercourse Setbacks

The GSP requires that effluent disposal areas be set back at least 100m from waterways, significant wetlands and drains that flow untreated into waterways or wetlands (Govt of WA, 2019). Figure 6 shows the required setbacks from Gingin Brook and its associated Conservation Category Wetland. All proposed lots have adequate space for effluent disposal outside of the 100m setback.

The shallow drain that flows across the eastern part of the property is recommended to be diverted into an easement along a lot boundary and into a road reserve, with intensive planting in the drain undertaken to provide water treatment before discharge into Gingin Brook. Given this treatment, a 100m setback from the drain is not considered necessary.

3.3 Groundwater Separation

Measurements in October 2024 and August 2025 suggest that the maximum groundwater level (MGL) is at or near the ground surface in the east of the site below about 98m AHD. LAAs east of the 102m AHD contour (Figure 6) will require filling to achieve the required 1.5m groundwater separation. Table 3.1 shows the recommended

fill heights in this area for effluent disposal using flatbed leach drains, allowing for 0.1m of soil cover over the leach drains. For prudence, a fill height of 0.6m is recommended for Lots 6, 7 and 10 to allow for uncertainty in the estimation of the MGL. All other lots appear to have sufficient clearance to the MGL without the need for filling.

Table 3.1 Recommended Fill Heights

Lot No. (LAA as shown on Figure 6)	*Ground Level (m AHD)*	*Estimated Depth to MGL (m)*	*Recommended Fill Height (m)*
6	101	3	0.6
7	99.3	1.3	0.6
8	98.8	0.8	0.8
9	98.5	0.5	1
10	100.5	2.5	0.6

3.4 Flooding and Inundation Risk

The GSP does not permit effluent disposal on land that is subject to inundation in a 1-in-10 year ARI flood event. This includes both regional flooding and local inundation resulting from ponding of rainfall on saturated ground surfaces.

No published floodplain mapping is available for Gingin Brook upstream of the Gingin Townsite. Calculations using the Rational Method (Engineers Australia, 1987) suggest that the catchment of the Brook upstream of the site would produce a flow of around 37.1m^3/sec in a critical 10-year ARI storm at the closest point to the site. Appendix C shows the flow calculations.

Calculations using Manning's Open Channel Flow Formula (Fang, 2000) suggest that this flow rate would produce a flow 1.33m deep and 76m wide in the Brook, which would extend up to 6m into the north-east corner of Lot 106 (Figure 6). This area is within the 100m setback from the Brook and will not be used for effluent disposal.

The sloping topography of the site (minimum 1%) means that rain falling on saturated ground in the lower eastern parts will run off, rather than ponding on the ground surface.

It is therefore concluded that there is no significant risk of flooding or inundation in areas used for effluent disposal at a frequency of 10 years or less.

3.5 Soil Permeability

Test pitting, permeability testing and soil analysis suggest that the soils of Lot 62 are sands or sandy loams with moderate to high permeability. Australian Standard AS1547:2012 recommends that special measures including pressure dosing of leach

drains be employed to ensure even distribution of effluent in highly permeable sands. The use of ATUs on the site will satisfy this requirement.

3.6 Phosphorus Retention Index

The site soils have a moderate to very high PRI (8-123.8). The Government Sewerage Policy does not impose a minimum PRI requirement in cases where secondary treatment systems with nutrient removal capability are used, as is required in Sewage Sensitive Areas.

3.7 Site Capability Summary

The capability of the site to support on-site effluent disposal has been assessed against the criteria set out in AS1547:2012. Table 3.2 summarises the AS1547:2012 factors and the degree to which they are satisfied by the site.

Table 3.2 On-site Effluent Disposal Capability

Factor	*Criterion*	*Site Characteristics*	*Complies*
Slope	<20%	1-8%	Yes
Groundwater depth	>1.5m below discharge point	Estimated 0 - >20 m	Fill required in east on Lots 6-10
Soil permeability (Ks)	>0.06 m/day	0.5 - 40 m/day	Yes
Soil PRI	>15 without secondary treatment	8 - 123.8	Yes
Distance from surface watercourses and significant wetlands	>100m	>100m	Yes
Lot area	Minimum 1ha in SSAs 2,000m^2 elsewhere	Minimum 1ha	Yes
Inundation and flooding	Not subject to inundation or flooding in a 10% AEP (1 in 10 year) rainfall event	Outside Gingin Brook 10-yr ARI floodplain	Yes

This Site & Soil Evaluation has shown that the site is suitable for on-site effluent disposal in accordance with the criteria set out in AS1547:2012. Fill be required on some lots in the east below about 102m AHD to achieve the required groundwater clearance. Further groundwater measurements in peak winter conditions will be required to better define the minimum depth to groundwater and the height of fill required.

3.8 Effluent System Conceptual Design

The GSP states a general requirement for secondary treatment systems with nutrient removal capability in sewage sensitive areas.

The Health Department's website (https://ww2.health.wa.gov.au/Articles/A_E/Approved-Secondary-Treatment-Systems) lists approved secondary treatment systems. The website lists the nutrient removal capability of some systems, with final effluent phosphorus concentrations ranging from <1mg/L with alum dosing to 11.6mg/L. The website states that the relevant local government authority should be consulted to determine whether the nutrient removal capability of a particular system will meet its requirements.

Effluent from secondary treatment systems may be disposed of by surface spray irrigation, subsurface drip irrigation or leach drains. Given the site characteristics, the use of surface spray irrigation would require the least height of fill, but flatbed leach drains would require the smallest land application area (LAA) and the smallest quantity of fill overall.

3.9 Land Application Areas

Schedule 2, Table 3 of the GSP recommends an LAA of 180m^2 for a five-bedroom house with six occupants generating a total of 900 litres of secondary-treated effluent per day on Category 1 soils. For Category 3 soils the recommended area is 225m^2. These areas are based on loading rates of 5mm/day for Category 1 soils and 4mm/day for Category 2 soils, which are equivalent to the Design Irrigation Rates (DIR) specified in AS1547:2012 for surface spray or subsurface drip irrigation on Category 1 and 4 soils.

Table L1 of AS1547:2012 recommends design loading rates (DLR) for secondary-treated effluent using leach drains of 50mm/day in Category 1 soils and 30-50mm/day in Category 3 soils. Given the dispersive nature of the Category 3 soils in the east of the site, the lower recommended DLR of 30mm/day has been adopted. Higher loading rates may be employed on individual lots if site-specific testing shows that the soils have higher permeability and/or lower dispersivity.

Using the adopted DLRs, the length of leach drain required for a 5-bedroom house using flatbed leach drains is:

- Category 1 soils (generally above 102m AHD) 8m
- Category 3 soils (generally below 102m AHD) 13m.

Appendix D shows the system sizing calculations.

Leach drains are normally arranged in equal-length pairs, with a 1.8m separation between them. A diverter valve between the leach drains is switched every six to twelve months to rest each leach drain in turn.

Figure 6 shows indicative footprints of the default LAAs and flatbed leach drains on each lot. The figure shows that each of the lots has sufficient unconstrained area to

accommodate the default LAA and other site developments. The locations of the LAAs may be varied to suit the requirements of individual lot developers, provided that the exclusion zones shown on Figure 6 are avoided and that the fill heights shown in Table 3.1 are revisited if the LAA is moved further downslope. Detailed sizing and siting of the LAA for each lot will be required at the building approval stage based on the size of house proposed and the method of disposal to be used.

4.0 CONCLUSION

This Site and Soil Evaluation has found that the subject site is capable of supporting on-site effluent disposal in accordance with the Government Sewerage Policy. Specifically:

- All lots meet the minimum lot size specified by the GSP for sewage sensitive areas.
- All proposed lots have sufficient area more than 100m from Gingin Brook to accommodate a land application area.
- The soils have suitable slope and PRI to support effluent disposal.
- Lots in the east of the site below 102m AHD will require filling to achieve the required minimum 1.5m clearance to groundwater.
- The site is not susceptible to flooding in a 1-in-10 year event.

5.0 REFERENCES

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Government of Western Australia (2019). *Government Sewerage Policy.* Dept of Planning, Lands & Heritage, Perth.

Health Department of Western Australia (2001). *Code of Practice for the Design, Manufacture, Installation and Operation of Aerobic Treatment Units (ATUs).* Health Department of WA, Perth.

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Low G.H. (1971). *Explanatory notes on the Phanerozoic rocks of the Perth 1:250 000 geological sheet, Western Australia.* Record 1971/24, Geological Survey of Western Australia, Perth.

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Figures



SUBDIVISION CONCEPT
LOT 106 (No. 62) CHERITON ROAD
GINGIN

Figure 1

DRAFT

SCALE @ A3: 1:2500

9929-CON-02-A

DRAWN: WC
DATE CREATED: 2024.09.11
PROJECTION: MGA50 GDA94
CADASTRE: LANDGATE
AERIAL: LANDGATE 2023 MARCH

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ROWE GROUP DESIGN



N

Figure 2

THE SITE AND SURROUNDINGS

bayley environmental services

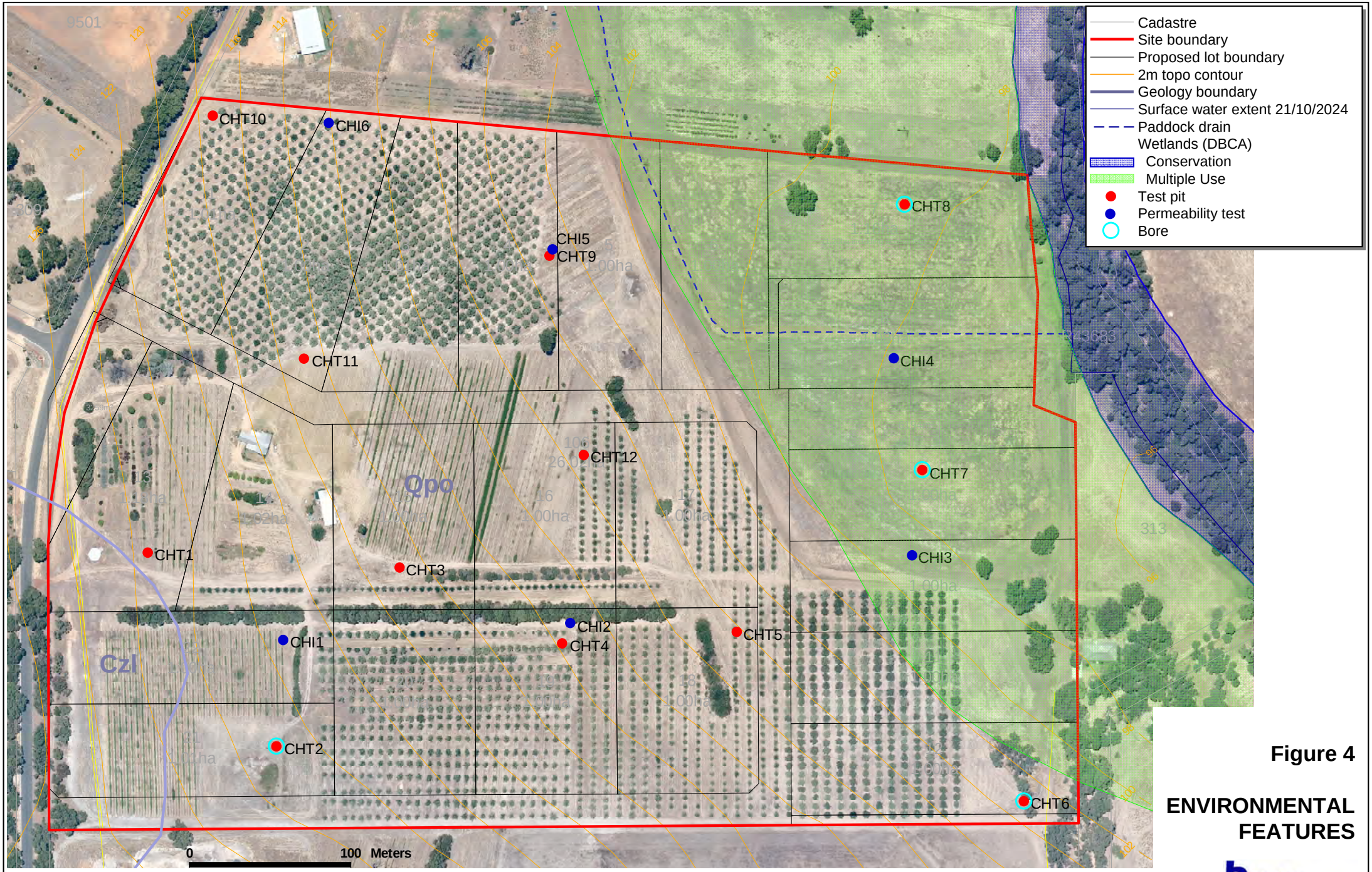
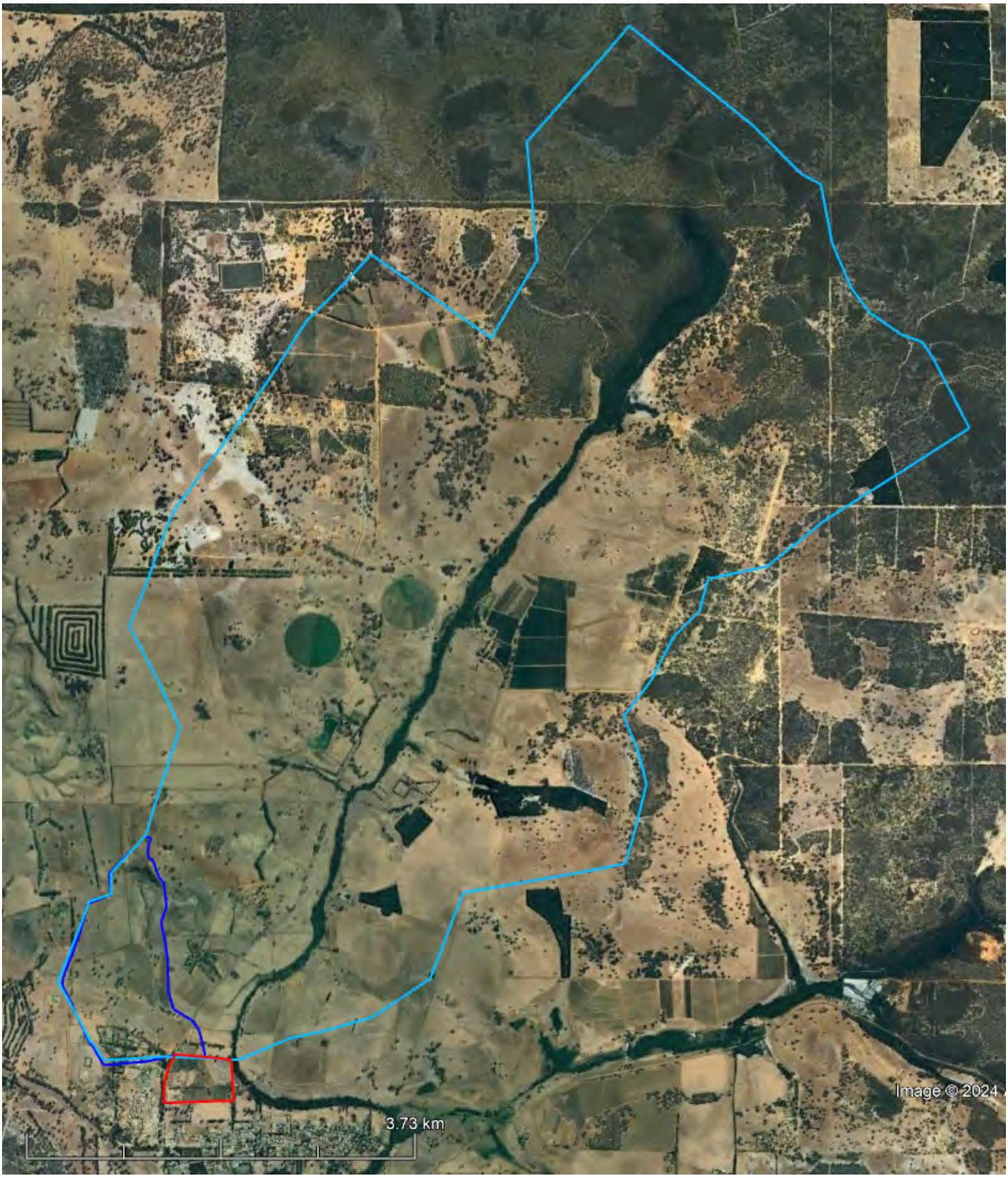


Figure 4

ENVIRONMENTAL FEATURES

bayley environmental services



N

Site boundary
Gingin Brook catchment
Drain catchment

Figure 5

CATCHMENTS

Image source: Google

bayley environmental services



Figure 6

LAND APPLICATION AREAS

bayley environmental services

Appendix A

Soil Logs

SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT1
EASTING:	395881
NORTHING:	6532558
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.5
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.1	Brown topsoil		
0.1 - 2.2	Orange slightly clayey sand		
2.2 - 2.5	Orange slightly clayey sand with ironstones to 50mm		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT2
EASTING:	395921
NORTHING:	6532827
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	3.1
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.1	Brown topsoil		
0.1 - 1.0	Orange-brown slightly gravelly sand		
1 - 1.8	Orange gravelly clayey sand		
1.8 - 3.1	Red/orange/brown mottled well structured sandy clay		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT3
EASTING:	395978
NORTHING:	6532677
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.5
REFUSAL (Y/N):	Y
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.2	Brown topsoil		
0.2 - 1.2	Orange to orange-yellow sand		
1.2 - 2.4	Orange gravelly sandy clay, cemented from 1.5m		
2.4 - 2.5	Orange well structured lateritic gravelly clay		
2.5	Refusal on laterite		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT4
EASTING:	396150
NORTHING:	6532618
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	3.0
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.1	Brown topsoil		
0.1 - 2.0	Orange sand		
2.0 - 3.0	Orange/red mottled well structured gravelly sandy clay		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT5
EASTING:	395961
NORTHING:	6532438
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	3.0
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.2	Brown topsoil		
0.2 - 0.5	Orange-brown sand		
0.5 - 2.2	Orange sand		
2.2 - 3.0	Orange-yellow sand, becoming paler		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT6
EASTING:	396036
NORTHING:	6532548
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.8
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.2	Brown topsoil		
0.2 - 0.5	Brown sand		
0.5 - 2.3	Orange/red/brown mottled gravelly sandy clay with ironstone rocks to 100mm		
2.3 - 2.8	Hard orange-yellow gravelly clayey sand		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT7
EASTING:	396137
NORTHING:	6532501
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	3.0
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	1.0

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.2	Brown topsoil		
0.2 - 1.0	Brown sand		
1.0 - 1.2	Dark brown peaty sand, wet		
1.2 - 2.0	Dark brown/green/dark orange mottled well structured sandy clay		
2.0 - 2.5	Dark green gritty clay with minor orange mottling, poorly structured		
2.5 - 3.0	Greenish-grey sandy clay, poorly structured, wet		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT8
EASTING:	396245
NORTHING:	6532508
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	3.0
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 -0.1	Dark brown topsoil		
0.1 - 1.0	Dark brown sand		
1.0 - 1.5	Brown/dark brown dully mottled, moderately structured sandy clay		
1.5 - 2.0	Dull orange/dark brown/green mottled poorly structured sandy clay		
2.0 - 2.2	Dull brown slightly mottled poorly structured sandy clay with occasional ironstone nodules		
2.2 - 3.0	Orange/brown/grey mottled well-structured sandy clay with soft laterite nodules		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT9
EASTING:	396422
NORTHING:	6532404
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.9
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.1	Brown topsoil		
0.1 - 0.5	Orange-brown sand		
0.5 - 2.9	Orange sand		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT10
EASTING:	396359
NORTHING:	6532608
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.8
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.1	Yellow-brown sand		
0.1 - 2.8	Orange sand		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT11
EASTING:	396348
NORTHING:	6532773
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.8
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.2	Pale grey-brown topsoil		
0.2 - 2.0	Orange sand		
2.0 - 2.8	Dark orange/pale orange mottled well structured slightly lateritic sandy clay		







SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	CHT12
EASTING:	396130
NORTHING:	6532742
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.8
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.1	Dark brown topsoil		
0.1 - 0.8	Yellow-brown sand		
0.8 - 2.8	Orange sand		





Appendix B

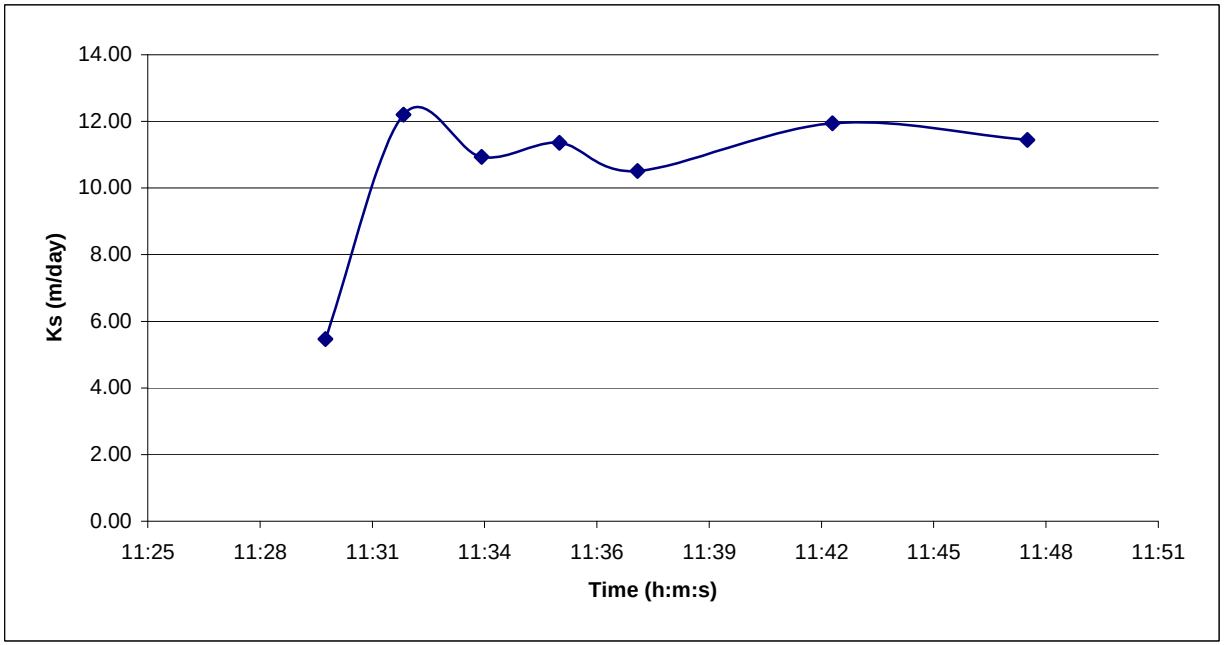
Infiltration Test Results

SOIL PERMEABILITY TEST

Site No.	CHI1	Orange sand
Date	29/10/24	
Easting	395964	
Northing	6532504	
Depth	0.5	

Time (h:m:s)	Weight (kg)	Change in Weight (kg)	Ks (m/d)
11:28:00	44		
11:30:00	42.7	1.3	**5.47**
11:32:00	39.8	2.9	**12.20**
11:34:00	37.2	2.6	**10.94**
11:36:00	34.5	2.7	**11.36**
11:38:00	32	2.5	**10.52**
11:43:00	24.9	7.1	**11.95**
11:48:00	18.1	6.8	**11.44**
		18.1	

H =	25
r =	**4.5**



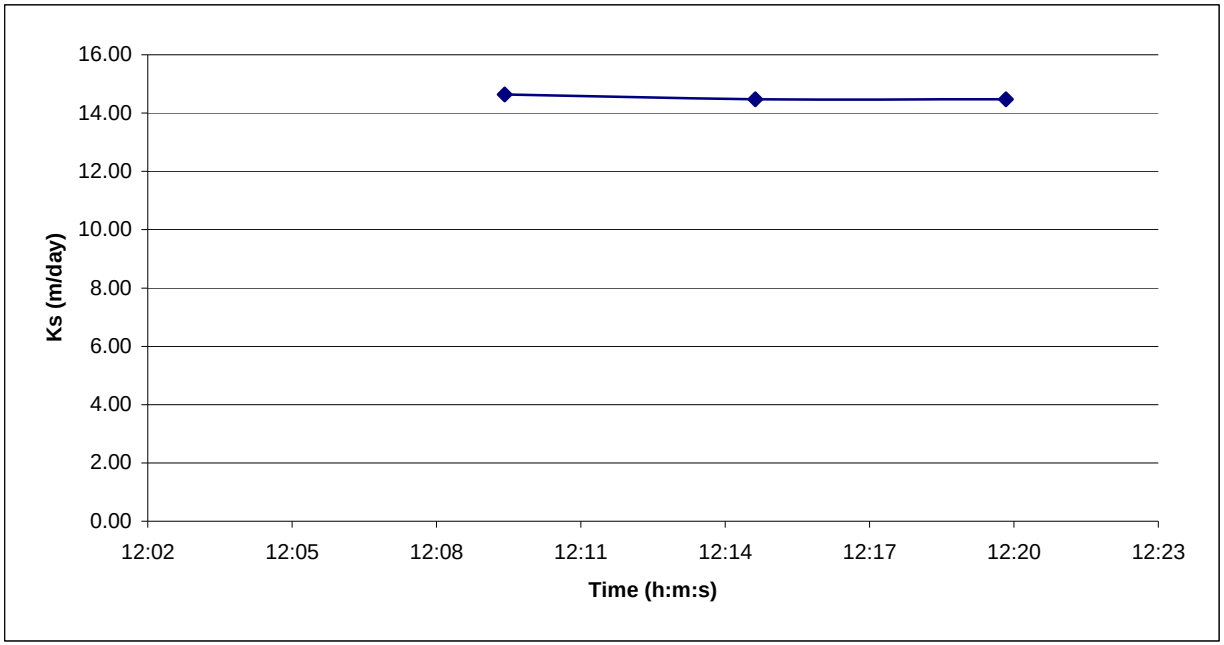
Ks = 11 m/day

SOIL PERMEABILITY TEST

Site No.	CHI2	Orange sand
Date	29/10/24	
Easting	396142	
Northing	6532513	
Depth	0.5	

Time (h:m:s)	Weight (kg)	Change in Weight (kg)	Ks (m/d)
12:05:00	46.3		
12:10:00	37.6	8.7	**14.64**
12:15:00	29	8.6	**14.47**
12:20:00	20.4	8.6	**14.47**
		20.4	

H =	25
r =	**4.5**



Ks = 14 m/day

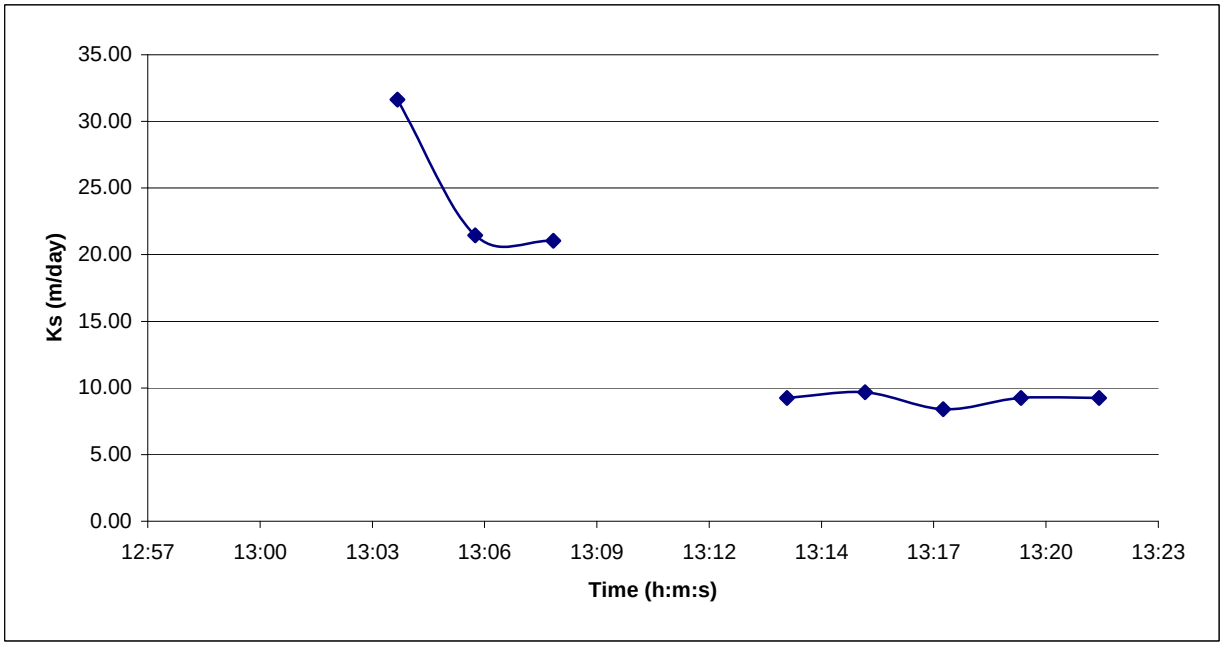
SOIL PERMEABILITY TEST

Site No.	CHI3
Date	29/10/24
Easting	396353
Northing	6532556
Depth	0.5

Dark brown clayey sand over black sandy/peaty clay

Time (h:m:s)	Weight (kg)	Change in Weight (kg)	Ks (m/d)
12:59:00	41.9		
13:04:00	23.1	18.8	**31.63**
13:06:00	18	5.1	**21.45**
13:08:00	13	5	**21.03**
13:12:00	40.6		
13:14:00	38.4	2.2	**9.25**
13:16:00	36.1	2.3	**9.68**
13:18:00	34.1	2	**8.41**
13:20:00	31.9	2.2	**9.25**
13:22:00	29.7	2.2	**9.25**
		29.7	

H =	25
r =	**4.5**



Ks = 9 m/day

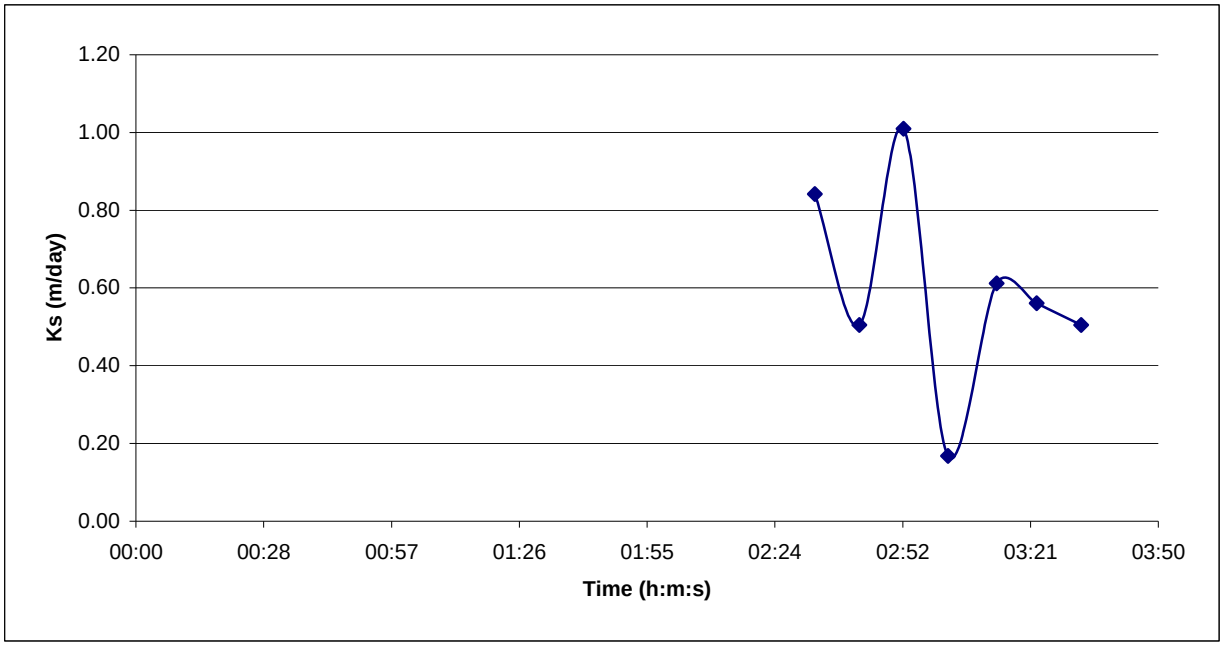
SOIL PERMEABILITY TEST

Site No.	CHI4
Date	29/10/24
Easting	396342
Northing	6532677
Depth	0.5

Dark grey clayey sand over sandy clay

Time (h:m:s)	Weight (kg)	Change in Weight (kg)	Ks (m/d)
02:28:00	40.7		
02:33:00	40.2	0.5	**0.84**
02:43:00	39.6	0.6	**0.50**
02:53:00	38.4	1.2	**1.01**
03:03:00	38.2	0.2	**0.17**
03:14:00	37.4	0.8	**0.61**
03:23:00	36.8	0.6	**0.56**
03:33:00	36.2	0.6	**0.50**
		36.2	

H =	25
r =	**4.5**



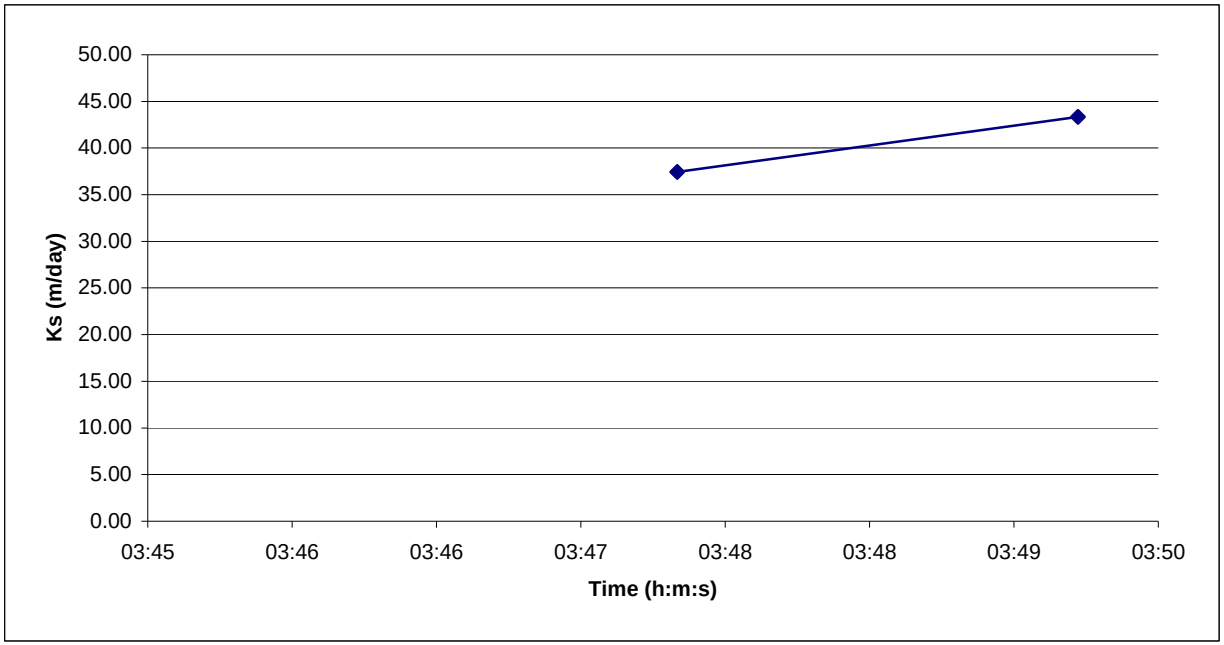
Ks = 0.5 m/day

SOIL PERMEABILITY TEST

Site No.	CHI5	Dark orange-brown sand
Date	29/10/24	
Easting	396131	
Northing	6532743	
Depth	0.5	

Time (h:m:s)	Weight (kg)	Change in Weight (kg)	Ks (m/d)
03:46:00	33.1		
03:48:00	24.2	8.9	**37.44**
03:50:00	13.9	10.3	**43.33**
		13.9	

H =	25
r =	**4.5**



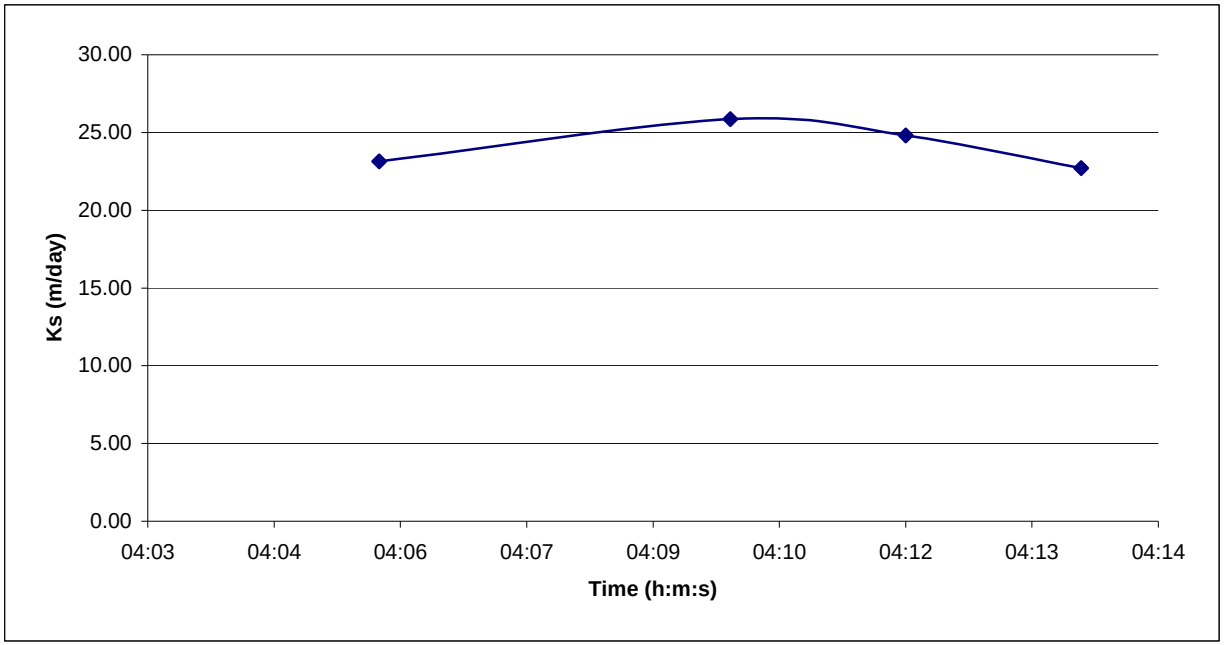
Ks = 40 m/day

SOIL PERMEABILITY TEST

Site No.	CHI6	Orange sand
Date	29/10/24	
Easting	395993	
Northing	6532822	
Depth	0.5	

Time (h:m:s)	Weight (kg)	Change in Weight (kg)	Ks (m/d)
04:04:00	41.2		
04:06:00	35.7	5.5	**23.14**
04:10:00	23.4	12.3	**25.87**
04:12:00	17.5	5.9	**24.82**
04:14:00	12.1	5.4	**22.72**
		12.1	

H =	25
r =	**4.5**



Ks = 22 m/day

Appendix C

Gingin Brook Flow Calculations

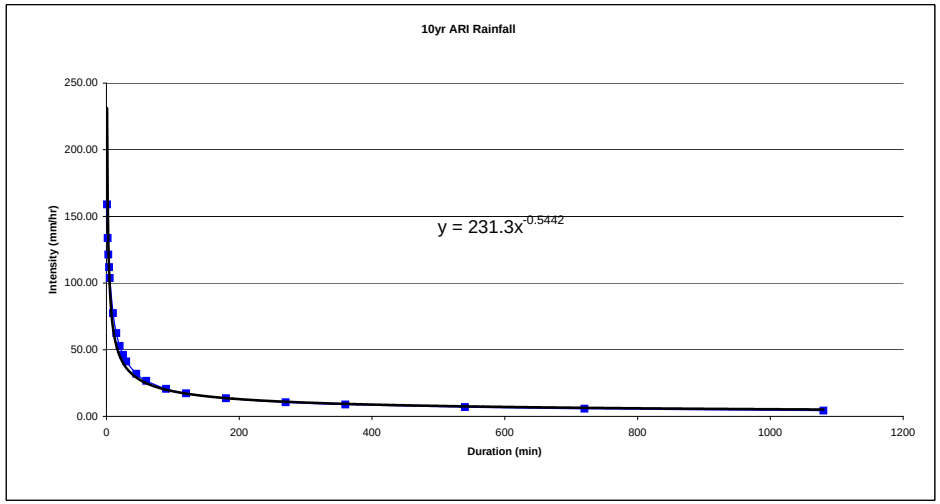
10 YEAR ARI CRITICAL FLOWS

CATCHMENT	AREAS (m2)			EFFECTIVE AREAS (m2)		TIME OF CONCENTRATION PRE DEVELOPMENT					TIME OF CONCENTRATION POST-DEVELOPMENT					CRITICAL STORM INTENSITY (mm/h)		FLOW		
	Cleared	Forested	Total	Pre	Post	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope (m/km)	TC (mln)	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope	TC (mln)	Pre-Dev	Post-Dev	Pre Dev	Post Dev	Total Flow (m3)
Gingin Brook Upstream	28700000	11050000	39750000	13360000	13360000	11582	231	104	10.97	321.1	11582	231	104	10.97	321.1	10.0	10.0	37117.03	37117.03	715074.63

Runoff Coefficients	Pre-Dev	Post-Dev
Cr Cleared	0.35	0.35
Cr Forested	0.3	0.3

Rainfall IFD

Event	Duration (mins)	Intensity (mm/hr)	Event Rainfall (mm)
1 min	1	159.00	2.65
2 min	2	133.80	4.46
3 min	3	121.40	6.07
4 min	4	111.90	7.46
5 min	5	103.80	8.65
10 min	10	77.40	12.9
15 min	15	62.40	15.6
20 min	20	52.80	17.6
25 min	25	46.08	19.2
30 min	30	41.20	20.6
45 min	45	32.00	24
1 hr	60	26.70	26.7
1.5 hr	90	20.67	31
2 hr	120	17.30	34.6
3 hr	180	13.53	40.6
4.5 hr	270	10.60	47.7
6 hr	360	8.92	53.5
9 hr	540	6.93	62.4
12 hr	720	5.77	69.2
18 hr	1080	4.38	78.8



Appendix D

Effluent Generation and System Sizing

EFFLUENT GENERATION AND SYSTEM SIZING

	Population	Effluent lpd	
			0
			0
Residents	**6**	**150**	900
	0		0
Daily flow			**900**

SEPTIC TANK SIZING

Reserve capacity	1820
Daily flow	900
Total capacity	2720

FLATBED LEACH DRAIN SIZING - WITH ATU

DLR (Category 1 Soil)	**50**	mm/day									
Infiltrative area required	18	m2									
Leach drain effective width	2.4	m									
Effluent per m	120	litres/day									
Length of LD required	8	m	(	2.0	x	4	m or	2.0	x	3.8	m)
Total width - parallel (excluding setbacks)	6.8	m									
Total area - parallel (excluding setbacks)	27	m2									
Total length - end to end (excluding setbacks)	9.8	m									
Total area - end to end (excluding setbacks)	24.5	m2									

DLR (Category 3 soil)	**30**	mm/day									
Infiltrative area required	30	m2									
Leach drain effective width	2.4	m									
Effluent per m	72	litres/day									
Length of LD required	13	m	(	2.0	x	6.5	m or	2.0	x	6.3	m)
Total width - parallel (excluding setbacks)	6.8	m									
Total area - parallel (excluding setbacks)	44	m2									
Total length - end to end (excluding setbacks)	14.8	m									
Total area - end to end (excluding setbacks)	37	m2									

ATTACHMENT 4

SITE AND SOIL EVALUATION

LOT 106 (No. 62) CHERITON ROAD, GINGIN

SITE AND SOIL EVALUATION

Prepared for

Fairlands Farm Pty Ltd
23 Kilkenny Rd
FLOREAT WA 6014

Draft Report No. J24041
13 December 2024

BAYLEY ENVIRONMENTAL SERVICES
30 Thomas Street
SOUTH FREMANTLE WA 6162

Sundowner Nominees Pty Ltd as trustee for the Bayley Cook Family Trust ABN 20 822 598 897
trading as Bayley Environmental Services

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Appendix	Title
A	Soil Logs
B	Infiltration Test Results
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1.0 INTRODUCTION

1.1 Background

Fairlands Farm Pty Ltd proposes to subdivide Lot 106 Cheriton Rd, Gingin for rural-residential use. The 26.02ha site is proposed to be subdivided into 22 lots ranging in size from 1ha to 1.2ha. All lots will employ on-site effluent disposal. Figure 1 shows the proposed plan of subdivision. Figure 2 shows an aerial view of the site and its surroundings.

Bayley Environmental Services was commissioned in October 2024 to prepare a Site & Soil Evaluation (SSE) for the proposed development. The SSE included:

- test pitting up to 2.5-3m depth at 12 locations across the site using a 600mm auger;
- constant-head permeability testing at 0.5m depth at six locations;
- site survey noting landforms, surface soils, hydrology and vegetation;
- collation of published information on landforms, soils and land capability; and
- assessment of the site's capability for effluent disposal in accordance with AS1547:2012 – *Onsite Domestic Wastewater Management* and the *Government Sewerage Policy 2019*.

1.2 Qualifications and Experience of Assessor

This Site & Soil Evaluation has been prepared by Phillip Bayley, an Environmental Scientist with 40 years' experience in the field including 35 years as a private consultant. Phillip Bayley has undertaken over 70 site & soil evaluations and land capability assessments for onsite effluent disposal since 2006.

The investigations and analyses presented in this report are in accordance with Australian Standard AS1547:2012 – *Onsite Domestic Wastewater Management* and the *Government Sewerage Policy 2019.*

2.0 EXISTING ENVIRONMENT

2.1 Climate

Gingin has a strongly seasonal rainfall, with most of the annual rain falling between May and September in association with winter cold fronts. Occasional heavy falls may occur from summer thunderstorms. The long-term average annual rainfall for RAAF Gingin (located 13km south-west of the site) is 637.7mm, of which 78% falls between the months of May and September.

Figure 2 shows a rainfall occurrence chart for RAAF Gingin.

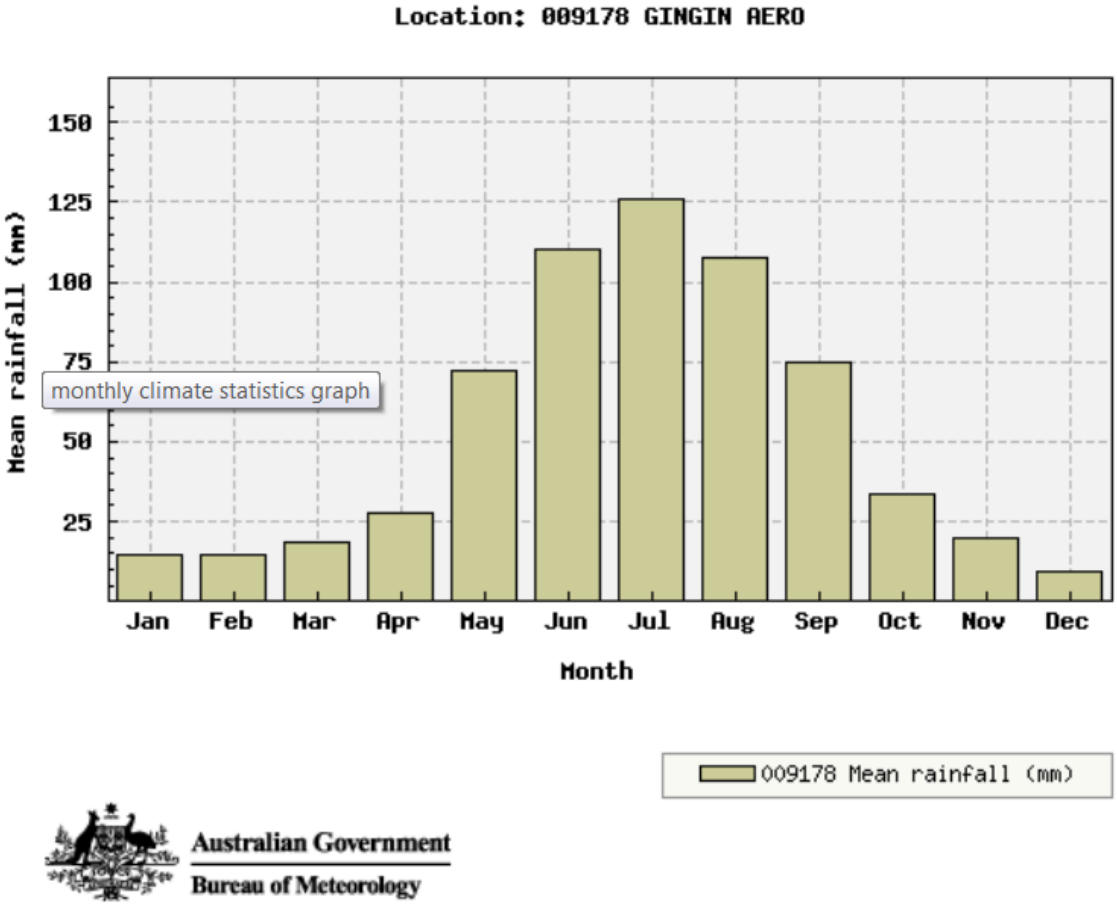


Figure 2 RAAF Gingin Mean Rainfall

2.2 Physiography

2.2.1 Topography

The site lies on the east-facing western side of the Gingin Brook valley on the northern edge of the Gingin Townsite. The elevation of the site ranges from 97m AHD in the north-east near the Brook to 134m in the south-west corner. The slope is linear and

slightly convergent, varying from about 1% in the north-east to 8% in the west and averaging 5.5% across most of the site. Figure 3 shows topographic contours over the site.

2.2.2 Geology and Soils

The Geological Survey of Western Australia (Hocking *et al.*, 1975) maps of the site as Colluvium (Qpo): a Quaternary-aged varicoloured (white-cream-brown), poorly sorted, poorly rounded sand which was formerly an eluvial (weathered in-situ) horizon overlying laterite which has been partly redistributed. A small area in the south-west of the site is mapped as Laterite (Czl): typically a ferruginous, pisolitic, siliceous laterite forming layers from 1.5m to 3m thick and associated with eluvial quartz sand, overlying a weathered rock zone which can be up to 30m thick.

Figure 4 shows the GSWA mapping. Test pitting to 2.5-3m at 12 locations across the site (Figure 4) found a profile that generally matched the GSWA mapping. Appendix A shows soil logs from the test pits.

2.2.3 Acid Sulphate Soils

ASS-risk mapping by the DBCA shows the site as Class 3 (Nil to Low risk of ASS within 3m of the ground surface). The soils of the site are elevated and have had no recent marine influence. The age and origin of the soils and the absence of a shallow water table over most of the site indicate that acid sulphate soils are unlikely to be present. The nearest mapped high ASS risk zone is a wetland 3.3km south of the site.

Development of the site is not expected to involve any excavation deeper than about 2m (for installation of effluent systems) or dewatering. Any ASS present is therefore unlikely to be disturbed. No further ASS assessment is considered necessary.

2.2.4 Phosphorus Retention Index

The strongly coloured and/or clayey soils of the site are expected to have a high to very high PRI. Analysis by the CSBP Soil Laboratory of samples from 0.5m and/or 1m depth at four locations (CH2, CH6, CH8, CH10 – Figure 4) gave PRI values of ranging from 8.0 to 123.8, with a mean of 56.8 and a median of 27.2.

2.2.5 Soil Permeability

Constant-head permeability tests in accordance with AS1547:2012 were carried out at 0.5m depth at eleven locations as shown on Figure 4. Appendix B shows the detailed test results.

The tests gave saturated hydraulic conductivities (Ks) ranging from 0.5m/day to 40m/day, with a mean of 16m/day and a median of 12.5m/day. The lowest value of 0.5m/day was recorded in the low part of the site in clayey sand.

2.2.6 Soil Geotechnical Analysis

Soil samples collected at 0.5m and 1.0m from test pit CHT8 in the north-east corner of the site (Figure 4) was subjected to analysis by the CSBP Soil Laboratory for geotechnical parameters including particle size distribution, dispersion index, exchangeable cations and exchangeable sodium percentage (sodicity). Table 2.1 shows the results of the analysis. The soil profile at CHT8 was typical of the profile in the lower parts of the site.

Table 2.1 Soil Analysis

Sample (Figure 4)	*Particle Size*		*Soil Type*	*Dispersion Index (range 0-16)*	*Exchangeable Sodium %*
CHT8 0.5m	Clay (<2µm) Silt (2-20µm) Sand (20-2000µm)	16.11% 15.67% 68.22%	Sandy loam	14	5.4
CHT8 1.0m	Clay (<2µm) Silt (2-20µm) Sand (20-2000µm)	26.22% 13.14% 60.64%	Sandy clay loam	10	13.6

The soil analyses show that the soils in the lower lying parts of the site are predominantly non-sodic (Exchangeable Sodium % <6) to moderately sodic (ESP >15), highly dispersive sandy loams overlying sandy clay loams.

2.2.7 Soil Category

The results of the test pitting and infiltration tests place the soils of the higher part of the site (above 104m AHD) in Soil Category 1 (Gravels and Sands) according to AS1547:2012. The soils in the lower part are conservatively assigned to Category 3 (Loams) given their clayey subsoil and lower permeability.

The high dispersivity of the low-lying soils suggests that special measures, perhaps including gypsum addition, may be justified to improve their characteristics for effluent disposal.

2.3 Hydrology

2.3.1 Surface Drainage

There is no defined natural surface drainage on the site. The sandy surface soils of the majority of the site (above about 102m AHD) mean that runoff would occur only over short distances under very heavy rainfall conditions. The lower eastern part of the site has heavier soils and a shallower water table, and may generate surface runoff in a 1-year ARI storm event or less.

A shallow constructed drain runs from the mid-northern boundary south and then east through the north-east of the lot to Gingin Brook. This drain extends upstream across

other properties to its source 2km upstream of Lot 106. The drain has a catchment of about 165ha but is dammed by at least eight farm dams, so it would be unlikely to carry large flows. It is recommended that this drain be diverted into an easement along a lot boundary into a road reserve as part of the subdivision, with intensive planting undertaken to turn it into a "living stream" to provide treatment of the water prior to discharge into Gingin Brook.

The major surface hydrological feature of the area is Gingin Brook, which flows south to north between 20m and 200m east of the site. Surface pools associated with the Brook occurred as close as 15m from the site boundary in October 2024.

Figure 5 shows the catchments upstream of the site.

2.3.2 Groundwater

There is no published groundwater information available for the subject land. Given the topography of the site and surroundings, groundwater would likely exist as localised aquifers in creek and river valleys and possibly as seasonal perched water tables above impermeable layers on slopes.

Groundwater was present at a depth of 1.14m below ground in test pit CHT7 in the east of the site (Figure 4) on 29 October 2024. No usable DWER bores are available in the near vicinity of Lot 106 to enable this level to be compared with long-term averages. However, the topography, soils and presence of wetland vegetation (sedges) in the vicinity of CHT7 suggests that the water table would reach the ground surface in this area during wet winters. Groundwater measurement in midwinter will be necessary to more accurately determine the maximum groundwater level and the need for fill in areas below 100m AHD.

2.4 Wetlands

The DBCA maps the lower-lying eastern part of the site below about 101m AHD as Multiple Use category palusplain (seasonally waterlogged plain). This appears to correspond with the topography and vegetation in the area.

Gingin Brook is mapped as Conservation category palusplain, although its profile suggests that it is a watercourse rather than a palusplain. Figure 4 shows the DBCA wetland mapping.

3.0 ON-SITE EFFLUENT DISPOSAL

3.1 Statutory and Policy Constraints

Lot 106 and its surroundings are mapped as a Sewage Sensitive Area (SSA) under the Government Sewerage Policy by virtue of its location within 1km of a significant wetland (Gingin Brook). The GSP imposes additional requirements on effluent disposal within SSAs including:

- a minimum lot size of 1ha;
- a minimum clearance to groundwater of 1.5m; and
- a requirement for secondary effluent treatment systems.

A small area on the southern boundary is within a Wellhead Protection Zone around the Gingin town water supply bore. The WPZ extends only 10m into the corner of one proposed lot (Figure 6) and will not significantly constrain effluent disposal on the lot.

The site meets the lot size requirement of the GSP, with all proposed lots having an area of at least 1ha. Land Application Areas (LAAs) below about 100m AHD will require filling to achieve the minimum 1.5m depth to groundwater. A requirement for nutrient-removing secondary treatment systems is expected to be a condition of subdivision approval.

3.2 Wetland and Watercourse Setbacks

The GSP requires that effluent disposal areas be set back at least 100m from waterways, significant wetlands and drains that flow untreated into waterways or wetlands (Govt of WA, 2019). Figure 6 shows the required setbacks from Gingin Brook and its associated Conservation Category Wetland. All proposed lots have adequate space for effluent disposal outside of the 100m setback.

The shallow drain that flows across the eastern part of the property is recommended to be diverted into an easement along a lot boundary and into a road reserve, with intensive planting in the drain undertaken to provide water treatment before discharge into Gingin Brook. Given this treatment, a 100m setback from the drain is not considered necessary.

3.3 Groundwater Separation

Measurements in October 2024 suggest that the maximum groundwater level (MGL) is at or near the ground surface in the east of the site below about 98m AHD. LAAs east of about the 100m AHD contour (Figure 6) are likely to require filling to achieve the

required 1.5m groundwater separation. Further groundwater measurement in midwinter 2025 will be required to better define the extent and height of fill required.

3.4 Flooding and Inundation Risk

The GSP does not permit effluent disposal on land that is subject to inundation in a 1-in-10 year ARI flood event. This includes both regional flooding and local inundation resulting from ponding of rainfall on saturated ground surfaces.

No published floodplain mapping is available for Gingin Brook upstream of the Gingin Townsite. Calculations using the Rational Method (Engineers Australia, 1987) suggest that the catchment of the Brook upstream of the site would produce a flow of around 37.1m^3/sec in a critical 10-year ARI storm at the closest point to the site. Appendix C shows the flow calculations.

Calculations using Manning's Open Channel Flow Formula (Fang, 2000) suggest that this flow rate would produce a flow 1.33m deep and 76m wide in the Brook, which would extend up to 6m into the north-east corner of Lot 106 (Figure 6). This area is within the 100m setback from the Brook and will not be used for effluent disposal.

The sloping topography of the site (minimum 1%) means that rain falling on saturated ground in the lower eastern parts will run off, rather than ponding on the ground surface.

It is therefore concluded that there is no significant risk of flooding or inundation in areas used for effluent disposal at a frequency of 10 years or less.

3.5 Soil Permeability

Test pitting, permeability testing and soil analysis suggest that the soils of Lot 62 are sands or sandy loams with moderate to high permeability. Australian Standard AS1547:2012 recommends that special measures including pressure dosing of leach drains be employed to ensure even distribution of effluent in highly permeable sands. The use of ATUs on the site will satisfy this requirement.

3.6 Phosphorus Retention Index

The site soils have a high to very high PRI (8-123.8). The Government Sewerage Policy does not impose a minimum PRI requirement in cases where secondary treatment systems with nutrient removal capability are used, as is required in Sewage Sensitive Areas.

3.7 Site Capability Summary

The capability of the site to support on-site effluent disposal has been assessed against the criteria set out in AS1547:2012. Table 3.1 summarises the AS1547:2012 factors and the degree to which they are satisfied by the site.

Table 3.1 On-site Effluent Disposal Capability

Factor	*Criterion*	*Site Characteristics*	*Complies*
Slope	<20%	1-8%	Yes
Groundwater depth	>1.5m below discharge point	Estimated 0 - >20 m	Fill required in east below 100m AHD
Soil permeability (Ks)	>0.06 m/day	0.5 - 40 m/day	Yes
Soil PRI	>15 without secondary treatment	8 - 123.8	Yes
Distance from surface watercourses and significant wetlands	>100m	>100m	Yes
Lot area	1ha in SSAs 2,000m^2 elsewhere	Minimum 1ha	Yes
Inundation and flooding	Not subject to inundation or flooding in a 10% AEP (1 in 10 year) rainfall event	Outside Gingin Brook 10-yr ARI floodplain	Yes

This Site & Soil Evaluation has shown that the site is suitable for on-site effluent disposal in accordance with the criteria set out in AS1547:2012. Fill be required on some lots in the east below about 100m AHD to achieve the required groundwater clearance. Further groundwater measurements in peak winter conditions will be required to better define the minimum depth to groundwater and the height of fill required.

3.8 Effluent System Conceptual Design

The GSP states a general requirement for secondary treatment systems with nutrient removal capability in sewage sensitive areas.

The Health Department's website (https://ww2.health.wa.gov.au/Articles/A_E/Approved-Secondary-Treatment-Systems) lists approved secondary treatment systems. The website lists the nutrient removal capability of some systems, with final effluent phosphorus concentrations ranging from <1mg/L with alum dosing to 11.6mg/L. The website states that the relevant local government authority should be consulted to determine whether the nutrient removal capability of a particular system will meet its requirements.

Effluent from secondary treatment systems may be disposed of by surface spray irrigation, subsurface drip irrigation or leach drains. Given the site characteristics, the use of surface spray irrigation would require the least height of fill, but flatbed leach

drains would require the smallest land application area (LAA) and the smallest quantity of fill overall.

3.9 Land Application Areas

Schedule 2, Table 3 of the GSP recommends an LAA of 180m^2 for a five-bedroom house with six occupants generating a total of 900 litres of secondary-treated effluent per day on Category 1 soils. For Category 3 soils the recommended area is 225m^2. These areas are based on loading rates of 5mm/day for Category 1 soils and 4mm/day for Category 2 soils, which are equivalent to the Design Irrigation Rates (DIR) specified in AS1547:2012 for surface spray or subsurface drip irrigation on Category 1 and 4 soils.

Table L1 of AS1547:2012 recommends design loading rates (DLR) for secondary-treated effluent using leach drains of 50mm/day in Category 1 soils and 30-50mm/day in Category 3 soils. Given the dispersive nature of the Category 3 soils in the east of the site, the lower recommended DLR of 30mm/day has been adopted. Higher loading rates may be employed on individual lots if site-specific testing shows that the soils have higher permeability and/or lower dispersivity.

Using the adopted DLRs, the length of leach drain required for a 5-bedroom house using flatbed leach drains is:

- Category 1 soils (generally above 100m AHD) 8m
- Category 3 soils (generally below 100m AHD) 13m.

Appendix D shows the system sizing calculations.

Leach drains are normally arranged in equal-length pairs, with a 1.8m separation between them. A diverter valve between the leach drains is switched every six to twelve months to rest each leach drain in turn.

Figure 6 shows indicative footprints of the default LAAs and flatbed leach drains on each lot. The figure shows that each of the lots has sufficient unconstrained area to accommodate the default LAA and other site developments. The locations of the LAAs may be varied to suit the requirements of individual lot developers, provided that the exclusion zones shown on Figure 6 are avoided. Detailed sizing and siting of the LAA for each lot will be required at the building approval stage based on the size of house proposed and the method of disposal to be used.

4.0 CONCLUSION

This Site and Soil Evaluation has found that the subject site is capable of supporting on-site effluent disposal in accordance with the Government Sewerage Policy. Specifically:

- All lots meet the minimum lot size specified by the GSP for sewage sensitive areas.
- All proposed lots have sufficient area more than 100m from Gingin Brook to accommodate a land application area.
- The soils have suitable slope and PRI to support effluent disposal.
- Lots in the east of the site below 100m AHD may require filling to achieve the required minimum 1.5m clearance to groundwater. Further mid-winter groundwater measurements will be required to determine the height of filling necessary on each lot.
- The site is not susceptible to flooding in a 1-in-10 year event.

5.0 REFERENCES

Government of Western Australia (2003). *Health Act 1911: Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974.*

Government of Western Australia (2019). *Government Sewerage Policy.* Dept of Planning, Lands & Heritage, Perth.

Health Department of Western Australia (2001). *Code of Practice for the Design, Manufacture, Installation and Operation of Aerobic Treatment Units (ATUs).* Health Department of WA, Perth.

Hocking R.M., Marcos G.W. and Archer R.H. (1975). *Gingin Urban Geology Sheet 2035 II.* 1:50,000 Urban Geology Series. Geological Survey of Western Australia, Perth.

Low G.H. (1971). *Explanatory notes on the Phanerozoic rocks of the Perth 1:250 000 geological sheet, Western Australia.* Record 1971/24, Geological Survey of Western Australia, Perth.

Standards Australia (2012). *Australian/New Zealand Standard 1547:2012 – On-site Domestic Wastewater Management.* SAI Global Ltd, Sydney.

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Figures



SUBDIVISION CONCEPT
LOT 106 (No. 62) CHERITON ROAD
GINGIN

Figure 1

DRAFT

N

0 100 m
SCALE @ A3: 1:2500

9929-CON-02-A

DRAWN: WC
DATE CREATED: 2024.09.11
PROJECTION: MGA50 GDA94
CADASTRE: LANDGATE
AERIAL: LANDGATE 2023 MARCH

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ROWE GROUP DESIGN



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Figure 2

THE SITE AND SURROUNDINGS

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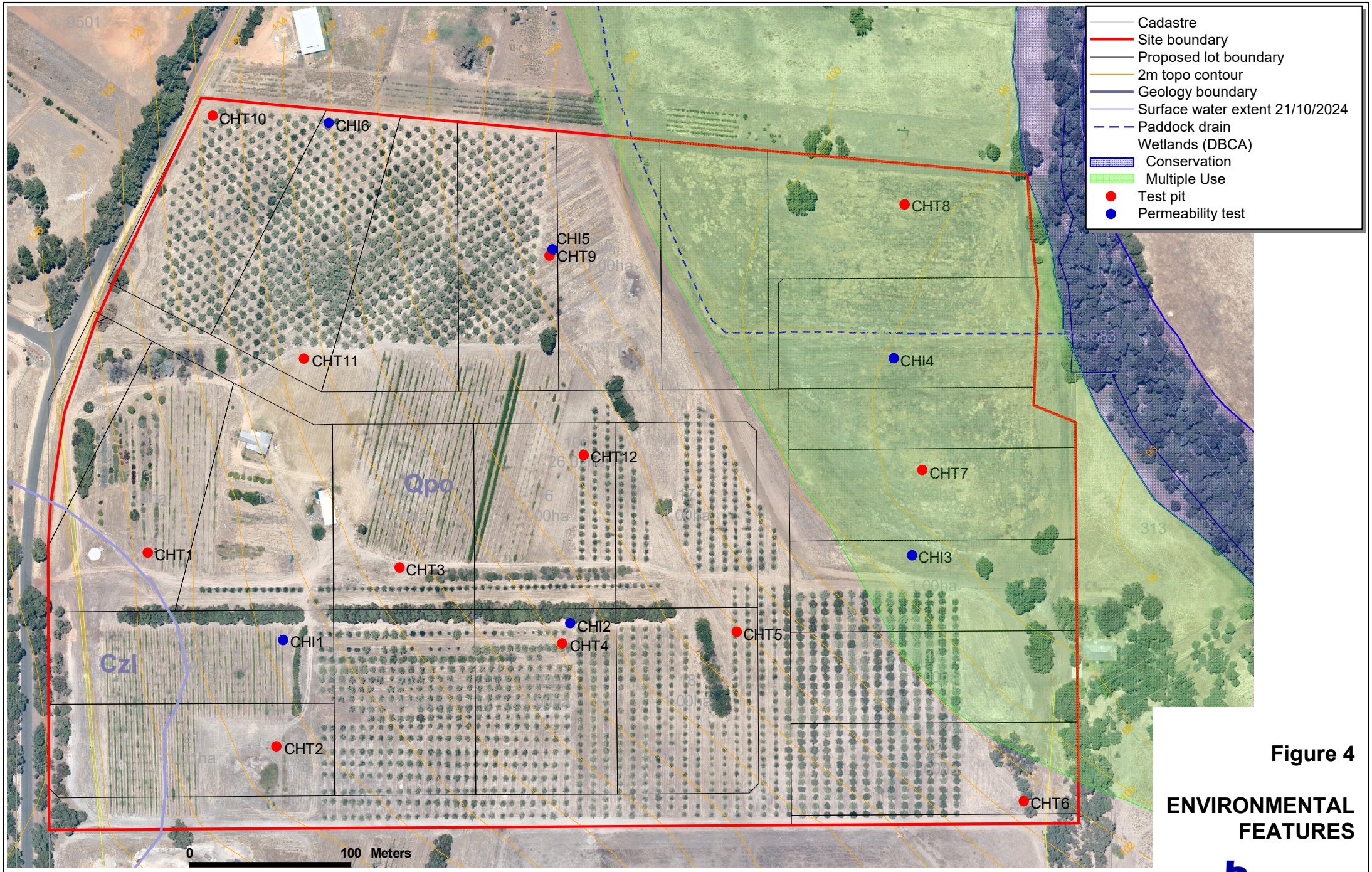
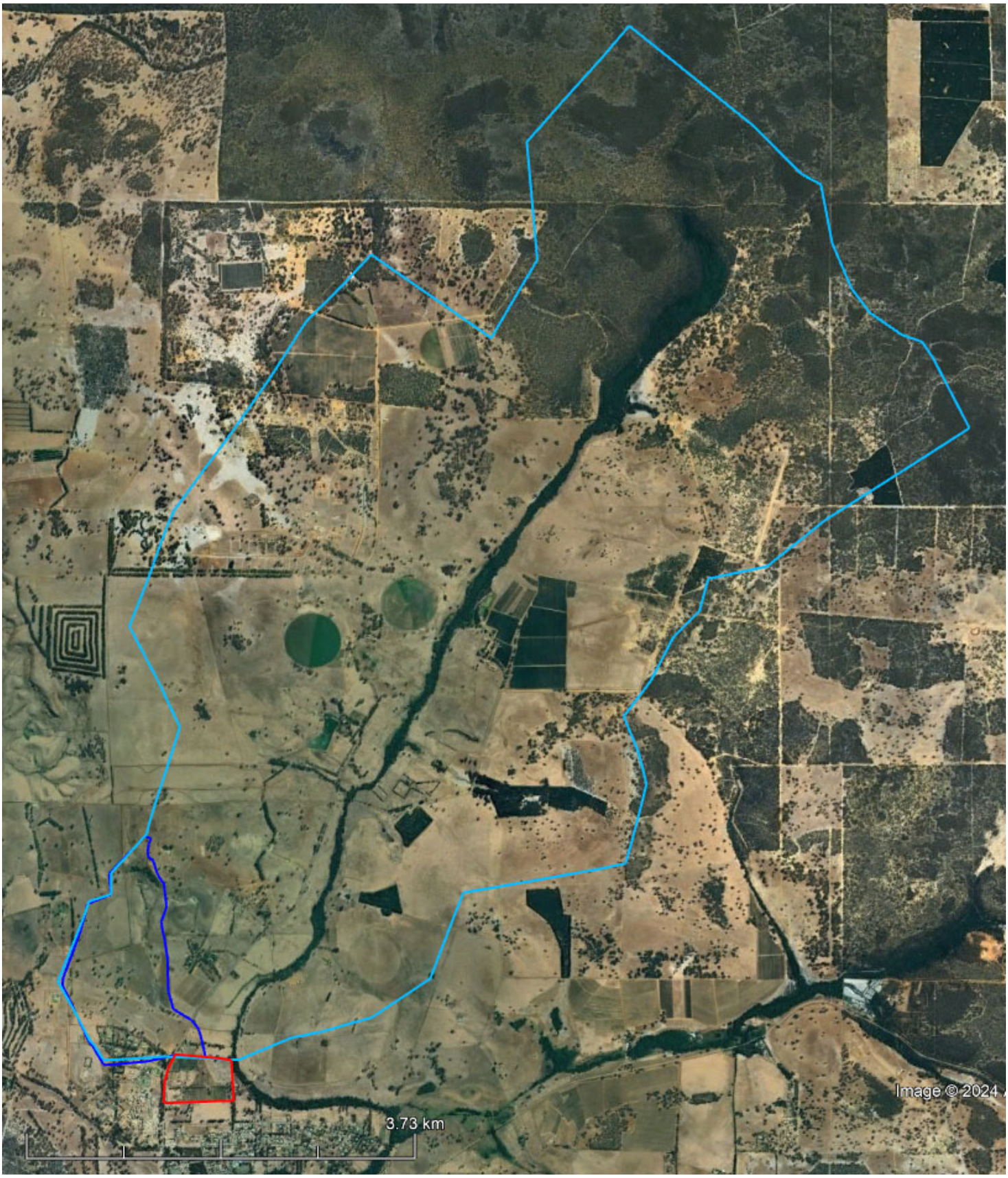


Figure 4

ENVIRONMENTAL FEATURES

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Site boundary
Gingin Brook catchment
Drain catchment

Figure 5

CATCHMENTS

Image source: Google

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Figure 6

LAND APPLICATION AREAS

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Appendix A

Soil Logs

SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	**CHT1**
EASTING:	395881
NORTHING:	6532558
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.5
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		**SAMPLE DATA**	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.1	Brown topsoil		
0.1 - 2.2	Orange slightly clayey sand		
2.2 - 2.5	Orange slightly clayey sand with ironstones to 50mm		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	**CHT2**
EASTING:	395921
NORTHING:	6532827
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	3.1
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		**SAMPLE DATA**	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.1	Brown topsoil		
0.1 - 1.0	Orange-brown slightly gravelly sand		
1 - 1.8	Orange gravelly clayey sand		
1.8 - 3.1	Red/orange/brown mottled well structured sandy clay		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	**CHT3**
EASTING:	395978
NORTHING:	6532677
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.5
REFUSAL (Y/N):	Y
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		**SAMPLE DATA**	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.2	Brown topsoil		
0.2 - 1.2	Orange to orange-yellow sand		
1.2 - 2.4	Orange gravelly sandy clay, cemented from 1.5m		
2.4 - 2.5	Orange well structured lateritic gravelly clay		
2.5	Refusal on laterite		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	**CHT4**
EASTING:	396150
NORTHING:	6532618
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	3.0
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		**SAMPLE DATA**	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.1	Brown topsoil		
0.1 - 2.0	Orange sand		
2.0 - 3.0	Orange/red mottled well structured gravelly sandy clay		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	**CHT5**
EASTING:	395961
NORTHING:	6532438
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	3.0
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		**SAMPLE DATA**	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.2	Brown topsoil		
0.2 - 0.5	Orange-brown sand		
0.5 - 2.2	Orange sand		
2.2 - 3.0	Orange-yellow sand, becoming paler		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	**CHT6**
EASTING:	396036
NORTHING:	6532548
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.8
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		**SAMPLE DATA**	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.2	Brown topsoil		
0.2 - 0.5	Brown sand		
0.5 - 2.3	Orange/red/brown mottled gravelly sandy clay with ironstone rocks to 100mm		
2.3 - 2.8	Hard orange-yellow gravelly clayey sand		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	**CHT7**
EASTING:	396137
NORTHING:	6532501
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	3.0
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	1.0

SOIL PROFILE		**SAMPLE DATA**	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.2	Brown topsoil		
0.2 - 1.0	Brown sand		
1.0 - 1.2	Dark brown peaty sand, wet		
1.2 - 2.0	Dark brown/green/dark orange mottled well structured sandy clay		
2.0 - 2.5	Dark green gritty clay with minor orange mottling, poorly structured		
2.5 - 3.0	Greenish-grey sandy clay, poorly structured, wet		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	**CHT8**
EASTING:	396245
NORTHING:	6532508
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	3.0
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		**SAMPLE DATA**	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 -0.1	Dark brown topsoil		
0.1 - 1.0	Dark brown sand		
1.0 - 1.5	Brown/dark brown dully mottled, moderately structured sandy clay		
1.5 - 2.0	Dull orange/dark brown/green mottled poorly structured sandy clay		
2.0 - 2.2	Dull brown slightly mottled poorly structured sandy clay with occasional ironstone nodules		
2.2 - 3.0	Orange/brown/grey mottled well-structured sandy clay with soft laterite nodules		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	**CHT9**
EASTING:	396422
NORTHING:	6532404
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.9
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		**SAMPLE DATA**	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.1	Brown topsoil		
0.1 - 0.5	Orange-brown sand		
0.5 - 2.9	Orange sand		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	**CHT10**
EASTING:	396359
NORTHING:	6532608
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.8
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		**SAMPLE DATA**	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.1	Yellow-brown sand		
0.1 - 2.8	Orange sand		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	**CHT11**
EASTING:	396348
NORTHING:	6532773
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.8
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		**SAMPLE DATA**	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.2	Pale grey-brown topsoil		
0.2 - 2.0	Orange sand		
2.0 - 2.8	Dark orange/pale orange mottled well structured slightly lateritic sandy clay		







SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	**CHT12**
EASTING:	396130
NORTHING:	6532742
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.8
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		**SAMPLE DATA**	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.1	Dark brown topsoil		
0.1 - 0.8	Yellow-brown sand		
0.8 - 2.8	Orange sand		





Appendix B

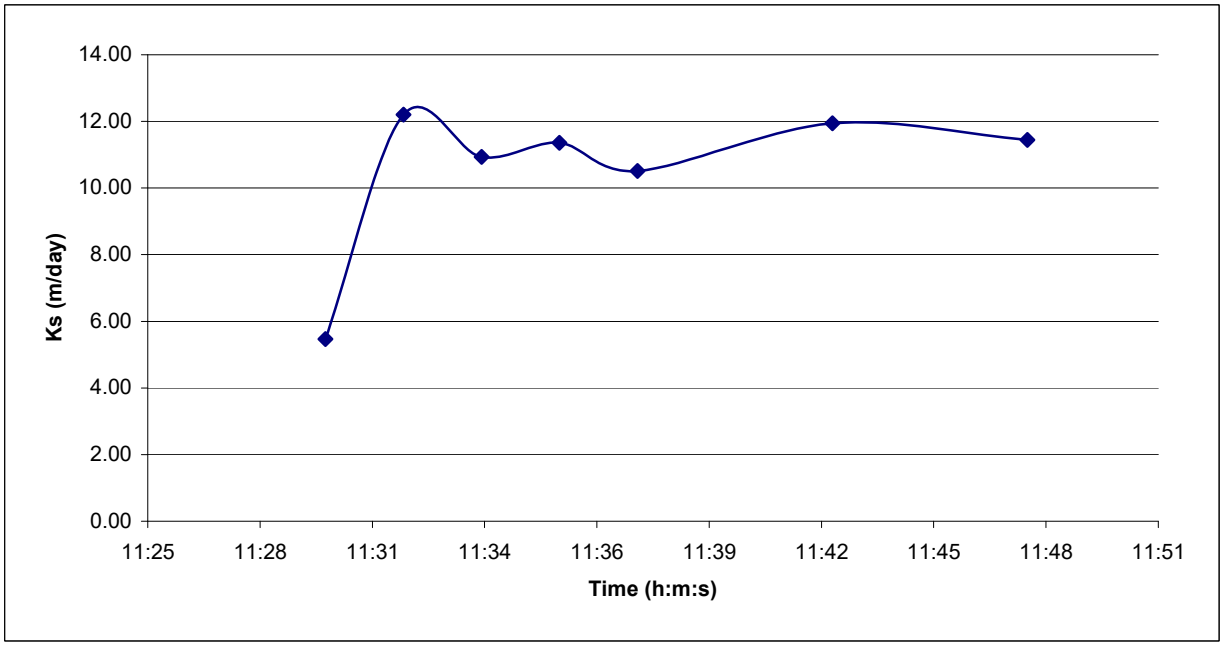
Infiltration Test Results

SOIL PERMEABILITY TEST

Site No.	CHI1	Orange sand
Date	29/10/24	
Easting	395964	
Northing	6532504	
Depth	0.5	

Time (h:m:s)	Weight (kg)	Change in Weight (kg)	Ks (m/d)
11:28:00	44		
11:30:00	42.7	1.3	**5.47**
11:32:00	39.8	2.9	**12.20**
11:34:00	37.2	2.6	**10.94**
11:36:00	34.5	2.7	**11.36**
11:38:00	32	2.5	**10.52**
11:43:00	24.9	7.1	**11.95**
11:48:00	18.1	6.8	**11.44**
		18.1	

H =	25
r =	**4.5**



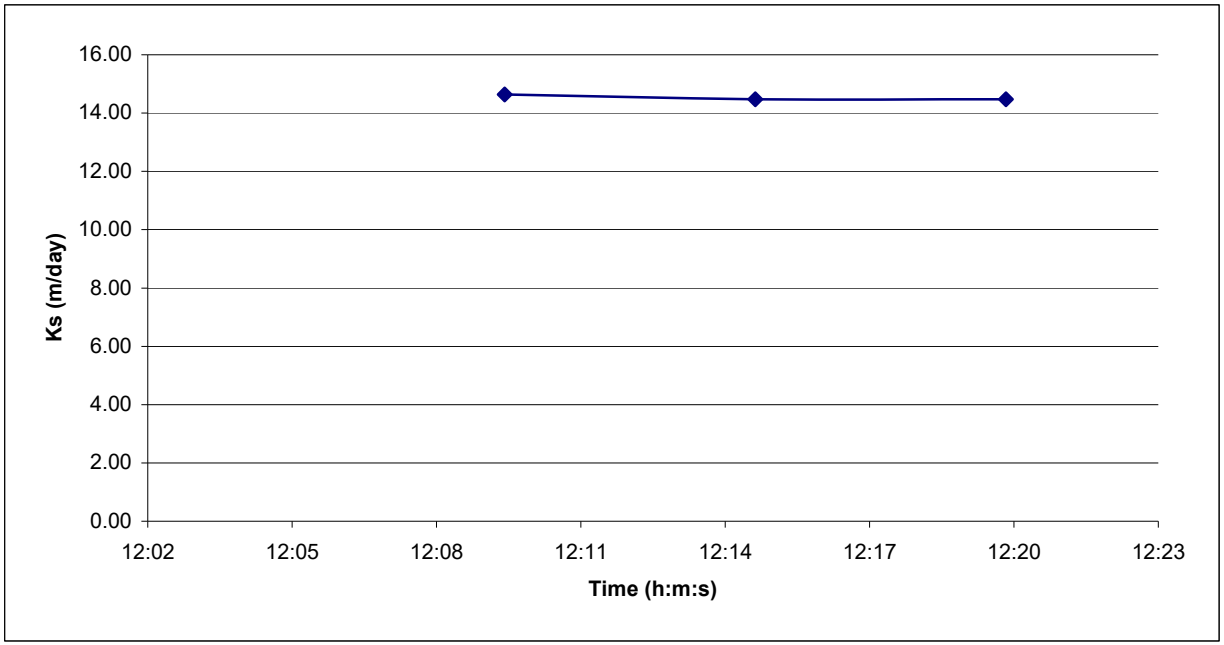
Ks = 11 m/day

SOIL PERMEABILITY TEST

Site No.	CHI2	Orange sand
Date	29/10/24	
Easting	396142	
Northing	6532513	
Depth	0.5	

Time (h:m:s)	Weight (kg)	Change in Weight (kg)	Ks (m/d)
12:05:00	46.3		
12:10:00	37.6	8.7	**14.64**
12:15:00	29	8.6	**14.47**
12:20:00	20.4	8.6	**14.47**
		20.4	

H =	25
r =	**4.5**



Ks = 14 m/day

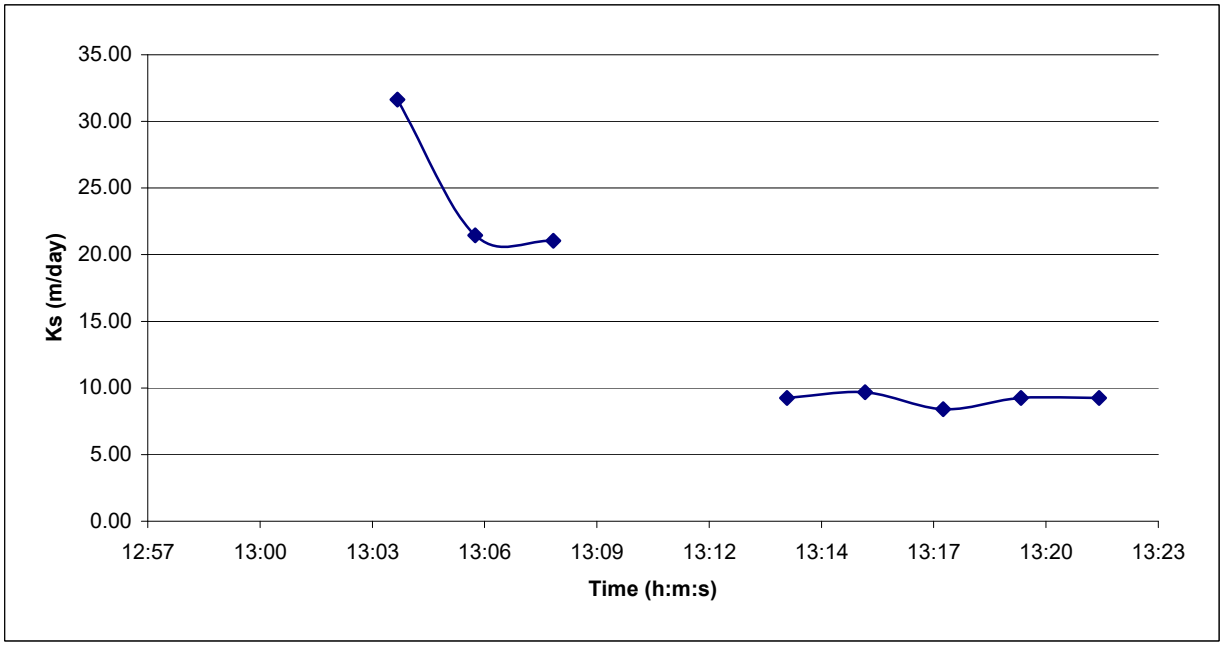
SOIL PERMEABILITY TEST

Site No.	CHI3
Date	29/10/24
Easting	396353
Northing	6532556
Depth	0.5

Dark brown clayey sand over black sandy/peaty clay

Time (h:m:s)	Weight (kg)	Change in Weight (kg)	Ks (m/d)
12:59:00	41.9		
13:04:00	23.1	18.8	**31.63**
13:06:00	18	5.1	**21.45**
13:08:00	13	5	**21.03**
13:12:00	40.6		
13:14:00	38.4	2.2	**9.25**
13:16:00	36.1	2.3	**9.68**
13:18:00	34.1	2	**8.41**
13:20:00	31.9	2.2	**9.25**
13:22:00	29.7	2.2	**9.25**
		29.7	

H =	25
r =	**4.5**



Ks = 9 m/day

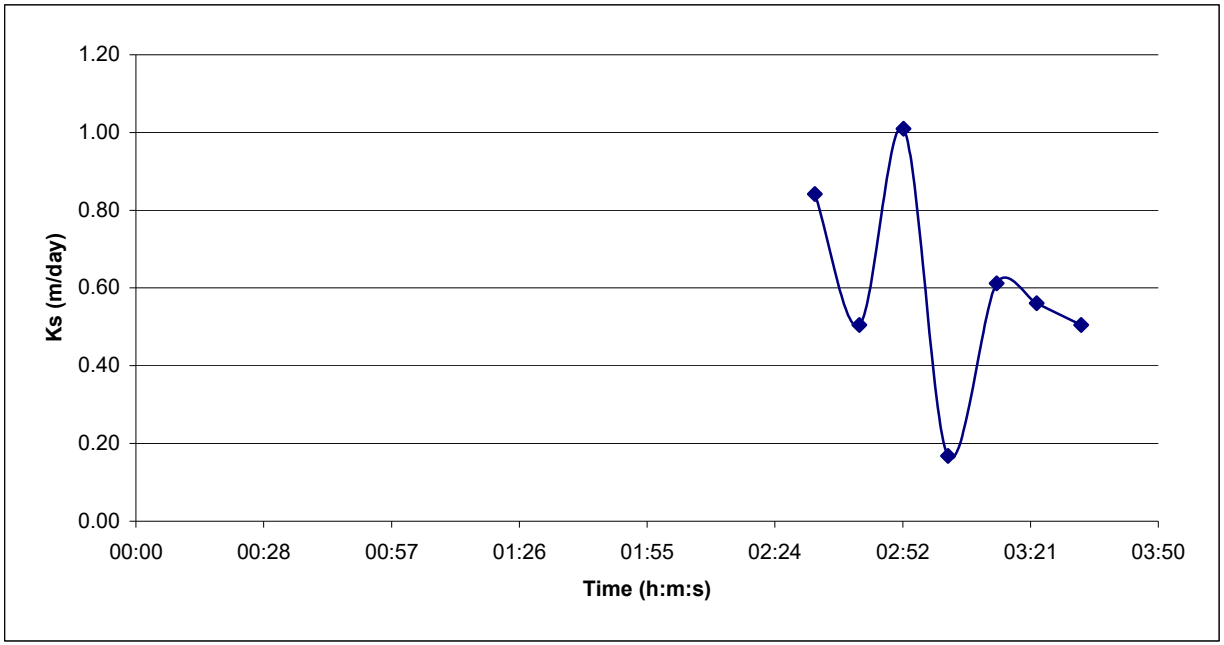
SOIL PERMEABILITY TEST

Site No.	CHI4
Date	29/10/24
Easting	396342
Northing	6532677
Depth	0.5

Dark grey clayey sand over sandy clay

Time (h:m:s)	Weight (kg)	Change in Weight (kg)	Ks (m/d)
02:28:00	40.7		
02:33:00	40.2	0.5	**0.84**
02:43:00	39.6	0.6	**0.50**
02:53:00	38.4	1.2	**1.01**
03:03:00	38.2	0.2	**0.17**
03:14:00	37.4	0.8	**0.61**
03:23:00	36.8	0.6	**0.56**
03:33:00	36.2	0.6	**0.50**
		36.2	

H =	25
r =	**4.5**



Ks = 0.5 m/day

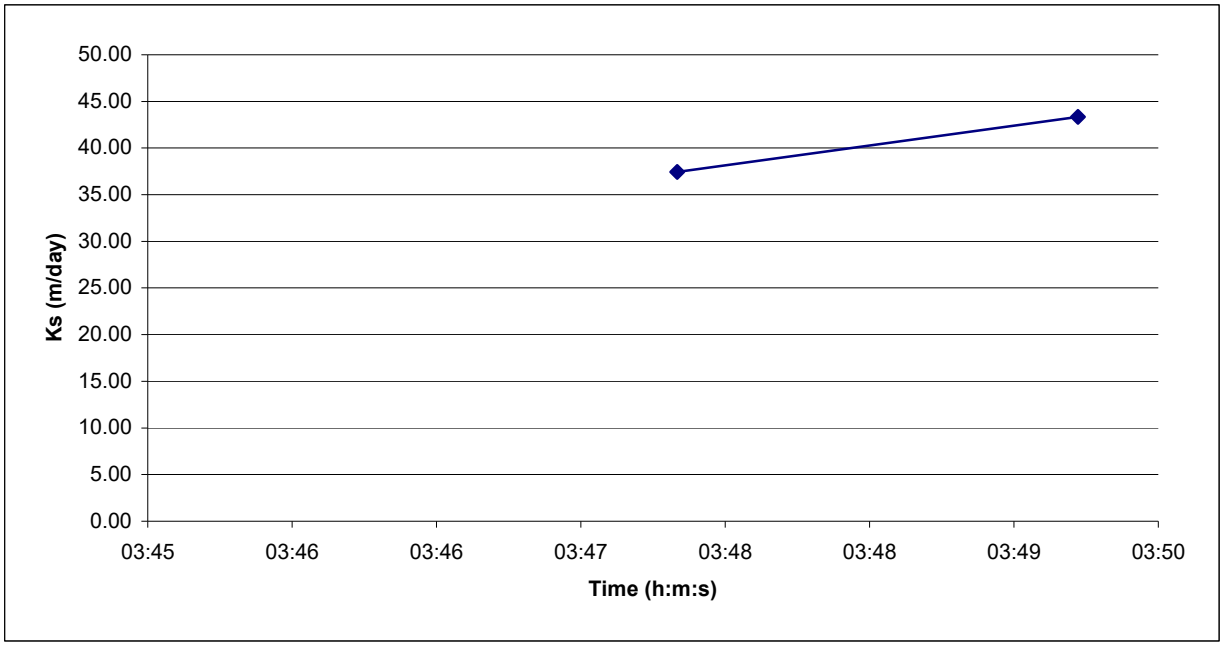
SOIL PERMEABILITY TEST

Site No.	CHI5
Date	29/10/24
Easting	396131
Northing	6532743
Depth	0.5

Dark orange-brown sand

Time (h:m:s)	Weight (kg)	Change in Weight (kg)	Ks (m/d)
03:46:00	33.1		
03:48:00	24.2	8.9	**37.44**
03:50:00	13.9	10.3	**43.33**
		13.9	

H =	25
r =	**4.5**



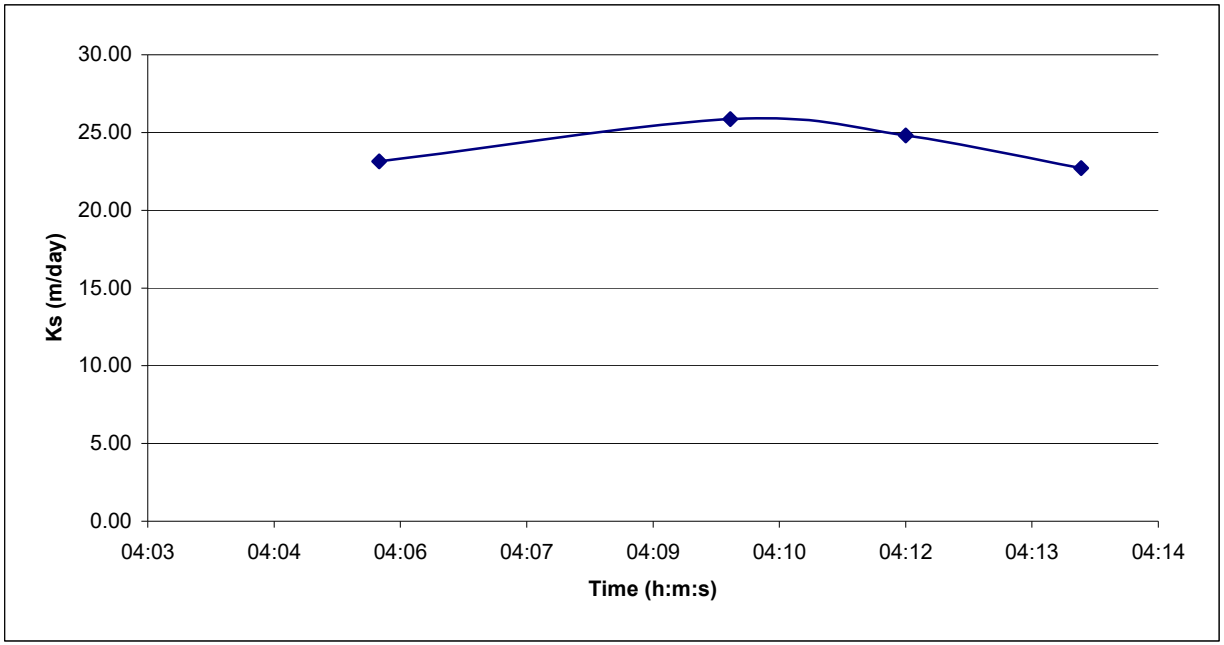
Ks = 40 m/day

SOIL PERMEABILITY TEST

Site No.	CHI6	Orange sand
Date	29/10/24	
Easting	395993	
Northing	6532822	
Depth	0.5	

Time (h:m:s)	Weight (kg)	Change in Weight (kg)	Ks (m/d)
04:04:00	41.2		
04:06:00	35.7	5.5	**23.14**
04:10:00	23.4	12.3	**25.87**
04:12:00	17.5	5.9	**24.82**
04:14:00	12.1	5.4	**22.72**
		12.1	

H =	25
r =	**4.5**



Ks = 22 m/day

Appendix C

Gingin Brook Flow Calculations

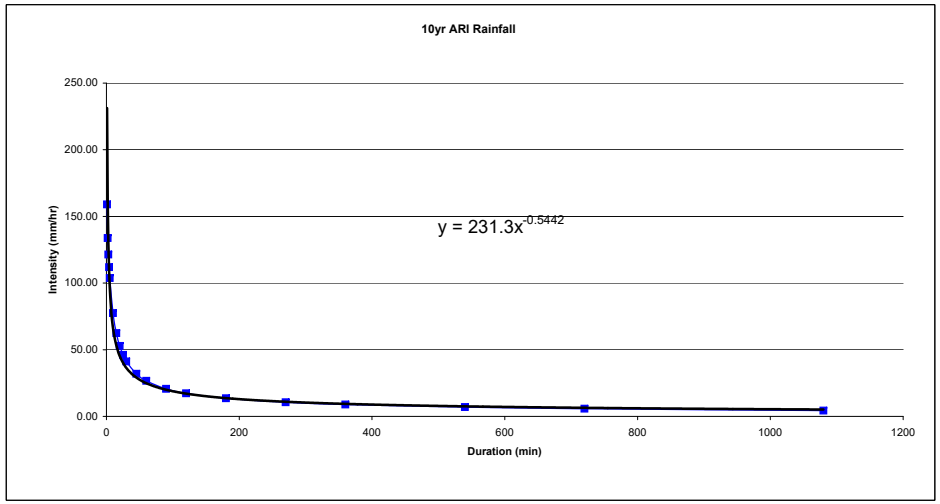
10 YEAR ARI CRITICAL FLOWS

CATCHMENT	AREAS (m2)			EFFECTIVE AREAS (m2)		TIME OF CONCENTRATION PRE DEVELOPMENT					TIME OF CONCENTRATION POST-DEVELOPMENT					CRITICAL STORM INTENSITY (mm/h)		FLOW		
	Cleared	Forested	Total	Pre	Post	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope (m/km)	TC (mln)	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope	TC (mln)	Pre-Dev	Post-Dev	Pre Dev	Post Dev	Total Flow (m3)
Gingin Brook Upstream	28700000	11050000	39750000	13360000	13360000	11582	231	104	10.97	321.1	11582	231	104	10.97	321.1	10.0	10.0	37117.03	37117.03	715074.63

Runoff Coefficients	Pre-Dev	Post-Dev
Cr Cleared	0.35	0.35
Cr Forested	0.3	0.3

Rainfall IFD

Event	Duration (mins)	Intensity (mm/hr)	Event Rainfall (mm)
1 min	1	159.00	2.65
2 min	2	133.80	4.46
3 min	3	121.40	6.07
4 min	4	111.90	7.46
5 min	5	103.80	8.65
10 min	10	77.40	12.9
15 min	15	62.40	15.6
20 min	20	52.80	17.6
25 min	25	46.08	19.2
30 min	30	41.20	20.6
45 min	45	32.00	24
1 hr	60	26.70	26.7
1.5 hr	90	20.67	31
2 hr	120	17.30	34.6
3 hr	180	13.53	40.6
4.5 hr	270	10.60	47.7
6 hr	360	8.92	53.5
9 hr	540	6.93	62.4
12 hr	720	5.77	69.2
18 hr	1080	4.38	78.8



Appendix D

Effluent Generation and System Sizing

EFFLUENT GENERATION AND SYSTEM SIZING

	Population	Effluent lpd	
			0
			0
Residents	6	150	900
	0		0
Daily flow			**900**

SEPTIC TANK SIZING

Reserve capacity	1820
Daily flow	900
Total capacity	2720

FLATBED LEACH DRAIN SIZING - WITH ATU

DLR (Category 1 Soil)	50	mm/day									
Infiltrative area required	18	m2									
Leach drain effective width	2.4	m									
Effluent per m	120	litres/day									
Length of LD required	8	m	(	2.0	x	4	m or	2.0	x	3.8	m)
Total width - parallel (excluding setbacks)	6.8	m									
Total area - parallel (excluding setbacks)	27	m2									
Total length - end to end (excluding setbacks)	9.8	m									
Total area - end to end (excluding setbacks)	24.5	m2									

DLR (Category 3 soil)	30	mm/day									
Infiltrative area required	30	m2									
Leach drain effective width	2.4	m									
Effluent per m	72	litres/day									
Length of LD required	13	m	(	2.0	x	6.5	m or	2.0	x	6.3	m)
Total width - parallel (excluding setbacks)	6.8	m									
Total area - parallel (excluding setbacks)	44	m2									
Total length - end to end (excluding setbacks)	14.8	m									
Total area - end to end (excluding setbacks)	37	m2									

ATTACHMENT 5

LOCAL WATER MANAGEMENT STRATEGY

LOT 106 (No. 62) CHERITON ROAD, GINGIN

LOCAL WATER MANAGEMENT STRATEGY

Prepared for

Fairlands Farm Pty Ltd
23 Kilkenny Rd
FLOREAT WA 6014

Report No. J24041b
11 March 2025

BAYLEY ENVIRONMENTAL SERVICES
30 Thomas Street
SOUTH FREMANTLE WA 6162

Sundowner Nominees Pty Ltd as trustee for the Bayley Cook Family Trust ABN 20 822 598 897
trading as Bayley Environmental Services

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1.0 INTRODUCTION

1.1 Background

Fairlands Farm Pty Ltd proposes to rezone and subdivide Lot 106 Cheriton Rd, Gingin for rural-residential use. The 26.02ha site is proposed to be subdivided into 22 lots ranging in size from 1ha to 1.2ha. The lots will be supplied with scheme water, underground telecommunications and power and will employ on-site effluent disposal. Figure 1 shows the proposed subdivision layout. Figure 2 shows an aerial view of the site and its surroundings.

Fairlands Farm Pty Ltd has submitted an application to the Shire of Gingin to amend the zoning of the subject land from Rural to Rural Living in order to facilitate the subdivision.

1.2 Relevant Statutes, Policies and Guidelines

1.2.1 State Planning Policy 2.9

State Planning Policy 2.9: *Water Resources* (WAPC, 2006) lists the following key principles for total water cycle management:

- Consideration of all water sources (including wastewater) in water planning, maximising the value of water resources.
- Integration of water and land use planning.
- Sustainable and equitable use of all water sources, having consideration of the needs of all water users including the community, industry and the environment.
- Integration of water use and natural water processes.
- A whole-of-catchment integration of natural resource use and management.

SPP 2.9 also lists the following general objectives for water-sensitive urban design:

- To manage a water regime.
- To maintain and, where possible, enhance water quality.
- To encourage water conservation.
- To enhance water-related environmental values.
- To enhance water-related recreational and cultural values.

1.2.2 Liveable Neighbourhoods

Element 5 of *Liveable Neighbourhoods* Edition 3 (WAPC, 2004) identifies specific objectives and requirements for Urban Water Management. These are based on Best Planning Practices which are defined as the best practical approach for achieving water resource management objectives within an urban framework.

1.2.3 Better Urban Water Management

Better Urban Water Management (WAPC, 2008) sets out the following objectives for water sensitive urban design:

Water Conservation

- Consumption of 100kL/p/yr including less than 40-60 kL/p/yr scheme water.

Water Quantity

- Ecological Protection – Maintain pre-development flow rates and volumes for the 1 year ARI event. Maintain or restore desirable environmental flows and/or hydrological cycles.

- Flood Management – Maintain pre-development flow rates and volumes for the 100 year ARI event.

Water Quality

- Maintain pre-development nutrient outputs (if known) or meet relevant water quality guidelines (e.g. ANZECC & ARMCANZ, 2000).

- Treat all runoff in the drainage network prior to discharge consistent with the Stormwater Management Manual.

- As compared to a development that does not actively manage stormwater quality, achieve:
  - at least 80% reduction of Total Suspended Solids;
  - at least 60% reduction of Total Phosphorus;
  - at least 45% reduction of Total Nitrogen; and
  - at least 70% reduction of gross pollutants.

Mosquitoes and Midges

- Design detention structures so that, between the months of November and May, stormwater is fully infiltrated within 96 hours.

- Design permanent water bodies (where accepted by DoW) to maximise predation of mosquito larvae by native fauna.

1.2.4 Shire of Gingin Local Planning Scheme No. 9

The subject site is zoned as General Rural under the Shire of Gingin LPS No. 9. Under the proposal, the site will be rezoned to Rural Living 1 (RL1).

The LPS contains two Special Control Areas (SCAs) that impinge on the site:

- *SCA1 – River Environs Management Area*

SCA1 covers land close to Gingin Brook, extending 8-62m into four lots in the north-east of the site (Figure 1). It contains the following development standards and considerations:

"a) More intensive development such as residential, industrial or rural residential subdivision, will generally not be supported within the River Environs Management Area.

b) Development applications for land within the River Environs Management Area should not be approved where it could reasonably be expected that the development may result in;
- an obstruction to major river flows and increase flood levels upstream;
- the removal of or damage to riparian vegetation or other nearby vegetation which influences the waterway; or
- harm to water quality or habitat values of the waterway.

c) Public works or community facilities may be permitted within the River Environs Management Area, subject to advice from the Department of Water that such public works can be designed and located in a manner so as to minimise flood risk, property damage and obstruction to river flow.

d) For those areas within the River Environs Management Area where the Department of Water has identified the flood plain boundary, development will be subject to a minimum habitable floor level of 0.5m above the predicted 1 in 100-year flood level."

All proposed developments on the site including roads, houses and effluent land application areas are outside of SCA1 and are not constrained by the SCA.

- *SCA2 – Public Drinking Water Supply Area*

SCA2 extends up to 16m into a road reserve and one proposed lot in the south of the site (Figure 1). The purpose of the SCA is to protect Gingin's bore water supply.

SCA2 prohibits polluting land uses such as piggeries and abattoirs. Any proposals involving intensive agriculture, application of fertilisers or pesticides, chemical storage or substantially increased runoff are to be referred to the DWER.

All proposed developments on the site except for a small section of road are outside of SCA2 and will have no effect on the SCA.

1.2.5 Government Sewerage Policy 2019

The Government Sewerage Policy (2019) requires that all new residential development should be deep-sewered unless it is exempt for one of several reasons. For exempt developments, the policy establishes minimum site capability requirements and density limits. Provisions of the policy that are relevant in this case include:

- Large lot subdivision (minimum lot size 2,000m^2; density R5 equivalent or less) in the outer metropolitan area may be undertaken without deep sewerage provided the responsible authorities are satisfied that no significant environmental impact is likely and there is no further opportunity for subdivision without sewerage.

- Land used for on-site effluent disposal must meet the following requirements:
  - The slope must be less than 20% (1 in 5) and the land shall be engineered to prevent runoff.
  - The site should not be subject to inundation or flooding at a probability greater than once in 10 years.
  - In loams and heavy soils, the discharge point of the effluent disposal system should be at least 0.6m above the highest groundwater level.
  - The discharge point should not be within 100m of a waterway, a significant wetland or a drain that discharges directly into a waterway or significant wetland without treatment. Smaller setbacks may be approved where the relevant agencies are satisfied that the reduced setback will not have significant impact on the environment or public health.

- In areas identified as Sewage Sensitive Areas (SSA) the following additional requirements apply:
  - a minimum lot size of 1ha, unless an existing WAPC-approved rezoning or structure plan provides for a higher lot density;
  - a minimum 1.5m clearance from the effluent discharge point to the highest groundwater table; and
  - use of secondary treatment systems with nutrient removal capability.

1.2.6 Water Quality Protection Note (WQPN) 70: *Wastewater treatment and disposal – domestic systems* (DWER, 2016)

WQPN 70 sets out the DWER's advice regarding domestic on-site effluent disposal in public drinking water source areas or near other sensitive water resources. The key recommendation relevant to this case is that effluent disposal systems should be located at least 100m from waterways and wetlands and outside the area subject to flooding by a 10-year ARI flood event.

The Note provides that smaller setbacks may be considered on a case-by-case basis in low-risk situations.

1.2.7 DoW Interim Guideline: Developing a Local Water Management Strategy

The DoW LWMS guideline was published in 2008 and sets out the DoW's preferred format and content for LWMS documents. The guideline expands on the LWMS guidance provided in *Better Urban Water Management* (2008).

This LWMS has been prepared in accordance with the principles set out in the DoW guideline.

1.3 Scope of This Report

The scope of this report is to:

- Document the existing environment of the site in relation to soils, drainage, erosion, watercourses, groundwater and water-dependent ecosystems.
- Briefly describe the proposed development in relation to water management.
- Address relevant regulatory requirements and design criteria for setbacks to watercourses, groundwater management and drainage.
- Describe the strategies to be implemented for water conservation, watercourse protection, groundwater management and stormwater drainage.
- Outline the proposed water monitoring program.

2.0 PRE-DEVELOPMENT ENVIRONMENT

2.1 Climate

2.1.1 Rainfall

Gingin has a strongly seasonal rainfall, with most of the annual rain falling between May and September in association with winter cold fronts. Occasional heavy falls may occur from summer thunderstorms. The long-term average annual rainfall for RAAF Gingin (located 13km south-west of the site) is 637.7mm, of which 78% falls between the months of May and September.

Figure 3 shows a rainfall occurrence chart for RAAF Gingin. Table 2.1 shows rainfall intensity, frequency and duration for Gingin.

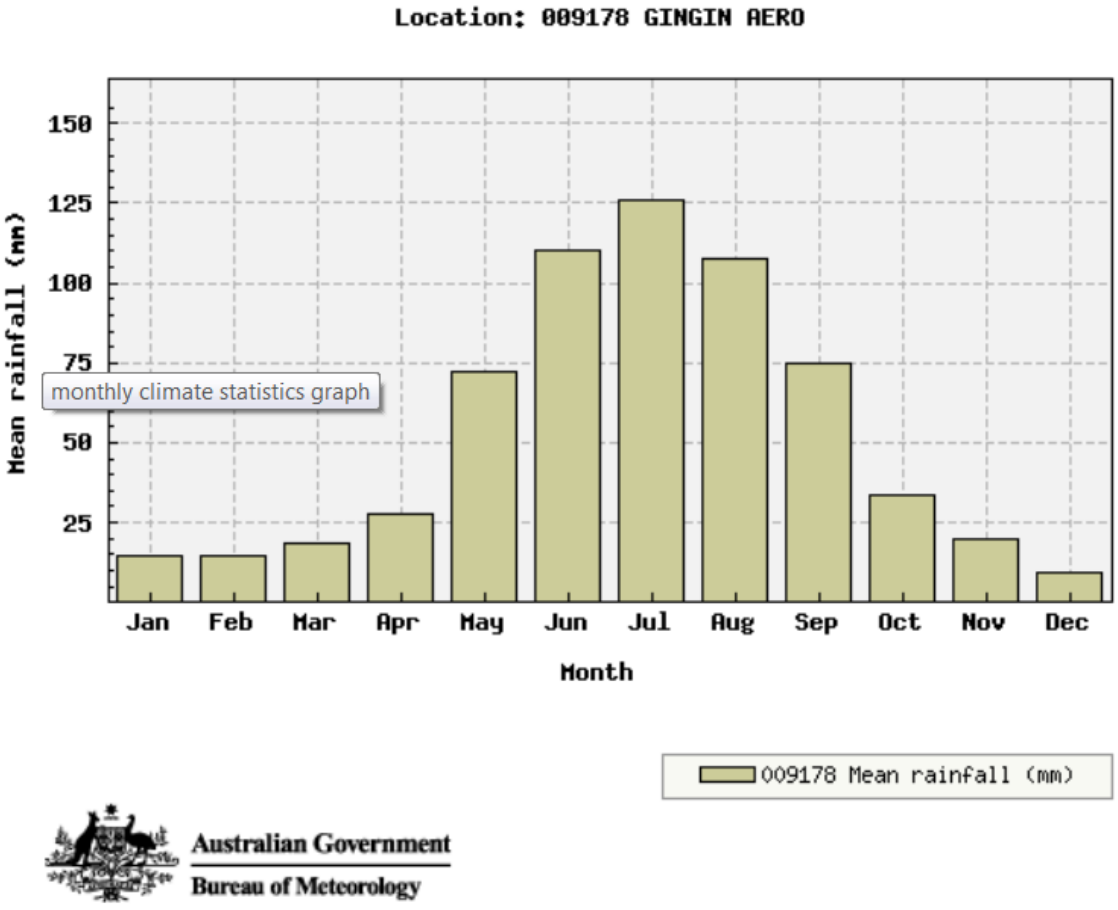


Figure 3 RAAF Gingin Mean Rainfall

IFD Design Rainfall Depth (mm)

Issued: 06 December 2024

Rainfall depth for Durations, Exceedance per Year (EY), and Annual Exceedance Probabilities (AEP).
FAQ for New ARR probability terminology

	Annual Exceedance Probability (AEP)						
Duration	**63.2%**	**50%#**	**20%***	**10%**	**5%**	**2%**	**1%**
1 min	1.41	1.59	2.20	2.65	3.13	3.80	4.36
2 min	2.45	2.74	3.73	4.46	5.22	6.34	7.27
3 min	3.30	3.71	5.07	6.07	7.12	8.67	9.95
4 min	4.02	4.52	6.21	7.46	8.77	10.7	12.3
5 min	4.62	5.21	7.19	8.65	10.2	12.4	14.2
10 min	6.78	7.67	10.7	12.9	15.2	18.5	21.2
15 min	8.22	9.29	12.9	15.6	18.4	22.3	25.5
20 min	9.31	10.5	14.6	17.6	20.7	25.2	28.8
25 min	10.2	11.5	16.0	19.2	22.7	27.5	31.5
30 min	11.0	12.4	17.1	20.6	24.3	29.5	33.8
45 min	12.9	14.5	19.9	24.0	28.3	34.4	39.5
1 hour	14.4	16.1	22.2	26.7	31.4	38.4	44.2
1.5 hour	16.8	18.8	25.7	31.0	36.7	45.1	52.2
2 hour	18.7	20.9	28.7	34.6	41.1	50.7	59.1
3 hour	21.9	24.4	33.5	40.6	48.4	60.3	70.7
4.5 hour	25.6	28.5	39.2	47.7	57.3	72.0	84.9
6 hour	28.5	31.8	43.7	53.5	64.5	81.4	96.5
9 hour	33.1	36.9	50.9	62.4	75.6	95.9	114
12 hour	36.7	40.9	56.3	69.2	83.9	107	127
18 hour	42.0	46.7	64.3	78.8	95.4	121	144
24 hour	45.9	51.0	69.9	85.4	103	130	154

Note:
The 50% AEP IFD **does not** correspond to the 2 year Average Recurrence Interval (ARI) IFD. Rather it corresponds to the 1.44 ARI.

Table 2.1 Rainfall Intensity for Gingin

2.2 Physiography

2.2.1 Topography

The site lies on the east-facing western side of the Gingin Brook valley on the northern edge of the Gingin Townsite. The elevation of the site ranges from 97m AHD in the north-east near the Brook to 134m in the south-west corner. The slope is linear and slightly convergent, varying from about 1% in the north-east to 8% in the west and averaging 5.5% across most of the site. Figure 4 shows topographic contours over the site.

2.2.2 Geology and Soils

The Geological Survey of Western Australia (Hocking *et al.*, 1975) maps the site as Colluvium (Qpo): a Quaternary-aged varicoloured (white-cream-brown), poorly sorted, poorly rounded sand which was formerly an eluvial (weathered in-situ) horizon overlying laterite which has been partly redistributed. A small area in the south-west of the site is mapped as Laterite (Czl): typically a ferruginous, pisolitic, siliceous laterite forming layers from 1.5m to 3m thick and associated with eluvial quartz sand, overlying a weathered rock zone which can be up to 30m thick.

Figure 4 shows the GSWA mapping. Test pitting to 2.5-3m at 12 locations across the site (Figure 4) found a profile that generally matched the GSWA mapping. Appendix A shows soil logs from the test pits.

2.2.3 Acid Sulphate Soils

ASS-risk mapping by the DBCA shows the site as Class 3 (Nil to Low risk of ASS within 3m of the ground surface). The soils of the site are elevated and have had no recent marine influence. The age and origin of the soils and the absence of a shallow water table over most of the site indicate that acid sulphate soils are unlikely to be present. The nearest mapped high ASS risk zone is a wetland 3.3km south of the site.

Development of the site is not expected to involve any excavation deeper than about 2m (for installation of effluent systems) or dewatering. Any ASS present is therefore unlikely to be disturbed. No further ASS assessment is considered necessary.

2.2.4 Phosphorus Retention Index

The strongly coloured and/or clayey soils of the site are expected to have a high to very high PRI. Analysis by the CSBP Soil Laboratory of samples from 0.5m and/or 1m depth at four locations (CH2, CH6, CH8, CH10 – Figure 4) gave PRI values ranging from 8.0 to 123.8, with a mean of 56.8 and a median of 27.2.

PRI is a measure of the ability of a soil to adsorb and retain phosphorus from solution. A high PRI indicates that the soil is unlikely to leach phosphorus to the water table. Typical ranges for PRI values in soils are as follows:

PRI Range	*Rating*	*Typical soils*
0 – 0.5	Very Low	Bassendean Sand
2 – 4	Low – Moderate	Karrakatta Sands
5 – 12	Moderate – High	Cottesloe Sands
12 – 20	High	Crushed Limestone, Limesand
20 – 1000+	Very High	Clay

2.2.5 Soil Permeability

Constant-head permeability tests in accordance with AS1547:2012 were carried out at 0.5m depth at five locations as shown on Figure 4. Appendix B shows the detailed test results.

The tests gave saturated hydraulic conductivities (Ks) ranging from 0.5m/day to 40m/day, with a mean of 16m/day and a median of 12.5m/day. The lowest value of 0.5m/day was recorded from the low part of the site in clayey sand.

2.2.6 Soil Geotechnical Analysis

Soil samples collected at 0.5m and 1.0m from test pit CHT8 in the north-east corner of the site (Figure 4) were subjected to analysis by the CSBP Soil Laboratory for geotechnical parameters including particle size distribution, dispersion index, exchangeable cations and exchangeable sodium percentage (sodicity). Table 2.2 shows the results of the analysis. The soil profile at CHT8 was typical of the profile in the lower parts of the site.

Table 2.2 Soil Analysis

Sample (Figure 4)	*Particle Size*		*Soil Type*	*Dispersion Index (range 0-16)*	*Exchangeable Sodium %*
CHT8 0.5m	Clay (<2µm) Silt (2-20µm) Sand (20-2000µm)	16.11% 15.67% 68.22%	Sandy loam	14	5.4
CHT8 1.0m	Clay (<2µm) Silt (2-20µm) Sand (20-2000µm)	26.22% 13.14% 60.64%	Sandy clay loam	10	13.6

The soil analyses show that the soils in the lower lying parts of the site are predominantly non-sodic (Exchangeable Sodium % <6) to moderately sodic (ESP >15), highly dispersive sandy loams overlying sandy clay loams.

2.3 Hydrology

2.3.1 Surface Drainage

There is no defined natural surface drainage on the site. The sandy surface soils of the majority of the site (above about 102m AHD) mean that runoff would occur only over short distances under very heavy rainfall conditions. The lower eastern part of the site has heavier soils and a shallower water table, and may generate surface runoff in a 1-year ARI storm event or less.

The major surface hydrological feature of the area is Gingin Brook, a tributary of the Moore River, which flows north between 20m and 200m east of the site. Surface pools

associated with the Brook occurred as close as 15m from the site boundary in October 2024.

A shallow constructed drain runs from the mid-northern boundary south and then east through the north-east of the lot to Gingin Brook. This drain extends upstream across other properties to its source 2km upstream of Lot 106. The drain has a catchment of about 163ha but is dammed by at least eight farm dams, so it would be unlikely to carry large flows. This drain will be diverted into an easement along the northern lot boundaries as part of the subdivision works, with intensive planting undertaken to turn it into a "living stream" to provide treatment of the water prior to discharge into Gingin Brook.

Figure 5 shows the catchments upstream of the site.

2.3.2 Groundwater

Groundwater Occurrence and Flows

There is no published groundwater level information available for the subject site or its surrounds. Given the topography of the site and surroundings, groundwater would likely exist as localised aquifers in creek and river valleys and possibly as seasonal subsurface seepage above impermeable layers on slopes.

Groundwater was present at a depth of 1.14m below ground in test pit CHT7 in the east of the site (Figure 4) on 29 October 2024. No usable DWER bores are available in the near vicinity of Lot 106 to enable this level to be compared with long-term averages. However, the topography, soils and presence of wetland vegetation (sedges) in the vicinity of CHT7 suggests that the water table would reach the ground surface in this area during wet winters. Groundwater measurements in midwinter will be necessary to more accurately determine the maximum groundwater level and the need for fill in areas below 100m AHD.

Groundwater Resources

The subject site is within the following subareas under the Gingin Groundwater Allocation Plan (DoW, 2015):

- Surficial aquifer - Gingin Townsite Subarea
- Mirrabooka and Fractured Rock aquifers – Southern Scarp Subarea (but not within either aquifer)
- Leederville, Leederville-Parmelia, Lesueur and Cattamarra aquifers – Cowalla Subarea
- Yarragadee aquifer – Chandala Subarea.

Only the surficial aquifer is relevant to private groundwater abstraction on the subject site.

The Gingin Groundwater Allocation Plan allocates 5,000 ML/yr for licensable supply from the surficial aquifer within the Gingin Townsite Subarea. Groundwater abstraction from the surficial aquifer within the plan area is permitted without a licence under Section 25A of the *Rights in Water & Irrigation Act 1914* provided that the water is used only for:

- fire fighting;
- stock watering (non-intensive); or
- household and domestic garden and lawn irrigation not exceeding 0.2ha.

Regardless of the exemption of domestic use from licensing, construction of any bore within the site will require a licence under Section 26D of the RIWI Act.

2.3.3 Wetlands

The DBCA maps the lower-lying eastern part of the site below about 101m AHD as Multiple Use category palusplain (seasonally waterlogged plain). This appears to correspond with the topography and vegetation in the area.

Gingin Brook is mapped as Conservation category palusplain, although its profile suggests that it is a watercourse rather than a palusplain. Figure 4 shows the DBCA wetland mapping.

2.4 Vegetation

The subject site is cleared of native vegetation except for scattered mature trees (most or all Marri *Corymbia calophylla*) located along the south-western boundary with Cheriton Road and in the south-east corner. There are also non-local eucalypts in planted shelter belts in the south of the site. Two Olive (*Olea europaea*) groves are located in the north-west and south of the site, totalling about 9ha.

There is no riparian or groundwater-dependent vegetation on the site except for some sedges in the east of the site. To the east, Gingin Brook supports a fringing woodland of paperbarks (*Melaleuca preissiana*).

2.5 Fauna and Habitats

The subject land provides no significant fauna habitat except for those species able to utilise open cleared paddocks. It is unlikely that any native mammals would be dependent on the site.

2.6 Land Uses

2.6.1 Current and Previous Land Uses

The subject land is currently used for broad acre sheep and cattle grazing. Historical Landgate aerial photography shows that the land has been cleared and grazed since at least 1981. Olives have been grown on the site since the 1990s. The lower north-eastern part of the site (below about 101m AHD) appears to have been used for cropping, possibly of potatoes, in the 1980s.

There is no visual or other evidence on site or on aerial photographs of any contamination or potentially contaminating land uses.

2.6.2 Neighbouring Land Uses

The subject land is bounded to the west, north and east by mixed land uses including broad acre grazing, small rural lots and rural residential lots. The Gingin town site is located 250m to the south.

3.0 WATER USE SUSTAINABILITY

3.1 Water Supply

The development will be supplied with potable water provided by the Water Corporation.

Groundwater is available at shallow depth within the subject land, although its yield, quality and suitability for irrigation may vary. Over much of the site, groundwater of suitable salinity for irrigation of gardens will be available.

In accordance with the amended *Building Regulations 1989*, all new homes within the development will incorporate the following features:

- Minimum 4 stars WELS rated tap fittings, except bath outlets and garden taps.
- Minimum 3 stars WELS rated shower heads.
- Minimum 4 stars WELS rated dual flush toilets.
- Covers on all private swimming pools.
- All internal hot water pipes installed in accordance with AS/NZS 3500:2003.
- Maximum run of pipe from hot water system to outlet not exceeding 20 metres length or 2 litres of internal volume.

The design and installation of water wise initiatives such as rainwater tanks, grey water reuse systems and water efficient fixtures and fittings will be promoted as part of the marketing of the estate to ensure such initiatives can be implemented by homeowners.

3.2 POS Irrigation

No irrigated public open space is proposed within the site.

3.3 Wastewater Management

All lots in the subdivision will employ on-site effluent disposal. The Site & Soil Evaluation (BES, 2024) showed that all proposed building envelopes are suitable, in terms of soil permeability, slope and setbacks from watercourses, for on-site effluent disposal. Constraints posed by groundwater clearance on some lots may be addressed by a combination of filling and drainage.

As the site is within a Sewage Sensitive Area (SSA) under the Government Sewerage Policy (GSP), all lots within the subdivision will be required to employ secondary effluent treatment systems with phosphorus removal capability.

Grey water reuse may be implemented by individual lot owners. Any person wishing to install a grey water reuse system must lodge an Application to Construct or Install an Apparatus for the Treatment of Sewage with the Shire of Gingin.

4.0 SURFACE WATER MANAGEMENT

4.1 Principles and Objectives

The subdivision guide plan aims to comply with the principles and objectives for stormwater management identified in the *Stormwater Management Manual for WA* (DoE, 2004) and *Better Urban Water Management* (WAPC, 2008).

The drainage system will be designed to maintain surface flow rates and volumes within and from the developed site at or below their pre-development levels, and as far as possible to maintain the existing flow paths. The priorities for managing the various sizes of flow event will be as follows:

- 1 year ARI Retain and infiltrate all flows as close to source as possible. Maintain pre-development flow rates and volumes. Minimise export of nutrients and sediments.
- 5 year ARI Detain water prior to discharge. Maintain pre-development flow rates and volumes. Maintain amenity and serviceability. Prevent scouring and damage.
- 100 year ARI Maintain pre-development flow rates and volumes. Prevent flooding and damage.

The drainage design presented here is conceptual and will be refined during the detailed design stage.

4.2 Drainage Management System

4.2.1 Lot Drainage

Runoff from private lots may be increased by the partial replacement of vegetated surfaces with roofs and paved areas. This is expected to be balanced by the capture of roof runoff in rainwater tanks or soak wells and the interception of runoff from driveways and other paved areas by lawns and gardens.

Storms up to 15mm are not expected to generate any runoff from private lots or open space. Runoff from larger storms will flow into the road drainage system or open space areas along existing flow paths.

4.2.2 Road Drainage

Road reserves will occupy an estimated 2.26ha within the development (8.7% of the total area). The paved area of the internal road network will constitute about 2.6% of

the total site area. All roads within the development will be kerbed. These will generally be semi-mountable kerbs.

Road runoff from storms up to 15mm will be captured and infiltrated in a series of small, linked infiltration basins located at approximately 50-65m intervals along both sides of the road reserves, with the spacing dependent on the slope of the road and the area of catchment being drained. The basins will also capture and detain the flow from critical storms up to 100-year ARI (1% AEP), releasing it at no more than the pre-development rate.

The basins will nominally be sized with base dimensions of 2m x 2m and top dimensions of 5m x 5m, with a total depth of 0.5m and a maximum water depth of 0.3m. Detailed sizing and siting of the basins will be carried out in the detailed design stage of subdivision and reported in the UWMP. Figure 6 shows the conceptual layout of the drainage network. Figure 7 shows a conceptual plan and profile of the basins.

Runoff from larger and longer-duration storms, incorporating runoff from both roads and lots, will progressively overflow the basins and flow via open swales and/or pavement flow along the road reserves to the vegetated Drainage/PAW reserve in the east of the site, from where it will flow overland into Gingin Brook. The peak flows in storms up to 100-year ARI will be no greater than the pre-development flow rates. There will therefore be no requirement for dedicated compensating basins to attenuate the flow prior to it leaving the site. The peak flow rates entering Gingin Brook from the site will be no greater following development than before.

Preliminary calculations using the Rational Method (Engineers Australia, 1987) suggest that v-shaped swale drains up to 0.32m deep will be sufficient to carry the 100-year combined road and lot overflows from the basins.

Table 5.1 summarises the parameters adopted in the preliminary drainage calculations and the overall runoff and retention/detention volumes. The detailed flow calculations are set out in Appendix C.

Detailed design including selection, sizing and location of retention structures will be undertaken as part of the detailed subdivision design and reported in the UWMP.

Table 5.1 Drainage Parameters

1 yr 1 hr rainfall	15mm				
Basins					
Base dimensions (m)	2 x 2				
Top dimensions (m)	5 x 5				
Depth (m)	0.5				
Maximum water depth	0.3				
Side slopes	1:2				
Base permeability (m/d)	6				
Runoff coefficients	*1 yr (15mm)*	*5 yr*		*100 yr*	
		Pre Dev	*Post Dev*	*Pre Dev*	*Post Dev*
Road pavement	0.8	0.28	0.85	0.36	1
Road verge	0.1	0.28	0.48	0.36	0.6
Lots	0	0.28	0.28	0.36	0.36
Basins	1	0.28	1	0.36	1
Open space	0	0.28	0.28	0.36	0.36
Effective Impervious Area	7434	72897	80223	93542	102123
Flows					
Peak flow (L/sec)	31	882	969	2299	2508
Total flow (m^3)	112		909		2299
Storage required (m^3)	112		33		74
Effective storage (m^3)	174		120		120

4.2.3 Through Drainage

McHavloe Drive Drainage

McHavloe Drive provides access to a rural-residential subdivision opposite the subject site on the east of Cheriton Road. A catchment area of approximately 14.2ha (Figure 5) drains via roadside swales along McHavloe Drive into Cheriton Road. McHavloe Drive and its adjoining streets were constructed between 2003 and 2006, apparently without any detention or attenuation in the roadside drains. Since then, flows in the drains have filled the drains in the lower end of McHavloe Drive with sediment.

Video footage supplied by the Shire of Gingin show high runoff volumes flowing down McHavloe Drive, across Cheriton Road and into the nearby part of Lot 106. Calculations using the Rational Method (Engineers Australia, 1987) suggest that flows of up to 1179 litres per second could enter the subject site from McHavloe Drive in a critical 100 year ARI (1% AEP) storm event. This runoff must be conveyed through the site in a manner that does not cause flooding of lots or damage to the drainage infrastructure or roads.

It is proposed that a drainage reserve or easement be created opposite McHavloe Drive at the northern entrance to the subject site, with a swale constructed to carry the storm runoff from McHavloe Drive into the northern roadside drains and down to the Drainage/PAW reserve, from where it will flow into Gingin Brook. The flows from McHavloe drive will not be detained or attenuated within the site, but simply conveyed to

the eastern end and Gingin Brook. Figure 6 shows the conceptual layout of the drainage reserve/easement and roadside swales. Appendix C shows the detailed flow calculations.

The roadside swale on the southern side of the northern road will be sized to accommodate the extra flow from McHavloe Drive. The layout and sizing of the swales will be refined at the detailed subdivision design stage and reported in the UWMP.

Paddock Drain
The paddock drain that enters the site on the mid-northern boundary will be realigned into an easement along the northern boundary, exiting the site at the north-eastern corner from where it will flow into Gingin Brook. The swale will be densely planted with native species at the time of subdivision to control the flow, minimise erosion and remove sediments and nutrients from the water before it exits the site. Figure 6 shows the conceptual alignment of the drain and easement.

4.3 Surface Water Quality Management

The drainage system will be designed to maximise on-site retention of nitrogen and phosphorus. This will be achieved by:

- Retaining and infiltrating all lot runoff from storms up to 15mm (approx. 1-year ARI) within the lots.

- Infiltrating all road runoff from storms up to 15mm (estimated by the DWER to carry more than 99% of total flows and nutrients) in vegetated bioretention swales and with a tested average soil PRI of 56.8.

- Detaining runoff from storms between 15mm and 100-year ARI (1% AEP) to allow suspended particles to settle.

4.4 Maintenance

The drainage system has been designed to require minimal maintenance. The following will be required to ensure that the system continues to function as designed:

- Regular (possibly annual) cleaning of side entry pits and inlet pits. More frequent cleaning may be required during the construction phase.

- Tending and maintenance of Drainage/PAW reserve, swales and other vegetated drainage features to remove litter, control weeds and encourage the growth of native species.

- Pruning, mulching or removal of vegetation in bioretention basins as necessary to maintain ground fuel loads below 8 tonnes/ha.

5.0 GROUNDWATER MANAGEMENT

5.1 Groundwater Levels

Development of the site will have little or no effect on winter groundwater levels, although abstraction of groundwater via private bores for irrigation of lawns and gardens may draw down groundwater levels in summer and may lead to lower groundwater levels in the early part of winter.

Subsoil drains may be employed beneath house pads and road embankments in the lower part of the site to prevent groundwater rise into filled areas. Drainage swales and subsoil drains will be set with their inverts at least 300mm above the AAMGL, thereby minimising the impact of the development on maximum groundwater levels.

5.2 Groundwater Quality

The relationship between nutrient inputs and exports is complex, especially in the case of phosphorus, which travels through the soil profile as a “front” in a complex series of adsorption and desorption reactions. Nitrogen is subject to denitrification and mineralisation in the soil and groundwater. As a result, nutrient exports from the site at present will be a reflection of nutrient inputs over the last several decades, modified by soil hydrology and nutrient retention capacity.

The aim of nutrient management will be to limit nutrient inputs to the site so that nutrient outputs are minimised. The primary source of groundwater-borne nutrients will be soluble garden fertilisers. With low-phosphorus garden fertilisers being strongly promoted under the State government’s Fertiliser Action Plan, most garden fertilisers for sale in hardware and garden stores contain little or no phosphorus.

Measures available to minimise nutrient inputs and exports in the development will include:

- regular street sweeping to remove accumulated contaminants;
- selection of native species with low water and fertiliser requirements for public open space, drainage and landscape areas;
- community education on water wise gardening and fertiliser use; and
- community education on management of pet wastes.

6.0 LANDSCAPING STRATEGY

Landscaping of the site will focus on the use of local native species with low water demand. Plantings will be limited to the Drainage/PAW reserves, drainage easements and bioretention basins.

The bioretention basins, easements and Drainage/PAW reserve will be densely vegetated with local species selected with reference to the Monash University (2014) *Vegetation Guidelines for Stormwater Biofilters in the South-West of Western Australia*. Together with the high-PRI soils of the site, this will ensure a high quality of water entering Gingin Brook.

Fertiliser use will be minimal. New tube stock plantings may (depending on the results of pre-planting soil testing) be fertilised with slow-release nitrogen and phosphorus tablets on establishment and thereafter will be unfertilised. The plantings will not be irrigated after the establishment phase.

The Drainage/PAW reserve will be designed as passive open space, with landscaping focussed on native sedges, low shrubs and scattered trees. Trees will be spaced at least 15m apart so as to maintain a 10m canopy separation.

The total area to be planted will be approximately one hectare. If this area were irrigated at the DWER's recommended rate for POS (4,750 KL/ha/yr) during the establishment phase, approximately 4.75ML of water would be required to irrigate the new plantings for one year.

The irrigation requirements for landscape establishment will most likely be met by by tanker or scheme water. Because there will be no ongoing irrigation past the establishment phase, there will be no need for any bores to be operated or maintained by the Shire of Gingin.

The density of planting will be controlled to keep flammable ground fuel loads below 8 tonnes/ha, in accordance with the Bushfire Management Plan (_____).

7.0 IMPLEMENTATION AND FURTHER MANAGEMENT PLANS

Subdivision of the subject land will be carried out in accordance with the general water management principles set out in this LWMS.

An Urban Water Management Plan (UWMP) is expected to be required as a condition of subdivision approval. The UWMP will contain a detailed design of the stormwater drainage system.

The developer will maintain the drainage system and landscape plantings outlined in this LWMS for two years after the completion of subdivision works. At the end of that time the responsibility for management will pass to the Shire of Gingin, subject to the Shire's acceptance of the works.

8.0 REFERENCES

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WAPC (2008). *Better Urban Water Management.* WAPC, Perth.

Figures



SUBDIVISION CONCEPT
LOT 106 (No. 62) CHERITON ROAD
GINGIN

Figure 1

DRAFT

N

0 100 m
SCALE @ A3: 1:2500

9929-CON-02-A

DRAWN: WC
DATE CREATED: 2024.09.11
PROJECTION: MGA50 GDA94
CADASTRE: LANDGATE
AERIAL: LANDGATE 2023 MARCH

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ROWE GROUP DESIGN



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Figure 2

THE SITE AND SURROUNDINGS

bayley environmental services

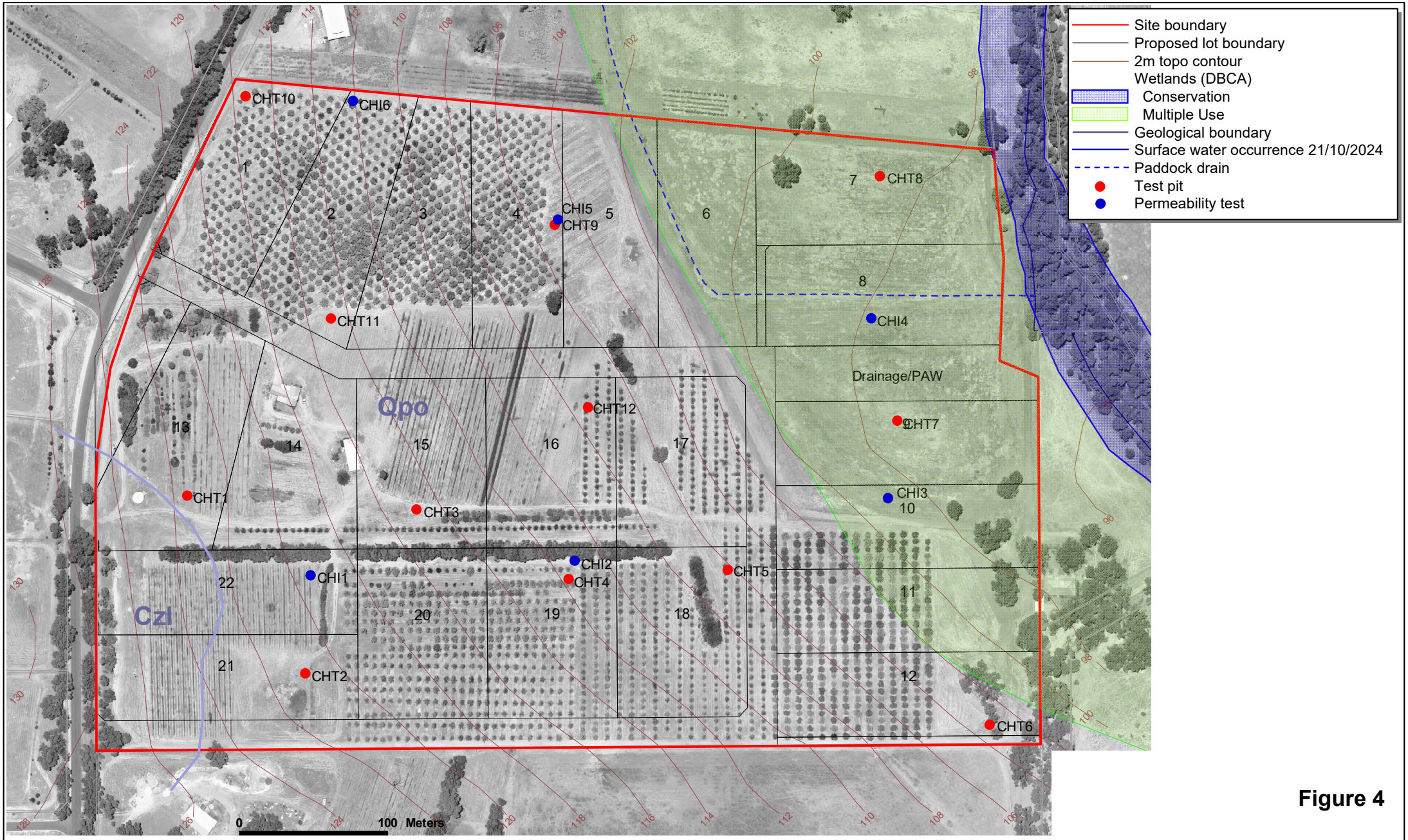
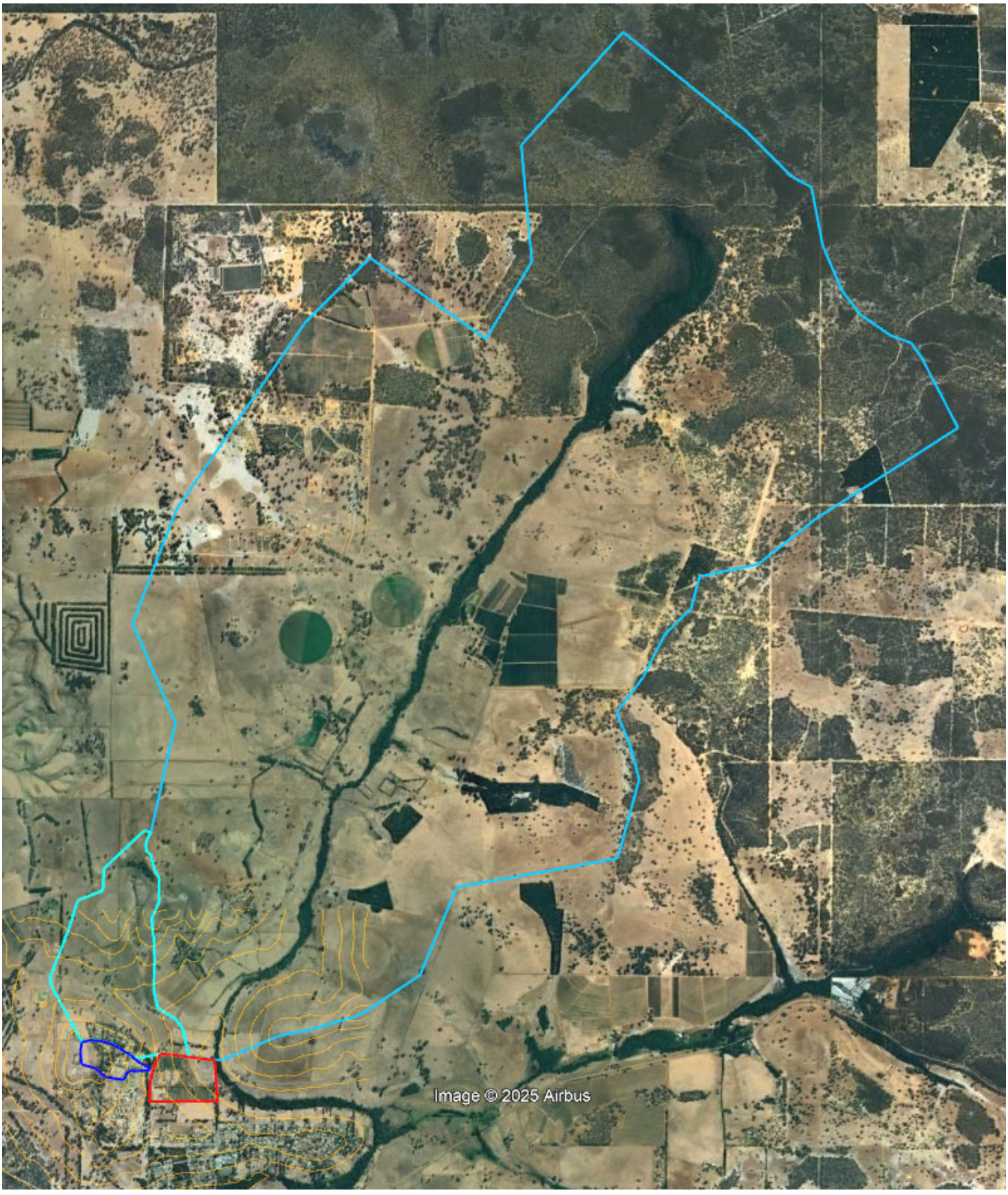


Figure 4

ENVIRONMENTAL FEATURES

bayley environmental services



0 2 km

Subject site
10m topo contour
McHavloe Dr catchment
Paddock drain catchment
Gingin Brook catchment

Figure 5

CATCHMENTS

bayley environmental services

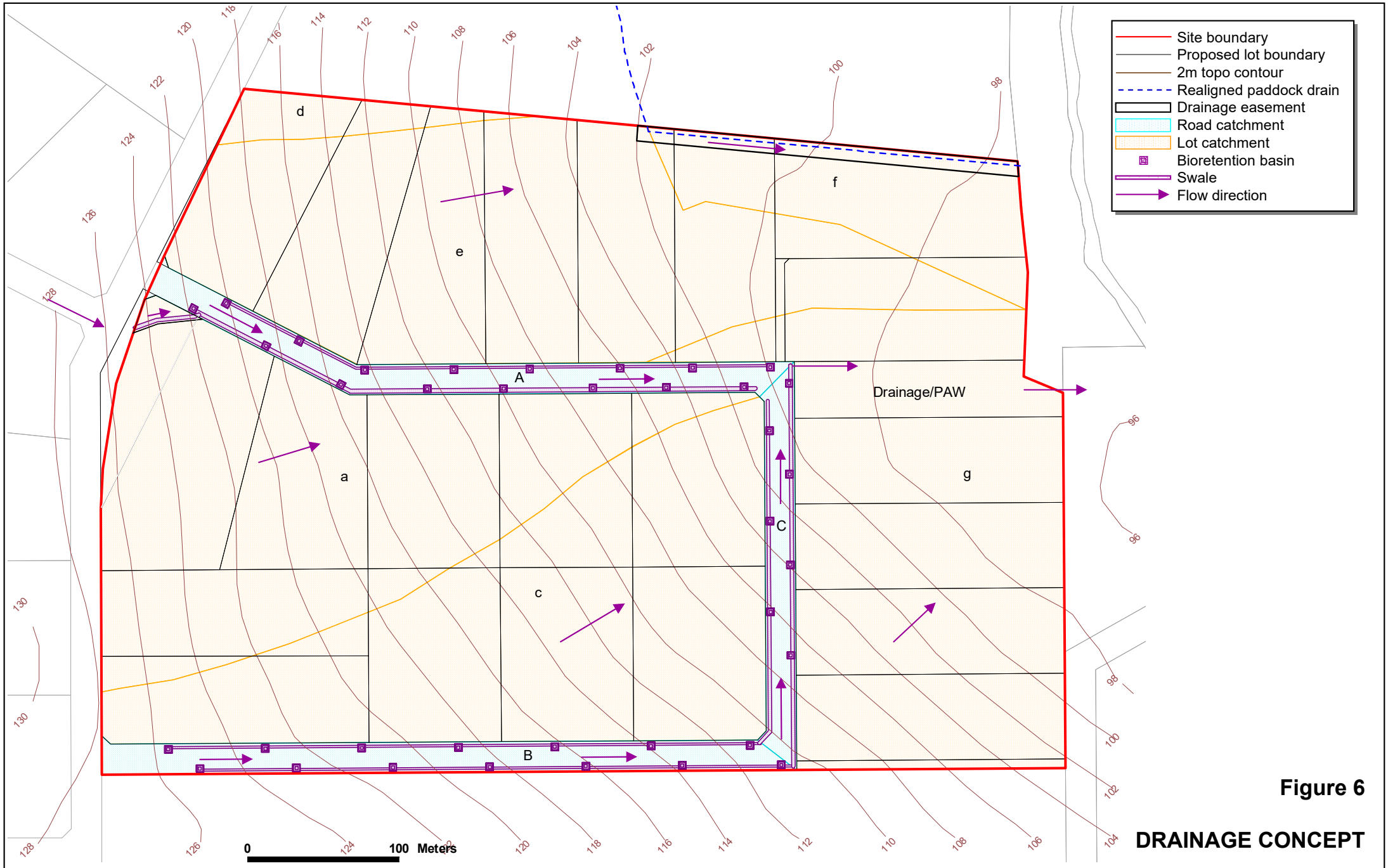


Figure 6

DRAINAGE CONCEPT

bayley environmental services

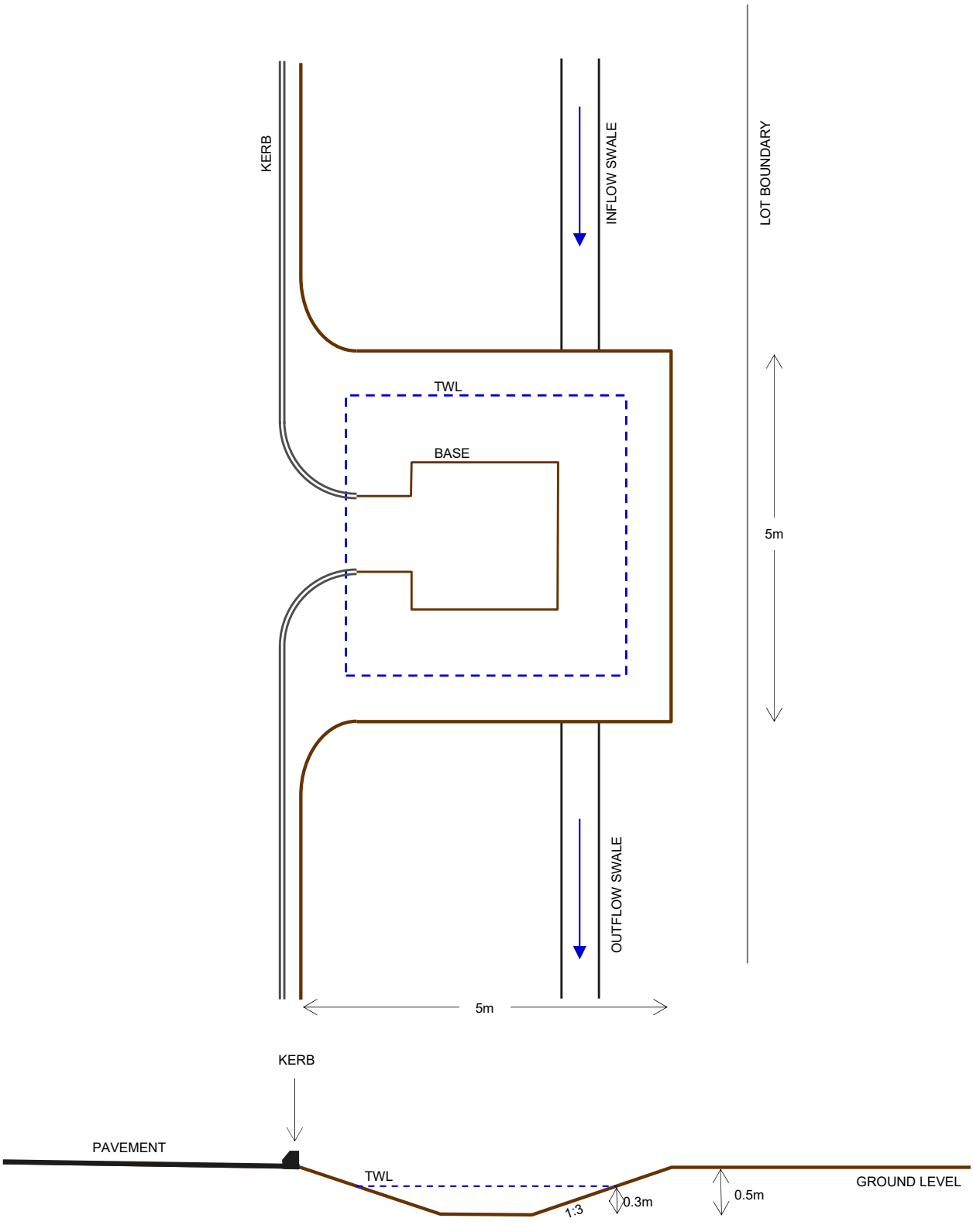


Figure 7

BASIN CONCEPT

bayley environmental services

Appendix A

Soil Logs

SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	**CHT1**
EASTING:	395881
NORTHING:	6532558
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.5
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		**SAMPLE DATA**	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.1	Brown topsoil		
0.1 - 2.2	Orange slightly clayey sand		
2.2 - 2.5	Orange slightly clayey sand with ironstones to 50mm		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	**CHT2**
EASTING:	395921
NORTHING:	6532827
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	3.1
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		**SAMPLE DATA**	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.1	Brown topsoil		
0.1 - 1.0	Orange-brown slightly gravelly sand		
1 - 1.8	Orange gravelly clayey sand		
1.8 - 3.1	Red/orange/brown mottled well structured sandy clay		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	**CHT3**
EASTING:	395978
NORTHING:	6532677
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.5
REFUSAL (Y/N):	Y
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		**SAMPLE DATA**	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.2	Brown topsoil		
0.2 - 1.2	Orange to orange-yellow sand		
1.2 - 2.4	Orange gravelly sandy clay, cemented from 1.5m		
2.4 - 2.5	Orange well structured lateritic gravelly clay		
2.5	Refusal on laterite		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	**CHT4**
EASTING:	396150
NORTHING:	6532618
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	3.0
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		**SAMPLE DATA**	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.1	Brown topsoil		
0.1 - 2.0	Orange sand		
2.0 - 3.0	Orange/red mottled well structured gravelly sandy clay		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	**CHT5**
EASTING:	395961
NORTHING:	6532438
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	3.0
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		**SAMPLE DATA**	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.2	Brown topsoil		
0.2 - 0.5	Orange-brown sand		
0.5 - 2.2	Orange sand		
2.2 - 3.0	Orange-yellow sand, becoming paler		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	**CHT6**
EASTING:	396036
NORTHING:	6532548
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.8
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		**SAMPLE DATA**	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.2	Brown topsoil		
0.2 - 0.5	Brown sand		
0.5 - 2.3	Orange/red/brown mottled gravelly sandy clay with ironstone rocks to 100mm		
2.3 - 2.8	Hard orange-yellow gravelly clayey sand		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	**CHT7**
EASTING:	396137
NORTHING:	6532501
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	3.0
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	1.0

SOIL PROFILE		**SAMPLE DATA**	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.2	Brown topsoil		
0.2 - 1.0	Brown sand		
1.0 - 1.2	Dark brown peaty sand, wet		
1.2 - 2.0	Dark brown/green/dark orange mottled well structured sandy clay		
2.0 - 2.5	Dark green gritty clay with minor orange mottling, poorly structured		
2.5 - 3.0	Greenish-grey sandy clay, poorly structured, wet		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	**CHT8**
EASTING:	396245
NORTHING:	6532508
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	3.0
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		**SAMPLE DATA**	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 -0.1	Dark brown topsoil		
0.1 - 1.0	Dark brown sand		
1.0 - 1.5	Brown/dark brown dully mottled, moderately structured sandy clay		
1.5 - 2.0	Dull orange/dark brown/green mottled poorly structured sandy clay		
2.0 - 2.2	Dull brown slightly mottled poorly structured sandy clay with occasional ironstone nodules		
2.2 - 3.0	Orange/brown/grey mottled well-structured sandy clay with soft laterite nodules		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	**CHT9**
EASTING:	396422
NORTHING:	6532404
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.9
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		**SAMPLE DATA**	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.1	Brown topsoil		
0.1 - 0.5	Orange-brown sand		
0.5 - 2.9	Orange sand		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	**CHT10**
EASTING:	396359
NORTHING:	6532608
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.8
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		**SAMPLE DATA**	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.1	Yellow-brown sand		
0.1 - 2.8	Orange sand		





SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	**CHT11**
EASTING:	396348
NORTHING:	6532773
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.8
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		**SAMPLE DATA**	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.2	Pale grey-brown topsoil		
0.2 - 2.0	Orange sand		
2.0 - 2.8	Dark orange/pale orange mottled well structured slightly lateritic sandy clay		







SOIL PROFILE LOG

PROJECT NUMBER:	J24041
SITE ID:	**CHT12**
EASTING:	396130
NORTHING:	6532742
METHOD:	400mm auger
TOTAL DEPTH (mbgl):	2.8
REFUSAL (Y/N):	N
DATE:	21/10/2024
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		**SAMPLE DATA**	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0 - 0.1	Dark brown topsoil		
0.1 - 0.8	Yellow-brown sand		
0.8 - 2.8	Orange sand		





Appendix B

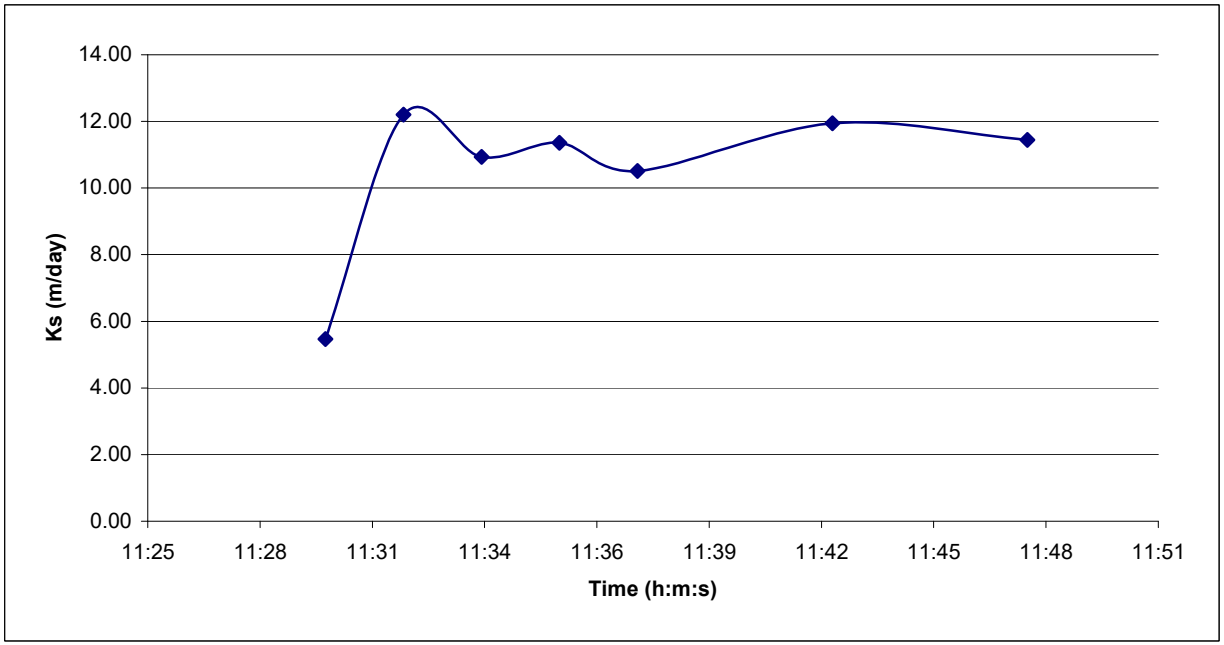
Permeability Test Results

SOIL PERMEABILITY TEST

Site No.	CHI1	Orange sand
Date	29/10/24	
Easting	395964	
Northing	6532504	
Depth	0.5	

Time (h:m:s)	Weight (kg)	Change in Weight (kg)	Ks (m/d)
11:28:00	44		
11:30:00	42.7	1.3	**5.47**
11:32:00	39.8	2.9	**12.20**
11:34:00	37.2	2.6	**10.94**
11:36:00	34.5	2.7	**11.36**
11:38:00	32	2.5	**10.52**
11:43:00	24.9	7.1	**11.95**
11:48:00	18.1	6.8	**11.44**
		18.1	

H =	25
r =	**4.5**



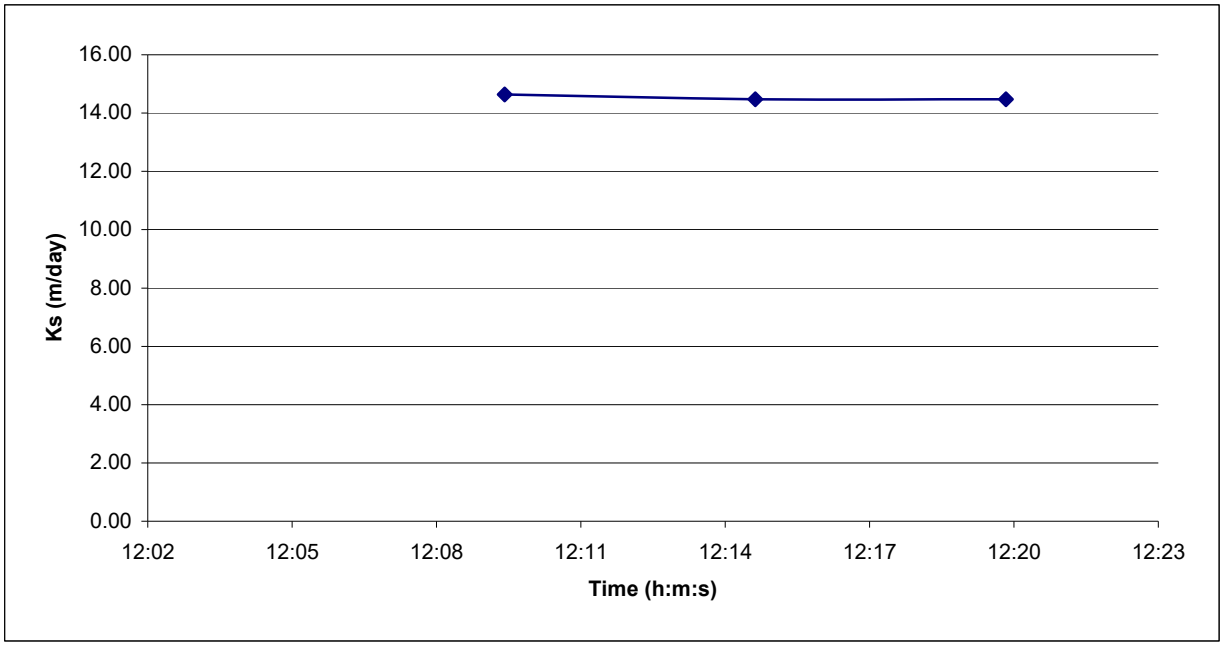
Ks = 11 m/day

SOIL PERMEABILITY TEST

Site No.	CHI2	Orange sand
Date	29/10/24	
Easting	396142	
Northing	6532513	
Depth	0.5	

Time (h:m:s)	Weight (kg)	Change in Weight (kg)	Ks (m/d)
12:05:00	46.3		
12:10:00	37.6	8.7	**14.64**
12:15:00	29	8.6	**14.47**
12:20:00	20.4	8.6	**14.47**
		20.4	

H =	25
r =	**4.5**



Ks = 14 m/day

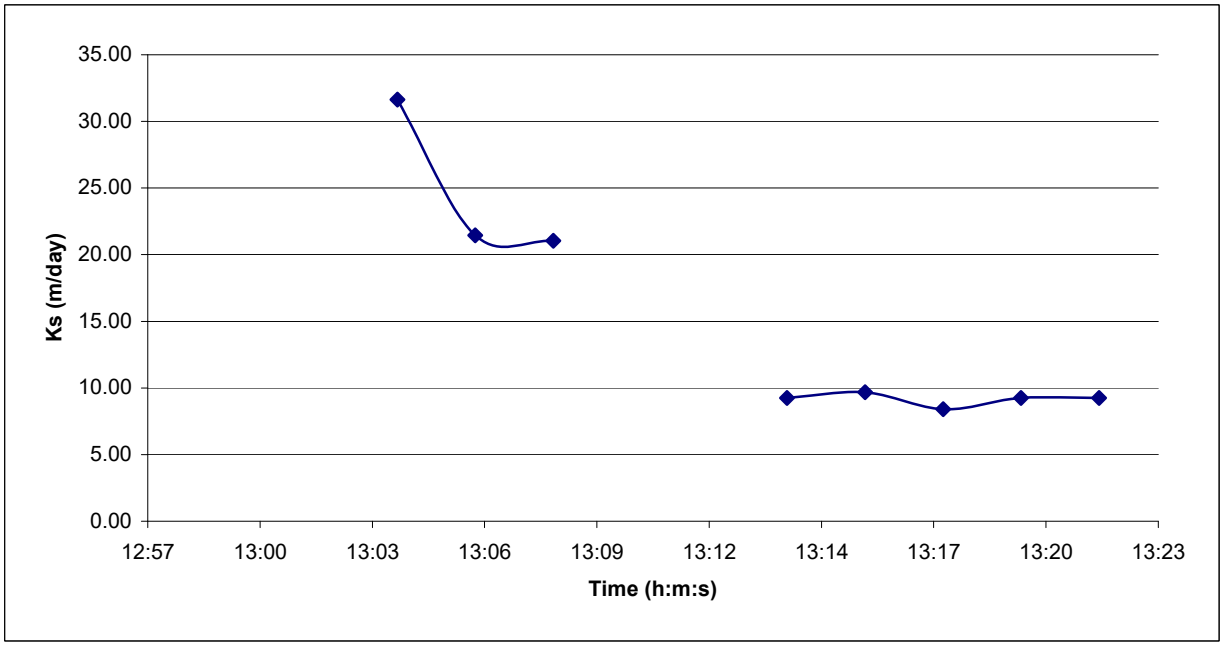
SOIL PERMEABILITY TEST

Site No.	CHI3
Date	29/10/24
Easting	396353
Northing	6532556
Depth	0.5

Dark brown clayey sand over black sandy/peaty clay

Time (h:m:s)	Weight (kg)	Change in Weight (kg)	Ks (m/d)
12:59:00	41.9		
13:04:00	23.1	18.8	**31.63**
13:06:00	18	5.1	**21.45**
13:08:00	13	5	**21.03**
13:12:00	40.6		
13:14:00	38.4	2.2	**9.25**
13:16:00	36.1	2.3	**9.68**
13:18:00	34.1	2	**8.41**
13:20:00	31.9	2.2	**9.25**
13:22:00	29.7	2.2	**9.25**
		29.7	

H =	25
r =	**4.5**



Ks = 9 m/day

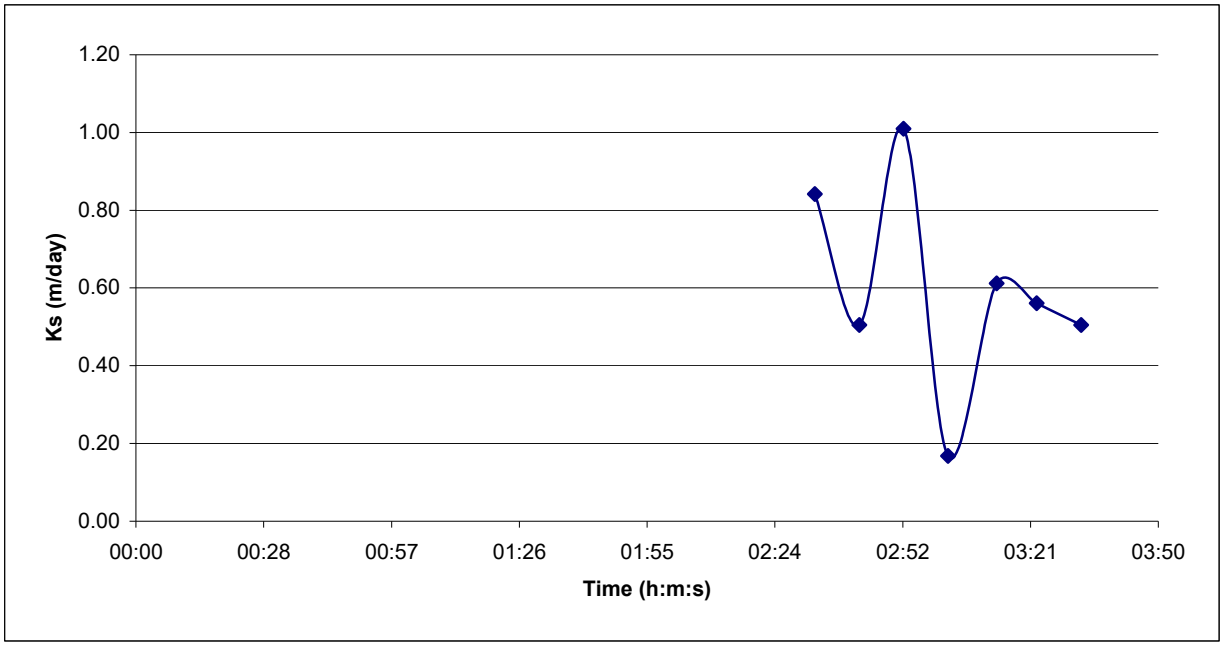
SOIL PERMEABILITY TEST

Site No.	CHI4
Date	29/10/24
Easting	396342
Northing	6532677
Depth	0.5

Dark grey clayey sand over sandy clay

Time (h:m:s)	Weight (kg)	Change in Weight (kg)	Ks (m/d)
02:28:00	40.7		
02:33:00	40.2	0.5	**0.84**
02:43:00	39.6	0.6	**0.50**
02:53:00	38.4	1.2	**1.01**
03:03:00	38.2	0.2	**0.17**
03:14:00	37.4	0.8	**0.61**
03:23:00	36.8	0.6	**0.56**
03:33:00	36.2	0.6	**0.50**
		36.2	

H =	25
r =	**4.5**



Ks = 0.5 m/day

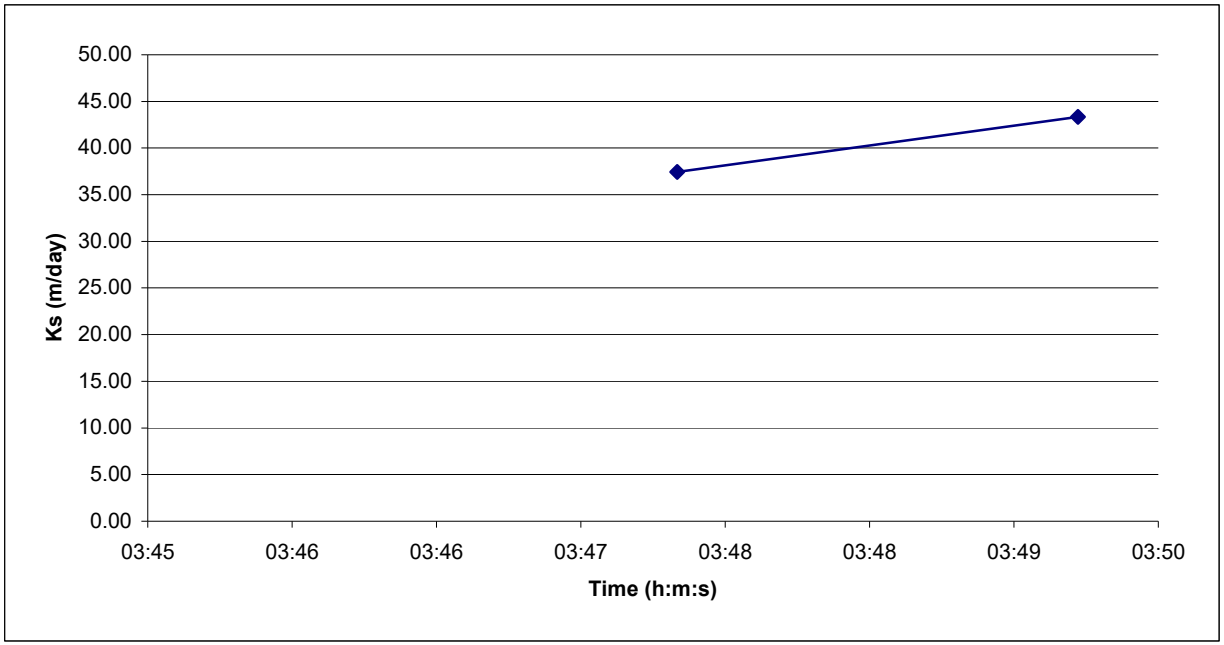
SOIL PERMEABILITY TEST

Site No.	CHI5
Date	29/10/24
Easting	396131
Northing	6532743
Depth	0.5

Dark orange-brown sand

Time (h:m:s)	Weight (kg)	Change in Weight (kg)	Ks (m/d)
03:46:00	33.1		
03:48:00	24.2	8.9	**37.44**
03:50:00	13.9	10.3	**43.33**
		13.9	

H =	25
r =	**4.5**



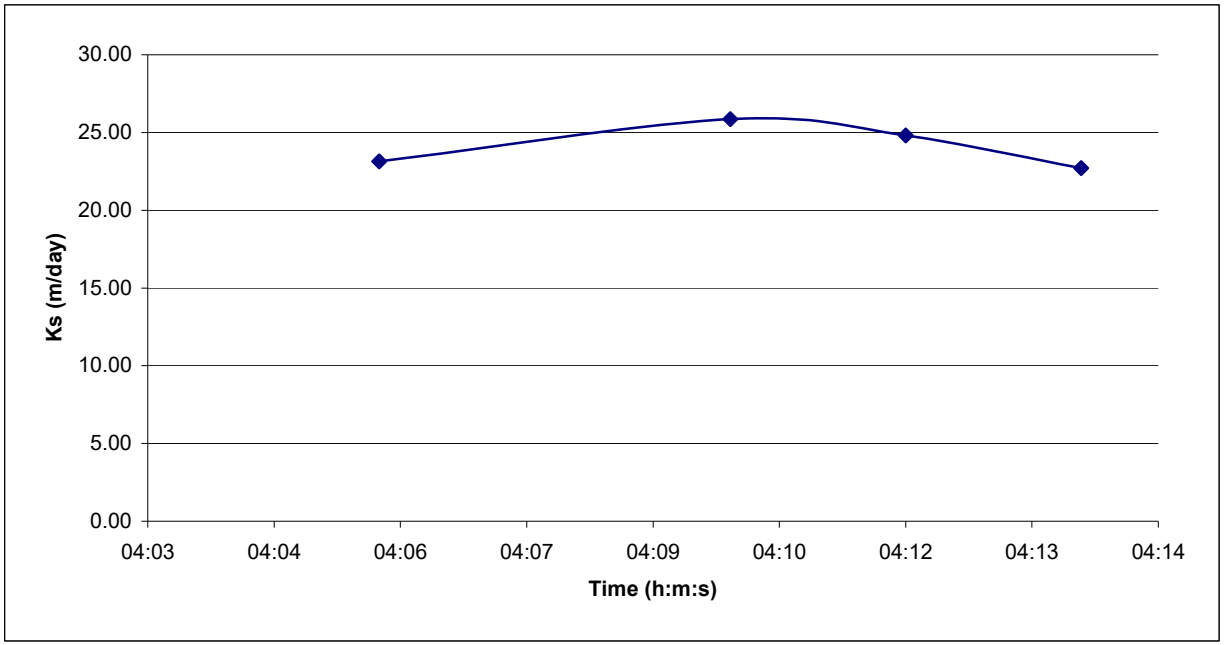
Ks = 40 m/day

SOIL PERMEABILITY TEST

Site No.	CHI6	Orange sand
Date	29/10/24	
Easting	395993	
Northing	6532822	
Depth	0.5	

Time (h:m:s)	Weight (kg)	Change in Weight (kg)	Ks (m/d)
04:04:00	41.2		
04:06:00	35.7	5.5	**23.14**
04:10:00	23.4	12.3	**25.87**
04:12:00	17.5	5.9	**24.82**
04:14:00	12.1	5.4	**22.72**
		12.1	

H =	25
r =	**4.5**



Ks = 22 m/day

Appendix C

Drainage Calculations

15mm STORM FLOWS

Rainfall (mm)	15	15mm storm
Cr Cleared	0	
Cr Forested	0	
Cr Basin	1	
Cr Lots	0	
Cr Pavement	0.8	
Cr Verge	0.1	
Permeability k (m/hr)	0.25	6.0 m/day
Basin freeboard (m)	0.20	

Catchment	Cleared/Lots	Forested	Basin	Pavement	Verge	Total	Ai	Q (L/s)	Vinflow (m3)
Gingin Brook Upstream	28700000	11050000	0	0	0	39750000	0	0.00	0.0
McHavloe St	120033	0	0	7425	15424	142882	7482	31.20	112.3
A north	0	0	82	1281	3599	4962	1467	6.12	22.0
A south	53308	0	82	1281	3599	58270	1467	6.12	22.0
B	0	0	133	2670	6128	8931	2882	12.02	43.3
C	52286	0	83	1482	3509	57360	1619	6.75	24.3
d	3847	0	0	0	0	3847	0	0.00	0.0
e	57450	0	0	0	0	57450	0	0.00	0.0
f	14767	0	0	0	0	14767	0	0.00	0.0
g	54253	0	0	0	0	54253	0	0.00	0.0

Basin Sizing

Catchment	Storm Event	Depth	Available Depth	Effective Depth	Side Slopes (1:x)	No. Basins	No. Soakwells	Base Width	Base Length	Top Width (m)	Top Length (m)	Top Area (m2)	Volume	Effective Volume	Water Depth (m)	Inundated Area (m2)	1yr 1hr Volume Check	100yr Volume Check	%Ai
Gingin Brook Upstream																			
McHavloe St	1					0	0						0	0		0			
A north	1	0.5	0.30	0.55	3	8	0	2	2	5.0	5.0	25	21	38	0.20	82	ok	ok	2.3
A south	1	0.5	0.30	0.55	3	8	0	2	2	5.0	5.0	25	21	38	0.20	82	ok	ok	2.3
B	1	0.5	0.30	0.55	3	13	5	2	2	5.0	5.0	25	38	66	0.20	133	ok	ok	2.2
C	1	0.5	0.30	0.55	3	7	0	2	2	5.0	5.0	25	18	33	0.24	83	ok	ok	2.4
d	1																		
e	1																		
f	1																		
g	1																		

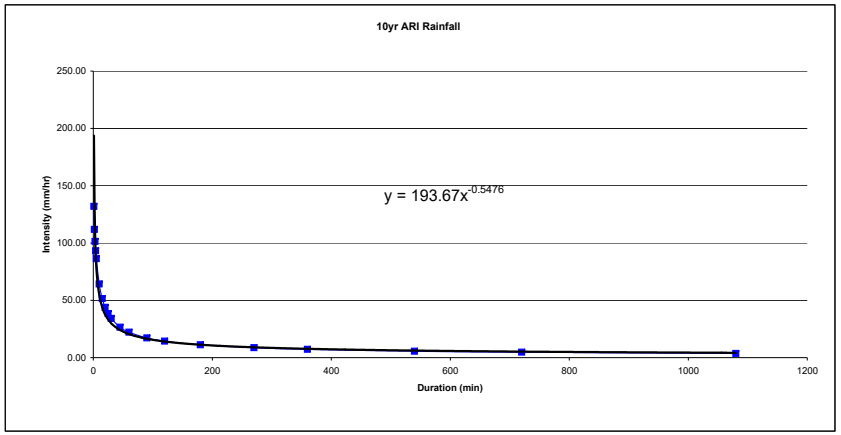
5 YEAR ARI CRITICAL FLOWS

CATCHMENT	AREAS (m2)					EFFECTIVE AREAS (m2)			TIME OF CONCENTRATION PRE DEVELOPMENT					TIME OF CONCENTRATION POST-DEVELOPMENT					CRITICAL STORM INTENSITY (mm/h)		FLOW			STORAGE		
	Cleared/Lots	Forested	Basin	Pavement	Verge	Total	Pre	Post	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope (m/km)	TC (mln)	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope	TC (mln)	Pre-Dev	Post-Dev	Pre Dev	Post Dev	Total Flow (m3)	Storage Req (m3)	Effective Storage (m3)	Volume Check
Gingin Brook Upstream	28700000	11050000	0	0	0	39750000	10246000	10246000	11582	231	104	10.97	329.7	11582	231	104	10.97	329.7	8.1	8.1	23034.25	23034.25	455698.35	0.00	0.00	
McHavloe St	120033	0	0	7425	15424	142882	40155	47324	921	160	126	36.92	35.8	921	160	126	36.92	35.2	27.3	27.5	304.51	362.12	765.13	19.36	0.00	
A north	0	0	82	1281	3599	4962	1417	2898	420	123	100	54.76	21.1	420	123	100	54.76	19.6	36.5	37.9	14.36	30.55	35.97	10.10	26.11	ok
A south	53308	0	82	1281	3599	58270	16343	17825	488	128	100	57.38	19.0	488	128	100	57.38	18.8	38.6	38.8	175.32	192.13	217.14	1.66	25.89	ok
B	0	0	133	2670	6128	8931	2557	5344	430	127.5	111	38.37	21.8	430	127.5	111	38.37	20.3	35.8	37.3	25.41	55.30	67.33	19.67	47.74	ok
C	52286	0	83	1482	3509	57360	16092	17667	249	110.5	100	42.17	10.3	249	110.5	100	42.17	10.2	53.9	54.2	241.06	266.01	163.29	1.44	20.51	ok
d	3847	0	0	0	0	3847	1077	1077	184	119	106	70.65	9.0	184	119	106	70.65	9.0	58.1	58.1	17.38	17.38	9.40			
e	57450	0	0	0	0	57450	16086	16086	570	123	97	45.61	23.3	570	123	97	45.61	23.3	34.6	34.6	154.43	154.43	215.63			
f	14767	0	0	0	0	14767	4135	4135	276	102	97	18.12	15.5	276	102	97	18.12	15.5	43.1	43.1	49.54	49.54	46.15			
g	54253	0	0	0	0	54253	15191	15191	305	110	96.5	44.26	12.6	305	110	96.5	44.26	12.6	48.4	48.4	204.07	204.07	154.28			

Runoff Coefficients	Pre-Dev	Post-Dev
Cr Cleared/Lots	0.28	0.28
Cr Forested	0.2	0.2
Cr Basin	0.3	1
Cr Pavement	0.3	0.85
Cr Verge	0.28	0.48

Rainfall IFD

Event	Duration (mins)	Intensity (mm/hr)	Event Rainfall (mm)
1 min	1	132.00	2.2
2 min	2	111.90	3.73
3 min	3	101.40	5.07
4 min	4	93.15	6.21
5 min	5	86.28	7.19
10 min	10	64.20	10.7
15 min	15	51.60	12.9
20 min	20	43.80	14.6
25 min	25	38.40	16
30 min	30	34.20	17.1
45 min	45	26.53	19.9
1 hr	60	22.20	22.2
1.5 hr	90	17.13	25.7
2 hr	120	14.35	28.7
3 hr	180	11.17	33.5
4.5 hr	270	8.71	39.2
6 hr	360	7.28	43.7
9 hr	540	5.66	50.9
12 hr	720	4.69	56.3
18 hr	1080	3.57	64.3



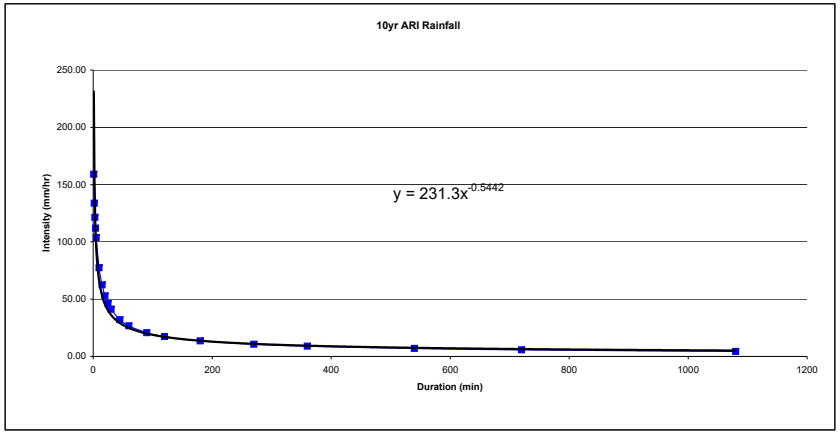
10 YEAR ARI CRITICAL FLOWS

CATCHMENT	AREAS (m2)					EFFECTIVE AREAS (m2)			TIME OF CONCENTRATION PRE DEVELOPMENT					TIME OF CONCENTRATION POST-DEVELOPMENT					CRITICAL STORM INTENSITY (mm/h)		FLOW			STORAGE		
	Cleared/Lots	Forested	Basin	Pavement	Verge	Total	Pre	Post	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope (m/km)	TC (mln)	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope	TC (mln)	Pre-Dev	Post-Dev	Pre Dev	Post Dev	Total Flow (m3)	Storage Req (m3)	Effective Storage (m3)	Volume Check
Gingin Brook Upstream	28700000	11050000	0	0	0	39750000	10820000	10820000	11582	231	104	10.97	327.9	11582	231	104	10.97	327.9	9.9	9.9	29717.37	29717.37	584717.85	0.00	0.00	
McHavloe St	120033	0	0	7425	15424	142882	42865	50404	921	160	126	36.92	35.6	921	160	126	36.92	35.0	33.1	33.4	394.37	467.84	982.31	24.23	0.00	
A north	0	0	82	1281	3599	4962	1489	3034	420	123	100	54.76	21.0	420	123	100	54.76	19.5	44.1	45.9	18.25	38.68	45.33	12.64	26.09	ok
A south	53308	0	82	1281	3599	58270	17481	19027	488	128	100	57.38	18.9	488	128	100	57.38	18.7	46.8	47.0	227.05	248.27	278.77	2.04	25.85	ok
B	0	0	133	2670	6128	8931	2679	5600	430	127.5	111	38.37	21.7	430	127.5	111	38.37	20.2	43.3	45.1	32.22	70.10	84.95	24.81	47.70	ok
C	52286	0	83	1482	3509	57360	17208	18857	249	110.5	100	42.17	10.3	249	110.5	100	42.17	10.2	65.2	65.5	311.45	343.00	209.18	1.77	20.49	ok
d	3847	0	0	0	0	3847	1154	1154	184	119	106	70.65	9.0	184	119	106	70.65	9.0	70.1	70.1	22.49	22.49	12.09			
e	57450	0	0	0	0	57450	17235	17235	570	123	97	45.61	23.1	570	123	97	45.61	23.1	41.9	41.9	200.48	200.48	278.02			
f	14767	0	0	0	0	14767	4430	4430	276	102	97	18.12	15.4	276	102	97	18.12	15.4	52.2	52.2	64.23	64.23	59.42			
g	54253	0	0	0	0	54253	16276	16276	305	110	96.5	44.26	12.5	305	110	96.5	44.26	12.5	58.5	58.5	264.38	264.38	198.49			

Runoff Coefficients	Pre-Dev	Post-Dev
Cr Cleared/Lots	0.3	0.3
Cr Forested	0.2	0.2
Cr Basin	0.3	1
Cr Pavement	0.3	0.9
Cr Verge	0.3	0.5

Rainfall IFD

Event	Duration (mins)	Intensity (mm/hr)	Event Rainfall (mm)
1 min	1	159.00	2.65
2 min	2	133.80	4.46
3 min	3	121.40	6.07
4 min	4	111.90	7.46
5 min	5	103.80	8.65
10 min	10	77.40	12.9
15 min	15	62.40	15.6
20 min	20	52.80	17.6
25 min	25	46.08	19.2
30 min	30	41.20	20.6
45 min	45	32.00	24
1 hr	60	26.70	26.7
1.5 hr	90	20.67	31
2 hr	120	17.30	34.6
3 hr	180	13.53	40.6
4.5 hr	270	10.60	47.7
6 hr	360	8.92	53.5
9 hr	540	6.93	62.4
12 hr	720	5.77	69.2
18 hr	1080	4.38	78.8



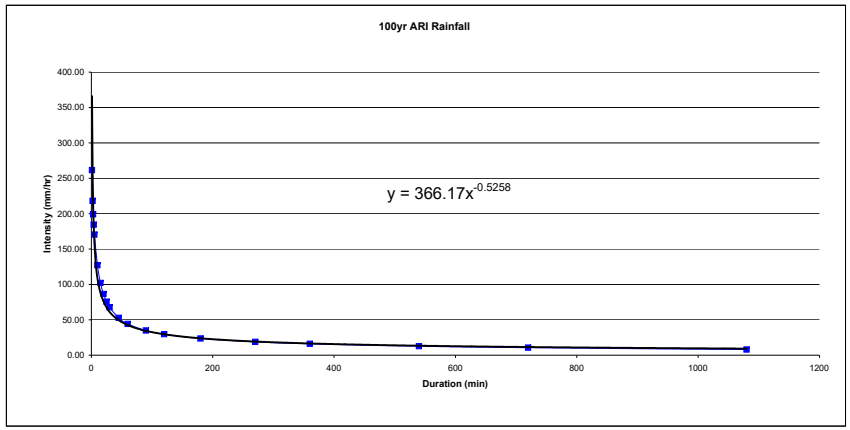
100 YEAR ARI CRITICAL FLOWS

CATCHMENT	AREAS (m2)					EFFECTIVE AREAS (m2)			TIME OF CONCENTRATION PRE DEVELOPMENT					TIME OF CONCENTRATION POST-DEVELOPMENT					CRITICAL STORM INTENSITY (mm/h)		FLOW			STORAGE		
	Cleared/Lots	Forested	Basin	Pavement	Verge	Total	Pre	Post	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope (m/km)	TC (mIn)	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope	TC (mIn)	Pre-Dev	Post-Dev	Pre Dev (L/sec)	Post Dev (L/sec)	Total Flow (m3)	Storage Req (m3)	Effective Storage (m3)	Volume Check
Gingin Brook Upstream	28700000	11050000	0	0	0	39750000	13094500	13094500	11582	231	104	10.97	321.7	11582	231	104	10.97	321.7	17.6	17.6	63977.37	63977.37	1235026.51	0.00	0.00	
McHavloe St	120033	0	0	7425	15424	142882	51438	59891	921	160	126	36.92	34.9	652	160	126	52.15	22.7	56.5	70.9	807.77	1178.96	1607.47	159.34	0.00	
A north	0	0	82	1281	3599	4962	1786	3522	420	123	100	54.76	20.6	420	123	100	54.76	19.2	74.6	77.3	37.03	75.67	87.37	22.78	26.00	ok
A south	53308	0	82	1281	3599	58270	20977	22713	488	128	100	57.38	18.5	488	128	100	57.38	18.4	78.9	79.2	459.68	499.80	551.34	3.55	25.76	ok
B	0	0	133	2670	6128	8931	3215	6480	430	127.5	111	38.37	21.3	430	127.5	111	38.37	19.9	73.2	76.0	65.40	136.76	163.32	44.46	47.56	ok
C	52286	0	83	1482	3509	57360	20650	22493	249	110.5	100	42.17	10.1	249	110.5	100	42.17	10.0	108.7	109.2	623.51	682.24	408.80	3.03	20.45	ok
d	3847	0	0	0	0	3847	1385	1385	184	119	106	70.65	8.8	184	119	106	70.65	8.8	116.7	116.7	44.91	44.91	23.70			
e	57450	0	0	0	0	57450	20682	20682	570	123	97	45.61	22.7	570	123	97	45.61	22.7	70.9	70.9	407.41	407.41	554.76			
f	14767	0	0	0	0	14767	5316	5316	276	102	97	18.12	15.1	276	102	97	18.12	15.1	87.7	87.7	129.55	129.55	117.70			
g	54253	0	0	0	0	54253	19531	19531	305	110	96.5	44.26	12.3	305	110	96.5	44.26	12.3	97.9	97.9	531.22	531.22	391.63			

Runoff Coefficients	Pre-Dev	Post-Dev
Cr Cleared/Lots	0.36	0.36
Cr Forested	0.25	0.25
Cr Basin	0.36	1
Cr Pavement	0.36	1
Cr Verge	0.36	0.6

Rainfall IFD

Event	Duration (mins)	Intensity (mm/hr)	Event Rainfall (mm)
1 min	1	261.60	4.36
2 min	2	218.10	7.27
3 min	3	199.00	9.95
4 min	4	184.50	12.3
5 min	5	170.40	14.2
10 min	10	127.20	21.2
15 min	15	102.00	25.5
20 min	20	86.40	28.8
25 min	25	75.60	31.5
30 min	30	67.60	33.8
45 min	45	52.67	39.5
1 hr	60	44.20	44.2
1.5 hr	90	34.80	52.2
2 hr	120	29.55	59.1
3 hr	180	23.57	70.7
4.5 hr	270	18.87	84.9
6 hr	360	16.08	96.5
9 hr	540	12.67	114
12 hr	720	10.58	127
18 hr	1080	8.00	144



5 YEAR ARI CUMULATIVE FLOWS

CATCHMENT	Contributing Segments	AREAS (m2)						EFFECTIVE AREAS (m2)		FLOW	Overflow through site	
		Cleared/Lots	Forested	Basin	Pavement	Verge	Total	Pre	Post		Slope	Depth in 1:2 V-Drain
A north	A north	0	0	82	1281	3599	4962	1417	2898	14.36	0.0549	0.09
A south	McHavloe St, A south	173341	0	82	8706	19023	201152	56498	65149	537.44	0.0551	0.31
B	B	0	0	133	2670	6128	8931	2557	5344	25.41	0.0376	0.11
C	B,C	52286	0	216	4152	9637	66291	18649	23011	266.47	0.0444	0.26

100 YEAR ARI CUMULATIVE FLOWS

CATCHMENT	Contributing Segments	AREAS (m2)						EFFECTIVE AREAS (m2)		FLOW	Overflow through site		
		Cleared/Lots	Forested	Basin	Pavement	Verge	Total	Pre	Post		Slope	Depth in 1:2 V-Drain	Drain Width (inc 200mm freeboard)
A north	A north	0	0	82	1281	3599	4962	1786	3522	37.03	0.0549	0.12	1.3
A south	McHavloe St, A south	173341	0	82	8706	19023	201152	72415	82604	1638.64	0.0551	0.49	2.0
B	B	0	0	133	2670	6128	8931	3215	6480	65.40	0.0376	0.16	1.4
C	B,C	52286	0	216	4152	9637	66291	23865	28973	688.91	0.0444	0.37	2.3