

Chapter 2

Project Description



NOONAMAH
RIDGE

INTRAPAC

2 PROJECT DESCRIPTION

The purpose of this chapter is to describe the construction and occupancy phases of the development. The concept master plan is presented and discussed, together with an overview of the ecologically sustainable development principles and planning design principles that will inform the development of a more detailed master plan. Each type of essential service (e.g. water, electricity etc.) that a residential development requires is then examined in terms of:

- Existing capacity
- Infrastructure planned for the area by the relevant authority
- Expected volume/demand
- Infrastructure required for this development
- Staging of infrastructure implementation
- Relevant approvals, standards and conditions
- Alternatives (where relevant)
- Responsibility for construction and maintenance

Management of domestic waste and provision of emergency services are also described, as is the construction phase.

2.1 CONTEXT

Development of Noonamah Ridge will require rezoning and subdivision approvals in accordance with the requirements of the *Planning Act*. The preparation of an EIS is a precursor to the development approvals process, which is administered by the DLPE. The EIS assessment process conducted by the NTEPA will inform the future rezoning and subdivision approvals' processes by providing recommendations to the Minister for planning and by detailing the conditions that should be placed on future planning approvals to ensure environmental impacts of the development are minimised.

The EIS has been prepared early in the project-planning phase and so the project description presented in this section is based only on the early design work undertaken by Intrapac. Following completion of the environmental assessment process, the development master plan will be further progressed to the point where a subdivision application can be submitted under the *Planning Act*. It is the role of the EIS to present sufficient information to provide for assessment of the development's potential to cause significant impacts to the environment, and to present a plan for avoiding and reducing those impacts as the development progresses through more detailed planning and approvals.

In order to undertake a subdivision, an application must be lodged with Development Assessment Services (DAS) of the DLPE. The development application is subject to a notification period during which relevant authorities (e.g. Litchfield Council, Telstra, Power and Water Corporation, DLRM), stakeholders and the general public may view and provide submissions to the DAS, who then assesses the merits of the application and comments received from these parties, and provides recommendations to the Development Consent Authority (DCA). The DCA then consents to, defers or refuses the application – taking into account whether or not the application accords with the SU zoning requirements (as discussed in Section 1.6.4). If it consents, there are generally a list of conditions attached, some of which need to be met prior to the commencement of works (i.e. conditions precedent) – see Section 6.3.2 for detail.

Litchfield Council has a number of requirements relating to property developments. These are described in a series of development guidelines accessible via the council's [website](#). The *Litchfield Council Development Guidelines A – General Planning Requirements* (2014) states that prior to commencement of construction, all the required design documentation is to be submitted for assessment and approval.

Once council approval has been obtained:

Works are to be carried out in accordance with the approved drawings and specifications, relevant legislation, the requirements of the Development Permit and these Guidelines. Final approval and acceptance will only be given when all works have been executed to the true intent and meaning of the approved drawings and specifications.

In addition, clearances and/or approvals for construction will be required by the council (from all relevant authorities) prior to responsibility for infrastructure being completely handed-over and may, in some circumstances, be required prior to approval for construction.

2.2 OVERVIEW

The vision for Noonamah Ridge is to create a high quality, master-planned, rural community that provides a range of lot sizes and types, with an emphasis on retaining and enhancing the rural character and amenity of the area. The development will aim to connect to the surrounding rural area, providing the opportunity to create a strong sense of community. Ecologically-sustainable development principles will guide this project, as discussed in Section 2.2.1. The conservation-significant values identified in Section 3.9 will be contained within the development's green space network.

It is proposed that Noonamah Ridge will consist of the following:

- A maximum of 4,200 homes accommodating around 11,000 people.
- A range of lot types between 800 and 20,000 m² (based on the land's capabilities and market demand). Lot sizes along Redcliffe Road and to the northern boundary will be complementary to existing neighbouring lot sizes.
- Two rural activity centres (villages) – similar in size to the existing Fannie Bay or Parap village centres – potentially including:
 - Community facilities (schools, childcare and shared buildings)
 - Local shops and services
 - Sports-fields
 - Community gardens
 - Bus stops.
- A residential mix of approximately 90 % of the site (including the provision of open space, community facilities and social infrastructure). The remaining 10 % of the site will be for enterprise/commercial purposes.
- Alternative approaches to the delivery of services and infrastructure to the development.
- No less than 15 % of the site being green space and public open space.
- Approximately 35 km of pedestrian and cycle paths.
- Additional bus services to Humpty Doo, Coolalinga, Palmerston and Darwin CBD.

A preliminary Area Plan and a concept master plan have both been devised for the development (see Figure 2-1 and Figure 2-2). The design of this development has been strongly influenced by the outcomes of both the stakeholder and community consultation processes described in Section 7.2.

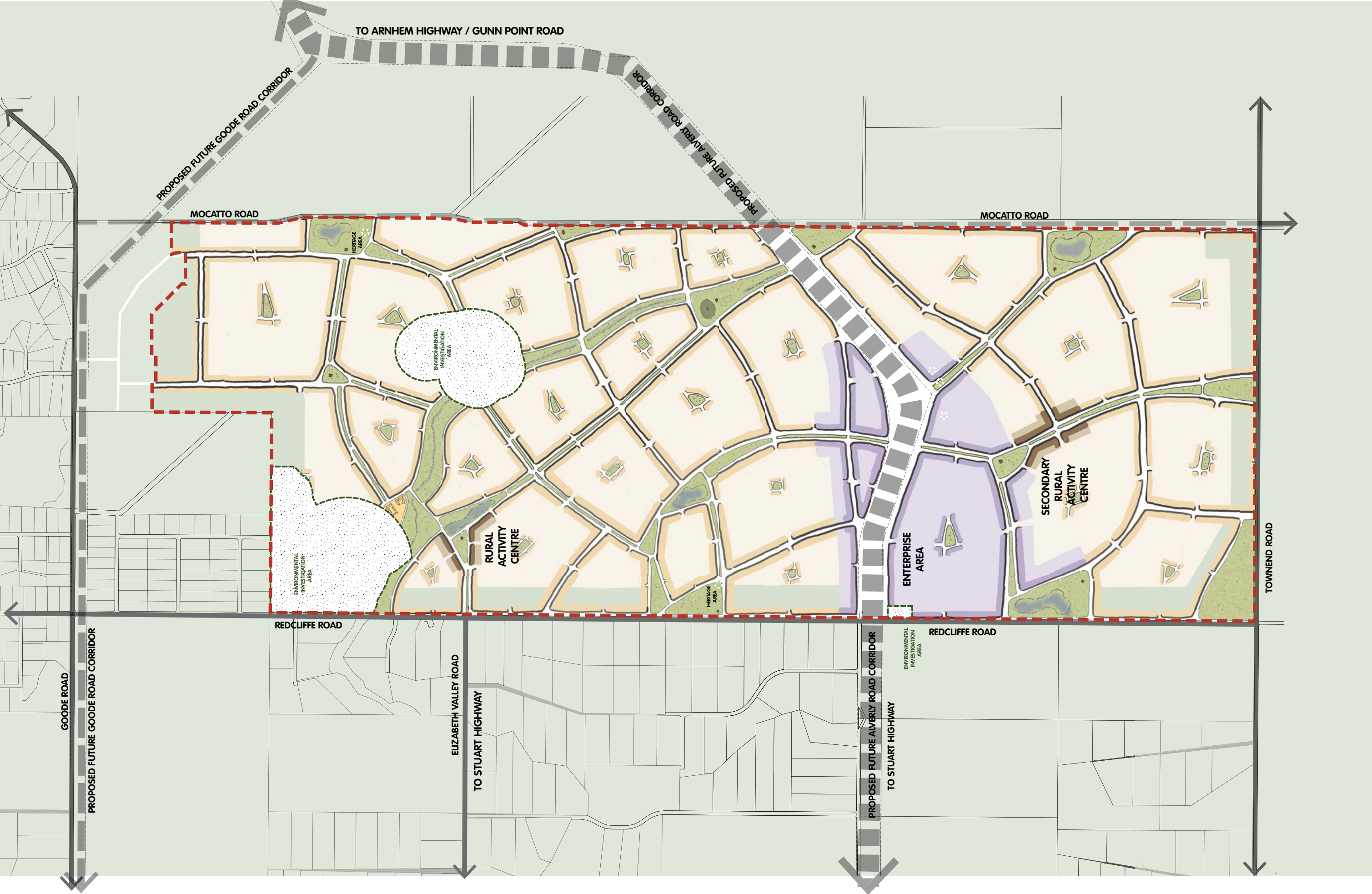


Figure 2-2. Concept master plan

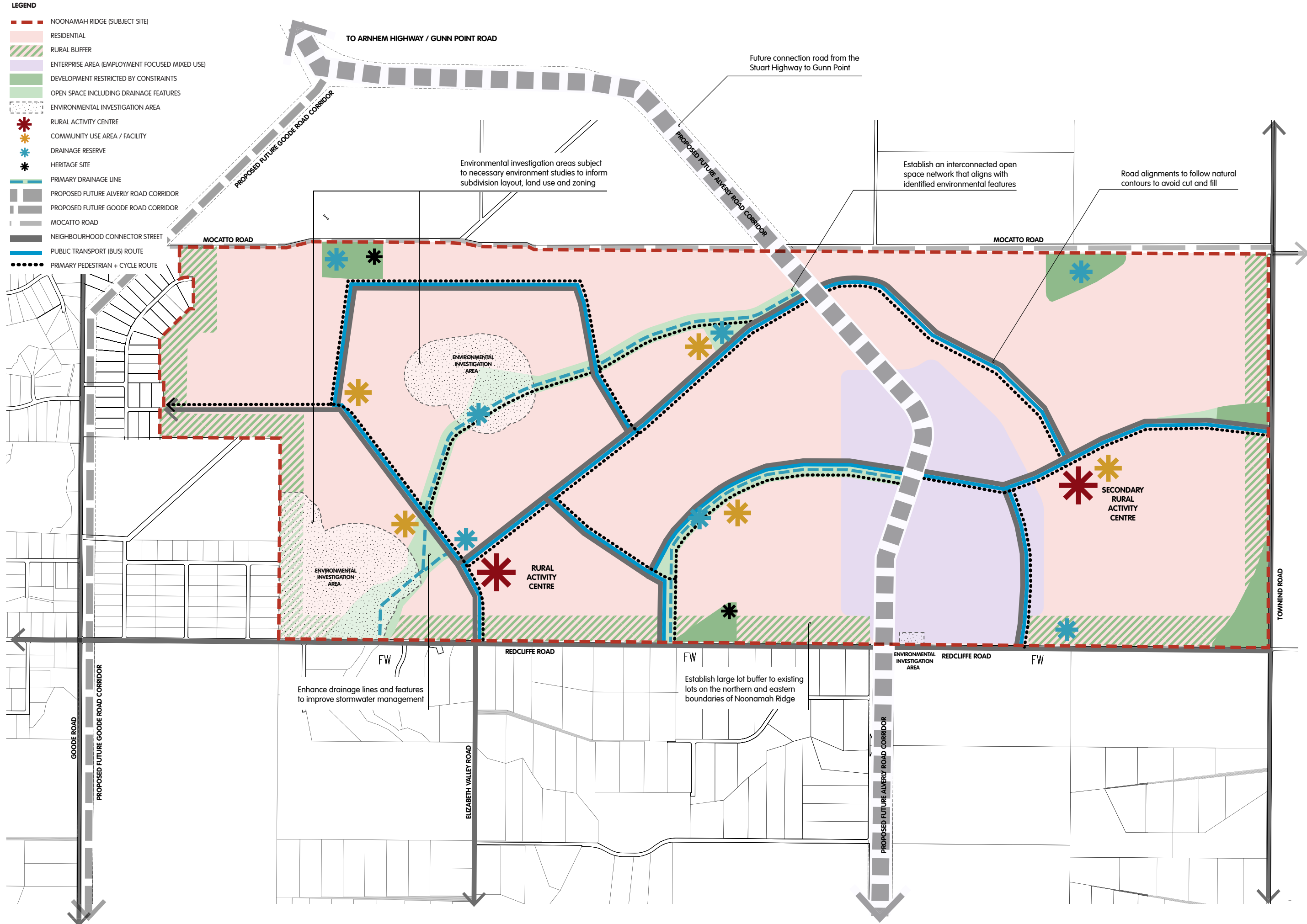
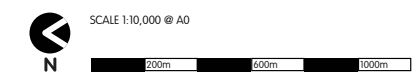


Figure 2-1. Area plan (proposed)

NOTES:
- Cadastre sourced from Byrne Design

D	for EIS input	170915	JD	EP
C	per R02011G	050615	JD	EP
B	village one update + EIA add.	130415	KT	EP
A	draft for review	300315	KT	EP
REV	DESCRIPTION	DDMMYY	DRAWN	APPRD



2.2.1 Ecologically sustainable development

Ecologically sustainable development (ESD) is defined in the *National Strategy for Ecologically Sustainable Development* (ESDSC 1992) as ‘development which aims to meet the needs of Australians today, while conserving ecosystems for the benefit of future generations’. The three main facets of ESD that require consideration when assessing potential impacts of development are economic, social and environmental.

The NTEPA refers to five guiding principles when assessing potential impacts of a project in relation to ESD. These guiding principles are individually defined (as per NTEPA 2010) and discussed below to identify how they relate to, and have been addressed by, the Noonamah Ridge development.

Precautionary principle

The precautionary principle states that:

Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

Detailed ecological and hydrological surveys have been performed on the site in order to gain an understanding of the existing environment. Using this information, this EIS contains an assessment of the potential impacts of this development on the environment (see Section 5) that is comprehensive and thorough, leading to the establishment of a suite of mitigation measures.

There are some aspects of the development, however, for which there is a lack of full scientific certainty. These are acknowledged within this EIS, and further investigations are committed to. One such aspect is the uncertainties – despite a baseline survey – relating to the capacity, extent and sustainability of local aquifers from which the development may draw some of its potable water. Mindful of this knowledge gap, Intrapac has applied the precautionary principle and committed to undertaking a groundwater sustainability study – including pump testing of groundwater bores – to determine the existence of a sustainable water supply for some stages of the development, and to understand and predict the response of the aquifer to extraction.

Another aspect of the development that demonstrates an application of the precautionary principle is the establishment within the Area Plan and master plan of environmental investigation areas (as described in Section 2.3.4). These areas are an indication that there is some uncertainty surrounding the extent and hydrology associated with important populations of a threatened species, and therefore that the development will not disturb these areas until those uncertainties have been resolved, and management responsibility and actions determined.

Inter-generational principle

Inter-generational equity is defined as:

The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

Noonamah Ridge fulfils this principle through providing for future housing and liveable space, conserving significant environmental areas within the development footprint, and minimising resource use. The development has been designed to minimise impacts now, and maintain resources and environmental health into the future. Additionally, local economic growth and employment will be provided throughout the development phases, and once the development is established, to ensure future opportunities for the region.

Affordable housing will be provided in the growing Darwin market, giving future generations the opportunity to enter the competitive housing market. The design of the development will also provide wider choices in rural living and an array of lot and living arrangements for families and residents to live in a planned community.

Resource use and waste minimisation is a key focus of the design phase, with the aim of preserving resources for future generations and focusing on whole-of-life cycle management (e.g. of potable water, stormwater and wastewater). Specifically:

- Onsite sewerage disposal will help establish a sustainable balance in wastewater management by using it to maintain the landscaped and parkland areas of the site. This will in turn reduce water demands of the site.
- Bore-fields will be gauged to ensure sustainable use, preserving water resources for future generations.
- Active aquifer recharge (i.e. pumping suitably-treated excess stormwater directly into the aquifer) will be considered in future to enhance available water resource for future generations.
- Housing design guidelines and property covenants will relate to environmental sustainability and climate responsiveness within the built environment (as discussed in Section 2.2.3).
- Power saving will be achieved through architecturally-designed houses that incorporate passive solar design, and through utilising low voltage DC lighting in urban areas.
- The use of roof-top solar panels for powering homes, schools and commercial buildings (and potentially feeding back into the existing grid) will be explored. This will reduce overall resource demand and enhance the use of existing, local and renewable resources.
- Other alternative power sources will be investigated, including using the bio-mass that is produced from onsite sewerage disposal to produce electricity for the site. Many of these measures will be adopted for minimising energy use and for achieving energy efficiency ratings as required under *Building Advisory Services Energy Efficiency Requirements* (DLPE 2010).

Green spaces within the development are designed to align with ecologically significant areas such as drainage lines and habitat for threatened species, providing the added benefit of conserving species for future generations' enjoyment and wonder, and maintaining the ecological services provided by the spaces. Significant cultural heritage sites are also conserved within the green space network for posterity.

As discussed in the remainder of Section 2.2, as well as Section 2.3, the development will be designed with a focus on residents' use and enjoyment of place, benefiting future generations and ensuring the site is accessible, safe and provides essential services.

Biodiversity principle

The biodiversity principle is defined as:

The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making.

As discussed in Section 3, a detailed study of the project area was undertaken to quantify the ecological and biological significance of the proposed development area, and to identify particularly significant areas that should be conserved (see specifically Section 3.9). The concept master plan for the development buffers conservation-significant areas, riparian zones, waterways and wildlife corridors within the green space network. The land (including biodiversity) dictates the design. The development has been designed to not only conserve significant areas, but also to minimise impacts on these areas (as described throughout the EMP in Section 6). Consideration has also been given to impacts on key ecosystems, habitats and waterways in the areas surrounding the project area which may be impacted by poor management of (for example) stormwater run-off and/or fire. An EMP have been developed to provide a framework for ongoing management of the development in order to minimise potential impacts such as fire, altered hydrology issues, erosion, weeds, and potential pollution from onsite wastewater management – all of which will lessen the impact of the development on the existing biodiversity values and functions of the site into the future.

It is acknowledged that residential development necessarily involves land clearing and habitat fragmentation in order to provide for infrastructure and buildings. For Noonamah Ridge, landowners will be encouraged – through the combined use of building envelopes and land-clearing permit requirements – to retain as much natural vegetation as possible on their lots.

Valuation principle

The valuation principle:

...includes recognition of the principles that the costs of environmental externalities should be internalised and that the polluter should bear the costs associated with environmental pollution.

As the proponent, Intrapac is required to provide and/or contribute to the provision of services such as electricity and water supply. As such potential impacts to water resources (i.e. the environmental externality) are incorporated and accounted for economically (internalised and paid for by the proponent). Similarly, preservation of ecologically significant areas (the externality) have been internalised through the establishment of green spaces which not only reduce the amount of land available for development (i.e. cost the developer to set aside), but also require ongoing economic investment in management programs.

More importantly, though, Noonamah Ridge is being designed to minimise environmental externalities such as pollution, waste and power production. This is evidenced in the intention to investigate the use of renewable energy sources, closed loop wastewater treatment facilities, passive solar housing design and aquifer active recharge, amongst other strategies to minimise resource use. Such is Intrapac's commitment to pursuing these strategies that the company has been entering into discussions with the relevant authorities about the potential for becoming a water and/or power utility

Integration principle

Decision-making processes should effectively integrate both long-term and short-term economic, social, environmental and equitable considerations.

The integration principle has been poorly applied in the rural areas of greater Darwin. Residential development has been limited to *ad hoc* and infrequent subdivision by private landowners. The incremental subdivision of rural land by private landowners also fails to adequately plan for, or accommodate, social and physical infrastructure requirements. Little attention is paid to the environmental context within which these piece-meal developments occur.

A master-planned development presents the opposite approach and embodies the integration principle. By having a strong understanding of the environmental context of the whole development, but then undertaking the development in stages, many mitigation measures can be put in place to minimise the potential for negative environmental impact. These mitigation measures will be enshrined within the SU zoning requirements, thereby requiring any Development Application for Subdivision to provide the required technical information at application stage. This information will then be assessed by the respective responsible authorities and, where relevant, will result in conditions being placed on the development permit – therefore ensuring compliance with commitments made during the EIS.

In the absence of a master plan, there is a much greater risk of a development's mitigation measures being inadequate. Examples of how this may manifest are:

- **Water supply** – Piece-meal subdivisions in the Darwin rural area are usually not connected to mains water supply and instead access groundwater using individual bores. There is little regulation of these bores and so aquifers are being over-extracted in a 'death by a thousand cuts' situation.

The Noonamah Ridge development is at scale that justifies and expedites the provision of mains water to the site (if required). If further groundwater investigation studies demonstrate that groundwater extraction to supply some of the water requirements of the development is sustainable

and economic, then that extraction will be gauged and managed such that extraction does not outstrip recharge.

- **Sewerage** – Piece-meal subdivisions in the Darwin rural area are usually not connected to the main sewer and instead utilise individual septic tanks. With the situation of there being thousands of septic systems dotted throughout the landscape, there is a high chance that some of them are compromised and hence leak contaminants into the surrounding environment.

Again, the Noonamah Ridge development is at scale that justifies the provision of community-scale sewerage treatment plants (using bio-remediation technology) within the site (see Section 2.10.3). These will be subject to high degree of scrutiny and regulation, and so the likelihood of contamination is negligible.

- **Drainage and erosion** – Standard conditions precedent for rural subdivisions are the development and approval of an Erosion and Sediment Control Plan, and of a schematic plan demonstrating the methods of onsite collection of stormwater. The advantage of a master-planned development is that each subdivision will more readily be able to take into account both the previous subdivisions and those proposed for the future, and that quite possibly the same engineering and construction companies will be involved for consecutive subdivisions. The development involves integrated stormwater management which greatly improves the ability to manage stormwater flows and quality; something not feasible in smaller subdivisions (see Section 2.9.4).
- **Biodiversity** – Piece-meal subdivisions are subject to less comprehensive environmental impact assessment processes as, occurring in isolation, they do not trigger assessment requirements. In contrast, Noonamah Ridge has been subject to arguably the most comprehensive biodiversity survey for a development of this type in the NT. As a consequence, there is a good understanding of the biodiversity values, sensitive vegetation types and threatened species (flora and fauna) that exists within the project area. This knowledge means that the development master plan can allow for the adequate provision of green spaces to buffer and protect the significant biodiversity values within the project area (see Section 2.3.4). It also allows for discussions amongst stakeholders as to the optimum means for managing these green spaces to occur well before development takes place.
- **Social** – There is little requirement for piece-meal subdivisions to provide any social infrastructure and facilities for its population, therefore increasing the burden on existing infrastructure and facilities. As a master-planned development, Noonamah Ridge has followed relevant benchmarks to guide indicative planning of social infrastructure. In particular, the development proposes two villages that will provide opportunities for the provision of social infrastructure such as community or recreational facilities, activities and lifestyle opportunities that will be linked to and integrated with the residential components. Social infrastructure proposed for the development is described in Section 2.3.1 and addresses all the forecast requirements for the development.

The EMP and SIMP for this development present monitoring programs of water quality and quantity, and of the provision for social infrastructure, respectively. Once responsibility for the management of conservation-significant areas has been determined, the management plan/s for these areas will necessarily include monitoring of threatened species populations. Ongoing monitoring provides informs both long-term and short-term decision-making, and thereby contributes towards meeting the integration principle.

2.2.2 Planning design principles

The concept master plan for Noonamah Ridge (Figure 2-2) has been developed utilising the principles of 'Timeless Neighbourhood Design' (also known as 'Traditional Neighbourhood Design' – see Thadani 2010, Duany et al. 2010a & 2010b, Steuteville & Langdon 2009). While these principles are normally applied to urban developments, they have been adapted to this development to ensure that, where possible, the rural subdivision achieves the principles of good development – in particular, providing opportunity for walkability and connectivity which has not traditionally been a focus in Darwin's rural area.

The 'Timeless Neighbourhood Design' principles are:

- **Compact walkable neighbourhoods** – The neighbourhoods are limited in size so that the majority of residents are within 800 metres of its centre, bringing the basic daily needs within walking and cycling distance. In the rural context this includes being able to walk to recreation, open space, community facilities or other amenities, but not necessarily to a rural activity centre.
- **Connected network** – Thoroughfares are laid out in an interconnected network, providing alternative routes to most destinations. This allows traffic to be evenly distributed and streets to be narrower – resulting in slower traffic, as well as accommodating parking, trees, footpaths and buildings.
- **Mix of buildings and uses** – There is provision for a diversity of homes, small low-rise apartment buildings, terraces, live/works, courtyard houses and lightweight eco-housing, as well as mixed-use buildings and offices. These buildings are varied in function but compatible in size and disposition on their lots. By providing a full range of housing types and work places, age and economic classes are integrated and an authentic community is formed – including multiple prospects for affordable housing.
- **Quality open spaces** – Open space, to be truly public, should be overlooked by buildings and fronted by thoroughfares. To be fully functional, open spaces should be located on significant pedestrian routes or be adjacent to meaningful destinations. The spaces must be usable and should include amenities for leisure, recreation and play. The spaces should be designed to enhance safety and encourage social interaction.
- **Distinct character and identity** – A consistent character that is drawn from the site and its broader context creates opportunities to promote a unique identity for the new community. Building types, form and materials – in addition to detailing of public spaces and streets – all integrate to create a unique urban character and place.

The development will be sensitive to the people residing along its boundary. Lot sizes along Redcliffe Road and to the northern boundary will be complementary to existing lots/homes in order to create an interface between them. Setbacks will be provided to the development's boundaries in accordance with the requirements of the *NT Planning Scheme* and will be endorsed through the application of building envelopes. Streets will connect to existing road reserves (to the north of the site) promoting a connected community and allowing existing residents to access facilities within Noonamah Ridge. A relevant controlling clause will be introduced into the *NT Planning Scheme* to ensure that, once developed, no further subdivision of individual properties will be permitted.

A *Land Suitability Assessment* (LSA) is a requirement for all developments that are subject to Clause 11.4.1 (Site Characteristics of Subdivisions of Rural and Unzoned Land) of the *NT Planning Scheme*. The *NT Land Suitability Guidelines* (DLPE 2013) stipulate how to assess rural subdivisions to demonstrate that the proposed development has sufficient unconstrained land to support planned uses. Such an assessment has been undertaken for the entire site – see Appendix G. The development will use the LSA to ensure that each subdivision is designed and planned to minimise erosion and sedimentation – see Section 6.7.1 of the EMP for detail.

2.2.3 Housing design principles

A key component of the vision that Intrapac has for Noonamah Ridge is to provide a built environment with structures that tread lightly on the site, acknowledge the particularity of the tropical climate, and reflect the aesthetics of the landscape. Buildings within the development will be subject to tried-and-tested tropical architectural design whilst integrating energy efficient practices. This is in contrast to many recent developments in the northern half of Australia that have ignored the climatic context. Such developments have placed a plethora of structures in locations that are philosophically, culturally and visually out of place, as well as being high energy consumers with very low living value.

Intrapac is taking the opportunity for appropriate tropical building design principles to be established at Noonamah Ridge. Accordingly, the buildings to be created will seek to have the following characteristics:

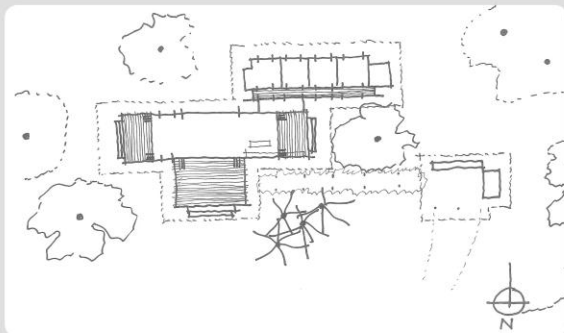
- Sited for optimum passive cooling breeze paths, as well as for privacy from the street and neighbours.
- Utilise plan forms that easily allow breezes to pass through all interior and exterior spaces. These structures should incorporate outdoor rooms, verandas and other landscape transitional spaces to develop a more tropical feel.
- Located to suit the existing landforms, site vegetation, sun paths, prospect and aspect.
- Utilise building forms with 'over sailing' roofs and awnings to shade external walls, windows and external living spaces from sun and rain.
- Produce interior and exterior spaces that are fully integrated with the project area's landscaping concepts. Landscaping – whilst promoting living amenity – should also be configured to assist in reducing heat load on building structures, whilst also respecting fire, termite and vermin risks.
- Utilise low thermal mass materials and building systems that easily shed acquired heat gained during the day.
- Utilise materials that fit into the unique qualities of the site and which are resonant of contemporary regional north Australian architecture. These materials must be low maintenance to withstand the harshness of the Top End climate – thereby assisting in minimising energy consumption and resultant carbon footprint – whilst also considering whole-of-life costs.
- All structures should consider the harvesting and storage of rainwater for use in toilets, garden irrigation etc.
- All structures must consider smart energy and water devices – both passive and active – including photovoltaic cells and wind turbines for energy creation, LED light fixtures, insulation types, avoiding dark external colours, efficient tap-ware (and other bathroom fixtures and fittings), and low or no water toilets.
- All structures should be designed by architects with proven experience and skill in tropical architecture.
- The built structures should include a variety of housing affordabilities in order to satisfy owner's budgets. This allows owners to enjoy a low impact rural lifestyle at lower costs if desired. Underpinning all such buildings will be the same principles of appropriate tropical architecture, thereby ensuring a common feel throughout, and producing a consistent approach to investment that is not put at risk through inappropriate development.

See Figure 2-3 and Figure 2-4 for examples of some of these characteristics that will underpin housing design at Noonamah Ridge.

High-level architectural design guidelines will be developed and incorporated into each sale agreement. The main aim of the guidelines will be to ensure key outcomes in relation to environmental sustainability and

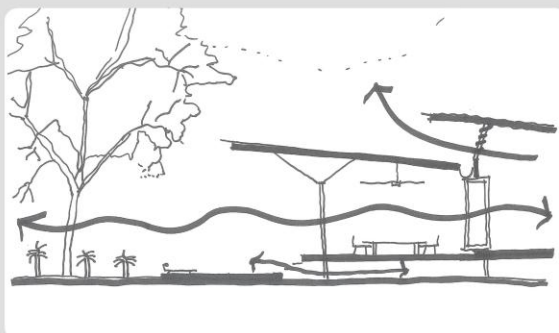
climate responsive design, and to ensure key elements of the rural character are maintained – particularly in those areas of the site with the smaller lot sizes. The guidelines will aim to not be too prescriptive and will allow for incremental development of houses in keeping with existing rural living habits. A covenant will be placed on the title of each property. This will require an assessment of building plans against the guidelines, and approval before construction can commence. The assessment and approval process will be undertaken by a nominated representative of the development (either an internal staff member or a controlling architect).

Building envelopes will be established for all lots to ensure the appropriate placement of dwellings in relation to each other, and in response to land suitability. At the time of lodgement of each subdivision application, a building envelope plan for each lot will be lodged for endorsement as part of the subdivision development permit. All development will need to be in keeping with these building envelope plans to ensure occupancy certificates can be granted. Copies of the building envelope plan will be attached to each deed of sale.



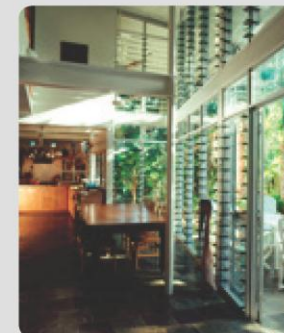
Orientation

- Buildings to be sited for optimum passive cooling breeze paths in both dry and wet seasons;
- Buildings to be sited to minimise east-west sun exposure;
- Interior and exterior spaces to be integrated with the site landscaping concepts to promote living amenity;
- Landscaping should also be configured to assist in reducing heat load on building structures whilst also respecting fire, termite and vermin risks etc.; and
- Buildings to be sited to afford privacy from street and neighbours.



Openings + natural ventilation

- Buildings where possible to be one room wide for optimal cross ventilation;
- Plan forms should easily allow cooling breezes to pass through interior and exterior spaces;
- External glazing + doors to allow maximum cross ventilation, e.g. louvres, french doors etc.;
- Internal spaces to be directly linked to outdoor rooms, verandahs and other landscape transitional spaces to develop a more tropical feel.; and
- Rooves to be ventilated to expel built up heat.



Eaves + shading

- Broad roof overhangs, awnings, sunscreens etc. to be used to shade external walls, windows and external living spaces from sun and rain;
- Shaded outdoor rooms and verandahs are great tropical architecture + buffer to external heat + glare;
- Landscaping to be considered to shade buildings + associated garden living spaces; and
- Minimise energy consumption via environmental protection devices.

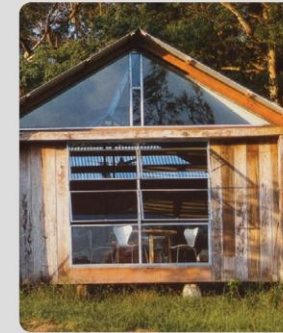


Figure 2-3. Sketches and photographs of proposed housing design characteristics (1)



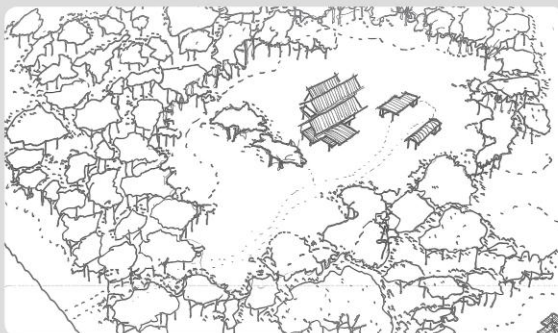
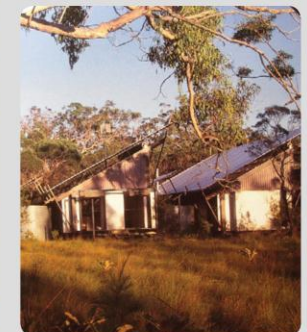
Build on the local character + design

- Buildings to be designed with good tropical architectural principles that reflect a north Australian appearance;
- Buildings to be integrated into the landscape reflecting our rural lifestyle;
- Buildings to be located to suit land forms, existing bush, privacy etc.; and
- Materials should be low maintenance to withstand the harshness of the Top End climate.



Respond to the land

- Buildings to be carefully located to suit the existing landforms, site vegetation, sun + breeze paths, prospect, aspect etc.;
- Buildings to tread lightly on sloping sites + adjust to integrate internal + external spaces; and
- Excessive site works to be avoided to preserve natural appearance of site.



Incorporate the natural landscape

- Existing landscape to be retained where possible to ensure an appropriate rural lifestyle;
- Site planning to preserve + protect the existing landscape habitat and fauna;
- Buildings to be designed to include existing bush for privacy, sun shading and amenity; and
- Landscaping and courtyards to provide outdoor living options.

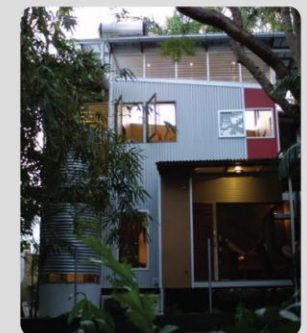


Figure 2-4. Sketches and photographs of proposed housing design characteristics (2)

2.2.4 Character

Each of the key character areas that will be represented within the development footprint are described below, moving from the sparsely developed natural edges of the site to the more built-up environment in the rural activity centres. This sequence of character areas is the basis for organising the components of the community – including buildings, lots, land use, street and parklands.

- **Natural**

The natural environment includes land set aside for conservation and heritage reasons, as well as that unsuitable for urban development due to topography and hydrology. The natural environment presents opportunities to provide additional public access trails, and for the community to gain a greater understanding and affinity for the natural environment.

- **Rural**

This area consists of open or sparsely settled land. Housing will occur as eco-living on large rural allotments, employing sensitive built-form construction and designated development footprints to minimise the impact upon the natural landscape.

- **Sub-urban**

This area is the low-density edge of a neighbourhood. This zone typically has larger residential homes and naturalistic planting, with buildings that respond to the surrounding landscape and landforms while protecting key view corridors. Homes here will generally be larger detached houses.

- **General urban**

This area has a denser, and primarily residential, urban fabric which gradually transitions to the busier rural activity centre. Here buildings are closer to the street and there are some attached residential dwellings, shop-top housing and neighbourhood level retail, commercial and community activities. Homes here may include compact courtyard houses, contemporary cottages, duplexes, studios above garages and attached town houses.

Key community facilities such as schools, recreational reserves and community activity hubs are located to ensure these are all within walking distance for local residents.

- **Village centre**

This area is akin to a typical main street environment. This zone includes mixed-use building types that accommodate retail, offices, accommodation, health services and entertainment activities. As the civic, commercial and cultural heart of the new community, it will be used both day and night.

Dwellings within this area will include a range of housing typologies, suited to a rural activity centre in the Darwin Context. This could include terrace houses, SOHO terraces, maisonettes and shop-top apartment living (in later stages). This area encompasses a tighter network of streets and blocks with wide footpaths, aligned street tree planting, and buildings set close to street frontages, creating a more urban setting close to the village centre where small home office and home-based businesses are encouraged.

- **Enterprise area**

The proposed enterprise area is a special district served by an ease of access to the major arterial road routes that also connect Noonamah Ridge to the wider regional area. The Noonamah Ridge enterprise area will be anchored by businesses and activities that provide a high concentration of employment. The enterprise area will be linked to the broader Noonamah Ridge community and integrated with the adjacent rural activity centre.

2.3 COMPONENTS

2.3.1 Social infrastructure

Given the projected population of Noonamah Ridge, the development will be planned to be reasonably self-contained in terms of social infrastructure in order to avoid the potential for overloading existing services in nearby rural communities. In the early stages, Noonamah Ridge will rely on many facilities and services in Humpty Doo and Palmerston until it has reached thresholds to make its own facilities and services viable.

Benchmarks

Benchmarks for social infrastructure provision provide a useful starting point to guide planning, but need to be applied flexibly, taking into account other considerations such as:

- The likely characteristics and needs of the future population (not just population numbers).
- The capacity and accessibility of existing services and facilities.
- The distribution and layout of development – including travel distances and physical barriers such as conservation lands and major roads.
- The potential for more innovative models of provision – including multi-purpose design, co-location and shared use of facilities.
- Opportunities for partnership and collaboration among agencies and providers.

Benchmarks for social infrastructure provision have not been developed for the NT, partly because of the high variability between Territory communities. Palmerston City Council has adopted within its community plan a set of benchmarks to guide its future planning (City of Palmerston 2008). These are based on South-East Queensland *Social Infrastructure Guidelines* (Queensland Government 2007), but adapted to Palmerston's particular demographic characteristics, settlement pattern, service hierarchy and existing rates of provision.

In the absence of other standards, the Palmerston benchmarks have been used to guide indicative planning of social infrastructure for Noonamah Ridge. These are shown in Table 2-1. No benchmarks or guidelines are used by councils in the greater Darwin region to guide the provision of sporting fields, courts and other recreation facilities.

Table 2-1. Palmerston community facility standards

Facility type	Rate of provision per population
Neighbourhood meeting room	1: 3,000
Local multi-purpose community centre	1: 5,000
District multi-purpose community centre	1: 20,000
Childcare centre	1: 2,000
Primary school	1: 5-6,000
Middle school	1: 12-15,000
Senior school	1: 20,000
Youth centre	1: 25,000
Aged care/respice centre	1: 30,000
Cultural centre/performing arts space	1: 40,000
Community health centre	1: 30,000
Branch library	1: 20,000
Central library	1: 50,000
Police and emergency services	1: 30,000
Vocational/further education centre	1: 30,000

Source: Palmerston Community Plan (2008)

Based upon the Palmerston benchmarks, upon completion Noonamah Ridge would require (for 11,000 residents):

- 2 primary schools
- 1 middle/high school
- A family services hub with family support services, early childhood services and space for government programs.
- 5 – 6 childcare centres
- 3 – 4 neighbourhood meeting rooms
- 2 local multi-purpose community centres.

The NT Department of Education has agreed to provide a primary school within the Noonamah Ridge. However, the staging of the Noonamah development suggests that a primary school might not be provided for at least five years into the development program, and any new middle/high school would be further into the future. Thus, while the government school needs of the Noonamah Ridge community may be met by proposed new schools in time, in the short-term school students will need to be accommodated in existing schools, which will need to be expanded to accommodate growth associated with Noonamah Ridge. It will be important to monitor population growth and associated schools' demand within Noonamah Ridge closely, and to consider how this might impact on the timing of provision of new schools. A middle/high school – if developed within Noonamah Ridge – would also not be built until well into the development, so students would initially be accommodated at nearby schools.

A multi-purpose children and family centre in the village would complement existing facilities, and responded to a need documented through the community consultation process. In terms of childcare, as the development proceeds there will be demand for new facilities. Privately-operated childcare centres could be established within the proposed village, should an operator determine that there is demand for such a facility. It is also possible for childcare centres to be located within areas with a residential zoning.

Each application for subdivision will typically include an update to the demographic information, and an assessment as to whether social infrastructure proposed and already developed is meeting the requirements

of the new and existing community in the broader area. This will ensure the ongoing appropriate delivery of social infrastructure in a timely and coordinated manner.

2.3.2 Villages

The first rural activity centre will be a village providing for the daily needs of residents (within Noonamah Ridge and the surrounding community). Currently referred to as 'Village One', development will commence with Stage 1 of the project. Village One will include a community of around 1,500 people in five neighbourhoods surrounding the rural activity centre. The design of Village One will be defined by the natural landform and waterways – see Figure 2-5 for a preliminary master plan (developed for community engagement purposes) and Figure 2-6 for an artist's impression.

A range of lot and housing types will be developed in Village One – including 20,000 m² rural residential lots around the edges of the village, smaller lots (800 – 4000 m²) moving toward the rural activity centre, and higher density housing directly adjacent and within the centre. Also included will be provision of land for aged care and retirement living.

Village One will contain a concentration of commercial and retail activity (potentially including a supermarket) located on the main street. Home-based businesses, medium-density dwellings, attached homes and smaller lot dwellings will be clustered around Village One close to the amenities the centre will offer. Streets will be designed to be safe and highly interconnected, as well as landscaped to promote walking and cycling. Walking and cycling paths will be provided within open spaces, creating recreation opportunities.

The village will be centred around a lake and extensive parklands – including a Village Green with a building for community use. A community garden and sports fields will be in close proximity to the rural activity centre, within walking distance of the surrounding residents. The bus route will travel through Village One, stopping in the rural activity centre.

Village One will include the provision of land for a new primary school, and could include land for a middle/high school. Additional facilities such as childcare, meeting/function spaces, a library and community health services, and land for a new volunteer fire brigade and other community organisations will be considered.

A second rural activity centre will be developed at the southern end of the project in the latter stages of the project (in approximately 20 years' time), with facilities to be determined on an 'as needs' basis closer to the time.

2.3.3 Enterprise area

During initial consultation with the NT Planning Commission, the need for employment land was flagged by the Commission. In response, Intrapac has committed to providing an enterprise area within the development that will provide the opportunity for the establishment of an employment centre. The site is located on the future Alverly Road corridor, an earmarked heavy vehicle corridor between the possible future industrial port areas at Cox Peninsula and Glyde Point. While the final make-up of this area is subject to further investigation and market demand, it could include:

- Light or general industry
- Transport-related industry
- Transport hub
- Science and technology-related industry.



Figure 2-5. Master plan of Village One (preliminary) developed for community-engagement purposes

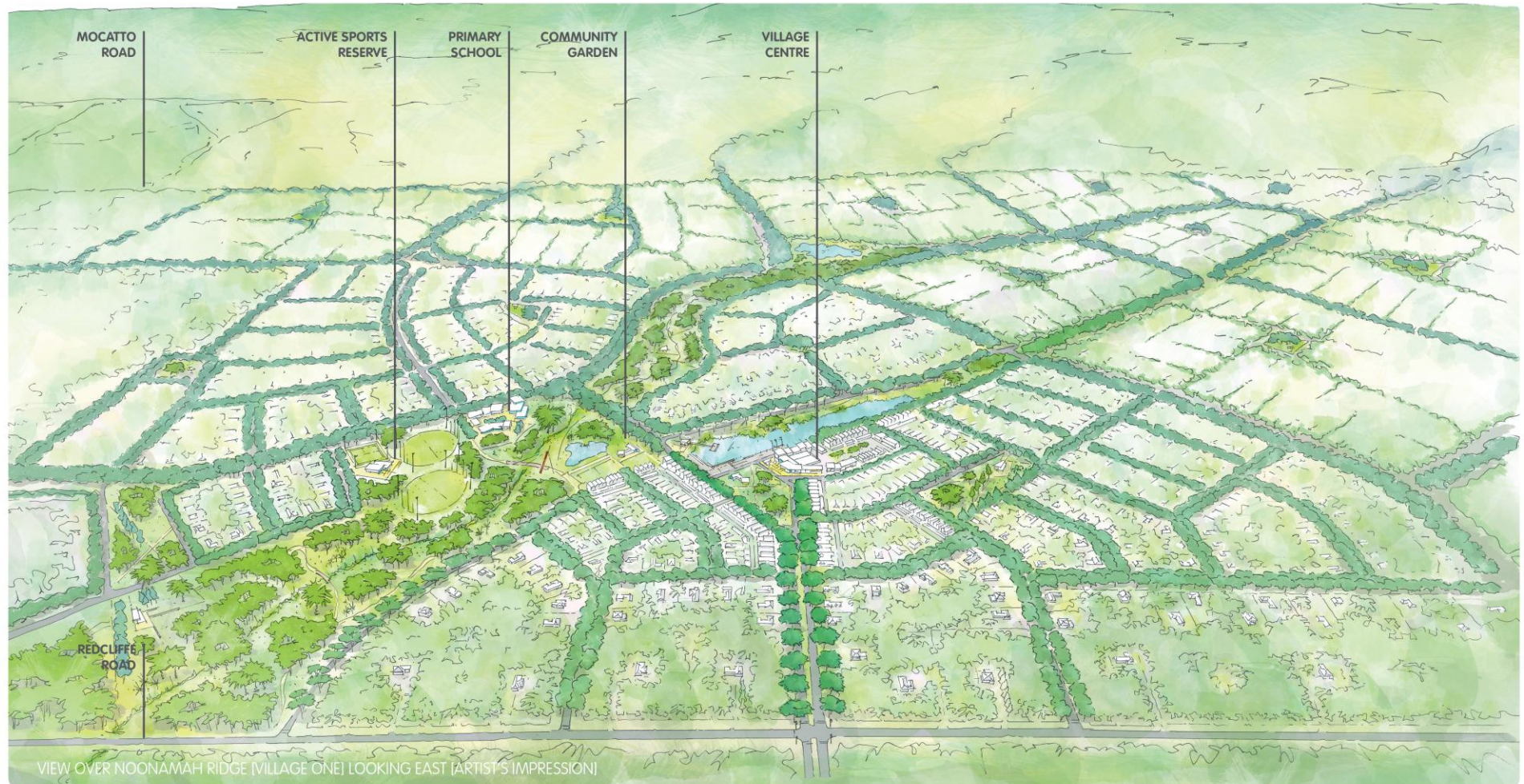


Figure 2-6. Artist's impression of Village One

2.3.4 Green space

Intrapac considers the local natural environment within the project area to be a unique attribute of the site. As shown in the concept master plan (see Figure 2-2 and Figure 2-7), Noonamah Ridge contains a network of green spaces that include public open spaces (see sub-section below), existing waterways and remnant vegetation. The indicative location of these green spaces coincides either with walkability design criteria (e.g. for open spaces such as parks and sporting venues) or with conservation-significant values (e.g. sensitive vegetation types and threatened species). All conservation-significant values identified in Section 3.9 are contained within the green space network. Second-order waterways are buffered by at least 50 m as required in the *Land Clearing Guidelines* (NTG 2010).

The management of parks and ovals will be the responsibility of Litchfield Council. The green spaces that incorporate conservation-significant values will need to be carefully managed to ensure that the values within them are not compromised by weed infestation, altered water quality or quantity, human disturbance and bushfire. Some of the sites (particularly that in the north-west corner) contain such significant values (namely important populations of threatened species) that their management requires a level of experience and skill in natural resource management that is beyond that of both Intrapac and Litchfield Council. To ensure that these values are protected, the relevant authorities will be engaged to determine: the appropriate size of the green spaces enclosing them; the optimum zoning (and, as a consequence, who is responsible for their management); the level of public accessibility, management of the areas (including fire and weed management); monitoring programs (and who will undertake these); and how to promote within the community an understanding and appreciation of the values that occur 'on their doorstep'.

Other areas that contain conservation-significant values could potentially be managed by a 'Friends of' group – although issues with funding, capability and commitment for such groups can be problematic (and even a short period of inactivity in management could be deleterious to these values). Ongoing, active management will be needed; responsibility for that is still to be determined.

Open spaces

Open space requirements articulated in Litchfield Council's development guidelines (2014a-d) state that:

- 10 % of the land area in subdivisions is to be provided as public open space.
- This calculation is to exclude buffer strips that do not provide any usable open space.
- No more than 20 % of the total open space can be used for drainage or stormwater management and no more than 40 % of any individual park can be used for stormwater management for 1 in 10 year flood events.

The proposed development will meet the local recreation needs of its residents through provision of local public open space, which comprises 15 % of the site area. This proportion recognises that some of the recreation needs of households will be met through provision of larger lots, reducing the demand for public open space.

Public open spaces will be located throughout Noonamah Ridge to provide amenity for residents – including playgrounds, BBQ and picnic facilities, public artwork, exercise equipment, walking and cycling trails – as well as to provide sports-fields and recreation facilities for both the new community and surrounding residents (see Figure 2-7).

Less open space is provided within the rural area because lots are bigger. Where parks are provided, they will be informal in character. Within the sub-urban and general urban areas there will be a range of parks, becoming more formal the nearer they are to the rural activity centres.

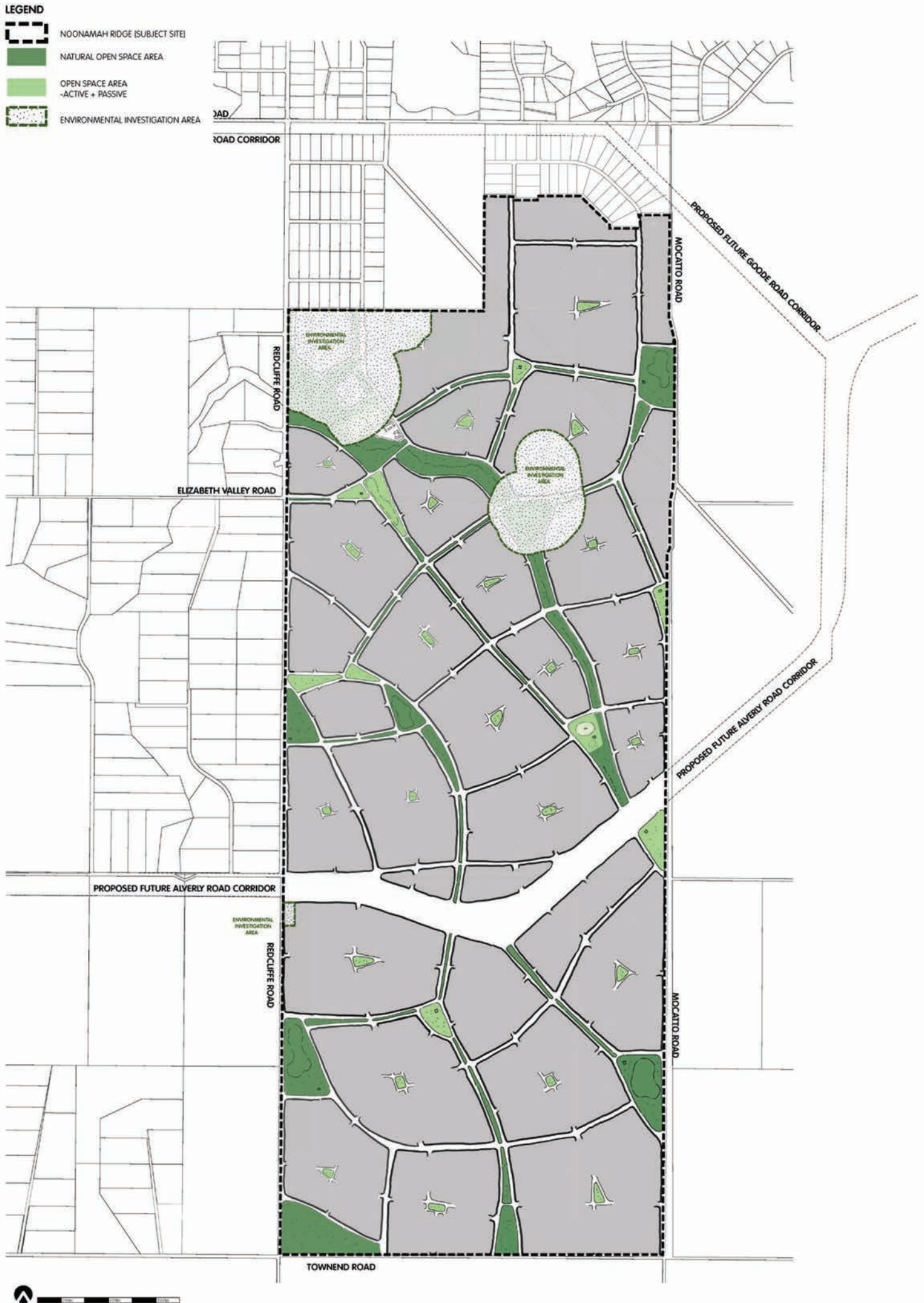


Figure 2-7. Map of green space network (indicative)

Environmental investigation areas

Certain sites within the project area have been identified during field surveys as being environmentally sensitive. Most have been encapsulated within the green space network proposed for the development (as discussed in the preceding section); however, three locations have been depicted on the concept master plan as 'environmental investigation areas'. They have been labelled as such because there are uncertainties associated with them that require further ecological investigation prior to the development of a final master plan.

The small 'environmental investigation area' adjacent to Redcliffe Road near the Alverly Road intersection relates to the threatened flora species – *Typhonium praetermissum* – contained within. The uncertainty relating to this site is that, because it is located immediately adjacent to the Alverly Road corridor owned by the NT Government, it may be disturbed when that road is developed. Further discussion amongst stakeholders about the fate of and, if retained, responsibility for management of that population will need to occur prior to the road corridor being developed.

The other two 'environmental investigation areas' in the north of the project area are significantly larger. The particular uncertainty relating to these is the distribution of the threatened Howard River Toadlet within them. The species is most readily identified in the wet season from the calls it makes within suitable inundated areas (see the *Flora and Fauna Assessment* in Appendix I – for more detail). What is known about this species' ecology is that at the end of the wet season it moves from its breeding grounds into surrounding habitat and burrows underground during the dry season to 'hibernate'. What is not known is what constitutes the species' preferred dry season habitat.

Intrapac is committed to protecting the two key populations of the Howard River Toadlet that occur within the project area, but until the distance and direction of the toadlets' movements are determined, an adequate buffer between toadlet habitat (both calling and hibernating) and the development cannot be determined. Further studies are needed.

The extents of the two large 'environmental investigation areas' were developed in consultation with Graeme Gillespie and Ian Liddle from DLRM's Biodiversity Unit. The extractive industry is required to buffer its activities by 500 m from sandsheet heath because of the possible impact on threatened species, particularly the Howard River Toadlet. The buffer is so large because of the uncertainties surrounding the toadlet's post-wet season movements.

For the 'environmental investigation area' in the north-west of the project area adjacent to Redcliffe Road, a 500 m buffer has been applied to the area of wet season calling habitat (as mapped in the *Flora and Fauna Assessment* report in Appendix I), with two exceptions:

- On the assumption that the creek to the south of the calling habitat is a barrier to toadlet movement, the buffer has been reduced to only extend 50 m south of the creek (i.e. the buffer required in the *Land Clearing Guidelines* (NTG 2010) for such a riparian area). This assumption appears valid given there is little documentation of toadlets occurring within strongly-flowing drainage lines (hence their preference for inundated sandsheet heath) and that at this site toadlets stopped calling (and likely moved away) long before the creek's flow slowed down.
- The buffer in the north-east has been extended beyond 500 m to include the *Typhonium praetermissum* population there and the drainage path that supplies the toadlet calling habitat. The *Typhonium* population has been buffered to the south-east by 50 m.

For the 'environmental investigation area' relating to the Howard River Toadlet population in the centre of the northern block (i.e. to the east of Village One), a 250 m buffer has been applied. Given the topography (hilly terrain) on some sides of the calling habitat, it is arguable that a 500 m buffer is excessive as that would extend beyond the catchment of that population, and it seems unlikely that toadlets would move that far.

All these buffer zones will be further refined prior to any development affecting the 'environmental investigation areas'.

2.3.5 Project footprint

Out of a total area of approximately 2,800 ha, a maximum of approximately 1,570 ha of the project area will be cleared for the development (see Table 2-2). Of this, a maximum of approximately 880 ha will be impervious surfaces such as bitumen, concrete and rooftops; the remaining being gardens, grassed areas and bushland (see Table 2-3).

Table 2-2. Preliminary calculations of the area of the project site that will be cleared (upper limit)

Project component	% cleared	Approx. area (ha)
Road reserves	100	524.14
Enterprise area	80	274.36
Rural activity centre	100	8.00
Community centre sites	100	1.00
Primary school	80	2.80
Active recreation reserve	90	14.40
Neighbourhood parks	30	62.89
Open space	10	3.43
Residential area	50*	681.38

* Covenants and building envelopes will minimise the area cleared within individual lots (see Section 2.2.3)

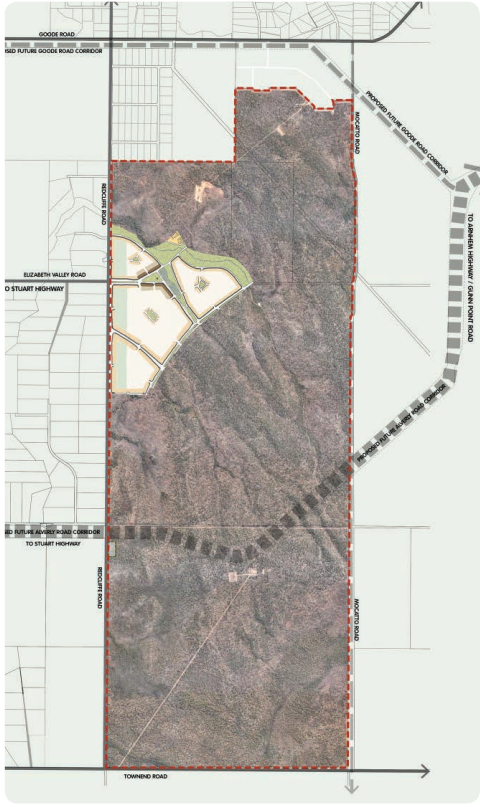
Table 2-3. Preliminary calculations of the area of the project site that will be impervious (upper limit)

Project component	% of area	Approx. area (ha)
Road reserves	50	262.07
Enterprise area	70	192.05
Rural activity centre	90	7.20
Community centre sites	90	0.90
Primary school	50	1.75
Residential area	1000 m ² per envelope	419.30

2.3.6 Staging

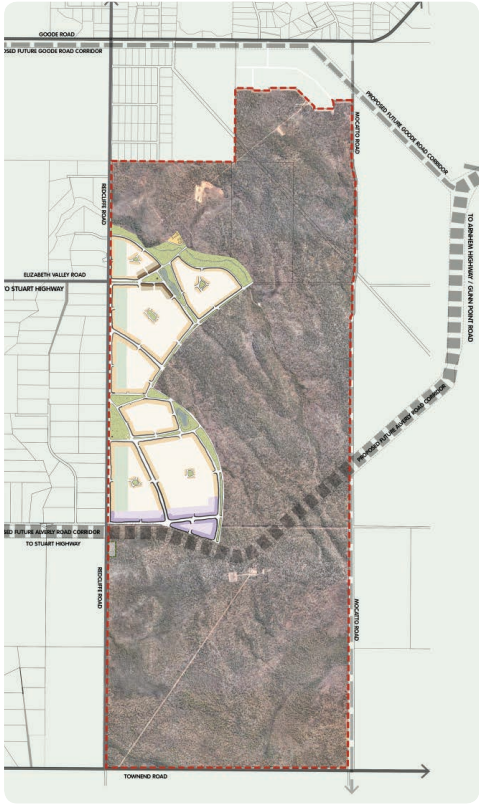
It is envisaged that the development will be completed over the course of 30 years – possibly longer – with approximately 150 – 200 lots/homes sold and constructed each year (see Figure 2-8). This time frame is dependent on market drivers, as well as population and economic growth in the region.

The first stage will involve the release of 400 lots and the commencement of Village One. A primary school, community centre, community garden, corner store and cafe are proposed to be available to both existing surrounding residents and the new community in the first stages of development. It is envisaged that the primary school could be established temporarily in the local shopping centre until population density and demand warrant the Department of Education to invest in a permanent school facility. The land for this, however, will be set aside within Stage 1. Each stage of development will be co-ordinated with the timely provision of services, infrastructure and employment opportunities – see relevant sections below regarding the staging of head works and associated infrastructure.



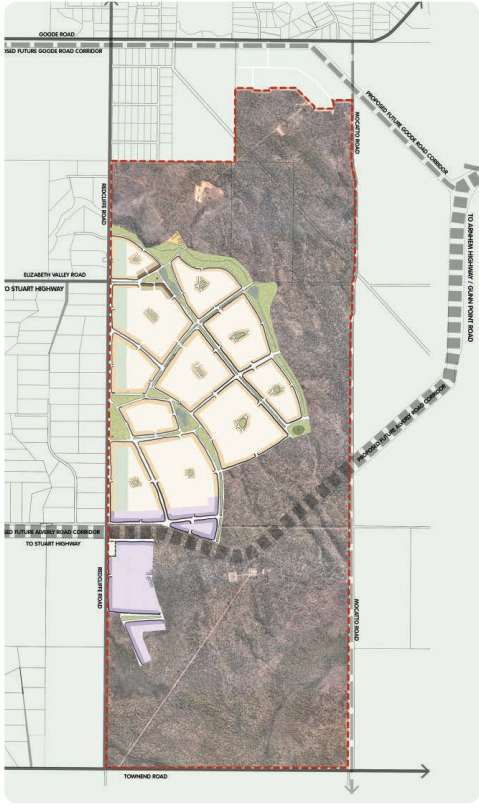
0 - 3 YEARS

 320
 870



4 - 7 YEARS

 730
 1,980



8 - 11 YEARS

 1,200
 3,200



12 - 14 YEARS

 1,850
 5,000



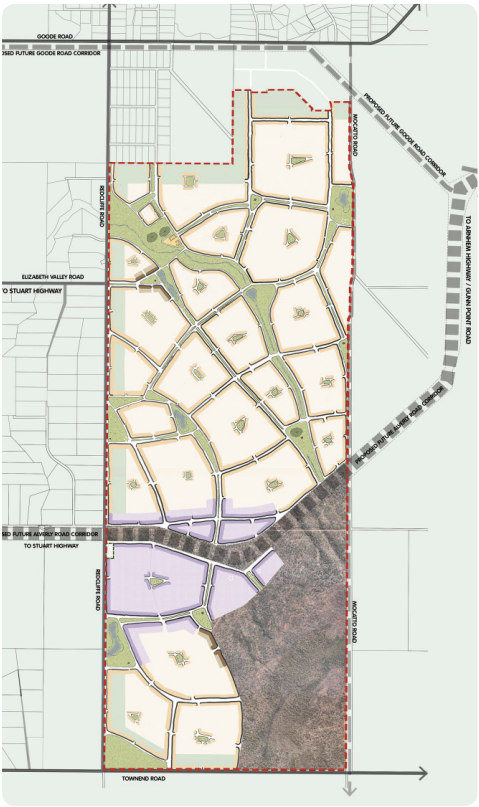
15 - 18 YEARS

 2,410
 6,500



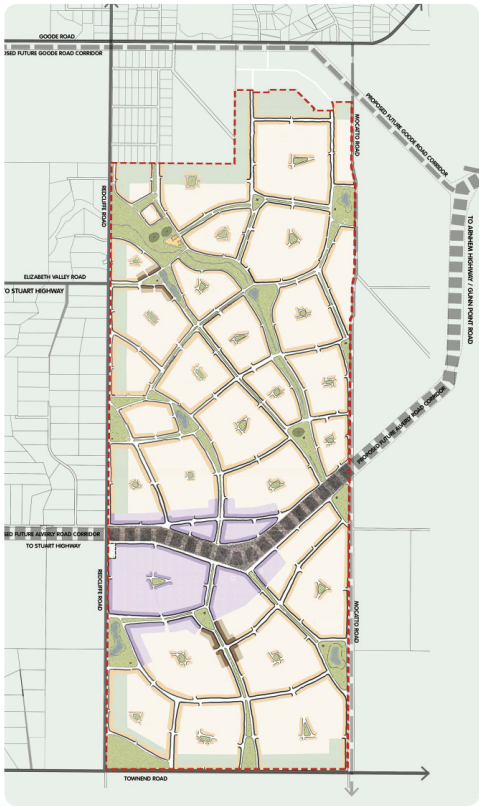
19 - 22 YEARS

 2,755
 7,450



23 - 26 YEARS

 3,365
 9,100



27+ YEARS

 4,200
 11,000

Figure 2-8. Maps showing the staging of the development (indicative)

2.3.7 Responsibility

Construction of each stage of the development will be undertaken by a civil contractor. Following construction, the responsibility for the maintenance and upkeep of infrastructure and open space will likely lie with Intrapac for a period of 'on maintenance', before responsibility being completely handed over to the relevant authority ('off maintenance'). Management of green spaces is discussed in Section 2.2.4.

2.4 TRANSPORT

The information for this section comes from the *Traffic Impact Assessment* (TIA) in Appendix C1.

Prior to the TIA being undertaken, a stakeholder workshop was undertaken on March 2, 2015 to discuss the development proposal, as well as the key inputs and assumptions. The workshop included representatives from the Department of Transport (DoT) – both the Transport Infrastructure Planning Division and the Passenger Transport Division – and Litchfield Council. This workshop built on initial consultation with DoT in 2013.

Prior to approval of each subdivision (stage), Intrapac will need to have the approval of the Department of Transport and/or the Department of Infrastructure (DoI) with respect to the design and undertaking of roadworks and associated earthworks, drainage works, verges, pathways, street lighting, and street-scaping for all roads associated with the development. In addition, a condition is generally placed on the subdivision development permit requiring the provision of plans – to the satisfaction of the relevant authority – and approval of the plans by this authority, prior to commencement of works.

2.4.1 Planned infrastructure

There are several road schemes being considered for the future road network as discussed with the DoT during the stakeholder workshop. All potential road schemes proposed by NT Government are preliminary concepts with no planning or design undertaken to date. The main road scheme in the vicinity of the study area is a high-capacity road link between Stuart Highway and Palmerston via Channel Island Road, providing an alternative to Stuart Highway. It is assumed that this link join up with Elizabeth Valley Road. This alignment is likely to encourage motorists from the Noonamah Ridge village centre (off Elizabeth Valley Road) to use this new road link. If the new road link approaches Stuart Highway from further south (closer to Cox Peninsula Road), a large proportion of traffic generated from Noonamah Ridge and other potential developments is still likely to use Stuart Highway to access Palmerston.

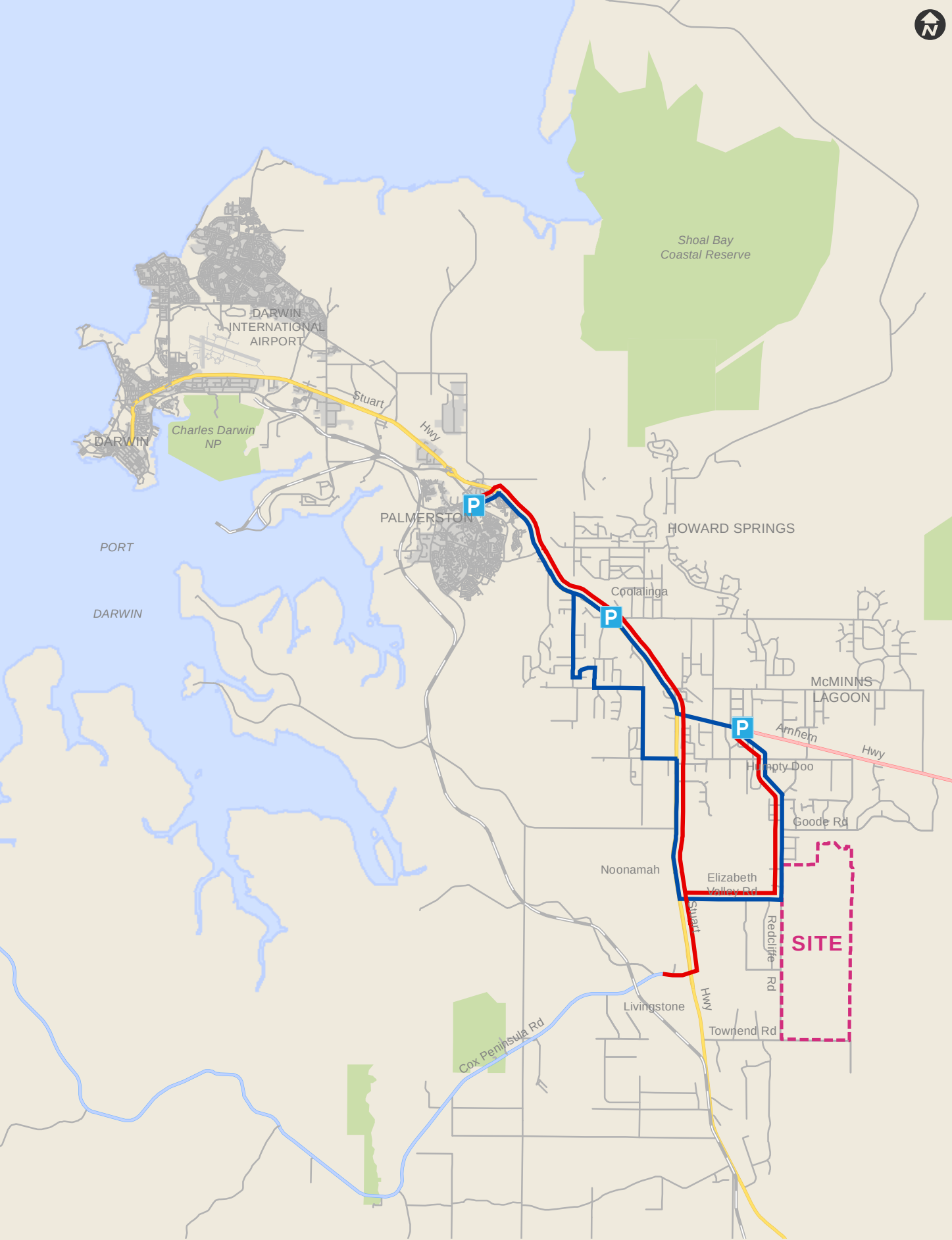


Figure 2-9. Map of existing bus networks

2.4.2 Existing capacity

Infrastructure

Figure 2-10 shows the existing road hierarchy and overall road network within the local area. The Stuart Highway – a key road within the study area – is a National Highway and only 3.5 km (closest point) from the project area.

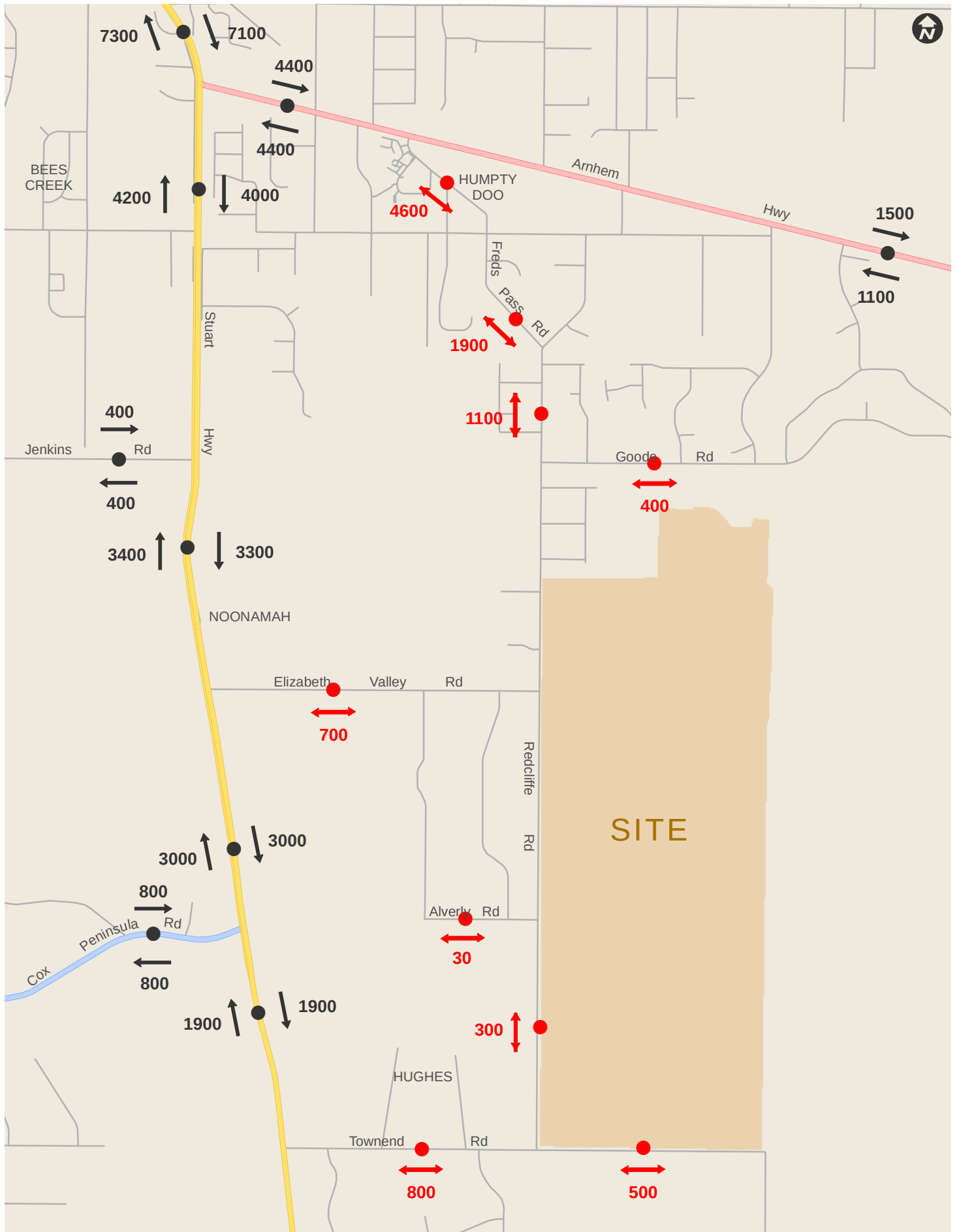
Volumes

Figure 2-11 summarises the current daily traffic volumes (i.e. numbers of cars) at key survey locations surrounding the project area. The data shows a typical daily traffic profile with distinct peaks at approximately 7 – 8 am and 4 – 6 pm (evening peak hour is 5 – 6 pm) – as graphed in Figure 2-10. The Stuart Highway (north of Cox Peninsula Road) and Arnhem Highway (west of Humpty Doo) have moderate traffic volumes with more than 3,000 vehicles per day per direction. Traffic volumes are otherwise generally quite low due to the rural setting.



Figure 2-10. Graph of hourly traffic profile over a 24-hour period

(recorded at the Stuart Highway/Arnhem Highway intersection)



Legend

- One-way daily traffic volume
- Two-way daily traffic volume

- National Highway
- State Arterial
- Secondary Road
- Local Road

Figure 2-11. Map showing the existing local road network and daily traffic volumes

0 1 2 Km

Bus routes

Two bus routes currently provide services from Palmerston to the project area, as shown in Figure 2-9. These services are:

- Bus Route 440 – Humpty Doo Park and Ride via Coolalinga Park and Ride, Virginia, Noonamah and Palmerston.
- Bus Route 445 – Humpty Doo Park and Ride to Palmerston via Cox Peninsula, Noonamah, and Coolalinga Park and Ride. This route follows a diverted route during school terms to allow it to go via Bees Creek School and Litchfield Christian School within Freds Pass.

Both bus routes primarily travel along the Stuart Highway. Bus stops are spaced along each route, though it is identified that the region allows for “Hail ‘n’ Ride” operation outside of these designated stops where it is safe to do so. In addition, three Park and Ride stops are serviced by each route. These are Humpty Doo Park and Ride, Coolalinga Park and Ride, and Palmerston Interchange, all of which include lockable bike enclosures as part of their facilities.

Services are provided for both routes Monday to Saturday, with neither having timetabled services on Sundays or public holidays.

Pedestrian

There are no footpaths or shared use paths in vicinity of the project area due to the existing rural conditions and lack of development.

Bicycle

An extensive network of shared use paths exist in and around the greater Darwin region that provides connections within Darwin city, suburbs, Palmerston and along the Stuart Highway until Arnhem the Highway. These paths provide facilities for cyclists and pedestrians as off-road or separate paths.

At present, no shared user paths are provided near the project area. A short length of isolated, shared user path is located along Arnhem Highway near Humpty Doo.

2.4.3 Expected project volumes

Noonamah Ridge is designed to be relatively self-contained in the provision of residents’ daily needs (including education, recreation and employment, as well as daily necessities) thereby reducing the number of vehicle trips required to leave Noonamah Ridge. Of the total trips generated by the land uses within the development, a certain amount will stay within the development – ‘internal trips’, and the remainder will either leave the development to a surrounding area – ‘in-out external trips’ or arrive to the development from a surrounding area – “out-in external trips”.

Figure 2-12 and Figure 2-13 show the results of modelling the internal and external trip split by stage for the AM and PM peak hours, respectively. Both of these figures indicate a fairly consistent number of internal trips in the first four stages. During this time, the main growth is in residential, without an accompanying growth in jobs and retail attractors. Therefore, the additional population up to Stage 4 will mainly look outside the development to satisfy their employment and shopping demands.

At Stage 5 – when the enterprise area is proposed – there will be a marked growth in total trips. This stage will create many new jobs, which may be filled by residents of the development who have moved in during Stages 1 – 4. This creates a step increase in internal trips between Stage 4 and Stage 5. It should be acknowledged that there may be a period where it is more balanced between Stage 4 and Stage 5; however, as the enterprise area becomes more established, the rate of generated trips is expected to steadily increase. As Stage 6 and 7 come in, most of the additional trips are external to Noonamah because of a similar principle to the Stages 1 – 4 growth, whereby there is not an accompanying increase in jobs and retail to service the new residential areas.

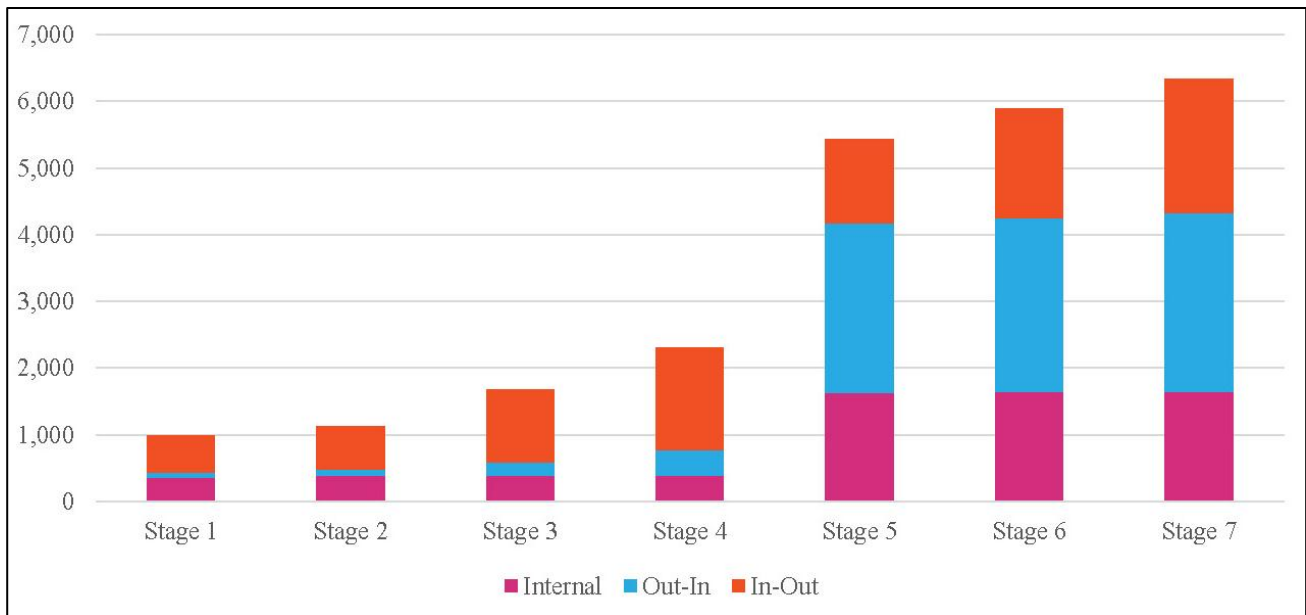


Figure 2-12. Modelling the internal and external split by stage for the AM peak hour
(the enterprise area is proposed to be developed in Stage 5)

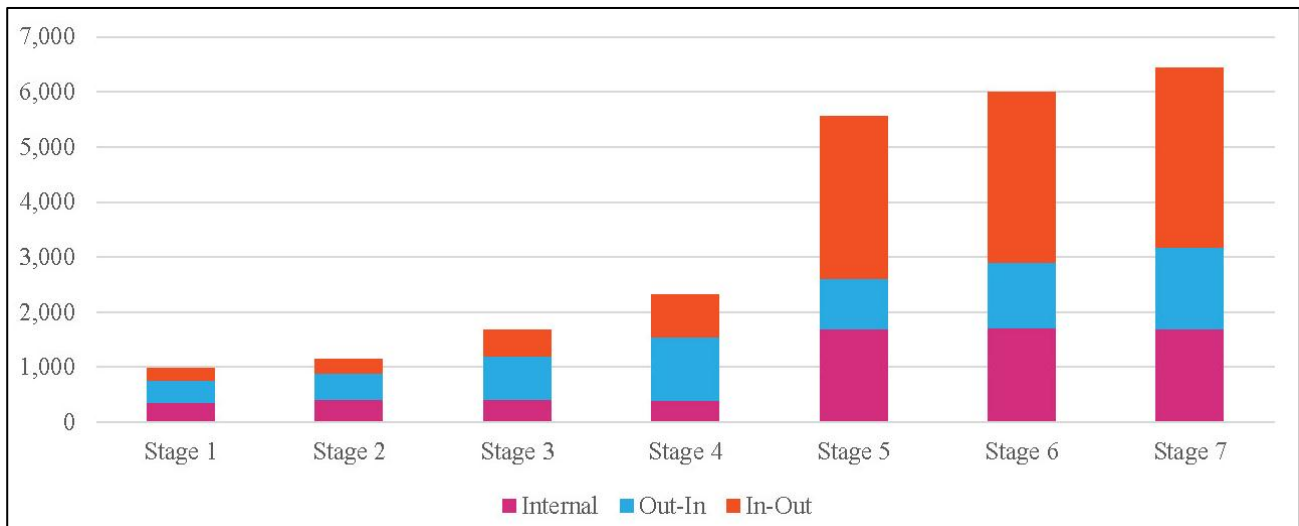


Figure 2-13. Modelling the internal and external split by stage for the PM peak hour
(the enterprise area is proposed to be developed in Stage 5)

2.4.4 Proposed infrastructure

Considerations

The location of the project area suggests a significant reliance on private vehicle access for trips to and from the area. New access roads within the project area are required to enable development of Noonamah Ridge. Across the area, multiple access roads will be required to ensure sufficient capacity is provided for the anticipated number of trips, and spaced to maximise access to the regional road network – reducing travel distances. Multiple access points also promote route choice, which offers network resilience benefits.

For external trips, private car use is likely to be the predominant mode of transport choice for residents of Noonamah Ridge in the short and medium term for making external trips. In the long term, the transport network will need to respond to the predicted increase in walking, cycling and public transport use that is demonstrated in other suburbs of Darwin.

As employment onsite increases this will alter the balance of movement patterns, encouraging greater bi-directional travel during the peaks. For residents employed elsewhere in Darwin, a relatively low number can be expected to use bus services linking Noonamah with the rest of Darwin.

Internal road infrastructure

The proposed street network within the development is highly interconnected and allows for direct access to neighbourhoods, reducing the need for traffic on local collector roads. Streets will be designed to enhance the character of the area and to accommodate private vehicles, service vehicles, public transport (buses), cyclists and pedestrians. Streets within each of the rural activity centres and the enterprise area will be attractively designed.

The main access to the rural activity centre is proposed as either an extension of Elizabeth Valley Road or via an access road 800 m north of Elizabeth Valley Road. Street connections from the north side to the south side of the Alverly Road corridor will be created using underpasses or bridges.

There are two hills on the approach to the Redcliffe Road/Elizabeth Valley Road intersection, resulting in vertical curvature of these roads and potential sight distance issues for motorists approaching the intersection. Given this may be one of the main access points to the rural activity centre, an assessment of the current road conditions (in terms of stopping sight distance and road gradients) will be undertaken at a subsequent design stage.

External road infrastructure

Modelling shows that six intersections and a number of roads will require upgrades as a result of new road schemes and access roads into the development. Figure 2-14 shows the assumed implementation stage for each new road and upgraded intersection within the study area. The timings of these upgrade requirements (i.e. the corresponding stages of the Noonamah Ridge development) are as follows:

- Stage 1**
 - Goode Road between the Stuart Highway and Redcliffe Road
 - Alverly Road between the Stuart Highway and Weaver Road
 - Intersection of Redcliffe Road/Goode Road (new east arm)
 - Intersection of Redcliffe Road/Elizabeth Valley Road (new west arm)
 - Intersection of Stuart Highway/Jenkins Road/Goode Road (new west arm)
 - Intersection of Stuart Highway/Cox Peninsula Road/Alverly Road (new east arm)
- Stage 2**
 - Mocatto Road (north section)
- Stage 3**
 - New road link between Palmerston and the Stuart Highway
 - Mocatto Road (central section)
 - Intersection of Stuart Highway/Elizabeth Valley Road/New Palmerston Link (new west arm)
- Stage 4**
 - None required

- Stage 5**
- Alverly Road between Redcliffe Road and east of the study area
 - Mocatto Road (south section)
 - Intersection of Redcliffe Road/Alverly Road (new east arm).

Road upgrades external to the project area are the responsibility of NT Government, and therefore assessment of the potential environmental impacts of these works is not within this scope of this EIS.

Public transport

Current public transport services adjacent to the site are of a very low frequency and coverage given the largely rural nature of the area. To enable connection to other areas within the greater Darwin region, extensions to existing bus services will be investigated prior to development (see Figure 2-16). Investigation of the feasibility of extending bus routes would be undertaken in conjunction with the NT Government and private bus operators.

Additional general bus requirements that are proposed to be implemented as part of the development include:

- Park and Ride bus service being provided at the development as part of Stage 1, with the intent that a longer-term bus interchange be provided (as the development grows).
- Increasing service frequency and operating hours of existing services to Palmerston.
- Introducing a new direct service between the development and Darwin CBD.
- Bus routes being provided within 600 metres of 90 % of dwellings within the development.

Pedestrian facilities will to be provided along with the bus infrastructure to ensure that safe access routes were available between residential dwellings, activity centres and bus stops.

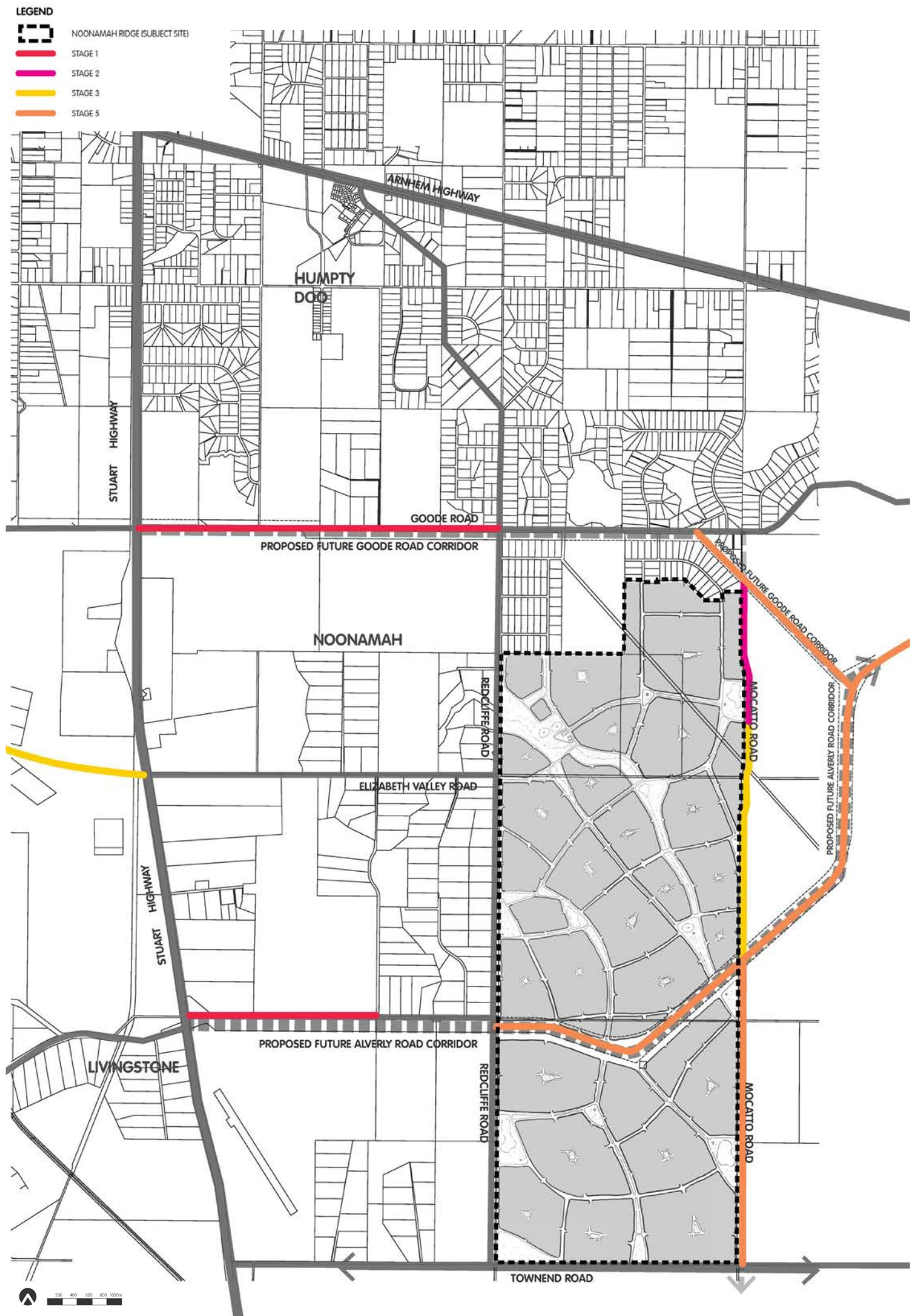


Figure 2-14. Map of proposed future road scheme

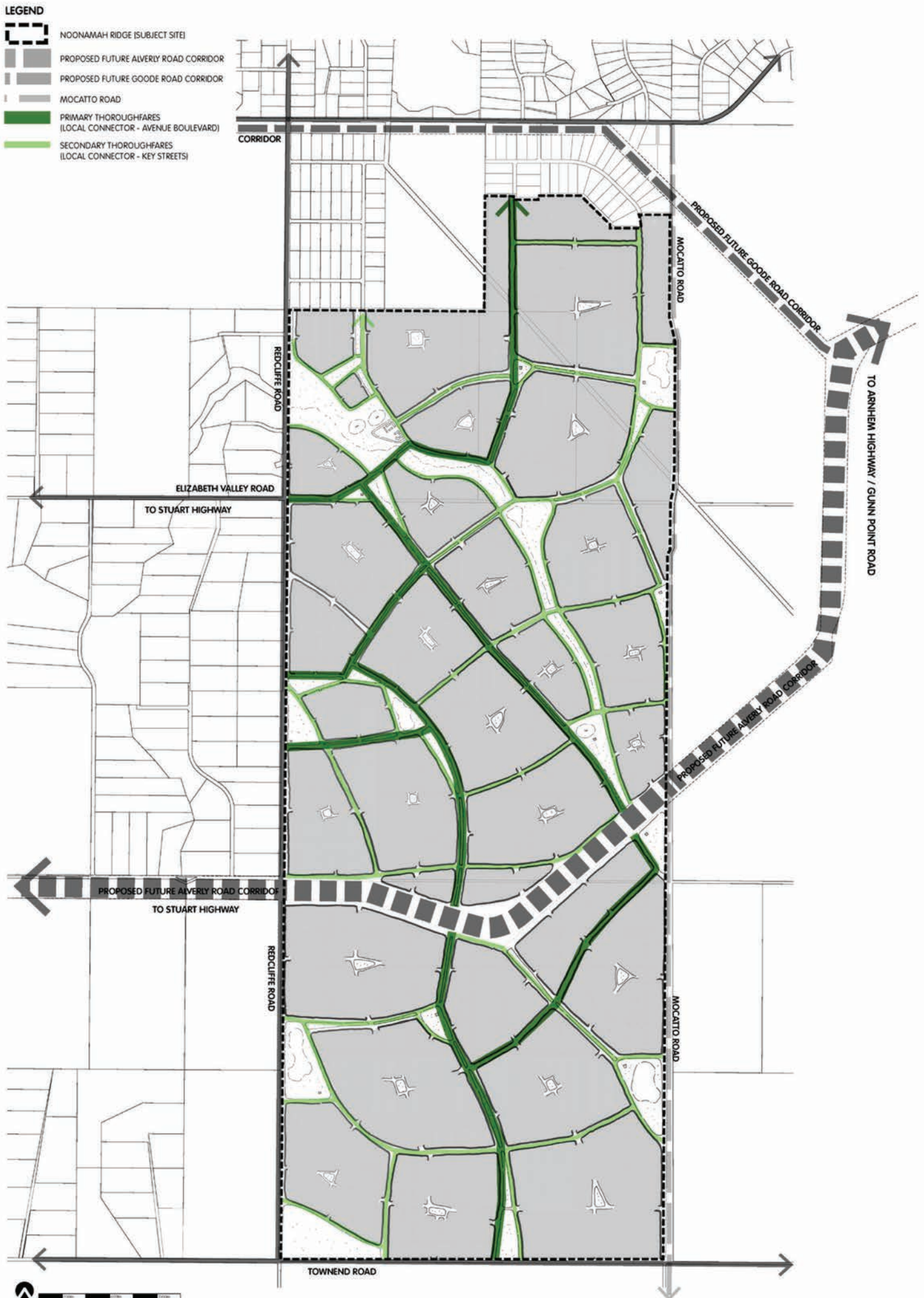


Figure 2-15. Map of road network (indicative)

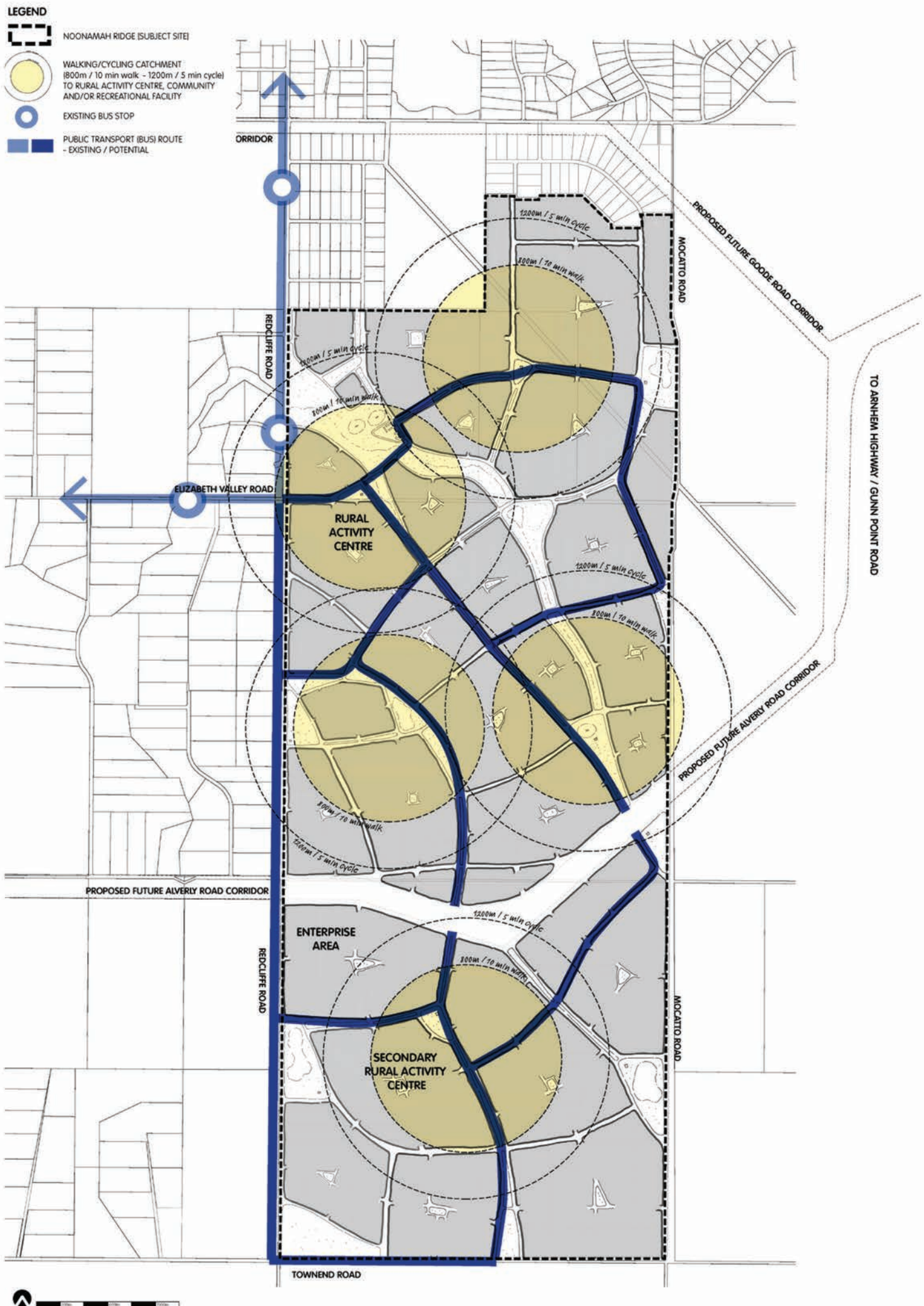


Figure 2-16. Map of internal public transport network (indicative)

Cycling

Good quality pedestrian and cycle facility provision is essential for future-proofing the development as it increasingly develops over time. The mixed land uses proposed on the site offer opportunity for commuting, school trips and leisure trips to take place on foot, on bicycles and on public transport. Ensuring that facilities, or space for future facilities, are included in road design will enable the development to provide a truly multi-modal transport network.

The existing bicycle/shared path network finishes prior to the intersection of the Stuart Highway and Arnhem Highway to the north-west of the project area. To encourage residents of Noonamah Ridge to make active transport choices, cycle or shared paths will be provided within the site as part of each development stage, extending the previous network as required (see Figure 2-17). This would provide a secondary network connecting residential areas, activity and community centres, and recreation areas such as green spaces and parklands.

In addition to the localised network within the project area, extensions to the regional shared path network will be investigated to provide links to surrounding local activity centres, Park and Ride stops, and the city centres of Darwin and Palmerston. Other key cycling improvements that are proposed include:

- Core on-road cycle path network connections to employment precincts.
- A wider off-road bicycle path network.
- Bicycle trip-end facilities at key land use destinations.

Pedestrian

Pedestrian paths will be provided to ensure connectivity, in particular within the project area (see Figure 2-17). Further to this, pedestrian connections will be provided to bus stops and local activity centres – including installing crossing points where required.

Other pedestrian infrastructure improvements that are proposed include:

- A connected network of footpaths providing access to key land uses and centres.
- Pedestrian crossing facilities standard at traffic signals and on key desire lines.
- Longer term upgrades to the pedestrian environments in areas of high activity.
- Road cross-sections in urban areas that allow for one paved pedestrian footpath as a minimum and which safeguard space for future paved footpaths on both sides.

2.4.5 Staging

Internal roads, public transport, cycling and pedestrian infrastructure will be constructed as required for each stage of the subdivision. For the proposed staging of external road upgrades to facilitate connections to the internal road network, see previous sections.

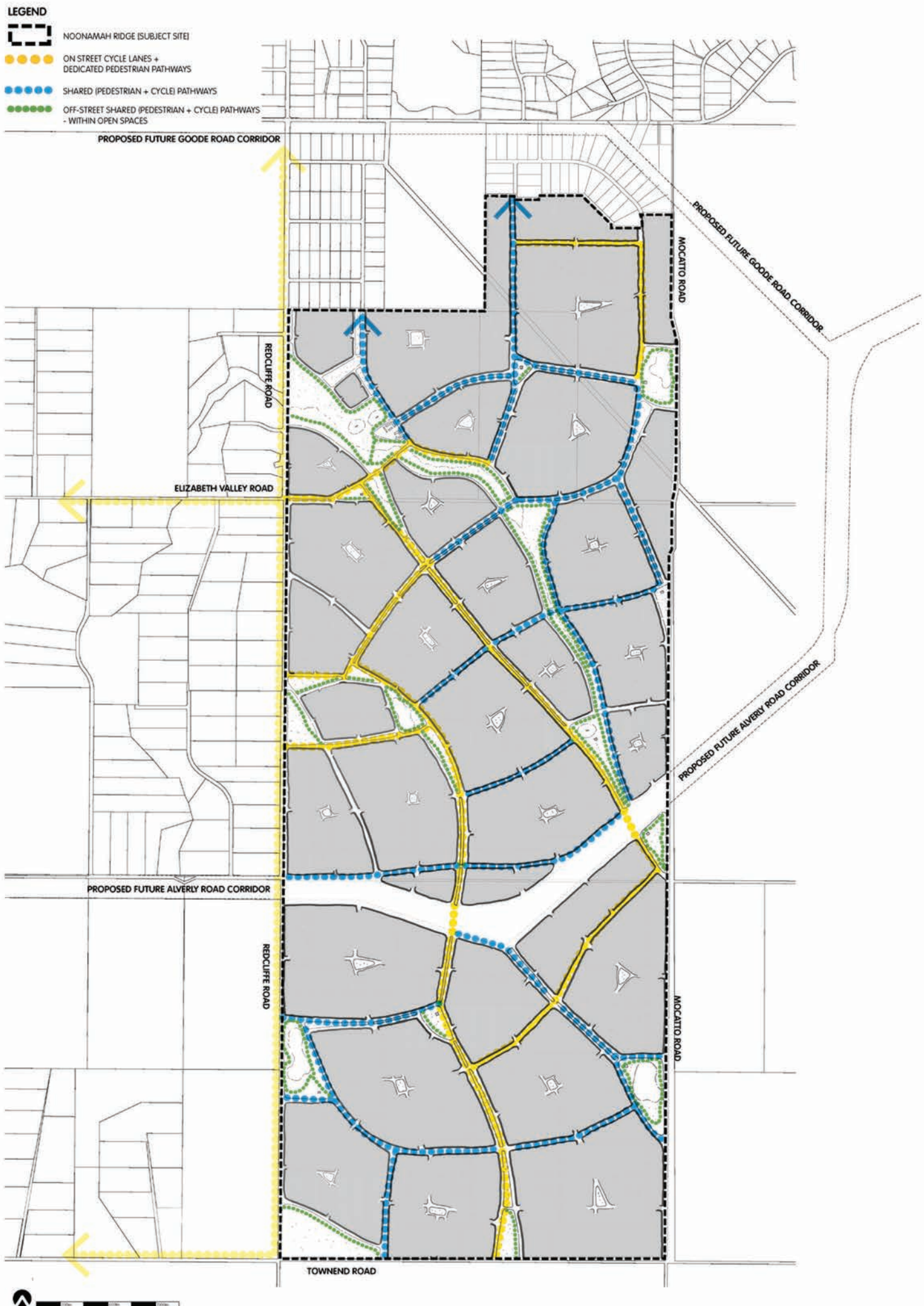


Figure 2-17. Map of internal cycling and pedestrian network (indicative)

2.4.6 Relevant approvals, standards and conditions

The *Litchfield Council Development Guidelines C – Road and Pathway Requirements* (2014c) stipulate how roads should be designed and constructed within subdivisions. The guidelines state that road designs must conform to the relevant current Australian Standards, AustRoads, Australian Road Research Board and all other relevant publications.

An approved Traffic Management Plan is required in accordance with *AS 1742.3-2009 – Manual of uniform traffic control devices – traffic control for works on roads* prior to the commencement of any works in an existing road or road reserve. Where relevant, a 'Permit To Work Within A Road Reserve' is also required from Litchfield Council.

Prior to approval from Litchfield Council, Intrapac will need to have the approval of the DoI with respect to the design and undertaking of roadworks and associated earthworks, drainage works, verges, pathways, street lighting, and street-scaping for all roads associated with the development.

2.4.7 Responsibility

All internal roads will be constructed by Intrapac with ongoing maintenance by Litchfield Council. External road upgrades for works not associated with the development are the responsibility of the DoI. Where upgrades to external roads are required to service the proposed development, an appropriate level of contribution will be required by Intrapac. This could take the form of development contributions or direct construction; however, it will be determined at each subdivision stage through appropriate conditions placed on the development permit by the responsible authority.

As outlined in Section 2.4.6, the development will need to comply with Litchfield Council's subdivision design guidelines. Following satisfactory completion, Litchfield Council will assume responsibility for the ongoing ownership and maintenance of road infrastructure, as well as public open space and community infrastructure such as bicycle paths. This is in accordance with the *Local Government Act*.

Bus shelters and other infrastructure related to public transport will be constructed to the requirements of the DoT, and ownership will be ceded to the NT Government, along with responsibility for the long-term maintenance of this infrastructure, unless alternate arrangements are agreed to at a subdivision application stage.

2.5 ELECTRICITY

Power and Water Corporation (PWC) was consulted to obtain information on existing electrical infrastructure and future interconnection requirements, and to clarify its role and responsibilities in servicing the development with power – see Consultation Register in Appendix N.

Prior to the approval of each subdivision (stage), Intrapac will have to demonstrate to both PWC and Litchfield Council that there is sufficient electricity to supply the new subdivision without impinging on the supply to existing users. In addition, a condition is generally imposed on the developer by the responsible authority in relation to the ensuring that required upgrades to electrical infrastructure to support the development will be undertaken, prior to commencement of works.

2.5.1 Existing infrastructure

The existing PWC network in the rural area is a 22 kV overhead power line that runs along Redcliffe Road. There is minimal spare capacity in the existing PWC network and, as such, it is inadequate for servicing the whole development.

2.5.2 Planned infrastructure

A new substation (Strangways Zone Substation) is currently under construction and due to be commissioned in the next 12 months. It is adjacent to the existing McMinns Zone Substation located at the Stuart Highway/Arnhem Highway intersection.

In addition, Intrapac is of the understanding that PWC might consider in the long term establishing a zone substation near Noonamah Ridge that would be interconnected to the existing 66 kV transmission line via a new 66 kV transmission line extension. The zone substation would be located close to the main/high load area, with a recommended location being near the Alverly Road/Redcliffe Road intersection. Allocation of land for this substation within the Noonamah Ridge development may be needed and will be the subject of further consultations with PWC.

2.5.3 Expected project demand

The estimated load allocations for the development are classified as ‘basic supply’. These are the loads to be used as part of the subdivision design for lot servicing.

PWC load allocations’ standards are as follows:

- Single Dwelling (SD) lot – 10 kVA single phase
- Rural Residential (RR) lot – 10 kVA three phase
- Multiple Dwelling (MD) lot – 22 VA per m².

For the purposes of calculating baseline electricity loads for this development, broad assumptions have been made of the number of different lot types. The lot numbers below do not reflect the final lot make-up, as that will be subject to further detailed design work at subdivision stage based on land capability and land suitability, as well as community consultation. Instead, SD lots in this instance refer to all lots between 800m² and 3,999m², which are subject to further subdivision limitations under the proposed Specific Use Zone (as detailed in Section 1.6.6). MD lots refer to the provision of retirement living, duplex allotments close to the village centres and shop-top living. From these, the load allocations are estimated as follows:

- SD lots (1,155 lots) – 3.81 MVA
- RR lots (3,000 lots) – 30 MVA
- MD lots (50 lots) – 1.65 MVA
- School/Commercial precinct – 2.5 MVA (estimated).

Based on the above load allocations, the total basic supply equates to approximately 37.96 MVA. This is the loading that would be used to size electricity reticulation throughout the development – including substation sizing. For sizing of feeders to the subdivision, diversity is used and the diversified total load is 21.11 MVA.

PWC would be responsible for ensuring contingency measures were in place to safeguard the electricity supply during extreme weather events and to maintain supply during times of high demand.

2.5.4 Proposed supply strategy

The proposed subdivision can be serviced with the provision of up to three dedicated feeders – one overhead and two underground (see Figure 2-18) – with the requirement for the second underground feeder to be assessed during the later stages of development. These are the minimum requirements for the development – during preliminary design a higher requirement may be imposed on the development.

The proposed dedicated feeders will have the following approximate ratings:

- 22 kV overhead (Neon) – 8.8 MVA (11 km route)
- 22 kV underground (Aluminium 400 mm²) – 12.8 MVA (14.2 km route)
- 22 kV underground (Aluminium 400 mm²) – 11.2 MVA (17.1 km route).

Total capacity of the three feeders (based on a 70 % loading) is 22.96 MVA, which accounts for the estimated diversified total load of 21.11 MVA.

The proposed reticulation within the project area would consist of a 22 kV underground supply.

It has been communicated to Intrapac that PWC's preferred power supply solution is for Noonamah Ridge to be connected to the Strangways Zone Substation which is currently under construction, and that there is capacity for at least two feeders to be connected for such a purpose.

2.5.5 Staging

Due to the higher cost of the underground feeder, it is likely that the overhead feeder will be provided before the underground feeder; and that the underground feeder will then be provided once the load on the overhead feeder reaches a maximum acceptable level to PWC as a single dedicated feeder (around 70 %). Assuming that 200 lots are developed per year it is expected that the underground feeder would be required in the 7th or 8th year of the development.

Approximately 4 km section of Redcliffe Road currently has no high voltage reticulation and therefore, as part of this development, it is expected that for this length a new overhead 22 kV will be required to be constructed. Additionally, a section of Goode Road is currently only a road reserve (with no existing road). As part of the construction of the new access road, a new 22 kV overhead will need to be constructed.

A third feeder (if required) would be constructed in a later stage of the development and would be assessed in relation to the actual load on the first two feeders, as well as whether other users external to Noonamah Ridge have connected to the other two feeders.

2.5.6 Alternative supply options

One aim of the project is to challenge the traditional ways of servicing developments and to find viable solutions to reduce the emission of greenhouse gasses and the dependency on fossil fuels.

The project will look for opportunities to use solar energy to reduce the demand for electricity across the development. As solar technology improves and becomes more efficient, Intrapac will involve the community, PWC and Litchfield Council in identifying areas where solar technology can be efficiently used to service schools, dwellings, commercial buildings and recreational areas. Energy may also be sourced from the sewerage system. Intrapac will assess new products and suppliers to determine which technology can be adopted, and in which stage of the project these technologies can be implemented.

As in any significant project, the implementation of new green technology will require a strong collaboration with the authorities and a whole-of-life cost-benefit analysis. Intrapac will also consider managing the supply of energy to the site – as a new utilities' provider – if feasible and approved by the relevant authorities.

2.5.7 Relevant approvals, standards and conditions

Approvals for the proposed electricity supply network will occur through the subdivision and development approval processes administered under the *Planning Act*. Prior to approval from Litchfield Council, Intrapac will need to have the approval of PWC with respect to electricity arrangements within the development.

2.5.8 Responsibility

Intrapac will be responsible for the design and construction cost of the required feeders (external to the project area). Once constructed, these feeders will become PWC assets and, as such, Intrapac will no longer have control over the connected load.

As is typical in a land development project of this nature, Intrapac will install the internal power distribution network to the satisfaction of PWC and cede this infrastructure to the responsible authority on completion. Intrapac is also investigating the opportunity to own, manage and maintain the electrical infrastructure as a utility provider, if possible.

PWC is responsible for approving the electrical infrastructure works required to service the development, as well as for servicing and maintaining infrastructure once in place.

LEGEND

-  NOONAMAH RIDGE (SUBJECT SITE)
-  PROPOSED OVER HEAD POWER (FEEDER 1)
-  PROPOSED UNDER GROUND POWER (FEEDER 2)
-  PROPOSED UNDER GROUND POWER (FEEDER 3)

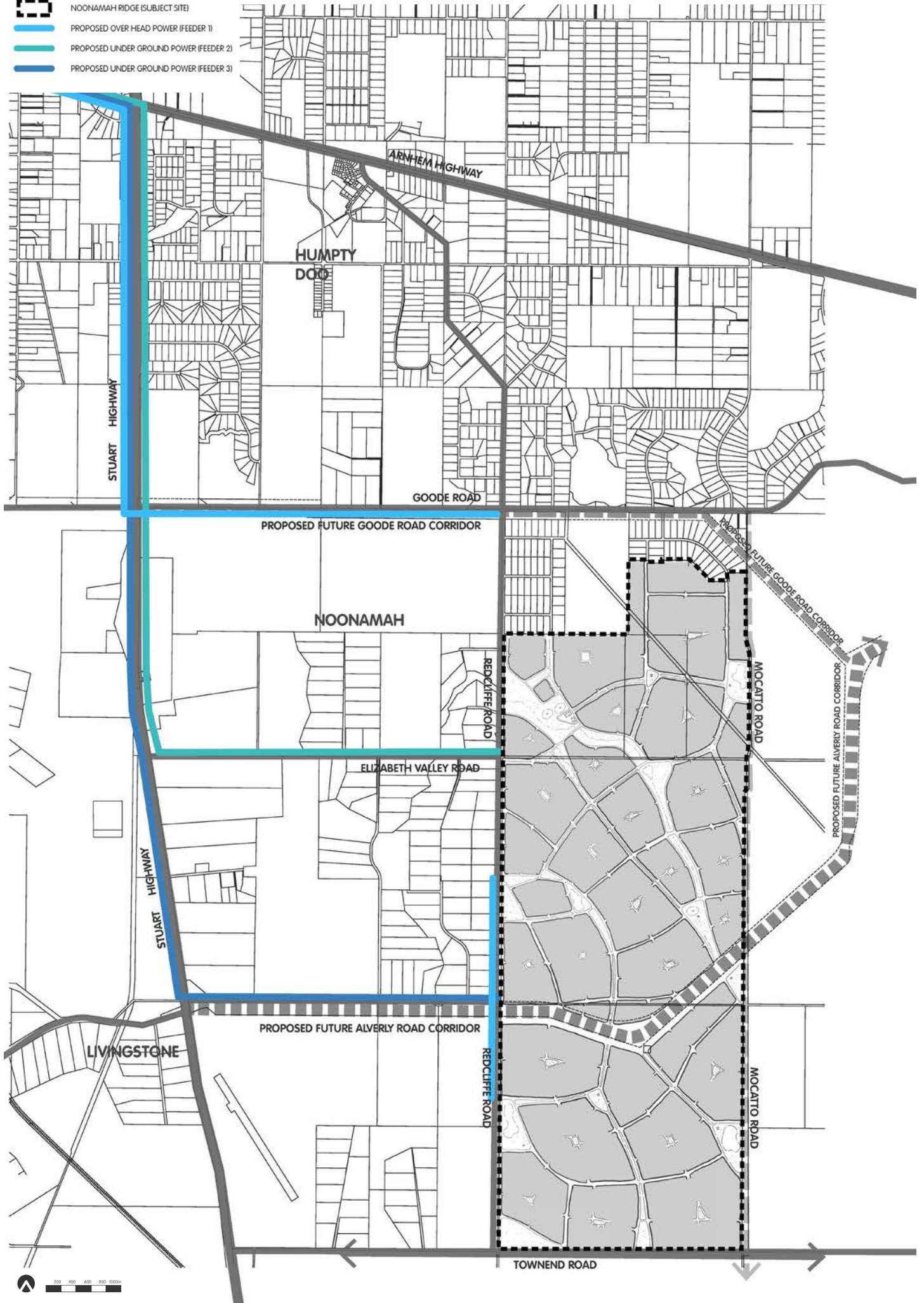


Figure 2-18. Map of electrical headworks (indicative)

2.6 STREET LIGHTING

Litchfield Council planning requirements stipulate that a developer shall provide street lighting – including lighting of traffic management treatments, external works, parks, walkways, footpaths, shared paths and other public areas of the proposed development. This lighting must be in accordance with Australian Standards for illumination level, materials and installation, and the requirements and specifications of council and PWC. Lighting design should be in accordance with *AS/NZS 1158.1.3-1997 – Road lighting – Vehicular traffic (Category V) lighting – Guide to design, installation, operation and maintenance* (Standards Australia 1997) and with AustRoads guidelines.

For Noonamah Ridge, no overhead streetlights will be used. Low/ground level lighting will only be provided in the rural activity centres and on roads where the average lot size is 2,000 m² or smaller. In transition areas between peri-urban and rural areas, the option of sensor-lighting (i.e. that which comes on in response to car movement triggers) will be considered.

According to *Litchfield Council Development Guidelines D – Lighting* (2014d) street lighting design in urban, commercial, industrial, and rural residential subdivision of less than 2 ha lots is to meet the following criteria:

- Intersections, cul-de-sacs, traffic calming devices and pedestrian crossings shall be directly lit.
- Lights are to be placed opposite to the boundaries of allotments where possible.
- Minimise the light shining into private properties.
- Lamps are to be the highest energy efficient.
- Lighting is to be designed considering the adjacent surrounding areas and to minimise future maintenance costs.

For pathway and open space lighting:

- Lights are to be placed at each end and each bend of a walkway – and at appropriate intervals in between – and to comply with standard illumination minimum levels.
- Mature development of street trees shall be accommodated.
- All open space areas intended to be used or traversed at night should allow appropriate levels of visibility and conform to Crime Prevention Through Environmental Design principals.
- Lighting should be designed so that it is resistant to vandalism.
- Alternatives to reticulated power should be considered (e.g. solar, battery etc.).

2.7 TELECOMMUNICATIONS

Telstra was consulted to obtain information on existing telecommunication infrastructure and to clarify their role in servicing the development with telecommunications (see Consultation Register in Appendix N).

2.7.1 Existing infrastructure

An underground Telstra cable runs along Alverly Road, crosses Redcliffe Road and continues up the firebreak to service the existing telecommunications tower (see Figure 2-18 above).

2.7.2 Planned infrastructure

As telecommunications services are provided on an 'as needs' basis, there are no current plans for expansion of the existing infrastructure.

2.7.3 Proposed supply strategy

Intrapac will coordinate with the relevant authorities to provide a system of pipes and pits throughout the subdivision area to enable the National Broadband Network Corporation (NBN Co) to pull through fibre optic cable as part of each individual stage of works.

2.7.4 Staging

The Noonamah Ridge development is classed by NBN Co as a 'large' development because it is over 100 lots. When detailed design commences, the development will be registered with NBN and will consequently be issued by them with a Master Developer Agreement. As the development continues, each stage will be registered to ensure that infrastructure is provided.

2.7.5 Relevant approvals, standards and conditions

Telecommunication infrastructure design will be carried out in accordance with the standards and conditions set by Telstra and NBN Co for new subdivisions. Prior to approval from Litchfield Council, Intrapac will need to have the approval of Telstra with respect to telecommunications arrangements within the development.

2.7.6 Responsibility

The federal government released the *Telecommunications Infrastructure in New Developments Policy* on 27 May 2015. The policy requires developers to:

- Be directly involved in the provision of telecommunications for their development.
- Contribute to the cost of telecommunications infrastructure, including where Telstra is deploying copper access infrastructure, and where the network infrastructure is being provided by NBN Co or Telstra in its capacity as the Infrastructure Provider of Last Resort (IPOLR).
- Recognise that, where it applies, Telstra's IPOLR obligation is to offer a commercial solution to a developer.
- Recognise that where they choose a party other than Telstra or NBN Co to build infrastructure in their development, the alternative provider becomes responsible for providing infrastructure and services to all premises in the development, and Telstra is not required to install fixed line infrastructure or use alternative provider infrastructure to offer its retail services.

2.8 POTABLE WATER

Section 3.6 and Appendices E, F and G should be referred to for details on the surface water and groundwater hydrology within the project area.

PWC and DLPE were consulted to obtain information on existing and planned water supply infrastructure, and to identify PWC's involvement and role in future connections with the development – see Consultation Register in Appendix N.

Prior to the approval of each subdivision (stage), Intrapac will have to demonstrate to both PWC and Litchfield Council's that there is sufficient potable water to supply the new subdivision without affecting the supply to existing users and/or the environment.

2.8.1 Existing infrastructure

There is no water infrastructure within the project area. Residential allotments near the site are serviced with individual groundwater bores. There is one DN300 and one DN375 pipe running along the Stuart Highway 3 km west of the development; however, these pipes are not able to accommodate an increase in pressure.

PWC has advised that the existing pump station on Stuart Highway does not have sufficient capacity to service the entire development and will therefore need to be upgraded if connection to mains water is required.

2.8.2 Planned infrastructure

Intrapac understands that PWC's future plans include a new water treatment plant to be located 1 km north of the intersection of Stuart Highway and Elizabeth Valley Road. This plant will treat water supplied from Manton Dam for provision of potable water to surrounding areas. The plans also include a proposed elevated water tank within the boundaries of Noonamah Ridge, south of Alverly Road.

2.8.3 Expected project demand

For the purposes of calculating baseline potable water demand for this development, broad assumptions have been made of the number of different lot types. The lot numbers below do not reflect the final lot make-up, as that will be subject to further detailed design work at subdivision stage based on land capability and land suitability, as well as community consultation. Instead, SD lots in this instance refer to all lots between 800m² and 3,999m², which are subject to further subdivision limitations under the proposed Specific Use Zone (as detailed in Section 1.6.6). MD lots refer to the provision of retirement living, duplex allotments close to the village centres and shop-top living.

Peak day storage

The calculations for the total peak day storage at full occupancy are presented in Table 2-4 and Table 2-5. These are based on the *Water Supply Code of Australia WSA-03-2011 (NT Supplement)*. From these tables the combined total peak day storage required for both residential and non-residential is 23.945 ML (15.361 ML plus 8.584 ML).

Table 2-4. Full occupancy water requirements (residential)

Residential demand	Allowance (EP per lot)	No. of lots	EP	Peak day flow (L/s)	One peak day storage (ML)	4 hr fire flow + ultimate peak hour flow (KL)
Rural residential	3.5	1,246	4,361	55.38	4.785	-
Single dwelling residential	3.5	2,493	8,726	110.81	9.574	-
Multiple dwelling residential	2.2	415	913	11.60	1.002	-
Total			14,000	177.80	15.361	1172

Table 2-5. Full occupancy water requirements (non-residential)

Non-residential demand	Base rate (L/s/ha)	No. of hectares	Peak day flow (L/s)	Total ML water/peak day
Retail, small shopping centre	0.25	8.0	2.0	0.173
Commercial/enterprise	0.45	193.0	86.9	7.504
School	0.60	3.5	2.1	0.181
Activities/recreation	1.05	8.0	8.4	0.726
Total peak day storage required				8.584

Peak hour flow

The peak flow requirements for water are presented in Table 2-6 and Table 2-7. From these it can be calculated that the combined ultimate peak hour flow required for residential and non-residential is 451.14 L/s (337.82 L/s plus 113.32 L/s).

Note: Assumed peak hour factor for the purpose of these calculations is 1.9; this may be reduced to 1.8 subject to approval from PWC.

Table 2-6. Full occupancy peak water flow requirements (residential)

Residential demand	Allowance (EP per lot)	No. of lots	EP	Peak day flow (L/s)	Peak hour demand flow (L/s)	Fire flow 25L/plus 2/3 PH (L/s)
Rural residential	3.5	1,246	4,361	55.38	-	-
Single dwelling residential	3.5	2,493	8,726	110.81	-	-
Multiple dwelling residential	2.2	415	913	11.60	-	-
Total			14,000	177.80	337.82	251

Table 2-7. Full occupancy peak flow requirements (non-residential)

Non-residential demand	Base rate (L/s/ha)	No. of hectares	Peak day flow (L/s)	Non-synchronous	Peak hour flow (L/s)
Retail, small shopping centre	0.25	8.0	2.0	60 %	2.28
Commercial/enterprise	0.45	193.0	86.9	60 %	99.01
School	0.60	3.5	2.1	60 %	2.39
Activities/recreation	1.05	8.0	8.4	60 %	9.58
Total					113.32

2.8.4 Proposed supply strategy – Stage 1

Context

Intrapac intends to service Stage 1 of the development – 400 lots – with groundwater extracted from onsite aquifers.

Preliminary onsite groundwater investigations have been conducted on six groundwater investigation bores (see Figure 3-12 and *Groundwater Report* in Appendix E) and a number of prospective aquifers have been identified in the central and southern portions of the project area. Water quality in all aquifers tested is of potable quality. These aquifers are at moderate depths (generally > 25 metres below ground level) and preliminary yields appear to range up to a maximum of 15 L/s (to be confirmed via pump-testing).

Water resource regulators estimate that the recharge rate in this region is in the vicinity of 200 mm/annum, based on standard recharge estimation techniques (for detail, see *Groundwater Report* in Appendix E). The NT Government currently requires that 80 % of recharge be apportioned to the environment (to maintain stream and spring flows, and to protect groundwater-dependent ecosystems) (D. Yinfoo pers. comm. 2015). That leaves 20 % for consumptive use.

Sustainable use is therefore considered the extraction of not more than the 20 % of estimated annual recharge, which equates to 40 mm/annum. The volume of groundwater that can be sustainably extracted from the aquifers in the project area can therefore be calculated by multiplying this amount by the land area of the development (40 mm multiplied by 28,000,000 m²), which equates to 1,120 ML a year. Based on the standard water consumption figure per lot of 1.4 ML/annum, a sustainable extraction of local aquifers could support up to 808 lots. This is more than sufficient to supply Stage 1.

Peak day storage

The total peak day storage for Stage 1 is 1.564 ML (0.938 ML plus 0.626 ML) as shown in Table 2-8 and Table 2-9).

Table 2-8. Stage 1 water requirements (residential)

Residential demand	Allowance (EP per lot)	No. of lots	EP	Peak day flow (L/s)	One peak day storage (ML)	4 hr fire flow + ultimate peak hour flow (KL)
Rural residential	3.5	0	0	0	-	-
Single dwelling residential	3.5	150	525	6.67	-	-
Multiple dwelling residential	2.2	150	330	4.19	-	-
Total			855	10.86	0.938	425

Table 2-9. Stage 1 water requirements (non-residential)

Non-residential demand	Base rate (L/s/ha)	No. of hectares	Peak day flow (L/s)	Total ML water/peak day
Retail, small shopping centre	0.25	2.0	0.5	0.0432
Commercial/enterprise	0.45	2.0	0.9	0.0776
School	0.60	3.5	2.1	0.4184
Activities/recreation	1.05	1.0	1.1	0.0907
Total peak day storage required				0.626

Peak hour flow

The requirements for Stage 1 are presented in Table 2-10 and Table 2-11. From these it can be calculated that combined ultimate peak hour flow required for residential and non-residential is 33.71 L/s (27.15 L/s plus 6.56 L/s).

Table 2-10. Stage 1 peak water flow requirements (residential)

Residential demand	Allowance (EP per lot)	No. of lots	EP	Peak day flow (L/s)	Peak hour demand flow (L/s)	Fire flow 25L/plus 2/3 PH (L/s)
Rural residential	3.5	0	0	0	-	-
Single dwelling residential	3.5	150	525	6.67	-	-
Multiple dwelling residential	2.2	150	330	4.19	-	-
Total			855	10.86	27.15	43.11

Table 2-11. Stage 1 peak flow requirements (non-residential)

Non-residential demand	Base rate (L/s/Ha)	No. of hectares	Peak day flow (L/s)	Non-synchronous %	Peak hour flow (L/s)
Retail, small shopping centre	0.25	2.0	0.5	60%	0.75
Commercial/enterprise	0.45	2.0	0.9	60%	1.35
School	0.60	3.5	2.1	60%	3.15
Activities/recreation	1.05	1.0	1.1	50%	1.31
Total					6.56

Proposed supply

It is proposed that 300 lots of Stage 1 will be serviced with potable water piped from bore-fields located within the project area. Each bore-field will comprise a number of bores extracting from the same aquifer (with sufficient distance between them to avoid interference). Water extracted from the bore-fields would be pumped to a holding tank located on a high point within the project area and then piped to properties. The bore-field will be 'gauged' in order to monitor water extraction and ensure extraction is within sustainable limits as defined by the licencing process under the *Water Act*.

Water requirements for the 300 lots in Stage 1 that will be serviced by bore-fields are presented below in Table 2-8 and Table 2-9. From these tables the calculated peak day storage is 1.564 ML a day (0.937 ML for residential plus 0.626 ML for non-residential). From the *Groundwater Report* (Appendix E), preliminary results indicate that three of the bore holes drilled onsite (NR-01, NR-03 and NR-04) have a combined yield of 49.5 L/s, which can supply a total of 1.78 ML a day (considering a pumping regimen of 20 hours a day at 50 % of the yield). This is a higher volume of water than is required to service 300 lots in Stage 1 (1.564 ML/day); therefore, it is feasible to consider the supply of water from the bore-fields. A fourth bore hole will be required to guarantee redundancy during maintenance.

The remaining 100 lots of Stage 1 will be sized and located in areas in which it is possible for each lot to have its own bore (or for a number of lots to share a bore). In the event that some of these larger lots are unable to access sufficient potable groundwater, the abovementioned bore-fields will be able to accommodate these (perhaps requiring the drilling of an extra bore within them). In order to best ensure sustainable groundwater extraction by the larger lots, Intrapac will investigate the possibility of having multiple lots connected to a single bore (e.g. three lots to a bore), as well as other ways to manage and monitor water extraction by individual lots.

A Groundwater Sustainability Study – including pump testing of groundwater bores – will be undertaken to verify the existence of a sustainable water supply for Stage 1 of the development, and to understand and

predict the response of the aquifer to extraction. In the unlikely event that it is found that the aquifers within the project area are not able to sustainably supply the water needs for Stage 1, there remains the option of connecting to mains water (see next section).

2.8.5 Proposed supply strategy – future stages

Concurrently with Stage 1, Intrapac intends to investigate the viability of the Koolpinyah Aquifer (see Section 3.6.2 for more detail) as an ongoing water supply for Noonamah Ridge. This aquifer is accessible through a pastoral lease that has the same owner as the majority of the project area. Water would be piped to the project area, pumped up to water tanks on elevated sites, and then dispersed throughout the development's internal reticulation. This bore-field, if developed, would be gauged to ensure sustainable extraction.

If the Koolpinyah Aquifer does not present a feasible water supply for the project, Intrapac proposes to enter into an agreement with PWC to connect Noonamah Ridge to mains water supply. This agreement could include cost-sharing or development contributions/levies.

From an infrastructure perspective, this would involve the following:

1) Construction of a replacement booster pump station at Stuart Highway

There is currently no land allocated for a replacement pump station. A new pump station needs to be at the existing location, unless new land is acquired at the corner of Elizabeth Valley Road and Stuart Highway. The requirement for a possible storage tank as a buffer next to the pump will be defined by the project engineers during later stages.

2) Construction of a rising main along Elizabeth Valley Road

The rising main will be constructed on the road reserve at an agreed offset from the property boundary. There are floodways and creek crossings along Elizabeth Valley Road, and a high hill on the approach of Redcliffe Road also needs to be considered during detailed design to assess the need for additional appurtenances or alternative routes.

3) Construction of a ground-level water tank (and possibly an elevated tank) within the site

The ground-level water tank is necessary to achieve required storage volumes and pressure parameters across the whole site, with initial calculations showing it will need the capacity to store 24 ML of water. As communicated to the project engineers by PWC, one peak day storage for a ground-level tank is acceptable. There are several locations across the site that are 75 – 80 m AHD which are considered suitable locations for the water tank. The selection of the site will be important for maintaining pressure and minimising losses as stages of the development are released. The design life of a ground-level tank is 50 years; the design life of an elevated tank is 20 years. Depending on the allotment distribution across the site, it is possible that an elevated tank will not be needed.

4) Provision of an internal pipe for distribution and reticulation to the majority of allotments

Regardless of whether groundwater or mains water is used to supply the development, at least some internal pipe distribution and reticulation will be required. The geological and geotechnical characteristics of the site are important for the construction of the underground pipe reticulation from Stuart Highway and within the development. With a large percentage of the site containing rocky areas – where bedrock is likely to be found within 2 m of the ground surface (and less at the top of the ridges) – the road layout, allotment distribution and pipe alignment will need to avoid areas where it can be difficult to dig trenches. In order to manage this risk, a sound geotechnical investigation accompanied with rippability tests and video trials will be conducted before engineering design commences.

See Figure 2-19 for a map indicating internal reticulation, as well as water infrastructure should mains water connection be the final supply option.

2.8.6 Alternatives

Intrapac is considering the potential for 'active aquifer recharge' – i.e. actively returning surface water into an aquifer (having first ensured its quality). The results of future groundwater investigations will be used to assess the initial feasibility of such an endeavour, with a more detailed feasibility study commissioned if it is decided that such a proposal has merit.

2.8.7 Relevant approvals, standards and conditions

All water supply infrastructures will be constructed in accordance with PWC guidelines, standards and specifications. Prior to approval from Litchfield Council, Intrapac will need to have the approval of PWC with respect to mains water reticulation arrangements within the development. Approvals for the proposed water supply will occur through the subdivision and development approval processes administered under the *Planning Act*.

The *Water Act* provides for the investigation, allocation, use, control, protection and management of surface water and groundwater resources, as well as the administrative process for licensing these activities. The Act allows the enforceable allocation of water to various declared beneficial uses, while ensuring that adequate provisions are made to maintain cultural and environmental requirements.

Water Control Districts are declared in areas where it is recognised that increasing development and demand for water have the potential to cause degradation to water quality and to reduce flows required to maintain water-dependent ecosystems in the region. The project area is located within the Darwin Rural Water Control District, which is exempt from the requirement for a Groundwater Extraction Licence for bores pumping less than 15 L/s. It is understood that a licence is not required to operate a bore-field, *per se*, but is required for every bore pumping greater than 15 L/s.

The following licencing/permitting requirements also apply under this Act:

- Surface Water and Groundwater Extraction Licences (for bores pumping greater than 15 L/s)
- Bore Construction Permits (within Water Control Districts).

The *Water Supply and Sewerage Services Act* provides for the protection of the NT's water supply system or any water source from which water is drawn for human consumption. Any abstraction or diversion of water from the NT's supply system must not be undertaken unless authorised by the appropriate authorities. Penalties are in place for pollution of any water supply or source. Under this Act, licencing is required for provision of water supply services.

2.8.8 Responsibility

If sufficient groundwater resources are identified beneath the project area and within the Koolpinyah aquifer, Intrapac intends to investigate the potential of becoming a water utility for the Noonamah Ridge development and beyond. As such, Intrapac would install, own, and be responsible for the maintenance and upgrade of the required water supply infrastructure for the project. Groundwater extraction bores within rural properties will be owned, installed and maintained by the residents.

If connecting to mains supply is necessary, PWC are responsible for approving the required water infrastructure works. Once constructed, the ground-level water tank, pump station and all water infrastructure will become PWC assets and will be maintained by PWC.

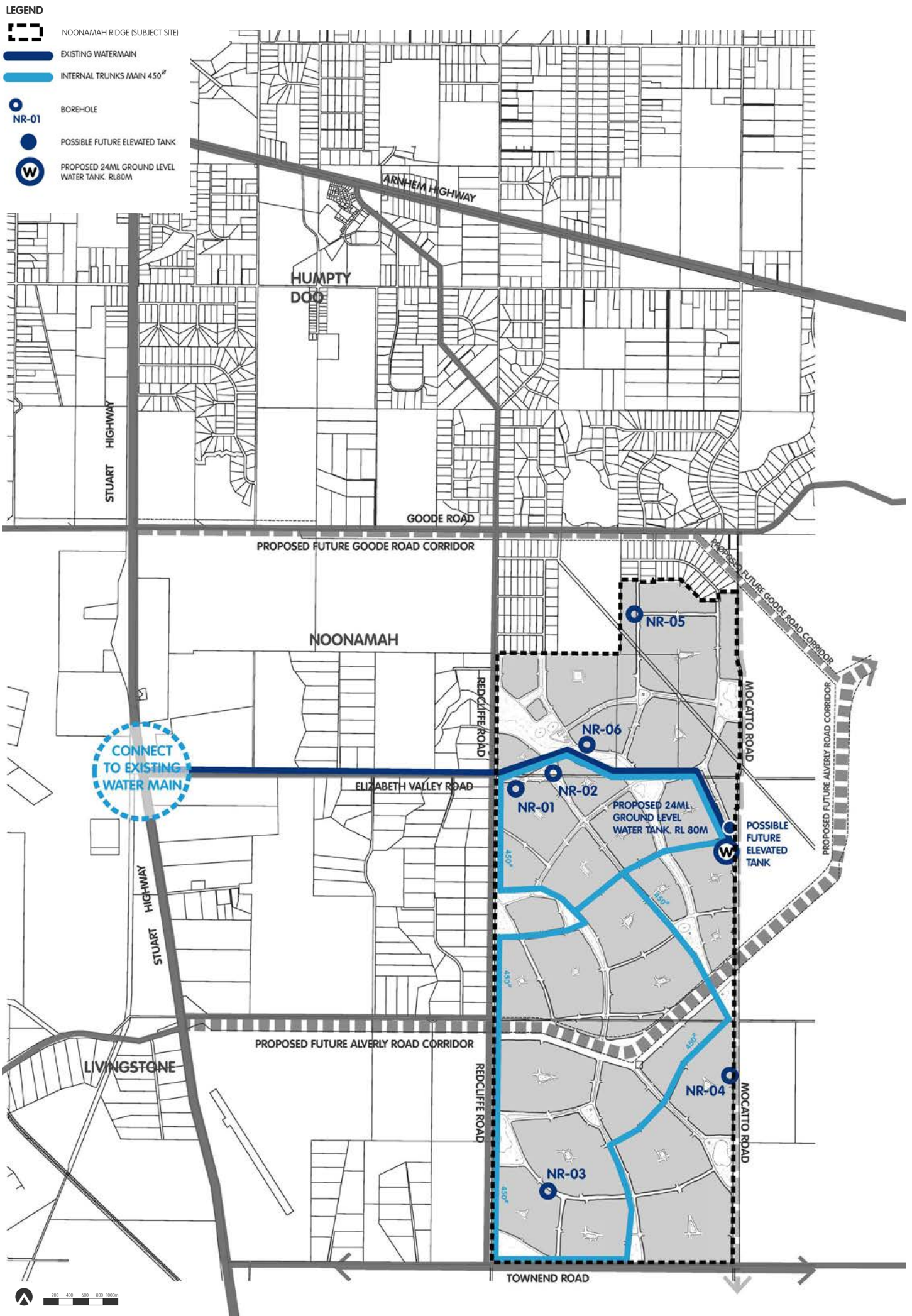


Figure 2-19. Map of water infrastructure (indicative)

2.8.9 Water conservation

Wastewater minimisation and potable water conservation will be accommodated throughout the development through means such as water-efficient products in homes, guidelines to builders/landowners, lot layout, site grading and type of sewer treatment installed.

Potable water conservation methods include:

- Reducing garden irrigation demand through 'low water use' landscaping in public parks
- Encouraging 'low water use' gardens in private allotments
- Use of recycled wastewater for irrigation
- Public education and guidelines (e.g. suitable 'low water use' plants and gardening methods)
- Leading by example in public spaces.

The proposed wastewater treatment facilities have been selected because, amongst other things, they minimise the wastewater produced (see Section 2.10.3). In addition, homes, commercial precincts and public areas can reduce their wastewater by careful selection of products. Intrapac will seek to provide recommendations and guidelines to promote this.

2.9 STORMWATER

Chapter 3 should be referred to for details on the hydrology, topography, geology and soil types within the project area that dictate and inform stormwater management requirements.

DLPE, DLRM and Litchfield Council were consulted to obtain information on existing and planned stormwater management infrastructure – see Consultation Register in Appendix N.

Prior to approval of each subdivision (stage), Intrapac will have to demonstrate to the NT Government and Litchfield Council that stormwater drainage is sufficient to deal with the anticipated loads (including flood events).

2.9.1 Existing infrastructure

There is no significant drainage infrastructure within the project area, apart from two 300 mm drainage pipes along the telecommunications tower access road. Outside the development area, there are six culverts under Redcliffe Road – three of which have been constructed as floodways and include rock protection. Redcliffe Road also has a drain running along its entire eastern boundary with the project area.

Across the western side of the development (along the Mocatto Road reserve), three low points provide overland flow paths for the run-off from inside the development to outside areas.

2.9.2 Planned infrastructure

Litchfield Council currently has no plans for upgrading and/or formalising the stormwater management infrastructure in the areas surrounding the project area.

2.9.3 Expected project volumes

Preliminary calculations of pre-development and post-development, unmitigated, peak flow rates (m^3/s) have been calculated for each catchment within the project area (see Table 2-12). A high run-off co-efficient was used to assess a Q100 event (a flood event that has a 1 % probability of occurring in any given year and therefore, theoretically, may occur once every 100 years), to account for the saturated nature of the soils during such an event. The time of concentration was obtained using Horton's or Bransby William's formulae depending on catchment topography. Rainfall intensities were extracted from the Bureau of Meteorology dataset for the Humpty Doo area.

The results indicate that – in the absence of any mitigation measures – there will be an increase in run-off flow rates of approximately 8.7 % for a Q100 event, 10.1 % for a Q20 event and 10.5 % for a Q5 event. Onsite stormwater management will be based on the peak flow for a *critical event*. The critical event will be determined at the detailed design stage, through a series of iterative calculations – for instance, it may be that a 10-minute Q2 storm will be critical, or instead a 60-minute Q5 storm may be the critical event.

The assessment of post-development flow conditions will be carried out progressively by engineers in line with the development staging. This will enable the design process to include more accurate data in relation to proposed impervious areas, roads and drainage layout.

Table 2-12. Pre- and post-development, unmitigated, peak flow rates (m³/s) per catchment

Catchment	Q5			Q20			Q100		
	Pre-development	Post-development	Difference	Pre-development	Post-development	Difference	Pre-development	Post-development	Difference
A	6	9	3	8	11	3	15	20	5
B	13	19	6	15	21	6	30	38	8
C	25	36	11	28	40	12	57	71	14
D	155	155	0	175	175	0	311	311	0
E	82	83	1	92	93	1	154	166	12
F	80	95	15	90	106	16	170	189	19
G	81	86	5	91	97	6	161	173	12
H	1	1	0	1	2	1	3	3	0
I	13	19	6	15	21	6	29	38	9
J	2	3	1	2	3	1	4	6	2
Total	458	506	48	517	569	52	934	1015	81
% Difference			10.5			10.1			8.7

2.9.4 Proposed stormwater management strategy

Water-Sensitive Urban Design

The protection of receiving ecosystems and the enhancement of water conservation within the development will be achieved by implementing a Water Management Plan in line with the *Darwin Harbour Strategy* (Darwin Harbour Advisory Committee 2010) – see Chapter 6 (EMP).

The *Darwin Harbour Strategy* includes the following guidelines:

- 1.4. *Water quality and ecological health of the marine, freshwater and terrestrial catchment environments in the region are to be maintained or, if quality and health have been negatively affected through human activity, improved where possible*
- 1.10. *Stormwater collection systems are to be designed and managed to minimise pollution of receiving waters, protect the structure of waterways, optimise the protections of property, and where and when possible provide grey water for reuse and ensure public health and safety.*

The proposed strategy to follow these guidelines is through embracing selected applications of Water-Sensitive Urban Design (WSUD). This is an urban planning and design philosophy that aims to overcome some of the deficiencies associated with conventional developments by integrating 'whole of water cycle' management into new urban development and re-development areas. WSUD promotes an approach to urban development that responds to the site's natural features, protects natural ecosystems onsite and downstream, and optimises the use of water as a resource. The technical literature (Hatt et al. 2004) suggests a strong correlation between disconnection of impervious areas (defined below) – where stormwater is generated (e.g. driveways, car parks, roofs) – and receiving catchments, with health and quality of discharging waters. 'Disconnection' refers to an additional stormwater management step to the traditional process of direct discharge to a drainage system (i.e. pipe and pits). The middle ground is generally a pervious, vegetated area.

For this development, disconnection will endeavour to be provided early in the cycle – i.e. in proximity to where rainfall occurs on impervious areas. This is more readily achieved in the rural areas where impervious surfaces are minimal and stormwater drains will not be directly connected. In these areas, water will flow overland to receiving grassed open drains or overland to receiving creeks or streams. In urban catchments, disconnection will need to be engineered into the design of open space and green space areas.

The principles of WSUD are:

- Protect existing natural features and ecological processes
- Maintain natural hydrologic behaviour of catchments
- Protect water quality of surface and ground waters
- Minimise demand on the reticulated water supply system
- Minimise wastewater discharges to the natural environment
- Integrate water into the landscape to enhance visual, social, cultural and ecological values.

WSUD was developed for southern climates where annual rainfall is more regular than in the tropics. Many WSUD solutions – such as bio-retention basins and grassed swales – utilise some form of vegetation that works well in a southern climate, where there is effectively continual rainfall throughout the year. However, the tropics pose challenges for vegetation receiving large volumes of water during the wet season and then being subject to a long dry period in the dry season. In cases of similar climates (such as Queensland), this has led to weeds growing during the wet season and/or damage and fatality of plants due to extended periods of high volumes of water. The potential impacts of this include:

- Reduced aesthetics and creation of an 'eye-sore' due to dead vegetation and weeds
- Reduced filtration and treatment of water (particularly suspended sediment and nutrient removal)
- Contributions to loads of total suspended solids due to erosion
- Associated maintenance and repair costs.

Therefore, careful consideration and modelling will be undertaken prior to adopting WSUD stormwater management solutions within the tropical context of the project area.

The drainage management system for the Noonamah Ridge development will be designed to maintain pre-development flows and reduce the discharge of pollutants into receiving waterways. The site is a greenfield area with well-defined catchments and can accommodate a wide range of available WSUD drainage features, performing different water treatment functions. As mentioned above, some features are considered less suitable for application in the tropical region (e.g. wetlands and bio-remediation systems). A summary of available features, their key treatment functions and applicability to the site is provided in Table 2-13. The most suitable solutions for the proposed development are likely to be detention basins; grassed swales, gross pollutant traps and porous pavement (refer to Figure 2-20 to Figure 2-24 for examples).

Table 2-13. Summary of WSUD features suitable for Noonamah Ridge

Feature	Summary	Effectiveness of functions*			Climate	Limitations	Relevant image
		High	Medium	Low			
Grassed swales	Open grassed drains which slow down flows and passively treat run-off	• Infiltrate • Filtration	• Retention • Sediment settling • Biological treatment	Nil	Can be sized to accommodate high rainfall events, and grass will be selected to withstand dry season	Filtration can be reduced with large volumes of water	Figure 2-20
Detention basins	Engineered basins to capture, hold and slowly release flows	Nil	• Retention • Sediment settling	• Infiltration • Filtration • Biological treatment	Sized to accommodate large flows, with overflow spillways incorporated. Will not be affected by dry periods.	None	Figure 2-21 & Figure 2-22
Gross pollutant traps	Sediment traps with a litter or trash rack at the downstream end to remove coarse litter and sediment > 5 mm	• Filtration	Nil	Nil	Can be sized to accommodate high rainfall events. Not affected by dry periods	Maintenance requirements can be high if there is high amounts of gross pollutants	Figure 2-23
Porous/permeable pavement	Specially designed pavement to allow infiltration and treatment of run-off	• Infiltration • Filtration	• Biological treatment	• Retention	No affected by climatic variation, although infiltration may be limited during high rainfall periods.	Prone to clogging	Figure 2-24

* Key functions for features include retention of flows, infiltration into the ground, filtration of pollutants (e.g. total suspended solids, nutrients and gross pollutants), capture and settling of sediments (usually associated with retention of flows), and biological treatment (e.g. of nutrients).



Figure 2-20. Photograph of grassed swales



Figure 2-21. Photograph of detention basin

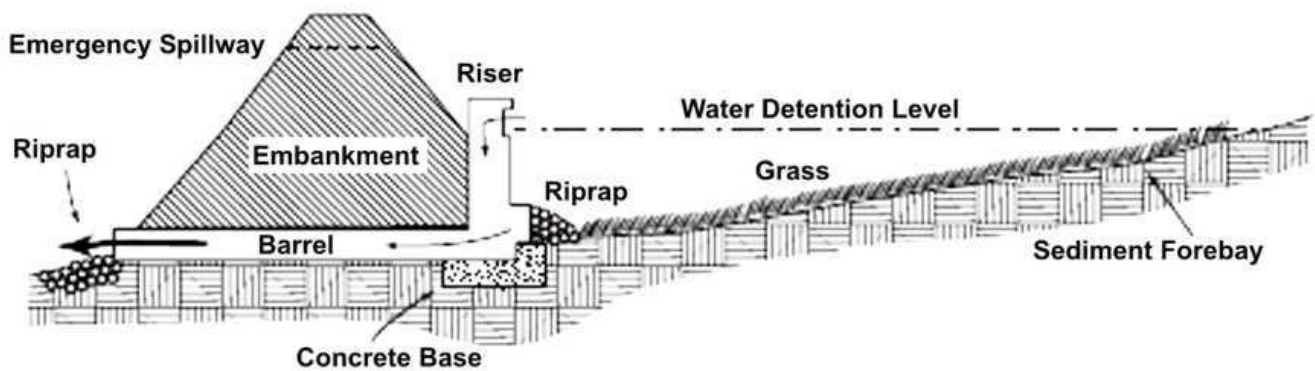


Figure 2-22. Example standard drawing for a detention basin



Figure 2-23. Photograph of grid gross pollutant trap



Figure 2-24. Photograph of porous pavement

Application

Prior to development, and during the detailed design phase, Model of Urban Stormwater Improvement Conceptualisation software will be used to predict the performance of the proposed stormwater quality management system for each stage of the development and to determine appropriate locations (depending on density of the surrounding area and proximity to riparian areas). The general approach is summarised in Table 2-14.

Table 2-14. Development zones and proposed WSUD measures

Zone	Considerations	WSUD options
Sub-urban	• Mid to high density of buildings and mid to high % of impervious surfaces • High run-off co-efficient • Higher contaminant loads	• Permeable pavement • Gross pollutant traps • Landscaped vegetated strips • Small grassed swales • Detention basins
Road reserves	• Large impervious areas • Can contain pollutants from cars (heavy metals, oil and grease, gross pollutants)	• Grassed swales • Potential to convey to other detention basins if required prior to discharge
Non-urban	• Large lots • Run-off co-efficient and pollutant loads not expected to change from pre-development conditions • Mostly pervious surfaces and naturally-vegetated to provide natural treatment and flow control	• No additional pre-treatment required
Riparian	• Existing, natural riparian zones slow down flows, stabilise banks and provide filtration prior to discharge to waterways	• Existing riparian zones will be buffered and preserved • Pre-treatment prior to discharge to riparian zones will include grassed swales and detention basins

Detention basins

Detention basins will be constructed at various locations across the development, with the greenfield nature of the project area allowing flexibility in relation to the number and location of basins. These features are designed to manage water flows during critical storm events. When flow rates are higher than pre-development conditions, stormwater will be diverted to detention basins for controlled release via small outlet pipes that are designed to maintain pre-development flows to downstream drainage lines. A spillway structure will also be included to accommodate for a Q100 event.

Figure 2-25 shows locations where detention basins are planned to be built. Indicative sizes of detention basins have been calculated and are shown in Table 2-15. The specific size, type and location of these detention basins will be defined during detailed design, which will require topographic surveys, hydrographs, Hecras modelling, geotechnical and geological site condition assessments.

Table 2-15. Proposed detention basin sizing

Basin number	1	2	3	4	5	6
Relevant sub-catchment	C	D	D	E	F	G
Breadth (top) (m)	70-95	90-110	75-95	80-100	90-110	50-65
Surface area (m ²)	4,900-9,000	8,000-12,000	5,600-9,000	6,800-9,500	8,100-12,000	2,500-4,200
Slope (m/m)	2	2	2	2	2	2
Depth (m)	3	3	3	4	3	3

The design of detention basins will be in accordance with *Australian Rainfall and Run-off – A Guide to Flood Estimation – Volume 1* (Pilgrim 1987) and will take into consideration all NT regulations, including minimising mosquito breeding habitat (refer to Section 2.9.7 and Appendix H).

The interface between the detention basins and any underlying aquifers will be limited by lining the basins with clay (as required) to reduce infiltration. This will ensure that aquifers are protected from any contamination from stormwater or anything contained in the ground between the aquifer and surface level.

Recreational lake

The development is proposed to include a permanent waterbody in the form of a recreational lake to enhance the landscaping and amenity values of the area surrounding the rural activity centre. The lake will be located around the rural activity centre in a location along the waterway in Catchment D (see Figure 2-2). The size of the lake is anticipated to cover between 7 and 15 ha. The *Townsville Constructed Lakes Design Guideline* (DesignFlow & RPS 2010) will be the main reference document for the design of the lake (as recommended by Palmerston City Council, which has much experience in the construction and maintenance of similar lakes in a tropical climate). The lake will be used to provide stormwater retention during rainfall events and provide water quality treatment to remove sediments.

A design assessment including engineering and environmental considerations will be undertaken to assess the best location and size of the proposed lake. Initial geotechnical and hydrological testing has been conducted in the proposed area (see the *Recreational Lake and Subgrade Suitability: Preliminary Geotechnical Investigation* in Appendix D). The testing indicates the presence of fractured rock, which could result in connectivity with the underlying aquifer. Therefore, a clay liner (and possible geotextile) will be installed to ameliorate this if required.

Given the high rate of evaporation in the region, it is expected that recharge of the lake will be required during the dry season. The availability of a sustainable source of water (e.g. groundwater or partially-treated raw water from Darwin River Dam) will be included in the design assessment.

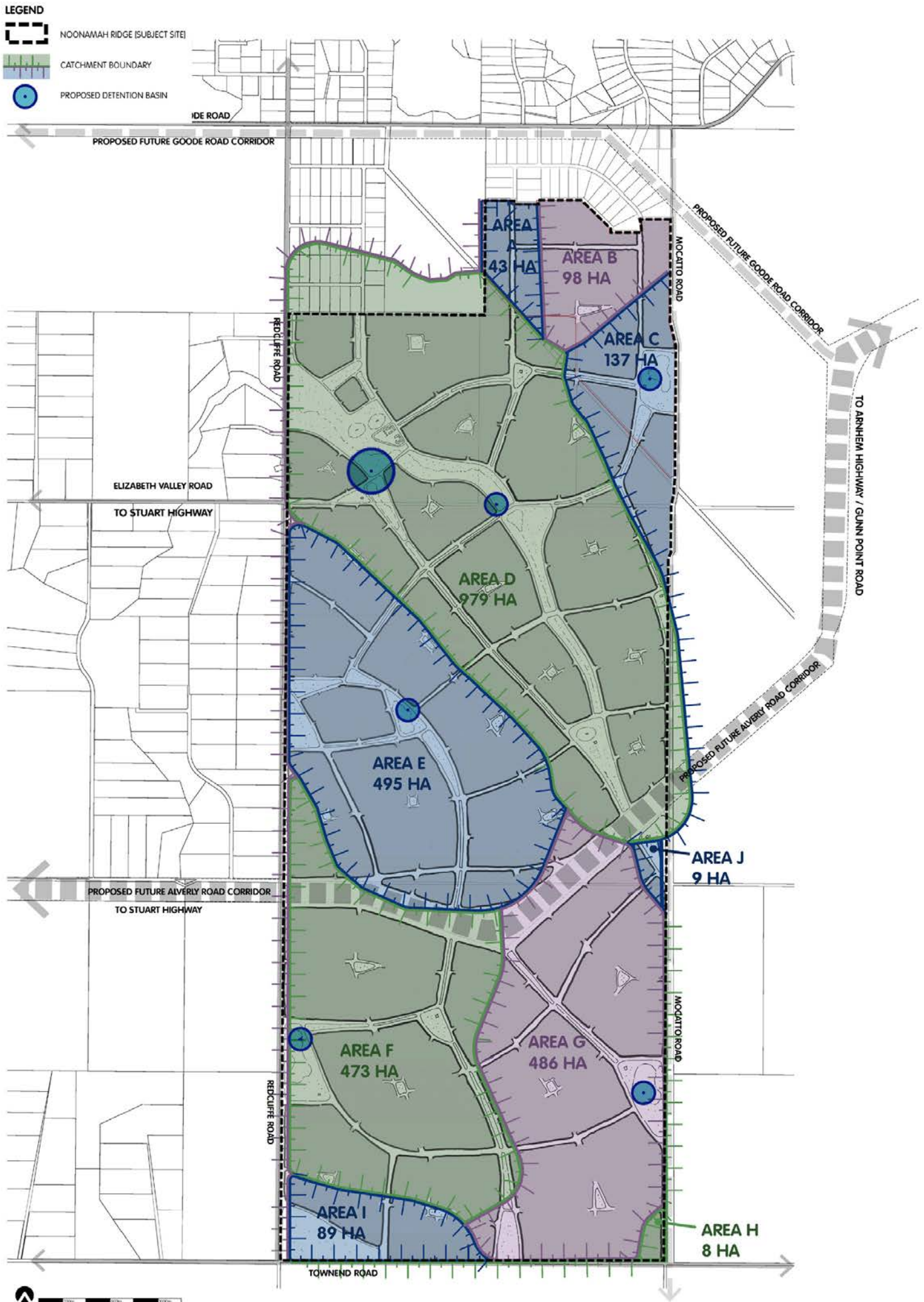


Figure 2-25. Map of the location of detention basins (indicative)

2.9.5 Erosion and sediment control

During construction

Erosion and sediment controls aim to minimise the creation of drainage, erosion and subsequent sedimentation issues – particularly during construction periods when soil disturbance, earthworks and land clearing result in exposure of soils to erosive forces (e.g. wind and rain). It is a standard condition of development permits that an Erosion and Sediment Control Plan (ESCP) be developed and submitted to DLRM prior to commencement of works. The development contractor, or suitably qualified sub-consultant, will therefore devise a site-specific and project-specific ESCP for each subdivision, and all works will be required to be undertaken under the ESCP.

The Noonamah Ridge development is still in the preliminary design and planning phase, and so the detail required to create an ESCP for any stage (let alone the whole development) does not yet exist. Instead, broad principles of erosion and sediment control have been outlined in the EMP (see Section 6.7 of the EIS). Examples of typical erosion and sediment control features are shown in the Addendum to Section 6.7 of the EMP. The ESCP required for each phase of the subdivision will be approved through the development approvals' processes administered under the *Planning Act*.

Post-construction

As shown in Figure 3-4, most of the site has a slope that can be managed with the implementation of effective drainage features (as described in Section 2.9.4). The acceptable velocity values will depend on the specific soil and design conditions. In general, flows need to be kept between 0.8 and 1.2 m/s (as per Litchfield Council guidelines) before more complex design considerations would need to be investigated.

Longitudinal grades along the swales will be kept between 0.5 % and 2 %. It is a common practice in the region to include drop structures along drainage swales to maintain the flow velocity within acceptable values (see the Addendum to Section 6.7 of the EMP). In some areas, the slope reaches up to 5 % and, in these cases, drop structures will be constructed in open drains to manage the flow velocity.

It should be noted that erosion and sediment movement is greatest when soils are exposed and when earthworks are being undertaken. Therefore, once the site has been stabilised post-construction, on-going erosion and sediment control requirements will be minimal (assuming adequate design of site drainage, roads and infrastructure).

2.9.6 Staging

Detention basins, swales and underground pipe networks will be constructed as part of each subdivision stage. The detailed civil engineering design for each stage will dictate the selection, number and location of drainage structures, and will also include future-proofing considerations (e.g. design calculations for Stage 1 will account for the run-off contribution from Stage 2 and 3 catchments etc.).

The location, type and details of these features will be in accordance with the civil engineering design drawings, to be approved by the relevant authorities prior to construction.

Construction of drainage works outside the project area is not proposed.

2.9.7 Relevant approvals, standards and conditions

The following legislation is applicable to the proposed drainage infrastructure:

- *Water Act*
- *Water Supply and Sewerage Services Act*
- *Waste Management and Pollution Control Act*
- *Public and Environmental Health Act and Regulations*

The stormwater drainage system design will be assessed through the development approvals' processes administered under the *Planning Act*. Prior to commencement of works, approval is required from Litchfield Council, who will ultimately be responsible for maintenance and upkeep of the stormwater drainage network.

The *Litchfield Council Development Guidelines B – Stormwater Drainage* (2014b) stipulate how stormwater drainage should be designed and constructed within subdivisions. The guidelines state that stormwater drainage design must conform to the current version of the following publications:

- *Australian Rainfall and Run-off* (Pilgrim 1987)
- *Stormwater Drainage Design in Small Urban Catchments* (AARB 2013)
- *Subsurface Drainage of Road Structures* (Gerke 1987)
- *Managing Urban Stormwater – Soils and Construction* (DECC NSE 2008)
- *Erosion and Sediment Control Guidelines Built Environment* (DNREA 2007)

Prior to approval from Litchfield Council, Intrapac will need to have the approval of DLRM with respect to erosion and sediment control arrangements, the approval of the DoI with respect to drainage works, and the approval of the Department of Health (DoH) and NTEPA with respect to stormwater quality related to the development.

A separate *Development Application for Cut and Fill* will be required to construct the lake. If the lake is re-located to a waterway, the embankment is higher than 3.0 m, or the catchment area is larger than 50 ha an *Application For A Permit to Construct or Alter Works Form 4* will need to be approved by DLRM.

In general, all concrete structures such as underground pipes and culverts will have a design life of 50 years, as per *AS 3600-2009 – Concrete Structures*.

2.9.8 Responsibility

Since the site is located within Litchfield Council, all drainage structures and features will become Litchfield Council assets after an on-maintenance period. The exception to this will be any drainage works that are built on NT Government land – such as Alverly Road reserve – which will be maintained by DoI.

2.10 SEWERAGE

Chapter 3 should be referred to for details on the topography, geology and soil types within the project area. A preliminary *Land Capability Assessment* has been undertaken to assess suitability for onsite wastewater management – see Appendix H.

PWC, DLPE and DoH were consulted to obtain information on existing and planned infrastructure – see Consultation Register in Appendix N.

Prior to approval of each subdivision (stage), Intrapac will have to seek approval from Litchfield Council, DLRM, DoH and the NTEPA with respect to wastewater management for the development. This would require, amongst other things, demonstrating that there is sufficient capacity within the sewerage treatment system to service the new subdivision without impinging on the service provided to existing users.

2.10.1 Existing infrastructure

There is no sewer infrastructure in the vicinity of the site. Residential developments around the project area are serviced with septic tanks in each lot. The closest centralised sewerage treatment facility is located in Humpty Doo and does not have spare capacity for additional inputs. PWC have advised that reticulated municipal sewer treatment services are not proposed for the area in the foreseeable future.

2.10.2 Expected project volumes

As the majority of the land use within the development will be residential detached dwellings, an initial value of 3.5 equivalent persons (EP) per dwelling has been adopted to determine the peak EP. The *Gravity Sewer Code of Australia WSA-02-2014 (NT Supplement)* will be used during detailed design to calculate the actual EP values.

Based on 4,155 lots, the peak capacity will be 14,542 EP and the total wastewater generated will be 2.9 ML/day (assuming generation of 200 L/EP/day in accordance with *AS 1547-2012 Onsite domestic wastewater management* (Standards Australia 2012). The flow associated with this value will be 200 L/EP/day. This is a widely accepted value for wastewater generation in Australia and is based on modern water savings fixtures being used throughout the development.

Each of the stages proposed will have approximately 2,000 – 2,500 EP, which equates to 0.4 – 0.5 ML/day.

2.10.3 Proposed wastewater management strategy – community-scale

A community-scale, onsite treatment solution is the preferred wastewater management method for Noonamah Ridge because reticulated, municipal sewer treatment services are not proposed for the area in the foreseeable future.

Integrated Transpiration (IT) technology is proposed as suitable treatment facilities for reticulated wastewater (see Figure 2-26 and Table 2-16 for a summary of the key characteristics of the IT system). The system is an in-ground, enclosed recirculating system that uses a series of holding tanks and evapo-transpiration channels to treat and dispose of the effluent. It is modular, allowing for straightforward up-sizing.

Evapo-transpiration channels are planted with a selection of native/exotic plants (but not invasive/weed species) which further treat the effluent and take up the nutrients. The plants use the treated effluent as their primary water source, and the IT system becomes a series of landscaped garden beds that can be incorporated into the landscaping plan of the development.

To allow for remote control and monitoring of the operation of the IT system, an electronic system is incorporated into the design. This system controls all pumps and monitors levels throughout the facility.

When critical limits are reached, the system initiates an alarm condition. This system is connected to a host monitor located at the contractor's office, generally via a broadband internet connection.

An IT system has been successfully used for the last two years in nearby Coolalinga – providing local practical experience and availability of data and feedback to assess the system's performance.

Table 2-16. IT system attributes

Criteria	Response
Maintenance and operation cost	Approximately 40 to 55 % of the cost of other wastewater technologies, with low risk of additional costs arising from major equipment failures.
Mode of operation	Remote system operation with minimal training requirements for routine onsite inspections.
Chemical usage	Chlorine dosing is minimal and restricted to the tertiary treatment stage. It can be eliminated completely where storage is not required and treated water can be sent directly to irrigation.
Sludge accumulation and disposal	Depending on the nature of the system inputs, de-sludging may be required in intervals between six months and two years.
Capability to deal with fluctuating effluent flows	Peak flows can be readily accommodated because the system is designed with large primary treatment tanks, the evapo-transpiration channels provide additional capacity, and the system is programmed to accommodate fluctuations in daily flow rates.
Component failure	Modular design allows extensive redundancy of components with minimal impact of component failure on system operation.
Odour	Odour is well controlled because the system is contained and secondary treatment occurs underground through the evapo-transpiration channels.
Area requirement	While the area of the system itself is larger, the total area is generally smaller than other examples of full irrigation systems.
Energy use and carbon retention	Uses approximately 1 kWh/kL. The process is largely biological and intermittent dosing by pumps allows batch flow processing. Carbon is retained in living plants that are part of the system.
Life span	At least 50 years with basic component replacement, such as pumps.
Aesthetics and landscaping	Attractive and unobtrusive gardens can be incorporated into landscaping of a site. Untreated effluent is contained below surface to prevent public contact.
Staging	Has the capacity to be constructed in modules in pace with the stages of the project, thus reducing initial capital costs.

Storage and capacity

With the IT system, irrigation storage and wet weather retention is accomplished through the use of an appropriately-sized, sub-surface, storage tank (rather than holding ponds), which minimises the infiltration of groundwater and stormwater into the system. The closed system also reduces odour and noise emissions. As the IT system treats to a secondary/tertiary stage, no treatment is necessary in these holding tanks.

Effluent storage in IT systems is incorporated as part of the standard design of the system and is sized by considering the relevant climate data (historic rainfall for at least 50 years) for each site and optimised using MEDLI modelling. Historical flood event and climate data will also be used when determining the location of the wastewater treatment facilities. The programming of the system is designed to have a 100 % buffer capacity above the normal operating range to allow for unusual flows. To date, there have been no over-topping events in any of the operating IT systems and these systems have experienced some extreme events, including a record daily rainfall at an Amity Point facility near Brisbane.

Treatment

Treatment will involve:

- Initial primary treatment with all-waste septic tanks.
- The primary system will have a minimum of 32 hours retention (as nominated by *AS 1547-2012 – Onsite domestic wastewater management* (Standards Australia 2012)), with high quality filters in the outputs of each tank.
- Secondary treatment will be achieved in two stages:
 - Primary treated effluent is initially dosed through a rotating biological contactor.
 - The outflow then circulated through a series of contained evapo-transpiration channels for complementary nutrient and water uptake.

Additional programmed recirculation through the IT channels increases water uptake and reduces the volume of influent through transpiration.

- Tertiary treatment utilises sand filtration, UV sterilisation and chlorine dosing as determined by the required final use of the remaining recycled water.

Disposal

Beneficial reuse of treated water (e.g. irrigation of amenity areas) will be encouraged where possible to maximise the sustainability of the treatment system. Preliminary calculations indicate that 30 to 40 ha are required for disposal of treated wastewater through irrigation. Based on the concept master plan, 136 ha will be available for irrigation in the following areas:

- Playing/sports-fields – 16 ha (2 x 8 ha reserves)
- School grounds – 3.5 ha
- Portion of drainage and linear reserves (5 % of 240.30 ha) – 12 ha
- Portion of neighbourhood and local parks (50 % of 209 ha) – 104 ha, assuming that 50 % of parks will be more 'natural' in character and therefore will not be irrigated.

Alternatively, excess treated water can be used in dedicated cropping systems specifically designed to dispose of recycled water, for example:

- Lucerne production – a high transpiration crop that can last for up to five years without replanting and producing good yields on small plots.
- Dry forage production.
- Bamboo production – planted in the actual transpiration treatment channels and performs well in the tropical conditions.

Intrapac has an agreement with the owner of the property immediately south-east of lot 4574 to provide land for irrigation in the unlikely event that this is required.

Water quality

The treated effluent will be treated to 'Class A' standard (i.e. tertiary treatment, which is required where there is high risk of direct human contact with water). The IT system, by its nature, ensures that a multi-barrier approach is employed in protecting public and environmental health. This includes full containment of wastewater through all stages of the treatment process.

Prior to commencing design, all stakeholders will be consulted to ensure the appropriate infrastructure will be installed, and approval will be sought from regulators to ensure the system complies with all regulations and guidelines. An Irrigation Management Plan describing all of the relevant procedures and guidelines will be part of this process (see Section 6.6.1).

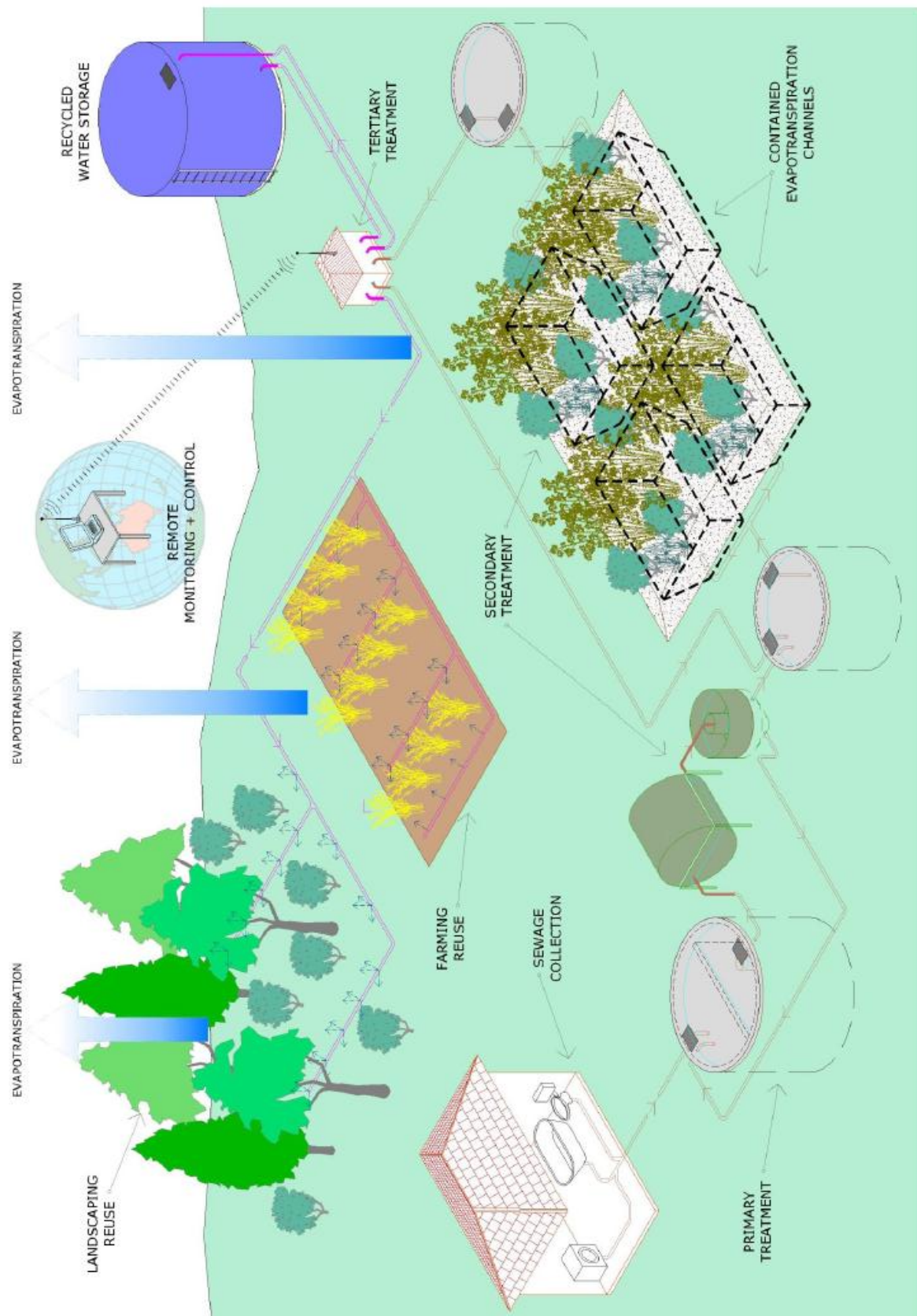


Figure 2-26. Diagram of integrated transpiration wastewater treatment system

Location

Figure 2-27 indicates where wastewater treatment sites are being considered, and shows the indicative sewer internal reticulation and associated catchments.

There are a number of issues that require consideration for the preliminary design stage:

- Site topography, to allow gravity flow of the sewer collection network where possible.
- Proximity to drainage lines and seasonally-inundated and/or saturated zones.
- Proximity to water supply bores.
- Potential interaction with groundwater and/or high seasonal water-tables
- Avoidance of natural ephemeral wetland areas, sensitive vegetation and cultural heritage sites.
- A school and a commercial retail area are proposed and these are of indeterminate size at this stage.

A preliminary *Land Capability Assessment* (see Appendix H) concluded that there are sufficient unconstrained soils within the sampled land units capable of supporting on-site wastewater management systems. However, the site has some areas that are not suitable for disposal – including a number of rocky ridges and some wetland areas. Prior to the detailed design stage, site-specific LCA's will be required to determine the location for every community-scale wastewater treatment facility, and for every subdivision that contains lots that will have a residential septic system.

Detailed design and an application for approval of each wastewater treatment system will be provided to DoH as each wastewater treatment site is determined within the development area.

Maintenance

An IT system should function for the most part automatically, with very little onsite operation required. However, the contractor offers a comprehensive operation and maintenance contract that focuses on remote monitoring and preventative maintenance. The main activities undertaken as part of the maintenance and monitoring program are listed below:

- Regular monitoring of water quality output and plant functioning (as required by the licence conditions), including real-time data
- Monthly analysis of overall treatment performance
- Coordinated responses to alarm events
- Ongoing operational support
- Horticultural upkeep of the vegetation
- Pump maintenance, instrumentation cleaning, solids removal (every 1 – 2 years) and freshwater flushing of holding tanks and plumbing network (annually)
- De-sludge of evapo-transpiration channels (biannually).

The operation and maintenance of the IT systems will also involve ground-keeping and general duties within the site – including maintaining secure fencing and signage, keeping access-ways clear and ensuring adherence to personal hygiene and personal safety.

Greenhouse gas emissions

Compared to traditional sewerage treatment facilities (e.g. ponds), there are lower greenhouse gas emissions associated with the IT treatment systems because fixing and storage of atmospheric carbon occurs in the transpiration beds. Lower energy use by IT systems in comparison to conventional treatment systems also results in greenhouse gas reductions.

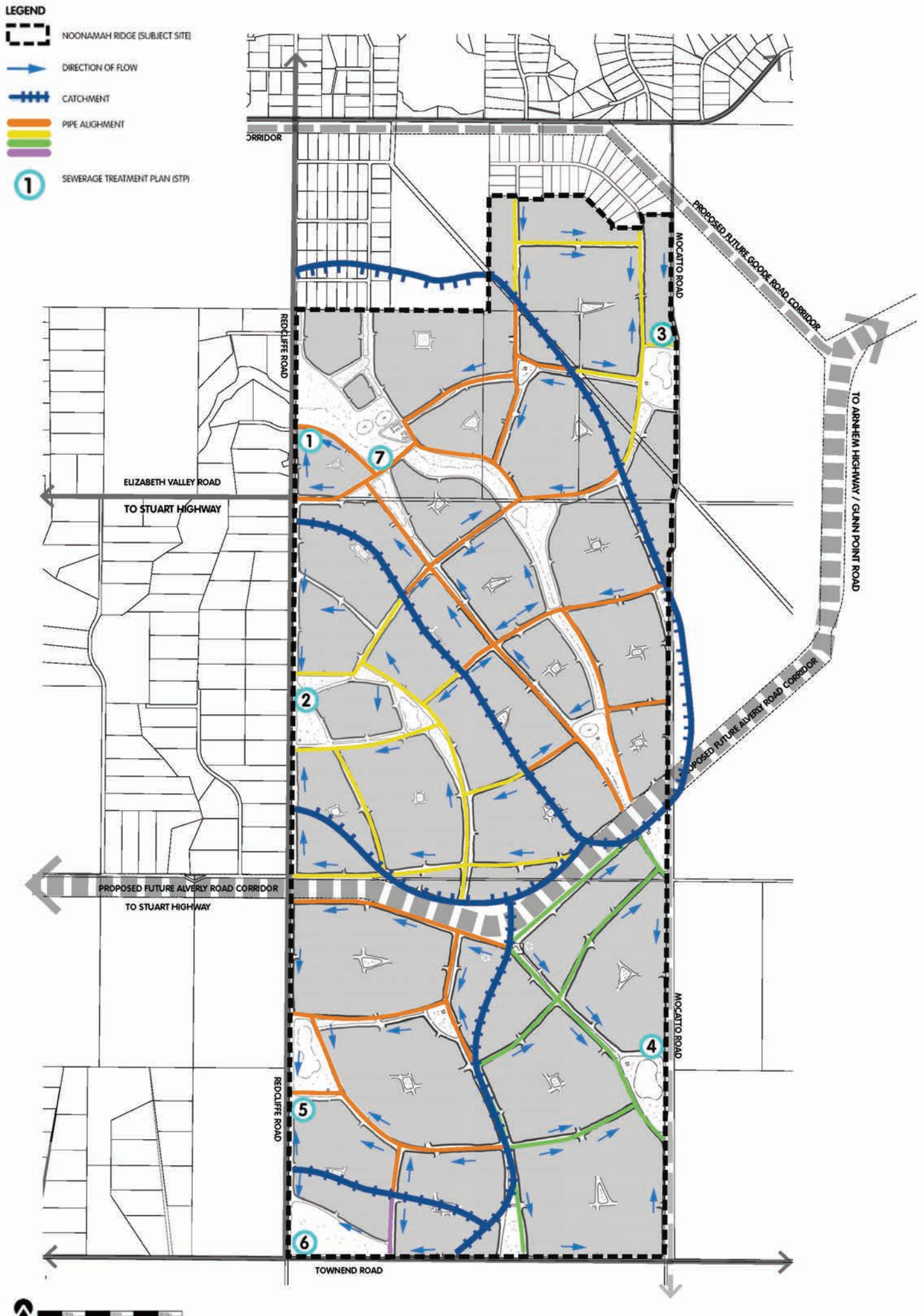


Figure 2-27. Map of internal sewerage reticulation and associated catchments (indicative)

Traffic impacts

Traffic impacts of IT systems are dependent on the stage of the implementation of the development. During construction, traffic is consistent with the normal construction traffic on a site and traffic management is handled in conformity with the procedures of a Traffic Management Plan that will be developed for the site. During operation, traffic impacts are minimal and can be less than alternative systems due to the reduced requirement for de-sludging and effluent pump-out during normal operations.

2.10.4 Proposed wastewater management strategy – individual lots

Where individual lot sizes have suitable land available for onsite wastewater management as per the requirements of the *Guidelines for Land Capability Assessment* (DoH 2014), individual wastewater management systems may be used. Setback requirements from buildings, watercourses, lot boundaries, bores etc. apply to wastewater management systems in accordance with the *Code of Practice for Small Onsite Sewage and Sullage Treatment Systems* (Territory Health Services 1996). Sizing of rural lots will be sufficient to accommodate all required setbacks.

All proposals for onsite wastewater management systems will be subject to NT Government regulations and codes of practice, and Australian Standards. The existing application and approval requirements will ensure that individual lot systems are appropriately designed, sited and installed to minimise risks of pollution.

2.10.5 Alternative options for wastewater management

The following may be considered over the course of the development:

- Building the communal treatment systems such they that can be converted to pump stations in the future.
- Collaborating with the authorities and landowners to allocate land for the construction of a traditional sewer treatment pond to the west of the site.
- Installing a sewer treatment plant that could generate electricity for the development.

2.10.6 Staging

During the construction of each stage of the subdivision, either up-sizing of existing onsite IT systems will be undertaken or separate IT systems will be installed. This strategy is in line with the current staging proposal of the development and will allow close matching of service provision to demand during the construction of the development. It will also allow the system to be tested as part of Stage 1 before it is adopted into other stages of the development.

2.10.7 Relevant approvals, standards and conditions

The *Water Act* is administered by DLRM and NTEPA (for Waste Discharge Licences only). A Waste Discharge Licence is required under this Act for discharge of water when waste has come into contact with water or when water has otherwise been polluted (e.g. discharge from sewage treatment plants). Prior to approval from Litchfield Council, Intrapac will need to have the approval of DLRM, DoH and the NTEPA with respect to wastewater management for the development. This includes obtaining a Wastewater Works Design Approval from DoH, and compiling associated documents (e.g. an Irrigation Management Plan) for irrigation of treated wastewater from centralised treatment systems.

The *Water Supply and Sewerage Services Act* provides for the protection of the NT's water supply system, or any water source from which water is drawn for human consumption.

The proposed treatment system contractor has operated approved and licenced systems in the NT and in New South Wales ranging from 40 – 1,375 EP, and licences granted in Queensland up to 3,100 EP. In all

cases, the approvals and licences have been obtained in direct consultation with local councils and the relevant state authorities.

National standards that apply are the *Building Code of Australia, AS 3500-2003 Plumbing and Drainage Standard* (Standards Australia & Standards New Zealand 2003) and *AS 1547-2012 Onsite domestic wastewater management* (Standards Australia 2012). In specific instances, additional approvals may be required and PWC will be consulted. If any additional infrastructure is required by any stakeholder, these components will be installed as instructed and become part of the system.

Individual lot wastewater treatment systems will need to comply with the *Code of Practice for Small Onsite Sewage and Sullage Treatment Systems and Disposal or Reuse of Sewage Effluent* (THS 1996), *AS 1547:2012 Onsite domestic wastewater management* (Standards Australia 2012) and applicable NT government guidelines. Approval is also required from DoH. The permitting process minimises the potential for septic systems to impact on ground and/or surface waters, and/or on surrounding users.

2.10.8 Responsibility

The proposed IT system can be managed and operated by a single operator under the direct oversight of PWC and DoH. The supplier will take responsibility for commissioning the treatment facility within a dedicated commission, defects and liability timeframe. Intrapac will then take over ownership after the commissioning process has been completed and validated by the relevant government agencies. An ongoing maintenance agreement between the contractor and Intrapac will then be implemented.

2.11 DOMESTIC WASTE MANAGEMENT

Currently residents in the local area are responsible for taking their own rubbish and recyclables to the Humpty Doo transfer station. Litchfield Council then transfers the waste to Shoal Bay Waste Management Facility. Ongoing monitoring of Shoal Bay's capacity is undertaken by the City of Darwin.

For the first stage of the development, this will continue to be the case. As the development evolves, collection of domestic waste will be undertaken using rubbish and recycling trucks, and will be the responsibility of Litchfield Council. Internal roads within the development will be designed to accommodate onsite collection. Intrapac will work with Litchfield Council and City of Darwin to ensure that household waste can be accommodated.

2.12 EMERGENCY SERVICES PROVISIONS

Prior to approval from Litchfield Council, Intrapac will need to have the approval of Northern Territory Police, Fire and Emergency Services with respect to fire-fighting arrangements within the development.

2.12.1 Police and ambulance

The nearest police station is in Humpty Doo. The nearest ambulance service operates out of Palmerston. The nearest hospital is in the Darwin northern suburb of Tiwi. A new hospital is proposed for Palmerston.

Provision of police and ambulance services is the responsibility of the NT Government.

2.12.2 Fire

With regards to fire services, the project area is within the boundaries of Bushfire NT (Vernon Council Region). Livingstone Volunteer Brigade is responsible for the area south of Alverly Road. The area from Alverly Road to Goode Road is not gazetted to a brigade but is taken on by Elizabeth Valley Volunteer Brigade.

The project area lies just outside of the NT Fire and Rescue emergency response area (Goode Road is southern boundary). If there is a house fire during business hours, the nearest fire brigade is at Humpty Doo. The fastest estimated response time is 9 minutes (approximately 7.5 km). After hours, the nearest brigade is in Palmerston. The fastest estimated response time is 25 minutes (approximately 25 km).

Under Section 6 of the *Fire and Emergency Act*, the Fire and Rescue Service can only respond to incidents outside an emergency response area if sufficient resources of the Fire and Rescue Service remain available to respond to incidents within an emergency response area. Intrapac will seek to have the emergency response area extended to include the project area. There will be provision of land for a new volunteer fire brigade within Village One.

2.12.3 Cyclone

One of the public buildings within Village One – most likely the school or the community hall – will be constructed as a cyclone shelter.

2.13 CONSTRUCTION

The selection of construction-related infrastructure will be determined by the project scope and the layout of the land being developed. At this stage no indication can be given as to their location, suffice to say that set-up and establishment will be in accordance with the relevant construction company's site set-up and establishment guidelines, as well as an integrated project management plan incorporating the Environmental Management Plan (EMP) in Chapter 6.

Construction infrastructure will be temporary and will be sited to ensure no impact on environmentally- or culturally-sensitive areas, which have been comprehensively surveyed and mapped as part of the EIS process. All areas used during construction will be remediated by the construction contractor.

2.13.1 Permanent or temporary fuel storage areas

The selection, use, transportation and storage of hazardous chemicals and dangerous goods will comply with the construction group's operating procedures for hazardous chemicals management and relevant legislation requirements, safety data sheets and Australian Standards. Procedures – to be provided by the construction group or contractor – will detail the roles and responsibilities of all persons within the workplace and will clearly outline the requirements for hazardous chemicals. This will include instructions for risk assessment, storage, use, health monitoring and environmental management.

2.13.2 Material storage areas and stockpiles

In addition to the information in Section 2.9.5, for each subdivision Erosion and Sediment Control Plans will be developed to manage project-specific construction activities with respect to erosion and sediment control, with reference to the EMP in Chapter 6. Its objectives will be to:

- Provide a strategic and systematic framework to enable construction of the project with minimal environmental or social impact due to erosion and sediment-laden run-off.
- Identify relevant site characteristics and construction activities that have the potential to contribute to erosion or sedimentation impacts.
- Ensure all construction activities are undertaken with the objective of preventing such impacts.
- Ensure no potential risks to health or amenity occur due to construction-related erosion or sediment-laden run-off

These documents will describe mitigation measures, responsibilities, monitoring, reporting and corrective actions.

2.13.3 Equipment hardstand and maintenance areas

The selection, use and maintenance of plant and equipment will be in accordance with the construction group's core operating procedures relating to plant and equipment management. This document will define the processes that will ensure the safe and controlled operation onsite. It will detail the requirements for selection of suitable plant and equipment, as well as other machinery, and the responsibilities of competent persons for maintenance and repair.