



Public Domain Design Guidelines

Karratha Revitalisation Strategy - Stage 2

June 2017





Acknowledgements

City of Karratha



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Mayor's Foreword



Councillor Peter Long
Mayor of City of Karratha

It is with great pleasure that I present the Karratha Revitalisation Strategy – an overarching framework for the revitalisation and future development of the established suburbs of Bulgarra, Pegs Creek and Millars Well. The Strategy aims to assist in the achievement of the Pilbara Cities vision for Karratha as described in the Karratha City of the North Plan, which is to be a liveable, affordable, compact Regional City of 50,000 or more people, with a diversified economy and high quality amenity and infrastructure. It is our aim to develop a healthy local community which demonstrates demographic balance and is a place of choice to work, visit, grow up, raise families and age gracefully.

The Strategy establishes a specific framework for revitalisation to occur and recognises the efficiencies and economic benefits that can be delivered by infill

development and redevelopment through the utilisation of existing infrastructure. It facilitates the guidance of these opportunities in a coordinated manner.

The Strategy has been developed in consultation with the people of Karratha and emphasises the City's determination to communicate with its citizens and our commitment to on-going community development. I look forward to seeing continued engagement from the community as we work together to implement its recommendations.

Our proactive delivery of this Strategy demonstrates the City's leadership and a can-do attitude to the ongoing development of Karratha.

Table 1. Document Register

Document Register			
Project Details	Revision	Date	Description
KARVS S2	Working	20/07/2015	Final Draft - City of Karratha Review
KARVS S2	DRAFT for REVIEW	24/06/2016	Revisions
KARVS S2	Final Draft	23/06/2017	Final Draft - Staging and Graphics Amendments

Table of Contents

1.0	Introduction	6
1.1	Karratha Revitalisation Strategy (KRS) Framework	7
1.2	Purpose	7
1.3	Methodology	8
1.4	Staging, funding & review	8
1.5	Document structure	8
2.0	Context & Analysis	10
2.1	Context	11
2.2	Benchmark Streetscape Projects	18
2.3	Existing Built Form Vernacular	20
2.4	Existing Streetscape Vernacular	22
2.5	Proposed Streetscape Typologies	24
2.6	Summary of Key Issues	26
3.0	Concept Design	28
3.1	Concept Plan	29
3.2	Design Principles	30
4.0	Streetscapes	32
4.0	Streetscapes	33
4.1	Recommended minimum setbacks	33
4.2	The 'Green Link' Principles	33
4.3	'The Green Link' Proposed Route	34
4.4	Character of 'The Green Link'	35
4.4	'Potential Road Connections'	44
4.6	North / South Streets	50
4.7	Local Access Streets	54
5.0	Policy Provisions	58
5.1	Review of Current Policy Framework	59
5.2	Policy Framework Modification Scenarios	62
5.3	Policy DP7: Residential Frontages	62
5.4	Policy TE3: Maintenance of Reserves and Street Verges Adjoining Residential Properties	62
5.5	Recommendation for New Policy Framework	62
5.6	Recommended Policy Framework: Guidelines for New Development	62
5.7	Housing Typology General Guidelines	64
6.0	Public Open Space	72
6.0	Shakespeare Street Park	73
6.1	Malster Way Park	80
7.0	Staging, Funding & Review	84
7.0	Staging, Funding and Review	85
7.1	Green Link	85
7.2	North-South Links	86
7.3	Localised Engagement & Responsive Design	86
7.4	Footpath Establishment	86
7.3	Proposed Drainage Reserve Crossings	86
7.4	Drainage Reserve Establishment & Crossings	86
7.9	Preferred Staging of Drainage Reserve Crossings	86
7.10	Demonstration Street as First Stage of Works	87
7.11	Traffic Calming	87
7.12	Future Management	88
7.13	Funding	88
7.14	Review	88
8.0	References	92
9.0	References	93
9.1	List of Figures	94
9.2	Image References	96
9.0	Annexure	100
Annex A:	Drainage Swales	102
Annex B:	Engineering Drawings	126



1.0 Introduction



1.0 Introduction

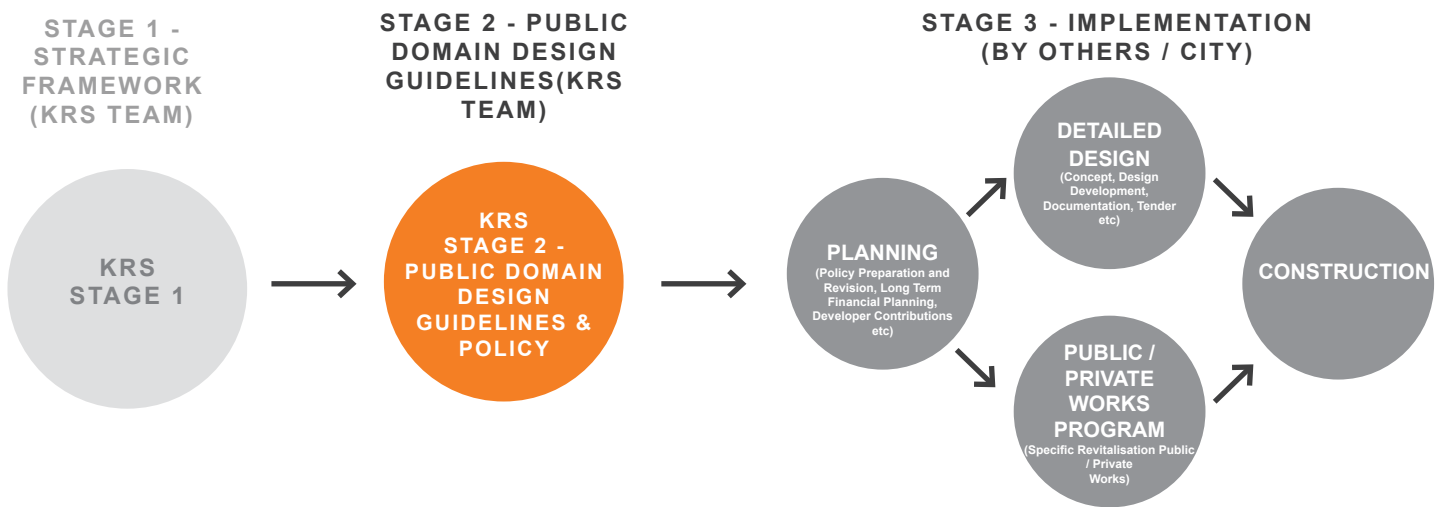


Figure 1. KRS Framework

1.1 Karratha Revitalisation Strategy (KRS) Framework

The Karratha Revitalisation Strategy (KRS) aims to identify opportunities and key actions required to improve the liveability of the suburbs of Pegs Creek, Millars Well and Bulgarra, as Karratha grows towards its goal of becoming a liveable, affordable city with high quality amenity and infrastructure as envisaged by the Pilbara Cities Plan. These guidelines forms Part 2 of the KRS, and should be read in conjunction with the Stage 1 companion document.

1.2 Purpose

Whilst Stage 1 focuses on the Strategic Framework, the purpose of Stage 2 is to build upon the findings of Stage 1 and provide the City of Karratha with Public Domain Design Guidelines that informs the decision making, design and staging of the public realm. The guidelines aim to provide a framework for public domain upgrades including:

1. Streetscape Typologies

- The Green Link;
- North / South Streets; and,
- Local Access Streets.

2. Priority Public Open Space

- Shakespeare St Park (Scout Hall); and,
- Malster Way Park.

3. Priority Drainage Swales

- Bathgate Road;

- South of Millars Well Primary School;
- South of Pegs Creek Primary School; and,
- South of Karratha Primary School.

This framework will ensure that future capital works within the public realm can be implemented with consistency, and with the knowledge that the City of Karratha's strategic documents have been incorporated. The guidelines provide a place based response that reflects the environmental and social context of the subject suburbs. This project basis is underpinned by an evidential analysis that was undertaken during Stage 1 and verified during Stage 2. As such, the guidelines aim to accommodate anticipated changes in land use, densification, connectivity and streetscape demands. These guidelines have been developed in close consultation with the community, stakeholders and City of Karratha using an evidence based approach. Key outcomes include:

Design principles:

- The provision of higher levels of amenity and comfort for pedestrians;
- The establishment and enhancement of tree-lined streets, drainage swales and parks;
- The provision of shade and relief from heat; and,
- The prospect to attract people, activity and act as a catalyst for public revitalisation.

Cost and ongoing maintenance:

- Practical;
- Affordable; and,
- Relatively easy and logical to implement.

1.3 Methodology

The development of successful Public Domain Design Guidelines requires an understanding of the special qualities and characteristics of a place; its history, people, natural environment, the desired future character and urban vision. This understanding formed the evidential basis and understanding of the functions, constraints and opportunities of the existing streetscape, parks and swales.

Much of this work was already undertaken in the Stage 1 component, with Stage 2 providing opportunity for more in-depth analysis focusing on the existing streetscape and public realm make-up.

The Public Domain Design Guidelines have been developed through a facilitated design and planning process with valuable inputs from representatives of the Karratha community, City of Karratha officers with expertise in planning, engineering and asset management, community and parks services. As shown in Figure 2, the facilitated design process included two small planning design workshops, which provided an opportunity for shared two-way learning and discussion including:

- Workshop 1 – Sketch Design Options; and
- Workshop 2 – Draft Concepts.

The strategy recommends this approach to the development of Karratha's public realm is continued into implementation with shared input and responsibility from City stakeholders, interest groups and community.

1.4 Staging, funding & review

The realisation of a continuous link and a 'low speed' transport connection is a long term priority. Therefore the KRS is intended to be understood as framework that evolves over a 20 year timeline, implemented through the City of Karratha's long term financial planning. The interim 5 years includes early on-ground focus for delivering pedestrian amenity through community engagement and localised design responses.

The Green Link establishment priorities in order of importance will include:

1. **The first priority** - the creation of a continuous pedestrian path and cyclist connection;
2. **The second priority** - the establishment of trees (tree planting) within road verges where footpaths exist;
3. **The third priority** - the establishment of drainage reserve crossings for pedestrians and cyclists;
4. **The fourth priority** - the drainage reserve crossings for vehicles; and,

5. Establishment of erosion control and planting within drainage swales commencing in proximity of the Green Link or entire swale, as a separate project.

While the KRS guideline provides consistency on a suburb wide level, it also allows flexibility and adaptability during implementation on a section by section basis. The time frame for the delivery of sections may vary given budget constraints and site specific requirements.

It is recognised that there are a number financial, communal, land and infrastructure factors that will influence localised staging including:

- Community engagement approach and specific requirements;
- Cost of pedestrian and road infrastructure;
- Cost of swale crossings;
- Feasibility and availability of required lots and land to provide Green Link connections;
- Traffic modelling; and,
- Availability of infrastructure funding and contributions.

There will be an ongoing responsibility for the City of Karratha to enable appropriate infill which does not compromise the objectives of the Karratha Revitalisation Strategy. The application of developer contributions to subsidise KRS delivery. Furthermore there is to be recognition that the creation of Local Planning Scheme No.9 and associated rezoning/residential up-coding will precede the completion of the KRS program.

1.5 Document structure

The guidelines are intended to provide the City of Karratha with a framework to guide implementation. This framework should allow consistency on a suburb wide level, but allow flexibility during implementation and be adaptable to the existing public realm.

The guidelines are divided into six (6) sections:

- Introduction;
- Context and Analysis;
- Design;
- Streetscapes;
- Public Open Space;
- Drainage Swale;
- Staging, Funding & Review; and,
- References.

The appendix document provides:

- Final Engineering Concept Plans.

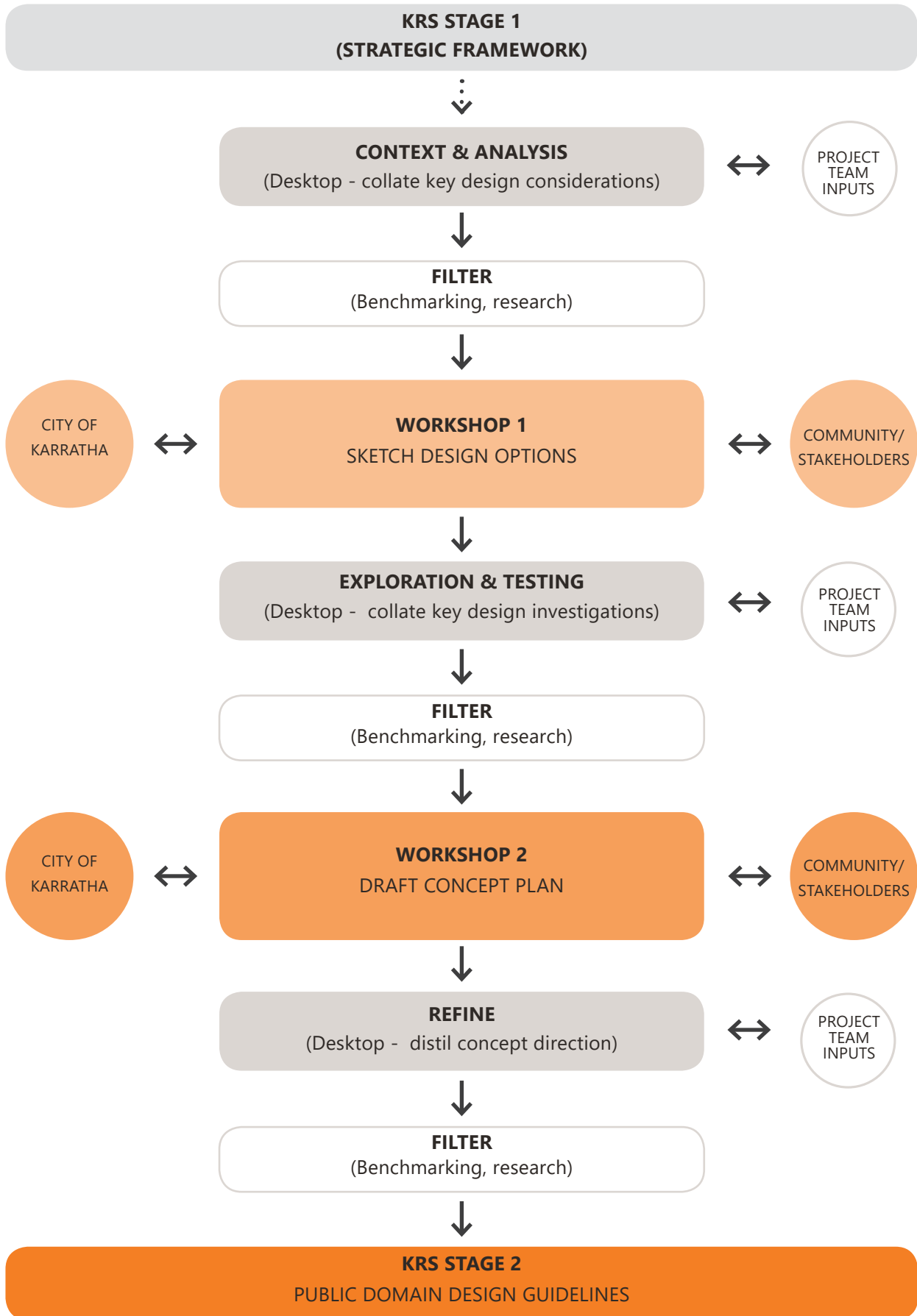


Figure 2. Design Methodology Diagram



2.0 Context & Analysis



2.0 Context & Analysis

In order to prepare a robust set of guidelines a series of in-depth analysis on key design considerations, place amenity and review of the existing fabric has been undertaken including:

Context

- Implementing Karratha Revitalisation Strategy Stage 1;
- Pilbara Vernacular;
- Karratha Vernacular;
- Value of Streetscapes; and,
- Benefits of Street Trees.

Analysis

- Benchmark Streetscape Projects;
- Existing Built Form Analysis;
- Existing Streetscape Analysis; and,
- Research of best practice streetscape and urban forest projects.

This analysis forms the evidential basis underpinning the design direction including:

- Proposed streetscape typologies; and,
- Identification of key opportunities and constraints.

2.1 Context

2.1.1 Implementing Karratha Revitalisation Strategy Stage 1

The Karratha Revitalisation Strategy (KRS) Stage 1 provides the vision and identified opportunities and key actions required to improve the liveability of the suburbs of Pegs Creek, Millars Well and Bulgarra, as Karratha grows towards its goal of becoming a liveable, affordable city with high quality amenity and infrastructure. Revitalisation involves a variety of actions to be undertaken by a range of bodies and people including landowners, the City of Karratha, other government agencies and the community towards the provision of a mid to long term socio-economic outcome.

Stage 1 recommendations address:

- **Priority Areas** in each suburb for targeted improvements;
- **Density & Intensity:** Recommendations for opportunities to increase density in existing residential areas;
- **New Development:** Appropriate levels of new and diverse development to improve affordability and cater for population increases;

- **Improved Connectivity:** Better connections for all forms of transport to improve amenity and provide better connections to the City Centre;
- **Parks:** Strategically located quality parks to improve amenity, and sense of community that cater for all ages; and,
- **Streetscapes and Swales:** Improved streetscapes and enhanced swales that improve amenity and ecology.

These Stage 2 guidelines deliver greater detail regarding the particular works required, as well as the planning tools necessary to facilitate implementation via the Public Domain Design Guidelines and amendments to Planning Policy. The guidelines should be read in conjunction with the Stage 1 companion document.

2.1.2 Alignment with the Pilbara Vernacular Handbook

The guidelines aim to uphold key values and principles captured in the 2012 Pilbara Vernacular Handbook, as well as, the previous guideline of the Karratha Vernacular Handbook.

Figure 3, outlines the key values and principles of the Pilbara Vernacular Handbook.

DESIGN VALUES	DESIGN PRINCIPLES
Responding to CLIMATE	<ul style="list-style-type: none"> • Control solar heat gain • Encourage natural ventilation and air movement • Minimise conditions which create heat islands • Work to local conditions
Incorporating the NATURAL LANDSCAPE	<ul style="list-style-type: none"> • Respect topography • Use vegetation, especially native vegetation • Ensure biodiversity
Building on the PILBARA CHARACTER & IDENTITY	<ul style="list-style-type: none"> • Consider community-based art, culture and creativity • Consider local character and design • Work with Pilbara friendly materials • Acknowledge informality • Consider street life: content, movement and conviviality • Identify opportunities for tourism
Enhancing LIVABILITY	<ul style="list-style-type: none"> • Ensure open space diversity • Incorporate access and connections to open space • Develop outdoor meeting and living places • Design for water • Diversify the built environment
MOBILISING for CHANGE	<ul style="list-style-type: none"> • Focus on town centre vitality • Focus on local economies • Create affordable housing • Integrate new technologies

Figure 3. *Pilbara Vernacular Handbook Summary of Values and Principles*

2.1.3 Value of Streetscapes

Similar to many of the recent town developments in the Pilbara, there has been a rugged pragmatism and purpose in the development of Karratha streetscapes. This has led to the rolling out of engineered spaces, which although highly practical for large vehicle, often lack attention to the design of social places, human amenity for people to engage with and inspire respect of place.

A significant component of the physical makeup of streets is street tree planting. Trees create definition; promote a town's character, sense of place, as well as, providing a range of social, environmental and economic value.

Therefore, trees are a critical element in the overall perception of the public realm leaving a lasting impression on visitors and tourists. Interestingly, most 'great streets' commonly have evenly and closely spaced trees, comprising a single species which provides the greatest impact on peoples positive perception of the street (City of Sydney, 2011, A-7).

Whilst providing increased visual amenity, this coordinated and strategic commitment will provide ongoing socio-economic and environmental benefits including:



Image 1. View to the City from Karratha Hills

Economics

The ideal of an economically resilient city is reliant upon high performing streets. Provision of infrastructure, services and amenity provide significant economic value to the local government and the broader community. (City of Ipswich, 2013, 10)

Key points to note:

Increase Property Values

- Street trees, particularly avenues of trees have been found to increase property values and make the area more desirable to live in (City of Yarra, 2004, p7);

Increase Lifespan of Infrastructure

- Shaded tree canopies also increase the lifespan of infrastructure including road surfaces and footpaths, as the shade lowers the street surface temperature and reduces heading and volatilization of the binder (McPherson, Simpson, Gardner, Vargas, Xiau, 2007);
- Research undertaken by Greg Moore (2008) at the University of Melbourne has found that a tree canopy of 75m² shading bitumen covering 30% of its canopy area can save up to \$450 per square metre of pavement for its asset life of 20 years;

Infrastructure Considerations

- An important infrastructure consideration is trees and power lines competing for the same space within the streetscape. This can increase the maintenance resources as trees planted to close to power lines require regular pruning and or in some cases removal. Fortunately in the City of Karratha, Horizon Power has indicated that they will be installing underground power in Pegs Creek as part of the Pilbara Underground Power Project in 2015 with the program across the study area scheduled to be completed in 2017.



Image 2. *Creating inclusive spaces*

Inclusive Community

Well-designed streetscapes promote a range of social benefits including:

Aesthetics

- Increased visual appeal and increased sense of pride in the street for locals, visitors and tourists;

Improved Public Safety

- There is an opportunity to improve public safety by creating pedestrian focused spaces which slow the traffic speeds. Double row planting on either side of the footpath also creates protection and provides a buffer against passing traffic for pedestrians and cyclists;

Use of Outdoor Space & Behavioural Change

- Evidence shows that the presence of street trees impacts on how people use outdoor space e.g. residents walk more on tree line streets as observed in Newman Town Centre. Research undertaken by Kao & Sullivan (2001) also demonstrates that improved public realm promotes spontaneous meetings and encounters with residents leading towards a stronger more cohesive neighbourhood;

The great public space

- Recently its been reflected that 'streets, as public spaces, have lost their importance in terms of their share of land, as well as their prominent role in shaping the culture and history of cities' (UN-habitat, 2014). The goal is 'to make streets par of public space' ensuring these spaces are the life line of the subject suburbs, define neighbourhoods and allow residents to be well connected with one another.



Image 3. *View along Sharp Avenue*

Public Health

There is a link between the role of streetscapes and providing increased public health. Public health includes provisions for physical comfort as well as general community well-being, stimulated by encouraging people to walk, run, cycle, play and provide opportunity for spontaneous interaction with neighbours.

Therefore a tree canopy is now understood as critical green infrastructure, which is to be managed for health and well-being of community.

Tourism

Streetscapes have an integral role in the creating the image of a town or city including:

- Creation of a positive first impression upon arrival;
- Impacting how people navigate through the city including legibility and ease of way finding to find landmarks, destination points and attractions; and,
- Leaving a lasting impression (memory).

There is opportunity that public revitalisation could support the wider strategy to increase tourism within the Pilbara (Pilbara Development Commission, 2014). It's widely acknowledged that development of the local tourism industry is important to the future sustainability of the region, as it is essential to diversify the local economy, provide necessary supporting infrastructure and foster attractive places that build social capital and are comfortable for people to live and work in the future.



SOCIAL

- Shade
- Sense of place
- Way finding
- Amenity**
- Provide a human scale**
- Safety
- Define destination points
- Health
- Define views

ENVIRONMENT

- Control stormwater run off**
- Local Ecology
- Provide Habitat
- Fire Management**
- Reduce soil erosion

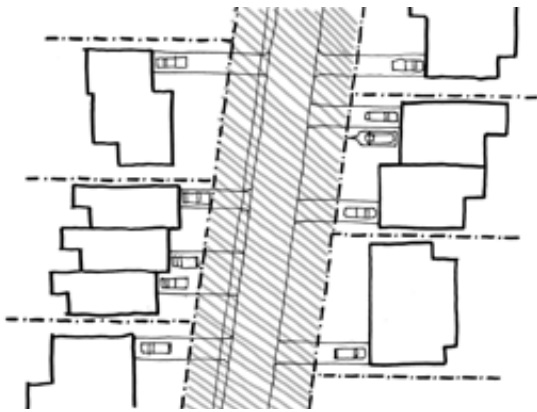
ECONOMIC

- Infrastructure longevity**
- Increased aesthetics
- Enhance property values**
- Traffic calming
- Pragmatic approach to implementation**

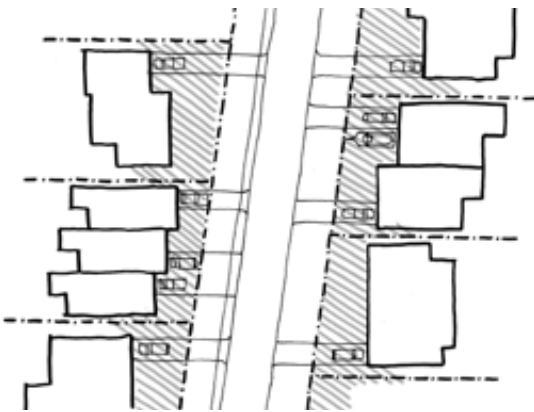
Figure 4. Evidence Based Benefits of Street Trees

2.1.4 Evidence Based Benefits of Street Trees

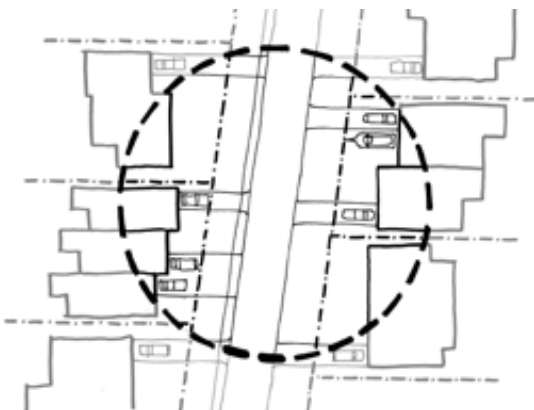
Street trees provide more than aesthetic and recreational values. The interrelated social, environmental and economic values of the urban forest are now being realised. These diverse values are highlighted in the figure, above.



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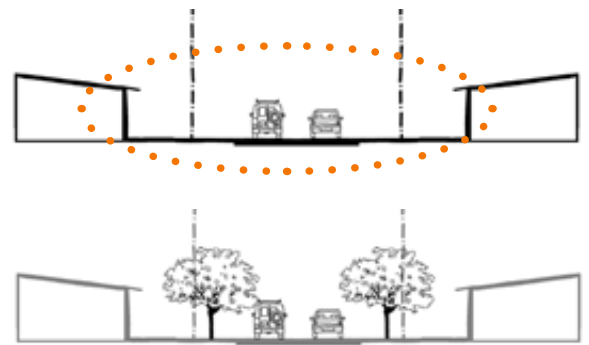


Public Space

- Social, environmental and economic benefits;
- Provision of pedestrian amenity;
- Unified and consistent theme and streetscape language

Private Space

- Blurs the public / private interface;
- Storage of big toys, cars etc;
- Private occupation e.g. decorative pots, plants, ownership



↔

Figure 5. Understanding what comprises a streetscape

2.1.5 What Comprises a Streetscape?

Typically a streetscape is considered the public space within the road reserve. These guidelines consider the public space, as well as the private interface as streetscape components.

Trees are a significant component of the physical makeup of streets. Trees create definition, provide structure, and are the visual glue that define and creating lasting impressions.

Streetscape

- Negotiates public and private space;
- Trees are critical infrastructure providing structure and defining the form of streets;

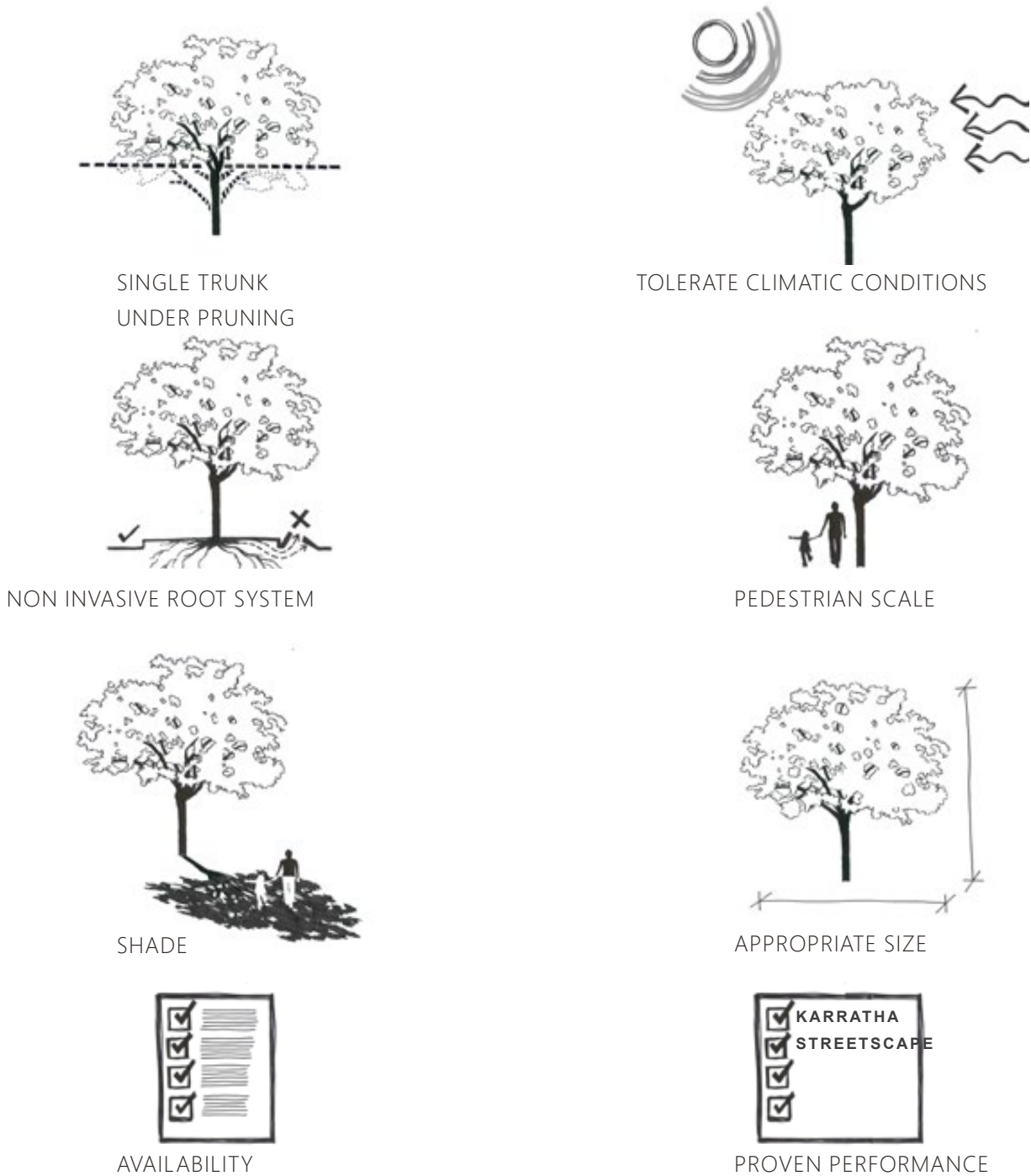


Figure 6. Evidence Based Factors of Tree Selection Sketches

2.1.6 Evidence Based Factors of Tree Selection

The guidelines recognize that there is not one single and ideal street tree. A number of factors must be taken into consideration including:

- Social;
- Aesthetic;
- Functional;
- Management;
- Scientific

More specifically, critical factors for the Karratha context as shown in the diagrams above.



2.2 Benchmark Streetscape Projects

The guidelines recommend a coordinated approach to raising the public realm amenity throughout Karratha's streetscapes, parks and swales. This is linked to the value of streetscapes on previous pages, as well as the triple bottom line benefits of street trees. In addition, increased treatment of streetscapes will assist in generating and demonstrating a level of public pride. This leads behavioural change and raising the social-economic capacity within Karratha.

This approach has been demonstrated in multiple precedent examples internationally, nationally and even throughout the North West.

A key benchmark project within the NW WA is:

Newman

Street | Iron Ore Parade to Newman Town Centre

Planting | Double row of planting

Spacing | 5 – 6m

Installation Date | 2012

Three years since installation, this pedestrian asset is now starting to transform and as a result there are noted behavioural changes in the way locals are using the streetscapes. One example of this, is previously people drove between the Shire offices and the Town Centre, however now people are walking along this continuously shaded corridor.



Image 4. Iron Ore Parade, Newman



Image 5. Street tree planting along Iron Ore Parade



Broome

Street | Magabala Road, Broome

Planting | Clumps of planting along Boulevard

Spacing | 8 - 12m

Installation Date | 2010

Clumps of native planting along Magabala Road in Broome. This approach is more suitable for a boulevard treatment.

Kununurra

Street | Hibiscus Drive, Kununurra

Planting | Clumps of planting along Boulevard

Spacing | 8 - 12m

Installation Date | 2010

Tree planting along Hibiscus Drive, Kununurra and adjacent swale.



Image 6. Magabala Road, Broome



Image 8. Street view of Hibiscus Drive



Image 7. View of Magabala Road, Broome



Image 9. Street view of Hibiscus Drive



2.3 Existing Built Form Vernacular

Karratha's existing built form vernacular has been informed by its unusual urban planning, which is driven by the 'trapezoidal' configuration of the land parcels. The street alignments are predominantly arranged topographically, running west to east parallel to the coast and adjacent rocky ridge line with north - south connectors. Many lots have been aligned as close to due north as possible providing 'trapezoidal' land parcels of varying configurations depending on adjacent street alignment.

Dwellings have been predominantly built parallel to side lot boundaries with varied and staggered front setbacks. This traditional planning typology has not been emulated in the more recently developed Nickol or Baynton suburbs where lots are perpendicular to street alignment and houses are aligned and uniformly setback. It is advocated that all infill development associated with the KRS should follow the traditional Karratha urban, built form.



Image 10. Aerial view of 'trapezoidal' built form vernacular and relationship to the street



Image 11. Streetscape view of built form vernacular and relationship to the street





Image 12. Nearmaps



Figure 7. Sketch of 'trapezoidal' configuration



Image 13. Example of new development in Baynton





Figure 8. Existing Street Analysis

2.4 Existing Streetscape Vernacular

In order to understand the existing streetscape of the subject suburbs a desktop analysis was undertaken across all streets to assess the existing fabric including:

- Road carriageway;
- Road reserve;
- Footpath;
- Power lines;
- Street lights; and,
- Number of occurrences of cars and 'toys' being parked on the verge.

Key findings include:

- Houses fronting onto the street typically run east west. This configuration also results in higher number of crossovers driveways along the street (refer figure 7);
- Houses with side fence interfaces typically run north / south and have limited interaction with the street caused by enclosed 'colorbond' steel

fences. The side interface also results in fewer occurrences of driveways and crossovers, in comparison to the typology with houses fronting onto the street as noted above (refer figure 8);

- There are less occurrences of cars and 'big toys' being parked on verges along the north / south streets, which may be a result of the limited passive surveillance of this area;
- Many streets forming the Green Link in Millars Well and Pegs Creek have existing footpaths where as streets segments in Bulgarrá typically don't have existing footpaths; and,
- All streets don't have a consistent tree canopy or a formalised street language.



Figure 9. A / Existing houses with front interface to street



Figure 10. A / Existing houses with side interface to street



Image 14. A / House to house with footpath



Image 16. C / House to house side interface



Image 15. A / House to house with footpath



Image 17. A / House to house Side Interface

Table 2. Existing Analysis

EXISTNG ELEMENT	DESCRIPTION
Road carriageway	approx. 7.4m
Road Reserve	20m
Footpath	1.8m wide, semi mountable kerb, adjacent to road (south)
Power lines	Overhead power lines, north side, wires crossing road profile at two points
Street lights	South adjacent to footpath
Cars and toys	Typically 4 out of 25 houses

Table 3. Existing Analysis

EXISTNG ELEMENT	DESCRIPTION
Road carriageway	approx. 7.5 - 7.8m
Road Reserve	20 - 23m
Footpath	1.6 - 1.8m wide, semi mountable kerb, adjacent to road (west)
Power lines	Underground power
Street lights	East side of street
Cars and toys	Typically none parked on verge



Figure 11. *Proposed Street Typologies*

2.5 Proposed Streetscape Typologies

As a result of this evidence based analysis and key findings, the following streetscape typologies are recommended:

- 'The Green Link'
- North/South Streets
- Local Access Streets

Refer to Section 4 for a full overview of each Streetscape including design intent, plans, sections and proposed locations.



2.6 Summary of Key Issues

Based on the site and desktop analysis of the existing streetscapes and local environment the key opportunities and constraints to be reconciled in the KRS S2 Concept Design Guidelines include:



Image 18. *No consistent canopy*



Image 19. *Existing random access track*

1. Lack of connectivity within the streetscape and path network

Pedestrian network

- Presently, a dislocated footpath network, without clear, strong and continuous pathways, results in a lack of permeability for pedestrians;
- A lack of continuous shade further contributes to this disconnection, with existing networks exposed to the extreme Karratha climate;
- Present need to support

Street network

- Areas of the study suburbs are impacted by flood risk from both storm water and storm surge. Escape routes from homes in these areas are compromised by a disconnected and impermeable road layout;
- Limited and incoherent north / south linkages to major distributor roads (major issues with regard to emergency evacuation routes);
- Opportunity to formalise / mitigate some of the cross reserves that vehicles are using as short cuts.

2. Lack of shade

- There are no streets with continuous shade or shelter;
- Extended periods, between cool mornings and evenings, where outdoor activity is precluded due to lack of shade; and,
- There is no overarching strategy for street tree planting.

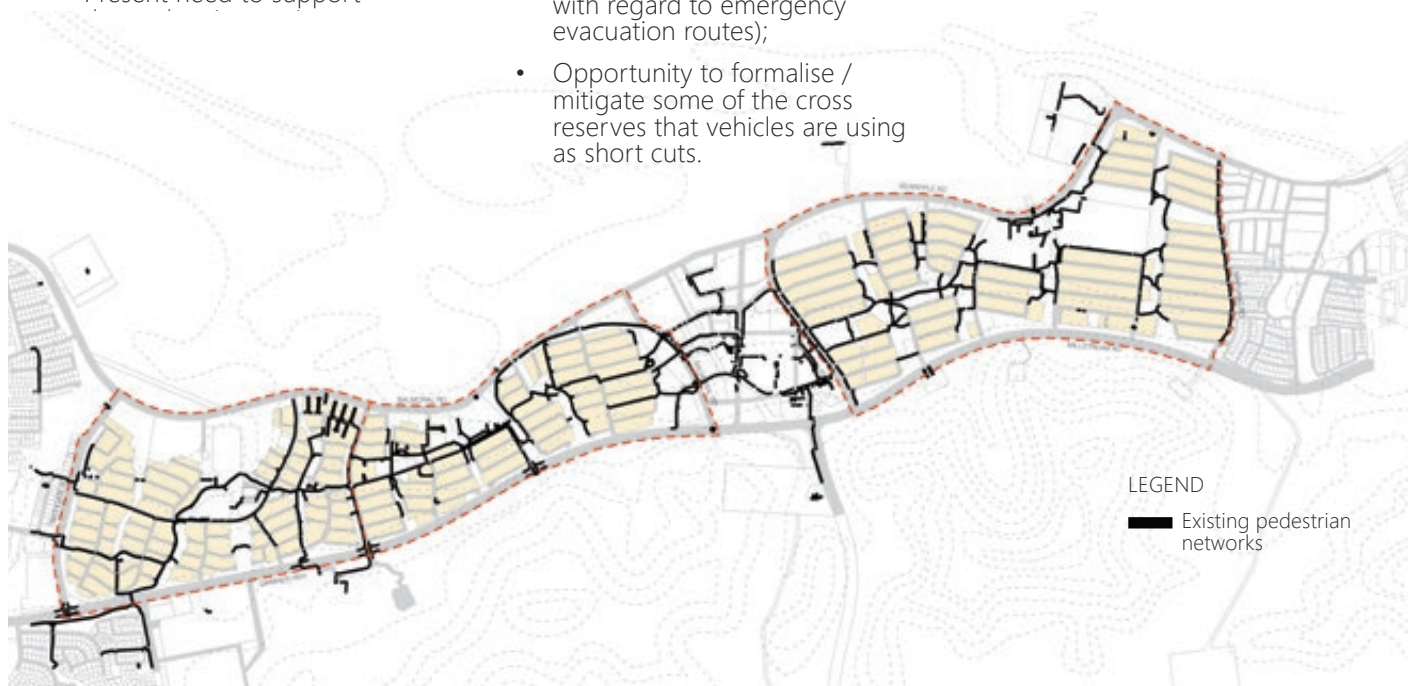


Figure 12. *Disconnected existing pedestrian network*



Image 20. *Limited pedestrian amenity*



Image 21. *Views towards the Karratha Hills*



Image 22. *Example of 'big toys' parked on verge*

3. Lack of pedestrian amenity and clear way finding

- Opportunity to maintain relatively safe local streets with low traffic volumes yet provide pedestrian focused amenity. Design for the pedestrian first, rather than the vehicle; and,
- Limited pedestrian amenity and scale.

4. Opportunity to create a place based response which celebrates Karratha's unique qualities

- Poor pedestrian amenity (lack of tree planting, shade, seating etc) discourages people from using the streets as places to meet and linger;
- Opportunity to maximize the City's close relationship to the hills, creek line vegetation and the tidal flats of Nickol Bay; and,
- Current materials and elements are inconsistent with Karratha's vision of becoming a liveable, high amenity and regional city.

5. Lack of a consistent theme & poor visual quality of elements and materials

- There is no clear or consistent suite of streetscape elements, materials or hierarchy between the subject suburbs streets;
- Lack of consistent design language for elements and materials;
- Along the streetscapes there are relatively high levels of 'clutter' including large vehicles, boats, caravans which reflect the lifestyle of the Pilbara locals; and,
- No protection or incentive for street parking to provide traffic friction.



3.0 Concept Design



3.1 Concept Plan



Figure 13. Concept Plan

Through the use of a 'Green Spine' streetscape amenity the Concept plan outlines the revitalisation strategies for the older Karratha suburbs of Bulgarra, Pegs Creek and Millers Well. The concept strategies focuses on increasing connectivity, legibility, pedestrian amenity including shade and safety. Encouraging a vibrant, desirable setting through consistent theming, use of materials that in turn build upon and enhancing Karratha's unique lifestyle and 'sense of place'.

The concept plan (Figure 12) clearly illustrates the following:

- Streetscape Typology hierarchy;
- Two (2) Priority Public Open Spaces;
 - Shakespeare Street Park;
 - Malster Way Park; and,
- Four (4) Priority Drainage Swales;
 - Bathgate Road;
 - South of Millars Well Primary School;
 - South of Pegs Creek Primary School; and,
 - South of Karratha Primary School.

3.2 Design Principles



Image 23. Continuous shade in Newman Streetscapes



Image 24. Image of existing streetscape



Image 25. Pedestrian path protected from shared road via avenue of trees

Strategy 1 - Provide a continuous shade canopy

Design Principles:

- Develop a hierarchy of streets and provide a continuous canopy of street trees to provide shade, good amenity, interest and visually unified streets that encourage walking.
- Incorporate tree species which can tolerate the harsh climatic conditions and maximize shade along major pedestrian corridors.

Strategy 3 - Provide high quality and legible street connections and increase connectivity of isolated cells

Design Principles:

- Provide a 'green link' corridor that is designed around the pedestrian experience rather than the vehicle;
- Provide a network of streets that provides permeability and legibility including access during emergency management events; and
- Create a well-connected and legible pedestrian and bicycle network.

Strategy 4 - Create a safe and vibrant public realm which is designed for people first

Design Principles:

- Promote walking and cycling for residents to access the City Centre and key destination points (schools, community facilities, parks etc);
- Provide appropriate footpath widths and zones which are well-connected and reflect pedestrian flows; and,
- Provide solar lighting to ensure safe and pedestrian friendly movement corridors.

Strategy 2 - Increase connectivity of isolated residential cells

Design Principles:

- Increased permeability.



Image 26. *Grid of Melaleuca trees*



Image 27. *Consistent street language*

Strategy 5 - Reveal Karratha's unique natural and cultural qualities

Design Principles:

- Use materials, paving and colours that are complimentary to Karratha's context;
- Incorporate native vegetation including endemic species where possible, in secondary streets, drainage swales and parks; and,
- Acknowledge and celebrate unique cultural and environmental context with interpretation, art and signage opportunities.

Strategy 6 - Establish a consistent theme including material and plant palette;

Design Principles:

- Establish a framework of elements and materials that has consistency on a suburb wide level, but has sufficient flexibility to be adaptable to the existing streetscape fabric and rolled out through a staged approach;
- Select materials and planting species that are suitable to environmental conditions; and,
- Develop a hierarchy of streetscape typologies to improve way finding and legibility.

Strategy 6 - Establish streets that increase property values and make places desirable to live.

Design Principles:

- Establish street identities where people want to live with higher:
 - market prices;
 - street activity;
 - non-vehicular connectivity;
 - street pride; and,
 - neighbour connectedness.

4.0 Streetscapes



4.0 Streetscapes

The Streetscape Typologies across Bulgarra, Pegs Creek and Millars Well have been conceived to provide a network and hierarchy of streets that provide high quality pedestrian amenity, as well as, low speed permeability and legibility between the subject suburbs and Karratha City Centre.

The proposed streetscape typologies include:

- 'The Green Link';
- North / South Streets; and,
- Local Access Streets.

4.1 Recommended minimum setbacks

The ultimate goal of the proposed streetscape typologies are noted above, and throughout this document. For example, it is an aim of 'The Green Link' to establish a consistent tree canopy (i.e. planting as many trees as possible). It is imperative that the guidelines as listed below are implemented with the overall vision and aim of 'The Green Link', North / South Streets, and Local Access Streets as a priority.

- 2.5m preferred footpath width, minimum 2m (Refer Figure 15) (Sub-main category of CofK Future Works Report Footpaths 2013-2023). Discretion applies where double row of trees will be implicated due to increased footpath width;
- 1-1.3m minimum setback of trees from front of kerb (Refer Figure 15) (IPWEA guidelines). Discretion applies where double row of trees will be implicated due to increased setback width. It is noted that street lights have a 1m setback from kerb.
- 1.5m minimum setback of trees from crossover with the exception of adjacent crossovers where discretion applies (Refer Figure 15);
- 3m setback from street lights;
- 1-1.5m minimum setback from private property. Discretion applies where double row of trees will be implicated due to increased setback width (Refer Figure 15);
- 3.3m minimum setback between trees (Refer Figure 15); and,
- 7m setback from corners (Refer Figure 29).

Please note, the above guidelines and following diagrams are a broad guide only. 'The Green Link' will require detailed design, to be site truthed according to the specific characteristics of each street area. Discretion and flexibility will apply in all instances to ensure that the character of 'The Green Link' remains throughout its length.

4.2 The 'Green Link' Principles

4.2.1 Design Intent

1. **'The Green Link' can be described as a 'people first' corridor. 'The Green Link' is intended to become the central public space stimulus equally shared across all suburbs, for place revitalisation. It will become the corridor that prioritises the pedestrian experience over the vehicular, linking people with Karratha City Centre, schools, parks, sports fields and community focused amenity.**

The success of 'The Green Link' relies on the opportunity to improve pedestrian amenity and slow the traffic route via good design. This is achieved through 'principle of friction' and will include:

- Perceived narrowing of the road corridor with a high density of tree planting;
- Providing on-road parking to create traffic friction (other vehicles);
- Encourage visual (eye to eye contact) between drivers and pedestrians;
- Increased cycle and pedestrian interaction (right-of-way); and,
- Materials and surfaces more typically associated with the pedestrian;

Creating a lesser sense of vehicle right-of-way is proven to reduce drivers speed and everyone's level of risk providing a pedestrian orientated place.

4.2.2 Alternative Route

Increased road friction motivates vehicle users to choose an alternate (quicker) route if required to travel any distance. Therefore 'The Green Link' through the subject suburbs could be thought of as a vehicle watershed device where traffic flows away from this central corridor (either north, south, east & west). Travelling through or across 'The Green Link' is slowed due to proposed four way pedestrian friendly intersections controlled with stop signs or traffic signals.

Traffic wanting to quickly travel into the City Centre from Millars Well will either choose the northern or southern link main road distributors (Dampier Highway or alternately Balmoral / Searipple Roads), which is essentially what is commonly occurring. Unfortunately at present some north/south through roads do not have traffic control and become uncontrolled thoroughfares, whereas 'The Green Link' road has the potential to ease these main north / south distributors by providing friction when these cars traverse the central green link.



Figure 14. The 'Green Link' Context Plan

4.3 'The Green Link' Proposed Route

'The Green Link' is intended to be a framework that aims to create a community and pedestrian focused amenity. The proposed route includes a series of linkages or 'potential connections' of existing streets to create a connected, public space central stimulus for place revitalisation.

For the pedestrian, this will create a shaded corridor linking the suburbs with the City Centre, as well as parks, drainage swales, schools and community facilities. For the vehicle, this route is intended to be inconvenient due to the segmented nature of the journey.

'The Green Link' 20 Year Framework

Key points to note about the proposed route include:

- 'The Green Link' is intended as a framework that will be implemented over the next 20 years; however it will also be used to drive action on the ground (street tree planting), in the interim 5 years;
- 'The Green Link' will be undertaken as a staged approach comprising street segments, swale crossings and four way intersections;
- The order of staging is dependent on a number of drivers including:
 - Implementation approach;
 - Feasibility of each potential connection; and,
 - Potential developer contributions.
- 'The Green Link' also acts as future proofing the subject suburb providing alternative escape routes or management strategies for climate change and potential natural disasters;

4.4 Character of 'The Green Link'

To reflect the 'people first' design intent of 'The Green Link', as well as accentuating the segmented form and nature of the journey it is proposed that the character of 'The Green Link' changes and varies along its 6.7km length.

Character variation includes:

- Double residential frontage (housing on both sides of the road); and,
- Residential to Park / Swale / School frontage.

Further description of each character is provided on the following pages.

Additional variation can be explored during detailed design and implementation, with starting suggestions:

- Tree species changes to define suburb and / or specific road segments;
- Variation in implementation, e.g. tree spacing, footpath to reflect existing fabric, etc; and,
- Opportunity to develop experimental typologies such as on street parking with planting nibs to break long stretches of road.

Double Residential Frontage

To reflect the 'people first' design intent of 'The Green Link', as well as accentuating the segmented form and nature of the journey it is proposed that the character of 'The Green Link' changes and varies along its 6.7km length.

- Double row of trees;
- Proposed tree layout is less formal than a 'boulevard' therefore more suitable for a local access street;
- 'The Green Link' typology can utilize a single species or combination of exotic and native species;
- Staggered spacing provides the appearance of increased depth and screening of 'clutter' e.g. cars, big toys, etc along the street profile;
- Principle spacing is based on a 6-8m spacing which aligns with typical property frontage of 24m;
- Staggered layout provides greater flexibility during implementation e.g. spacing, species configuration etc, which can be adapted to suit existing conditions in specific street segments; and,
- There is opportunity to investigate an experimental typology, which encourages friction and on-street parking via a planting nib, as shown in the precedent image below. This could be undertaken in long sections e.g. Galbraith Road, Millars Well to assist in slowing traffic speeds and providing protection for pedestrians.

Hyde Park Connection

In response to concerns raised during the public advertisement of the Karratha Revitalisation Strategy the proposed connection between Hyde Road and Demetre Crescent has been removed as a North-South connection to the Green Link.

Table 4. 'The Green Link' Design Elements

EXISTING ELEMENT	DESCRIPTION
Road Reserve	20m
Carriageway width	7.2 – 7.8m
Verge	Approximately 6m
Footpath	Ideal condition 1.8m footpath is setback from road reserve and lined by double row of trees on a minimum of one side of the street. Where existing footpath is in good condition retain, and develop succession plan to replace footpaths setback from road reserve over time.
Planting pattern	Double row in staggered formation
Tree type	Single exotic species (OR) Mixed approach with internal exotic species and external native species
Cyclist Provision	On road to both sides of the street
Tree Canopy	Continuous canopy full length of both sides of the street



Image 29. Existing View of Streetscape



Figure 15. Proposed view of the 'Green Link'



Image 28. Mix species precedent



Figure 16. 'The Green Link' Existing Footpath

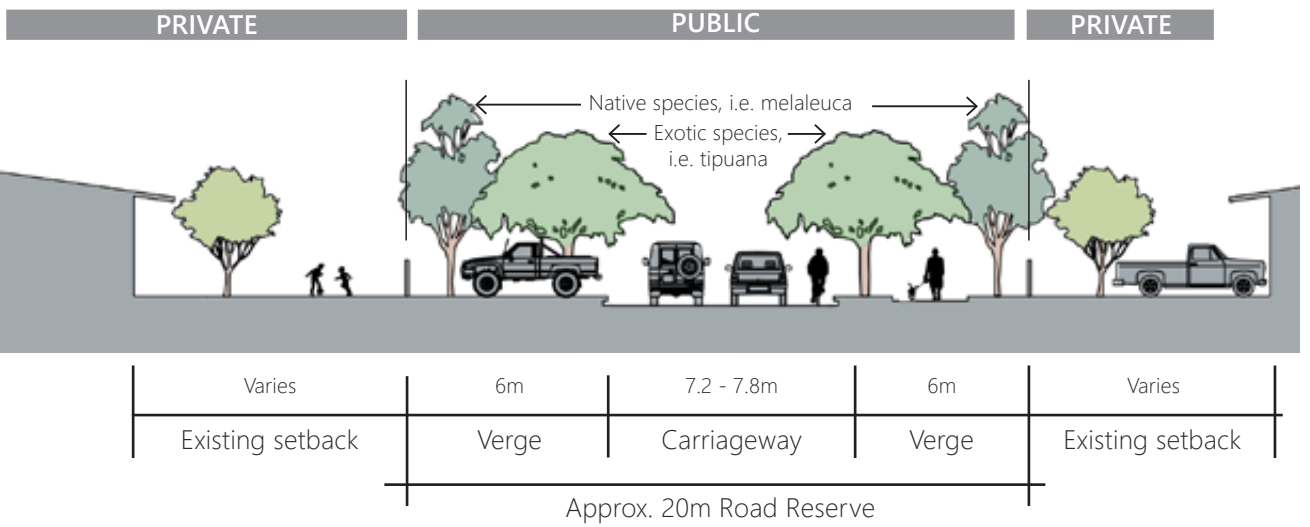


Figure 17. 'The Green Link' typical plan & section and typical dimensions. Scale 1 : 250 @ A4

Residential to Park / Swale / School frontage

The residential to park / drainage swale interface has different treatments on either side of the street. Typically the park or swale side has less spatial constraints, however must be able to cope with higher volume of pedestrians.

The proposed typology reiterates these distinct treatments, e.g. continue the natural planting formation along the parks or drainage swale, whereas provide a more formal approach along the built form (residential) edge via a planting strategy that reflects the respective streetscape typology e.g. 'The Green Link', North / south Street or Local Access Streets.



Image 30. Existing view

Table 5. Residential / Park Typology Design Elements

EXISTING ELEMENT	DESCRIPTION
Road Reserve	20m
Carriageway width	7.2 – 7.8m
Verge	Approximately 6m
Footpath	Ideal condition 1.8m footpath is setback from road reserve and lined by tree planting on either side of footpath on both sides of the road.
Planting pattern	Where existing footpath is in good condition retain, and develop succession plan to replace footpaths in location setback from road reserve.
Tree type	Park or Drainage Swale Side Natural formation, clumps of native planting Built form side Planting pattern and type to reflect respective streetscape typology
Cyclist Provision	On road to both sides of the street
Tree Canopy	Semi continuous – continuous canopy along both sides of the street.



Image 31. Opportunity to re-vegetate the end of cul de sacs and roads adjacent to the drainage swales

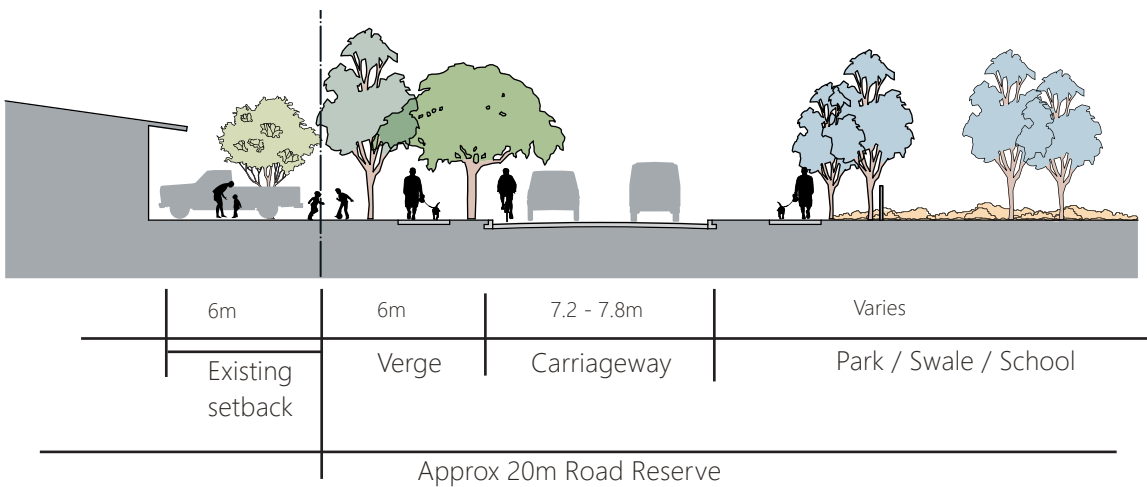


Figure 19. Residential / Park Typology Plan and Section and typical dimensions, Scale 1 : 250 @ A4

Tree Palette

Listed below are the suggested exotic species suitable for single species use along the 'The Green Link' or in combination with the native Melaleuca on the outer profile. Suggested Melaleuca species are listed on the next pages.



Image 32. *Delonix regia*



Image 33. *Peltophorum pterocarpum*



Image 34. *Tipuana tipu*

FACTOR	SUITABILITY
Shade	Yes
Availability	Readily available in advanced sizes
Suitability as a street tree	Yes
Size	12m H x 12m W
Form	Horizontal canopy
Proven Performance as a street tree	Yes
Pedestrian Scale	Yes
Tolerate climatic conditions	Yes

FACTOR	SUITABILITY
Shade	Yes
Availability	Readily available in advanced sizes
Suitability as a street tree	Yes
Size	8 - 15m H x 8 - 12m W
Form	Horizontal canopy
Proven Performance as a street tree	Yes
Pedestrian Scale	Yes
Tolerate climatic conditions	Yes

FACTOR	SUITABILITY
Shade	Yes
Availability	Readily available in advanced sizes
Suitability as a street tree	Yes
Size	Up to 15m H
Form	Horizontal canopy
Proven Performance as a street tree	Yes
Pedestrian Scale	Yes
Tolerate climatic conditions	Yes



Image 35. *Melaleuca leucadendron*



Image 36. *Melaleuca quinquenervia*



Image 37. *Melaleuca argentea*

FACTOR	SUITABILITY
Shade	Yes, however wont provide a continuous canopy
Availability	Readily available in advanced sizes
Suitability as a street tree	Better planted in natural clumps or specimen
Size	10 - 14m H x 8 - 10m W
Form	Narrow upright form
Proven Performance as street tree	Not as an avenue
Tolerate climatic conditions	Yes
Origin	Occurs in WA, NT along watercourses and swamps

FACTOR	SUITABILITY
Shade	Yes, however wont provide a continuous canopy
Availability	Readily available in advanced sizes
Suitability as a street tree	Better planted in natural clumps or specimen
Size	8 - 12m H x 4-6m W
Form	Narrow upright form
Proven Performance as street tree	Not as an avenue
Tolerate climatic conditions	Yes
Origin	East coast of New South Wales and Queensland usually along watercourses and swamps

FACTOR	SUITABILITY
Shade	Yes, however wont provide a continuous canopy
Availability	Available in advanced sizes
Suitability as a street tree	Better planted in natural clumps or specimen
Size	5 - 7m H x 2 - 3m W
Form	Narrow upright form
Proven Performance as street tree	Not as an avenue
Tolerate climatic conditions	Yes
Origin	NW WA along watercourses and swamps

Verge treatment

The guidelines recommend three alternatives for the verge treatment along local streetscapes:

1. Street tree and compressed gravel; and,
2. Street tree and native planting. Planting may extend to footpath, or comprise a combination of planting and gravel to minimize maintenance inputs.

Implementation Principles:

- Opportunity to work with the community to develop engagement programs and encourage shared responsibility towards the verge. Maintenance of lower species, weeds and irrigation to be undertaken by owners, whereas maintenance of street tree to be undertaken by the City; and
- Opportunity to undertake works on key streets within each suburb to be undertaken as street tree & verge demonstration projects to promote neighbourhood incentives amongst further streets.



Image 38. Gravel and street trees



Image 39. Gravel and planting

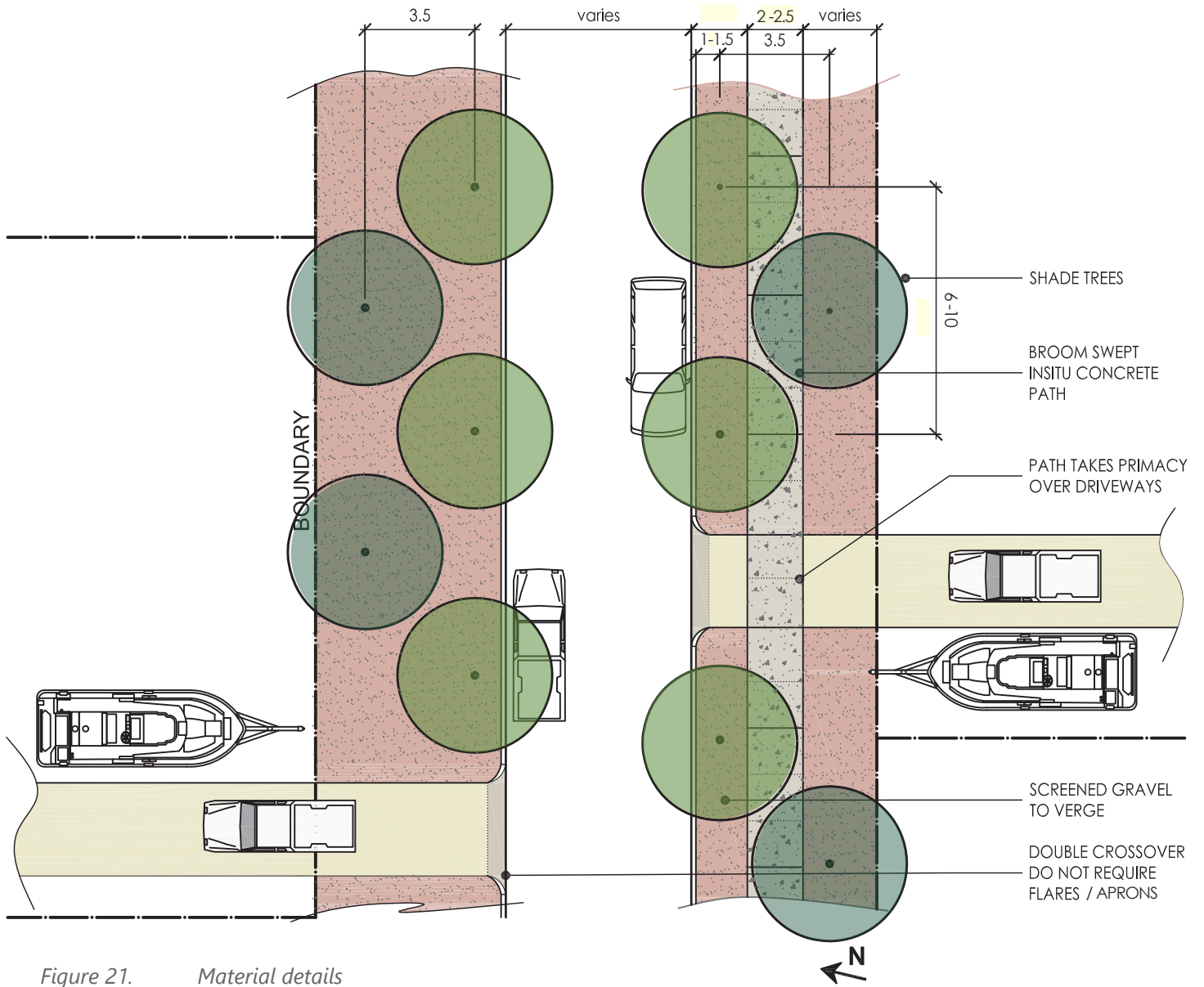


Figure 21. Material details



Image 40. Concrete path set back from road reserve

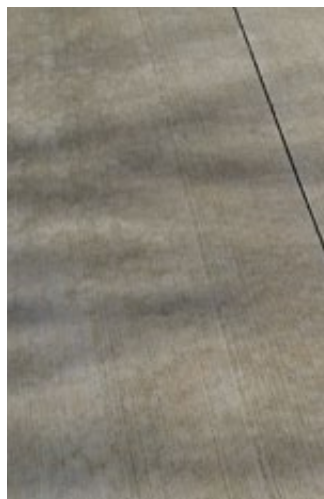


Image 41. Broome swept concrete finish

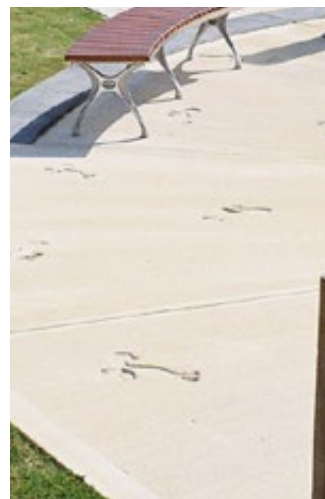


Image 42. Opportunity for paving detail



Image 43. Gravel surface



Figure 22. 'Potential Connections' Plan

4.4 'Potential Road Connections'

Engineering Review Process

As part of Stage 2, an investigation and more detailed design review of the proposed route advertised under Stage 1 has been completed. The purpose of this exercise was to undertake a more rigorous review of the potential route in relation to:

- Existing service locations (as available through Dial Before You Dig);
- Land resumption requirements;
- Review of the drainage crossings locations including subsequent culvert structures required to allow road crossings at respective points:

Following this review process, Engineering Concept Plans have been prepared that provide the City with a more informed understanding on the feasibility of the 'potential connections' including estimated costs, possible staging and implementation direction.

At the time of the engineering review process, the City was involved in traffic modelling which will provide quantifiable data about traffic movements associated with the potential connections which is scheduled for provision in April, 2016. Therefore until the full disclosure is considered, all connections are considered 'potential connections'.

A summary of the 'potential connections' are listed in Table 6. Please refer to Annex B for Engineering Final Concept Plans.

Table 6. 'Potential Connections'

Potential Connection	Advertised Connection under Stage 1	Recommended Alternative Connection
(A) Emma to Andover Way		✓
	<ul style="list-style-type: none"> Advertised Stage 1 connection between Hunt Way to Andover Way goes through an existing Water Treatment Plan which is expensive to relocate; Consideration given to aligning the Road connection North and connecting to Clarkson Way, however this isn't recommended as: North road alignment is in close proximity to Bulgarra Oval and; Potential connection doesn't align with the proposed east west link through future Mulataga Development. 	<ul style="list-style-type: none"> Recommended Alternative Connection is between Emma Street and Andover Way, which requires Lot 655 or Lazy Land Parcel P55 to be reclaimed;
(B) Turner Way to Emma Street	✓	
(C) Viveash Way to Samson Way	✓	
	<ul style="list-style-type: none"> Recommended four way intersection 	
(D) Wellard Way to Viveash Way, and north connection to Nairn Street)	✓	
(E) Balmoral Road to Frinderstein Way)	✓	
(F & G) Frinderstein Way to Williams Cr To Demetre Cres		✓
	<ul style="list-style-type: none"> Advertised Connection under Stage 1 connecting Frinderstein Way and Dodd Court requires Department of Housing Stock to be reclaimed; 	<ul style="list-style-type: none"> Recommended Alternative Connection between Frinderstein Way, Williams Court to Demetre Crescent. This is preferred due to the connections: Segmented road alignment, which assist in slowing traffic speeds; Potential connection doesn't require houses to be reclaimed; Preferred approach supported by the Department of Housing;
(H) Galbraith Rd to Demetre Cres Connection. Potential connection to Hyde Road subject to further investigation and may be modified to be a bollarded emergency access road.		✓
		<p>Pros</p> <ul style="list-style-type: none"> Provides alternative access/egress point for the Hyde Road residential cell other than Balmoral Road – an important consideration for emergency access/egress; Short connection; <p>Cons</p> <ul style="list-style-type: none"> Submissions received during public advertising opposing connection and seeking retention of cul de sac design;



Figure 25. Swale Crossings

4.4.1 Swale Crossings

Along the proposed route of 'The Green Link' there are seven (7) potential swale crossings. The design intent is to create a natural creek crossing which provides urban relief and assists in slowing traffic speeds. Key features include:

- Maintain connection to country by maximizing views along the drainage swale, towards the Karratha hills and to the tidal flats of Nickol Bay.
- Maintain slow traffic speeds and volumes through the sweeping alignment of swale crossing;
- Create swales crossings to provide a series of 'nodes' along 'The Green Link';
- Increase pedestrian amenity and treatment around swale crossings including increased tree planting, revegetation, rock batters and alignment of pedestrian footpath;

There are two options for the swale crossings:

Option A - Culverts

Aligned with the 'potential road crossing' are culvert installation to direct stormwater drainage under proposed road connection.

Option B - Concrete Causeway. Bitumised road following drainage reserve contours

In many 'potential crossing locations' random access tracks already existing where vehicles are informally crossings the swales.

There is opportunity to formalise these random access tracks and install an interim measure (or longer term if agreed by the City) via a concrete causeway.



Figure 23. Swale Crossing Option A



Key considerations include:

- Lower order swale crossing measure;
- Opportunity for concrete causeways to be either an interim measure or developed as a longer term treatment and become a defining feature within the City;
- Opportunity to integrate with artwork or interpretation;
- Consideration given to directing traffic through a significant drainage conveyance route, which may pose a significant safety hazard, even if signed to alert vehicles;
- Additional project cost if installed as an interim measure due to the redundant concrete requirements to be removed at a later date.

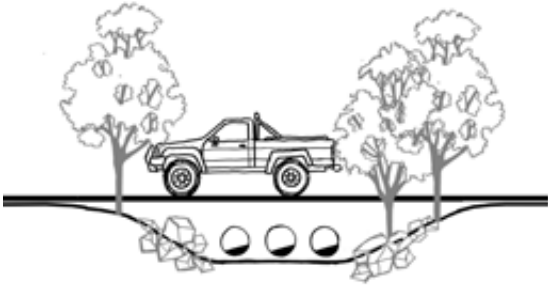


Figure 26. Sketch of Option A - Culvert

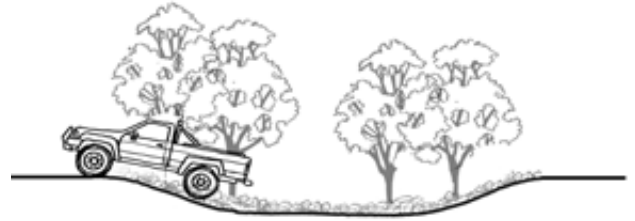


Figure 27. Indicative Sketch of Option B - Concrete Causeway



Image 44. Image of existing swale crossing

There is an alternative option that the City supports where bitumised road without culverts is built over a drainage swale. An example of this is Gardugarli Drive.



Figure 28. Four way Intersection Context Plan

4.4.2 Four way intersections

Continuing the approach of the 'The Green Link' as a community amenity, four way intersections are recommended, where required, rather than the use of roundabouts. Four way intersections, controlled by give way signs, increases the perception of greater road safety. This encourages the negotiation of priority in shared areas between different road users.

As well as providing an important transport and connectivity function, intersections also provide opportunity for significant landmarks or 'place-making functions'.

Key principles include:

- Minimize conflicts between transport modes by creating a shared space that is designed for 'people first';
- Design intersections to be as compact as possible to minimize pedestrians crossing time, distance, exposure to traffic and encouragement of walking as the preferred mode; and,
- Maintain clear sight lines when entering and within the intersection and ensure approaches are as flat and accessible as possible.



Image 45. Aerial view of four way intersection, Third Avenue, Onslow



Image 46. Street view of four way intersection, Third Avenue, Onslow





Figure 29. North / South Streets Context Plan

4.6 North / South Streets

The North / South Streets form the second level hierarchy of the streetscapes. Typically, streets run north / south and are flanked by the side of residential blocks. This results in higher occurrences of the 'colourbond' fences and less interaction between the houses and the streetscape.

4.6.1 North / South Street Character

As the North / South Streets typically have a reduced interface with the streetscape, due to the houses facing onto the quieter east west local access streets, the following is recommended:

- North / south Streets have predominantly a landscape focus including clumps of tree planting to mimic the natural creek lines also running north / south;
- This approach will increase the ease of way finding and legibility throughout the suburbs;
- Clumps of planting in staggered formation in groups of 3,5,7 etc;
- Recommended verge treatment is stabilized gravel;



Image 47. Informal clumps of native trees

Table 7. North / south Design Elements

EXISTING ELEMENT	DESCRIPTION
Road Reserve	20m
Carriageway width	7.2 – 7.8m
Verge	Approximately 6m
Footpath	Ideal condition 1.8m footpath is setback from road reserve and lined by clumps of tree planting on a minimum of one side of the street. Where existing footpath is in good condition retain, and develop succession plan to replace footpaths setback from road reserve over time.
Planting pattern	Clumps of tree planting in odd numbers
Tree type	Native tree species
Cyclist Provision	On road to both sides of the street
Tree Canopy	Semi continuous canopy along both sides of the street



Note: Trees to be planted at a 7m setback from corners

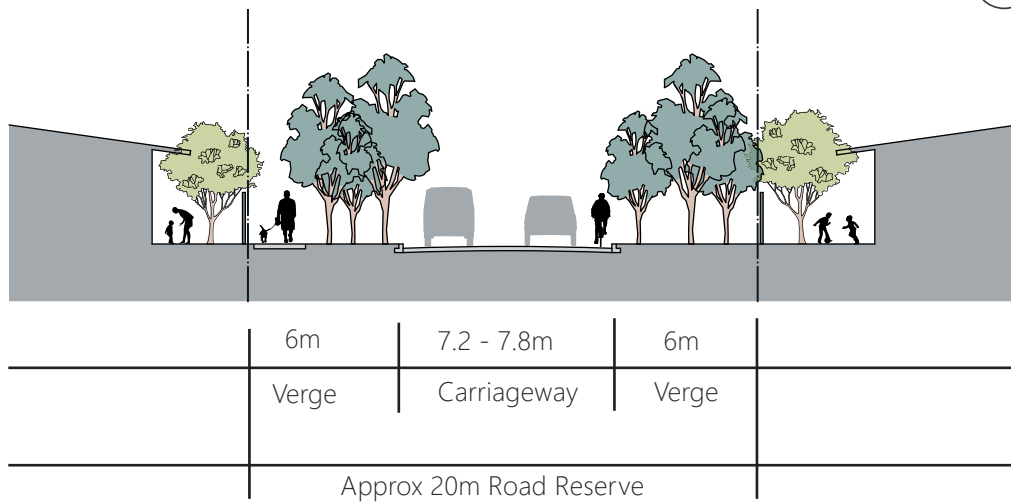


Figure 30. North / south Plan & Section and typical dimensions
Scale 1 : 250 @ A4



Image 48. Existing Streetscape



Figure 31. Proposed view of the North / South streets



Image 49. *Melaleuca leucadendron*



Image 50. *Melaleuca quinquenervia*



Image 51. *Eucalyptus victrix*

FACTOR	SUITABILITY
Shade	Yes, however wont provide a continuous canopy
Availability	Readily available in advanced sizes
Suitability as a street tree	Better planted in natural clumps or specimen
Size	10 - 14m H x 8 - 10m W
Form	Narrow upright form
Proven Performance as street tree	Not as an avenue
Tolerate climatic conditions	Yes
Origin	Occurs in WA, NT along watercourses and swamps

FACTOR	SUITABILITY
Shade	Yes, however wont provide a continuous canopy
Availability	Readily available in advanced sizes
Suitability as a street tree	Better planted in natural clumps or specimen
Size	8 - 12m H x 4-6m W
Form	Narrow upright form
Proven Performance as street tree	Not as an avenue
Tolerate climatic conditions	Yes
Origin	East coast of New South Wales and Queensland usually along watercourses and swamps

FACTOR	SUITABILITY
Shade	Dappled shade, however wont provide a continuous canopy
Availability	Available in advanced sizes
Suitability as a street tree	Better planted in natural clumps
Size	6 - 12m H x 7m W
Form	Narrow upright form
Proven Performance as street tree	Yes
Tolerate climatic conditions	Yes
Origin	NW WA

Verge treatment

As the north / south streets typically have less interaction with the street due to the side frontage and solid colour bond fences, the recommended verge treatment is stabilised gravel under the clumps of native tree planting.

There's opportunity for adjacent property owners to take ownership of this area and plant verges with clumps of low understorey native planting and feature rock boulders.



Image 52. *Street tree and gravel*

4.7 Local Access Streets



Figure 32. Local Access Streets Context Plan

4.7.1 Local Access Street Typology

Access Streets are the finer grain within the transport network and are often final destination points for traffic. These streets provide a sense of 'home' to residents and can have strong place-association and sentiment. The intimate nature of the streets, presents opportunity to encourage the contribution of private landowners to contribute to the sense of place by planting trees on their land. Key features include:

- The provision of a consistent tree canopy along the local access streets;
- The provision of approximately two trees per lot; and,
- Opportunity for shaded areas and space for ad-hoc habitation.



Image 53. Canopy trees along local access street in Kununurra

Table 8. Local Access Design Elements

EXISTING ELEMENT	DESCRIPTION
Road Reserve	20m
Carriageway width	7.2 – 7.8m
Verge	Approximately 6m
Footpath	Typically no footpath
Planting pattern	Two trees per lot
Tree type	Exotic tree species
Cyclist Provision	On road to both sides of the street
Tree Canopy	Semi continuous canopy along both sides of the street

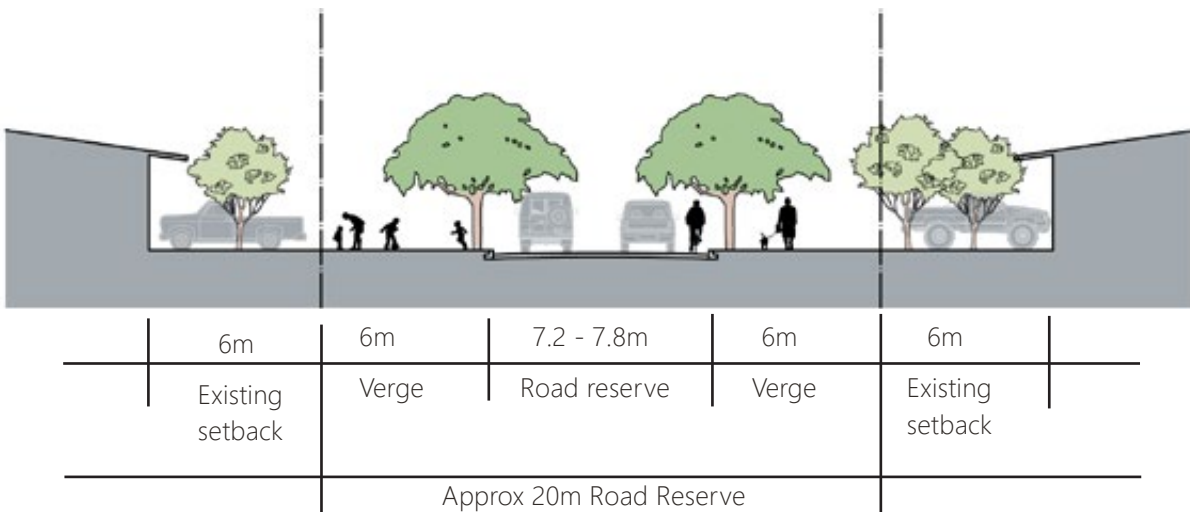


Figure 33. Local Access Plan and Section and typical dimensions
Scale 1 : 250 @ A4



Image 54. Existing view



Figure 34. Proposed view of the local access streets



Image 55. *Tipuana tipu*

FACTOR	SUITABILITY
Shade	Yes
Availability	Readily available in advanced sizes
Suitability as a street tree	Yes
Size	Up to 15m H
Form	Horizontal canopy
Proven Performance as a street tree	Yes
Pedestrian Scale	Yes
Tolerate climatic conditions	Yes



5.0 Policy Provisions

5.1 Review of Current Policy Framework

Objectives and Summary of Content

In order to achieve the vision stipulated within the Karratha Revitalisation Strategy (KRS), with a particular focus on the proposed east-west 'Green Link', it is necessary to ensure the City enforces certain design elements on private land, in addition to the ongoing maintenance of the public realm. As such, the current policy framework has been reviewed to best inform what statutory mechanisms are available to the City and what, if any, new mechanisms are needed to guide development.

Relevant to the KRS, the City's current policy framework has two existing policies to control the private and public realm design and maintenance.

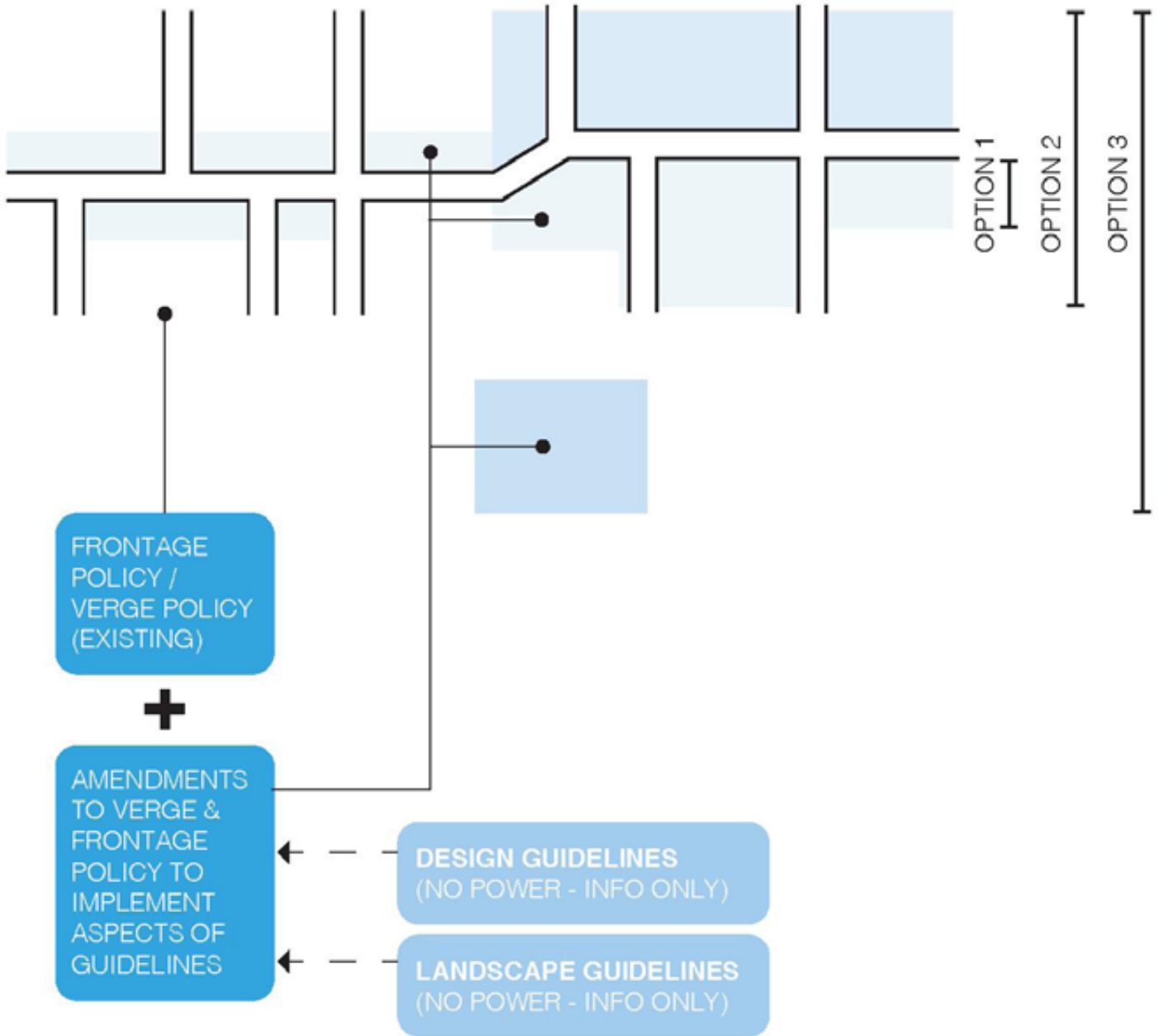
Firstly, Policy TE3: Maintenance of Reserves and Street Verges Adjoining Residential Properties applies to verge areas adjoining residential properties, but also extends to maintenance of undeveloped drainage, parkland, and recreation reserves. To summarise, the policy scope is twofold;

1. To delegate the maintenance of verges adjoining residential property to respective owners; and
2. To state that Council will generally conduct major maintenance of all other public reserves/verges once a year.

Additionally, Policy DP-07 Residential Frontages Policy applies to all residential areas in the municipality, and is concerned with built form design guidance and relationship with the street. Current policy provisions are focused on the predominant housing structure, being single detached dwellings on freehold lots. Notwithstanding, the provisions are quite substantive and are summarised in Table 9 Right.

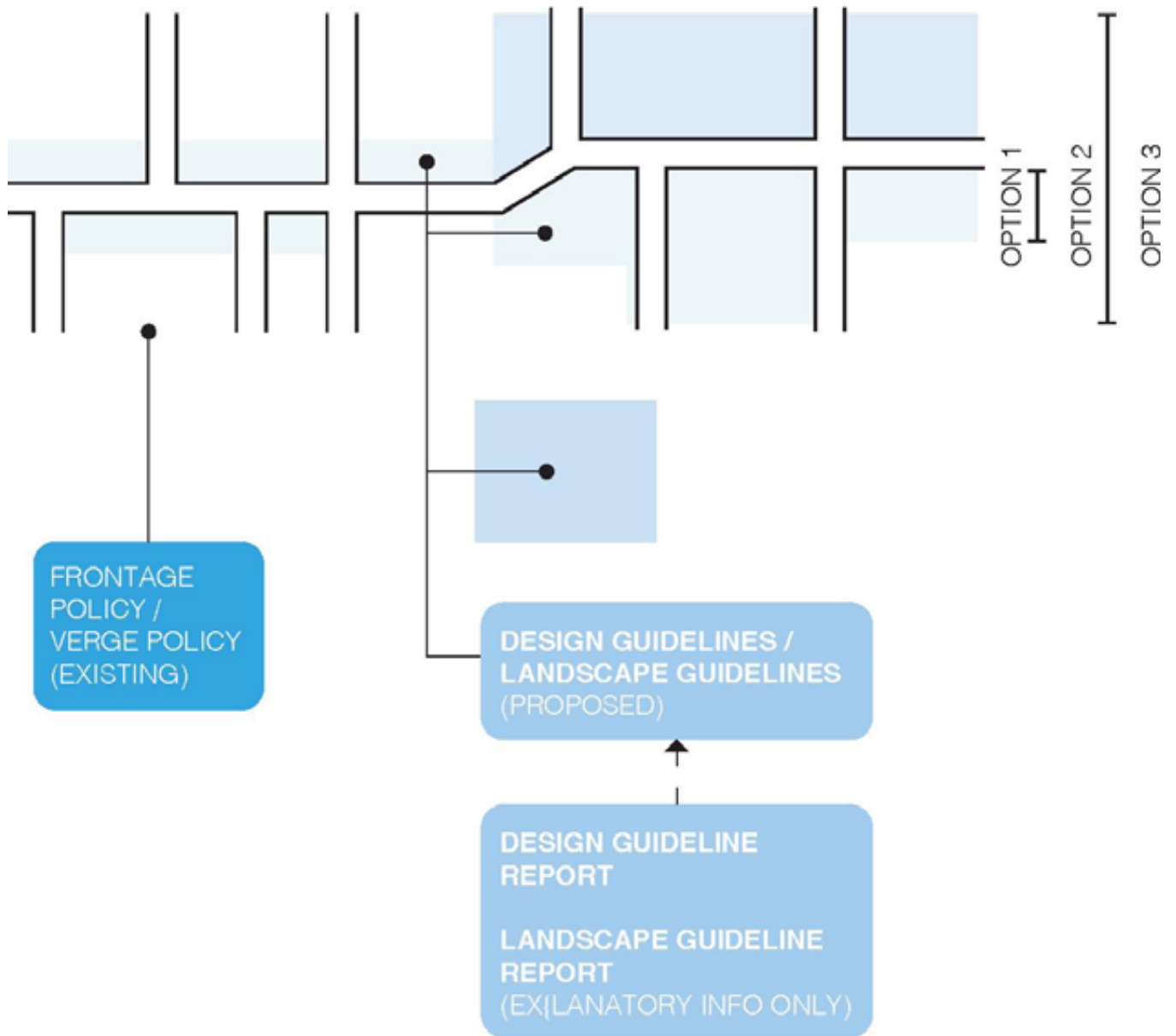
Table 9. Policy DP-07 Residential Frontages Policy Provisions

Policy DP-07 Residential Frontages Policy Provisions	
Scheme Prescribed Development Standards	Site coverage R40 Density maximum for Town Centre, Tourism, and Mixed Business zones
Appearance of Buildings and Structures	Building Setbacks Garages Carports and Boatports Outbuildings, Sea Containers and Structures without Permanent Roofing. Height of Buildings and Structures Site Cover
Driveways	Visual Truncations Width and Provision
Primary Frontage and Fences	Design and Materials Colour of Materials
Secondary Frontage and Reserve Frontage Walls and Fences	Design and Materials Colour of Materials
Boundary Walls and Fences	Design and Materials Colour of Materials



KARRATHA REVITALISATION - POLICY OPTION 1

Figure 35. Karratha Revitalisation - Policy Strategy 1



KARRATHA REVITALISATION - POLICY OPTION 2

Figure 36. *Karratha Revitalisation - Policy Strategy 2*

5.2 Policy Framework Modification Scenarios

With consideration of the two policies, there are essentially two options for the policy framework necessary to achieve the KRS objectives, illustrated in the following figures (Option 1 and 2). Option 1 contemplates amendments to the current policy framework, while Option 2 considers a new policy / set of guidelines that would be specific to property and public road reserves within the east-west 'Green Link'.

5.3 Policy DP7: Residential Frontages

Actions under the two identified options are explored in Table 2 below. Either modify the current Policy or create a new standalone Policy and/or set of design guidelines. A set of design guidelines could be packaged up as a Policy and adopted under clause 5.1 of the Scheme. This is consistent with the approach many other Local Authorities take for dealing with design criteria.

5.4 Policy TE3: Maintenance of Reserves and Street Verges Adjoining Residential Properties

Generally, the Verges Policy provisions are considered adequate for achieving the goals of KRS 'Green Link'. However, it is the statutory weight and status of this policy that requires review.

Any new development could compel occupants to maintain the verge by way of a condition of Planning Approval. Alternatively, new strata development could provide the opportunity for the strata scheme to facilitate the management of verges, with an agreement with the City, which could be requested as a condition of Planning Approval.

In lieu of any of the above-mentioned arrangements, a Local Law would be the most suitable instrument to control the ongoing maintenance of verges.

5.5 Recommendation for New Policy Framework

The review of the current policy framework has informed the development of guidelines specific to the KRS. The current framework applies to the entire municipality and it is recommended the current policy framework is not utilised as its content is too generic to apply specifically to a new east-west 'Green Link'. A new policy framework specific to the KRS would provide a better platform to articulate design outcomes to applicants. As such, it is recommended that Option 2 is actioned.

5.6 Recommended Policy Framework: Guidelines for New Development

Principles and Objectives

It is not within the scope of this review to draft a new set of development guidelines; however, it is considered necessary to establish some development principles, objectives, and design provisions that may be included in a new policy, subject to further consideration by the City.

The KRS east-west 'Green Link' presents the City with a unique opportunity to encourage development that will satisfy the future housing needs of Karratha, by way of investment into the public realm. It should be the overarching policy principle to, not only ensure any new development responds appropriately to the streetscape, but to encourage exceptional built-form and high quality living environments guided by desirable housing typologies. This could be encouraged through a series of objectives, including (draft only):

- To achieve the highest standard of residential development and subdivision outcomes that respond exceptionally to areas of high amenity;
- To provide for housing choice and variety with a high quality living environment;
- To encourage the amalgamation of existing lots into larger lots capable of accommodating a high standard of development;
- To promote the development a vibrant new community;
- To encourage household activity within street setback areas; and,
- To encourage residents to walk and cycle to nearby facilities and services.

Table 10. Policy DP-07 Residential Frontages Policy Provisions

Policy DP7: Residential Frontages	
<p>Option 1 Modify Policy</p>	<ul style="list-style-type: none"> • Add in new points into Objectives (section 1), to this effect or similar: <p>Provide street interface guidance for proposals that seek to develop at higher density than current existing development.</p> <p>Provide street interface guidance for proposals that seek to develop abutting areas of high amenity, with a particular focus on the Pegs Creek, Millars Well, and Bulgarra East / West 'Green Link' identified within the Karratha Revitalisation Strategy.</p> <ul style="list-style-type: none"> • Add in definition of East-West Green Link to section 3, to this effect: <p>The East-West Green Link is the series of road reserves identified within the Karratha Revitalisation Strategy, running between the suburbs of Pegs Creek, Millars Well, and Bulgarra, which provides for enhanced amenity of public space and spaces through additional plantings of vegetation that create shade and improve streetscape.</p> <ul style="list-style-type: none"> • Any current 'get out' clauses granted to applicants who do not entirely comply with the Policy should be reviewed and potentially disallowed for development abutting the East-West Green Link. • There are essentially two ways in which the policy provisions (section 5) could be modified: <ol style="list-style-type: none"> 1. Modify each policy provision to ensure they relate to other housing typologies other than just single detached dwellings (anticipating alternate built form outcomes). 2. Create a reference at the beginning of the section that refers readers to a specific sub-section for development abutting the East-West Green Link. That sub-section could make more specific policy provisions relevant to alternate typologies such as terrace, row, apartments etc.
<p>Option 2 Create New Policy and/or Design Guidelines</p>	<ul style="list-style-type: none"> • The current Residential Frontages Policy should refer readers to the newly created policy and/or design guidelines for development that abuts the East-West Green Link, and state that the new policy shall prevail for any inconsistencies. • A new policy would provide the platform to create a range of provisions that guide development through the use of pictorial examples, diagrammatic typologies, and textual guidance.

Anticipating Built-form and Housing Typologies

As outlined within the City's Local Planning Strategy: Population and Demographic Analysis, the mid-scenario, between the low and high population projections, predicts that the municipality will grow from a population of 23,926 in 2011 to 42,430 by 2031, with Karratha itself anticipated to absorb a large majority of the influx. As articulated within the Strategy, there are three major considerations that can be used to anticipate the type of demanded housing stock that will drive development:

1. Alternate housing required, in lieu of short-stay accommodation, to better encourage permanent and/or long-term lone person residents associated with the mining and construction workforce to reside within the town site and contribute to the community.
2. Although single detached family homes are the current dominant form of housing stock, it is expected that this mix of household type will not change markedly, as many families with children are relocating to the municipality as encouraged by the City.
3. Affordability and proximity to amenity and services will continue to be a large market factor that influences the size of lots and housing typology dependant on location.

With consideration of the high amenity that is intended for the east-west 'Green Link', the KRS Revitalisation is likely to foster the current housing typologies:

- Row house form;
- Stand-alone side-loaded group housing;
- Amalgamated side loaded group housing;
- Some limited walk-up apartment product; and,
- Unique corner lot response abutting swale.

5.7. Housing Typology General Guidelines

Housing Typology General Guidelines are to be read in conjunction with the Housing Typology Diagram on the next page.

Areas Zoned R25

Primary Setback

Mandatory:

In accordance with WAPC's Residential Design Code:

- Primary setback 6m.

Advisory Note:

Averaging of setbacks in accordance with R-Codes Clause 5.1.2 Street Setback to be encouraged to emulate the existing pattern of development which responds to north rather than the street geometry. This original built form and street scape typology should be encouraged for all new developments as it affords the following:

- Presents varied and staggered street setback across individual lots and along the street;
- Allows for the broad access and aspect of dwellings to face the street;
- Provides greater separation and therefore privacy between dwellings as façades are not aligned;
- Presents both fronts and sides elevations of dwelling to the street encouraging greater design resolution of individual and collective dwellings;
- Enhances opportunities for passive surveillance due to greater opportunities for windows on fronts and sides;
- Affords varied setback depth across individual lots to better accommodate trees and toys;
- Provides excellent building orientation and passive solar opportunities; and,
- Compliments the LandCorp's Pilbara Vernacular Handbook.

Secondary and Rear Setbacks

In accordance with WAPC's Residential Code:

- Secondary setback 1.5m; and,
- Other/rear setbacks to be calculated according to table 2a and 2b and clause 5.1.3.

Building Heights

Building heights are in accordance with WAPC's Residential Code

- To be calculated according to R-Codes Table 3 Maximum Building Heights;

Fences

Mandatory Requirements:

- Fences facing the street or in front of the building line are to be no more than 1.2m high and be 80% visually permeable;
- For privacy, the following exceptions allow for visually impermeable 1.8m high fences in line with the building;
 - Fences directly adjacent to private open spaces;
 - On the secondary road of corner blocks, for up to 30% of the boundary, but not that closest to the corner;

Advisory Note:

- Dividing fences between collocated driveways are discouraged forward of the building line;
- Dividing fences between group housing forward of the building line are discouraged;

Private Open Space

Mandatory

- Private open space is not permitted within the front setback.

Advisory notes:

- The location of private open space behind the building line is encouraged.

Cross Overs and Carport

Mandatory

- Double crossovers do not require flares; and,
- Driveways for group dwellings are to be paired wherever possible.
- Carports structures are to be setback a minimum of 6m from the primary setback to allow for tandem parking;

Advisory Notes:

- Collocated driveways and paired cross overs are encouraged.

Areas Zoned R40

Primary Setback

Mandatory:

In accordance with WAPC's Residential Design Code:

- Primary setback 4m.

Advisory Notes:

Averaging in accordance with clause R-Codes 5.1.2 would be encouraged to emulate the existing pattern of development which responds to north rather than the street geometry. This original built form and street scape typology should be encouraged for all new developments as it affords the following:

- Presents varied and staggered street setback across individual lots and along the street;
- Allows for the broad access and aspect of dwellings to face the street;
- Provides greater separation and therefore privacy between dwellings as façades are not aligned;
- Presents both fronts and sides elevations of dwelling to the street encouraging greater design resolution of individual and collective dwellings;
- Enhances opportunities for passive surveillance due to greater opportunities for windows on fronts and sides;
- Affords varied setback depth across individual lots to better accommodate trees and toys;
- Provides excellent building orientation and passive solar opportunities; and,
- Complements LandCorp's Pilbara Vernacular Handbook.

Secondary and Rear Setbacks

In accordance with WAPC's Residential Code:

- Secondary setback 1.5m; and,
- Other/rear setbacks to be calculated according to table 2a and 2b and clause 5.1.3.

Building Heights

Building heights are in accordance with WAPC's Residential Code

- To be calculated according to R-Codes Table 3.

Fences

Mandatory Requirements:

- Fences facing the street or in front of the building line are to be no more than 1.2m high and be 80% visually permeable; and,
- For privacy, the following exceptions allow for visually impermeable 1.8m high fences in line with the building:
 - Fences directly adjacent to private open spaces; and,
 - On the secondary road of corner blocks, for up to 30% of the boundary, but not that closest to the corner.

Advisory Note:

- Dividing fences between collocated driveways are discouraged forward of the building line; and,
- Dividing fences between group housing forward of the building line are discouraged.

Private Open Space

Mandatory:

- Private open space is not permitted within the front setback.

Advisory notes:

- The location of private open space behind the building line is encouraged.

Cross Overs and Carport

Mandatory

- Double crossovers do not require flares;
- Driveways for group dwellings are to be paired wherever possible; and,
- Carports structures are to be setback a minimum of 6m to allow for tandem parking.

Advisory Notes:

- Collocated driveways and paired cross overs are encouraged.

Continue existing block orientation

Orient lots to maximise passive solar design potential

1.8m fencing permissible for 30% of secondary boundary on corner lots

Co locate driveways where possible. Fencing between collocated driveways discouraged

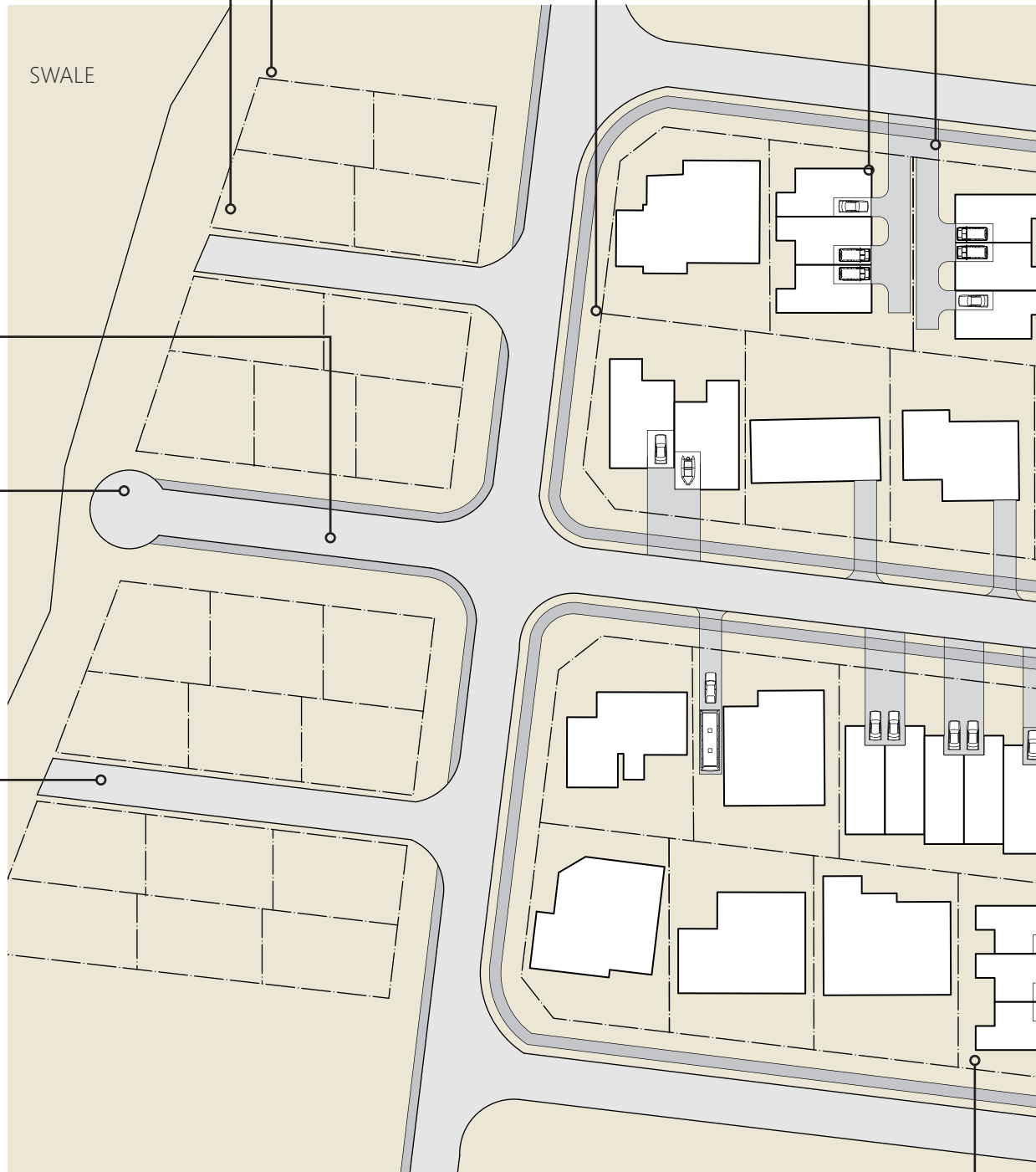
1.2m visually permeable fencing to street

SWALE

Continue line of existing road, maintain depth of road reserves etc.

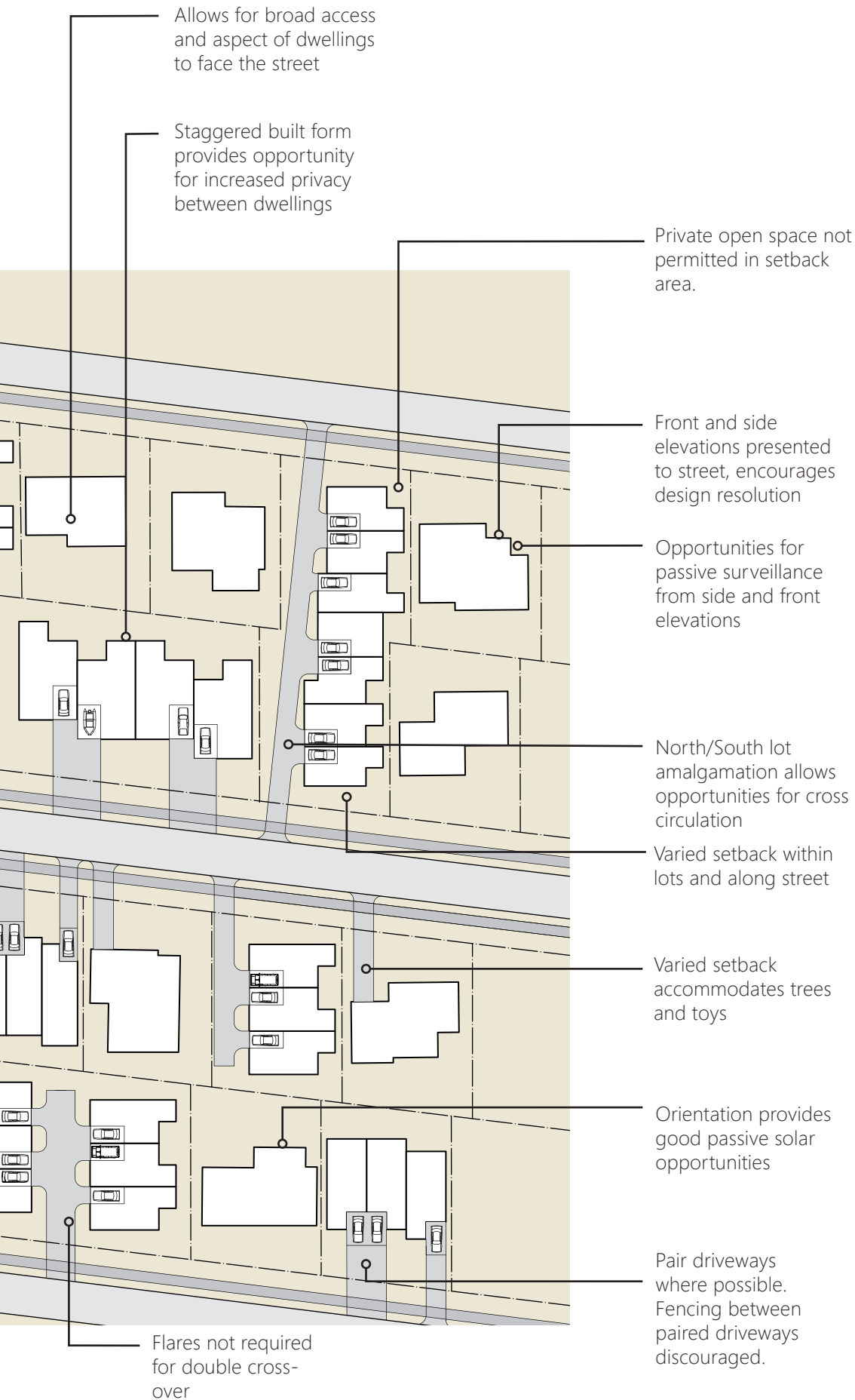
Maintain vistas and access through to swales

'Mid-block' roads to be secondary in scale and align with existing



1.8m fencing to street allowable adjacent to private

Figure 37. Building Typologies Diagram



Swale Sleevling

Housing infill adjacent to stormwater swales or 'swale sleeving' has been undertaken in a number of locations and in a variety of forms across Karratha. Swale sleeving should be undertaken only in areas identified in the KRS to ensure that storm water management is not compromised.

'Horse shoe' infill such as the development on Sampson Way and corner of McCourt and Nairn, or single dwelling sleeving such as on Teesdale Place should not be emulated. This type of development inhibits informal pedestrian routes, future formal connections, and restricts public access to the swales which have been identified in the KRS as important open spaces.

'Finger' or 'bar' sleeving similar to that near the corner of Dugald Way and Nairn St and the corner of Turner and Lockyer St is a more flexible option that provides greater public amenity. These models have vehicle access arranged perpendicular to the swale with lots and dwellings provided with north / south axis. This model is more an extension of the surrounding established built form it provides the following important benefits:

- Provides greater permeability to and from and across swales and therefore passive surveillance of both streets and swales
- Reinforces the swale system as open public space / ecosystems
- Provides vistas and views to open space are maintained and enhanced
- Allows for informal pedestrian paths to develop and be developed
- Allow for future formal connection to be made, further future-proofing Karratha

North / South

The north / south feeder roads have houses which predominantly face the secondary, quieter streets and accordingly have reduced setbacks we believe this pattern should be followed.

Local Access Streets

Built form guidelines to the local access streets as the same as the green link.

General Development Provisions

In order to achieve the policy objectives and provide the housing typologies identified, it is recommended that residential lots adjacent the east-west 'Green Link' should be up-coded to a base density of R40. Given the majority of densities within the town site are R20 and R30, this should be a sufficient density increase to encourage short-medium term private investment.

An immediate increase in densities does, however, present a risk of development effectively sterilizing the potential of adjoining larger lots from achieving a high quality built form outcome from an alternate built-form typology that may have only been developed in the long-term, by the time the housing market matures. The introduction of strata schemes through further subdivision, private vehicular access ways, and the built-form itself, act as 'restrictive' layers that become difficult to unlock moving forward.

- Some examples of poor quality development outcomes that should be discouraged include:
- Internally facing housing types that provide 'blank walls' or turn their side to streetscapes.
- Non-permeable fences or large street walls provided to the street.
- The proliferation of internal private access ways and smaller driveways prohibiting the effective use of street setback areas for activity and landscaping.
- Underdevelopment of lots, where the underdevelopment represents an inefficient use of land and failure to properly engage with the streetscape.

Recognising these risks, it will be imperative that any new development is encouraged to achieve the highest quality design outcome.

To avoid some of the risks identified, amalgamation of lots could serve as a significant development incentive for applicants willing to participate, with the potential for the City to allow a bonus lot/dwelling if certain design merits are achieved.

Some of the design provisions that should be encouraged/mandated in the new guidelines include:

- Requiring paired driveways for row housing to minimise excessive dissection of landscaped verges
- Advice note in policy to remove need for crossover flares for double crossovers
- Carports for row housing to have a minimum setback of 6m. This assumes single carports (paired), and a second on-site car-space in driveway in front of carport (hence mandatory 6m).
- Habitable room setbacks for row housing as per R-Codes (4m), allowing streetscape to have greater presence of habitable dwelling elements rather than carports.
- Single side loaders – advice note to encourage co-location of group housing driveways, and reduction or removal of dividing fence. This will open up the sense of space for group housing, and improve CPTED.
- Discourage 1.8m fenced private use areas between the nearest unit to the street and the street boundary. Setback area ought to remain open and landscaped, with only 1,2m transparent fencing permitted to the street and returns.
- Private use areas for nearest units to street should be located to the side of the unit, behind the building line
- Minimise fencing to secondary street on corner lots. 1.8m fencing should only extend sufficiently to give privacy to private open space. Dwelling design should address all other streets.
- Advice note to discourage dividing fences forward of the building line between co-located driveways.

The detailed development principles, objectives, and design provisions that are to be included in any new policy or guidelines are subject to a further review and consideration by the City.



6.0 Public Open Space

6.0 Shakespeare Street Park



Figure 38. Shakespeare Street Park Context Plan

Location

The Shakespeare Street Park is a Level 3 Neighbourhood Park located around the Karratha Scout Hall and bound by the roads of Wellard Way to the west, Nairn Street and Viveash Way to the north and south and Lockyer St to the east. The area of land is approximately 6.6ha.

The recommendation from KRS Stage 1 was to expand and improve this park, by combining lazy land sites P38, P39 & P40, including a provision for the relocation of Rex Webb Park and Richardson Way Park.

Throughout the engagement process it was widely recognised that this is an important community asset for residents, interest groups and the City of Karratha.

Existing Features

Shakespeare Park is a high value place-identity space. The locals use this park to identify and connect to their local setting. The natural setting clearly distinguishes this area of Bulgarra apart from the rest of Karratha. In this way it is imperative to maintain the park's native integrity and freestyle use.

Key existing features include:

- Large areas of remnant revegetation and canopy trees, predominantly *Eucalyptus victrix*;
- The park includes a central walking trail, which has recently been upgraded and is popular for passive recreation;
- The Scout Hall and surrounding area, including fire pit, existing playground, lawn area, carpark etc is the central activity hub of the park;
- The area to the east of the Scout Hall has been adopted by neighbouring residents who developed a series of bike paths, jumps and circuits; and,
- The Shakespeare Street Park (Scout Hall) has an important role in servicing and providing amenity to the Bulgarra residents.



Image 56. Formalise existing access tracks



Image 57. Retain existing trees and central walking path



Image 58. Maximise view to the hills



Figure 39. Shakespeare Street Park Concept Plan
Scale 1: 1500 @A3

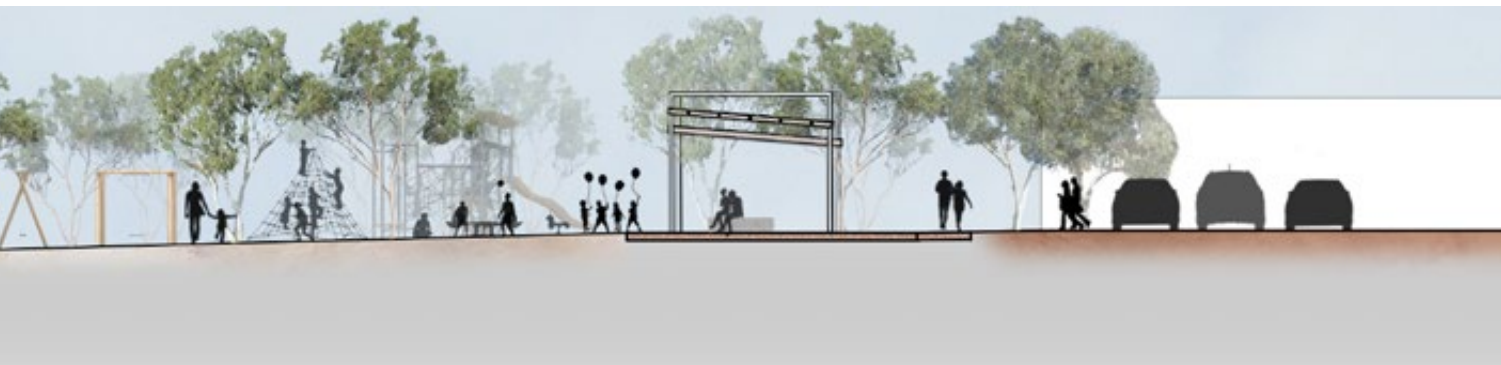


Figure 40. Section E-E
Scale 1: 200 @ A3



- Expand lawn area
- Expand existing playground with adventure play, ropes, climbing, activities etc
- Retain bike track (See note)
- Existing scout hall building
- Lawn kick about space
- Activity node
- Retain revegetation area
- Proposed road connection
- Activity node and lawn area at Wellard way
- Park 'entrance' and activity node adjacent to Wellard Way
- Proposed road connection

Note: Bike track is retention of community driven use of land and not included within City's level of service for this park categorisation



Key features of the proposed Concept Plan include:

- Expand and improve the Shakespeare St Park to create a shared use amenity between the Scout Hall / City of Karratha and surrounding residents.

Road Connections

- Formalise the existing vehicle tracks to connecting to Wellard Way and Viveash Street, as well as north / south link to Nairn Street.

Spatial rooms

- Strengthen the existing natural assets of the site by creating a series of spatial 'rooms' which are connected via the existing walking path through the centre of the park.

Revegetation

- Supplement existing revegetation with local endemic species and wildflowers. It's recommended the existing white fence around revegetation areas could be replaced with a simple national park style post and three wire fence that is set back approximately 2m from the pedestrian path to mitigate people entering this area; and,
- Signage and interpretation to be installed along the central path to celebrate this asset and educate people on the environmental and cultural benefits, uses, names etc of the plant species.

Scout Hall Activity Hub

- Expand the existing playground toward Nairn Street, which maximizes existing trees and views toward Nickol Bay. Suggested play activities include a large rope structures with two or more equal peaks to complete the outdoor nature of the Scouts;
- Incorporate outdoor shelter, seating and relocated fire pit on the Shakespeare side of the Scout Hall, to provide an open multi use and flexible space;
- Extend existing lawn area to Shakespeare Street Road Reserve;
- Retain and formalise existing bike tracks initiated by the surrounding residents;
- Retain and formalise the existing carpark including wheel stops to demarcate parking areas, tree planting and realignment of the sea containers closer to the air monitoring station to provide connection between the carpark and lawn area;
- Provide an open kick about lawn area to the south of the Scout Hall; and,
- Promote the shared use philosophy of Shakespeare Street Park by removing the existing fence separating the Scout Hall and public space.

Lighting

- Provide solar lighting along the central pathway to ensure a safe, well lit amenity for surrounding residents.

Implementation

- It is recommended that further detailed design and implementation should continue the collaborative approach taken to develop the Concept Plans with shared input and responsibility from City stakeholders, community and stakeholder interest groups. The Scout Hall have support this recommendation and are willing to provide further input and assistance into this process.

Wellard Way

Currently the Concept Plan shows a lawn breakout area and activity node adjacent to Wellard Way. It is understood the Council has made a commitment to providing amenity at this location due to the relocation of Rex Webb and Richardson Way Parks. This breakout area is linked to the Scout Hall by two smaller breakout activity nodes.

Whilst this approach honours the Councils commitment, it is recommended that this node is retained as revegetation and the activity area is centralised around the Scout Hall. This will result in reduced maintenance resources and upholds the City's overarching public open space strategy of providing less parks with higher quality amenity in centralised locations.

Table 11. Shakespeare Street Park Design Elements

PUBLIC OPEN SPACE TYPE	PARK
City of Karratha Playspace Standards	Level 3
Size	6.6ha
Accessibility	Residents in excess of an 800m radius
Edge Conditions	Clear views into the park
Design Conditions	Informal Spaces, minimal turf areas, endemic planting and local materials.
Planting	Endemic Planting Clumps of trees with low understory planting
Drainage	Revegetation drainage swales
Play Equipment	Large playground with 5+ play activities Shaded social gathering area with BBQ and picnic facilities
Lighting	Solar lighting along central path, lighting for sports activities in the evening and general lighting for safety purposes
Carpark	Co-located with Scout Hall Provision for 10 – 20 vehicles in carpark
Furniture	Robust materials in consolidated rest areas
Signage	Retain existing way finding signage Opportunity for interpretative signage along central access path

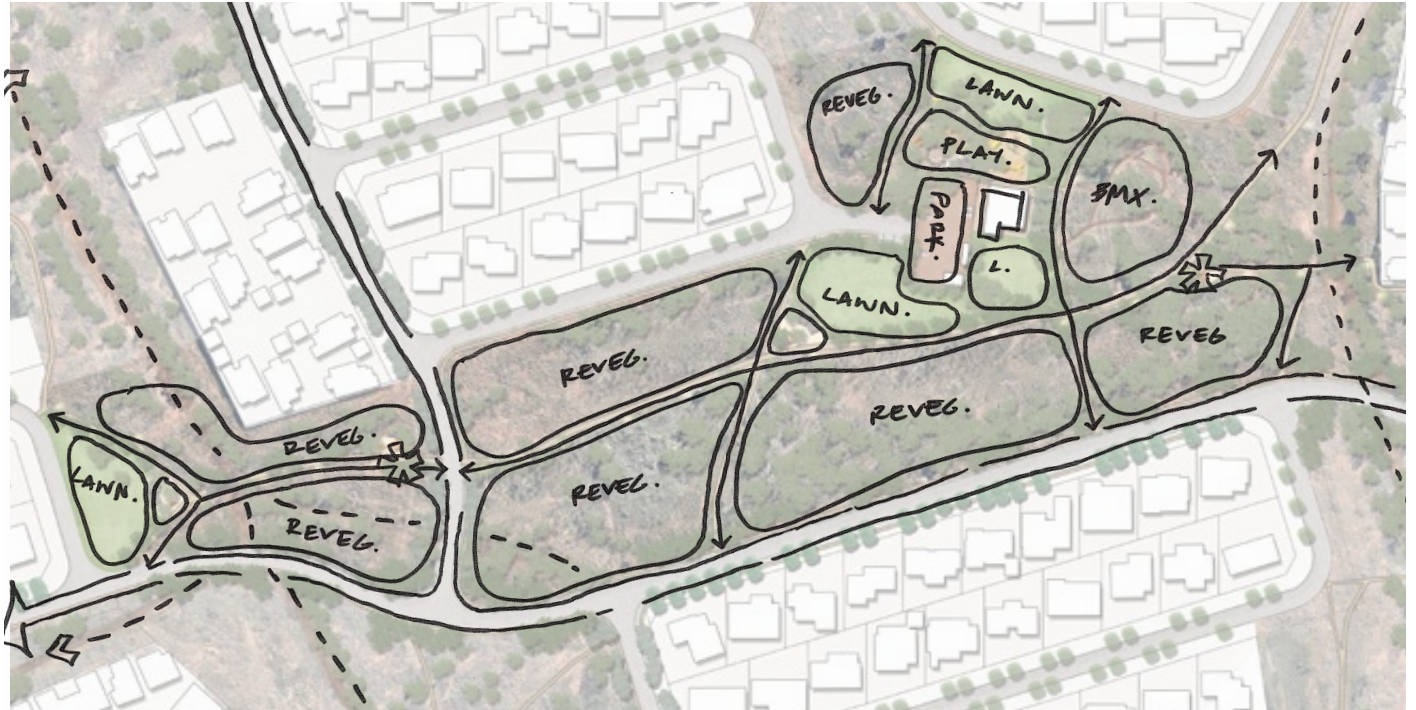


Figure 41. Shakespeare Street Park Sketches
Scale NTS



Image 59. Precedent image of natural playground, Wallarah Park, Oculus



Image 60. Opportunity for adventure play to align with Scout Hall, Parc Diagonal Mar, Barcelona, EDAW / EMBT



Image 61. Opportunity for natural play



Image 62. Formalise existing bike tracks

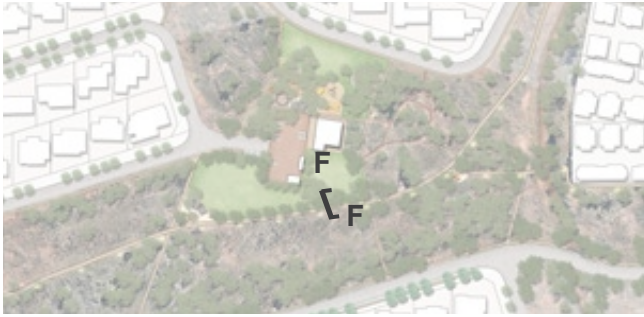


Figure 42. Section Context Plan



Figure 43. Section F-F
Scale 1: 100 @ A3



Image 63. Existing vegetation to be retained



Image 64. Precedent image of cultural interpretation. Pedra Tosca Park, RCR



6.1 Malster Way Park



Figure 44. Malster Way Park Context Plan

Location

The Malster Way Park is a Level 3 Park, surrounded by residential area in the south west corner of Millars Well. The park is bound and between Geyer Place and Malster Place cul de sacs. The southern edge is bounded by solid colourbond fences of properties which back onto the space, which provides limited interaction and passive surveillance.

The recommendation from Karratha Revitalisation Strategy Stage 1 was to improve this park including expanding grass areas, play equipment, shade and planting. This park has been selected for priority upgrade as a potential offset due to the recommended closure of Aston Way Park.

Existing Features

Key existing features include:

- Opportunity to utilise the east-west swale with regard to topographical and spatial interest;
- Retain and supplement local native trees including feature shade exotic trees along path and meeting areas; and,
- Take advantage of the area's convenience as a strong connection or meeting catchment for a number of walkable neighbourhoods.



Image 65. Existing lawn area and view towards existing playground



Image 66. Retain existing swale and supplement with additional planting



Image 67. Existing playground. Opportunity to relocate closer to Malster Way

Proposed Features

Key features of the proposed Concept Plan include:

- Retain and regrade existing east west drainage line running east west, to create a multi-use corridor;
- Relocate and expand existing playground on the top of drainage swale batter adjacent to Malster Way. Include provision for seating area, shade, as well as additional play opportunities;
- Extend lawn area through swale batter and to the southern side of the park;
- Provide canopy trees and low planting along the boundary of properties to the south of the space;
- Revegetate along the existing drainage lines and opportunity to integrate with natural play opportunities; and,
- Provide solar lighting to ensure a safe, well lit amenity for surrounding residents.

Table 12. Malster Way Park Design Elements

PUBLIC OPEN SPACE TYPE	PARK
City of Karratha Playspace Standards	Level 3 - Neighbourhood
Size	0.9ha
Accessibility	Residents within an 800m radius
Edge Conditions	Clear views into the park
Design Conditions	Transform drainage line into a multi-use corridor including a lawn area, playspace, seating area and revegetation along drainage line
Planting	Endemic Planting Clumps of trees with low understorey planting
Drainage	Multi-use corridor and revegetation of drainage swales
Play Equipment	Large playground with 3-5 play activities Grassed area, shade structure for play space and seating areas.
Lighting	Lighting for safety purposes only
Carpark	Provision for some car parking only
Furniture	Robust materials
Signage	Provide way finding and directional signage



Image 68. Precedent image of seating areas. Lizard Log Park, McGregor Coxall



Image 69. Example shade and seating area, Victoria Park Public Domain, Hassell



Image 70. Feature path, Kings Park



Figure 45. Malster Way Concept Plan
1: 1000 @ A3












Figure 46. Section GG
Scale 1: 200 @ A3



- Revegetated swale
- Relocated and expanded play equipment
- Shaded pedestrian path
- Expanded lawn area
- Existing trees and revegetation
- Clumps of tree planting along boundary fences

LEGEND

	Existing vegetation		Shade structure and seating		Retained swale
	Existing path		Road		
	Lawn		Lighting along pedestrian path		
	The 'Green Link'		Extend existing playground		





7.0 Staging, Funding & Review



7.0 Staging, Funding and Review

The realisation of a continuous link and a 'low speed' transport connection is a long term priority. Therefore the KRS is intended to be understood as a framework that evolves over a 20 year timeline, implemented through the City of Karratha's long term financial planning.

The interim 5 years includes early on-ground focus for delivering pedestrian amenity through community engagement and localised design responses.

While the KRS guideline provides consistency on a suburb wide level, it also allows for flexibility and adaptability during implementation on a section by section basis. The time frame for the delivery of sections may vary given budget constraints and site specific requirements.

It is recognised that there are a number financial, communal, land and infrastructure factors that will influence localised staging including:

- Community engagement approach and specific requirements;
- Cost of pedestrian and road infrastructure;
- Cost of swale crossings;
- Feasibility and availability of required lots and land to provide Green Link connections;
- Traffic modelling; and,
- Availability of infrastructure funding and contributions.

The guidelines are intended to provide the City of Karratha with a framework to guide implementation. This framework should allow consistency on a suburb wide level, but allow flexibility during implementation and be adaptable to the existing public realm.

The components listed above could be viewed as a 'kit of parts' that provide principle direction for implementation. However it's encouraged that the exact form of 'The Green Link' varies along its 6.7km journey, again accentuating the segmented nature of this pedestrian focused amenity.

The following list includes opportunities to apply variation and adaptability at the detailed design and implementation phase, for example:

- 'The Green Link' could be implemented using a single species or combination of exotic species on the internal profile and native species on the external profile. Please note, the application of a single native species is not recommended along 'The Green Link' as native species will not provide the continuous and dense shade in comparison to that of an exotic species;
- An exotic species e.g. Delonix, Peltophorum or Tipuana could be aligned to a respective suburb e.g. Bulgarra, Pegs Creek or Millars Well;
- The native species could be applied to particular road segments with major intersections or swale crossings defining the segments;
- Principle tree spacing is based on 6-8m, which aligns with the typical property frontage of 24m. Exact spacing distance is to be determined during detailed design, depending on the existing streetscape fabric in specific segments e.g. location of crossovers, footpaths, light poles etc.

7.1 Green Link

Figure 47 illustrates the three suburbs of Millars Well, Pegs Creek and Bulgarra broken down into seven sections and prioritised accordingly.

A flexible approach is advocated with the priority being to expand outwards from the City Centre with priority A areas, followed by priority B areas, then priority C areas.

The Green Link establishment priorities, in order of importance, will include:

1. The first priority - the creation of a continuous pedestrian path and cyclist connection;
2. The second priority - the establishment of trees (tree planting) within road verges where footpaths exist;
3. The third priority - the establishment of drainage reserve crossings for pedestrians and cyclists;
4. The fourth priority - the drainage reserve crossings for vehicles; and,
5. Establishment of erosion control and planting within drainage swales commencing in proximity of the Green Link or entire swale as a separate project.

7.2 North-South Links

The North-South links are to be developed following the establishment of the urban amenity corridor, the Green Link.

Closer consideration will be given to the traffic along North-South roads as transport links to the major commuter arteries and in the context of the earlier established Green Link. This will be undertaken via updated traffic modelling and the City's traffic counting program.

7.3 Localised Engagement & Responsive Design

Localised engagement strategies will occur prior to the finalisation of verge landscaping plans and finalisation of local footpath routes. Individual design responses will be planned in response to immediate site constraints and verge use within the context of KRS objectives and the co-ordinated delivery of a high amenity corridor.

7.4 Footpath Establishment

Continuous pedestrian and cyclist connection is to be established prior to tree planting and is to inform and align with the City of Karratha's 'Future Works Report Footpaths 2013-2023' report.

In general, the City's 'Future Works Report Footpaths 2013-2023' prioritises footpath connections on the periphery of the study area, along major distributor roads. In contrast the KRS strategy proposes footpath establishment through the middle of the study area, as part of the Green Link. While there is a substantial amount of footpath existing along the route of the Green Link, new footpaths will need to be installed as the first element of the Green Link. Funding for these footpath works will need to be factored into the City's long term financial plan.

7.3 Proposed Drainage Reserve Crossings

During the consultation and public advertisement processes there was concern raised regarding vehicular traffic associated with the Green Link. As previously mentioned, the movement network can develop over time (first pedestrians and cyclists) and in conjunction with streetscape upgrades and traffic calming. In this way, the objectives of the KRS to create a low speed, high amenity shared movement corridor will be delivered.

As the Green Link is a long-term project, it is envisaged that footpath installation and streetscape planting will have time to become established before vehicular

movements are opened up. The benefits are that the objectives of the KRS to encourage alternative movement patterns are delivered before vehicular connections and traffic movements are established.

Notwithstanding the above, it is recognised that there are efficiencies associated with full construction of drainage reserve crossings. It is more cost efficient to build the vehicular connections at the same time as pedestrian/cyclist connections. Highest cost efficiencies are possible when the drainage reserve crossing incorporates all movement types.

Decisions regarding the staging of works for drainage reserve crossings are likely to be some way off and will need to be further considered, including community consultation, if and when delivery of those works are being contemplated.

7.4 Drainage Reserve Establishment & Crossings

Five of the seven sections include drainage reserve crossings. The drainage reserve crossings are treated as separate sub-sections with a staggered delivery of pedestrian/cyclist crossings, vehicular crossings and erosion control/ecological planting.

The staggered approach is as follows:

1. Footpaths are established within road verges;
2. Trees are planted within road verges;
3. Erosion control and ecological planting is established within drainage swales and reserves in proximity to the chosen section (without compromising drainage reserve crossings) to note: The planting of drainage swales will be undertaken via two approaches as follows:
 - a. The first being the planting of trees in proximity to the Green Link; and,
 - b. The second being a future plant-out of drainage swales as individual projects;
4. Pedestrian/cyclist connections across the drainage reserve are established or formalised; and,
5. Vehicular crossings are established at a future time.

The staggered approach to delivering drainage swale crossings achieves the primary goal of the strategy allowing for:

- Alternative movement patterns and pedestrian prioritisation to be established;
- A Verge tree planting program to provide amenity, traffic calming and enclosure of the Green Link;
- Build community confidence in the Green Link; and,
- for an economically sustainable approach to delivering up front expensive infrastructure, i.e. avoiding immediate delivery of vehicular drainage swale crossings.



Image 71. *Separate pedestrian / cyclist bridge*



Image 72. *Combined Bridge*



Image 73. *Causeway crossing*

As an alternative, the delivery of one drainage reserve crossing combining all movement types i.e. combined bridge, may be considered. This option may respond to pecuniary priorities where higher upfront expenses may be accommodated for lower overall cost.

7.9 Preferred Staging of Drainage Reserve Crossings

The City of Karratha has the following preference structure in regard to Drainage Reserve Crossings. These preferences can be further considered as individual design responses are required for each of the crossings.

1. First Preference - separate pedestrian/cyclist bridge
Establishment of pedestrian and cyclist connections via a pedestrian bridge prior vehicle connection (Refer Image 71).
2. Second Preference – combined bridge
The combined provision of pedestrian and vehicle connections across the drainage reserves has been costed. This combined crossing may be appropriate where upfront expenses deliver lower overall costs in the delivery of the infrastructure. (Refer Image 72).
3. Third Preference - Causeway crossing
The third preference is for an at-grade crossing. This option has less establishment costs however higher ongoing maintenance costs compared to bridge options. (Refer Image 73).

7.10 Demonstration Street as First Stage of Works

A demonstration street has the potential to show rather than tell, what the intent of the Green Link is and the environments that will be created. As the implementation of the Green Link is a long term strategy, there is merit to the creation of a demonstration street as the first package of works. A preferred demonstration street will be identified through an evaluation process.

7.11 Traffic Calming

As previously mentioned in part 4.2, the tree planting program will 'enclose' the street. This will work to calm traffic whilst emphasising a low speed environment. Notwithstanding, some stretches of the Green Link will require horizontal or vertical traffic calming mechanisms. The length of Galbraith Road, for example, currently encourages higher speeds which can be reduced through the introduction of traffic calming mechanisms.

The investigation of pelican crossings for pedestrians is encouraged, particularly in proximity to schools and parks. It may be desirable to provide these as raised crossings for further traffic calming. This can be considered as part of local road upgrades. Similarly, there may be the opportunity to reduce corner radii for the carriageway to reduce vehicular turning speeds and reduce pedestrian crossing distances. This may be considered as part of long term maintenance and upgrade works.

All traffic calming methods will be supported by signposted traffic speeds which limit traffic to 50km per hour.

7.12 Future Management

In the medium to long term (5 - 10 years) the tree establishment program is to be monitored, with identified gaps in the tree canopy or sequence to be considered for a new round of planting.

Future management is to address the instance of short term failure of certain trees, and allow future implementation of the strategy to be adjusted to suit.

7.13 Funding

There are ways to contribute in the delivery of the KRS vision which also can be referenced to staging.

Funding contributions include:

1. Developer contributions;
2. The development of City-owned lazy land sites
- A general principle where the contribution of proceeds from the uptake of lazy land sites goes towards nearby KRS delivery; and,
3. Land rationalisation throughout the consolidation of Public Open Space - i.e. Shakespeare Park and Malster Way Park are to be upgraded on the sale and development of Rex Webb, Richardson Way and Aston Way Parks respectively.

7.14 Review

There will be an ongoing responsibility for the City of Karratha to enable appropriate infill which does not compromise the objectives of the Karratha Revitalisation Strategy, specifically the proliferation of crossovers. The application of developers contributions are to subsidise KRS delivery.

Furthermore there is to be recognition that the creation of Local Planning Scheme No.9 and associated rezoning/residential up-coding will precede the completion of the KRS program.



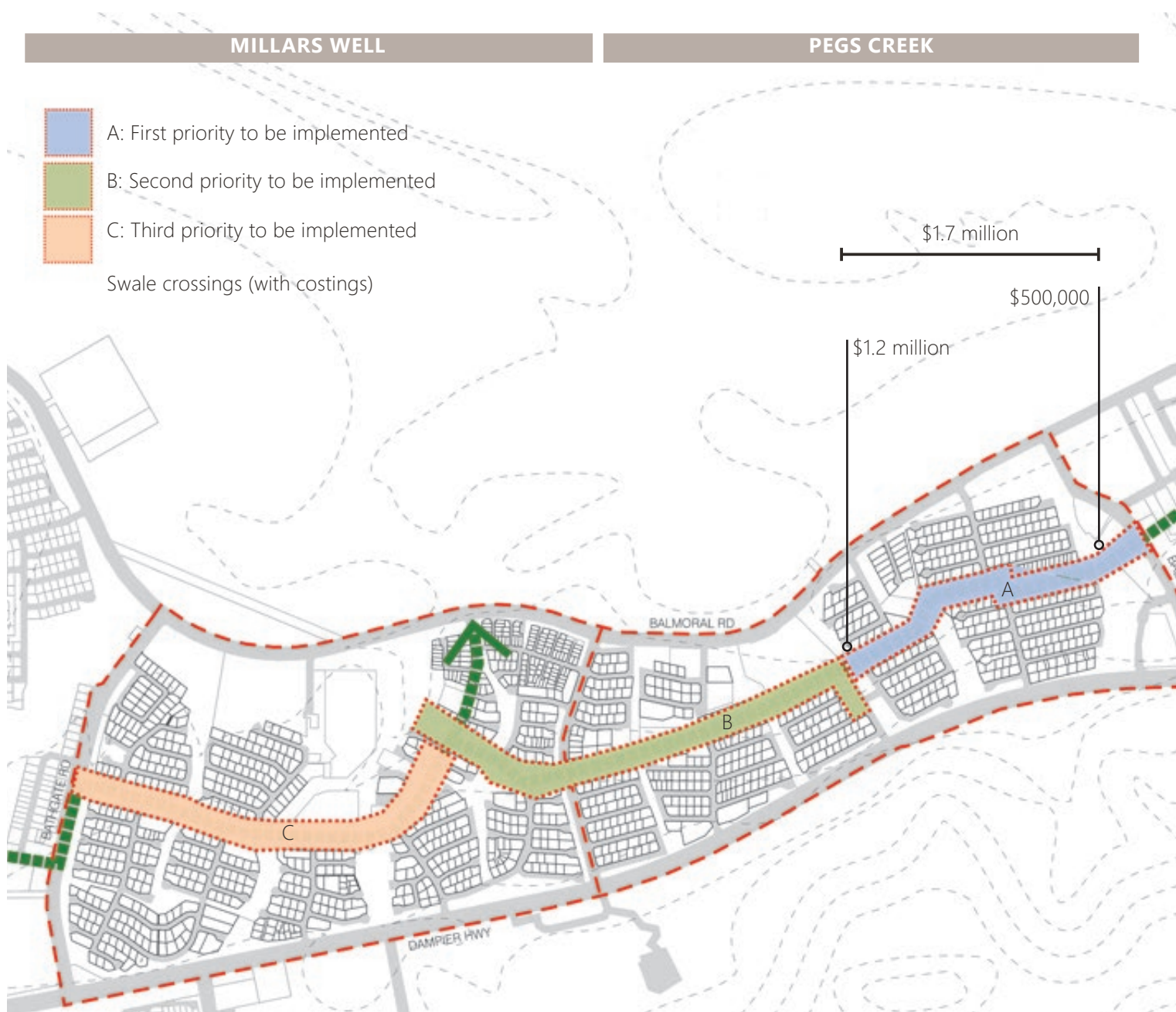


Figure 47. 'The Green Link' Staging Plan

BULGARRA





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9.0 References

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9.1 List of Figures

Figure 1.	KRS Framework	7
Figure 2.	Design Methodology Diagram	9
Figure 3.	Pilbara Vernacular Handbook Summary of Values and Principles	11
Figure 4.	Evidence Based Benefits of Street Trees	14
Figure 5.	Understanding what comprises a streetscape	15
Figure 6.	Evidence Based Factors of Tree Selection Sketches	16
Figure 7.	Sketch of 'trapezoidal' configuration	21
Figure 8.	Existing Street Analysis	22
Figure 9.	A / Existing houses with front interface to street	23
Figure 10.	A / Existing houses with side interface to street	23
Figure 11.	Proposed Street Typologies	24
Figure 12.	Disconnected existing pedestrian network	26
Figure 13.	Concept Plan	29
Figure 14.	The 'Green Link' Context Plan	34
Figure 15.	Proposed view of the 'Green Link'	36
Figure 16.	'The Green Link' Existing Footpath	36
Figure 17.	'The Green Link' typical plan & section and typical dimensions. Scale 1 : 250 @ A4	37
Figure 19.	Residential / Park Typology Plan and Section and typical dimensions, Scale 1 : 250 @ A4	39
Figure 21.	Material details	43
Figure 22.	'Potential Connections' Plan	44
Figure 24.	Swale Crossing Context Plan	46
Figure 25.	Swale Crossings	46
Figure 23.	Swale Crossing Option A	46
Figure 26.	Sketch of Option A - Culvert	47
Figure 27.	Indicative Sketch of Option B - Concrete Causeway	47
Figure 28.	Four way Intersection Context Plan	48
Figure 29.	North / South Streets Context Plan	50
Figure 30.	North / south Plan & Section and typical dimensions	51
Figure 31.	Proposed view of the North / South streets	52
Figure 32.	Local Access Streets Context Plan	54
Figure 33.	Local Access Plan and Section and typical dimensions	55
Figure 34.	Proposed view of the local access streets	56
Figure 35.	Karratha Revitalisation - Policy Strategy 1	60
Figure 36.	Karratha Revitalisation - Policy Strategy 2	61

Figure 37.	Building Typologies Diagram	68
Figure 38.	Shakespeare Street Park Context Plan	73
Figure 39.	Shakespeare Street Park Concept Plan	74
Figure 40.	Section E-E	74
Figure 41.	Shakespeare Street Park Sketches	77
Figure 42.	Section Context Plan	78
Figure 43.	Section F-F	78
Figure 44.	Malster Way Park Context Plan	80
Figure 45.	Malster Way Concept Plan	82
Figure 46.	Section GG	82
Figure 47.	'The Green Link' Staging Plan	90
Figure 48.	Priority Swale Context Plan	103
Figure 49.	Swale Treatment Cameo	105
Figure 50.	Bathgate Road Context Plan	107
Figure 51.	Bathgate Road Context Plan	107
Figure 52.	Bathgate Road Context Plan	117
Figure 53.	Bathgate Road Context Plan	119
Figure 54.	Pegs Creek Primary School Context Plan	121
Figure 55.	Pegs Creek Primary School Context Plan	123

9.2 Image References

Image 1.

Image 1.	Site Photo - UDLA	12
Image 2.	Site Photo - UDLA	13
Image 3.	Site Photo - UDLA	13
Image 4.	Nearmaps	18
Image 5.	Site Photo - UDLA	18
Image 6.	Nearmaps	19
Image 7.	Site Photo - UDLA	19
Image 8.	Nearmaps	19
Image 9.	Site Photo - UDLA	19
Image 10.	Example of new development in Baynton	20
Image 11.	Site Photo - UDLA	20
Image 12.	Nearmaps	21
Image 13.	Site Photo - UDLA	21
Image 14.	Nearmaps	23
Image 15.	Nearmaps	23
Image 16.	Nearmaps	23
Image 17.	Nearmaps	23
Image 18.	Site Photo - UDLA	26
Image 19.	Site Photo - Planning Consultants Australia	26
Image 20.	Site Photo - UDLA	26
Image 21.	Site Photo - UDLA	27
Image 22.	Site Photo - UDLA	27
Image 23.	Site Photo - UDLA	30
Image 24.	Site Photo - UDLA	30
Image 25.	Site Photo - UDLA	30
Image 26.	Site Photo - UDLA	31
Image 27.	Site Photo - UDLA	31
Image 28.	Site Photo - UDLA	36
Image 29.	Nearmaps	36
Image 30.	Site Photo - UDLA	38
Image 31.	Site Photo - UDLA	38

Image 32.	Site Photo - UDLA	40
Image 33.	Top Tropicals	40
Image 34.	Site Photo - UDLA	40
Image 35.	Site Photo - UDLA	41
Image 36.	Site Photo - UDLA	41
Image 37.	Lullfitz Nursery - http://www.lullfitz.com.au/search/factsheet.asp?masterlist_id=260	41
Image 38.	Site Photo - UDLA	42
Image 39.	Site Photo - Planning Consultants Australia	42
Image 40.	Site Photo - UDLA	43
Image 41.	Site Photo - UDLA	43
Image 42.	Site Photo - UDLA	43
Image 43.	Site Photo - UDLA	43
Image 44.	Nearmaps	47
Image 45.	Nearmaps	48
Image 46.	Nearmaps	48
Image 47.	Site Photo - UDLA	50
Image 48.	Nearmaps	52
Image 49.	Site Photo - UDLA	53
Image 50.	Site Photo - UDLA	53
Image 51.	Australian Native Plant Society (Australia) http://anpsa.org.au/e-vic.html	53
Image 52.	Site Photo - UDLA	53
Image 53.	Site Photo - UDLA	54
Image 54.	Nearmaps	56
Image 55.	Site Photo - UDLA	57
Image 56.	Site Photo - UDLA	73
Image 57.	Site Photo - UDLA	73
Image 58.	Site Photo - UDLA	73
Image 59.	Site Photo - Oculus	77
Image 61.	Site Photo - UDLA	77
Image 60.	Site Photo - Oculus	77
Image 62.	Site Photo - UDLA	77
Image 63.	Site Photo - UDLA	78

Image 64.	Landzine - http://www.landzine.com/index.php/2010/12/pedra-tosca-park-by-rcr/rcr-landscape-architecture-pedra-tosca-park-17/	78
Image 65.	Site Photo - UDLA	80
Image 66.	Site Photo - UDLA	80
Image 67.	Site Photo - UDLA	80
Image 68.	Lizard Log Park Picnic Pods - Landzine - http://www.landzine.com/index.php/2013/09/lizard-log-parklands-by-mcgregor-coxall/06-lizard-log-park-picnic-pods/	81
Image 69.	Victoria Park Public Domain - Hassell - http://www.hassellstudio.com/en/cms-projects/detail/victoria-park-public-domain/	81
Image 70.	Kings Park - Site Photo - UDLA	81
Image 71.	Site Photo - CoK	87
Image 72.	Site Photo - CoK	87
Image 73.	Site Photo - CoK	87
Image 74.	Site Photo - UDLA	103
Image 75.	Site Photo - UDLA	103
Image 76.	Site Photo - UDLA	103
Image 77.	Site Photo - UDLA	105
Image 78.	Site Photo - UDLA	105
Image 79.	Site Photo - UDLA	124
Image 80.	Wattles of the Pilbara - http://www.worldwidewattle.com/speciesgallery/descriptions/pilbara/html/coriacea_subsp._pendens.htm	124
Image 81.	Piscasa Web Gallery - http://picasaweb.google.com/lh/photo/1LevgAeIMkIT0BbYqN9Ypw	124
Image 82.	Desert Terrarium - http://www.google.com.au/imgres?imgurl=http://www.exploroz.com/images/blogs/2841_96_TN800x600.jpg%3F_36043&imgrefurl=http://desertterrarium.blogspot.com/&h=535&w=800&tbnid=xmforMjfpkpBXM&zoom=1&tbnh=183&tbnw=275&usq=__2dkJ-Gan0nxxmHpNsu5-KnwO3W0=&docid=qmBYn9JXCicrjM	125



9.0 Annexure







Annex A: Drainage Swales



A. Drainage Swales



Figure 48. Priority Swale Context Plan

A.1 Design Intent

The drainage swales have the potential to be a defining feature within the subject suburbs. The drainage lines connect the hills to the Nickol Bay and are extremely important in directing and slowing water towards the ocean, as well as, filtering out the sediments that in large quantities can choke the nutrient balance and be detrimental to the mangrove and associated marine ecosystem.

The aim is to undertake revegetation to create 'modified' natural creek lines providing passive and recreational amenity for the surrounding communities.

Priority Drainage Swales:

It's recommended that the following generic treatment and revegetation guidelines are applied to the four priority drainage swales.

- Bathgate Road;
- Millars Well Primary School;
- Pegs Creek Primary School; and,
- Karratha Primary School;



Image 74. Existing drainage swale in Millars Well



Image 75. Existing drainage swale in Bulgarra



Image 76. Existing drainage swale in Pegs Creek

A.2 Revegetation Guidelines

The following revegetation notes are intended as a guide only, to promote best practice revegetation and swale improvements.

SITE PREPARATION

Weed Control:

- Spray planting and rock area with a weed control containing glyphosate as the active herbicide ingredient. (Glyphosate is a non-selective and non-residual in the soil. Effective against perennial weeds when applied to the green part of a plant). Apply glyphosate as per manufactures instructions;
- Rip topsoil to loosen dead weeds and prepare topsoil for spread of topsoil/ mulch and supplementary planting; and,
- Spray area again with glyphosate to increase the reduction of weeds and reduce the likelihood of weeds re germinating, as per manufactures instructions.

Grading of Swale:

- Ensuring that there are no obstructions to the low flow line, maintain the minor variation of swale grade as is to provide a more natural appearance, similar to a Pilbara creek line.

Water:

- Water in batter of swale prior to spread of topsoil/mulch and planting, or if rare timing opportunity arises align with rainfall.

PROPOSED WORKS

Stockpiled Rocks / Topsoil

In an ideal scenario, stockpiled rocks are recommended to be spread along the base of the swale and 1-2m along the internal lip of swale batter. The following notes apply to the best case scenario, however it is recognised that this is a large area, and therefore not feasible. Therefore rocks should be spread in focused areas to stop water scouring. Focus areas may include areas that are:

- highly susceptible to erosion;
- near culverts;
- near footpaths;
- near road crossings; and,
- other highly visible areas.

Stockpiled rocks

Stockpiled rocks to be separated into two sizes and spread as follows:

- Spread rocks to the base of swale and 1m batter of swale. Ensure low flow line throughout the swale is maintained. Priority should be given to areas around the culverts and areas showing signs of erosion.

Large Rocks

- If available, large rocks can be placed as features along top of batter and within swale batter. Place rocks in groups of 2 - 3 rocks, approximately every 20m either side of swale. However placement must not impede water flow path. If quantity of large rocks allows, place extra rocks along path as informal seating opportunity.

Stockpiled Topsoil

- Spread stockpiled topsoil and mulch mix - refer to locations shown on plan. Topsoil / mulch mix shall be spread to a depth of approximately 200mm. Maintain chunkiness / large particle size. This will cause the depth to vary, which is acceptable;
- Once top soil and mulch spreading is completed, area should be watered in to promote growth of seed bank and stop the spread of dust; and,
- Top soil and mulch / planting area should not be compacted with a roller.

Supplementary Tubestock Planting

- Assist revegetation of soil seed bank with supplementary tree tubestock planting using endemic species;
- Plant in groups of 10+ in approximately 30m spacing; and,
- Its recommended that tree planting should primarily occur in the swale profile, similar to a natural Pilbara Creekline. This allows low understorey planting along the top of batters, reducing maintenance inputs and potential fire hazards.

Table 13. Drainage Swale Design Elements

PUBLIC OPEN SPACE TYPE	DRAINAGE SWALE
Function	Linear corridor that comprises a combination of retained existing vegetation, drainage lines, low vegetated buffer along top of batter, pedestrian paths and respite areas for passive recreation
Size	Varies
Accessibility	400m
Edge Conditions	Clear views from roads and path ways Low vegetation and scattered clumps of trees along property boundaries
Design Conditions	Retained and supplemented local vegetation
Planting	Retained and supplemented local vegetation
Drainage	Retain drainage profile and revegetate
Lighting	Security lighting
Furniture	Opportunity for robust seating to provide respite areas. Large flat and smooth rock boulders, 1/3 buried in groups
Signage	Potential for themed interpretative signage for education purposes as well as way finding



Image 77. Stockpiled rocks to base and side of swale



Image 78. Stockpiled mulch and topsoil. Retain large particle size

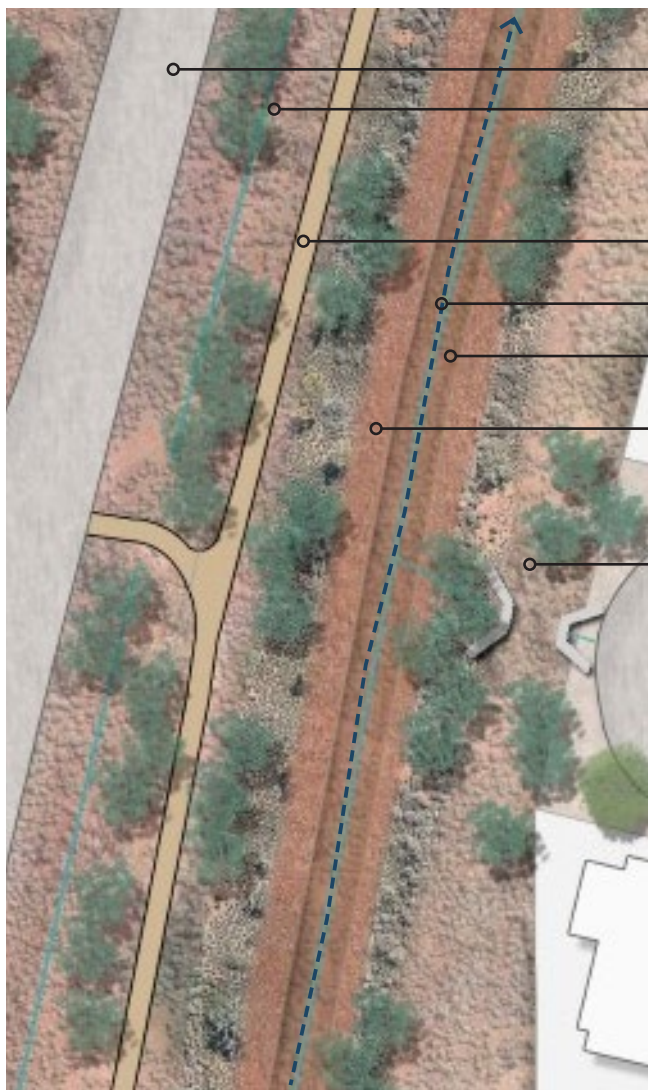


Figure 49. Swale Treatment Cameo

- Road
- Clumps of supplementary tree planting
- Path
- Drainage line
- Base of swale stockpiled rocks
- Stockpiled rocks along side slope of swale to minimise erosion
- Low understorey planting along the top batters of swale / adjacent to property boundaries to reduce maintenance inputs and potential fire hazard

Partnership with local construction project

If available work with local construction site and utilise stockpiled topsoil / rocks from best practice site clearing by:

- Site slashing and stock piling of existing vegetation
- Removal and stockpile of spinifex profile and top 100mm of topsoil. Stockpile topsoil / mulch mix including endemic seedbank, as well as rocks, for use at Pegs Creek Primary School site.
- This best practice revegetation practice will help mitigate sediment transportation, erosion and encourage local species re-vegetation.

Precedent project: Stage 1 Mulataga

Corner of Millstream and Maitland Road



A.3 Priority Swale - Bathgate Road



Figure 50. Bathgate Road Context Plan



Figure 51. Bathgate Road Context Plan



Priority Swale - Bathgate Road L01
Scale 1 : 1000 @ A3





0 10 20 30 50m



LEGEND

-  Existing House
-  Road
-  Proposed Tree - The Green Link
-  Proposed Tree - Minor Streets
-  Proposed Trees - Swale
-  Culvert
-  Path
-  Swale Crossing
-  Swale - Stockpiled rocks
-  Swale - Stockpiled mulch



Priority Swale - Bathgate Road L02

Scale 1 : 1000 @ A3

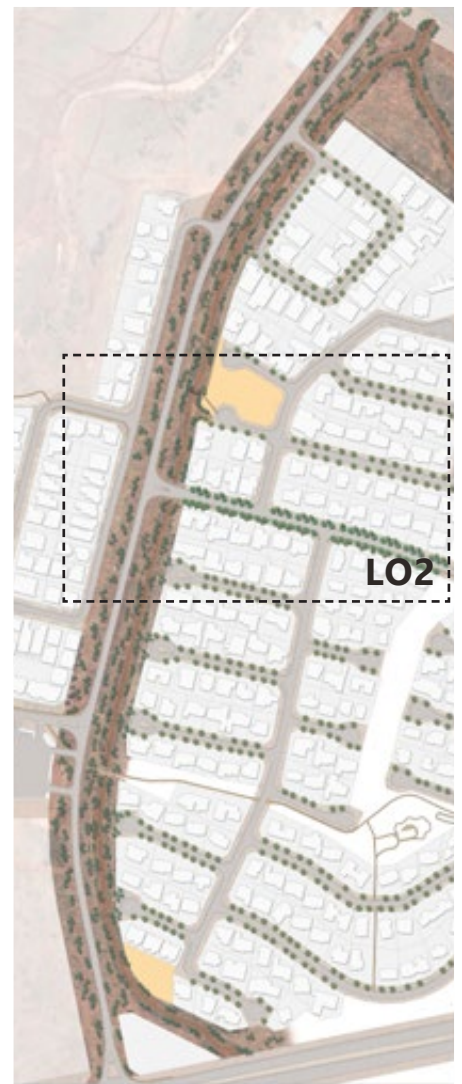




N WAY
AL INFILL

RT

0 10 20 30 50m



LEGEND

-  Existing House
-  Road
-  Proposed Tree - The Green Link
-  Proposed Tree - Minor Streets
-  Proposed Trees - Swale
-  Culvert
-  Path
-  Swale Crossing
-  Swale - Stockpiled rocks
-  Swale - Stockpiled mulch



Priority Swale - Bathgate Road L03

Scale 1 : 1000 @ A3





0 10 20 30 50m



LEGEND

-  Existing House
-  Road
-  Proposed Tree - The Green Link
-  Proposed Tree - Minor Streets
-  Proposed Trees - Swale
-  Culvert
-  Path
-  Swale Crossing
-  Swale - Stockpiled rocks
-  Swale - Stockpiled mulch



Priority Swale - Bathgate Road L04

Scale 1 : 1000 @ A3





0 10 20 30 50m



LEGEND

-  Existing House
-  Road
-  Proposed Tree - The Green Link
-  Proposed Tree - Minor Streets
-  Proposed Trees - Swale
-  Culvert
-  Path
-  Swale Crossing
-  Swale - Stockpiled rocks
-  Swale - Stockpiled mulch



Priority Swale - Millars Well Primary School South L01
Scale 1 : 1000 @ A3





A.4 Priority Swale - Millars Well Primary School South



Figure 52. Bathgate Road Context Plan

LEGEND

-  Existing House
-  Road
-  Proposed Tree - The Green Link
-  Proposed Tree - Minor Streets
-  Proposed Trees - Swale
-  Culvert
-  Path
-  Swale Crossing
-  Swale - Stockpiled rocks
-  Swale - Stockpiled mulch



Priority Swale - Millars Well Primary School South L02

Scale 1 : 1000 @ A3





0 10 20 30 50m



Figure 53. Bathgate Road Context Plan

LEGEND

-  Existing House
-  Road
-  Proposed Tree - The Green Link
-  Proposed Tree - Minor Streets
-  Proposed Trees - Swale
-  Culvert
-  Path
-  Swale Crossing
-  Swale - Stockpiled rocks
-  Swale - Stockpiled mulch



Priority Swale - Pegs Creek Primary School South L01

Scale 1 : 1000 @ A3





A.5 Priority Swale - Pegs Creek Primary School South

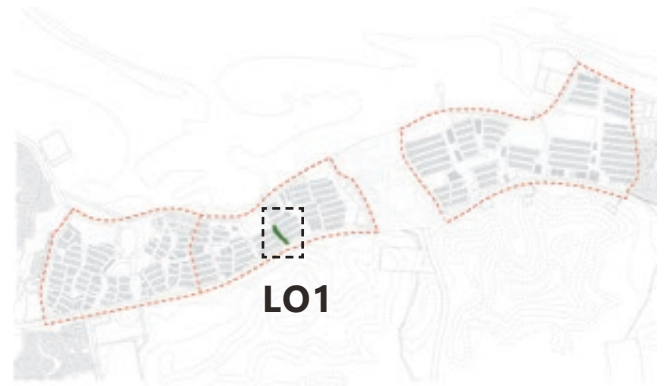


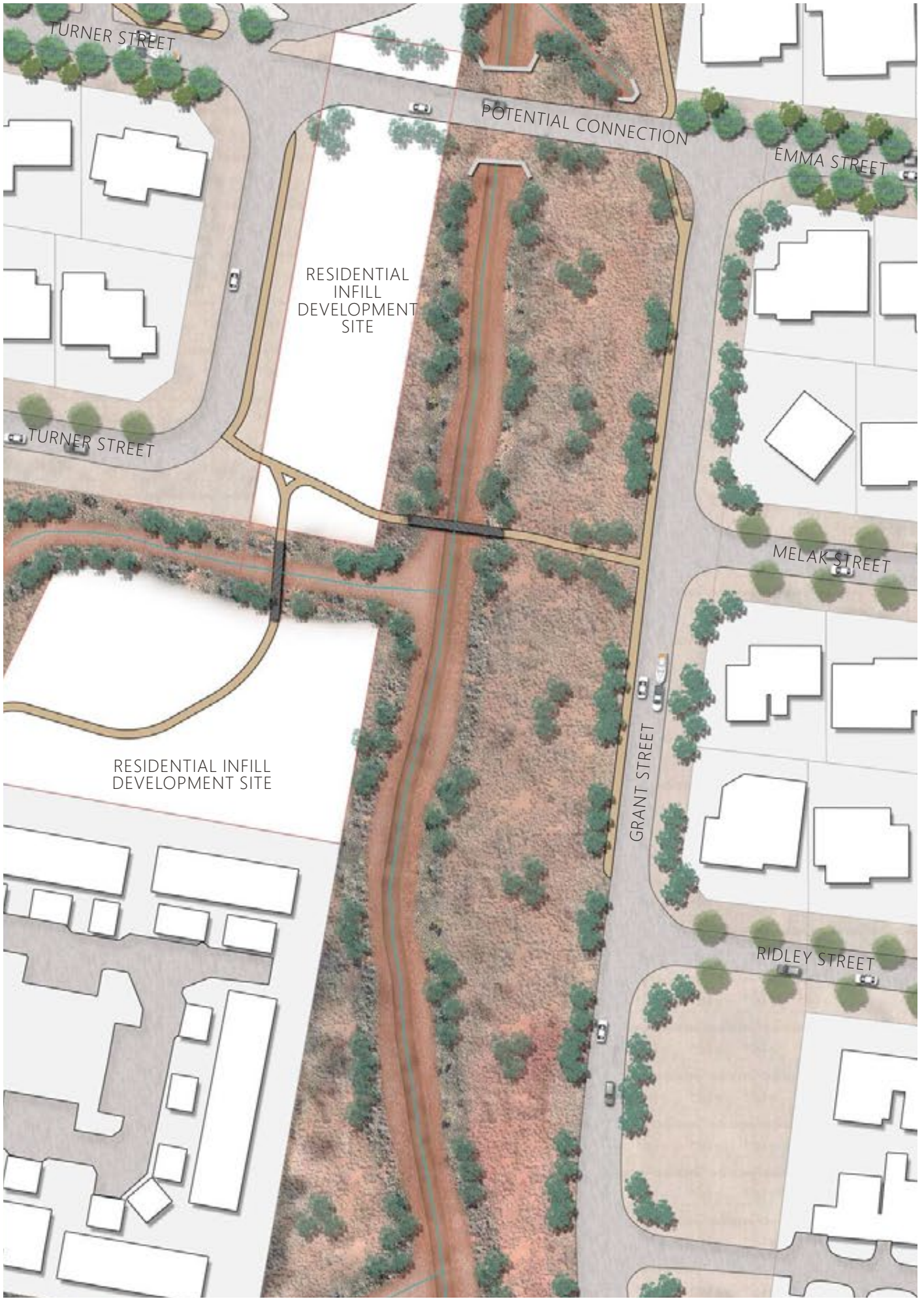
Figure 54. Plan

Pegs Creek Primary School Context

LEGEND

-  Existing House
-  Road
-  Proposed Tree - The Green Link
-  Proposed Tree - Minor Streets
-  Proposed Trees - Swale
-  Culvert
-  Path
-  Swale Crossing
-  Swale - Stockpiled rocks
-  Swale - Stockpiled mulch

0 10 20 30 50m



Priority Swale - Karratha Primary School South L01

Scale 1 : 1000 @ A3



A.6 Priority Swale - Karratha Primary School South



Figure 55. Pegs Creek Primary School Context Plan

LEGEND

-  Existing House
-  Road
-  Proposed Tree - The Green Link
-  Proposed Tree - Minor Streets
-  Proposed Trees - Swale
-  Culvert
-  Path
-  Swale Crossing
-  Swale - Stockpiled rocks
-  Swale - Stockpiled mulch

7.7 Park and Drainage Swale Suggested Planting Palette



Image 79. *Corymbia hamersleyana*



Image 80. *Acacia coriacea*



Image 81. *Brachychiton acuminatus*

FACTOR	SUITABILITY
Shade	Yes dappled shade
Availability	7m H x 9m W
Suitability as a street tree	Tree (rarely a mallee)
Size	Yes
Form	NW WA. Drainage lines, stony hillsides and plains
Proven Performance as street tree	Yes
Tolerate climatic conditions	Contract grow
Origin	Parks, Drainage Swale and Revegetation

FACTOR	SUITABILITY
Shade	With adequate water it will become a shade tree
Size	1 - 10m H
Form	Shrub or tree. Prune lower branches to create a dense overhead crown
Tolerate climatic conditions	Yes
Origin	NW WA. Coastal dunes & ridges, sand plains, along rivers & creeks.
Aboriginal use	Yes
Propagation	Contract grow
Use	Parks, Drainage Swale and Revegetation

FACTOR	SUITABILITY
Shade	Yes. <i>Brachychiton</i> do shed their leaves once a year and lower branches need to be pruned initially to create a nice overhead crown.
Availability	20m H x 10m W
Suitability as a street tree	Specimen
Size	Yes
Form	NW WA. Rock outcrops, rocky scarps, rugged hills & ranges
Proven Performance as street tree	Yes
Tolerate climatic conditions	Contract grow
Origin	Parks, Drainage Swales, Revegetation



Image 82. *Owenia reticulata*

FACTOR	SUITABILITY
Shade	Yes as a specimen tree
Availability	4 - 14m H
Suitability as a street tree	Specimen
Size	Yes
Form	NW WA. Stony ridges, red sand dunes, plains.
Proven Performance as street tree	Yes
Tolerate climatic conditions	Contract grow
Origin	Parks, Drainage Swales, Revegetation



Annex B: Engineering Drawings





WOOD & GRIEVE ENGINEERS

ENQUIRIES: VIVIENNE EDWARDS
PROJECT NO: 27875-PER-C

17 July 2015

Essential Environmental
622 Newcastle Street
LEEDERVILLE WA 6007

Attention: Helen Brookes

Dear Helen

**RE: KARRATHA REVITALISATION STRATEGY
STAGE 2 – SPINE ROAD
ESTIMATE OF DEVELOPMENT COSTS**

Please find attached the estimate of development costs for the above project. This estimate is based on the Karratha Revitalisation Strategy (KRS) Stage 2 Workshop 2 Draft Concept Plan prepared by UDLA dated 24 June 2015 and the WGE Concept Plans dated 17 July 2015 (attached). Some points of which you need to be aware when using this estimate are as follows:

Staging

Due to the fragmented land ownership, differing physical locations of each connection and nature of likely funding arrangements of this project, we have costed each connection as being undertaken on a stand-alone basis.

Groundwater Levels

This estimate does not make an allowance for treatment of groundwater during construction as it is recommended that these structures are constructed outside of the wet season.

We do not have any information regarding groundwater levels and we recommend that you engage a specialist consultant to confirm groundwater levels in the area in order that the costs may be more accurately defined.

Earthworks

We have made a nominal allowance for minor earthworks to the proposed road pavement areas.

We recommend that you engage a specialist consultant to undertake a geotechnical report of this area and provide advice regarding the geotechnical conditions for each site.

We have made an allowance for clearing to the proposed road pavement are, we have not made an allowance for obtaining a Clearing Permit for these works or complying with the requirements of such a

To us, it's more than just work

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Phone +61 8 6222 7000 Fax +61 8 6222 7100 Email wge@wge.com.au www.wge.com.au
Wood & Grieve Engineers Limited ACN 137 999 609 trading as Wood & Grieve Engineers ABN 97 137 999 609
Albany • Brisbane • Busselton • Darwin • Melbourne • Perth • Shenzhen (China) • Sydney

Page 1 of 4



permit. We recommend seeking the advice of an environmental consultant regarding existing vegetation and fauna.

Stormwater Drainage

We have made a nominal allowance for culvert installation at each nominated drainage crossing location. These culverts have been preliminarily sized as directed by the City of Karratha, based on the 100 year flows and top water levels detailed within JDA's "Lazy Lands, Karratha 2D Flood Study & Local Water Management Framework" dated April 2013.

Given the limited nature of data in this report we have utilised downstream 100 year flow values and have scaled indicative 100 year top water levels.

Given that the installation of culverts to existing drainage corridors will likely change the flow characteristics, we recommend that further drainage modelling be undertaken of the proposed scenario.

We have made an allowance for a pedestrian balustrade to be installed to the top of the culvert outside the vehicular clear zone area.

With respect to proposed Connection E, our estimate assumes the culvert and Karratha Tce extension works to the eastern side of the drainage reserve being undertaken within the Karratha City Centre Infrastructure Works Project.

Roadworks

Our roadworks estimate assumes a standard kerbed and asphalt roadway to City of Karratha standards. If you require a different standard of roadworks, please advise us and we will revise the estimate accordingly.

Footpaths

Our estimate does not make any allowance for footpath treatments.

Underground Power

Our underground power estimate assumes that supply for streetlights to proposed roadways will come from an existing pillar assumed to have been constructed within the PUPP works. Should these works precede the PUPP works then additional power works will be required to provide a power connection.

We advise that power supply arrangements are unable to be confirmed until the development formally proceeds and we request a Design Information Package from Horizon Power.

No allowance has been made for any Horizon Power system charge payment.

Concrete Causeway

We note your request for a costing for the installation of temporary concrete causeway structures in the interim of the full connection treatment.

We confirm our previous concerns regarding concrete causeway installation in that such a treatment would direct traffic through a significant drainage conveyance route and would as such pose a significant safety hazard, even if signed to alert vehicles.

A temporary concrete causeway treatment would result in a significant amount of redundant concrete being required to be removed at a later date when the ultimate culvert scenario is installed and would therefore result in additional project costs.

We estimate that an indicative temporary concrete causeway treatment would cost in the order of \$650,000 (exc GST) per crossing.

Geotechnical Issues

It is possible there may be geotechnical issues associated with these works and we strongly suggest you engage a specialist consultant to investigate this.

Environmental Issues

It is possible there may be environmental issues associated with these works and we strongly suggest you engage a specialist consultant to investigate this.

Ethnographic Issues

It is possible there may be ethnographic issues associated with these works and we strongly suggest you engage a specialist consultant to investigate this.

Acid Sulfate Issues

We have made no allowance to treat Acid Sulfate Soils. We recommend that specialist advice be sought in this regard to determine treatment of acid sulphate soils and the resulting dewatered effluent.

Landscaping

Our estimate does not include any allowance for landscaping or estate betterment and we recommend you seek advice from a specialist consultant in this regard.

Design and Approvals

Our cost estimate is based on preliminary, notional designs. These are subject to change due to local and other authorities' requirements and conditions, detailed design and formal approvals.

Construction Costs

Our estimate has been prepared using current construction rates for similar works. We do not have any information regarding the future movement of rates and these may change due to changed material or labour prices and conditions at the time of tender.

Professional Fees

We have not made an allowance for professional fees within our estimate.

GST

Our estimate makes allowance for the effects of a goods and services tax.

Risks

An estimate of engineering costs is based on a number of assumptions at the time of preparation. As such, a number of inherent risks which may change the estimate exist. Some of these may include the following:

- Changes to the planning approval of the subdivision may change the layout, stage timing or scope of works.
- Proceeding through the design process may entail changes to the nature and scope of elements required from the initial preliminary designs assumed here.

- Authorities may impose additional requirements or change design parameters from those assumed.
- Construction rates and material costs at the time of tender may be different to rates assumed.
- Infrastructure requirements or design parameters may change.
- The geotechnical nature of the site may prove to be different than assumed.
- Issues regarding groundwater, contamination, or the environment may change assumptions or add additional elements to the works.
- Other normal commercial and/or legislative risks exist.

General

The estimate makes no allowance for the following:

- acquisition cost of the land
- holding costs
- legal costs
- cost escalation

We understand you intend to use this estimate for the purposes of checking the feasibility of proceeding with the proposed works. If the estimate is used for purposes other than this without our knowledge, then we cannot accept responsibility for any claims or actions which may arise as a result.

This estimate has been completed in accordance with the agreed Terms of Agreement.

Please ensure that a copy of this letter is always attached to the estimate.

If you have any queries, please do not hesitate to contact the undersigned.

Yours faithfully



Vivienne Edwards
for **Wood & Grieve Engineers**

Encl (Estimate, Plans)

DOCUMENT IN 2499.XLS (KM)

Karratha Revitalisation Strategy - Stage 2							
Spine Road Connection Estimates							
17-July-2015							
	A2	B	C	D	E	G2	H
Preliminaries	\$200,000.00	\$200,000.00	\$200,000.00	\$300,000.00	\$150,000.00	\$200,000.00	\$200,000.00
Siteworks & Dust Control	\$100,000.00	\$100,000.00	\$100,000.00	\$100,000.00	\$60,000.00	\$100,000.00	\$100,000.00
Demolition of Existing Structures	\$20,000.00	\$20,000.00	\$20,000.00	\$40,000.00	\$20,000.00	\$60,000.00	\$40,000.00
Adjustment of Existing Services	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Clearing	\$1,500.00	\$1,200.00	\$1,200.00	\$3,000.00	\$700.00	\$1,500.00	\$1,500.00
Import Fill	\$4,816.00	\$3,784.00	\$4,128.00	\$11,008.00	\$2,752.00	\$4,472.00	\$4,644.00
Earthworks QA	\$5,000.00	\$5,000.00	\$5,000.00	\$5,000.00	\$5,000.00	\$5,000.00	\$10,000.00
Reroute Drain	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$32,400.00
Subgrade Preparation	\$6,020.00	\$4,730.00	\$5,160.00	\$13,760.00	\$3,440.00	\$5,590.00	\$5,805.00
200mm Subbase	\$18,060.00	\$14,190.00	\$15,480.00	\$41,280.00	\$10,320.00	\$16,770.00	\$17,415.00
200mm Basecourse	\$25,284.00	\$19,866.00	\$21,672.00	\$57,792.00	\$14,448.00	\$23,478.00	\$24,381.00
Primer Coat	\$2,648.80	\$2,081.20	\$2,270.40	\$6,054.40	\$1,513.60	\$2,459.60	\$2,554.20
Primer Seal	\$5,658.80	\$4,446.20	\$4,850.40	\$12,934.40	\$3,233.60	\$5,254.60	\$5,456.70
Sealing Crew Mobilisation	\$10,000.00	\$10,000.00	\$10,000.00	\$10,000.00	\$10,000.00	\$10,000.00	\$10,000.00
AC10	\$22,792.00	\$17,908.00	\$19,536.00	\$52,096.00	\$13,024.00	\$21,164.00	\$21,978.00
AC Mobilisation	\$5,000.00	\$5,000.00	\$5,000.00	\$5,000.00	\$5,000.00	\$5,000.00	\$5,000.00
Tie Ins to Existing Pavement	\$10,000.00	\$10,000.00	\$10,000.00	\$15,000.00	\$10,000.00	\$10,000.00	\$15,000.00
Driveway Reconstruction	\$15,000.00	\$30,000.00	\$0.00	\$0.00	\$0.00	\$75,000.00	\$0.00
Semi-mountable Kerb	\$8,680.00	\$6,820.00	\$7,440.00	\$19,840.00	\$4,960.00	\$8,060.00	\$8,370.00
Linemarking & Signage	\$30,000.00	\$30,000.00	\$30,000.00	\$60,000.00	\$15,000.00	\$30,000.00	\$45,000.00
Trim Verges	\$5,600.00	\$4,400.00	\$4,800.00	\$12,800.00	\$3,200.00	\$5,200.00	\$5,400.00
Roadworks QA	\$5,000.00	\$5,000.00	\$5,000.00	\$10,000.00	\$5,000.00	\$5,000.00	\$5,000.00
Streetlights	\$15,000.00	\$15,000.00	\$15,000.00	\$30,000.00	\$10,000.00	\$15,000.00	\$20,000.00
Streetlight Cable	\$2,800.00	\$2,200.00	\$2,400.00	\$6,400.00	\$1,600.00	\$2,600.00	\$2,700.00
Excavation	\$5,740.00	\$4,510.00	\$4,920.00	\$13,120.00	\$3,280.00	\$5,330.00	\$5,535.00
Connection to existing power	\$10,000.00	\$10,000.00	\$10,000.00	\$30,000.00	\$10,000.00	\$10,000.00	\$10,000.00
Testing	\$5,000.00	\$5,000.00	\$5,000.00	\$10,000.00	\$5,000.00	\$5,000.00	\$5,000.00
QA	\$5,000.00	\$5,000.00	\$5,000.00	\$5,000.00	\$5,000.00	\$5,000.00	\$5,000.00
Power Crew Mobilisation	\$15,000.00	\$15,000.00	\$15,000.00	\$15,000.00	\$15,000.00	\$15,000.00	\$15,000.00
Culverts	\$400,000.00	\$400,000.00	\$400,000.00	\$1,080,000.00	\$0.00	\$480,000.00	\$400,000.00
Kerb Opening	\$0.00	\$20,000.00	\$0.00	\$20,000.00	\$20,000.00	\$0.00	\$20,000.00
Contingency	\$100,000.00	\$100,000.00	\$100,000.00	\$100,000.00	\$75,000.00	\$100,000.00	\$100,000.00
Sub-Total	\$1,059,599.60	\$1,071,135.40	\$1,028,856.80	\$2,085,084.80	\$482,471.20	\$1,231,878.20	\$1,143,138.90
GST	\$105,959.96	\$107,113.54	\$102,885.68	\$208,508.48	\$48,247.12	\$123,187.82	\$114,313.89
Total (inc GST)	\$1,165,559.56	\$1,178,248.94	\$1,131,742.48	\$2,293,593.28	\$530,718.32	\$1,355,066.02	\$1,257,452.79
This estimate shall be read in conjunction with covering our letter dated 17 July 2015.							



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PLAN
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REV.	DESCRIPTION	DATE	DRAWN	VER	APPROVED
A	ORIGINAL ISSUE				



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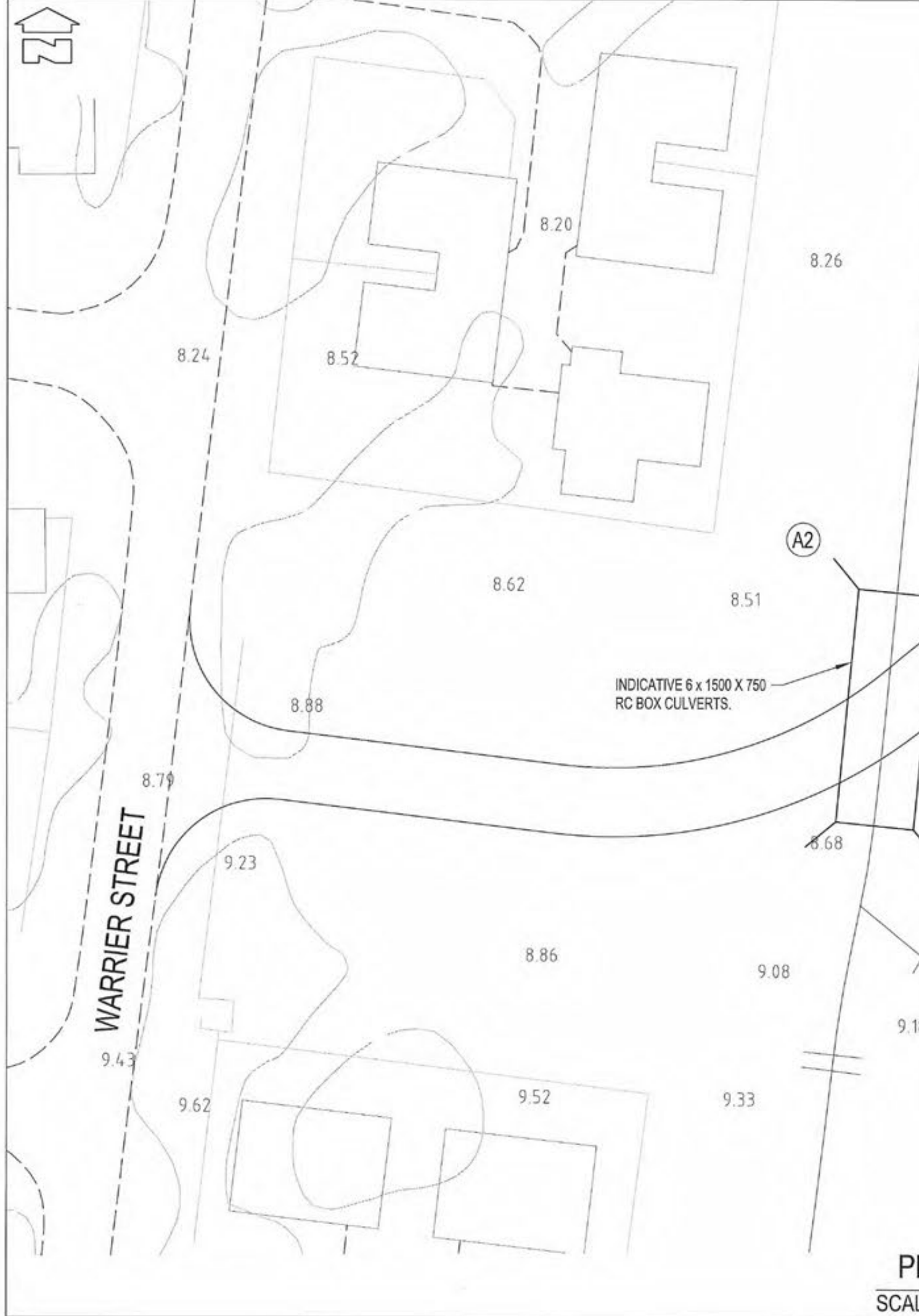
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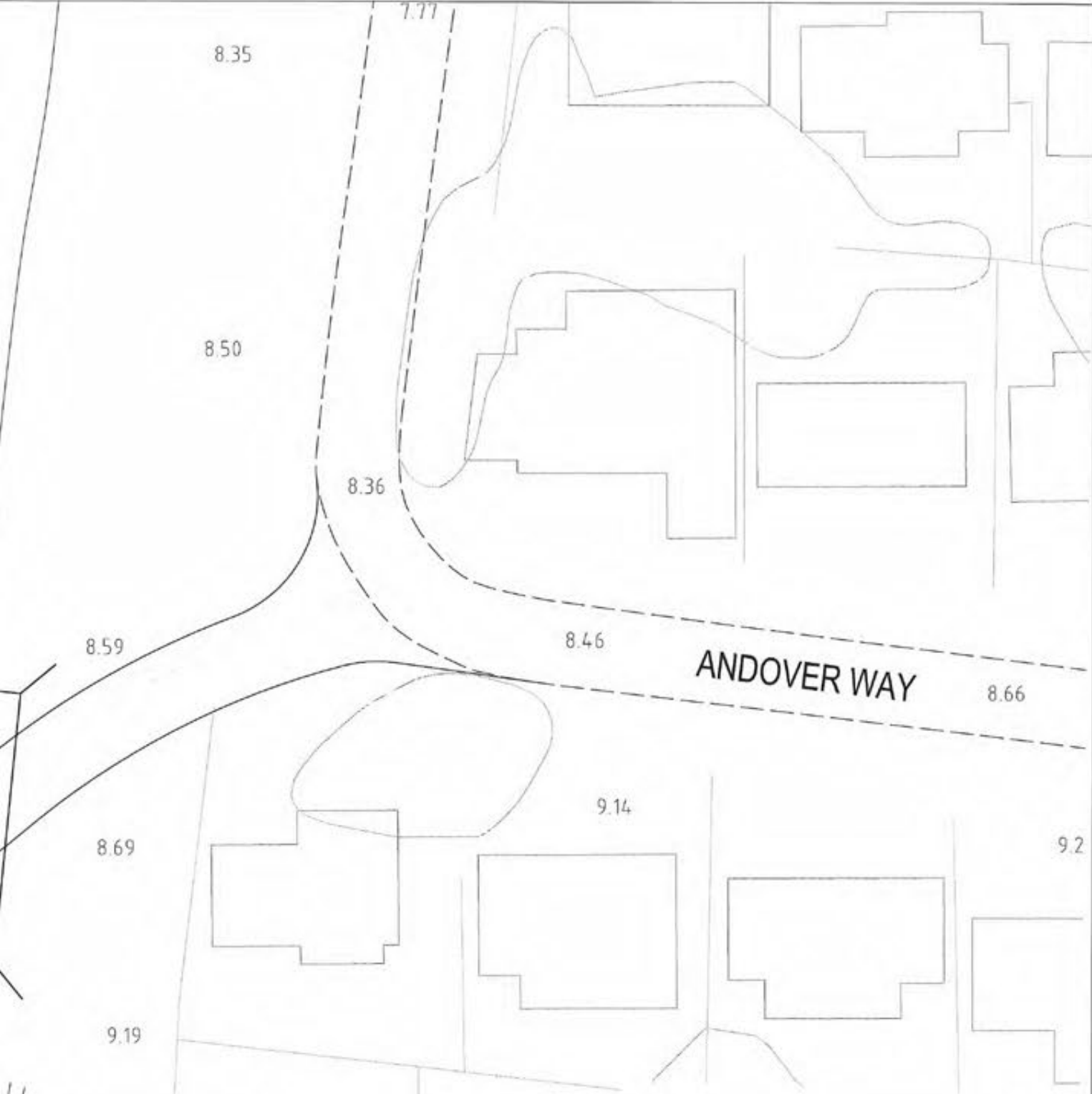
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ESSENTIAL ENVIRONMENTAL
PROJECT:
KARRATHA - REVITALISATION STAGE 2 SPINE ROAD
TITLE:
OVERALL CONCEPT PLAN

CONCEPT ISSUE

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DRAWN: N. HERNANDEZ	APPROVED FOR CONSTRUCTION:	WAPC: -

PROJECT No. 27875-PER-C	DRAWING No. SK1	REVISION A
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PLAN
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NAME: NHERNANDEZ
DESIGNED: NHERNANDEZ
DRAWN: NHERNANDEZ
CHECKED: NHERNANDEZ
DATE: 17/7/15

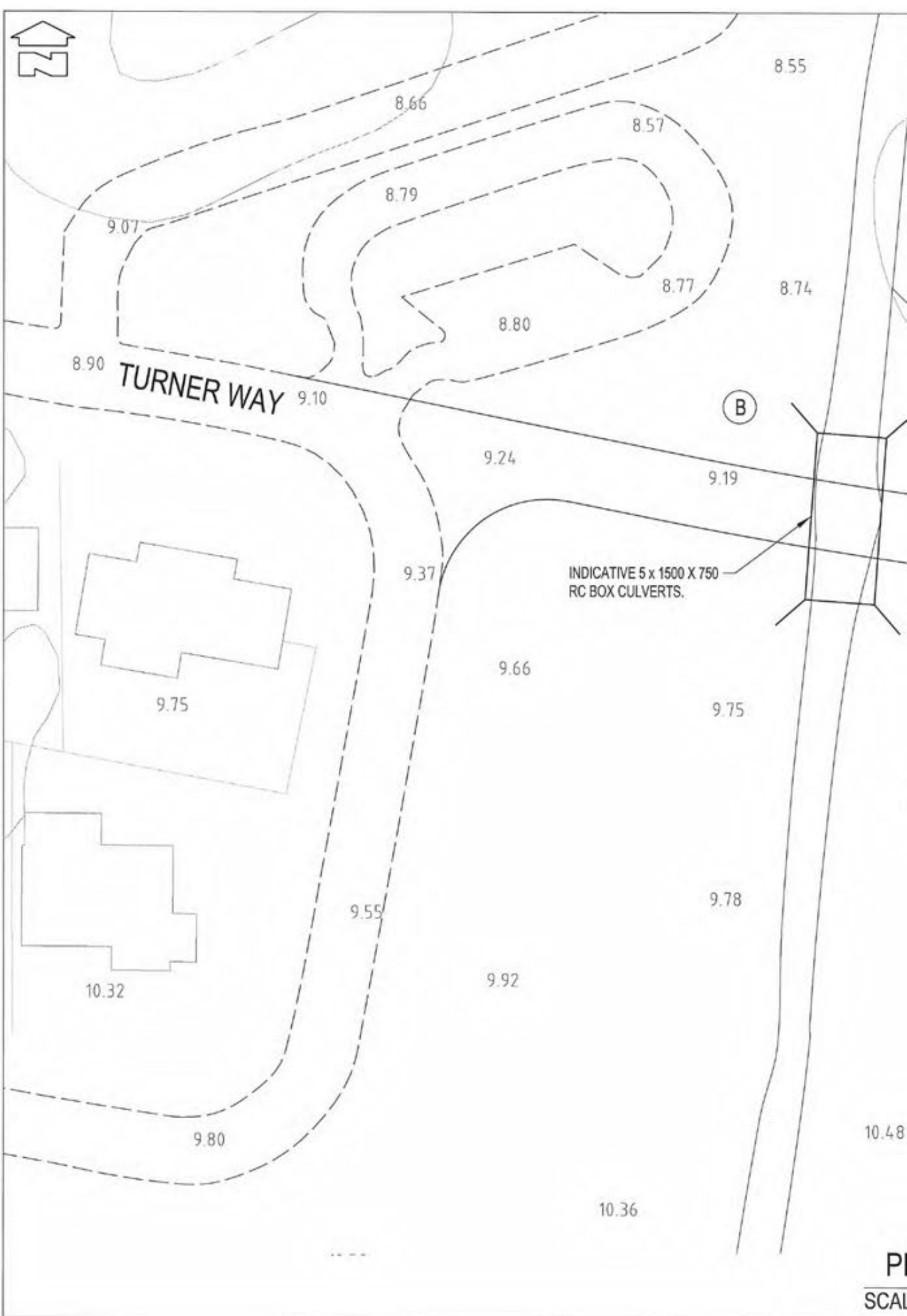
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PROJECT:
KARRATHA - REVITALISATION STAGE 2 SPINE ROAD
TITLE:
CONNECTION A2 PLAN

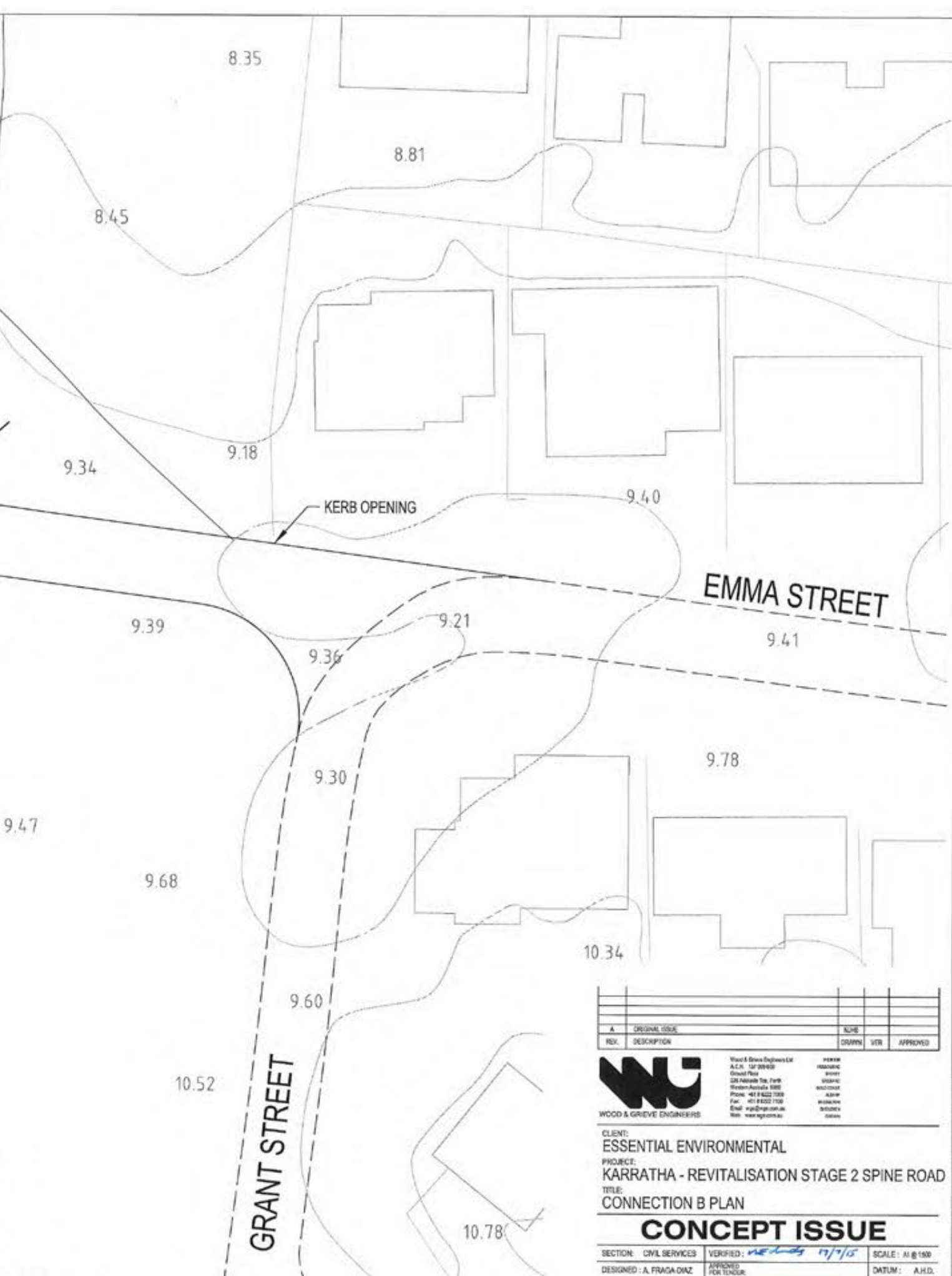
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DRAWN: N.HERNANDEZ	APPROVED FOR CONSTRUCTION:	WAPC: -

PROJECT No. 27875-PER-C	DRAWING No. SK2	REVISION A
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CLIENT:
ESSENTIAL ENVIRONMENTAL
PROJECT:
KARRATHA - REVITALISATION STAGE 2 SPINE ROAD
TITLE:
CONNECTION B PLAN

CONCEPT ISSUE

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DRAWN: N. HERNANDEZ	APPROVED FOR CONSTRUCTION:	WAPC: -

PROJECT No. 27875-PER-C	DRAWING No. SK3	REVISION A
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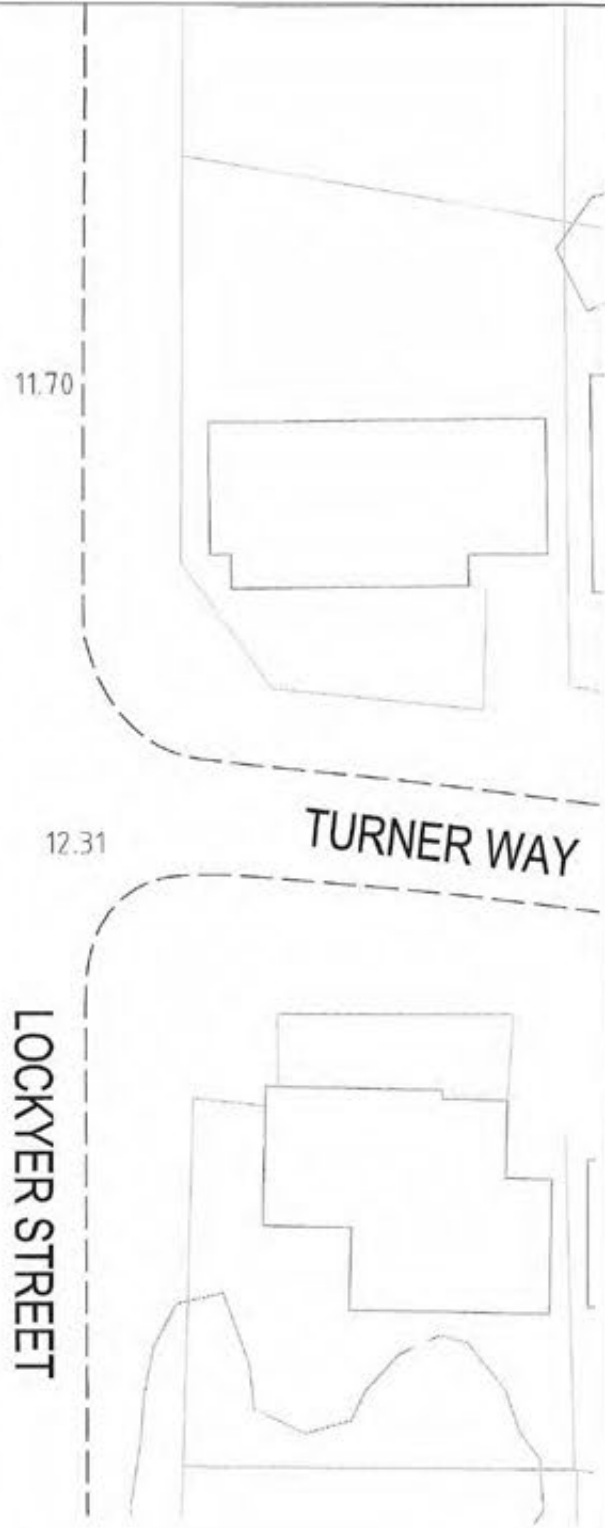
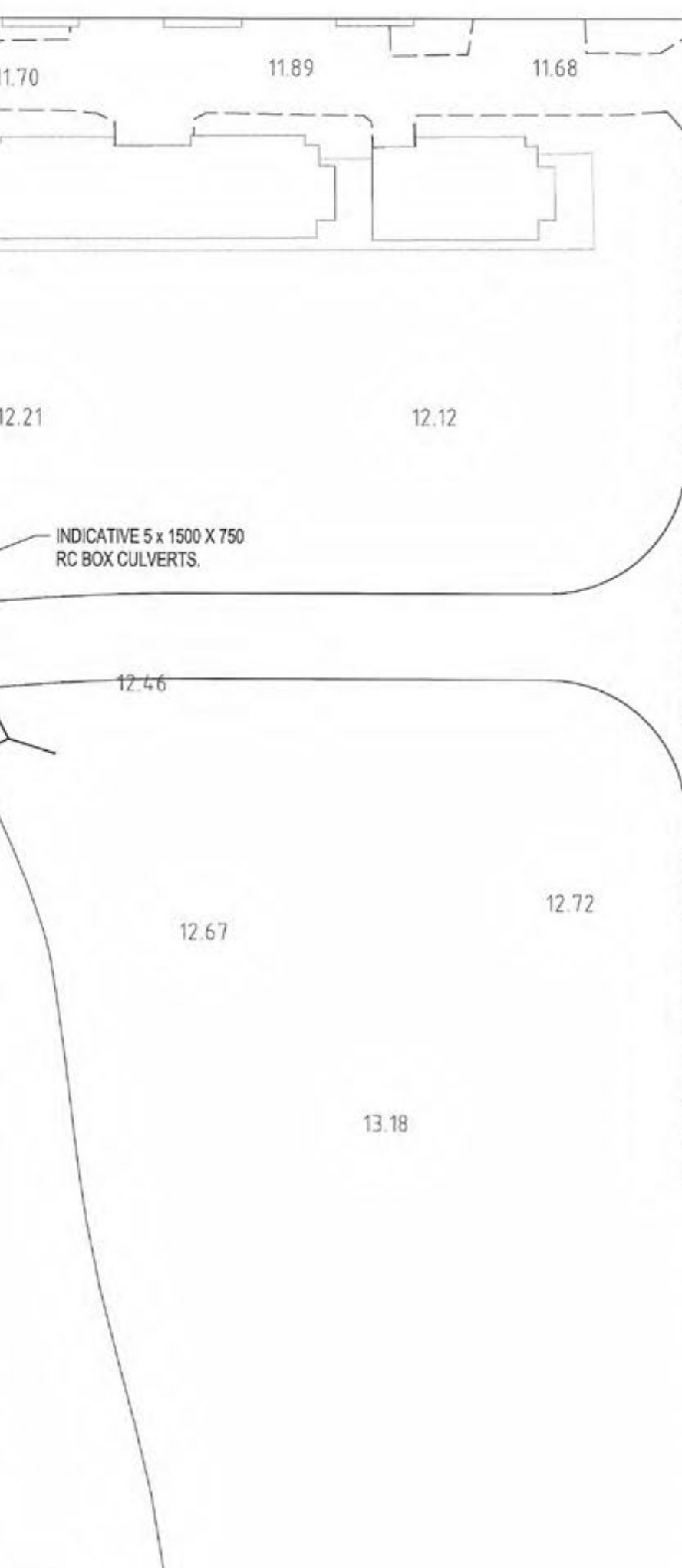
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CLIENT: ESSENTIAL ENVIRONMENTAL
 PROJECT: KARRATHA - REVITALISATION STAGE 2 SPINE ROAD
 TITLE: CONNECTION C PLAN

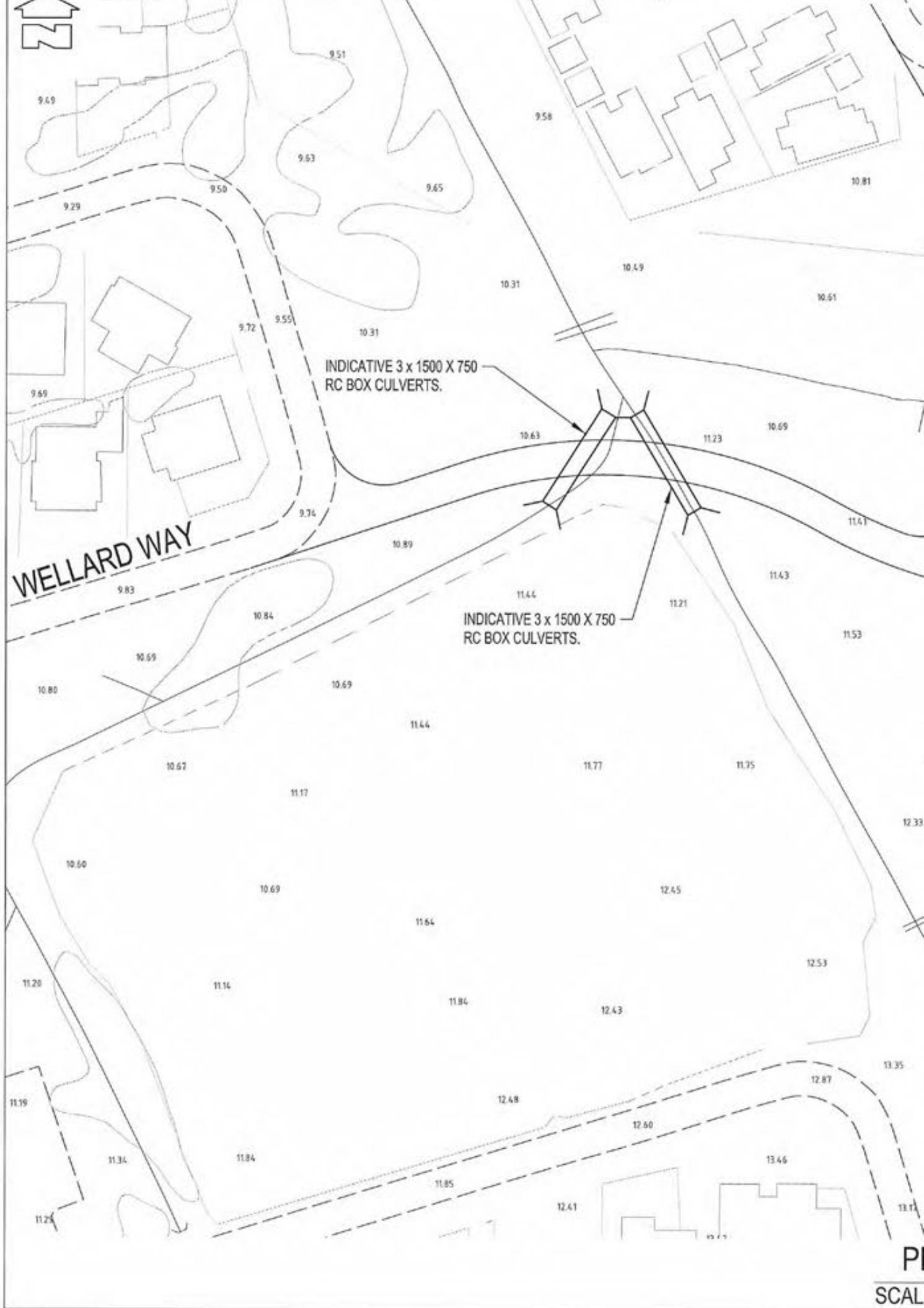
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DRAWN: N. HERNANDEZ	APPROVED FOR CONSTRUCTION:	WAPC: -

PROJECT No. 27875-PER-C	DRAWING No. SK4	REVISION A
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INDICATIVE 7 x 1200 X 450 RC BOX CULVERTS.

KERB OPENING

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REV.	DESCRIPTION	DATE	DRAWN	VER.	APPROVED
A	ORIGINAL ISSUE				



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PERM
 PLANNING
 CIVIL
 STRUCT
 ROAD CIVIL
 ASSESS
 SURVEYING
 WATERWAYS
 DESIGN

CLIENT:
ESSENTIAL ENVIRONMENTAL
 PROJECT:
KARRATHA - REVITALISATION STAGE 2 SPINE ROAD
 TITLE:
CONNECTION D PLAN

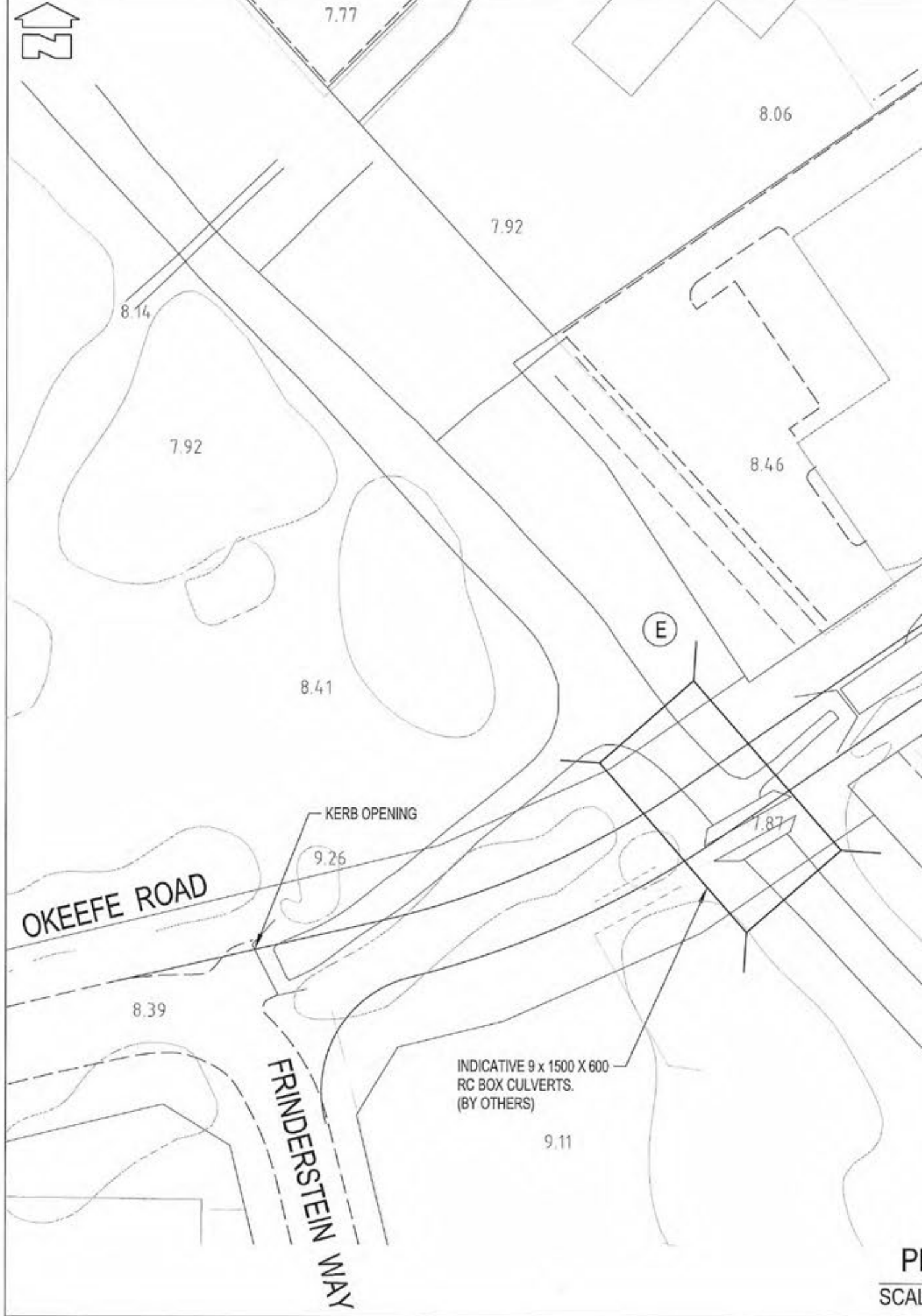
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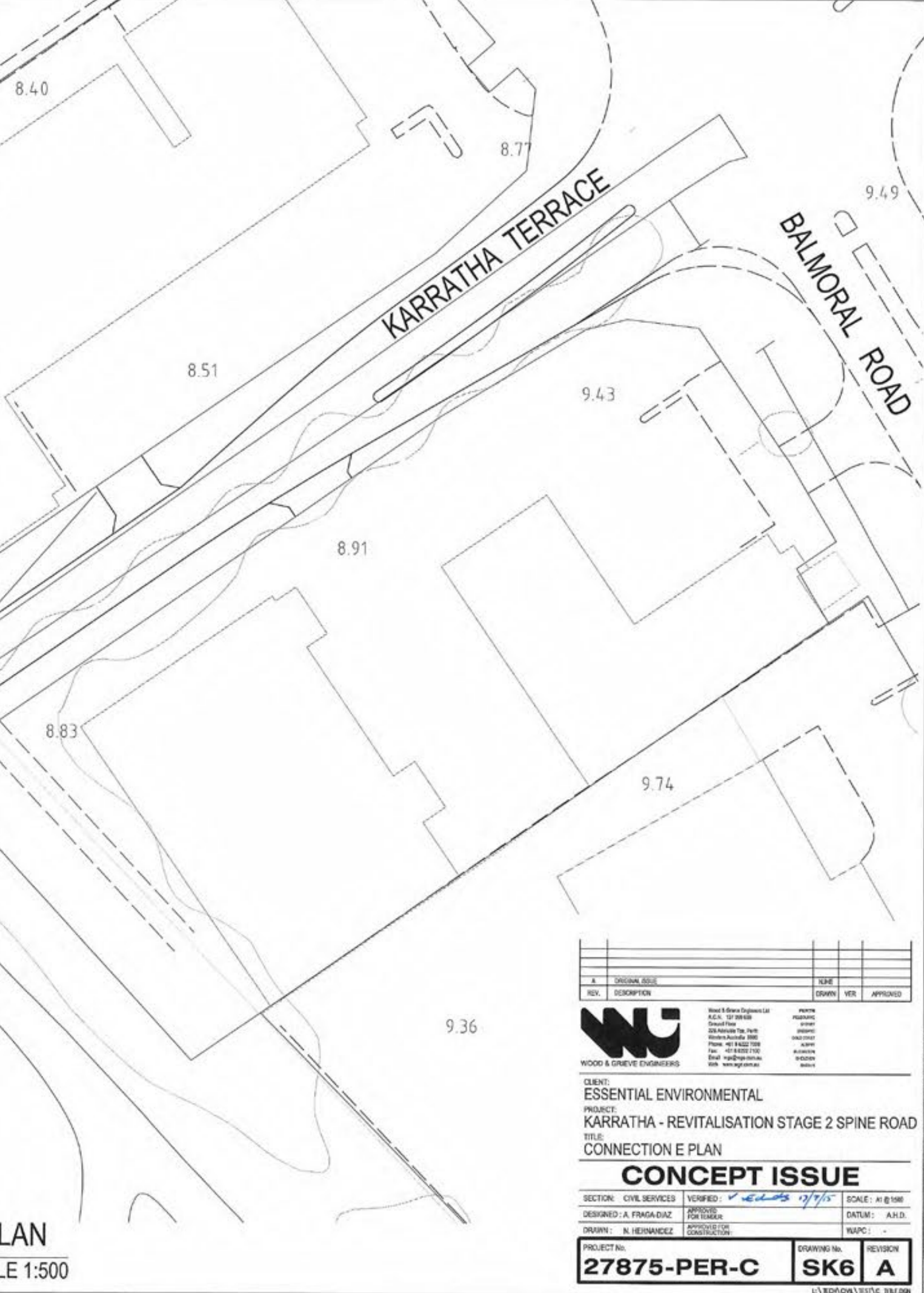
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DRAWN: M. HERNANDEZ	APPROVED FOR CONSTRUCTION:	TMPC: -

PROJECT No. 27875-PER-C	DRAWING No. SK5	REVISION A
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PERMITS
PLANNING
CIVIL
STRUCTURAL
ELECTRICAL
MECHANICAL
WATER
SEWER

CLIENT:
ESSENTIAL ENVIRONMENTAL
PROJECT:
KARRATHA - REVITALISATION STAGE 2 SPINE ROAD
TITLE:
CONNECTION E PLAN

CONCEPT ISSUE

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DESIGNED: A. FRAGA DIAZ	APPROVED FOR TENDER	DATUM: A.H.D.
DRAWN: N. HERNANDEZ	APPROVED FOR CONSTRUCTION	WAPC: -

PROJECT No. 27875-PER-C	DRAWING No. SK6	REVISION A
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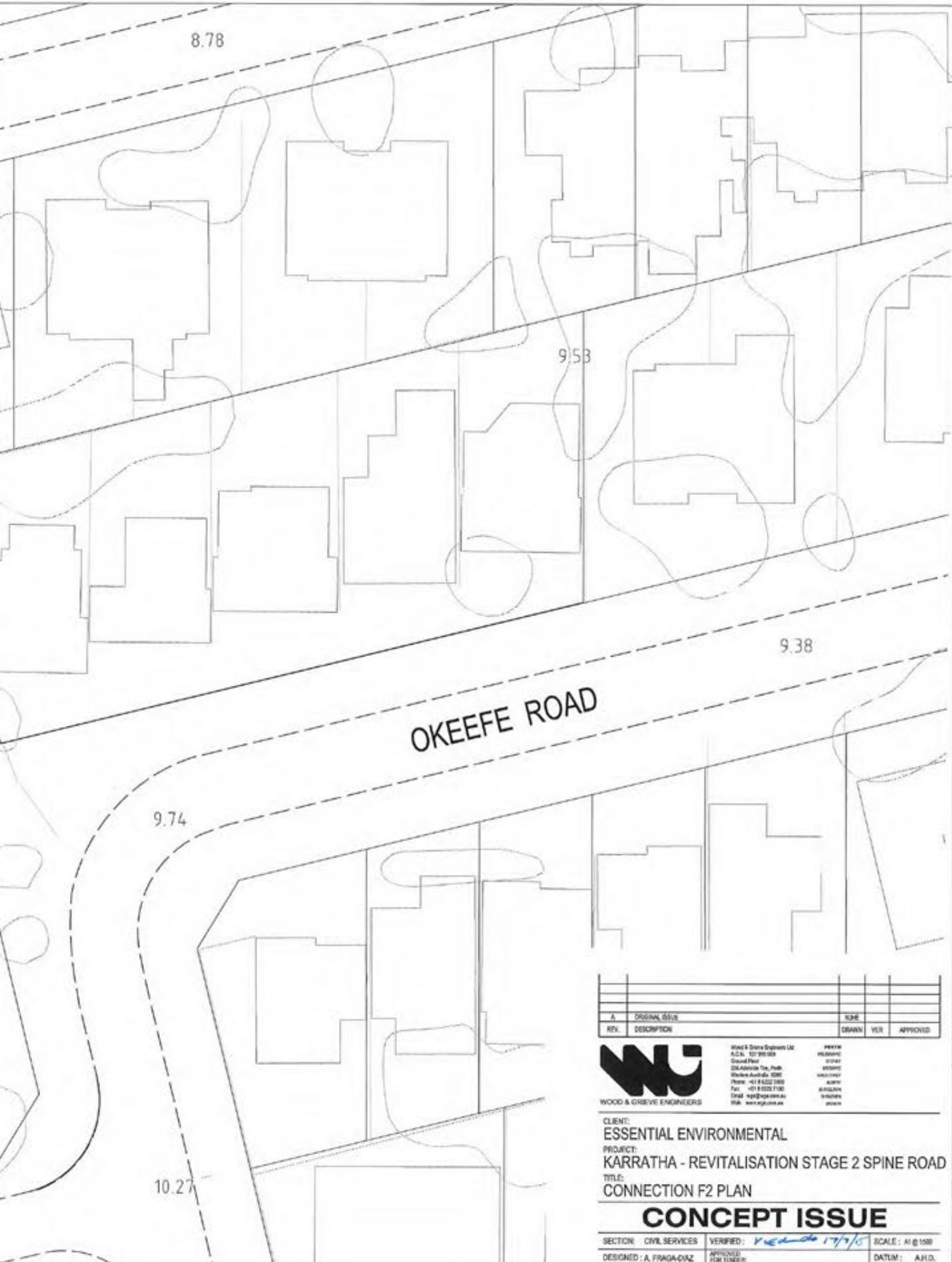
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O'KEEFE ROAD

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REV.	DESCRIPTION	DATE	BY	APP'D
A	Original Issue			



Wood & Greve Engineers Ltd
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MGR
CHKD
DESIGN
DRAWN
SCALE

CLIENT:
ESSENTIAL ENVIRONMENTAL
PROJECT:
KARRATHA - REVITALISATION STAGE 2 SPINE ROAD
TITLE:
CONNECTION F2 PLAN

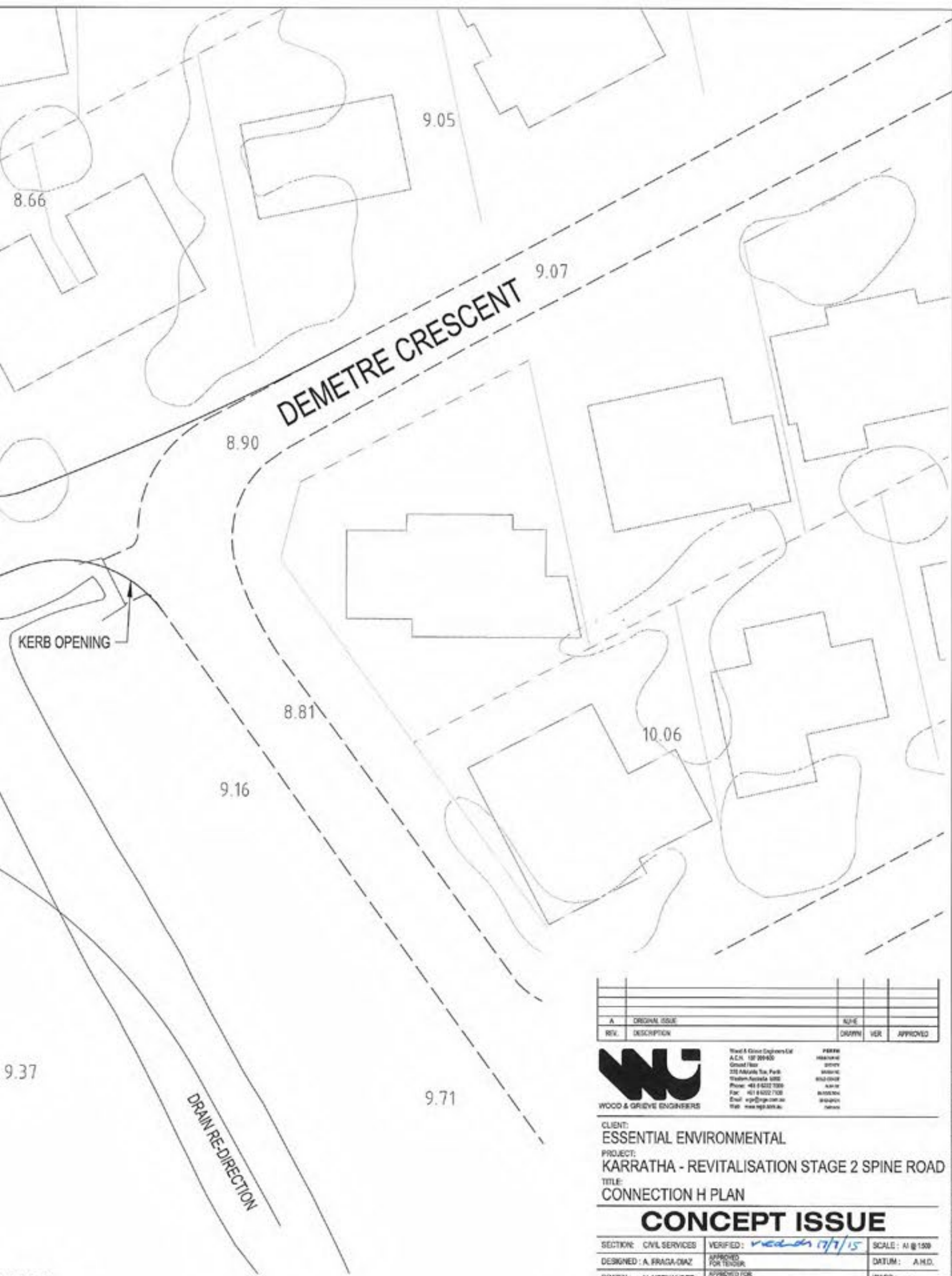
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DRAWN: N. HERNANDEZ	APPROVED FOR CONSTRUCTION:	WAPC: -

PROJECT No. 27875-PER-C	DRAWING No. SK7	REVISION A
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Wood & Grieve Engineers Ltd
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Woodville SA 5012
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Web: www.wge.com.au

PERM
MEASUREMENT
DIVERSITY
SUSTAINABLE
WELL-BEING
WELLNESS
WELLBEING

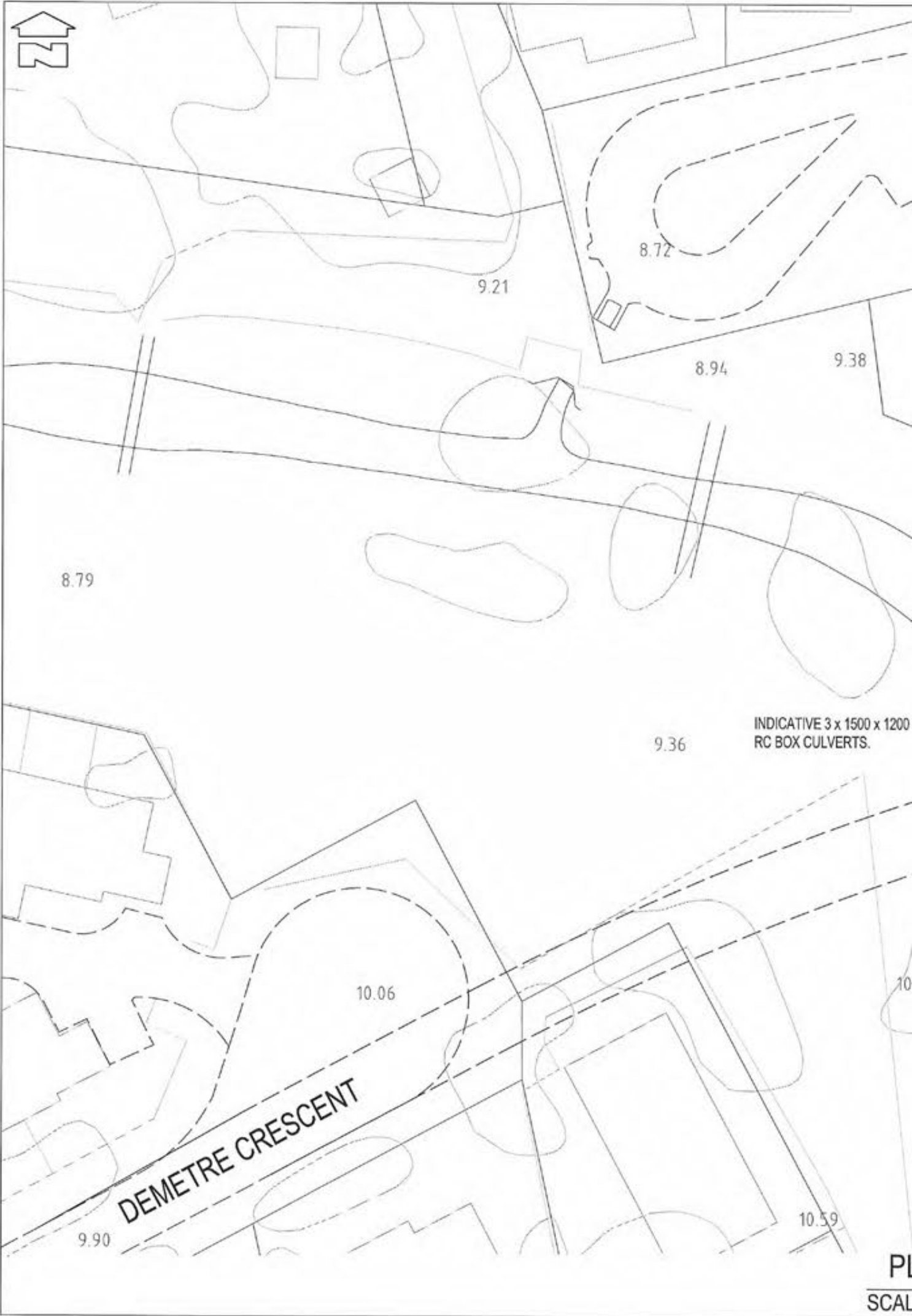
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PROJECT:
KARRATHA - REVITALISATION STAGE 2 SPINE ROAD
TITLE:
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DESIGNED: A. FRAGA-DIAZ	APPROVED FOR TENDER:	DATUM: A.H.D.
DRAWN: N. HERNANDEZ	APPROVED FOR CONSTRUCTION:	WAPC: -

PROJECT No. 27875-PER-C	DRAWING No. SK9 A	REVISION A
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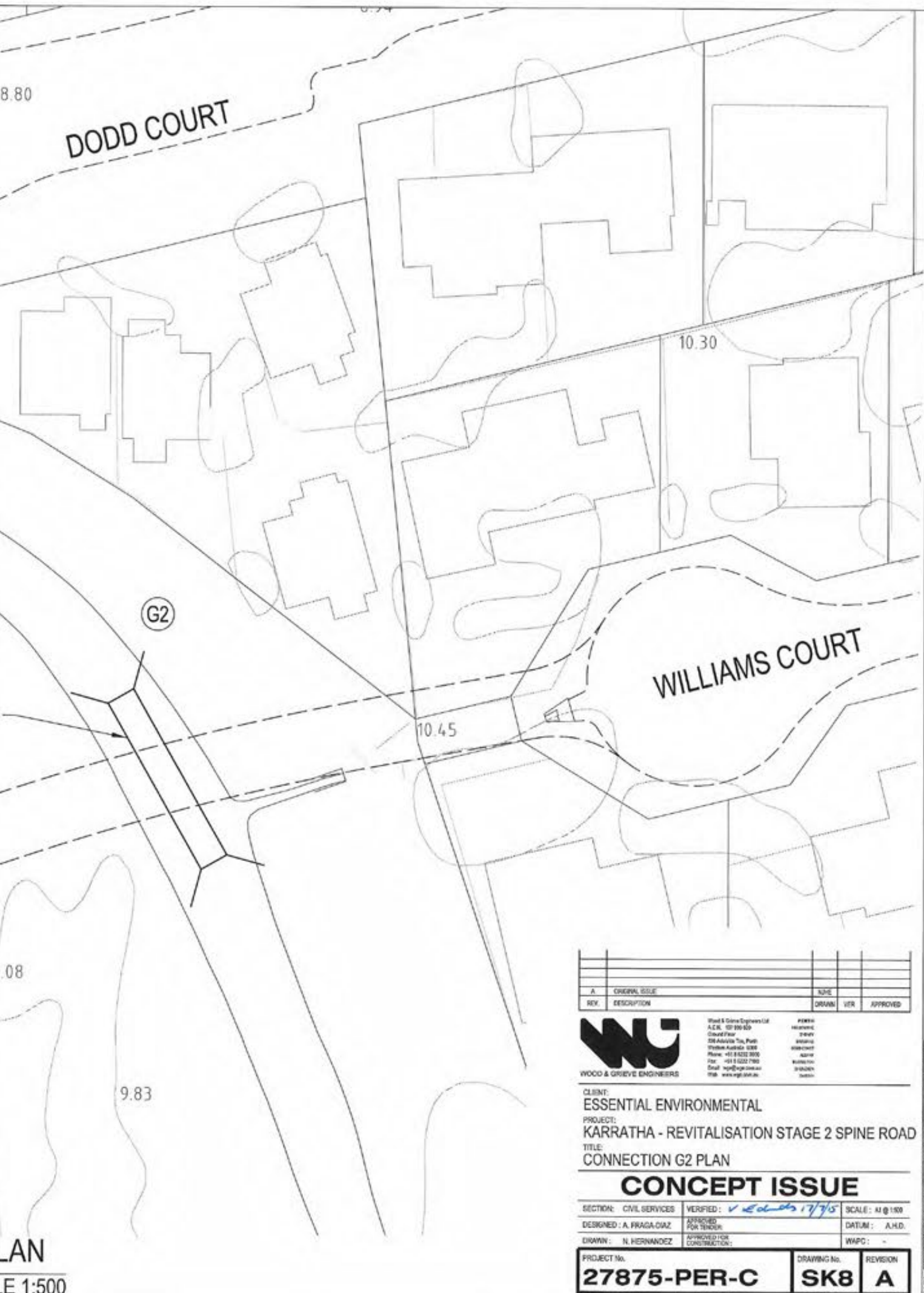
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INDICATIVE 3 x 1500 x 1200
RC BOX CULVERTS.

DEMETRE CRESCENT

PL
SCAL



DODD COURT

WILLIAMS COURT

G2

PLAN
SCALE 1:500

REV.	DESCRIPTION	DATE	DRAWN	VER	APPROVED
A	CONCEPT ISSUE				



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NAME
DESIGN
DATE
SCALE
PROJECT NO.
DRAWN BY

CLIENT:
ESSENTIAL ENVIRONMENTAL
PROJECT:
KARRATHA - REVITALISATION STAGE 2 SPINE ROAD
TITLE:
CONNECTION G2 PLAN

CONCEPT ISSUE

SECTION: CIVIL SERVICES	VERIFIED: <i>v Edm 17/15</i>	SCALE: A1 @ 1:500
DESIGNED: A. FRAGA DIAZ	APPROVED FOR TENDER:	DATUM: A.H.D.
DRAWN: N. HERNANDEZ	APPROVED FOR CONSTRUCTION:	WAPC: -

PROJECT No. 27875-PER-C	DRAWING No. SK8	REVISION A
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