

# Design Requirements for Blocks 1, 2 and 3 Section 15

Strathnairn

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# Part 1: Introduction

## **The Ginninderry vision: an inspiring 21st century community**

The Ginninderry community will be unique in our region. It extends across the ACT/NSW border to the west of Belconnen and is being developed by a Joint Venture between the ACT Suburban Land Agency (SLA) and Riverview Developments (ACT) Pty Ltd.

From the start, our vision for Ginninderry has been to build a community of international significance, with innovation, diversity and ecological criteria at its core. Now we're bringing this vision to life.

## **Setting the highest standards**

This Integrated Development Parcel at Ginninderry will form part of a whole neighbourhood design.

The project team has established high expectations for Ginninderry, perhaps best illustrated by the project's accreditation as Canberra's first 6 Star Green Star Community, through the Green Building Council of Australia. To achieve this certification, we've shown that Ginninderry will be a worldleading community, exhibiting international best practice in urban design and development.

All residents at Ginninderry will benefit from a vast conservation corridor, well connected pedestrian and cycling pathways, tree lined streets and easy access to public transport.

Ginninderry aspires to be recognised as a world leader in sustainable development, delivering a community that is:

- better planned and designed
- more dynamic and vibrant
- a healthy place to live work and play
- productive and prosperous
- flexible, adaptable and resilient.

## **Innovative ideas and technologies**

Like all communities, Ginninderry will evolve and change over time, and so too will building design technologies and materials. It is quite possible that innovative energy, comfort and cost outcomes may be achieved by using new technologies, practices and principles not contemplated in this document.

At the discretion of the Development Manager, mandatory requirements may be varied if better alternatives and solutions are proposed, that do not compromise the overall integrity of Ginninderry's design philosophy.



# Part 2:

# Design Approval Process

## Integrated Development Parcel designs at Ginninderry need to comply with the following:

- These Design Requirements
- Plans relating to this block in Part 4 Appendices
- Relevant rules in the Single Residential Dwelling Housing Development Code of the Territory Plan
- Strathnairn Precinct Map and Code

## Compliance Bond

An important part of the Contract for Sale of land at Ginninderry is the requirement for the payment of a Compliance Bond at the time of settlement. The Compliance Bond is to ensure the adherence to these Design Requirements.

## Minimum Requirements

The conditions for the return of the Compliance Bond are:

- You must attend a pre application meeting with the Design Team prior to design submission. Pre application documents should include:
  - A concept site plan
  - Concept floor plans
  - Concept lane way elevation and open space elevation
- The design(s) has been submitted to and approved by the Development Manager prior to building commencement.
- The Integrated Development Parcel homes have been built to the approved design in accordance with the Design Requirements

- A letter/quote from your solar installer certifying that the PV system with inverter and Home Energy Management System has been installed to comply with the Design Requirements
- Any damage caused by the construction of the dwellings to the surrounding verges, street trees, footpath, services and adjoining land has been rectified to the satisfaction of Transport Canberra and City Services (TCCS) and our Development Manager
- All waste on the public verge and adjoining land has been removed
- The purchaser (builder) may not seek to transfer the compliance bond requirements to the ultimate owner of the dwelling(s)
- If found to be compliant, your full Compliance Bond will be returned.



# Part 3: Design Requirements

The following information outlines the Design Requirements for Blocks 1-3 Section 15 within Strathnairn.

| Design Principle                                                                                                                                          | Design Requirements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Public Domain Interface</b></p> <p>Provide legible and attractive interfaces that achieve passive surveillance to public streets and lane-ways.</p> | <p>Front doors of each dwelling are clearly visible from a public street or lane-way and include a covered entry feature or portico.</p> <p>Windows fronting a public road from habitable rooms, balconies or decks overlook the public domain.</p> <p>Courtyard walls are to be provided to comply with the Precinct Code and are required to be coordinated with all service requirements, including clearance to any water meters and free access to any electrical meter boxes.</p> <p>Where development frontages are adjacent to open spaces, parks, public walkways or located on a corner, the following requirements apply:</p> <ul style="list-style-type: none"><li>• Habitable rooms have windows to provide passive surveillance (i.e. no 'blank' facades)</li><li>• Building entries and pathways are visible and legible from public domain.</li></ul> |



Surveillance of Public Domain



Clear entries behind courtyard walls

| Design Principle                                                                                                                             | Design Requirements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Local Character and Context</b><br><br>The built form, articulation and scale relates to the local character of the area and its context. | The design should sit comfortably with the Strathnairn Master plan. Blocks 1-3 Section 15 is a part of an existing urban framework. The blocks are bound by a primary street frontage Bonthron Street and a rear lane network Ferrari Court. The Integrated Development Parcel is rear loaded for vehicular access from Ferrari Court. Blocks 7-10 Section 16 to the East are 2 storey townhouse style dwellings. Blocks 1-5 Section 16 to the West are standard single residential blocks with individual dwellings located. Block 6 Section 16 is an MU4 site located immediately to the North of Ferrari Court. |
| <b>Landscape Design</b><br><br>The landscape design requires healthy plant and tree growth space for medium sized trees.                     | Primary frontages require 1 medium tree with mature height of 5m if primary setback is 3m or greater.<br><br>Rear or Internal courtyards must include 1 tree with mature height of 5-8m.<br><br>The landscape plan proposes a combination of tree planting, for shade, mid height shrubs, lawn and ground covers.<br><br>Include a mix of species that are appropriate for scale and shading.<br><br>Synthetic or artificial grass is not permitted<br><br>The verge areas between the front boundary of the Land and the kerb must be turfed.<br><br>Refer Appendix B for suggested Landscape Planting Palette.   |



*Courtyard spaces should allow natural light and cross-ventilation to living spaces*



*An example of a vertical greenwall to help soften small courtyard areas*



| Design Principle                                                                                                                                                                                                                                                                                                   | Design Requirements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Visual Appearance and Façade Articulation</b></p> <p>To promote well designed buildings of high Architectural quality that contribute to the local character.</p> <p>The facades of the integrated development parcel homes must be designed as an integrated pack to provide an consistent streetscape.</p> | <p>The development is to incorporate articulation to frontages.</p> <p>The following elements help provide functional articulation. The design must demonstrate how it responds to the following elements:</p> <ul style="list-style-type: none"><li>• Covered entry feature or portico is mandatory</li><li>• A balcony, deck, pergola, terrace, or veranda</li><li>• Extruded box window treatments</li><li>• Awnings, sunhood, and louvres</li><li>• Eaves</li><li>• Access ramps as required</li></ul> <p>The overall streetscape must have a light base colour as the prominent wall finish with light weight cladding and include a mix of materials to provide articulation.</p> <p>Double storey designs must incorporate balconies at bookends/ corners with a combination of solid and perforated metal or glass balustrades.</p> <p>Facade glazing to street frontages must be more vertical in proportion with mullion spacing less than 1.0m. Openings of 2.4m wide or more must be a minimum of 3 panels.</p> <p>Metal profile cladding systems or FC style boards with profile widths of a maximum 200mm are encouraged.</p> |



Sunhood and Awning



Light filled screened balconies.



Clearly articulated facades add value and character to the streetscape



Passive Surveillance with articulated and screened balconies



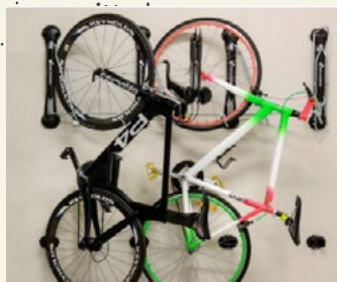
Clearly articulated facades add value and character to the streetscape

| Design Principle                                     | Design Requirements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Visual Appearance and Articulation to Corners</b> | <p>Refer to the block planning controls.</p> <p>Corner blocks are required to provide a minimum of 50% articulation to the secondary frontage.</p> <p>Articulation elements such as balconies, blade walls, pergolas, sunhoods, awnings, façade treatments, material use and expressed structure are required to add visual interest and avoid large blank wall planes to prominent corners.</p> <p>Buildings may need to be stepped back further on corners to permit balconies, glazing and larger eaves without encroachment into secondary front setbacks. All materials must wrap around the corner of the dwellings by at least 4 metres.</p> <p>The blocks identified below must provide articulation elements as set out above. Refer to the Block Planning Controls drawings which identifies the locations.</p> <p>Block 1 Section 15 to Ferrari Court and Bonthrone Street</p> <p>Block 3 Section 15 to Bonthrone Street and Ferrari Court</p>                                                                |
| <b>Roof Form</b>                                     | <p>The roof treatments are integrated into the building design and positively respond to the street and laneway and provide for individual expression for each dwelling.</p> <p>The roof form must consider how to integrate the solar panels. Lights and ventilation systems are integrated into the roof design.</p> <ul style="list-style-type: none"> <li>• Gable roof – minimum 25 degrees Skillion – 10 to 15 degrees minimum</li> <li>• Carports and garages to laneways 5-10 degrees</li> <li>• Parapets must be constructed in such a way that they project past the roofline to conceal all gutters.</li> <li>• Integrated roof forms concealing multiple dwellings are not permitted.</li> <li>• Standard Colourbond roof profiles are permitted Roof solar absorption of &lt;0.7 preferred (typically light or medium colours).</li> <li>• Very dark/black roofs and very light, highly reflective roofs are not permitted</li> <li>• Others roof forms may be considered on architectural merit.</li> </ul> |
| <b>Roofing Materials</b>                             | <p>Metal profile roof sheeting only. Refer to Approved Colours and Finishes palette Part 4</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Eaves, Awnings and Sunhoods</b>                   | <p>Minimum 450mm eaves required. Any windows that are not protected by an eave , i.e. parapet walls, require awnings or sunhoods, except south facing windows.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

| Design Principle                     | Design Requirements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Mailbox</b>                       | <p>Mailboxes should be incorporated into a courtyard wall (where permitted).</p> <p>Standalone mailboxes must compliment the home and must be constructed of masonry such as smooth face brick, stone faced masonry, rendered or bagged masonry or natural stone.</p> <p>Any pre-fabricated stand alone mailboxes must be of a high quality and may only be approved on merit.</p>                                                                                                                                                                                                                                                                                                                |
| <b>Bush Fire Requirements</b>        | There are no bush fire requirements within Strathnairn                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Energy Efficiency Rating</b>      | A minimum NatHERS rating of 7.0 is required for each dwelling.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Zoning</b>                        | RZ3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Building Height</b>               | Up to 2 storeys permitted                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Building Front Setback</b>        | Minimum 4m – to Bonthrone street                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Fencing &amp; Courtyard Walls</b> | <p>Refer to Strathnairn Precinct Map and Code, Single Dwelling Housing Development Code and Block Planning Control Plans.</p> <p><b>Mandatory</b> – refer to Fencing Controls Plan, Strathnairn Precinct Map and Code and Single Dwelling Housing Development Code and Block Planning Control Plans.</p>                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>PPOS Requirements</b>             | Refer to Strathnairn Precinct Map and Code, Single Dwelling/ Multi Unit Housing Development Code (as applicable) and Block Planning Control Plans.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Natural Ventilation</b>           | All habitable rooms must be naturally ventilated.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Garage and Garage Doors</b>       | <p>Garages are to be located where zero boundary are permitted via the Strathnairn Precinct Code Provision, refer to the Block Planning Control Plan. Consider the use of masonry base elements to corners of garages and lightweight elements where appropriate.</p> <p>We may consider alternate articulation of rear laneways on architectural merit such as where surveillance units are adopted or unusual lot shapes require an alternate design response. Additional setbacks to a laneway may be required to accommodate services such as sewer, water and storm water ties and any other associated service.</p> <p>Provide panel lift or tilt up garage doors. Roller doors are not</p> |



Garage storage solutions



Bicycle storage solutions



Laundry linen storage

| Design Principle               | Design Requirements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Bin Locations</b>           | <p>Storage for three bins must be provided including general waste, recycling and green waste. Bin locations should be integrated with the dwelling designs and screened from public view.</p> <p>Kitchen design must allow for easy waste separation.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Ceiling Heights</b>         | <p>Ceiling heights are to achieve sufficient natural ventilation and provide daylight access and spatial quality.</p> <p>Minimum ceiling heights:</p> <ul style="list-style-type: none"> <li>• 2.7m to ground floor habitable rooms</li> <li>• 2.7m to upper floor living areas</li> <li>• 2.5m to upper level bedrooms</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Glazing</b>                 | <p>uPVC or thermally broken aluminum double glazing is required to all external windows and doors.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Home Energy Systems</b>     | <p>Main gas connections are not provided to residential blocks in Ginninderry. Dwellings must be all-electric with no mains or bottled gas connections.</p> <p>A PV System with a Home Energy Systems and compatible inverter must be installed for all dwellings under the following provisions:</p> <ol style="list-style-type: none"> <li>Minimum PV size: <ul style="list-style-type: none"> <li>• 1-2 Bedroom = 3 (mandatory minimum PV size(kW))</li> <li>• 3+ Bedroom = 4 (mandatory minimum PV size(kW))</li> </ul> </li> <li>Home Energy Systems must be a Reposit Power (battery is required) or Evergen.</li> <li>The solar inverter must be compatible with the chosen Home Energy Systems above.</li> <li>Where PV panels are located on a roof section fronting a street, they must be installed flush with the roof.</li> <li>All hardware components must be installed by a certified Clean Energy Council Installer.</li> </ol> |
| <b>Appliances and Fixtures</b> | <p>Induction cooktops must be provided to all dwellings.</p> <p>All appliances, water fixtures and fittings must have a minimum 4 star rating under the water efficiency labeling and standards (WELS) scheme and (where required) a 4 star energy rating under the energy rating label (Energy Efficiency Rating) scheme.</p> <p>This includes showerheads, tap ware, toilets, fridges, freezers, washing machines, dryers and any other appliance provided with the dwelling</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                               |



| Design Principle           | Design Requirements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Hot Water Systems</b>   | <p>All dwellings must have a solar or heat pump hot water system installed.</p> <p>Roof top solar water collectors are not permitted on the roof fronting the street. Consideration must be given to the location of any tank including screening or placement within a cupboard or garage space.</p> <p>Hot water systems must be climate appropriate and have temperature application range down to -5 degrees ambient air temperature.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Heating and Cooling</b> | <p>Passive heating and cooling must be considered for all dwellings including ceiling fans and thermal mass)</p> <p>If Mechanical heating and/ or cooling systems are installed they must be:</p> <ol style="list-style-type: none"> <li>reverse cycle air conditioning with: <ul style="list-style-type: none"> <li>Energy Efficiency Rating of 3.1 or higher for cooling cycle</li> <li>Coefficient of Performance of 3.5 or higher for heating cycle</li> <li>Outdoor unit with sound pressure level of 57dBA or lower for heating and cooling cycle</li> </ul> </li> <li>air conditioning with a cooling cycle only that achieves an Energy Efficiency Rating of 3.1 or higher</li> <li>ducted evaporative cooling with self-closing damper</li> <li>ground source heat pump.</li> </ol> <p>Considerations must be given to the location of any outdoor fan coil unit including screening and compliance with ACT EPA noise requirements.</p> |
| <b>Rainwater Tanks</b>     | <p>Rainwater Tanks should be considered for all dwellings</p> <p>The following minimum size requires applies:</p> <ul style="list-style-type: none"> <li>Block 1 Section 15: 4,000 litres</li> <li>Block 2 Section 15: 2,000 litres</li> <li>Block 3 Section 15: 2,000 litres</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |



*Narrow style rainwater tanks can be used where space requirements are restrictive*



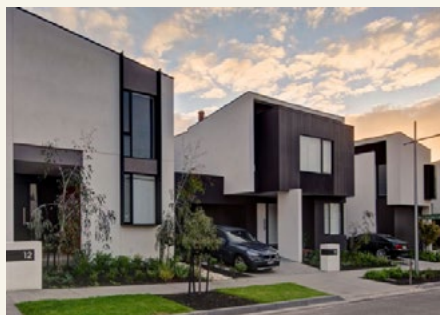
*Rainwater tanks incorporated into a carport design shows clever and effective use of small spaces*



| Design Principle                                                                                                                                                              | Design Requirements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Retaining Walls</b><br><br>Extensive earthworks should be limited where possible to minimise the extent of retaining wall costs and the visual impacts to the streetscape. | <b>Minimum Requirements:</b> <ul style="list-style-type: none"> <li>• The height of site cuts along the side boundaries with attached neighbouring wall cannot exceed 500mm in height</li> <li>• Retaining wall forward of the front building line must be constructed from the following materials at the discretion of the Ginninderry Development Manager               <ul style="list-style-type: none"> <li>- Approved face brick</li> <li>- Approved rendered masonry</li> <li>- Approved brickwork such as split face, honed or shot blast finishes</li> <li>- Approved stone faced masonry</li> <li>- Approved reinforced concrete finishes</li> </ul> </li> <li>• Timber, concrete sleepers or prefabricated modular systems are not permitted forward of the building line.</li> <li>• Retaining walls alongside boundaries forward of the building line must be tapered or stepped in line with the finished ground level at the front boundary.</li> <li>• Where there are services such as water, electrical, communications, sewer and storm water, detailed coordination of all courtyard wall locations and associated services must be considered in the initial design process.</li> </ul> |
| <b>Rear Lane Access</b>                                                                                                                                                       | Blocks 1-3 Section 15 are rear loaded blocks. Access is via flush kerb from Ferrari Court to all blocks.<br><br><b>Minimum Requirements:</b><br><br>Driveways must be constructed from either <ul style="list-style-type: none"> <li>- plain concrete or</li> <li>- maximum 5% Oxide finish</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |



Arch split face block



Streetscape



Well articulated dwelling designs provide a functional and more attractive streetscape

| Design Principle                         | Design Requirements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Services and ancillary structures</b> | <p>Services such as water, electricity meter boxes, NBN and home energy system cabinets can have an adverse impact on the overall streetscape if not considered as part of the overall design.</p> <p>The location of the above services will be required to be shown on the site plan as part of the design approval process.</p> <p><b>Minimum Requirements:</b></p> <ul style="list-style-type: none"> <li>• Water, electricity meter boxes, NBN and home energy system cabinets must be integrated into the front façade and located away from the front door</li> <li>• Solar panels must sit flush with the roof line if located to the street frontages of the dwellings</li> <li>• Storage tank for solar HWS is not permitted to be mounted on the roof fronting the street</li> <li>• Aerials, satellite dishes, antennae, heat pumps, A/C units and evaporative units are to be located to the rear of the dwellings and must not be visible from the street.</li> <li>• Clothes drying lines and garbage bins are to be located to the rear of the terraces. If they are located to the side of the house within the Primary Building zone, they must be screened from public view.</li> <li>• Sheds, outdoor structures are to be located to the rear of the terraces and away from public view.</li> </ul> |
| <b>Dog and Cat containment</b>           | <p><b>Minimum Requirements:</b></p> <p>Suburbs within Ginninderry are Cat Containment and Dog on Leash areas. Terrace designs should give consideration to responsible pet ownership principles including the use of enclosures or cat runs. More information can be obtained at: <a href="https://www.cityservices.act.gov.au/pets-and-wildlife/domestic-animals/cats/cat-containment">https://www.cityservices.act.gov.au/pets-and-wildlife/domestic-animals/cats/cat-containment</a></p> <ul style="list-style-type: none"> <li>• Dogs must remain on leash in public areas except within designated un-leashed areas such as dog parks.</li> <li>• Dogs are not permitted in the conservation corridor.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

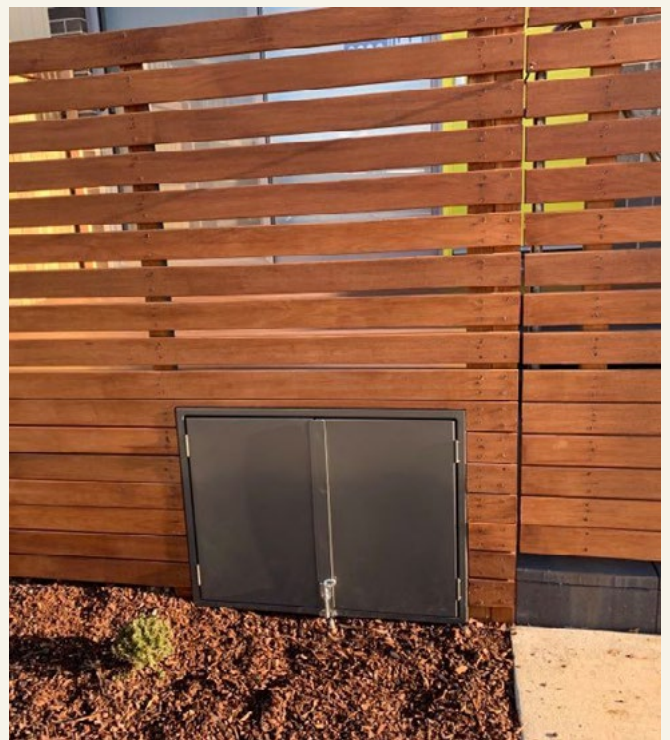




*Cat containment*



*Integrated water meter details within courtyard walls*









# Site location map





# Part 4: Appendix

# External Colours and Finishes Schedule

Please tick the boxes below

## Roof Tiles – Monier

|         |                          |           |                          |           |                          |          |                          |          |
|---------|--------------------------|-----------|--------------------------|-----------|--------------------------|----------|--------------------------|----------|
| Atura   | <input type="checkbox"/> | Mist Grey | <input type="checkbox"/> | Saltspray | <input type="checkbox"/> | Seashell | <input type="checkbox"/> | Wildrice |
| Horizon | <input type="checkbox"/> | Mist Grey | <input type="checkbox"/> | Saltspray | <input type="checkbox"/> | Seashell | <input type="checkbox"/> | Wildrice |

## Roof Tiles – Boral

|          |                          |           |
|----------|--------------------------|-----------|
| Vogue    | <input type="checkbox"/> | Stonewall |
| Contour  | <input type="checkbox"/> | Quartz    |
| Slimline | <input type="checkbox"/> | Stonewall |

## Roof Tiles – Bristle

|          |                          |            |                          |       |                          |            |
|----------|--------------------------|------------|--------------------------|-------|--------------------------|------------|
| Prestige | <input type="checkbox"/> | Silver Gum | <input type="checkbox"/> |       | <input type="checkbox"/> |            |
| Classic  | <input type="checkbox"/> | Alabaster  | <input type="checkbox"/> | Linen | <input type="checkbox"/> | Silver Gum |

## Metal Roof – Colorbond

|                          |        |                          |            |                          |          |                          |              |                          |           |                          |           |
|--------------------------|--------|--------------------------|------------|--------------------------|----------|--------------------------|--------------|--------------------------|-----------|--------------------------|-----------|
| <input type="checkbox"/> | Basalt | <input type="checkbox"/> | Cove       | <input type="checkbox"/> | Dune     | <input type="checkbox"/> | Evening Haze | <input type="checkbox"/> | Gully     | <input type="checkbox"/> | Windspray |
| <input type="checkbox"/> | Jasper | <input type="checkbox"/> | Shale Grey | <input type="checkbox"/> | Surfmist | <input type="checkbox"/> | Wallaby      | <input type="checkbox"/> | Paperbark |                          |           |

## Fence Colour - Colorbond

Side and Rear Boundary Fencing

|                          |        |
|--------------------------|--------|
| <input type="checkbox"/> | Jasper |
|--------------------------|--------|

## Fence Infill Panel / Street Facing Fencing - Colorbond

|                          |                 |                          |                 |                          |            |                          |              |                          |         |                          |              |
|--------------------------|-----------------|--------------------------|-----------------|--------------------------|------------|--------------------------|--------------|--------------------------|---------|--------------------------|--------------|
| <input type="checkbox"/> | Basalt          | <input type="checkbox"/> | Cove            | <input type="checkbox"/> | Dune       | <input type="checkbox"/> | Evening Haze | <input type="checkbox"/> | Gully   | <input type="checkbox"/> | Windspray    |
| <input type="checkbox"/> | Jasper          | <input type="checkbox"/> | Natural Pearl   | <input type="checkbox"/> | Shale Grey | <input type="checkbox"/> | Surfmist     | <input type="checkbox"/> | Wallaby | <input type="checkbox"/> | Ultra Silver |
| <input type="checkbox"/> | Precious Silver | <input type="checkbox"/> | Silver Medalist |                          |            |                          |              |                          |         |                          |              |

## Garage Doors

|                                                                                   |                 |                                                                                   |                 |                                                                                   |                  |                                                                                   |                   |                                                                                     |           |                                                                                     |              |
|-----------------------------------------------------------------------------------|-----------------|-----------------------------------------------------------------------------------|-----------------|-----------------------------------------------------------------------------------|------------------|-----------------------------------------------------------------------------------|-------------------|-------------------------------------------------------------------------------------|-----------|-------------------------------------------------------------------------------------|--------------|
|  | Basalt          |  | Cove            |  | Dune             |  | Evening Haze      |  | Gully     |  | Windspray    |
|  | Jasper          |  | Natural Pearl   |  | Shale Grey       |  | Surfmist          |  | Wallaby   |  | Ultra Silver |
|  | Precious Silver |  | Silver Medalist |  | Blushed Teak     |  | Classic Cedar     |  | Iron Bark |  | Kwila        |
|  | Merbau          |  | Silky Oak       |  | Weathered Timber |  | Western Red Cedar |                                                                                     |           |                                                                                     |              |

## Façade Colours Walls / Render / Cladding

|                                                                                   |                 |                                                                                   |                 |                                                                                   |               |                                                                                   |              |                                                                                     |               |                                                                                     |                |
|-----------------------------------------------------------------------------------|-----------------|-----------------------------------------------------------------------------------|-----------------|-----------------------------------------------------------------------------------|---------------|-----------------------------------------------------------------------------------|--------------|-------------------------------------------------------------------------------------|---------------|-------------------------------------------------------------------------------------|----------------|
|  | Basalt          |  | Cove            |  | Dune          |  | Evening Haze |  | Gully         |  | Windspray      |
|  | Jasper          |  | Natural Pearl   |  | Shale Grey    |  | Surfmist     |  | Wallaby       |  | Ultra Silver   |
|  | Precious Silver |  | Silver Medalist |  | Beige Royal   |  | Braid        |  | Cru           |  | Lexicon        |
|  | Light Rice      |  | Linseed         |  | Natural White |  | Oyster Linen |  | Terrace White |  | Toffee Fingers |
|  | Tuft            |  | Warm Neutral    |                                                                                   |               |                                                                                   |              |                                                                                     |               |                                                                                     |                |

## Bricks – Austral

|                          |                                                                                     |                                                                                     |                      |                                                                                     |                      |                                                                                     |                     |                                                                                       |                   |  |  |
|--------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|----------------------|-------------------------------------------------------------------------------------|----------------------|-------------------------------------------------------------------------------------|---------------------|---------------------------------------------------------------------------------------|-------------------|--|--|
| <b>La Paloma</b>         |  |  | Miro                 |                                                                                     |                      |                                                                                     |                     |                                                                                       |                   |  |  |
| <b>Urban One</b>         |  |  | Silver               |  | Chiffon              |  | Pepper              |                                                                                       |                   |  |  |
| <b>Wilderness Design</b> |  |  | Silver Birch         |  | Blue Gum             |  | Blackbutt           |                                                                                       |                   |  |  |
| <b>Everyday Life</b>     |  |  | Engage               |  | Freedom              |  | Leisure             |                                                                                       |                   |  |  |
| <b>Whitsunday Range</b>  |  |  | Brampton             |  | Orpheus              |                                                                                     |                     |                                                                                       |                   |  |  |
| <b>San Selmo Smoked</b>  |  |  | Grey Cashmere (F.O.) |  | Cloudy Silver (F.O.) |  | Opaque Slate (F.O.) |  | Wild Storm (F.O.) |  |  |
| <b>Metallix</b>          |  |  | Quartz               |  | Platinum             |  | Titanium            |  | Cuprum            |  |  |
|                          |  |  | Bronze               |  | Gun Metal Blue       |                                                                                     |                     |                                                                                       |                   |  |  |
| <b>Park Lane</b>         |  |  | Biltmore             |  | Grosvenor            |  | Dorchester          |  | Mayfair           |  |  |
|                          |  |  | Westminster          |  | Chesterfield (F.O.)  |                                                                                     |                     |                                                                                       |                   |  |  |
| <b>Stratos</b>           |  |  | Winter Frost         |  | Coastal Storm        |                                                                                     |                     |                                                                                       |                   |  |  |
| <b>Bowral Highlands</b>  |  |  | Meryla (F.O.)        |  | Penrose (F.O.)       |  | Wingello (F.O.)     |  | Jellore           |  |  |
|                          |  |  | Tarlo                |                                                                                     |                      |                                                                                     |                     |                                                                                       |                   |  |  |

F.O. Feature area only



## Bricks – PGH

|                           |                                                                                     |                       |                                                                                     |                     |                                                                                     |                  |                                                                                       |                  |
|---------------------------|-------------------------------------------------------------------------------------|-----------------------|-------------------------------------------------------------------------------------|---------------------|-------------------------------------------------------------------------------------|------------------|---------------------------------------------------------------------------------------|------------------|
| Alfresco                  |    | Vino                  |    | Chocolatto          |    | Truffle          |    | Espresso         |
|                           |    | Urban Blue            |                                                                                     |                     |                                                                                     |                  |                                                                                       |                  |
| Altitude                  |    | Olympus               |    | Apollo              |    | Matterhorn       |                                                                                       |                  |
| Dry Pressed Architectural |    | Bennelong Blue        |    | Bradfield Bronze    |    | Flinders Red     |    | Gledswood Blend  |
|                           |    | Macquarie Blend       |    | Tinto Cream         |    | Mawson White     |    | Silver Shadow    |
|                           |    | McKinlay Brown        |    | Monash Grey         |                                                                                     |                  |                                                                                       |                  |
| Dark and Stormy           |    | Monsoon               |    | Thunder             |    | Whirlwind        |    | Zephyr           |
| Foundations               |    | Gravel                |    | Stone               |                                                                                     |                  |                                                                                       |                  |
| Highlands                 |    | Blackheath            |    | Leura (F.O.)        |                                                                                     |                  |                                                                                       |                  |
| Manhattan                 |    | Chelsea (F.O.)        |    | East Hampton (F.O.) |    | Tribeca (F.O.)   |                                                                                       |                  |
| Metallic                  |    | Nickel Flash          |    | Pewter              |    | Blue Steel Flash |                                                                                       |                  |
| Morada                    |  | Blanco                |  | Ceniza              |  | Nero (F.O.)      |  | Gris             |
| Opaline                   |  | Tourmaline            |  | Garnet              |  | Tiger Eye        |                                                                                       |                  |
| Pure Linens               |  | Cinders & Soot        |  | Flannel Grey        |  | Pebble Creek     |  | Whispering White |
| Smooth                    |  | Mineral               |  | Volcanic            |  | Cream            |  | Pearl Grey       |
|                           |  | Brown                 |  | Terracota           |  | Choc Tan         |  | Copper Glow      |
|                           |  | Black & Tan           |                                                                                     |                     |                                                                                     |                  |                                                                                       |                  |
| Urban Essence             |  | Melbourne Blue (F.O.) |  | Storm (F.O.)        |                                                                                     |                  |                                                                                       |                  |
| Velour                    |  | Terracota             |  | Cream               |  | Pearl Grey       |  | Red              |
|                           |  | Brown                 |  | Choc Tan            |  | Mineral          |  | Volcanic         |

F.O. Feature area only

# Appendix B

# Landscape Concept Planting Palette

## Edible Plants

Below is a list of edible plants that Ginninderry encourages you to plant when landscaping your garden.

| Code                          | Botanical Name                            | Common Name           | Mature Plant Size | Container Size | Spacing            |
|-------------------------------|-------------------------------------------|-----------------------|-------------------|----------------|--------------------|
| <b>Small Trees</b>            |                                           |                       |                   |                |                    |
| Mad                           | <i>Malus domestica</i>                    | Apple                 | 3m x 3m           | 100L           | -                  |
| Pyc                           | <i>Prunus cerasifera</i>                  | Cherry Plum           | 5m x 5m           | 100L           | -                  |
| PrpA                          | <i>Prunus persica</i> 'Anzac'             | Australian Peach      | 4m x 4m           | 100L           | -                  |
| PrsAB                         | <i>Prunus salicina</i> 'Angelina Burdett' | Plum                  | 4-10m x 2-4m      | 100L           | -                  |
| <b>Large Shrubs</b>           |                                           |                       |                   |                |                    |
| Cil                           | <i>Citrus limon</i> 'Meyer'               | Meyer Lemon           | 3m x 2m           | 25L/300mm      | 1.5/m <sup>2</sup> |
| Fes                           | <i>Feijoa sellowiana</i>                  | Pineapple Guava       | 4m x 2m           | 25L/300mm      | 1.5/m <sup>2</sup> |
| Mia                           | <i>Microcitrus australasica</i>           | Finger Lime           | 4m x 2m           | 25L/300mm      | 1.5/m <sup>2</sup> |
| <b>Small Shrubs</b>           |                                           |                       |                   |                |                    |
| Roo                           | <i>Rosemarinus officinalis</i>            | Rosemary              | 0.5-1.5m x 1m     | 5L/200mm       | 3/m <sup>2</sup>   |
| Vac                           | <i>Vaccinium corymbosum</i>               | Blueberry - Blue Rose | 1-2m x 1-2m       | 5L/200mm       | 3/m <sup>2</sup>   |
| Cij                           | <i>Citrus japonica</i>                    | Kumquat               | 2-3m x 3m         | 5L/200mm       | 3/m <sup>2</sup>   |
| <b>Groundcovers/ Climbers</b> |                                           |                       |                   |                |                    |
| Fra                           | <i>Fragaria ananassa</i>                  | Strawberry            | 0.3m H            | 2.5L/150mm     | 4/m <sup>2</sup>   |

### Small Trees



*Malus domestica*



*Malus domestica* – fruit



*Prunus cerasifera*



*Prunus persica*



*Prunus salicina* - fruit

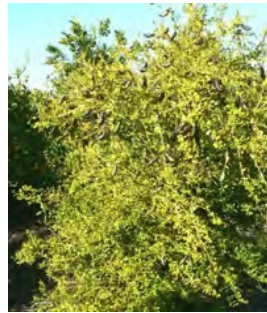
## Large Shrubs



*Citrus limon*



*Feijoa sellowiana*



*Microcitrus australasica*

## Groundcovers



*Fragaria ananassa*

## Small Shrubs



*Rosemarinus officinalis*



*Vaccinium corymbosum*



*Citrus japonica*



# Landscape Concept Planting Palette

## Native Plants

Below is a list of native plants that Ginninderry encourages you to plant when landscaping your garden.

| Code                                      | Botanical Name                              | Common Name              | Mature Plant Size | Container Size | Spacing            |
|-------------------------------------------|---------------------------------------------|--------------------------|-------------------|----------------|--------------------|
| <b>Large Shrubs (Hedging)</b>             |                                             |                          |                   |                |                    |
| BNm                                       | <i>Banksia marginata</i>                    | Silver Banksia           | 5m x 3m           | 25L/300mm      | 1.5/m <sup>2</sup> |
| BNsp                                      | <i>Banksia spinulosa</i>                    | Hairpin Banksia          | 3m x 3m           | 25L/300mm      | 1.5/m <sup>2</sup> |
| Cbf                                       | <i>Callistemon 'Great Balls of Fire'</i>    | Bottlebrush              | 2m x 2m           | 25L/300mm      | 1.5/m <sup>2</sup> |
| Ckp                                       | <i>Callistemon 'King's Park Special'</i>    | Bottlebrush              | 2-4m x 3-4m       | 25L/300mm      | 1.5/m <sup>2</sup> |
| Cra                                       | <i>Callistemon viminalis 'Red Alert'</i>    | Creek Bottlebrush        | 4m x 2m           | 25L/300mm      | 1.5/m <sup>2</sup> |
| Gpp                                       | <i>Grevillea 'Poorinda Peter'</i>           | Poorinda Peter Grevillea | 3m x 4m           | 25L/300mm      | 1.5/m <sup>2</sup> |
| Gpq                                       | <i>Grevillea 'Poorinda Queen'</i>           | Poorinda Queen Grevillea | 3m x 4m           | 25L/300mm      | 1.5/m <sup>2</sup> |
| Gho                                       | <i>Grevillea 'Red Hooks'</i>                | Red Hooks Grevillea      | 3m x 4m           | 25L/300mm      | 1.5/m <sup>2</sup> |
| <b>Small Shrubs</b>                       |                                             |                          |                   |                |                    |
| Anf                                       | <i>Anigozanthus 'Bush Gem'</i>              | Kangaroo Paw             | 0.6m x 1m         | 5L/200mm       | 3/m <sup>2</sup>   |
| Bkl                                       | <i>Baeckea linifolia</i>                    | Flax-leaf Heath Myrtle   | 1-2.5m x 0.5-2m   | 5L/200mm       | 3/m <sup>2</sup>   |
| Gco                                       | <i>Grevillea confertifolia</i>              | Dense-leaf Grevillea     | 2m x 1-2m         | 5L/200mm       | 3/m <sup>2</sup>   |
| Gla                                       | <i>Grevillea lanigera</i>                   | Wooly Grevillea          | 0.5-1m x 1-2m     | 5L/200mm       | 3/m <sup>2</sup>   |
| Wab                                       | <i>Westingia sp. 'Aussie Box'</i>           | Coast Rosemary           | 1.5m x 1.5m       | 5L/200mm       | 3/m <sup>2</sup>   |
| <b>Small Shrubs (Hedging to Frontage)</b> |                                             |                          |                   |                |                    |
| Cvc                                       | <i>Callistemon viminalis 'Captain Cook'</i> | Bottlebrush              |                   | 5L/200mm       | 3/m <sup>2</sup>   |
| Etm                                       | <i>Philotheca myoporoides</i>               | Long-leaf Waxflower      | 1.5-2m x 2m       | 5L/200mm       | 3/m <sup>2</sup>   |
| Gba                                       | <i>Grevillea baueri</i>                     | Bauer's Grevillea        | 0.6-1.5m x 2m     | 5L/200mm       | 3/m <sup>2</sup>   |
| Wew                                       | <i>Westingia fruticosa 'Grey Box'</i>       | Coastal Rosemary         | 2m x 4m           | 5L/200mm       | 3/m <sup>2</sup>   |
| <b>Groundcover/Climbers</b>               |                                             |                          |                   |                |                    |
| Acc                                       | <i>Acacia cognata 'limelight'</i>           | Dwarf River Wattle       | 0.5m x 1m         | 2.5L/150mm     | 4/m <sup>2</sup>   |
| Asfp                                      | <i>Astartea fascicularis</i>                | Winter Pink              | 0.3m x 1.5m       | 2.5L/150mm     | 4/m <sup>2</sup>   |
| BNsp                                      | <i>Banksia spinulosa 'Birthday Candle'</i>  | Birthday Candle Banksia  | 0.5m x 1.5m       | 2.5L/150mm     | 4/m <sup>2</sup>   |
| BRm                                       | <i>Brachyscome multifida</i>                | Rock Daisy               | 0.3m x 1.5m       | 2.5L/150mm     | 4/m <sup>2</sup>   |
| Coc                                       | <i>Convolvulus cneorum</i>                  | Bush Morning Glory       | 0.6m x 1m         | 2.5L/150mm     | 4/m <sup>2</sup>   |
| Gbr                                       | <i>Grevillea sp. 'Bronze Rambler'</i>       | Bronze Rambler Grevillea | 0.3m x 2m         | 2.5L/150mm     | 4/m <sup>2</sup>   |

|                |                                        |                          |               |            |                  |
|----------------|----------------------------------------|--------------------------|---------------|------------|------------------|
| Hav            | Hardenbergia violacea                  | Purple Coral Pea         | 3m x 1m       | 2.5L/150mm | 4/m <sup>2</sup> |
| Myp            | Myoporum parvifolium                   | Creeping Boobialla       | 0.2m x 2m     | 2.5L/150mm | 4/m <sup>2</sup> |
| RHs            | Rhagodia spinescens 'Aussie Flat Bush' | Aussie Flat Bush         | 0.3-0.5m x 1m | 2.5L/150mm | 4/m <sup>2</sup> |
| Vih            | Viola hederacea                        | Australian Native Violet | 0.1m x 0.5m   | 2.5L/150mm | 4/m <sup>2</sup> |
| <b>Grasses</b> |                                        |                          |               |            |                  |
| Dlc            |                                        |                          |               |            |                  |
| Dic            | Dianella caerulea 'Cassa Blue'         | Cassa Blue Flax Lily     | 0.7m x 1m     | Growtube   | 6/m <sup>2</sup> |
| DII            | Dianella longifolia                    | Pale Flax Lily           | 0.6m x 0.4m   | Growtube   | 6/m <sup>2</sup> |
| Dlr            | Dianella revoluta                      | Black Anther Flax Lily   | 0.5m x 0.5m   | Growtube   | 6/m <sup>2</sup> |
| DIt            | Dianella tasmanica                     | Blue Flax Lily           | 0.7m x 1m     | Growtube   | 6/m <sup>2</sup> |
| LDIC           | Lomandra longifolia 'Cassica'          | Cassica Mat Rush         | 1.2m x 0.8m   | Growtube   | 6/m <sup>2</sup> |
| LDIT           | Lomandra longifolia 'Tanika'           | Tanika Mat Rush          | 0.5m x 0.5m   | Growtube   | 6/m <sup>2</sup> |
| POAIE          | Poa labillardieri                      | Tussock Grass            | 0.6m x 0.4m   | Growtube   | 6/m <sup>2</sup> |
| THt            | Themeda triandra                       | Kangaroo Grass           | 1m x 0.5m     | Growtube   | 6/m <sup>2</sup> |

## Large Shrubs (Hedging)



*Banksia marginata*



*Banksia spinulosa*



*Callistemon 'Balls of Fire'*



*Callistemon 'Kings Park'*



*Callistemon 'Red Alert'*



*Grevillea 'Poorinda Peter'*



*Grevillea 'Poorinda Queen'*



*Grevillea 'Red Hooks'*



## Small Shrubs



*Angiozanthus 'Bush Gem'*



*Baeckea linifolia*



*Grevillea confertifolia*



*Grevillea lanigerav*

## Small Shrubs (Hedging to Frontage)



*Callistemon viminalis*



*Philotheca myoproides*



*Grevillea baueri*



*Westringia 'Grey Box'*

## Groundcover/Climbers



*Acacia cognata 'Limelight'*



*Astartea fascicularis*



*Banksia 'Birthday Candles'*



*Brachyscome multifida*



*Convolvulus cneorum*



*Grevillea 'Bronze Rambler'*



*Hardenbergia violacea*



*Myoporum parvifolium*



*Rhagodia spinescens*



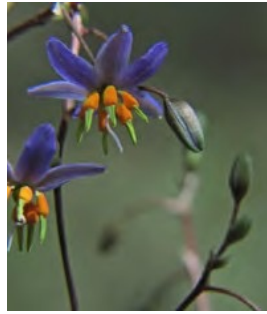
*Viola hederacea*



## Grasses



*Camellia sasanqua*



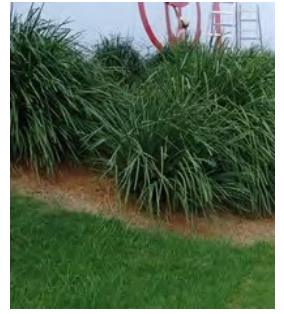
*Cupressus sp.*



*Michelia figo*



*Thuja sp.*



*Viburnum tinus*



*Lomandra 'Tanika'*



*Poa labillardieri*



*Themeda triandra*



# Landscape Concept Planting Palette

## Exotic Plants

Below is a list of exotic plants that Ginninderry encourages you to plant when landscaping your garden.

| Code                     | Botanical Name                         | Common Name        | Mature Plant Size | Container Size | Spacing            |
|--------------------------|----------------------------------------|--------------------|-------------------|----------------|--------------------|
| Small trees/Large Shrubs |                                        |                    |                   |                |                    |
| Acb                      | Acer buergeranum                       | Trident Maple      | 5m x 3m           | 100L           |                    |
| Acj                      | Acer japonicum                         | Japanese Maple     | 5m x 5m           | 100L           |                    |
| Cil                      | Citrus x Lemon                         | Lemon              | -                 | 25L/300mm      | 1.5/m2             |
| Cra                      | Cordyline Australis                    | Cabbage Tree       | 2m x 1.5m         | 5L/200mm       | 3/m <sup>2</sup>   |
| CNc                      | Cornus capitata                        | Evergreen Dogwood  | 3m x 3m           | 25L/300mm      | 1.5/m <sup>2</sup> |
| Dyk                      | Diospyros kaki                         | Japanese Persimmon | 6-8m x 6m         | 100L           | -                  |
| Dia                      | Dicksonia antarctica                   | Soft Tree Fern     | 2-4m x 2.5m       | 25L/300mm      | -                  |
| Kop                      | Koelreuteria paniculata                | Golden Rain Tree   | 5m x 8m           | 100L           | -                  |
| Lai                      | Lagerstroemia indica                   | Crepe Myrtle       | 3m x 2m           | 25L/300mm      | -                  |
| MGI                      | Magnolia grandiflora 'Little Gem'      | -                  | 6m x 3m           | 100L           | -                  |
| Mgso                     | Magnolia soulangeana                   | Saucer Magnolia    | 4m (h)            | 100L           | -                  |
| Mgst                     | Magnolia stellata                      | Star Magnolia      | 4-6m x 4.5m       | 100L           | -                  |
| Pcp                      | Prunus cerasifera 'Pissardii'          | Cherry Plum        | 5m x 5m           | 100L           | -                  |
| Pcs                      | Prunus cerasifera 'Spire'              | Black Cherry Plum  | 6m x 2m           | 100L           | -                  |
| Pyc                      | Pyrus calleryana                       | Ornamental Pear    | 11m x 4m          | 100L           | -                  |
| Large Shrubs (Hedging)   |                                        |                    |                   |                |                    |
| CAMs                     | Camellia sasanqua                      | Sasanqua Camellia  | 4m x 3m           | 25L/300mm      | 1.5/m <sup>2</sup> |
| Cup                      | Cupressus sp.                          | Cypress Sp.        | -                 | 25L/300mm      | -                  |
| Eiv                      | Escallonia sp. 'Iveyi'                 | Escallonia         | 3m x 3m           | 25L/300mm      | 1.5/m <sup>2</sup> |
| MIlf                     | Michelia figo                          | Port Wine Magnolia | 2m x 2m           | 25L/300mm      | 1.5/m <sup>2</sup> |
| Pitt                     | Pittosporum tenuifolium 'Green Pillar' | Pittosporum        | 3m x 2m           | 25L/300mm      | 1.5/m2             |
| Pla                      | Prunus laurocerasus                    | Cherry Laurel      | 5m x 3m           | 25L/300mm      | -                  |
| Plu                      | Prunus lusitanica                      | Portugese Laurel   | 4m x 2m           | 25L/300mm      | -                  |
| THj                      | Thuja Sp.                              | Cedar Sp.          | -                 | 25L/300mm      | -                  |
| VIO                      | Viburnum odoratissimum                 | Sweet Viburnum     | 4-6m x 4m         | 25L/300mm      | 1.5/m <sup>2</sup> |
| VIT                      | Viburnum tinus                         | Lauristinus        | 3m x 3m           | 25L/300mm      | 1.5/m <sup>2</sup> |

| Small Shrubs                       |                                      |                        |               |                         |                    |
|------------------------------------|--------------------------------------|------------------------|---------------|-------------------------|--------------------|
| Azs                                | Azalea sp.                           | Azalea                 |               | 5L/200mm<br>- 25L/300mm | 3/m <sup>2</sup>   |
| Bey                                | Beschorneria yuccoides               | Mexican Lily           | 1-1.5m x 1-2m | 25L/300mm               | -                  |
| Epp                                | Escallonia sp. 'Pink Pixie'          | Escallonia             | 0.8m x 0.8m   | 5L/200mm                | 3/m <sup>2</sup>   |
| LVA                                | Lavandula angustifolia               | White English Lavender | 0.3m x 0.3m   | 5L/200mm                | 3/m <sup>2</sup>   |
| LOn                                | Lonicera nitida                      | Dwarf Honeysuckle      | 2m x 3m       | 25L/300mm               | 1.5/m <sup>2</sup> |
| NNn                                | Nandina domestica 'Nana'             | Dwarf Screen Bamboo    | 0.3m x 2m     | 5L/200mm                | 3/m <sup>2</sup>   |
| Small Shrubs (Hedging to Frontage) |                                      |                        |               |                         |                    |
| ABg                                | Abelia grandiflora                   | Glossy Abelia          | 1.5m x 1.2m   | 5L/200mm                | 3/m <sup>2</sup>   |
| BUs                                | Buxus sempervirens                   | English Box            | 2m x 1m       | 5L/200mm                | 3/m <sup>2</sup>   |
| CYt                                | Choisya ternata                      | Mexican Orange Blossom | 1.5m x 1.5m   | 25L/300mm               | 1.5/m <sup>2</sup> |
| Erk                                | Escallonia sp. 'Red Knight'          | Escallonia             | 1.5m x 1.5m   | 25L/300mm               | 1.5/m <sup>2</sup> |
| GAf                                | Gardenia augusta 'Florida'           | Gardenia Florida       | 1-1.5m x 1m   | 5L/200mm                | 3/m <sup>2</sup>   |
| Groundcovers/Climbers              |                                      |                        |               |                         |                    |
| AJr                                | Ajuga reptans                        | Common Bugle           | 0.1m x 0.3m   | 2.5L/150mm              | 4/m <sup>2</sup>   |
| COPk                               | Coprosma x kirkii                    | Mirror Plant           | 0.6m x 1m     | 2.5L/150mm              | 4/m <sup>2</sup>   |
| HEc                                | Hedera canariensis (green form only) | Canary Island Ivy      | n/a           | 2.5L/150mm              | 4/m <sup>2</sup>   |
| HYc                                | Hypericum calycinum                  | Aaron's Beard          | 0.3m x 0.5m   | 2.5L/150mm              | 4/m <sup>2</sup>   |
| RSI                                | Rosmarinus lavandulaceus             | Creeping Rosemary      | 0.3m x 0.3m   | 2.5L/150mm              | 4/m <sup>2</sup>   |
| TRj                                | Trachelospermum jasminoides          | Chinese Star Jasmine   | n/a           | 2.5L/150mm              | 4/m <sup>2</sup>   |
| Vla                                | Vitis amurensis                      | Ornamental Grape Vine  | n/a           | 2.5L/150mm              | -                  |
| Grasses                            |                                      |                        |               |                         |                    |
| LIEg                               | Liriope 'Evergreen Giant'            | Evergreen Giant Lily   | 0.4m x 0.7m   | Growtube                | 6/m <sup>2</sup>   |
| Opn                                | Ophiopogon planiscapus 'Nigrescens'  | Black Mondo Grass      | 0.2m x 0.8m   | Growtube                | 6/m <sup>2</sup>   |

## Grasses



*Liriope 'Evergreen Giant'*



*Ophiopogon 'Nigrescens'*



## Small Trees/ Large Shrubs



*Acer buergerianum*



*Acer japonicum*



*Citrus x limon*



*Cordyline australis*



*Cornus capitata*



*Diospyros kaki*



*Koelreuteria paniculata*



*Lagerstroemia indica*



*Magnolia grandiflora*



*Magnolia soulangeana*



*Magnolia stellata*



*Prunus cerasifera 'Pissardii'*



*Prunus cerasifera 'Spire'*



*Ptrus calleryana*

## Large Shrubs (Hedging)



*Camellia sasanqua*



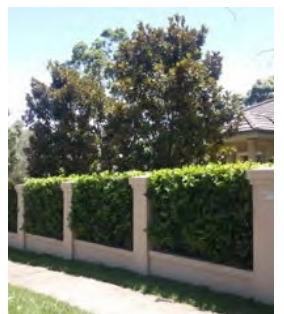
*Cupressus sp.*



*Michelia figo*



*Thuja sp.*



*Viburnum tinus*



## Small Shrubs



*Camellia sasanqua*



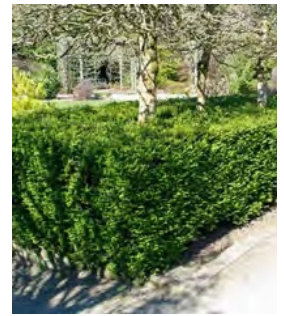
*Cupressus sp.*



*Michelia figo*



*Thuja sp.*



*Viburnum tinus*

## Small Shrubs (Hedging to Frontage)



*Abelia grandiflora*



*Buxus sempervirens*



*Choisya ternata*



*Gardenia augusta*

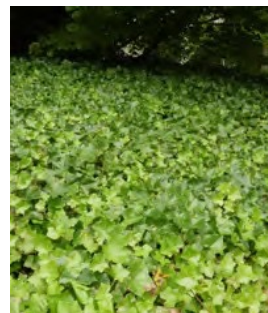
## Groundcover/Climbers



*Ajuga reptans*



*Coprosma x 'Kirkii'*



*Hedera canariensis*



*Hypericum calycinum*



*Rosmarinus lavandulaceus*



*Trachelospermum sp.*



*Vitis amurensis*



# Pest Plant List

## Not for use at Ginninderry

| Botanical Name                                  | Common Name                        | Reason                         |
|-------------------------------------------------|------------------------------------|--------------------------------|
| <i>Ailanthus altissima</i>                      | Tree of Heaven                     | Declared pest plant of the ACT |
| <i>Alnus glutinosa</i>                          | Black Alder                        | Declared pest plant of the ACT |
| <i>Alternanthera philoxeroides</i>              | Alligator Weed                     | Declared pest plant of the ACT |
| <i>Andropogon gayanus</i>                       | Gamba Grass                        | Declared pest plant of the ACT |
| <i>Annona glabra</i>                            | Pond Apple                         | Declared pest plant of the ACT |
| <i>Anredera cordifolia</i>                      | Madeira Vine                       | Declared pest plant of the ACT |
| <i>Asparagus aethiopicus</i>                    | Ground Asparagus Fern              | Declared pest plant of the ACT |
| <i>Asparagus africanus</i>                      | Climbing Asparagus Fern            | Declared pest plant of the ACT |
| <i>Asparagus asparagoides</i>                   | Bridal Creeper                     | Declared pest plant of the ACT |
| <i>Asparagus asparagoides</i> Western Cape Form | Bridal Creeper – Western Cape Form | Declared pest plant of the ACT |
| <i>Asparagus declinatus</i>                     | Bridal Veil                        | Declared pest plant of the ACT |
| <i>Asparagus plumosa</i>                        | Climbing Asparagus Fern            | Declared pest plant of the ACT |
| <i>Asparagus scandens</i>                       | Asparagus Fern                     | Declared pest plant of the ACT |
| <i>Austrocylindropuntia</i> (ALL species)       | Coral Cacti                        | Declared pest plant of the ACT |
| <i>Cabomba caroliniana</i>                      | Cabomba                            | Declared pest plant of the ACT |
| <i>Carduus nutans</i>                           | Nodding Thistle                    | Declared pest plant of the ACT |
| <i>Carduus pycnocephalus</i>                    | Slender Thistle                    | Declared pest plant of the ACT |
| <i>Carduus tenuiflorus</i>                      | Slender Thistle                    | Declared pest plant of the ACT |
| <i>Carthamus lanatus</i>                        | Saffron Thistle                    | Declared pest plant of the ACT |
| <i>Celtis australis</i>                         | Nettle Tree                        | Declared pest plant of the ACT |
| <i>Centaurea maculosa</i>                       | Spotted Knapweed                   | Declared pest plant of the ACT |
| <i>Chrysanthemoides monilifera</i>              | Bitou Bush / Boneseed              | Declared pest plant of the ACT |
| <i>Cortaderia jubata</i>                        | Pampas Grass                       | Declared pest plant of the ACT |
| <i>Cortaderia selloana</i>                      | Pampas Grass                       | Declared pest plant of the ACT |
| <i>Cotoneaster franchettii</i>                  | Cotoneaster                        | Declared pest plant of the ACT |
| <i>Cotoneaster glaucophyllus</i>                | Cotoneaster                        | Declared pest plant of the ACT |
| <i>Cotoneaster pannosus</i>                     | Cotoneaster                        | Declared pest plant of the ACT |
| <i>Cotoneaster salicifolius</i>                 | Willow-leaf Cotoneaster            | Declared pest plant of the ACT |
| <i>Cotoneaster simonsii</i>                     | Cotoneaster                        | Declared pest plant of the ACT |

| Botanical Name                                                  | Common Name                    | Reason                         |
|-----------------------------------------------------------------|--------------------------------|--------------------------------|
| <i>Crataegus monogyna</i>                                       | Hawthorn                       | Declared pest plant of the ACT |
| <i>Cryptostegia grandiflora</i>                                 | Rubber Vine                    | Declared pest plant of the ACT |
| <i>Cylindropuntia</i> (ALL species)                             | Pear Cacti                     | Declared pest plant of the ACT |
| <i>Cytisus</i> (ALL species)                                    | Broom species                  | Declared pest plant of the ACT |
| <i>Echium plantagineum</i>                                      | Paterson's Curse               | Declared pest plant of the ACT |
| <i>Echium vulgare</i>                                           | Viper's Bugloss                | Declared pest plant of the ACT |
| <i>Eichornia crassipes</i>                                      | Water Hyacinth                 | Declared pest plant of the ACT |
| <i>Equisetum</i> species                                        | Horsetail                      | Declared pest plant of the ACT |
| <i>Eragrostis curvula</i>                                       | African Love Grass             | Declared pest plant of the ACT |
| <i>Genista</i> (ALL species)                                    | Broom species                  | Declared pest plant of the ACT |
| <i>Gymnocoronis spilanthoides</i>                               | Senegal Tea Plant              | Declared pest plant of the ACT |
| <i>Hedera helix</i>                                             | English Ivy                    | Declared pest plant of the ACT |
| <i>Hieracium aurantiacum</i>                                    | Orange Hawkweed                | Declared pest plant of the ACT |
| <i>Hieracium pilosella</i>                                      | Mouse-ear Hawkweed             | Declared pest plant of the ACT |
| <i>Hymenachne amplexicaulis</i>                                 | Hymenachne                     | Declared pest plant of the ACT |
| <i>Hypericum perforatum</i>                                     | St John's Wort                 | Declared pest plant of the ACT |
| <i>Jatropha gossypifolia</i>                                    | Bellyache Bush                 | Declared pest plant of the ACT |
| <i>Kochia scoparia</i>                                          | Kochia                         | Declared pest plant of the ACT |
| <i>Lagarosiphon major</i>                                       | Lagarosiphon                   | Declared pest plant of the ACT |
| <i>Lantana camara</i>                                           | Lantana                        | Declared pest plant of the ACT |
| <i>Ligustrum lucidum</i>                                        | Broad-leaf privet              | Declared pest plant of the ACT |
| <i>Ligustrum sinense</i>                                        | Narrow-leaf privet             | Declared pest plant of the ACT |
| <i>Lonicera japonica</i>                                        | Japanese Honeysuckle           | Declared pest plant of the ACT |
| <i>Lycium ferocissimum</i>                                      | African Boxthorn               | Declared pest plant of the ACT |
| <i>Macfadyena unguis-cati</i>                                   | Cat's Claw Creeper             | Declared pest plant of the ACT |
| <i>Mimosa pigra</i>                                             | Mimosa                         | Declared pest plant of the ACT |
| <i>Miscanthus sinensis</i> (ALL varieties)                      | Chinese Fairy Grass            | Declared pest plant of the ACT |
| <i>Myriophyllum aquaticum</i>                                   | Parrot's Feather               | Declared pest plant of the ACT |
| <i>Nasella tenuissima</i>                                       | Mexican Feather Grass          | Declared pest plant of the ACT |
| <i>Nassella charruana</i>                                       | Lobed Needlegrass              | Declared pest plant of the ACT |
| <i>Nassella neesiana</i>                                        | Chilean Needle Grass           | Declared pest plant of the ACT |
| <i>Nassella trichotoma</i>                                      | Serrated Tussock               | Declared pest plant of the ACT |
| <i>Onopordum acanthium</i>                                      | Scotch Thistle                 | Declared pest plant of the ACT |
| <i>Onopordum illyricum</i>                                      | Illyrian Thistle               | Declared pest plant of the ACT |
| <i>Opuntia</i> (ALL species) (excludes <i>O. ficus-indica</i> ) |                                |                                |
| Prickly Pears                                                   | Declared pest plant of the ACT |                                |
| <i>Parkinsonia aculeata</i>                                     | Parkinsonia                    | Declared pest plant of the ACT |
| <i>Parthenium hysterophorus</i>                                 | Parthenium Weed                | Declared pest plant of the ACT |
| <i>Pennisetum setaceum</i>                                      | African Fountain Grass         | Declared pest plant of the ACT |

| Botanical Name                                                                                                                                                                                                                                              | Common Name                                                                                                                   | Reason                                                                                                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| <i>Phyllostachys aurea</i>                                                                                                                                                                                                                                  | Yellow Bamboo                                                                                                                 | Declared pest plant of the ACT                                                                             |
| <i>Pinus radiata</i>                                                                                                                                                                                                                                        | Radiata Pine                                                                                                                  | Declared pest plant of the ACT                                                                             |
| <i>Pistia stratiotes</i>                                                                                                                                                                                                                                    | Water Lettuce                                                                                                                 | Declared pest plant of the ACT                                                                             |
| <i>Populus alba</i>                                                                                                                                                                                                                                         | White Poplar                                                                                                                  | Declared pest plant of the ACT                                                                             |
| <i>Populus nigra</i> 'Italica'                                                                                                                                                                                                                              | Lombardy Poplar                                                                                                               | Declared pest plant of the ACT                                                                             |
| <i>Prosopis</i> spp.                                                                                                                                                                                                                                        | Mesquite                                                                                                                      | Declared pest plant of the ACT                                                                             |
| <i>Pyracantha angustifolia</i>                                                                                                                                                                                                                              | Firethorn                                                                                                                     | Declared pest plant of the ACT                                                                             |
| <i>Pyracantha coccinea</i>                                                                                                                                                                                                                                  | Scarlet Firethorn                                                                                                             | Declared pest plant of the ACT                                                                             |
| <i>Pyracantha fortuneana</i>                                                                                                                                                                                                                                | Firethorn                                                                                                                     | Declared pest plant of the ACT                                                                             |
| <i>Robinia pseudoacacia</i>                                                                                                                                                                                                                                 | False Acacia                                                                                                                  | Declared pest plant of the ACT                                                                             |
| <i>Rosa rubiginosa</i>                                                                                                                                                                                                                                      | Sweet Briar, Briar Rose                                                                                                       | Declared pest plant of the ACT                                                                             |
| <i>Rubus fruticosus</i> (aggregate) All species except for the permitted cultivars:<br><br><i>R. armeniacus</i> and <i>R. ulmifolius</i> species hybrid<br><i>R. armeniacus</i> species hybrid<br><i>R. ursinus</i> and <i>R. armeniacus</i> species hybrid | All Blackberry except for the permitted cultivars:<br><br>Black Satin, Chester Thornless, Dirksen<br>Loch Ne and Chehale.     | Declared pest plant of the ACT                                                                             |
| <i>Sagittaria platyphylla</i>                                                                                                                                                                                                                               | Sagittaria                                                                                                                    | Declared pest plant of the ACT                                                                             |
| <i>Salix</i> ALL species of willow, except for the permitted species:<br><br><i>Salix babylonica</i><br><i>S. babylonica</i><br><i>S. caladendron</i><br><i>S. reichardtii</i>                                                                              | All Willows except for the permitted species:<br><br>Weeping Willow<br>Weeping Willow<br>Pussy Willow<br>Sterile Pussy Willow | Declared pest plant of the ACT                                                                             |
| <i>Salvinia molesta</i>                                                                                                                                                                                                                                     | Salvinia                                                                                                                      | Declared pest plant of the ACT                                                                             |
| <i>Senecio madagascariensis</i>                                                                                                                                                                                                                             | Fireweed                                                                                                                      | Declared pest plant of the ACT                                                                             |
| <i>Solanum elaeagnifolium</i>                                                                                                                                                                                                                               | Silverleaf Nightshade                                                                                                         | Declared pest plant of the ACT                                                                             |
| <i>Sorbus</i> sp.                                                                                                                                                                                                                                           | Service Tree, Rowan                                                                                                           | Declared pest plant of the ACT                                                                             |
| <i>Spartium junceum</i>                                                                                                                                                                                                                                     | Spanish Broom                                                                                                                 | Declared pest plant of the ACT                                                                             |
| <i>Tamarix aphylla</i>                                                                                                                                                                                                                                      | Athel Pine                                                                                                                    |                                                                                                            |
| <i>Toxicodendron succedaneum</i>                                                                                                                                                                                                                            | Rhus Tree                                                                                                                     | Declared pest plant of the ACT                                                                             |
| <i>Ulex europaeus</i>                                                                                                                                                                                                                                       | Gorse                                                                                                                         | Declared pest plant of the ACT                                                                             |
| <i>Vinca major</i>                                                                                                                                                                                                                                          | Periwinkle                                                                                                                    | Declared pest plant of the ACT                                                                             |
| <i>Xanthium occidentale</i>                                                                                                                                                                                                                                 | Noogoora Burr                                                                                                                 | Declared pest plant of the ACT                                                                             |
| <i>Xanthium spinosum</i>                                                                                                                                                                                                                                    | Bathurst Burr                                                                                                                 | Declared pest plant of the ACT                                                                             |
| <b>Landscaping Plant Species</b>                                                                                                                                                                                                                            |                                                                                                                               |                                                                                                            |
| <i>Agapanthus</i> species                                                                                                                                                                                                                                   | Agapanthus                                                                                                                    | Multiple varieties where the seed is easily distributed and forms dense monocultures in conservation areas |

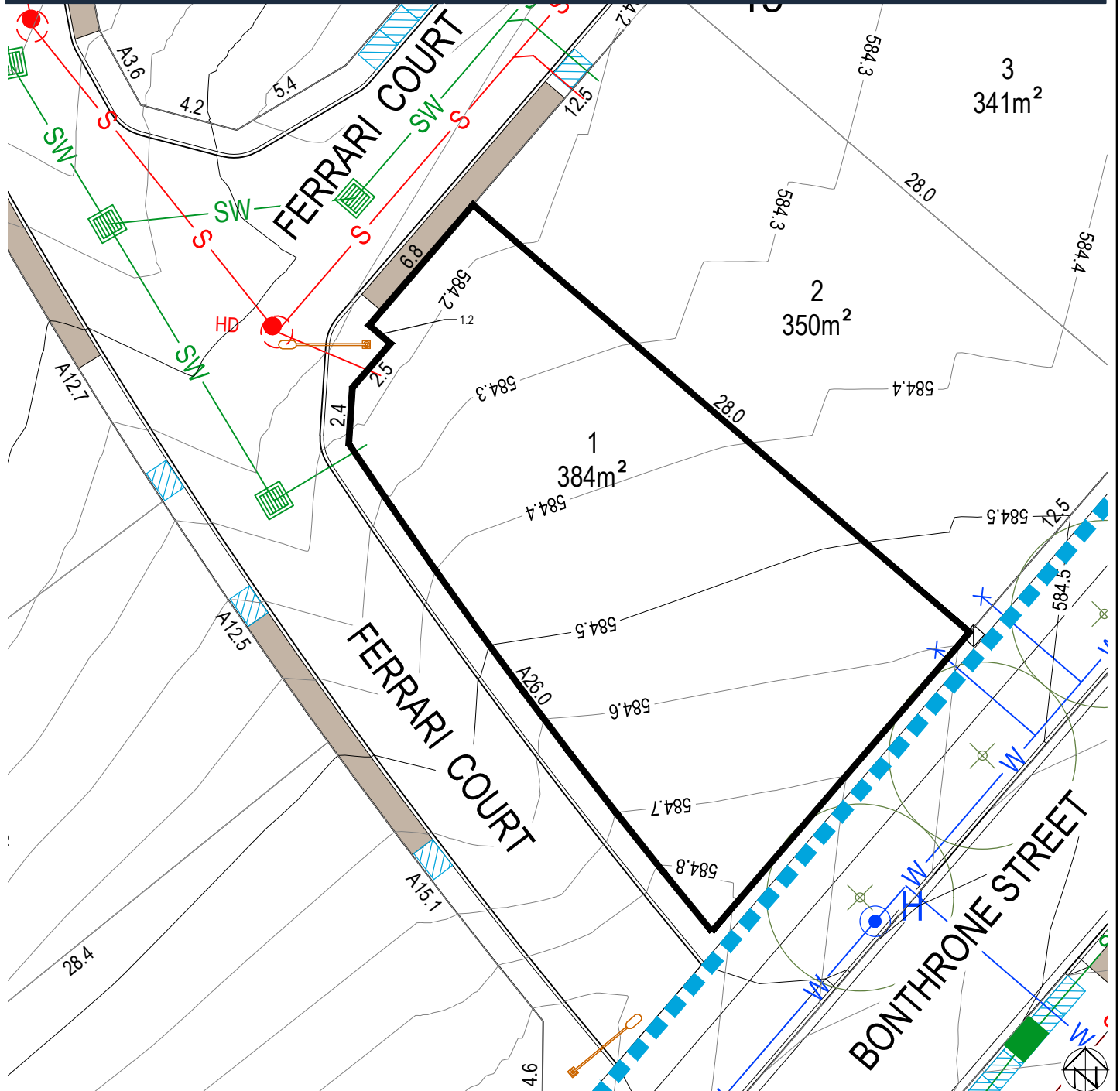


| Botanical Name    | Common Name      | Reason                                                                     |
|-------------------|------------------|----------------------------------------------------------------------------|
| Nandina domestica | Sacred Bamboo    | Berries toxic to birds, seed easily distributed into the conservation zone |
| Photinia species  | Photinia         | Seed easily distributed into conservation zone                             |
| Wisteria sinensis | Chinese Wisteria | Spread by seed, particularly along established waterways                   |

# Appendix C



## Block Disclosure Plan



BLOCK LAYOUT - SCALE 1:250

ISSUE DATE: 05/09/2018

### LEGEND

|  |                                         |  |                                           |  |                                     |  |                                       |
|--|-----------------------------------------|--|-------------------------------------------|--|-------------------------------------|--|---------------------------------------|
|  | LOT BOUNDARY                            |  | SEWER MAIN / MANHOLE / TIE                |  | SERVICES TRENCH                     |  | WASTE COLLECTION POINT                |
|  | EASEMENT                                |  | STORMWATER MAIN / SUMP / MANHOLE / TIE    |  | NBNC PIT                            |  | SUBSTATION                            |
|  | CONTOUR 0.5m INTERVAL                   |  | WATER MAIN / STOP VALVE / HYDRANT / TIE   |  | STREETLIGHT                         |  | STREET TREES                          |
|  | CONTOUR 0.1m INTERVAL                   |  | WATER MAIN (IRRIGATION)                   |  | ABOVE GROUND MINIPILLAR             |  | GARAGE OFFSET FROM REAR BOUNDARY      |
|  | RETAINING WALL                          |  | REINFORCED CONCRETE DRIVEWAY BY PURCHASER |  | IN GROUND MINIPILLAR                |  | BLOCK SUBJECT TO MID-SIZED PROVISIONS |
|  | MANDATORY TWO(2) STOREYS                |  | POTENTIALLY NOISE AFFECTED BLOCK          |  | FRONT FENCING AND GATE BY DEVELOPER |  |                                       |
|  | SEWER MAINTENANCE ACCESS ROUTE REQUIRED |  |                                           |  |                                     |  |                                       |

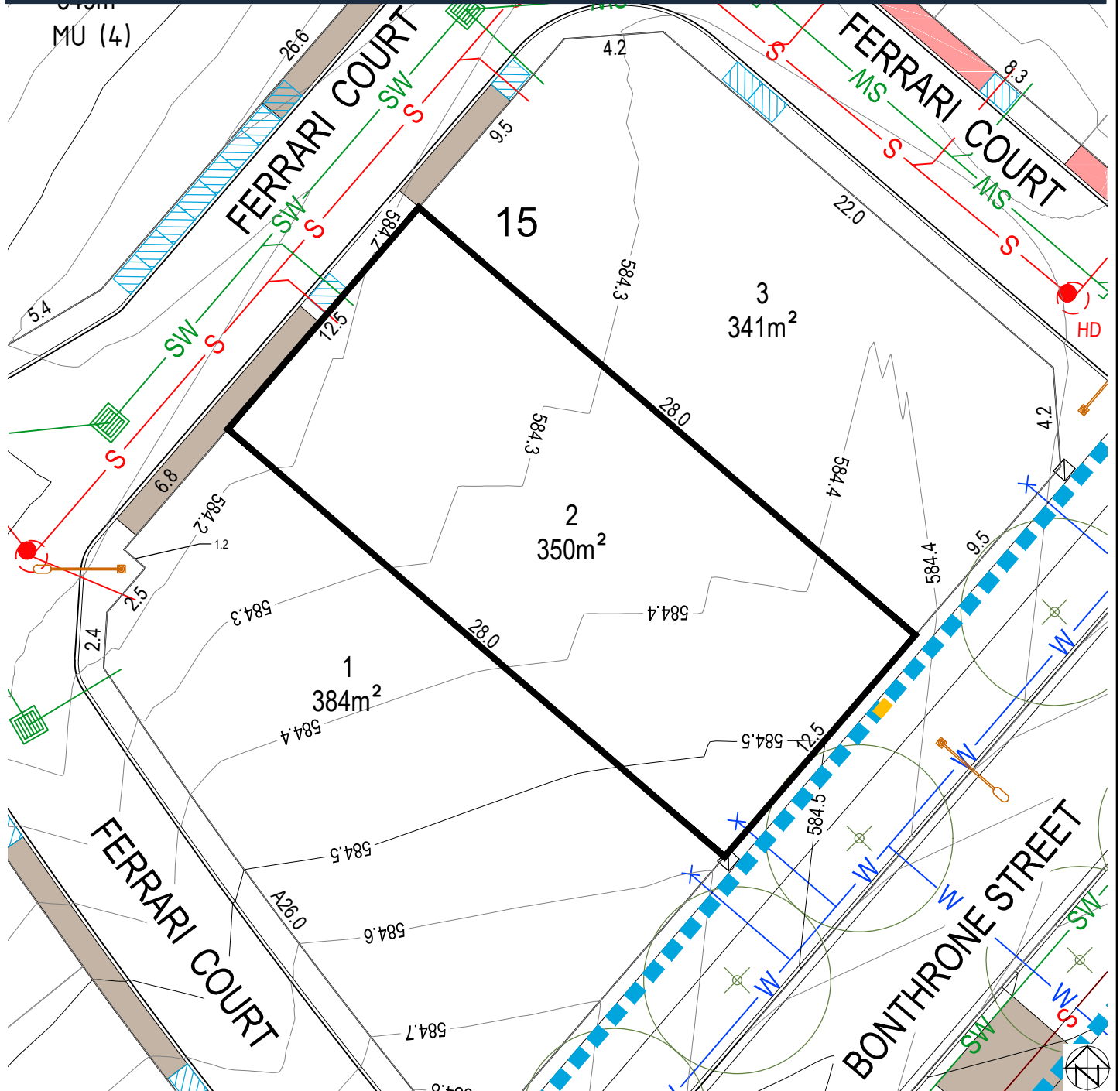
PLEASE NOTE: INFORMATION SHOWN IN THIS DRAWING IS FROM FINAL DESIGN AND SUBJECT TO CHANGE DURING CONSTRUCTION  
 REFER ALSO TO PLANNING CONTROLS PLAN AND FENCING CONTROLS PLAN

Disclaimer: All care has been taken in the preparation of this material. No responsibility is taken by the vendor for any errors or omissions, and details may be subject to change. All road designs, contours, block sizes, block dimensions, easements, services, ties and trees are subject to change.





## Block Disclosure Plan



BLOCK LAYOUT - SCALE 1:250

ISSUE DATE: 05/09/2018

### LEGEND

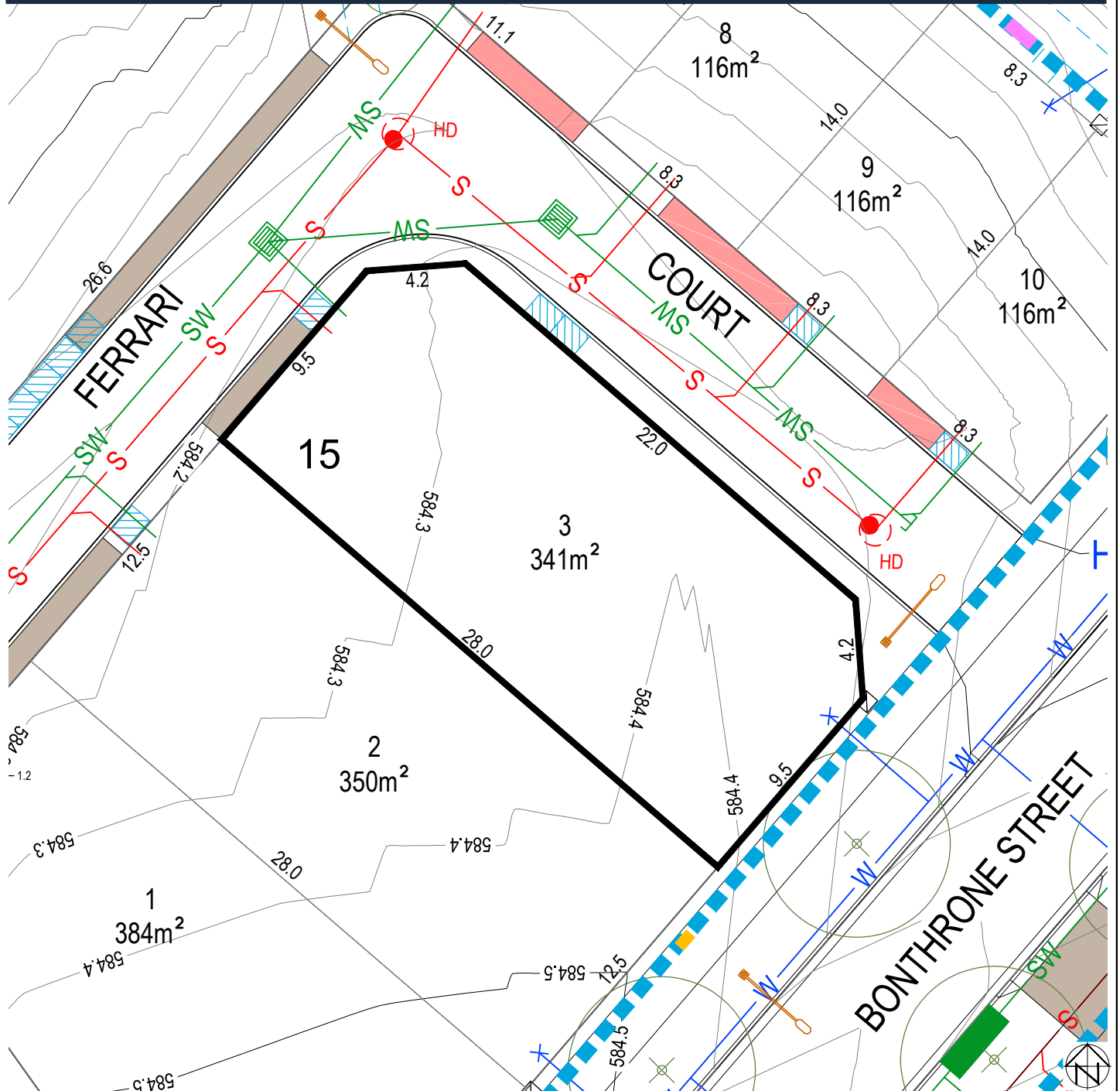
|  |                                         |  |                                           |  |                                     |  |                                       |
|--|-----------------------------------------|--|-------------------------------------------|--|-------------------------------------|--|---------------------------------------|
|  | LOT BOUNDARY                            |  | SEWER MAIN / MANHOLE / TIE                |  | SERVICES TRENCH                     |  | WASTE COLLECTION POINT                |
|  | EASEMENT                                |  | STORMWATER MAIN / SUMP / MANHOLE / TIE    |  | NBN Co. PIT                         |  | SUBSTATION                            |
|  | CONTOUR 0.5m INTERVAL                   |  | WATER MAIN / STOP VALVE / HYDRANT / TIE   |  | STREETLIGHT                         |  | STREET TREES                          |
|  | CONTOUR 0.1m INTERVAL                   |  | WATER MAIN (IRRIGATION)                   |  | ABOVE GROUND MINIPILLAR             |  | GARAGE OFFSET FROM REAR BOUNDARY      |
|  | RETAINING WALL                          |  | REINFORCED CONCRETE DRIVEWAY BY PURCHASER |  | IN GROUND MINIPILLAR                |  | BLOCK SUBJECT TO MID-SIZED PROVISIONS |
|  | MANDATORY TWO(2) STOREYS                |  | POTENTIALLY NOISE AFFECTED BLOCK          |  | FRONT FENCING AND GATE BY DEVELOPER |  |                                       |
|  | SEWER MAINTENANCE ACCESS ROUTE REQUIRED |  |                                           |  |                                     |  |                                       |

PLEASE NOTE: INFORMATION SHOWN IN THIS DRAWING IS FROM FINAL DESIGN AND SUBJECT TO CHANGE DURING CONSTRUCTION  
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## Block Disclosure Plan



BLOCK LAYOUT - SCALE 1:250

ISSUE DATE: 05/09/2018

### LEGEND

|  |                                         |  |                                           |  |                                     |  |                                       |
|--|-----------------------------------------|--|-------------------------------------------|--|-------------------------------------|--|---------------------------------------|
|  | LOT BOUNDARY                            |  | SEWER MAIN / MANHOLE / TIE                |  | SERVICES TRENCH                     |  | WASTE COLLECTION POINT                |
|  | EASEMENT                                |  | STORMWATER MAIN / SUMP / MANHOLE / TIE    |  | NBNC PIT                            |  | SUBSTATION                            |
|  | CONTOUR 0.5m INTERVAL                   |  | WATER MAIN / STOP VALVE / HYDRANT / TIE   |  | STREETLIGHT                         |  | STREET TREES                          |
|  | CONTOUR 0.1m INTERVAL                   |  | WATER MAIN (IRRIGATION)                   |  | ABOVE GROUND MINIPILLAR             |  | GARAGE OFFSET FROM REAR BOUNDARY      |
|  | RETAINING WALL                          |  | REINFORCED CONCRETE DRIVEWAY BY PURCHASER |  | IN GROUND MINIPILLAR                |  | BLOCK SUBJECT TO MID-SIZED PROVISIONS |
|  | MANDATORY TWO(2) STOREYS                |  | POTENTIALLY NOISE AFFECTED BLOCK          |  | FRONT FENCING AND GATE BY DEVELOPER |  |                                       |
|  | SEWER MAINTENANCE ACCESS ROUTE REQUIRED |  |                                           |  |                                     |  |                                       |

PLEASE NOTE: INFORMATION SHOWN IN THIS DRAWING IS FROM FINAL DESIGN AND SUBJECT TO CHANGE DURING CONSTRUCTION  
REFER ALSO TO PLANNING CONTROLS PLAN AND FENCING CONTROLS PLAN

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# Appendix D

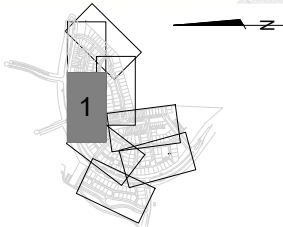


**WARNING**

THIS PLAN ONLY INDICATES AREAS OF FILL OF WHICH THE DEVELOPER AND THEIR AGENTS ARE AWARE. IT HAS NOT BEEN CHECKED BY THE DEVELOPER, AND THE DEVELOPER DOES NOT GUARANTEE ITS ACCURACY. IN NO WAY SHOULD THIS PLAN BE READ AS A CONCLUSIVE STATEMENT OF THE FULL EXTENT OF THE FILL THAT MAY BE FOUND ON THE WHOLE LAND DEPICTED. LESSEES AND PURCHASERS SHOULD MAKE THEIR OWN INQUIRIES IN REGARD TO THE EXACT DRAINAGE, GEOTECHNICAL AND FILL CONDITIONS AFFECTING THEIR BLOCKS.

**LEGEND**

- GRADING LIMITS
- FILL
- DESIGN CONTOURS @ 1m INTERVALS
- × 0.3 FILL DEPTHS (IN METRES)





# Appendix E

# SITE CLASSIFICATION REPORT SUMMARY

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                  |                 |              |                |             |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|-----------------|--------------|----------------|-------------|
| <b>BLOCK:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1 (c)                            | <b>SECTION:</b> | 15 (AH)      | <b>SUBURB:</b> | Strathnairn |
| <b>JOB No:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 77356.22                         | <b>DATE:</b>    | October 2018 |                |             |
| <b>CLIENT:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Calibre Consulting (ACT) Pty Ltd |                 |              |                |             |
| <b>CLASSIFICATION PROCEDURES:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                  |                 |              |                |             |
| <b>EXISTING SUBSURFACE CONDITIONS:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                  |                 |              |                |             |
| <b>Test Pit 16:</b> Gravelly sand filling to 0.05 m depth overlying granodiorite to the slow progress depth of 0.7 m.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                  |                 |              |                |             |
| <b>Test Pit 17:</b> Granodiorite with some clay seams to the slow progress depth of 1.3 m.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                  |                 |              |                |             |
| <b>LABORATORY RESULTS:</b> Previous laboratory results indicated liquid limit ranging from 52-81%, plasticity index ranging from 39-68% and linear shrinkage ranging from 13.5-22.5%                                                                                                                                                                                                                                                                                                                                                                                                                  |                                  |                 |              |                |             |
| <b>SITE CLASSIFICATION:</b> Class S (slightly reactive) based on limited subsurface information and determined in general accordance with the requirements of AS2870-2011 (Ref 1). If the building pad is founded entirely on weathered rock, a Class A classification may be appropriate. Therefore the classification must be reassessed should the soil profile change either by adding fill or removing soil from the block and/or if the presence of service trenches or retaining walls are within the zone of influence of the block. Reference should be made to the comments provided below. |                                  |                 |              |                |             |
| <b>FOOTING SYSTEMS:</b> Reference must be made to AS2870-2011 (Ref 1) which indicates footing systems that are appropriate for each site classification. All footings must found within a uniform bearing stratum of suitable strength/material, below the zone of influence of any service trenches, backfill zones, retaining walls or underground structures. Masonry walls should be articulated in accordance with current best practice. Footing systems must be confirmed by a structural engineer taking into consideration any onsite or offsite constraints.                                |                                  |                 |              |                |             |
| <b>MAINTENANCE GUIDELINES:</b> CSIRO Sheet BTF 18 'Foundation Maintenance & Footing Performance' (attached). Refer to comments about gardens, landscaping and trees on the performance of foundation soils.                                                                                                                                                                                                                                                                                                                                                                                           |                                  |                 |              |                |             |
| <b>COMMENTS/<br/>LIMITATIONS:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                  |                 |              |                |             |
| The successful purchaser must make their own interpretations, deductions and conclusions from the information made available and will need to accept full responsibility for such interpretations, deductions and conclusions.                                                                                                                                                                                                                                                                                                                                                                        |                                  |                 |              |                |             |
| Development specific geotechnical investigations must be undertaken.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                  |                 |              |                |             |
| Additional topsoils / filling may have been spread subsequent to the investigation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                  |                 |              |                |             |
| Site preparation prior to the construction should include removal of all vegetation, topsoil and any uncontrolled filling.                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                  |                 |              |                |             |
| All new filling must be placed under controlled conditions (AS 3798-2007). If filling is placed uncontrolled, those areas would require a Class P site classification.                                                                                                                                                                                                                                                                                                                                                                                                                                |                                  |                 |              |                |             |
| Some variability in subsurface conditions must be anticipated.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                  |                 |              |                |             |
| Moisture condition of site soils and/or the presence of groundwater may vary considerably from time of investigation compared to at the time of construction.                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                  |                 |              |                |             |
| Hard rock excavation must be anticipated.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                  |                 |              |                |             |
| It is recommended that footing excavations be inspected by a geotechnical engineer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                  |                 |              |                |             |
| This report must be read in conjunction with the attached notes "Limitations", "About this Report", "Drawing 3", "Explanatory Notes" and "Test Pit Logs (16 and 17)".                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                  |                 |              |                |             |
| <b>REFERENCES:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                  |                 |              |                |             |
| 1. AS 2870-2011 'Residential Slabs and Footings,' Standards Association of Australia.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                  |                 |              |                |             |
| <div><b>Douglas Partners</b><br/>Geotechnics   Environment   Groundwater</div>                                                                                                                                                                                                                                                                                                                                                  |                                  |                 |              |                |             |

## Limitations

Douglas Partners (DP) has prepared this report for this project at Stage 1 Strathnairn in accordance with DP's proposal dated 9 August 2017 and acceptance received from Calibre Consulting (ACT) Pty Ltd dated 29 September 2018. The work was carried out under an amended Calibre Consulting (ACT) Pty Ltd Professional Services Agreement. This report is provided for the exclusive use of Calibre Consulting (ACT) Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the geotechnical components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

# About this Report

# Douglas Partners



## Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

## Copyright

This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

## Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

## Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;

- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

## Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.



# *About this Report*

## **Site Anomalies**

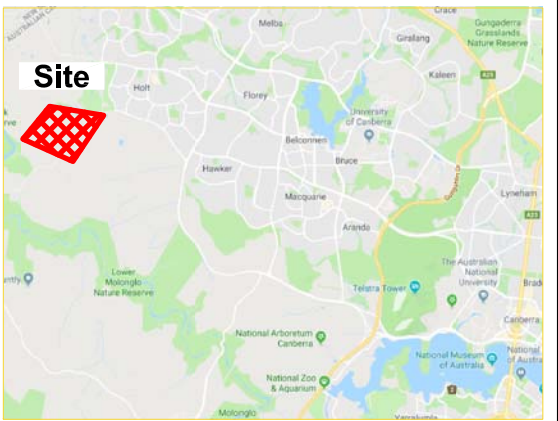
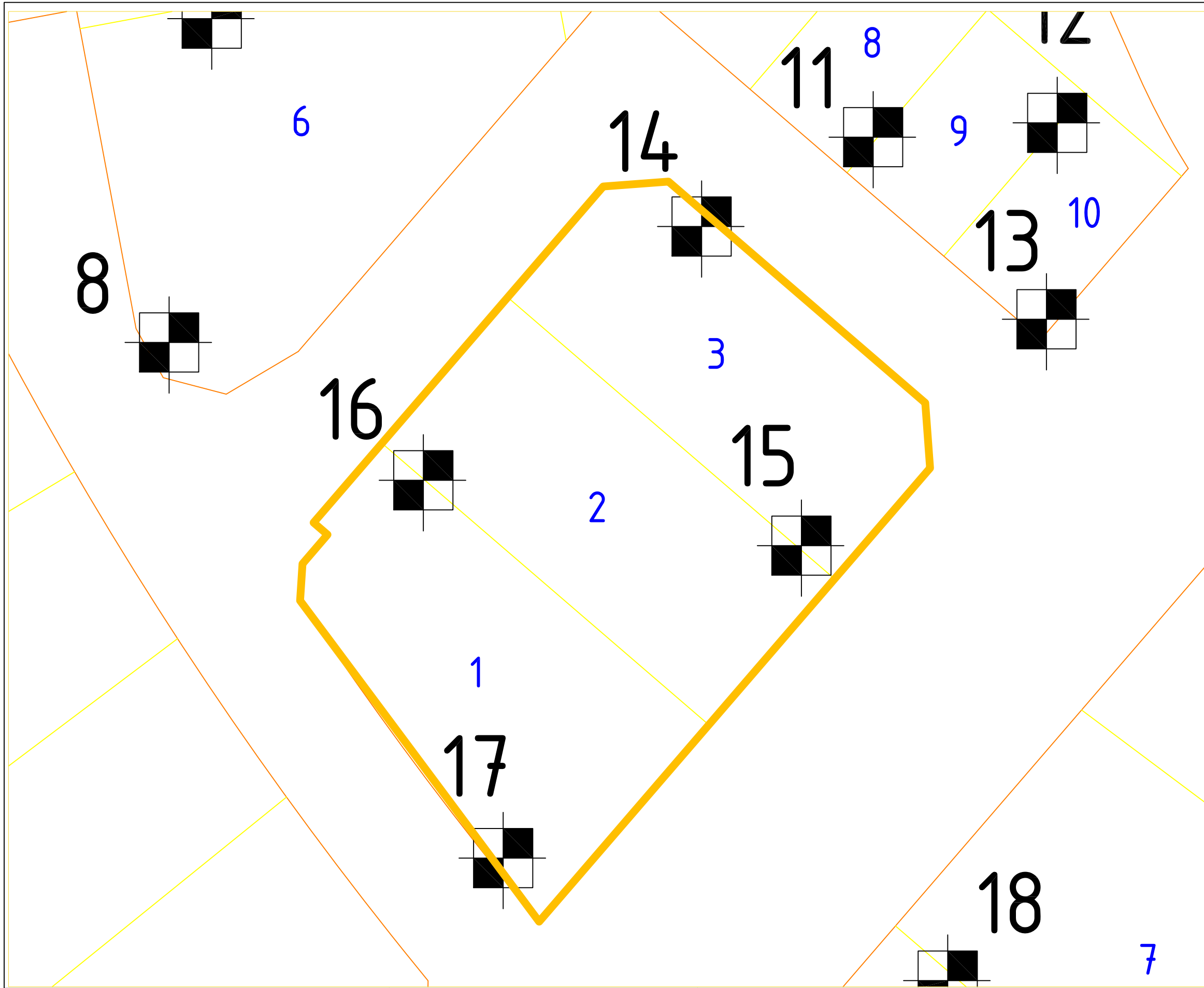
In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

## **Information for Contractual Purposes**

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

## **Site Inspection**

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.



Locality Plan

LEGEND

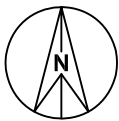
- Test Pit Location
- Block Number
- Block Boundary
- Section Boundary

NOTE: Base drawing from Calibre Consulting (ACT) Pty Ltd



CLIENT: Calibre Consulting (ACT) Pty Ltd  
OFFICE: Canberra  
SCALE: NTS  
DRAWN BY: SDG  
DATE: 18.09.2018

TITLE: **Test Pit Location Plan**  
**Strathnairn Stage 1**  
**Blocks 1 - 3 Section 15, Strathnairn**



PROJECT No: 77356.22  
DRAWING No: 3  
REVISION: 0



## Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

## Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

## Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

## Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low

reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

## Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

## Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

## Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:  
4,6,7  
N=13
- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:  
15, 30/40 mm

# *Sampling Methods*

The results of the SPT tests can be related empirically to the engineering properties of the soils.

## **Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests**

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.





## Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726-1993, Geotechnical Site Investigations Code. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

## Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

| Type    | Particle size (mm) |
|---------|--------------------|
| Boulder | >200               |
| Cobble  | 63 - 200           |
| Gravel  | 2.36 - 63          |
| Sand    | 0.075 - 2.36       |
| Silt    | 0.002 - 0.075      |
| Clay    | <0.002             |

The sand and gravel sizes can be further subdivided as follows:

| Type          | Particle size (mm) |
|---------------|--------------------|
| Coarse gravel | 20 - 63            |
| Medium gravel | 6 - 20             |
| Fine gravel   | 2.36 - 6           |
| Coarse sand   | 0.6 - 2.36         |
| Medium sand   | 0.2 - 0.6          |
| Fine sand     | 0.075 - 0.2        |

The proportions of secondary constituents of soils are described as:

| Term            | Proportion | Example                   |
|-----------------|------------|---------------------------|
| And             | Specify    | Clay (60%) and Sand (40%) |
| Adjective       | 20 - 35%   | Sandy Clay                |
| Slightly        | 12 - 20%   | Slightly Sandy Clay       |
| With some       | 5 - 12%    | Clay with some sand       |
| With a trace of | 0 - 5%     | Clay with a trace of sand |

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

## Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

| Description | Abbreviation | Undrained shear strength (kPa) |
|-------------|--------------|--------------------------------|
| Very soft   | vs           | <12                            |
| Soft        | s            | 12 - 25                        |
| Firm        | f            | 25 - 50                        |
| Stiff       | st           | 50 - 100                       |
| Very stiff  | vst          | 100 - 200                      |
| Hard        | h            | >200                           |

## Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

| Relative Density | Abbreviation | SPT N value | CPT qc value (MPa) |
|------------------|--------------|-------------|--------------------|
| Very loose       | vl           | <4          | <2                 |
| Loose            | l            | 4 - 10      | 2 - 5              |
| Medium dense     | md           | 10 - 30     | 5 - 15             |
| Dense            | d            | 30 - 50     | 15 - 25            |
| Very dense       | vd           | >50         | >25                |

# *Soil Descriptions*

## **Soil Origin**

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.



## Rock Strength

Rock strength is defined by the Point Load Strength Index ( $Is_{(50)}$ ) and refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects. The test procedure is described by Australian Standard 4133.4.1 - 2007. The terms used to describe rock strength are as follows:

| Term           | Abbreviation | Point Load Index<br>$Is_{(50)}$ MPa | Approximate Unconfined<br>Compressive Strength MPa* |
|----------------|--------------|-------------------------------------|-----------------------------------------------------|
| Extremely low  | EL           | <0.03                               | <0.6                                                |
| Very low       | VL           | 0.03 - 0.1                          | 0.6 - 2                                             |
| Low            | L            | 0.1 - 0.3                           | 2 - 6                                               |
| Medium         | M            | 0.3 - 1.0                           | 6 - 20                                              |
| High           | H            | 1 - 3                               | 20 - 60                                             |
| Very high      | VH           | 3 - 10                              | 60 - 200                                            |
| Extremely high | EH           | >10                                 | >200                                                |

\* Assumes a ratio of 20:1 for UCS to  $Is_{(50)}$ . It should be noted that the UCS to  $Is_{(50)}$  ratio varies significantly for different rock types and specific ratios should be determined for each site.

## Degree of Weathering

The degree of weathering of rock is classified as follows:

| Term                 | Abbreviation | Description                                                                                                                                                                                                                                                  |
|----------------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Extremely weathered  | EW           | Rock substance has soil properties, i.e. it can be remoulded and classified as a soil but the texture of the original rock is still evident.                                                                                                                 |
| Highly weathered     | HW           | Limonite staining or bleaching affects whole of rock substance and other signs of decomposition are evident. Porosity and strength may be altered as a result of iron leaching or deposition. Colour and strength of original fresh rock is not recognisable |
| Moderately weathered | MW           | Staining and discolouration of rock substance has taken place                                                                                                                                                                                                |
| Slightly weathered   | SW           | Rock substance is slightly discoloured but shows little or no change of strength from fresh rock                                                                                                                                                             |
| Fresh stained        | Fs           | Rock substance unaffected by weathering but staining visible along defects                                                                                                                                                                                   |
| Fresh                | Fr           | No signs of decomposition or staining                                                                                                                                                                                                                        |

## Degree of Fracturing

The following classification applies to the spacing of natural fractures in diamond drill cores. It includes bedding plane partings, joints and other defects, but excludes drilling breaks.

| Term               | Description                                                       |
|--------------------|-------------------------------------------------------------------|
| Fragmented         | Fragments of <20 mm                                               |
| Highly Fractured   | Core lengths of 20-40 mm with some fragments                      |
| Fractured          | Core lengths of 40-200 mm with some shorter and longer sections   |
| Slightly Fractured | Core lengths of 200-1000 mm with some shorter and longer sections |
| Unbroken           | Core lengths mostly > 1000 mm                                     |

# Rock Descriptions

## Rock Quality Designation

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

$$\text{RQD \%} = \frac{\text{cumulative length of 'sound' core sections} \geq 100 \text{ mm long}}{\text{total drilled length of section being assessed}}$$

where 'sound' rock is assessed to be rock of low strength or better. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

## Stratification Spacing

For sedimentary rocks the following terms may be used to describe the spacing of bedding partings:

| Term                | Separation of Stratification Planes |
|---------------------|-------------------------------------|
| Thinly laminated    | < 6 mm                              |
| Laminated           | 6 mm to 20 mm                       |
| Very thinly bedded  | 20 mm to 60 mm                      |
| Thinly bedded       | 60 mm to 0.2 m                      |
| Medium bedded       | 0.2 m to 0.6 m                      |
| Thickly bedded      | 0.6 m to 2 m                        |
| Very thickly bedded | > 2 m                               |



# Symbols & Abbreviations

## Douglas Partners



### Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

### Drilling or Excavation Methods

|      |                          |
|------|--------------------------|
| C    | Core drilling            |
| R    | Rotary drilling          |
| SFA  | Spiral flight augers     |
| NMLC | Diamond core - 52 mm dia |
| NQ   | Diamond core - 47 mm dia |
| HQ   | Diamond core - 63 mm dia |
| PQ   | Diamond core - 81 mm dia |

### Water

|   |             |
|---|-------------|
| ▷ | Water seep  |
| ▽ | Water level |

### Sampling and Testing

|                 |                                |
|-----------------|--------------------------------|
| A               | Auger sample                   |
| B               | Bulk sample                    |
| D               | Disturbed sample               |
| E               | Environmental sample           |
| U <sub>50</sub> | Undisturbed tube sample (50mm) |
| W               | Water sample                   |
| pp              | Pocket penetrometer (kPa)      |
| PID             | Photo ionisation detector      |
| PL              | Point load strength Is(50) MPa |
| S               | Standard Penetration Test      |
| V               | Shear vane (kPa)               |

### Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

### Defect Type

|     |                 |
|-----|-----------------|
| B   | Bedding plane   |
| Cs  | Clay seam       |
| Cv  | Cleavage        |
| Cz  | Crushed zone    |
| Ds  | Decomposed seam |
| F   | Fault           |
| J   | Joint           |
| Lam | Lamination      |
| Pt  | Parting         |
| Sz  | Sheared Zone    |
| V   | Vein            |

### Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

|    |                |
|----|----------------|
| h  | horizontal     |
| v  | vertical       |
| sh | sub-horizontal |
| sv | sub-vertical   |

### Coating or Infilling Term

|     |          |
|-----|----------|
| cln | clean    |
| co  | coating  |
| he  | healed   |
| inf | infilled |
| stn | stained  |
| ti  | tight    |
| vn  | veneer   |

### Coating Descriptor

|     |              |
|-----|--------------|
| ca  | calcite      |
| cbs | carbonaceous |
| cly | clay         |
| fe  | iron oxide   |
| mn  | manganese    |
| slt | silty        |

### Shape

|    |            |
|----|------------|
| cu | curved     |
| ir | irregular  |
| pl | planar     |
| st | stepped    |
| un | undulating |

### Roughness

|    |              |
|----|--------------|
| po | polished     |
| ro | rough        |
| sl | slickensided |
| sm | smooth       |
| vr | very rough   |

### Other

|     |            |
|-----|------------|
| fg  | fragmented |
| bnd | band       |
| qtz | quartz     |

# Symbols & Abbreviations

## Graphic Symbols for Soil and Rock

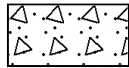
### General



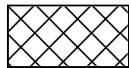
Asphalt



Road base



Concrete



Filling

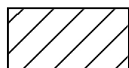
### Soils



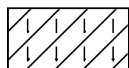
Topsoil



Peat



Clay



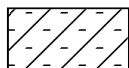
Silty clay



Sandy clay



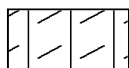
Gravelly clay



Shaly clay



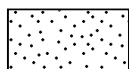
Silt



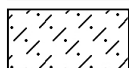
Clayey silt



Sandy silt



Sand



Clayey sand



Silty sand



Gravel



Sandy gravel



Cobbles, boulders



Talus

### Sedimentary Rocks



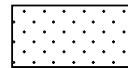
Boulder conglomerate



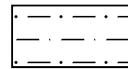
Conglomerate



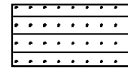
Conglomeratic sandstone



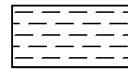
Sandstone



Siltstone



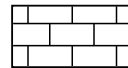
Laminite



Mudstone, claystone, shale

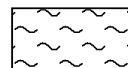


Coal

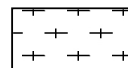


Limestone

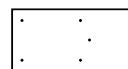
### Metamorphic Rocks



Slate, phyllite, schist

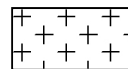


Gneiss

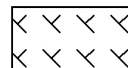


Quartzite

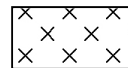
### Igneous Rocks



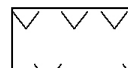
Granite



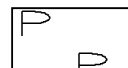
Dolerite, basalt, andesite



Dacite, epidote



Tuff, breccia



Porphyry

# TEST PIT LOG

**CLIENT:** Calibre Consulting (ACT) Pty Ltd  
**PROJECT:** Ginnindery Residential Development  
**LOCATION:** Strathnairn Stage 1

**SURFACE LEVEL:** 584.2 AHD  
**EASTING:** 198723.88  
**NORTHING:** 609415.89

**PIT No:** 16  
**PROJECT No:** 77356.22  
**DATE:** 12/9/2018  
**SHEET 1 OF 1**

| RL  | Depth (m) | Description of Strata                                                                                                                                                                                                             | Graphic Log                                                                       | Sampling & In Situ Testing |       |        |                    | Water | Dynamic Penetrometer Test (blows per mm) |    |    |    |
|-----|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------|-------|--------|--------------------|-------|------------------------------------------|----|----|----|
|     |           |                                                                                                                                                                                                                                   |                                                                                   | Type                       | Depth | Sample | Results & Comments |       | 5                                        | 10 | 15 | 20 |
| 584 | 0.05      | FILLING-generally comprising loose, dry to moist, brown, fine to coarse grained gravelly sand<br><br>GRANODIORITE-extremely low to low strength, extremely to highly weathered, orange/brown, fine to coarse grained granodiorite |  | D                          | 0.6   |        |                    |       |                                          |    |    |    |
|     | 0.7       | Pit discontinued at 0.7m<br>-slow progress                                                                                                                                                                                        |                                                                                   |                            |       |        |                    |       |                                          |    |    |    |
| 583 | 1         |                                                                                                                                                                                                                                   |                                                                                   |                            |       |        |                    |       |                                          |    |    |    |
| 582 | 2         |                                                                                                                                                                                                                                   |                                                                                   |                            |       |        |                    |       |                                          |    |    |    |

**RIG:** Kubota KX057-4 mini-excavator, 300mm bucket

**LOGGED:** SDG

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:**

- ☐ Sand Penetrometer AS1289.6.3.3  
☐ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND |                      |                |                                        |
|-----------------------------------|----------------------|----------------|----------------------------------------|
| A                                 | Auger sample         | G              | Gas sample                             |
| B                                 | Bulk sample          | P              | Piston sample                          |
| BLK                               | Block sample         | U <sub>s</sub> | Tube sample (x mm dia.)                |
| C                                 | Core drilling        | W              | Water sample                           |
| D                                 | Disturbed sample     | W <sub>s</sub> | Water seep                             |
| E                                 | Environmental sample | W <sub>L</sub> | Water level                            |
|                                   |                      | PID            | Photo ionisation detector (ppm)        |
|                                   |                      | PL(A)          | Point load axial test Is(50) (MPa)     |
|                                   |                      | PL(D)          | Point load diametral test Is(50) (MPa) |
|                                   |                      | pp             | Pocket penetrometer (kPa)              |
|                                   |                      | S              | Standard penetration test              |
|                                   |                      | V              | Shear vane (kPa)                       |

# TEST PIT LOG

**CLIENT:** Calibre Consulting (ACT) Pty Ltd  
**PROJECT:** Ginnindery Residential Development  
**LOCATION:** Strathnairn Stage 1

**SURFACE LEVEL:** 584.8 AHD  
**EASTING:** 198728.96  
**NORTHING:** 609391.37

**PIT No: 17**  
**PROJECT No: 77356.22**  
**DATE: 12/9/2018**  
**SHEET 1 OF 1**

[illegible]

**RIG:** Kubota KX057-4 mini-excavator, 300mm bucket

**LOGGED: SDG**

**SURVEY DATUM: MGA94**

**WATER OBSERVATIONS:** No free groundwater observed

## REMARKS:

- ☐ Sand Penetrometer AS1289.6.3.3
- ☐ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND |                      |                    |                                        |
|-----------------------------------|----------------------|--------------------|----------------------------------------|
| A                                 | Auger sample         | G                  | Gas sample                             |
| B                                 | Bulk sample          | P                  | Piston sample                          |
| BLK                               | Block sample         | U <sub>s</sub>     | Tube sample (x mm dia.)                |
| C                                 | Core drilling        | W                  | Water sample                           |
| D                                 | Disturbed sample     | W <sub>seep</sub>  | Water seep                             |
| E                                 | Environmental sample | W <sub>level</sub> | Water level                            |
|                                   |                      | PID                | Photo ionisation detector (ppm)        |
|                                   |                      | PL(A)              | Point load axial test Is(50) (MPa)     |
|                                   |                      | PL(D)              | Point load diametral test Is(50) (MPa) |
|                                   |                      | pp                 | Pocket penetrometer (kPa)              |
|                                   |                      | S                  | Standard penetration test              |
|                                   |                      | V                  | Shear vane (kPa)                       |





# Foundation Maintenance and Footing Performance: A Homeowner's Guide



**BTF 18**  
replaces  
**Information**  
**Sheet 10/91**

Buildings can and often do move. This movement can be up, down, lateral or rotational. The fundamental cause of movement in buildings can usually be related to one or more problems in the foundation soil. It is important for the homeowner to identify the soil type in order to ascertain the measures that should be put in place in order to ensure that problems in the foundation soil can be prevented, thus protecting against building movement.

This Building Technology File is designed to identify causes of soil-related building movement, and to suggest methods of prevention of resultant cracking in buildings.

## Soil Types

The types of soils usually present under the topsoil in land zoned for residential buildings can be split into two approximate groups – granular and clay. Quite often, foundation soil is a mixture of both types. The general problems associated with soils having granular content are usually caused by erosion. Clay soils are subject to saturation and swell/shrink problems.

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870, the Residential Slab and Footing Code.

## Causes of Movement

### Settlement due to construction

There are two types of settlement that occur as a result of construction:

- Immediate settlement occurs when a building is first placed on its foundation soil, as a result of compaction of the soil under the weight of the structure. The cohesive quality of clay soil mitigates against this, but granular (particularly sandy) soil is susceptible.
- Consolidation settlement is a feature of clay soil and may take place because of the expulsion of moisture from the soil or because of the soil's lack of resistance to local compressive or shear stresses. This will usually take place during the first few months after construction, but has been known to take many years in exceptional cases.

These problems are the province of the builder and should be taken into consideration as part of the preparation of the site for construction. Building Technology File 19 (BTF 19) deals with these problems.

### Erosion

All soils are prone to erosion, but sandy soil is particularly susceptible to being washed away. Even clay with a sand component of say 10% or more can suffer from erosion.

### Saturation

This is particularly a problem in clay soils. Saturation creates a bog-like suspension of the soil that causes it to lose virtually all of its bearing capacity. To a lesser degree, sand is affected by saturation because saturated sand may undergo a reduction in volume – particularly imported sand fill for bedding and blinding layers. However, this usually occurs as immediate settlement and should normally be the province of the builder.

### Seasonal swelling and shrinkage of soil

All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below). The degree of increase varies considerably between different clays, as does the degree of decrease during the subsequent drying out caused by fair weather periods. Because of the low absorption and expulsion rate, this phenomenon will not usually be noticeable unless there are prolonged rainy or dry periods, usually of weeks or months, depending on the land and soil characteristics.

The swelling of soil creates an upward force on the footings of the building, and shrinkage creates subsidence that takes away the support needed by the footing to retain equilibrium.

### Shear failure

This phenomenon occurs when the foundation soil does not have sufficient strength to support the weight of the footing. There are two major post-construction causes:

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.
- In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

## GENERAL DEFINITIONS OF SITE CLASSES

| Class  | Foundation                                                                                                                                                                                                                                            |
|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A      | Most sand and rock sites with little or no ground movement from moisture changes                                                                                                                                                                      |
| S      | Slightly reactive clay sites with only slight ground movement from moisture changes                                                                                                                                                                   |
| M      | Moderately reactive clay or silt sites, which can experience moderate ground movement from moisture changes                                                                                                                                           |
| H      | Highly reactive clay sites, which can experience high ground movement from moisture changes                                                                                                                                                           |
| E      | Extremely reactive sites, which can experience extreme ground movement from moisture changes                                                                                                                                                          |
| A to P | Filled sites                                                                                                                                                                                                                                          |
| P      | Sites which include soft soils, such as soft clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise |

### Tree root growth

Trees and shrubs that are allowed to grow in the vicinity of footings can cause foundation soil movement in two ways:

- Roots that grow under footings may increase in cross-sectional size, exerting upward pressure on footings.
- Roots in the vicinity of footings will absorb much of the moisture in the foundation soil, causing shrinkage or subsidence.

### Unevenness of Movement

The types of ground movement described above usually occur unevenly throughout the building's foundation soil. Settlement due to construction tends to be uneven because of:

- Differing compaction of foundation soil prior to construction.
- Differing moisture content of foundation soil prior to construction.

Movement due to non-construction causes is usually more uneven still. Erosion can undermine a footing that traverses the flow or can create the conditions for shear failure by eroding soil adjacent to a footing that runs in the same direction as the flow.

Saturation of clay foundation soil may occur where subfloor walls create a dam that makes water pond. It can also occur wherever there is a source of water near footings in clay soil. This leads to a severe reduction in the strength of the soil which may create local shear failure.

Seasonal swelling and shrinkage of clay soil affects the perimeter of the building first, then gradually spreads to the interior. The swelling process will usually begin at the uphill extreme of the building, or on the weather side where the land is flat. Swelling gradually reaches the interior soil as absorption continues. Shrinkage usually begins where the sun's heat is greatest.

### Effects of Uneven Soil Movement on Structures

#### Erosion and saturation

Erosion removes the support from under footings, tending to create subsidence of the part of the structure under which it occurs. Brickwork walls will resist the stress created by this removal of support by bridging the gap or cantilevering until the bricks or the mortar bedding fail. Older masonry has little resistance. Evidence of failure varies according to circumstances and symptoms may include:

- Step cracking in the mortar beds in the body of the wall or above/below openings such as doors or windows.
- Vertical cracking in the bricks (usually but not necessarily in line with the vertical beds or perpendes).

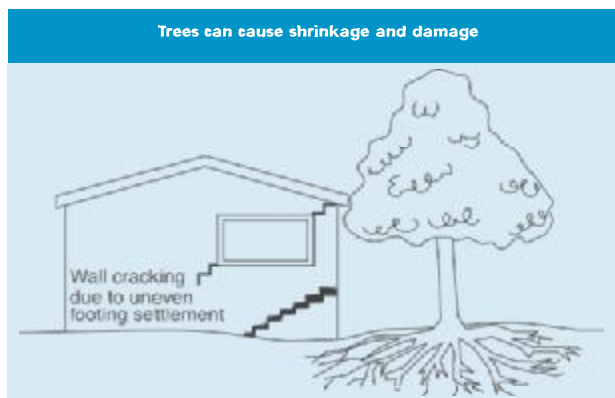
Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

#### Seasonal swelling/shrinkage in clay

Swelling foundation soil due to rainy periods first lifts the most exposed extremities of the footing system, then the remainder of the perimeter footings while gradually permeating inside the building footprint to lift internal footings. This swelling first tends to create a dish effect, because the external footings are pushed higher than the internal ones.

The first noticeable symptom may be that the floor appears slightly dished. This is often accompanied by some doors binding on the floor or the door head, together with some cracking of cornice mitres. In buildings with timber flooring supported by bearers and joists, the floor can be bouncy. Externally there may be visible dishing of the hip or ridge lines.

As the moisture absorption process completes its journey to the innermost areas of the building, the internal footings will rise. If the spread of moisture is roughly even, it may be that the symptoms will temporarily disappear, but it is more likely that swelling will be uneven, creating a difference rather than a disappearance in symptoms. In buildings with timber flooring supported by bearers and joists, the isolated piers will rise more easily than the strip footings or piers under walls, creating noticeable doming of flooring.



As the weather pattern changes and the soil begins to dry out, the external footings will be first affected, beginning with the locations where the sun's effect is strongest. This has the effect of lowering the external footings. The doming is accentuated and cracking reduces or disappears where it occurred because of dishing, but other cracks open up. The roof lines may become convex.

Doming and dishing are also affected by weather in other ways. In areas where warm, wet summers and cooler dry winters prevail, water migration tends to be toward the interior and doming will be accentuated, whereas where summers are dry and winters are cold and wet, migration tends to be toward the exterior and the underlying propensity is toward dishing.

#### Movement caused by tree roots

In general, growing roots will exert an upward pressure on footings, whereas soil subject to drying because of tree or shrub roots will tend to remove support from under footings by inducing shrinkage.

#### Complications caused by the structure itself

Most forces that the soil causes to be exerted on structures are vertical – i.e. either up or down. However, because these forces are seldom spread evenly around the footings, and because the building resists uneven movement because of its rigidity, forces are exerted from one part of the building to another. The net result of all these forces is usually rotational. This resultant force often complicates the diagnosis because the visible symptoms do not simply reflect the original cause. A common symptom is binding of doors on the vertical member of the frame.

#### Effects on full masonry structures

Brickwork will resist cracking where it can. It will attempt to span areas that lose support because of subsided foundations or raised points. It is therefore usual to see cracking at weak points, such as openings for windows or doors.

In the event of construction settlement, cracking will usually remain unchanged after the process of settlement has ceased.

With local shear or erosion, cracking will usually continue to develop until the original cause has been remedied, or until the subsidence has completely neutralised the affected portion of footing and the structure has stabilised on other footings that remain effective.

In the case of swell/shrink effects, the brickwork will in some cases return to its original position after completion of a cycle, however it is more likely that the rotational effect will not be exactly reversed, and it is also usual that brickwork will settle in its new position and will resist the forces trying to return it to its original position. This means that in a case where swelling takes place after construction and cracking occurs, the cracking is likely to at least partly remain after the shrink segment of the cycle is complete. Thus, each time the cycle is repeated, the likelihood is that the cracking will become wider until the sections of brickwork become virtually independent.

With repeated cycles, once the cracking is established, if there is no other complication, it is normal for the incidence of cracking to stabilise, as the building has the articulation it needs to cope with the problem. This is by no means always the case, however, and monitoring of cracks in walls and floors should always be treated seriously.

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also exert lateral forces that attempt to separate sections of brickwork after initial cracking has occurred.

The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls (depending on the roof type) comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

#### Effects on framed structures

Timber or steel framed buildings are less likely to exhibit cracking due to swell/shrink than masonry buildings because of their flexibility. Also, the doming/dishing effects tend to be lower because of the lighter weight of walls. The main risks to framed buildings are encountered because of the isolated pier footings used under walls. Where erosion or saturation cause a footing to fall away, this can double the span which a wall must bridge. This additional stress can create cracking in wall linings, particularly where there is a weak point in the structure caused by a door or window opening. It is, however, unlikely that framed structures will be so stressed as to suffer serious damage without first exhibiting some or all of the above symptoms for a considerable period. The same warning period should apply in the case of upheaval. It should be noted, however, that where framed buildings are supported by strip footings there is only one leaf of brickwork and therefore the externally visible walls are the supporting structure for the building. In this case, the subfloor masonry walls can be expected to behave as full brickwork walls.

#### Effects on brick veneer structures

Because the load-bearing structure of a brick veneer building is the frame that makes up the interior leaf of the external walls plus perhaps the internal walls, depending on the type of roof, the building can be expected to behave as a framed structure, except that the external masonry will behave in a similar way to the external leaf of a full masonry structure.

### Water Service and Drainage

Where a water service pipe, a sewer or stormwater drainage pipe is in the vicinity of a building, a water leak can cause erosion, swelling or saturation of susceptible soil. Even a minuscule leak can be enough to saturate a clay foundation. A leaking tap near a building can have the same effect. In addition, trenches containing pipes can become watercourses even though backfilled, particularly where broken rubble is used as fill. Water that runs along these trenches can be responsible for serious erosion, interstrata seepage into subfloor areas and saturation.

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem.

Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.

- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

### Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870.

AS 2870 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

### Prevention/Cure

#### Plumbing

Where building movement is caused by water service, roof plumbing, sewer or stormwater failure, the remedy is to repair the problem. It is prudent, however, to consider also rerouting pipes away from the building where possible, and relocating taps to positions where any leakage will not direct water to the building vicinity. Even where gully traps are present, there is sometimes sufficient spill to create erosion or saturation, particularly in modern installations using smaller diameter PVC fixtures. Indeed, some gully traps are not situated directly under the taps that are installed to charge them, with the result that water from the tap may enter the backfilled trench that houses the sewer piping. If the trench has been poorly backfilled, the water will either pond or flow along the bottom of the trench. As these trenches usually run alongside the footings and can be at a similar depth, it is not hard to see how any water that is thus directed into a trench can easily affect the foundation's ability to support footings or even gain entry to the subfloor area.

#### Ground drainage

In all soils there is the capacity for water to travel on the surface and below it. Surface water flows can be established by inspection during and after heavy or prolonged rain. If necessary, a grated drain system connected to the stormwater collection system is usually an easy solution.

It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

#### Protection of the building perimeter

It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

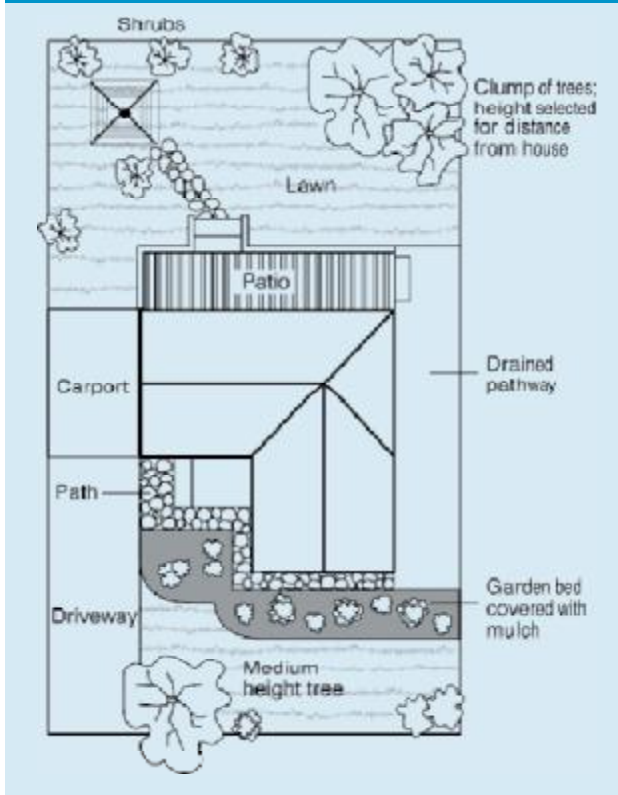
For this reason, particularly where problems exist or are likely to occur, it is recommended that an apron of paving be installed around as much of the building perimeter as necessary. This paving

### CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

| Description of typical damage and required repair                                                                                                                                                                                       | Approximate crack width limit (see Note 3)                | Damage category |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|-----------------|
| Hairline cracks                                                                                                                                                                                                                         | <0.1 mm                                                   | 0               |
| Fine cracks which do not need repair                                                                                                                                                                                                    | <1 mm                                                     | 1               |
| Cracks noticeable but easily filled. Doors and windows stick slightly                                                                                                                                                                   | <5 mm                                                     | 2               |
| Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weathertightness often impaired                                                               | 5–15 mm (or a number of cracks 3 mm or more in one group) | 3               |
| Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably, some loss of bearing in beams. Service pipes disrupted | 15–25 mm but also depend on number of cracks              | 4               |



#### Gardens for a reactive site



should extend outwards a minimum of 900 mm (more in highly reactive soil) and should have a minimum fall away from the building of 1:60. The finished paving should be no less than 100 mm below brick vent bases.

It is prudent to relocate drainage pipes away from this paving, if possible, to avoid complications from future leakage. If this is not practical, earthenware pipes should be replaced by PVC and backfilling should be of the same soil type as the surrounding soil and compacted to the same density.

Except in areas where freezing of water is an issue, it is wise to remove taps in the building area and relocate them well away from the building – preferably not uphill from it (see BTF 19).

It may be desirable to install a grated drain at the outside edge of the paving on the uphill side of the building. If subsoil drainage is needed this can be installed under the surface drain.

#### Condensation

In buildings with a subfloor void such as where bearers and joists support flooring, insufficient ventilation creates ideal conditions for condensation, particularly where there is little clearance between the floor and the ground. Condensation adds to the moisture already present in the subfloor and significantly slows the process of drying out. Installation of an adequate subfloor ventilation system, either natural or mechanical, is desirable.

**Warning:** Although this Building Technology File deals with cracking in buildings, it should be said that subfloor moisture can result in the development of other problems, notably:

- Water that is transmitted into masonry, metal or timber building elements causes damage and/or decay to those elements.
- High subfloor humidity and moisture content create an ideal environment for various pests, including termites and spiders.
- Where high moisture levels are transmitted to the flooring and walls, an increase in the dust mite count can ensue within the living areas. Dust mites, as well as dampness in general, can be a health hazard to inhabitants, particularly those who are abnormally susceptible to respiratory ailments.

#### The garden

The ideal vegetation layout is to have lawn or plants that require only light watering immediately adjacent to the drainage or paving edge, then more demanding plants, shrubs and trees spread out in that order.

Overwatering due to misuse of automatic watering systems is a common cause of saturation and water migration under footings. If it is necessary to use these systems, it is important to remove garden beds to a completely safe distance from buildings.

#### Existing trees

Where a tree is causing a problem of soil drying or there is the existence or threat of upheaval of footings, if the offending roots are subsidiary and their removal will not significantly damage the tree, they should be severed and a concrete or metal barrier placed vertically in the soil to prevent future root growth in the direction of the building. If it is not possible to remove the relevant roots without damage to the tree, an application to remove the tree should be made to the local authority. A prudent plan is to transplant likely offenders before they become a problem.

#### Information on trees, plants and shrubs

State departments overseeing agriculture can give information regarding root patterns, volume of water needed and safe distance from buildings of most species. Botanic gardens are also sources of information. For information on plant roots and drains, see Building Technology File 17.

#### Excavation

Excavation around footings must be properly engineered. Soil supporting footings can only be safely excavated at an angle that allows the soil under the footing to remain stable. This angle is called the angle of repose (or friction) and varies significantly between soil types and conditions. Removal of soil within the angle of repose will cause subsidence.

#### Remediation

Where erosion has occurred that has washed away soil adjacent to footings, soil of the same classification should be introduced and compacted to the same density. Where footings have been undermined, augmentation or other specialist work may be required. Remediation of footings and foundations is generally the realm of a specialist consultant.

Where isolated footings rise and fall because of swell/shrink effect, the homeowner may be tempted to alleviate floor bounce by filling the gap that has appeared between the bearer and the pier with blocking. The danger here is that when the next swell segment of the cycle occurs, the extra blocking will push the floor up into an accentuated dome and may also cause local shear failure in the soil. If it is necessary to use blocking, it should be by a pair of fine wedges and monitoring should be carried out fortnightly.

**This BTF was prepared by John Lewer FAIB, MIAMA, Partner, Construction Diagnosis.**

The information in this and other issues in the series was derived from various sources and was believed to be correct when published.

The information is advisory. It is provided in good faith and not claimed to be an exhaustive treatment of the relevant subject.

Further professional advice needs to be obtained before taking any action based on the information provided.

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# SITE CLASSIFICATION REPORT SUMMARY

**BLOCK:** 2 (b)      **SECTION:** 15 (AH)      **SUBURB:** Strathnairn  
**JOB No:** 77356.22      **DATE:** October 2018  
**CLIENT:** Calibre Consulting (ACT) Pty Ltd

## CLASSIFICATION PROCEDURES:

### EXISTING SUBSURFACE CONDITIONS:

**Test Pit 15:** Gravelly sand filling to 0.5 m depth, then clay with trace sand to 0.7 m depth overlying granodiorite to the slow progress depth of 1.1 m.

**Test Pit 16:** Gravelly sand filling to 0.05m depth overlying granodiorite to the slow progress depth of 0.7 m.

**BULK EARTHWORKS:** Filling within the block was placed under Level 1 control as defined in AS 3798 – 2007 (Ref 1).

**LABORATORY RESULTS:** Previous laboratory results indicated liquid limit ranging from 52-81%, plasticity index ranging from 39-68% and linear shrinkage ranging from 13.5-22.5%

**SITE CLASSIFICATION:** Class S\* (slightly reactive/filled block) based on limited subsurface information and determined in general accordance with the requirements of AS2870-2011 (Ref 1) inclusive of additional ground movements resulting from the presence of former and existing trees. If the building pad is founded entirely on weathered rock, a Class A classification may be appropriate. Therefore the classification must be reassessed should the soil profile change either by adding fill or removing soil from the block and/or if the presence of service trenches or retaining walls are within the zone of influence of the block.

**FOOTING SYSTEMS:** Reference must be made to AS2870-2011 (Ref 2) which indicates footing systems that are appropriate for each site classification. All footings must be founded within a uniform bearing stratum of suitable strength/material, below the zone of influence of any service trenches, backfill zones, retaining walls or underground structures. Masonry walls should be articulated in accordance with current best practice. Footing systems must be confirmed by a structural engineer taking into consideration any onsite or offsite constraints.

**MAINTENANCE GUIDELINES:** CSIRO Sheet BTF 18 'Foundation Maintenance & Footing Performance' (attached). Refer to comments about gardens, landscaping and trees on the performance of foundation soils.

### COMMENTS/ LIMITATIONS:

The successful purchaser must make their own interpretations, deductions and conclusions from the information made available and will need to accept full responsibility for such interpretations, deductions and conclusions.

Development specific geotechnical investigations must be undertaken.

Additional topsoils / filling may have been spread subsequent to the investigation.

Site preparation prior to the construction should include removal of all vegetation, topsoil and any uncontrolled filling.

All new filling must be placed under controlled conditions (AS 3798-2007). If filling is placed uncontrolled, those areas would require a Class P site classification.

Some variability in subsurface conditions must be anticipated.

Moisture condition of site soils and/or the presence of groundwater may vary considerably from time of investigation compared to at the time of construction.

Hard rock excavation must be anticipated.

It is recommended that footing excavations be inspected by a geotechnical engineer.

This report must be read in conjunction with the attached notes "Limitations", "About this Report", "Drawing 3", "Explanatory Notes" and "Test Pit Logs (15 and 16)".

### REFERENCES:

1. AS 3798-2007 'Guidelines on Earthworks for Commercial and Residential Developments', Standards Association of Australia.
2. AS 2870-2011 'Residential Slabs and Footings', Standards Association of Australia.

*Handwritten signature*



**Douglas Partners**  
 Geotechnics | Environment | Groundwater

## Limitations

Douglas Partners (DP) has prepared this report for this project at Stage 1 Strathnairn in accordance with DP's proposal dated 9 August 2017 and acceptance received from Calibre Consulting (ACT) Pty Ltd dated 29 September 2018. The work was carried out under an amended Calibre Consulting (ACT) Pty Ltd Professional Services Agreement. This report is provided for the exclusive use of Calibre Consulting (ACT) Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the geotechnical components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

# About this Report

# Douglas Partners



## Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

## Copyright

This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

## Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

## Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;

- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

## Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

# *About this Report*

## **Site Anomalies**

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

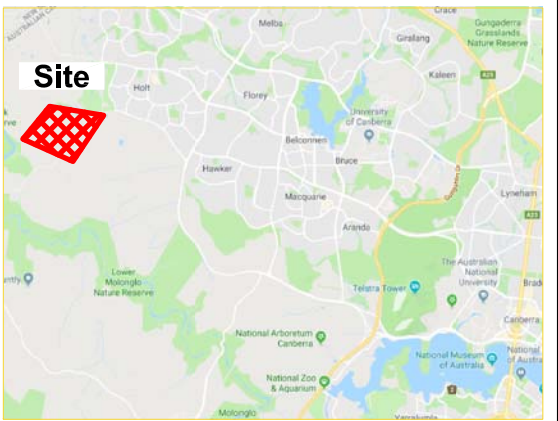
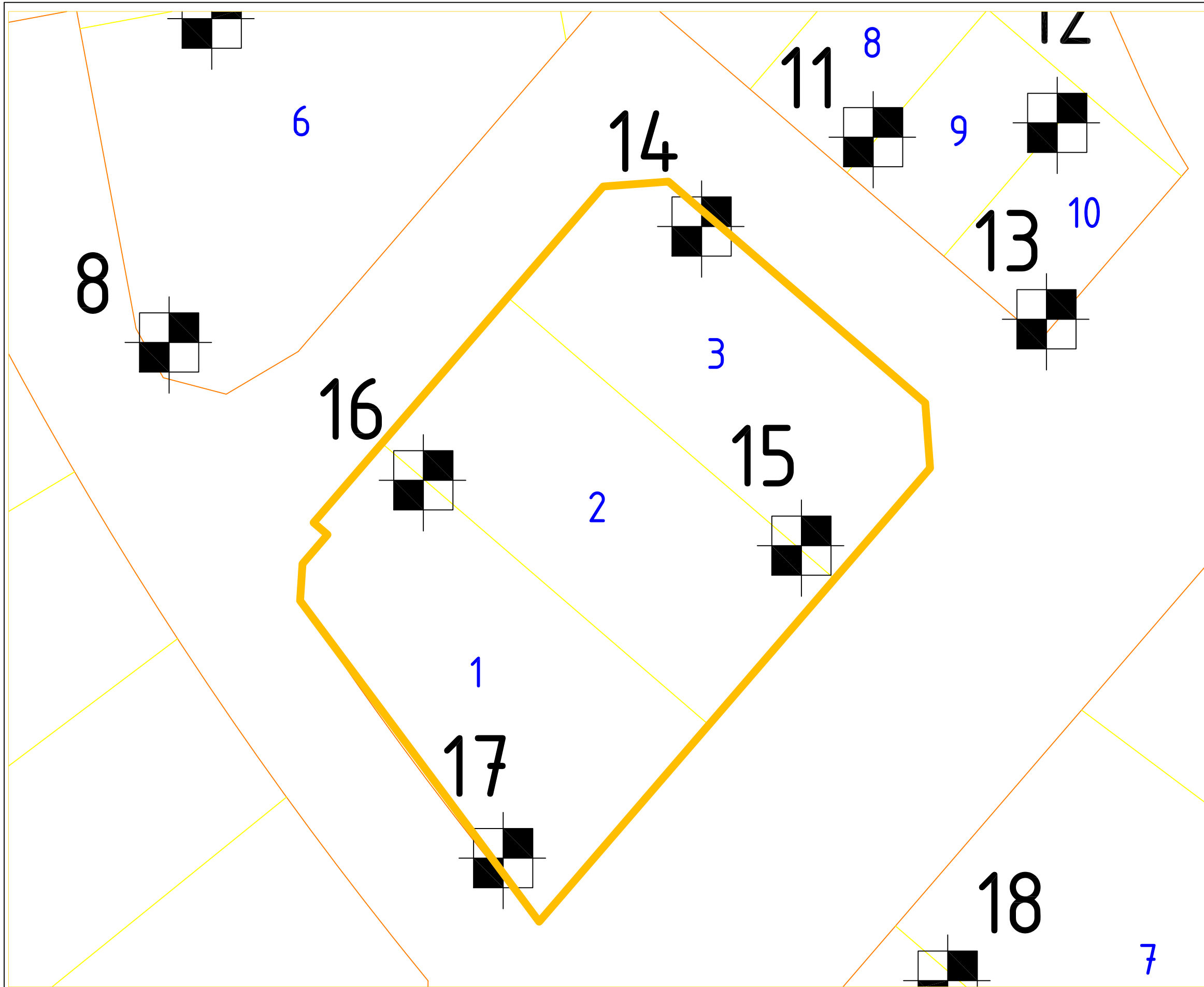
## **Information for Contractual Purposes**

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

## **Site Inspection**

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.





Locality Plan

LEGEND

- Test Pit Location
- Block Number
- Block Boundary
- Section Boundary

NOTE: Base drawing from Calibre Consulting (ACT) Pty Ltd



CLIENT: Calibre Consulting (ACT) Pty Ltd

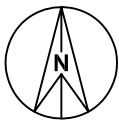
OFFICE: Canberra

DRAWN BY: SDG

SCALE: NTS

DATE: 18.09.2018

TITLE: **Test Pit Location Plan**  
**Strathnairn Stage 1**  
**Blocks 1 - 3 Section 15, Strathnairn**



PROJECT No: 77356.22

DRAWING No: 3

REVISION: 0



## Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

## Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

## Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

## Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low

reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

## Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

## Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

## Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:  
4,6,7  
N=13
- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:  
15, 30/40 mm

# *Sampling Methods*

The results of the SPT tests can be related empirically to the engineering properties of the soils.

## **Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests**

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.



## Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726-1993, Geotechnical Site Investigations Code. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

## Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

| Type    | Particle size (mm) |
|---------|--------------------|
| Boulder | >200               |
| Cobble  | 63 - 200           |
| Gravel  | 2.36 - 63          |
| Sand    | 0.075 - 2.36       |
| Silt    | 0.002 - 0.075      |
| Clay    | <0.002             |

The sand and gravel sizes can be further subdivided as follows:

| Type          | Particle size (mm) |
|---------------|--------------------|
| Coarse gravel | 20 - 63            |
| Medium gravel | 6 - 20             |
| Fine gravel   | 2.36 - 6           |
| Coarse sand   | 0.6 - 2.36         |
| Medium sand   | 0.2 - 0.6          |
| Fine sand     | 0.075 - 0.2        |

The proportions of secondary constituents of soils are described as:

| Term            | Proportion | Example                   |
|-----------------|------------|---------------------------|
| And             | Specify    | Clay (60%) and Sand (40%) |
| Adjective       | 20 - 35%   | Sandy Clay                |
| Slightly        | 12 - 20%   | Slightly Sandy Clay       |
| With some       | 5 - 12%    | Clay with some sand       |
| With a trace of | 0 - 5%     | Clay with a trace of sand |

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

## Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

| Description | Abbreviation | Undrained shear strength (kPa) |
|-------------|--------------|--------------------------------|
| Very soft   | vs           | <12                            |
| Soft        | s            | 12 - 25                        |
| Firm        | f            | 25 - 50                        |
| Stiff       | st           | 50 - 100                       |
| Very stiff  | vst          | 100 - 200                      |
| Hard        | h            | >200                           |

## Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

| Relative Density | Abbreviation | SPT N value | CPT qc value (MPa) |
|------------------|--------------|-------------|--------------------|
| Very loose       | vl           | <4          | <2                 |
| Loose            | l            | 4 - 10      | 2 - 5              |
| Medium dense     | md           | 10 - 30     | 5 - 15             |
| Dense            | d            | 30 - 50     | 15 - 25            |
| Very dense       | vd           | >50         | >25                |



# *Soil Descriptions*

## **Soil Origin**

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.



## Rock Strength

Rock strength is defined by the Point Load Strength Index ( $Is_{(50)}$ ) and refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects. The test procedure is described by Australian Standard 4133.4.1 - 2007. The terms used to describe rock strength are as follows:

| Term           | Abbreviation | Point Load Index<br>$Is_{(50)}$ MPa | Approximate Unconfined<br>Compressive Strength MPa* |
|----------------|--------------|-------------------------------------|-----------------------------------------------------|
| Extremely low  | EL           | <0.03                               | <0.6                                                |
| Very low       | VL           | 0.03 - 0.1                          | 0.6 - 2                                             |
| Low            | L            | 0.1 - 0.3                           | 2 - 6                                               |
| Medium         | M            | 0.3 - 1.0                           | 6 - 20                                              |
| High           | H            | 1 - 3                               | 20 - 60                                             |
| Very high      | VH           | 3 - 10                              | 60 - 200                                            |
| Extremely high | EH           | >10                                 | >200                                                |

\* Assumes a ratio of 20:1 for UCS to  $Is_{(50)}$ . It should be noted that the UCS to  $Is_{(50)}$  ratio varies significantly for different rock types and specific ratios should be determined for each site.

## Degree of Weathering

The degree of weathering of rock is classified as follows:

| Term                 | Abbreviation | Description                                                                                                                                                                                                                                                  |
|----------------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Extremely weathered  | EW           | Rock substance has soil properties, i.e. it can be remoulded and classified as a soil but the texture of the original rock is still evident.                                                                                                                 |
| Highly weathered     | HW           | Limonite staining or bleaching affects whole of rock substance and other signs of decomposition are evident. Porosity and strength may be altered as a result of iron leaching or deposition. Colour and strength of original fresh rock is not recognisable |
| Moderately weathered | MW           | Staining and discolouration of rock substance has taken place                                                                                                                                                                                                |
| Slightly weathered   | SW           | Rock substance is slightly discoloured but shows little or no change of strength from fresh rock                                                                                                                                                             |
| Fresh stained        | Fs           | Rock substance unaffected by weathering but staining visible along defects                                                                                                                                                                                   |
| Fresh                | Fr           | No signs of decomposition or staining                                                                                                                                                                                                                        |

## Degree of Fracturing

The following classification applies to the spacing of natural fractures in diamond drill cores. It includes bedding plane partings, joints and other defects, but excludes drilling breaks.

| Term               | Description                                                       |
|--------------------|-------------------------------------------------------------------|
| Fragmented         | Fragments of <20 mm                                               |
| Highly Fractured   | Core lengths of 20-40 mm with some fragments                      |
| Fractured          | Core lengths of 40-200 mm with some shorter and longer sections   |
| Slightly Fractured | Core lengths of 200-1000 mm with some shorter and longer sections |
| Unbroken           | Core lengths mostly > 1000 mm                                     |

# Rock Descriptions

## Rock Quality Designation

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

$$\text{RQD \%} = \frac{\text{cumulative length of 'sound' core sections} \geq 100 \text{ mm long}}{\text{total drilled length of section being assessed}}$$

where 'sound' rock is assessed to be rock of low strength or better. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

## Stratification Spacing

For sedimentary rocks the following terms may be used to describe the spacing of bedding partings:

| Term                | Separation of Stratification Planes |
|---------------------|-------------------------------------|
| Thinly laminated    | < 6 mm                              |
| Laminated           | 6 mm to 20 mm                       |
| Very thinly bedded  | 20 mm to 60 mm                      |
| Thinly bedded       | 60 mm to 0.2 m                      |
| Medium bedded       | 0.2 m to 0.6 m                      |
| Thickly bedded      | 0.6 m to 2 m                        |
| Very thickly bedded | > 2 m                               |

# Symbols & Abbreviations

## Douglas Partners



### Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

### Drilling or Excavation Methods

|      |                          |
|------|--------------------------|
| C    | Core drilling            |
| R    | Rotary drilling          |
| SFA  | Spiral flight augers     |
| NMLC | Diamond core - 52 mm dia |
| NQ   | Diamond core - 47 mm dia |
| HQ   | Diamond core - 63 mm dia |
| PQ   | Diamond core - 81 mm dia |

### Water

|   |             |
|---|-------------|
| ▷ | Water seep  |
| ▽ | Water level |

### Sampling and Testing

|                 |                                |
|-----------------|--------------------------------|
| A               | Auger sample                   |
| B               | Bulk sample                    |
| D               | Disturbed sample               |
| E               | Environmental sample           |
| U <sub>50</sub> | Undisturbed tube sample (50mm) |
| W               | Water sample                   |
| pp              | Pocket penetrometer (kPa)      |
| PID             | Photo ionisation detector      |
| PL              | Point load strength Is(50) MPa |
| S               | Standard Penetration Test      |
| V               | Shear vane (kPa)               |

### Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

### Defect Type

|     |                 |
|-----|-----------------|
| B   | Bedding plane   |
| Cs  | Clay seam       |
| Cv  | Cleavage        |
| Cz  | Crushed zone    |
| Ds  | Decomposed seam |
| F   | Fault           |
| J   | Joint           |
| Lam | Lamination      |
| Pt  | Parting         |
| Sz  | Sheared Zone    |
| V   | Vein            |

### Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

|    |                |
|----|----------------|
| h  | horizontal     |
| v  | vertical       |
| sh | sub-horizontal |
| sv | sub-vertical   |

### Coating or Infilling Term

|     |          |
|-----|----------|
| cln | clean    |
| co  | coating  |
| he  | healed   |
| inf | infilled |
| stn | stained  |
| ti  | tight    |
| vn  | veneer   |

### Coating Descriptor

|     |              |
|-----|--------------|
| ca  | calcite      |
| cbs | carbonaceous |
| cly | clay         |
| fe  | iron oxide   |
| mn  | manganese    |
| slt | silty        |

### Shape

|    |            |
|----|------------|
| cu | curved     |
| ir | irregular  |
| pl | planar     |
| st | stepped    |
| un | undulating |

### Roughness

|    |              |
|----|--------------|
| po | polished     |
| ro | rough        |
| sl | slickensided |
| sm | smooth       |
| vr | very rough   |

### Other

|     |            |
|-----|------------|
| fg  | fragmented |
| bnd | band       |
| qtz | quartz     |



# Symbols & Abbreviations

## Graphic Symbols for Soil and Rock

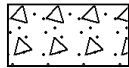
### General



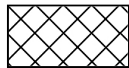
Asphalt



Road base



Concrete



Filling

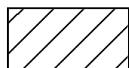
### Soils



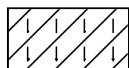
Topsoil



Peat



Clay



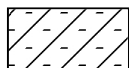
Silty clay



Sandy clay



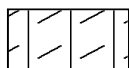
Gravelly clay



Shaly clay



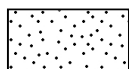
Silt



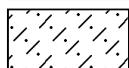
Clayey silt



Sandy silt



Sand



Clayey sand



Silty sand



Gravel



Sandy gravel



Cobbles, boulders



Talus

### Sedimentary Rocks



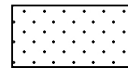
Boulder conglomerate



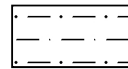
Conglomerate



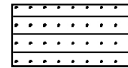
Conglomeratic sandstone



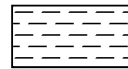
Sandstone



Siltstone



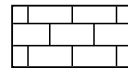
Laminite



Mudstone, claystone, shale

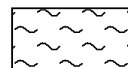


Coal

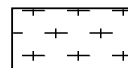


Limestone

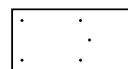
### Metamorphic Rocks



Slate, phyllite, schist

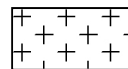


Gneiss

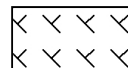


Quartzite

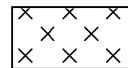
### Igneous Rocks



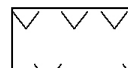
Granite



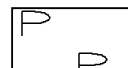
Dolerite, basalt, andesite



Dacite, epidote



Tuff, breccia



Porphyry

# TEST PIT LOG

**CLIENT:** Calibre Consulting (ACT) Pty Ltd  
**PROJECT:** Ginnindery Residential Development  
**LOCATION:** Strathnairn Stage 1

**SURFACE LEVEL:** 584.4 AHD  
**EASTING:** 198748.32  
**NORTHING:** 609411.34

**PIT No:** 15  
**PROJECT No:** 77356.22  
**DATE:** 12/9/2018  
**SHEET 1 OF 1**

| RL  | Depth (m) | Description of Strata                                                                                  | Graphic Log | Sampling & In Situ Testing |       |        |                    | Water | Dynamic Penetrometer Test (blows per mm) |    |    |    |
|-----|-----------|--------------------------------------------------------------------------------------------------------|-------------|----------------------------|-------|--------|--------------------|-------|------------------------------------------|----|----|----|
|     |           |                                                                                                        |             | Type                       | Depth | Sample | Results & Comments |       | 5                                        | 10 | 15 | 20 |
| 584 |           | FILLING-generally comprising loose, dry to moist, brown, fine to coarse grained gravelly sand          |             | D                          | 0.2   |        | pp >400            |       |                                          |    |    |    |
|     | 0.5       | CLAY-hard, dry to moist, yellow brown, high plasticity clay with trace sand                            |             |                            |       |        |                    |       |                                          |    |    |    |
|     | 0.7       | GRANODIORITE-very low strength, extremely weathered, orange/brown, fine to coarse grained granodiorite |             |                            |       |        |                    |       |                                          |    |    |    |
| 583 |           | -from 0.9m, moderately weathered                                                                       |             | D                          | 1.0   |        |                    |       |                                          |    |    |    |
|     | 1.1       | Pit discontinued at 1.1m<br>-slow progress                                                             |             |                            |       |        |                    |       |                                          |    |    |    |
| 582 | 2         |                                                                                                        |             |                            |       |        |                    |       |                                          |    |    |    |

**RIG:** Kubota KX057-4 mini-excavator, 300mm bucket

**LOGGED:** SDG

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:**

- ☐ Sand Penetrometer AS1289.6.3.3  
☐ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND |                      |                |                                        |
|-----------------------------------|----------------------|----------------|----------------------------------------|
| A                                 | Auger sample         | G              | Gas sample                             |
| B                                 | Bulk sample          | P              | Piston sample                          |
| BLK                               | Block sample         | U <sub>s</sub> | Tube sample (x mm dia.)                |
| C                                 | Core drilling        | W              | Water sample                           |
| CD                                | Disturbed sample     | W <sub>s</sub> | Water seep                             |
| E                                 | Environmental sample | W <sub>L</sub> | Water level                            |
|                                   |                      | PID            | Photo ionisation detector (ppm)        |
|                                   |                      | PL(A)          | Point load axial test Is(50) (MPa)     |
|                                   |                      | PL(D)          | Point load diametral test Is(50) (MPa) |
|                                   |                      | pp             | Pocket penetrometer (kPa)              |
|                                   |                      | S              | Standard penetration test              |
|                                   |                      | V              | Shear vane (kPa)                       |

# TEST PIT LOG

**CLIENT:** Calibre Consulting (ACT) Pty Ltd  
**PROJECT:** Ginnindery Residential Development  
**LOCATION:** Strathnairn Stage 1

**SURFACE LEVEL:** 584.2 AHD  
**EASTING:** 198723.88  
**NORTHING:** 609415.89

**PIT No:** 16  
**PROJECT No:** 77356.22  
**DATE:** 12/9/2018  
**SHEET 1 OF 1**

| RL  | Depth (m) | Description of Strata                                                                                                                                                                                                             | Graphic Log                                                                       | Sampling & In Situ Testing |       |        |                    | Water | Dynamic Penetrometer Test (blows per mm) |    |    |    |
|-----|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------|-------|--------|--------------------|-------|------------------------------------------|----|----|----|
|     |           |                                                                                                                                                                                                                                   |                                                                                   | Type                       | Depth | Sample | Results & Comments |       | 5                                        | 10 | 15 | 20 |
| 584 | 0.05      | FILLING-generally comprising loose, dry to moist, brown, fine to coarse grained gravelly sand<br><br>GRANODIORITE-extremely low to low strength, extremely to highly weathered, orange/brown, fine to coarse grained granodiorite |  | D                          | 0.6   |        |                    |       |                                          |    |    |    |
|     | 0.7       | Pit discontinued at 0.7m<br>-slow progress                                                                                                                                                                                        |                                                                                   |                            |       |        |                    |       |                                          |    |    |    |
| 583 | 1         |                                                                                                                                                                                                                                   |                                                                                   |                            |       |        |                    |       |                                          |    |    |    |
| 582 | 2         |                                                                                                                                                                                                                                   |                                                                                   |                            |       |        |                    |       |                                          |    |    |    |

**RIG:** Kubota KX057-4 mini-excavator, 300mm bucket

**LOGGED:** SDG

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:**

- ☐ Sand Penetrometer AS1289.6.3.3  
☐ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND |                      |                |                         |       |                                        |
|-----------------------------------|----------------------|----------------|-------------------------|-------|----------------------------------------|
| A                                 | Auger sample         | G              | Gas sample              | PID   | Photo ionisation detector (ppm)        |
| B                                 | Bulk sample          | P              | Piston sample           | PL(A) | Point load axial test Is(50) (MPa)     |
| BLK                               | Block sample         | U <sub>s</sub> | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C                                 | Core drilling        | W              | Water sample            | pp    | Pocket penetrometer (kPa)              |
| D                                 | Disturbed sample     | W <sub>s</sub> | Water seep              | S     | Standard penetration test              |
| E                                 | Environmental sample | W <sub>L</sub> | Water level             | V     | Shear vane (kPa)                       |

# Foundation Maintenance and Footing Performance: A Homeowner's Guide



**BTF 18**  
**replaces**  
**Information**  
**Sheet 10/91**

Buildings can and often do move. This movement can be up, down, lateral or rotational. The fundamental cause of movement in buildings can usually be related to one or more problems in the foundation soil. It is important for the homeowner to identify the soil type in order to ascertain the measures that should be put in place in order to ensure that problems in the foundation soil can be prevented, thus protecting against building movement.

This Building Technology File is designed to identify causes of soil-related building movement, and to suggest methods of prevention of resultant cracking in buildings.

## Soil Types

The types of soils usually present under the topsoil in land zoned for residential buildings can be split into two approximate groups – granular and clay. Quite often, foundation soil is a mixture of both types. The general problems associated with soils having granular content are usually caused by erosion. Clay soils are subject to saturation and swell/shrink problems.

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870, the Residential Slab and Footing Code.

## Causes of Movement

### Settlement due to construction

There are two types of settlement that occur as a result of construction:

- Immediate settlement occurs when a building is first placed on its foundation soil, as a result of compaction of the soil under the weight of the structure. The cohesive quality of clay soil mitigates against this, but granular (particularly sandy) soil is susceptible.
- Consolidation settlement is a feature of clay soil and may take place because of the expulsion of moisture from the soil or because of the soil's lack of resistance to local compressive or shear stresses. This will usually take place during the first few months after construction, but has been known to take many years in exceptional cases.

These problems are the province of the builder and should be taken into consideration as part of the preparation of the site for construction. Building Technology File 19 (BTF 19) deals with these problems.

### Erosion

All soils are prone to erosion, but sandy soil is particularly susceptible to being washed away. Even clay with a sand component of say 10% or more can suffer from erosion.

### Saturation

This is particularly a problem in clay soils. Saturation creates a bog-like suspension of the soil that causes it to lose virtually all of its bearing capacity. To a lesser degree, sand is affected by saturation because saturated sand may undergo a reduction in volume – particularly imported sand fill for bedding and blinding layers. However, this usually occurs as immediate settlement and should normally be the province of the builder.

### Seasonal swelling and shrinkage of soil

All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below). The degree of increase varies considerably between different clays, as does the degree of decrease during the subsequent drying out caused by fair weather periods. Because of the low absorption and expulsion rate, this phenomenon will not usually be noticeable unless there are prolonged rainy or dry periods, usually of weeks or months, depending on the land and soil characteristics.

The swelling of soil creates an upward force on the footings of the building, and shrinkage creates subsidence that takes away the support needed by the footing to retain equilibrium.

### Shear failure

This phenomenon occurs when the foundation soil does not have sufficient strength to support the weight of the footing. There are two major post-construction causes:

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.
- In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

## GENERAL DEFINITIONS OF SITE CLASSES

| Class  | Foundation                                                                                                                                                                                                                                            |
|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A      | Most sand and rock sites with little or no ground movement from moisture changes                                                                                                                                                                      |
| S      | Slightly reactive clay sites with only slight ground movement from moisture changes                                                                                                                                                                   |
| M      | Moderately reactive clay or silt sites, which can experience moderate ground movement from moisture changes                                                                                                                                           |
| H      | Highly reactive clay sites, which can experience high ground movement from moisture changes                                                                                                                                                           |
| E      | Extremely reactive sites, which can experience extreme ground movement from moisture changes                                                                                                                                                          |
| A to P | Filled sites                                                                                                                                                                                                                                          |
| P      | Sites which include soft soils, such as soft clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise |



### Tree root growth

Trees and shrubs that are allowed to grow in the vicinity of footings can cause foundation soil movement in two ways:

- Roots that grow under footings may increase in cross-sectional size, exerting upward pressure on footings.
- Roots in the vicinity of footings will absorb much of the moisture in the foundation soil, causing shrinkage or subsidence.

### Unevenness of Movement

The types of ground movement described above usually occur unevenly throughout the building's foundation soil. Settlement due to construction tends to be uneven because of:

- Differing compaction of foundation soil prior to construction.
- Differing moisture content of foundation soil prior to construction.

Movement due to non-construction causes is usually more uneven still. Erosion can undermine a footing that traverses the flow or can create the conditions for shear failure by eroding soil adjacent to a footing that runs in the same direction as the flow.

Saturation of clay foundation soil may occur where subfloor walls create a dam that makes water pond. It can also occur wherever there is a source of water near footings in clay soil. This leads to a severe reduction in the strength of the soil which may create local shear failure.

Seasonal swelling and shrinkage of clay soil affects the perimeter of the building first, then gradually spreads to the interior. The swelling process will usually begin at the uphill extreme of the building, or on the weather side where the land is flat. Swelling gradually reaches the interior soil as absorption continues. Shrinkage usually begins where the sun's heat is greatest.

### Effects of Uneven Soil Movement on Structures

#### Erosion and saturation

Erosion removes the support from under footings, tending to create subsidence of the part of the structure under which it occurs. Brickwork walls will resist the stress created by this removal of support by bridging the gap or cantilevering until the bricks or the mortar bedding fail. Older masonry has little resistance. Evidence of failure varies according to circumstances and symptoms may include:

- Step cracking in the mortar beds in the body of the wall or above/below openings such as doors or windows.
- Vertical cracking in the bricks (usually but not necessarily in line with the vertical beds or perpendes).

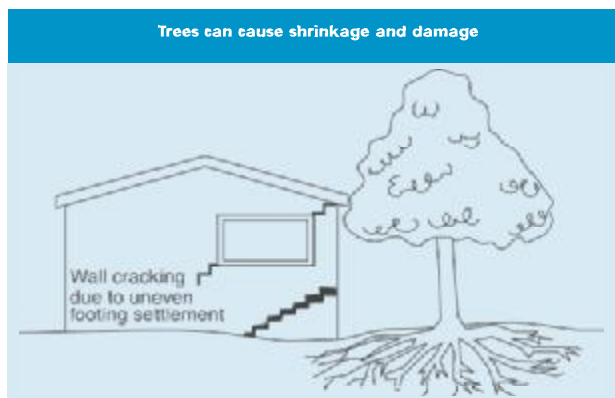
Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

#### Seasonal swelling/shrinkage in clay

Swelling foundation soil due to rainy periods first lifts the most exposed extremities of the footing system, then the remainder of the perimeter footings while gradually permeating inside the building footprint to lift internal footings. This swelling first tends to create a dish effect, because the external footings are pushed higher than the internal ones.

The first noticeable symptom may be that the floor appears slightly dished. This is often accompanied by some doors binding on the floor or the door head, together with some cracking of cornice mitres. In buildings with timber flooring supported by bearers and joists, the floor can be bouncy. Externally there may be visible dishing of the hip or ridge lines.

As the moisture absorption process completes its journey to the innermost areas of the building, the internal footings will rise. If the spread of moisture is roughly even, it may be that the symptoms will temporarily disappear, but it is more likely that swelling will be uneven, creating a difference rather than a disappearance in symptoms. In buildings with timber flooring supported by bearers and joists, the isolated piers will rise more easily than the strip footings or piers under walls, creating noticeable doming of flooring.



As the weather pattern changes and the soil begins to dry out, the external footings will be first affected, beginning with the locations where the sun's effect is strongest. This has the effect of lowering the external footings. The doming is accentuated and cracking reduces or disappears where it occurred because of dishing, but other cracks open up. The roof lines may become convex.

Doming and dishing are also affected by weather in other ways. In areas where warm, wet summers and cooler dry winters prevail, water migration tends to be toward the interior and doming will be accentuated, whereas where summers are dry and winters are cold and wet, migration tends to be toward the exterior and the underlying propensity is toward dishing.

#### Movement caused by tree roots

In general, growing roots will exert an upward pressure on footings, whereas soil subject to drying because of tree or shrub roots will tend to remove support from under footings by inducing shrinkage.

#### Complications caused by the structure itself

Most forces that the soil causes to be exerted on structures are vertical – i.e. either up or down. However, because these forces are seldom spread evenly around the footings, and because the building resists uneven movement because of its rigidity, forces are exerted from one part of the building to another. The net result of all these forces is usually rotational. This resultant force often complicates the diagnosis because the visible symptoms do not simply reflect the original cause. A common symptom is binding of doors on the vertical member of the frame.

#### Effects on full masonry structures

Brickwork will resist cracking where it can. It will attempt to span areas that lose support because of subsided foundations or raised points. It is therefore usual to see cracking at weak points, such as openings for windows or doors.

In the event of construction settlement, cracking will usually remain unchanged after the process of settlement has ceased.

With local shear or erosion, cracking will usually continue to develop until the original cause has been remedied, or until the subsidence has completely neutralised the affected portion of footing and the structure has stabilised on other footings that remain effective.

In the case of swell/shrink effects, the brickwork will in some cases return to its original position after completion of a cycle, however it is more likely that the rotational effect will not be exactly reversed, and it is also usual that brickwork will settle in its new position and will resist the forces trying to return it to its original position. This means that in a case where swelling takes place after construction and cracking occurs, the cracking is likely to at least partly remain after the shrink segment of the cycle is complete. Thus, each time the cycle is repeated, the likelihood is that the cracking will become wider until the sections of brickwork become virtually independent.

With repeated cycles, once the cracking is established, if there is no other complication, it is normal for the incidence of cracking to stabilise, as the building has the articulation it needs to cope with the problem. This is by no means always the case, however, and monitoring of cracks in walls and floors should always be treated seriously.

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also exert lateral forces that attempt to separate sections of brickwork after initial cracking has occurred.

The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls (depending on the roof type) comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

#### Effects on framed structures

Timber or steel framed buildings are less likely to exhibit cracking due to swell/shrink than masonry buildings because of their flexibility. Also, the doming/dishing effects tend to be lower because of the lighter weight of walls. The main risks to framed buildings are encountered because of the isolated pier footings used under walls. Where erosion or saturation cause a footing to fall away, this can double the span which a wall must bridge. This additional stress can create cracking in wall linings, particularly where there is a weak point in the structure caused by a door or window opening. It is, however, unlikely that framed structures will be so stressed as to suffer serious damage without first exhibiting some or all of the above symptoms for a considerable period. The same warning period should apply in the case of upheaval. It should be noted, however, that where framed buildings are supported by strip footings there is only one leaf of brickwork and therefore the externally visible walls are the supporting structure for the building. In this case, the subfloor masonry walls can be expected to behave as full brickwork walls.

#### Effects on brick veneer structures

Because the load-bearing structure of a brick veneer building is the frame that makes up the interior leaf of the external walls plus perhaps the internal walls, depending on the type of roof, the building can be expected to behave as a framed structure, except that the external masonry will behave in a similar way to the external leaf of a full masonry structure.

### Water Service and Drainage

Where a water service pipe, a sewer or stormwater drainage pipe is in the vicinity of a building, a water leak can cause erosion, swelling or saturation of susceptible soil. Even a minuscule leak can be enough to saturate a clay foundation. A leaking tap near a building can have the same effect. In addition, trenches containing pipes can become watercourses even though backfilled, particularly where broken rubble is used as fill. Water that runs along these trenches can be responsible for serious erosion, interstrata seepage into subfloor areas and saturation.

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem.

Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.

- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

### Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870.

AS 2870 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

### Prevention/Cure

#### Plumbing

Where building movement is caused by water service, roof plumbing, sewer or stormwater failure, the remedy is to repair the problem. It is prudent, however, to consider also rerouting pipes away from the building where possible, and relocating taps to positions where any leakage will not direct water to the building vicinity. Even where gully traps are present, there is sometimes sufficient spill to create erosion or saturation, particularly in modern installations using smaller diameter PVC fixtures. Indeed, some gully traps are not situated directly under the taps that are installed to charge them, with the result that water from the tap may enter the backfilled trench that houses the sewer piping. If the trench has been poorly backfilled, the water will either pond or flow along the bottom of the trench. As these trenches usually run alongside the footings and can be at a similar depth, it is not hard to see how any water that is thus directed into a trench can easily affect the foundation's ability to support footings or even gain entry to the subfloor area.

#### Ground drainage

In all soils there is the capacity for water to travel on the surface and below it. Surface water flows can be established by inspection during and after heavy or prolonged rain. If necessary, a grated drain system connected to the stormwater collection system is usually an easy solution.

It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

#### Protection of the building perimeter

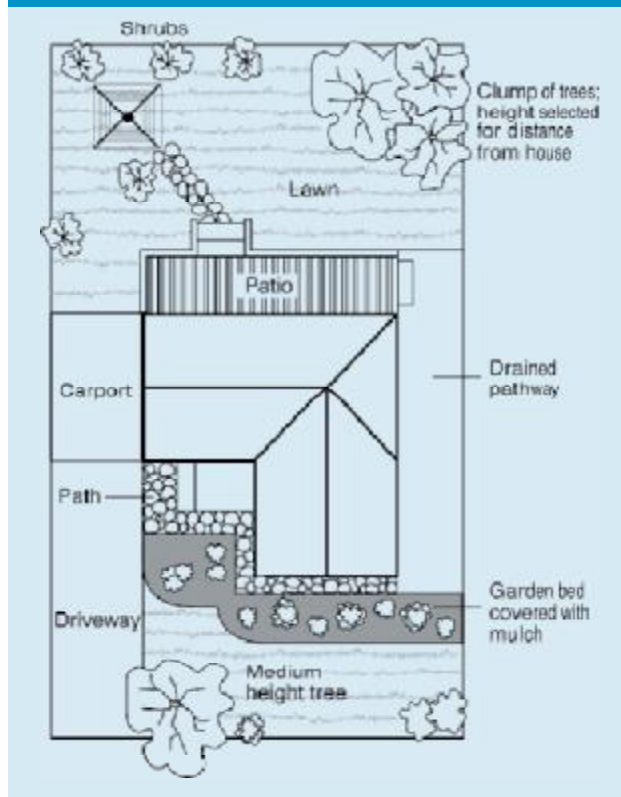
It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

For this reason, particularly where problems exist or are likely to occur, it is recommended that an apron of paving be installed around as much of the building perimeter as necessary. This paving

### CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

| Description of typical damage and required repair                                                                                                                                                                                       | Approximate crack width limit (see Note 3)                | Damage category |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|-----------------|
| Hairline cracks                                                                                                                                                                                                                         | <0.1 mm                                                   | 0               |
| Fine cracks which do not need repair                                                                                                                                                                                                    | <1 mm                                                     | 1               |
| Cracks noticeable but easily filled. Doors and windows stick slightly                                                                                                                                                                   | <5 mm                                                     | 2               |
| Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weathertightness often impaired                                                               | 5–15 mm (or a number of cracks 3 mm or more in one group) | 3               |
| Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably, some loss of bearing in beams. Service pipes disrupted | 15–25 mm but also depend on number of cracks              | 4               |

## Gardens for a reactive site



should extend outwards a minimum of 900 mm (more in highly reactive soil) and should have a minimum fall away from the building of 1:60. The finished paving should be no less than 100 mm below brick vent bases.

It is prudent to relocate drainage pipes away from this paving, if possible, to avoid complications from future leakage. If this is not practical, earthenware pipes should be replaced by PVC and backfilling should be of the same soil type as the surrounding soil and compacted to the same density.

Except in areas where freezing of water is an issue, it is wise to remove taps in the building area and relocate them well away from the building – preferably not uphill from it (see BTF 19).

It may be desirable to install a grated drain at the outside edge of the paving on the uphill side of the building. If subsoil drainage is needed this can be installed under the surface drain.

### Condensation

In buildings with a subfloor void such as where bearers and joists support flooring, insufficient ventilation creates ideal conditions for condensation, particularly where there is little clearance between the floor and the ground. Condensation adds to the moisture already present in the subfloor and significantly slows the process of drying out. Installation of an adequate subfloor ventilation system, either natural or mechanical, is desirable.

**Warning:** Although this Building Technology File deals with cracking in buildings, it should be said that subfloor moisture can result in the development of other problems, notably:

- Water that is transmitted into masonry, metal or timber building elements causes damage and/or decay to those elements.
- High subfloor humidity and moisture content create an ideal environment for various pests, including termites and spiders.
- Where high moisture levels are transmitted to the flooring and walls, an increase in the dust mite count can ensue within the living areas. Dust mites, as well as dampness in general, can be a health hazard to inhabitants, particularly those who are abnormally susceptible to respiratory ailments.

### The garden

The ideal vegetation layout is to have lawn or plants that require only light watering immediately adjacent to the drainage or paving edge, then more demanding plants, shrubs and trees spread out in that order.

Overwatering due to misuse of automatic watering systems is a common cause of saturation and water migration under footings. If it is necessary to use these systems, it is important to remove garden beds to a completely safe distance from buildings.

### Existing trees

Where a tree is causing a problem of soil drying or there is the existence or threat of upheaval of footings, if the offending roots are subsidiary and their removal will not significantly damage the tree, they should be severed and a concrete or metal barrier placed vertically in the soil to prevent future root growth in the direction of the building. If it is not possible to remove the relevant roots without damage to the tree, an application to remove the tree should be made to the local authority. A prudent plan is to transplant likely offenders before they become a problem.

### Information on trees, plants and shrubs

State departments overseeing agriculture can give information regarding root patterns, volume of water needed and safe distance from buildings of most species. Botanic gardens are also sources of information. For information on plant roots and drains, see Building Technology File 17.

### Excavation

Excavation around footings must be properly engineered. Soil supporting footings can only be safely excavated at an angle that allows the soil under the footing to remain stable. This angle is called the angle of repose (or friction) and varies significantly between soil types and conditions. Removal of soil within the angle of repose will cause subsidence.

### Remediation

Where erosion has occurred that has washed away soil adjacent to footings, soil of the same classification should be introduced and compacted to the same density. Where footings have been undermined, augmentation or other specialist work may be required. Remediation of footings and foundations is generally the realm of a specialist consultant.

Where isolated footings rise and fall because of swell/shrink effect, the homeowner may be tempted to alleviate floor bounce by filling the gap that has appeared between the bearer and the pier with blocking. The danger here is that when the next swell segment of the cycle occurs, the extra blocking will push the floor up into an accentuated dome and may also cause local shear failure in the soil. If it is necessary to use blocking, it should be by a pair of fine wedges and monitoring should be carried out fortnightly.

**This BTF was prepared by John Lewer FAIB, MIAMA, Partner, Construction Diagnosis.**

The information in this and other issues in the series was derived from various sources and was believed to be correct when published.

The information is advisory. It is provided in good faith and not claimed to be an exhaustive treatment of the relevant subject.

Further professional advice needs to be obtained before taking any action based on the information provided.

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# SITE CLASSIFICATION REPORT SUMMARY

**BLOCK:** 3 (a)      **SECTION:** 15 (AH)      **SUBURB:** Strathnairn  
**JOB No:** 77356.22      **DATE:** October 2018  
**CLIENT:** Calibre Consulting (ACT) Pty Ltd

## CLASSIFICATION PROCEDURES:

### EXISTING SUBSURFACE CONDITIONS:

**Test Pit 14:** Gravelly sand filling to 0.1 m depth, then silty clay with ironstone nodules and staining to 0.8 m depth overlying silty clay with trace sand and some rock like structure to the limit of investigation depth of 1.9 m.

**Test Pit 15:** Gravelly sand filling to 0.5 m depth, then clay with trace sand to 0.7 m depth overlying granodiorite to the slow progress depth of 1.1 m.

**BULK EARTHWORKS:** Filling within the block was placed under Level 1 control as defined in AS 3798 – 2007 (Ref 1).

**LABORATORY RESULTS:** Previous laboratory results indicated liquid limit ranging from 52-81%, plasticity index ranging from 39-68% and linear shrinkage ranging from 13.5-22.5%

**SITE CLASSIFICATION:** High range Class M\* (moderately reactive/filled block) based on the current soil profile/status, from limited subsurface information and determined in general accordance with the requirements of AS2870-2011 (Ref 2). The classification must be reassessed should the soil profile change either by adding fill or removing soil from the block and/or if the presence of service trenches or retaining walls are within the zone of influence of the block. Class H1 conditions may be warranted should the site be subject to cut. Reference should be made to the comments provided below.

**FOOTING SYSTEMS:** Reference must be made to AS2870-2011 (Ref 2) which indicates footing systems that are appropriate for each site classification. All footings must found within a uniform bearing stratum of suitable strength/material, below the zone of influence of any service trenches, backfill zones, retaining walls or underground structures. Masonry walls should be articulated in accordance with current best practice. Footing systems must be confirmed by a structural engineer taking into consideration any onsite or offsite constraints.

**MAINTENANCE GUIDELINES:** CSIRO Sheet BTF 18 'Foundation Maintenance & Footing Performance' (attached). Refer to comments about gardens, landscaping and trees on the performance of foundation soils.

### COMMENTS/ LIMITATIONS:

The successful purchaser must make their own interpretations, deductions and conclusions from the information made available and will need to accept full responsibility for such interpretations, deductions and conclusions.

Development specific geotechnical investigations must be undertaken.

Additional topsoils / filling may have been spread subsequent to the investigation.

Site preparation prior to the construction should include removal of all vegetation, topsoil and any uncontrolled filling.

All new filling must be placed under controlled conditions (AS 3798-2007). If filling is placed uncontrolled, those areas would require a Class P site classification.

Some variability in subsurface conditions must be anticipated.

Moisture condition of site soils and/or the presence of groundwater may vary considerably from time of investigation compared to at the time of construction.

Hard rock excavation should be anticipated over parts of the site.

It is recommended that footing excavations be inspected by a geotechnical engineer.

This report must be read in conjunction with the attached notes "Limitations", "About this Report", "Drawing 3", "Explanatory Notes" and "Test Pit Logs (14 and 15)".

### REFERENCES:

1. AS 3798-2007 'Guidelines on Earthworks for Commercial and Residential Developments', Standards Association of Australia.
2. AS 2870-2011 'Residential Slabs and Footings,' Standards Association of Australia.



**Douglas Partners**  
 Geotechnics | Environment | Groundwater

## Limitations

Douglas Partners (DP) has prepared this report for this project at Stage 1 Strathnairn in accordance with DP's proposal dated 9 August 2017 and acceptance received from Calibre Consulting (ACT) Pty Ltd dated 29 September 2018. The work was carried out under an amended Calibre Consulting (ACT) Pty Ltd Professional Services Agreement. This report is provided for the exclusive use of Calibre Consulting (ACT) Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the geotechnical components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.



# About this Report

# Douglas Partners



## Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

## Copyright

This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

## Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

## Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;

- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

## Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

# *About this Report*

## **Site Anomalies**

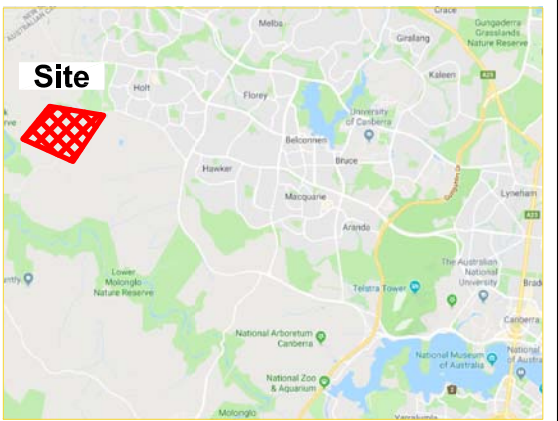
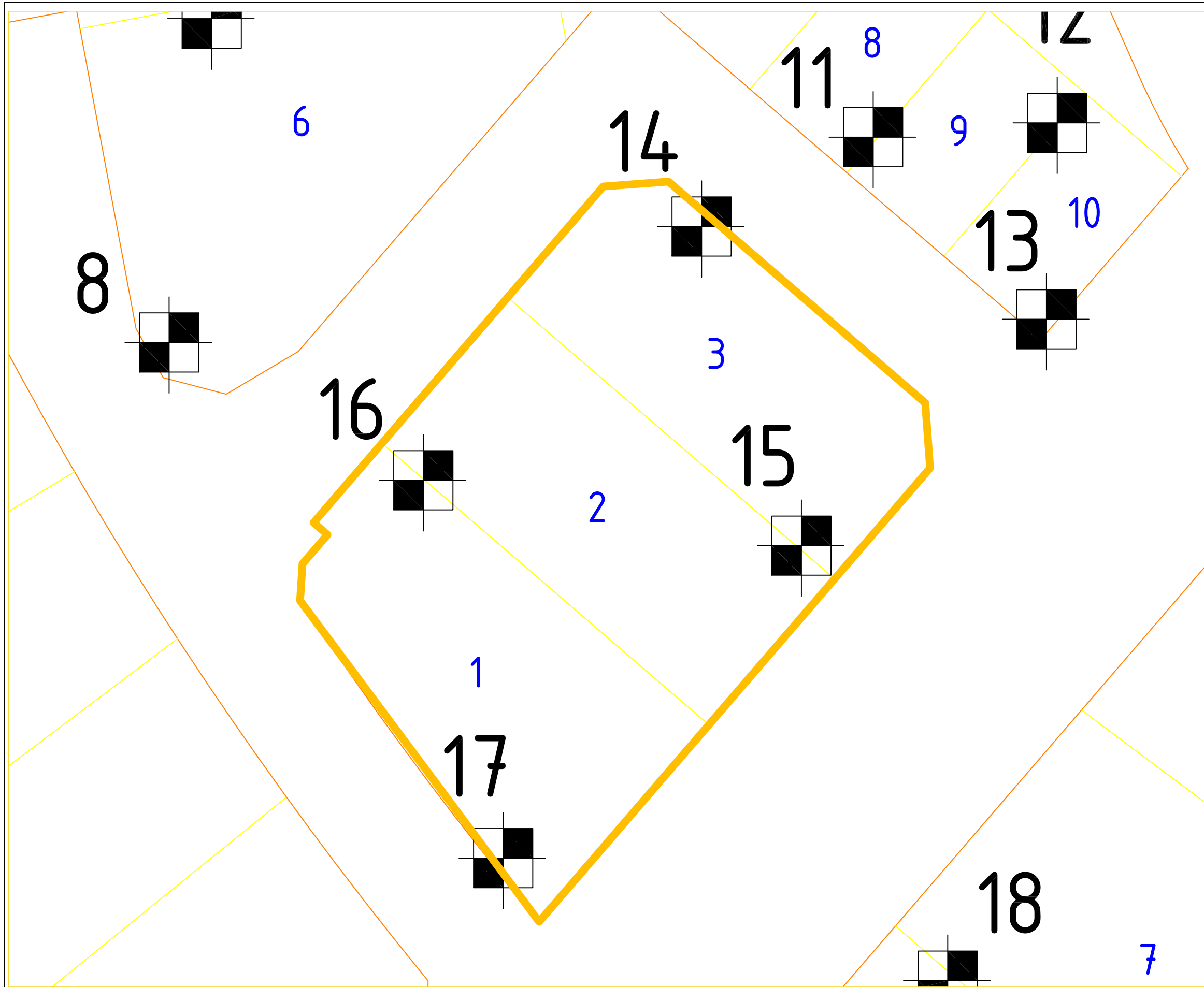
In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

## **Information for Contractual Purposes**

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

## **Site Inspection**

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.



Locality Plan

LEGEND

- Test Pit Location
- Block Number
- Block Boundary
- Section Boundary

NOTE: Base drawing from Calibre Consulting (ACT) Pty Ltd



CLIENT: Calibre Consulting (ACT) Pty Ltd  
OFFICE: Canberra  
SCALE: NTS  
DRAWN BY: SDG  
DATE: 18.09.2018

TITLE: **Test Pit Location Plan**  
**Strathnairn Stage 1**  
**Blocks 1 - 3 Section 15, Strathnairn**



PROJECT No: 77356.22  
DRAWING No: 3  
REVISION: 0



## Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

## Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

## Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

## Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low

reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

## Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

## Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

## Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:  
4,6,7  
N=13
- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:  
15, 30/40 mm



# *Sampling Methods*

The results of the SPT tests can be related empirically to the engineering properties of the soils.

## **Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests**

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.



## Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726-1993, Geotechnical Site Investigations Code. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

## Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

| Type    | Particle size (mm) |
|---------|--------------------|
| Boulder | >200               |
| Cobble  | 63 - 200           |
| Gravel  | 2.36 - 63          |
| Sand    | 0.075 - 2.36       |
| Silt    | 0.002 - 0.075      |
| Clay    | <0.002             |

The sand and gravel sizes can be further subdivided as follows:

| Type          | Particle size (mm) |
|---------------|--------------------|
| Coarse gravel | 20 - 63            |
| Medium gravel | 6 - 20             |
| Fine gravel   | 2.36 - 6           |
| Coarse sand   | 0.6 - 2.36         |
| Medium sand   | 0.2 - 0.6          |
| Fine sand     | 0.075 - 0.2        |

The proportions of secondary constituents of soils are described as:

| Term            | Proportion | Example                   |
|-----------------|------------|---------------------------|
| And             | Specify    | Clay (60%) and Sand (40%) |
| Adjective       | 20 - 35%   | Sandy Clay                |
| Slightly        | 12 - 20%   | Slightly Sandy Clay       |
| With some       | 5 - 12%    | Clay with some sand       |
| With a trace of | 0 - 5%     | Clay with a trace of sand |

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

## Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

| Description | Abbreviation | Undrained shear strength (kPa) |
|-------------|--------------|--------------------------------|
| Very soft   | vs           | <12                            |
| Soft        | s            | 12 - 25                        |
| Firm        | f            | 25 - 50                        |
| Stiff       | st           | 50 - 100                       |
| Very stiff  | vst          | 100 - 200                      |
| Hard        | h            | >200                           |

## Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

| Relative Density | Abbreviation | SPT N value | CPT qc value (MPa) |
|------------------|--------------|-------------|--------------------|
| Very loose       | vl           | <4          | <2                 |
| Loose            | l            | 4 - 10      | 2 - 5              |
| Medium dense     | md           | 10 - 30     | 5 - 15             |
| Dense            | d            | 30 - 50     | 15 - 25            |
| Very dense       | vd           | >50         | >25                |

# *Soil Descriptions*

## **Soil Origin**

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.



## Rock Strength

Rock strength is defined by the Point Load Strength Index ( $Is_{(50)}$ ) and refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects. The test procedure is described by Australian Standard 4133.4.1 - 2007. The terms used to describe rock strength are as follows:

| Term           | Abbreviation | Point Load Index<br>$Is_{(50)}$ MPa | Approximate Unconfined<br>Compressive Strength MPa* |
|----------------|--------------|-------------------------------------|-----------------------------------------------------|
| Extremely low  | EL           | <0.03                               | <0.6                                                |
| Very low       | VL           | 0.03 - 0.1                          | 0.6 - 2                                             |
| Low            | L            | 0.1 - 0.3                           | 2 - 6                                               |
| Medium         | M            | 0.3 - 1.0                           | 6 - 20                                              |
| High           | H            | 1 - 3                               | 20 - 60                                             |
| Very high      | VH           | 3 - 10                              | 60 - 200                                            |
| Extremely high | EH           | >10                                 | >200                                                |

\* Assumes a ratio of 20:1 for UCS to  $Is_{(50)}$ . It should be noted that the UCS to  $Is_{(50)}$  ratio varies significantly for different rock types and specific ratios should be determined for each site.

## Degree of Weathering

The degree of weathering of rock is classified as follows:

| Term                 | Abbreviation | Description                                                                                                                                                                                                                                                  |
|----------------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Extremely weathered  | EW           | Rock substance has soil properties, i.e. it can be remoulded and classified as a soil but the texture of the original rock is still evident.                                                                                                                 |
| Highly weathered     | HW           | Limonite staining or bleaching affects whole of rock substance and other signs of decomposition are evident. Porosity and strength may be altered as a result of iron leaching or deposition. Colour and strength of original fresh rock is not recognisable |
| Moderately weathered | MW           | Staining and discolouration of rock substance has taken place                                                                                                                                                                                                |
| Slightly weathered   | SW           | Rock substance is slightly discoloured but shows little or no change of strength from fresh rock                                                                                                                                                             |
| Fresh stained        | Fs           | Rock substance unaffected by weathering but staining visible along defects                                                                                                                                                                                   |
| Fresh                | Fr           | No signs of decomposition or staining                                                                                                                                                                                                                        |

## Degree of Fracturing

The following classification applies to the spacing of natural fractures in diamond drill cores. It includes bedding plane partings, joints and other defects, but excludes drilling breaks.

| Term               | Description                                                       |
|--------------------|-------------------------------------------------------------------|
| Fragmented         | Fragments of <20 mm                                               |
| Highly Fractured   | Core lengths of 20-40 mm with some fragments                      |
| Fractured          | Core lengths of 40-200 mm with some shorter and longer sections   |
| Slightly Fractured | Core lengths of 200-1000 mm with some shorter and longer sections |
| Unbroken           | Core lengths mostly > 1000 mm                                     |



# Rock Descriptions

## Rock Quality Designation

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

$$\text{RQD \%} = \frac{\text{cumulative length of 'sound' core sections} \geq 100 \text{ mm long}}{\text{total drilled length of section being assessed}}$$

where 'sound' rock is assessed to be rock of low strength or better. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

## Stratification Spacing

For sedimentary rocks the following terms may be used to describe the spacing of bedding partings:

| Term                | Separation of Stratification Planes |
|---------------------|-------------------------------------|
| Thinly laminated    | < 6 mm                              |
| Laminated           | 6 mm to 20 mm                       |
| Very thinly bedded  | 20 mm to 60 mm                      |
| Thinly bedded       | 60 mm to 0.2 m                      |
| Medium bedded       | 0.2 m to 0.6 m                      |
| Thickly bedded      | 0.6 m to 2 m                        |
| Very thickly bedded | > 2 m                               |

# Symbols & Abbreviations

## Douglas Partners



### Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

### Drilling or Excavation Methods

|      |                          |
|------|--------------------------|
| C    | Core drilling            |
| R    | Rotary drilling          |
| SFA  | Spiral flight augers     |
| NMLC | Diamond core - 52 mm dia |
| NQ   | Diamond core - 47 mm dia |
| HQ   | Diamond core - 63 mm dia |
| PQ   | Diamond core - 81 mm dia |

### Water

|   |             |
|---|-------------|
| ▷ | Water seep  |
| ▽ | Water level |

### Sampling and Testing

|                 |                                |
|-----------------|--------------------------------|
| A               | Auger sample                   |
| B               | Bulk sample                    |
| D               | Disturbed sample               |
| E               | Environmental sample           |
| U <sub>50</sub> | Undisturbed tube sample (50mm) |
| W               | Water sample                   |
| pp              | Pocket penetrometer (kPa)      |
| PID             | Photo ionisation detector      |
| PL              | Point load strength Is(50) MPa |
| S               | Standard Penetration Test      |
| V               | Shear vane (kPa)               |

### Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

### Defect Type

|     |                 |
|-----|-----------------|
| B   | Bedding plane   |
| Cs  | Clay seam       |
| Cv  | Cleavage        |
| Cz  | Crushed zone    |
| Ds  | Decomposed seam |
| F   | Fault           |
| J   | Joint           |
| Lam | Lamination      |
| Pt  | Parting         |
| Sz  | Sheared Zone    |
| V   | Vein            |

### Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

|    |                |
|----|----------------|
| h  | horizontal     |
| v  | vertical       |
| sh | sub-horizontal |
| sv | sub-vertical   |

### Coating or Infilling Term

|     |          |
|-----|----------|
| cln | clean    |
| co  | coating  |
| he  | healed   |
| inf | infilled |
| stn | stained  |
| ti  | tight    |
| vn  | veneer   |

### Coating Descriptor

|     |              |
|-----|--------------|
| ca  | calcite      |
| cbs | carbonaceous |
| cly | clay         |
| fe  | iron oxide   |
| mn  | manganese    |
| slt | silty        |

### Shape

|    |            |
|----|------------|
| cu | curved     |
| ir | irregular  |
| pl | planar     |
| st | stepped    |
| un | undulating |

### Roughness

|    |              |
|----|--------------|
| po | polished     |
| ro | rough        |
| sl | slickensided |
| sm | smooth       |
| vr | very rough   |

### Other

|     |            |
|-----|------------|
| fg  | fragmented |
| bnd | band       |
| qtz | quartz     |

# Symbols & Abbreviations

## Graphic Symbols for Soil and Rock

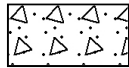
### General



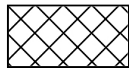
Asphalt



Road base



Concrete



Filling

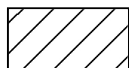
### Soils



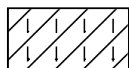
Topsoil



Peat



Clay



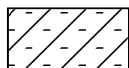
Silty clay



Sandy clay



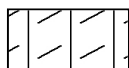
Gravelly clay



Shaly clay



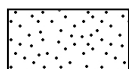
Silt



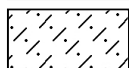
Clayey silt



Sandy silt



Sand



Clayey sand



Silty sand



Gravel



Sandy gravel



Cobbles, boulders



Talus

### Sedimentary Rocks



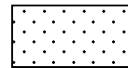
Boulder conglomerate



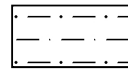
Conglomerate



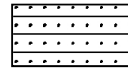
Conglomeratic sandstone



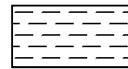
Sandstone



Siltstone



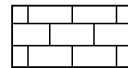
Laminite



Mudstone, claystone, shale

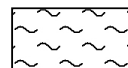


Coal

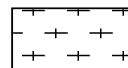


Limestone

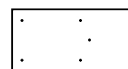
### Metamorphic Rocks



Slate, phyllite, schist

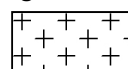


Gneiss

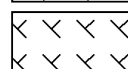


Quartzite

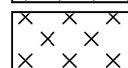
### Igneous Rocks



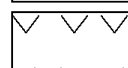
Granite



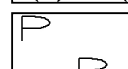
Dolerite, basalt, andesite



Dacite, epidote



Tuff, breccia



Porphyry

# TEST PIT LOG

**CLIENT:** Calibre Consulting (ACT) Pty Ltd  
**PROJECT:** Ginnindery Residential Development  
**LOCATION:** Strathnairn Stage 1

**SURFACE LEVEL:** 584.3 AHD  
**EASTING:** 198741.84  
**NORTHING:** 609432.36

**PIT No:** 14  
**PROJECT No:** 77356.22  
**DATE:** 12/9/2018  
**SHEET 1 OF 1**

| RL  | Depth (m) | Description of Strata                                                                                                    | Graphic Log                                                                         | Sampling & In Situ Testing |       |        |                    | Water | Dynamic Penetrometer Test (blows per mm) |    |    |    |
|-----|-----------|--------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|----------------------------|-------|--------|--------------------|-------|------------------------------------------|----|----|----|
|     |           |                                                                                                                          |                                                                                     | Type                       | Depth | Sample | Results & Comments |       | 5                                        | 10 | 15 | 20 |
| 584 | 0.1       | FILLING-generally comprising loose, dry to moist, brown, fine to coarse grained gravelly sand                            |    |                            |       |        |                    |       |                                          |    |    |    |
|     |           | SILTY CLAY-hard, dry to moist, orange/red brown, low to medium plasticity silty clay with ironstone nodules and staining |                                                                                     |                            |       |        |                    |       |                                          |    |    |    |
| 583 | 0.8       | SILTY CLAY-very stiff, moist, yellow/grey brown, high plasticity silty clay with trace coarse grained sand               |    | D                          | 0.9   |        |                    |       |                                          |    |    |    |
|     |           |                                                                                                                          |                                                                                     |                            |       |        |                    |       |                                          |    |    |    |
| 582 | 1.9       | -from 1.5m, some rock like structure                                                                                     |  | D                          | 1.8   |        |                    |       |                                          |    |    |    |
|     |           |                                                                                                                          |                                                                                     |                            |       |        |                    |       |                                          |    |    |    |
|     | 1.9       | Pit discontinued at 1.9m<br>-limit of investigation                                                                      |                                                                                     |                            |       |        |                    |       |                                          |    |    |    |

**RIG:** Kubota KX057-4 mini-excavator, 300mm bucket

**LOGGED:** SDG

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:**

- ☐ Sand Penetrometer AS1289.6.3.3  
☐ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND |                      |                |                         |       |                                        |
|-----------------------------------|----------------------|----------------|-------------------------|-------|----------------------------------------|
| A                                 | Auger sample         | G              | Gas sample              | PID   | Photo ionisation detector (ppm)        |
| B                                 | Bulk sample          | P              | Piston sample           | PL(A) | Point load axial test Is(50) (MPa)     |
| BLK                               | Block sample         | U <sub>s</sub> | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C                                 | Core drilling        | W              | Water sample            | pp    | Pocket penetrometer (kPa)              |
| CD                                | Disturbed sample     | >              | Water seep              | S     | Standard penetration test              |
| IE                                | Environmental sample | ≡              | Water level             | V     | Shear vane (kPa)                       |

# TEST PIT LOG

**CLIENT:** Calibre Consulting (ACT) Pty Ltd  
**PROJECT:** Ginnindery Residential Development  
**LOCATION:** Strathnairn Stage 1

**SURFACE LEVEL:** 584.4 AHD  
**EASTING:** 198748.32  
**NORTHING:** 609411.34

**PIT No:** 15  
**PROJECT No:** 77356.22  
**DATE:** 12/9/2018  
**SHEET 1 OF 1**

| RL  | Depth (m) | Description of Strata                                                                                  | Graphic Log | Sampling & In Situ Testing |       |        |                    | Water | Dynamic Penetrometer Test (blows per mm) |    |    |    |
|-----|-----------|--------------------------------------------------------------------------------------------------------|-------------|----------------------------|-------|--------|--------------------|-------|------------------------------------------|----|----|----|
|     |           |                                                                                                        |             | Type                       | Depth | Sample | Results & Comments |       | 5                                        | 10 | 15 | 20 |
| 584 |           | FILLING-generally comprising loose, dry to moist, brown, fine to coarse grained gravelly sand          |             | D                          | 0.2   |        | pp >400            |       |                                          |    |    |    |
|     | 0.5       | CLAY-hard, dry to moist, yellow brown, high plasticity clay with trace sand                            |             |                            |       |        |                    |       |                                          |    |    |    |
|     | 0.7       | GRANODIORITE-very low strength, extremely weathered, orange/brown, fine to coarse grained granodiorite |             |                            |       |        |                    |       |                                          |    |    |    |
|     |           | -from 0.9m, moderately weathered                                                                       |             | D                          | 1.0   |        |                    |       |                                          |    |    |    |
| 1   | 1.1       | Pit discontinued at 1.1m<br>-slow progress                                                             |             |                            |       |        |                    |       |                                          |    |    |    |
| 583 |           |                                                                                                        |             |                            |       |        |                    |       |                                          |    |    |    |
|     | 2         |                                                                                                        |             |                            |       |        |                    |       |                                          |    |    |    |
| 582 |           |                                                                                                        |             |                            |       |        |                    |       |                                          |    |    |    |

**RIG:** Kubota KX057-4 mini-excavator, 300mm bucket

**LOGGED:** SDG

**SURVEY DATUM:** MGA94

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:**

- ☐ Sand Penetrometer AS1289.6.3.3  
☐ Cone Penetrometer AS1289.6.3.2

| SAMPLING & IN SITU TESTING LEGEND |                      |                |                                        |
|-----------------------------------|----------------------|----------------|----------------------------------------|
| A                                 | Auger sample         | G              | Gas sample                             |
| B                                 | Bulk sample          | P              | Piston sample                          |
| BLK                               | Block sample         | U <sub>s</sub> | Tube sample (x mm dia.)                |
| C                                 | Core drilling        | W              | Water sample                           |
| CD                                | Disturbed sample     | W <sub>s</sub> | Water seep                             |
| E                                 | Environmental sample | W <sub>L</sub> | Water level                            |
|                                   |                      | PID            | Photo ionisation detector (ppm)        |
|                                   |                      | PL(A)          | Point load axial test Is(50) (MPa)     |
|                                   |                      | PL(D)          | Point load diametral test Is(50) (MPa) |
|                                   |                      | pp             | Pocket penetrometer (kPa)              |
|                                   |                      | S              | Standard penetration test              |
|                                   |                      | V              | Shear vane (kPa)                       |



# Foundation Maintenance and Footing Performance: A Homeowner's Guide



**BTF 18**  
**replaces**  
**Information**  
**Sheet 10/91**

Buildings can and often do move. This movement can be up, down, lateral or rotational. The fundamental cause of movement in buildings can usually be related to one or more problems in the foundation soil. It is important for the homeowner to identify the soil type in order to ascertain the measures that should be put in place in order to ensure that problems in the foundation soil can be prevented, thus protecting against building movement.

This Building Technology File is designed to identify causes of soil-related building movement, and to suggest methods of prevention of resultant cracking in buildings.

## Soil Types

The types of soils usually present under the topsoil in land zoned for residential buildings can be split into two approximate groups – granular and clay. Quite often, foundation soil is a mixture of both types. The general problems associated with soils having granular content are usually caused by erosion. Clay soils are subject to saturation and swell/shrink problems.

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870, the Residential Slab and Footing Code.

## Causes of Movement

### Settlement due to construction

There are two types of settlement that occur as a result of construction:

- Immediate settlement occurs when a building is first placed on its foundation soil, as a result of compaction of the soil under the weight of the structure. The cohesive quality of clay soil mitigates against this, but granular (particularly sandy) soil is susceptible.
- Consolidation settlement is a feature of clay soil and may take place because of the expulsion of moisture from the soil or because of the soil's lack of resistance to local compressive or shear stresses. This will usually take place during the first few months after construction, but has been known to take many years in exceptional cases.

These problems are the province of the builder and should be taken into consideration as part of the preparation of the site for construction. Building Technology File 19 (BTF 19) deals with these problems.

### Erosion

All soils are prone to erosion, but sandy soil is particularly susceptible to being washed away. Even clay with a sand component of say 10% or more can suffer from erosion.

### Saturation

This is particularly a problem in clay soils. Saturation creates a bog-like suspension of the soil that causes it to lose virtually all of its bearing capacity. To a lesser degree, sand is affected by saturation because saturated sand may undergo a reduction in volume – particularly imported sand fill for bedding and blinding layers. However, this usually occurs as immediate settlement and should normally be the province of the builder.

### Seasonal swelling and shrinkage of soil

All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below). The degree of increase varies considerably between different clays, as does the degree of decrease during the subsequent drying out caused by fair weather periods. Because of the low absorption and expulsion rate, this phenomenon will not usually be noticeable unless there are prolonged rainy or dry periods, usually of weeks or months, depending on the land and soil characteristics.

The swelling of soil creates an upward force on the footings of the building, and shrinkage creates subsidence that takes away the support needed by the footing to retain equilibrium.

### Shear failure

This phenomenon occurs when the foundation soil does not have sufficient strength to support the weight of the footing. There are two major post-construction causes:

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.
- In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

## GENERAL DEFINITIONS OF SITE CLASSES

| Class  | Foundation                                                                                                                                                                                                                                            |
|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A      | Most sand and rock sites with little or no ground movement from moisture changes                                                                                                                                                                      |
| S      | Slightly reactive clay sites with only slight ground movement from moisture changes                                                                                                                                                                   |
| M      | Moderately reactive clay or silt sites, which can experience moderate ground movement from moisture changes                                                                                                                                           |
| H      | Highly reactive clay sites, which can experience high ground movement from moisture changes                                                                                                                                                           |
| E      | Extremely reactive sites, which can experience extreme ground movement from moisture changes                                                                                                                                                          |
| A to P | Filled sites                                                                                                                                                                                                                                          |
| P      | Sites which include soft soils, such as soft clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise |

### Tree root growth

Trees and shrubs that are allowed to grow in the vicinity of footings can cause foundation soil movement in two ways:

- Roots that grow under footings may increase in cross-sectional size, exerting upward pressure on footings.
- Roots in the vicinity of footings will absorb much of the moisture in the foundation soil, causing shrinkage or subsidence.

### Unevenness of Movement

The types of ground movement described above usually occur unevenly throughout the building's foundation soil. Settlement due to construction tends to be uneven because of:

- Differing compaction of foundation soil prior to construction.
- Differing moisture content of foundation soil prior to construction.

Movement due to non-construction causes is usually more uneven still. Erosion can undermine a footing that traverses the flow or can create the conditions for shear failure by eroding soil adjacent to a footing that runs in the same direction as the flow.

Saturation of clay foundation soil may occur where subfloor walls create a dam that makes water pond. It can also occur wherever there is a source of water near footings in clay soil. This leads to a severe reduction in the strength of the soil which may create local shear failure.

Seasonal swelling and shrinkage of clay soil affects the perimeter of the building first, then gradually spreads to the interior. The swelling process will usually begin at the uphill extreme of the building, or on the weather side where the land is flat. Swelling gradually reaches the interior soil as absorption continues. Shrinkage usually begins where the sun's heat is greatest.

### Effects of Uneven Soil Movement on Structures

#### Erosion and saturation

Erosion removes the support from under footings, tending to create subsidence of the part of the structure under which it occurs. Brickwork walls will resist the stress created by this removal of support by bridging the gap or cantilevering until the bricks or the mortar bedding fail. Older masonry has little resistance. Evidence of failure varies according to circumstances and symptoms may include:

- Step cracking in the mortar beds in the body of the wall or above/below openings such as doors or windows.
- Vertical cracking in the bricks (usually but not necessarily in line with the vertical beds or perpendes).

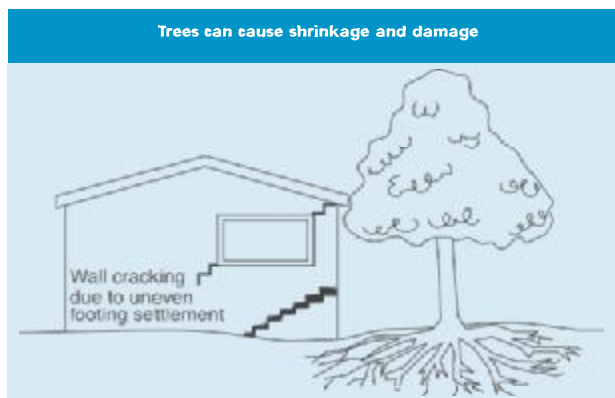
Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

#### Seasonal swelling/shrinkage in clay

Swelling foundation soil due to rainy periods first lifts the most exposed extremities of the footing system, then the remainder of the perimeter footings while gradually permeating inside the building footprint to lift internal footings. This swelling first tends to create a dish effect, because the external footings are pushed higher than the internal ones.

The first noticeable symptom may be that the floor appears slightly dished. This is often accompanied by some doors binding on the floor or the door head, together with some cracking of cornice mitres. In buildings with timber flooring supported by bearers and joists, the floor can be bouncy. Externally there may be visible dishing of the hip or ridge lines.

As the moisture absorption process completes its journey to the innermost areas of the building, the internal footings will rise. If the spread of moisture is roughly even, it may be that the symptoms will temporarily disappear, but it is more likely that swelling will be uneven, creating a difference rather than a disappearance in symptoms. In buildings with timber flooring supported by bearers and joists, the isolated piers will rise more easily than the strip footings or piers under walls, creating noticeable doming of flooring.



As the weather pattern changes and the soil begins to dry out, the external footings will be first affected, beginning with the locations where the sun's effect is strongest. This has the effect of lowering the external footings. The doming is accentuated and cracking reduces or disappears where it occurred because of dishing, but other cracks open up. The roof lines may become convex.

Doming and dishing are also affected by weather in other ways. In areas where warm, wet summers and cooler dry winters prevail, water migration tends to be toward the interior and doming will be accentuated, whereas where summers are dry and winters are cold and wet, migration tends to be toward the exterior and the underlying propensity is toward dishing.

#### Movement caused by tree roots

In general, growing roots will exert an upward pressure on footings, whereas soil subject to drying because of tree or shrub roots will tend to remove support from under footings by inducing shrinkage.

#### Complications caused by the structure itself

Most forces that the soil causes to be exerted on structures are vertical – i.e. either up or down. However, because these forces are seldom spread evenly around the footings, and because the building resists uneven movement because of its rigidity, forces are exerted from one part of the building to another. The net result of all these forces is usually rotational. This resultant force often complicates the diagnosis because the visible symptoms do not simply reflect the original cause. A common symptom is binding of doors on the vertical member of the frame.

#### Effects on full masonry structures

Brickwork will resist cracking where it can. It will attempt to span areas that lose support because of subsided foundations or raised points. It is therefore usual to see cracking at weak points, such as openings for windows or doors.

In the event of construction settlement, cracking will usually remain unchanged after the process of settlement has ceased.

With local shear or erosion, cracking will usually continue to develop until the original cause has been remedied, or until the subsidence has completely neutralised the affected portion of footing and the structure has stabilised on other footings that remain effective.

In the case of swell/shrink effects, the brickwork will in some cases return to its original position after completion of a cycle, however it is more likely that the rotational effect will not be exactly reversed, and it is also usual that brickwork will settle in its new position and will resist the forces trying to return it to its original position. This means that in a case where swelling takes place after construction and cracking occurs, the cracking is likely to at least partly remain after the shrink segment of the cycle is complete. Thus, each time the cycle is repeated, the likelihood is that the cracking will become wider until the sections of brickwork become virtually independent.

With repeated cycles, once the cracking is established, if there is no other complication, it is normal for the incidence of cracking to stabilise, as the building has the articulation it needs to cope with the problem. This is by no means always the case, however, and monitoring of cracks in walls and floors should always be treated seriously.

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also exert lateral forces that attempt to separate sections of brickwork after initial cracking has occurred.

The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls (depending on the roof type) comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

#### Effects on framed structures

Timber or steel framed buildings are less likely to exhibit cracking due to swell/shrink than masonry buildings because of their flexibility. Also, the doming/dishing effects tend to be lower because of the lighter weight of walls. The main risks to framed buildings are encountered because of the isolated pier footings used under walls. Where erosion or saturation cause a footing to fall away, this can double the span which a wall must bridge. This additional stress can create cracking in wall linings, particularly where there is a weak point in the structure caused by a door or window opening. It is, however, unlikely that framed structures will be so stressed as to suffer serious damage without first exhibiting some or all of the above symptoms for a considerable period. The same warning period should apply in the case of upheaval. It should be noted, however, that where framed buildings are supported by strip footings there is only one leaf of brickwork and therefore the externally visible walls are the supporting structure for the building. In this case, the subfloor masonry walls can be expected to behave as full brickwork walls.

#### Effects on brick veneer structures

Because the load-bearing structure of a brick veneer building is the frame that makes up the interior leaf of the external walls plus perhaps the internal walls, depending on the type of roof, the building can be expected to behave as a framed structure, except that the external masonry will behave in a similar way to the external leaf of a full masonry structure.

### Water Service and Drainage

Where a water service pipe, a sewer or stormwater drainage pipe is in the vicinity of a building, a water leak can cause erosion, swelling or saturation of susceptible soil. Even a minuscule leak can be enough to saturate a clay foundation. A leaking tap near a building can have the same effect. In addition, trenches containing pipes can become watercourses even though backfilled, particularly where broken rubble is used as fill. Water that runs along these trenches can be responsible for serious erosion, interstrata seepage into subfloor areas and saturation.

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem.

Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.

- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

### Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870.

AS 2870 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

### Prevention/Cure

#### Plumbing

Where building movement is caused by water service, roof plumbing, sewer or stormwater failure, the remedy is to repair the problem. It is prudent, however, to consider also rerouting pipes away from the building where possible, and relocating taps to positions where any leakage will not direct water to the building vicinity. Even where gully traps are present, there is sometimes sufficient spill to create erosion or saturation, particularly in modern installations using smaller diameter PVC fixtures. Indeed, some gully traps are not situated directly under the taps that are installed to charge them, with the result that water from the tap may enter the backfilled trench that houses the sewer piping. If the trench has been poorly backfilled, the water will either pond or flow along the bottom of the trench. As these trenches usually run alongside the footings and can be at a similar depth, it is not hard to see how any water that is thus directed into a trench can easily affect the foundation's ability to support footings or even gain entry to the subfloor area.

#### Ground drainage

In all soils there is the capacity for water to travel on the surface and below it. Surface water flows can be established by inspection during and after heavy or prolonged rain. If necessary, a grated drain system connected to the stormwater collection system is usually an easy solution.

It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

#### Protection of the building perimeter

It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

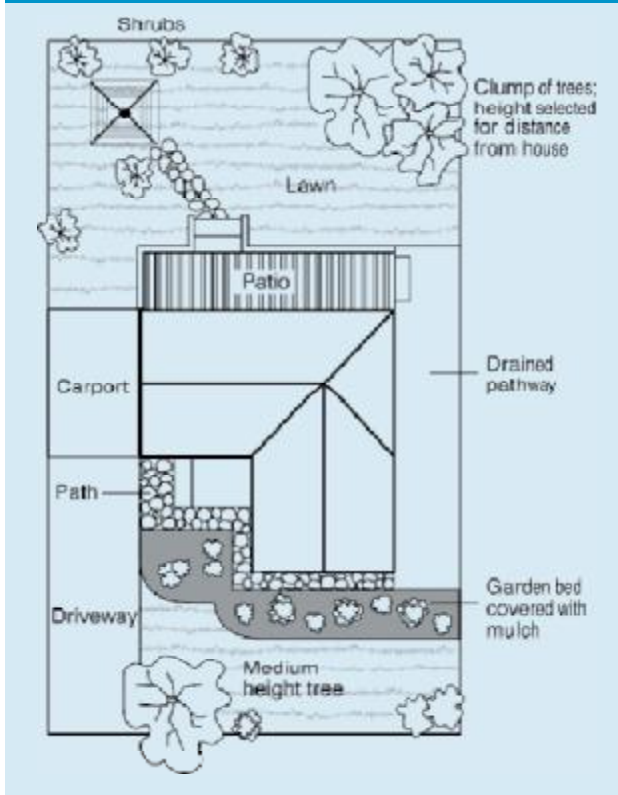
For this reason, particularly where problems exist or are likely to occur, it is recommended that an apron of paving be installed around as much of the building perimeter as necessary. This paving

### CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

| Description of typical damage and required repair                                                                                                                                                                                       | Approximate crack width limit (see Note 3)                | Damage category |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|-----------------|
| Hairline cracks                                                                                                                                                                                                                         | <0.1 mm                                                   | 0               |
| Fine cracks which do not need repair                                                                                                                                                                                                    | <1 mm                                                     | 1               |
| Cracks noticeable but easily filled. Doors and windows stick slightly                                                                                                                                                                   | <5 mm                                                     | 2               |
| Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weathertightness often impaired                                                               | 5–15 mm (or a number of cracks 3 mm or more in one group) | 3               |
| Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably, some loss of bearing in beams. Service pipes disrupted | 15–25 mm but also depend on number of cracks              | 4               |



#### Gardens for a reactive site



should extend outwards a minimum of 900 mm (more in highly reactive soil) and should have a minimum fall away from the building of 1:60. The finished paving should be no less than 100 mm below brick vent bases.

It is prudent to relocate drainage pipes away from this paving, if possible, to avoid complications from future leakage. If this is not practical, earthenware pipes should be replaced by PVC and backfilling should be of the same soil type as the surrounding soil and compacted to the same density.

Except in areas where freezing of water is an issue, it is wise to remove taps in the building area and relocate them well away from the building – preferably not uphill from it (see BTF 19).

It may be desirable to install a grated drain at the outside edge of the paving on the uphill side of the building. If subsoil drainage is needed this can be installed under the surface drain.

#### Condensation

In buildings with a subfloor void such as where bearers and joists support flooring, insufficient ventilation creates ideal conditions for condensation, particularly where there is little clearance between the floor and the ground. Condensation adds to the moisture already present in the subfloor and significantly slows the process of drying out. Installation of an adequate subfloor ventilation system, either natural or mechanical, is desirable.

**Warning:** Although this Building Technology File deals with cracking in buildings, it should be said that subfloor moisture can result in the development of other problems, notably:

- Water that is transmitted into masonry, metal or timber building elements causes damage and/or decay to those elements.
- High subfloor humidity and moisture content create an ideal environment for various pests, including termites and spiders.
- Where high moisture levels are transmitted to the flooring and walls, an increase in the dust mite count can ensue within the living areas. Dust mites, as well as dampness in general, can be a health hazard to inhabitants, particularly those who are abnormally susceptible to respiratory ailments.

#### The garden

The ideal vegetation layout is to have lawn or plants that require only light watering immediately adjacent to the drainage or paving edge, then more demanding plants, shrubs and trees spread out in that order.

Overwatering due to misuse of automatic watering systems is a common cause of saturation and water migration under footings. If it is necessary to use these systems, it is important to remove garden beds to a completely safe distance from buildings.

#### Existing trees

Where a tree is causing a problem of soil drying or there is the existence or threat of upheaval of footings, if the offending roots are subsidiary and their removal will not significantly damage the tree, they should be severed and a concrete or metal barrier placed vertically in the soil to prevent future root growth in the direction of the building. If it is not possible to remove the relevant roots without damage to the tree, an application to remove the tree should be made to the local authority. A prudent plan is to transplant likely offenders before they become a problem.

#### Information on trees, plants and shrubs

State departments overseeing agriculture can give information regarding root patterns, volume of water needed and safe distance from buildings of most species. Botanic gardens are also sources of information. For information on plant roots and drains, see Building Technology File 17.

#### Excavation

Excavation around footings must be properly engineered. Soil supporting footings can only be safely excavated at an angle that allows the soil under the footing to remain stable. This angle is called the angle of repose (or friction) and varies significantly between soil types and conditions. Removal of soil within the angle of repose will cause subsidence.

#### Remediation

Where erosion has occurred that has washed away soil adjacent to footings, soil of the same classification should be introduced and compacted to the same density. Where footings have been undermined, augmentation or other specialist work may be required. Remediation of footings and foundations is generally the realm of a specialist consultant.

Where isolated footings rise and fall because of swell/shrink effect, the homeowner may be tempted to alleviate floor bounce by filling the gap that has appeared between the bearer and the pier with blocking. The danger here is that when the next swell segment of the cycle occurs, the extra blocking will push the floor up into an accentuated dome and may also cause local shear failure in the soil. If it is necessary to use blocking, it should be by a pair of fine wedges and monitoring should be carried out fortnightly.

**This BTF was prepared by John Lewer FAIB, MIAMA, Partner, Construction Diagnosis.**

The information in this and other issues in the series was derived from various sources and was believed to be correct when published.

The information is advisory. It is provided in good faith and not claimed to be an exhaustive treatment of the relevant subject.

Further professional advice needs to be obtained before taking any action based on the information provided.

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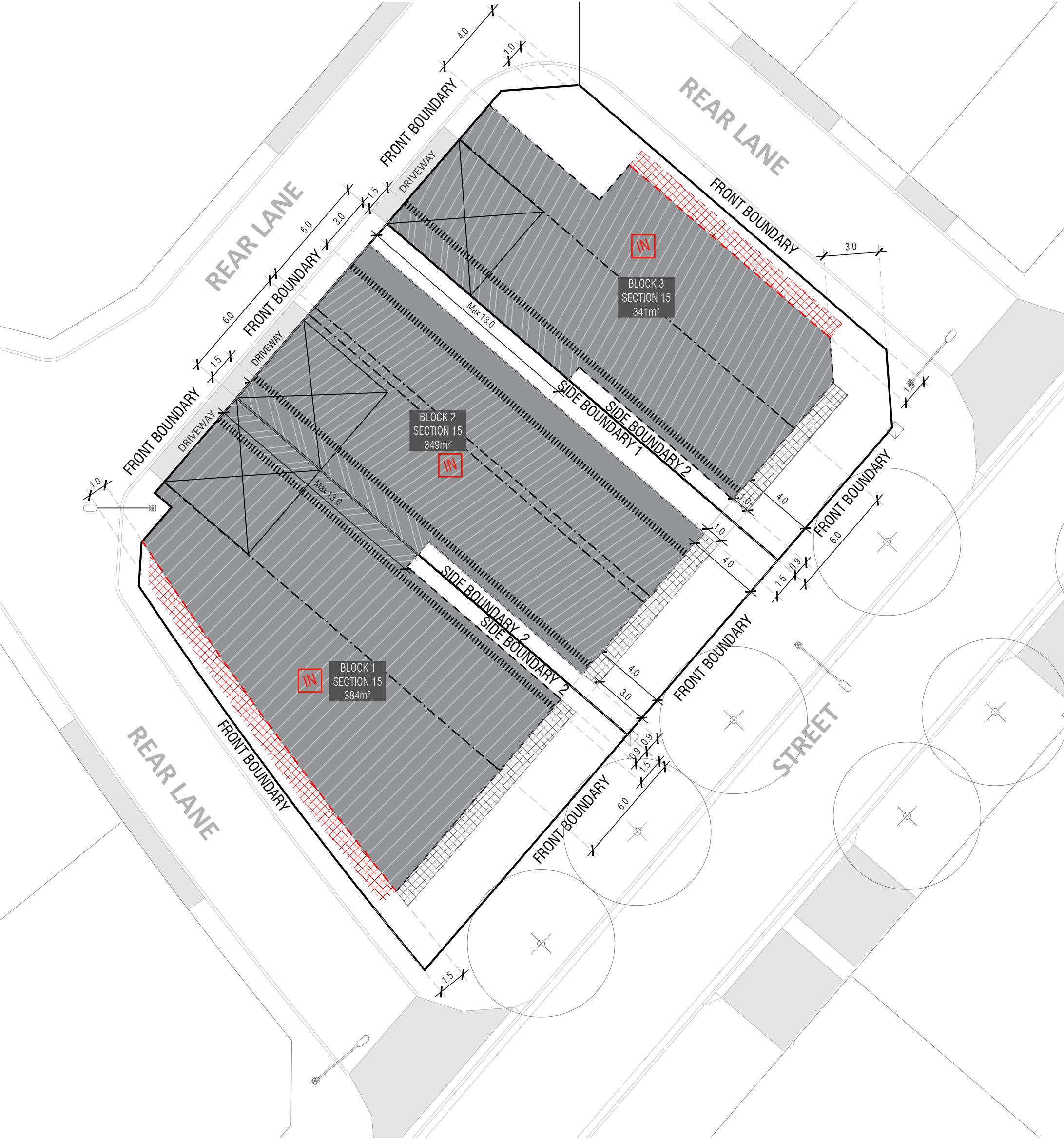
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# Appendix F





### KEY MAP

SITE LOCATION

### LEGEND

Block Boundary

Garage Location

BOUNDARY

 Boundary Defined by SDHDC

Part of Integrated Development Parcel by SPC  
*Refer to Figure 25*

#### INDICATIVE BUILDING FOOTPRINTS

(based on min. building setbacks only)

Lower Floor Level

Upper Floor Level

#### MINIMUM BOUNDARY SETBACKS

Strathnairn Precinct Code (SPC)  
*refer to the SPC - Rule 1, Figure 5*

Single Dwelling Housing Development Code (SDHDC)  
*front setbacks: refer to Rule 11, Table 3C*  
*side and rear setbacks: refer to Rule 12, Table 6B*

Upper Floor Level - Screened

Upper Floor Level - Unscreened

Articulation Elements (Articulation Zone)  
*refer SDHDC Rule 11, Table 3C*

Articulation Elements (Articulation Zone)  
*refer to the SPC - Rule 1, Figure 5*

1.5m or nil setback to a max length of 13m  
*refer to SDHDC Rule 12, Rule 15, Table 6B*

### BLOCK INFORMATION

|                |                 |
|----------------|-----------------|
| STAGE          | 1A              |
| ZONE           | RZ3             |
| SECTION        | 15              |
| BLOCKS         | 1-3             |
| CLASSIFICATION | MID SIZE        |
| HOUSING TYPE   | SINGLE DWELLING |

| REV | DRAWN | CHECKED | APPROVED | DATE     |
|-----|-------|---------|----------|----------|
| A   | CS    | JE      | BR       | 10/09/19 |
| B   | CS    | DZ      | CS       | 15/08/22 |

DO NOT SCALE OFF DRAWINGS. DIMENSIONS ARE IN METRES.

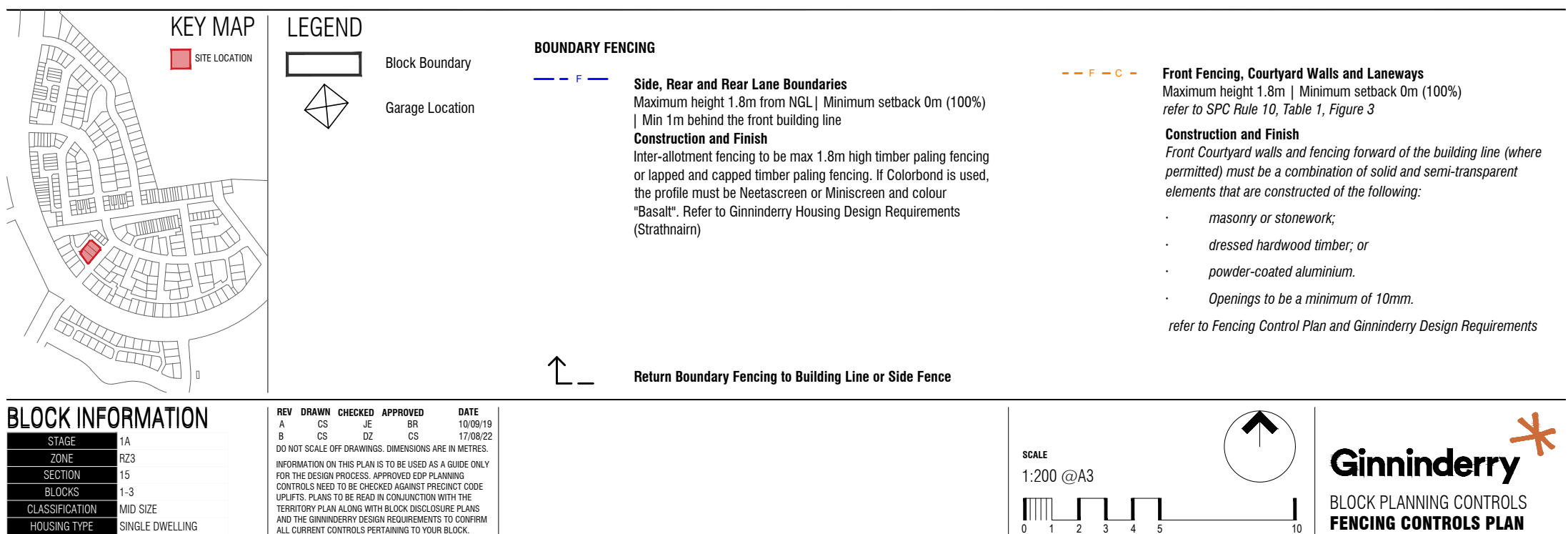
INFORMATION ON THIS PLAN IS TO BE USED AS A GUIDE ONLY FOR THE DESIGN PROCESS. APPROVED EDP PLANNING CONTROLS NEED TO BE CHECKED AGAINST PRECINCT CODE UPLIFTS. PLANS TO BE READ IN CONJUNCTION WITH THE TERRITORY PLAN ALONG WITH BLOCK DISCLOSURE PLANS AND THE GINNINDERRY DESIGN REQUIREMENTS TO CONFIRM ALL CURRENT CONTROLS PERTAINING TO YOUR BLOCK.

SCALE

1:200 @A3

**BLOCK PLANNING CONTROLS**

**BUILDING & SITING CONTROLS PLAN**



# Appendix G



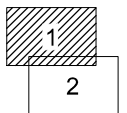
PLANNING AND DEVELOPMENT ACT 2007  
**APPROVAL GRANTED**  
SUBJECT TO THE CONDITIONS SET OUT IN THE  
NOTICE OF DECISION  
PURSUANT TO SECTION 162

Delegate name DALE BILLING  
Date 9/3/2018

**LEGEND:**

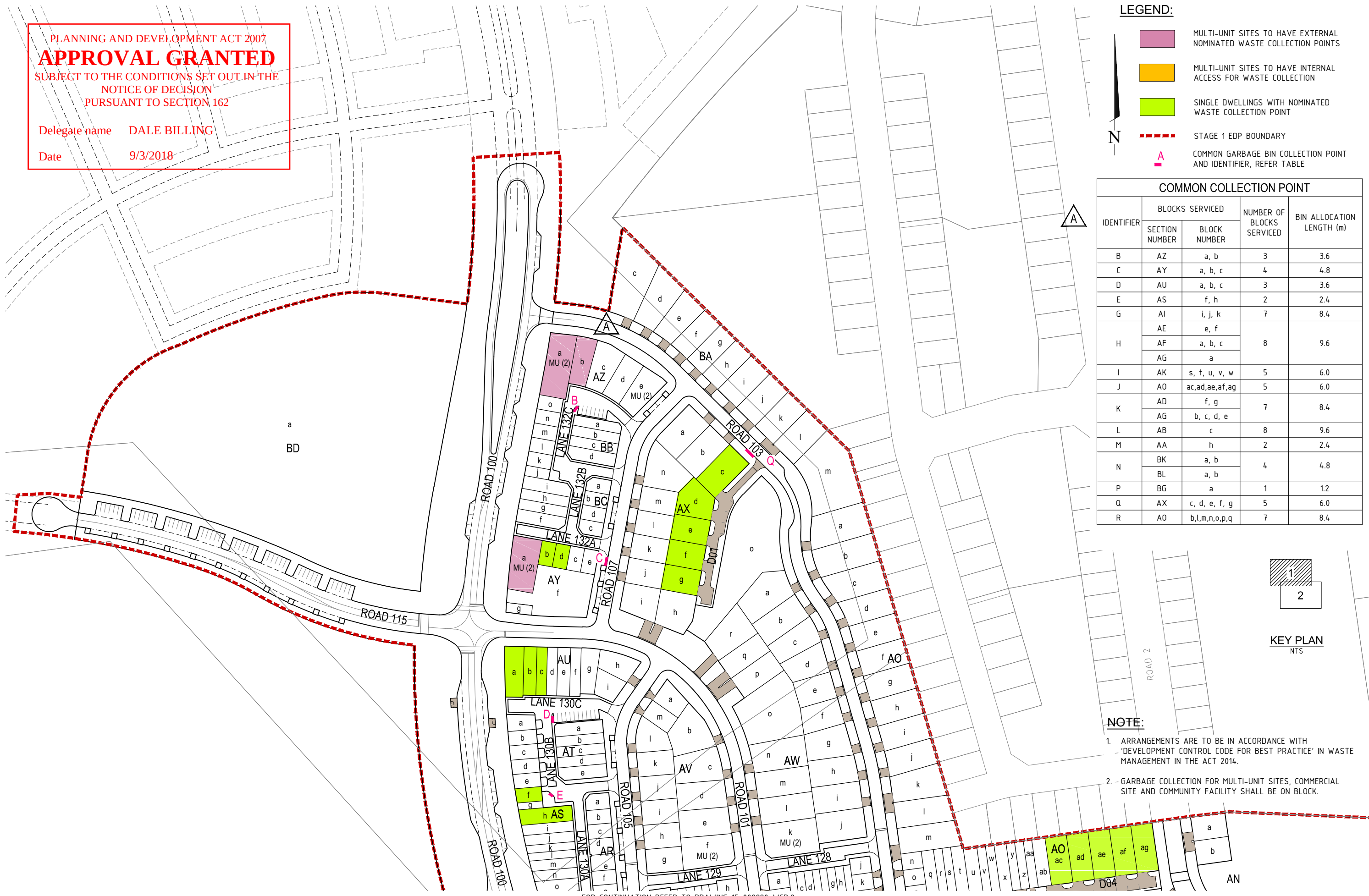
- MULTI-UNIT SITES TO HAVE EXTERNAL NOMINATED WASTE COLLECTION POINTS
- MULTI-UNIT SITES TO HAVE INTERNAL ACCESS FOR WASTE COLLECTION
- SINGLE DWELLINGS WITH NOMINATED WASTE COLLECTION POINT
- STAGE 1 EDP BOUNDARY
- COMMON GARBAGE BIN COLLECTION POINT AND IDENTIFIER, REFER TABLE

| COMMON COLLECTION POINT |                |                |                         |                           |
|-------------------------|----------------|----------------|-------------------------|---------------------------|
| IDENTIFIER              | BLOCKS SERVED  |                | NUMBER OF BLOCKS SERVED | BIN ALLOCATION LENGTH (m) |
|                         | SECTION NUMBER | BLOCK NUMBER   |                         |                           |
| B                       | AZ             | a, b           | 3                       | 3.6                       |
| C                       | AY             | a, b, c        | 4                       | 4.8                       |
| D                       | AU             | a, b, c        | 3                       | 3.6                       |
| E                       | AS             | f, h           | 2                       | 2.4                       |
| G                       | AI             | i, j, k        | 7                       | 8.4                       |
| H                       | AE             | e, f           | 8                       | 9.6                       |
|                         | AF             | a, b, c        |                         |                           |
|                         | AG             | a              |                         |                           |
| I                       | AK             | s, t, u, v, w  | 5                       | 6.0                       |
| J                       | AO             | ac,ad,ae,af,ag | 5                       | 6.0                       |
| K                       | AD             | f, g           | 7                       | 8.4                       |
|                         | AG             | b, c, d, e     |                         |                           |
| L                       | AB             | c              | 8                       | 9.6                       |
| M                       | AA             | h              | 2                       | 2.4                       |
| N                       | BK             | a, b           | 4                       | 4.8                       |
|                         | BL             | a, b           |                         |                           |
| P                       | BG             | a              | 1                       | 1.2                       |
| Q                       | AX             | c, d, e, f, g  | 5                       | 6.0                       |
| R                       | AO             | b,l,m,n,o,p,q  | 7                       | 8.4                       |



KEY PLAN  
NTS

- NOTE:**
- 1. ARRANGEMENTS ARE TO BE IN ACCORDANCE WITH - 'DEVELOPMENT CONTROL CODE FOR BEST PRACTICE' IN WASTE MANAGEMENT IN THE ACT 2014.
  - 2. - GARBAGE COLLECTION FOR MULTI-UNIT SITES, COMMERCIAL SITE AND COMMUNITY FACILITY SHALL BE ON BLOCK.



FOR CONTINUATION REFER TO DRAWING 15-002280-WCP.2+

| FIRST ISSUE | DESIGN | DRAWN | CHECK | APPROVED | DATE       |
|-------------|--------|-------|-------|----------|------------|
| SB          | LA     | CR    | BP    |          | 14/05/2016 |

| AMENDMENT | DATE       | DESCRIPTION                    |
|-----------|------------|--------------------------------|
| A         | 23/09/2016 | AMENDED TO SUIT REVISED LAYOUT |

WAE No. ....

PROJECT No. ....

SCALE (METRES)  
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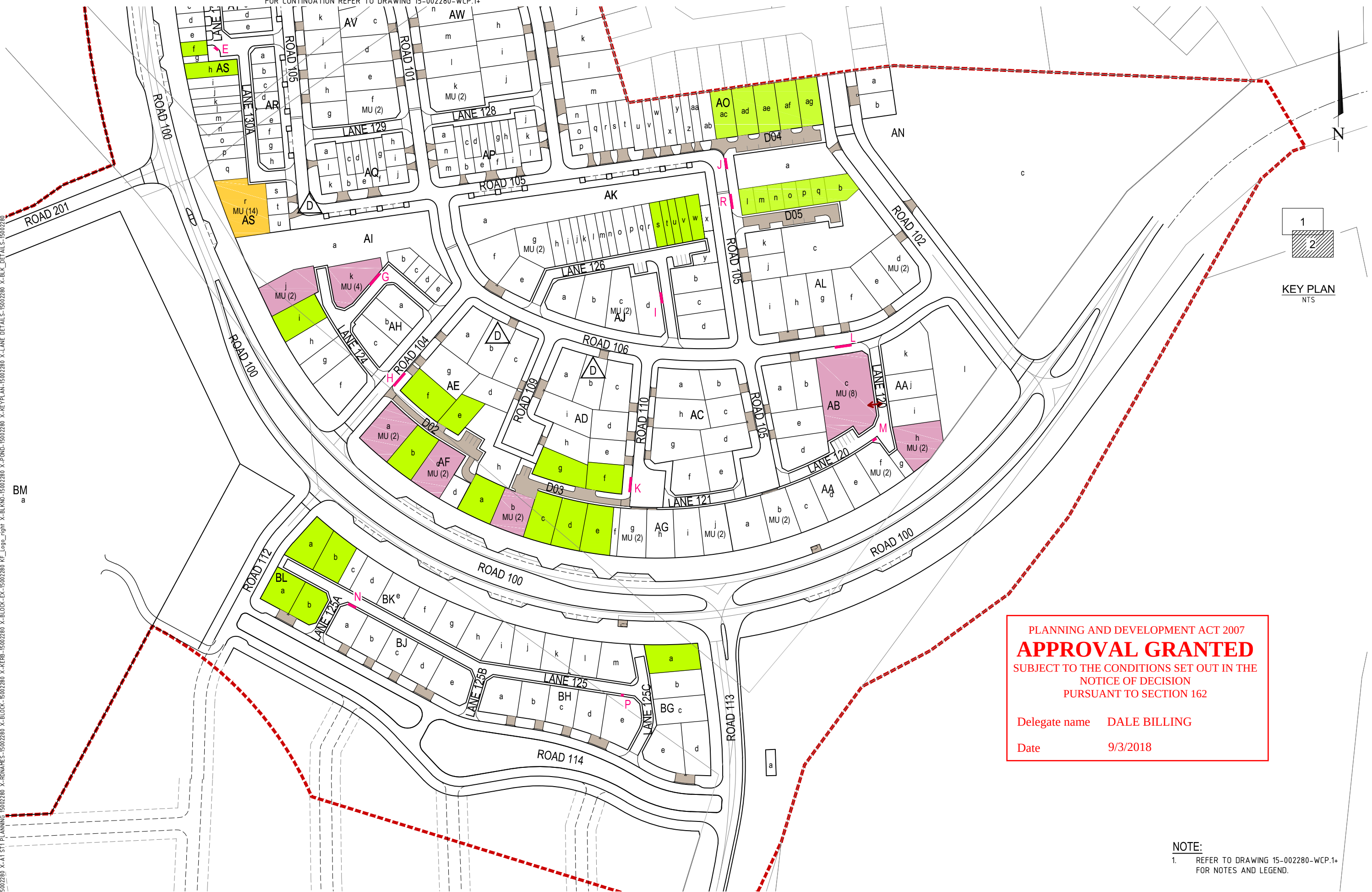
CLIENT  
RIVERVIEW PROJECTS (ACT)

PROJECT  
WEST BELCONNEN  
STAGE 1  
PLANNING

DRAWING TITLE  
WASTE COLLECTION PLAN  
SHEET 1 OF 2

DRAWING NUMBER  
15-002280-WCP.1+ PLAN NO: 23.1

AMEND.  
A



|               |              |
|---------------|--------------|
| Delegate name | DALE BILLING |
| Date          | 9/3/2018     |

**NOTE:**

1. REFER TO DRAWING 15-002280-WCP.1+  
FOR NOTES AND LEGEND.

|                                                                  |        |       |           |           |            |                                |
|------------------------------------------------------------------|--------|-------|-----------|-----------|------------|--------------------------------|
| A<br>M<br>E<br>N<br>D<br>M<br>E<br>N<br>T<br>S<br>X-SHEET LAYOUT | DESIGN | DRAWN | CHECK     | APPROVED  | DATE       | AMENDMENT DETAILS              |
|                                                                  | SB     | LA    | <i>OK</i> | <i>AP</i> | 14/06/2016 |                                |
|                                                                  |        |       |           |           |            |                                |
|                                                                  |        |       |           |           |            |                                |
|                                                                  |        |       |           |           |            |                                |
| A                                                                | SB     | JK    | <i>OK</i> | <i>AP</i> | 23/09/2016 | AMENDED TO SUIT REVISED LAYOUT |
| B                                                                | SB     | JK    | <i>OK</i> | <i>AP</i> | 05/10/2016 | STAGE BOUNDARY AMENDED         |
| C                                                                | SB     | JK    | <i>OK</i> | <i>AP</i> | 16/12/2016 | DRIVEWAY AMENDMENTS            |
| D                                                                | SB     | JK    | <i>OK</i> | <i>AP</i> |            |                                |



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RobertsDay  
*planning-design-place*

**GROUP GSA**

**Cia**  
landscapes  
+  
colour

WAE No. ....

PROJECT No. ....

A3 PLOT SCALE (METRES)

1:2000 

A1 PLOT 1:1000



CLIENT

 RIVERVIEW PROJECTS (ACT)

PROJECT

WEST BELCONNEN  
STAGE 1  
PLANNING



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DRAWING TITLE

**WASTE COLLECTION PLAN SHEET 2**

DRAWING NUMBER

AMEND.

15-002280-WCP.2+ PLAN NO: 23.2 D



# Appendix H

# Smart living.

Building what's best for  
you and the environment



Ginninderry



# Building a new house is one of the most costly decisions you will make in your lifetime.

A new home – if built well – can last more than 100 years, so building it right the first time is important! The decisions you make around the size, orientation and materials can make a significant impact on the long term running costs of your home. At Ginninderry, our aim is to help you design a home that is more comfortable to live in, will provide a better lifestyle and will help you save on energy costs. Here we've put together some tips and guidelines to help you make the most of your investment.

## Setting the Highest Standards



Ginninderry has achieved a World Leading 6 Star rating through the Green Building Council of Australia's Green Star – Communities program.

Ginninderry has been designed with best practice sustainability features front of mind. Now it's your turn!



# Your house Building the shell

## Insulation and Draught Proofing

Controlling how air flows in and out of your home is important. The shell of your home should act like an esky – you want to seal and insulate it the best you can. Increasing the insulation in your ceilings and walls is one way to keep you warm in winter and cool in summer by giving you the greatest barrier between you and the external climate. This will not only help you save money on heating and cooling but will also stop air escaping unwillingly.

Consider having an air leakage test. A newly built house should achieve less than 10 air changes an hour.

## Windows and Glazing

Windows and glass doors let in light, fresh air and provide good indoor and outdoor living connections. Windows are also the weakest link in the insulation of your building and can be a major source of unwanted heat gain in summer and significant heat loss in winter. Where possible, consider using double glazed, or low-e glass. The thermal performance of your windows also includes your frames. Aim for a window system with thermally broken frames, low U-values (less than 4.1) and high solar heat gain coefficient (around 0.66). A single glazed window can be up to 15 times worse at insulating your house than a wall. Choose the location of your windows carefully and size them appropriately.

## Roof

Your roof plays an important part in orientating your solar panels. Your panels will work best if installed facing North at 30 degrees from horizontal. When designing your home, think about your roof design to easily cater for your panels. The more basic the design, the easier your job will be!

The colour of your roof could also affect how much heat your home absorbs. Pick lighter shades of roofing so yours doesn't have unwanted heat in your ceiling space.

## Designing for the Canberra Climate

Canberra is a cool, temperate area of Australia. It has low humidity and large changes between day and night (diurnal) temperatures and four very distinct seasons. We have highly variable spring and autumn conditions, cold to very cold winters and hot, dry summers.

The variability of our climate will only become greater with climate change. Winter sun and summer shading will help to passively heat and cool your home when it needs it most.

## Energy Efficiency Rating

In the ACT, all new homes are required to meet a minimum 6 Star Energy Efficiency Rating (EER). The EER of your home assesses the building design, materials, and layout; and predicts how much heating and cooling you need to be comfortable. The overall EER is made up of both heating and cooling components. The heating load tells you how much heating is required to make your home comfortable. The cooling load tells you how much cooling you will require. The bigger the home, the more it takes to heat and cool your home and therefore affect your EER. The overall EER is a balance of both (like a see-saw) so make sure your EER is not weighted heavily to either heating or cooling. Or better still, ask how to achieve a higher EER!

## Reduce Material Use

Think about a secure car port rather than a garage. While your car might need to be protected from the elements, you can create secure car ports that are cheaper than a fully bricked garage. Also consider future-proofing for electric vehicles by installing cabling in your garage or carport wall. This will save you time and money adapting in the future.

## Questions to ask:

- Will my roof design allow for the PV panels I need?
- Is my heating load from my EER sensible for the Canberra climate?
- How can I achieve a higher EER?
- Is my insulation the highest it can be in my walls, floor, and roof?
- Should I install double glazing?
- Do my windows give me good air flow throughout my home?
- Are my windows shaded from the summer sun?
- Can I orientate my living areas to the North to make use of the sun in winter?



# Your house The inside

## Generating, Managing & Storing Energy

Reducing the amount of energy you use is the most cost effective way to cut your energy costs.

Your PV panels and demand management system can help to provide renewable energy for you home.

Your demand management system (DMS) can help you monitor and manage your energy use. Air conditioner systems, heat pump hot water systems, lighting and security systems can also be managed by your DMS as long as the right appliances are selected.

Talk to your energy package provider about how appliances can be connected to your DMS.

Household Solar Battery systems can also store the power you generate with your PV system, letting you use the power when the sun isn't shining. Remember to consider the location of your battery – either now or allocating space for it in the future. It may need to be on an external wall or within a fire rated enclosure.

## Indoor Air Quality

The paints, sealants and glues used in your home can sometimes be quite toxic. Look for materials with low or no Volatile Organic Compounds (VOCs). Removing VOCs from your home will result in a fresher, healthier home environment.

## Designing for Accessibility

Designing for accessibility is about thinking about how your house caters for a range of mobility and health levels and how these needs can change over time.

**Accessibility is important for:**

**Families with young children** – making it easier to manoeuvre prams and strollers and removing trip hazards for toddlers

**People with temporary injuries** – larger doorways and step-free entries make it easier for people in wheelchair and crutches.

**Ageing population** – for both residents and elderly visitors, family and friends

**People with a disability and their families** – not only in their own homes but for visiting others.

## Lighting

Think about using natural light from windows before using artificial light. Installing energy efficient LED lighting will save you money over time. Reduce the number of downlights you install in your home. If you really need them, make sure they are fully sealed, LED downlights which can allow insulation around them. Traditional downlights act as big holes in your ceiling – making your insulation less effective.

## Reduce Materials

The less materials required to build your home, the cheaper it will be. Consider using polished concrete floors, exposed brick (rather than adding a render) and other material which don't require further finishes where sensible

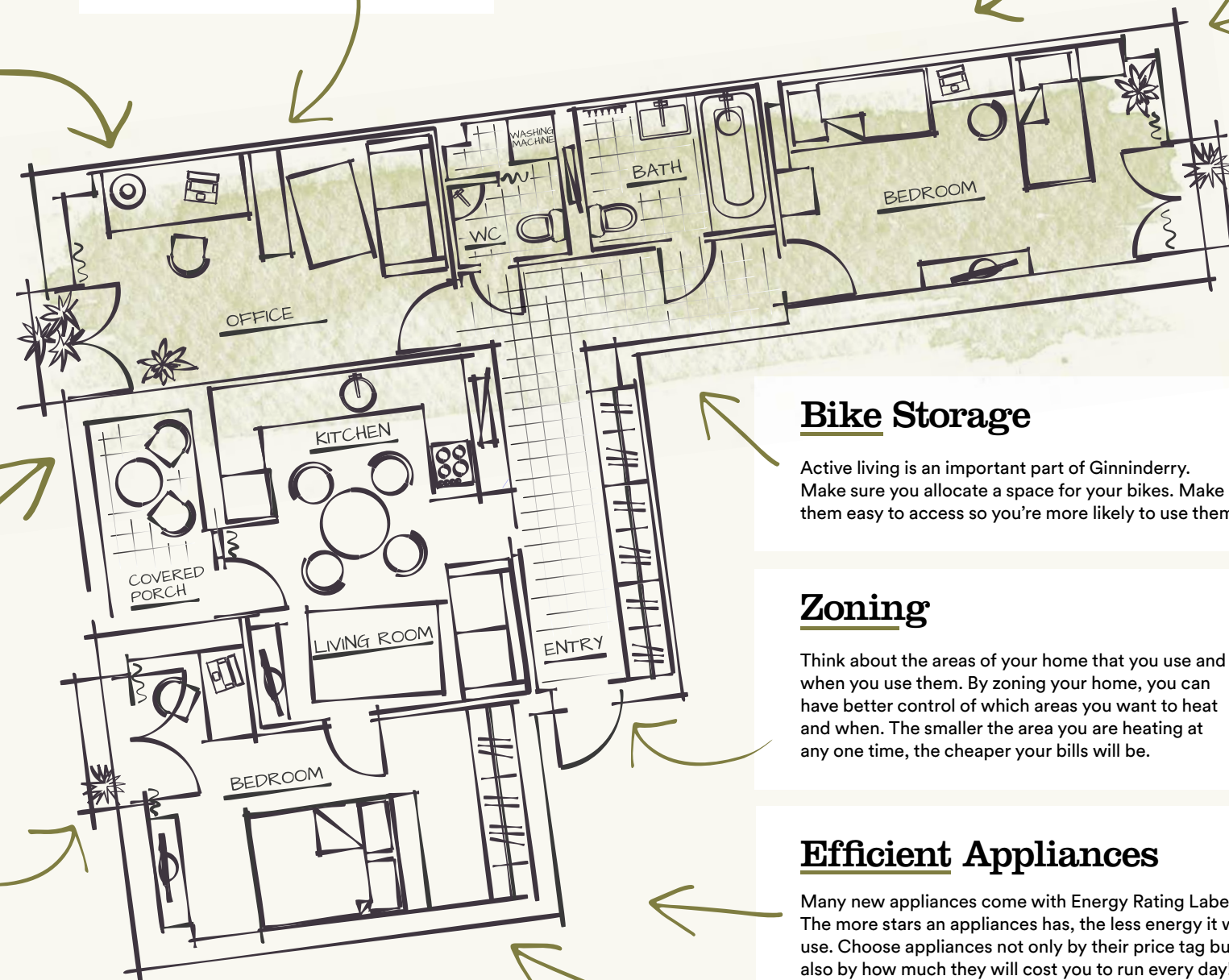
## Make Recycling Easy

Designing separate waste bins into your kitchen will make it easier on bin day! Design for composting, recycling and general waste.

## Heating and Cooling

The cheapest way to heat your home is with the sun. To make the most of it, your house should allow for lots of winter sun and keep out the harsh summer sun. Place rooms that you're likely to spend daylight hours in (typically your living rooms) to the north of your block. This will allow you to get good winter sunlight and reduce the hot summer sun.

Use thermal mass to store the sun's heat and provide night time warmth in cold conditions. This can be achieved with tiled or polished concrete floors in north facing living areas. This allows the sun to heat the area inside and contribute to a naturally cool home in summer.



## Bike Storage

Active living is an important part of Ginninderry. Make sure you allocate a space for your bikes. Make them easy to access so you're more likely to use them.

## Zoning

Think about the areas of your home that you use and when you use them. By zoning your home, you can have better control of which areas you want to heat and when. The smaller the area you are heating at any one time, the cheaper your bills will be.

## Efficient Appliances

Many new appliances come with Energy Rating Labels. The more stars an appliances has, the less energy it will use. Choose appliances not only by their price tag but also by how much they will cost you to run every day!

## Saving Water

Using rain water to flush your toilets and wash your clothes (as well as for your garden) can help you save money on your water bill.

Installing water efficient fixtures and fittings will also help you save water.

## Cross Ventilation

Your doors and windows can help cool your home on summer nights by allowing air to travel through your home. Install flyscreens to your openable windows and doors so that you can securely open your windows and doors.

## Questions to ask:

- Is my home zoned in a way that I can heat and cool different areas separately?
- Is there good ventilation throughout the house?
- Has my heating and cooling system been designed to take into account my EER rating?
- Can I use no or low VOC products in building my home?
- Can my demand management system be connected to other appliances like my air conditioner?
- Have I allocated space for bikes?

## Indoor Drying Space

Canberra winters are cold but we get really lovely sunny days. Consider space inside for your washing that gets good winter sun. This will reduce the need for a dryer.



# Your house Landscape

## Choose a garden you can maintain

Not everyone has a green thumb. Pick a garden design that suits your lifestyle. If you forget to water your plants, pick drought tolerant, hardy natives or woody herbs like rosemary that don't require a lot of attention.

## Free Water

Most homes in Ginninderry have a rain water tank. Rain water is great for watering your plants.

## Green Shading

Plants do a great job of shading East and West facing windows. Use them to keep you cool in summer. Choose plants that can be pruned back in winter (or that are deciduous) so that you can let in the winter sun.

## Make your plants useful plantings

Whether you plant edible foods or plants that attract bees (or other pollinators and wildlife), your garden can not only look pretty but also have a higher purpose.

## Space for Bins

The ACT Government is currently trialling green bins for garden waste. To futureproof for a potential ACT-wide rollout, allocate space for three bins:

- General waste (red lid)
- Mixed Recycling (yellow lid)
- Green waste (green lid)

## Clothes Drying

Allocate an outdoor drying space that has good access to winter sun. This is usually on the northern side of your home. Using the sun to dry your clothes is a lot cheaper than a dryer!

## Soft space vs Hard space

The more concrete or hard surfaces in your yard, the hotter your house will be in summer. Think about how you can use grasses, plantings or permeable pavers to limit the amount of hard spaces you have.

This will help you save money by reducing your energy and water required to keep your home cool.

## Compost

Use your kitchens scraps as compost for your yard or get a worm garden. Don't have room? Donate your scraps to the Community Garden!

This will help reduce unnecessary waste going to landfill.

## Questions to ask:

- How can I reduce the amount concrete and hard spaces in my yard?
- Can I use alternatives like permeable paving, groundcovers or mulch?
- Have I allowed enough space for my bins?
- Have I checked that my plants won't become weeds in the conservation corridor?
- Are my plants edible or good for birds, bees and other pollinators?
- Is my garden drought and frost tolerant?
- Have I made the most of my rain water tank?



## Conserving our Conservation Corridor

The plants that you plant in your yard will impact our conservation corridor. Bins and other animals will spread seeds through our landscape. It is therefore very important that we don't plant species that are considered weeds (easily spreading) or sleeper weeds (plants that could become weeds in the future or in other climate conditions).



## Mandatory Requirements:

Check the Ginninderry Housing Development Requirements

## More Info:

### FACTSHEETS

Ginninderry Front Garden Landscape Concept Designs

Ginninderry Energy Package Factsheet

Are your garden plants going bush? ACT Government Parks and Conservation Service

### WEBSITES

YourHome – Australia's guide to environmentally sustainable homes [www.yourhome.gov.au](http://www.yourhome.gov.au)

Josh's House – showcasing the benefits of sustainable housing to the community through demonstration and inspiration [www.joshshouse.com.au](http://www.joshshouse.com.au)

Scinergy – the science of energy efficiency [www.scinergy.com.au/airleakage](http://www.scinergy.com.au/airleakage)

Water Efficient Labelling and Standards (WELS) Scheme [www.waterrating.gov.au](http://www.waterrating.gov.au)

Energy Rating – the more stars the more savings [www.energyrating.gov.au](http://www.energyrating.gov.au)

National House Energy Rating Scheme (NATHERS) [www.nathers.gov.au](http://www.nathers.gov.au)

Livable Housing Australia [www.livablehousingaustralia.org.au](http://www.livablehousingaustralia.org.au)

### BOOKS

The Energy-Freedom Home: how to wipe out electricity and gas bills in nine steps. Beyond Zero Emissions (2015)

The CSIRO home energy saving handbook: how to save energy, save money and reduce your carbon footprint. John Wright, Peter Osman Peta Ashworth (2009)

## Got More Questions?

Contact Ginninderry and ask to speak to our Design Co-ordinator or Sustainability Manager:

 [enquiries@ginninderry.com](mailto:enquiries@ginninderry.com)

 [ginninderry.com](http://ginninderry.com)

**Phone** 1800 316 900

**Fax** 02 6239 6004



**For more information**

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P: 1800 316 900

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**[ginninderry.com](http://ginninderry.com)**



ACT  
Government

**Suburban Land**  
Agency



**Riverview**  
Developments

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# Strathnairn Housing Development Requirements Application Form



# Ginninderry Housing Development Requirements Application Form



**Ginninderry**

## Property details

|            |  |
|------------|--|
| Block      |  |
| Section    |  |
| Block size |  |
| Suburb     |  |

## Purchaser details

|        |  |
|--------|--|
| Name   |  |
| Phone  |  |
| Mobile |  |
| Email  |  |

## Architect/designer details

|         |  |
|---------|--|
| Name    |  |
| Company |  |
| Phone   |  |
| Mobile  |  |
| Email   |  |

## Builder details

|         |  |
|---------|--|
| Name    |  |
| Company |  |
| Phone   |  |
| Mobile  |  |
| Email   |  |

## Required documents

- ☐ **1. 1:200 site plan with the following details:**
  - Overall building envelope with setback dimensions
  - Extent of any retaining walls
  - Location and size of Principal Private Open Space (PPOS)
  - Location and clearance of all easements
  - Services locations such as electrical and NBN meter boxes, water and gas meter, water tank, condenser units, HWS, clothes line
  - Finished floor levels for the house and garage as well as gradient of driveway
  - Extent of driveway and location of letterbox
- ☐ **2. Provide a fencing plan show all precinct code fencing requirements.**
  - Include location of letter box incorporated in wall on as a masonry pier.
- ☐ **3. 1:200 erosion sediment controls plan.**
- ☐ **4. 1:100 floor plan and roof plan(s) with dimensions and size of dwelling area.**
- ☐ **5. 1:100 elevations with the following details:**
  - Natural and proposed ground level with proposed FFL from boundary to boundary
  - Extent of cut and/or fill and any retaining walls, including details of the height and materials
  - Roof pitch
- ☐ **6. Energy efficiency rating certificate for the dwelling.**
- ☐ **8. Water fixture list.**

## Contact us:

**E:** [designs@ginninderry.com](mailto:designs@ginninderry.com)

**P:** 1800 316 900 **M:** Charlotte 0411 844 645 (Tuesday to Thursday)

Ginninderry is a joint venture between the Suburban Land Agency and Riverview Developments, with Riverview Projects (ACT) Pty Ltd ABN 30 165 870 539 acting as development manager. Correct as at 26/10/2020

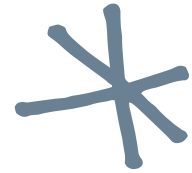
# Ginninderry Housing Development Requirements



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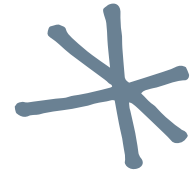
|                                                                   | Minimum requirements                                                                                                                                                                                                  | Record for your home                                                 |
|-------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| Star rating as shown on your energy efficiency rating certificate | 6 Star                                                                                                                                                                                                                | <div></div> <div><input type="checkbox"/> Certificate Provided</div> |
| Solar PV array size (kW)                                          | Block size <250m <sup>2</sup> : 2kW<br>Block size 251m <sup>2</sup> < 350m <sup>2</sup> : 3kW<br>Block size 351m <sup>2</sup> < 500m <sup>2</sup> : 4kW<br>Block size > 500m <sup>2</sup> : 5kW                       | Panel Array Size:<br><div></div>                                     |
| Home energy management system                                     | Reposit Power, Combined Energy and Evergen home energy management systems have been pre-approved. If an alternative system is installed, please provide a copy of a signed Alternative Home Energy System Assessment. | Brand:<br><div></div>                                                |
| Inverter                                                          | Inverter compatible with an approved home energy management system above.                                                                                                                                             | Brand:<br><div></div><br>Model:<br><div></div>                       |
| Hot water system                                                  | Solar or Heat Pump Systems Only<br>Temperature range to -5°C.                                                                                                                                                         | Brand:<br><div></div><br>Model:<br><div></div>                       |

# Ginninderry Housing Development Requirements



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| Minimum requirements                                     |                                                                                                                                                                                                                                                                                                                                                       | Record for your home                                                         |             |
|----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|-------------|
| <b>Heating and cooling systems</b>                       |                                                                                                                                                                                                                                                                                                                                                       | <b>Brand:</b>                                                                |             |
| Please select:                                           |                                                                                                                                                                                                                                                                                                                                                       |                                                                              |             |
| <input type="checkbox"/> Reverse cycle air conditioning  | <b>Cooling Cycle:</b><br><b>EER</b> $\geq 3$<br><b>SPL</b> $< 57$<br><b>Temp. Range</b> -5°C to 43°C                                                                                                                                                                                                                                                  | <b>Model:</b>                                                                |             |
| <input type="checkbox"/> Air conditioning – cooling only |                                                                                                                                                                                                                                                                                                                                                       |                                                                              |             |
| <input type="checkbox"/> Ducted evaporative cooling      |                                                                                                                                                                                                                                                                                                                                                       | <b>EER:</b>                                                                  | <b>SPL:</b> |
| <input type="checkbox"/> Ground source heat pump         |                                                                                                                                                                                                                                                                                                                                                       |                                                                              |             |
| <input type="checkbox"/> Other (please specify)          |                                                                                                                                                                                                                                                                                                                                                       |                                                                              |             |
|                                                          | <b>Heating Cycle:</b><br><b>COP</b> $\geq 3.5$<br><b>SPL</b> $< 57$<br><b>Temp. Range</b> -10°C to 15°C                                                                                                                                                                                                                                               | <b>Temp Range:</b>                                                           |             |
|                                                          | <small>EER = Energy Efficiency Ratio   SPL = Sound Pressure Level of outdoor unit measured at 1m. Why is this important? <a href="#">Read more here</a>   COP = Coefficient of Performance</small>                                                                                                                                                    |                                                                              |             |
|                                                          |                                                                                                                                                                                                                                                                                                                                                       | <b>COP:</b>                                                                  | <b>SPL:</b> |
|                                                          |                                                                                                                                                                                                                                                                                                                                                       |                                                                              |             |
|                                                          |                                                                                                                                                                                                                                                                                                                                                       | <b>Temp Range:</b>                                                           |             |
|                                                          |                                                                                                                                                                                                                                                                                                                                                       |                                                                              |             |
| <b>Water fixtures and fittings</b>                       | Showerheads 3 star ( $< 9\text{L/min}$ )<br>Tapware 4 star<br>Toilets 4 star                                                                                                                                                                                                                                                                          | <input type="checkbox"/> All fixtures comply                                 |             |
|                                                          |                                                                                                                                                                                                                                                                                                                                                       | <input type="checkbox"/> Fixture List Provided                               |             |
| <b>Rain water tank</b>                                   | <b>Block Size <math>&lt; 250\text{m}^2</math>:</b> N/A<br><b>Block Size <math>251\text{m}^2 &lt; 350\text{m}^2</math>:</b> 2,000L<br><b>Block Size <math>351\text{m}^2 &lt; 600\text{m}^2</math>:</b> 4,000L<br><b>Block Size <math>601\text{m}^2 &lt; 800\text{m}^2</math>:</b> 8,000L<br><b>Block Size <math>&gt; 800\text{m}^2</math>:</b> 10,000L | <b>Tank Size:</b>                                                            |             |
|                                                          |                                                                                                                                                                                                                                                                                                                                                       |                                                                              |             |
|                                                          |                                                                                                                                                                                                                                                                                                                                                       | <input type="checkbox"/> Connected to Laundry, toilets and all external taps |             |



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# External colours and finishes schedule (Please tick the boxes below)

## Roof Tiles – Monier

### Atura

|                          |               |                          |            |                          |         |                          |           |                          |           |                          |          |
|--------------------------|---------------|--------------------------|------------|--------------------------|---------|--------------------------|-----------|--------------------------|-----------|--------------------------|----------|
| <input type="checkbox"/> | Babylon       | <input type="checkbox"/> | Barramundi | <input type="checkbox"/> | Caraway | <input type="checkbox"/> | Mist Grey | <input type="checkbox"/> | Saltspray | <input type="checkbox"/> | Seashell |
| <input type="checkbox"/> | Silver Pearch | <input type="checkbox"/> | Wildrice   | <input type="checkbox"/> | Wollemi | <input type="checkbox"/> | Aniseed   |                          |           |                          |          |

### Horizon

|                          |          |                          |              |                          |          |                          |         |                          |           |                          |           |
|--------------------------|----------|--------------------------|--------------|--------------------------|----------|--------------------------|---------|--------------------------|-----------|--------------------------|-----------|
| <input type="checkbox"/> | Babylon  | <input type="checkbox"/> | Barramundi   | <input type="checkbox"/> | Camelot  | <input type="checkbox"/> | Caraway | <input type="checkbox"/> | Mist Grey | <input type="checkbox"/> | Saltspray |
| <input type="checkbox"/> | Seashell | <input type="checkbox"/> | Silver Perch | <input type="checkbox"/> | Wildrice | <input type="checkbox"/> | Wollemi | <input type="checkbox"/> | Aniseed   |                          |           |

## Roof Tiles – Boral

### Artline

|                          |       |                          |        |                          |        |                          |              |                          |         |                          |         |
|--------------------------|-------|--------------------------|--------|--------------------------|--------|--------------------------|--------------|--------------------------|---------|--------------------------|---------|
| <input type="checkbox"/> | Earth | <input type="checkbox"/> | Fossil | <input type="checkbox"/> | Basalt | <input type="checkbox"/> | Night Quartz | <input type="checkbox"/> | Eclipse | <input type="checkbox"/> | Asphalt |
|--------------------------|-------|--------------------------|--------|--------------------------|--------|--------------------------|--------------|--------------------------|---------|--------------------------|---------|

### Wave

|                          |       |                          |        |                          |        |                          |              |                          |         |                          |         |
|--------------------------|-------|--------------------------|--------|--------------------------|--------|--------------------------|--------------|--------------------------|---------|--------------------------|---------|
| <input type="checkbox"/> | Earth | <input type="checkbox"/> | Fossil | <input type="checkbox"/> | Basalt | <input type="checkbox"/> | Night Quartz | <input type="checkbox"/> | Eclipse | <input type="checkbox"/> | Asphalt |
|--------------------------|-------|--------------------------|--------|--------------------------|--------|--------------------------|--------------|--------------------------|---------|--------------------------|---------|

### Vogue

|                          |       |                          |          |                          |               |                          |           |                          |       |
|--------------------------|-------|--------------------------|----------|--------------------------|---------------|--------------------------|-----------|--------------------------|-------|
| <input type="checkbox"/> | Shale | <input type="checkbox"/> | Gunmetal | <input type="checkbox"/> | Charcoal Grey | <input type="checkbox"/> | Stonewall | <input type="checkbox"/> | Taupe |
|--------------------------|-------|--------------------------|----------|--------------------------|---------------|--------------------------|-----------|--------------------------|-------|

### Contour

|                          |               |                          |       |                          |        |                          |       |                          |          |                          |      |
|--------------------------|---------------|--------------------------|-------|--------------------------|--------|--------------------------|-------|--------------------------|----------|--------------------------|------|
| <input type="checkbox"/> | Quartz        | <input type="checkbox"/> | Taupe | <input type="checkbox"/> | Walnut | <input type="checkbox"/> | Shale | <input type="checkbox"/> | Gunmetal | <input type="checkbox"/> | Peat |
| <input type="checkbox"/> | Charcoal Grey |                          |       |                          |        |                          |       |                          |          |                          |      |

### Striata

|                          |          |                          |       |                          |        |                          |               |
|--------------------------|----------|--------------------------|-------|--------------------------|--------|--------------------------|---------------|
| <input type="checkbox"/> | Gunmetal | <input type="checkbox"/> | Taupe | <input type="checkbox"/> | Walnut | <input type="checkbox"/> | Charcoal Grey |
|--------------------------|----------|--------------------------|-------|--------------------------|--------|--------------------------|---------------|

### Slimline

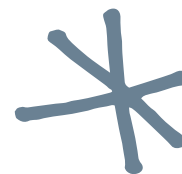
|                          |          |                          |           |                          |       |
|--------------------------|----------|--------------------------|-----------|--------------------------|-------|
| <input type="checkbox"/> | Gunmetal | <input type="checkbox"/> | Stonewall | <input type="checkbox"/> | Taupe |
|--------------------------|----------|--------------------------|-----------|--------------------------|-------|

## Roof Tiles – Bristle

### Prestige

|                          |         |                          |           |                          |          |                          |         |                          |          |
|--------------------------|---------|--------------------------|-----------|--------------------------|----------|--------------------------|---------|--------------------------|----------|
| <input type="checkbox"/> | Lithium | <input type="checkbox"/> | Palladium | <input type="checkbox"/> | Titanium | <input type="checkbox"/> | Mercury | <input type="checkbox"/> | Tungsten |
|--------------------------|---------|--------------------------|-----------|--------------------------|----------|--------------------------|---------|--------------------------|----------|





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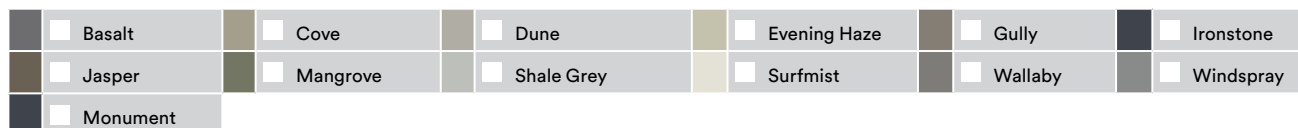
## Roof Tiles – Bristle (cont.)

### Classic

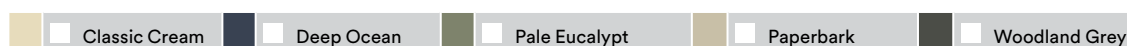


## Metal Roof – Colorbond

### Contemporary Colours



### Classic Colours



### Matt Colours



## Fence Colour

### Side and Rear Boundary Fencing



## Window Frame Colour

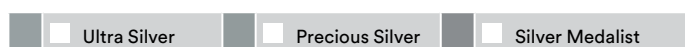
### Contemporary Colours

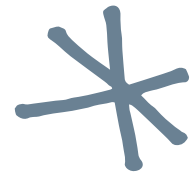


### Standard Colours



### Selected Pearls





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## Bricks – Austral

|                     |  |                                 |  |                                |  |                                  |  |                                 |
|---------------------|--|---------------------------------|--|--------------------------------|--|----------------------------------|--|---------------------------------|
| <b>Ultra Smooth</b> |  | <input type="checkbox"/> Tempo  |  | <input type="checkbox"/> Chill |  | <input type="checkbox"/> Jazz    |  | <input type="checkbox"/> Rhythm |
| <b>La Paloma</b>    |  | <input type="checkbox"/> Miro   |  | <input type="checkbox"/> Azul  |  |                                  |  |                                 |
| <b>Urban One</b>    |  | <input type="checkbox"/> Silver |  | <input type="checkbox"/> Latte |  | <input type="checkbox"/> Chiffon |  | <input type="checkbox"/> Pepper |

## Wilderness Design

|  |                                   |  |                                       |  |                                   |  |                                     |  |                                    |
|--|-----------------------------------|--|---------------------------------------|--|-----------------------------------|--|-------------------------------------|--|------------------------------------|
|  | <input type="checkbox"/> Grey Gum |  | <input type="checkbox"/> Silver Birch |  | <input type="checkbox"/> Blue Gum |  | <input type="checkbox"/> Blackberry |  | <input type="checkbox"/> Blackbutt |
|  | <input type="checkbox"/> Rosewood |  |                                       |  |                                   |  |                                     |  |                                    |

## Everyday Life

|  |                                 |  |                                  |  |                                  |  |                                    |  |                                 |
|--|---------------------------------|--|----------------------------------|--|----------------------------------|--|------------------------------------|--|---------------------------------|
|  | <input type="checkbox"/> Engage |  | <input type="checkbox"/> Freedom |  | <input type="checkbox"/> Leisure |  | <input type="checkbox"/> Stimulate |  | <input type="checkbox"/> Unwind |
|  | <input type="checkbox"/> Escape |  |                                  |  |                                  |  |                                    |  |                                 |

## Whitsunday Range

## Metropolis

|  |                                   |  |                                  |  |                                    |  |                                    |  |                                |
|--|-----------------------------------|--|----------------------------------|--|------------------------------------|--|------------------------------------|--|--------------------------------|
|  | <input type="checkbox"/> Brampton |  | <input type="checkbox"/> Orpheus |  | <input type="checkbox"/> Alabaster |  | <input type="checkbox"/> Marcasite |  | <input type="checkbox"/> Topaz |
|--|-----------------------------------|--|----------------------------------|--|------------------------------------|--|------------------------------------|--|--------------------------------|

## San Selmo Smoked

|  |                                                                        |  |                                                                        |  |                                                                       |  |                                                                     |
|--|------------------------------------------------------------------------|--|------------------------------------------------------------------------|--|-----------------------------------------------------------------------|--|---------------------------------------------------------------------|
|  | <input type="checkbox"/> Grey Cashmere<br>(feature only or arch merit) |  | <input type="checkbox"/> Cloudy Silver<br>(feature only or arch merit) |  | <input type="checkbox"/> Opaque Slate<br>(feature only or arch merit) |  | <input type="checkbox"/> Wild Storm<br>(feature only or arch merit) |
|--|------------------------------------------------------------------------|--|------------------------------------------------------------------------|--|-----------------------------------------------------------------------|--|---------------------------------------------------------------------|

## Metallix

|  |                                         |  |                                   |  |                                   |  |                                 |  |                                 |
|--|-----------------------------------------|--|-----------------------------------|--|-----------------------------------|--|---------------------------------|--|---------------------------------|
|  | <input type="checkbox"/> Quartz         |  | <input type="checkbox"/> Platinum |  | <input type="checkbox"/> Titanium |  | <input type="checkbox"/> Cuprum |  | <input type="checkbox"/> Bronze |
|  | <input type="checkbox"/> Gun Metal Blue |  |                                   |  |                                   |  |                                 |  |                                 |

## Bricks – PGH

|                                  |  |                                            |  |                                          |  |                                       |  |                                        |
|----------------------------------|--|--------------------------------------------|--|------------------------------------------|--|---------------------------------------|--|----------------------------------------|
| <b>Alfresco</b>                  |  | <input type="checkbox"/> Vino              |  | <input type="checkbox"/> Choccolato      |  | <input type="checkbox"/> Truffle      |  | <input type="checkbox"/> Cocoa         |
|                                  |  | <input type="checkbox"/> Espresso          |  |                                          |  |                                       |  |                                        |
| <b>Altitude</b>                  |  | <input type="checkbox"/> Olympus           |  | <input type="checkbox"/> Apollo          |  | <input type="checkbox"/> Matterhorn   |  |                                        |
| <b>Academy</b>                   |  | <input type="checkbox"/> Quantum           |  | <input type="checkbox"/> Alumni          |  | <input type="checkbox"/> Oscar        |  | <input type="checkbox"/> Nobel         |
|                                  |  | <input type="checkbox"/> Juilliard         |  |                                          |  |                                       |  |                                        |
|                                  |  | <input type="checkbox"/> Quantum           |  | <input type="checkbox"/> Alumni          |  | <input type="checkbox"/> Oscar        |  | <input type="checkbox"/> Nobel         |
|                                  |  | <input type="checkbox"/> Juilliard         |  |                                          |  |                                       |  |                                        |
| <b>Composite</b>                 |  | <input type="checkbox"/> Pebble            |  | <input type="checkbox"/> Aluminium       |  | <input type="checkbox"/> Urban Blue   |  | <input type="checkbox"/> Charcoal      |
| <b>Dry Pressed Architectural</b> |  | <input type="checkbox"/> Hawkesbury Bronze |  | <input type="checkbox"/> Livingston Gold |  | <input type="checkbox"/> Mowbray Blue |  | <input type="checkbox"/> Macarthur Mix |
|                                  |  | <input type="checkbox"/> Balmerino Blend   |  | <input type="checkbox"/> Tinto Cream     |  | <input type="checkbox"/> Red Rum      |  | <input type="checkbox"/> Silver Shadow |
|                                  |  | <input type="checkbox"/> Black Beauty      |  |                                          |  |                                       |  |                                        |



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## Bricks – PGH (cont.)

|                        |  |                                                               |  |                                                                    |  |                                                               |  |                                           |
|------------------------|--|---------------------------------------------------------------|--|--------------------------------------------------------------------|--|---------------------------------------------------------------|--|-------------------------------------------|
| <b>Dark and Stormy</b> |  | <input type="checkbox"/> Monsoon                              |  | <input type="checkbox"/> Thunder                                   |  | <input type="checkbox"/> Whirlwind                            |  | <input type="checkbox"/> Zephyr           |
| <b>Foundations</b>     |  | <input type="checkbox"/> Gravel                               |  | <input type="checkbox"/> Stone                                     |  |                                                               |  |                                           |
| <b>Highlands</b>       |  | <input type="checkbox"/> Blackheath                           |  | <input type="checkbox"/> Leura (feature only)                      |  |                                                               |  |                                           |
| <b>Manhattan</b>       |  | <input type="checkbox"/> Chelsea (feature only or arch merit) |  | <input type="checkbox"/> East Hampton (feature only or arch merit) |  | <input type="checkbox"/> Tribeca (feature only or arch merit) |  |                                           |
| <b>Metallic</b>        |  | <input type="checkbox"/> Nickel Flash                         |  | <input type="checkbox"/> Pewter                                    |  | <input type="checkbox"/> Blue Steel Flash                     |  |                                           |
| <b>Morada</b>          |  | <input type="checkbox"/> Blanco                               |  | <input type="checkbox"/> Ceniza                                    |  | <input type="checkbox"/> Nero (feature only)                  |  | <input type="checkbox"/> Gris             |
| <b>Opaline</b>         |  | <input type="checkbox"/> Tourmaline                           |  | <input type="checkbox"/> Garnet                                    |  | <input type="checkbox"/> Tiger Eye                            |  |                                           |
| <b>Palazzo</b>         |  | <input type="checkbox"/> Sorbetto                             |  |                                                                    |  |                                                               |  |                                           |
| <b>Pure Linens</b>     |  | <input type="checkbox"/> Cinders & Soot                       |  | <input type="checkbox"/> Flannel Grey                              |  | <input type="checkbox"/> Pebble Creek                         |  | <input type="checkbox"/> Whispering White |
| <b>Smooth</b>          |  | <input type="checkbox"/> Harvest Cream                        |  | <input type="checkbox"/> Cashmere                                  |  | <input type="checkbox"/> Cream                                |  | <input type="checkbox"/> Pearl Grey       |
|                        |  | <input type="checkbox"/> Mineral                              |  | <input type="checkbox"/> Volcanic                                  |  | <input type="checkbox"/> Rustic Harvest Cream                 |  | <input type="checkbox"/> Copper Glow      |
|                        |  | <input type="checkbox"/> Black & Tan                          |  | <input type="checkbox"/> Brown                                     |  | <input type="checkbox"/> Choc Tan                             |  | <input type="checkbox"/> Terracota        |
| <b>Foundations</b>     |  | <input type="checkbox"/> Granite                              |  | <input type="checkbox"/> Red                                       |  |                                                               |  |                                           |
| <b>Urban Essence</b>   |  | <input type="checkbox"/> Melbourne Blue (feature only)        |  | <input type="checkbox"/> Storm (feature only)                      |  |                                                               |  |                                           |
| <b>Velour</b>          |  | <input type="checkbox"/> Crevole                              |  | <input type="checkbox"/> Cream                                     |  | <input type="checkbox"/> Pearl Grey                           |  | <input type="checkbox"/> Red              |
|                        |  | <input type="checkbox"/> Brown                                |  | <input type="checkbox"/> Choc Tan                                  |  | <input type="checkbox"/> Mineral                              |  | <input type="checkbox"/> Volcanic         |
|                        |  | <input type="checkbox"/> Terracota                            |  | <input type="checkbox"/> Granite                                   |  |                                                               |  |                                           |

### Additional colour and finishes information

Driveway finish colour:

Retaining wall material finish and colour:

Courtyard wall material and finish:

Feature materials or colours:

Rendered wall colours:

Light weight cladding:

Fencing along street frontage:

Side gate & fencing parallel to street frontage:

**Ginninderry** 